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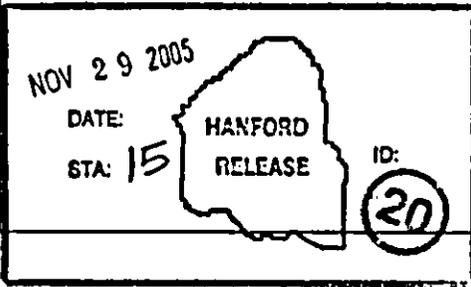
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# **Borehole Summary Report for Wells 299-E24-24 (C4647) and 299-E17-26 (C4648), Integrated Disposal Facility**

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

Project Hanford Management Contractor for the  
U.S. Department of Energy under Contract DE-AC06-96RL13200

**Fluor Hanford**

P.O. Box 1000  
Richland, Washington

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# Borehole Summary Report for Wells 299-E24-24 (C4647) and 299-E17-26 (C4648), Integrated Disposal Facility

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M. Caron  
Gram, Inc.

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Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the  
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ACRONYMS

bgs	below ground surface
btoc	below the top of casing
bwt	below the water table
CHG	CH2M Hill Hanford Group, Inc.
DOE-RL	U.S. Department of Energy, Richland Operations Office
DOW	Description of Work
DQO	Data Quality Objective
EPA	U.S. Environmental Protection Agency
FH	Fluor Hanford, Inc.
gpm	gallons per minute
ID	inside diameter
IDF	Integrated Disposal Facility
NTU	Nephelometric Turbidity Unit
OD	outside diameter
psi	pounds per square inch
QA	Quality Assurance
RCRA	<i>Resource Conservation and Recovery Act of 1976</i>
ROD	record of decision
SGLS	Spectral Gamma Logging System
SOW	Statement of Work
TOC	top of casing
WAC	<i>Washington Administrative Code</i>

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## METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
<i>If You Know</i>	<i>Multiply By</i>	<i>To Get</i>	<i>If You Know</i>	<i>Multiply By</i>	<i>To Get</i>
<b>Length</b>			<b>Length</b>		
inches	25.4	millimeters	millimeters	0.039	inches
inches	2.54	centimeters	centimeters	0.394	inches
feet	0.305	meters	meters	3.281	feet
yards	0.914	meters	meters	1.094	yards
miles	1.609	kilometers	kilometers	0.621	miles
<b>Area</b>			<b>Area</b>		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.093	sq. meters	sq. meters	10.76	sq. feet
sq. yards	0.0836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.6	sq. kilometers	sq. kilometers	0.4	sq. miles
acres	0.405	hectares	hectares	2.47	acres
<b>Mass (weight)</b>			<b>Mass (weight)</b>		
ounces	28.35	grams	grams	0.035	ounces
pounds	0.454	kilograms	kilograms	2.205	pounds
ton	0.907	tonne	tonne	1.102	ton
<b>Volume</b>			<b>Volume</b>		
teaspoons	5	milliliters	milliliters	0.033	fluid ounces
tablespoons	15	milliliters	liters	2.1	pints
fluid ounces	30	milliliters	liters	1.057	quarts
cups	0.24	liters	liters	0.264	gallons
pints	0.47	liters	cubic meters	35.315	cubic feet
quarts	0.95	liters	cubic meters	1.308	cubic yards
gallons	3.8	liters			
cubic feet	0.028	cubic meters			
cubic yards	0.765	cubic meters			
<b>Temperature</b>			<b>Temperature</b>		
Fahrenheit	subtract 32, then multiply by 5/9	Celsius	Celsius	multiply by 9/5, then add 32	Fahrenheit
<b>Radioactivity</b>			<b>Radioactivity</b>		
picocuries	37	millibecquerel	millibecquerel	0.027	picocuries

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**1.0 INTRODUCTION**

This report describes the fiscal year 2005 field activities associated with the installation of two monitoring wells drilled in the 200 East Area to support the Integrated Disposal Facility (IDF) groundwater monitoring network. These wells were installed for Fluor Hanford, Inc. (FH) in accordance with *Hanford Federal Facility Agreement and Consent Order*, Milestone M-24-57 (Ecology et al. 1989), the *Resource Conservation and Recovery Act of 1976* (RCRA), and the appropriate Description of Work (DOW) document (FH 2004b).

