100-10

Y/ER/MS-6

Proposed Modifications to the RCRA Post-Closure Permit for the Bear Creek Hydrogeologic Regime at the U.S. Department of Energy Y-12 Plant, Oak Ridge, Tennessee

Permit Number TNHW-087
EPA ID No. TN3 89 009 0001

May 1997

Prepared by

GRAM, INC.
and
AJA TECHNICAL SERVICES, INC.
Under Subcontract 18Y-JVC11C

for the

Y-12 Surveillance and Maintenance Program,
Environmental Restoration Program,
and the
Water Compliance Department
Environmental Compliance Organization
Oak Ridge Y-12 Plant
Oak Ridge, Tennessee 37831

Managed by

LOCKHEED MARTIN ENERGY SYSTEMS, INC.
for the U.S. Department of Energy
Under Contract No. DE-AC05-84OR21400

DISCLAIMER

DISCLAIMER

Portions of this document may be illegible electronic image products. Images are produced from the best available original document.

Proposed Modifications to the RCRA Post-Closure Permit for the Bear Creek Hydrogeologic Regime at the U.S. Department of Energy at the Oak Ridge Y-12 Plant, Oak Ridge, Tennessee

Permit Number TNHW-087
EPA ID No. TN3 89 009 0001

May 1997

Prepared by

GRAM, INC.
and
AJA TECHNICAL SERVICES, INC.
Under Subcontract 18Y-JVC11C

for the

Y-12 Surveillance and Maintenance Program,
Environmental Restoration Program,
and the
Water Compliance Department
Environmental Compliance Organization
Oak Ridge Y-12 Plant
Oak Ridge, Tennessee 37831

Managed by

LOCKHEED MARTIN ENERGY SYSTEMS, INC.
for the U.S. Department of Energy
Under Contract No. DE-AC05-84OR21400

CONTENTS

Section — Page

CONTENTS (cont'd)

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirement
BCHR	Bear Creek Hydrogeologic Regime
BCV	Bear Creek Valley
bgs	below ground surface
CE	counting error
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DOE	Department of Energy
FS	Feasibility Study
GWPP	Groundwater Protection Program
GWPS	Groundwater Protection Standards
^{129}I	Iodine-129
LMES	Lockheed Martin Energy Systems, Inc.
MDA	minimum detectable activity
mg/L	milligrams per liter
N	nitrogen
ORR	Oak Ridge Reservation
PCE	tetrachloroethene
PCP	Post-Closure Permit
^{238}Pu	Plutonium-238
pCi/L	picocuries per liter
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
^{99}Tc	Technetium-99
TCE	trichloroethene
TDEC	Tennessee Department of Environment and Conservation
TDS	total dissolved solids
UTL	upper tolerance limit
1,1-DCE	1,1-dichlorothene
1,1,1-TCA	1,1,1-trichloroethane

CERTIFICATION

Ref: 1200-1-11-.07(2)(a)10

I certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, and 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.

Department of Energy Owner and Operator	Date Signed
Lockheed Martin Energy Sytems, Inc. Co-Operator	Date Signed

The Department of Energy (DOE) and its operating contractor, Lockheed Martin Energy Systems, Inc., (LMES) have jointly signed this permit modification request as the operator of the permitted facility. The Department has determined that dual signatures best reflect the actual apportionment of responsibility under which the Department's Resource Conservation and Recovery Act (RCRA) responsibilities are for policy, programmatic, funding and scheduling decisions, as well as general oversight; and the contractor's RCRA responsibilities are for the day-to-day operations, including but not limited to the following responsibilities: waste analysis and handling, monitoring, recordkeeping, reporting, and contingency planning. For purposes of the certification required by Tennessee Rule 1200-1-11-.07(2)(a)10, the Department's and LMES' representatives certify, to the best of their knowledge and belief, the truth, accuracy, and completeness of the permit modification request for their respective areas of responsibility.

This statement is attached hereto for the purpose of clarifying the roles and responsibilities of DOE and LMES with respect to the permitted facility and it shall not be construed as altering or limiting the certification.

1.0 INTRODUCTION

This report presents proposed modifications to several conditions of the Resource Conservation and Recovery Act (RCRA) Post-Closure Permit (PCP) for the Bear Creek Hydrogeologic Regime (BCHR) (permit number TNHW-087, EPA ID No. TN3 89 009 0001). These permit conditions define the requirements for RCRA post-closure corrective action groundwater monitoring at the S-3 Ponds, the Oil Landfarm, and the Bear Creek Burial Grounds (units A, C-West, and Walk-in Pits). Modification of these PCP conditions is requested to: (1) clarify the planned integration of RCRA post-closure corrective action groundwater monitoring with the monitoring program to be established in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Record of Decision (ROD) for the Bear Creek Valley (BCV) Watershed, (2) revise several of the current technical requirements for groundwater monitoring based on implementation of the RCRA post-closure corrective action monitoring program during 1996, and (3) update applicable technical procedures with revised versions recently issued by the Y-12 Plant Groundwater Protection Program (GWPP). With these modifications, the Y-12 Plant will continue to meet the full intent of all regulatory obligations for post-closure care of these facilities.

Section 2.0 provides the technical justification for each proposed permit modification. The proposed changes to permit language are provided in Section 3.0 (S-3 Ponds), Section 4.0 (Oil Landfarm), and Section 5.0 (Bear Creek Burial Grounds). Sections 6.0 and 7.0 reference updated and revised procedures for groundwater sampling, and monitoring well plugging and abandonment, respectively. Appendix A includes all proposed revisions to the PCP Attachments.

2.0 TECHNICAL JUSTIFICATION

This section provides a description of the proposed permit modifications and their justification. As shown in the following summary, the proposed changes include Class 1, Class 2, and Class 3 permit modifications, as specified in the Title 40 Code of Federal Regulations (40 CFR), §270.42 Appendix I- Classification of Permit Modifications.

Proposed Permit Modification	Classification of Modification		
	Class 1	Class 2	Class 3
Clarify the RCRA/CERCLA Integration Strategy	●		
Modify Corrective Action Monitoring Well Networks		●	
Modify Groundwater Protection Standards Constituents List			●
Revise and Clarify Corrective Action Monitoring Data Evaluation	●(1)		
Update Technical Field Procedures	●(1)		
Editorial/Clarification Revisions	●		

(1) Class 1 modifications requiring prior approval of the commissioner.

Table 1 lists all the proposed modifications to site-specific conditions of the PCP. The following sections describe the technical justification for the proposed modifications.

2.1 Clarify the RCRA/CERCLA Integration Strategy

The S-3 Ponds, the Oil Landfarm, and the Bear Creek Burial Grounds are regulated under RCRA and CERCLA. In April 1993, the U.S. Department of Energy (DOE), Lockheed Martin Energy Systems, Inc. (LMES), and the Tennessee Department of Environment and Conservation (TDEC) signed an Agreed Order, which formally established CERCLA as the lead regulatory program with regard to remedial action at these sites, with RCRA as an applicable or relevant, and appropriate requirement (ARAR). Under this agreement, RCRA will be applied as an ARAR to the extent that post-closure maintenance and care of the S-3 Ponds, Oil Landfarm, and Bear Creek Burial Grounds will be conducted in compliance with the terms of the PCP, but RCRA-driven groundwater cleanup is deferred to the CERCLA Remedial Investigation (RI)/Feasibility Study (FS) process.

The Oak Ridge Reservation (ORR) near the Y-12 Plant is divided into two watersheds for CERCLA action: the BCV Watershed and the Upper East Fork Poplar Creek Watershed. The RI for the BCV Watershed was completed in 1996 and effectively characterized the nature and extent of contamination, evaluated the fate and transport of the contaminants, and determined the risk to human health and the environment. The FS for the BCV Watershed is currently in progress to evaluate remedial alternatives that allow for protection of human health and the environment. Following completion and approval of the FS, which is expected in 1998, a Proposed Plan for implementation of the preferred remedial alternative will be prepared, and a draft ROD will be issued after final approval of the Proposed Plan. The draft ROD will establish remediation objectives and

Table 1.
Summary of Proposed Modifications to the Post-Closure Permit for the Bear Creek Hydrogeologic Regime

PROPOSED PERMIT MODIFICATION		CLASSIFICATION OF MODIFICATION				Class 1	Class 2	Class 3
		40 CFR § 270.42 Appendix I Citation						
Type	Modification	Permit Condition						
		S-3 Ponds	Oil Landfarm	Burial Grounds				
Technical	Modify selected components of the corrective action monitoring well networks.	IV.A	V.A	VI.A	C.1.a		●	
Technical	Modify sampling requirements for background and plume boundary monitoring wells.	IV.C.1	V.C.1	VI.C.1	C.1.a		●	
Editorial	Clarify criteria for selection of the point of compliance well(s) for semi-annual sampling.	IV.C.2	V.C.2	VI.C.2	A.1	●		
Editorial	Renumber Permit Conditions (IV,V,VI). D.2 to (IV, V, VI).D.5.	IV.D.2	V.D.2	VI.D.2	A.1	●		
Editorial	Clarify the purpose and objective of the plume boundary monitoring data evaluation.	IV.D.2 (New)	V.D.2 (New)	VI.D.2 (New)	A.1	●		
Editorial	Clarify the purpose and objective of the point-of compliance monitoring data evaluation.	IV.D.3 (New)	V.D.3 (New)	VI.D.3 (New)	A.1	●		
Editorial/ Technical	Clarify integration of RCRA/CERCLA groundwater monitoring requirements.	IV.D.4 (New)	V.D.4 (New)	VI.D.4 (New)	A.1	●		
Editorial	Clarify reference to analytical requirements.	IV.G.2	V.G.2	VI.G.2	A.1	●		
Editorial	Correct the regulatory citations and/or revise the Permit Condition references.	IV.G.3	V.G.3	VI.G.3	A.1	●		
Technical	Define the trend analysis approach for plume boundary monitoring data evaluation.	IV.G.4	V.G.4	VI.G.4	C.3	●[1]		
Editorial/ Technical	Clarify the response of Permittee to evidence of contaminant plume migration.	IV.G.5	V.G.5	VI.G.5	A.1	●		
Technical	Define the trend analysis approach for point of compliance monitoring data evaluation.	IV.G.6	V.G.6	VI.G.6	C.3	●[1]		

Table 1. (cont'd)

PROPOSED PERMIT MODIFICATION		CLASSIFICATION OF MODIFICATION						
								Class 3
							Class 2	
						Class 1		
		40 CFR § 270.42 Appendix I Citation						
Type	Modification	Permit Condition						
		S-3 Ponds	Oil Landfarm	Burial Grounds				
Editorial	Clarify when the specified laboratory analyses are performed.	IV.H.3	V.H.3	VI.H.3	A.1	●		
Editorial	Consolidate and clarify annual reporting requirements.	IV.H.4 (New)	V.H.4 (New)	VI.H.4 (New)	A.1	●		
Technical	Update well inspection and well depth measurement procedures.	Attach. 2 Section C	Attach. 3 Section D	Attach. 4 Section D	A.1	●		
Editorial	Modify attachment with well construction details as per revised monitoring well network.	Attach. 2 Section D	Attach. 3 Section E	Attach. 4 Section E	A.1	●		
Technical	Modify the specified list of GWPS constituents.	Attach. 2 Section E	Attach. 3 Section F	Attach. 4 Section F	C.5			●
Editorial	Modify Site Map to show revised monitoring well network.	Attach. 2 Section F	Attach. 3 Section G	Attach. 4 Section G	A.1	●		
Technical	Rename title of Attachment 6 and update the groundwater sampling procedure.	Attach. 6	Attach. 6	Attach. 6	A.1 C.2	● ●[1]		
Technical	Update the well plugging and abandonment procedure.	Attach. 7	Attach. 7	Attach. 7	C.2	●[1]		

GWPS - Groundwater Protection Standards

1. Class 1 modifications requiring prior Commissioner approval.

cleanup goals, and present a plan for remedial actions and the criteria for implementing those actions; a final ROD for the BCV Watershed is anticipated in 1999. Implementation of remedial actions specified in the ROD will be an iterative process, with the effectiveness of previous actions determining the selection, timing or modification of future actions needed to achieve the specified remedial objectives.

The ROD for the BCV Watershed will establish a groundwater, surface water, and ecological monitoring program intended to gauge remedial action effectiveness. Results of this ROD-driven monitoring program will be evaluated annually in a Remediation Effectiveness Report, which will also serve as a mechanism to modify the groundwater, surface water, and ecological components of the program as needed. Once the ROD-driven monitoring program has been implemented, a permit modification request to integrate the ROD-driven groundwater monitoring and reporting requirements with those specified in the PCP may be submitted if the groundwater component of the ROD-driven monitoring program satisfies the RCRA post-closure corrective action monitoring objectives.

Current Permit Conditions IV.D (S-3 Ponds), V.D (Oil Landfarm), and VI.D (Bear Creek Burial Grounds) should be revised to more fully describe this RCRA/CERCLA integration approach for groundwater monitoring. This is a Class 1 permit modification.

2.2 Modify Corrective Action Monitoring Well Networks

The current list of background wells designated for the S-3 Ponds, the Oil Landfarm, and the Bear Creek Burial Grounds; point of compliance wells designated for the Oil Landfarm and the Bear Creek Burial Grounds; and wells comprising the Westernmost Exit Pathway Transect that are designated as plume boundary wells for the S-3 Ponds, the Oil Landfarm, and the Bear Creek Burial Grounds should be revised. This is a Class 2 permit modification.

2.2.1 Background Wells

The permit designates the following background wells for the S-3 Ponds, the Oil Landfarm, and the Bear Creek Burial Grounds:

S-3 Ponds	Oil Landfarm	Bear Creek Burial Grounds		Exit Pathway
GW-115	~~GW-043~~	~~GW-040~~	~~GW-162~~	~~GW-521~~
~~GW-613~~	~~GW-044~~	~~GW-042~~	~~GW-372~~	
~~GW-614~~	~~GW-084~~	~~GW-079~~	~~GW-373~~	
		~~GW-080~~	~~GW-642~~	

All of these wells except GW-115, which is located upgradient of all known sources of groundwater contamination in the BCHR, should be removed from the respective list of background wells. This is consistent with the PCP for the Upper East Fork Poplar Creek Hydrogeologic Regime, which specifies monitoring a single background well for the entire regime. Additionally, the permit neither

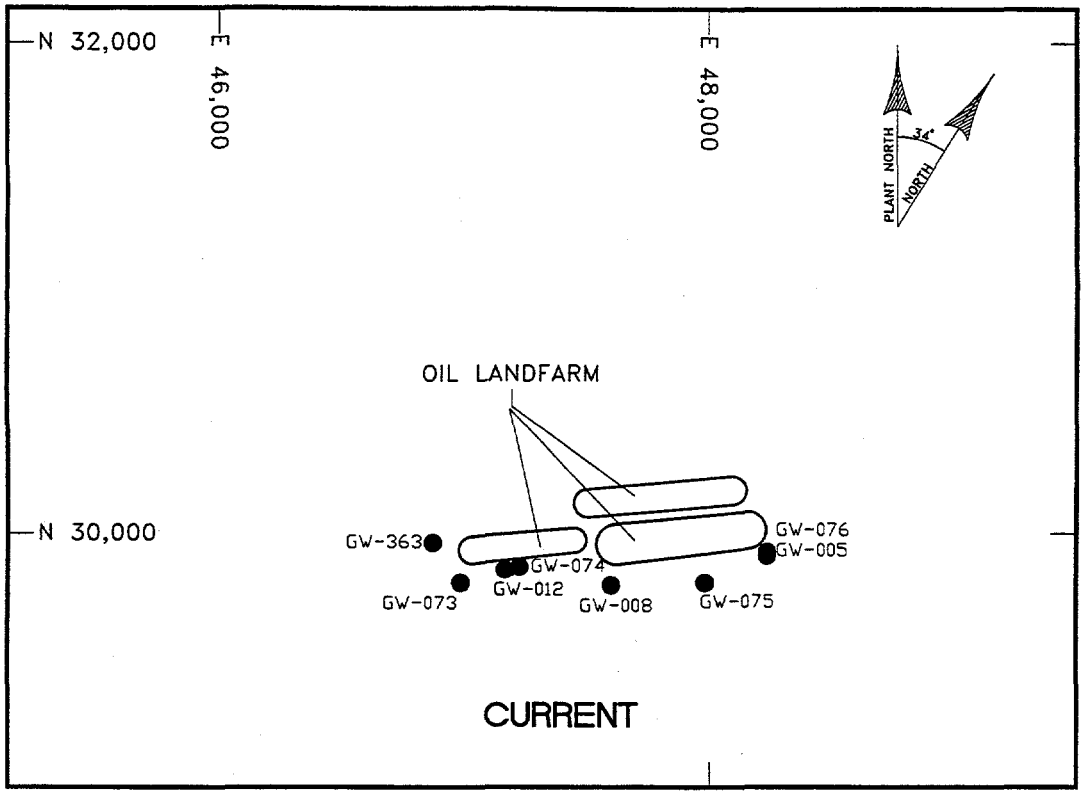
defines nor implies the purpose for collecting the site-specific background groundwater quality data, and the general RCRA groundwater monitoring requirements specified in 40 CFR §264.97 do not explicitly state that more than one background well is necessary. Without a regulatory requirement for monitoring multiple background wells in BCHR and a stated purpose for collecting or evaluating the monitoring data, sampling one background well (GW-115) for the entire regime is consistent with regulatory objectives.

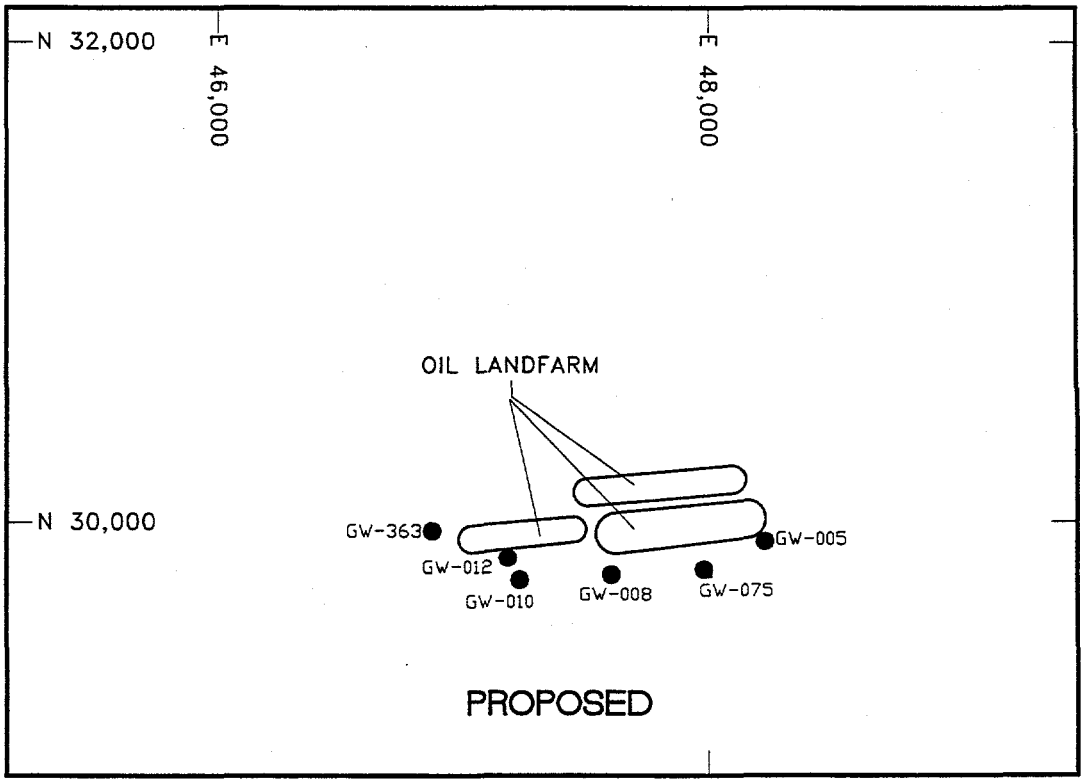
Permit Condition IV.A defines the corrective action monitoring well network for the S-3 Ponds and designates well GW-521 as the background well for the Westernmost Exit Pathway Transect (plume boundary wells). Instead of comparison with background data from well GW-521, temporal trend analysis is a more technically appropriate method for evaluating the groundwater quality data for the plume boundary wells (see Section 2.4.2). Accordingly, continued sampling of well GW-521 is not necessary for corrective action monitoring purposes.

2.2.2 Point of Compliance Wells

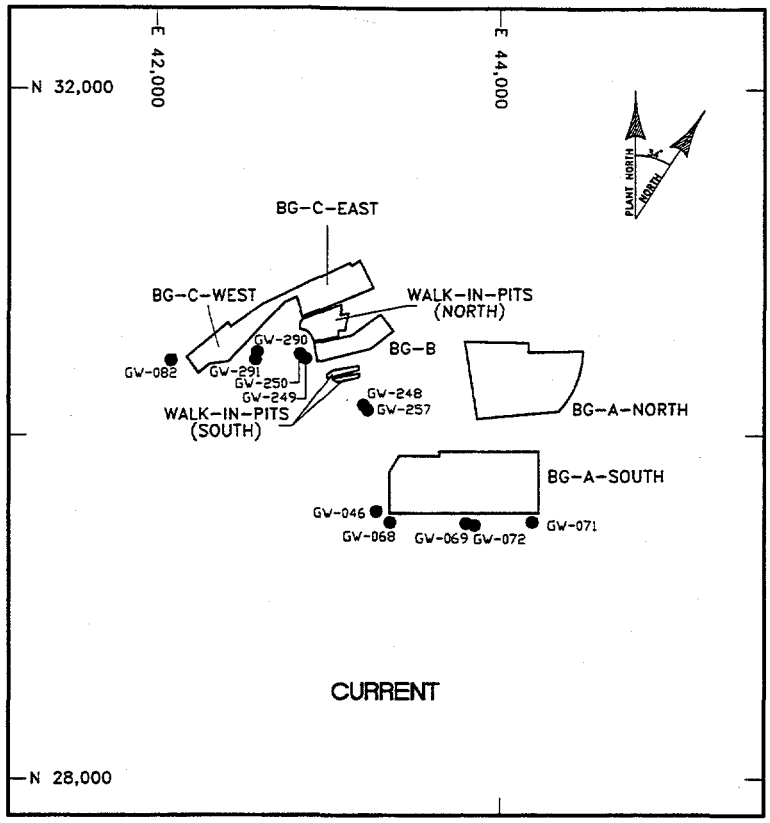
The permit currently requires an evaluation of the effectiveness of the low-permeability cap at each site based on review of the semiannual monitoring data for at least one of the designated point of compliance wells. However, only two (GW-008 and GW-012) of the eight point of compliance wells designated for the Oil Landfarm (Figure 1) and four (GW-046, GW-071, GW-257, and GW-291) of the twelve point of compliance wells designated for the Bear Creek Burial Grounds (Figure 2) monitor contaminated groundwater. The remaining point of compliance wells designated for each site monitor uncontaminated groundwater, and consequently provide little information regarding the influence of the low-permeability cap on groundwater quality at each site. Wells which monitor contaminated groundwater should be substituted for some of the wells which monitor uncontaminated groundwater. However, selected uncontaminated wells should be retained to provide sufficient monitoring coverage in the event of contaminant migration. Permit Conditions V.A (Oil Landfarm) and VI.A (Bear Creek Burial Grounds) should be modified to designate the following point of compliance wells for each site.

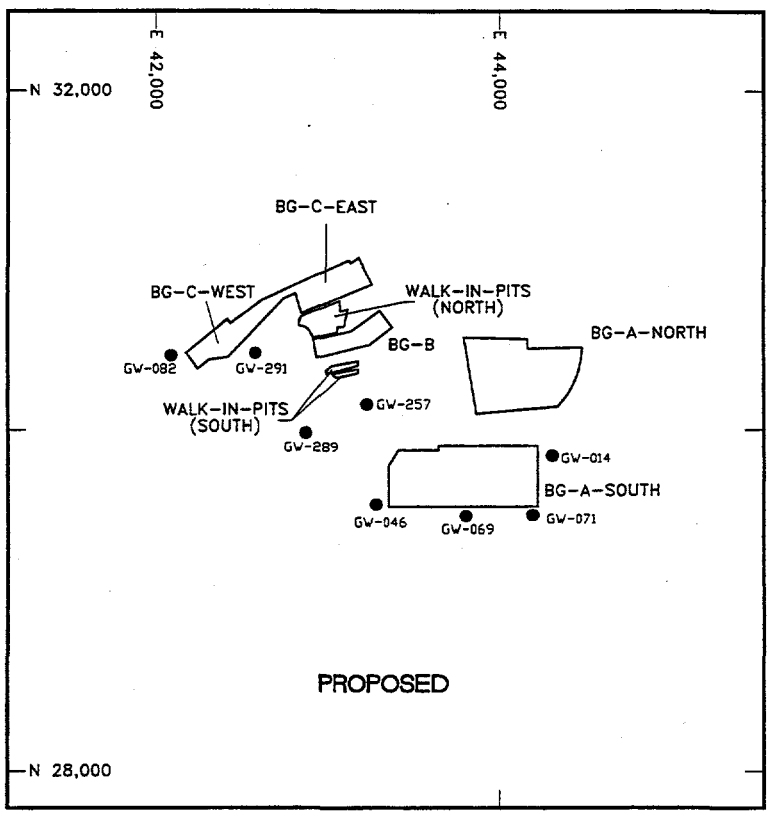
Site/ Well No.	Monitored Interval			GWPS Constituents
	Depth (ft bgs)	Geologic Unit	Aquifer Zone	
Oil Landfarm				
GW-005	5.3 - 10.3	Nolichucky Shale	Water Table	.
GW-008	15.7 - 20.7	Nolichucky Shale	Water Table	PCE
GW-010	7.7 - 12.7	Nolichucky Shale	Water Table	PCE; TCE; 1,1,1-TCA
GW-012	12.3 - 14.3	Nolichucky Shale	Water Table	PCE
GW-075	180.0 - 200.0	Nolichucky Shale	Bedrock	.
GW-363	50.0 - 75.0	Nolichucky Shale	Bedrock	.
Burial Grounds				
GW-014	10.0 - 12.0	Nolichucky Shale	Water Table	TCE
GW-046	8.1 - 18.1	Nolichucky Shale	Water Table	PCE; 1,1-DCE
GW-069	89.0 - 99.2	Nolichucky Shale	Bedrock	.
GW-071	198.4 - 219.0	Nolichucky Shale	Bedrock	Benzene
GW-082	29.4 - 34.5	Maryville Limestone	Bedrock	.
GW-257	23.0 - 33.7	Maryville Limestone	Water Table	PCE
GW-289	30.6 - 40.6	Maryville Limestone	Water Table	PCE
GW-291	11.5 - 16.5	Maryville Limestone	Water Table	PCE





PREPARED FOR: *LOCKHEED MARTIN ENERGY SYSTEMS, INC.*	LOCATION:	Y-12 PLANT OAK RIDGE, TN.	FIGURE 1
PREPARED BY: *AJA TECHNICAL SERVICES, INC.*	DOC NUMBER:		CURRENT AND PROPOSED POINT OF COMPLIANCE MONITORING WELLS AT THE OIL LANDFARM
	DWG ID.:	97-055	
	DATE:	3-19-97	





PREPARED FOR: *LOCKHEED MARTIN ENERGY SYSTEMS, INC.*	LOCATION:	Y-12 PLANT OAK RIDGE, TN.	FIGURE 2
PREPARED BY: *AJA TECHNICAL SERVICES, INC.*	DOC NUMBER:		CURRENT AND PROPOSED POINT OF COMPLIANCE MONITORING WELLS AT THE BEAR CREEK BURIAL GROUNDS
	DWG ID.:	97-056	
	DATE:	3-19-97	

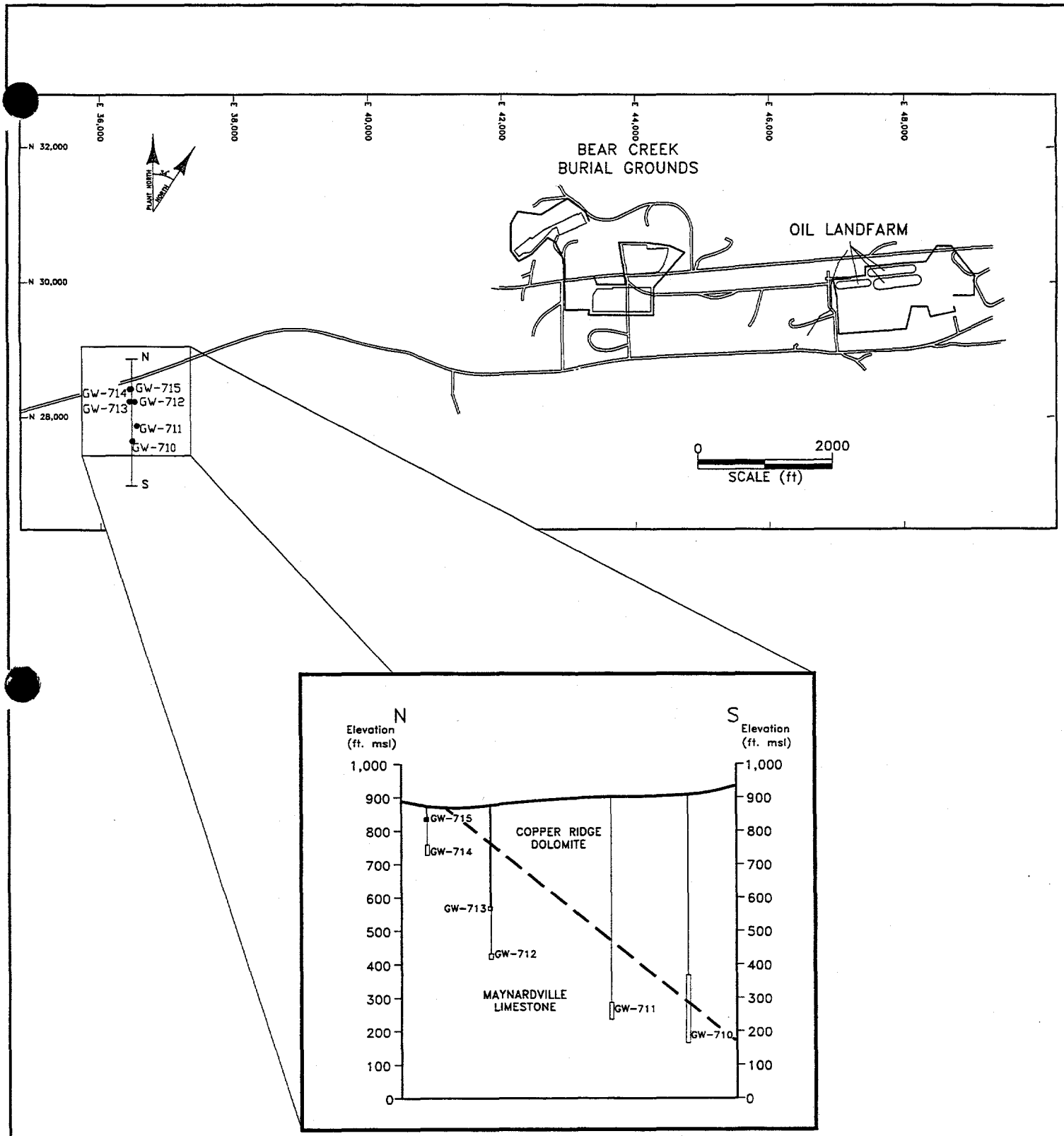
As shown in the preceding data summary, several of the constituents listed in the Groundwater Protection Standard (GWPS) currently defined for each site, including tetrachloroethene (PCE), trichloroethene (TCE), 1,1,1-trichloroethane (1,1,1-TCA), and 1,1,1-dichloroethene (1,1-DCE), are contaminants in groundwater at the respective point of compliance wells proposed for each site. Additionally, the revised point of compliance well networks will continue to provide adequate downgradient monitoring coverage at the Oil Landfarm (Figure 1) and the Bear Creek Burial Grounds (Figure 2).

