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**OAK RIDGE
Y-12
PLANT**

LOCKHEED MARTIN

**FISCAL YEAR 1998 WELL INSTALLATION,
PLUGGING AND ABANDONMENT, AND
REDEVELOPMENT SUMMARY REPORT
Y-12 PLANT, OAK RIDGE, TENNESSEE**

December 1998

Prepared by

**Science Applications International Corporation
P.O. Box 2501
800 Oak Ridge Turnpike
Oak Ridge, Tennessee 37830**

Under Purchase Order 22B-EBF49V

for the

**Environmental Compliance Department
Environment, Safety, and Health Organization
Oak Ridge Y-12 Plant
Oak Ridge, Tennessee**

Managed by

**Lockheed Martin Energy Systems, Inc.
for the
U.S. Department of Energy
Under Contract Number DE-AC05-84OR21400**

**MANAGED BY
LOCKHEED MARTIN ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY**

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SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

contributed to the preparation of this document and should not
be considered an eligible contractor for its review.

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ABBREVIATIONS

API	American Petroleum Institute
Bechtel Jacobs	Bechtel Jacobs Company LLC
bgs	below ground surface
CFR	Code of Federal Regulations
CPR	cardiopulmonary resuscitation
EPA	U.S. Environmental Protection Agency
ES&H	Environment, Safety, and Health Organization
Energy Systems	Lockheed Martin Energy Systems, Inc.
ER	Environmental Restoration (Program)
ft	feet
FY	fiscal year
FID	flame ionization detector
GWPP	Groundwater Protection Program
Highland	Highland Drilling Company, Inc.
ID	inside diameter
in.	inch
OD	outside diameter
ORR	Oak Ridge Reservation
ORNL	Oak Ridge National Laboratory
OVA	organic vapor analyzer
P&A	plugging and abandonment
PID	photoionization detector
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
SAIC	Science Applications International Corporation
TD	total depth
UEFPC	Upper East Fork Poplar Creek
VOC	volatile organic compound

EXECUTIVE SUMMARY

This report summarizes the well installation, plugging and abandonment, and redevelopment activities conducted during the federal fiscal year (FY) 1998 at the Y-12 Plant, Oak Ridge, Tennessee.

Five new groundwater monitoring wells were installed at the Y-12 Plant under the FY 1998 drilling program. Two of the wells are located in west Bear Creek Valley, one is in the eastern Y-12 Plant area near Lake Reality, and two are located near the Oil Landfarm Waste Management Area, which were installed by Bechtel Jacobs Company LLC (Bechtel Jacobs) as part of a site characterization activity for the Oak Ridge Reservation (ORR) Disposal Cell. Also, two existing wells were upgraded and nine temporary piezometers were installed to characterize hydrogeologic conditions at the Disposal Cell site. In addition, 40 temporary piezometers were installed in the Boneyard/Burnyard area of Bear Creek Valley by Bechtel Jacobs as part of the accelerated remedial actions conducted by the Environmental Restoration Program. Ten monitoring wells at the Y-12 Plant were decommissioned in FY 1998.

Two existing monitoring wells were redeveloped during FY 1998 (of these, GW-732 was redeveloped twice).

All well installation and development (including redevelopment) was conducted following industry-standard methods and approved procedures from the *Environmental Surveillance Procedures Quality Control Program* (Energy Systems 1988); the *Resource Conservation and Recovery Act (RCRA) Groundwater Monitoring Technical Enforcement Guidance Document* (EPA 1992); and the *Monitoring Well Installation Plan for the Department of Energy Y-12 Plant, Oak Ridge, Tennessee* (Energy Systems 1997a). Well installation and development of the non-Y-12 Plant GWPP oversight installation projects were conducted using procedures/guidance defined in the following documents: *Work Plan for Support to Upper East Fork Poplar Creek East End Volatile Organic Compound Plumes Well Installation Project, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (SAIC 1998a); *Sampling and Analysis Plan for the Oil Landfarm Soils Containment Pad* (SAIC 1998b); and *Work Plan for Phase III Predesign Site Characterization, Environmental Waste Management Facility, Oak Ridge, Tennessee* (Jacobs 1998a). Plugging and abandonment of all wells for which such action was taken were done in accordance with the *Monitoring Well Plugging and Abandonment Plan, Y-12 Plant, Oak Ridge, Tennessee (Revised)* (Energy Systems 1997b).

Health and safety monitoring and field screening of drilling returns and development waters were conducted in accordance with the *Health and Safety Plan for Well Installation and Plugging and Abandonment Activities, Y-12 Plant, Oak Ridge, Tennessee* (SAIC 1992), *Sampling and Analysis Plan for the Oil Landfarm Soils Containment Pad* (SAIC 1998b), *Work Plan for Phase III Predesign Site Characterization, Environmental Waste Management Facility, Oak Ridge, Tennessee* (Jacobs 1998a), and other applicable MK Ferguson health and safety documents (Project Hazard Analysis, Site-specific Activity Hazard Analysis).

1. INTRODUCTION

In January 1998, Science Applications International Corporation (SAIC) was authorized by Lockheed Martin Energy Systems, Inc. (Energy Systems) to provide hydrogeologic oversight for the Oak Ridge Y-12 Plant Groundwater Protection Program (GWPP) during the installation, plugging and abandonment (P&A), and redevelopment of groundwater monitoring wells from January 1, 1998, through September 30, 1998. As part of this effort, SAIC was tasked with supervising drilling activities, directing monitoring well construction and development, providing well-site health and safety monitoring, and providing technical oversight for the P&A of obsolete monitoring wells and for the redevelopment of existing monitoring wells.

This report presents a summary of the well installation, P&A, and development activities performed during FY 1998 by the Y-12 Plant GWPP, the Environmental Restoration (ER) Program, and Bechtel Jacobs. The report is organized in the following manner:

- general introduction and FY 1998 summaries of the Y-12 Plant installation, P&A, and redevelopment activities (Chap. 1);
- general geologic and hydrologic settings of the Y-12 Plant and vicinity (Chap. 2);
- discussion of Y-12 Plant well installations during FY 1998 (Chap. 3);
- discussion of well decommissioning (including P&A methods, grouting procedures, and waste management practices) during FY 1998 (Chap. 4);
- discussion of well redevelopments during FY 1998 (Chap. 5); and
- quality assurance/quality control and health and safety protocols used during the Y-12 Plant GWPP activities during FY 1998 (Chaps. 6 and 7).

Individual well installation reports, well P&A reports, and well rehabilitation/redevelopment reports are included in Appendixes A, B, and C, respectively. The Y-12 Plant GWPP drilling and development effluents waste management guidelines appear in Appendix D.

1.1 FISCAL YEAR 1998 WELL INSTALLATION SUMMARY

Five new monitoring wells were installed at the Y-12 Plant during FY 1998. Two of those wells, GW-902 and GW-915, were installed in the Gum Branch Road area in support of an Oak Ridge National Laboratory (ORNL) Environmental Management Science Program injection experiment using Y-12 Plant GWPP support oversight. A third well, GW-845, was located within the Upper East Fork Poplar Creek (UEFPC) Watershed and was installed as part of the East End Volatile Organic Compound (VOC) Plume Project under the ER Program (SAIC 1998c). In the vicinity of the Oil Landfarm Waste Management Area of Bear Creek Valley as part of the ORR Disposal Cell Characterization Project, two monitoring wells (GW-904 and GW-905) and nine temporary piezometers (GW-906 through GW-914) were installed. Additionally, two existing piezometers (GW-838 and GW-840) were upgraded to monitoring wells. A total of 40 temporary piezometers were also installed by Bechtel Jacobs in Bear Creek Valley, west of the Y-12 Plant, as part of the ER Program Boneyard/Burnyard accelerated remedial action project (SAIC 1998d).

1.2 FISCAL YEAR 1998 WELL PLUGGING AND ABANDONMENT SUMMARY

Ten groundwater monitoring wells at the Y-12 Plant were plugged and abandoned in FY 1998. Eight of the wells were located around Bldgs. 9204-2 and 9201-1. All of these wells had once been installed as part of the Y-12 Plant underground storage tank investigations. Of the other two wells decommissioned during FY 1998, one well was located at the Ravine Disposal site, and the other in the Gum Branch Road area of west Bear Creek Valley.

1.3 FISCAL YEAR 1998 WELL REDEVELOPMENT SUMMARY

Two wells, GW-731 and GW-732, at the Y-12 Plant were redeveloped (well GW-732 was redeveloped twice) in FY 1998. Redevelopment of the wells was necessary due to the suspected grout contamination of excessively turbid water obtained from these wells during sampling.

2. GENERAL GEOLOGY

2.1 LOCATION AND PHYSIOGRAPHY

The Y-12 Plant is located in Bear Creek Valley on the U.S. Department of Energy ORR, in the southwestern corner of Anderson County. The area of interest covered by this report includes Pine Ridge (which bounds Bear Creek Valley to the north), Bear Creek Valley, Chestnut Ridge (to the south of Bear Creek Valley), and parts of Bethel Valley.

The ORR, occupying an area of approximately 55 square miles, lies in a portion of the Tennessee section of the Valley and Ridge Physiographic Province (McMaster 1963). This province is characterized by narrow, elongated ridges and valleys trending northeast-southwest. Resistant sandstone, siltstone, and siliceous limestone and dolostone typically form the ridges; the valleys are commonly underlain by less resistant shale and soluble carbonates (Rodgers 1953). Elevations within the ORR range from about 900 feet (ft) to just over 1200 ft above mean sea level.

2.2 STRATIGRAPHY

Four major stratigraphic units, classified according to lithology, fossils, and age, underlie the Y-12 Plant vicinity. From oldest to youngest, these units are the Rome Formation, Conasauga Group, Knox Group, and Chickamauga Group. The formations located in and around Bear Creek Valley generally strike N47E to N67E. Regional dips range from 30° to 50° to the southeast (King and Haase 1987). Figures 2.1 and 2.2 represent a generalized geologic cross section and map, respectively, that illustrate the locations and stratigraphic relationships of the major stratigraphic groups and formations that occur in the Bear Creek Valley area.

The Rome Formation, which forms Pine Ridge, is of Lower Cambrian age and consists of interbedded sandstone, shale, and siltstone, with local beds of dolostone (McMaster 1963).

The Conasauga Group, of middle to late Cambrian age, has been subdivided into six formations of alternating, predominantly shale and limestone lithologies. The six formations, from oldest to youngest, are the Pumpkin Valley Shale, Rutledge Limestone, Rogersville Shale, Maryville Limestone, Nolichucky Shale, and Maynardville Limestone. Detailed lithologic descriptions of these formations are given in King and Haase (1987). Figure 2.3 shows the relative positions of the member formations of the Conasauga Group, in cross section, as they appear in Bear Creek Valley.

Chestnut Ridge, to the south of Bear Creek Valley, is underlain by siliceous dolostone of the Knox Group. This late Cambrian- to early Ordovician-age unit is divided into five formations that are, from oldest to youngest, the Copper Ridge Dolomite, Chepultepec Dolomite, Longview Dolomite, Kingsport Formation, and Mascot Dolomite. Detailed lithologic descriptions of the Knox Group formations are provided in Milici (1973).

The Chickamauga Group consists of Middle to Upper Ordovician units of mostly limestone composition with varying amounts of interlayered dolostone, conglomerate, chert, hematite-rich clastic red beds, shale, and siltstone. This group is subdivided in Bethel Valley, from oldest to youngest, into the following units: Blackford Formation, Eidson Member, Fleanor Shale Member

Source: McMaster 1963

Fig. 2.1. Generalized geologic cross-section through the Y-12 Plant and vicinity.

Fig. 2.2. Geologic map of the Y-12 Plant and surrounding areas.

Fig. 2.3. Generalized geologic cross-section through the Y-12 Plant area.

(Lincolnshire Formation), Rockdell Formation, Benbolt/Wardell Formation, Bowen Formation, Witten Formation, and Moccasin Formation. Detailed lithologic descriptions of these formations are given in Hatcher et al. (1992).

All of the bedrock formations in Bear Creek Valley and the vicinity are overlain by unconsolidated deposits of fill, alluvium, colluvium, and in situ weathered bedrock (residium and saprolite). The thickness of unconsolidated deposits overlying the Conasauga and Chickamauga Groups (occupying valleys) ranged from approximately 1.0 ft to as much as 46.0 ft. Unconsolidated deposits overlying the Knox Group on Chestnut Ridge are considerably thicker (ranging from 6.0 to 150.0 ft) than those in the adjacent valleys.

Figure 2.4 is a generalized stratigraphic column of the major stratigraphic units and accepted subdivisions of the Y-12 Plant area bedrock formations.

2.3 HYDROLOGY

Three distinct hydrogeologic regimes exist [Bear Creek, Upper East Fork Poplar Creek (East Fork) and Chestnut Ridge] in the Y-12 Plant vicinity. Within Bear Creek Valley, the East Fork Regime encompasses the UEFPC watershed and shallow groundwater in most of the Y-12 Plant vicinity and to the east into Union Valley.

The Bear Creek Regime encompasses the Bear Creek Watershed and shallow groundwater west of the Y-12 Plant to Highway 95. Karst features and fractures within the Maynardville Limestone that underlie the streams provide the principal conduits for groundwater movement. Although the surface and shallow subsurface hydrology have been altered by construction and recontouring of the topography, the original drainage still plays an important role in the subsurface movement of water. Major components of groundwater flow include movement through unconsolidated weathered rock and fill under unconfined conditions and flow along bedding planes, fractures, and solution channels in the consolidated rock, generally under confined conditions (Kamp 1985). In Bear Creek Valley, recharge occurs predominantly by infiltrating precipitation through unconsolidated material downward to the underlying bedrock. Groundwater flow in bedrock is predominantly within solution cavities and fractures.

The Chestnut Ridge Regime contributes recharge to Bear Creek Valley through strike-normal groundwater flow to the UEFPC and Bear Creek Regimes (Geraghty & Miller 1990). Groundwater flow within this regime is also principally in fractures and cavities within consolidated bedrock or in the weathered bedrock zone under unconfined conditions. Groundwater flow in this regime is substantially influenced by topography of surface streams, with the principal flow directions both parallel and normal to strike. Groundwater discharges to surface streams and springs in Bear Creek Valley to the north and Bethel Valley to the south and, potentially, springs and surface streams along Scarboro Creek east of the Y-12 Plant.

Age	Group	Formation	Approximate Thickness (ft)		
			King and Haase 1987	Milici 1973	McMaster 1963
Middle & Upper Ordovician	Chickamauga	Undifferentiated	Not determined		1750
Lower Ordovician	Knox	Mascot Dolomite	Not determined	400-800	3000 (undivided)
		Kingsport Formation		200-320	
		Longview Dolomite		250-450	
		Chepultepec Dolomite		725-880	
		Copper Ridge Dolomite		900-1000	
Middle & Upper Cambrian	Conasauga	Maynardville Limestone	418-450		1500 (undivided)
		Nolichucky Shale	422-550		
		Maryville Limestone	346-445		
		Rogersville Shale	90-120		
		Rutledge Limestone	90-120		
		Pumpkin Valley Shale	260-320		
Lower Cambrian		Rome	Not determined		800+

Fig. 2.4. Stratigraphic units in the vicinity of the Y-12 Plant.

3. WELL INSTALLATIONS

The two wells, GW-902 and GW-915, installed by Law Engineering, Inc. in the Gum Branch Road area (Figs. 3.1 and 3.2) were of polyvinyl chloride (PVC)-screened construction. Well GW-845, installed by Highland Drilling Company, Inc. (Highland) near Lake Reality (Figs. 3.1 and 3.3), is an open-interval well using steel intermediate casing. The 40 Boneyard/Burnyard piezometers (Fig. 3.4) were installed by Highland and are of PVC-screened construction. The 13 ORR Disposal Cell wells (Figs. 3.1 and 3.5) were installed by the U.S. Corps of Engineers and are of PVC- and stainless steel-screened construction.

Table 3.1 presents a list of the wells and piezometers installed at the Y-12 Plant during FY 1998 and includes: the installing organization, the functional area in which the well/piezometer is located, location coordinates, and ground surface and top of casing elevations. Table 3.2 summarizes selected construction and lithologic information pertaining to the wells and piezometers installed at the Y-12 Plant during FY 1998.

3.1 WELL INSTALLATION METHODS

Screened wells and piezometers installed during FY 1998 targeted the water table or groundwater at shallow depths. The open-interval well was designed to span a specific interval of the Maynardville Limestone within the intermediate and deep flow systems (greater than 150 ft below ground surface [bgs]). The following sections present brief descriptions of the applicable standard well installation methods used at the Y-12 Plant.

3.1.1 Screened Wells in the Unconsolidated Zone

In general, the borehole is advanced to the target depth using either a tricone roller bit or auger. PVC or stainless steel screen and riser casing are installed in the borehole, ideally with the top of the screen at the level of the permanent groundwater table. If mud or cuttings remain in the well bore after final cleaning, approximately 1 ft of high-purity silica sand, on which to set the screen, is placed in the borehole. For wells GW-902 and GW-915, the screen and riser casing were inserted inside the augers, with the sand pack added as the augers were withdrawn from the borehole. Because of the shallow depths of unconsolidated zone wells, centralizers are normally not used. Figure 3.6 presents a schematic of a typical screened well installed in unconsolidated material.

A high-purity sand pack is placed around the screen to a level approximately 1 ft above the top of the screen. The sand pack level is monitored during installation by continuous sounding with a weighted tape. A bentonite pellet seal of 2 ft minimum thickness (if applicable) is placed on the sand and allowed to hydrate per manufacturer's recommendations prior to cementing (approximately 1 hour). The remaining annulus is cemented using a neat cement grout, usually in one stage, and allowed to cure for 24 hours.

Fig. 3.2. Gum Branch Road area.

Fig. 3.3. Monitoring well locations in the eastern Y-12 Plant area.

Fig. 3.4. Location of piezometers in the Boneyard/Burnyard area (SAIC, 1998d).

Fig. 3.5. ORR Disposal Cell area.

Table 3.1. FY 1998 monitoring well/piezometer location information

Well	Organization	Functional area	Y-12 Plant grid		Elevation	
			Northing coordinate	Easting coordinate	Ground	Top of casing
Monitoring wells						
GW-838	Bechtel Jacobs	Oil Landfarm	30395.55	46084.20	964.42	967.73
GW-840	Bechtel Jacobs	Oil Landfarm	31173.36	47090.25	1024.24	1027.63
GW-845	LMES-ER	Lake Reality	28600.91	64391.98	924.71	926.47
GW-902	GWPP	Gum Branch Road	29911.50 ^a	30756.05 ^a	870.30 ^a	872.60 ^a
GW-904	Bechtel Jacobs	Oil Landfarm	29783.61	45889.53	949.86	952.88
GW-905	Bechtel Jacobs	Oil Landfarm	30426.78	46121.23	970.11	973.59
GW-906	Bechtel Jacobs	Oil Landfarm	29899.14	46196.37	948.48	951.16
GW-907	Bechtel Jacobs	Oil Landfarm	30440.14	46374.36	992.98	995.30
GW-908	Bechtel Jacobs	Oil Landfarm	30573.70	46980.35	983.71	985.59
GW-909	Bechtel Jacobs	Oil Landfarm	30616.07	46458.08	991.21	993.40
GW-910	Bechtel Jacobs	Oil Landfarm	30783.27	47775.47	1008.51	1011.03
GW-911	Bechtel Jacobs	Oil Landfarm	30512.13	47799.85	1003.66	1006.23
GW-912	Bechtel Jacobs	Oil Landfarm	30277.36	48226.71	976.23	978.91
GW-913	Bechtel Jacobs	Oil Landfarm	29981.98	47922.83	973.42	973.15
GW-914	Bechtel Jacobs	Oil Landfarm	29782.68	47508.31	958.77	961.58
GW-915	GWPP	Gum Branch Road	29914.65 ^a	30702.20 ^a	862.50 ^a	865.90 ^a
Piezometers						
BY-10	Bechtel Jacobs	Boneyard/Burnyard	29707.25	48300.80	962.15	NM
BY-11	Bechtel Jacobs	Boneyard/Burnyard	29756.49	48303.76	964.02	NM
BY-12	Bechtel Jacobs	Boneyard/Burnyard	29805.80	48306.54	967.28	NM
BY-13	Bechtel Jacobs	Boneyard/Burnyard	29857.11	48308.15	965.99	NM
BY-14	Bechtel Jacobs	Boneyard/Burnyard	29908.12	48313.50	965.99	NM
BY-15	Bechtel Jacobs	Boneyard/Burnyard	29955.65	48314.30	967.74	NM
BY-16	Bechtel Jacobs	Boneyard/Burnyard	30005.65	48312.95	969.04	NM
BY-17	Bechtel Jacobs	Boneyard/Burnyard	29862.86	48215.43	963.71	NM
BY-18	Bechtel Jacobs	Boneyard/Burnyard	29859.30	48272.24	964.16	NM
BY-19	Bechtel Jacobs	Boneyard/Burnyard	29850.36	48358.34	966.90	NM
BY-20	Bechtel Jacobs	Boneyard/Burnyard	29848.80	48407.92	966.45	NM
BY-21	Bechtel Jacobs	Boneyard/Burnyard	29871.97	48502.49	965.36	NM
BY-22	Bechtel Jacobs	Boneyard/Burnyard	29778.67	48152.66	959.02	NM
BY-23	Bechtel Jacobs	Boneyard/Burnyard	29968.29	48241.63	964.93	NM
BY-24	Bechtel Jacobs	Boneyard/Burnyard	30137.39	48442.43	969.36	NM
BY-25	Bechtel Jacobs	Boneyard/Burnyard	29700.82	48415.39	969.32	NM
BY-26	Bechtel Jacobs	Boneyard/Burnyard	29739.70	48598.95	972.41	NM
BY-27	Bechtel Jacobs	Boneyard/Burnyard	29601.46	48431.25	967.21	NM
BY-28	Bechtel Jacobs	Boneyard/Burnyard	29643.73	48605.22	969.95	NM
BY-29	Bechtel Jacobs	Boneyard/Burnyard	29899.66	48407.27	966.71	NM
BY-30	Bechtel Jacobs	Boneyard/Burnyard	29954.12	48383.19	967.22	NM
BY-31	Bechtel Jacobs	Boneyard/Burnyard	29550.84	48187.38	954.55	NM
BY-32	Bechtel Jacobs	Boneyard/Burnyard	29551.37	48290.64	956.93	NM
BY-33	Bechtel Jacobs	Boneyard/Burnyard	29532.89	48406.54	964.92	NM
BY-34	Bechtel Jacobs	Boneyard/Burnyard	29542.13	48502.03	966.62	NM
BY-35	Bechtel Jacobs	Boneyard/Burnyard	29551.56	48600.94	966.21	NM
BY-36	Bechtel Jacobs	Boneyard/Burnyard	30284.73	48469.67	974.37	NM
BY-37	Bechtel Jacobs	Boneyard/Burnyard	30316.65	48549.35	977.12	NM
BY-38	Bechtel Jacobs	Boneyard/Burnyard	30393.17	48520.07	977.92	NM
BY-39	Bechtel Jacobs	Boneyard/Burnyard	30364.83	48466.59	976.38	NM

Table 3.1 (continued)

Well	Organization	Functional area	Y-12 Plant grid		Elevation	
			Northing coordinate	Easting coordinate	Ground	Top of casing
BY-40	Bechtel Jacobs	Boneyard/Burnyard	29429.03	48243.13	953.59	NM
BY-41	Bechtel Jacobs	Boneyard/Burnyard	29471.49	48364.80	957.93	NM
BY-43	Bechtel Jacobs	Boneyard/Burnyard	29990.75	48439.09	966.17	NM
BY-44	Bechtel Jacobs	Boneyard/Burnyard	29910.78	48447.63	966.13	NM
BY-45	Bechtel Jacobs	Boneyard/Burnyard	29775.52	48049.28	960.61	NM
BY-46	Bechtel Jacobs	Boneyard/Burnyard	29766.93	48239.62	961.94	NM
BY-47	Bechtel Jacobs	Boneyard/Burnyard	29684.92	48231.20	959.40	NM
BY-48	Bechtel Jacobs	Boneyard/Burnyard	29521.15	48237.59	955.87	NM
BY-49	Bechtel Jacobs	Boneyard/Burnyard	30048.83	48399.88	968.81	NM
BY-50	Bechtel Jacobs	Boneyard/Burnyard	29671.18	48502.17	969.80	NM

^a Estimated coordinates and elevations; no as-built survey performed.

GWPP = Groundwater Protection Program.

LMES-ER = Lockheed Martin Energy Systems-Environmental Restoration.

NM = Not measured.

Table 3.2. FY 1998 monitoring well/piezometer construction data summary

Well	Depth to bedrock		Construction material/type	Monitoring interval	Total depth (ft bgs) ^a	Collar/target formation
	Weathered/fresh (ft bgs)	Depth of surface casing (ft bgs)				
Monitoring wells						
GW-838	24.0/NA	NA	SS/Screened	16.0–26.0	30.0	Cm/Cm
GW-840	30.0/NA	NA	SS/Screened	19.0–29.0	30.0	Crt/Crt
GW-845	19.8/NA	4.2 ^b	Steel/Open-interval	167.0–438.3	438.3	Cmn/Cmn
GW-902	24.5/29.5	NA	PVC/Screened	22.5–31.6	31.8	Cm/Cm
GW-904	31.0/33.0	35.5	SS/Screened	273.5–293.5	300.0	Cnl/Cnl
GW-905	26.0/33.0	37.0	SS/Screened	41.0–51.0	71.0	Cm/Cm
GW-906 ^c	11.8/28.6	NA	PVC/Screened	17.5–27.5	28.6	Cnl/Cnl
GW-907	5.0/31.9	NA	PVC/Screened	21.9–31.9	31.9	Cm/Cm
GW-908	10.0/38.2	NA	PVC/Screened	25.0–35.0	38.2/48.2	Cm/Cm
GW-909	5.0/26.1	NA	PVC/Screened	16.1–26.1	26.1	Cm/Cm
GW-910	3.5/35.6	NA	PVC/Screened	25.5–35.5	35.6	Cm/Cm
GW-911	5.3/NA	NA	PVC/Screened	16.0–31.0	50.0/55.4	Cm/Cm
GW-912	5.0/31.8	NA	PVC/Screened	15.5–25.5	31.8/42.2	Cm/Cm
GW-913	NA/32.7	NA	PVC/Screened	22.1–32.1	32.7	Cnl/Cnl
GW-914	5.0/35.2	NA	PVC/Screened	20.0–30.0	35.2/45.2	Cnl/Cnl
GW-915	18.5/20.5	NA	PVC/Screened	16.5–21.2	21.2	Cm/Cm
Piezometers						
BY-10	NA	NA	PVC/Screened	9.0–14.0	14.0	Cnl/Cnl
BY-11	NA	NA	PVC/Screened	11.0–16.0	16.0	Cnl/Cnl
BY-12	NA	NA	PVC/Screened	13.0–18.0	18.0	Cnl/Cnl
BY-13	NA	NA	PVC/Screened	11.0–16.0	16.0	Cnl/Cnl
BY-14	NA	NA	PVC/Screened	10.0–15.0	15.0	Cnl/Cnl
BY-15	NA	NA	PVC/Screened	13.0–18.0	18.0	Cnl/Cnl

Table 3.2 (continued)

Well	Depth to bedrock		Construction material/type	Monitoring interval	Total depth (ft bgs) ^a	Collar/target formation
	Weathered/fresh (ft bgs)	Depth of surface casing (ft bgs)				
BY-16	NA	NA	PVC/Screened	12.0–17.0	17.0	Cnl/Cnl
BY-17	NA	NA	PVC/Screened	9.0–14.0	14.0	Cnl/Cnl
BY-18	NA	NA	PVC/Screened	11.0–16.0	16.0	Cnl/Cnl
BY-19	NA	NA	PVC/Screened	15.0–20.0	20.0	Cnl/Cnl
BY-20	NA	NA	PVC/Screened	12.0–17.0	17.0	Cnl/Cnl
BY-21	NA	NA	PVC/Screened	7.0–12.0	12.0	Cnl/Cnl
BY-22	NA	NA	PVC/Screened	7.0–12.0	12.0	Cnl/Cnl
BY-23	NA	NA	PVC/Screened	6.0–11.0	11.0	Cnl/Cnl
BY-24	NA	NA	PVC/Screened	10.0–15.0	15.0	Cnl/Cnl
BY-25	NA	NA	PVC/Screened	10.0–15.0	15.0	Cnl/Cnl
BY-26	NA	NA	PVC/Screened	10.5–15.5	15.5	Cnl/Cnl
BY-27	NA	NA	PVC/Screened	13.0–18.0	18.0	Cnl/Cnl
BY-28	NA	NA	PVC/Screened	13.0–18.0	18.0	Cnl/Cnl
BY-29	NA	NA	PVC/Screened	7.0–12.0	12.0	Cnl/Cnl
BY-30	NA	NA	PVC/Screened	11.0–16.0	16.0	Cnl/Cnl
BY-31	NA	NA	PVC/Screened	7.0–12.0	12.0	Cnl/Cnl
BY-32	NA	NA	PVC/Screened	7.0–12.0	12.0	Cnl/Cnl
BY-33	NA	NA	PVC/Screened	8.5–13.5	13.5	Cnl/Cnl
BY-34	NA	NA	PVC/Screened	11.0–16.0	16.0	Cnl/Cnl
BY-35	NA	NA	PVC/Screened	13.0–18.0	18.0	Cnl/Cnl
BY-36	NA	NA	PVC/Screened	11.0–16.0	16.0	Cnl/Cnl
BY-37	NA	NA	PVC/Screened	11.0–16.0	16.0	Cnl/Cnl
BY-38	NA	NA	PVC/Screened	2.0–7.0	7.0	Cnl/Cnl
BY-39	NA	NA	PVC/Screened	9.0–14.0	14.0	Cnl/Cnl
BY-40	NA	NA	PVC/Screened	7.0–12.0	12.0	Cnl/Cnl
BY-41	NA	NA	PVC/Screened	3.0–8.0	8.0	Cnl/Cnl
BY-43	NA	NA	PVC/Screened	10.0–15.0	15.0	Cnl/Cnl
BY-44	NA	NA	PVC/Screened	9.0–14.0	14.0	Cnl/Cnl
BY-45	NA	NA	PVC/Screened	7.0–12.0	12.0	Cnl/Cnl
BY-46	NA	NA	PVC/Screened	11.0–16.0	16.0	Cnl/Cnl
BY-47	NA	NA	PVC/Screened	11.0–16.0	16.0	Cnl/Cnl
BY-48	NA	NA	PVC/Screened	11.0–16.0	16.0	Cnl/Cnl
BY-49	NA	NA	PVC/Screened	12.0–17.0	17.0	Cnl/Cnl
BY-50	NA	NA	PVC/Screened	20.5–25.5	25.5	Cnl/Cnl

^aDepth to bottom of borehole. Where two depths are reported, the first is the depth of the soil boring, and the second is the bottom of the cored interval.

^bSurface casing for GW-845 was temporary steel casing installed to preserve integrity of borehole collar. Surface casing subsequently removed.

^cPresent well is offset approximately 10 ft from original location. Original borehole drilled to 31.2 ft bgs (auger refusal) and cored 31.2 to 41.1 ft bgs. Lithologic and core descriptions are based on original/abandoned location. bgs = Below ground surface.

Cmn = Maynardville Limestone.

Cm = Maryville Limestone.

Cnl = Nolichucky Shale.

Crt = Rutledge Limestone.

NA = Not applicable/not available.

PVC = Polyvinyl chloride.

Fig. 3.6. Schematic of a typical unconsolidated zone screened well.

3.1.2 Open-hole Completion Wells

Open-hole completion monitoring wells (Fig. 3.7) are generally constructed for groundwater characterization at depths greater than 150 ft below ground surface (bgs) and when targeting a specific, known stratigraphic interval of interest. Typical construction of this type of well involves drilling a 10 5/8-inch (in.) -diameter pilot bore with a tricone bit approximately 10 to 20 ft into competent bedrock. The pilot bore provides reconnaissance information regarding the thickness of the unconsolidated and weathered, cavatose bedrock intervals. Based on the pilot bore data, an optimum depth for the surface casing is selected, usually 3 to 5 ft into competent bedrock. The pilot bore is then reamed using a two-stage hole-opener bit to a diameter of 15.0 to 16.0 in. Once reamed to the set point for the surface casing, 11.0-in.-inside diameter (ID), 11.75-in.-outside diameter (OD) steel casing (typical) is installed. The surface casing is cemented in place with 2% bentonite-cement grout using one of two methods, depending on depth. In general, if the surface casing is set at depths of approximately 50 ft or less, grout is either poured into the annulus or pumped in using a small, low-pressure grout plant. Surface casing installed deeper than approximately 50 ft bgs may be pressure-grouted to ensure adequate isolation of the unconsolidated and weathered bedrock intervals and any shallow groundwater. Grout is allowed to cure for a minimum of 24 hours. The surface casing may be omitted if drilling conditions are optimal.

Subsequent to surface casing installation, the 10 5/8-in.-diameter bore is advanced to the top of the zone of interest. A steel, 6.54-in.-ID, 7.0-in.-OD (typical) inner casing string is installed in this segment of the borehole. Centralizers are used at approximately 60- to 80-ft intervals. This casing string is pressure-grouted in place using a 2% bentonite-cement grout mixture. Calcium chloride to a ratio of 2% by weight is often added to accelerate grout curing. Before pressure grouting, potable water is circulated through the annulus to remove any accumulated fill at the base and to ensure that the casing is set completely on the bottom of the borehole. Borehole pretreatment by circulation of a bentonite gel is commonly employed to aid in sealing the borehole wall and to minimize grout migration into the surrounding formation. In wells penetrating extremely cavatose bedrock or when drilling is conducted in proximity to existing wells, high-density polyethylene flakes (Flocele™) may be added to the bentonite gel to assist with borehole sealing. In addition, grout weight is often increased from 11 to 12 lb/gal to 16 to 18 lb/gal to increase viscosity and minimize migration into the formation. If pressure grouting fails to cement the annulus to the ground surface, additional 2% bentonite-cement grout may be added by tremie pipe in stages. Grout curing time for this phase of well construction ranges from a minimum of 48 to 72 hours.

The completion zone is drilled using a 6.25-in.-diameter (or similar size) tricone bit. In an open-hole completion well, the bit is advanced to 0.5 to 1.0 ft below the bottom of the casing. The borehole is subsequently cleaned thoroughly with potable water and dried completely with air. The interval below the casing is observed for a minimum of 1 hour to determine if groundwater infiltrates through the annulus and into the well. If no water accumulation occurs during that period, the completion interval is drilled to the base of the target interval.

3.2 WELL DEVELOPMENT

Upon completion of well construction, all wells installed at the Y-12 Plant are developed. Development involves removing all foreign sediment from the well and restoring the groundwater source to its original condition. Wells deeper than 50 ft are generally developed by the swab method. This procedure involves the installation of 2 3/8-in.-OD, 2-in.-ID steel tubing with a bottom check valve to the full depth of the well. A swab tool attached to a stainless steel

Fig. 3.7. Schematic of a typical open-hole completion well.

wireline is then moved repeatedly up and down the length of the tubing, evacuating water to the surface through an outlet. Very shallow, unconsolidated zone wells are developed by hand bailing or by using a submersible pump. Development water obtained by all methods is placed in a drum where volumes are noted and field observations made.

Prior to development, a water level is taken in each well and a casing volume is calculated. An excess of one well volume, depending on recharge rates, is typically removed from each well for several consecutive days. Specific conductance, pH, temperature, and turbidity are monitored daily during development. A minimum total of three well volumes is removed from each well; however, the principal acceptance criteria are stable values for pH and conductance for three consecutive samples. If the nonspecific indicator parameters (specific conductance, pH, and temperature) stabilize but turbidity levels remain high, then development continues until no further turbidity improvements are noted.

Table 3.3 summarizes the development data for the wells installed in FY 1998.

Table 3.3. FY 1998 well development data summary

Well	Water level (ft bgs)	Total depth ^a (ft bgs)	Well volume (gal)	Development water		Development method	Aquifer
				(gal)	(well volumes)		
GW-838	16.7	27.0	6.9	65	9.4	Pump	U/WB
GW-840	19.3	29.0	5.3	16	3.0	Pump	U
GW-845	23.0	438.3	1084.5	4000	3.7	Pump	B
GW-904	11.3	293.5	183.5	425	2.3	Pump	B
GW-905	19.7	51.0	20.2	70	3.5	Pump	B
GW-906	11.8	27.5	2.5	75	30	Bailer	WB
GW-907	23.1	31.9	1.6	55.5	34.7	Bailer/pump	WB
GW-908	7.6	35.0	4.3	58.5	13.6	Pump	WB
GW-909	12.1	26.1	2.4	22.5	9.4	Bailer	WB
GW-910	22.1	35.5	2.4	60	25	Bailer/pump	WB
GW-911	18.7	31.0	2.4	91	38	Bailer/pump	WB
GW-912	12.7	25.5	2.5	102.5	41	Bailer/pump	WB
GW-913	17.8	32.1	2.3	81.5	36.4	Bailer/pump	U/WB
GW-914	10.9	30.0	3.0	134	44.7	Pump	WB

^aDepth to bottom of screen or open interval.

B = Bedrock.

bgs = Below ground surface.

U = Unconsolidated zone.

WB = Weathered bedrock.

3.3 WASTE MANAGEMENT PRACTICES

Waste management guidelines for drilling/well installation activities were supplied by Energy Systems (Appendix D). In cases in which well sites were outside areas of known or suspected contamination, drill cuttings and water were discharged to the ground surface or to an excavated cuttings pit, provided that field screening criteria for radioactivity, VOCs, and pH were not exceeded.

3.4 WELL INSTALLATION SUMMARIES

This section presents a brief summary of each Y-12 Plant well installation during FY 1998. Included in each summary are pertinent drilling data, geologic and hydrologic observations, and rationale for the well location. Details of well installation activities, lithology, and well construction elements are included in individual installation reports found in Appendix A. Table 3.2 presents a well construction summary for all of the wells and piezometers installed during FY 1998.

3.4.1 Gum Branch Road Area

Wells GW-902 and GW-915 were installed approximately 4 miles west of the Y-12 Plant in the Gum Branch Road area (Figs. 3.1 and 3.2) within a research site containing a high concentration of monitoring wells. Both wells were installed such that the monitored interval would span the weathered bedrock/fresh bedrock interface. Development of these wells was undertaken by personnel of the Environmental Sciences Division of ORNL and is not described in this document.

GW-902

For well GW-902, a 6 1/2-in.-OD hollow-stem auger was used to drill the well bore. Auger refusal was reached at 31.8 ft bgs, 2.3 ft into fresh bedrock. The well bore penetrated 24.5 ft of silty soil/residuum prior to encountering weathered, thinly laminated shale bedrock. The water table was encountered at 15.0 ft bgs. The top of fresh bedrock (also thinly laminated shale) occurred at 29.5 ft bgs.

One 8-ft section of 2 3/8-in.-OD, 2-in.-ID, slotted PVC screen with end cap and a total of 30 ft of 2 3/8-in.-OD, 2-in.-ID, Schedule 40 PVC casing were installed in the borehole. The screen is located between 23.6 and 31.6 ft bgs.

Three and one-quarter 50-lb sacks of very fine-grained filter pack sand were poured into the annulus as the augers were removed from the bore. Sand fills the annulus of the well bore from 31.6 to 22.5 ft bgs. Approximately one-third of a 50-lb sack of pelletized bentonite was used to create an annular seal from 22.5 to 21.0 ft bgs. The annulus was backfilled with soil cuttings from 21.0 to 1.7 ft bgs and capped to the ground surface with granular bentonite.

GW-915

Well GW-915 is located approximately 50 ft west of GW-902. A 6 1/2-in. hollow-stem auger was used to drill the well bore. Auger refusal was reached at 21.2 ft bgs, 0.7 ft into fresh bedrock. The well bore penetrated 18.5 ft of silty soil residuum before encountering weathered bedrock (thinly laminated shale and sandy siltstone). The water table was encountered at 10.0 ft bgs. The top of the fresh bedrock (very hard, thinly laminated shale) occurred at 20.5 ft bgs.

One 4.3-ft section of 2 3/8-in.-OD, 2-in.-ID, slotted PVC screen with end cap and a total of 25 ft of 2 3/8-in.-OD, 2-in.-ID, Schedule 40 PVC casing was installed in the borehole. The screen is located between 16.7 and 21.0 ft bgs.

One and one-third 50-lb sacks of very fine-grained filter pack sand were poured into the annulus as the augers were removed from the bore. Sand fills the annulus of the well bore from 21.1 to 16.5 ft bgs. Approximately one-third of a 50-lb sack of granular bentonite was used to

create an annular seal from 16.5 to 15.5 ft bgs. The annulus was backfilled with soil cuttings from 15.5 to 7.5 ft bgs. More granular bentonite was used to seal the annulus from 7.5 ft to 6.5 ft bgs. The remaining annulus was filled to the ground surface with soil cuttings.