Documents supporting field activities as well as procedures followed during borehole characterization and well construction are listed in Section 7.0 of this document (References).

**1.1 PURPOSE AND SCOPE**

The primary purpose of this field effort was to install two compliance monitoring wells in the 200 East Area. These wells, located to the west and southwest of PUREX, will serve as monitoring wells to support the IDF groundwater monitoring network. A summary of the new wells is provided in Table 1-1 and the well locations are shown in Figure 1-1.

The scope of activities described in this report includes the technical data that encompasses the drilling of two boreholes and related well construction. Additional scope of work described in the report includes waste management and subsurface descriptions.

These boreholes were completed as RCRA compliance monitoring wells for CH2M Hill Hanford Group, Inc. (CHG).

**Table 1-1 Drilling Summary of Boreholes and Wells.**

Well ID	Area	Drilling Date		Northing (m)	Easting (m)	Ground Surface Elevation* (Brass Cap) (m)	Total Depth (feet bgs)
		Start	Finish				
C4647	200 East	5/9/05	5/26/05	135459.30	574179.77	220.483	364
C4648	200 East	5/23/05	6/29/05	135025.06	574662.61	224.430	379

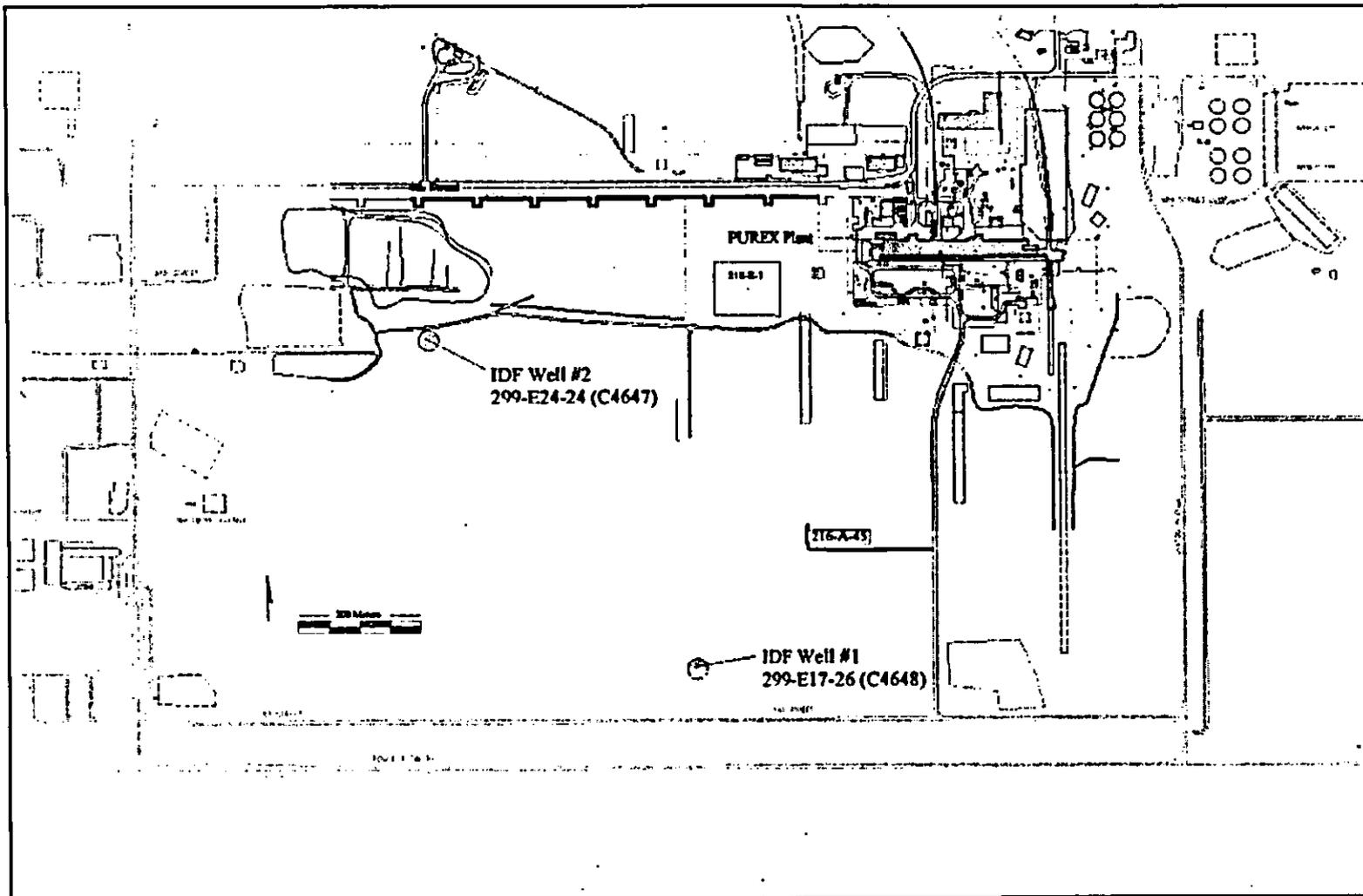
**Notes:**

Northing and easting coordinates are based on Washington State Plane Coordinates North American Datum of 1983 (NAD83[91]) rounded to 1 m.

\*North American Vertical Datum of 1988 (NAVD88) values rounded to 0.001 m.

bgs = below ground surface.

Figure 1-1 Location Map for IDF Monitoring Wells.



## **2.0 TECHNICAL DATA**

This section describes the methods used to drill and install, and develop wells in addition to the waste handling activities related to drilling.