2.2.3 Plume Boundary Wells

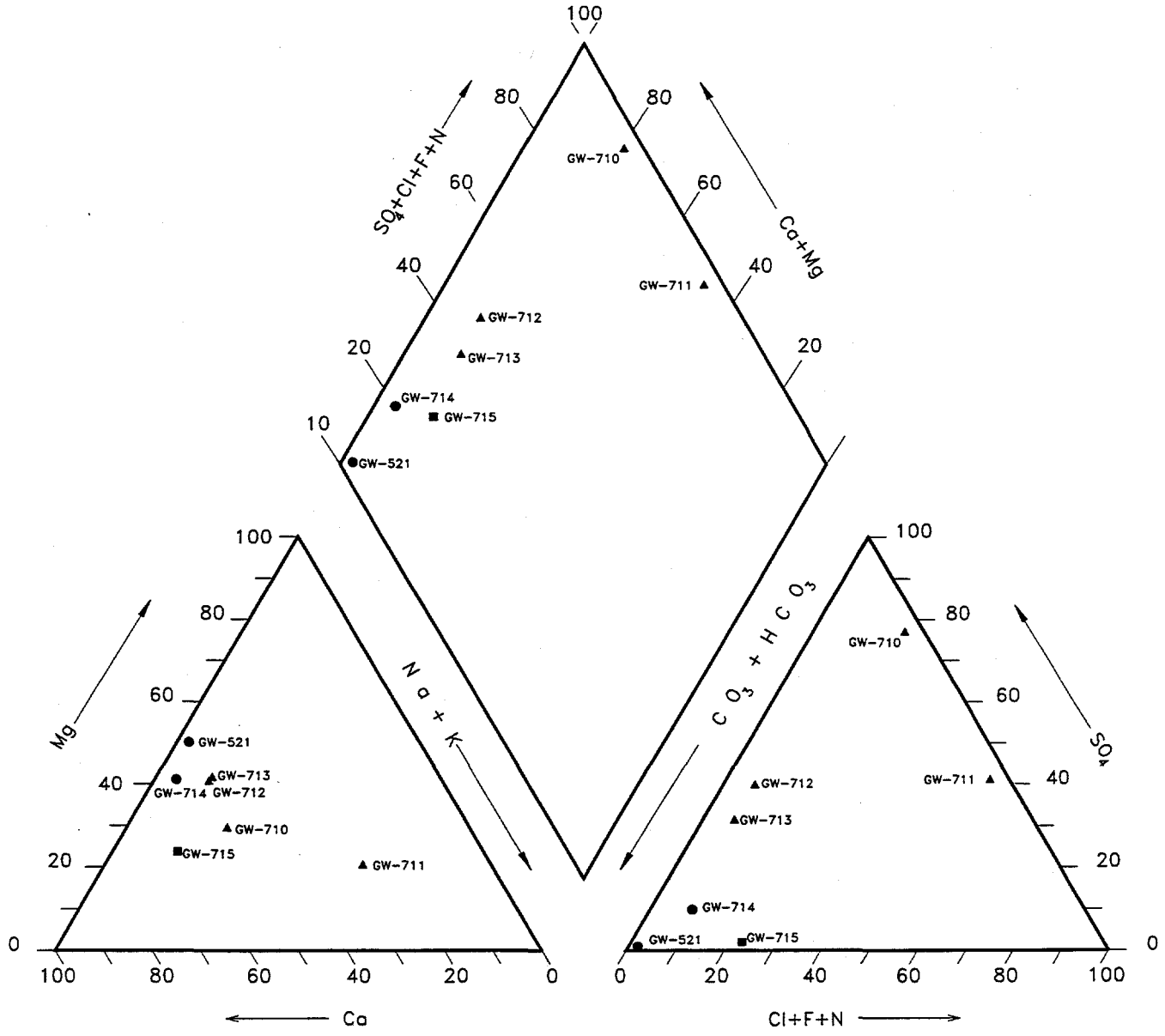
Site-specific permit conditions designate the Westernmost Exit Pathway Transect as plume boundary wells for corrective action groundwater monitoring purposes. The Westernmost Exit Pathway Transect is located about 6,500-ft west of the Bear Creek Burial Grounds (Figure 3), and consists of the following six monitoring wells completed along a strike-normal traverse across the Maynardville Limestone at the specified depth below ground surface (bgs).

Well Number	Depth of Monitored Interval (ft bgs)
GW-710	539.7 - 744.5
GW-711	616.0 - 666.2
GW-712	441.5 - 457.5
GW-713	305.0 - 315.2
GW-714	115.1 - 145.0
GW-715	32.0 - 44.0

Wells GW-710 and GW-711 are not suitable for plume boundary monitoring purposes. Both wells produce uncontaminated, highly mineralized, calcium-magnesium-sulfate groundwater; total dissolved solids (TDS) typically exceed 1,000 milligrams per liter (mg/L). This geochemistry distinctly differs from the calcium-magnesium-bicarbonate geochemistry of less mineralized (TDS<250 mg/L) groundwater typically produced from shallower depths in the Maynardville Limestone, as illustrated by data for wells GW-714 and GW-715 (Figure 4). Considering the depth and distinctive groundwater geochemistry, the monitored intervals for wells GW-710 and GW-711 do not intercept hydraulically active flow paths where groundwater contamination in the Maynardville Limestone is most likely to be detected. Thus, neither well meets the performance standard defined in 40 CFR § 264.97(a)(3) requiring wells used for corrective action monitoring to yield groundwater samples that allow for detection of hazardous waste or hazardous waste constituents which have migrated into the uppermost aquifer. Accordingly, wells GW-710 and GW-711 should be deleted from the plume boundary monitoring network.



PREPARED FOR: *LOCKHEED MARTIN ENERGY SYSTEMS, INC.*	LOCATION:	Y-12 PLANT OAK RIDGE, TN.	FIGURE 3
PREPARED BY: *AJA TECHNICAL SERVICES, INC.*	DOC NUMBER:		WESTERNMOST EXIT-PATHWAY TRANSECT (MAYNARDVILLE LIMESTONE PICKET W)
	DWG ID.:	97-054	
	DATE:	3-19-97	



PREPARED FOR: *LOCKHEED MARTIN ENERGY SYSTEMS, INC.*	LOCATION:	Y-12 PLANT OAK RIDGE, TN.	FIGURE 4
PREPARED BY: *AJA TECHNICAL SERVICES, INC.*	DOC NUMBER:		GEOCHEMISTRY OF GROUNDWATER AT PLUME BOUNDARY BACKGROUND WELL GW-521 AND WESTERNMOST EXIT-PATHWAY TRANSECT WELLS GW-710 THROUGH GW-715
	DWG ID.:	97-053	
	DATE:	3-19-97	

2.3 Modify Groundwater Protection Standards Constituent List

Site-specific permit attachments currently list the following radioanalytes in the GWPS constituent list for the S-3 Ponds (Attachment 2, Section E), the Oil Landfarm (Attachment 3, Section F), and the Bear Creek Burial Grounds (Attachment 4, Section F):

Radioanalytes		
Americium-241	Strontium-89/90	Uranium-235
~~Iodine-129~~	Technetium-99	Uranium-238
Neptunium-237	~~Tritium~~	Gross alpha
~~Plutonium-238~~	Uranium-234	Gross beta
Total Radium		

The constituents with a strikethrough should be removed from the list of radioanalytes specified in the GWPS for each site. This is a Class 3 permit modification.

Iodine-129 (^{129}I), plutonium-238 (^{238}Pu), and tritium results for groundwater samples collected between 1989 and 1996 (including samples collected during the RI for the BCV Watershed) from point of compliance wells (current and proposed) at the S-3 Ponds, the Oil Landfarm, and the Bear Creek Burial Grounds, and several other monitoring wells located near the point of compliance at each site, are summarized below.

Radioanalyte	S-3 Ponds		Oil Landfarm		Bear Creek Burial Grounds	
	# of Results	Results>CE	# of Results	Results >CE	# of Results	Results >CE
Iodine-129	7	0	6	0	3	0
Plutonium-238	12	0	12	1	11	0
Tritium	73	17	13	0	13	0

As shown above, none of the ^{129}I results and only one of the ^{238} Pu results exceed the associated counting error (CE); i.e., exceed the counting statistic representative of analytical uncertainty. The one result for ^{238}Pu (0.271 picoCuries per liter [pCi/L]) just barely exceeds the CE (0.27 pCi/L) and was reported for an Oil Landfarm point of compliance well (GW-363) that monitors uncontaminated groundwater. The overall lack of detectable ^{129}I and ^{238}Pu concentrations, particularly in the samples of the highly-radioactive groundwater in the wells at the S-3 Ponds, indicates that these isotopes are not groundwater contaminants in the BCHR.

As shown in the preceding summary table, tritium results that exceed associated counting errors have been reported only in groundwater samples collected from point of compliance wells at the S-3 Ponds. Tritium has a relatively short half-life (12 years), and tritium levels have steadily decreased since closure of the S-3 Ponds; tritium concentrations in the most recent samples collected from point of compliance wells GW-243 (August 1995) and GW-276 (July 1996) did not exceed the corresponding minimum detectable activity (MDA) reported for each sample. Also, the highest tritium concentration (5,400 ±1,080 pCi/L in a sample from well GW-243 in October 1991) is less

than the Maximum Contaminant Level for drinking water (20,000 pCi/L), and the DOE reference standard for radionuclides in water [four percent of the Derived Concentration Guide (2×10^6 pCi/L) for point data (80,000 pCi/L)]. Considering the lack of tritium in the groundwater at the Oil Landfarm and the Bear Creek Burial Grounds, the low tritium concentrations (relative to reference standards) and decreasing temporal trends in the groundwater at the S-3 Ponds, and the relatively short half-life of tritium, removing this radioanalyte from the GWPS would not adversely impact the effectiveness of the corrective action monitoring program at each site.

2.4 Revise and Clarify Corrective Action Monitoring Data Evaluation

Applicable site-specific permit conditions should be revised to clarify the technical approach for evaluating corrective action groundwater monitoring data. Permit Conditions IV.G.6 (S-3 Ponds), V.G.6 (Oil Landfarm), and VI.G.6 (Bear Creek Burial Grounds) require annual evaluation of the low-permeability cap at each site based on the semiannual monitoring data for at least one point of compliance well. None of these permit conditions, however, specify the data-evaluation approach. Also, Permit Conditions IV.G.5 (S-3 Ponds), V.G.5 (Oil Landfarm), and VI.G.5 (Bear Creek Burial Grounds) infer a background-comparison approach (based on data for well GW-521) for evaluating the semiannual monitoring data for the plume boundary wells. However, the method of comparison is not specified and the suitability of this approach is questionable. This requirement to compare plume boundary well(s) constitutes a detection monitoring scenario/requirement in a corrective action monitoring program. Additionally, statistical evaluations of plume boundary well data against background data is inappropriate technically because groundwater in the plume boundary wells has distinctly different geochemical characteristics and trace element concentrations than groundwater in well GW-521.

The specified permit conditions for both point of compliance and plume boundary well data evaluations should be revised to require trend analysis as the technical approach for evaluating the corrective action monitoring data for each site. This is a Class 1 permit modification requiring prior approval of the Commissioner.

2.4.1 Point of Compliance Well Evaluation

The influence of the low-permeability cap at each site on groundwater quality at the respective point of compliance monitoring wells should be evaluated based on analysis of temporal concentration trends for selected GWPS constituents. Constituents that are primary components of the groundwater contaminant plume at each site will be selected for trend analysis. For example, analysis of nitrate (as N) concentration trends is appropriate for point of compliance wells at the S-3 Ponds because nitrate is the primary groundwater contaminant at the site, but is not appropriate for the Oil Landfarm or the Bear Creek Burial Grounds because nitrate is not a groundwater contaminant at either site. Assuming there is no inflow of additional contaminants or significant changes in current hydrologic conditions, concentrations of the selected GWPS constituents should decrease over the long term as natural recharge/discharge cycles flush contaminated groundwater from the shallow flow system. Details regarding the GWPS constituent selection criteria and trend-analysis method will be included in the annual corrective action monitoring report for the BCHR.

2.4.2 Plume Boundary Well Evaluation

Evaluation of the semiannual monitoring data for the plume boundary wells based on a comparison with data for plume boundary background well GW-521 is not appropriate because the designated plume boundary wells monitor a different groundwater, and consequently the background-comparison approach is prone to erroneous indications of groundwater contamination. Whereas the plume boundary wells monitor calcium-magnesium-bicarbonate groundwater (GW-714 and GW-715), highly mineralized calcium-magnesium-sulfate groundwater (GW-710 and GW-711), or a mixture of these groundwater types (GW-712 and GW-713), well GW-521 monitors a separately distinct groundwater in the Knox Group (Copper Ridge Dolomite) characterized by nearly equal molar concentrations of calcium and magnesium (see Figure 4 in Appendix B). Results of a detailed statistical study presented in *Determination of Reference Concentrations for Inorganic Analytes in Groundwater at the Department of Energy Y-12 Plant, Oak Ridge, Tennessee* show that, in addition to the geochemical differences between the groundwater in these wells, the concentrations of many trace elements, including several GWPS constituents, likewise differ. This study involved calculating upper tolerance limits (UTLs) for inorganic analytes (principal ions and trace elements) based on statistical analysis of the groundwater quality data for specific groups of wells differentiated by similar geochemical characteristics. The UTL for each inorganic analyte represents the maximum concentration expected in groundwater monitored by the group of wells. Because of the differences in water types, the UTLs for several GWPS constituents applicable to the plume boundary wells conflict with monitoring data for well GW-521. For example, the maximum total barium concentration reported for well GW-521 (0.01 mg/L) is an order-of-magnitude lower than the barium UTL applicable to the plume boundary wells (0.71 mg/L). Also, there are no wells completed within the Maynardville Limestone that monitor uncontaminated groundwater upgradient of the permitted waste disposal units. Therefore, there are no good candidate wells that could be used for background comparison.

Instead of the background-comparison approach, evaluation of the semiannual monitoring data for the plume boundary wells should be based on analysis of temporal concentration trends for nitrate (as N), TCE, and technetium-99 (^{99}Tc). These GWPS constituents are primary components of the groundwater contaminant plumes in the Maynardville Limestone, are mobile in groundwater (particularly nitrate and ^{99}Tc), and are reliable indicators of contaminant plume migration. Because ^{99}Tc and TCE have not been detected at the plume boundary wells, consistent, validated detection of these parameters may be construed as indications of plume migration.. This approach accommodates episodic or seasonal concentration fluctuations, which are characteristic of the monitoring data for several GWPS constituents. Additionally, the PCP for the Upper East Fork Poplar Creek Hydrogeologic Regime specifies a similar technical approach using ^{99}Tc as the groundwater contamination indicator.

2.5 Update Technical Field Procedures

The following technical field procedures should be replaced with the most recent versions issued by the Y-12 Plant GWPP. These are Class 1 permit modifications.

- The Well Inspection Procedure (Appendix A-1) and Well Depth Measurement Procedure (Appendix A-2) included as Permit Attachment 2, Section C (S-3 Ponds); Permit Attachment 3, Section D (Oil Landfarm); and Permit Attachment 4, Section D (Bear Creek Burial Grounds).

- The groundwater sampling procedure (Appendix A-12) included as Permit Attachment 6. Also, the title for Attachment 6 should be changed from "Sampling and Analysis Plan" to "Groundwater Sampling Procedure." Technical updates and modifications in the revised version include a procedural description of low-flow sampling. The specified-low flow sampling procedure will apply to most of the monitoring wells sampled for the multiple programmatic purposes of the Y-12 Plant GWPP, including the corrective action monitoring wells in the BCHR.

- The well plugging and abandonment procedure included as Permit Attachment 7.

Revised versions of these technical procedures will not be implemented until this permit modification request is approved.

2.6 Editorial/Clarification Revisions

Based on review of the permit, additional modifications are proposed to clarify the intent of the permit conditions. All editorial changes are Class 1 permit modifications.

3.0 PERMIT SECTION IV: GROUNDWATER MONITORING — S-3 PONDS

This section contains current and revised text for the proposed modifications to the RCRA corrective action groundwater monitoring requirements specified for the S-3 Ponds under Permit Conditions IV.A, IV.C, IV.D, IV.G, and IV.H, including references to updated versions of the procedures in Permit Attachment 2, Section C; Permit Attachment 2, Section D; Permit Attachment 2, Section E; and Permit Attachment 2, Section F. These are Class 1, Class 2, and Class 3 permit modifications (see Table 1, page 2-2).

3.1 Permit Condition IV.A — Unit Identification

Current: The groundwater monitoring well network consists of nineteen wells. Nine wells will be located at the point of compliance and six wells will be located at the edge of the Bear Creek Hydrogeologic Regime contaminate plume (Westernmost Exit Pathway Transect). Four wells serve as background wells for the S-3 Ponds. One well (GW-115) is upgradient of the S-3 Ponds, two wells (GW-613 and GW-614) serve as background wells and one well (GW-521) serves as a background well for the westernmost picket. In the permit all four wells will be referred to as background wells. Information detailing well location and depth is provided in Attachment 2, Section D. The monitoring constituents are outlined in Attachment 2, Section E.

Revised: The groundwater monitoring well network consists of fourteen wells. One is a background well: GW-115; nine are point of compliance wells: GW-101, GW-127, GW-243, GW-244, GW-245, GW-246, GW-247, GW-276, and GW-615; and four are downgradient plume boundary wells: GW-712, GW-713, GW-714, and GW-715. Details regarding the depth and construction of each well are provided in Attachment 2, Section D. The monitoring parameters and constituents are specified in Attachment 2, Section E. Locations of the wells are shown on the map presented in Attachment 2, Section F.

3.2 Permit Condition IV.C — Groundwater Protection Standards

IV.C.1. Current: The Permittee shall monitor the groundwater semi-annually at the Westernmost Exit Pathway wells GW-710, GW-711, GW-712, GW-713, GW-714, and GW-715, and all background wells, as described in Permit Condition IV.B, for parameters and constituents, specified in Attachment 2, Section E.

Revised: The Permittee shall monitor the groundwater semi-annually at the plume boundary wells GW-712, GW-713, GW-714, and GW-715, and background well GW-115, as described in Permit Condition IV.B, for parameters and constituents specified in Attachment 2, Section E.

IV.C.2. Current: The Permittee shall monitor the groundwater from at least one of the Point of Compliance wells, GW-101, GW-127, GW-243, GW-244, GW-245, GW-246, GW-247, GW-276, and GW-615 semi-annually for all parameters and constituents specified in Attachment 2, Section E. Comprehensive valley-wide sampling of surface water and groundwater will be integrated with the attributes of the geologic and hydrogeologic environment to evaluate the effectiveness of the closure activities and evaluate additional actions required to ensure the resources of the valley are acceptable for the intended uses.

Revised: The Permittee shall monitor the groundwater from at least one of the Point of Compliance wells, GW-101, GW-127, GW-243, GW-244, GW-245, GW-246, GW-247, GW-276, and GW-615 semi-annually for all parameters and constituents specified in Attachment 2, Section E. Selection of the point of compliance well(s) for semi-annual monitoring will be based on the data needed for the evaluation required in Permit Condition IV.D.3 and integration with CERCLA activities.

3.3 Permit Condition IV.D — Corrective Action Program

IV.D.2. Current: After the work called for under CERCLA has been completed, the need for any further corrective action, under this permit, shall be evaluated. Such further corrective actions shall be limited to action required based on new information or conditions not available at the time of the remedy selection under CERCLA, that render the record of decision no longer protective of human health and the environment

Revised: Renumber Permit Condition IV.D.2 as IV.D.5.

IV.D.2. New: The plume boundary wells specified in Permit Condition IV.B are located hydraulically downgradient of the groundwater contaminant plumes in the Bear Creek Hydrogeologic Regime. The monitoring data required for these wells in Permit Condition IV.C.1 will be evaluated annually, as described in Permit Condition IV.G.4, for evidence of contaminant plume migration in the regime. Results of the data evaluations will be included in the narrative report required in Permit Condition IV.H.4. The Permittee shall notify the Commissioner if the data evaluations indicate that the wells no longer serve the plume boundary monitoring purposes of the Corrective Action Program.

IV.D.3. New: The monitoring data for the point of compliance well(s) specified in Permit Condition IV.B selected for semi-annual monitoring under Permit Condition IV.C.2 will be evaluated annually, as described in Permit Condition IV.G.6, to gauge the influence of the low-permeability cap at the S-3 Ponds on groundwater quality at the point of compliance. Results of the

data evaluation will be described in the narrative report required in Permit Condition IV.H.4.

IV.D.4. New: The S-3 Ponds are regulated under RCRA and CERCLA. In April 1993 the U.S. Department of Energy, Lockheed Martin Energy Systems, Inc., and the Tennessee Department of Environment and Conservation signed an Agreed Order, which formally established CERCLA as the lead regulatory program with regard to remedial action in the Bear Creek Valley (BCV) Watershed, with RCRA as an applicable or relevant, and appropriate requirement (ARAR). Under this agreement, RCRA will be applied as an ARAR to the extent that post-closure maintenance and care of the S-3 Ponds will be conducted in compliance with the terms of the PCP, but RCRA-driven groundwater cleanup is deferred to the CERCLA Remedial Investigation (RI)/Feasibility Study (FS) process.

The RI for the BCV Watershed was completed in 1996 and effectively characterized the nature and extent of contamination, evaluated the fate and transport of the contaminants, and determined the risk to human health and the environment. The FS for the BCV Watershed is currently in progress to evaluate remedial alternatives that allow for protection of human health and the environment. Following completion of the RI/FS process, the final CERCLA record of decision (ROD) will establish remediation objectives and cleanup goals, and present a plan for remedial actions and the criteria for implementing those actions. The ROD also will establish a groundwater, surface water, and ecological monitoring program intended to gauge the effectiveness of remedial action in the BCV Watershed. If the groundwater component of this monitoring program satisfies the RCRA post-closure corrective action monitoring objectives at the S-3 Ponds, the Permittee may submit a permit modification request to integrate the ROD-driven groundwater monitoring and reporting requirements with those of RCRA specified for the site.

3.4 Permit Condition IV.G — Monitoring Program and Data Evaluation

IV.G.2. Current: The Permittee shall determine the concentration of hazardous waste constituents specified in Permit Condition IV.C. The Permittee shall determine the concentration of hazardous constituents in groundwater at each monitoring well at the Westernmost Exit Pathway and the selected Point of Compliance wells on a semi-annual basis.

Revised: The Permittee shall determine the concentration of hazardous waste constituents specified in Permit Condition IV.C. The Permittee shall determine the concentration of hazardous constituents in groundwater from at least one of the point of compliance wells and each of the plume boundary wells, specified in Permit Condition IV.B, on a semi-annual basis.

IV.G.3. Current: The Permittee shall determine the groundwater flow rate and direction in the upper-most aquifer at least annually, as required by 40 CFR 264.99, as incorporated by reference in Rule 1200-1-11-.06(6)(a)5. A narrative report shall accompany this information to describe how these determinations were made.

Revised: The Permittee shall determine the groundwater flow rate and direction in the upper-most aquifer at least annually, as required by 40 CFR 264.99(e), as incorporated by reference in Rule 1200-1-11-.06(6)(a)1. This information, along with a description of how these determinations were made, shall be included in the narrative report required in Permit Condition IV.H.4.

IV.G.4. Current: The Permittee must notify the Commissioner if the monitoring wells at the Westernmost Exit Pathway no longer serve to monitor the edge of the contaminate plume.

Revised: Semi-annual monitoring data required in Permit Condition IV.C.1 for the plume boundary wells specified in Permit Condition IV.B will be evaluated annually for evidence of contaminant plume migration in the Bear Creek Hydrogeologic Regime, as required in Permit Condition IV.D.2. This evaluation will be based on trend analysis of the results for nitrate (as N), trichloroethene (TCE), and technetium-99 (^{99}Tc), which are groundwater contaminants representative of the most mobile inorganic, organic, and radiochemical constituents listed in Attachment 2, Section E. Results of the evaluations will be included in the narrative report required in Permit Condition IV.H.4.

IV.G.5. Current: If the constituents, sampled in Permit Condition IV.C.1, are detected at the Western-most Exit Pathway above background level, additional wells will be installed to determine the extent of the groundwater contaminate plume.

Revised: If, before the work called for under CERCLA is completed and prior to the final ROD for the BCV Watershed, the monitoring data evaluation required in Permit Condition IV.D.2 indicates that the plume boundary wells specified in Permit Condition IV.B no longer monitor the downgradient boundary of the groundwater contaminant plumes in the Bear Creek Hydrogeologic Regime, the Permittee will re-evaluate the corrective action groundwater monitoring program under this permit. The Permittee will assess the need for additional actions under CERCLA to ensure that the resources of the regime are acceptable for the intended uses.

IV.G.6. Current: The data from wells in Permit Condition IV.C.2 that serve to support the performance of the cap shall be evaluated annually. A narrative report shall accompany the information showing data and/or trends to support the effectiveness of the cap on the point of compliance.

Revised: Monitoring data for the point of compliance well(s) specified in Permit Condition IV.B and selected for semi-annual monitoring under Permit Condition IV.C.2 will be evaluated annually to assess the performance of the low-permeability cap at the S-3 Ponds, as required in Permit Condition IV.D.3. This evaluation will be based on trend analysis of the results for selected inorganic, organic, and radiochemical constituents and parameters listed in Attachment 2, Section E that are representative of the groundwater contamination at the point of compliance. Results of the evaluation will be described in the narrative report required in Permit Condition IV.H.4.

3.5 Permit Condition IV.H — Reporting and Recordkeeping

IV.H.3. Current: The Permittee shall perform the evaluations described in Permit Condition IV.G.2 within 60 days after completion of the semi-annual sampling.

Revised: The Permittee shall perform the laboratory analyses required in Permit Condition IV.G.2 within 60 days after completion of each semi-annual sampling event.

IV.H.4. New: The Permittee shall prepare an annual narrative report as required in Permit Condition II.C.6. This report shall evaluate the groundwater flow rate and direction as required in Permit Condition IV.G.3, and evaluate the monitoring data for the plume boundary wells as specified in Permit Condition IV.G.4 and the point of compliance well(s) as specified in Permit Condition IV.G.6. The narrative report will accompany the monitoring and analytical data required on March 1 in Permit Condition IV.H.1.

3.6 Permit Attachment 2, Section C — Inspections

Updated field procedures for well inspections and well depth measurements are included in Appendices A-1 and A-2, respectively.

3.7 Permit Attachment 2, Section D — Groundwater Monitoring Wells and Construction Details

Appendix A-3 contains a revised table of well construction details for background well GW-115; point of compliance wells GW-101, GW-127, GW-243, GW-244, GW-245, GW-246, GW-247, GW-276, and GW-615; and downgradient plume boundary wells GW-712, GW-713, GW-714, and GW-715. Note that the schematic well construction diagrams for wells GW-521, GW-613, GW-614, GW-710, and GW-711 should be removed from the current version of Permit Attachment 2, Section D.

3.8 Permit Attachment 2, Section E — Groundwater Protection Standards

The revised Groundwater Protection Standards constituent list is presented in Appendix A-4.

3.9 Permit Attachment 2, Section F — Site Map

Appendix A-5 includes a revised site map showing the locations of background well GW-115; point of compliance wells GW-101, GW-127, GW-243, GW-244, GW-245, GW-246, GW-247, GW-276, and GW-615; and downgradient plume boundary wells GW-712, GW-713, GW-714, and GW-715.

4.0 PERMIT SECTION V: GROUNDWATER MONITORING — OIL LANDFARM

This section contains current and revised text for the proposed modifications to the RCRA corrective action groundwater monitoring requirements specified for the Oil Landfarm under Permit Conditions V.A, V.C, V.D, V.G, and V.H, including references to updated versions of the procedures in Permit Attachment 3, Section D and Permit Attachment 3, Section E , Permit Attachment 3, Section F, and Permit Attachment 3, Section G. These are Class 1, Class 2, and Class 3 permit modifications (see Table 1, page 2-2).

4.1 Permit Condition V.A — Unit Identification

Current: The groundwater monitoring well network consists of seventeen wells. Eight wells will be located at the point of compliance and six wells will be located at the edge of the Bear Creek Hydrogeologic Regime contaminate plume (Westernmost Exit Pathway Transect). Three wells serve as background wells (GW-43, GW-44, and GW-84). Information detailing well location and depth is provided in Attachment 3, Section E. The monitoring constituents are outlined in Attachment 3, Section F.

Revised: The groundwater monitoring well network consists of eleven wells. One is a background well: GW-115; six are point of compliance wells: GW-005, GW-008, GW-010, GW-012, GW-075, and GW-363; and four are downgradient plume boundary wells: GW-712, GW-713, GW-714, and GW-715. Details regarding the depth and construction of each well are provided in Attachment 3, Section E. The monitoring parameters and constituents are specified in Attachment 3, Section F. Locations of the wells are shown on the map presented in Attachment 3, Section G.

4.2 Permit Condition V.C — Groundwater Protection Standards

V.C.1. Current: The Permittee shall monitor the groundwater semi-annually at the Westernmost Exit Pathway wells GW-710, GW-711, GW-712, GW-713, GW-714, GW-715, and all background wells as described in Permit Condition V.B, for parameters and constituents specified in Attachment 3, Section F.