3.4.2 Lake Reality Area

Well GW-845 was installed as part of the East End VOC Plume Project. The well was to be used to evaluate the feasibility of groundwater contaminant plume interception as a long-term remediation choice. Well GW-845 is located along the Sediment Disposal Basin access road adjacent to the old pistol range at the east end of the Y-12 Plant (Fig. 3.3). Well GW-845 is an open-interval well with the open interval located between 167.0 and 438.3 ft bgs. The open interval includes all of Zone 2 and most of Zone 3 of the Maynardville Limestone of the Conasauga Group (the apparent vertical extent of a known contaminant plume on the east end of the Y-12 Plant). Well construction and development details can be found in SAIC (1998c).

3.4.3 Boneyard/Burnyard Area

In the spring of 1998, 40 temporary piezometers were installed in and around the Boneyard/Burnyard in Bear Creek Valley (Fig. 3.4). The piezometers were installed in soil boring holes constructed as part of the Bear Creek Valley Boneyard/Burnyard Accelerated Action Project (SAIC 1998d).

Temporary piezometers consisting of 1-in.-ID PVC pipe with a 5-ft section of slotted PVC screen at the base were installed within direct-push soil borings. Each piezometer was completed by attaching a collar to the pipe, approximately 6 in. bgs. The annulus above the collar to the ground surface was sealed using bentonite pellets (SAIC 1998d).

3.4.4 ORR Disposal Cell Area

Between June and August 1998, 13 monitoring wells were installed in the vicinity of the Oil Landfarm in Bear Creek Valley (Fig. 3.5). The wells were installed as part of the ORR Disposal Cell Characterization Project.

The monitoring wells were installed in boreholes augered to refusal. The wells consisted of 2-in.-ID PVC casing with 10-ft (typical) slotted screens. (Wells GW-838, GW-840, GW-904, and GW-905 were constructed of 4-in.-ID stainless steel screen and casing.) Fine-grained sand was used for the filter pack that extends 2 to 5 ft above the top of the screen. An approximately 3-ft-thick bentonite seal overlies the filter pack, and the remaining well annulus was backfilled with clay soil.

Upon completion of the soil boring, wells GW-906, GW-908, GW-911, GW-912, and GW-914 were extended up to an additional 10 ft by coring. The cored portion of the hole was filled with sand, and the bedrock was sealed with bentonite prior to well construction. Well GW-906 was completed in a borehole offset approximately 10 ft from the original, abandoned location.

All the Oil Landfarm wells were developed using a bailer, a 2-in.-diameter submersible pump, or a combination of the bailer and pump.

Construction details of the Oil Landfarm wells are provided in Table 3.2. Individual well installation reports, consisting of a well diagram, well logs/core logs, well development progress form(s), and a well development summary, are provided in Appendix A.

4. WELL PLUGGING AND ABANDONMENT

4.1 DRILLING CONTRACTOR

All P&A activities at the Y-12 Plant during FY 1998 were initiated by the GWPP. The drilling contractor for P&A activities at the Y-12 Plant during FY 1998 was Highland. Table 4.1 provides a summary of the drilling contractor services for each abandoned well, piezometer, or boring.

Table 4.1. Summary of drilling contractor services at each abandoned well, piezometer, or boring

Well	Drilling contractor	Service supplied
GW-201	Highland	P&A of a stainless steel-screened well
GW-707	Highland	P&A of a stainless steel-screened well
GW-708	Highland	P&A of a stainless steel-screened well
GW-805	Highland	P&A of a PVC-screened well
GW-806	Highland	P&A of a PVC-screened well
GW-807	Highland	P&A of a PVC-screened well
GW-808	Highland	P&A of a PVC-screened well
GW-809	Highland	P&A of a PVC-screened well
GW-810	Highland	P&A of a PVC-screened well
LL/HAZ-03	Highland	P&A of a PVC-screened well

P&A = Plugging and abandonment.

PVC = Polyvinyl chloride.

Most of the wells decommissioned during FY 1998 were located in places that did not allow drill rig access or where casing overdrilling or well bore reaming was not necessary (see Sect. 4.5, "Deviations from Normal Plugging and Abandonment Procedures"). When a drill rig was used, Highland used an Ingersoll-Rand XL-750 air rotary drilling rig. Plugging of wells in place was done using granular bentonite and cement grout. The two exceptions (well GW-201 at the Ravine Disposal site and LL/HAZ-03 in the Gum Branch area) were decommissioned using the standard P&A Method C as described in Sect. 4.2.

4.2 PLUGGING AND ABANDONMENT METHODS

There are four generalized P&A methods for the decommissioning of obsolete monitoring wells at the Y-12 Plant. The four methods are discussed in *Monitoring Well Plugging and Abandonment Plan, Y-12 Plant, Oak Ridge, Tennessee* (Energy Systems 1997b). These methods are applicable to different types of well, piezometer, or boring construction. Wells that were plugged and abandoned during FY 1998 required the use of Methods A and C.

Method A is used for wells constructed of 7.0-in.-OD steel or stainless steel well casing, typically completed with 5.0- to 20.0-ft well screens and sand filter packs. Wells completed in

bedrock may also have 8.0- to 12.0-in.-OD steel or PVC surface casing extending from the ground surface to the top of the bedrock. Some wells may also be completed with a conductor or surface casing. Method A involves the over-wash and removal of casing with washover pipe. Once the well casing has been removed, the borehole is reamed with a tricone bit or auger at least 0.25 in. larger in diameter than the original bore. American Petroleum Institute (API) Class A (Type I) neat cement is tremied to within 4.0 ft of the surface (if there is no surface casing or conductor casing) and, after verification of the depth to the grout plug, the remaining 4.0 ft of bore are capped using compacted, noncontaminated soil or local materials. If the well was completed with surface casing, the first grout plug is tremied to the bottom of the surface casing and allowed to cure. The surface casing is then over-washed in the same manner as the inner casing, and grout is tremied from the bottom to within 4.0 ft of the surface. If the well was also completed with a conductor casing, it is removed in a manner similar to that for the surface casing.

Method C is used for wells constructed of ≤ 7.0 -in.-OD PVC well casing, typically completed with 5.0- to 20.0-ft well screens and sand filter packs. The P&A procedure for Method C is identical to that for Method A above.

4.3 GROUTING PROCEDURES

Following removal of screen and casing from these wells and for subsequent conditioning of the borehole (or for wells plugged in place), neat cement grout was placed into the bore to within 4.0 ft of the bottom of the surface casing (if no surface casing was present, the grout was brought to within 4.0 ft of the ground surface). After the grout had cured, surface casings (if any) were removed, and neat cement grout was placed into the reamed bore to within 4.0 ft bgs. This grout was allowed to cure, and the remaining open bore was filled with a clay/soil plug.

Highland either hand-mixed API Class I (Type I) grout used in P&A or used premixed cement of the same specifications delivered to the site by a cement subcontractor. In bores greater than 20.0 ft deep, grout was tremied through 1.5-in.-OD PVC tremie pipe at a depth of approximately 10.0 to 20.0 ft from the bottom of the bore. For boreholes less than 20.0 ft deep or where the danger of bridging was negligible, grouting was accomplished by pouring or by pumping directly into the bore.

4.4 WASTE MANAGEMENT PRACTICES

Waste management guidelines for P&A activities were supplied by Energy Systems (Appendix D). In cases in which well sites were outside areas of known or suspected contamination, drilling cuttings and water were discharged to the ground surface or to an excavated cuttings pit, provided that field screening criteria for radioactivity, VOCs, and pH were not exceeded.

Extracted well screens and casings were cleaned of all remaining annular cement, cut into manageable lengths, split lengthwise, and segregated by material type prior to removal from the site. In the event that drill (or auger) cuttings or materials exceeded acceptable disposal limits, Environment Safety and Health Organization (ES&H) personnel directed subcontractor personnel in the proper disposal techniques.

4.5 DEVIATIONS FROM NORMAL PLUGGING AND ABANDONMENT PROCEDURES

Due to certain irregularities or unusual circumstances, deviations from the approved P&A methods were necessary to complete the P&A. Authorization to deviate from P&A methods was obtained from ES&H prior to beginning P&A activities. Generally, deviations of this type included: using bentonite aggregate instead of cement to bridge voids, cavities, or fractures and abbreviating P&A activities at a well when removal of the well casing/screen was deemed impractical (either the casing could not be extracted or waste generation was a concern).

Deviations (other than the generalized ones listed above) that occurred during FY 1998 were as follows: wells GW-707, GW-708, GW-805, GW-806, GW-807, GW-808, GW-809, and GW-810 were all plugged in place due to waste minimization and logistics concerns (i.e., traffic or ongoing operations). Generally, the decommissioning of these wells consisted of a first-stage plug of granular bentonite to absorb all of the water in the casing. The remaining casing was plugged to the ground surface using a sack concrete mix. Nonessential protective posts, concrete pads, or flush-mount boxes were also removed, if practical, from the location.

4.6 PLUGGING AND ABANDONMENT SUMMARIES

This section provides a brief P&A summary of each of the 10 wells decommissioned for the Y-12 Plant GWPP during FY 1998 (Figs 3.1 and 3.3). The wells are arranged numerically within the same geographic region or operational area. A summary of the recorded well construction and location information is presented in Tables 4.2 and 4.3 (Jones, Thompson, and Field 1995). Occasionally, minor differences existed between reported and actual construction. These differences, as well as deviations from the P&A procedures, are included below. Some wells had no listing in the subsurface database (Jones, Thompson, and Field 1995); information for these wells that is reported in Tables 4.2 and 4.3 is based on field observations.

4.6.1 Y-12 Plant Site

GW-707

Well GW-707 was an obsolete, stainless steel-screened well constructed in a 9 1/2-in.-diameter borehole with a reported total depth (TD) of 26.0 ft. The 4 1/2-in.-OD well casing and screen were plugged in place using granular bentonite from 17.3 to 4.7 ft bgs. (*Note:* The reported depth of the well was 16.9 ft bgs.) The remaining casing and flush-mount box were plugged with concrete. The large, heavy steel flush-mount cover was replaced.

GW-708

Well GW-708 was an obsolete, stainless steel-screened well constructed in a 9 1/2-in.-diameter borehole with a reported TD of 13.9 ft. The 4 1/2-in.-OD well casing and screen were plugged in place using granular bentonite from 13.6 to 4.1 ft bgs. The remaining casing and flush-mount box were plugged to the ground surface with concrete.

Table 4.2. Summary of decommissioned well construction data, Part I

Well no.	Y-12 coordinates (ft)		Surface elevation (ft amsl)	Total depth (ft bgs)	Functional area	Other names	Screened (S)
	Northing	Easting					
GW-201	30378.00	61914.00	965.87	21.0	Ravine Disposal Site	None	S
GW-707	29319.23	59578.51	931.16	26.0	Bldg. 9201-1	None	S
GW-708	29335.42	59529.84	931.03	13.9	Bldg. 9201-1	None	S
GW-805	29884.80	57402.70	955.25	13.8	Bldg. 9204-2	None	S
GW-806	29899.70	57461.00	952.16	12.9	Bldg. 9204-2	None	S
GW-807	29866.00	57458.90	951.52	11.3	Bldg. 9204-2	None	S
GW-808	29318.00	49529.90	931.24	40.4	Bldg. 9201-1	None	S
GW-809	29316.60	59408.40	931.27	40.0	Bldg. 9201-1	None	S
GW-810	29323.80	59606.50	931.68	26.8	Bldg. 9201-1	None	S
LL/HAZ-03	29812.00	32788.00	866.30	15.0	Gum Branch Road area	None	S

amsl = Above mean sea level.

bgs = Below ground surface.

Source: Jones, Thompson, and Field 1995.

Table 4.3. Summary of decommissioned well construction data, Part II

Well no.	Protective casing depth/OD (ft bgs/in.)	Surface casing type	Casing depth ^a /OD (ft bgs/in.)	Top of weathered rock (ft bgs)	Top of fresh rock (ft bgs)	P&A method	Rock formation(s)
GW-201	2.3/6 5/8	NA	15.0/4.5	2.5	21.0	C	Rogersville
GW-707	0.6/24 ^b	Steel	5.5/4.5	20.0	NA	A	Maynardville
GW-708	0.5/8 ^b	NA	2.7/4.5	NA	NA	A	Maynardville
GW-805	1.0/12 ^b	NA	5.2/4.5	11.0	NA	C	Maynardville
GW-806	1.0/12 ^b	NA	4.2/4.5	9.0	NA	C	Maynardville
GW-807	NA	NA	4.0/4.5	8.0	NA	C	Maynardville
GW-808	0.5/12 ^b	NA	24.0/4.5	4.0	NA	C	Maynardville
GW-809	0.8/12 ^b	NA	23.9/4.5	NA	NA	C	Maynardville
GW-810	0.6/8 ^b	Steel	13.9/4.5	NA	NA	C	Maynardville
LL/HAZ-03	NA	NA	5.0/6.63	12.0	NA	C	Nolichucky/Maryville

bgs = Below ground surface.

OD = Outside diameter.

P&A = Plugging and abandonment.

NA = Not applicable.

^aDenotes surface casing for open-interval wells or well casing for screened-interval wells.^bDenotes flush-mount box and not actual protective casing.

Source: Jones, Thompson, and Field 1995.

4.6.2 Building 9204-2

GW-805

Well GW-805 was an obsolete, PVC-screened well constructed in a 10 5/8-in.-diameter borehole with a reported TD of 13.8 ft. The 4 1/2-in.-OD well casing and screen were plugged in place using granular bentonite from 13.1 to 6.4 ft bgs. The remaining casing and flush-mount box were plugged to the ground surface with concrete.

GW-806

Well GW-806 was an obsolete, PVC-screened well constructed in a 10 5/8-in.-diameter borehole with a reported TD of 12.9 ft. The 4 1/2-in.-OD well casing and screen were plugged in place using granular bentonite from 12.9 to 3.4 ft bgs. The remaining casing and flush-mount box were plugged to the ground surface with concrete.

GW-807

Well GW-807 was an obsolete, PVC-screened well constructed in a 10 5/8-in.-diameter borehole with a reported TD of 11.3 ft. The 4 1/2-in.-OD well casing and screen were plugged in place using granular bentonite from 10.2 to 5.2 ft bgs. After the casing stick-up had been cut off to 0.9 ft bgs, the remaining casing was plugged to the ground surface with concrete.

4.6.3 Building 9201-1

GW-808

Well GW-808 was an obsolete, PVC-screened well constructed in a 10 5/8-in.-diameter borehole with a reported TD of 40.4 ft. The 4 1/2-in.-OD well casing and screen were plugged in place using granular bentonite from 38.5 to 5.4 ft bgs. The remaining casing and flush-mount box were plugged to the ground surface with concrete.

GW-809

Well GW-809 was an obsolete, PVC-screened well constructed in a 10 5/8-in.-diameter borehole with a reported TD of 40.0 ft. The 4 1/2-in.-OD well casing and screen were plugged in place using granular bentonite from 36.2 to 0.7 ft bgs. The remaining casing and flush-mount box were plugged to the ground surface with concrete.

GW-810

Well GW-810 was an obsolete, PVC-screened well constructed in a 10 5/8-in.-diameter borehole with a reported TD of 26.8 ft. The 4 1/2-in.-OD well casing and screen were plugged in place using granular bentonite from 26.4 to 3.1 ft bgs. The remaining casing and flush-mount box were plugged to the ground surface with concrete.

4.6.4 Ravine Disposal Site

GW-201

Well GW-201 was a PVC-screened well damaged when it was struck by mowing equipment. The well had been completed to 21.0 ft bgs in an 8-in.-diameter borehole. The 4 1/2-in.-OD well casing and screen were pulled out of the ground along with a 5.3-ft section of 6 5/8-in.-OD steel protective casing. An 8 3/4-in.-diameter tricone roller bit was used to ream the wellbore to fresh material to a depth of 22.0 ft bgs. The reamed wellbore was plugged from 21.5 to 3.3 ft bgs by pouring seven 94-lb sacks of Type I Portland cement, mixed neat, into the borehole. The remaining 3.3 ft of hole were backfilled and capped with cuttings and native soil.

4.6.5 Gum Branch Road Area

LL/HAZ-03

Well LL/HAZ-03 was an obsolete, PVC-screened well constructed in an 8-in.-diameter borehole with a reported total depth of 15.0 ft. The 6 5/8-in.-OD well casing and screen were pulled out of the ground. The wellbore was reamed to fresh material to a depth of 16.3 ft bgs using a tricone roller bit. The reamed borehole was plugged from 16.3 to 2.3 ft bgs by pouring five 94-lb. sacks of Type I Portland cement into the hole. The remaining 2.3 ft of hole were capped with clay soil.

5. WELL REDEVELOPMENT

Well redevelopment is performed when siltation, grout contamination, or poor sample quality decrease the likelihood of obtaining representative data or when Energy Systems' well maintenance and inspection program has identified wells with discrepancies between measured depths and reported depths. Well redevelopment is performed in an attempt to remove silt/sediment accumulations, purge grout contamination from the surrounding formation, or improve recharge and turbidity. Prior to redevelopment, the water level is measured in each well, and a casing volume is calculated. An excess of one well volume, depending on recharge rates, is typically removed from each well for several consecutive days. Nonspecific indicator parameters (specific conductance, pH, and temperature) are measured, and visual turbidity levels are monitored daily during redevelopment.

Two monitoring wells at the Y-12 Plant were redeveloped during FY 1998 (Fig. 3.3 and Table 5.1). Note that well GW-732 was redeveloped twice during FY 1998. Development of these wells was by the swab method. A minimum total of three well volumes was removed from each well. A summary of development information for the wells redeveloped during FY 1998 is included in Table 5.2. Appendix C contains well development data and redevelopment activity/progress reports.

Waste management guidelines for the well installation, P&A, and development activities were supplied by Energy Systems (Appendix D). Water produced during well redevelopment was discharged to the ground surface, provided that field screening criteria for radioactivity, pH, specific conductance, and VOCs were not exceeded. If development water exceeded acceptable disposal limits, ES&H personnel directed subcontractor personnel in the proper disposal procedures. At no time did the development water obtained from any of the wells redeveloped in FY 1998 exceed acceptable limits for discharge to the ground surface.

Table 5.1. FY 1998 rehabilitated wells and functional areas

Well	Functional area	Northing coordinate (ft)	Easting coordinate (ft)
GW-731	Sediment Disposal Basin	27463.65	63863.14
GW-732	Sediment Disposal Basin	27716.72	64267.74

Table 5.2 FY 1998 well redevelopment summary

Well	Date of development	Water level (ft bgs)	Total depth ^a (ft bgs)	Well volume (gal)	Development water		Development method	Aquifer
					(gal)	(well volumes)		
GW-731	9/14/98– 9/16/98	121.5	175.2	39.8	330	8.3	Swab	B
GW-732	3/10/98– 3/11/98	152.6	189.3	27.0	550	20.4	Swab	B
GW-732	9/16/98– 9/18/98	153.9	189.3	26.0	265	10.2	Swab	B

B = Bedrock. bgs = Below ground surface.

^aDepth to bottom of open interval or screen.

5.1 WELL REDEVELOPMENT METHODS

A number of development methods are used on newly installed wells or in the redevelopment of existing wells at the Y-12 Plant. The methods are described in *Monitoring Well Installation Plan for the Department of Energy Y-12 Plant, Oak Ridge, Tennessee* (Energy Systems 1997a).

All of the rehabilitation/redevelopment efforts undertaken at the Y-12 Plant during FY 1998 were accomplished using the swab method. The swab method of development is described in detail in Sect. 3.2 of this document.

5.2 WELL REDEVELOPMENT SUMMARIES

This section presents a brief summary of each of the redevelopment efforts performed at the Y-12 Plant during FY 1998. Included in each summary are pertinent development activities/water quality parameter measurements, development volumes, and hydrologic observations. All FY 1998 redevelopment efforts at the Y-12 Plant were on wells at the Sediment Disposal Basin located on Chestnut Ridge. Detailed descriptions of the redevelopment activities, including water quality/screening measures, are included in individual redevelopment reports found in Appendix C.

GW-731 (9/14/98 – 9/16/98)

Well GW-731 is located on the southeastern edge of the capped disposal basin. High pH and specific conductance readings in previous samples from this well indicated suspected grout contamination of the aquifer.

A total of 330 gal of water (8.3 well volumes) was removed from the well during this redevelopment effort. The initial water quality parameter measurements were elevated (pH = 9.3, specific conductance = 340 μ mhos/cm). Parameters quickly dropped and remained relatively stable throughout the redevelopment effort. The development water was turbid to moderately turbid to begin with, and failed to improve in clarity beyond that.

GW-732 (3/10/98 – 3/11/98)

Well GW-732 is located north of and across a gravel road from the capped disposal basin. Sampling data from well GW-732 indicated excessive turbidity, high pH, and excessively high concentrations of major and trace ions. These results indicate probable grout contamination within the bedrock near the monitoring interval.

A total of 550 gal of water (20.4 well volumes) was removed from the well during this redevelopment effort. The first well volume removed from the well contained a small amount of fine-grained sand, which was not observed afterward. The first well volume also measured an elevated pH (the pH after the first well volume ranged from 7.1 to 7.7 throughout the duration of redevelopment). The development began turbid and eventually cleared substantially, though not completely (a phenomenon typical of wells completed in the Knox Dolomite). Overall, the well exhibited good production, which actually appeared to increase as development progressed.

GW-732 (9/16/98 – 9/18/98)

Well GW-732 was redeveloped a second time during FY 1998 to remove any potential excessively turbid water prior to the fourth quarter sampling event.

A total of 265 gal of water (10.2 well volumes) was removed from the well during this redevelopment effort. Well GW-732 continues to be a good producer. The water quality parameters stabilized quickly during this redevelopment effort. The development water was slightly turbid throughout redevelopment, with no real improvement in clarity being observed.

6. QUALITY ASSURANCE

Installation or decommissioning of monitoring wells by Y-12 Plant GWPP oversight in FY 1998 (as well as those that underwent rehabilitation/redevelopment) was done following the procedures and technical guidelines in Environmental Surveillance Procedure ESP-600, "Well Installation, Development, and Abandonment" (Energy Systems 1988), the *RCRA Groundwater Monitoring Technical Enforcement Guidance Document* (EPA 1992), *Monitoring Well Plugging and Abandonment Plan, Y-12 Plant, Oak Ridge, Tennessee* (Energy Systems 1997b), and *Monitoring Well Installation Plan for the Department of Energy Y-12 Plant, Oak Ridge, Tennessee* (Energy Systems 1997a). Non-Y-12 Plant GWPP oversight well installations were conducted in accordance with applicable procedures and guidelines presented in individual project work plans: *Work Plan for Support to Upper East Fork Poplar Creek East End Volatile Organic Compound Plumes Well Installation Project, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee* (SAIC 1998a), *Sampling and Analysis Plan for the Oil Landfarm Soils Containment Pad* (SAIC 1998b), and *Work Plan for Phase III Predesign Site Characterization, Environmental Waste Management Facility, Oak Ridge, Tennessee* (Jacobs 1998a). Details of well installation, well P&A, and redevelopment were recorded by oversight geologists in bound field books, and the information was compiled into progress reports (well installation reports in Appendix A, P&A reports in Appendix B, and redevelopment reports in Appendix C). Any deviations from standard well installation guidelines, such as the use of bentonite Hole Plug™ for the borehole plug, were preapproved by the organization manager (Energy Systems GWPP, Energy Systems ER, or Bechtel Jacobs) or designee and were recorded in the activity report.

All drilling equipment and/or development equipment was decontaminated or certified as precleaned before use at each well and as needed during well P&A. Inspection of all materials and equipment before use at each well site was conducted by the oversight geologist. Equipment was periodically checked during drilling activities to ensure sound mechanical operation and to avoid detrimental impact to groundwater from equipment failure. A nonpetroleum (beeswax)-based lubricant (Well-Guard™) was used for all drilling activities.

Lithologic control during well/piezometer installation was maintained by continuously collecting and logging drill cuttings, soil cores, or rock cores. The presence of cavities, fractures, and soft drilling zones was denoted by continuous observation of drilling characteristics, such as penetration rate.

All well installation, well P&A, and redevelopment reports underwent internal technical and editorial reviews prior to being issued to Energy Systems.

7. HEALTH AND SAFETY

The Y-12 Plant GWPP Health and Safety Plan (SAIC 1992) was followed for all FY 1998 installation, P&A, and redevelopment activities initiated and overseen by the Y-12 Plant GWPP. Well GW-845 and Boneyard/Burnyard piezometers were initiated by the ER Program and were subject to that program's health and safety requirements. For Y-12 Plant GWPP activities, on-site personnel were in compliance with training requirements mandated by 29 *Code of Federal Regulations (CFR)* 1910.120, and all were enrolled in an annual health screening and occupational medical examination program. On-site personnel attended a site-specific health and safety briefing before starting drilling activities to discuss potentially hazardous materials, potentially dangerous activities and situations, protective equipment, and decontamination procedures. Low potential for exposure to hazardous materials at all work sites allowed the use of Level D personal protective equipment. This protective level consisted of steel-toed footwear, gloves, hard hats, hearing protection in the form of plugs or muffs, and safety glasses.

For Y-12 Plant GWPP activities, technical oversight personnel provided health and safety monitoring at the work sites using monitoring equipment supplied and maintained by Energy Systems. Instrumentation used on site typically consisted of an HNu Model HW-101 photoionization detector (PID), a Foxboro Century Model 108 or Model 128 organic vapor analyzer (OVA) with flame ionization detector (FID), and Ludlum radiation meters. The HNu PID and OVA FID were used to detect organic vapors. Radiation detection instruments included a Ludlum Model 3 Survey Meter for detection of beta and gamma radiation with a Geiger-Mueller "pancake"-type probe. Alpha radiation was monitored using a Ludlum Model 12 Count Ratemeter with a scintillation tube probe or an air probe. Oversight personnel were required to have been Red Cross-certified in first aid and cardiopulmonary resuscitation (CPR) techniques and to maintain that certification throughout the task.

In addition to screening for health and safety, drilling returns and development water were screened in accordance with Energy Systems guidelines in a general waste management plan for drilling activities (Appendix D). This daily screening consisted of alpha, beta, and gamma radiation screening of composited drill cuttings and selected grab samples of development water. A headspace analysis of organic vapors and a pH measurement were also performed on the composited cuttings samples and development water samples (specific conductance was measured on development water only). Because grout cuttings often were a significant component of drilling returns during over-washing and borehole reaming, pH levels sometimes exceeded the upper bounds of waste screening criteria. If grout cuttings were present, as identified visually, and no screening parameters other than pH exceeded guideline criteria, then no containment actions were taken. Screening results are included with each well installation, P&A, and redevelopment report.

Health and safety plan action levels (SAIC 1992) and waste management guideline values used during P&A activities are presented in Table 7.1.

Table 7.1. Action levels used for well plugging and abandonment

Parameter	Action level
Waste Management Guidelines:	
pH	<4.0 and >10.5 standard units
Organic vapors	>5 ppm
Alpha radiation	>500 counts per minute
Beta/gamma radiation	>100 counts per minute
Health and Safety Plan:	
pH	Below 5 or above 9
Explosivity	>25% lower explosive limit
Organic vapors	>10 ppm in breathing zone
Radiation	>2 mrem/h, and/or an 8-h time-weighted average of 0.25 mrem/h at chest level

8. REFERENCES

- Energy Systems (Martin Marietta Energy Systems, Inc.) 1988. *Environmental Surveillance Procedures Quality Control Program*, ES/ESH/INT-14.
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- SAIC 1998a. *Work Plan for Support to Upper East Fork Poplar Creek East End Volatile Organic Compound Plumes Well Installation Project, Oak Ridge Y-12 Plant, Oak Ridge, Tennessee*, BJC/OR-56, July.
- SAIC 1998b. *Sampling and Analysis Plan for the Oil Landfarm Soils Containment Pad*, August.
- SAIC 1998c. *East End VOC Plume Pump and Tracer Test Technical Memorandum*, BJC/OR-103, August.
- SAIC 1998d. *Characterization Report for the Boneyard/Burnyard Accelerated Action Project for the U.S. Department of Energy, Oak Ridge Reservation, Oak Ridge, Tennessee*, August.

APPENDIX A
WELL INSTALLATION REPORTS

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-838

WELL INSTALLATION DIAGRAM

LOGGED BY: Brett J. Heffernan - Jacobs EM Team

DRILLING DATES

DRILLING COMPANY: Highland DrillingSTARTED: 7/14/98DRILLER: Scott GilbertHELPER: Ken FortnerFINISHED: 7/14/98

NOT TO SCALE

Y-12 PLANT GROUNDWATER PROTECTION PROGRAMWELL NO: GW-838**MONITORING WELL DEVELOPMENT PROGRESS**

Page 1 of 2

LOCATION: Y-12 Plant

WELL INSTALLATION

ONE WELL VOLUME: 6.89 GALLONSCOMPLETION DATE: 7/14/98

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	pH	CONDUCTIVITY ms/cm	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
8/12/98	1	Very Turbid	7.48	0.336	1	0.15	Brown
8/12/98	5	Very Turbid	7.32	0.340	6	0.87	Brown
8/12/98	5	Very Turbid	7.36	0.368	11	1.60	Brown
8/12/98	8	Very Turbid	7.37	0.338	19	2.76	Brown
8/12/98	1	Very Turbid	7.56	0.342	20	2.90	Brown
8/12/98	5	Very Turbid	7.43	0.347	25	3.63	Brown
8/12/98	3	Very Turbid	7.41	0.335	28	4.06	Brown
8/12/98	2	Very Turbid	7.43	0.336	30	4.35	Brown
8/12/98	5	Very Turbid	7.77	0.347	35	5.08	Brown
8/12/98	2	Turbid	7.64	0.315	37	5.37	Light Brown
8/12/98	1	Turbid	7.58	0.312	38	5.52	Light Brown
8/12/98	2	Turbid	7.53	0.329	40	5.81	Light Brown
8/12/98	2	Turbid	7.53	0.334	42	6.10	Light Brown
8/12/98	3	Turbid	7.47	0.336	45	6.53	Light Brown
8/12/98	1	Turbid	7.45	0.337	46	6.68	Light Brown
8/12/98	3	Turbid	7.45	0.325	49	7.11	Light Brown
8/12/98	2	Turbid	7.46	0.311	51	7.40	Light Brown
8/12/98	2	Turbid	7.48	0.311	53	7.69	Light Brown
8/12/98	2	Turbid	7.48	0.329	55	7.98	Light Brown

**RESULTS AT END OF
DEVELOPMENT**

SEE NEXT PAGE

COMMENTS:

MONITORING WELL DEVELOPMENT PROGRESS

Page 2 of 2

LOCATION: Y-12

WELL INSTALLATION

ONE WELL VOLUME: 6.89 GALLONS

COMPLETION DATE: 7/14/98

COMMENTS:

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM	WELL NO. <u>GW-838</u>
MONITORING WELL DEVELOPMENT SUMMARY	PAGE 1 of 1
METHOD OF DEVELOPMENT: <u>2-in. Submersible Grundfos Pump</u>	
DEVELOPMENT OBSERVED BY: _____	
DEVELOPMENT DATE: START: <u>8/12/98</u> FINISH: <u>8/12/98</u>	
ONE WELL VOLUME: <u>6.89</u> GALLONS	
TOTAL GALLONS PUMPED: <u>65</u> TOTAL WELL VOLUMES PUMPED: <u>9.4</u>	
INITIAL pH: <u>7.48</u> FINAL pH: <u>7.51</u>	
INITIAL SPECIFIC CONDUCTANCE: <u>0.336 ms/cm</u> FINAL: <u>0.331 ms/cm</u>	
DESCRIPTION OF INITIAL TURBIDITY: <u>very turbid, brown</u>	
DESCRIPTION OF FINAL TURBIDITY: <u>turbid, light brown</u>	
FINAL MEASURED TURBIDITY: <u>649 NTU</u>	
WELL APPROVED BY: <u>Bethel Jacobs Company LLC</u>	
 ODOR OF WATER: <u>N/A</u>	
WATER DISCHARGED TO: ☒ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANKS ☐ DRUMS ☐ OTHER	
INITIAL PRE-DEVELOPMENT WATER DEPTH: <u>20.05 ft below TOC</u>	
DEVELOPMENT OBSERVATIONS: _____	
OBSERVER SIGNATURE: <u>Brett J. Heffernan</u>	
DATE: <u>August 24, 1998</u>

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-840

WELL INSTALLATION DIAGRAM

LOGGED BY: Brett J. Heffernan - Jacobs EM Team

DRILLING DATES

DRILLING COMPANY: Highland DrillingSTARTED: 7/9/98DRILLER: Ken FortnerHELPER: Scott GilbertFINISHED: 7/15/98

NOT TO SCALE

WELL LOG

LOCATION: Oil Landfarm

DATE: START: 7-9-98

DRILLER: Ken Fortner - Highland Drilling Co.

FINISH: 7-15-98

HELPER: Scott Gilbert - Highland Drilling Co.

DRILLING METHOD: Hollow Stem Auger

DRILL: Ford 555B Backhoe with McMillan Diggerhead

LOGGED BY: Brett J. Heffernan

NOTES: Stainless steel screened well installed as part of the Oak Ridge Reservation Disposal Cell
Characterization Project investigations.

A-10

WELL NO. GW-840

MONITORING WELL DEVELOPMENT SUMMARY

PAGE 1 of 1

METHOD OF DEVELOPMENT: 2-in. Submersible Grundfos Pump

DEVELOPMENT DATE:

DEVELOPMENT OBSERVED BY: Brett J. Heffernan

START: 8/14/98

FINISH: 8/14/98

ONE WELL VOLUME: 5.30 GALLONS

TOTAL GALLONS PUMPED: 16 TOTAL WELL VOLUMES PUMPED: 3.02

INITIAL pH: 6.26 FINAL pH: 6.68

INITIAL SPECIFIC CONDUCTANCE: 0.371 ms/cm FINAL: 0.285 ms/cm

DESCRIPTION OF INITIAL TURBIDITY: very turbid, light brown

DESCRIPTION OF FINAL TURBIDITY: very turbid, light brown

FINAL MEASURED TURBIDITY: 999 NTU (off scale)

WELL APPROVED BY: Bechtel Jacobs Company LLC

ODOR OF WATER: N/A

WATER DISCHARGED TO: ☒ GROUND SURFACE ☐ TANK TRUCK
☐ STORM SEWERS ☐ STORAGE TANKS
☐ DRUMS ☐ OTHER

INITIAL PRE-DEVELOPMENT

WATER DEPTH: 22.70 ft below TOC (prior to final stick up)

DEVELOPMENT OBSERVATIONS: _____

OBSERVER SIGNATURE: Brett J. Heffernan

DATE: August 24, 1998

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-845

WELL INSTALLATION DIAGRAM

LOGGED BY: Timothy Coffey - SAIC

DRILLING DATES

DRILLING COMPANY: Highland Drilling CompanySTARTED: 1-28-98DRILLER: Randy Phillips HELPER: Jimbo GallaherFINISHED: 2-27-98

NOT TO SCALE

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-845</u>
WELL INSTALLATION ACTIVITY/PROGRESS REPORT			PAGE 1 of 25
LOCATION: <u>Eastern Y-12 Plant Area</u>		DATE: START: <u>1-28-98</u>	
OPERATOR: <u>R. Phillips - Highland Drilling Co.</u>		FINISH: <u>2-27-98</u>	
HELPER: <u>J. Gallaher - Highland Drilling Co.</u>		LOGGED BY: <u>T. Coffey - SAIC</u>	
DRILL: <u>Ingersoll-Rand XL-750</u>			

DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
1-28-98	0758	0814	Arrive at GW-845 site. The first pit has been dug, and lined. The drill rig mast is up, and the crew has rigged up with an 8 3/4-in. diameter tri-cone roller bit on a stabilizer. Total length of bit/stabilizer assembly is 22.3 ft, table height = 3.1 ft.
	0814	0832	Crew arrives, begin tending to frozen water hoses. Crew also conducts pre-work equipment inspection.
	0832	0912	Start drill rig, let warm up. Crew lines conduit from borehole to lined pit with plastic. Re-erect flagging around lined pit.
	0912	0920	Commence drilling using compressed air only. Drill from 0.0 ft to 5.2 ft below ground surface (BGS). A small blowout appears at the ground surface approximately 10 ft NE of the borehole. Two more blowouts appear from 15-20 ft both E and W of the borehole.
	0920	0931	Stop drilling. Push in a 5.2-ft section of 9 5/8-in. outside diameter (OD), 9-in. inside diameter (ID) steel temporary conductor casing. Casing stick-up = 1.0 ft. Table height remains at 3.1 ft.
	0931	0941	Resume drilling. Drill from 5.2 ft to 8.2 ft BGS. Drill rig sounds like it's going to stall.
	0941	0955	Shut off drill rig. Replace fuel filter.

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DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
1-28-98	0955	1030	Start drill rig again. Wires behind the control panel begin smoking.
(cont.)			A couple of wires may have grounded out, insulation has burned
			off. Two, maybe three, wires need to be replaced.
	1030	1148	D. Key (Highland) arrives with auxiliary compressor. Position the
			compressor near the drill rig (have to use the backhoe due to the
			muddy conditions).
	1148	1252	S. Gilbert (Highland) arrives with wire and connectors to repair the
			drill rig. Replace the bad wires.
	1252	1315	Break for lunch.
	1315	1335	Resume work-checking wiring on drill rig. The problem appears
			to be a faulty emergency kill-switch. J. Stiner (MK-F) approves
			removal of the switch (provided that the drill rig has another device
			to shut off the power, which it does).
	1335	1728	Continue drilling using compressed air and water. Drill from 8.2 ft
			to 74.4 ft BGS. Encounter top of bedrock at 19.8 ft BGS. Drill rods
			are bouncing: rock is very hard. Cuttings indicate fresh rock, no
			weathered bedrock at this location. Drill through cavities at: 23.8
			- 26.4 ft, 26.8 - 29.2 ft (possibly mud-filled) and 30.0 - 31.2 ft BGS.
			Interval from 23.2 ft to 35.2 ft BGS is honey-combed with
			alternating cavities and interstitial rock ledges. Encounter a
			cavity from 36.5 ft to 37.5 ft BGS. Rock is fragmentary from 37.5 ft
			to 42.6 ft BGS. Encounter another cavity at 45.0 - 45.8 ft with
			fragmentary rock 45.8 ft to 50.2 ft BGS. Encounter more cavities
			at 53.2 ft to 53.6 ft and 55.0 ft to 55.9 ft BGS. Rock drills solidly
			from approximately 60 ft BGS to the end of the interval.

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WELL INSTALLATION ACTIVITY/PROGRESS REPORT continued			PAGE 3 of 25
DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
1-28-98	1728	1802	At 74.4 ft BGS. Flush the borehole clean. Trip tools completely out
(cont.)			of the borehole. Collect sample #980128 from lined pit. Screen
			cuttings composite (see Cuttings Field Screening/Disposal Form).
			Secure site and depart.
1-29-98	1039	1120	Oversight arrives at GW-845 site. Driller is connecting the auxiliary
			compressor to the drill rig air system. Helper is off getting water.
			Measure water level in borehole at 22.95 ft BGS. Tag bottom of
			borehole at 70.9 ft BGS (3.5 ft of fill).
	1120	1149	Conduct pre-work equipment inspection. Start drill rig, break bit
			from stabilizer, and replace with a newer bit of the same size (8 3/4-
			in. diameter). Begin tripping tools into borehole.
	1149	1219	Break for lunch.
	1219	1233	Continue tripping tools into the borehole. Blow accumulated water
			out of the borehole. Turning tools through fill material.
	1233	1627	At 74.4 ft BGS, commence drilling using compressed air and water.
			Drill from 74.4 ft to 144.2 ft BGS. Drill through a zone of
			fragmentary rock, possibly a fracture zone from 85.5 ft to 88.5 ft
			BGS. Cavity: 85.6-85.9 ft. Drilling continues to be slow: very hard
			rock.
	1627	1701	At 144.2 ft BGS. Flush the borehole clean. Trip tools completely
			out of the borehole. Collect sample #980129 from lined pit. Screen
			cuttings composite (see Well Log).
	1701	1747	Crew fuels drill rig and auxiliary compressor. Secure site and
			depart.