### **2.1 IDF MONITORING WELL NETWORK**

This section provides technical details of the drilling methods, well completion, well development, and pump installation activities performed during construction of the two groundwater compliance monitoring wells for the Integrated Disposal Facility (see Figure 1-1). Drilling data are presented in Table 1-1 and well summary information is located in Appendices A through D.

#### **2.1.1. Well 299-E24-24 (C4647)**

This section summarizes activities related to the drilling, sampling, and construction of groundwater compliance monitoring well 299-E24-24 (C4647).

##### **2.1.1.1. Drilling Summary**

Drilling of Well 299-E24-24 (C4647) began on May 9, 2005 using a diesel hammer (Becker Hammer drill rig) driving 9x6 inch dual wall temporary casing. The casing advanced to 364.0 feet below ground surface (bgs), with the total depth (TD) at 364.0 feet bgs reached on May 11, 2005. The static groundwater level was reached on May 10, 2005 at 322.7 feet bgs. It should be noted that groundwater depths based on drilling returns were likely artificially depressed by the high air injection rates required to lift coarse gravels encountered during dual wall percussion drilling.

##### **2.1.1.2. Sampling Summary**

Archive samples (1-pint jars) were collected for CHG at five-foot intervals. Also, five-foot interval samples were placed in plastic chip trays. A total of two split spoon samples were collected for sieve tray analysis. The first split spoon was collected on May 10, 2005 from 329.5 to 331.1 feet bgs, 6.7 feet below the water table (btw). The second split spoon sample was collected on May 11, 2005 from 354.5 to 356.2 feet bgs, which is 31.8 feet bwt. Table 2-1 summarizes the sampling for Well 299-E24-24 (C4647).

Table 2-1 Summary of Sampling at Well 299-E24-24 (4647).