Revised: The Permittee shall monitor the groundwater semi-annually at plume boundary wells GW-712, GW-713, GW-714, and GW-715, and background well GW-115, as described in Permit Condition V.B, for parameters and constituents specified in Attachment 3, Section F.

V.C.2. Current: The Permittee shall monitor the groundwater from at least one of the Point of Compliance wells, GW-005, GW-008, GW-012, GW-073, GW-074, GW-075, GW-076, and GW-363 semi-annually for all

parameters and constituents specified in Attachment 3, Section F. Comprehensive valley-wide sampling of surface water and groundwater will be integrated with the attributes of the geologic and hydrogeologic environment to evaluate the effectiveness of the closure activities and evaluate additional actions required to ensure the resources of the valley are acceptable for the intended uses.

Revised: The Permittee shall monitor the groundwater from at least one of the Point of Compliance wells, GW-005, GW-008, GW-010, GW-012, GW-075, and GW-363 semi-annually for all parameters and constituents specified in Attachment 3, Section F. Selection of the point of compliance well(s) for semi-annual monitoring will be based on the data needed for the evaluation required in Permit Condition V.D.3 and integration with CERCLA activities.

4.3 Permit Condition V.D — Corrective Action Program

V.D.2. Current: After the work called for under CERCLA has been completed, the need for any further corrective action, under this permit, shall be evaluated. Such further corrective actions shall be limited to action required based on new information or conditions not available at the time of the remedy selection under CERCLA, that render the record of decision no longer protective of human health and the environment.

Revised: Renumber Permit Condition V.D.2 as V.D.5.

V.D.2. New: The plume boundary wells specified in Permit Condition V.B are located hydraulically downgradient of the groundwater contaminant plumes in the Bear Creek Hydrogeologic Regime. The monitoring data required for these wells in Permit Condition V.C.1 will be evaluated annually, as described in Permit Condition V.G.4, for evidence of contaminant plume migration in the regime. Results of the data evaluations will be included in the narrative report required in Permit Condition V.H.4. The Permittee shall notify the Commissioner if the data evaluations indicate that the wells no longer serve the plume boundary monitoring purposes of the Corrective Action Program.

V.D.3. New: The monitoring data for the point of compliance well(s) specified in Permit Condition V.B that are selected for semi-annual monitoring under Permit Condition V.C.2 will be evaluated annually, as described in Permit Condition V.G.6, to gauge the influence of the low-permeability cap at the Oil Landfarm on groundwater quality at the point of compliance. Results of the data evaluation will be described in the narrative report required in Permit Condition V.H.4.

V.D.4. New: The Oil Landfarm is regulated under RCRA and CERCLA. In April 1993 the U.S. Department of Energy, Lockheed Martin Energy Systems, Inc., and the Tennessee Department of Environment and Conservation signed an Agreed Order which formally established CERCLA as the lead regulatory program with regard to remedial action in the Bear Creek Valley (BCV) Watershed, with RCRA as an applicable or relevant, and appropriate requirement (ARAR). Under this agreement, RCRA will be applied as an ARAR to the extent that post-closure maintenance and care of the Oil Landfarm will be conducted in compliance with the terms of the PCP, but RCRA-driven groundwater cleanup is deferred to the CERCLA Remedial Investigation (RI)/Feasibility Study (FS) process.

The RI for the BCV Watershed was completed in 1996 and effectively characterized the nature and extent of contamination, evaluated the fate and transport of the contaminants, and determined the risk to human health and the environment. The FS for the BCV Watershed is currently in progress to evaluate remedial alternatives that allow for protection of human health and the environment. Following completion of the RI/FS process, the final CERCLA record of decision (ROD) will establish remediation objectives and cleanup goals, and present a plan for remedial actions and the criteria for implementing those actions. The ROD also will establish a groundwater, surface water, and ecological monitoring program intended to gauge the effectiveness of remedial action in the BCV Watershed. If the groundwater component of this monitoring program satisfies the RCRA post-closure corrective action monitoring objectives at the Oil Landfarm, the Permittee may submit a permit modification request to integrate the ROD-driven groundwater monitoring and reporting requirements with those of RCRA specified for the site.

4.4 Permit Condition V.G — Monitoring Program and Data Evaluation

V.G.2. Current: The Permittee shall determine the concentration of hazardous waste constituents specified in Permit Condition V.C. The Permittee shall determine the concentration of hazardous constituents in groundwater at each monitoring well at the Westernmost Exit Pathway and the selected Point of Compliance wells on a semi-annual basis.

Revised: The Permittee shall determine the concentration of hazardous waste constituents specified in Permit Condition V.C. The Permittee shall determine the concentration of hazardous constituents in groundwater from at least one of the point of compliance wells and each of the plume boundary wells, as specified in Permit Condition V.B, on a semi-annual basis.

V.G.3. Current: The Permittee shall determine the groundwater flow rate and direction in the upper-most aquifer at least annually, as required by 40 CFR 264.99(e), as incorporated by reference in Rule 1200-1-11-.06(6)(a)1. A narrative report shall accompany this information to describe how these determinations were made.

Revised: The Permittee shall determine the groundwater flow rate and direction in the upper-most aquifer at least annually, as required by 40 CFR 264.99(e), as incorporated by reference in Rule 1200-1-11-.06(6)(a)1. This information, along with a description of how these determinations were made, shall be included in the narrative report required in Permit Condition V.H.4.

V.G.4. Current: The Permittee must notify the Commissioner if the monitoring wells at the Westernmost Exit Pathway no longer serve to monitor the edge of the contaminant plume.

Revised: Semi-annual monitoring data required in Permit Condition V.C.1 for the plume boundary wells specified in Permit Condition V.B. will be evaluated annually for evidence of contaminant plume migration in the Bear Creek Hydrogeologic Regime, as required in Permit Condition V.D.2. This evaluation will be based on trend analysis of the results for nitrate (as N), trichloroethene (TCE), and technetium-99 (^{99}Tc), which are groundwater contaminants representative of the most mobile inorganic, organic, and radiochemical constituents listed in Attachment 3, Section F. Results of the evaluations will be included in the narrative report required in Permit Condition V.H.4.

V.G.5. Current: If the constituents, sampled in Permit Condition V.C.1, are detected at the Westernmost Exit Pathway above background levels additional wells will be installed to determine the extent of the groundwater contaminant plume.

Revised: If, before the work called for under CERCLA is completed and prior to the final ROD for the BCV Watershed, the monitoring data evaluation required in Permit Condition V.D.2 indicates that the plume boundary wells specified in Permit Condition V.B. no longer monitor the downgradient boundary of the groundwater contaminant plumes in the Bear Creek Hydrogeologic Regime, the Permittee will re-evaluate the corrective action groundwater monitoring program under this permit. The Permittee will assess the need for additional actions under CERCLA to ensure that the resources of the regime are acceptable for the intended uses.

V.G.6. Current: The data from wells in Permit Condition V.C.2 that serve to support the performance of the cap shall be evaluated annually. A narrative report

shall accompany this information showing data/or trends to support the effectiveness of the cap on the point of compliance.

Revised: Monitoring data for the point of compliance well(s) specified in Permit Condition V.B that are selected for semi-annual monitoring under Permit Condition V.C.2 will be evaluated annually to assess the performance of the low-permeability cap at the Oil Landfarm, as required in Permit Condition V.D.3. This evaluation will be based on trend analysis of the results for selected inorganic, organic, and radiochemical constituents and parameters listed in Attachment 3, Section F that are representative of the groundwater contamination at the point of compliance. Results of the evaluation will be described in the narrative report required in Permit Condition V.H.4.

4.5 Permit Condition V.H — Reporting and Recordkeeping

V.H.3. Current: The Permittee shall perform the evaluations described in Permit Condition V.G.2 within 60 days after completion of the semi-annual sampling.

Revised: The Permittee shall perform the laboratory analyses required in Permit Condition V.G.2 within 60 days after completion of each semi-annual sampling event.

V.H.4. New: The Permittee shall prepare an annual narrative report as required in Permit Condition II.C.6. This report shall evaluate the groundwater flow rate and direction as required in Permit Condition V.G.3, and evaluate the monitoring data for the plume boundary wells as specified in Permit Condition V.G.4, and the point of compliance well(s) as specified in Permit Condition V.G.6. The narrative report will accompany the monitoring and analytical data required on March 1 in Permit Condition V.H.1.

4.6 Permit Attachment 3, Section D — Inspections

Updated field procedures for well inspections and well depth measurements are included in Appendices A-1 and A-2, respectively.

4.7 Permit Attachment 3, Section E — Groundwater Monitoring Wells and Construction Details

Appendix A-6 includes a revised table of well construction details for background well GW-115; point of compliance wells GW-005, GW-008, GW-010, GW-012, GW-075, and GW-363; and

downgradient plume boundary wells GW-712, GW-713, GW-714, and GW-715 . Schematic well construction diagrams for wells GW-115 and GW-010 are also included. Note that the schematic diagrams for wells GW-043, GW-044, GW-073, GW-074, GW-076, GW-084, GW-710, and GW-711 should be removed from the current version of Permit Attachment 3, Section E.

4.8 Permit Attachment 3, Section F — Groundwater Protection Standards

The revised Groundwater Protection Standards constituent list is presented in Appendix A-7.

4.9 Permit Attachment 3, Section G — Site Map

Appendix A-8 includes a revised site map showing the locations of background well GW-115; point of compliance wells GW-005, GW-008, GW-010, GW-012, GW-075, and GW-363; and downgradient plume boundary wells GW-712, GW-713, GW-714, and GW-715.

5.0 PERMIT SECTION VI: GROUNDWATER MONITORING — BURIAL GROUNDS

This section contains current and revised text for the proposed modifications to the RCRA corrective action groundwater monitoring requirements specified for the Burial Grounds under Permit Conditions VI.A, VI.C, VI.D, VI.G, and VI.H, including references to updated versions of the procedures in Permit Attachment 3, Section D and Permit Attachment 4, Section E, Permit Attachment 4, Section F, and Permit Attachment 4, Section G. These are Class 1, Class 2, and Class 3 permit modifications (see Table 1, page 2-2).

5.1 Permit Condition VI.A — Unit Identification

Current: The groundwater monitoring well network consists of twenty-six wells. Twelve wells will be located at the point of compliance and six wells will be located at the edge of the Bear Creek Hydrogeologic Regime contaminate plume (Westernmost Exit Pathway Transect). Eight wells serve as background wells (GW-40, GW-42, GW-79, GW-80, GW-162, GW-372, GW-373, and GW-642). Information detailing well location and depth is provided in Attachment 4, Section E. The monitoring constituents are outlined in Attachment 4, Section F.

Revised: The groundwater monitoring well network consists of thirteen wells. One is a background well: GW-115; eight are point of compliance wells: GW-014, GW-046, GW-069, GW-071, GW-082, GW-257, GW-289, and GW-291; and four are downgradient plume boundary wells: GW-712, GW-713, GW-714, and GW-715. Details regarding the depth and construction of each well are provided in Attachment 4, Section E. The monitoring parameters and constituents are specified in Attachment 4, Section F. Locations of the wells are shown on the map presented in Attachment 4, Section G.

5.2 Permit Condition VI.C — Groundwater Protection Standards

VI.C.1. Current: The Permittee shall monitor the groundwater semi-annually at the Westernmost Exit Pathway wells GW-710, GW-711, GW-712, GW-713, GW-714, and GW-715, and all the background wells as described in Permit Condition VI.B. for parameters and constituents specified in Attachment 4, Section F.

Revised: The Permittee shall monitor the groundwater semi-annually at plume boundary wells GW-712, GW-713, GW-714, and GW-715, and background well GW-115, as described in Permit Condition VI.B, for parameters and constituents as specified in Attachment 4, Section F.

VI.C.2. Current: The Permittee shall monitor the groundwater from at least one of the Point of Compliance wells, GW-46, GW-68, GW-69, GW-71, GW-72, GW-82, GW-248, GW-249, GW-250, GW-257, GW-290, and GW-291 semi-annually for all parameters and constituents specified in Attachment 4, Section F. Comprehensive valley-wide sampling of surface water and groundwater will be integrated with the attributes of the geologic and hydrogeologic environment to evaluate the effectiveness of the closure activities and evaluate additional actions required to ensure the resources of the valley are acceptable for the intended uses.

Revised: The Permittee shall monitor the groundwater from at least one of the Point of Compliance wells, GW-014, GW-046, GW-069, GW-071, GW-082, GW-257, GW-289, and GW-291 semi-annually for all parameters and constituents specified in Attachment 4, Section F. Selection of the point of compliance well(s) for semi-annual monitoring will be based on the data needed for the evaluation required in Permit Condition VI.D.3 and integration with CERCLA activities.

5.3 Permit Condition VI.D — Corrective Action Program

VI.D.2. Current: After the work called for under CERCLA has been completed, the need for any further corrective action, under this permit, shall be evaluated. Such further corrective actions shall be limited to action required based on new information or conditions not available at the time of the remedy selection under CERCLA, that render the record of decision no longer protective of human health and the environment.

Revised: Renumber Permit Condition VI.D.2 as VI.D.5.

VI.D.2. New: The plume boundary wells specified in Permit Condition VI.B are located hydraulically downgradient of the groundwater contaminant plumes in the Bear Creek Hydrogeologic Regime. The monitoring data required for these wells in Permit Condition VI.C.1 will be evaluated annually, as described in Permit Condition VI.G.4, for evidence of contaminant plume migration in the regime. Results of the data evaluations will be included in the narrative report required in Permit Condition VI.H.4. The Permittee shall notify the Commissioner if the data evaluations indicate that the wells no longer serve the plume boundary monitoring purposes of the Corrective Action Program.

VI.D.3. New: The monitoring data for the point of compliance well(s) specified in Permit Condition VI.B that are selected for semi-annual monitoring under Permit Condition VI.C.2 will be evaluated annually, as described in Permit Condition VI.G.6, to gauge the influence of the low-permeability cap at the Burial Grounds on groundwater quality at the point of

compliance. Results of the data evaluation will be described in the narrative report required in Permit Condition VI.H.4.

VI.D.4. New: The Bear Creek Burial Grounds (units A, C-West, and Walk-In Pits) are regulated under RCRA and CERCLA. In April 1993 the U.S. Department of Energy, Lockheed Martin Energy Systems, Inc., and the Tennessee Department of Environment and Conservation signed an Agreed Order, which formally established CERCLA as the lead regulatory program with regard to remedial action in the Bear Creek Valley (BCV) Watershed, with RCRA as an applicable or relevant, and appropriate requirement (ARAR). Under this agreement, RCRA will be applied as an ARAR to the extent that post-closure maintenance and care of the Bear Creek Burial Grounds will be conducted in compliance with the terms of the PCP, but RCRA-driven groundwater cleanup is deferred to the CERCLA Remedial Investigation (RI)/Feasibility Study (FS) process.

The RI for the BCV Watershed was completed in 1996 and effectively characterized the nature and extent of contamination, evaluated the fate and transport of the contaminants, and determined the risk to human health and the environment. The FS for the BCV Watershed is currently in progress to evaluate remedial alternatives that allow for protection of human health and the environment. Following completion of the RI/FS process, the final CERCLA record of decision (ROD) will establish remediation objectives and cleanup goals, and present a plan for remedial actions and the criteria for implementing those actions. The ROD also will establish a groundwater, surface water, and ecological monitoring program intended to gauge the effectiveness of remedial action in the BCV Watershed. If the groundwater component of this monitoring program satisfies the RCRA post-closure corrective action monitoring objectives at the Bear Creek Burial Grounds, the Permittee may submit a permit modification request to integrate the ROD-driven groundwater monitoring and reporting requirements with those of RCRA specified for the site.

5.4 Permit Condition VI.G — Monitoring Program and Data Evaluation

VI.G.2. Current: The Permittee shall determine the concentration of hazardous waste constituents specified in Permit Condition VI.C. The Permittee shall determine the concentration of hazardous constituents in groundwater at each monitoring well at the Westernmost Exit Pathway and the selected Point of Compliance wells on a semi-annual basis.

Revised: The Permittee shall determine the concentration of hazardous waste constituents specified in Permit Condition VI.C. The Permittee shall

determine the concentration of hazardous constituents in groundwater from at least one of the point of compliance wells and each of the plume boundary wells, as specified in Permit Condition VI.B, on a semi-annual basis.

VI.G.3. Current: The Permittee shall determine the groundwater flow rate and direction in the upper-most aquifer at least annually, as required by 40 CFR 264.99(e), as incorporated by reference in Rule 1200-1-11-.06(6)(a)1. A narrative report shall accompany this information to describe how these determinations were made.

Revised: The Permittee shall determine the groundwater flow rate and direction in the upper-most aquifer at least annually, as required by 40 CFR 264.99(e), as incorporated by reference in Rule 1200-1-11-.06(6)(a)1. This information, along with a description of how these determinations were made, shall be included in the narrative report required in Permit Condition VI.H.4.

VI.G.4. Current: The Permittee must notify the Commissioner if the monitoring wells at the Westernmost Exit Pathway no longer serve to monitor the edge of the contaminant plume.

Revised: Semi-annual monitoring data required in Permit Condition VI.C.1 for the plume boundary wells specified in Permit Condition VI.B will be evaluated annually for evidence of contaminant plume migration in the Bear Creek Hydrogeologic Regime, as required in Permit Condition VI.D.2. This evaluation will be based on trend analysis of the results for nitrate (as N), trichloroethene (TCE), and technetium-99 (^{99}Tc), which are groundwater contaminants representative of the most mobile inorganic, organic, and radiochemical constituents listed in Attachment 4, Section F. Results of the evaluations will be included in the narrative report required in Permit Condition VI.H.4.

VI.G.5. Current: If the constituents, sampled in Permit Condition VI.C.1, are detected at the Westernmost Exit Pathway above background levels additional wells will be installed to determine the extent of the groundwater contaminant plume.

Revised: If, before the work called for under CERCLA is completed and prior to the final ROD for the BCV Watershed, the monitoring data evaluation required in Permit Condition VI.D.2 indicates that the plume boundary wells specified in Permit Condition VI.B no longer monitor the downgradient boundary of the groundwater contaminant plumes in the Bear Creek Hydrogeologic Regime, the Permittee will re-evaluate the corrective action groundwater monitoring program under this permit. The Permittee will assess the need for additional actions under CERCLA

to ensure that the resources of the regime are acceptable for the intended uses.

VI.G.6. Current: The data from wells in Permit Condition VI.C.2 that serve to support the performance of the cap shall be evaluated annually. A narrative report shall accompany the information showing data and/or trends to support the effectiveness of the cap on the point of compliance.

Revised: Monitoring data for the point of compliance well(s) specified in Permit Condition VI.B that are selected for semi-annual monitoring under Permit Condition VI.C.2 will be evaluated annually to gauge the performance of the low-permeability cap at the Burial Grounds, as required in Permit Condition VI.D.3. This evaluation will be based on trend analysis of the results for selected inorganic, organic, and radiochemical constituents and parameters listed in Attachment 4, Section F that are representative of the groundwater contamination at the point of compliance. Results of the evaluation will be described in the narrative report required in Permit Condition VI.H.4.

5.5 Permit Condition VI.H — Reporting and Recordkeeping

VI.H.3. Current: The Permittee shall perform the evaluations described in Permit Condition VI.G.2 within 60 days after completion of the semi-annual sampling.

Revised: The Permittee shall perform the laboratory analyses required in Permit Condition VI.G.2 within 60 days after completion of each semi-annual sampling event.

VI.H.4. New: The Permittee shall prepare a narrative report as required in Permit Condition II.C.6. This report shall evaluate: (1) the groundwater flow rate and direction, as required in Permit Condition VI.G.3, (2) the monitoring data for the plume boundary wells, as required in Permit Condition VI.G.4, and (3) the monitoring data for the point of compliance well(s), as required in Permit Condition VI.G.6. The narrative report will accompany the sampling information and analytical data required on March 1 in Permit Condition VI.H.1.

5.6 Permit Attachment 4, Section D — Inspections

Updated field procedures for well inspections and well depth measurements are included in Appendices A-1 and A-2, respectively.

5.7 Permit Attachment 4, Section E — Groundwater Monitoring Wells and Construction Details

Appendix A-9 includes a revised table of well construction details for background well GW-115; point of compliance wells GW-014, GW-046, GW-069, GW-071, GW-082, GW-257, GW-289, and GW-291; and downgradient plume boundary wells GW-712, GW-713, GW-714, and GW-715. Also included are schematic well construction diagrams for wells GW-115, GW-014, and GW-289.

The well construction schematic diagrams for wells GW-040, GW-042, GW-068, GW-072, GW-079, GW-080, GW-162, GW-248, GW-249, GW-250, GW-290, GW-372, GW-373, GW-642, GW-710, and GW-711 should be removed from the current version of Permit Attachment 4, Section E.

5.8 Permit Attachment 4, Section F — Groundwater Protection Standards

The revised Groundwater Protection Standards constituent list is presented in Appendix A-10.

5.9 Permit Attachment 4, Section G — Site Map

Appendix A-11 includes a revised site map showing the locations of background well GW-115; point of compliance wells GW-014, GW-046, GW-069, GW-071, GW-082, GW-257, GW-289, and GW-291; and downgradient plume boundary wells GW-712, GW-713, GW-714, and GW-715.

6.0 PERMIT ATTACHMENT 6 — SAMPLING AND ANALYSIS PLAN

Appendix A-12 contains a copy of the most current version of the Y-12 Plant GWPP technical procedure for groundwater sampling. In addition to the revised procedure, the title of the Permit Attachment is revised as shown below.

Current: ATTACHMENT 6 — SAMPLING AND ANALYSIS PLAN

Revised: ATTACHMENT 6 — GROUNDWATER SAMPLING PROCEDURE

7.0 PERMIT ATTACHMENT 7 — METHODOLOGY FOR MONITORING WELL ABANDONMENT

Appendix A-13 contains the most recent version of the Y-12 Plant GWPP technical procedure for groundwater monitoring well plugging and abandonment.

APPENDIX A
REVISED PERMIT ATTACHMENTS

APPENDIX A-1
Well Inspection Procedure

Permit Attachment 2, Section C, Appendix 2C-1
(S-3 Ponds)

Permit Attachment 3, Section D, Appendix 3D-1
(Oil Landfarm)

Permit Attachment 4, Section D, Appendix 4D-1
(Bear Creek Burial Grounds)

Oak Ridge Y-12 Plant
Groundwater Protection Program
Standard Practice Procedure

Monitoring Well Inspection Procedure
G-001
Rev. 2., May 1997

Approved by: W. Kevin Jago Date: 4-28-97

Effective Date: 5-1-97

Record of Changes

Change No.	Affected Pages	Approved Date	Expiration Date	Change No.	Affected Pages	Approved Date	Expiration Date

Next 3-year review required no later than: May 2000.

CONTENTS

1.0 PURPOSE

This is a procedure intended to establish a systematic method for inspecting the physical condition of a monitoring well and to identify monitoring well maintenance needs that will extend its life and ensure the collection of representative groundwater quality samples and hydrologic data.

2.0 APPLICABILITY

This procedure is applicable to all monitoring wells located at the Y-12 Plant.

3.0 DEFINITIONS

Annular Seal - a grout seal installed between the well casing and borehole wall or outer casing.

Christy Box - steel or plastic box installed below the ground surface that allows access to the top of casing in a flush-mounted monitoring well design.

Concrete Pad - typically a neat cement or concrete pad at ground surface that surrounds the well casing or protective surface casing.

Constructed Depth - the distance from the top of the innermost well casing to the bottom of the screened or open interval as reported in: Updated Subsurface Data Base for Bear Creek Valley, Chestnut Ridge, and Parts of Bethel Valley on the U.S. Department of Energy Oak Ridge Reservation, Y/TS-881(R3), July 1995 (or most recent version).

Flush-Mounted Well - monitoring well head completion where the top of casing is below the ground surface.

Groundwater Protection Program (GWPP) - a program developed per DOE Order 5400.1 to characterize the hydrogeology and monitor and protect groundwater quality at the Y-12 Plant.

GWPP Manager - person responsible for day-to-day management of the Y-12 Plant GWPP.

Guard Posts - posts placed around a monitoring well to prevent vehicular collision damage.

Hasp - a welded fastening that allows a monitoring well cap to be locked to the well casing, or a hinged steel lid to be locked to the protective casing.

Incrustation - deposition of mineral matter on the well screen and/or casing, typically through chemical or biological reactions.

Lock - a waterproof, steel or brass fastening device that secures the well cap or protective-casing lid and prevents unauthorized access to the well.

Measured Depth - the distance from the top of the innermost well casing to the bottom of the well as measured in the field.

Monitoring Well - a well installed to enable collection of groundwater samples and/or hydrologic data (i.e., static water level).

Open-Hole Interval - a portion of a monitoring well designed so that groundwater enters the well through a segment of borehole that is open to the water-bearing formation.

Primary Inspection Items - those components of a monitoring well that are critical to the collection of representative groundwater quality samples and hydrologic information. Primary inspection items include the well casing and screen, annular grout seal, hasp, lock, cap, well identification, and condition of the screened or open-hole interval.

Protective Surface Casing - a section of large-diameter steel or polyvinyl chloride (PVC) pipe that is emplaced over the surface extension of a smaller diameter well casing to provide structural protection to the well and restrict unauthorized access to the well. A weep (hole) is usually located near the base of the casing to serve as a drain and prevent water from collecting inside the protective surface casing.

Screened Interval - A portion of a monitoring well that contains a slotted, perforated, or wire-wound section of casing (e.g., screen) through which groundwater enters the monitoring well and samples are obtained.

Secondary Inspection Items - those components of a monitoring well which generally do not affect collection of representative groundwater quality samples or hydrologic information; these include well access, guard posts, and concrete pad.

Sediment Accumulation - accumulation of sand, silt, precipitates, or other debris in the bottom of the monitoring well.

Well Access - the means by which a monitoring well is accessible (e.g., gravel road).

Well Cap - a removable cap or hinged steel lid used to cover a well casing.

Well Casing - steel, stainless steel or PVC pipe which provides unobstructed access to the monitored interval.

Well Identification - a stainless steel plate that is engraved with the monitoring well identification number and is attached to the outermost casing.

4.0 REFERENCES

4.1 Use References

4.1.1 "Comprehensive Groundwater Monitoring Plan for the Department of Energy Y-12 Plant Oak Ridge, Tennessee," Y/SUB/90-00206C/5, September 1990.

4.1.2 "Calendar Year 1996 Annual Groundwater Monitoring Report for the Bear Creek Hydrogeologic Regime at the U.S. Department of Energy Y-12 Plant, Oak Ridge, Tennessee," Y/SUB/97-KDS15V/1, Parts 1 and 2.

4.1.3 "Calendar Year 1996 Groundwater Quality Report for the Chestnut Ridge Hydrogeologic Regime at the U.S. Department of Energy Y-12 Plant, Oak Ridge, Tennessee," Y/SUB/97-KDS15V/2, Parts 1 and 2.

4.1.4 "Calendar Year 1996 Groundwater Quality Report for the Upper East Fork Poplar Creek Hydrogeologic Regime at the U.S. Department of Energy Y-12 Plant, Oak Ridge, Tennessee," Y/SUB/97-KDS15V/3, Parts 1 and 2.

4.1.5 "Oak Ridge Y-12 Plant Groundwater Protection Program Management Plan (Revised)," Y/SUB/96-KDS15V/1, June 1996 (or most recent revision).

4.1.6 "Updated Subsurface Data Base for Bear Creek Valley, Chestnut Ridge, and Parts of Bethel Valley on the U.S. Department of Energy Oak Ridge Reservation," Y/TS-881(R3), July 1995 (or most recent revision).

4.1.7 "Monitoring Well Inspection and Maintenance Plan, Y-12 Plant, Oak Ridge, Tennessee (Revised)," Y/TS-1215, September 1996.

4.2 Source References

4.2.1 Aller, Linda, Truman W. Bennett, Gene Hackett, Rebecca J. Petty, Jay H. Lehr, Helen Sedoris, and David M. Nielsen "Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells", NWWA, Dublin, Ohio, 398 p.

4.2.2 Driscoll, Fletcher G., 1986, "Groundwater and Wells", Johnson Division, St. Paul, Minnesota, 1089 p.

4.2.3 "Environmental Surveillance Quality Control Program," ES/ESH/INT-14, February 1988.

4.2.4 Gass, Tyler E., Truman W. Bennett, James Miller and Robin Miller, 1980, "Manual of Water Well Maintenance and Rehabilitation Technology", NWWA, Dublin, Ohio, 247 p.

4.2.5 Nielsen, David M., 1991, "Practical Handbook of Groundwater Monitoring", Lewis Publishers, Chelsea, Michigan, 717 p.

4.2.6 U.S. Department of Energy, "Procedures for the Collection and Preservation of Groundwater and Surface Water Samples and for the Installation of Monitoring Wells", GJ/TMC-08 (Second Edition) UC-70A, October 1985.

4.2.7 U.S. Environmental Protection Agency, "Environmental Compliance Branch Standard Operating Procedures and Quality Assurance Manual", Region IV, Athens, Georgia, February 1991.

4.2.8 U.S. Environmental Protection Agency, "RCRA Comprehensive Groundwater Monitoring Evaluation Document" (RCRA Groundwater Monitoring Systems), RCRA Enforcement Division, March 1988.

4.2.9 U.S. Environmental Protection Agency, "RCRA Facility Investigation (RFI) Guidance, Volumes I-IV", OSWER Directive 9502.00-6C, July 1987.

4.2.10 U.S. Environmental Protection Agency, "RCRA Groundwater Monitoring: Draft Technical Guidance," EPA/530-R-93-001, November 1992.

5.0 PRECAUTIONS AND LIMITATIONS

5.1 Annular Seal

The downhole condition of the annular seal cannot be determined without geophysical techniques. Such evaluation is beyond the scope of this procedure.

5.2 Constructed Well Depth

The reported constructed depth of a monitoring well may require confirmation or may be inaccurate as recorded in original well construction records.

5.3 Incrustation

The downhole condition of a well screen cannot be determined without remote sensing. Such evaluation is beyond the scope of this procedure.

5.4 Limits of Tape Measure

Some monitoring wells are completed at depths (i.e., > 300 ft) that cannot be measured with a flat, weighted steel or fiberglass measuring tape. Additionally, the depth of monitoring wells, which contain large water columns (i.e., greater than 100 ft) also may not be measurable with a flat, weighted measuring tape. A circular, stainless steel or coated steel

measuring cable shall be used for all monitoring wells greater than a 300 ft depth and is preferable for all monitoring wells.

5.5 Measurement Accuracy

Increased depth and large water columns decrease the accuracy of the monitoring well depth measurements.

5.6 Safety

Established safety standards and requirements of Lockheed Martin Energy Systems, DOE, and OSHA will apply to the inspection and maintenance of a monitoring well. All field personnel will be provided with appropriate safety clothing, equipment, and training.