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DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
1-30-98	0814	0908	Arrive at GW-845 site: Crew adds more fuel to drill rig. Measure water level at 23.15 ft BGS. Tag bottom: obstruction in borehole at 34.6 ft BGS. Crew conducts pre-work equipment inspections. Start drill rig and auxiliary compressor, let warm up.
	0908	0940	Begin tripping tools into the borehole. Had to drill through obstruction at 34.6 ft BGS. Have used all the drill rods in the carousel. Will be adding extra rods to the carousel to continue drilling.
	0940	1006	Interrupt trip-in to move drill rods to other side of drill rig: a recently installed guard on the left side of the carousel precludes adding drill rods from that side.
	1006	1018	Continue tripping tools into the borehole. Encounter fill at 142.5 ft BGS (1.7 ft of fill in borehole).
	1018	1149	At 144.2 ft BGS. Add a drill rod. Commence drilling using compressed air and water. Drill from 144.2 ft to 169.2 ft BGS. Other crew members begin digging the unlined pit. Much less fragmentary rock this interval.
	1149	1220	At 169.2 ft BGS. The lined pit has reached approximately 80% capacity. Flush borehole clean. Trip tools completely out of the borehole. Rig down bit/stabilizer assembly. Tag bottom of borehole at 168.0 ft BGS (1.2 ft of fill). Collect sample #980130 from lined pit.
	1220	1330	Crew breaks for lunch. Oversight delivers pit water samples to lab at ORNL for analysis.
	1330	1554	Oversight returns to GW-845 site. Crew continues to dig the unlined pit. Screen cuttings composite (see Well Log). Perform

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DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
1-30-98	1330	1554	general site clean-up. Oversight departs. Crew will remain
(cont.)	(cont.)	(cont.)	approximately 1 more hour digging the unlined pit. Note: analyses
			of all three pit water samples taken so far indicate volatile organic
			compounds (VOCs) below detectable range. Water in lined pit
			cleared to pump into unlined pit when unlined pit is finished.
2-2-98			Note: After reviewing the stratigraphy encountered in GW-845 so
			far with K. Jago (SAIC), it was advised to set casing at or near the
			present depth. Kevin believes that Zone 3 of the Maynardville
			Limestone has been encountered within the last 30 ft of the
			borehole, indicating that the Nolichucky Shale contact will probably
			be shallower than the 500 ft originally thought.
	0808	0900	Arrive at GW-845 site. Crew is fueling the backhoe. The unlined pit
			appears to be approximately 2/3 complete. Measure water level in
			the borehole at 23.38 ft BGS. Resume digging the unlined pit.
	0900	1008	Start drill rig. Pull out the 9 5/8-in. OD conductor casing. Rig up with
			a new stabilizer. Add a 2.5-ft drilling sub to the stabilizer. Rig up
			with a 12 1/4-in. diameter hole opener bit. Length of the hole
			opener/stabilizer assembly (to the reaming cones) = 20.3 ft; total
			length = 21.7 ft. Table height remains at 3.1 ft. Complete the
			unlined pit; finished dimensions: 20 x 30 x 5 ft.
	1008	1029	Commence reaming the pilot hole using compressed air only.
			Ream from 0.0 ft to 17.2 ft BGS. Begin adding water at 2.0 ft BGS
			to keep the reamed hole clean.
	1029	1117	At 17.2 ft BGS. Trip tools out of the borehole. Rig down the hole
			opener/stabilizer assembly. Shut off rig. Load a section of
			13 3/8-in. OD casing onto a truck and take to Highland's shop to be
			cut.

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DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
2-2-98	1117	1258	Wait on return of casing.
(cont.)			
	1258	1355	Crew returns with casing: 13 3/8-in. OD, 12 3/4-in. ID, 21.2 ft long.
			Push the casing into the ground, to bedrock surface. Casing
			stick-up = 1.3 ft.
	1355	1432	Rig back up with the hole opener. Add a drill rod, and secure
			bushings in table (to keep from dropping into the borehole). Begin
			pumping water from lined pit to unlined pit.
	1432	1709	Continue reaming the pilot hole using compressed air only. Ream
			from 17.2 ft to 109.8 ft BGS. Confirm bedrock at 19.8 ft BGS.
			Confirm cavatose/fragmentary rock zone: 23.2 ft-35.2 ft BGS. Add
			water at 24.0 ft BGS, good circulation. Observed increase in water
			production associated with cavity: 45.0-45.8 ft BGS. The reaming
			is proceeding more quickly and smoothly than the pilot hole drilling
			did.
	1709	1734	At 109.8 ft BGS (out of water). Trip tools out of the borehole, had
			to drill back out on occasion.
	1734	1753	Crew is building diversionary structures to keep run-off out of pits
			in anticipation of heavy rain forecasted for tonight and tomorrow.
			Secure site and depart.
2-3-98			No drilling work today. Crew working to direct site run-off away
			from the pits, and filtering run-off water through silt fencing and
			straw bales prior to it leaving the site. M. Wiest (LMES) gives
			approval to pump clear faction of pit water onto grassy area west
			and north of site. Crew pumps water out of the pits, again, taking
			care to filter any muddy water leaving the site.

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DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
2-4-98			No drilling work today: snow.
2-5-98	0915	1005	Arrive at GW-845 site. Crew is on site pumping water out of the lined pit and into the unlined pit. S. Gilbert (Highland) will be the driller today. The storm of the last 2 days is responsible for flipping a corner of the pit liner back into the pit. The liner integrity appears to have been maintained, and no water has leaked out. Drill rig is on, warming up. Pull liner back into place.
	1005	1042	Begin tripping tools into borehole. Encounter several tight spots along the way. Top of fill is at 105.5 ft BGS (4.3 ft of fill). Drilling through fill.
	1042	1535	At 109.8 ft BGS. Commence reaming using compressed air and water. Ream from 109.8 ft to 167.0 ft BGS. Hole opener got stuck (unable to pull out of borehole) for a short while. Color of drilling returns changes (becomes lighter) at approximately 119 ft BGS.
	1535	1720	At 167.0 ft BGS. Flush borehole clean. Trip tools completely out of the borehole. Tag bottom of borehole at 155.3 ft BGS (11.7 ft of fill). Secure site and depart.
2-6-98	0830	0854	Arrive at GW-845 site. Crew conducts pre-work equipment inspections. Start drill rig, let warm up. R. Phillips (Highland) resumes drilling duties. Tag bottom of borehole again at 154.0 ft BGS (another 1.3 ft of fill accumulated overnight). Note that tape hangs up at approximately 35 ft and 49 ft BGS.
	0854	0913	Rig down the hole opener/stabilizer assembly.
	0913	1010	Thread a clevis into drill head. Prepare to run casing into borehole.

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WELL INSTALLATION ACTIVITY/PROGRESS REPORT continued			
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DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
2-6-98	1010	1107	Thread a lifting bell onto the lead section of casing. Begin running
(cont.)			casing into borehole. Casing will not go past approximately 35 ft
			BGS. Driller thinks the borehole may have dog-legged at the
			bottom of a cavity.
	1107	1129	Trip casing back out. Bottom end of casing is badly deformed.
	1129	1252	Thread a floatshoe onto another section of casing and attempt to
			run casing a second time. Casing still does not go past 35 ft BGS.
			Shut off drill rig.
	1252	1328	Break for lunch.
	1328	1423	Drill rig back on, try to push casing past obstruction/dog-leg at 35 ft
			BGS. Halliburton cementing crew is on location, standing by.
			Casing still will not go.
	1423	1435	Load the casing section with damaged end on a truck to be taken
			to Highland's shop to cut end at 45° angle. Depart.
	1435	1500	Trip casing back out of the borehole.
	1500	1520	Run drill rods only into borehole nearly to total depth. Rods hang
			up at approximately 35 ft, 45 ft, and 49 ft BGS, but punch through.
	1520	1545	Trip rods out of the borehole. S. Gilbert returns with casing with
			end cut at 45° angle.
	1545	1824	Attempt to run casing a third time. Pointed casing section seems
			to enter dog-legged hole. Casing going into the hole, but slowly.
			Having to mash down pretty hard with drill rig. Once bottom of
			casing gets past all tight spots, the casing goes in relatively easily.

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DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
2-6-98	1545	1824	Total length of casing is 161.8 ft. Casing stick-up is approximately
(cont.)	(cont.)	(cont.)	12 ft (casing setting on pile of fill).
	1824	1903	Halliburton crew setting up.
	1903	1915	Begin pumping water down the casing to flush the fill out of the way.
			Pushing on casing again. Circulate water. Casing pumped down
			as far as possible (approximate stick-up of 5 ft).
	1915	1926	Mixing gel.
	1926	1939	Pump gel into casing. Circulate water again.
	1939	1955	Mix and pump the cement into casing. Halliburton engineer states
			he's mixing 2x calculated volume of cement (95 sacks).
	1955	2033	Finished pressure grouting. Clean out lines and trucks. Casing
			stick-up = 4.9 ft. Bottom of casing is at 156.9 ft BGS. Secure site
			and depart.
2-9-98	0825	0939	Arrive at GW-845 site. Crew is fueling the drill rig. Tag cement
			level in annulus at 31.9 ft BGS. Calculate an annular volume to the
			ground surface of 12.6 cubic ft, equivalent to 18.3 sacks of granular
			bentonite.
	0939	1013	Slowly pour 20, 50-lb sacks of 3/8-in. granular bentonite (Shur-
			Plug™) into the annulus. Bentonite level is not yet up to the bottom
			of the 13-in. surface casing (must be filling cavities).
	1013	1024	Remove the lifting bell from the casing. Water level inside casing
			is 4.5 ft below the top of the casing (BTOC). Tag cement level
			inside casing at 113.4 ft BTOC.

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DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
2-9-98	1024	1115	Cut off 3.1 ft of the casing stick-up. New stick-up = 1.8 ft.
(cont.)			
	1115	1144	Break a 7 7/8-in. diameter tri-cone roller bit loose from a small drilling subadapter. Rig up with the stabilizer used to drill the pilot hole. Break the 8 3/4-in. bit from the stabilizer, and thread the 7 7/8-in. bit on. Length of bit/stabilizer assembly is 22.3 ft, table height = 3.2 ft.
	1144	1201	Begin tripping tools into casing. Blow the water out of the casing. Cement-colored water at approximately 109 ft BGS.
	1201	1239	Break for lunch.
	1239	1501	Start the drill rig. Hang 2 more drill rods in the carousel. Continue tripping into casing. Cement is solid at 124 ft BGS. Drilling up cement using compressed air and water. Very hard drilling at 155.8 ft BGS. Bottom of casing may be distorted from pushing the casing through tight spots. Observe metal fragments in the returns. Drill bit passes out of casing at 156.9 ft BGS, and drills through fill (cuttings) to end of pilot hole.
	1501	1535	At 169.1 ft BGS. Flush borehole clean. Blow the hole dry: borehole is making almost no water. Trip tools out of the borehole. Rig down bit/stabilizer assembly (the bit is worn out).
	1535	1630	Observed hydraulic oil dripping from drill head. Driller ascertains that the seal between the rotation motor and drill head is bad and leaking hydraulic oil into the drill head which, in turn, is leaking out the vent. Done for the day. Secure site and depart.

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DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
2-10-98	0801	0819	Arrive at GW-845 site. Complete annular seal of intermediate casing. Slowly pour 4, 50-lb sacks of 3/8-in. granular bentonite into the annulus. Unhydrated bentonite level at 18.3 ft BGS (top of bentonite is up into the surface casing).
	0819	0940	Crew begins removing hydraulic hoses from rotation motor prior to removal. Motor seal will need to be replaced. No drilling work today. Oversight departs.
2-11-98	0803	0848	Arrive at GW-845 site. Motor seal has been replaced, and motor has been connected to the drill head. Measure water level in casing at 165.9 ft BGS (3.1 ft of water in borehole). Cement seal is excellent. Crew arrives and starts the rig.
	0848	0904	Rig up with the bit/stabilizer assembly. Break worn-out bit loose from stabilizer and replace with a new 7 7/8-in. diameter bit. Length of bit/stabilizer assembly is still 22.3 ft, table height remains at 3.1 ft.
	0904	0932	Begin tripping tools into casing. Lower bit to 169.2 ft BGS.
	0932	1400	Commence drilling using compressed air and water. Drill from 169.2 ft to 246.0 ft BGS. From 176.0 ft to 194.2 ft BGS circulation is spotty. Bring auxiliary compressor on-line at 194.2 ft BGS. Fragmentary rock at 223.8 ft BGS. Rods drop from 223.8 ft to 224.0 ft BGS (cavity/fracture zone). Return water muddies up slightly. Obvious increase in water production. Return water becomes thick and muddy at 227.0 ft BGS. Water production increases at 227.6 ft BGS.
	1400	1436	At 246.0 ft BGS, the bushings blow out of the table due to the high pressure of the return water. Pull bit back off bottom. Shut off drill

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DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
2-11-98	1400	1436	rig. Bolt the 2 bushings together, and secure in the table with a
(cont.)	(cont.)	(cont.)	chain attached to the p-tong hydraulic piston.
	1436	1510	Trip back to bottom of borehole, and continue drilling. Drill from
			246.0 ft to 254.0 ft BGS using compressed air and water.
			Fragmentary rock at 252.8 ft BGS (fracture), with very large
			additional water production.
	1510	1610	At 254.0 ft BGS. The lined pit is full of water. The last water zone
			filled the remaining pit space surprisingly fast. Pull bit back up into
			casing. Shut off drill rig. Collect sample #980211 from the lined pit.
			Secure site and depart.
2-12-98	0914	1052	Arrive at GW-845 site. Note: Oversight delivered sample #980211
			to ORNL for analysis prior to arriving at GW-845 site. Crew is
			building a straw-bale barrier around the borehole collar to better
			contain the drilling returns. Measure water level in well at 22.5 ft
			BGS. Waiting for sample analysis results.
	1052	1212	Receive word of analysis: results are below action level. Pump
			clear faction to ground surface. Pump sludge to unlined pit. Eat
			lunch.
	1212	1226	Lined pit is empty. Start drill rig. Lower bit back to the bottom of
			the borehole. Blow excess water out of the hole.
	1226	1329	Commence drilling using compressed air and water, auxiliary
			compressor is on-line. Drill from 254.0 ft to 278.5 ft BGS.
			Fragmentary rock: 256.2 ft to 256.8 ft BGS, 261.0 ft, and 264.3 ft
			BGS. Possible increase in water production in this area. Distinct
			lithology change at 274.0 ft BGS (see Well Log), encounter top of
			Zone 2 of Maynardville Limestone.

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DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
2-12-98	1329	1355	At 278.5 ft BGS. The lined pit is full of water. Pull bit off bottom.
(cont.)			Shut off drill rig. Collect sample #980212 from lined pit. Secure
			site and depart. Oversight delivers sample #980212 to ORNL for
			analysis.
2-13-98	0815	0937	Arrive at GW-845 site. Pump clear water out of lined pit, pump
			sludge into unlined pit.
	0937	0949	Start drill rig. Lower bit back to the bottom of the borehole. Blow
			excess water out of the hole.
	0949	1049	Commence drilling using compressed air and water, auxiliary
			compressor on-line. Drill from 278.5 ft to 300.5 ft BGS. Fragmentary
			rock: 278.5 ft to approximately 280 ft, 291.5 ft, 295.2 ft, and 298.0
			ft to 300.2 ft BGS. Return water muddies up during the last break,
			assume an increase in water production
	1049	1108	At 300.5 ft BGS. The lined pit is full of water. Pull bit off bottom.
			Shut off drill rig. Collect sample #980213A from lined pit.
	1108	1318	Deliver sample #980213A to ORNL for analysis. Return to
			GW-845 site. Awaiting analysis results. Screen cuttings from
			278.5 ft to 300.5 ft BGS (see Well Log).
	1318	1426	Receive word of analysis: results are below action level. Pump
			out the pits.
	1426	1440	Start drill rig. Trip bit back to bottom of the borehole. Blow excess
			water out of the borehole.
	1440	1525	Commence drilling using compressed air and water, auxiliary
			compressor on-line. Drill from 300.5 ft to 318.8 ft BGS. Fragmentary

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DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
2-13-98	1440	1525	rock at 304.5 ft BGS. Return water muddies up, obvious increase
(cont.)	(cont.)	(cont.)	in water production. More fragmentary rock at 306.0 ft BGS.
			Return water muddies again, unable to determine if water production
			increases. Fragmentary rock: 307.7 ft to 308.2 ft. Drilling
			becomes smoother and rate increases at 315.5 ft BGS.
	1525	1543	At 318.8 ft BGS. The lined pit is full of water. Pull bit off bottom.
			Shut off drill rig. Collect sample #980213B from lined pit. Secure
			site and depart. Oversight delivers sample #980213B to ORNL for
			analysis.
2-16-98	0801	0921	Arrive at GW-845 site. Pump out the pits.
	0921	0943	Start drill rig. Trip bit back to bottom of borehole. Blow excess
			water out of the borehole.
	0943	1020	Commence drilling using compressed air and water, auxiliary
			compressor on-line. Drill from 318.8 ft to 334.0 ft BGS. Drilling
			continues to be smooth and relatively rapid. Fragmentary rock:
			325.9 ft to 239.2 ft BGS. Impossible to determine if water production
			has increased.
	1020	1051	At 334.0 ft BGS. The lined pit is full. Pull bit off bottom. Shut off
			drill rig. Collect sample #980216A from the lined pit.
	1051	1435	Deliver sample #980213A to ORNL for analysis. Return to
			GW-845 site. Awaiting analysis results. Screen cuttings composite
			from 318.8 ft to 334.0 ft BGS (see Well Log).
	1435	1535	Receive word of analysis: results are below action level. Pump out
			of the pits.

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DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
2-16-98	1535	1539	Start drill rig. Bit already at bottom of borehole. Blow excess water
(cont.)			out of the hole.
	1539	1600	Commence drilling using compressed air and water, auxiliary
			compressor on-line. Fragmentary rock: 334.0 ft to 334.6 ft BGS.
			Obvious increase in water production (big water, pit is filling
			rapidly).
	1600	1638	At 344.0 ft BGS. Lined pit is approximately 80% full (need to leave
			room in pit because rain is forecast for tonight). Pull bit off bottom.
			Shut off drill rig. Collect sample #980216B from lined pit. Screen
			cuttings composite from 334.0 ft to 344.0 ft BGS (see Well Log).
			Secure site and depart.
2-17-98	0830	0925	Arrive at GW-845 site. Note: Oversight delivered sample #980216B
			to ORNL for analysis prior to arriving at GW-845 site. Crew is on
			site. Awaiting analysis results.
	0925	1035	Receive word of analysis: results are below action level. Pump out
			the pits.
	1035	1053	Start drill rig. Trip bit back to bottom of borehole. Blow excess
			water from the hole.
	1053	1125	Commence drilling using compressed air and water, auxiliary
			compressor is on-line. Drill from 344.0 ft to 360.4 ft BGS.
			Fragmentary rock at 350.2 ft and 358.4 ft BGS.
	1125	1212	At 360.4 ft BGS. Lined pit is full. Pull bit off bottom. Shut off drill
			rig. Collect sample #980217 from the lined pit. Screen cuttings
			composite from 344.0 ft to 360.4 ft BGS (see Well Log).

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-845</u>
WELL INSTALLATION ACTIVITY/PROGRESS REPORT continued			
			PAGE 16 of 25
DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
2-17-98	1212	1405	Deliver sample #980217 to ORNL for analysis. Return to GW-845
(cont.)			site. Awaiting analysis results.
	1405	1505	Receive word of analysis: results are below action level. Begin
			pumping off the pits. Heavy rain begins at 1455 hrs, decide not to
			drill another round. Secure site and depart.
2-18-98	0815	0916	Arrive at GW-845 site. Continue pumping the pits.
	0916	0935	Start drill rig. Trip bit back to bottom. Blow excess water from the
			borehole.
	0935	0955	Commence drilling using compressed air and water, auxiliary
			compressor on-line. Drill from 360.4 ft to 370.4 ft BGS. Fragmentary
			rock at 370.2 ft BGS, lost circulation momentarily. When circulation
			returns, it is with a huge increase in water production; return water
			is muddied.
	0955	1038	Stop drilling at 370.4 ft BGS. The borehole is producing an
			incredible amount of water, plus the lined pit is nearly full. Pull bit
			off bottom. Shut off drill rig. Collect sample #980218A from lined
			pit.
	1038	1150	Deliver sample #980218A to ORNL for analysis. Return to
			GW-845 site. Awaiting analysis results. Screen cuttings composite
			from 360.4 ft to 370.4 ft BGS (see Well Log).
	1150	1303	Receive word of analysis: results are below action level. Pump out
			the pit.
	1303	1318	Start drill rig. Trip bit back to bottom. Blow excess water from
			borehole.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-845</u>
WELL INSTALLATION ACTIVITY/PROGRESS REPORT continued			
			PAGE 17 of 25
DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
2-18-98	1318	1323	Commence drilling using compressed air and water. Drill from
(cont.)			370.4 ft to 370.8 ft BGS.
	1323	1403	Large volume of return water blows table bushings out of the rig
			table. The strength of the water pulled the p-tong arm out of the
			hydraulic cylinder. Stop drilling. Pull bit off bottom. Shut off drill
			rig. The borehole is making just about too much water to deal with.
			Filled the pit approximately 1/2 full in only 5 minutes of drilling.
			Estimated water production is at 1000 gpm. Water is also beginning
			to undermine the rig jack support timbers. Collect sample #980218B
			from the lined pit.
	1403	1439	Deliver sample #980218B to ORNL for analysis.
	1439	1456	Return to GW-845 site. Discuss the situation with J. Stiner (MK-F)
			who suggests shutting down the operation for the rest of the day.
			He will notify project management of the situation. Secure site and
			depart.
2-19-98	0813	1002	Arrive at GW-845 site. Sample #980218B results less than action
			levels. Pump water out of the pits. J. Stiner and V. Turner (LMES)
			at site to discuss the situation. Safety is the main concern, and
			there will be no more drilling until it can continue safely.
	1002	1203	Oversight departs to attend teleconference with SAIC, LMES,
			MK-F, Jacobs Engineering (JE) and Department of Energy (DOE)
			personnel regarding the current situation. Outcome of the
			teleconference: the safety issues (rig support undermining and
			table bushings) must be remedied, but drilling should be continued
			to accomplish original objective of extending borehole to the top of
			the Nolichucky Shale. Will try installing a string of temporary
			casing to hold back the majority of the water.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-845</u>
WELL INSTALLATION ACTIVITY/PROGRESS REPORT continued			
			PAGE 18 of 25
DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
2-19-98	1203	1424	Return to GW-845 site. Additional drilling will have to occur before
(cont.)			the temporary casing can be seated because the bottom of the
			borehole is right in the middle of a water-bearing fracture zone.
			Crew re-secures the table bushings to the 13-in. casing. Crew
			also re-builds the straw-bale diversion wall to cover the jack-
			support timbers. Spread a piece of plastic on ground to help
			further retard erosion around the surface casing.
	1424	1433	Start drill rig. Trip bit back to bottom. Blow excess water out of the
			borehole.
	1433	1455	Commence drilling using compressed air and water. Drill from
			370.8 ft to 378.0 ft BGS. Encounter more fractures (fragmentary
			rock) at: 371.4-371.8 ft, 372.2 ft, 373.0-373.2 ft, 373.8-374.2 ft,
			375.0 ft, and 377.0 ft BGS; probably contributed minimal additional
			water.
	1455	1516	At 378.0 ft BGS. Lined pit is full. Pull bit off bottom. Shut off drill
			rig. Collect sample #980219 from lined pit.
	1516	1553	Deliver sample #980219 to ORNL for analysis.
	1553	1625	Return to GW-845 site. Screen cuttings composite from 370.8 ft
			to 378.0 ft BGS (see Well Log). LMES and MK-F have decided to
			continue drilling because of the improved drilling conditions, and
			because it would take at least 2 days (without encountering any
			difficulties) to run the temporary casing. Secure site and depart.
2-20-98	0809	0938	Arrive at GW-845 site. Sample #980219 results: less than action
			levels. Pump water out of the pits.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-845</u>
WELL INSTALLATION ACTIVITY/PROGRESS REPORT continued			PAGE 19 of 25
DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
2-20-98	0938	0951	Start drill rig. Trip bit back to bottom. Blow excess water out of the
(cont.)			borehole.
	0951	1010	Commence drilling using compressed air and water, auxiliary
			compressor is on-line. Drill from 378.0 ft to 385.7 ft BGS. Observe
			a sulfur odor at start. Fragmentary rock: 378.7 ft, 380.5-380.8 ft
			(along with a possible increase in water production), and 381.5 ft
			BGS. Fragmentary rock again: 382.0 ft to 382.4 ft, cavity: 382.4
			ft to 382.8 ft. Lost circulation momentarily at 382.8 ft BGS. Return
			water is slightly muddy when circulation is restored, and there
			appears to be yet another increase in water production. Observe
			a sulfur odor again. Fragmentary rock: 383.5 ft and 384.9-385.2 ft
			BGS.
	1010	1031	At 385.7 ft BGS. Lined pit is full. Pull bit off bottom. Shut off drill
			rig. Collect sample #980220A from lined pit.
	1031	1137	Deliver sample #980220A to ORNL for analysis. Return to
			GW-845 site. Awaiting analysis results. Screening cuttings
			composite from 378.0 ft to 385.7 ft BGS (see Well Log).
	1137	1246	Receive word of analysis: results are below action level. Pump out
			the pits.
	1246	1257	Start drill rig. Trip bit back to bottom. Blow excess water from hole.
	1257	1316	Commence drilling using compressed air and water. Drill from
			385.7 ft to 393.0 ft BGS. Fragmentary rock: 387.7-388.0 ft and
			390.0-390.5 ft.
	1316	1334	At 393.0 ft BGS. Lined pit is full. Pull bit off bottom. Shut off drill
			rig. Collect sample #980220B from lined pit.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-845</u>
WELL INSTALLATION ACTIVITY/PROGRESS REPORT continued			
			PAGE 20 of 25
DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
2-20-98	1334	1437	Deliver sample #980220B to ORNL for analysis. Return to
(cont.)			GW-845 site. Awaiting analysis results.
	1437	1540	Receive word of analysis: results are below action level. Pump out
			the pits. Screen cuttings from 385.7 ft to 393.0 ft BGS (see Well
			Log).
	1540	1547	Start drill rig. Trip bit back to bottom. Blow excess water from hole.
	1547	1600	Commence drilling using compressed air and water. Drill from
			393.0 ft to 395.5 ft BGS. Fragmentary rock: 394.3-394.5 ft and
			395.2-395.5 ft BGS.
	1600	1632	At 395.5 ft BGS. Lined pit is full. Pull bit off bottom. Shut off drill
			rig. Collect sample #980220C from lined pit. Screen cuttings
			composite from 393.0 ft to 395.5 ft BGS (see Well Log). Secure site
			and depart.
2-23-98	0848	1050	Arrive at GW-845 site. Note: Oversight delivered sample #980220C
			to ORNL for analysis prior to arriving at GW-845 site. Awaiting
			analysis results.
	1050	1150	Receive word of analysis: results are below action level. Pump out
			the pits.
	1150	1216	Start drill rig. Trip bit back to bottom. Blow excess water from hole.
	1216	1233	Commence drilling using compressed air and water. Drill from
			395.5 ft to 401.0 ft BGS. Fragmentary rock at 396.4 (return water
			is cream-colored). Possible increase in water at 397.4 ft BGS.
			Fragmentary rock: 398.0 ft to 400.9 ft BGS. Cavity/void: 399.4-
			400.0 ft; definite increase in water production.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-845</u>
WELL INSTALLATION ACTIVITY/PROGRESS REPORT continued			PAGE 21 of 25
DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
2-23-98	1233	1251	At 401.0 ft BGS. Lined pit is full. Pull bit off bottom. Shut off drill
(cont.)			rig. Collect sample #980223A from lined pit.
	1251	1401	Deliver sample #980223A to ORNL for analysis. Return to GW-
			845 site. Awaiting analysis results.
	1401	1515	Receive word of analysis: results are below action level. Pump out
			pits.
	1515	1526	Start drill rig. Trip bit back to bottom. Blow excess water from hole.
	1526	1543	Commence drilling using compressed air and water. Drill from
			401.0 ft to 407.8 ft BGS. Fragmentary rock: 401.0-402.6 ft, 403.0-
			403.7 ft, 404.4 ft, 405.1 ft, and 405.8 ft BGS. Cavity/void: 406.8-
			407.0 ft BGS (cream-colored returns, possible water increase).
	1543	1618	At 407.8 ft BGS. Lined pit is full. Pull bit off bottom. Shut off drill
			rig. Collect sample #980223B from lined pit. Screen cuttings
			composite from 401.0 ft to 407.8 ft BGS (see Well Log). Secure site
			and depart.
2-24-98	0838	0856	Arrive at GW-845 site. Note: Oversight delivered sample #980223B
			to ORNL for analysis prior to arriving at GW-845 site.
	0856	1000	Receive word of analysis: results are below action level. Pump out
			the pits.
	1000	1021	Start drill rig. Trip bit back to bottom. Blow excess water from hole.
	1021	1038	Commence drilling using compressed air and water. Drill from
			407.8 ft to 415.1 ft BGS. Drilled relatively smoothly for the entire
			interval.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-845</u>
WELL INSTALLATION ACTIVITY/PROGRESS REPORT continued			
			PAGE 22 of 25
DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
2-24-98	1038	1105	At 415.1 ft BGS. Lined pit is full. Pull bit off bottom. Shut off drill
(cont.)			rig. Collect sample #980224A from lined pit.
	1105	1242	Deliver sample #980224A to ORNL for analysis. Return to
			GW-845 site. Awaiting analysis results. Screen cuttings composite
			from 407.8 ft to 415.1 ft. BGS (see Well Log).
	1242	1346	Receive word of analysis: results are below action level. Pump out
			the pits.
	1346	1355	Start drill rig. Trip bit back to bottom. Blow excess water from hole.
	1355	1413	Commence drilling using compressed air and water. Drill from
			415.1 ft to 420.2 ft BGS. Fragmentary rock: 419.2-420.2 ft.
	1413	1429	At 420.2 ft BGS. Lined pit is full. Pull bit off bottom. Shut off drill
			rig. Collect sample #980224B from lined pit.
	1429	1637	Deliver sample #980224B to ORNL for analysis. Return to
			GW-845 site. Awaiting analysis results. Screen cuttings composite
			from 415.1 ft to 420.2 ft BGS (see Well Log).
	1637	1654	Receive word of analysis: results are below action level. Begin
			pumping the pits. Secure site and depart.
2-25-98	0755	0855	Arrive at GW-845 site. Continue pumping out the pits.
	0855	0925	Start drill rig. Trip bit back to bottom. Blow excess water from hole.
	0925	0942	Commence drilling using compressed air and water. Drill from
			420.2 ft to 425.2 ft BGS. Fragmentary rock: 422.0-422.6 ft,
			possible increase in water production.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-845</u>
WELL INSTALLATION ACTIVITY/PROGRESS REPORT continued			PAGE 23 of 25
DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
2-25-98	0942	0959	At 425.2 ft BGS. Lined pit is full. Pull bit off bottom. Shut off drill
(cont.)			rig. Collect sample #980225A from lined pit.
	0959	1059	Deliver sample #980225A to ORNL for analysis. Return to
			GW-845 site. Awaiting analysis results.
	1059	1209	Receive word of analysis: results are below action level. Pump out
			the pits. Screen cuttings composite from 420.2 ft to 425.2 ft BGS
			(see Well Log).
	1209	1218	Start drill rig. Trip bit back to bottom. Blow excess water from hole.
	1218	1235	Commence drilling using compressed air and water. Drill from
			425.2 ft to 431.6 ft BGS. Fragmentary rock: 429.4-429.8 ft and
			430.6 ft to 431.0 ft BGS. Drilling rate makes a marked increase at
			431.0 ft BGS. Observe shale fragments in returns below 431.0 ft
			BGS.
	1235	1252	At 431.6 ft BGS. Lined pit is full. Pull bit off bottom. Shut off drill
			rig. Collect sample #980225B from lined pit.
	1252	1352	Deliver sample #980225B to ORNL for analysis. Return to
			GW-845 site. Awaiting analysis results.
	1352	1459	Receive word on analysis: results are below action level. Pump out
			the pits. Screen cuttings composite from 425.2 ft to 431.6 ft BGS
			(see Well Log).
	1459	1509	Start drill rig. Trip bit back to bottom. Blow excess water from hole.
	1509	1525	Commence drilling using compressed air and water. Drill from
			431.6 ft to 438.3 ft BGS. Rig chatter occurring throughout most of

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-845</u>
WELL INSTALLATION ACTIVITY/PROGRESS REPORT continued			
			PAGE 24 of 25
DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
2-25-98	1509	1525	interval. Cuttings from 431.6 ft to 435.0 ft are approximately 50%
(cont.)	(cont.)	(cont.)	shale. Below 435.0 ft BGS, cuttings are all limestone.
	1525	1617	At 438.3 ft BGS. Lined pit is full. Pull bit off bottom. Shut off drill
			rig. Collect sample #980225C from lined pit. Screen cuttings
			composite from 431.6 ft to 438.3 ft BGS (see Well Log). A
			representative from Tennessee Department of Environment and
			Conservation (TDEC) at location to sample pit water for dye from
			a tracer study involving well GW-382. Secure site and depart.
2-26-98	1114	1212	Arrive at GW-845 site. Note: Oversight delivered sample #980225C
			to ORNL for analysis prior to arriving at GW-845 site. Also received
			word of analysis: results are below action level. Discussed
			placement of the Maynardville/Nolichucky contact with K. Jago
			(SAIC) who advises that the contact is placed at the top of the first
			shale occurrence below Zone 2 of the Maynardville Limestone. In
			that case, it is determined that the Nolichucky Shale has been
			reached. There will be no more drilling. Pump out the pits.
	1212	1258	Break for lunch.
	1258	1304	Start drill rig. Trip bit to bottom of borehole. Bit touches bottom at
			437.0 ft BGS (1.3 ft of fill in hole).
	1304	1420	Trip out tools. Rig down bit/stabilizer assembly.
	1420	1450	Thread a clevis into drill head. Attach a 4-hook choker to the 13-in.
			surface casing, and attempt to pull casing out of the ground: casing
			eventually comes out, but only after using a great deal of hold-back
			pressure. Lay the casing down.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-845</u>
WELL LOG			PAGE 1 of 6
LOCATION: <u>Eastern Y-12 Plant Area</u>		DATE: START: <u>1-28-98</u>	
DRILLERS: <u>R. Phillips - Highland Drilling Co.</u>		FINISH: <u>2-27-98</u>	
HELPERS: <u>J. Gallaher - Highland Drilling Co.</u>		DRILLING METHOD: <u>Air Rotary</u>	
DRILL: <u>Ingersoll-Rand XL-750</u>		LOGGED BY: <u>T. Coffey - SAIC</u>	
NOTES: <u>Open-interval well monitoring large interval of Maynardville Limestone. BGS: Below ground surface. Rock chip colors described while wet.</u>			
DEPTH (ft)		SAMPLE (NO. & INTERVAL)	SOIL/BEDROCK DESCRIPTION
FROM	TO		
0.0	1.0		Light gray (N7) to grayish-black (N2), miscellaneous undifferentiated gravel (from drill pad).
1.0	2.2		Dark yellowish-brown (10YR 4/2) to grayish-brown (5YR 3/2), moist, silty clay topsoil; minor gravel pad fragments.
2.2	19.8	Cuttings composite (0.0-8.2 ft): alpha = 0 cpm, beta/gamma = 50 cpm, pH = 8.3; organic vapors: 0.2 ppm	Light brown (5YR 5/6), moist, plastic, silty clay (residium); rare gravel pad fragments; plus rare pale yellowish-orange (10YR 8/6) chert fragments.
19.8	44.2		Top of fresh bedrock. Grayish-black (N2) to olive black (5Y 2/1), massive, medium-crystalline micrite with sparite common. Interval contains rare pellets and fossil fragments as well as scattered, thin, light gray (N7) beds of oolites. Small calcite veinlets observed. Note: the interval, 23.2 ft to 35.2 ft BGS, contains fragmentary rock and cavities. Very few rock cuttings were returned from aforementioned interval. Cavities noted at following depths:
			23.8 - 26.4 ft
			26.8 - 29.2 ft
			30.0 - 31.2 ft
			36.5 - 37.5 ft

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-845</u>
WELL LOG - continued			PAGE 2 of 6
DEPTH (ft)		SAMPLE (NO. & INTERVAL)	SOIL/BEDROCK DESCRIPTION
FROM	TO		
44.2	132.2	Cuttings composite	Grayish-black (N2) to olive black (5Y 2/1) pelletal micrite of above
		(8.2-74.4 ft): alpha =	continues and comprises 50-60% of the total interval. Brownish-
		0 cpm, beta/gamma =	gray (5YR 4/1), massive, very finely-crystalline micrite with scattered
		50 cpm, pH = 9.2,	and rare intraclasts make up another 30-40% of the interval. Some
		organic vapors:	large fragments exhibit bedding near bottom of the interval. Between
		7.0 ppm	44.2 ft and 94.2 ft BGS a dusky yellow (5Y 6/4), thinly laminated,
			lithified, shale-like sediment that probably occupies some of the
			cavities is observed. This material sometimes occurs in a cemented,
			granular (sandy) form. Cavities noted at following depths:
			45.0 - 45.8 ft
			55.0 - 55.9 ft
			Zone of fragmentary rock (possibly a fracture zone) from 85.5 ft to
			88.5 ft BGS (with a possible cavity: 85.6 - 85.9 ft).
132.2	144.2	Cuttings composite	Predominantly black (N1), massive, finely crystalline micrite with
		(74.4-144.2 ft): alpha =	minor sparite occurrences. The grayish-black (N2) to olive black
		0 cpm, beta/gamma =	(5Y 2/1) pelletal micrite of above decreasing. Minor pale yellowish-
		50 cpm, pH = 9.2,	brown (10YR 6/2) to yellowish-gray (5Y 7/2), massive micrite/
		organic vapors:	intramicrite. Possibly the top of Zone 3 of the Maynardville
		5.0 ppm	Limestone.
144.2	194.2	Cuttings composite	The pale yellowish-brown (10YR 6/2) micrite of above continues
		(144.2-169.2 ft): alpha	and comprises 40-50% of the interval. The remainder of the
		= 0 cpm, beta/gamma	interval consists of grayish-brown (5YR 3/2), massive, mottled
		= 50 cpm, pH = 9.1,	micrite with sparite abundant. Thin beds of intraclasts, pellets, and
		organic vapors =	ooliths are scattered throughout the interval. Possible fractures at
		3.6 ppm	177.0 ft and 184.0 ft BGS.
194.2	246.0	Cuttings composite	Brownish-black (5YR 2/1), mostly massive (sometimes mottled)
		(169.2-219.2 ft): alpha	micrite with minor sparite occurrences. The mottling predominates
		= 0 cpm, beta/gamma	with depth. Rock becomes oolitic (oolitic) near bottom of this
		= 40 cpm, pH = 10.1,	interval. Also, approximately 20% of rock near bottom of interval

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-845</u>
WELL LOG - continued			PAGE 3 of 6
DEPTH (ft)		SAMPLE (NO. & INTERVAL)	SOIL/BEDROCK DESCRIPTION
FROM	TO		
		organic vapors =	is pale yellowish-brown (10YR 6/2), massive, finely-crystalline
		12.0 ppm	micrite. Fracture zone (with water) at 223.8-224.0 ft BGS. Another
			possible fracture at 245.5 ft BGS. Fragments from water-bearing
			fractures are stained dark yellowish-orange (10YR 6/6) to light
			brown (5YR 4/4) due to iron oxide.
246.0	274.0	Cuttings composite	Brownish-gray (5YR 4/1) to olive black (5Y 2/1), massive oolitic
		(219.2-254.0 ft): alpha	micrite/oomicrite. Iron oxide staining common on fragments near
		= 0 cpm, beta/gamma	water-bearing fractures. Calcite veining and infilling with subhedral
		= 40 cpm, pH = 9.9,	to euhedral crystals also observed in fracture zones. Fractures
		organic vapors =	noted at following depths: 246.7 ft, 248.9 ft, 252.8 ft (water-
		1.2 ppm	bearing), 256.2 ft, 261.0 ft (water-bearing), and 264.3 ft BGS.
274.0	281.0	Cuttings composite	Medium gray (N5) to olive gray (5Y 4/1), mottled (bioturbated?),
		(254.0-278.5 ft): alpha	stylolitic micrite with locally abundant intraclasts. Unit is
		= 0 cpm, beta/gamma	characterized by having thin, wisp-like shale partings. Zone 2 of
		= 40 cpm, pH = 9.5,	the Maynardville Limestone. Water-bearing fracture zone: 278.5-
		organic vapors =	280.0 ft BGS.
		1.4 ppm	
281.0	312.0	Cuttings composite	Brownish-black (5YR 2/1), massive oomicrite. Microcrystalline
		(278.5-300.5 ft): alpha	calcite cement is generally very light gray (N8) in color. Oolith size
		= 0 cpm, beta/gamma	increases with depth. Fractures: 295.2 ft, 298.0-300.2 ft (water-
		= 50 cpm, pH = 9.4,	bearing), 304.5 ft (water-bearing), 306.0 ft (water-bearing), and
		organic vapors =	307.7-308.2 ft BGS.
		4.3 ppm	
312.0	395.5	Cuttings composite	Medium gray (N5) to olive gray (5Y 4/1), mottled (bioturbated?),
		(300.5-318.8 ft): alpha	stylolitic micrite with locally abundant intraclasts. Unit contains the
		= 0 cpm, beta/gamma	characteristic thin, wisp-like shale partings as the 274.0-281.0 ft
		= 40 cpm, pH = 9.6,	interval above. Rock becomes darker and wisp-like shale partings
		organic vapors =	become less apparent with depth. Fractures/fracture zones noted

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-845

WELL LOG - continued

PAGE 4 of 6

DEPTH (ft)		SAMPLE (NO. & INTERVAL)	SOIL/BEDROCK DESCRIPTION	
FROM	TO			
		2.5 ppm	at following depths: 321.6 ft, 325.9-329.2 ft, 334.0-334.6 ft (water-	
			bearing), 350.2 ft, 358.4 ft, 370.2-370.6 ft (water-bearing), 371.4-	
		Cuttings composite	371.8 ft, 372.2 ft, 373.0-373.2 ft, 373.8-374.2 ft, 375.0 ft, 377.0 ft,	
		(318.8-334.0 ft): alpha	378.7 ft, 380.5-380.8 ft (water-bearing), 381.5 ft, 382.0-382.8 ft	
		= 0 cpm, beta/gamma	(water-bearing with a cavity/void: 382.4-382.8 ft), 383.5 ft, 384.9-	
		= 40 cpm, pH = 9.3,	385.2 ft, 387.7-388.0 ft, 390.0-390.5 ft, 394.3-394.5 ft, and 395.2-	
		organic vapors =	395.5 ft.	
		0.7 ppm		
			Sample data continued:	
		Cuttings composite	Cuttings composite	Cuttings composite
		(334.0-344.0 ft): alpha	(370.8-378.0 ft):	(378.0-385.7 ft):
		= 0 cpm, beta/gamma	alpha - 0 cpm,	alpha - 0 cpm,
		= 40 cpm, pH = 9.7,	beta/gamma = 40 cpm	beta/gamma = 40 cpm,
		organic vapors =	pH = 9.3, organic	pH = 9.2, organic
		0.6 ppm	vapors = 0.4 ppm	vapors = 0.1 ppm
		Cuttings composite	Cuttings composite	Cuttings composite
		(344.0-360.4 ft): alpha	(385.7-393.0 ft):	(393.0-395.5 ft):
		= 0 cpm, beta/gamma	alpha = 0 cpm,	alpha = 0 cpm,
		= 40 cpm, pH = 9.3,	beta/gamma = 40 cpm	beta/gamma = 40 cpm,
		organic vapors =	pH = 9.5, organic	pH = 9.3, organic
		0.9 ppm	vapors = 0.2 ppm	vapors = 0.0 ppm
		Cuttings composite		
		(360.4-370.4 ft): alpha		
		= 0 cpm, beta/gamma		
		= 50 cpm, pH = 9.5,		
		organic vapors =		
		0.2 ppm		
395.5	431.0	Cuttings composite	Light brownish-gray (5YR 6/1) to brownish-gray (5YR 4/1), mottled	
		(395.5-401.0 ft): alpha	(bioturbated?), stylolitic micrite with locally abundant intraclasts;	

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-845</u>
WELL LOG - continued			
			PAGE 5 of 6
DEPTH (ft)		SAMPLE (NO. & INTERVAL)	SOIL/BEDROCK DESCRIPTION
FROM	TO		
		= 0 cpm, beta/gamma	plus greenish-gray (5GY 6/1), massive, very finely-crystalline
		= 40 cpm, pH = 9.4,	micrite. Unit still has the thin, wisp-like shale partings, but they
		organic vapors =	appear to grow less apparent with depth. Unit also has areas of
		0.2 ppm	iron oxide staining (water-bearing fractures) and some occurrences
			of granular calcite veining/infilling in the larger fractures. Fractures/
		Cuttings composite	fracture zones noted at following depths: 396.4 ft, 397.4 ft (water-
		(401.0-407.8 ft): alpha	bearing), 398.0-400.9 ft (with a cavity/void: 399.4-400.0 ft), 401.0-
		= 0 cpm, beta/gamma	402.6 ft, 403.0-403.7 ft, 404.4 ft, 405.1 ft, 405.8-407.8 ft (with a
		= 40 cpm, pH = 9.5,	cavity/void: 406.8-407.0 ft), 408.0-409.0 ft, 419.2-420.2 ft (water-
		organic vapors =	bearing), 422.0-422.6 ft (water-bearing), 429.4-429.8 ft, and 430.6-
		0.4 ppm	431.0 ft.
		Cuttings composite	
		(407.8-415.1 ft): alpha	
		= 0 cpm, beta/gamma	
		= 40 cpm, pH = 9.3,	
		organic vapors =	
		0.2 ppm	
		Cuttings composite	
		(415.1-420.2 ft): alpha	
		= 0 cpm, beta/gamma	
		= 50 cpm, pH = 9.3,	
		organic vapors =	
		0.1 ppm	
		Cuttings composite	
		(420.2-425.2 ft): alpha	
		= 0 cpm, beta/gamma	
		= 40 cpm, pH = 9.2,	
		organic vapors =	
		0.1 ppm	

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-845

WELL CUTTINGS FIELD SCREENING / DISPOSAL FORM

Page 1 of 1

LOCATION: Eastern Y-12 Plant Area

DATE: START: 1-28-98

APPROX. VOLUME OF CUTTINGS: 228.6 cubic ft.