Sampling Method	Sample Media	Collection Date	Sample Depth (ft bgs)	Sample Depth (ft bwt)
Split Spoon	Sediment	5/10/05	329.5 to 331.1	6.7
Split Spoon	Sediment	5/11/05	354.5 to 356.2	31.8

## Notes:

bgs = below ground surface

bwt = below the water table

ft = feet

**2.1.1.3. Well Construction**

Well construction materials, filter pack installation, initial well development, and annular seal for Well 299-E24-24 (C4647) are discussed below. A straightness test was performed using a 4.5-inch outer diameter (OD), 20 foot-long tool prior to well completion activities. Construction and completion of this well were carried out on May 13, 16, 17, and 24, 2005. Well completion summary data are provided in Table 2-5 and well construction summary sheets are presented in Appendix D.

- **Screen, Riser Casing, and Filter Pack.** Stainless steel screen and riser materials were chosen for this well, consisting of 4-inch inner diameter (ID), 20-slot (0.020-inch), continuous v-wire wrap, Type 304L stainless steel screen, 35.00 feet in length; a 4-inch ID, Type 304L stainless steel sump, 2.00 feet in length; and a 4-inch ID, Type 304L stainless steel casing. Filter pack material consists of 10-20 mesh Colorado silica sand. These selections were based on hydrogeology encountered during drilling, as well as information from nearby wells. The bottom of the stainless steel sump was placed at 358.4 feet bgs and the bottom of the stainless steel screen was set at 356.4 feet bgs while the top of the screen was set at 321.4 feet bgs. The top of the stainless steel riser casing was set 2.0 feet above ground surface. The top of the stainless steel protective casing was set 2.4 feet above the concrete pad (approximately 3.0 feet above ground surface). The annular space between the stainless steel screen and the sediments in the borehole was filled with 10-20 mesh filter pack sand from total depth of 364.0 feet bgs to 310.9 feet bgs (10.5 feet above the top of the screen).
- **Filter Pack Installation and Initial Well Development.** The filter pack installation and initial well development process consisted of introducing silica sand into the annular space around the screen and settling the filter pack to eliminate void spaces. Development of the well removed fines in the newly constructed well and reconditioned the borehole walls to minimize effects of drilling, primarily due to air injection and caving. A dual-flange surge block was used to develop and settle the sand filter pack in the annular space between the screen and the borehole walls. Surging was carried out in three stages, with the first stage of surging developing the bottom portion of the screen (about 357 feet bgs to 337 feet bgs). The second stage of surging developed the middle portion

of the screen (about 348 feet bgs to 337 feet bgs), and the third stage of surging developed the upper portion of the screen (about 337 feet bgs to 322 feet bgs). Overlap between the filter sand and temporary casing was maintained throughout so that unconsolidated formation sediments would not cave and come in direct contact with the well screen. The level of the filter pack was measured periodically with a weighted tape to monitor overlap and determine when the settling rate within the filter pack had decreased to less than 0.1 feet over a period of 15 minutes. The bottom portion of the sand filter pack was surged for 71 minutes, with stability achieved after surging for 56 minutes. The middle portion of the sand filter pack was surged for 60 minutes, with stability achieved after surging for 45 minutes. The upper portion of the sand filter pack was subsequently surged for 65 minutes, with stability achieved after surging for 50 minutes.

- **Annular Seal.** An annular seal was constructed above the filter pack using bentonite pellets, extending from 310.9 feet bgs to 305.5 feet bgs. The bentonite pellets were followed by granular bentonite from 305.5 to 11.3 feet bgs. Additionally, a cement grout surface seal was installed from 11.3 feet bgs to ground surface, consisting of Portland cement and approximately 2% by weight ground bentonite.

#### **2.1.1.4. Final Well Development and Pumping Test.**

Final well development for 299-E24-24 (C4647) was performed on May 25, 2005, in accordance with CP-GPP-EE-01-6.3, "Well Development and Testing". A 5-HP Franklin electric submersible pump was used to develop the well in two intervals until turbidity was less than 5 Nephelometric Turbidity Units (NTU) and other water parameters including temperature and conductivity had stabilized. Water level drawdown during development was monitored continuously using a 20 pounds per square inch (psi) pressure transducer and was recorded with an In-Situ Hermit 3000 datalogger.