5.7 Well Access

A monitoring well may be deemed inaccessible because of site conditions or operations.

6.0 PREREQUISITES

6.1 Initial Inspection

If a monitoring well is currently scheduled for Plugging and Abandonment (P/A), inspection and maintenance is not performed.

6.2 Subsequent Inspections

If a monitoring well is currently included in the comprehensive groundwater monitoring program, it is classified as active and an inspection is performed annually. If not, the monitoring well is classified as inactive and an inspection is performed every three years. Monitoring wells for which the status changes from inactive to active will be inspected prior to monitoring.

7.0 EQUIPMENT, TOOLS AND SUPPLIES

7.1 Documentation

Updated Subsurface Data Base (Y/TS-881/R3 or most recent revision), Well Inspection Maintenance Summary, Monitoring Well Construction Summary, Well Inspection Checklist, Well Maintenance Request Form, Monitoring Well Depth Measurement Procedure (G-002), Active Well Status Checklist, and Daily Activity Log.

7.2 Field Equipment

Well locks, keys to unlock wells, weighted steel or fiberglass measuring tape and/or cable, pens, indelible markers, and clip-board.

7.3 Personal Protective Equipment

Required: Rubber gloves, protective eye-wear.
Optional: Safety shoes, tyvek coveralls, and hard hat.

7.4 Decontamination Equipment

Plastic ground cover, distilled water, wash bottles, mild detergent, and collection vessels for wash and rinse water.

8.0 ACTION STEPS

8.1 Preparation

8.1.1 Identify monitoring wells to be inspected from the Well Inspection/Maintenance Summary.

8.1.2 Review Well Location Map(s) and Monitoring Well Construction Summary to determine:

a. the monitoring well location;
b. the constructed depth; and
c. length of the screen or open-hole interval.

8.2 Inspection

8.2.1 On the Well Inspection Checklist, enter the inspection number for the monitoring well. The Y-12 Plant GWPP Manager or authorized designee will assign the inspection number using the following format: two-digit number denoting the year followed by a dash followed by a three-digit number (example: 91-001). Inspection numbers should be assigned consecutively (i.e., 91-001, 91-002, 91-003,...) as each monitoring well is inspected. Complete the Well Information section of checklist using information from the Updated Subsurface Data Base and the Monitoring Well Construction Summary (for site, screened or open-hole interval length, and constructed depth).

8.2.2 Verify that the monitoring well is accessible by vehicle (active monitoring wells only). If construction, fencing, fallen trees, or site operation or closure activities

have isolated the well, note on the Well Inspection Checklist and report the finding to the Y-12 GWPP Manager or authorized designee. Otherwise, note any maintenance needs for access roads on the Well Inspection Checklist.

8.2.3 Inspect guard posts for damage, physical deterioration, paint degradation, and proper positioning (active monitoring wells only). Each post should be painted high-traffic yellow, and be a height above ground that is adequate to prevent vehicular collision damage. The guard posts should be situated between the monitoring well and each direction of traffic approach. Complete appropriate section of Well Inspection Checklist.

8.2.4 Confirm that a stainless steel plate engraved with a legible identification number is attached to the outermost casing of the monitoring well. Through a comparison with the Updated Subsurface Data Base, confirm that the identification number is correct. Complete appropriate section of Well Inspection Checklist.

8.2.5 Inspect the concrete pad for cracks and deterioration (active monitoring wells only). The top of the pad should be level or slope away from the casing to prevent ponding of rain water around the well casing. Complete appropriate section of Well Inspection Checklist.

8.2.6 Inspect the lock for corrosion and operation of the locking mechanism. If a lock is corroded and difficult to open, replace it. **Do not** use any lubricant to improve lock performance. Complete appropriate section of Well Inspection Checklist.

8.2.7 Inspect the integrity of the hasps, making certain that they are firmly welded to the well cap and/or the metal casing. Complete appropriate section of Well Inspection Checklist.

8.2.8 Inspect the condition of the well cap or hinged steel lid. Complete appropriate section of Well Inspection Checklist.

8.2.9 Inspect all above-ground well casings and protective surface casings (if present) for cracks, corrosion, breaks, bends, or any other signs of deterioration that may effect structural integrity. Inspect base of protective surface casing to locate weep. Complete appropriate section of Well Inspection Checklist.

8.2.10 For flush-mounted monitoring wells, inspect traffic covers for presence of fasteners (bolts), excessive rust or deterioration, or any other notable damage. Covers should be securely bolted to the christy box.

8.2.11 For flush-mounted monitoring wells, inspect christy box for excessive rust or other damage. The concrete pad surrounding the christy box should be sloped to minimize the potential for water accumulation inside of the box.

8.2.12 For flush-mounted monitoring wells, inspect the water-tight well cap for tightness and condition of the rubber seal. Caps should fit securely so that they cannot be turned by hand.

8.2.13 Inspect the annular seal for cracks, if visible, and by shaking the well casing. The casing should not easily move. Complete appropriate section of Well Inspection Checklist.

8.2.14 Put on rubber gloves and protective eye-wear.

8.2.15 Remove lock and well cap.

8.2.16 Verify that an established reference mark (measuring point) is on the top of the innermost well casing. If not, establish a mark with indelible marker on the well casing for future reference and notify the Y-12 Plant GWPP Manager or authorized designee.

8.2.17 Measure the monitoring well depth from the established reference mark and record on the checklist to the nearest 0.1 foot. Perform measurement in accordance with Y-12 Plant Monitoring Well Depth Measurement Procedure (G-002).

8.2.18 Compare measured depth to the constructed depth of the monitoring well by using the equation: Sediment Accumulation = Constructed Depth - Measured Depth. The sediment accumulation divided by the screen or open-hole interval length must be less than 0.2. Complete appropriate section of Well Inspection Checklist.

8.2.19 If any shaded yes/no answer box for each item on the Well Inspection Checklist is checked, complete the Well Maintenance Request section of the checklist noting if maintenance is needed for Primary or Secondary Inspection Item(s), or both. Enter the Well Maintenance Request number on the Well Inspection Checklist and Maintenance Request Form. The Y-12 Plant GWPP Manager or authorized designee will assign Well Maintenance Request numbers using the following format: a two-digit number denoting the year followed by a dash followed by a three-digit number with a "P" (for Primary Inspection Item), or "S" (for Secondary Inspection Item), or "PS" (for both Primary and Secondary Inspection Items) suffix (examples: 91-001P, 91-001S, 91-001PS). Consecutive maintenance request numbers for each well should be assigned (example: 91-001P, 91-002S, 91-003S,...).

8.2.20 Sign and date Well Inspection Checklist.

9.0 ACCEPTANCE CRITERIA

If none of the inspection items require maintenance, inspection of the monitoring well is complete.

10.0 POST PERFORMANCE WORK ACTIVITIES

10.1 Documentation

Compile Well Inspection Checklists and Well Maintenance Request Forms. Transfer appropriate data from checklists and forms to the Well Inspection/Maintenance Summary. Submit all checklists, forms, and the completed Well Inspection/Maintenance Summary to the Y-12 Plant GWPP Manager or authorized designee.

10.2 Maintenance Work Inspection

The Y-12 Plant GWPP Manager or authorized designee will schedule and coordinate all well maintenance activities. When requested maintenance has been completed, obtain original Well Maintenance Request Form from the Y-12 Plant GWPP Manager or authorized designee and inspect maintenance work performed.

10.3 Plugging and Abandonment Requests

If the Y-12 Plant GWPP Manager or authorized designee determines that, based upon consultations with field inspection personnel and a well site visit (if needed), a Primary Inspection Item is damaged or deteriorated beyond practical repair, the well may require plugging and abandonment. The Y-12 Plant GWPP Manager or authorized designee will prepare all Plugging and Abandonment Request Forms and schedule and coordinate all related activities.

11.0 RECORDS

The documentation listed in items 11.1 through 11.3 below will be included in the annual well inspection documentation report and become part of the administrative record for the Y-12 Plant GWPP.

11.1 Well Inspection Checklist

11.2 Well Maintenance Request Form

11.3 Plugging and Abandonment Request Form

11.4 Daily Log

A daily log of field inspection activities shall be maintained. This log will be placed in the administrative record of the Y-12 Plant GWPP.

APPENDIX A-2
Well Depth Measurement Procedure

Permit Attachment 2, Section C, Appendix 2C-2
(S-3 Ponds)

Permit Attachment 3, Section D, Appendix 3D-2
(Oil Landfarm)

Permit Attachment 4, Section D, Appendix 4D-2
(Bear Creek Burial Grounds)

Oak Ridge Y-12 Plant
Groundwater Protection Program
Standard Practice Procedure

Monitoring Well Depth Measurement Procedure
G-002
Rev. 2., May 1997

Approved by: W. Kevin Pago Date: 4-28-97

Effective Date: 5-1-97

Record of Changes

Change No.	Affected Pages	Approved Date	Expiration Date	Change No.	Affected Pages	Approved Date	Expiration Date

Next 3-year review required no later than: May 2000.

CONTENTS

1.0 PURPOSE

This procedure is a standardized method for determining the measured depth of a groundwater monitoring well. The measured depth of a monitoring well, when compared to the constructed depth, provides an indication of sediment accumulation or obstructions.

2.0 APPLICABILITY

Monitoring well depth measurement is applicable to all monitoring wells located at the Y-12 Plant.

3.0 DEFINITIONS

Constructed Depth - the distance from the top of the innermost well casing to the bottom of the screened or open interval as reported in: Updated Subsurface Data Base for Bear Creek Valley, Chestnut Ridge, and Parts of Bethel Valley on the U.S. Department of Energy Oak Ridge Reservation, Y/TS-881(R3), July 1995 (or most recent revision).

Groundwater Protection Program (GWPP) - a program developed per DOE Order 5400.1 to characterize the hydrogeology and monitor and protect groundwater quality at the Y-12 Plant.

GWPP Manager - person responsible for day-to-day management of the Y-12 Plant GWPP.

Measured Depth - the distance from the top of the innermost well casing to the bottom of the monitoring well as measured in the field.

Sediment Accumulation - accumulation of sand, silt, precipitates, or other debris in the bottom of the monitoring well.

Well Cap - a removable cap used to cover a well casing.

Well Casing - steel, stainless steel, or PVC pipe which provides unobstructed access to the monitored interval.

Well Identification - a steel plate embossed with the monitoring well identification number that is attached to the outermost casing.

4.0 REFERENCES

4.1 Use References

4.1.1 "Updated Subsurface Data Base for Bear Creek Valley, Chestnut Ridge, and Parts of Bethel Valley on the U.S. Department of Energy Oak Ridge Reservation", Y/TS-881(R3), July 1995 (or most revision).

4.1.2 "Monitoring Well Inspection and Maintenance Plan, Y-12 Plant, Oak Ridge, Tennessee (Revised)", Y/TS-1215, September 1996.

4.1.3 "Oak Ridge Y-12 Plant Groundwater Protection Program Management Plan (Revised)," Y/SUB/96-KDS15V/1, June 1996 (or most recent revision).

4.2 Source References

4.2.1 Driscoll, Fletcher G., 1986, "Groundwater and Wells", Johnson Division, St. Paul, Minnesota, 1089 p.

4.2.2 "Environmental Surveillance Quality Control Program", ES/ESH/INT-14, February 1988.

4.2.3 Gass, Tyler E., Truman W. Bennett, James Miller and Robin Miller, 1980, "Manual of Water Well Maintenance and Rehabilitation Technology", NWWA, Dublin, Ohio, 247 p.

4.2.4 U.S. Environmental Protection Agency, "A Compendium of Superfund Field Operations Methods", EPA/540/P-87/001, 1987.

4.2.5 U.S. Environmental Protection Agency, "RCRA Groundwater Monitoring: Draft Technical Guidance," EPA/530-R-93-001, November 1992.

5.0 PRECAUTIONS AND LIMITATIONS

5.1 Constructed Depth

The reported constructed depth of the monitoring well may require confirmation or may be inaccurate as recorded in original construction records.

5.2 Limits of Tape Measure

Some monitoring wells are completed at depths (i.e., > 300 ft) that cannot be measured with a flat, weighted steel or fiberglass measuring tape. Additionally, the depth of monitoring wells, which contain large water columns (i.e., greater than 100 ft.) also may not be measurable with a flat, weighted measuring tape. A stainless steel or coated steel measuring cable shall be used for all monitoring wells greater than a 300-foot depth and is preferable for all monitoring wells.

5.3 Measurement Accuracy

Increased depth and large water columns decrease the accuracy of the monitoring well depth measurement.

5.4 Safety

Established safety standards and requirements of Lockheed Martin Energy Systems, DOE, and OSHA will apply to the process of obtaining the measured depth of a monitoring well. All field personnel will be provided with appropriate safety clothing, equipment, and training.

5.5 Well Access

A monitoring well may be deemed inaccessible because of site conditions or operations.

6.0 PREREQUISITES

All monitoring wells will have the measured depth determined during a scheduled well inspection.

7.0 EQUIPMENT, TOOLS AND SUPPLIES

7.1 Documentation

Monitoring Well Construction Summary, Updated Subsurface Data Base, Y/TS-881(R3) (or most recent version), Daily Activity Logbook, and Well Inspection Checklist.

7.2 Personnel Protection Equipment

Required: rubber gloves, protective eye-wear.
Optional: safety shoes, tyvek coveralls, and hard hat.

7.3 Field Equipment

Keys to unlock wells, indelible marker, pen, clipboard, and weighted fiberglass or steel

measuring tape(s) and/or cable (the weight will be stainless steel or other approved inert material and have a blunt end facing down).

7.4 **Decontamination Equipment**

Plastic ground cover, de-ionized water, mild detergent, and wash and rinse water collection vessels.

8.0 ACTION STEPS

8.1 Preparation: Review the Monitoring Well Construction Summary and Updated Subsurface Data Base to determine the monitoring well location and obtain the constructed depth of the monitoring well.

8.2 Record well identification and date.

8.3 Put on rubber gloves and protective eye-wear.

8.4 Remove the lock and well cap.

8.5 Locate the reference mark at the top of the innermost well casing. If a reference mark is not present, make one with indelible marker, and notify Y-12 Plant GWPP Manager or authorized designee.

8.6 Select the appropriate length measuring tape and/or cable.

8.7 Slowly lower the weight into the monitoring well until the bottom of the monitoring well is encountered as indicated by slack in the tape measure or a solid impact.

8.8 When slack or impact occurs, slowly lift the tape until the tape becomes taut. Raise and lower the tape until the point of tension release becomes clearly defined.

8.9 Hold the tape to the reference mark on the casing and note the measurement.

8.10 Repeat steps 8.7 - 8.9 several times to ensure an accurate measurement. Readings should remain constant (i.e., within 0.1 ft).

8.11 Record the final measurement to the nearest 0.1 ft as the measured depth in the Daily Activity Logbook and/or Well Inspection Checklist.

8.12 Remove the measuring tape from the monitoring well and decontaminate in accordance with ESP-900.

8.13 Close well cap and replace lock.

9.0 ACCEPTANCE CRITERIA

An acceptable measured depth of a monitoring well is achieved when the range of three or more consecutive measurements are within 0.1 ft.

10.0 POST PERFORMANCE ACTIVITIES

Report to the Y-12 GWPP Manager or authorized designee those wells with significant (i.e., greater than 20% of the length of the monitored interval) differences between the constructed depth and the measured depth.

11.0 RECORDS

11.1 Well Inspection Checklist

The Well Inspection Checklist will be included in the annual well inspection documentation report and become part of the administrative record for the Y-12 Plant GWPP.

11.2 Daily Log

A daily log of field inspection activities shall be maintained. This log will be placed in the administrative record of the Y-12 Plant GWPP.

APPENDIX A-3
Permit Attachment 2, Section D — Groundwater Monitoring Wells and Construction Details
(S-3 Ponds)

CONSTRUCTION DETAILS OF CORRECTIVE ACTION AND BACKGROUND MONITORING WELLS FOR THE S-3 PONDS
U. S. Department of Energy Y-12 Plant, Oak Ridge, Tennessee

Well Number	GW-115	GW-101*	GW-127*	GW-243*	GW-244*
Well Network Component	Background Well	Point of Compliance Well	Point of Compliance Well	Point of Compliance Well	Point of Compliance Well
North Coordinates	31073.00	30241.00	29850.00	30155.00	30060.00
East Coordinates	52685.00	51845.00	51828.00	51990.00	51974.00
Surface Elevation (ft)	1051.90	1006.00	1003.70	1008.60	1006.90
Measuring Point Elevation (ft)	1054.40	1007.30	1005.90	1011.60	1009.30
Zone Monitored	wB	U/wB	U/wB	wB	wB
Formation Monitored	CON: Maryville	CON: Nolichucky	CON: Maynardville/Nolichuck	CON: Nolichucky	CON: Nolichucky
Lithology	limestone/shale	shale	limestone/shale	shale	shale
Top of Fresh Bedrock (ft bgs)	unknown	17.50	unknown	unknown	unknown
Total Drilled Depth (ft bgs)	57.00	17.50	24.00	77.00	77.00
Screen or Open	screen	screen	screen	screen	screen
Top of Mon. Intvl. (ft bgs)	42.00	12.30	18.80	45.10	47.30
Bottom of Mon. Intvl. (ft bgs)	52.00	16.30	22.80	72.90	75.40
Screen Material	PVC	SS/#304	SS/#304	PVC/#40	PVC/#40
Screen Slot Size (inches)	0.01	0.01	0.01	0.01	0.01
Screen Length (ft)	10.00	4.00	4.00	27.90	28.10
Silt Trap (yes or no)	no	no	no	no	no
Silt Trap Length (ft)	n/a	n/a	n/a	n/a	n/a
Filter Pack	sand	sand	sand	sand	sand
Top Filter Pack (ft bgs)	38.00	10.10	14.00	43.20	42.90
Bottom Filter Pack (ft bgs)	57.00	17.50	24.00	77.00	77.00
Top Filter Pack (elev. in ft)	1013.90	995.90	989.70	965.40	964.00
Bottom Filter Pack (elev. in ft)	994.90	988.50	979.70	931.60	929.90
Top Bentonite Seal (ft bgs)	n/a	n/a	unknown	35.80	37.30
Bottom Bentonite Seal (ft bgs)	n/a	n/a	unknown	43.20	42.90
Cond. Borehole Depth (ft bgs)	21.00	2.70	unknown	37.80	38.00
Cond. Borehole Diameter (inches)	9.00	excavated	unknown	15.00	15.00
Cond. Csg. Type	steel	steel/gal.	steel/gal	PVC/#40	PVC/#40
Cond. Csg. O.D. (inches)	6.00	7.00	7.00	12.50	12.50
Cond. Csg. I.D. (inches)	unknown	unknown	unknown	unknown	unknown
Cond. Csg. Depth (ft bgs)	21.00	2.70	2.00	37.80	38.00
Pilot Borehole Depth (ft bgs)	57.00	17.50	24.00	77.00	77.00
Pilot Borehole Diameter (inches)	6.50	6.50	6.50	12.00	12.00
Inner Csg. Type	PVC	SS/#304	SS/#304	PVC/#40	PVC/#40
Inner Csg. O.D. (inches)	2.37	2.37	2.37	6.50	6.50
Inner Csg. I.D. (inches)	unknown	unknown	unknown	unknown	unknown
Inner Csg. Depth (ft bgs)	42.00	12.30	18.80	45.00	47.30
Date Completed	Finished 84	Finished 12Sept84	Finished 84	Finished 10Mar86	Finished 10Mar86
Well Development Method	pump	unknown	unknown	pump and surge	pump and surge
Reference	1	1	1	1,7	1,7
Comments	See footnote 4	See footnote 3			

Abbreviations:

B - Bedrock
bgs - Below Ground Surface
CON - Conasauga Group
Cond. - Conductor
Csg. - Casing
Dia. - Diameter
ft - Feet
I.D. - Inside Diameter
in. - Inches
N/A - Not Available
O.D. - Outside Diameter
U - Unconsolidated
SS - Stainless Steel (Schedule 304)
PVC - Polyvinyl Chloride (Schedule 40)
wB - Weathered Bedrock

* At least one of these wells will be monitored semiannually.

CONSTRUCTION DETAILS OF CORRECTIVE ACTION AND BACKGROUND MONITORING WELLS FOR THE S-3 PONDS
U. S. Department of Energy Y-12 Plant, Oak Ridge, Tennessee

Well Number	GW-245*	GW-246*	GW-247*	GW-276*	GW-615*
Well Network Component	Point of Compliance Well	Point of Compliance Well	Point of Compliance Well	Point of Compliance Well	Point of Compliance Well
North Coordinates	29977.00	29992.00	30005.00	29926.00	30009.32
East Coordinates	51992.00	52098.00	52181.00	52557.00	52223.78
Surface Elevation (ft)	1006.10	1006.10	1006.70	998.80	1014.20
Measuring Point Elevation (ft)	1009.10	1009.20	1009.60	1001.30	1016.80
Zone Monitored	wB	wB	wB	wB	B
Formation Monitored	CON: Nolichucky	CON: Nolichucky	CON: Nolichucky	CON: Nolichucky	CON: Nolichucky
Lithology	shale	shale	shale	shale	shale
Top of Fresh Bedrock (ft bgs)	unknown	unknown	unknown	unknown	15.00
Total Drilled Depth (ft bgs)	76.00	76.00	78.00	18.50	245.00
Screen or Open	screen	screen	screen	screen	open
Top of Mon. Intvl. (ft bgs)	43.60	46.50	46.90	13.00	222.50
Bottom of Mon. Intvl. (ft bgs)	71.60	74.60	74.90	18.30	245.00
Screen Material	PVC/#40	PVC/#40	PVC/#40	SS/#304	n/a
Screen Slot Size (inches)	0.01	0.01	0.01	0.01	n/a
Screen Length (ft)	28.00	28.10	28.00	5.30	n/a
Silt Trap (yes or no)	no	no	no	no	n/a
Silt Trap Length (ft)	n/a	n/a	n/a	n/a	n/a
Filter Pack	sand	sand	sand	sand	n/a
Top Filter Pack (ft bgs)	25.20	34.20	31.50	11.30	n/a
Bottom Filter Pack (ft bgs)	76.00	76.00	78.00	18.50	n/a
Top Filter Pack (elev. in ft)	980.80	971.90	975.20	987.50	n/a
Bottom Filter Pack (elev. in ft)	930.10	930.10	928.70	980.30	n/a
Top Bentonite Seal (ft bgs)	20.90	29.20	24.80	4.70	n/a
Bottom Bentonite Seal (ft bgs)	25.20	34.20	31.50	11.30	n/a
Cond. Borehole Depth (ft bgs)	25.00	27.00	28.00	n/a	84.50
Cond. Borehole Diameter (inches)	15.00	15.00	15.00	n/a	15.50
Cond. Csg. Type	PVC/#40	PVC/#40	PVC/#40	n/a	steel/J-55
Cond. Csg. O.D. (inches)	12.50	12.50	12.50	n/a	11.75
Cond. Csg. I.D. (inches)	unknown	unknown	unknown	n/a	11.00
Cond. Csg. Depth (ft bgs)	25.00	27.00	22.50	n/a	84.50
Pilot Borehole Depth (ft bgs)	76.00	76.00	78.00	18.50	222.50
Pilot Borehole Diameter (inches)	12.00	12.00	12.00	8.00	10.63
Inner Csg. Type	PVC/#40	PVC/#40	PVC/#40	SS/#304	steel/F25
Inner Csg. O.D. (inches)	6.50	6.50	6.50	4.50	7.00
Inner Csg. I.D. (inches)	unknown	6.00	6.00	4.25	6.54
Inner Csg. Depth (ft bgs)	43.60	46.50	46.90	13.00	222.50
Date Completed	Finished 10Mar86	Finished 10Mar86	Finished 13Mar86	Finished 15Jul86	Finished 13Feb90
Well Development Method	pump and surge	pump and surge	pump and surge	pump	swab
Reference	1,7	1,7	1,7	1,8	1,9
Comments					

Abbreviations:

B - Bedrock
bgs - Below Ground Surface
CON - Conasauga Group
Cond. - Conductor
Csg. - Casing
Dia. - Diameter
ft - Feet
I.D. - Inside Diameter
in. - Inches
N/A - Not Available
O.D. - Outside Diameter
U - Unconsolidated
SS - Stainless Steel (Schedule 304)
PVC - Polyvinyl Chloride (Schedu
wB - Weathered Bedrock

* At least one of these wells will be monitored semiannually.

CONSTRUCTION DETAILS OF CORRECTIVE ACTION AND BACKGROUND MONITORING WELLS FOR THE S-3 PONDS
U. S. Department of Energy Y-12 Plant, Oak Ridge, Tennessee

Well Number	GW-712	GW-713	GW-714	GW-715
Well Network Component	Plume Boundary Well	Plume Boundary Well	Plume Boundary Well	Plume Boundary Well
North Coordinates	28232.52	28235.95	28421.56	28424.58
East Coordinates	36506.87	36434.40	36435.09	36453.11
Surface Elevation (ft)	873.61	877.83	872.30	872.17
Measuring Point Elevation (ft)	877.09	880.63	875.08	874.72
Zone Monitored	B	B	B	U/wB
Formation Monitored	CON: Maynardville	CON: Maynardville	CON: Maynardville	CON: Maynardville
Lithology	limestone	limestone	limestone	limestone
Top of Fresh Bedrock (ft bgs)	66.00	63.80	35.00	n/a
Total Drilled Depth (ft bgs)	457.50	315.20	145.00	44.60
Screen or Open	open/6.25 in. dia.	open/6.25 in. dia.	open/6.25 in. dia.	screen
Top of Mon. Intvl. (ft bgs)	441.50	305.00	115.10	33.10
Bottom of Mon. Intvl. (ft bgs)	457.50	315.20	145.00	43.10
Screen Material	n/a	n/a	n/a	SS/#304
Screen Slot Size (inches)	n/a	n/a	n/a	0.01
Screen Length (ft)	n/a	n/a	n/a	10
Silt Trap (yes or no)	no	no	no	no
Silt Trap Length (ft)	n/a	n/a	n/a	n/a
Filter Pack	n/a	n/a	n/a	sand
Top Filter Pack (ft bgs)	n/a	n/a	n/a	32.00
Bottom Filter Pack (ft bgs)	n/a	n/a	n/a	44.00
Top Filter Pack (elev. in ft)	n/a	n/a	n/a	842.72
Bottom Filter Pack (elev. in ft)	n/a	n/a	n/a	830.72
Top Bentonite Seal (ft bgs)	n/a	n/a	n/a	14.4
Bottom Bentonite Seal (ft bgs)	n/a	n/a	n/a	32.00
Cond. Borehole Depth (ft bgs)	89.50	64.00	40.50	n/a
Cond. Borehole Diameter (inches)	15.00	15.00	15.00	n/a
Cond. Csg. Type	steel/J-55	steel/J-55	steel/J-55	n/a
Cond. Csg. O.D. (inches)	11.75	11.75	11.75	n/a
Cond. Csg. I.D. (inches)	11.00	11.00	11.00	n/a
Cond. Csg. Depth (ft bgs)	44.80	50.00	40.50	n/a
Pilot Borehole Depth (ft bgs)	441.50	305.00	145.00	44.60
Pilot Borehole Diameter (inches)	10.60	10.60	10.60	10.60
Inner Csg. Type	steel/F25	steel/F25	steel/F25	SS/#304
Inner Csg. O.D. (inches)	7.00	7.00	7.00	4.25
Inner Csg. I.D. (inches)	6.54	6.54	6.54	4.00
Inner Csg. Depth (ft bgs)	451.50	305.00	113.80	43.10
Date Completed	Finished 20Jun91	Finished 13Jan92	Finished 24Jan92	Finished 29Jan92
Well Development Method	swab	swab	swab	swab
Reference	1,2	1,3	1,3	1,3
Comments		See footnote 1		

Abbreviations:

B - Bedrock
bgs - Below Ground Surface
CON - Conasauga Group
Cond. - Conductor
Csg. - Casing
Dia. - Diameter
ft - Feet
I.D. - Inside Diameter
in. - Inches
N/A - Not Available
O.D. - Outside Diameter
U - Unconsolidated
SS - Stainless Steel (Schedule 304)
PVC - Polyvinyl Chloride (Schedu
wB - Weathered Bedrock

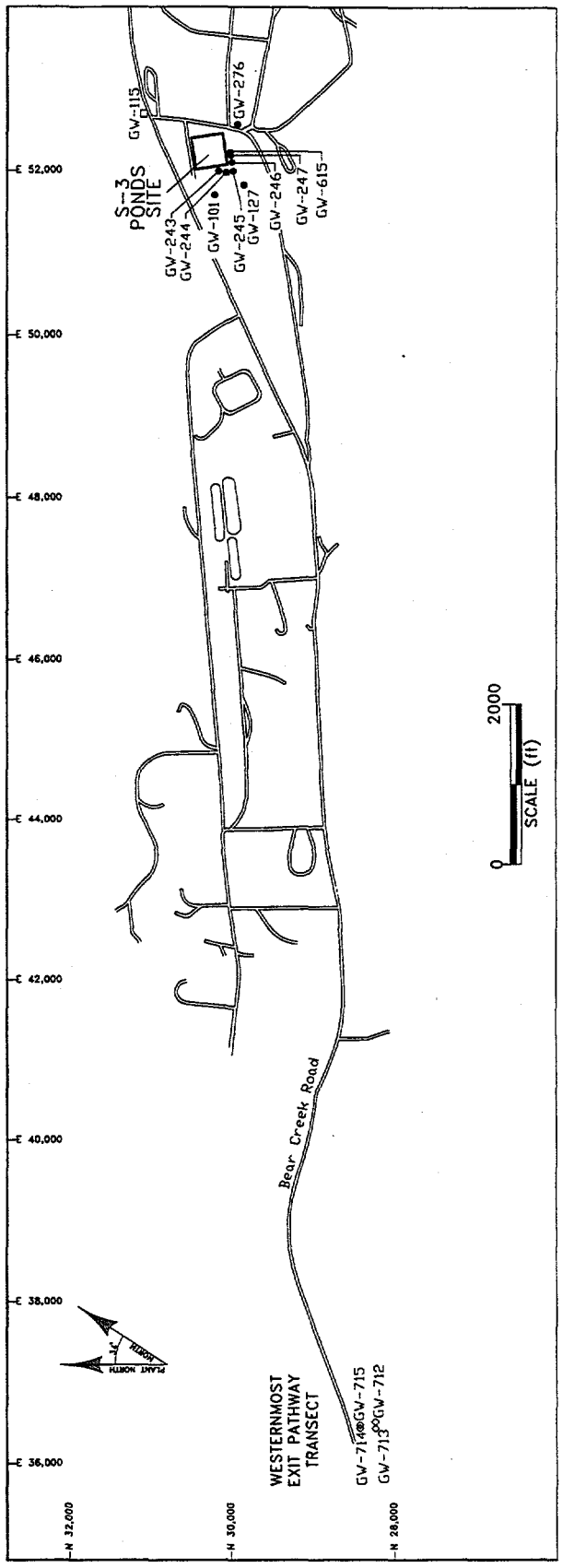
APPENDIX A-4
Permit Attachment 2, Section E — Groundwater Protection Standards
(S-3 Ponds)

Groundwater Protection Standards
S-3 Ponds

Constituents	Concentration Limit (a)
Inorganics	
Barium	
Cadmium	
Chromium	
Lead	
Mercury	
Nickel	
Nitrate (as N)	
Uranium	
Organics	
Acetone	
Benzene	
Bromoform	
2-Butanone	
Carbon Tetrachloride	
Chloroform	
1,1-Dichloroethene	
Trans-1,2-Dichloroethene	
Methylene Chloride	
4-Methyl-2-Pentanone	
Tetrachloroethene	
Toluene	
1,1,1-Trichloroethane	
Trichloroethene	
Radiochemical Parameters	
Americium-241	
Neptunium-237	
Total Radium	
Strontium-89/90	
Technetium-99	
Uranium-234	
Uranium-235	
Uranium-238	
Gross alpha	
Gross beta	

(a) Limits will be developed as per Permit Condition IV.D.