FINISH: 2-27-98

CALIBRATION OF INSTRUMENTS: Check those calibrated to manufacturer's specifications.

pH meter	<u>X</u>	(model)	<u>Horiba Model U-7</u>
Organic vapor meter	<u>X</u>	(model)	<u>Century-Foxboro OVA Model 128</u>
Beta/gamma meter	<u>X</u>	(model)	<u>Ludlum Model 3 Survey Meter with G-M Pancake Probe</u>
Alpha meter	<u>X</u>	(model)	<u>Ludlum Model 12 Count Ratemeter with Scintillation Tube Probe</u>

FIELD SCREENING RESULTS (background/highest observed values):

pH	<u>10.1</u>	Date/Time	<u>2-11-98/1330</u> (4.0-10.5)
Organic vapors	<u>1 ppm/13 ppm</u>	Date/Time	<u>2-11-98/1328</u> (<10 ppm above background) <u>2-13-98/1155</u>
Beta/Gamma	<u>40 cpm/50 cpm</u>	Date/Time	<u>2-18-98/1144</u> (<100 cpm above background) <u>2-24-98/1518</u>
Alpha	<u>0 cpm/0 cpm</u>	Date/Time	<u>All Readings</u> (<500 cpm above background)

Weather: Refer to field logbook

Temp.: Refer to field logbook

DISPOSITION: Drill-site Disposal X

Containerization N/A
(Labeled?) y / n

Describe: Cuttings discharged to lined pit on location.

On-site Geologist (print): Timothy Coffey - SAIC

Signature: *Timothy Coffey for Tim Coffey*

Date: 2-27-98

MONITORING WELL REDEVELOPMENT PROGRESS

ONE WELL VOLUME: 1084.5 GALLONS

WELL INSTALLATION
COMPLETION DATE: 2-27-98

RESULTS AT END OF DEVELOPMENT

Pump used is a Red Jacket brand, 1 hp submersible pump. Pumping rate averaged approximately 13 gpm throughout development.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-845

MONITORING WELL REDEVELOPMENT SUMMARY

METHOD OF DEVELOPMENT: Pumping

DEVELOPMENT DATE:

DEVELOPMENT OBSERVED BY: T. Coffey - SAICSTART: 3-3-98FINISH: 3-3-98ONE WELL VOLUME: 1084.5 GALLONSTOTAL GALLONS PUMPED: 4000 TOTAL WELL VOLUMES PUMPED: 3.7INITIAL pH: 7.2 FINAL pH: 7.2INITIAL SPECIFIC CONDUCTANCE: 378 μ mhos/cm FINAL: 389 μ mhos/cmDESCRIPTION OF INITIAL TURBIDITY: ClearDESCRIPTION OF FINAL TURBIDITY: ClearFINAL MEASURED TURBIDITY: Not MeasuredWELL APPROVED BY: V. Turner - LMESODOR OF WATER: None Discernable

WATER DISCHARGED TO: ☐ GROUND SURFACE ☐ TANK TRUCK
☐ STORM SEWERS ☐ STORAGE TANKS
☐ DRUMS ☒ OTHER Lined Pit

INITIAL PRE-DEVELOPMENT
WATER DEPTH: 23.0 ft BGS on 2-27-98DEVELOPMENT OBSERVATIONS: Well is an excellent producer. Water level in well dropped a maximum of 1.6 ft during development.OBSERVER SIGNATURE: *Tim Coffey* ^{for} Tim CoffeyDATE: 3-3-98

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-845

WELL WATER FIELD SCREENING / DISPOSAL FORM

Page 1 of 1

LOCATION: Eastern Y-12 Plant Area

DATE: START: 3-3-98

APPROX. VOLUME OF WATER: 4000 gallons

FINISH: 3-3-98

CALIBRATION OF INSTRUMENTS: Check those calibrated to manufacturer's specifications.

pH meter	<u>X</u>	(model)	<u>Horiba Model U-7</u>
Sp. Cond. meter	<u>X</u>	(model)	<u>YSI S-C-T Meter Model 33</u>
Organic vapor meter	<u>X</u>	(model)	<u>Century-Foxboro OVA Model 128</u>
Beta/gamma meter	<u>X</u>	(model)	<u>Ludlum Model 3 Survey Meter with G-M Pancake Probe</u>
Alpha meter	<u>X</u>	(model)	<u>Ludlum Model 12 Count Ratemeter with Scintillation Tube Probe</u>

FIELD SCREENING RESULTS:

Date	Time	pH	Sp. Cond.	Organic Vapors	Beta/Gamma	Alpha
<u>3-3-98</u>	<u>0911</u>	<u>7.2</u>	<u>378 µmhos/cm</u>	<u>0.8 ppm</u>	<u>40 cpm</u>	<u>0 cpm</u>
<u>3-3-98</u>	<u>1022</u>	<u>7.2</u>	<u>376 µmhos/cm</u>	<u>0.6 ppm</u>	<u>40 cpm</u>	<u>0 cpm</u>
<u>3-3-98</u>	<u>1138</u>	<u>7.2</u>	<u>381 µmhos/cm</u>	<u>0.7 ppm</u>	<u>40 cpm</u>	<u>0 cpm</u>
<u>3-3-98</u>	<u>1259</u>	<u>7.2</u>	<u>372 µmhos/cm</u>	<u>0.2 ppm</u>	<u>40 cpm</u>	<u>0 cpm</u>
<u>3-3-98</u>	<u>1415</u>	<u>7.2</u>	<u>389 µmhos/cm</u>	<u>0.5 ppm</u>	<u>40 cpm</u>	<u>0 cpm</u>

(4.0-10.5)

(<1000 umhos/cm)

(<5 ppm)

(<100 cpm)

(<500 cpm)

Weather: Cloudy to partly cloudy, windy, snow flurries

Temp.: Upper 20's to upper 30's °F

DISPOSITION: Drill-site Disposal X

Containerization
(Labeled?) y/n

Describe: Development water discharged to lined pit on location. Upon receipt of "clean" analysis results, water discharged to ground surface.

On-site Geologist (print): Timothy Coffey - SAIC

Signature: *Timothy Coffey*

Date: 3-3-98

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM		WELL NO. <u>GW-845</u>		
EQUIPMENT DECONTAMINATION INSPECTION SUMMARY		INSTALLATION ☒		
		P&A ☐		
LOCATION: <u>Eastern Y-12 Plant Area</u>		DATE: START: <u>1-28-98</u>		
DECONTAMINATION CREW: <u>R. Phillips - Highland Drilling Co.</u>		FINISH: <u>3-3-98</u>		
		<u>J. Gallaher - Highland Drilling Co.</u>		
EQUIPMENT	DECON DATE	INSPECTION DATE	INSPECTION (PASS/FAIL)	INSPECTOR'S INITIALS
DRILL RIG <u>Ingersoll-Rand XL-750</u> (Mast, Chassis, Cables, Carousel, Hoses, Etc.)	1-15-98	1-28-98	Pass	TJC
DRILLING TOOLS (Pipe Wrenches, Hand Tools, Lifting Bells, Clevis, Chains, Etc.)	1-15-98	1-28-98	Pass	TJC
DOWN HOLE TOOLS (Drilling Rods, Stabilizers, Washover Pipe, Bits, Etc.)	1-22-98	1-28-98	Pass	TJC
WELL CONSTRUCTION MATERIALS (Casing, Screen, Centralizers, Etc.)	See Below	See Below	See Below	See Below
WORKOVER RIG _____ (Mast, Chassis, Cables, Hoses, Etc.)	NA	--	--	--
DEVELOPMENT TOOLS (Tubing, Bailers, Pumps, Etc.)	2-27-98	3-2-98	Pass	TJC
OTHER EQUIPMENT OR RE-INSPECTIONS (SPECIFY)				
Hole opener stabilizer	1-30-98	2-2-98	Pass	TJC
Casing (13 3/8-in. OD, 12 3/4-in. ID)*	2-2-98	2-2-98	Pass	TJC
Casing (8 5/8-in. OD, 8 1/8-in. ID)*	2-6-98	2-6-98	Pass	TJC
COMMENTS: *Casing sandblasted and steam-cleaned by manufacturer, casing steam-cleaned on date indicated to clean threads of grease.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-902

WELL INSTALLATION DIAGRAM

LOGGED BY: Timothy Coffey - SAIC

DRILLING DATES

DRILLING COMPANY: Law EngineeringSTARTED: 1/20/98DRILLER: John VoekelHELPER: Jimmy WarrenFINISHED: 1/20/98

NOT TO SCALE

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-902</u>
WELL INSTALLATION ACTIVITY/PROGRESS REPORT continued			
			PAGE 2 of 3
DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
1-20-98	1146	1156	Auger refusal at 31.8 ft BGS. Spin augers to clean out the
(cont.)			borehole. Break augers loose from drill head. Pull out center
			clean-out rods. Tag bottom of borehole at 31.6 ft BGS.
	1156	1209	Prepare well construction materials. Cut screen section and glue
			cap on bottom end. Well construction materials tally:
			Screen: 1, 8.0-ft section of 2 3/8-in. OD, 2-in. ID, slotted,
			schedule 40 PVC screen (cap is approximately 0.05 ft long,
			glued onto bottom end of screen).
			Riser: 3, 10-ft sections of 2 3/8-in. OD, 2-in. ID, schedule 40
			PVC casing.
			Total length of screen, cap, and riser casing is 38.05 ft. Run the
			screen and casing into the borehole, inside of the augers. Casing
			stick-up = 6.4 ft. Bottom of the screen is at 31.6 ft BGS, top of the
			screen is at 23.55 ft BGS. Cut off 2.6 ft of the casing stick-up. Pull
			up and remove 1 auger flyte.
	1209	1305	Pour 3 1/4, 50-lb sacks of very fine-grained filter pack sand (no
			grain size indicated) into the annulus (sand bridges frequently
			between casing and augers). Sand pack level to 22.5 ft BGS.
			Screen cuttings composite sample (see Well Cuttings Field
			Screening/Disposal Form).
	1305	1345	Break for lunch.
	1345	1400	Return to GW-902 site. Begin pouring Easy Seal™, a fine-
			grained granular bentonite, into the annulus. The bentonite
			immediately bridges between the casing and augers forming a
			plug which the drill crew is unable to clear.

WELL NO. GW-902

PAGE 3 of 3

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM		WELL NO. <u>GW-902</u>	
WELL LOG		PAGE 1 of 1	
LOCATION: <u>West Bear Creek Valley</u>		DATE: START: <u>1-20-98</u>	
DRILLERS: <u>J. Voekel - Law Engineering</u>		FINISH: <u>1-20-98</u>	
HELPERS: <u>J. Warren - Law Engineering</u>		DRILLING METHOD: <u>Hollow-stem Auger</u>	
DRILL: <u>CME Model 550</u>		LOGGED BY: <u>T. Coffey - SAIC</u>	
NOTES: <u>Soil and rock colors from GSA Rock-color chart. BZA: Breathing zone analysis. BGS: below ground surface. Bkgd: background.</u>			
DEPTH (ft)		SAMPLE (NO. & INTERVAL)	SOIL/BEDROCK DESCRIPTION
FROM	TO		
0.0	6.0	BZA at 3.2 ft = 2.0 ppm (Bkgd).	Dark yellowish-orange (10YR 6/6), dry, silty soil. Rare clay.
6.0	24.5	BZA at 9.0, 11.5, 17.0, and 22.0 ft = 2.0 ppm (Bkgd).	Moderate yellowish-brown (10YR 5/4), moist, silty sub-soil/ residuum. Clay content increases below 9.0 ft BGS. Begin to see scattered fragments of weathered shale also at 9.0 ft BGS. Possible thin bed of weathered shale at 11.0 - 11.5 ft BGS. Cuttings quite moist at 15.0 ft BGS (suspect groundwater table). Wet zone: 22.0 ft to 23.0 ft BGS.
24.5	26.5	BZA at 26.0 ft = 2.0 ppm (Bkgd).	Top of weathered bedrock at 24.5 ft BGS. Moderate olive brown (5Y 4/4) to dark greenish-gray (5G 4/1), thinly laminated (weathered) shale.
26.5	29.5	BZA at 29.5 ft = 1.5 ppm (Bkgd).	Olive gray (5Y 3/2), moist, clayey soil with abundant weathered shale fragments. Interval is either a zone of extremely weathered shale or a clay-filled void.
29.5	31.8	Cuttings composite (0.0- 31.8 ft BGS): alpha = 0 cpm, beta/gamma = 80 cpm, pH = 5.5; organic vapors = 4.7 ppm (Bkgd = 1.7 ppm).	Top of fresh bedrock at 29.5 ft BGS. Dark gray (N3) to grayish- black (N2), thinly laminated shale. Total depth = 31.8 ft (auger refusal).

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM		WELL NO. <u>GW-902</u>
WELL CUTTING FIELD SCREENING/DISPOSAL FORM		PAGE 1 of 1

LOCATION: West Bear Creek Valley DATE: START: 1-20-98

APPROX. VOLUME OF CUTTINGS: 7.3 cubic ft. FINISH: 1-20-98

CALIBRATION OF INSTRUMENTS: Check those calibrated to manufacturer's specifications.

pH meter	<u>X</u>	(model)	<u>Horiba Model U-7</u>
Organic vapor meter	<u>X</u>	(model)	<u>Century-Foxboro OVA Model 128</u>
Beta/gamma meter	<u>X</u>	(model)	<u>Ludlum Model 3 Survey Meter with G-M Pancake Probe</u>
Alpha meter	<u>X</u>	(model)	<u>Ludlum Model 12 Count Ratemeter with Scintillation Tube Probe</u>

FIELD SCREENING RESULTS: (background/highest observed values):

pH	<u>5.5</u>	Date/Time	<u>1-20-98/1300</u> (4.0-10.5)
Organic vapors	<u>1.7 ppm/4.7 ppm</u>	Date/Time	<u>1-20-98/1250</u> (<10 ppm above background)
Beta/Gamma	<u>60 cpm/80 cpm</u>	Date/Time	<u>1-20-98/1220</u> (<100 cpm above background)
Alpha	<u>0 cpm/0 cpm</u>	Date/Time	<u>1-20-98/1216</u> (<500 cpm above background)

Weather: Clear to mostly clear, dry Temp.: Mid-20's to mid-40's°F.

DISPOSITION: Drill-site Disposal X Containerization (Labeled?) y/n N/A

Describe: Some of the cuttings used to backfill well annulus; remaining cuttings scattered around the well site.

On-site Geologist (print): Timothy Coffey - SAIC

Signature: Date: January 20, 1998

[illegible]

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-904

WELL INSTALLATION DIAGRAM

LOGGED BY: Brett J. Heffernan - Jacobs EM Team

DRILLING DATES

DRILLING COMPANY: Highland DrillingSTARTED: 7/22/98DRILLER: Randy PhillipsHELPER: Ken FortnerFINISHED: 8/5/98

NOT TO SCALE

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM		WELL NO. <u>GW-904</u>																																																			
WELL LOG		PAGE 1 of 2																																																			
LOCATION: <u>Oil Landfarm</u>		DATE: START: <u>7-22-98</u>																																																			
DRILLER: <u>Randy Phillips - Highland Drilling Co.</u>		FINISH: <u>8-5-98</u>																																																			
HELPER: <u>Ken Fortner - Highland Drilling Co.</u>		DRILLING METHOD: <u>Air Rotary</u>																																																			
DRILL: <u>Ingersoll-Rand XL-750</u>		LOGGED BY: <u>Brett J. Heffernan</u>																																																			
NOTES: <u>Stainless steel screened well installed as part of the Oak Ridge Reservation Disposal Cell</u> <u>Characterization Project investigations.</u>																																																					
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="text-align: center;">DEPTH (ft)</th> <th rowspan="2" style="text-align: center;">SAMPLE (NO. & INTERVAL)</th> <th rowspan="2" style="text-align: center;">SOIL/BEDROCK DESCRIPTION</th> </tr> <tr> <th style="text-align: center;">FROM</th> <th style="text-align: center;">TO</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0.0</td> <td style="text-align: center;">5.0</td> <td></td> <td>Silty, sandy, clayey weathered shale; dark brown (7.5 YR 4/6). Shale is olive gray (5 Y 3/2), medium- to fine-grained, poorly sorted, dry, non-plastic.</td> </tr> <tr> <td style="text-align: center;">5.0</td> <td style="text-align: center;">16.0</td> <td></td> <td>Silty, sandy, clayey weathered shale; dark brown (7.5 YR 4/6). Shale is olive gray (5 Y 3/2), medium- to fine-grained, poorly sorted, dry, non-plastic.</td> </tr> <tr> <td style="text-align: center;">16.0</td> <td style="text-align: center;">31.0</td> <td></td> <td>Silty, sandy, clayey weathered shale; dark brown (7.5 YR 4/6). Shale is olive gray (5 Y 3/2), medium- to fine-grained, poorly sorted, dry, non-plastic.</td> </tr> <tr> <td style="text-align: center;">31.0</td> <td style="text-align: center;">33.0</td> <td></td> <td>Shaley, silty weathered limestone; olive gray (5 Y 4/1); dry.</td> </tr> <tr> <td style="text-align: center;">33.0</td> <td style="text-align: center;">67.0</td> <td></td> <td>Shaley, silty limestone; olive gray (5 Y 4/1); dry; hard.</td> </tr> <tr> <td style="text-align: center;">67.0</td> <td style="text-align: center;">115.0</td> <td></td> <td>Shaley limestone, olive gray (5 Y 4/1), some calcite deposits.</td> </tr> <tr> <td style="text-align: center;">115.0</td> <td style="text-align: center;">190.0</td> <td></td> <td>Shaley limestone, olive gray (5 Y 4/1), some calcite deposits and pink dolomite nodules.</td> </tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> </tbody> </table>				DEPTH (ft)		SAMPLE (NO. & INTERVAL)	SOIL/BEDROCK DESCRIPTION	FROM	TO	0.0	5.0		Silty, sandy, clayey weathered shale; dark brown (7.5 YR 4/6). Shale is olive gray (5 Y 3/2), medium- to fine-grained, poorly sorted, dry, non-plastic.	5.0	16.0		Silty, sandy, clayey weathered shale; dark brown (7.5 YR 4/6). Shale is olive gray (5 Y 3/2), medium- to fine-grained, poorly sorted, dry, non-plastic.	16.0	31.0		Silty, sandy, clayey weathered shale; dark brown (7.5 YR 4/6). Shale is olive gray (5 Y 3/2), medium- to fine-grained, poorly sorted, dry, non-plastic.	31.0	33.0		Shaley, silty weathered limestone; olive gray (5 Y 4/1); dry.	33.0	67.0		Shaley, silty limestone; olive gray (5 Y 4/1); dry; hard.	67.0	115.0		Shaley limestone, olive gray (5 Y 4/1), some calcite deposits.	115.0	190.0		Shaley limestone, olive gray (5 Y 4/1), some calcite deposits and pink dolomite nodules.																
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Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-904

PAGE 2 of 2

WELL LOG (continued)[illegible]

Y-12 PLANT GROUNDWATER PROTECTION PROGRAMWELL NO: GW-904**MONITORING WELL DEVELOPMENT PROGRESS**

Page 1 of 1

LOCATION: Y-12 Plant

WELL INSTALLATION

ONE WELL VOLUME: 183.5 GALLONSCOMPLETION DATE: 8/15/98

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	pH	CONDUCTIVITY ms/cm	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
8/13/98	0	Very Turbid	9.90	1.00	0	0	Light Brown
8/13/98	10	Very Turbid	10.01	0.909	10	0.05	Light Brown
8/13/98	10	Very Turbid	10.02	0.858	20	0.11	Light Brown
8/13/98	10	Very Turbid	10.05	1.06	30	0.16	Light Brown
8/13/98	10	Very Turbid	9.58	0.950	40	0.22	Light Brown
8/13/98	10	Very Turbid	9.66	0.990	50	0.27	Light Brown
8/13/98	10	Very Turbid	9.73	1.01	60	0.33	Light Brown
8/13/98	20	Very Turbid	9.76	1.02	80	0.44	Light Brown
8/13/98	20	Very Turbid	9.79	1.03	100	0.54	Light Brown
8/13/98	25	Very Turbid	9.82	1.04	125	0.68	Light Brown
8/13/98	25	Very Turbid	9.71	1.01	150	0.82	Light Brown
8/13/98	25	Very Turbid	9.74	1.01	175	0.95	Light Brown
8/13/98	25	Very Turbid	9.58	0.97	200	1.09	Light Brown
8/13/98	25	Turbid	9.40	0.94	225	1.23	Light Gray
8/13/98	25	Turbid	9.35	0.92	250	1.36	Light Gray
8/13/98	25	Turbid	9.40	0.93	275	1.50	Light Gray
8/13/98	25	Turbid	9.40	0.94	300	1.63	Light Gray
8/13/98	25	Turbid	9.49	0.94	325	1.77	Light Gray
8/13/98	25	Turbid	9.48	0.95	350	1.91	Light Gray
8/13/98	25	Turbid	9.51	0.92	375	2.04	Light Gray
8/13/98	25	Turbid	9.51	0.93	400	2.18	Light Gray
8/13/98	25	Turbid	9.52	0.92	425	2.32	Light Gray
RESULTS AT END OF DEVELOPMENT		Turbid	9.52	0.92	425	2.32	

COMMENTS:

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM		WELL NO. <u>GW-904</u>
MONITORING WELL DEVELOPMENT SUMMARY		PAGE 1 of 1
METHOD OF DEVELOPMENT: <u>2-in. Submersible Grundros Pump</u>		DEVELOPMENT DATE:
DEVELOPMENT OBSERVED BY: <u>Brett J. Heffernan</u>		START: <u>8/13/98</u>
ONE WELL VOLUME: <u>183.5</u> GALLONS		FINISH: <u>8/13/98</u>
TOTAL GALLONS PUMPED: <u>425</u>	TOTAL WELL VOLUMES PUMPED: <u>2.32</u>	
INITIAL pH: <u>9.90</u>	FINAL pH: <u>9.52</u>	
INITIAL SPECIFIC CONDUCTANCE: <u>1.00 ms/cm</u>		FINAL: <u>0.92 ms/cm</u>
DESCRIPTION OF INITIAL TURBIDITY: <u>very turbid, light brown</u>		
DESCRIPTION OF FINAL TURBIDITY: <u>turbid, light gray</u>		
FINAL MEASURED TURBIDITY: <u>456 NTU</u>		
WELL APPROVED BY: <u>Bechtel Jacobs Company LLC</u>		
ODOR OF WATER: <u>N/A</u>		
WATER DISCHARGED TO: ☒ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANKS ☐ DRUMS ☐ OTHER		
INITIAL PRE-DEVELOPMENT WATER DEPTH: <u>14.31 ft below TOC</u>		
DEVELOPMENT OBSERVATIONS:		
OBSERVER SIGNATURE: <u>Brett J. Heffernan</u>		
DATE: <u>August 24, 1998</u>

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-905

WELL INSTALLATION DIAGRAM

LOGGED BY: Brett J. Heffernan - Jacobs EM Team

DRILLING DATES

DRILLING COMPANY: Highland DrillingSTARTED: 7/15/98DRILLER: Scott GilbertHELPER: Ken FortnerFINISHED: 7/20/98

NOT TO SCALE

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-905

MONITORING WELL DEVELOPMENT SUMMARY

PAGE 1 of 1

METHOD OF DEVELOPMENT: 2-in. Submersible Grundfos Pump

DEVELOPMENT DATE:

DEVELOPMENT OBSERVED BY: Brett J. HeffernanSTART: 8/12/98FINISH: 8/12/98ONE WELL VOLUME: 20.20 GALLONSTOTAL GALLONS PUMPED: 70 TOTAL WELL VOLUMES PUMPED: 3.47INITIAL pH: 9.66 FINAL pH: 7.89INITIAL SPECIFIC CONDUCTANCE: 0.418 ms/cm FINAL: 0.354 ms/cmDESCRIPTION OF INITIAL TURBIDITY: ClearDESCRIPTION OF FINAL TURBIDITY: slightly turbid, light brownFINAL MEASURED TURBIDITY: 57 NTUWELL APPROVED BY: Bechtel Jacobs Company LLCODOR OF WATER: N/A

WATER DISCHARGED TO: ☒ GROUND SURFACE ☐ TANK TRUCK
☐ STORM SEWERS ☐ STORAGE TANKS
☐ DRUMS ☐ OTHER

INITIAL PRE-DEVELOPMENT

WATER DEPTH: 23.20 ft below TOC

DEVELOPMENT OBSERVATIONS:

OBSERVER SIGNATURE: Brett J. HeffernanDATE: August 24, 1998

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-906

WELL INSTALLATION DIAGRAM

LOGGED BY: Karen L. Speed - Jacobs EM Team

DRILLING DATES

DRILLING COMPANY: U.S. Army Corps of Engineers (USACE)STARTED: 6/22/98DRILLER: James DarnellHELPER: Ron ReidFINISHED: 6/24/98

NOT TO SCALE

NOTE: Well location is offset approximately 10 ft from original location.
Lithologic and rock core descriptions are based on original/abandoned location.
Cored from 31.1 ft to 39.9 ft at abandoned location.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-906</u>
WELL LOG			PAGE 1 of 2
LOCATION: <u>Oil Landfarm</u>		DATE: START: <u>6-22-98</u>	
DRILLER: <u>James Darnell - USACE</u>		FINISH: <u>6-24-98</u>	
HELPER: <u>Ron Reid - USACE</u>		DRILLING METHOD: <u>Hollow Stem Auger</u>	
DRILL: <u>CME 75</u>		LOGGED BY: <u>Karen L. Speed</u>	
NOTES: <u>Well location is offset approximately 10 ft from original location. Soil/bedrock descriptions are based on original/abandoned location. Collected samples using split spoon (2 in. x 2 ft stainless steel). Analytical sample collected from (0-0.5 ft) and geotechnical 0-20 ft.</u>			
DEPTH (ft)		SAMPLE (NO. & INTERVAL)	SOIL/BEDROCK DESCRIPTION
FROM	TO		
0	0.66	1 (0-2)	Silty clay, some sand, damp. Note: Some organic matter from 0-0.17 ft. Color: 10YR3/2.
0.66	1.16		Silty clay, moist. Color: 10YR4/3.
1.16	2.00		Silty clay, very moist. Color: 2.5Y6/4
2.0	5.0		Auger cuttings: silty clay
5.0	7.0	2 (5-7)	Silty clay; moist, moderate plasticity. Color: Mottled 10YR5/8, 2.5Y6/4, and 10YR2/1.
7.0	10.0		Auger cuttings: silty clay; moist, moderate plasticity.
10.0	10.66	3 (10-12)	Silty clay; moist, moderate plasticity. Color: mottled 10YR5/8, 2.5Y6/4, and 10YR2/1.
10.66	11.83		Clayey, silty shale; weathered, dry, little fine sand. Color: 5Y5/2, laminated 10YR6/6, 5YR4/4, and 5GY8/1.
11.83	12.00		Silty shale, highly weathered, laminated. Color: 5Y5/2, laminated 10YR6/6, 5YR4/4.
12.00	15.00		Auger cuttings: silty shale, highly weathered.
15.00	17.00	4 (15-17)	Silty shale, highly weathered, tends to break along bedding planes, saprolitic, dry. Color: laminated 5Y5/2, 10YR6/6, 5YR4/4, and 5GY8/1.
17.00	20.00		Auger cuttings: silty shale, weathered.
20.00	20.83	5 (20-22)	Silty shale, weathered, laminated. Color: laminated 10YR6/6 and 10YR5/4.
20.83	28.00		Auger cuttings: silty shale, dry.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-906

WELL LOG - continued

PAGE 2 of 2

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CORE LITHOLOGY

Well <u>GW-906</u>		Date <u>06/23/98</u>		Logged by <u>Karen L. Speed</u>		Page <u>1</u> of <u>2</u>	
Run	Length	Depth		Description	% Shale		
		From	To				
1	4.5	31.1	35.6		45		
		31.1	32.25	Limestone interbedded with silty shale. Limestone is slightly coarser-			
				grained than shale, crystalline (micrite), rough bedding plane surface, limy			
				nodules. Color: N4. Note: From 31.85-32.0 ft, interbedded shale and			
				limestone have same bedding thickness. From 32.0-32.25 ft, limestone is			
				oolitic with calcite-filled veins perpendicular to bedding, and contains			
				stylolites-significant pressure solution along bedding plane surface.			
		32.25	33.6	Oolitic limestone (N3) interbedded with competent limy shale (N4), calcite-			
				filled veins perpendicular to bedding.			
		33.6	34.5	Limy shale, silty, not as competent (broke apart in core box), calcite filled			
				veins perpendicular to bedding, limy nodules. Color: N5.			
		34.5	35.0	Silty shale, competent, limy, bedding plane fractures, limestone nodules,			
				calcite-filled veins. Color: N4.			
		35.0	35.6	Silty shale, highly fractured, tends to break along bedding planes, calcite-			
				filled veins perpendicular to bedding, and thin laminae of micrite.			
				Color: N5-N4.			
2	4.3	35.6	39.9		22		
		35.6	36.9	Limestone, crystalline (micrite), oolitic, contains stylolites, some shale			
				interbeds, calcite-filled veins perpendicular to bedding planes. Color: 5B5/1.			

CORE LITHOLOGY

Well <u>GW-906</u>		Date <u>06/23/98</u>		Logged by <u>Karen L. Speed</u>		Page <u>2</u> of <u>2</u>	
Run	Length	Depth		Description	% Shale		
		From	To				
		36.9	37.9	Limestone interbedded with shale and shaley limestone. Limestone:			
				crystalline (micrite), oolitic, dense, rough bedding plane surface. Shale			
				(N5): Thinly bedded, glossy/slick bedding plane surfaces. Shaley lime-			
				stone (N3): Thinly bedded (1 cm), smooth bedding plane surface, fine			
				grained. Note: This interval contains calcite-filled veins perpendicular to			
				bedding.			
		37.9	38.4	Silty shale (N4): Highly fractured; tends to break along bedding planes,			
				fissile, very fine grained, limy nodules/lenses, and contains calcite-filled			
				veins.			
		38.4	38.8	Shaley limestone (N4): Slick bedding plane surface, limy, tends to break			
				along bedding planes, and contains calcite-filled fractures.			
		38.8	39.0	Shaley limestone (N4 with greenish-hue): Less competent, fissile, limy,			
				highly fractured, friable.			
		39.0	39.9	Oolitic limestone (N5): Styolites, large calcite-filled veins. Some veins are			
				shaped like boomerangs, which are also filled with calcite. Both styolites			
				and fractures offset each other.			