Since the well screen is greater than 20 feet in length, the Statement of Work (SOW), RFP-115806 (FH 2004c), states that the final well development should be performed in 2 stages. During the first stage of development, the pump intake was located at 353.7 ft. below the top of casing (btoc) or 350.7 feet bgs. There were two unsuccessful drawdown tests prior to the successful drawdown test which produced a flow rate of approximately 30 gallons per minute (gpm) for 43 minutes. The turbidity value at the completion of development was 0.53 NTU. Measurable drawdown was not observed for the first stage of the final well development. During the second stage of development, the pump intake was placed at a depth of 338.5 feet btoc or 335.5 feet bgs. The pump ran for a total of 20 minutes producing a flow rate of approximately 32 gpm. The turbidity value at the completion of development was 3.17 NTU. Again, measurable drawdown was not observed for the second stage of the pumping test.

Final groundwater parameters are presented in Table 2-3 and well development data are found in Appendix E. Drawdown and recovery curves for the final well

development of Well 299-E24-24 (C4647) are not presented due to a lack of measurable drawdown during final well development.

#### **2.1.1.5. Pump Installation**

Pump installation was completed on May 26, 2005. An electric submersible pump (Grundfos™ 10Redi-Flo3, Model 10SQE340NE) was set with the pump intake at 340.0 feet bgs (343.0 feet btoc [6-inch protective casing]), which is 16.4 feet above the bottom of the screen and approximately 17.3 feet below the static water table.

#### **2.1.2. WELL 299-E17-26 (C4648)**

This section summarizes activities related to the drilling, sampling, and construction of groundwater compliance monitoring well 299-E17-26 (C4648).

##### **2.1.2.1. Drilling Summary**

Drilling of well 299-E17-26 (C4648) began on May 23, 2005 using a diesel hammer (Becker Hammer drill rig) driving 9x6 inch dual wall temporary casing. The casing advanced to 378.8 feet bgs, with the TD at 379.0 feet bgs on June 1, 2005. The static groundwater level was reached on May 31, 2005 at 339.3 feet bgs. It should be noted that groundwater depths based on drilling returns were likely artificially depressed by the high air injection rates required to lift coarse gravels encountered during dual wall percussion drilling.

##### **2.1.2.2. Sampling Summary**

Archive samples (1-pint jars) were collected for CHG at five-foot intervals. Also, five-foot interval samples were placed in plastic chip trays. A total of two split spoon samples were collected for sieve tray analysis. The first split spoon was collected on June 1, 2005 from 343.5 to 344.3 feet bgs, 4.8 feet below water table. The second split spoon sample was also collected on June 1, 2005 from 369.3 to 370.5 feet bgs (only 1.2 feet due to refusal), or 30.6 feet bwt. Table 2-2 summarizes the sampling for Well 299-E24-24 (C4647).

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™ Grundfos 10Redi-Flo3 is a trademark of Grundfos Pumps Corporation of Clovis, California.

Table 2-2 Summary of Sampling at Well 299-E17-26 (4648).

Sampling Method	Sample Media	Collection Date	Sample Depth (ft bgs)	Sample Depth (ft bwt)
Split Spoon	Sediment	6/1/05	343.5 to 344.3	4.8
Split Spoon	Sediment	6/1/05	369.3 to 370.5	30.6

## Notes:

bgs = below ground surface

bwt = below the water table

ft = feet

**2.1.2.3. Well Construction**

Well construction materials, filter pack installation, initial well development, and annular seal for Well 299-E17-26 (C4648) are discussed below. A straightness test was performed using a 4.5-in OD, 20 foot-long tool prior to well completion activities. Construction and completion of this well were carried out from June 6 to 28, 2005. Well completion summary data are provided in Table 2-5 and well construction summary sheets are presented in Appendix D.