APPENDIX A-5
Permit Attachment 2, Section F — Site Map
(S-3 Ponds)



PREPARED FOR: *LOCKHEED MARTIN ENERGY SYSTEMS, INC.*	LOCATION:	Y-12 PLANT OAK RIDGE, TN.	MONITORING WELLS FOR THE S-3 PONDS HAZARDOUS WASTE DISPOSAL UNIT IN THE BEAR CREEK HYDROGEOLOGIC REGIME
PREPARED BY: *AJA TECHNICAL SERVICES, INC.*	DOC NUMBER:		
	DWG ID.:	97-052	
	DATE:	4-22-97	

APPENDIX A-6
Permit Attachment 3, Section E — Groundwater Monitoring Wells and Construction Details
(Oil Landfarm)

CONSTRUCTION DETAILS OF CORRECTIVE ACTION AND BACKGROUND MONITORING WELLS FOR THE OIL LANDFARM
U. S. Department of Energy Y-12 Plant, Oak Ridge, Tennessee

Well Number / Well Network Component	*GW-115* Background Well	*GW-005** Point of Compliance Well	*GW-008** Point of Compliance Well	*GW-010** Point of Compliance Well	*GW-012** Point of Compliance Well	*GW-075** Point of Compliance Well
North Coordinates	31073.00	29921.00	29781.00	29760.00	29868.00	29795.00
East Coordinates	52685.00	48242.00	47597.00	47220.00	47189.00	47988.00
Surface Elevation (ft)	1015.90	962.37	962.11	950.78	949.50	962.10
Measuring Point Elevation (ft)	1054.40	965.13	964.79	952.76	953.57	966.01
Zone Monitored	wB	U	wB	U/wB	wB	B
Formation Monitored	CON:Maryville	CON: Nolichucky	CON: Nolichucky	CON: Nolichucky	CON: Nolichucky	CON: Nolichucky
Lithology	limestone/shale	shale	shale	Shale	shale	shale
Top of Fresh Bedrock (ft bgs)	unknown	n/a	25.50	n/a	n/a	14.00
Total Drilled Depth (ft bgs)	57.00	12.50	25.50	15.00	15.50	200.00
Screen Or Open	screen	screen	screen	screen	screen	screen
Top of Monitoring Interval (ft bgs)	42.00	5.30	15.70	7.70	11.50	179.60
Bottom of Monitoring Interval (ft bgs)	52.00	10.30	20.70	12.70	13.50	199.60
Screen Material	PVC	SS/#304	SS/#304	SS/#304	SS/#304	SS/#304
Screen Slot Size (inches)	0.01	0.01	0.01	0.01	0.01	0.01
Screen Length (ft)	10.00	5.00	5.00	5.00	2.00	20.00
Silt Trap (yes/no)	no	no	no	no	no	no
Silt Trap Length (ft)	n/a	n/a	n/a	n/a	n/a	n/a
Filter Pack	sand	sand	sand	sand	sand	sand
Top Filter Pack (ft bgs)	38.00	3.00	13.00	13.00	8.70	176.50
Bottom Filter Pack (ft bgs)	57.00	12.50	25.50	25.50	15.50	199.60
Top Filter Pack (elev. in ft)	977.90	962.13	951.79	937.78	944.87	789.51
Bottom Filter Pack (elev. in ft)	958.90	952.63	939.29	925.28	938.07	766.41
Top Bentonite Seal (ft bgs)	n/a	unknown	unknown	unknown	unknown	unknown
Bottom Bentonite Seal (ft bgs)	n/a	3.00	13.00	13.00	8.70	176.50
Cond. Borehole Depth (ft bgs)	21.00	n/a	n/a	n/a	n/a	16.00
Cond. Borehole Diameter (inches)	9.00	n/a	n/a	n/a	n/a	11.25
Conductor Casing Type	steel	n/a	n/a	n/a	n/a	PVC/#40
Conductor Casing O.D. (inches)	6.00	n/a	n/a	n/a	n/a	10.63
Conductor Casing I.D. (inches)	unknown	n/a	n/a	n/a	n/a	10.00
Conductor Casing Depth (ft bgs)	21.00	n/a	n/a	n/a	n/a	16.00
Pilot Borehole Depth (ft bgs)	57.00	12.50	25.50	15.00	15.50	200.00
Pilot Borehole Diameter (inches)	6.50	6.00	6.00	6.00	6.00	8.75
Inner Casing Type	PVC	SS/#304	SS/#304	SS/#304	SS/#304	SS/#304
Inner Casing O.D. (inches)	2.37	2.37	2.37	2.37	2.37	2.37
Inner Casing I.D. (inches)	unknown	unknown	unknown	2.00	unknown	unknown
Inner Casing Depth (ft bgs)	42.00	5.30	15.70	7.70	11.50	179.60
Date Completed	Finished 1984	Finished 22Sep83	Finished 23Sep83	Finished 23Sep83	Finished 28Sep83	Finished 31Mar84
Well Development Method	pump	bail/pump	bail/pump	bail/pump	bail/pump	bail/pump

Abbreviations:

B - Bedrock
bgs - Below Ground Surface
CON - Conasauga Group
Cond. - Conductor
Csg. - Casing
Dia. - Diameter
ft - Feet
I.D. - Inside Diameter
in. - Inches
N/A - Not Available
O.D. - Outside Diameter
U - Unconsolidated
SS - Stainless Steel (Schedule 304)
PVC - Polyvinyl Chloride (Schedule 40)
wB - Weathered Bedrock

* At least one of these wells will be monitored semiannually.

CONSTRUCTION DETAILS OF CORRECTIVE ACTION AND BACKGROUND MONITORING WELLS FOR THE OIL LANDFARM
U. S. Department of Energy Y-12 Plant, Oak Ridge, Tennessee

Well Number / Well Network Component	GW-363* Point of Compliance Well	GW-712 Plume Boundary Well	GW-713 Plume Boundary Well	GW-714 Plume Boundary Well	GW-715 Plume Boundary Well
North Coordinates	29961.00	28232.52	28235.95	28421.56	28424.58
East Coordinates	46872.00	36506.87	36434.40	36435.09	36453.11
Surface Elevation (ft)	955.41	873.61	877.83	872.30	872.17
Measuring Point Elevation (ft)	957.91	877.09	880.63	875.08	874.72
Zone Monitored	wB	B	B	B	U/wB
Formation Monitored	CON: Nolichucky	CON:Maynardville	CON:Maynardville	CON:Maynardville	CON:Maynardville
Lithology	shale	limestone	limestone	limestone	limestone
Top of Fresh Bedrock (ft bgs)	21.00	66.00	63.80	35.00	n/a
Total Drilled Depth (ft bgs)	75.00	457.50	315.20	145.00	44.60
Screen Or Open	open/6.00 in. dia.	open/6.25 in. dia.	open/6.25 in. dia.	open/6.25 in. dia.	screen
Top of Monitoring Interval (ft bgs)	50.00	441.50	305.00	115.10	33.10
Bottom of Monitoring Interval (ft bgs)	75.00	457.50	315.20	145.00	43.10
Screen Material	n/a	n/a	n/a	n/a	SS/#304
Screen Slot Size (inches)	n/a	n/a	n/a	n/a	0.01
Screen Length (ft)	n/a	n/a	n/a	n/a	10.00
Silt Trap (yes/no)	n/a	n/a	no	no	no
Silt Trap Length (ft)	n/a	no	n/a	n/a	n/a
Filter Pack	n/a	n/a	n/a	n/a	sand
Top Filter Pack (ft bgs)	n/a	n/a	n/a	n/a	32.00
Bottom Filter Pack (ft bgs)	n/a	n/a	n/a	n/a	44.00
Top Filter Pack (elev. in ft)	n/a	n/a	n/a	n/a	842.72
Bottom Filter Pack (elev. in ft)	n/a	n/a	n/a	n/a	830.72
Top Bentonite Seal (ft bgs)	n/a	n/a	n/a	n/a	14.40
Bottom Bentonite Seal (ft bgs)	n/a	n/a	n/a	n/a	32.00
Cond. Borehole Depth (ft bgs)	36.00	89.50	64.00	40.50	n/a
Cond. Borehole Diameter (inches)	14.50	15.00	15.00	15.00	n/a
Conductor Casing Type	steel	steel/J-55	steel/J-55	steel/J-55	n/a
Conductor Casing O.D. (inches)	10.75	11.75	11.75	11.75	n/a
Conductor Casing I.D. (inches)	10.00	11.00	11.00	11.00	n/a
Conductor Casing Depth (ft bgs)	36.00	44.80	50.00	40.50	n/a
Pilot Borehole Depth (ft bgs)	75.00	441.50	305.00	145.00	44.60
Pilot Borehole Diameter (inches)	9.50	10.60	10.60	10.60	10.60
Inner Casing Type	steel/F25	steel/F25	steel/F25	steel/F25	SS/#304
Inner Casing O.D. (inches)	6.62	7.00	7.00	7.00	4.25
Inner Casing I.D. (inches)	unknown	6.54	6.54	6.54	4.00
Inner Casing Depth (ft bgs)	50.00	451.50	305.00	113.80	43.10
Date Completed	Finished 16Mar88	Finished 20Jun91	Finished 13Jan92	Finished 24Jan92	Finished 29Jan92
Well Development Method	bail/pump	swab	swab	swab	swab

Abbreviations:

B - Bedrock
bgs - Below Ground Surface
CON - Conasauga Group
Cond. - Conductor
Csg. - Casing
Dia. - Diameter
ft - Feet
I.D. - Inside Diameter
in. - Inches
N/A - Not Available
O.D. - Outside Diameter
U - Unconsolidated
SS - Stainless Steel (Schedule 304)
PVC - Polyvinyl Chloride (Schedule 40)
wB - Weathered Bedrock

* At least one of these wells will be monitored semiannually.

ORNL-DWG 90M-13687

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-010

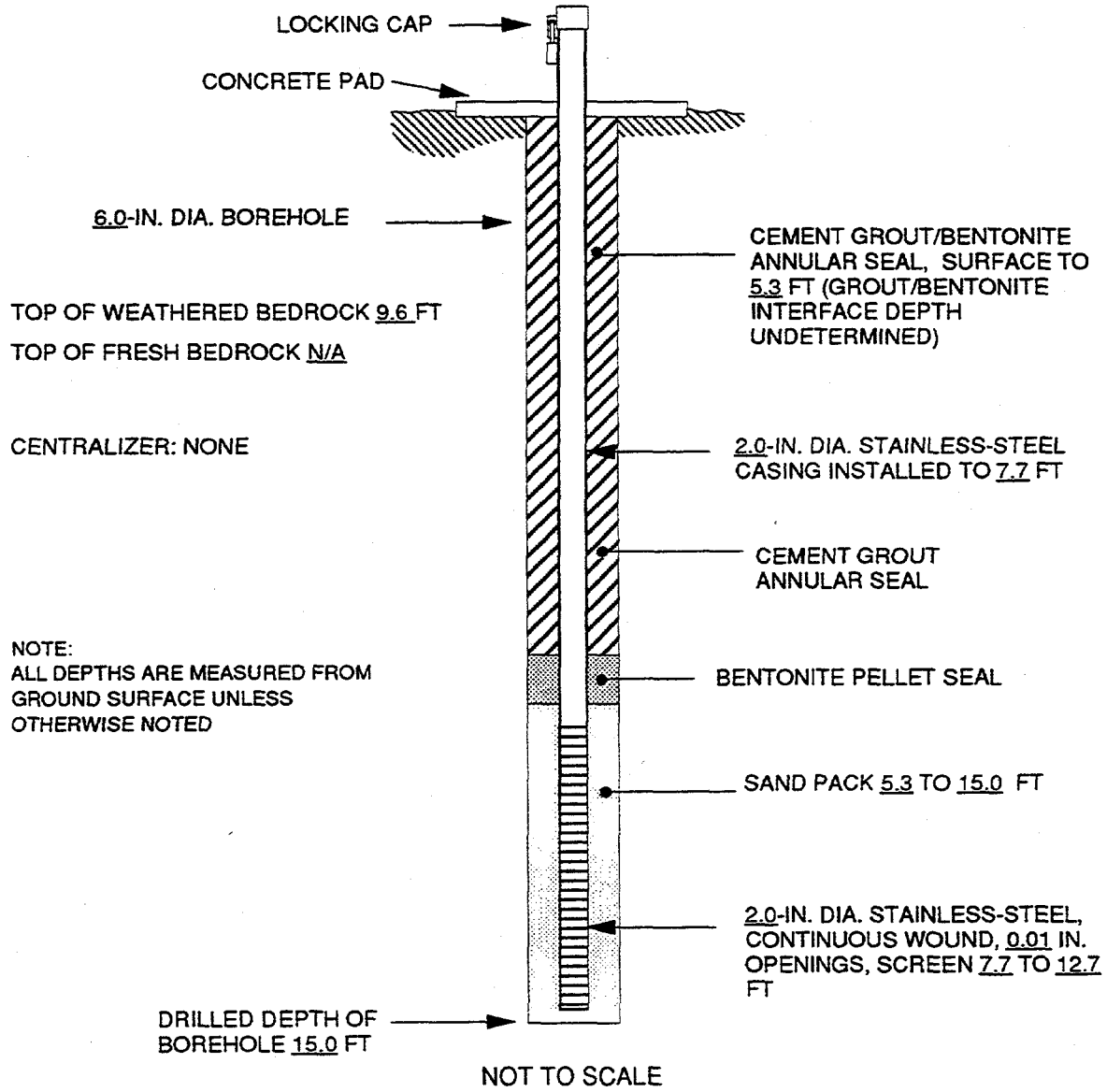
WELL INSTALLATION DIAGRAM

LOGGED BY: T. W. Crosby, Bechtel, Inc.

DRILLING COMPANY: Geotek, Inc.

DRILLER: Ron Tatum HELPERS: Unknown

DRILLING DATES
STARTED: 9/22/83
FINISHED: 9/23/83



GERAGHTY & MILLER, INC.
Ground-Water Consultants

WELL CONSTRUCTION DIAGRAM

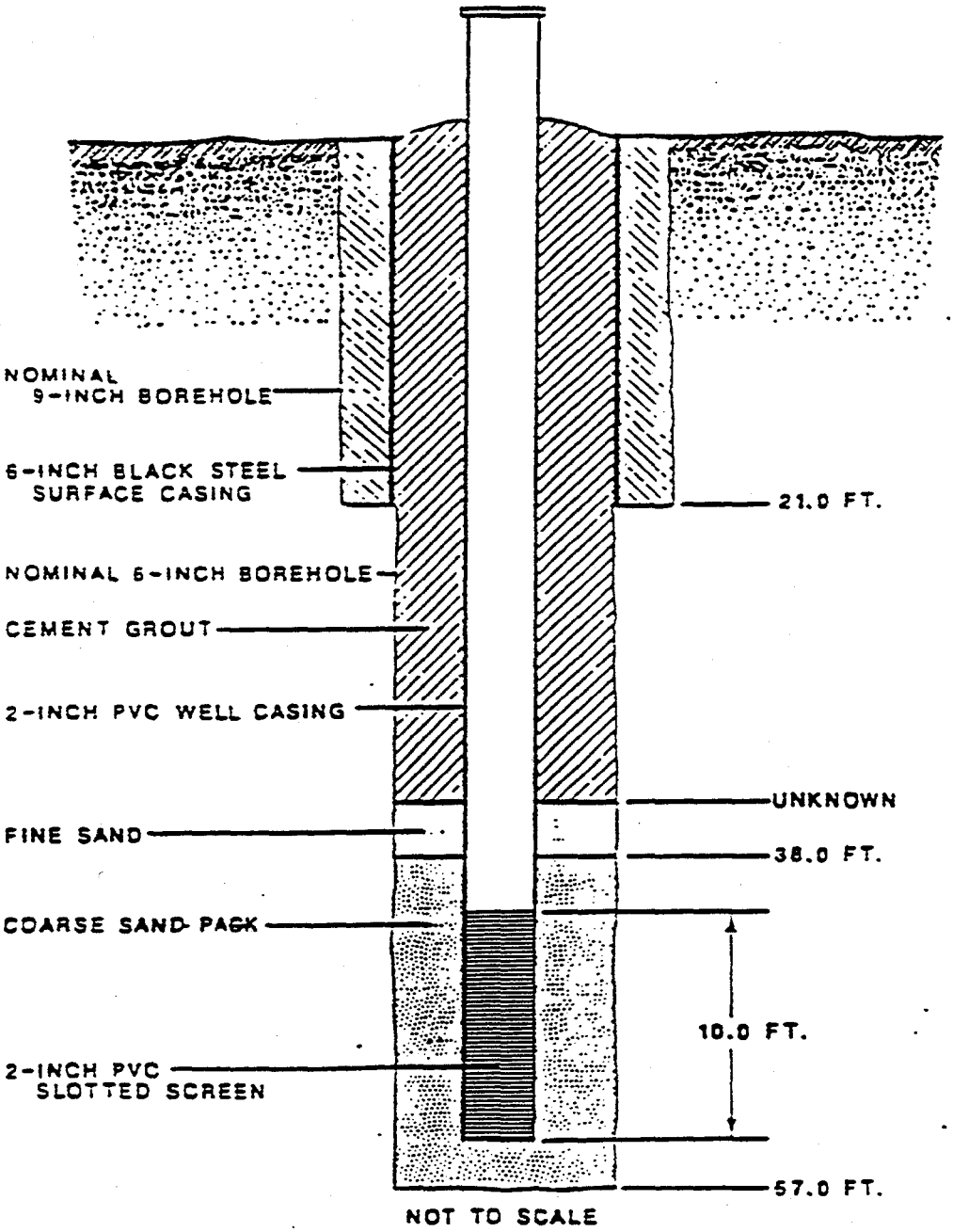
WELL NO. GW-115

PROJECT Phase III Drilling Bear Creek Valley

LOCATION	COORDINATES	GROUND ELEVATION	MEASURING PT. ELEVATION
Y-12 Plant, S-3 Ponds	N31073.48 (Plant Grid) E52684.99	1051.92 ft. msl	1054.41 ft. msl

GEOLOGIST	DRILLING CONTRACTOR	DRILLING METHOD	RIG TYPE
Bechtel Corp.	Geotek	Air Rotary	Ingersoll Rand T-5

WELL DEVELOPMENT METHOD	WELL DEVELOPMENT DURATION	WELL COMPLETED	MONITORED FORMATION
Submersible Pump			Maryville Limestone



NOT TO SCALE

NOTE: DEPTH MEASUREMENTS IN FEET BELOW GROUND SURFACE

27-27 MODIFIED PER AGREED ORDER

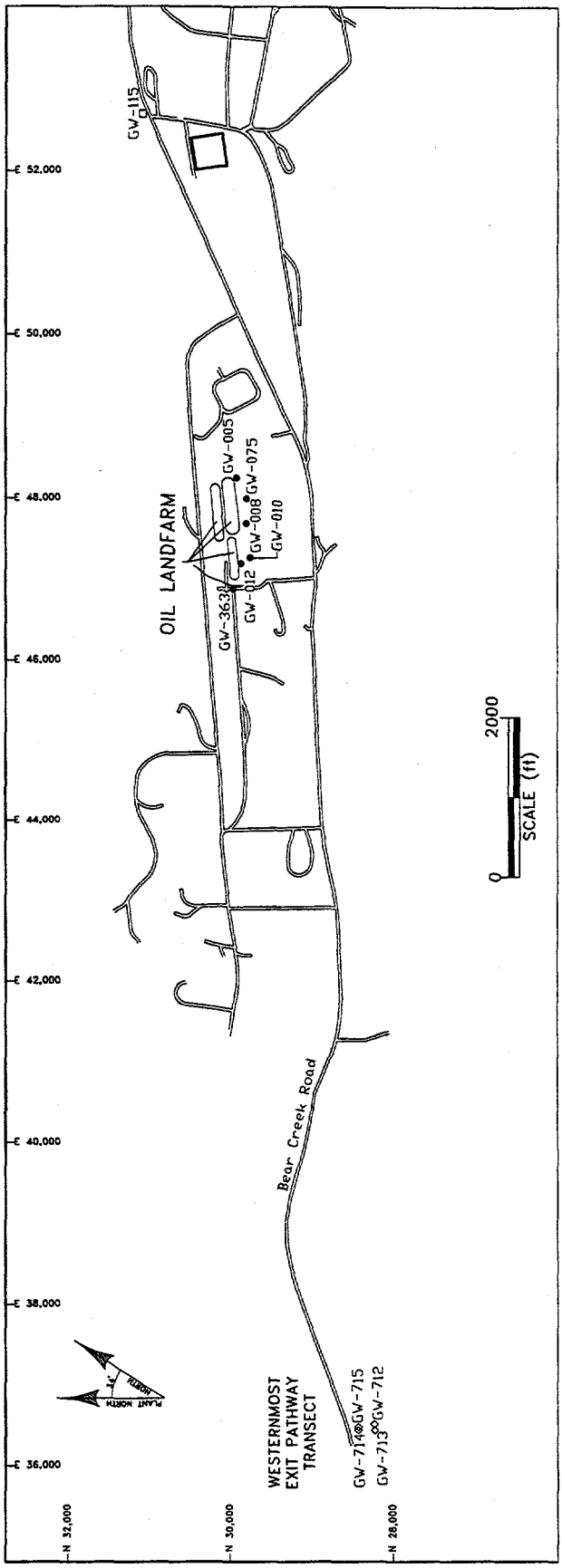
APPENDIX A-7
Permit Attachment 3, Section F — Groundwater Protection Standards
(Oil Landfarm)

Groundwater Protection Standards
Oil Landfarm

Constituents	Concentration Limit (a)
Inorganics	
Barium	
Cadmium	
Chromium	
Lead	
Mercury	
Nickel	
Nitrate (as N)	
Uranium	
Organics	
Acetone	
Benzene	
Bromoform	
2-Butanone	
Carbon Tetrachloride	
Chloroform	
1,1-Dichloroethene	
Trans-1,2-Dichloroethene	
Methylene Chloride	
4-Methyl-2-Pentanone	
Tetrachloroethene	
Toluene	
1,1,1-Trichloroethane	
Trichloroethene	
Radiochemical Parameters	
Americium-241	
Neptunium-237	
Total Radium	
Strontium-89/90	
Technetium-99	
Uranium-234	
Uranium-235	
Uranium-238	
Gross alpha	
Gross beta	

(a) Limits will be developed as per Permit Condition V.D.

APPENDIX A-8
Permit Attachment 3, Section G — Site Map
(Oil Landfarm)



PREPARED FOR: *LOCKHEED MARTIN ENERGY SYSTEMS, INC.*	LOCATION:	Y-12 PLANT OAK RIDGE, TN.	MONITORING WELLS FOR THE OIL LANDFARM HAZARDOUS WASTE DISPOSAL UNIT IN THE BEAR CREEK HYDROGEOLOGIC REGIME
PREPARED BY: *AJA TECHNICAL SERVICES, INC.*	DOC NUMBER:		
	DWG ID.:	97-050	
	DATE:	4-22-97	

APPENDIX A-9
Permit Attachment 4, Section E — Groundwater Monitoring Wells and Construction Details
(Bear Creek Burial Grounds)

CONSTRUCTION DETAILS OF CORRECTIVE ACTION AND BACKGROUND MONITORING WELLS FOR THE BEAR CREEK BURIAL GROUNDS
U. S. Department of Energy Y-12 Plant, Oak Ridge, Tennessee

Well Number	GW-115	GW-014*	GW-046*	GW-069*	GW-071*	GW-082*	GW-257*
Well Network Component	Background Well	Point of Compliance Well	Point of Compliance Well	Point of Compliance Well	Point of Compliance Well	Point of Compliance Well	Point of Compliance Well
North Coordinates	31073.00	29843.00	29562.00	29490.00	29496.00	30434.00	30147.60
East Coordinates	52685.00	44311.00	43284.00	43803.00	44191.00	42090.00	43229.71
Surface Elevation (ft)	1015.90	931.39	917.21	924.25	925.47	959.49	959.21
Measuring Point Elevation (ft)	1054.40	933.76	919.61	927.01	928.42	962.49	961.68
Zone Monitored	wB	U/wB	U	B	B	B	U
Formation Monitored	CON:Maryville	CON: Nolichucky	CON:Nolichucky	CON:Nolichucky	CON:Nolichucky	CON:Maryville	CON:Maryville
Lithology	limestone/shale	shale	shale	shale	shale	limestone	limestone
Top of Fresh Bedrock (ft bgs)	unknown	4.00	n/a	24.00	16.00	23.00	33.70
Total Drilled Depth (ft bgs)	57.00	13.20	20.50	100.00	220.60	35.00	33.70
Screen Or Open	screen	screen	screen	screen	screen	screen	screen
Top of Monitoring Interval (ft bgs)	42.00	10.00	8.10	89.00	198.40	29.40	23.00
Bottom of Monitoring Interval (ft bgs)	52.00	12.00	18.10	99.20	219.00	34.40	33.70
Screen Material	PVC	SS	SS	SS	SS	SS	SS
Screen Slot Size (inches)	0.01	sw/0.01	sw/0.01	sw/0.01	sw/0.01	sw/0.01	sw/0.01
Screen Length (ft)	10.00	2.00	10.00	10.20	20.60	5.00	10.70
Silt Trap (yes or no)	no	n/a	no	no	no	no	no
Silt Trap Length (ft)	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Filter Pack	sand	n/a	sand	sand	sand	sand	sand
Top Filter Pack (ft bgs)	38.00	n/a	5.00	79.00	195.10	24.10	19.00
Bottom Filter Pack (ft bgs)	57.00	2.00	20.30	99.20	219.00	34.40	33.70
Top Filter Pack (elev. in ft)	977.90	n/a	912.21	845.25	730.37	935.39	940.21
Bottom Filter Pack (elev. in ft)	958.90	5.00	896.91	825.05	706.47	925.09	925.51
Top Bentonite Seal (ft bgs)	n/a	n/a	n/a	n/a	n/a	n/a	16.00
Bottom Bentonite Seal (ft bgs)	n/a	n/a	5.00	79.00	195.10	24.10	19.00
Cond. Borehole Depth (ft bgs)	21.00	13.20	n/a	22.00	16.00	25.00	n/a
Cond. Borehole Diameter (inches)	9.00	bentonite	n/a	11.25	11.75	n/a	n/a
Conductor Casing Type	steel	n/a	n/a	Sch 40 PVC	Sch 40 PVC	n/a	n/a
Conductor Casing O.D. (inches)	6.00	none	n/a	N/A	N/A	n/a	n/a
Conductor Casing I.D. (inches)	unknown	0.00	n/a	10.00	10.00	n/a	n/a
Conductor Casing Depth (ft bgs)	21.00	0.00	n/a	19.00	16.00	n/a	n/a
Pilot Borehole Depth (ft bgs)	57.00	13.20	20.50	100.00	220.60	35.00	33.70
Pilot Borehole Diameter (inches)	6.50	n/a	6.00	7.875	8.75	6.50(a)/4.0	9.00
Inner Casing Type	PVC	n/a	SS/#304	SS/#304	SS/#304	SS/#304	SS/#304
Inner Casing O.D. (inches)	2.37	6.00	2.37	2.37	2.37	2.37	N/A
Inner Casing I.D. (inches)	unknown	n/a	2.00	2.00	2.00	2.00	4.00
Inner Casing Depth (ft bgs)	42.00	2.37	8.10	89.00	198.40	29.40	23.00
Date Completed	1984	Finished 29Sep83	Finished 27Oct83	Finished 26Mar84	Finished 25Mar84	Finished 17Mar84	Finished 3Mar87
Well Development Method	pump	n/a	n/a	n/a	n/a	n/a	swab
Comments						6.5" hole, 0'-25'	

Abbreviations:

B - Bedrock
bgs - Below Ground Surface
CON - Conasauga Group
Cond. - Conductor
Csg. - Casing
Dia. - Diameter
ft - Feet
I.D. - Inside Diameter
in. - Inches
N/A - Not Available
O.D. - Outside Diameter
U - Unconsolidated
SS - Stainless Steel (Schedule 304)
[redacted] Polyvinyl Chloride (Schedule 40)
[redacted] Weathered Bedrock

* At least one of these wells will be monitored semiannually.