Y-12 PLANT GROUNDWATER PROTECTION PROGRAMWELL NO: GW-906**MONITORING WELL DEVELOPMENT PROGRESS**

Page 1 of 2

LOCATION: Oil Landfarm

WELL INSTALLATION

ONE WELL VOLUME: 2.5 GALLONSCOMPLETION DATE: 6/24/98

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	pH	SPECIFIC CONDUCTANCE (ms/cm)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
7/23/98	2.5	very turbid	7.14	0.545	2.5	1	
7/23/98	2.5	very turbid	6.88	0.535	5.0	2	
7/23/98	2.5	very turbid	6.74	0.560	7.5	3	
7/23/98	2.5	very turbid	6.76	0.554	10.0	4	
7/23/98	2.5	very turbid	6.79	0.549	12.5	5	
7/23/98	2.5	very turbid	6.89	0.540	15.0	6	
7/23/98	2.5	very turbid	6.89	0.542	17.5	7	
7/23/98	2.5	very turbid	6.97	0.535	20.0	8	
7/23/98	2.5	very turbid	6.94	0.535	22.5	9	
7/23/98	2.5	very turbid	6.96	0.534	25.0	10	
7/23/98	2.5	very turbid	7.00	0.560	27.5	11	
7/23/98	2.5	very turbid	6.71	0.575	30.0	12	
7/23/98	2.5	very turbid	6.59	0.569	32.5	13	
7/23/98	2.5	very turbid	6.60	0.564	35.0	14	
7/23/98	2.5	very turbid	6.68	0.558	37.5	15	
7/23/98	1.0	turbid	6.71	0.558	38.5	15.4	
7/23/98	1.5	very turbid	6.84	0.574	40.0	16.0	
7/23/98	2.5	very turbid	6.90	0.558	42.5	17	
7/23/98	2.5	very turbid	6.66	0.565	45.0	18	
7/23/98	2.5	very turbid	6.59	0.577	47.5	19	
RESULTS AT END OF DEVELOPMENT		*SEE NEXT PAGE					

COMMENTS:

MONITORING WELL DEVELOPMENT PROGRESS
(continued)

LOCATION: Oil Landfarm

WELL INSTALLATION

ONE WELL VOLUME: 2.5 GALLONS

COMPLETION DATE: 6/24/98

COMMENTS:

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM		WELL NO. <u>GW-906</u>
MONITORING WELL DEVELOPMENT SUMMARY		PAGE 1 of 1
METHOD OF DEVELOPMENT: <u>Teflon Bailer</u>		DEVELOPMENT DATE:
DEVELOPMENT OBSERVED BY: <u>Karen L. Speed</u>		START: <u>7/23/98</u>
		FINISH: <u>7/24/98</u>
ONE WELL VOLUME: <u>2.5</u> GALLONS		
TOTAL GALLONS PUMPED: <u>75.0</u> TOTAL WELL VOLUMES PUMPED: <u>30</u>		
INITIAL pH: <u>7.14</u> FINAL pH: <u>6.74</u>		
INITIAL SPECIFIC CONDUCTANCE: <u>0.545 ms/cm</u> FINAL: <u>0.539 ms/cm</u>		
DESCRIPTION OF INITIAL TURBIDITY: <u>very turbid (off scale)</u>		
DESCRIPTION OF FINAL TURBIDITY: <u>slightly turbid</u>		
FINAL MEASURED TURBIDITY: <u>181 NTU</u>		
WELL APPROVED BY: <u>Bechtel Jacobs Company LLC</u>		
ODOR OF WATER: <u>N/A</u>		
WATER DISCHARGED TO: ☒ GROUND SURFACE ☐ TANK TRUCK		
☐ STORM SEWERS ☐ STORAGE TANKS		
☐ DRUMS ☐ OTHER		
INITIAL PRE-DEVELOPMENT		
WATER DEPTH: <u>11.81 feet (BTOC)</u>		
DEVELOPMENT OBSERVATIONS:		
OBSERVER SIGNATURE: <u>Karen L. Speed</u>		
DATE: <u>September 16, 1998</u>

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-907

WELL INSTALLATION DIAGRAM

LOGGED BY: Karen L. Speed - Jacobs EM Team

DRILLING DATES

DRILLING COMPANY: U.S. Army Corps of Engineers (USACE)STARTED: 6/30/98DRILLER: James DarnellHELPER: Ron ReidFINISHED: 6/30/98

NOT TO SCALE

WELL NO. GW-907**WELL LOG - continued**

PAGE 2 of 2

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WELL NO: GW-907

MONITORING WELL DEVELOPMENT PROGRESS

Page 1 of 2

LOCATION: Oil Landfarm

WELL INSTALLATION

ONE WELL VOLUME: 1.6 GALLONS

COMPLETION DATE: 6/30/98

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	pH	SPECIFIC CONDUCTANCE (ms/cm)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
7/27/98	1.5	very turbid	5.93	0.133	1.5	0.94	
7/27/98	1.5	very turbid	5.95	0.100	3.0	1.88	
7/27/98	1.5	very turbid	5.68	0.099	4.5	2.82	
7/27/98	1.5	very turbid	5.53	0.097	6.0	3.76	
7/27/98	1.5	very turbid	5.56	0.093	7.5	4.70	
7/27/98	1.5	very turbid	5.45	0.081	9.0	5.64	
7/27/98	2.5	very turbid	5.41	0.076	11.5	7.20	
7/27/98	2.5	very turbid	5.57	0.087	14.0	8.76	
7/27/98	2.5	very turbid	5.70	0.080	16.5	10.32	
7/27/98	2.5	very turbid	5.95	0.089	19.0	11.88	
7/27/98	2.5	very turbid	6.05	0.086	21.5	13.44	
7/27/98	2.5	very turbid	6.12	0.086	24.0	15.00	
7/27/98	2.5	very turbid	5.93	0.090	26.5	16.56	
7/27/98	2.5	very turbid	5.88	0.089	29.0	18.12	
7/27/98	2.5	very turbid	6.00	0.088	31.5	19.68	
7/27/98	2.5	very turbid	5.98	0.086	34.0	21.24	
7/27/98	2.5	very turbid	6.32	0.086	36.5	22.80	
7/27/98	2.5	very turbid	6.05	0.085	39.0	24.36	
7/27/98	2.5	very turbid	6.03	0.086	41.5	25.92	
7/27/98	2.5	very turbid	6.16	0.085	44.0	27.48	
RESULTS AT END OF DEVELOPMENT		*SEE NEXT PAGE					

COMMENTS:

MONITORING WELL DEVELOPMENT PROGRESS (continued)

Page 2 of 2

LOCATION: Oil Landfarm

WELL INSTALLATION

ONE WELL VOLUME: 1.6 GALLONS

COMPLETION DATE: 6/30/98

COMMENTS:

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-907

MONITORING WELL DEVELOPMENT SUMMARY

PAGE 1 of 1

METHOD OF DEVELOPMENT: Teflon Bailer/2-in. Grundfos Pump

DEVELOPMENT DATE:

DEVELOPMENT OBSERVED BY: Karen L. SpeedSTART: 7/27/98FINISH: 7/27/98ONE WELL VOLUME: 1.6 GALLONSTOTAL GALLONS PUMPED: 55.5 TOTAL WELL VOLUMES PUMPED: 34.7INITIAL pH: 5.93 FINAL pH: 6.13INITIAL SPECIFIC CONDUCTANCE: 0.133 ms/cm FINAL: 0.094 ms/cmDESCRIPTION OF INITIAL TURBIDITY: very turbid (off scale)DESCRIPTION OF FINAL TURBIDITY: very turbid (off scale)FINAL MEASURED TURBIDITY: 999 NTU (off scale)WELL APPROVED BY: Bechtel Jacobs Company LLCODOR OF WATER: N/A

WATER DISCHARGED TO: ☒ GROUND SURFACE ☐ TANK TRUCK
☐ STORM SEWERS ☐ STORAGE TANKS
☐ DRUMS ☐ OTHER

INITIAL PRE-DEVELOPMENT

WATER DEPTH: 23.13 feet (BTOC)

DEVELOPMENT OBSERVATIONS:

OBSERVER SIGNATURE: Karen L. SpeedDATE: September 16, 1998

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-908

WELL INSTALLATION DIAGRAM

LOGGED BY: Karen L. Speed - Jacobs EM Team

DRILLING DATES

DRILLING COMPANY: U.S. Army Corps of Engineers (USACE)STARTED: 7/9/98DRILLER: James DarnellHELPER: Ron ReidFINISHED: 7/13/98

NOT TO SCALE

NOTE: Core drilling location, cored 38.2 ft to 48.2 ft.
Core hole filled with sand from 40.2 ft to 48.2 ft.
Bedrock sealed with bentonite pellets from 37.4 ft to 40.2 ft.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-908</u>
WELL LOG			PAGE 1 of 2
LOCATION: <u>Oil Landfarm</u>		DATE: START: <u>7-9-98</u>	
DRILLER: <u>James Darnell - USACE</u>		FINISH: <u>7-13-98</u>	
HELPER: <u>Ron Reid - USACE</u>		DRILLING METHOD: <u>Hollow Stem Auger</u>	
DRILL: <u>CME 75</u>		LOGGED BY: <u>Karen L. Speed</u>	
NOTES: <u>Collected samples with 2 in. x 2 ft, stainless steel split spoon. Analytical (chemical and radiological) samples collected from 0-0.5 ft. Geotechnical sample collected from 0-20 ft. Core drilling location (38.2-48.2 ft).</u>			
DEPTH (ft)		SAMPLE (NO. & INTERVAL)	SOIL/BEDROCK DESCRIPTION
FROM	TO		
0.00	0.17	1 (0-1.58)	Silty clay, reworked fill, significant organic matter (rootlets) friable, dry, nonplastic. Color: 2.5Y6/2).
0.17	0.58		Silty, sandy clay; specks of manganese (7.5YR2.5/1); not as oxidized; highly weathered; friable, dry, nonplastic, rootlets. Color: 10YR4/4.
0.58	1.58		Silty clay, some very fine-grained sand, specks of manganese (7.5YR2.5/1), highly weathered, oxidized (iron), friable, dry, nonplastic, rootlets. Color: 10YR5/6.
1.58	5.00		Silty clay, some very fine-grained sand, dry.
5.00	7.00	2 (5-7)	Silty clay, some very fine-grained sand, dry, friable, very slight plasticity, manganese nodules/lenses (7.5YR2.5/1), some clay staining (5YR4/6), some roots. Color: mottled 2.5Y6/3 and 7.5Y6/8.
10.00	11.00	3 (10-12)	Silty shale, some very fine-grained sand, highly weathered, saprolitic, friable, some structure, damp, nonplastic, significant manganese and ferrous staining, some lamination/layering. Also contains silty, sandy, clay lenses; slightly plastic; soft; moist. Color: Laminated 2.5Y7/4, 5Y4/2, 7.5YR2.5/1, 6/5GY.
11.00	11.16		Silty shale with some very fine-grained sand, highly weathered, fissile, laminated, moist, friable, nonplastic, saprolitic, some manganese and ferrous staining. Color: Laminated 2.5Y7/4, 7.5YR2.5/1, 5Y4/2, 7.5YR6/8, and 6N.
11.16	11.66		Silty, sandy clay, highly weathered, significant iron staining (iron oxides), moist, slightly plastic. Color: 7.5YR5/8, 2.5Y5/4.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-908

WELL LOG - continued

PAGE 2 of 2

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CORE DRILLING

[illegible]

CORE LITHOLOGY

Well GW-908

Date 07/10/98

Logged by Karen L. Speed

Page 1 of 1

Run	Length	Depth		Description	% Shale
		From	To		
1	10	38.2	48.2		20
		38.2	40.6	Interbedded limestone and silty shale, thin calcite-filled veins throughout	
				interval. Limestone (N5): Oolitic, some brecciations, matrix supported, fine	
				grained, thinly bedded. Some shaley limestone (N4): fissile, very fine	
				grained, limy nodules, tends to break along bedding planes, thinly bedded.	
				Shale (N3): Thickly laminated, wavy-parallel bedding planes, tends to	
				break along bedding planes, slick bedding plane surfaces.	
		40.6	42.9	Shaley limestone (N3): Highly fractured, tends to break along bedding	
				planes, wavy bedding planes, fractures perpendicular to bedding, thin	
				micrite-filled veins perpendicular and parallel to bedding, oolitic limestone	
				nodules.	
		42.9	48.2	Interbedded oolitic and shaley limestone, and shale laminae. Oolitic limestone	
				(N5): fine grained, wavy bedding planes, brecciated, matrix supported, thin-	
				micrite-filled veins perpendicular to bedding, very thinly bedded. Shaley	
				limestone (N3): Highly fractured, fissile, slick bedding plane surfaces,	
				micrite-filled veins, very thinly bedded. Shale (N3): Laminae, wavy, most	
				laminae contain small rounded to subrounded oolitic limestone nodules	
				(1mm x 2mm). Note: Rock tends to break along shale laminae and contains	
				micrite-filled veins.	

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO: GW-908

MONITORING WELL DEVELOPMENT PROGRESS

Page 1 of 1

LOCATION: Oil Landfarm

WELL INSTALLATION

ONE WELL VOLUME: 4.3 GALLONSCOMPLETION DATE: 7/13/98

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	pH	SPECIFIC CONDUCTANCE (ms/cm)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
7/28/98	4	very turbid	6.97	0.555	4	0.93	
7/28/98	4	very turbid	7.06	0.501	8	1.86	
7/28/98	6	very turbid	7.16	0.500	14	3.26	
7/28/98	5	very turbid	7.21	0.480	19	4.42	
7/28/98	5	very turbid	7.18	0.489	24	5.58	
7/28/98	5	very turbid	7.23	0.502	29	6.74	
7/28/98	5	very turbid	6.95	0.498	34	7.90	
7/28/98	2.5	turbid	6.88	0.492	36.5	8.48	
7/28/98	2.5	very turbid	7.13	0.488	39	9.06	
7/28/98	2.5	very turbid	7.18	0.498	41.5	9.64	
7/28/98	2.5	very turbid	7.19	0.497	44.0	10.22	
7/28/98	2.5	very turbid	7.22	0.483	46.5	10.80	
7/28/98	2.5	very turbid	7.01	0.488	49.0	11.38	
7/28/98	2.5	very clear	7.04	0.487	51.5	11.96	
7/28/98	2.5	turbid	7.10	0.488	54.0	12.54	
7/28/98	2.5	slightly turbid	7.08	0.488	56.5	13.12	
7/28/98	2.0	slightly turbid	7.09	0.489	58.5	13.70	
RESULTS AT END OF DEVELOPMENT		slightly turbid	7.09	0.489	58.5	13.70	

COMMENTS:

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM		WELL NO. <u>GW-908</u>
MONITORING WELL DEVELOPMENT SUMMARY		PAGE 1 of 1
METHOD OF DEVELOPMENT: <u>2-in. Grunfos Pump</u>		DEVELOPMENT DATE: <u>7/28/98</u>
DEVELOPMENT OBSERVED BY: <u>Karen L. Speed</u>		START: <u>7/28/98</u>
		FINISH: <u>7/28/98</u>
ONE WELL VOLUME: <u>4.3</u> GALLONS		
TOTAL GALLONS PUMPED: <u>58.5</u> TOTAL WELL VOLUMES PUMPED: <u>13.60</u>		
INITIAL pH: <u>6.97</u> FINAL pH: <u>7.09</u>		
INITIAL SPECIFIC CONDUCTANCE: <u>0.555 ms/cm</u> FINAL: <u>0.489 ms/cm</u>		
DESCRIPTION OF INITIAL TURBIDITY: <u>very turbid (off scale)</u>		
DESCRIPTION OF FINAL TURBIDITY: <u>slightly turbid</u>		
FINAL MEASURED TURBIDITY: <u>161 NTU</u>		
WELL APPROVED BY: <u>Bechtel Jacobs Company LLC</u>		
ODOR OF WATER: <u>N/A</u>		
WATER DISCHARGED TO: ☒ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANKS ☐ DRUMS ☐ OTHER		
INITIAL PRE-DEVELOPMENT WATER DEPTH: <u>7.58 feet (BTOC)</u>		
DEVELOPMENT OBSERVATIONS: _____		

OBSERVER SIGNATURE: <u>Karen L. Speed</u>		
DATE: <u>September 16, 1998</u>

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-909

WELL INSTALLATION DIAGRAM

LOGGED BY: Karen L. Speed - Jacobs EM Team

DRILLING DATES

DRILLING COMPANY: U.S. Army Corps of Engineers (USACE)STARTED: 6/25/98DRILLER: James DarnellHELPER: Ron ReidFINISHED: 6/25/98

NOT TO SCALE

Y-12 PLANT GROUNDWATER PROTECTION PROGRAMWELL NO: GW-909**MONITORING WELL DEVELOPMENT PROGRESS**

Page 1 of 1

LOCATION: Oil Landfarm

WELL INSTALLATION

ONE WELL VOLUME: 2.4 GALLONSCOMPLETION DATE: 6/26/98

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	pH	SPECIFIC CONDUCTANCE (ms/cm)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
7/29/98	2.5	very turbid	6.85	0.421	2.5	1.04	
7/29/98	2.5	very turbid	7.05	0.377	5.0	2.08	
7/29/98	2.5	very turbid	6.99	0.369	7.5	3.16	
7/29/98	2.5	very turbid	7.23	0.370	10.0	4.24	
7/29/98	2.5	very turbid	7.27	0.368	12.5	5.28	
7/29/98	1.0	very turbid	7.18	0.368	13.5	5.70	
7/29/98	1.0	very turbid	7.15	0.360	14.5	6.12	
7/29/98	1.0	very turbid	6.99	0.366	15.5	6.54	
7/29/98	0.5	very turbid	7.35	0.359	16.0	6.75	
7/29/98	1.0	very turbid	7.15	0.358	17.0	7.17	
7/29/98	1.0	very turbid	7.09	0.363	18.0	7.59	
7/29/98	1.5	very turbid	7.10	0.360	19.5	8.22	
7/29/98	1.0	very turbid	7.15	0.360	20.5	8.64	
7/29/98	1.0	very turbid	7.35	0.365	21.5	9.06	
7/29/98	1.0	very turbid	7.33	0.363	22.5	9.48	
RESULTS AT END OF DEVELOPMENT		very turbid	7.33	0.363	22.5	9.48	

COMMENTS:

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM		WELL NO. <u>GW-909</u>
MONITORING WELL DEVELOPMENT SUMMARY		PAGE 1 of 1
METHOD OF DEVELOPMENT: <u>Teflon Bailer</u>		DEVELOPMENT DATE:
DEVELOPMENT OBSERVED BY: <u>Karen L. Speed</u>		START: <u>7/29/98</u>
		FINISH: <u>7/29/98</u>
ONE WELL VOLUME: <u>2.4</u> GALLONS		
TOTAL GALLONS PUMPED: <u>22.5</u> TOTAL WELL VOLUMES PUMPED: <u>9.4</u>		
INITIAL pH: <u>6.85</u> FINAL pH: <u>7.33</u>		
INITIAL SPECIFIC CONDUCTANCE: <u>0.421 ms/cm</u> FINAL: <u>0.363 ms/cm</u>		
DESCRIPTION OF INITIAL TURBIDITY: <u>very turbid (off scale)</u>		
DESCRIPTION OF FINAL TURBIDITY: <u>very turbid (off scale)</u>		
FINAL MEASURED TURBIDITY: <u>999 NTU (off scale)</u>		
WELL APPROVED BY: <u>Bechtel Jacobs Company LLC</u>		
ODOR OF WATER: <u>N/A</u>		
WATER DISCHARGED TO: ☒ GROUND SURFACE ☐ TANK TRUCK		
☐ STORM SEWERS ☐ STORAGE TANKS		
☐ DRUMS ☐ OTHER		
INITIAL PRE-DEVELOPMENT		
WATER DEPTH: <u>12.14 feet (BTOC)</u>		
DEVELOPMENT OBSERVATIONS: _____		

OBSERVER SIGNATURE: <u>Karen L. Speed</u>		
DATE: <u>September 16, 1998</u>

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-910

WELL INSTALLATION DIAGRAM

LOGGED BY: Karen L. Speed - Jacobs EM Team

DRILLING DATES

DRILLING COMPANY: U.S. Army Corps of Engineers (USACE)STARTED: 7/1/98DRILLER: James DarnellHELPER: Ron ReidFINISHED: 7/1/98

NOT TO SCALE

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM				WELL NO. <u>GW-910</u>
WELL LOG				PAGE 1 of 2
LOCATION: <u>Oil Landfarm</u>		DATE: START: <u>7-1-98</u>		
DRILLER: <u>James Darnell - USACE</u>		FINISH: <u>7-1-98</u>		
HELPER: <u>Ron Reid - USACE</u>		DRILLING METHOD: <u>Hollow Stem Auger</u>		
DRILL: <u>CME 75</u>		LOGGED BY: <u>Karen L. Speed</u>		
NOTES: <u>Collected samples with split-spoon (2 in. x 2 ft stainless steel). Analytical sample (chemical and radiological) collected from 0-0.5 ft. Geotechnical sample collected from 0-20 ft.</u>				
DEPTH (ft)		SAMPLE (NO. & INTERVAL)	SOIL/BEDROCK DESCRIPTION	
FROM	TO			
0	0.58	1 (0-2)	Silty clay, reworked fill, some organic matter (leaves), moist, slightly plastic. Color: 2.5Y5/6.	
0.58	1.00		Silty clay, some shale fragments, slightly plastic, moist, some organic matter. Color: 10YR6/6.	
1.00	2.00		Silty shale, highly weathered, friable moist, slightly plastic, manganese staining (2.5Y2.5/1). Color: Laminated 10YR6/4 and 7.5YR5/8.	
3.50	3.58	2 (3.5-5.5)	Silty clay with shale fragments, damp, nonplastic, rootlets, some ferrous staining. Color: 2.5Y5/4.	
3.58	3.92		Silty, sandy clay; manganese-rich soil lense (10YR2/1); damp; nonplastic; some weathering. Color: Laminated 7.5YR6/8 and 2.5Y5/4.	
3.92	4.16		Silty shale, highly weathered, little structure, moist, nonplastic. Color: Mottled 5YR2.5/1 and 2.5Y7/4.	
4.16	5.50		Silty shale, highly weathered, ferrous and manganese staining, damp, nonplastic, saprolitic. Color: 5YR4/6, 5YR2.5/1, and 2.5Y5/4.	
8.50	8.96	3 (8.5-10.5)	Silty clay, shale fragments, moderate plasticity, moist, rootlets, significant manganese. Color: 5YR5/6 and 2.5Y5/3.	
8.96	9.41		Silty shale saprolite, less competent, less manganese, some sand, friable, nonplastic. Color: Laminated 5YR5/6 and 2.5Y5/3.	
9.41	10.50		Silty shale saprolite, friable, ferrous and manganese staining (5YR5/6 and 5YR2.5/1, respectively), trace amounts of manganese, dry nonplastic. Color: Laminated 5YR5/6 and 2.5Y5/3.	

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-910**WELL LOG - continued**

PAGE 2 of 2

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Y-12 PLANT GROUNDWATER PROTECTION PROGRAMWELL NO: GW-910**MONITORING WELL DEVELOPMENT PROGRESS**

Page 1 of 2

LOCATION: Oil Landfarm

WELL INSTALLATION

ONE WELL VOLUME: 2.4 GALLONSCOMPLETION DATE: 7/1/98

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	pH	SPECIFIC CONDUCTANCE (ms/cm)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
7/30/98	2.5	very turbid	6.60	0.180	2.5	1.04	
7/30/98	2.5	very turbid	6.45	0.160	5.0	2.08	
7/30/98	2.5	very turbid	6.30	0.160	7.5	3.12	
7/30/98	2.5	very turbid	6.40	0.195	10.0	4.16	
7/30/98	2.5	very turbid	6.71	0.263	12.5	5.20	
7/30/98	2.5	very turbid	6.60	0.234	15.0	6.24	
7/30/98	2.5	very turbid	6.52	0.177	17.5	7.28	
7/30/98	2.5	very turbid	6.42	0.142	20.0	8.32	
7/30/98	2.5	very turbid	6.49	0.164	22.5	9.36	
7/30/98	2.5	very turbid	6.50	0.156	25.0	10.40	
7/30/98	2.5	very turbid	6.46	0.163	27.5	11.44	
7/30/98	2.5	very turbid	6.24	0.164	30.0	12.48	
7/30/98	1.0	very turbid	6.23	0.160	31.0	12.90	
7/30/98	1.5	very turbid	6.59	0.201	32.5	13.53	
7/30/98	2.5	very turbid	6.31	0.153	35.0	14.57	
7/30/98	2.5	very turbid	6.35	0.145	37.5	15.61	
7/30/98	2.5	very turbid	6.43	0.155	40.0	16.65	
7/30/98	2.5	very turbid	6.44	0.146	42.5	17.69	
7/30/98	2.5	very turbid	6.45	0.142	45.0	18.73	
7/30/98	2.5	very turbid	6.46	0.153	47.5	19.77	
RESULTS AT END OF DEVELOPMENT		*SEE NEXT PAGE					

COMMENTS:

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO: GW-910

MONITORING WELL DEVELOPMENT PROGRESS (continued)

Page 2 of 2

LOCATION: Oil Landfarm

WELL INSTALLATION

ONE WELL VOLUME: 2.4 GALLONS

COMPLETION DATE: 7/1/98

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	pH	SPECIFIC CONDUCTANCE (ms/cm)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
7/30/98	2.5	very turbid	6.52	0.150	50.0	20.81	
7/30/98	2.5	very turbid	6.53	0.141	52.5	21.85	
7/30/98	2.5	very turbid	6.47	0.152	55.0	22.89	
7/30/98	2.5	very turbid	6.60	0.147	57.5	23.93	
7/30/98	2.5	very turbid	6.52	0.151	60.0	24.97	
RESULTS AT END OF DEVELOPMENT		very turbid	6.52	0.151	60.0	24.97	

COMMENTS:

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM	WELL NO. <u>GW-910</u>
MONITORING WELL DEVELOPMENT SUMMARY	PAGE 1 of 1

METHOD OF DEVELOPMENT: Teflon Bailer/2-in. Grundfos Pump

DEVELOPMENT OBSERVED BY: Karen L. Speed

ONE WELL VOLUME: 2.4 GALLONS

TOTAL GALLONS PUMPED: 60 TOTAL WELL VOLUMES PUMPED: 25

INITIAL pH: 6.60 FINAL pH: 6.52

INITIAL SPECIFIC CONDUCTANCE: 0.180 ms/cm FINAL: 0.151 ms/cm

DESCRIPTION OF INITIAL TURBIDITY: very turbid (off scale)

DESCRIPTION OF FINAL TURBIDITY: very turbid (off scale)

FINAL MEASURED TURBIDITY: 999 NTU (off scale)

WELL APPROVED BY: Bechtel Jacobs Company LLC

ODOR OF WATER: N/A

WATER DISCHARGED TO:
 ☒ GROUND SURFACE
☐ TANK TRUCK
☐ STORM SEWERS
☐ STORAGE TANKS
☐ DRUMS
☐ OTHER

INITIAL PRE-DEVELOPMENT
 WATER DEPTH: 22.10 feet (BTOC)

DEVELOPMENT OBSERVATIONS: _____

OBSERVER SIGNATURE: Karen L. Speed
 DATE: September 16, 1998

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-911

WELL INSTALLATION DIAGRAM

LOGGED BY: Karen L. Speed - Jacobs EM Team

DRILLING DATES

DRILLING COMPANY: U.S. Army Corps of Engineers (USACE)STARTED: 6/17/98DRILLER: James DarnellHELPER: Ron ReidFINISHED: 6/19/98

NOT TO SCALE

NOTE: Core drilling location, cored 45.9 ft to 55.4 ft.
 Core hole filled with sand from 44.5 ft to 55.4 ft.
 Bedrock sealed with bentonite pellets from 41.5 ft to 44.5 ft.
 Borehole filled with sand from 34.8 ft to 41.5 ft and another bentonite seal from 33.1 ft to 34.8 ft.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM				WELL NO. <u>GW-911</u>
WELL LOG				PAGE 1 of 2
LOCATION: <u>Oil Landfarm</u>		DATE: START: <u>6-17-98</u>		
DRILLER: <u>James Darnell - USACE</u>		FINISH: <u>6-19-98</u>		
HELPER: <u>Ron Reid - USACE</u>		DRILLING METHOD: <u>Hollow Stem Auger</u>		
DRILL: <u>CME 75</u>		LOGGED BY: <u>Karen L. Speed</u>		
NOTES: <u>Core drilling location. See Core Drilling Log for detailed description of 45.9-55.4 ft. Collected samples using split-spoons (2 in. x 2 ft stainless steel).</u>				
DEPTH (ft)		SAMPLE (NO. & INTERVAL)	SOIL/BEDROCK DESCRIPTION	
FROM	TO			
0	0.25	1 (0-2)	Silty clay with 5% sand, low plasticity, some organic matter, slightly moist. Color: Mottled 2.5Y4/2 and 7.5YR5/6.	
0.25	0.91		Silty clay with cobble size, rock fragments, medium plasticity, moist. Color: 7.5YR5/6.	
0.91	1.08		Root with little decay.	
1.08	2.00		Silty clay with 5% sand, medium plasticity, moist. Color: 7.5YR5/6.	
2.00	5.00		Silty clay with very little sand, medium plasticity, moist.	
5.00	5.25	2 (5-7)	Silty clay with 5% sand, medium plasticity, moist. Color: 7.5YR5/6.	
5.25	7.00		Weathered shale, silty, dry, no plasticity, friable. Color: Laminated 10YR6/6, 10Y6/2, 10YR4/2, and 7.5YR5/6.	
7.00	10.00		Weathered shale, silty, dry, no plasticity.	
10.00	11.34	3 (10-12)	Weathered shale, dry, no plasticity, friable. Color: Laminated 10YR6/6, 10Y6/2, 10YR4/2, and 7.5YR5/6.	
11.34	12.00		Weathered shale, silty, moist, no plasticity, friable. Color: Laminated 10YR6/6, 10Y6/2, 10YR4/2, and 7.5YR5/6.	
12.00	15.00		Auger cuttings: Weathered shale, silty, moist, no plasticity.	
15.00	16.00	4 (15-17)	Weathered shale, silty, dry, no plasticity, friable. Color: Laminated 10YR4/2, 10Y6/2, and 7.5YR5/8.	
16.00	16.17		Weathered shale, silty, moist.	
16.17	16.33		Very silty shale, weathered, wet.	
16.33	17.00		Weathered shale, silty, moist.	
17.00	20.00		Auger cuttings: Weathered shale, silty, moist.	

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-911

WELL LOG - continued

PAGE 2 of 2

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CORE LITHOLOGY

Well GW-911

Date 06/18/98

Logged by Karen L. Speed

Page 1 of 1

[illegible]

Y-12 PLANT GROUNDWATER PROTECTION PROGRAMWELL NO: GW-911**MONITORING WELL DEVELOPMENT PROGRESS**

Page 1 of 2

LOCATION: Oil Landfarm

WELL INSTALLATION

ONE WELL VOLUME: 2.4 GALLONSCOMPLETION DATE: 6/19/98

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	pH	SPECIFIC CONDUCTANCE (ms/cm)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
7/22/98	2.5	very turbid	6.98	0.396	2.5	1.04	
7/22/98	2.5	very turbid	7.01	0.387	5.0	2.08	
7/22/98	2.5	very turbid	6.91	0.389	7.5	3.12	
7/22/98	2.5	very turbid	6.91	0.387	10.0	4.16	
7/22/98	2.5	very turbid	7.23	0.386	12.5	5.20	
7/22/98	2.5	very turbid	7.16	0.389	15.0	6.24	
7/22/98	2.5	very turbid	7.09	0.387	17.5	7.28	
7/22/98	2.5	very turbid	6.87	0.388	20.0	8.32	
7/22/98	2.5	very turbid	6.88	0.387	22.5	9.36	
7/22/98	2.5	very turbid	6.85	0.383	25.0	10.40	
7/22/98	2.5	very turbid	7.31	0.382	27.5	11.44	
7/22/98	2.5	very turbid	7.24	0.384	30.0	12.48	
7/22/98	2.5	very turbid	6.97	0.385	32.5	13.52	
7/22/98	2.5	very turbid	6.88	0.383	35.0	14.56	
7/22/98	2.5	very turbid	6.83	0.383	37.5	15.60	
7/22/98	2.5	very turbid	6.85	0.384	40.0	16.64	
7/22/98	2.5	very turbid	6.87	0.385	42.5	17.68	
7/22/98	2.5	very turbid	6.87	0.380	45.0	18.72	
7/22/98	2.5	very turbid	6.84	0.370	47.5	19.76	
7/22/98	2.5	very turbid	6.90	0.378	50.0	20.80	
RESULTS AT END OF DEVELOPMENT		*SEE NEXT PAGE					

COMMENTS:

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO: GW-911MONITORING WELL DEVELOPMENT PROGRESS
(continued)

Page 2 of 2

LOCATION: Oil Landfarm

WELL INSTALLATION

ONE WELL VOLUME: 2.4 GALLONSCOMPLETION DATE: 6/19/98

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	pH	SPECIFIC CONDUCTANCE (ms/cm)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
7/22/98	2.5	turbid	6.93	0.375	52.5	21.84	
7/22/98	2.5	slightly turbid	6.93	0.371	55.0	22.88	
7/22/98	2.5	very turbid	6.99	0.383	57.5	23.92	
7/22/98	2.5	very turbid	7.00	0.381	60.0	24.96	
7/22/98	2.5	very turbid	7.01	0.371	62.5	26.00	
7/22/98	2.5	turbid	7.02	0.370	65.0	27.04	
7/22/98	2.5	slightly turbid	6.99	0.368	67.5	28.08	
7/22/98	2.5	turbid	6.99	0.368	70.0	29.12	
7/22/98	2.5	slightly turbid	7.08	0.368	72.5	30.16	
7/22/98	2.5	very turbid	7.00	0.372	75.0	31.20	
7/22/98	2.5	very turbid	7.02	0.369	77.5	32.24	
7/22/98	2.5	very turbid	7.01	0.371	80.0	33.28	
7/22/98	2.5	turbid	7.01	0.365	82.5	34.32	
7/22/98	2.5	slightly turbid	6.95	0.362	85.0	35.36	
7/22/98	2.5	clear	6.96	0.363	87.5	36.40	
7/22/98	2.5	clear	6.96	0.361	90.0	37.44	
7/22/98	1.0	slightly turbid	6.97	0.363	91.0	38.48	
RESULTS AT END OF DEVELOPMENT		slightly turbid	6.97	0.363	91.0	38.48	

COMMENTS:

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM	
MONITORING WELL DEVELOPMENT SUMMARY	
METHOD OF DEVELOPMENT: <u>Teflon Bailer/2-in. Grundfos Pump</u>	DEVELOPMENT DATE: START: <u>7/22/98</u> FINISH: <u>7/22/98</u>
DEVELOPMENT OBSERVED BY: <u>Karen L. Speed</u>	
ONE WELL VOLUME: <u>2.4</u> GALLONS	
TOTAL GALLONS PUMPED: <u>91</u>	TOTAL WELL VOLUMES PUMPED: <u>38</u>
INITIAL pH: <u>6.98</u>	FINAL pH: <u>6.97</u>
INITIAL SPECIFIC CONDUCTANCE: <u>0.396 ms/cm</u>	FINAL: <u>0.363 ms/cm</u>
DESCRIPTION OF INITIAL TURBIDITY: <u>very turbid (off scale)</u>	
DESCRIPTION OF FINAL TURBIDITY: <u>slightly turbid</u>	
FINAL MEASURED TURBIDITY: <u>101 NTU</u>	
WELL APPROVED BY: <u>Bechtel Jacobs Company LLC</u>	
ODOR OF WATER: <u>N/A</u>	
WATER DISCHARGED TO: ☒ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANKS ☐ DRUMS ☐ OTHER	
INITIAL PRE-DEVELOPMENT WATER DEPTH: <u>18.67 feet (BTOC)</u>	
DEVELOPMENT OBSERVATIONS: _____ _____ _____ _____ _____ _____ _____ _____ _____ _____	
OBSERVER SIGNATURE: <u>Karen L. Speed</u>	
DATE: <u>September 16, 1998</u>	

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-912

WELL INSTALLATION DIAGRAM

LOGGED BY: Karen L. Speed - Jacobs EM Team

DRILLING DATES

DRILLING COMPANY: U.S. Army Corps of Engineers (USACE)STARTED: 7/2/98DRILLER: James DarnellHELPER: Ron ReidFINISHED: 7/7/98

NOT TO SCALE

NOTE: Core drilling location, cored 31.8 ft to 42.2 ft.
Core hole filled with sloughed material (most likely shale) from 34.4 ft to 42.2 ft.
Bedrock sealed with bentonite pellets from 29.8 ft to 34.4 ft.
Sloughed material below sand pack from 27 ft to 29.8 ft.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-912</u>
WELL LOG			PAGE 1 of 3
LOCATION: <u>Oil Landfarm</u>		DATE: START: <u>7-2-98</u>	
DRILLER: <u>James Darnell - USACE</u>		FINISH: <u>7-7-98</u>	
HELPER: <u>Ron Reid - USACE</u>		DRILLING METHOD: <u>Hollow Stem Auger</u>	
DRILL: <u>CME Model 75</u>		LOGGED BY: <u>Karen L. Speed</u>	
NOTES: <u>Collected samples with 2 in. x 2 ft, stainless steel split spoon. Analytical (chemical and radiological) sample collected from 0-0.5 ft. Geotechnical sample collected from 0-20 ft. Core drilling location (31.8 - 42.2 ft).</u>			
DEPTH (ft)		SAMPLE (NO. & INTERVAL)	SOIL/BEDROCK DESCRIPTION
FROM	TO		
0.0	0.33	1 (0-2)	Silty clay, reworked fill, significant organic matter, moist, slightly plastic. Color: 10YR4/3.
0.33	2.00		Silty clay, dry, nonplastic, highly weathered, some structure - shale (saprolitic) layers, rootlets. Color: Laminated 5YR2.5/1, 7.5YR5/8, 10R4/6, and 10YR6/6.
2.00	5.00		Silty, clayey, shale saprolite.
5.00	5.33	2 (5-6.58)	Silty shale saprolite, little structure, highly weathered, rootlets, dry, nonplastic, laminated. Color: Laminated 10YR5/6, 2.5Y4/4.
5.33	6.58		Silty shale saprolite, highly weathered, dry, friable, nonplastic, clay coating (10R4/6), iron and manganese staining (10YR5/6 and 5YR2.5/1, respectively). Color: Laminated 7/10Y, 2.5Y4/3.
6.58	10.00		Silty shale saprolite, dry, highly weathered.
10.00	10.29	3 (10-11.74)	Silty shale, highly weathered, no structure, dry, nonplastic. Color: 10YR5/6.
10.29	11.25		Silty shale, highly weathered, dry, friable, nonplastic. Color: Laminated 5YR2.5/1, 7.5YR5/8, and 2.5Y5/6.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-912</u>
WELL LOG - continued			PAGE 2 of 3
DEPTH (ft)		SAMPLE (NO. & INTERVAL)	SOIL/BEDROCK DESCRIPTION
FROM	TO		
11.25	11.41		Silty shale, highly weathered, dry, friable, nonplastic, little ferrous staining. Color: Laminated 5/N, 7.5YR5/8.
11.41	11.74		Silty shale saprolite, highly weathered, friable, dry, nonplastic, ferrous and manganese staining (10YR5/6 and 7YR2.5/1, respectively). Color: Laminated 2.5Y5/6 and 7/10Y.
11.74	15.00		Silty shale saprolite, highly weathered, dry, friable, nonplastic.
15.00	15.33	4 (15-16.91)	Silty shale, highly weathered, saprolitic, some structure, dry, friable, some shale rock fragments, some ferrous and manganese staining. Color: 5YR4/6 and 5Y6/4.
15.33	15.58		Silty shale, highly weathered, dry, friable, saprolitic, nonplastic, significant ferrous and manganese staining (7.5YR5/8 and 7YR2.5/1, respectively). Color: 10YR6/8.
15.58	16.91		Silty shale, highly weathered, friable, dry, nonplastic, little ferrous staining. Color: Laminated 5YR4/4 and 4/N.
20.0	20.25	5 (20-21.66)	Silty clay, moist, moderate plasticity, little structure, highly weathered, some sand, some ferrous staining. Color: 10YR6/8, 5/N.
20.25	20.71		Silty shale, highly weathered, little/no ferrous or manganese staining, friable, fissile, damp, nonplastic. Color: 3N.
20.71	21.66		Silty, sandy shale saprolite, highly weathered, wet, nonplastic, friable, significant manganese (5YR2.5/1), some sand. Color: Laminated 10YR5/6, 5Y5/3.
			Auger refusal at 31.8 ft.
			Top of water table at approximately 23 ft.