- **Screen, Riser Casing, and Filter Pack.** Stainless steel screen and riser materials were chosen for this well, consisting of 4-inch ID, 20-slot (0.020-in), continuous v-wire wrap, Type 304L stainless steel screen, 34.98 feet in length; a 4-inch ID, Type 304L stainless steel sump, 2.00 feet in length; and a 4-inch ID, 304L stainless steel riser casing. Filter pack material consists of 10-20 mesh Colorado silica sand. These selections were based on hydrogeology encountered during drilling, as well as information from nearby wells. The bottom of the stainless steel sump was placed at 375.1 feet bgs and the bottom of the stainless steel screen was set at 373.1 feet bgs while the top of the screen was set at 338.1 feet bgs. The top of the stainless steel riser casing was set 2.0 feet above ground surface. The top of the stainless steel protective casing was set 2.4 feet above the concrete pad (approximately 3.1 feet above ground surface). The annular space between the stainless steel screen and the sediments in the borehole was filled with 10-20 mesh filter pack sand from total depth of 379.0 feet bgs to 327.1 feet bgs (11 feet above the top of the screen).
- **Filter Pack Installation and Initial Well Development.** The filter pack installation and initial well development process consisted of introducing silica sand into the annular space around the screen and settling the filter pack to eliminate void spaces. Development of the well removed fines in the newly constructed well and reconditioned the borehole walls to minimize effects of drilling, primarily due to air injection and caving. A dual-flange surge block was used to develop and settle the sand filter pack in the annular space between the screen and the borehole walls. Surging was carried out in three stages, with the first stage of surging developing the bottom portion of the screen (about 373 feet bgs to 358 feet bgs). The second stage of surging developed the middle portion

of the screen (about 358 feet bgs to 348 feet bgs), and the third stage of surging developed the upper portion of the screen (about 348 feet bgs to 338 feet bgs). Overlap between the filter sand and temporary casing was maintained throughout so that unconsolidated formation sediments would not cave and come in direct contact with the well screen. The level of the filter pack was measured periodically with a weighted tape to monitor overlap and determine when the settling rate within the filter pack had decreased to less than 0.1 feet over a period of 15 minutes. The bottom portion of the sand filter pack was surged for 60 minutes, with stability achieved after surging for 17 minutes. The middle portion of the sand filter pack was surged for 60 minutes, with stability achieved after surging for 21 minutes. The upper portion of the sand filter pack was subsequently surged for 60 minutes, with stability achieved after surging for 36 minutes.

- **Annular Seal.** An annular seal was constructed above the filter pack using bentonite pellets, extending from 327.1 feet bgs to 322.1 feet bgs. The bentonite pellets were followed by granular bentonite from 322.1 to 11.2 feet bgs. Additionally, a cement grout surface seal was installed from 11.2 feet bgs to ground surface, consisting of Portland cement and approximately 2% by weight ground bentonite.

#### **2.1.2.4. Final Well Development and Pumping Test**

Final well development for 299-E17-26 (C4648) was performed on June 27, 2005, in accordance with CP-GPP-EE-01-6.3, "Well Development and Testing". A 5-HP Franklin electric submersible pump was used to develop the well in two intervals until turbidity was less than 5 Nephelometric Turbidity Units (NTU) and other water parameters including temperature and conductivity had stabilized. Water level drawdown during development was monitored continuously using a 20 psi pressure transducer and was recorded with an In-Situ Hermit 3000 datalogger.

Since the well screen is greater than 20 feet in length, the SOW, RFP-115806 (FH 2004c), states that the final well development should be performed in 2 stages. During the first stage of well development, the pump was operated with the intake located approximately 370 feet bgs. The pump ran for a total of 34 minutes producing a flow rate of approximately 20 gpm. The turbidity value at the completion of development was 1.99 NTU. Measurable drawdown was not observed for the first stage of the final well development. Because the pump temporarily malfunctioned, a recovery test was not run. During the second stage of development, the pump intake was placed at a depth of approximately 355 feet bgs. The pump ran for a total of 17 minutes producing a flow rate of 18 gpm. The turbidity value at the completion of development was 4.91 NTU. Again, measurable drawdown was not observed for the second stage of the pumping test.