CONSTRUCTION DETAILS OF CORRECTIVE ACTION AND BACKGROUND MONITORING WELLS FOR THE BEAR CREEK BURIAL GROUNDS
U. S. Department of Energy Y-12 Plant, Oak Ridge, Tennessee

Well Number	GW-289*	GW-291*	GW-712	GW-713	GW-714	GW-715
Well Network Component	Point of Compliance Well	Point of Compliance Well	Plume Boundary Well	Plume Boundary Well	Plume Boundary Well	Plume Boundary Well
North Coordinates	29982.00	30449.09	28232.52	28235.95	28421.56	28424.58
East Coordinates	42875.00	42582.97	36506.87	36434.40	36435.09	36453.11
Surface Elevation (ft)	946.32	942.34	873.61	877.83	872.30	872.17
Measuring Point Elevation (ft)	948.47	944.80	877.09	880.63	875.08	874.72
Zone Monitored	wB/B	U	B	B	B	U/wB
Formation Monitored	CON: Nolichucky/Maryville	CON: Maryville	CON:Maynardville	CON:Maynardville	CON:Maynardville	CON:Maynardville
Lithology	shale/limestone	limestone	limestone	limestone	limestone	limestone
Top of Fresh Bedrock (ft bgs)	24.00	n/a	66.00	63.80	35.00	n/a
Total Drilled Depth (ft bgs)	40.80	14.20	457.50	315.20	145.00	44.60
Screen Or Open	screen	screen	open/6.25 in. dia.	open/6.25 in. dia.	open/6.25 in. dia.	screen
Top of Monitoring Interval (ft bgs)	30.60	8.70	441.50	305.00	115.10	33.10
Bottom of Monitoring Interval (ft bgs)	40.60	13.70	457.50	315.20	145.00	43.10
Screen Material	SS	SS	n/a	n/a	n/a	SS/#304
Screen Slot Size (inches)	sw/.01	sw/0.01	n/a	n/a	n/a	0.01
Screen Length (ft)	10.00	5.00	n/a	n/a	n/a	10.00
Silt Trap (yes or no)	n/a	n/a	n/a	no	no	no
Silt Trap Length (ft)	n/a	n/a	no	n/a	n/a	n/a
Filter Pack	n/a	sand	n/a	n/a	n/a	sand
Top Filter Pack (ft bgs)	28.90	6.70	n/a	n/a	n/a	32.00
Bottom Filter Pack (ft bgs)	40.80	14.20	n/a	n/a	n/a	44.00
Top Filter Pack (elev. in ft)	917.42	935.64	n/a	n/a	n/a	842.72
Bottom Filter Pack (elev. in ft)	905.52	928.14	n/a	n/a	n/a	830.72
Top Bentonite Seal (ft bgs)	25.80	n/a	n/a	n/a	n/a	14.40
Bottom Bentonite Seal (ft bgs)	28.90	n/a	n/a	n/a	n/a	32.00
Cond. Borehole Depth (ft bgs)	40.80	n/a	89.50	64.00	40.50	n/a
Cond. Borehole Diameter (inches)	9.00	n/a	15.00	15.00	15.00	n/a
Conductor Casing Type	n/a	n/a	steel/J-55	steel/J-55	steel/J-55	n/a
Conductor Casing O.D. (inches)	4.50	n/a	11.75	11.75	11.75	n/a
Conductor Casing I.D. (inches)	0.00	n/a	11.00	11.00	11.00	n/a
Conductor Casing Depth (ft bgs)	0.00	n/a	44.80	50.00	40.50	n/a
Pilot Borehole Depth (ft bgs)	0.00	14.20	441.50	305.00	145.00	44.60
Pilot Borehole Diameter (inches)	9.00	9.00	10.60	10.60	10.60	10.60
Inner Casing Type	SS/#304	SS/#304	steel/F25	steel/F25	steel/F25	SS/#304
Inner Casing O.D. (inches)	9.00	n/a	7.00	7.00	7.00	4.25
Inner Casing I.D. (inches)	SS/#304	4.00	6.54	6.54	6.54	4.00
Inner Casing Depth (ft bgs)	4.50	8.70	451.50	305.00	113.80	43.10
Date Completed	Finished 20Nov86	Finished 14Nov86	Finished 20Jun91	Finished 13Jan92	Finished 24Jan92	Finished 29Jan92
Well Development Method	n/a	surge block	swab	swab	swab	swab
Comments	Forms cluster with GW-288.					

Abbreviations:

B - Bedrock
bgs - Below Ground Surface
CON - Conasauga Group
Cond. - Conductor
Csg. - Casing
Dia. - Diameter
ft - Feet
I.D. - Inside Diameter
in. - Inches
N/A - Not Available
O.D. - Outside Diameter
U - Unconsolidated
SS - Stainless Steel (Schedule 304)
Polyvinyl Chloride (Schedule 40)
Weathered Bedrock

* At least one of these wells will be monitored semiannually.

ORNL-DWG 90M-13687

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-014

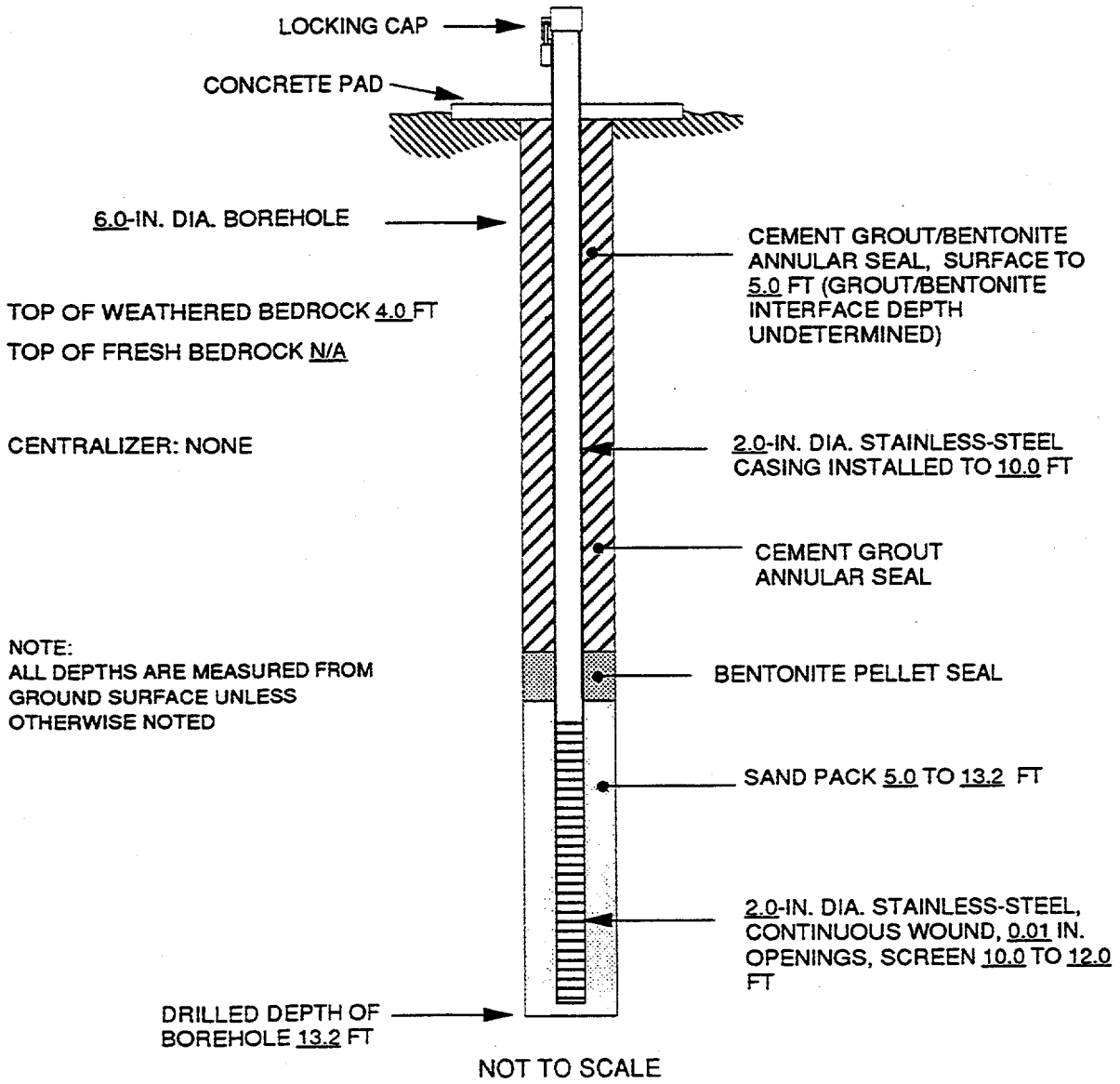
WELL INSTALLATION DIAGRAM

LOGGED BY: E. M. Fanelli, Bechtel, Inc.

DRILLING COMPANY: Geotek, Inc.

DRILLER: R. Gossage HELPERS: Unknown

DRILLING DATES
STARTED: 9/29/83
FINISHED: 9/29/83



NOT TO SCALE

GERAGHTY & MILLER, INC.
Ground-Water Consultants

WELL CONSTRUCTION DIAGRAM

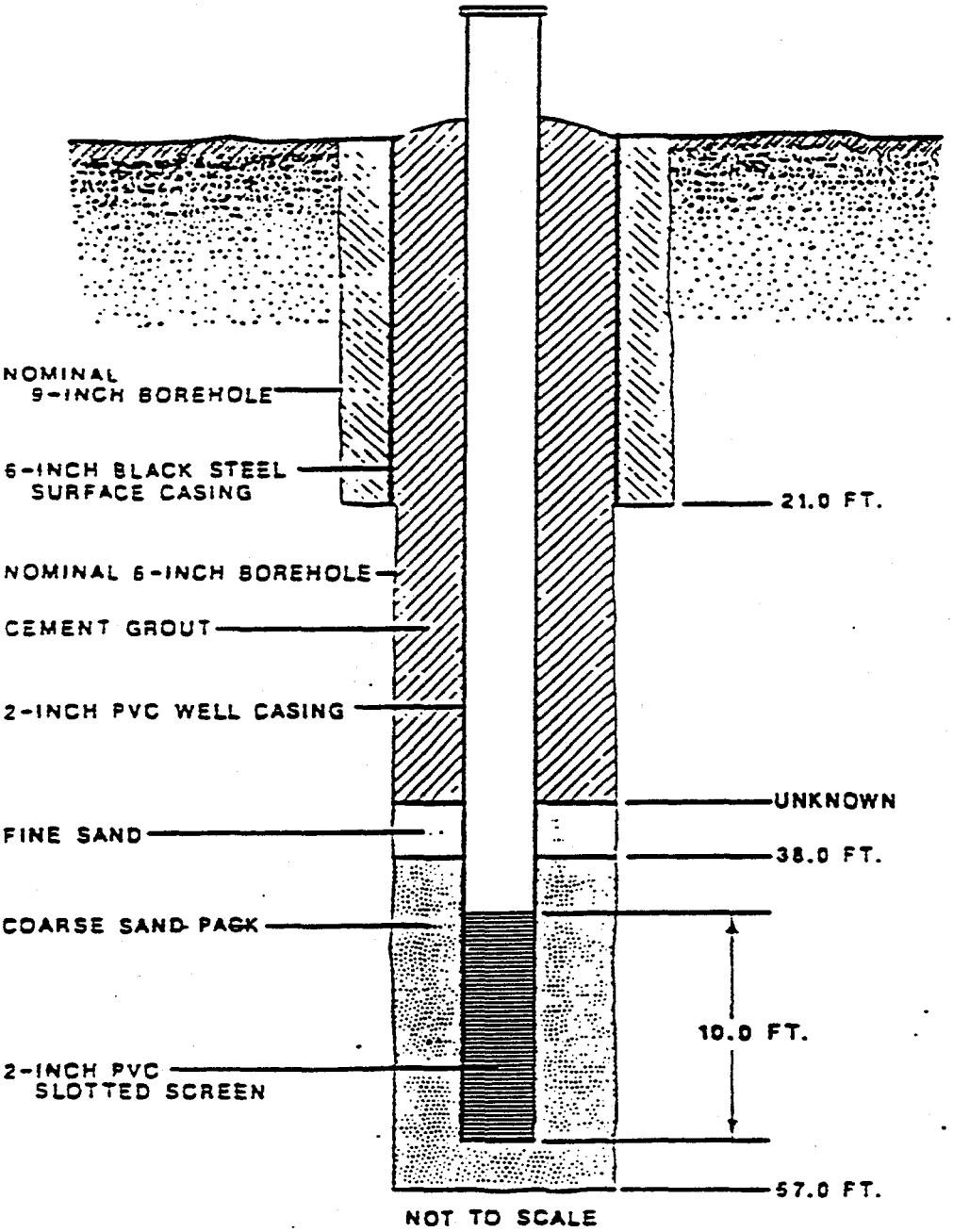
WELL NO. GW-115

PROJECT Phase III Drilling Bear Creek Valley

ION	COORDINATES	GROUND ELEVATION	MEASURING PT. ELEVATION
Y-12 Plant. S-3 Ponds	N31073.48 (Plant Grid) E52684.99	1051.92 ft. msl	1054.41 ft. msl

GEOLOGIST	DRILLING CONTRACTOR	DRILLING METHOD	RIG TYPE
Bechtel Corp.	Geotek	Air Rotary	Ingersoll Rand T-5

WELL DEVELOPMENT METHOD	WELL DEVELOPMENT DURATION	WELL COMPLETED	MONITORED FORMATION
Submersible Pump			Maryville Limestone



NOT TO SCALE

NOTE: DEPTH MEASUREMENTS IN FEET BELOW GROUND SURFACE

27-27 MODIFIED PER AGREED ORDER

ORNL-DWG 90M-13687

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-289

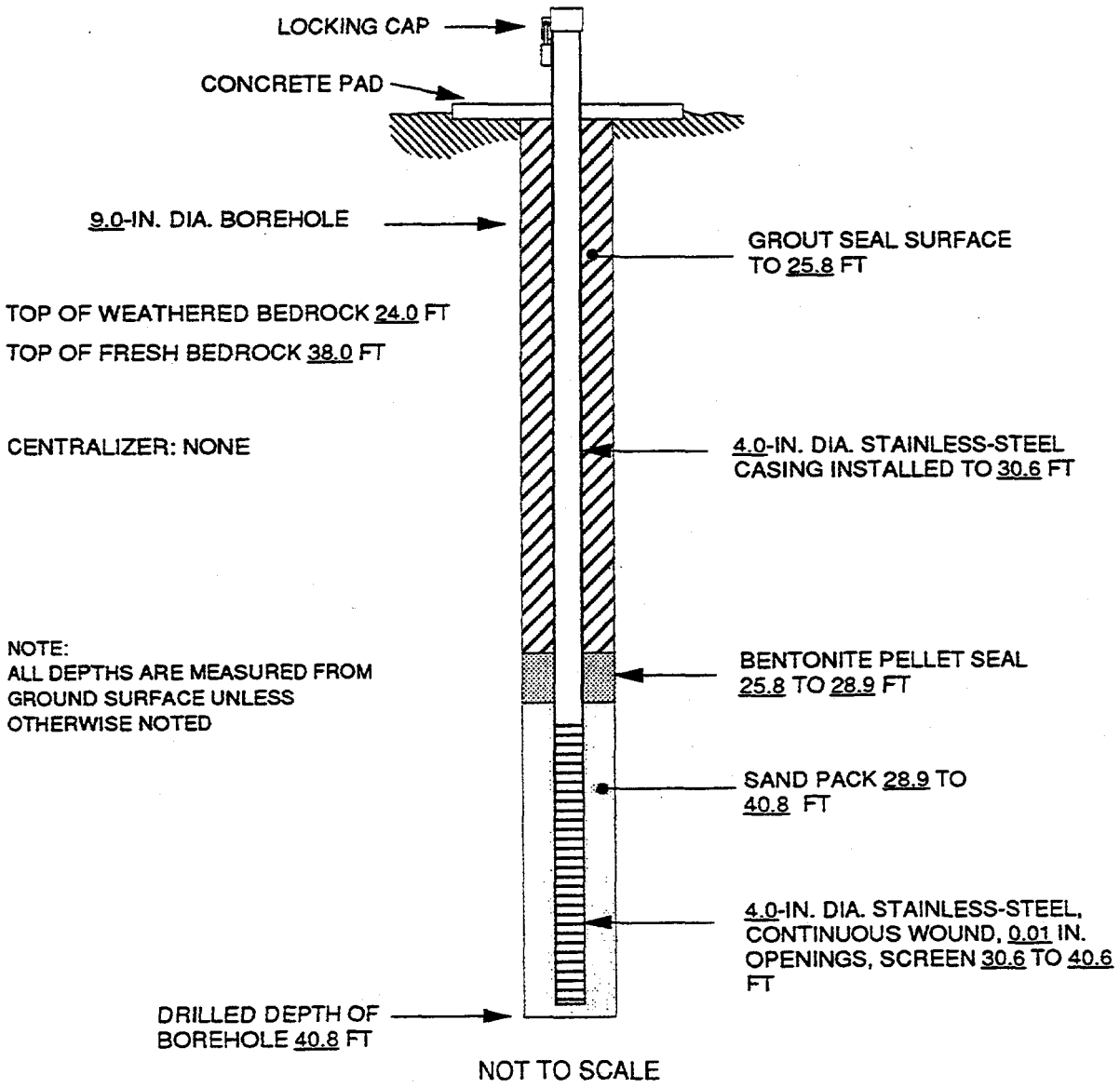
WELL INSTALLATION DIAGRAM

LOGGED BY: Jeff Walker, Geraghty & Miller, Inc.

DRILLING COMPANY: Highland Drilling Co.

DRILLER: Randy Phillips HELPERS: Unknown

DRILLING DATES
STARTED: Unknown
FINISHED: 11/20/86



NOT TO SCALE

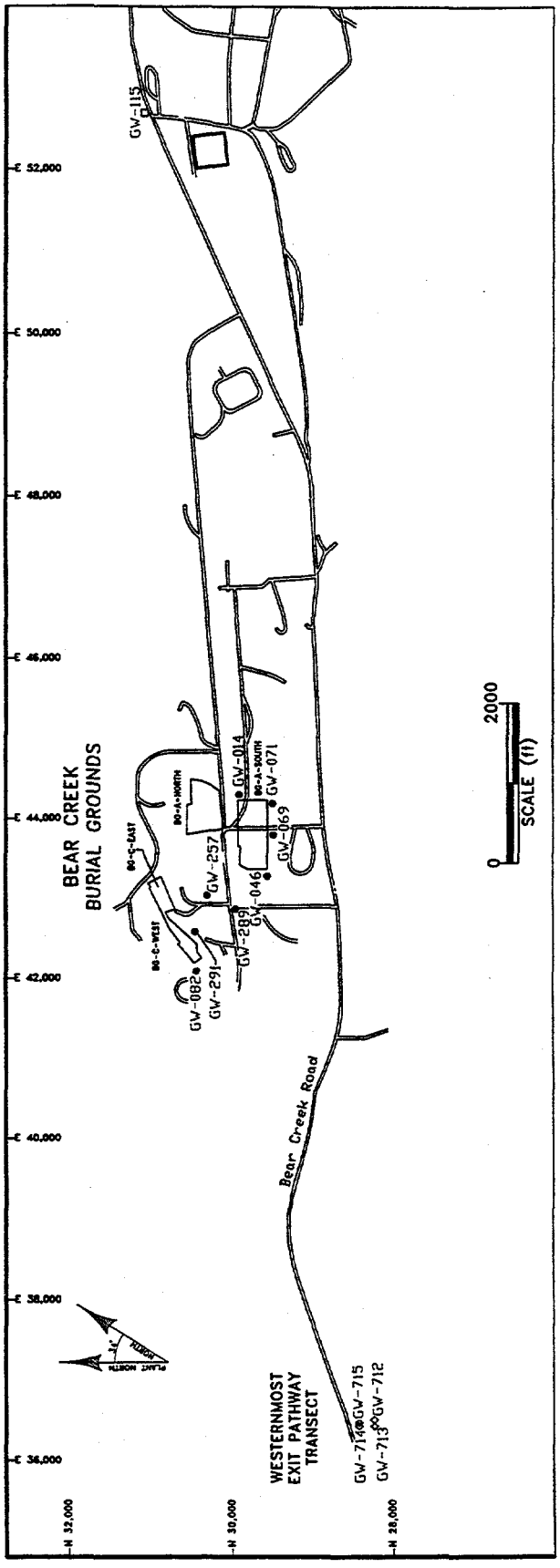
APPENDIX A-10
Permit Attachment 4, Section F — Groundwater Protection Standards
(Bear Creek Burial Grounds)

Groundwater Protection Standards
Bear Creek Burial Grounds (including Walk-in Pits)

Constituents	Concentration Limit (a)
Inorganics	
Barium	
Cadmium	
Chromium	
Lead	
Mercury	
Nickel	
Nitrate (as N)	
Uranium	
Organics	
Acetone	
Benzene	
Bromoform	
2-Butanone	
Carbon Tetrachloride	
Chloroform	
1,1-Dichloroethene	
Trans-1,2-Dichloroethene	
Methylene Chloride	
4-Methyl-2-Pentanone	
Tetrachloroethene	
Toluene	
1,1,1-Trichloroethane	
Trichloroethene	
Radiochemical Parameters	
Americium-241	
Neptunium-237	
Total Radium	
Strontium-89/90	
Technetium-99	
Uranium-234	
Uranium-235	
Uranium-238	
Gross alpha	
Gross beta	

(a) Limits will be developed as per Permit Condition VI.D.

APPENDIX A-11
Permit Attachment 4, Section G — Site Map
(Bear Creek Burial Grounds)



PREPARED FOR: *LOCKHEED MARTIN ENERGY SYSTEMS, INC.*	LOCATION:	Y-12 PLANT OAK RIDGE, TN.	MONITORING WELLS FOR THE BEAR CREEK BURIAL GROUNDS HAZARDOUS WASTE DISPOSAL UNIT IN THE BEAR CREEK HYDROGEOLOGIC REGIME
PREPARED BY: *AJA TECHNICAL SERVICES, INC.*	DOC NUMBER:		
	DWG ID.:	97-051	
	DATE:	4-22-97	

APPENDIX A-12
Permit Attachment 6 — Groundwater Sampling Procedure

Lockheed Martin Energy Systems, Inc.
Analytical Services Organization

APPROVAL SIGNATURE PAGE FOR

SESD-TP-8204, Rev. 3

GROUNDWATER SAMPLING

Author: M. E. Cleveland

Procedure Owner: M. E. Cleveland

IPC? Yes ___ No X

R. E. Flagle
Manager, Sample & Waste Management Department

3/14/97
Date

This procedure has been reviewed by an Authorized Derivative Classifier and has been determined to be UNCLASSIFIED.

W. O. Tucker
Authorized Derivative Classifier

14 Mar 97
Date

Title: GROUNDWATER SAMPLING **(R)**

M. E. Cleveland is responsible for the accuracy, compliance, and usability of this procedure.

THE USER OF THIS PROCEDURE IS RESPONSIBLE FOR VERIFYING THAT THIS IS THE CURRENT REVISION.

1.0 SCOPE

To provide a method for the Sampling and Environmental Support Department (SESD) personnel in the collection of representative groundwater samples from monitoring wells on the Oak Ridge Reservation (ORR). This procedure applies to wells specified in the customer's annual Sampling and Analysis Plan (SAP). The procedure is a compilation of Lockheed Martin Energy System's (LMES) Environmental Surveillance Procedures (ESPs) and the U.S. EPA's Technical Guidance document pertinent to groundwater sampling. This procedure does not replace manufacturer's instrument operation manuals.

2.0 REFERENCED DOCUMENTS

2.1 ASO-QAP-0001, entitled *Quality Assurance Plan for the Analytical Services Organization.*

2.2 ASO-AP-0002, entitled *Chemical Hygiene Plan for the Analytical Services Organization.*

2.3 ASO-AP-0007, entitled *Analytical Services Organization Procedures.*

2.4 SESD-TP-8005, entitled *Temperature Meter Operation and Calibration.*

2.5 SESD-TP-8007, entitled *pH Meter Operation and Verification.*

2.6 SESD-TP-8008, entitled *Dissolved Oxygen Meter Operation and Verification.*

2.7 SESD-TP-8201, entitled *Redox Meter Operation and Verification.*

2.8 SESD-TP-8202, entitled *Conductivity Meter Operation and Verification.*

2.9 SESD-TP-8009, entitled *Sample Transportation.*

2.10 SESD-TP-8020, entitled *Labelling Bottles.*

2.11 SESD-TP-8055, entitled *Chain-of-Custody Protocol for the Sampling and Environmental Support Department.*

2.12 SESD-TP-8203, entitled *Trip Blank Preparation.*

2.13 SESD-TP-8206. entitled *Steam Cleaning Bennett Sample Pumps.*

2.14 SESD-TP-8065. entitled *Neutralization of Acid and Base Waste Solutions.*

2.15 Job Hazard Analysis Documentation for SESD Groundwater Sampling.

2.16 Environmental Surveillance Quality Control Program Procedures (ESPs).

2.16.1 ESP-302-1. entitled *Water Level Measurements Using Water Level Indicator.*

2.16.2 ESP-302-2. entitled *Guidelines for Well Purging.*

2.16.3 ESP-302-3. entitled *Using a Bailer.*

2.16.4 ESP-302-4. entitled *Using a Gas Driven Piston Pump.*

2.16.5 ESP-302-5. entitled *Using a Bladder Pump.*

2.16.6 ESP-307-1. entitled *Temperature.*

2.16.7 ESP-307-2. entitled *pH (Hydrogen Ion Concentration).*

2.16.8 ESP-307-5. entitled *Oxygen/Reduction Potential of Water.*

2.16.9 ESP-307-8. entitled *Specific Conductance.*

2.16.10 ESP-505. entitled *Sample Packaging, Transporting, and Shipping.*

2.16.11 ESP-801. entitled *Cleaning and Decontaminating Sample Containers.*

3.0 RESPONSIBILITIES

3.1 Customer Sampling and Analysis Coordinator (e.g., Y-12 GWPP, K-25 GWPP, ER Project Manager)

3.1.1 Ensures the implementation of current approved SAP. Ensures monitoring requirements are met and completed in accordance with required schedules.

3.1.2 Records and issues any changes to the SAP through addenda.

3.1.3 Provides SESD with quarterly Groundwater Well Monitoring Schedules (GWMS), site maps, current bottle list, well information, site access, and any other pertinent information.

3.1.4 Coordinates with SESD to schedule sampling personnel at determined well locations.

3.1.5 Acts as primary point of contact for SESD personnel concerning monitoring and Health and Safety activities while on site.

3.1.6 Coordinates with waste management organization to provide and dispose of containment vessels for specified wells.

3.1.7 Coordinates with laboratory to receive and perform analyses as listed in the SAP.

3.1.8 Ensures proper implementation of this procedure through oversight of field activities and quarterly assessments of SESD personnel.

3.2 SESD Sampling Supervisor

3.2.1 Maintains communication with customer representatives and laboratory for information that could affect the performance of this procedure.

3.2.2 Provides trained field technicians for monitoring performed on ORR groundwater wells. Trains, approves, and documents training of field technicians in performance of this procedure.

3.2.3 Provides field technicians with all required documentation and information to effectively carry out this procedure.

3.2.4 Interfaces with customer and project manager to obtain scheduling information, containment availability, well access or entry requirements, and site-specific information concerning unusual conditions.

3.2.5 Provides field quality assurance through planning and use of established and approved procedures.

3.2.6 Ensures that materials and equipment are available for use, decontaminated, and properly maintained.

3.2.7 Coordinates with project management to receive samples.

3.2.8 Ensures quality in sampling through review of the technician's field data sheets and training reviews.

3.2.9 Ensures complete chain-of-custody through review of chain-of-custody documentation.

3.2.10 Implements corrective action for nonconformance with this procedure.

3.3 Laboratory Project Manager

3.3.1 Maintains communication with customer to convey information that could affect the performance of this procedure.

3.3.2 Acts as primary interface for all individual laboratories concerning analysis performed on groundwater samples.

3.3.3 Ensures samples are analyzed according to the most current applied and approved analytical procedure for the requested analyte in the SAP.

3.3.4 Ensures laboratory QA/QC measures are in place and documentation provided.

3.3.5 Ensures sample holding times are not exceeded.

3.3.6 Prepares Bottle List for SESD for specified monitoring locations in the SAP.

3.3.7 Prepares Bottle Menus for Sample & Waste Management personnel to receive samples.

3.3.8 Coordinates with DOE's contractor Sample Management Organization (SMO) for all outside laboratory work, if required.

3.3.9 Issues hard copy and electronic copy of analytical data to customers. Maintains archive copy.

3.4 Field Technician

3.4.1 Is properly trained in performance of this procedure under the supervision of the SESD Sampling Supervisor or qualified trainer.

3.4.2 Performs groundwater sampling according to this procedure. Conducts sampling operations in a safe and efficient manner, as to not injure themselves or others.

3.4.3 Documents all field measurements, field conditions, samples collected, and off-normal conditions, as required by this procedure.

3.4.4 Ensures sample quality and integrity are maintained at all times.

3.4.5 Ensures chain-of-custody is maintained at all times.

3.4.6 Relinquishes all samples to laboratory Sample & Waste Management personnel within the prescribed holding times.

3.4.7 Decontaminates and maintains well monitoring equipment.

3.4.8 Maintains (in the field) the most current approved version of this procedure, field copies of LMES ESPs and SESD technical procedures, and the following documents:

3.4.8.1 Bottle Lists: The list of analyte-specific sample containers required for the samples to be collected at a well site.

3.4.8.2 Field Data Sheets: The field record of monitoring activities at a well. Completed by SESD personnel to include well depths, water level measurements, purge volume calculations, purge rates, field measurements, and field comments. Field Data Sheets are numbered and bound to become part of the permanent administrative record for customer.

3.4.8.3 Groundwater Well Monitoring Schedule (GWMS): The schedule of groundwater wells to be monitored which is issued by customer. The GWMS is derived from the customer's current approved SAP for the groundwater and/or surface water monitoring on the ORR.

3.4.8.4 Site Maps: Maps that show the location of groundwater wells and surface water sites.

3.4.8.5 Bottle List Tracking Sheet (as required by the customer): Tracks the current revisions made throughout the calendar year to the Bottle List.

3.4.8.6 A current and approved copy of this procedure.

4.0 TERMINOLOGY

4.1 AOC: Additional organic compounds.

4.2 ASTM: American Society for Testing and Materials.

4.3 DOT: Department of Transportation.

4.4 ESP: Environmental Surveillance Procedure.

4.5 GWPP: Groundwater Protection Program (ORR).

4.6 GWMS: Groundwater Monitoring Schedule.

4.7 LMES: Lockheed Martin Energy Systems, Inc.

4.8 MSDS: Material Safety Data Sheet.

4.9 ORR: Oak Ridge Reservation [i.e., Y-12 Plant, Oak Ridge National Laboratory, East Tennessee Technology Park (formerly K-25 Site)].

4.10 PPE: Personal protective equipment.

4.11 SAP: Sampling and Analysis Plan.

4.12 SESD: Sampling and Environmental Support Department.

4.13 SMO: DOE's Sample Management Office.

4.14 TOC: Total organic carbon.

4.15 TOX: Total organic halides.

4.16 VOA: Volatile organic compound.

5.0 SUMMARY OF TEST METHOD

Groundwater samples are collected after an appropriate well purge by using a bailer or pump. If required, the purge water from the wells is transferred into collection containers and transported to the plant for appropriate water treatment. Field determinations which include pH, specific conductance, oxidation-reduction potential, dissolved oxygen, and temperature are obtained on an initial sample from the well. Additional measurements of the same type are taken for each well volume purged and after the final purge volume. All samples are preserved in the field according to EPA protocol as defined in the current SAP. The samples are then delivered to the Sample & Waste Management group or to the SMO for transfer to a contract laboratory.