WELL NO. GW-912

PAGE 3 of 3

[illegible]

CORE DRILLING

[illegible]

CORE LITHOLOGY

Well <u>GW-912</u>		Date <u>07/07/98</u>		Logged by <u>Karen L. Speed</u>		Page <u>1</u> of <u>2</u>	
Run	Length	Depth		Description	% Shale		
		From	To				
1	10.4	31.8	42.2		13		
		31.8	32.8	Limestone (N4), fine grained, crystalline, oolitic, 5 mm × 10 mm brecciated			
				fragments of micritic limestone, slick bedding plane surface, calcite-filled			
				veins, some iron/ferrous staining.			
		32.8	35.7	Limestone interbedded with shale. Limestone (N4): fine grained, crystalline,			
				oolitic, 8 mm × 18 mm breccia of fine-grained limestone suspended in			
				oolitic matrix, calcite-dolomite-filled veins. Shale: silty, fissile, not competent,			
				slick bedding plane surface, some limey mud.			
		35.7	38.1	Interbedded limestone and shale. Upper limestone section has significant			
				ferrous staining, relatively incompetent, very fine grained (micrite). Lower			
				limestone section is coarser grained, oolitic. Limestone (N4): highly			
				fractured, calcite-filled veins, shale stringers. Shale (NS): silty shale, fissile,			
				calcite-filled veins, brittle.			
		38.1	38.5	Shaley limestone (N5): fissile, slick bedding plane surfaces, brittle, limy,			
				high percentage of clay.			
		38.5	42.2	Limestone interbedded with shale. Limestone mostly oolitic with some			
				interbedding of micritic limestone, brecciated (12 mm × 15 mm breccia)			
				micrite, significant brecciations throughout interval, sparry calcite, ferrous/			
				iron staining along bedding planes in upper section, shale stringers, calcite/			
				dolomite-filled veins perpendicular to bedding. Color: N4 (oolitic) and			

CORE LITHOLOGY

[illegible]

WELL NO: GW-912

MONITORING WELL DEVELOPMENT PROGRESS

Page 1 of 2

LOCATION: Oil Landfarm

WELL INSTALLATION

ONE WELL VOLUME: 2.5 GALLONS

COMPLETION DATE: 7/7/98

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	pH	SPECIFIC CONDUCTANCE (ms/cm)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
7/21/98	2.5	very turbid	7.39	0.431	2.5	1	
7/21/98	2.5	very turbid	7.30	0.426	5.0	2	
7/21/98	2.5	very turbid	7.15	0.393	7.5	3	
7/21/98	2.5	very turbid	7.00	0.426	10.0	4	
7/21/98	2.5	very turbid	7.44	0.422	12.5	5	
7/21/98	2.5	very turbid	7.04	0.405	15.0	6	
7/21/98	2.5	very turbid	7.03	0.383	17.5	7	
7/21/98	2.5	very turbid	6.95	0.367	20.0	8	
7/21/98	2.5	very turbid	6.91	0.344	22.5	9	
7/21/98	2.5	very turbid	6.90	0.412	25.0	10	
7/21/98	2.5	very turbid	6.92	0.418	27.5	11	
7/21/98	2.5	very turbid	6.93	0.368	30.0	12	
7/21/98	2.5	very turbid	6.88	0.389	32.5	13	
7/21/98	2.5	very turbid	6.93	0.378	35.0	14	
7/21/98	2.5	very turbid	6.90	0.408	37.5	15	
7/21/98	2.5	very turbid	6.92	0.413	40.0	16	
7/21/98	2.5	very turbid	6.92	0.420	42.5	17	
7/21/98	2.5	very turbid	6.91	0.417	45.0	18	
7/21/98	2.5	very turbid	6.89	0.377	47.5	19	
7/21/98	2.5	very turbid	6.92	0.383	50.0	20	
RESULTS AT END OF DEVELOPMENT		*SEE NEXT PAGE					

COMMENTS:

WELL NO: GW-912

MONITORING WELL DEVELOPMENT PROGRESS
(continued)

Page 2 of 2

LOCATION: Oil Landfarm

WELL INSTALLATION

ONE WELL VOLUME: 2.5 GALLONS

COMPLETION DATE: 7/7/98

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	pH	SPECIFIC CONDUCTANCE (ms/cm)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
7/21/98	5.0	very turbid	6.92	0.401	55.0	22	
7/21/98	5.0	very turbid	7.03	0.354	60.0	24	
7/21/98	5.0	very turbid	7.04	0.328	65.0	26	
7/21/98	5.0	very turbid	7.05	0.357	70.0	28	
7/21/98	5.0	very turbid	7.21	0.407	75.0	30	
7/21/98	5.0	very turbid	6.94	0.353	80.0	32	
7/21/98	2.5	very turbid	6.76	0.338	82.5	33	
7/21/98	2.5	turbid	6.76	0.346	85.0	34	
7/21/98	2.5	clear	6.72	0.347	87.5	35	
7/21/98	2.5	turbid	6.68	0.316	90.0	36	
7/21/98	2.5	slightly turbid	6.69	0.327	92.5	37	
7/21/98	2.5	clear	6.70	0.333	95.0	38	
7/21/98	2.5	slightly turbid	6.69	0.338	97.5	39	
7/21/98	2.5	clear	6.75	0.335	100.0	40	
7/21/98	2.5	slightly turbid	6.74	0.336	102.5	41	
RESULTS AT END OF DEVELOPMENT		slightly turbid	6.74	0.336	102.5	41	

COMMENTS:

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM	WELL NO. <u>GW-912</u> PAGE 1 of 1
MONITORING WELL DEVELOPMENT SUMMARY	
METHOD OF DEVELOPMENT: <u>Teflon Bailer/2-in. Grundfos Pump</u>	DEVELOPMENT DATE: START: <u>7/21/98</u> FINISH: <u>7/21/98</u>
DEVELOPMENT OBSERVED BY: <u>Karen L. Speed</u>	
ONE WELL VOLUME: <u>2.5</u> GALLONS	
TOTAL GALLONS PUMPED: <u>102.5</u> TOTAL WELL VOLUMES PUMPED: <u>41</u>	
INITIAL pH: <u>7.39</u> FINAL pH: <u>6.74</u>	
INITIAL SPECIFIC CONDUCTANCE: <u>0.431 ms/cm</u> FINAL: <u>0.336 ms/cm</u>	
DESCRIPTION OF INITIAL TURBIDITY: <u>very turbid (off scale)</u>	
DESCRIPTION OF FINAL TURBIDITY: <u>slightly turbid</u>	
FINAL MEASURED TURBIDITY: <u>100 NTU</u>	
WELL APPROVED BY: <u>Bechtel Jacobs Company LLC</u>	
ODOR OF WATER: <u>N/A</u>	
WATER DISCHARGED TO: <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div style="width: 45%;"> ☒ GROUND SURFACE ☐ STORM SEWERS ☐ DRUMS </div> <div style="width: 45%;"> ☐ TANK TRUCK ☐ STORAGE TANKS ☐ OTHER </div> </div>	
INITIAL PRE-DEVELOPMENT WATER DEPTH: <u>12.73 feet (BTOC)</u>	
DEVELOPMENT OBSERVATIONS: _____ _____ _____ _____ _____ _____ _____ _____ _____ _____	
OBSERVER SIGNATURE: <u>Karen L. Speed</u> DATE: <u>September 16, 1998</u>	

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-913

WELL INSTALLATION DIAGRAM

LOGGED BY: Karen L. Speed - Jacobs EM Team

DRILLING DATES

DRILLING COMPANY: U.S. Army Corps of Engineers (USACE)STARTED: 7/13/98DRILLER: James DarnellHELPER: Ron ReedFINISHED: 7/14/986 IN. DIA. STEEL MAN-HOLE COVER
FLUSH MOUNTED WITH PAVEMENT

PAVEMENT SURFACE

LOCKING CAP

12.8 IN. DIA.
EXCAVATION TO
2.3 FT8 IN. DIA. BOREHOLE
FROM 2.3 TO 32.7 FT2.375 IN. OD, 2.061 IN. ID SCHEDULE 40, PVC
CASING FROM SURFACE TO 22.1 FTTOP OF WEATHERED BEDROCK 10.3 FT
TOP OF FRESH BEDROCK 32.7 FTNOTE:
ALL DEPTHS ARE MEASURED FROM
GROUND SURFACE UNLESS
OTHERWISE NOTEDBENTONITE PELLET SEAL
0.5 TO 19.0 FTSAND PACK 19.0 TO 32.7 FTHOLE CLEANED OUT
TO 32.7 FT2.375 IN. OD, 2.064 IN. ID PVC SLOTTED
0.010 IN. OPENINGS, SCREEN 22.1 TO 32.1 FTDRILLED DEPTH OF
BOREHOLE 32.7 FT2.375 IN OD PVC CAP 32.1 TO 32.4 FT

NOT TO SCALE

WELL NO: GW-913

Page 1 of 2

WELL INSTALLATION
COMPLETION DATE: 7/14/98

ONE WELL VOLUME: 2.3 GALLONS

COMMENTS:

WELL INSTALLATION
COMPLETION DATE: 7/14/98

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	pH	SPECIFIC CONDUCTANCE (ms/cm)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
8/3/98	2.5	very turbid	5.93	0.230	52.5	22.88	
8/3/98	2.5	turbid	5.93	0.223	55.0	23.97	
8/3/98	2.5	very turbid	6.05	0.260	57.5	25.06	
8/3/98	2.5	very turbid	6.00	0.242	60.0	26.15	
8/3/98	2.5	very turbid	5.86	0.239	62.5	27.24	
8/3/98	2.5	very turbid	5.47	0.220	65.0	28.33	
8/3/98	2.5	slightly turbid	5.54	0.232	67.5	29.42	
8/3/98	2.0	slightly turbid	5.51	0.231	69.5	30.51	
8/3/98	1.0	slightly turbid	5.53	0.237	70.5	31.60	
8/3/98	2.5	very turbid	5.52	0.228	73.0	32.69	
8/3/98	2.5	turbid	5.59	0.241	75.5	33.78	
8/3/98	2.5	clear	5.53	0.226	78.0	34.87	
8/3/98	1.5	clear	5.56	0.236	79.5	35.96	
8/3/98	1.0	clear	5.58	0.238	80.5	37.05	
8/3/98	1.0	very clear	5.59	0.237	81.5	38.14	
RESULTS AT END OF DEVELOPMENT		very clear	5.59	0.237	81.5	38.14	

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Y-12 PLANT GROUNDWATER PROTECTION PROGRAM	WELL NO. <u>GW-913</u> PAGE 1 of 1
MONITORING WELL DEVELOPMENT SUMMARY	
METHOD OF DEVELOPMENT: <u>Teflon Bailer/2-in. Grundfos Pump</u>	
DEVELOPMENT OBSERVED BY: <u>Karen L. Speed</u>	
DEVELOPMENT DATE: <u>8/3/98</u> FINISH: <u>8/3/98</u>	
ONE WELL VOLUME: <u>2.3</u> GALLONS	
TOTAL GALLONS PUMPED: <u>81.5</u> TOTAL WELL VOLUMES PUMPED: <u>35.4</u>	
INITIAL pH: <u>5.36</u> FINAL pH: <u>5.59</u>	
INITIAL SPECIFIC CONDUCTANCE: <u>0.167 ms/cm</u> FINAL: <u>0.237 ms/cm</u>	
DESCRIPTION OF INITIAL TURBIDITY: <u>very turbid (off scale)</u>	
DESCRIPTION OF FINAL TURBIDITY: <u>very clear</u>	
FINAL MEASURED TURBIDITY: <u>5 NTU</u>	
WELL APPROVED BY: <u>Bechtel Jacobs Company LLC</u>	
ODOR OF WATER: <u>N/A</u>	
WATER DISCHARGED TO: <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div> ☐ GROUND SURFACE ☐ STORM SEWERS ☒ DRUMS </div> <div> ☐ TANK TRUCK ☐ STORAGE TANKS ☐ OTHER </div> </div>	
INITIAL PRE-DEVELOPMENT WATER DEPTH: <u>17.81 feet (BTOC)</u>	
DEVELOPMENT OBSERVATIONS: _____ _____ _____ _____ _____ _____ _____ _____ _____ _____	
OBSERVER SIGNATURE: <u>Karen L. Speed</u> DATE: <u>September 16, 1998</u>	

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-914

WELL INSTALLATION DIAGRAM

LOGGED BY: Karen L. Speed - Jacobs EM Team

DRILLING DATES

DRILLING COMPANY: U.S. Army Corps of Engineers (USACE)STARTED: 7/8/98DRILLER: James DarnellHELPER: Ron ReidFINISHED: 7/9/98

NOT TO SCALE

NOTE: Core drilling location, cored 35.2 ft to 45.2 ft.
Core hole filled with sand from 33.9 ft to 45.2 ft.
Bentonite pellet seal from 31.9 ft to 33.9 ft.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-914</u>
WELL LOG			PAGE 1 of 2
LOCATION: <u>Oil Landfarm</u>		DATE: START: <u>7-8-98</u>	
DRILLER: <u>James Darnell - USACE</u>		FINISH: <u>7-9-98</u>	
HELPER: <u>Ron Reid - USACE</u>		DRILLING METHOD: <u>Hollow Stem Auger</u>	
DRILL: <u>CME 75</u>		LOGGED BY: <u>Karen L. Speed</u>	
NOTES: <u>Collected samples with 2 in. x 2 ft stainless steel split spoon. Analytical (chemical and radiological) sample collected from 0-0.5 ft. Geotechnical sample collected from 0-20 ft. Core drilling location (35.2-45.2 ft).</u>			
DEPTH (ft)		SAMPLE (NO. & INTERVAL)	SOIL/BEDROCK DESCRIPTION
FROM	TO		
0.0	2.00	1 (0-2)	Sandy, silty clay; very dry, highly weathered, compacted, nonplastic, shale fragments. Color: 2.5Y5/4.
5.00	5.66	2 (5-6.49)	Silty shale, highly weathered, friable, saprolitic, some sand, nonplastic, some clay staining, manganese staining (7.5YR2.5/1), some ferrous staining (7.5YR5/8). Color: 7.5YR5/2.
5.66	6.33		Sandy, silty clay; highly weathered, plastic, soft, damp, some layering. Color: 2.5Y5/6, 5/10G.
6.33	6.49		Silty, clayey shale; saprolitic, highly weathered, some laminations (structure), damp, friable, some sand, nonplastic. Color: 2.5Y5/6.
6.49	10.00		Silty shale saprolite, highly weathered.
10.00	10.66	3 (10-12)	Silty shale saprolite, highly weathered, friable, dry, nonplastic, some manganese and ferrous staining. Color: Laminated 6/10B and 5YR4/2.
10.66	11.16		Silty clay, highly weathered, some sand, damp, slightly plastic, laminated. Color: Laminated 5YR5/3, 8/10GY, and 5/10GY.
11.16	12.00		Silty shale, saprolite, some fissility, highly weathered, friable, damp, nonplastic, some iron and manganese. Color: 7.5YR5/1.
15.00	15.41	4 (15-16.58)	Silty clay-silty shale, highly weathered, little structure, some sand, damp, moderate plasticity. Color: 5YR4/2.
15.41	15.83		Silty clayey shale; some sand, highly weathered, damp, friable, slight plasticity, some manganese (7.5YR2.5/1). Color: 7.5YR4/6, 2.5Y5/4.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-914

WELL LOG - continued

PAGE 2 of 2

[illegible]

CORE DRILLING

[illegible]

CORE LITHOLOGY

Well <u>GW-914</u>		Date <u>07/08/98</u>		Logged by <u>Karen L. Speed</u>		Page <u>1</u> of <u>2</u>	
Run	Length	Depth		Description	% Shale		
		From	To				
1	10	35.2	45.2		30		
		35.2	36.1	Oolitic limestone (N4/N3), matrix supported, shale partings (wavy, interconnected), calcite-filled veins, U-shaped stylolites. Note: Lower section contains breccia and from 36.0-36.1 feet, limestone is highly weathered.			
		36.1	37.9	Micritic limestone (5GY4/1): Shale partings, sparry calcite-filled veins, coarser-grained limestone nodules/lenses, highly fractured, less competent. Note: Significant ferrous staining from 36.1-37.1 ft.			
		37.9	38.4	Oolitic limestone (N3): Coarse grained, shale partings, stylolites, micritic limestone nodules, grain supported, oolitic calcite nodules.			
		38.4	38.45	Silty shale laminae, highly fractured, limy mud. Color: 5GY6/1.			
		38.45	38.95	Clayey shale, fissile, competent, contains limy mud, some ferrous/iron staining, which becomes more significant towards lower section—highly weathered, very thin calcite-filled veins, slick bedding plane surfaces. Color: 5YR4/1.			
		38.95	39.10	Limestone, oolitic, interbedded shale laminae, significant ferrous staining along shale bedding planes, and contains very thin micrite laminae. Color: N3.			
		39.10	40.7	Clayey shale, fissile, highly fractured, micrite-filled veins both parallel and perpendicular to bedding, some ferrous staining increasing towards lower section of interval. Color: 5YR4/1.			

CORE LITHOLOGY

Well <u>GW-914</u>		Date <u>07/08/98</u>		Logged by <u>Karen L. Speed</u>		Page <u>2</u> of <u>2</u>	
Run	Length	Depth		Description	% Shale		
		From	To				
		40.7	41.0	Silty, clayey shale; highly fractured; fissile; micrite-filled veins parallel and			
				perpendicular to bedding. Color: 5GY6/1.			
		41.0	41.1	Interbedded shale and limestone laminae, calcite-filled veins perpendicular			
				to bedding. Shale: silty, clayey shale (5GY6/1). Limestone: oolitic, coarse			
				grained (N3).			
		41.1	42.1	Limestone: oolitic, grain supported, very fine-grained limestone nodules,			
				U-shaped calcite-filled veins, ferrous staining along bedding planes,			
				brecciated, contains shale partings and stylolites. Color: N4.			
		42.1	44.7	Limestone interbedded with shale laminae. Limestone (N6): Oolitic, fine			
				grained, significant ferrous staining along bedding planes, sparry calcite-filled			
				veins perpendicular to bedding. Shale (5GY6/1): slick bedding plane			
				surfaces, fissile.			
		44.7	45.2	Oolitic limestone, coarser grained, grain supported, ferrous staining along			
				bedding plane, U-shaped, thin calcite-filled veins perpendicular to bedding.			
				Color: N3.			

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO: GW-914

MONITORING WELL DEVELOPMENT PROGRESS

Page 1 of 2

LOCATION: Oil Landfarm

WELL INSTALLATION

ONE WELL VOLUME: 3.0 GALLONSCOMPLETION DATE: 7/9/98

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	pH	SPECIFIC CONDUCTANCE (ms/cm)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
7/20/98	3	very turbid	7.31	0.865	3	1	
7/20/98	3	very turbid	8.08	0.687	6	2	
7/20/98	3	very turbid	6.29	0.616	9	3	
7/20/98	3	very turbid	6.07	0.555	12	4	
7/20/98	3	very turbid	5.96	0.532	15	5	
7/20/98	3	very turbid	6.03	0.504	18	6	
7/20/98	3	very turbid	6.01	0.492	21	7	
7/20/98	3	very turbid	5.98	0.466	24	8	
7/20/98	5	very turbid	6.05	0.455	29	9.67	
7/20/98	5	very turbid	6.06	0.448	34	11.34	
7/20/98	5	very turbid	5.79	0.474	39	13.01	
7/20/98	5	very turbid	5.91	0.478	44	14.68	
7/20/98	5	turbid	5.86	0.469	49	16.35	
7/20/98	5	very turbid	6.09	0.474	54	18.02	
7/20/98	5	very turbid	6.02	0.499	59	19.69	
7/20/98	5	very turbid	6.27	0.534	64	21.36	
7/20/98	5	very turbid	6.00	0.466	69	23.03	
7/20/98	5	very turbid	6.24	0.588	74	24.70	
7/20/98	5	very turbid	5.81	0.454	79	26.37	
7/20/98	5	very turbid	5.80	0.455	84	28.04	
RESULTS AT END OF DEVELOPMENT		*SEE NEXT PAGE					

COMMENTS:

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO: GW-914MONITORING WELL DEVELOPMENT PROGRESS
(continued)

Page 2 of 2

LOCATION: Oil Landfarm

WELL INSTALLATION

ONE WELL VOLUME: 3.0 GALLONSCOMPLETION DATE: 7/9/98

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	pH	SPECIFIC CONDUCTANCE (ms/cm)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
7/20/98	5	very turbid	5.87	0.462	89	29.71	
7/20/98	5	very turbid	5.87	0.455	94	31.38	
7/20/98	5	very turbid	5.83	0.446	99	33.05	
7/20/98	5	slightly turbid	5.89	0.455	104	34.72	
7/20/98	5	slightly turbid	5.94	0.464	109	36.39	
7/20/98	5	slightly turbid	5.95	0.463	114	38.06	
7/20/98	5	slightly turbid	5.93	0.455	119	39.73	
7/20/98	5	slightly turbid	5.94	0.461	124	41.40	
7/20/98	5	slightly turbid	5.91	0.457	129	43.07	
7/20/98	5	clear	5.90	0.461	134	44.74	
RESULTS AT END OF DEVELOPMENT		clear	5.90	0.461	134	44.74	

COMMENTS:

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM		WELL NO. <u>GW-914</u>
MONITORING WELL DEVELOPMENT SUMMARY		PAGE 1 of 1
METHOD OF DEVELOPMENT: <u>2-in. Grundfos Pump</u>		DEVELOPMENT DATE:
DEVELOPMENT OBSERVED BY: <u>Karen L. Speed</u>		START: <u>7/20/98</u>
		FINISH: <u>7/20/98</u>
ONE WELL VOLUME: <u>3.0</u> GALLONS		
TOTAL GALLONS PUMPED: <u>134</u> TOTAL WELL VOLUMES PUMPED: <u>44.7</u>		
INITIAL pH: <u>7.31</u> FINAL pH: <u>5.90</u>		
INITIAL SPECIFIC CONDUCTANCE: <u>0.865 ms/cm</u> FINAL: <u>0.461 ms/cm</u>		
DESCRIPTION OF INITIAL TURBIDITY: <u>very turbid (off scale)</u>		
DESCRIPTION OF FINAL TURBIDITY: <u>clear</u>		
FINAL MEASURED TURBIDITY: <u>75 NTU</u>		
WELL APPROVED BY: <u>Bechtel Jacobs Company LLC</u>		
ODOR OF WATER: <u>N/A</u>		
WATER DISCHARGED TO: ☒ GROUND SURFACE ☐ TANK TRUCK ☐ STORM SEWERS ☐ STORAGE TANKS ☐ DRUMS ☐ OTHER		
INITIAL PRE-DEVELOPMENT WATER DEPTH: <u>10.90 feet (BTOC)</u>		
DEVELOPMENT OBSERVATIONS:		
OBSERVER SIGNATURE: <u>Karen L. Speed</u>		
DATE: <u>September 16, 1998</u>

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-915

WELL INSTALLATION DIAGRAM

LOGGED BY: Timothy Coffey - SAIC

DRILLING DATES

DRILLING COMPANY: Law EngineeringSTARTED: 1/20/98DRILLER: John VoekelHELPER: Jimmy WarrenFINISHED: 1/20/98

NOT TO SCALE

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-915</u>
WELL INSTALLATION ACTIVITY/PROGRESS REPORT			PAGE 1 of 2
LOCATION: <u>West Bear Creek Valley</u>		DATE: START: <u>1-20-98</u>	
OPERATOR: <u>J. Voekel - Law Engineering</u>		FINISH: <u>1-20-98</u>	
HELPERS: <u>J. Warren - Law Engineering</u>		LOGGED BY: <u>T. Coffey - SAIC</u>	
DRILL: <u>CME Model 550</u>			

DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
1-20-98	1422	1430	Move drill rig onto location and position over well site. Raise the mast, and rig up with the lead auger flyte. Lead auger (including bit) is 5.2 ft long, subsequent auger flytes are 5.0 ft long. Augers are 6 1/2-in. outside diameter (OD), 3 1/4-in. inside diameter (ID). Background radiological scan of location: Alpha = 0 cpm, Beta/Gamma = 60 cpm.
	1430	1456	Insert center clean-out rod inside augers. Commence augering. Auger the borehole from 0.0 ft to 21.2 ft below ground surface (BGS). Breathing zone analysis (BZA) at 3.0 ft BGS = 1.0 ppm (background). Begin to see weathered shale fragments at 7.0 ft BGS. BZA at 8.0 ft and 11.0 ft BGS both read 1.0 ppm (background). Drilling becoming harder at 13.0 ft BGS. BZA at 17.0 ft BGS reads 1.0 ppm (background). Encounter top of weathered bedrock at 18.5 ft BGS (hard drilling). Augers bouncing and chattering at 20.5 ft BGS (top of fresh bedrock).
	1456	1502	Auger refusal at 21.2 ft BGS. Spin augers to clean out the borehole. Break the augers loose from drill head. Pull out center clean-out rods. Prepare well construction materials. Cut screen section, and glue cap on bottom end. Well construction materials tally:
			Screen: 1, 4.3-ft section of 2 3/8-in. OD, 2-in. ID, slotted, schedule 40 PVC screen (cap is approximately 0.05 ft long, glued onto bottom end of screen).

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-915</u>
WELL INSTALLATION ACTIVITY/PROGRESS REPORT continued			PAGE 2 of 2
DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
1-20-98	1456	1502	Riser: 2, 10-ft sections and 1, 5-ft section of 2 3/8-in. OD,
(cont.)	(cont.)	(cont.)	2-in. ID schedule 40 PVC casing.
			Total length of screen, cap, and riser is 29.35 ft.
	1502	1505	Run the screen and casing into the borehole, inside of the augers.
			Pull up and remove 1 auger flyte. Remove the 5-ft section of
			casing. Casing stick-up = 3.3 ft. Bottom of screen is at 21.05 ft
			BGS, top of the screen is at 16.7 ft BGS.
	1505	1535	Remove another auger flyte from the borehole. Pour approximately
			1 1/3, 50 lb sacks of very fine-grained filter pack sand (no grain
			size indicated) into the annulus (sand bridges occasionally between
			casing and augers). Sand pack level to 16.5 ft BGS. Screen
			cuttings composite sample (see Well Cuttings Field Screening/
			Disposal Form).
	1535	1542	Trip the remaining augers out of the borehole. The borehole
			appears to have stayed open (no collapse) after the final auger is
			removed.
	1542	1544	Pour approximately 1/3 of a 50-lb sack of 3/8-in. granular bentonite
			(Hole Plug™) into the annulus. Level of unhydrated bentonite is
			at 15.5 ft BGS.
	1544	1557	Move the drill rig off the location. Backfill the well annulus from
			15.5 ft to 7.5 ft BGS with cuttings. Seal the annulus from 6.5 ft to
			7.5 ft BGS with granular bentonite (use approximately 1/3 of a
			50-lb sack). Cap remaining annulus to ground surface with
			cuttings.
			Installation of well GW-915 is complete.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM				WELL NO. <u>GW-915</u>	
WELL LOG				PAGE 1 of 1	
LOCATION: <u>West Bear Creek Valley</u>			DATE: START: <u>1-20-98</u>		
DRILLERS: <u>J. Voekel - Law Engineering</u>			FINISH: <u>1-20-98</u>		
HELPERS: <u>J. Warren - Law Engineering</u>			DRILLING METHOD: <u>Hollow-stem Auger</u>		
DRILL: <u>CME Model 550</u>			LOGGED BY: <u>T. Coffey - SAIC</u>		
NOTES: <u>Soil and rock colors from GSA Rock-color chart. BZA: Breathing zone analysis. BGS: below ground surface. Bkgd: background.</u>					
DEPTH (ft)		SAMPLE (NO. & INTERVAL)	SOIL/BEDROCK DESCRIPTION		
FROM	TO				
0.0	3.0	BZA at 3.0 ft =	Light brown (5YR 5/6), moist, silty clay soil.		
		1.0 ppm (Bkgd).			
3.0	10.0	BZA at 8.0 ft =	Moderate yellowish-brown (10YR 5/4) to dark yellowish-brown		
		1.0 ppm (Bkgd).	(10YR 4/2), dry, silty subsoil. Rare clay. Begin to see fragments		
			of weathered shale at 7.0 ft BGS.		
10.0	18.5	BZA at 11.0 and	Dusky brown (5YR 2/2) to grayish-brown (5YR 3/2), moist, silty		
		17.0 ft = 1.0 ppm	clay with minor weathered shale fragments. Suspect groundwater		
		(Bkgd).	table at 10.0 ft BGS.		
18.5	20.5		Top weathered bedrock at 18.5 ft BGS. Olive gray (5Y 3/2), thinly		
			laminated shale (50%) and moderate olive brown (5Y 4/4), thinly		
			bedded, sandy siltstone (50%).		
20.5	21.2	Cuttings composite	Top of fresh bedrock at 20.5 ft BGS. Medium dark gray (N4), thinly		
		(0.0-21.2 ft BGS):	laminated shale. Total depth = 21.2 ft (auger refusal).		
		alpha = 0 cpm, beta/			
		gamma = 60 cpm, pH			
		= 5.7; organic vapors			
		= 3.0 ppm (Bkgd =			
		1.6 ppm).			

Y-12 PLANT GROUNDWATER PROTECTION PROGRAMWELL NO. GW-915**WELL CUTTING FIELD SCREENING/DISPOSAL FORM**

PAGE 1 of 1

LOCATION: West Bear Creek Valley DATE: START: 1-20-98APPROX. VOLUME OF CUTTINGS: 4.9 cubic ft. FINISH: 1-20-98

CALIBRATION OF INSTRUMENTS: Check those calibrated to manufacturer's specifications.

pH meter	<u>X</u>	(model)	<u>Horiba Model U-7</u>
Organic vapor meter	<u>X</u>	(model)	<u>Century-Foxboro OVA Model 128</u>
Beta/gamma meter	<u>X</u>	(model)	<u>Ludlum Model 3 Survey Meter with G-M Pancake Probe</u>
Alpha meter	<u>X</u>	(model)	<u>Ludlum Model 12 Count Ratemeter with Scintillation Tube Probe</u>

FIELD SCREENING RESULTS: (background/highest observed values):

pH	<u>5.7</u>	Date/Time	<u>1-20-98/1545</u> (4.0-10.5)
Organic vapors	<u>1.6 ppm/3.0 ppm</u>	Date/Time	<u>1-20-98/1539</u> (<10 ppm above background)
Beta/Gamma	<u>60 cpm/60 cpm</u>	Date/Time	<u>1-20-98/1507</u> (<100 cpm above background)
Alpha	<u>0 cpm/0 cpm</u>	Date/Time	<u>1-20-98/1505</u> (<500 cpm above background)

Weather: Clear to mostly clear, dry Temp.: Mid-20's to mid-40's°F.DISPOSITION: Drill-site Disposal X Containerization (Labeled?) y/n N/ADescribe: Cuttings used to backfill well annulus.On-site Geologist (print): Timothy Coffey - SAICSignature: Date: January 20, 1998

[illegible]

APPENDIX B
WELL PLUGGING AND ABANDONMENT REPORTS

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-201</u>
WELL PLUGGING AND ABANDONMENT ACTIVITY/PROGRESS REPORT			PAGE 1 of 3
LOCATION: <u>Ravine Disposal Site</u>		DATE: START: <u>8-27-98</u>	
DRILLER: <u>R. Phillips - Highland Drilling Co.</u>		FINISH: <u>8-28-98</u>	
HELPER: <u>K. Fortner - Highland Drilling Co.</u>		METHOD: <u>C</u>	
DRILL: <u>Ingersoll-Rand XL-750</u>		LOGGED BY: <u>T.J. Coffey - SAIC</u>	
DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
8-27-98	0815	0843	Arrive at GW-201 site. The drill rig is on location and positioned over
			the well with the mast up. The crew has already removed the
			protective casing, with some of the well casing still cemented
			inside. The crew has also broken up the concrete pad. Measure
			the water level at 16.9 ft below ground surface (BGS). Tag the
			bottom of the well (solid) at 19.4 ft BGS. Apparently the well casing
			was pulled out of the well slightly when the protective casing was
			removed. Background radiological scan of the location: alpha =
			0 cpm, beta/gamma = 50 cpm.
	0843	0855	Crew arrives. Also present: B. McMaster [UT/Environmental
			Safety & Health (ES&H)] and T. Harris (AJA Technical Services).
			B. McMaster conducts a site-specific Health and Safety briefing.
			T. Harris to conduct an audit of P&A procedures.
	0855	0907	Attach a jawed clamp to the top of the remaining casing and
			attempt to pull it out: clamp pulls out a chunk of the casing.
	0907	0933	Attempt to pull out the casing using chokers, chains, and other
			clamping devices in various combinations.
	0933	0940	Finally pull out the casing using a chain. Extract 5.5 ft of 4 1/2-in.
			outside diameter (OD) slotted PVC screen (includes a 0.5-ft-long
			cap section) and 14.0 ft of 4-in. inside diameter (ID), 4 1/2-in. OD
			PVC casing (add to 5.2 ft of PVC casing still cemented inside the
			protective casing for 19.2 ft of total casing).

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-201</u>
WELL PLUGGING AND ABANDONMENT ACTIVITY/PROGRESS REPORT - continued			PAGE 2 of 3
DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
8-27-98	0940	0945	Rig up with an 8 3/4-in. diameter tri-cone roller bit on a drilling
(cont.)			subadapter; total length = 2.3 ft, table height = 2.3 ft, table height
			= 2.5 ft. Add a 25-ft drill rod to the bit/subadapter assembly.
	0945	1000	Commence reaming the wellbore using compressed air only.
			Ream from 0.0 ft to 22.0 ft BGS. Breathing zone analysis (BZA)
			from 1.0 ft to 2.0 ft BGS is <1 ppm (background). Cuttings from
			0.0 ft to 2.5 ft BGS consist of brownish-black (5 YR 2/1) to black
			(N1) sandy, silty topsoil with minor amounts of medium dark gray
			(N4) cement and black (N1) "cooked" shale. Cuttings from 2.5 ft to
			11.8 ft BGS consist primarily of medium gray (N5) and medium
			dark gray (N4) cement fragments and includes minor amounts of:
			moderate yellowish-brown (10 YR 5/4) to dark yellowish-orange
			(10 YR 6/6) clay, and black (N1) and moderate brown (5 YR 3/4)
			and moderate yellowish-brown (10 YR 5/4) weathered shale. BZA
			at 15.8 ft and 19.8 ft BGS both read <1 ppm (background). Begin
			to see a fine mist of water in the returns at 19.8 ft BGS. Cuttings
			from 11.8 ft to 22.0 ft BGS continue to be the shale and cement
			fragments of above plus dark gray (N3), finely-crystalline micrite
			and subrounded, fine-grained quartz sand (filter pack). Hard drilling
			(bouncing tools) at 21.6 ft BGS.
	1000	1025	At 22.0 ft BGS. Clean out the borehole. Trip the tools out of the
			hole. Tag bottom of the borehole at 21.5 ft BGS (0.5 ft of fill). Rack
			the drill rod and rig down the bit/subadapter assembly. Lower the
			mast.
	1025	1056	Mix and pour 7, 94-lb sacks of Type I Portland cement (neat), with
			an average grout weight of 14.3 lbs/gal, into the borehole. The
			cement grout fills the hole from 21.5 ft to 1.6 ft BGS.
	1056	1132	Clean up and begin dismantling the site. Oversight departs.

PAGE 3 of 3

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM		WELL NO. <u>GW-201</u>																		
WELL PLUGGING AND ABANDONMENT DIAGRAM																				
LOCATION: <u>Ravine Disposal Site</u>		DATE: START: <u>8-27-98</u>																		
COORDINATES: <u>N30378 E61914</u>		FINISH: <u>8-28-98</u>																		
REFERENCE POINT FOR MEASUREMENTS: <u>Ground Surface</u>		PREPARED BY: <u>T. Coffey-SAIC</u>																		
DRILLING COMPANY: <u>Highland Drilling Co.</u>		DRILL: <u>Ingersoll-Rand XL-750</u>																		
DRILLER: <u>R. Phillips</u>		HELPERS: <u>K. Fortner</u>																		
REASON FOR P&A: <u>Well damaged by mowing equipment.</u>																				
P&A METHOD: <u>C</u> DEVIATIONS FROM METHOD: <u>None.</u>																				
WELL CONSTRUCTION SUMMARY		P&A SUMMARY																		
Note: Some of the information in this section obtained from field observations.		REAMED DIA: <u>8 3/4 in.</u>
<table border="1" style="margin-left: 20px;"> <tr> <td>CONDUCTOR HOLE DIA: <u>N/A</u></td> <td>DEPTH <u>N/A</u></td> </tr> <tr> <td>SURFACE CONDUCTOR TYPE: <u>Galv. Steel</u> DIA: <u>6 5/8-in. OD</u></td> <td>TOP <u>+3.0 ft</u> BOTTOM <u>2.3 ft</u></td> </tr> <tr> <td>BOREHOLE DIA: <u>8 in.</u></td> <td>TOP <u>0.0 ft</u> BOTTOM <u>21.0 ft</u></td> </tr> <tr> <td>FILLER: <u>Cement</u></td> <td></td> </tr> <tr> <td>CASING (WITH SCREEN) TYPE: <u>PVC/#40</u> DIA: <u>4.5-in. OD</u></td> <td>TOP <u>+3.0 ft</u> BOTTOM <u>16.0 ft</u></td> </tr> <tr> <td>SEAL: <u>Unknown</u></td> <td>TOP <u>N/A</u> BOTTOM <u>N/A</u></td> </tr> <tr> <td>FILTER PACK: <u>Sand</u></td> <td>TOP <u>15.0 ft</u> BOTTOM <u>21.0 ft</u></td> </tr> <tr> <td>SCREEN TYPE: <u>PVC/sl/0.01</u> DIA: <u>4.5-in. OD</u></td> <td>TOP <u>16.0 ft</u> BOTTOM <u>21.0 ft</u></td> </tr> <tr> <td>TOTAL DEPTH: <u>21.0</u></td> <td></td> </tr> </table>		CONDUCTOR HOLE DIA: <u>N/A</u>	DEPTH <u>N/A</u>	SURFACE CONDUCTOR TYPE: <u>Galv. Steel</u> DIA: <u>6 5/8-in. OD</u>	TOP <u>+3.0 ft</u> BOTTOM <u>2.3 ft</u>	BOREHOLE DIA: <u>8 in.</u>	TOP <u>0.0 ft</u> BOTTOM <u>21.0 ft</u>	FILLER: <u>Cement</u>		CASING (WITH SCREEN) TYPE: <u>PVC/#40</u> DIA: <u>4.5-in. OD</u>	TOP <u>+3.0 ft</u> BOTTOM <u>16.0 ft</u>	SEAL: <u>Unknown</u>	TOP <u>N/A</u> BOTTOM <u>N/A</u>	FILTER PACK: <u>Sand</u>	TOP <u>15.0 ft</u> BOTTOM <u>21.0 ft</u>	SCREEN TYPE: <u>PVC/sl/0.01</u> DIA: <u>4.5-in. OD</u>	TOP <u>16.0 ft</u> BOTTOM <u>21.0 ft</u>	TOTAL DEPTH: <u>21.0</u>		DRILLED/REAMED DEPTH: <u>22.0 ft</u> PLUG MATERIAL: <u>Cement</u> CAP MATERIAL: <u>Cuttings</u>
CONDUCTOR HOLE DIA: <u>N/A</u>	DEPTH <u>N/A</u>																			
SURFACE CONDUCTOR TYPE: <u>Galv. Steel</u> DIA: <u>6 5/8-in. OD</u>	TOP <u>+3.0 ft</u> BOTTOM <u>2.3 ft</u>																			
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TOTAL DEPTH: <u>21.0</u>
		<table border="1" style="margin-left: 20px;"> <tr> <td>CAP</td> <td>DEPTH: <u>3.3 ft</u></td> </tr> <tr> <td>PLUG</td> <td>DIA: <u>8 3/4 in.</u></td> </tr> <tr> <td>FILL/COLLAPSE</td> <td>DEPTH: <u>21.5 ft</u></td> </tr> <tr> <td></td> <td>DEPTH: <u>22.0 ft</u></td> </tr> </table>	CAP	DEPTH: <u>3.3 ft</u>	PLUG	DIA: <u>8 3/4 in.</u>	FILL/COLLAPSE	DEPTH: <u>21.5 ft</u>		DEPTH: <u>22.0 ft</u>										
CAP	DEPTH: <u>3.3 ft</u>																			
PLUG	DIA: <u>8 3/4 in.</u>																			
FILL/COLLAPSE	DEPTH: <u>21.5 ft</u>																			
	DEPTH: <u>22.0 ft</u>																			

N/A: Not applicable/not available

Y-12 PLANT GROUNDWATER PROTECTION PROGRAMWELL NO. GW-201**WELL CUTTINGS FIELD SCREENING / DISPOSAL FORM**

Page 1 of 1

LOCATION: Ravine Disposal SiteDATE: START: 8-27-98APPROX. VOLUME OF CUTTINGS: 9.2 cubic ftFINISH: 8-28-98

CALIBRATION OF INSTRUMENTS: Check those calibrated to manufacturer's specifications.

pH meter	<u>X</u>	(model)	<u>Horiba Model U-7</u>
Organic vapor meter	<u>X</u>	(model)	<u>Century-Foxboro OVA Model 128</u>
Beta/gamma meter	<u>X</u>	(model)	<u>Ludlum Model 3 Survey Meter with G-M Pancake Probe</u>
Alpha meter	<u>X</u>	(model)	<u>Ludlum Model 12 Count Ratemeter with Scintillation Tube Probe</u>

FIELD SCREENING RESULTS (background/highest observed values):

pH	<u>10.8*</u>	Date/Time	<u>8-27-98/1112</u>	(4.0-10.5)
Organic vapors	<u><1 ppm/<1 ppm</u>	Date/Time	<u>8-27-98/1110</u>	(<10 ppm above background)
Beta/Gamma	<u>50 cpm/60 cpm</u>	Date/Time	<u>8-27-98/1058</u>	(<100 cpm above background)
Alpha	<u>0 cpm/0 cpm</u>	Date/Time	<u>8-27-98/1056</u>	(<500 cpm above background)

*Elevated pH reading due to cement fragments in the cuttings composite.

Weather Clear with light breeze Temp.: Mid-70's to low-80's FDISPOSITION: Drill-site Disposal X Containerization N/A
(Labeled?) y / n

Describe: Some of the cuttings used to cap the reamed wellbore. Remaining cuttings scattered around the location.

On-Site Geologist (print): Timothy Coffey-SAIC

Signature:

Date: 8-27-98

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM		WELL NO: <u>GW-201</u>		
EQUIPMENT DECONTAMINATION INSPECTION SUMMARY		INSTALLATION ☐ P&A ☒		
LOCATION: <u>Ravine Disposal Site</u>		DATE: START: <u>8/27/98</u>		
DECONTAMINATION CREW: <u>R. Phillips/K. Fortner</u>		FINISH: <u>8/28/98</u>		
EQUIPMENT	DECON DATE	INSPECTION DATE	INSPECTION (PASS/FAIL)	INSPECTOR'S INITIALS
DRILLING RIG <u>Ingersoll-Rand XL-750</u> (Mast, Chassis, Cables, Carousel, Hoses, etc.)	8/26/98	8/27/98	Pass	TJC
DRILLING TOOLS (Pipe Wrenches, Hand Tools, Lifting Bells, Clevis, Chains, etc.)	8/26/98	8/27/98	Pass	TJC
DOWN HOLE TOOLS (Drilling Rods, Stabilizers, Washover Pipe, Bits, etc.)	8/26/98	8/27/98	Pass	TJC
WELL CONSTRUCTION MATERIALS (Casing, Screen, Centralizers, etc.)	N/A	N/A	N/A	N/A
WORKOVER RIG _____ (Mast, Chassis, Cables, Hoses, etc.)	N/A	N/A	N/A	N/A
DEVELOPMENT TOOLS (Tubing, Bailers, Pumps, etc.)	N/A	N/A	N/A	N/A
OTHER EQUIPMENT OR RE-INSPECTIONS (SPECIFY)				
COMMENTS:				

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-707</u>
WELL PLUGGING AND ABANDONMENT ACTIVITY/PROGRESS REPORT			PAGE 1 of 2
LOCATION: <u>Y-12 Plant Site</u>		DATE: START: <u>8-13-98</u>	
OPERATOR: <u>R. Phillips-Highland Drilling Co.</u>		FINISH: <u>8-14-98</u>	
HELPER: <u>N/A</u>		METHOD: <u>A</u>	
DRILL: <u>N/A</u>		LOGGED BY: <u>T. Coffey - SAIC</u>	

DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
8-13-98	1035	1041	Arrive at GW-707 site. Remove the flush-mount cover. Remove the cap; screen for organic vapors: 0.0 ppm in breathing zone, 0.0 ppm inside well casing (Background = 0.0 ppm). Tag bottom of well at 16.9 ft below top of casing (BTOC) = 17.3 ft below ground surface (BGS). Measure the water level at 7.51 ft BTOC.
	1041	1046	Slowly pour 1 1/2, 50-lb sacks of 3/8-in. granular bentonite into the well until the entire water column has been absorbed. Unhydrated bentonite level is at 4.3 ft BTOC. Allow the bentonite to hydrate. Re-cover the flush-mount box. Depart site.
8-14-98	1015	1019	Arrive at GW-707 site. Remove the flush-mount cover. Tag the hydrated bentonite level at 4.3 ft BTOC (no vertical swell of the bentonite).
	1019	1033	Mix and pour 3, 80-lb sacks of concrete into the casing and flush-mount box filling both to the cover lip on the flush-mount box cover receiver. Replace the cover (on this well, the cover will be used to cap the plugged well).
			P&A of well GW-707 is complete.

WELL NO. GW-707

PAGE 2 of 2

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-707

WELL PLUGGING AND ABANDONMENT DIAGRAM

LOCATION: Y-12 Plant SiteDATE: START: 8-13-98COORDINATES: N29319.23 E59578.51FINISH: 8-14-98REFERENCE POINT FOR MEASUREMENTS: Ground SurfacePREPARED BY: T. Coffey-SAICDRILLING COMPANY: Highland Drilling Co.DRILL: N/ADRILLER: R. PhillipsHELPERS: N/AREASON FOR P&A: Obsolete well: no more monitoring required due to closure of UST site.P&A METHOD: A DEVIATIONS FROM METHOD: Well screen, casing, and flush-mount box plugged in-place with approval from ES&H.

WELL CONSTRUCTION SUMMARY

Note: Some of the information in this section obtained from field observations.