Final groundwater parameters are presented in Table 2-3 and well development data are found in Appendix E. Drawdown and recovery curves for the final well development of Well 299-E17-26 (C4648) are not presented due to a lack of measurable drawdown during final well development.

**2.1.2.5. Pump Installation**

Pump installation was completed on June 28, 2005. An electric submersible pump (Grundfos™ 10Redi-Flo3, Model 10SQE340NE) was set with the pump intake at 343.3 feet bgs (346.4 feet btoc [6-inch protective casing]), which is 29.8 feet above the bottom of the screen and approximately 4.0 feet below the static water table.

---

™ Grundfos 10Redi-Flo3 is a trademark of Grundfos Pumps Corporation of Clovis, California.

**Table 2-3 Well Completion Summary for IDF Monitoring Wells.**

Well Name	Well ID	Water Level (ft bgs)	Screen <sup>a</sup>					Sandpack <sup>b</sup> Interval (ft bgs)	Seal <sup>f</sup> (ft bgs)	Grout <sup>d</sup> Depth (ft bgs)	Riser		Pump <sup>e</sup> Intake Depth <sup>f</sup> (ft bwt)
			Top of Screen (ft bgs)	Bottom of Screen (ft bgs)	Screen Length (ft)	Sump (ft)	Material				Top (ft)	Material	
299-E24-24	C4647	~322.7	321.4	356.4	35.00	2.00	ss304L	310.9 - 364.0	305.5 - 310.9	0 - 11.3	+2.0	ss304L	~17.3
299-E17-26	C4648	~339.3	338.1	373.1	34.98	2.00	ss304L	327.1 - 379.0	322.1 - 327.1	0 - 11.2	+2.0	ss304L	~4.0

Notes:

<sup>a</sup>Screen slot size is 0.02 inch

<sup>b</sup>Sandpack consists of Colorado silica sand (10-20 mesh)

<sup>c</sup>Bentonite seal consists of 3/8-inch bentonite pellets.

<sup>d</sup>Grout consists of Portland cement with ~2% by weight Quik-Gel bentonite powder.

<sup>e</sup>Redi-Flo3 pumps are manufactured by Grundfos Pumps Corporation, Clovis, California.

<sup>f</sup> Pump intake depth is determined from groundwater readings taken on day pump was installed and piping used in pump installation. Water level readings recorded at pump installation may vary somewhat from data collected during drilling (column 4).

bgs = below ground surface

bwt = below water table

ft = feet

N/A = not applicable

ss = stainless steel

~ = approximate value given

**Table 2-4 Well Development Data for IDF Monitoring Wells.**

Well Name	Well ID	Static Water Level (ft bgs)	Development Date	Pump Intake Depth (ft bgs)	Development Pumping Duration (minutes)	Final Turbidity (NTU)	Final Conductivity ( $\mu\text{S/cm}$ )	Final Temp ( $^{\circ}\text{C}$ )	Flow Rate (gpm)	Final Drawdown (ft)	Total Gallons Pumped
299-E24-24	C4647	322.7	5/25/05	353.7	43	0.53	458	22.7	~30	None <sup>1</sup>	~1290
				338.5	20	3.17	458	22.3	~32	None <sup>1</sup>	~640
299-E17-26	C4648	338.7	6/27/05	~370	34	1.99	506	20.3	~20	None <sup>1</sup>	~680
				~355	17	4.91	520	20.7	~18	None <sup>1</sup>	~300

Notes:

<sup>1</sup> = measurable drawdown was not observed during final well development activities

bgs = below ground surface

gpm = gallons per minute

ft = feet

NTU = Nephelometric Turbidity Units

$\mu\text{s/cm}$  = micro seimen per centimeter

$^{\circ}\text{C}$  = degrees Centigrade

~ = approximate value given

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### **3.0 WASTE MANAGEMENT**

Waste generated by the installation of the IDF monitoring wells was managed using the specific requirements regarding waste generation as outlined in the supporting documentation. Waste included drill cuttings, purgewater, decontamination waste, and miscellaneous waste. The specific waste characterization requirements are defined in the *Data Quality Objective [DQO] Summary Report for FY2004 Seismic Well in 200 East, WMP-21109 (FH 2004a)*, with additional details provided below.