6.0 SIGNIFICANCE AND USE

This method is applicable to the sampling of groundwater wells on the Oak Ridge Reservation. This procedure supplements instrument operating manuals from manufacturers and provides field sampling technicians with additional sampling instructions. In the event of an emergency sampling event or other unforseen occurrence. SESD has the option of calibrating any instrument in inventory according to the manufacturer's instructions.

7.0 INTERFERENCES

Not applicable.

8.0 APPARATUS

8.1 Personal Protective Equipment (PPE): Company-issued clothing (including cold weather apparel and rain suits), steel-toed safety shoes, safety glasses with side shields, rubber gloves (nitrile for work with reagents), hearing protection, and if required, Tyvek coveralls or rubber aprons, hard hat, and cotton gloves.

NOTE: Additional PPE may be warranted due to changing site-specific conditions or for specific projects. Additional PPE requirements will be specified by the site Health and Safety Officer or by the customer in project-specific Health and Safety Plans.

8.2 Safety Equipment

8.2.1 Cellular phone and pager with emergency contact numbers

8.2.2 Fire extinguisher.

8.2.3 Insect repellant.

8.2.4 Respirator.

8.2.5 Face shield.

8.2.6 Four-wheel drive vehicle.

8.2.7 Eye-wash solutions.

8.2.8 Insulated water cooler with potable drinking water.

8.2.9 DOT-approved containers.

8.2.10 Approved cylinder racks with safety bars (chains) for transporting nitrogen cylinders.

8.3 Consumables

8.3.1 pH paper.

8.3.2 Nylon cord.

8.3.3 Plastic bags.

8.3.4 Paper towels.

8.3.5 Tape.

8.3.6 Rinse bottles.

8.3.7 Wet ice (enough to preserve samples to 4°C).

8.3.8 Polyethlyene ground cloth.

8.3.9 10 gal of non-phosphate soap solution.

8.3.10 10 gal of ASTM Type II deionized, distilled water.

8.4 Field Instrumentation

8.4.1 Temperature meter (thermistor or thermometer, centigrade).

8.4.2 Redox (oxidation/reduction) meter (mV).

8.4.3 pH meter.

8.4.4 Dissolved oxygen meter (ppm or mg/L).

8.4.5 Specific conductance meter (μohm/cm).

8.4.6 Hunter/Keck Model KIR-89 or equivalent portable device for measuring the level and thickness of inorganic layers and groundwater monitoring well layers.

8.4.7 In-line water analyzer, if required (should include features in Steps 8.4.1 through 8.4.5).

8.4.8 Electronic water level indicator.

8.4.9 Turbidity meter.

8.5 Field Equipment

8.5.1 Well Wizard™ controller box with fittings and air lines.

8.5.2 Bottom loading Teflon or stainless steel bailer.

8.5.3 Compressed nitrogen gas cylinders with appropriate regulators or gasoline powered oil-less compressor with high pressure hoses and fittings.

8.5.4 Bennett pump (reel, pump head, and tubing bundle of sufficient length).

8.5.5 Electronic calculator.

8.5.6 Insulated ice chest.

8.5.7 Tools and tool box.

8.5.8 Graduated cylinder.

8.5.9 Large plastic trays.

8.5.10 Filtration apparatus equipped with 0.45 or 0.10 μm membrane filter.

8.5.11 Bottle labels.

8.5.12 Chain-of-custody seals (if applicable).

8.5.13 Chain-of-custody forms, equipment calibration forms, DOT approved packaging, labels, and shipping papers, and field data sheets.

8.6 Sample Containers: Sample bottles of assorted sizes and types as required by the analytes specified for each well as defined in the current SAP and Bottle List.

9.0 REAGENTS AND MATERIALS

9.1 Purity of Water: ASTM Type II distilled deionized water. (Refer to Section 19.0 of Ref. 2.12.)

9.2 Purity of Reagents: Reagent grade chemicals shall be used in all analyses. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society where such specifications are available. Other grades of chemicals may be used, provided it is first documented that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

9.3 A Chemical Inventory Sheet is required for the Groundwater Sampling Group and is located in the Groundwater Laboratory, K-1004-H Dock, and each of the sampling vehicles.

NOTE: The following is a list of standard reagents: other reagents may be required for specific activities.

NOTE: Visually inspect preservatives for discoloration or degradation before use to ensure reagent quality.

NOTE: Replace standard solutions in each field instrument box at the beginning of each quarter.

		DOT Hazard Class Shipping Code
9.4	Sulfuric acid (H_2SO_4), 96.4%.	UN 1830 PGII LTD-QTY*†
9.5	Hydrochloric acid (HCl), 36.5 to 38.0%.	UN 1789 PGII LTD-QTY*†
9.6	Sodium hydroxide (NaOH), 50.0%.	UN 1824 PGII LTD-QTY*†
9.7	Nitric acid (HNO_3), 69.0 to 71.0%.	UN 2031 PGII corrosive*†
9.8	Nitrogen (N), compressed.	UN 1066 Nonflammable Gas*†
9.9	Ascorbic acid.	
9.10	Wasp and hornet spray.*	
9.11	Buffer solutions, pH 7 and pH 10.*	
9.12	Formula 409™ or equivalent.	

9.13 Isopropyl alcohol.

9.14 Lava™ soap or equivalent.

9.15 Liqui-Nox™ detergent or equivalent.

9.16 Micro™ soap or equivalent.

9.17 Potassium chloride (KCl).

9.18 Potassium ferricyanide.

9.19 Potassium ferrocyanide.

9.20 Sodium sulfite.*

9.21 Softcide™ hand wash.

9.22 Zinc acetate.

9.23 0.01 *N* KCl Standard Solution: Record each lot prepared in reagent logbook.* Dissolve 1.4873 g of KCl in 2000 mL of Type II water.

9.24 Zobell Standard Solution: Record each lot prepared in reagent logbook.* Dissolve 7.460 g of KCl, 1.270 g of potassium ferrocyanide, and 0.99 g of potassium ferricyanide in 1000 mL of Type II water.

9.25 Lead-free gasoline.*

9.26 10W-30W motor oil.*

*Materials maintained in the sampling vehicle.
†DOT shipping label required for transfer.

10.0 HAZARDS

WARNING!

Serious injury could occur if the H_2SO_4, HCl, NaOH, or HNO_3 comes in contact with the skin or eyes. Nitrile gloves and safety glasses with side shields must be worn AT ALL TIMES when handling such reagents. Contact should be avoided. Should skin contact occur, flush the area of the skin IMMEDIATELY with water. Should eye contact occur, flush eyes IMMEDIATELY with water from the emergency eye baths mounted in the vehicles. Contact emergency personnel.

WARNING!

Any employee has stop work authority for sampling activities. If site conditions appear unsafe for any reason, or if health and safety requirements do not appear adequate for a site, immediately stop work and leave the site. Contact supervision or the customer representative.

WARNING!

Changing site conditions can pose hazards. Site conditions vary from well to well and from season to season. Wells located in isolated field areas may have hazards associated with the flora and fauna, trip and fall hazards, and hazardous road conditions. Wells located near plant areas have hazards associated with the general area of the plant or the associated building. Personnel should be aware and notify the customer representative or supervision of any off-normal conditions, or if site maintenance is required.

10.1 Refer to the ASO Chemical Hygiene Plan (Ref. 2.2) for important safety information on chemicals, laboratory hoods, and personal protective equipment.

10.2 Consult Material Safety Data Sheets (MSDSs) for information on chemical incompatibilities, specific hazards, or spill cleanup steps for any hazardous materials used in this procedure. Manufacturers' MSDSs are available through the Lockheed Martin Energy Systems Material Safety Reference Sheet computer data base.

10.3 Make sure at least two persons are present during well sampling operations.

10.4 No sampling operations shall be conducted during thunderstorms.

10.5 Have some form of communication in the field for use during sampling operations.

10.6 Follow posted site conditions for entry and safety considerations.

10.7 On weekends or overtime hours, contact the Plant Shift Superintendent at the specific site at the beginning and end of the work shift.

10.8 Carry an adequate supply of Type II water to rinse and clean equipment.

10.9 Use adequate protective clothing during cold weather sampling operations. During hot weather, carry an adequate supply of drinking water, insect repellent, and wasp spray.

10.10 Be familiar with and alert for hazardous flora and fauna.

10.11 Use the proper technique for moving and lifting heavy equipment.

10.12 Always remove the regulator and replace the cylinder cap before operating the vehicle.

10.13 Use proper technique for the safe operation of well pumps, portable gasoline engine-driven electric generators, portable air compressors, and high pressure compressed gas cylinders and regulators.

NOTE: Refer to Ref. 2.2 and/or appropriate customer Health and Safety Plans for environmental health and safety applications.

10.14 Store, transport, and use hazardous and flammable reagents in accordance with instructions in each chemical's MSDS and with DOT regulations.

10.15 Always wear steel-toed shoes, company-issued clothing, gloves, and safety glasses with side shields while performing sampling operations.

10.16 In accordance with ESP-505 (Ref. 2.16.10), have all samples taken from customer groundwater wells surveyed and green-tagged by Radiological Control before shipping to an off-site contract laboratory. Retain a copy of the green tags for records.

10.17 Dispose of waste according to project documentation or the project-specific Waste Management Plan.

11.0 SAMPLING, SUBSAMPLES, AND TEST SAMPLES

Covered in Section 15.0.

12.0 PREPARATION OF APPARATUS

12.1 All field analytical equipment is calibrated at the beginning of each day in accordance with Refs. 2.4 through 2.8. Results are recorded in calibration logbooks, with the sheet number is recorded on the field data sheet. All temperature meters are calibrated and verified against a National Institute of Standards certified thermometer, which is calibrated annually by the Metrology, Testing, and Equipment Laboratory. If an instrument is thought to be out of calibration while in the field, the technician must recalibrate the instrument. If the instrument is found to be out of calibration, the supervisor must be contacted so the customer and program management can determine if the previous data are valid or if a resample is required. If an instrument is not calibrated on the proper schedule, the instrument will be treated as out-of-calibration and will be tagged with a "Do Not Operate" tag. Immediate action should be taken to ensure the instrument is recalibrated (see Refs. 2.4 through 2.8).

NOTE: Do not use the balance if the certification has expired.

12.2 The laboratory analytical balance must be certified annually by the Metrology, Testing, and Equipment Laboratory and the standard weight checked and recorded in the reagent logbook by the technician each time it is used. The balance certification date must also be recorded in the reagent logbook.

13.0 CALIBRATION AND STANDARDIZATION

See Refs. 2.4 through 2.8.

14.0 CONDITIONING

Not applicable.

15.0 PROCEDURE

15.1 Field Preparation

15.1.1 Don the necessary PPE and safety equipment.

15.1.2 Decontaminate all pumps, bailers, water level indicators, and other down-hole equipment before use according to this procedure and as specified in ESP-801 (Ref. 2.16.11).

15.1.3 Check with SESD Supervisor for daily sampling instructions.

15.1.4 Calibrate instruments according to Refs. 2.4 through 2.8.

15.1.5 Record calibration results in designated and numbered calibration logbook.

15.1.6 Record the calibration logbook number on all field data sheets for all wells sampled each day.

15.1.7 Gather and prepare the appropriate sample bottles according to the most current Bottle List and SAP.

15.1.8 Prepare the required trip blanks or field blanks as specified in the bottle list and according to SESD-TP-8203 (Ref. 2.12).

15.1.9 Review the current GWMS for information on access restrictions, well depth and diameter. purge volume, purge method. type of sampling equipment needed, containment requirements, and other well information.

15.1.10 Check site maps for well locations.

15.1.11 Load vehicle with all required sampling equipment, and secure for transport.

> **WARNING!**
>
> Valve stem covers on the compressed gas cylinders MUST BE in place before operation of the vehicle. Severe injury could occur should the valve stem be severed in an accident.
>
> Ensure that compressed gas cylinders are secured in an upright position. Unsecured compressed gas cylinders can overturn during transport.

15.1.12 Load/replace nitrogen gas cylinders for the day's use in truck.

15.2 Well-Site Preparation

15.2.1 Locate and identify monitoring well (refer to site maps).

WARNING!

Off-road, non-paved surfaces are subject to change between monitoring events. Caution and discretion SHOULD BE USED when off-road driving is required to access a well. Notify supervision or customer of any hazardous conditions or blocked access requiring immediate attention. Fill out and submit a well maintenance request form for off-normal road maintenance as required.

15.2.2 Record well number, date, project number, weather conditions, arrival time, well depth and diameter, serial numbers of instruments, purging method, and trip blank preparation location on the field data sheet. Record any problems with site access and visitors at the well in the comments section of the field data sheet.

15.2.3 Don the necessary PPE.

NOTE: Customer will notify SESD when conditions warrant additional PPE.

NOTE: When removing sampling equipment from the tailgate area, use plastic trays and/or sheeting to prevent possible contamination. Discard the plastic sheeting after each use, along with any other disposable items, in accordance with the SAP or Area-Specific Waste Disposal Guide.

15.2.4 Unlock and open the well by removing the well cap. Note condition of the well and any strange odors.

15.2.5 Sample the air in the well head for organic vapors, if required by the SAP (contact customer representative for further instructions on sampling protocol).

15.2.6 Locate the reference mark on the well casing (if not present, contact customer or supervision) and note the diameter of the well.

NOTE: Nitrile gloves must be worn during sample collection and field reading activities to prevent cross-contamination. Gloves must be changed between sampling wells. Leather or work gloves may be worn while performing non-sampling activities (opening the well, preparing the Bennett pump, loading/unloading equipment, etc.).

15.3 Depth to Water (DTW) Measurement

15.3.1 Measure the DTW in the well casing using an electronic water level indicator according to ESP 302-1 (Ref. 2.16.1).

15.3.2 Check the battery on the water level indicator.

15.3.3 Lower the indicator probe into the well until the buzzer sounds (or indicator light flashes).

15.3.4 Pull up on the cable till the buzzer no longer sounds.

15.3.5 Lower the probe slowly and stop at the instant the buzzer sounds again.

15.3.6 Mark the cable with thumb and forefinger where it touches the reference mark.

15.3.7 Record on the field data sheet the measurement to the nearest 0.01ft from the increments on the cable. If the cable is not graduated to 0.01ft, measure with a ruler or measuring tape from the nearest increment to the position marked on the cable with the thumb.

15.3.8 Repeat Steps 15.3.3 through 15.3.7 two times.

15.3.9 Record on the field data sheet the average value of the three readings to the nearest 0.01ft.

15.3.10 Remove the water level indicator from the well.

15.3.11 Wipe the cable down with a paper towel soaked with ASTM Type II distilled deionized reagent grade water as the cable is being reeled up out of the well. Clean the probe tip with soap solution, and rinse with Type II water.

15.3.12 Place the water level indicator in a clean plastic bag to prevent contamination during transport.

NOTE: Accurate well depth data will be provided annually by the customer.

15.3.13 Record the well depth from the GWMS on the field data sheet.

15.3.14 Subtract DTW from the well depth to determine the height of the water column in the well. Record on the field data sheet.

15.3.15 Calculate the volume of the water column in the well casing as follows:

2-in. ID well: 0.1632 gal/ft × height of the water column = gallons

4-in. ID well: 0.6528 gal/ft × height of the water column = gallons

6-in. ID well: 1.4688 gal/ft × height of the water column = gallons

10-in. ID well: 4.0800 gal/ft × height of the water column = gallons

15.4 Three Well Volume Removal—Purging and Sampling Using a Bennett Pump (ESP-302-2 and ESP-302-4)

NOTE: Refer to the GWMS for the purge and sample method to be used at each individual well.

NOTE: A groundwater well is required to be purged a minimum of three well volumes before the collection of representative groundwater samples from the surrounding geological formation. Intermittent field measurements are collected throughout the purge cycle.

15.4.1 Multiply the volume of the water column by three. Record the value on the field data sheet under "Purge Volume."

NOTE: For nitrogen gas cylinders, remove valve stem cover, connect appropriate regulator, and attach air line to pump.

NOTE: For gasoline powered air compressor, connect appropriate hoses and fittings. Follow manufacturer's instructions in starting and operating the compressor. Place the compressor in a **downwind** position.

15.4.2 Connect air lines from the compressed air source to the Bennett pump.

NOTE: If the well's purge water exceeds containment criteria established by the customer, the water is to be collected in containment vessels. Notify customer or supervision if the containment vessels are not in place.

15.4.3 Connect and secure the discharge line of the pump to the containment vessel, if required (see the GWMS). If not required, discharge water to the ground surface.

15.4.4 Start the air flow to the pump. Use the pressure regulator on the pump to regulate the pump's flow rate.

NOTE: Bennett pumps have a maximum pump rate of 2 gpm.

15.4.5 Lower the pump to the air–water interface in the well, and check the pump's footage counter against the measured DTW. Reset counter if needed.

15.4.6 Lower the pump 10 to 20 ft below the air–water interface to begin purging.

15.4.7 Record purge start time on the field data sheet.

15.4.8 Purge a volume of water greater than one tubing volume.

15.4.9 Collect a sample for the initial field determinations of pH, specific conductance, dissolved oxygen, oxidation/reduction potential, and temperature (see Refs. 2.4 through 2.8). Dispose of the sample in the appropriate containment vessel, if required.

15.4.10 Determine the flow rate of the pump by performing the following steps:

15.4.10.1 Place the discharge line into a 1-L graduated cylinder.

15.4.10.2 Record in seconds the time required to fill the cylinder.

15.4.10.3 Convert liters to gallons by the following formula to obtain purge rate:

$$\frac{15.85}{\text{no. of seconds to fill cylinder}} = \text{gpm}$$

15.4.10.4 Record the flow rate in gpm on the field data sheet under "Purge Rate."

15.4.11 On the field data sheet, divide the " Purge Volume" (gallons) by the "Purge Rate" (gpm) to obtain the "Purge Time" (minutes). This is the minimum amount of time a well must purged in order to clear three casing volumes. Record the purge time on the field data sheet.

NOTE: The flow rate will need to be rechecked for wells that drawdown > 200ft, then rechecked every 100 ft subsequently. Recalculate the " Purge Time" on the field data sheet if there is >20% difference between the flow rates.

15.4.12 Divide the purge time by three. This is the time interval at which to collect the intermittent field measurements, as stated in ESP-302-2 (Ref. 2.16.2).

15.4.13 Lower the pump as needed as the water level in the well continues to drop. Always chase down the water in the well from the top.

15.4.14 Collect intermittent field measurements (according to Refs. 2.4 through 2.8) at the time intervals calculated in Step 15.4.12. Record the field measurements on the field data sheet.

15.4.15 Purge the well the required three well volumes. The well is ready to sample when three well volumes have been removed from the well casing or the well purges dry. Record the "Purge Stop" time on the field data sheet.

NOTE: Do not purge the well to dryness more than once.

NOTE: If a well purges dry (i.e., the pumphead is located at or below the midpoint of the monitored interval) before the removal of three well volumes, proceed as follows:

15.4.16 Allow the water level in the well to recover at least 30 min, and perform a water level measurement. Record the measurement on the field data sheet.

15.4.17 Calculate the volume of the water column in the well as described in Step 15.3.15. Record the measurement on the field data sheet.

15.4.18 If the well has recovered a sufficient volume (enough to collect the total volume of the sample set) then proceed with sampling. A standard 8-L volume of water to collect would required a minimum of 12 ft of water in a 2-in. well, 3 to 4 ft in a 4-in. well, and 1 ft in a 6-in. well.

15.4.19 If the water column has not recovered a sufficient volume, let the well recover for a period of time not to exceed 24 h.

15.4.20 Collect samples if sufficient volume is present.

NOTE: Do not place the pump below the midpoint of the monitored level.

NOTE: If insufficient volume is present, then start in the sequence listed in Step 15.4.22 and collect as many samples as the well will allow. Return at intervals not to exceed 24 h, and collect as many samples as the well will allow. Continue this process until the set of samples is complete.

15.4.21 Collect and record a final measurement of field parameters.

NOTE: It is recommended to reduce the flow rate to <300 mL/min in order to decrease agitation of the well.

15.4.22 Decrease the pumps flow rate as low as possible. Collect the following nonvolatile samples in sequence from the pump's discharge hose:

Turbidity
Anions
Carbonate/bicarbonate
Total coliform bacteria
Total suspended solids
Total dissolved solids
Total metals
Filtered metals

Radiochemistry samples:
- Gross alpha, gross beta activity
- Isotopic uranium (^{234}U, ^{235}U, ^{238}U)
- ^{129}I, ^{241}Am, ^{238}Pu, ^{237}Np
- Tritium, total strontium, ^{99}Tc
- Total radium
- Gamma spectrum

Total petroleum hydrocarbons
COD
Cyanide
Ammonia nitrogen
Base-neutral-acid extractable

NOTE: Collect duplicate samples concurrently (e.g., collect both total metal samples—the original and the duplicate—at the same time).

15.4.23 If required by the GWMS, collect a duplicate sample.

15.4.24 If insufficient water is present to collect all samples at one time, record the sample type and collection time for each recovery period on the field data sheet.

15.4.25 Ensure that all samples are labeled properly with the project and subproject numbers, well number, date, time, sampler's initials, analysis requested, preservative used, and any other pertinent information.

15.4.26 Collect the sample for filtered metals through an in-line 0.45-μm filter.

NOTE: The pH should be <2 for samples requiring the addition of an acid. The pH should be >12 for samples requiring addition of a base.

15.4.27 Add the appropriate preservative to the samples as specified in the most current approved Bottle List and GWMS.

NOTE: Do not insert the pH paper or pH meter probe into the sample.

15.4.28 Verify the pH of the preserved samples (except for preserved volatiles) by pouring a small amount of sample over narrow-range pH paper (litmus paper) or by using the calibrated pH meter. Document the pH adjustment on the field data sheet.

15.4.29 Wash the outside of each sample bottle with ASTM Type II water before packing samples in a cooler with ice.

NOTE: Field Blanks give an indication of any contaminants from the surrounding environment (i.e., any volatile present in the atmosphere).

15.4.30 If specified on the GWMS, collect a field blank sample by performing the following:

15.4.30.1 Review the most current approved bottle list to determine bottle type, size and preservative needed.

15.4.30.2 Bring the appropriate amount of ASTM Type II water to the field in a sealed glass jar. Prevent exposure to air until opened at site.

15.4.30.3 At the well site, open the glass jar and fill the specified containers under the same environmental condition in which the samples from the well were collected.

15.4.30.4 Label containers, and place in cooler with ice and trip blank.

15.4.30.5 Fill out separate field data sheet for field blank sample for submittal to ASO.

15.4.31 After collecting the nonvolatile portion of the sample set, pull the Bennett pump from the well.

NOTE: If required, collect rinse water waste from decontamination activities into appropriate containment vessels for disposal.

15.4.32 Conduct a field equipment rinse on the pump.

15.4.33 Place the pump head in a plastic bag filled with 2 gal of nonphosphate soap solution. Rinse outside of the pump head, and pump the soap solution through the tubing bundle.

15.4.34 Fill another plastic bag with 2 gal of ASTM Type II water, and flush soap solution from the pump head and tubing bundle.

15.4.35 Repeat Step 15.3.34.

15.4.36 If noted on the GWMS, collect an equipment rinsate (nonvolatile sample) from the pump at this time by completing the following steps:

15.4.37 Review the most current approved Bottle List to determine bottle type, size, and preservative needed.

15.4.38 Bring the appropriate amount of ASTM Type II water to the field in a sealed glass jar or carboy. Prevent exposure to air until opened at site.

15.4.39 Fill a plastic bag with 1 to 2 gal of ASTM Type II water.

15.4.40 Pump the ASTM Type II water through the pump and tubing, and collect appropriate bottles from the discharge tube of the pump.

15.4.41 Label the containers, preserve (if required), and place in cooler with ice.

15.4.42 Fill out a separate field data sheet for the equipment rinsate sample .

15.4.43 Seal the pump head in a plastic bag. Pump is ready to be used on the next well.

15.4.44 Remove a clean Teflon or stainless steel bottom loading bailer from the vehicle.

NOTE: If noted on the GWMS, collect an equipment rinsate (volatile portion) sample by completing the following steps:

15.4.46 Repeat Steps 15.4.37 and 15.4.38.

15.4.47 Fill the bailer with ASTM Type II water.

15.4.48 Pour the contents of the bailer into the appropriate container.

15.4.49 Label containers, preserve if required, and place in cooler with ice.

15.4.50 Fill out a separate field data sheet for the equipment rinsate sample.

15.4.51 Attach and secure a nylon cord to the top of the bailer. Lower the bailer slowly into the well to minimize agitation of the well water.

15.4.52 Lower the bailer to the screened/open interval of the well to collect samples.

15.4.53 Allow the bailer to fill with water. Gently raise the bailer to the surface (a hand-held crank reel or downrigger may be used) making sure not to allow the cord to touch the ground.

15.4.54 Fill the bottles for the required volatile samples by carefully pouring the contents of the bailer down the inside of the sample bottle. Minimize agitation to the sample as much as possible. Collect samples in the following order:

Volatile organic compounds (VOA)
Total organic carbon (TOC)
Total organic halides (TOX)
Additional organic compounds (AOC)
Phenols

NOTE: If required, dispose of the unused bailed portion of water into the proper containment vessel. To prevent spillage of bailer contents onto the ground surface, fill sample bottles in a plastic tray (non-leaking) and discard the tray's contents into the containment vessel.

15.4.55 Collect all volatile samples with zero headspace in the sample bottle. Check for air bubbles by inverting the bottle and tapping gently.

15.4.56 If the nonvolatile portion of the sample set could not be collected with the Bennett pump, collect samples using bailer in sequence as in Step 15.4.22.

NOTE: The bailed sample for filtered metals will have to be filtered and preserved at the lab. Label the sample bottle accordingly.

15.4.57 Pack all samples in the cooler with ice and the trip blank.

15.4.58 Dispose of the nylon cord, and return all sampling equipment to the vehicle.

15.4.59 Replace the well cap on the casing, and secure with lock.

15.4.60 Sign the field data sheet (both sampling personnel), and enter departure time. Note any required maintenance items in the comments section of the field data sheet, and complete a well maintenance request form, if applicable. Submit maintenance request form to customer or supervision.

15.5 Three Well Volume Removal—Purging and Sampling Using a Dedicated Bladder Pump (ESP-302-5)

NOTE: Refer to GWMS for the purge and sample methodology to be used at each individual well.

NOTE: A groundwater well must be purged a minimum of three well volumes before the collection of representative groundwater samples from the surrounding geological formation. Intermittent field measurements are collected throughout the purge cycle.

15.5.1 Purging

15.5.1.1 Connect air lines from the compression source to the Well Wizard™ bladder pump as follows:

15.5.1.1.1 Connect the air line from the compression source to the "Inlet" nipple on the Well Wizard™ controller box.

15.5.1.1.2 Connect an air line from the "Outlet" on the controller box to the corresponding nipple on the well cap.

15.5.1.1.3 Attach discharge tubing with an elbow fitting to protruding discharge tubing on the well cap. If required, connect discharge line to the appropriate containment vessel.

15.5.1.2 Calculate the "Purge Volume" on the field data sheet. Record the value on the field data sheet.

15.5.1.3 Start the air flow to the Well Wizard™ controller box.

NOTE: If known. use previous settings to achieve the same purge rate.

15.5.1.4 Set the controller box's discharge and refill cycles based on total depth of the well and the DTW. Refer to manufacturer's instructions printed on the controller.

15.5.1.5 Increase the throttle on the controller box to maximize flow rate from the pump (bladder pumps have a flow rate no greater than 1 gpm).

15.5.1.6 Determine the flow rate of the pump as in Step 15.4.10.

15.5.1.7 Calculate the purge time as in Steps 15.4.11 and 15.4.12. Record on field data sheet.

15.5.1.8 Collect intermittent field measurements (see Refs. 2.4 through 2.8) at the calculated time intervals. Record field measurements on field data sheet.

15.5.1.9 Purge the well the required three well volumes. Record the "Purge Stop" time on the field data sheet. The well is ready to sample when three well volumes have been removed from the well casing or the well purges dry.

NOTE: If well purges dry before the removal of three well volumes, follow Steps in 15.4.16 through 15.4.19.

NOTE: Reduced flow rates decrease the agitation of the well's water. Recommended flow rate is <300 mL/min.

15.5.1.10 When purging is complete, cut the flow rate on the pump down as low as possible.

15.5.1.11 Collect samples in the following sequence (collect all volatile samples using precautions described in Steps 15.4.54 and 15.4.55):

VOA
TOC
TOX
AOC
Phenols
Turbidity, pH, conductivity
Anions
Carbonate/Bicarbonate
Total coliform bacteria
Total suspended solids

Total dissolved solids
Total metals
Filtered metals
Radiochemistry samples
  Gross alpha, gross beta activity
  Isotopic uranium (^{234}U, ^{238}U, ^{235}U)
  ^{129}I, ^{241}Am, ^{238}Pu, ^{237}Np
  Tritium, total strontium, ^{99}Tc
  Total radium
  Gamma spectrum
Total petroleum hydrocarbons
COD
Cyanide
Ammonia nitrogen
Base-neutral-acid extractable

NOTE: Collect duplicate samples concurrently (e.g., collect both total metal samples—original and duplicate—at the same time).

15.5.1.12 If required, collect a duplicate sample.

15.5.1.13 If insufficient water is present to collect all samples at one time, record the sample type and collection time for each recovery period on the field data sheet.

15.5.1.14 Ensure that all samples are labeled properly as in Step 15.4.25.

15.5.1.15 Collect the sample for filtered metals through an in-line 0.45-μm filter.

15.5.1.16 Add the appropriate preservative to the samples as listed in the current approved SAP and Bottle List.

NOTE: The pH should be <2 for samples requiring the addition of an acid. The pH should be >12 for samples requiring the addition of a base.

NOTE: Do not insert the pH paper into the sample.

15.5.1.17 Verify the pH of the preserved samples (except for preserved volatile samples) by pouring a small amount of sample over narrow-range pH paper, or use a calibrated pH meter. Document the pH adjustment on the field data sheet.

15.5.1.18 Wash the outside of the sample bottles with ASTM Type II water before packing samples in the cooler with ice.

15.5.1.19 Pack all samples in cooler with ice along with the trip blank.

15.5.1.20 If specified on the GWMS, collect a field blank as described in Step 15.4.30.

15.5.1.21 Clean up around well site, and return all sampling equipment to the vehicle.

15.5.1.22 Replace well cap or covering on well casing, and secure with lock.

15.5.1.23 Sign the field data sheet (both sampling personnel), and enter departure time. Note any required maintenance items on a well maintenance request form, if applicable, and submit to customer or supervision.