N/A: Not applicable/not available

P&A SUMMARY

REAMED DIA: N/ADRILLED/REAMED DEPTH: N/APLUG MATERIAL: Granular bentoniteCAP MATERIAL: Concrete

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-708</u>
WELL PLUGGING AND ABANDONMENT ACTIVITY/PROGRESS REPORT			PAGE 1 of 2
LOCATION: <u>Y-12 Plant Site</u>		DATE: START: <u>8-13-98</u>	
OPERATOR: <u>R. Phillips-Highland Drilling Co.</u>		FINISH: <u>8-14-98</u>	
HELPER: <u>N/A</u>		METHOD: <u>A</u>	
DRILL: <u>N/A</u>		LOGGED BY: <u>T. Coffey - SAIC</u>	

DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
8-13-98	1005	1013	Arrive at GW-708 site. Remove the flush-mount cover. Bail water from the flush-mount box, exposing the wellhead. Remove the cap; screen for organic vapors: 0.0 ppm in breathing zone, up to 100 ppm (sporatically) at the pavement level, and approximately 600 ppm at the top of the casing (Background = 0.0 ppm). There is a gasoline odor emanating from the well. Tag the bottom of the well at 13.3 ft below top of casing (BTOC) = 13.6 ft below ground surface (BGS). Measure the water level at 4.98 ft BTOC.
	1013	1018	Slowly pour 1, 50-lb sack of 3/8-in. granular bentonite into the well until the entire water column has been absorbed. Continue to monitor the breathing zone: 0.0 ppm. Unhydrated bentonite level is at 3.9 ft BTOC. Allow bentonite to hydrate. Re-cover the flush-mount box. Depart site.
8-14-98	1037	1041	Arrive at GW-708 site. Tag hydrated bentonite level at 3.8 ft BTOC (bentonite swelled up-hole 0.1 ft).
	1041	1057	Mix and pour 1, 80-lb sack of concrete into the casing and flush-mount box filling both to the pavement surface. Trowel-finish the concrete flush with the surrounding pavement.
			P&A of well GW-708 is complete.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-708

**WELL PLUGGING AND ABANDONMENT
ACTIVITY/PROGRESS REPORT
continued**

PAGE 2 of 2

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Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-708

WELL PLUGGING AND ABANDONMENT DIAGRAM

LOCATION: Y-12 Plant SiteDATE: START: 8-13-98COORDINATES: N29335.42 E59529.84FINISH: 8-14-98REFERENCE POINT FOR MEASUREMENTS: Ground SurfacePREPARED BY: T. Coffey-SAICDRILLING COMPANY: Highland Drilling Co.DRILL: N/ADRILLER: R. PhillipsHELPERS: N/AREASON FOR P&A: Obsolete well: no more monitoring required due to closure of UST site.P&A METHOD: A DEVIATIONS FROM METHOD: Well screen, casing, and flush-mount box plugged in-place with approval from ES&H.

WELL CONSTRUCTION SUMMARY

Note: Some of the information in this section obtained from field observations.

N/A: Not applicable/not available

P&A SUMMARY

REAMED DIA: N/ADRILLED/REAMED
DEPTH: N/APLUG MATERIAL: Granular bentoniteCAP MATERIAL: Concrete

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-805</u>
WELL PLUGGING AND ABANDONMENT ACTIVITY/PROGRESS REPORT			PAGE 1 of 1
LOCATION: <u>Building 9204-2</u>		DATE: START: <u>8-13-98</u>	
OPERATOR: <u>R. Phillips-Highland Drilling Co.</u>		FINISH: <u>8-14-98</u>	
HELPER: <u>N/A</u>		METHOD: <u>C</u>	
DRILL: <u>N/A</u>		LOGGED BY: <u>T. Coffey - SAIC</u>	

DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
8-13-98	1316	1323	Arrive at GW-805 site. Remove the flush-mount cover. Remove the cap; screen for organic vapors: 0.0 ppm in breathing zone, 0.0 ppm at top of casing (Background = 0.0 ppm). Tag bottom of well at 12.9 ft below top of casing (BTOC) = 13.1 ft below ground surface (BGS). Measure the water level at 7.78 ft BTOC.
	1323	1330	Slowly pour approximately 2/3 of a 50-lb sack of 3/8-in. granular bentonite into the well until the entire water column has been absorbed. Unhydrated bentonite level is at 6.2 ft BTOC. Allow bentonite to hydrate. Re-cover the flush-mount box. Depart site.
8-14-98	1320	1334	Arrive at GW-805 site. Remove the flush-mount cover. Tag hydrated bentonite at 6.2 ft BTOC (no vertical swell of bentonite). Break up the concrete skirting around the flush-mount box (the concrete is extremely tough).
	1334	1344	Mix and pour 2, 80-lb sacks of concrete into the casing and flush-mount box filling both to the pavement level. Trowel the concrete smooth.
			P&A of well GW-805 is complete.
			NOTE: No intrusive work was performed on this well, hence no Cuttings Field Screening/Disposal Form or Equipment Decontamination Inspection Summary are included in this report.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM		WELL NO. <u>GW-805</u>
WELL PLUGGING AND ABANDONMENT DIAGRAM		
LOCATION: <u>Building 9204-2</u>		DATE: START: <u>8-13-98</u>
COORDINATES: <u>N29884.8 E57402.7</u>		FINISH: <u>8-14-98</u>
REFERENCE POINT FOR MEASUREMENTS: <u>Ground Surface</u>		PREPARED BY: <u>T. Coffey-SAIC</u>
DRILLING COMPANY: <u>Highland Drilling Co.</u>		DRILL: <u>N/A</u>
DRILLER: <u>R. Phillips</u>		HELPERS: <u>N/A</u>
REASON FOR P&A: <u>Obsolete well: no more monitoring required due to closure of UST site.</u>		
P&A METHOD: <u>C</u> DEVIATIONS FROM METHOD: <u>Well screen, casing, and flush-mount box plugged in-place with approval from ES&H.</u>		
WELL CONSTRUCTION SUMMARY		P&A SUMMARY
Note: Some of the information in this section obtained from field observations.		REAMED DIA: <u>N/A</u>
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>CONDUCTOR HOLE DIA: <u>N/A</u></p> <p>SURFACE CONDUCTOR TYPE: <u>None</u> DIA: <u>N/A</u></p> <p>BOREHOLE DIA: <u>10 5/8 in.</u></p> <p>FILLER: <u>Cement</u></p> <p>CASING (WITH SCREEN) TYPE: <u>PVC/#40</u> DIA: <u>4.5-in. OD</u></p> <p>SEAL: <u>Unknown</u></p> <p>FILTER PACK: <u>Sand</u></p> <p>SCREEN TYPE: <u>PVC/s/0.01</u> DIA: <u>4.5-in. OD</u></p> <p>TOTAL DEPTH: <u>13.8</u></p> </div> <div style="width: 45%;"> <p>DEPTH <u>N/A</u></p> <p>TOP <u>N/A</u> BOTTOM <u>N/A</u></p> <p>TOP <u>0.0 ft</u> BOTTOM <u>13.8 ft</u></p> <p>TOP <u>0.2 ft</u> BOTTOM <u>7.2 ft</u></p> <p>TOP <u>N/A</u> BOTTOM <u>N/A</u></p> <p>TOP <u>5.2 ft</u> BOTTOM <u>13.4 ft</u></p> <p>TOP <u>7.2 ft</u> BOTTOM <u>12.7 ft</u></p> </div> </div>		DRILLED/REAMED DEPTH: <u>N/A</u>
		PLUG MATERIAL: <u>Granular bentonite</u>
		CAP MATERIAL: <u>Concrete</u>
		<p>GROUND SURFACE</p> <p>CAP</p> <p>DIA: <u>12 in.</u></p> <p>DEPTH: <u>1.0 ft</u></p> <p>DEPTH: <u>6.4 ft</u></p> <p>DIA: <u>4 in.</u></p> <p>PLUG</p> <p>DEPTH: <u>13.1 ft</u></p>

N/A: Not applicable/not available

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-806</u>
WELL PLUGGING AND ABANDONMENT ACTIVITY/PROGRESS REPORT			PAGE 1 of 2
LOCATION: <u>Building 9204-2</u>		DATE: START: <u>8-13-98</u>	
OPERATOR: <u>R. Phillips-Highland Drilling Co.</u>		FINISH: <u>8-14-98</u>	
HELPER: <u>N/A</u>		METHOD: <u>C</u>	
DRILL: <u>N/A</u>		LOGGED BY: <u>T. Coffey - SAIC</u>	

DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
8-13-98	1330	1335	Arrive at GW-806 site. Remove the flush-mount cover. Remove the cap, screen for organic vapors: 0.0 ppm in breathing zone, 0.0 ppm at top of casing (Background = 0.0 ppm). Tag bottom of the well at 12.7 ft below top of casing (BTOC) = 12.9 ft below ground surface (BGS). Measure the water level at 6.96 ft BTOC.
	1335	1340	Slowly pour 1, 50-lb sack of 3/8-in. granular bentonite into the well until the entire water column has been absorbed. Unhydrated bentonite level is at 3.3 ft BTOC. Allow bentonite to hydrate.
	1340	1350	Use special casing cutting tool to cut off the top 0.6 ft of the casing stick-up. Re-cover the flush-mount box. Depart site.
8-14-98	1450	1458	Arrive at GW-806 site. Remove the flush-mount cover. Tag hydrated bentonite level at 2.6 ft BTOC (no vertical swell of bentonite). Break up the concrete skirting around the flush-mount box.
	1458	1508	Mix and pour 1, 80-lb sack of concrete into the casing and flush-mount box filling both to approximately 0.2 ft BGS.
	1508	1514	Mix and pour approximately 1/2 of another 80-lb sack of concrete into the flush-mount box filling it to the ground surface. Trowel-finish the concrete flush with the surrounding pavement.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-806

**WELL PLUGGING AND ABANDONMENT
ACTIVITY/PROGRESS REPORT
continued**

PAGE 2 of 2

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Y-12 PLANT GROUNDWATER PROTECTION PROGRAM		WELL NO. <u>GW-806</u>																																						
WELL PLUGGING AND ABANDONMENT DIAGRAM																																								
LOCATION: <u>Building 9204-2</u>	DATE: START: <u>8-13-98</u>																																							
COORDINATES: <u>N29899.7 E57461.0</u>	FINISH: <u>8-14-98</u>																																							
REFERENCE POINT FOR MEASUREMENTS: <u>Ground Surface</u>	PREPARED BY: <u>T. Coffey-SAIC</u>																																							
DRILLING COMPANY: <u>Highland Drilling Co.</u> DRILL: <u>N/A</u>																																								
DRILLER: <u>R. Phillips</u> HELPERS: <u>N/A</u>																																								
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	DEPTH: <u>12.9 ft</u>																																							

N/A: Not applicable/not available

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-807</u>
WELL PLUGGING AND ABANDONMENT ACTIVITY/PROGRESS REPORT			PAGE 1 of 2
LOCATION: <u>Building 9204-2</u>		DATE: START: <u>8-13-98</u>	
OPERATOR: <u>R. Phillips-Highland Drilling Co.</u>		FINISH: <u>8-14-98</u>	
HELPER: <u>N/A</u>		METHOD: <u>C</u>	
DRILL: <u>N/A</u>		LOGGED BY: <u>T. Coffey - SAIC</u>	

DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
8-13-98	1355	1401	Arrive at GW-807 site. Remove well cap; screen for organic vapors: 0.0 ppm in breathing zone, 0.0 ppm inside the casing (Background = 0.0 ppm). Tag bottom of well at 13.7 ft below top of casing (BTOC) = 10.2 ft below ground surface (BGS). Measure the water level at 10.57 ft BTOC.
	1401	1405	Slowly pour approximately 1/2 of a 50-lb sack of 3/8-in. granular bentonite into the well until the entire water column has been absorbed. Unhydrated bentonite level is at 8.7 ft BTOC = 5.2 ft BGS. Allow bentonite to hydrate. Re-cap the well. Depart site.
8-14-98	1408	1420	Arrive at GW-807 site. Tag hydrated bentonite level at 8.7 ft BTOC = 5.2 ft BGS (no vertical swell of bentonite). Break up the concrete pad using a sledge hammer. Move the pieces aside.
	1420	1424	Cut off 3.6 ft of the casing stick-up using a saw.
	1424	1444	Using a special casing cutter, cut off another 0.8 ft of the casing so that the top of the casing will be below the ground surface.
	1444	1450	Mix and pour 1, 80-lb sack of concrete into the casing, filling the casing to approximately 0.4 ft BGS.
	1450	1514	Mix and pour approximately 1/2 of another 80-lb sack of concrete into the hole to the ground surface. Cover the site with native gravel.

WELL NO. GW-807

PAGE 2 of 2

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM		WELL NO. <u>GW-807</u>																														
WELL PLUGGING AND ABANDONMENT DIAGRAM																																
LOCATION: <u>Building 9204-2</u> COORDINATES: <u>N29866.0 E57458.9</u> REFERENCE POINT FOR MEASUREMENTS: <u>Ground Surface</u>		DATE: START: <u>8-13-98</u> FINISH: <u>8-14-98</u> PREPARED BY: <u>T. Coffey-SAIC</u>																														
DRILLING COMPANY: <u>Highland Drilling Co.</u> DRILL: <u>N/A</u> DRILLER: <u>R. Phillips</u> HELPERS: <u>N/A</u>																																
REASON FOR P&A: <u>Obsolete well: no more monitoring required due to closure of UST site.</u> P&A METHOD: <u>C</u> DEVIATIONS FROM METHOD: <u>Well screen and casing plugged in-place with approval from ES&H.</u>																																
WELL CONSTRUCTION SUMMARY		P&A SUMMARY																														
Note: Some of the information in this section obtained from field observations.		REAMED DIA: <u>N/A</u> DRILLED/REAMED DEPTH: <u>N/A</u> PLUG MATERIAL: <u>Granular bentonite</u> CAP MATERIAL: <u>Concrete</u>																														
<table style="margin-left: 20px;"> <tr> <td>CONDUCTOR HOLE DIA: <u>N/A</u></td> <td>DEPTH <u>N/A</u></td> </tr> <tr> <td>SURFACE CONDUCTOR TYPE: <u>None</u> DIA: <u>N/A</u></td> <td>TOP <u>N/A</u> BOTTOM <u>N/A</u></td> </tr> <tr> <td>BOREHOLE DIA: <u>10 5/8 in</u></td> <td>TOP <u>0.0 ft</u> BOTTOM <u>11.3 ft</u></td> </tr> <tr> <td>FILLER: <u>Cement</u></td> <td></td> </tr> <tr> <td>CASING (WITH SCREEN) TYPE: <u>PVC/#40</u> DIA: <u>4.5-in. OD</u></td> <td>TOP <u>+3.5 ft</u> BOTTOM <u>4.5 ft</u></td> </tr> <tr> <td>SEAL: <u>Unknown</u></td> <td>TOP <u>N/A</u> BOTTOM <u>N/A</u></td> </tr> <tr> <td>FILTER PACK: <u>Sand</u></td> <td>TOP <u>4.0 ft</u> BOTTOM <u>10.5 ft</u></td> </tr> <tr> <td>SCREEN TYPE: <u>PVC/sl/0.01</u> DIA: <u>4.5-in. OD</u></td> <td>TOP <u>4.5 ft</u> BOTTOM <u>10.0 ft</u></td> </tr> <tr> <td>TOTAL DEPTH: <u>11.3</u></td> <td></td> </tr> </table>		CONDUCTOR HOLE DIA: <u>N/A</u>	DEPTH <u>N/A</u>	SURFACE CONDUCTOR TYPE: <u>None</u> DIA: <u>N/A</u>	TOP <u>N/A</u> BOTTOM <u>N/A</u>	BOREHOLE DIA: <u>10 5/8 in</u>	TOP <u>0.0 ft</u> BOTTOM <u>11.3 ft</u>	FILLER: <u>Cement</u>		CASING (WITH SCREEN) TYPE: <u>PVC/#40</u> DIA: <u>4.5-in. OD</u>	TOP <u>+3.5 ft</u> BOTTOM <u>4.5 ft</u>	SEAL: <u>Unknown</u>	TOP <u>N/A</u> BOTTOM <u>N/A</u>	FILTER PACK: <u>Sand</u>	TOP <u>4.0 ft</u> BOTTOM <u>10.5 ft</u>	SCREEN TYPE: <u>PVC/sl/0.01</u> DIA: <u>4.5-in. OD</u>	TOP <u>4.5 ft</u> BOTTOM <u>10.0 ft</u>	TOTAL DEPTH: <u>11.3</u>		<table style="margin-left: 20px;"> <tr> <td colspan="2">GROUND SURFACE</td> </tr> <tr> <td>CAP</td> <td></td> </tr> <tr> <td colspan="2">DEPTH <u>5.2 ft</u></td> </tr> <tr> <td>PLUG</td> <td></td> </tr> <tr> <td colspan="2">DIA: <u>4 in.</u></td> </tr> <tr> <td colspan="2">DEPTH: <u>10.2 ft</u></td> </tr> </table>	GROUND SURFACE		CAP		DEPTH <u>5.2 ft</u>		PLUG		DIA: <u>4 in.</u>		DEPTH: <u>10.2 ft</u>	
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SURFACE CONDUCTOR TYPE: <u>None</u> DIA: <u>N/A</u>	TOP <u>N/A</u> BOTTOM <u>N/A</u>																															
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DEPTH: <u>10.2 ft</u>																																
N/A: Not applicable/not available

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-808</u>
WELL PLUGGING AND ABANDONMENT ACTIVITY/PROGRESS REPORT			PAGE 1 of 1
LOCATION: <u>Building 9201-1</u>		DATE: START: <u>8-13-98</u>	
OPERATOR: <u>R. Phillips-Highland Drilling Co.</u>		FINISH: <u>8-14-98</u>	
HELPER: <u>N/A</u>		METHOD: <u>C</u>	
DRILL: <u>N/A</u>		LOGGED BY: <u>T. Coffey - SAIC</u>	

DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
8-13-98	0932	0949	Arrive at GW-808 site. Remove the flush-mount cover. Bail water from the flush-mount box, exposing the wellhead. Remove the cap; screen for organic vapors: 0.0 ppm in breathing zone, 0.0 ppm to the top of the casing (Background = 0.0 ppm). Tag the bottom of well (very soft) at 37.9 ft below top of casing (BTOC) = 38.5 ft below ground surface (BGS). Note: the subsurface data base (Y/TS-881/R3) reports the total depth of GW-808 at 36.9 ft. Measure the water level at 8.37 ft BTOC.
	0949	1002	Slowly pour 3 1/3, 50-lb sacks of 3/8-in. granular bentonite into the well until the entire water column has been absorbed. Unhydrated bentonite level is at 4.8 ft BTOC. Allow bentonite to hydrate. Recover flush-mount box. Depart site.
8-14-98	1058	1103	Arrive at GW-808 site. Remove flush-mount cover. Tag hydrated bentonite level at 4.8 ft BTOC (no vertical swell of bentonite). Break up the concrete skirting around the flush-mount box.
	1103	1112	Mix and pour 1, 80-lb sack of concrete into the casing and flush-mount box filling both to the ground surface. Trowel-finish the concrete flush with the surrounding pavement.
			P&A of well GW-808 is complete.

WELL NO. GW-808

PAGE 2 of 2

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM		WELL NO. <u>GW-808</u>
WELL PLUGGING AND ABANDONMENT DIAGRAM		
LOCATION: <u>Building 9201-1</u>		DATE: START: <u>8-13-98</u>
COORDINATES: <u>N29318.0 E59529.9</u>		FINISH: <u>8-14-98</u>
REFERENCE POINT FOR MEASUREMENTS: <u>Ground Surface</u>		PREPARED BY: <u>T. Coffey-SAIC</u>
DRILLING COMPANY: <u>Highland Drilling Co.</u>		DRILL: <u>N/A</u>
DRILLER: <u>R. Phillips</u>		HELPERS: <u>N/A</u>
REASON FOR P&A: <u>Obsolete well: no more monitoring required due to closure of UST site.</u>		
P&A METHOD: <u>C</u> DEVIATIONS FROM METHOD: <u>Well screen, casing, and flush-mount box plugged in-place with approval from ES&H.</u>		
WELL CONSTRUCTION SUMMARY		P&A SUMMARY
Note: Some of the information in this section obtained from field observations.		REAMED DIA: <u>N/A</u>
<div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="width: 45%;"> <p>CONDUCTOR HOLE DIA: <u>N/A</u></p> <p>SURFACE CONDUCTOR TYPE: <u>None</u> DIA: <u>N/A</u></p> <p>BOREHOLE DIA: <u>10 5/8 in.</u></p> <p>FILLER: <u>Cement</u></p> <p>CASING (WITH SCREEN) TYPE: <u>PVC/#40</u> DIA: <u>4.5-in. OD</u></p> <p>SEAL: <u>Unknown</u></p> <p>FILTER PACK: <u>Sand</u></p> <p>SCREEN TYPE: <u>PVC/sl/0.01</u> DIA: <u>4.5-in. OD</u></p> <p>TOTAL DEPTH: <u>40.4</u></p> </div> <div style="width: 45%;"> <p>DEPTH <u>N/A</u></p> <p>TOP <u>N/A</u> BOTTOM <u>N/A</u></p> <p>TOP <u>0.0 ft</u> BOTTOM <u>40.4 ft</u></p> <p>TOP <u>0.6 ft</u> BOTTOM <u>26.4 ft</u></p> <p>TOP <u>N/A</u> BOTTOM <u>N/A</u></p> <p>TOP <u>24.0 ft</u> BOTTOM <u>40.4 ft</u></p> <p>TOP <u>26.4 ft</u> BOTTOM <u>36.9 ft</u></p> </div> </div>		<p>DRILLED/REAMED DEPTH: <u>N/A</u></p> <p>PLUG MATERIAL: <u>Granular bentonite</u></p> <p>CAP MATERIAL: <u>Concrete</u></p>
<div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div style="width: 45%;"> <p>GROUND SURFACE</p> <p>CAP</p> <p>DIA: <u>12 in.</u></p> <p>DEPTH: <u>0.5 ft</u></p> <p>DEPTH: <u>5.4 ft</u></p> <p>DIA: <u>4 in.</u></p> <p>PLUG</p> <p>DEPTH: <u>38.5 ft</u></p> </div> <div style="width: 45%;"> <p>TOP <u>0.0 ft</u> BOTTOM <u>40.4 ft</u></p> <p>TOP <u>0.6 ft</u> BOTTOM <u>26.4 ft</u></p> <p>TOP <u>N/A</u> BOTTOM <u>N/A</u></p> <p>TOP <u>24.0 ft</u> BOTTOM <u>40.4 ft</u></p> <p>TOP <u>26.4 ft</u> BOTTOM <u>36.9 ft</u></p> </div> </div>		

N/A: Not applicable/not available

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-809</u>
WELL PLUGGING AND ABANDONMENT ACTIVITY/PROGRESS REPORT			PAGE 1 of 2
LOCATION: <u>Building 9201-1</u>		DATE: START: <u>8-13-98</u>	
OPERATOR: <u>R. Phillips-Highland Drilling Co.</u>		FINISH: <u>8-14-98</u>	
HELPER: <u>N/A</u>		METHOD: <u>C</u>	
DRILL: <u>N/A</u>		LOGGED BY: <u>T. Coffey - SAIC</u>	

DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
8-13-98	1018	1024	Arrive at GW-809 site. Remove the flush-mount cover. Remove the cap; screen for organic vapors: 0.0 ppm in breathing zone, up to 60 ppm (sporadically) at the top of casing (Background = 0.0 ppm). Tag the bottom of the well (firm) at 36.0 ft below top of casing (BTOC) = 36.2 ft below ground surface (BGS). Note: the subsurface data base (Y/TS-881/R3) reports the total depth of GW-809 to be 36.5 ft (the well has an apparent sediment accumulation of 0.5 ft). Measure the water level at 8.35 ft BTOC.
	1024	1034	Slowly pour 2 2/3, 50-lb sacks of 3/8-in. granular bentonite into the well. Circulate water out of the well. Unhydrated bentonite level is at 7.0 ft BTOC. Water level is dropping inside the well. Will wait awhile to see how far the water level drops. Depart site.
	1046	1049	Return to GW-809 site. Water level inside the well is at approximately 2 ft BTOC. Pour another 1/2 sack of granular bentonite into the well. Circulate water again. Unhydrated bentonite level is at 0.7 ft BTOC. Re-cover flush-mount box. Depart site.
8-14-98	1041	1050	Arrive at GW-809 site. Remove flush-mount cover. Tag hydrated bentonite level at 0.5 ft BTOC (bentonite swelled 0.2 ft). Mix and pour 1, 80-lb sack of concrete into the casing and flush-mount box filling both to the ground surface. Trowel-finish the concrete flush with the surrounding pavement. Depart site.

[illegible]

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-809

WELL PLUGGING AND ABANDONMENT DIAGRAM

LOCATION: Building 9201-1DATE: START: 8-13-98COORDINATES: N29316.6 E59548.4FINISH: 8-14-98REFERENCE POINT FOR MEASUREMENTS: Ground SurfacePREPARED BY: T. Coffey-SAICDRILLING COMPANY: Highland Drilling Co.DRILL: N/ADRILLER: R. PhillipsHELPERS: N/AREASON FOR P&A: Obsolete well: no more monitoring required due to closure of UST site.P&A METHOD: C DEVIATIONS FROM METHOD: Well screen, casing, and flush-mount box plugged in-place with approval from ES&H.

WELL CONSTRUCTION SUMMARY

Note: Some of the information in this section obtained from field observations.

N/A: Not applicable/not available

P&A SUMMARY

REAMED DIA: N/ADRILLED/REAMED DEPTH: N/APLUG MATERIAL: Granular bentoniteCAP MATERIAL: Concrete

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-810</u>
WELL PLUGGING AND ABANDONMENT ACTIVITY/PROGRESS REPORT			PAGE 1 of 1
LOCATION: <u>Building 9201-1</u>		DATE: START: <u>8-13-98</u>	
OPERATOR: <u>R. Phillips-Highland Drilling Co.</u>		FINISH: <u>8-14-98</u>	
HELPER: <u>N/A</u>		METHOD: <u>C</u>	
DRILL: <u>N/A</u>		LOGGED BY: <u>T. Coffey - SAIC</u>	

DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
8-13-98	1050	1056	Arrive at GW-810 site. Remove the flush-mount cover. Remove the cap; screen for organic vapors: 0.0 ppm in breathing zone, up to 70 ppm (sporatically) at the top of casing (Background = 0.0 ppm). Tag the bottom of the well at 26.2 ft below top of casing (BTOC) = 26.4 ft below ground surface (BGS). Measure the water level at 8.98 ft BTOC.
	1056	1103	Slowly pour 2 1/3, 50-lb sacks of 3/8-in. granular bentonite into the well until the entire water column has been absorbed. Unhydrated bentonite level is at 2.9 ft BTOC. Allow the bentonite to hydrate. Re-cover the flush-mount box. Depart site.
8-14-98	1112	1116	Arrive at GW-810 site. Remove flush-mount cover. Tag hydrated bentonite level at 2.9 ft BTOC (no vertical swell of bentonite). Break up cement skirting around the flush-mount box.
	1116	1125	Mix and pour 1, 80-lb sack of concrete into the casing and flush-mount box filling both to the ground surface. Trowel-finish the concrete flush with the surrounding pavement.
			P&A of well GW-810 is complete.
			NOTE: No intrusive work was performed on this well, hence no Cuttings Field Screening/Disposal Form or Equipment Decontamination Inspection Summary are included in this report.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM		WELL NO. <u>GW-810</u>
WELL PLUGGING AND ABANDONMENT DIAGRAM		
LOCATION: <u>Building 9201-1</u>		DATE: START: <u>8-13-98</u>
COORDINATES: <u>N29323.8 E59606.5</u>		FINISH: <u>8-14-98</u>
REFERENCE POINT FOR MEASUREMENTS: <u>Ground Surface</u>		PREPARED BY: <u>T. Coffey-SAIC</u>
DRILLING COMPANY: <u>Highland Drilling Co.</u>		DRILL: <u>N/A</u>
DRILLER: <u>R. Phillips</u>		HELPERS: <u>N/A</u>
REASON FOR P&A: <u>Obsolete well: no more monitoring required due to closure of UST site.</u>		
P&A METHOD: <u>C</u> DEVIATIONS FROM METHOD: <u>Well screen, casing, and flush-mount box plugged in-place with approval from ES&H.</u>		
WELL CONSTRUCTION SUMMARY		P&A SUMMARY
Note: Some of the information in this section obtained from field observations.		REAMED DIA: <u>N/A</u>
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>CONDUCTOR HOLE DIA: <u>N/A</u></p> <p>SURFACE CONDUCTOR TYPE: <u>Steel</u> DIA: <u>12-in. OD</u></p> <p>BOREHOLE DIA: <u>10 5/8 in.</u></p> <p>FILLER: <u>Cement</u></p> <p>CASING (WITH SCREEN) TYPE: <u>PVC/#40</u> DIA: <u>4.5-in. OD</u></p> <p>SEAL: <u>Unknown</u></p> <p>FILTER PACK: <u>Sand</u></p> <p>SCREEN TYPE: <u>PVC/sl/0.01</u> DIA: <u>4.5-in. OD</u></p> <p>TOTAL DEPTH: <u>26.8</u></p> </div> <div style="width: 45%;"> <p>DEPTH <u>N/A</u></p> <p>TOP <u>0.2 ft</u> BOTTOM <u>N/A</u></p> <p>TOP <u>0.0 ft</u> BOTTOM <u>26.8 ft</u></p> <p>TOP <u>N/A</u> BOTTOM <u>N/A</u></p> <p>TOP <u>13.9 ft</u> BOTTOM <u>26.8 ft</u></p> <p>TOP <u>15.8 ft</u> BOTTOM <u>26.3 ft</u></p> </div> </div>		DRILLED/REAMED DEPTH: <u>N/A</u> PLUG MATERIAL: <u>Granular bentonite</u> CAP MATERIAL: <u>Concrete</u>
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>GROUND SURFACE</p> <p>CAP</p> <p>DIA: <u>8 in.</u></p> <p>DEPTH: <u>0.6 ft</u></p> <p>DEPTH: <u>3.1 ft</u></p> <p>DIA: <u>4 in.</u></p> <p>PLUG</p> <p>DEPTH: <u>26.4 ft</u></p> </div> <div style="width: 45%;"> <p>REAMED DIA: <u>N/A</u></p> <p>DRILLED/REAMED DEPTH: <u>N/A</u></p> <p>PLUG MATERIAL: <u>Granular bentonite</u></p> <p>CAP MATERIAL: <u>Concrete</u></p> </div> </div>		REAMED DIA: <u>N/A</u> DRILLED/REAMED DEPTH: <u>N/A</u> PLUG MATERIAL: <u>Granular bentonite</u> CAP MATERIAL: <u>Concrete</u>

N/A: Not applicable/not available

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>LL/HAZ-03</u>
WELL PLUGGING AND ABANDONMENT ACTIVITY/PROGRESS REPORT - continued			PAGE 2 of 3
DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
9-2-98	1000	1021	Rig up with an 8 3/4-in diameter tri-cone roller bit on a drilling
(cont.)			subadapter, length = 2.3 ft; table height = 2.3 ft. Add a 25-ft drilling
			rod.
	1021	1031	Push a 4.4-ft section of 10 3/8-in ID, 10 3/4-in. OD steel conductor
			casing into the ground. Casing stick-up = 0.6 ft.
	1031	1048	Commence reaming the wellbore using compressed air only.
			Ream from 0.0 ft to 16.3 ft BGS. Cuttings from 0.0 ft to 3.0 ft BGS
			is pale brown (5YR 5/2) to pale yellowish-brown (10YR 6/2)
			weathered saprolite. Breathing zone analysis (BZA) at 4.0 ft BGS
			= 1 ppm (background). Begin to see water in the returns at 5.0 ft
			BGS. BZA at 10.0 ft and 14.5 ft BGS both read 1 ppm (background).
			Experience a minor amount of rig chatter at 11.0 ft BGS. Cuttings
			from 3.0 ft to 15.0 ft BGS consist of dark yellowish-orange (10YR
			6/6) to moderate olive brown (5Y 4/4), thinly laminated shale;
			brownish-black (5YR 2/1) to brownish-gray (5YR 4/1), massive
			finely crystalline micrite/pelmicrite with sparite blebs and pink
			calcite veinlets up to 5 mm thick; and sub-rounded, fine-grained
			quartz sand (filter pack). Very hard drilling at 15.0 ft BGS (bottom
			of original wellbore). Cuttings from 15.0 ft to 16.3 ft BGS are almost
			exclusively the micrite/pelmicrite lithology described above.
	1048	1104	At 16.3 ft BGS. Clean out the borehole. Trip out the tools. Tag the
			bottom of the borehole at 16.9 ft BTOC = 16.3 ft BGS (clean
			borehole). Rig down bit/subadapter assembly. Secure the drill
			rods. Lower the mast.
	1104	1135	Mix and pour 5, 94-lb sacks of Type I Portland cement into the
			borehole. Liquid cement fills the borehole to within 1.0 ft of the
			ground surface.

WELL NO. LL/HAZ-03

PAGE 3 of 3

[illegible]

Y-12 PLANT GROUNDWATER PROTECTION PROGRAMWELL NO. LL/HAZ-03**WELL CUTTINGS FIELD SCREENING / DISPOSAL FORM**

Page 1 of 1

LOCATION: Gum Branch Road AreaDATE: START: 9-2-98APPROX. VOLUME OF CUTTINGS: 6.81 cubic ftFINISH: 9-3-98

CALIBRATION OF INSTRUMENTS: Check those calibrated to manufacturer's specifications.

pH meter	<u>X</u>	(model)	<u>Horiba Model U-7</u>
Organic vapor meter	<u>X</u>	(model)	<u>Century-Foxboro OVA Model 128</u>
Beta/gamma meter	<u>X</u>	(model)	<u>Ludlum Model 3 Survey Meter with G-M Pancake Probe</u>
Alpha meter	<u>X</u>	(model)	<u>Ludlum Model 12 Count Ratemeter with Scintillation Tube Probe</u>

FIELD SCREENING RESULTS (background/highest observed values):

pH	<u>7.6</u>	Date/Time	<u>9-2-98/1152</u>	(4.0-10.5)
Organic vapors	<u>0.0 ppm/0.0 ppm</u>	Date/Time	<u>9-2-98/1150</u>	(<10 ppm above background)
Beta/Gamma	<u>50 cpm/50 cpm</u>	Date/Time	<u>9-2-98/1137</u>	(<100 cpm above background)
Alpha	<u>0 cpm/0 cpm</u>	Date/Time	<u>9-2-98/1135</u>	(<500 cpm above background)

*Elevated pH reading due to cement fragments in the cuttings composite.

Weather Clear to partly cloudy; warm Temp.: Mid-70's to mid-80's °FDISPOSITION: Drill-site Disposal X Containerization
(Labeled?) y / nDescribe: Cuttings discharged to the ground surface.On-Site Geologist (print) Timothy Coffey - SAICSignature: Date: 9-2-98

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM		WELL NO. <u>LL/HAZ-03</u>																												
WELL PLUGGING AND ABANDONMENT DIAGRAM																														
LOCATION: <u>Gum Branch Road Area</u>	DATE: START: <u>9-2-98</u>																													
COORDINATES: <u>N29812.00 E32788.00</u>	FINISH: <u>9-3-98</u>																													
REFERENCE POINT FOR MEASUREMENTS: <u>Ground surface</u>	PREPARED BY: <u>T.J. Coffey</u>																													
DRILLING COMPANY: <u>Highland Drilling Co.</u>	DRILL: <u>Ingersoll-Rand XL-750</u>																													
DRILLER: <u>R. Phillips</u>	HELPERS: <u>K. Fortner</u>																													
REASON FOR P&A: <u>Obsolete well</u>																														
P&A METHOD: <u>C</u> DEVIATIONS FROM METHOD: <u>None</u>																														
WELL CONSTRUCTION SUMMARY		P&A SUMMARY																												
<p>Note: Some of the information in this section obtained from field observations.</p> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="border: 1px solid black; padding: 2px;">CONDUCTOR HOLE DIA: <u>N/A</u></td> <td style="text-align: right; padding: 2px;">DEPTH <u>N/A</u></td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">SURFACE CONDUCTOR TYPE: <u>None</u> DIA: <u>N/A</u></td> <td style="text-align: right; padding: 2px;">TOP <u>N/A</u> BOTTOM <u>N/A</u></td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">BOREHOLE DIA: <u>8 in.</u></td> <td style="text-align: right; padding: 2px;">TOP <u>0.0 ft</u> BOTTOM <u>15.0 ft</u></td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">FILLER: <u>Cuttings</u></td> <td></td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">CASING (WITH SCREEN) TYPE: <u>PVC/#40</u> DIA: <u>6 1.2-in. OD</u></td> <td style="text-align: right; padding: 2px;">TOP <u>+3.2 ft</u> BOTTOM <u>5.0 ft</u></td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">SEAL: <u>Sand</u></td> <td style="text-align: right; padding: 2px;">TOP <u>1.0 ft</u> BOTTOM <u>15.0 ft</u></td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">FILTER PACK: <u>N/A</u></td> <td style="text-align: right; padding: 2px;">TOP <u>N/A</u> BOTTOM <u>N/A</u></td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">SCREEN TYPE: <u>PVC</u> DIA: <u>6 1.2-in. OD</u></td> <td style="text-align: right; padding: 2px;">TOP <u>5.0 ft</u> BOTTOM <u>15.0 ft</u></td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">TOTAL DEPTH: <u>15.0</u></td> <td></td> </tr> </table>		CONDUCTOR HOLE DIA: <u>N/A</u>	DEPTH <u>N/A</u>	SURFACE CONDUCTOR TYPE: <u>None</u> DIA: <u>N/A</u>	TOP <u>N/A</u> BOTTOM <u>N/A</u>	BOREHOLE DIA: <u>8 in.</u>	TOP <u>0.0 ft</u> BOTTOM <u>15.0 ft</u>	FILLER: <u>Cuttings</u>		CASING (WITH SCREEN) TYPE: <u>PVC/#40</u> DIA: <u>6 1.2-in. OD</u>	TOP <u>+3.2 ft</u> BOTTOM <u>5.0 ft</u>	SEAL: <u>Sand</u>	TOP <u>1.0 ft</u> BOTTOM <u>15.0 ft</u>	FILTER PACK: <u>N/A</u>	TOP <u>N/A</u> BOTTOM <u>N/A</u>	SCREEN TYPE: <u>PVC</u> DIA: <u>6 1.2-in. OD</u>	TOP <u>5.0 ft</u> BOTTOM <u>15.0 ft</u>	TOTAL DEPTH: <u>15.0</u>		<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="border: 1px solid black; padding: 2px;">REAMED DIA: <u>8 3/4 in</u></td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">DRILLED/REAMED DEPTH: <u>16.3 ft</u></td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">PLUG MATERIAL: <u>Cement</u></td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">CAP MATERIAL: <u>Clay soil</u></td> </tr> </table> <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="border: 1px solid black; padding: 2px;">CAP</td> <td style="text-align: right; padding: 2px;">DEPTH: <u>2.3 ft</u></td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">PLUG</td> <td style="text-align: right; padding: 2px;">DIA: <u>8 3/4 in.</u></td> </tr> <tr> <td style="border: 1px solid black; padding: 2px;">TOTAL DEPTH: <u>16.3 ft</u></td> <td></td> </tr> </table>	REAMED DIA: <u>8 3/4 in</u>	DRILLED/REAMED DEPTH: <u>16.3 ft</u>	PLUG MATERIAL: <u>Cement</u>	CAP MATERIAL: <u>Clay soil</u>	CAP	DEPTH: <u>2.3 ft</u>	PLUG	DIA: <u>8 3/4 in.</u>	TOTAL DEPTH: <u>16.3 ft</u>	
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N/A: Not applicable/not available

[illegible]

APPENDIX C

**WELL REHABILITATION/
REDEVELOPMENT REPORTS**

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-731</u>
WELL REDEVELOPMENT ACTIVITY/PROGRESS REPORT			PAGE 1 of 4
LOCATION: <u>Sediment Disposal Basin</u>		DATE: START: <u>9-14-98</u>	
OPERATOR: <u>R. Phillips - Highland Drilling Co.</u>		FINISH: <u>9-16-98</u>	
HELPER: <u>K. Fortner - Highland Drilling Co.</u>		LOGGED BY: <u>T. Coffey - SAIC</u>	
RIG: <u>Smeal Swab Rig</u>			

DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
9-14-98	0937	1015	Arrive at GW-731 site. Uncap the well, screen for organic vapors: 0.0 ppm in breathing zone, 0.0 ppm in casing headspace. Measure the water level at 124.88 ft below top of casing (BTOC) = 121.5 ft below ground surface (BGS). Tag the bottom of the well (solid) at 178.7 ft BTOC = 175.3 ft BGS. Note: The subsurface Data Base (Y/TS-881/R3) reports the total depth of well GW-731 to be 175.2 ft BGS. Calculate a well volume of 39.8 gallons.
	1015	1041	Crew arrives. Additionally, T. Harrison AJA (Technical Services) arrives, who will be conducting an audit of the well development procedures. Remove the dedicated sampling pump from the well. Place pump and tubing in a plastic bag.
	1041	1108	Move Smeal rig onto location, and position over the well. Raise and extend rig mast. Discover that crew doesn't have enough timbers to build a support for the pipe slips.
	1108	1214	Crew depart to get more timbers.
	1214	1231	Crew return; build support for pipe slips.
	1231	1314	Run 2-in. inside diameter (ID), 2 3/8-in. outside diameter (OD) steel swab tubing with check valve into the well. Bottom of the tubing is at 168.6 ft BGS.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-731</u>
WELL REDEVELOPMENT ACTIVITY/PROGRESS REPORT continued			
			PAGE 2 of 4
DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
9-14-98 (Cont.)	1314	1326	Begin swabbing the well. Swab approximately 5 gallons of water out of the well; water sample is moderately turbid.
	1326	1333	Screen the initial water sample. Readings: pH = 9.3, specific conductance = 340 μ mhos/cm, temperature = 30.0°C (high temperature due to high air temps).
	1333	1351	Continue swabbing the well. Swab an additional 15 gallons of water out of the well (well swabbed nearly to dryness); water sample is moderately turbid and contains a minor amount of fine-grained sand.
	1351	1408	Screen water sample. Readings: pH = 9.2, specific conductance = 272 μ mhos/cm, temperature = 21.5°C. Secure site and depart.
9-15-98	0835	0855	Arrive at GW-731 site. Crew adds an 8-ft section of tubing. Bottom of tubing now is at 175.0 ft BGS.
	0855	0915	Begin swabbing the well. Swab 40 gallons of water out of the well; water sample is moderately turbid.
	0915	0923	Screen water sample. Readings: pH = 7.9, specific conductance = 218 μ mhos/cm, temperature = 17.0°C.
	0923	1031	Wait on well to recharge.
	1031	1057	Continue swabbing the well. Swab another 50 gallons of water out of the well; water sample is moderately turbid, and contains a very minor amount of fine-grained sand.
	1057	1105	Screen water sample. Readings pH = 7.7, specific conductance = 195 μ mhos/cm, temperature = 17.5°C.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-731</u>
WELL REDEVELOPMENT ACTIVITY/PROGRESS REPORT continued			
			PAGE 3 of 4
DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
9-15-98	1105	1222	Wait on well to recharge.
(Cont.)			
	1222	1242	Continue swabbing the well. Swab another 50 gallons of water out of the well; water sample is moderately turbid.
	1242	1248	Screen water sample. Readings: pH = 7.8, specific conductance = 219 μ mhos/cm, temperature = 19.3°C (rising temperature due to high air temps).
	1248	1343	Wait on well to recharge.
	1343	1406	Continue swabbing the well. Swab another 20 gallons of water out of the well (well swabbed to dryness); water sample is turbid.
	1406	1432	Screen water sample. Readings: pH = 8.0, specific conductance = 182 μ mhos/cm, temperature = 20.2°C. Secure site, and depart.
9-16-98	0844	0905	Arrive at GW-731 site. Crew tops off washover rig hydraulic fluid reservoir.
	0905	0930	Begin swabbing the well. Swab 55 gallons of water out of the well; water sample is moderately turbid.
	0930	0935	Screen water sample. Readings: pH = 7.7, specific conductance = 202 μ mhos/cm, temperature = 16.3°C.
	0935	1042	Wait on well to recharge.
	1042	1106	Continue swabbing the well. Swab another 45 gallons of water out of the well; water sample is moderately turbid.