15.6 Low Flow Minimal Drawdown Sampling—Purging and Sampling Using a Dedicated Bladder Pump

NOTE: Refer to the GWMS for the purge and sample method to be used at each individual well.

NOTE: Low flow minimal drawdown sampling requires the well to be purged and sampled at low flow rates with a minimal drawdown of the well water level. Minimal drawdown of the water level prevents mixing of the stagnant water column with groundwater within the well's monitored interval. The end point of purging is determined when drawdown is in a steady state and field parameters have stabilized.

15.6.1 Purging

15.6.1.1 Connect air lines from the compression source to the Well Wizard™ bladder pump as in Steps 15.5.1.1.1 through 15.5.1.1.3.

NOTE: If using the in-line water analyzer, follow manufacturer's instructions for setup, calibration, and operation. Use a separate line for sampling separated from the water passing through the unit.

15.6.1.2 Insert the water level indicator into the well. Follow Steps 15.3.2 through 15.3.9, and record the "Depth to Water" on the field data sheet.

15.6.1.3 Leave the water level indicator in the well to monitor the drawdown of the well water throughout the purge cycle.

15.6.1.4 Set the controller box discharge and refill cycles based on total depth of the well and the DTW.

15.6.1.5 Start air flow to the pump at the lowest possible flow rate. Record the start time on the field data sheet.

NOTE: The optimal flow rate of the pump should be between 200 and 300 mL/min, and should not exceed 300 mL/min.

15.6.1.6 Use the throttle on the controller box to control the pump flow rate.

15.6.1.7 Determine the flow rate of the pump by following Step 15.4.10.

NOTE: Use 2-min increments if less than 5 ft of water is present in the well.

15.6.1.8 Once a consistent flow rate has been achieved, begin monitoring and recording the DTW in the well at 5-min intervals with the water level indicator.

15.6.1.9 Collect a sample for the initial field determinations as in Step 15.4.9.

15.6.1.10 When the drawdown in the well has stabilized to <0.05 ft to 0.10 ft over a 15-min interval, the well is considered to be in steady state drawdown.

15.6.1.11 Start collecting and recording field readings (see Refs. 2.4 through 2.8) in 5-min increments on the field data sheet.

NOTE: Contact customer if the following conditions are not reasonably achievable for a well.

15.6.1.12 Continue collecting and recording field readings until the readings have stabilized over three 5-min intervals as follows:

pH readings stable within ±0.1 pH unit

Temperature readings stable within ±1.0°C

Specific conductance readings stable within ±10%

Redox readings stable within ±10 mV

Dissolved oxygen readings stable within ±10%

15.6.1.13 The well is considered ready to sample when the following two conditions have been met:

(1) Water levels are stable.

(2) All field readings have stabilized.

15.6.1.14 Record the "Purge Stop" time and the estimated purged volume of water on the Field data sheet.

15.6.2 Sampling

15.6.2.1 Collect and record the final field readings and water level measurement on the Field data sheet.

NOTE: Collect VOA samples with minimal agitation. Hold discharge tubing in a near vertical position such that the water does not cascade down the tubing.

15.6.2.2 Collect the samples in the order indicated in Step 15.5.1.11, with the exception of filtered metals, which should be collected last in sequence.

15.6.2.3 If required, collect a duplicate sample concurrently.

15.6.2.4 If insufficient water is present to collect all samples at one time, record the sample type and collection time for each recovery period on the field data sheet.

15.6.2.5 Ensure that all sample bottles are labeled properly according to Step 15.4.25.

NOTE: Pump pressure may have to be increased when using in-line filters, and this may affect flow rates.

15.6.2.6 Collect the sample for filtered metals through an in-line 0.45-μm filter.

15.6.2.7 Add the appropriate preservative to the samples listed in the most current approved SAP and Bottle List.

NOTE: Do not insert pH paper into the sample.

15.6.2.8 Verify the pH of the preserved samples according to Step 15.5.1.17.

15.6.2.9 Wash the outside of each sample bottle with ASTM Type II water before packing samples in cooler with ice.

15.6.2.10 Remove water level indicator from the well and clean as in Steps 15.3.11 through 15.3.12. Replace well cap or covering on well casing, and secure with lock.

15.6.2.11 Pack all samples in cooler with ice along with the trip blank.

15.6.2.12 If specified on the GWMS, collect field blank as described in Step 15.4.30.

15.6.2.13 Clean up around well site, and return all sampling equipment to the vehicle.

15.6.2.14 Sign the field data sheet (both sampling personnel), and enter departure time. Note any required maintenance items on a well maintenance request form and submit to customer, if needed.

15.7 Equipment Decontamination

15.7.1 As indicated on the GWMS, when all wells in a well grouping have been completed, return all nondedicated sampling equipment to the laboratory to be decontaminated.

15.7.2 Decontaminate the non-dedicated pumps as follows:

15.7.2.1 Steam clean the exterior of the pumphead and entire tubing bundle according to Ref. 2.13.

15.7.2.2 Bring the pump into the laboratory to perform the internal rinse.

NOTE: To minimize waste of 10% nitric acid solution, use ≈0.7 gal of solution for the 125-ft pump; ≈1.4 gal for the 250-ft pump; and ≈2.8 gal for the 500-ft pump.

15.7.2.3 Run a rinse solution consisting of 10% nitric acid and ASTM Type II water. Make sure entire tubing bundle is filled with the solution.

15.7.2.4 Neutralize and dispose of the nitric acid solution according to Ref. 2.14.

15.7.2.5 Run a sufficient tap water rinse through the pump to completely remove all of the nitric acid solution and any other residue within the tubing bundle. Check the pH of the tap rinse to ensure the solution is neutral. Neutralize if necessary.

15.7.2.6 Pump at least two tubing bundles of ASTM Type II water through the pump.

15.7.2.7 Ensure pump head is clean. Wash with nonphosphate soap and rinse, if necessary.

15.7.2.8 Wipe down pump head with a paper towel, and wrap in aluminum foil for laboratory to field transport. Store pump in an area free of possible external contamination.

15.7.3 Decontaminate the bailers as follows:

15.7.3.1 Disassemble and wash the exterior and interior parts with nonphosphate soap solution and warm water. Allow time for parts to soak for easier cleaning.

15.7.3.2 Rinse with ASTM Type II water.

15.7.3.3 Rinse with reagent-grade isopropyl alcohol, taking care to contain any spillage in a containment tray or sink. Allow parts to air dry in hood.

15.7.3.4 Conduct a final rinse with Type II water, and allow to air dry in hood.

15.7.3.5 When completely dry, reassemble the parts and wrap in aluminum foil for laboratory to field transport and storage.

16.0 CALCULATION/INTERPRETATION OF RESULTS

The volume of water in a well casing is calculated using the formulas listed in Step 15.3.15.

17.0 REPORT

17.1 All field activities are recorded by field sampling technicians on a field data sheet. A field data sheet is completed for each well sampling event and contains the following information:

Well identification number.
Calibration logbook number.
Date and time of sample collection.
Well-specific information and volume calculations.
Field measurements of pH, specific conductance, redox, dissolved oxygen, and temperature.
Signatures of all field sampling personnel.
Assigned lab sample identification number.
Chain-of-custody record of all samples collected.
Record of field comments and off-normal occurrences encountered at well site.

17.2 Field data sheets are reviewed and signed off by the SESD supervisor. The field data sheets are numbered and permanently bound into logbooks for permanent record storage.

18.0 PRECISION AND BIAS

Not applicable.

19.0 QUALITY ASSURANCE/QUALITY CONTROL

19.1 The well sampling frequency, the required analyses, and the well location will be listed in the current Sampling and Analysis Plan.

19.2 The quality assurance and quality control measures described in Ref. 2.1 apply to this procedure.

20.0 APPENDIXES

Not applicable.

End of document

APPENDIX A-13
Permit Attachment 7 — Y-12 Plant Groundwater Protection Program Well Plugging and Abandonment Procedure

Oak Ridge Y-12 Plant
Groundwater Protection Program
Standard Practice Procedure

Monitoring Well Plugging and Abandonment Procedure

G-003
Rev. 2., May 1997

Approved by: W. Kevin Sago Date: 4-28-97

Effective Date: 5-1-97

Record of Changes

Change No.	Affected Pages	Approved Date	Expiration Date	Change No.	Affected Pages	Approved Date	Expiration Date

Next 3-year review required no later than: May 2000

CONTENTS

1.0 PURPOSE

This procedure contains guidelines and methods for monitoring well plugging and abandonment (P&A) at the Oak Ridge Y-12 Plant. Wells of similar construction materials and design are classified into one of four groups, and a specific P&A method is defined for each group. The methods are designed to remove all well components, seal the borehole to prevent fluid migration into or between water-bearing zones, and to minimize the amount of waste-materials generated during P&A operations.

2.0 APPLICABILITY

This procedure applies to all monitoring wells at the Y-12 Plant, which are designated for P&A by the Y-12 Plant Groundwater Protection Program Manager (GWPPM) or authorized designee.

3.0 DEFINITIONS

Annular Seal - material (grout or cement) which prevents fluid migration through the space between the well casing and borehole wall or outer casing.

Conductor Casing - an initial casing, typically steel or PVC, installed in the unconsolidated zone to support the borehole and provide drilling rig stability. This casing may be removed during completion of the monitoring well or grouted in place.

Containment System - excavated pit, drums, tanks or other containers used to collect and contain drill cuttings and fluids generated during P&A.

Diverter Assembly - apparatus used to direct drill cuttings and fluids to the containment system.

Groundwater Protection Program (GWPP) - a program developed per DOE Order 5400.1 to characterize the hydrogeology and monitor and protect groundwater quality at the Y-12 Plant.

GWPP Manager (GWPPM) - person responsible for day-to-day management of the Y-12 Plant GWPP.

On-Site Geologist - a geologist or professional geologist, registered in the State of Tennessee, responsible for field supervision of P&A operations.

Open-Hole Interval - a portion of a monitoring well designed so that groundwater enters the well

through a segment of borehole that is open to the water-bearing formation.

Primary Inspection Item - those components of a monitoring well that are critical to the collection of representative groundwater quality samples and hydrologic information. Primary inspection items include the well casing and screen, annular grout seal, hasp, lock, cap, well identification, and condition of the screened or open-hole interval.

Protective Surface Casing - a section of large-diameter steel or polyvinyl chloride (PVC) pipe that is emplaced over the surface extension of a smaller diameter well casing to provide structural protection to the well and restrict unauthorized access to the well.

Surface Casing - steel or PVC piping set from the ground surface into the top of bedrock to support the unconsolidated section of the borehole. The surface casing in a core hole extends into bedrock to the top of the open-hole interval.

Tremie Method - a method for placing cement in the borehole. Cement is pumped through a small diameter pipe (usually 2-in or less) extending to at least 1-ft above the bottom of the borehole or the top of a previously placed annular seal. The pipe is raised as the cement is emplaced. Use of this method reduces the potential for the cement to bridge and ensures placement of cement along the entire length of the borehole.

Washover Pipe - a drill pipe which fits over the well casing and is used to drill out the annular grout seal.

Well Casing - steel, stainless steel or PVC piping which provides unobstructed access to the monitored interval.

4.0 REFERENCES

4.1 Use References

4.1.1 "Environmental Surveillance Quality Control Program," ES/ESH/INT-14, Martin Marietta Energy Systems, Inc. 1988.

4.1.2 "Monitoring Well Inspection and Maintenance Plan, Y-12 Plant, Oak Ridge, Tennessee (Revised)," Y/TS-1215, Lockheed Martin Energy Systems, Inc. 1996.

4.1.3 "Halliburton Cementing Tables," Little's, Duncan, Oklahoma, Halliburton Services, Inc., 1981.

4.1.4 "Updated Subsurface Data Base for Bear Creek Valley, Chestnut Ridge, and Parts of Bethel Valley on the U.S. Department of Energy Oak Ridge Reservation," Y/TS-881/R3, July 1995 (or most recent revision).

4.2 Source References

4.2.1 Aller, Linda, Truman W. Bennett, Gene Hackett, Rebecca J. Petty, Jay H. Lehr, Helen Sedoris, and David M. Nielsen. Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells, National Water Well Association, Dublin, Ohio, 398 p.

4.2.2 Driscoll, Fletcher G. 1986. Groundwater and Wells, Johnson Division, St. Paul, Minnesota, 1089 p.

4.2.3 Martin Marietta Energy Systems, Inc. 1987. Plugging and Abandonment Procedures for the Oak Ridge Y-12 Plant, Y/TS-531.

4.2.4 "Oak Ridge Y-12 Plant Groundwater Protection Program Management Plan (Revised)," Y/SUB/96-KDS15V/1, June 1996 (or most recent revision).

5.0 PRECAUTIONS AND LIMITATIONS

5.1 Cavities and Fractures

Cavities, fractures, joints, bedding planes, or other voids may be encountered during removal of the well casing and reaming of the borehole, resulting in a greater volume of cement to plug the borehole than calculated from the borehole depth and diameter. Additionally, lost-circulation additives may be required to minimize fluid loss during P&A operations.

5.2 Method Selection

Because of differences in monitoring well construction and conditions that may occur during drilling operations, not all of the monitoring wells at the Y-12 Plant can be classified into one of the four categories of well construction. A flexible policy is necessary to determine the most appropriate P&A method for each monitoring well and to allow some deviation from the specified method as conditions warrant.

5.3 Safety

Established general safety standards and requirements of Lockheed Martin Energy Systems, Inc., the Department of Energy (DOE), and the Occupational Safety and Health Administration (OSHA) will apply to all P&A field operations. Specific safety requirements applicable to P&A are outlined in *Health and Safety Plan for Well Installation and Plugging and Abandonment Activities, Y-12 Plant, Oak Ridge, Tennessee*, Y/SUB/92-99928C(Y11)/1, July 1992.

5.4 Cement Slurry Weights and Curing Schedules

The length of the column of cement emplaced at one time should not exceed 300 ft so that the weight of the cement is less than the fracture pressure of the monitored formation. This will also minimize infiltration of cement into the formation. Cement cure times shall be determined by the on-site geologist. Cure times will be specified depending on temperature and required compressive strength using guidelines established in Reference 4.1.3.

5.5 Casing Extraction

Certain monitoring wells have been constructed using substandard annular seals or no annular seal. In such cases, casings may be extracted without use of overwashing techniques. In cases where the construction of the well allows, an attempt to extract the well casing may be made using the drilling rig head and appropriate lifting device, such as lifting bell, clevis, wire rope, or chain. Casing extraction jacks may alternately be used. Drilling rig leveling jacks or winches shall not be used to attempt to extract casings prior to overwashing. The decision to attempt to extract a well casing shall be made by the on-site geologist, in conjunction with the GWPPM or authorized designee, and documented as specified in Section 7.0.

5.6 Monitoring Well Construction Information

Data contained in Reference 4.1.4 is compiled from best available records. However, erroneous and missing construction data exists, particularly for older wells that pre-date the GW Series. Where monitoring well construction data is unavailable, best technical judgment as to casing set points or monitoring well depths will be employed by the on-site geologist in consultation with the GWPPM or authorized designee. As a result, deviations from the standard P&A likely will be required. All deviations shall be recorded as outlined in Section 9.0.

5.7 Setting Cement Plugs

Grout column height within a borehole is not a critical concern so long as potential cross-migration of groundwater is eliminated. A 4-ft depth for a completed plug is a standard target depth. Depths more or less than 4-ft may be technically justified and/or economically feasible.

6.0 EQUIPMENT, TOOLS AND SUPPLIES

6.1 Drilling Equipment

Drilling equipment includes, but is not limited to, drill bits, washover pipe, diverter assembly, etc.

6.2 Grouting Supplies and Equipment

Required items include, but are not limited to, cement, additives, potable water, mixer, pump, and tremie pipe.

6.3 Containment System

As directed by the Waste Management Plan, pits, drums, tanks, and/or other containers may be required.

6.4 Safety Equipment

Standard safety equipment is denoted in a site-specific health and safety checklist and includes, but is not limited to, safety shoes, company work clothes or tyvek coveralls, protective eye-wear, hard hat, and rubber gloves.

6.5 Decontamination Equipment

Includes steam cleaner, potable water, and mild detergent.

7.0 DOCUMENTATION

7.1 Well Plugging and Abandonment Request Form

This form is used to initiate P&A activities, and is completed by the Y-12 Plant GWPPM or authorized designee if: (1) a monitoring well impedes site operations, construction or closure, (2) inspection of a monitoring well has indicated significant damage to or deterioration of a Primary Inspection Item, or (3) the Y-12 Plant GWPPM or authorized designee determines that P&A of a monitoring well is warranted for other reasons. The completed form is transmitted to the on-site geologist when P&A operations are scheduled.

7.2 Well Plugging and Abandonment Waste Management Plan

This form is completed by the Y-12 Plant GWPPM or authorized designee. The plan includes: (1) the estimated volume of cuttings and fluids that will be generated during P&A, (2) the types and concentrations of contaminants (if any) known to be present in the monitoring well, (3) the appropriate waste containment method required during P&A operations (i.e., discharge to ground surface or containment system), (4) an estimate of the number and types of samples (e.g., cuttings) to be collected during P&A and the required analyses of the samples prior to disposal or treatment, and (5) the proposed disposition or treatment of any containerized materials.

7.3 Well Plugging and Abandonment Diagram

This form is completed by the Y-12 Plant GWPP Manager or authorized designee, and the on-site geologist. Before P&A operations begin, the Y-12 Plant GWPP Manager or authorized designee completes the following sections of the diagram: (1) the monitoring well location (site), (2) the drilling subcontractor, (3) the rationale for P&A of the monitoring well, (4) the P&A method (including any proposed deviations from the specified method), and (5) applicable monitoring well construction details (e.g., borehole diameter). During P&A operations, the on-site geologist completes the diagram with specific P&A details for the monitoring well (e.g., depth to the top of the cement plug).

7.4 Well Plugging and Abandonment Activity/Progress Report

This report is completed by the on-site geologist and includes descriptions of the daily activities performed during P&A operations.

8.0 PLUGGING AND ABANDONMENT

8.1 Site Preparation

8.1.1 Confirm the monitoring well identification and site access, and mobilize drilling and grouting equipment to the work site.

8.1.2 Remove the surface components of the monitoring well (lock, well cap, guard posts, surficial concrete pad, protective well casing or manhole cover) as applicable.

8.1.3 If specified in the Well Plugging and Abandonment Waste Management Plan, set up the diverter assembly and the containment system.

8.2 Equipment Decontamination

If specified in the Well Plugging and Abandonment Waste Management Plan, decontaminate the drilling and associated equipment (e.g., drill bits, drill rods, tremie pipe) when P&A operations at each monitoring well have been completed.

8.3 Method A

Method A is for monitoring wells constructed of 7 inch (in) outside diameter (OD) or smaller steel or stainless steel well casing, and typically completed with 5 to 20-ft well screens and sand filter packs. Monitoring wells completed in bedrock may also have 8- to 12-in-OD steel or PVC surface casing extending from ground surface to the top of bedrock. Some monitoring wells may also be completed with a conductor casing.

8.3.1 Remove the Well Casing

Drill out the annular grout seal using a washover pipe advanced to the bottom of the borehole. Retrieve the washover pipe and remove the well casing. Staged removal of the casing string may be necessary if it cannot be removed in one operation. Stainless steel casing may be drilled out (milled) with a tri-cone drill bit and the borehole conditioned simultaneously. If this approach is feasible, the bit size must be at least 0.25-in larger than the original borehole diameter to ensure that the casing and annular grout seal are completely removed.

8.3.2 Condition the Borehole

If the monitoring well was completed in bedrock, ream the borehole to the total depth with a tri-cone drill bit that is at least 0.25-in larger in diameter than the original borehole. This will expose fresh bedrock and help ensure an effective bond between the cement plug and the borehole wall. Monitoring wells completed within the unconsolidated zone do not require borehole conditioning.

8.3.3 Set the Plug

Tremie API Class A neat cement, mixed with potable water to a slurry density of 12 to 15 pounds per gallon (lbs/gal), from the bottom of the borehole. If no surface/conductor casing is present, tremie the cement to within approximately 4 ft of ground surface. If a surface/conductor casing is present, tremie the cement to the bottom of the casing.

8.3.4 Remove the Surface/Conductor Casing

If the monitoring well was completed with surface/conductor casing, drill out the annular grout seal using a washover pipe advanced to the bottom of the casing. Retrieve the washover pipe and remove the casing. Using a tri-cone drill bit at least 0.25-in larger in diameter than that of the original borehole, ream the borehole to the top of the existing cement plug. Tremie cement, mixed to a density of 12 to 15 lbs/gal, from the top of the existing plug to within approximately 4 ft of the ground surface (or to the bottom of the conductor casing, if removing a surface casing).

It may be possible to remove PVC surface/conductor casing by milling with a tri-cone drill bit. If this approach is feasible, the bit size must be at least 0.25-in larger than the original borehole diameter to ensure that the casing and annular grout seal are completely removed.

8.3.5 Verify Plug Depth

Measure the depth to the top of the cement plug to verify that it is within approximately 4 ft of the ground surface. If not, add more cement until the specified depth is reached.

8.3.6 Cap the Plug

Fill the remainder of the borehole to ground surface with compacted non-contaminated soil.

8.4 Method B

Method B is for monitoring wells constructed of 7-in-OD or smaller steel or PVC well casing completed with open-hole intervals in competent bedrock. The well casing typically extends from the ground surface to the top of the open-hole interval, which typically extends from 5 to 100 ft below the bottom of the well casing. The monitoring wells may also be completed with 8- to 12-in-OD steel or PVC surface casing extending from ground surface to the top of bedrock. Some monitoring wells may also be completed with a conductor casing.

8.4.1 Condition the Open-Hole Interval

Lower a drill string and tri-cone drill bit into the monitoring well to the bottom of the open-hole interval. Circulate air and potable water containing additives such as QUIK-GEL or QUICK-MUD to remove any old cuttings and debris that may have accumulated at the bottom of the well.

8.4.2 Set the Lower Plug

Tremie API Class A neat cement, mixed with potable water to a slurry density of 12 to 15 lbs/gal, from the bottom of the open-hole interval to the bottom of the well casing.

8.4.3 Remove the Well Casing

Drill out the annular grout seal surrounding the well casing using a washover pipe advanced to the top of the open-hole interval. Retrieve the washover pipe and remove the casing. Staged removal of the casing string may be necessary if it cannot be removed in one operation.

It may be possible to remove PVC well casing by milling with a tri-cone drill bit. If this approach is feasible, the bit size must be at least 0.25-in larger than the original borehole diameter to ensure that fresh bedrock is exposed and that the casing and annular grout seal are completely removed.

8.4.4 Condition the Borehole

Ream the borehole with a tri-cone drill bit that is at least 0.25-in larger in diameter than the original borehole. This will expose fresh bedrock and help ensure an effective bond between the cement plug and the borehole wall.

8.4.5 Set the Upper Plug

Tremie cement, mixed to a density of 12 to 15 lbs/gal, from the top of the lower plug. If no surface/conductor casing is present, tremie the cement to within approximately 4 ft of ground surface. If a surface/conductor casing is present, tremie the cement to the bottom of the casing.

8.4.6 Remove the Surface/Conductor Casing

If the monitoring well was completed with surface/conductor casing, drill out the annular grout seal using a washover pipe advanced to the bottom of the casing. Retrieve the washover pipe and remove the casing. Using a tri-cone drill bit at least 0.25-in larger in diameter than the original borehole, ream the borehole to the top of the existing cement plug. Tremie cement, mixed to a density of 12 to 15 lbs/gal, from the top of the existing plug to within approximately 4 ft of the ground surface (or bottom of the conductor casing, if removing a surface casing).

It may be possible to remove PVC surface/conductor casing by milling with a tri-cone drill bit. If this approach is feasible, the bit size must be at least 0.25-in larger than the original borehole diameter to ensure that the casing and annular grout seal are completely removed.

8.4.7 Verify Plug Depth

Measure the depth to the top of the cement plug to verify that it is within approximately 4 ft of the ground surface. If not, add more cement until the specified depth is reached.

8.4.8 Cap the Plug

Fill the remainder of the borehole to ground surface with compacted non-contaminated soil.

8.5 Method C

Method C is for monitoring wells constructed of 7-in-OD or smaller PVC well casing, and typically completed with 5 to 20-ft well screens and sand filter packs. Monitoring wells completed in bedrock may also have 8 to 12-in-OD steel or PVC surface casing extending from ground surface to the top of bedrock. Some monitoring wells may also be completed with a conductor casing.

8.5.1 Remove the Well Casing

Remove the PVC well casing and annular grout seal by milling with a tri-cone drill bit. The bit size must be at least 0.25-in larger than the original borehole diameter to ensure that fresh bedrock is exposed (bedrock wells only) and that the casing and annular grout seal are completely removed.

If milling is not feasible, drill out the annular grout seal around the well casing using a washover pipe advanced to the bottom of the borehole. Retrieve the washover pipe and remove the well casing. Staged removal of the casing string may be necessary if it cannot be removed in one operation.

8.5.2 Condition the Borehole

If the monitoring well was completed in bedrock and washover techniques were used, ream the borehole with a tri-cone drill bit that is at least 0.25-in larger in diameter than the original borehole. This will expose fresh bedrock and help ensure an effective bond between the cement plug and the borehole wall.

8.5.3 Set the Plug

Tremie API Class A neat cement, mixed with potable water to a slurry density of 12 to 15 lbs/gal, from the bottom of the borehole. If no surface/conductor casing is present, tremie the cement to within approximately 4 ft of ground surface. If a surface/conductor casing is present, tremie the cement to the bottom of the casing.

8.5.4 Remove the Surface/Conductor Casing

If the monitoring well was completed with surface/conductor casing, drill out the annular grout seal using a washover pipe advanced to the bottom of the casing. Retrieve the washover pipe and remove the casing. Using a tri-cone drill bit at least 0.25-in larger in diameter than the original borehole, ream the borehole to the top of the existing cement plug. Tremie cement, mixed to a density of 12 to 15 lbs/gal, from the top of the existing plug to within approximately 4 ft of the ground surface.

It may be possible to remove PVC casing by milling with a tri-cone drill bit. If this approach is feasible, the bit size must be at least 0.25-in larger than the original borehole diameter to ensure that the casing and annular grout seal are completely removed.

8.5.5 Verify Plug Depth

Measure the depth to the top of the cement plug to verify that it is within approximately 4 ft of the ground surface. If not, add more cement until the specified depth is reached.

8.5.6 Cap the Plug

Fill the remainder of the borehole from the top of the cement plug to ground surface with compacted non-contaminated soil.

8.6 Method D

Method D is for exploratory core holes constructed of 4.5-in-OD or smaller steel surface casing, which typically extends from ground surface into competent bedrock, with an open-hole interval below the bottom of the casing. The core holes may also have 8 to 12-in-OD steel or PVC conductor casing extending through the unconsolidated material.

8.6.1 Condition the Open-Hole Interval

The open-hole interval of the core holes will not be conditioned (i.e., fluid circulation or reamed to expose fresh bedrock). This would require the prior removal of the 4.5-in-OD surface casing, which may risk collapse of the upper portion of the core hole before P&A operations are completed. In addition, core hole diameters are normally 3.5-in. or less, which are smaller than standard tri-cone bits.

8.6.2 Set the Lower Plug

Tremie API Class A neat cement, mixed with potable water to give a slurry density of 12 to 15 lbs/gal, from the bottom of the open-hole portion of the core hole. Because of the long open hole intervals in typical core holes, the cement must be installed in stages of approximately 300 ft or less. During placement, tremie the cement from the bottom to the top of the particular interval being plugged, and allow the cement to cure according to cementing schedules. In the final stage, tremie the cement to the bottom of the surface casing.

8.6.3 Remove the Surface Casing

Drill out the annular grout seal around the surface casing using a washover pipe advanced to the bottom of the casing. Retrieve the washover pipe and remove

the casing. Staged removal of the casing may be necessary if it cannot be removed in one operation.

8.6.4 Condition the Borehole

Ream the borehole to the top of the existing cement plug using a tri-cone drill bit that is at least 0.25 larger than the original borehole diameter. This will expose fresh bedrock and help ensure an effective bond between the cement plug and the borehole wall.

8.6.5 Set the Upper Plug

Tremie cement, mixed to a density of 12 to 15 lbs/gal, from the top of the lower plug. If no conductor casing is present, tremie the cement to within approximately 4 ft of ground surface. If a conductor casing is present, tremie the cement to the bottom of the conductor casing.

8.6.6 Remove the Conductor Casing

If the core hole was completed with conductor casing, drill out the annular grout seal using a washover pipe advanced to the bottom of the conductor casing. Retrieve the washover pipe and remove the conductor casing. Using a tri-cone drill bit at least 0.25-in larger in diameter than the original borehole, ream the upper portion of the borehole to the top of the existing cement plug. Tremie cement, mixed to a density of 12 to 15 lbs/gal, from the top of the existing plug to within approximately 4 ft of the ground surface.

It may be possible to remove PVC conductor casing by milling with a tri-cone drill bit. If this approach is feasible, the bit size must be at least 0.25-in larger than the original borehole diameter to ensure that the casing and annular grout seal are completely removed.

8.6.7 Verify Plug Depth

Measure the depth to the top of the cement plug to verify that it is within approximately 4 ft of the ground surface. If not, add more cement until the specified depth is reached.

8.6.8 **Cap the Plug**

Fill the remainder of the borehole to the ground surface with compacted non-contaminated soil.

9.0 ACCEPTANCE CRITERIA

The on-site geologist will verify that P&A operations were performed in accordance with the specified method. Any deviations from the specified P&A method must be pre-approved by the Y-12 Plant GWPPM or authorized designee. Requests for deviations may be verbal, but must be recorded immediately in the field log book and include date, time, and authorizing personnel. Deviations will also be noted on Activity/Progress Forms and P&A Diagrams as appropriate.

10.0 POST PERFORMANCE WORK ACTIVITIES

10.1 The on-site geologist will submit the well P&A documentation to the Y-12 Plant GWPPM or authorized designee.

10.2 Waste materials generated during P&A will be disposed of in accordance with the Well Plugging and Abandonment Waste Management Plan.

11.0 RECORDS

The documentation listed in items 11.1 through 11.4 below will be included in the annual well plugging and abandonment report and become part of the administrative record for the Y-12 Plant GWPP.

11.1 Well Plugging and Abandonment Request Form

11.2 Well Plugging and Abandonment Waste Management Plan

11.3 Well Plugging and Abandonment Diagram

11.4 Well Plugging and Abandonment Activity/Progress Report

11.5 Daily Log

A daily log of field P&A activities shall be maintained. This log will be placed in the administrative record of the Y-12 Plant GWPP.