WELL NO. GW-731

PAGE 4 of 4

WELL NO. GW-731

MONITORING WELL REDEVELOPMENT SUMMARY

PAGE 1 of 1

METHOD OF DEVELOPMENT: Swab

DEVELOPMENT DATE:

DEVELOPMENT OBSERVED BY: T. Coffey - SAIC

START: 9/14/98

FINISH: 9/16/98

ONE WELL VOLUME: 39.8 GALLONS

TOTAL GALLONS PUMPED: 330 TOTAL WELL VOLUMES PUMPED: 8.3

INITIAL pH: 9.3 FINAL pH: 7.8

INITIAL SPECIFIC CONDUCTANCE: 340 $\mu\text{mhos/cm}$ FINAL: 214 $\mu\text{mhos/cm}$

DESCRIPTION OF INITIAL TURBIDITY: moderately turbid

DESCRIPTION OF FINAL TURBIDITY: moderately turbid

FINAL MEASURED TURBIDITY: Not Measured

WELL APPROVED BY: S.B. Jones - ES&H

ODOB OF WATER: None Discernable

WATER DISCHARGED TO: ☒ GROUND SURFACE ☐ TANK TRUCK
☐ STORM SEWERS ☐ STORAGE TANKS
☐ DRUMS ☐ OTHER

INITIAL PRE-DEVELOPMENT
WATER DEPTH: 121.5 ft BGS on 9-14-98

DEVELOPMENT OBSERVATIONS: Well is a fair to moderate producer. Well appears to recharge fully after approximately 1 hr. Well dried up 1 time after removing 4 well volumes in 1 day. Practically no improvement in water clarity throughout development.

Apparent rise in development water temperature is due to the heating of the temperature probe by rising ambient air temperatures through the day.

OBSERVER SIGNATURE: Matthew O'Leary

DATE: September 16, 1998

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM				WELL NO. <u>GW-731</u>	
WELL WATER FIELD SCREENING/DISPOSAL FORM				PAGE 1 of 2	

LOCATION: Sediment Disposal Basin DATE: START: 9-14-98

APPROX. VOLUME OF DEVELOPMENT WATER: 330 gallons FINISH: 9-16-98

CALIBRATION OF INSTRUMENTS: Check those calibrated to manufacturer's specifications.

pH meter	<u>X</u>	(model)	<u>Horiba Model U-7</u>
Sp. Cond. meter	<u>X</u>	(model)	<u>YSI S-C-T Meter Model 33</u>
Organic vapor meter	<u>X</u>	(model)	<u>Century-Foxboro OVA Model 128</u>
Beta/gamma meter	<u>X</u>	(model)	<u>Ludlum Model 3 Survey Meter with G-M Pancake Probe</u>
Alpha meter	<u>X</u>	(model)	<u>Ludlum Model 12 Count Ratemeter with Scintillation Tube Probe</u>

FIELD SCREENING RESULTS:

Date	Time	pH	Sp. Cond.	Organic Vapors	Gamma	Alpha
<u>9-14-98</u>	<u>1326</u>	<u>9.3</u>	<u>340 µmhos/cm</u>	<u>0.0 ppm</u>	<u>90 cpm*</u>	<u>0 cpm</u>
<u>9-14-98</u>	<u>1351</u>	<u>9.2</u>	<u>272 µmhos/cm</u>	<u>0.0 ppm</u>	<u>90 cpm*</u>	<u>0 cpm</u>
<u>9-15-98</u>	<u>0915</u>	<u>7.9</u>	<u>218 µmhos/cm</u>	<u>0.6 ppm</u>	<u>40 cpm</u>	<u>0 cpm</u>
<u>9-15-98</u>	<u>1057</u>	<u>7.7</u>	<u>195 µmhos/cm</u>	<u>0.0 ppm</u>	<u>40 cpm</u>	<u>0 cpm</u>
<u>9-15-98</u>	<u>1242</u>	<u>7.8</u>	<u>219 µmhos/cm</u>	<u>0.0 ppm</u>	<u>40 cpm</u>	<u>0 cpm</u>
<u>9-15-98</u>	<u>1406</u>	<u>8.0</u>	<u>182 µmhos/cm</u>	<u>0.0 ppm</u>	<u>40 cpm</u>	<u>0 cpm</u>
<u>9-16-98</u>	<u>0930</u>	<u>7.7</u>	<u>202 µmhos/cm</u>	<u>0.0 ppm</u>	<u>30 cpm</u>	<u>0 cpm</u>

(4.0-10.5) (<1000 µmhos/cm) (<10 ppm) (<100 cpm) (<500 cpm)

*Reading is a background reading; meter reading high for unknown reason.

Weather: Mostly clear, warm, and humid Temp.: Mid-70's to mid-90's°F.

DISPOSITION: Drill-site Disposal X Containerization (Labeled?) y/n _____

Describe: Development water discharged to ground surface.

On-site Geologist (print): Timothy Coffey - SAIC

Signature: Date: September 16, 1998

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-731

WELL WATER FIELD SCREENING/DISPOSAL FORM

PAGE 2 of 2

LOCATION: Sediment Disposal Basin DATE: START: 9-14-98

APPROX. VOLUME OF DEVELOPMENT WATER: 330 gallons FINISH: 9-16-98

CALIBRATION OF INSTRUMENTS: Check those calibrated to manufacturer's specifications.

pH meter	<u>X</u>	(model) <u>Horiba Model U-7</u>
Sp. Cond. meter	<u>X</u>	(model) <u>YSI S-C-T Meter Model 33</u>
Organic vapor meter	<u>X</u>	(model) <u>Century-Foxboro OVA Model 128</u>
Beta/gamma meter	<u>X</u>	(model) <u>Ludlum Model 3 Survey Meter with G-M Pancake Probe</u>
Alpha meter	<u>X</u>	(model) <u>Ludlum Model 12 Count Ratemeter with Scintillation Tube Probe</u>

FIELD SCREENING RESULTS:

Date	Time	pH	Sp. Cond.	Organic Vapors	Gamma	Alpha
<u>9-16-98</u>	<u>1106</u>	<u>7.8</u>	<u>198 µmhos/cm</u>	<u>0.0 ppm</u>	<u>40 cpm</u>	<u>0 cpm</u>
<u>9-16-98</u>	<u>1341</u>	<u>7.8</u>	<u>214 µmhos/cm</u>	<u>0.0 ppm</u>	<u>40 cpm</u>	<u>0 cpm</u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
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<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>
		<u>(4.0-10.5)</u>	<u>(<1000 µmhos/cm)</u>	<u>(<10 ppm)</u>	<u>(<100 cpm)</u>	<u>(<500 cpm)</u>

Weather: Mostly clear, warm, and humid Temp.: Mid-70's to mid-90's°F.

DISPOSITION: Drill-site Disposal X Containerization (Labeled?) y/n

Describe: Development water discharged to ground surface.

On-site Geologist (print): Timothy Coffey - SAIC

Signature: Date: September 16, 1998

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-732</u>
WELL REDEVELOPMENT ACTIVITY/PROGRESS REPORT			PAGE 1 of 3
LOCATION: <u>Sediment Disposal Basin</u>		DATE: START: <u>3-10-98</u>	
OPERATOR: <u>G. Shillings - Highland Drilling Co.</u>		FINISH: <u>3-11-98</u>	
HELPER: <u>N/A</u>		LOGGED BY: <u>T. Coffey - SAIC</u>	
RIG: <u>Smeal Swab Rig</u>			

DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
3-9-98	1043	1105	Arrive at GW-732 site. Measure water level at 156.4 ft below top of casing (BTOC) = 152.6 ft below ground surface (BGS). Tag bottom of well (solid) at 193.1 ft BTOC = 189.3 ft BGS. The Subsurface Data Base (Y/TS-881/R3) reports the constructed depth of well GW-732 to be 189.3 ft. Calculate a well volume of 27.0 gallons. A part needed to run the tubing into the well is not here; plan to begin development tomorrow. Secure wellhead and depart.
3-10-98	0755	0853	Arrive at GW-732 site. Remove the Well Wizard™ sampling pump from the well and place in plastic bag. Free up stuck check valve in tubing. Need more timbers to support the tubing clamp.
	0853	0923	G. Shillings (Highland) departs for more timbers.
	0923	0945	Greg returns. Position Smeal rig over the well. Raise the mast.
	0945	1018	Run 2-in. inside diameter (ID), 2 3/8-in. outside diameter (OD) steel swab tubing with check valve into the well. Bottom of tubing set on bottom of well (189.3 ft BGS).
	1018	1041	Begin swabbing the well. Swab 27 gallons of water out of the well: water sample is turbid and contains a very small amount of fine-grained sand.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-732</u>
WELL REDEVELOPMENT ACTIVITY/PROGRESS REPORT continued			PAGE 2 of 3
DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
3-10-98	1041	1104	Screen water sample. Readings: pH = 9.1, specific conductance
(cont.)			= 224 μ mhos/cm, temperature = 11.4°C.
	1104	1213	Continue swabbing the well. Swab another 83 gallons of water
			out of the well: water sample is turbid, and free of the sand
			observed in the first sample.
	1213	1247	Screen water sample. Readings: pH = 7.4, specific conductance
			= 222 μ mhos/cm, temperature = 12.1°C. Break for lunch.
	1247	1344	Continue swabbing the well. Swab another 110 gallons of water
			out of the well: water sample is moderately turbid. Have removed
			several pieces of a plastic wire-tie from the well.
	1344	1411	Screen water sample. Readings: pH = 7.7, specific conductance
			= 222 μ mhos/cm, temperature = 13.0°C.
	1411	1505	Continue swabbing the well. Swab another 110 gallons of water
			out of the well: water sample is slightly to moderately turbid.
	1505	1521	Screen water sample. Readings: pH = 7.6, specific conductance
			= 220 μ mhos/cm, temperature = 12.9°C. Secure site and depart.
3-11-98	0753	0842	Arrive at GW-732 site. Begin swabbing the well. Swab 55 gallons
			of water out of the well: water sample is slightly turbid.
	0842	0900	Screen water sample. Readings: pH = 7.7, specific conductance
			= 228 μ mhos/cm, temperature = 12.0°C. Discover that the beta/
			gamma meter has a dead battery.
	0900	0921	Oversight departs to get another beta/gamma meter.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-732</u>
WELL REDEVELOPMENT ACTIVITY/PROGRESS REPORT continued			
			PAGE 3 of 3
DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
3-11-98	0921	0946	Oversight returns. Continue swabbing the well. Swab another
(cont.)			55 gallons of water out of the well: water sample is slightly turbid.
			Haven't observed any more sand in grab samples since the first
			one, however, maybe a couple of pounds of sand has accumulated
			in the volume calculation barrel.
	0946	1006	Screen water sample. Readings: pH = 7.1, specific conductance
			= 232 μ mhos/cm, temperature = 12.6°C.
	1006	1034	Continue swabbing the well. Swab another 55 gallons of water out
			of the well: water sample is slightly turbid.
	1034	1055	Screen water sample. Readings: pH = 7.4, specific conductance
			= 232 μ mhos/cm, temperature = 13.0°C.
	1055	1125	Continue swabbing the well. Swab another 55 gallons of water out
			of the well: water sample is slightly turbid. Water clarity doesn't
			appear to be improving. Terminate redevelopment.
	1125	1210	Screen water sample. Readings: pH = 7.7, specific conductance
			= 235 μ mhos/cm, temperature = 13.0°C. Break for lunch.
	1210	1225	Remove swab tubing from the well.
	1225	1234	Tag bottom of well (solid) at 193.1 ft BTOC (no change from
			predevelopment depth measurement). Lower mast.
	1234	1309	Re-install Well Wizard™ sampling pump in well. Secure wellhead.
			Load swab tubing onto truck. Depart site.
			Rehabilitation/redevelopment of GW-732 is complete.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAMWELL NO: GW-732**MONITORING WELL REDEVELOPMENT PROGRESS**

Page 1 of 1

LOCATION: Sediment Disposal Basin

WELL INSTALLATION

ONE WELL VOLUME: 27.0 GALLONSCOMPLETION DATE: 9-11-91

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	pH	SPECIFIC CONDUCTANCE (ms/cm)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
3/10/98	27	turbid	9.1	224	27	1.0	
3/10/98	83	turbid	7.4	222	110	4.1	
3/10/98	110	moderately turbid	7.7	222	220	8.1	
3/10/98	110	slightly to mod. turbid	7.6	220	330	12.2	
3/11/98	55	slightly turbid	7.7	228	385	14.3	
3/11/98	55	slightly turbid	7.1	232	440	16.3	
3/11/98	55	slightly turbid	7.4	232	495	18.3	
3/11/98	55	slightly turbid	7.7	235	550	20.4	
RESULTS AT END OF DEVELOPMENT		slightly turbid	7.7	235	550	20.4	

COMMENTS: Bottom of swab tubing is at 189.3 ft BGS (on bottom of well).Swabbing removed several pieces of a plastic wire-tie

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM	WELL NO. <u>GW-732</u> PAGE 1 of 1
MONITORING WELL REDEVELOPMENT SUMMARY	
METHOD OF DEVELOPMENT: <u>Swab</u>	
DEVELOPMENT OBSERVED BY: <u>Timothy Coffey</u>	
DEVELOPMENT DATE: START: <u>3/10/98</u> FINISH: <u>3/11/98</u>	
ONE WELL VOLUME: <u>27.0</u> GALLONS	
TOTAL GALLONS PUMPED: <u>550</u> TOTAL WELL VOLUMES PUMPED: <u>20.4</u>	
INITIAL pH: <u>9.1</u> FINAL pH: <u>7.7</u>	
INITIAL SPECIFIC CONDUCTANCE: <u>224 µmhos/cm</u> FINAL: <u>235 µmhos/cm</u>	
DESCRIPTION OF INITIAL TURBIDITY: <u>turbid</u>	
DESCRIPTION OF FINAL TURBIDITY: <u>slightly turbid</u>	
FINAL MEASURED TURBIDITY: <u>not analyzed</u>	
WELL APPROVED BY: <u>S.B. Jones - LMES</u>	
ODOR OF WATER: <u>None Discernable</u>	
WATER DISCHARGED TO: <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <div style="width: 45%;"> ☒ GROUND SURFACE ☐ STORM SEWERS ☐ DRUMS </div> <div style="width: 45%;"> ☐ TANK TRUCK ☐ STORAGE TANKS ☐ OTHER </div> </div>	
INITIAL PRE-DEVELOPMENT WATER DEPTH: <u>153.6 ft BGS on 3-9-98</u>	
DEVELOPMENT OBSERVATIONS: <u>Well is a good producer, at no time did well dry up. In fact, water production appeared to improve as development progressed.</u>	
OBSERVER SIGNATURE: <u> </u> DATE: <u>March 11, 1998</u>	

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-732

WELL WATER FIELD SCREENING/DISPOSAL FORM

PAGE 1 of 1

LOCATION: Sediment Disposal Basin DATE: START: 3-10-98

APPROX. VOLUME OF DEVELOPMENT WATER: 550 gallons FINISH: 3-11-98

CALIBRATION OF INSTRUMENTS: Check those calibrated to manufacturer's specifications.

pH meter	<u>X</u>	(model)	<u>Horiba Model U-7</u>
Sp. Cond. meter	<u>X</u>	(model)	<u>YSI S-C-T Meter Model 33</u>
Organic vapor meter	<u>X</u>	(model)	<u>Century-Foxboro OVA Model 128</u>
Beta/gamma meter	<u>X</u>	(model)	<u>Ludlum Model 3 Survey Meter with G-M Pancake Probe</u>
Alpha meter	<u>X</u>	(model)	<u>Ludlum Model 12 Count Ratemeter with Scintillation Tube Probe</u>

FIELD SCREENING RESULTS:

Date	Time	pH	Sp. Cond.	Organic Vapors	Gamma	Alpha
3-10-98	1041	9.1	224 μ mhos/cm	0.0 ppm	40 cpm	0 cpm
3-10-98	1213	7.4	222 μ mhos/cm	0.0 ppm	50 cpm	0 cpm
3-10-98	1344	7.7	222 μ mhos/cm	0.0 ppm	40 cpm	0 cpm
3-10-98	1505	7.6	220 μ mhos/cm	0.0 ppm	40 cpm	0 cpm
3-11-98	0841	7.7	228 μ mhos/cm	0.0 ppm	N/M	0 cpm
3-11-98	0946	7.1	232 μ mhos/cm	0.0 ppm	40 cpm	0 cpm
3-11-98	1034	7.4	232 μ mhos/cm	0.0 ppm	40 cpm	0 cpm
3-11-98	1125	7.7	235 μ mhos/cm	0.0 ppm	40 cpm	0 cpm
		(4.0-10.5)	(<1000 μ mhos/cm)	(<10 ppm)	(<100 cpm)	(<500 cpm)

Weather: 3-10-98: Mostly to partly cloudy, windy, and cold with snow flurries
3-11-98: Partly cloudy and cool

Temp.: 3-10-98: Low-to upper-30's°F
3-11-98: Low-20's to mid-30's°F

DISPOSITION: Drill-site Disposal X

Containerization (Labeled?) y/n _____

Describe: Development water discharged to ground surface.

On-site Geologist (print): Timothy Coffey - SAIC

Signature:

Date: March 11, 1998

[illegible]

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-732</u>
WELL REDEVELOPMENT ACTIVITY/PROGRESS REPORT			PAGE 1 of 3
LOCATION: <u>Sediment Disposal Basin</u>		DATE: START: <u>9-16-98</u>	
OPERATOR: <u>R. Phillips - Highland Drilling Co.</u>		FINISH: <u>9-18-98</u>	
HELPER: <u>K. Fortner - Highland Drilling Co.</u>		LOGGED BY: <u>T. Coffey - SAIC</u>	
RIG: <u>Smeal Swab Rig</u>			

DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
9-16-98	1430	1443	Arrive at GW-732 site. Uncap the well, screen for organic vapors: 0.0 ppm in breathing zone, 0.0 ppm in casing headspace. Measure the water level at 157.91 ft below top of casing (BTOC) = 153.9 ft below ground surface (BGS). Tag the bottom of the well (solid) at 193.1 ft BTOC = 189.1 ft BGS. Note: The Subsurface Data Base (Y/TS-881/R3) reports the total depth of well GW-732 to be 189.3 ft. Calculate a well volume of 26.0 gallons.
	1443	1500	Move Smeal swab rig to GW-732 site, and position over the well.
	1500	1551	Haul swab tubing to GW-732 site, and unload onto plastic sheeting. Depart site.
9-17-98	0902	0922	Arrive at GW-732 site. Remove dedicated pump and tubing from the well and place in a plastic bag.
	0922	0942	Raise the mast of the rig. Build support for pipe slips.
	0942	1010	Run 2-in. inside diameter (ID), 2 3/8-inch outside diameter (OD) steel swab tubing, with check valve, into well. Bottom of tubing is at 187.5 ft BGS.
	1010	1015	Begin swabbing the well. Swab approximately 5 gallons of water out of well; water sample is clear.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM			WELL NO. <u>GW-732</u>
WELL REDEVELOPMENT ACTIVITY/PROGRESS REPORT continued			
			PAGE 2 of 3
DATE	TIME		ACTIVITY/COMMENTS
	START	FINISH	
9-17-98	1015	1026	Screen the initial water sample. Readings: pH = 10.7, specific
(Cont.)			conductance = 277 μ mhos/cm, temperature = 17.0°C.
	1026	1045	Continue swabbing the well. Swab another 50 gallons of water out
			of the well; water sample is slightly turbid.
	1045	1050	Screen water sample. Readings: pH = 8.4, specific conductance
			= 238 μ mhos/cm, temperature = 17.3°C.
	1050	1146	Wait on well to recharge completely.
	1146	1209	Continue swabbing the well. Swab another 55 gallons of water out
			of the well; water sample is slightly turbid.
	1209	1215	Screen water sample. Readings: pH = 8.0, specific conductance
			= 248 μ mhos/cm, temperature = 17.8°C.
	1215	1323	Wait on well to recharge completely.
	1323	1342	Continue swabbing the well. Swab another 55 gallons of water out
			of the well; water sample is slightly turbid.
	1342	1406	Screen water sample. Readings: pH = 7.8, specific conductance
			= 250 μ mhos/cm, temperature = 17.9°C. Lower mast on rig as a
			safety precaution. Secure site, and depart.
9-18-98	0826	0847	Arrive at GW-732 site. Raise mast on rig.
	0847	0912	Commence swabbing the well. Swab 50 gallons of water out of the
			well; water sample is slightly turbid.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-732

WELL REDEVELOPMENT ACTIVITY/PROGRESS REPORT
continued

PAGE 3 of 3

[illegible]

MONITORING WELL REDEVELOPMENT PROGRESS

Page 1 of 1

LOCATION: Sediment Disposal Basin

WELL INSTALLATION

ONE WELL VOLUME: 26.0 GALLONS

COMPLETION DATE: 9-11-91

COMMENTS:

1. Swab tubing at 187.5 ft BGS.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-732

MONITORING WELL REDEVELOPMENT SUMMARY

PAGE 1 of 1

METHOD OF DEVELOPMENT: Swab

DEVELOPMENT DATE:

DEVELOPMENT OBSERVED BY: T. Coffey - SAICSTART: 9/16/98FINISH: 9/18/98ONE WELL VOLUME: 26.0 GALLONSTOTAL GALLONS PUMPED: 265 TOTAL WELL VOLUMES PUMPED: 10.2INITIAL pH: 10.7 FINAL pH: 7.9INITIAL SPECIFIC CONDUCTANCE: 277 μ mhos/cm FINAL: 249 μ mhos/cmDESCRIPTION OF INITIAL TURBIDITY: clearDESCRIPTION OF FINAL TURBIDITY: slightly turbidFINAL MEASURED TURBIDITY: not measuredWELL APPROVED BY: S.B. Jones - ES&HODOR OF WATER: None Discernable

WATER DISCHARGED TO: ☒ GROUND SURFACE ☐ TANK TRUCK
☐ STORM SEWERS ☐ STORAGE TANKS
☐ DRUMS ☐ OTHER

INITIAL PRE-DEVELOPMENT

WATER DEPTH: 153.9 ft BGS on 9-16-98

DEVELOPMENT OBSERVATIONS: Well is a good producer. At no time during development did well dry up. Well recharged fully in less than an hour's time.

OBSERVER SIGNATURE: DATE: September 18, 1998

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM

WELL NO. GW-732

WELL WATER FIELD SCREENING/DISPOSAL FORM

PAGE 1 of 1

LOCATION: Sediment Disposal Basin

DATE: START: 9-16-98

APPROX. VOLUME OF DEVELOPMENT WATER: 265 gallons

FINISH: 9-18-98

CALIBRATION OF INSTRUMENTS: Check those calibrated to manufacturer's specifications.

pH meter	<u>X</u>	(model) <u>Horiba Model U-7</u>
Sp. Cond. meter	<u>X</u>	(model) <u>YSI S-C-T Meter Model 33</u>
Organic vapor meter	<u>X</u>	(model) <u>Century-Foxboro OVA Model 128</u>
Beta/gamma meter	<u>X</u>	(model) <u>Ludlum Model 3 Survey Meter with G-M Pancake Probe</u>
Alpha meter	<u>X</u>	(model) <u>Ludlum Model 12 Count Ratemeter with Scintillation Tube Probe</u>

FIELD SCREENING RESULTS:

Date	Time	pH	Sp. Cond.	Organic Vapors	Gamma	Alpha
9-17-98	1015	10.7	277 μ mhos/cm	0.0 ppm	N/A	0 cpm
9-17-98	1045	8.4	238 μ mhos/cm	0.0 ppm	40 cpm	0 cpm
9-17-98	1209	8.0	248 μ mhos/cm	0.0 ppm	40 cpm	0 cpm
9-17-98	1342	7.8	250 μ mhos/cm	0.0 ppm	50 cpm	0 cpm
9-18-98	0912	8.0	245 μ mhos/cm	0.0 ppm	40 cpm	0 cpm
9-18-98	1048	7.9	249 μ mhos/cm	0.0 ppm	40 cpm	0 cpm
		(4.0-10.5)	(<1000 μ mhos/cm)	(<10 ppm)	(<100 cpm)	(<500 cpm)

Weather: Mostly clear; warm and humid

Temp.: Upper-70's to upper 80's°F.

DISPOSITION: Drill-site Disposal X

Containerization
(Labeled?) y/n

Describe: Development water discharged to ground surface.

On-site Geologist (print): Timothy Coffey - SAIC

Signature:

Date: September 18, 1998

APPENDIX D

**WASTE MANAGEMENT PLAN FOR
DRILLING ACTIVITIES**

D.1. INTRODUCTION

The ultimate objective of monitoring groundwater is gathering data to assess potential impacts to human health and the environment. It is also the objective of the Y-12 Plant Groundwater Protection Program (GWPP) to handle drilling and development effluents from the installation of groundwater monitoring wells or borings in a manner that protects the environment. The Y-12 Plant philosophy has been and continues to be consistent with the U.S. Environmental Protection Agency (EPA) and Lockheed Martin Energy Systems, Inc., (Energy Systems) guidance for managing investigation-derived wastes. Site-specific professional judgment is used to determine the potential for contamination prior to the installation of each well. Factors considered in evaluating the potential for site contamination include the following:

- previously collected sampling and analysis data;
- groundwater flow patterns;
- geologic and hydrogeologic setting; and
- purpose of the well (contaminant plume assessment, background monitoring, compliance, monitoring, etc.).

Based on the evaluation, one of two options is selected:

- stabilize material on site or
- collect material for treatment or storage.

D.2. DRILLING EFFLUENTS DISPOSAL

There are two levels of drilling effluent management at the Y-12 Plant: (1) drill-site disposal and (2) containerization for waste disposal. Disposal of effluents at the drill site following best management practices (BMPs) is permitted if the cuttings do not exceed the criteria discussed below. If the criteria are exceeded, the cuttings must be containerized at the drill site, labeled, and handled according to Y-12 Plant waste disposal procedures. Sampling and field screening of the effluents will be conducted in accordance with the procedures specified in Energy Systems' *Environmental Surveillance Procedures Quality Control Program* (1988).

D.2.1 FIELD SCREENING

Field screening of drill cuttings will consist of measuring three parameters: radioactivity, organic vapors, and pH. The Energy Systems procedures specified in Table D.1 will be followed with some modification, as described below.

Radioactivity will be measured using two separate meters: a survey meter with a "pancake" Geiger tube for determining beta and gamma activity and a scintillation counter with a zinc sulfide window for determining alpha activity. The meters will be passed over the surface area of the cuttings, and the highest readings will be recorded.

Screening for organic vapors will be conducted on composite samples from the effluents generated each day from a single well. The samples will be collected with a hand trowel or similar tool to select cuttings from several depths. Enough cuttings will be placed in a clean 1-L glass or metal container to half fill it. Aluminum foil will be placed over the mouth of the container to make an airtight seal. The sample will then be incubated for 1 hour at 70°F or the ambient temperature, whichever is higher. Organic vapors in the headspace of the sample container will be measured by puncturing the aluminum foil and inserting the probe of an organic vapor analyzer. This instrument will have a photoionization detector with a 10.2 eV lamp and will be calibrated to isobutylene and/or a flame ionization detector calibrated to methane. The highest reading of the headspace vapors will be recorded.

Table D.1. Y-12 Plant field-screening criteria for drilling effluents and development water

Field Analysis	Energy Systems procedure no.	Limit
pH	ESP-307-1, Rev. 1	4.0 – 10.5
Specific conductivity ^a	ESP-307-1, Rev. 1	<1000 μ mhos/cm
Organic vapors	ESP-307-6, Rev. 1	<10 ppm
Radioactivity	ESP-307-7, Rev. 1	
beta/gamma		<600 dpm/100 cm ² (<100 cpm)
alpha		<1000 dpm/100 cm ² (<500 cpm)

^a Not applicable to drill cuttings.

The pH of the cuttings will be measured by adding one quart of deionized water to the composite sample used to determine the presence of organic vapors. The sample will be agitated until well mixed. The pH of the mixture will be determined by using a pH meter. This pH will be recorded.

D.2.2 QUANTITATIVE SCREENING

In addition to field screening, samples for selected laboratory analyses [i.e., volatile organic compounds (VOCs), metals, radioisotopes] may be required for quantitative verification of contaminant levels. Quantitative screening is typically conducted in areas of known or suspected contamination where certain criteria are of concern (i.e., Resource Conservation and Recovery Act Toxicity Characteristic Leaching Procedure levels). The well installation waste management plan will specify the types of quantitative screening to be conducted.

D.2.3 CONTAINERIZATION FOR WASTE DISPOSAL

If the effluents from a borehole exceed any one of the field screening limits, they will be containerized at the drill site and labeled with the contents (drill cuttings), borehole number, and date. The cuttings will then be handled according to Y-12 Plant waste management procedures.

An exception to the above may be made if the cuttings exceed only the organic vapor limits. Weather permitting, those cuttings may be passively treated by aeration at the drill site to reduce the organic vapor content. Such treatment shall not exceed 5 working days. If reanalysis following aeration indicates the cuttings continue to exceed the organic vapor limits, they must be containerized and handled as described above.

If quantitative screening is performed, the exceedance of applicable quantitative screening criteria will result in containment of effluents.

D.2.4 BEST MANAGEMENT PRACTICES FOR DRILL SITE DISPOSAL

Drilling effluents that do not exceed the containment criteria will be disposed of at the drill site, if practicable. BMPs dictate that the effluents be disposed of in such a way as to not be unsightly or cause erosion/sedimentation impacts on nearby surface water. The cuttings shall, therefore, be used as part of the restoration of the drill site, to fill in low areas and tire tracks, or spread to conform to the natural topography. They will subsequently be seeded and mulched. Care shall be taken to ensure that liquid fractions infiltrate or evaporate at the drill site and in no case run off into surface waters, ephemeral drainages, or storm sewers. Drill cuttings that do not exceed the containment criteria but cannot be disposed of at the drill site due to its location (e.g., parking lot, yard) will be transported to a designated location and disposed of as clean fill, following BMPs.

D.2.5 DOCUMENTATION

The results of all field screening analyses and a description of the disposition of the drilling effluents from each borehole will be documented on a Drill Cuttings Field Screening/Disposal Sheet, an example of which is attached (Attachment 1). These forms will be completed for each borehole by the on-site geologist who conducts the screening and will be maintained as part of the permanent record for the well.

D.3. DEVELOPMENT WATER DISPOSAL

There are two levels of development water management at the Y-12 Plant: (1) drill-site disposal and (2) containerization for waste disposal. Disposal of development water at the drill site following BMPs is permitted if the water does not exceed the criteria discussed below. If the criteria are exceeded, the water must be containerized at the drill site, labeled, and handled according to Y-12 Plant waste disposal procedures. Sampling and field screening of development water will be conducted in accordance with the procedures specified in Energy Systems' *Environmental Surveillance Procedures Quality Control Program* (1988).

D.3.1 FIELD SCREENING

Initial development water will be containerized until it has been screened. This is accomplished by pumping the water into drums or other suitable container(s). Subsequent screening will be conducted on grab samples taken approximately after each casing volume is removed. (An alternative to the grab sampling is to totally contain all the development water produced at a well, then analyze a composite sample.) If initial grab samples do not exceed the limits specified in Table D.1, development water may be pumped directly onto the ground (following BMPs) unless or until a subsequent grab sample exceeds the limits.

Field screening of development water will consist of measuring four parameters: radioactivity, organic vapors, specific conductivity, and pH. The Energy Systems procedures specified in Table D.1 will be followed with some modification, as described below.

Radioactivity will be measured using two separate meters: a survey meter with a "pancake" Geiger tube for determining beta and gamma activity and a scintillation counter with a zinc sulfide window for determining alpha activity. The meters will be passed over the surface area of the sample, and the highest readings will be recorded.

Screening for organic vapors will be conducted by placing enough development water in a clean 1-L glass or metal container to half fill it. Aluminum foil will be placed over the mouth of the container to make an airtight seal. The sample will then be incubated for 1 hour at 70°F or the ambient temperature, whichever is higher. Organic vapors in the headspace of the sample container will be measured by puncturing the aluminum foil and inserting the probe of an organic vapor analyzer. This instrument will have a photoionization detector with a 10.2 eV lamp calibrated to isobutylene and/or a flame ionization detector calibrated to methane. The highest reading of the headspace vapors will be recorded.

Specific conductivity and pH will be measured as soon as possible after collection of the sample. The specific conductivity and pH of the development water will be measured by immersing the probes of applicable instruments calibrated to the appropriate buffer solutions into the sample. The resulting readings will be recorded. If either instrument is equipped with a temperature option, the temperature of the sample will also be recorded.

D.3.2 QUANTITATIVE SCREENING

In addition to field screening, sampling for selected laboratory analyses (i.e., VOCs, metals, radioisotopes) may be required for quantitative verification of contaminant levels. Quantitative screening is typically conducted in areas of known or suspected contamination where certain criteria are of concern. The well installation waste management plan will specify the types of quantitative screening to be conducted.

D.3.3 CONTAINERIZATION FOR WASTE DISPOSAL

If the development water from a well exceeds any one of the field screening limits, it will be containerized at the drill site and labeled as to contents (development water), well number, and date. The water will then be handled according to Y-12 Plant waste management procedures.

An exception may be made if the development water exceeds only the organic vapor limits. Weather permitting, the water may be passively treated at the drill site by leaving the containers open for aeration to reduce the organic vapor content. Such treatment shall not exceed 5 working days and shall not be conducted over weekends without supervision. If reanalysis following aeration indicates that the development water continues to exceed the organic vapor limits, it must be containerized and handled as above. If quantitative screening is performed, the exceedance of applicable quantitative screening criteria will result in containment of effluents.

D.3.4 BMPs FOR DRILL-SITE DISPOSAL

Development water that does not exceed the containment criteria will be disposed of at the drill site if practicable. BMPs dictate that the water be disposed of in such a way as to not cause erosion or to enter nearby surface water or storm sewers. Precautions shall, therefore, be taken to ensure that development water pumped onto the ground or released from containers at the drill site either infiltrates or evaporates at the site and in no case runs off into surface waters, ephemeral drainages, or storm sewers. Development water that does not exceed the field screening but cannot be disposed of at the well site due to its location (e.g., within a drainage, near a storm sewer) will be transported to a designated location and disposed of as clean water following BMPs.

D.3.5 DOCUMENTATION

The results of all field screening analyses and a description of the disposition of the development water from each well will be documented on a Development Water Field Screening/Disposal Sheet, an example of which is attached (Attachment 2). These forms will be completed for each well by the on-site geologist who conducts the screening and will be maintained as part of the permanent record for the well.

D.4. REFERENCES

- Energy Systems (Lockheed Martin Energy Systems, Inc.) 1988. *Environmental Surveillance Procedures Quality Control Program*. ES/ESH/INT-14.
- Energy Systems 1994. *Management of Waste Generated from Field Investigation and Sampling Activities*. ERWM/ER-P2103, Rev. 0.
- Energy Systems 1997. *Monitoring Well Installation Plan for the Department of Energy Y-12 Plant, Oak Ridge, Tennessee*. Y/SUB/97-99069C(Y-27)/1, September.
- EPA (U.S. Environmental Protection Agency). 1992. *Management of Contaminated Media*. TSC-92-02.

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM	WELL NO. _____
WELL CUTTINGS FIELD SCREENING / DISPOSAL FORM	Page 1 of 1

LOCATION: _____	DATE: START: _____
APPROX. VOLUME OF CUTTINGS: _____	FINISH: _____

CALIBRATION OF INSTRUMENTS: Check those calibrated to manufacturer's specifications.

pH meter	_____	(model)	_____
Organic vapor meter	_____	(model)	_____
Beta/gamma meter	_____	(model)	_____
Alpha meter	_____	(model)	_____

FIELD SCREENING RESULTS (background/highest observed values):

pH	_____	Date/Time	_____ (4.0-10.5)
Organic vapors	_____	Date/Time	_____ (<10 ppm above background)
Beta/Gamma	_____	Date/Time	_____ (<100 cpm above background)
Alpha	_____	Date/Time	_____ (<500 cpm above background)

*Elevated pH reading due to cement fragments in the cuttings composite.

Weather _____	Temp.: _____
---------------	--------------

DISPOSITION: Drill-site Disposal _____	Containerization (Labeled?) y / n _____
--	--

Describe: _____

On-Site Geologist (print): _____

Signature: _____	Date: _____
------------------	-------------

Y-12 PLANT GROUNDWATER PROTECTION PROGRAM				WELL NO. _____		
WELL WATER FIELD SCREENING/DISPOSAL FORM				PAGE 1 of 1		

LOCATION: _____ DATE: START: _____

APPROX. VOLUME OF DEVELOPMENT WATER: _____ FINISH: _____

CALIBRATION OF INSTRUMENTS: Check those calibrated to manufacturer's specifications.

pH meter		(model)	
Sp. Cond. meter		(model)	
Organic vapor meter		(model)	
Beta/gamma meter		(model)	
Alpha meter		(model)	

FIELD SCREENING RESULTS:

Date	Time	pH	Sp. Cond.	Organic Vapors	Gamma	Alpha
		(4.0-10.5)	(<1000 μ mhos/cm)	(<10 ppm)	(<100 cpm)	(<500 cpm)

Weather: _____ Temp.: _____

DISPOSITION: Drill-site Disposal _____ Containerization (Labeled?) y/n _____

Describe: _____

On-site Geologist (print): _____

Signature: _____ Date: _____

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