All wastes generated from drilling and sampling operations were handled and managed in accordance with the appropriate DQO summary report, WMP-21109 (FH 2004a).

### **3.1 VADOSE ZONE CUTTINGS**

Vadose zone cuttings were handled as described in the following section.

#### **3.1.1. IDF Groundwater Monitoring Well Network**

Vadose zone cuttings from the new IDF groundwater monitoring wells (C4647 and C4648) did not designate as a dangerous waste, were below the *Model Toxics Control Act, Method B (WAC 173-340)* soil cleanup standards, and when released from a radiological perspective were placed on the ground near the point of generation on plastic sheeting until released back into the ground based on field surveys. Drill cuttings were surveyed in accordance with *Hanford Site Solid Waste Acceptance Criteria (HNF-EP-0063)*.

### **3.2 SATURATED ZONE CUTTINGS**

Saturated zone cuttings were handled as described in the following section.

#### **3.2.1 IDF Groundwater Monitoring Well Network**

All drill cuttings below the highest recorded water table were containerized in 55-gallon drums lined with a 10-mil plastic liner. Drums were stored on site for final disposition. As of the final walkdown, the drums were still stored on site.

### **3.3 PURGEWATER**

Purgewater was collected and contained at the well sites until transported to the Purgewater Storage and Treatment Facility or the Effluent Treatment Facility. Purgewater, groundwater samples, and decontamination fluids generated during well drilling and sample screening were managed as purgewater in accordance with CP-GPP-EE-02-10.2, "Purge Water Handling", and 90-ERB-040, *Strategy for Handling and Disposing of Purgewater at the Hanford Site*, Washington (Izatt 1990).

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#### **4.0 GEOPHYSICAL SURVEYS**

Borehole geophysical surveys were carried out in well 299-E24-24 (C4647) on May 12, 2005 and well 299-E17-26 (C4648) on June 2, 2005 and June 6, 2005. A Spectral Gamma Logging System (SGLS) survey was carried out by S.M. Stoller Corporation from ground surface to TD for both C4647 and C4648.

A separate report will provide details of these geophysical surveys.

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## 5.0 CIVIL SURVEY

A civil survey was performed on July 13, 2005 by a professional land surveyor registered in the State of Washington. The civil survey data are presented in Table 4-1 and will be entered into the Hanford Well Information System (HWIS) database.

**Table 5-1 Civil Survey Summary.**

Well Name	Well ID	Easting	Northing	Elevation (feet)
299-E24-24	C4647	574179.77	135459.30	221.223 Pump baseplate 221.217 Top of casing 220.483 Brass survey marker
299-E17-26	C4648	574662.61	135025.06	225.135 Pump baseplate 225.129 Top of casing 224.430 Brass survey marker

**Notes:**

Northing and easting coordinates are based on Washington State Plane Coordinates North American Datum of 1983 (NAD83[91]) rounded to 1 m.

North American Vertical Datum of 1988 (NAVD88) values rounded to 0.001 m.

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## 6.0 WELL ACCEPTANCE

The IDF groundwater monitoring wells were transferred from Layne Christensen and accepted by FH. The site acceptance walkdowns for wells C4647 and C4648 were performed on May 27, 2005 and June 29, 2005, respectively, and included representatives from Layne Christensen and FH, including FH representatives from Geosciences, Environmental Compliance and Quality Assurance (QA).

QA Surveillance was performed during the drilling and construction phase and during the final acceptance walkdowns. Aspects of well drilling such as waste handling, drill rig decontamination, driller qualification, selection of well construction materials, surface protection features, sampling pumps, well identification and site clean-up were observed. The surveillance was deemed satisfactory.

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## **7.0 SUBSURFACE DESCRIPTION**

This section provides the generalized stratigraphy at the IDF, as well as summaries of field observations.

### **7.1 IDF GEOLOGY/HYDROGEOLOGY**

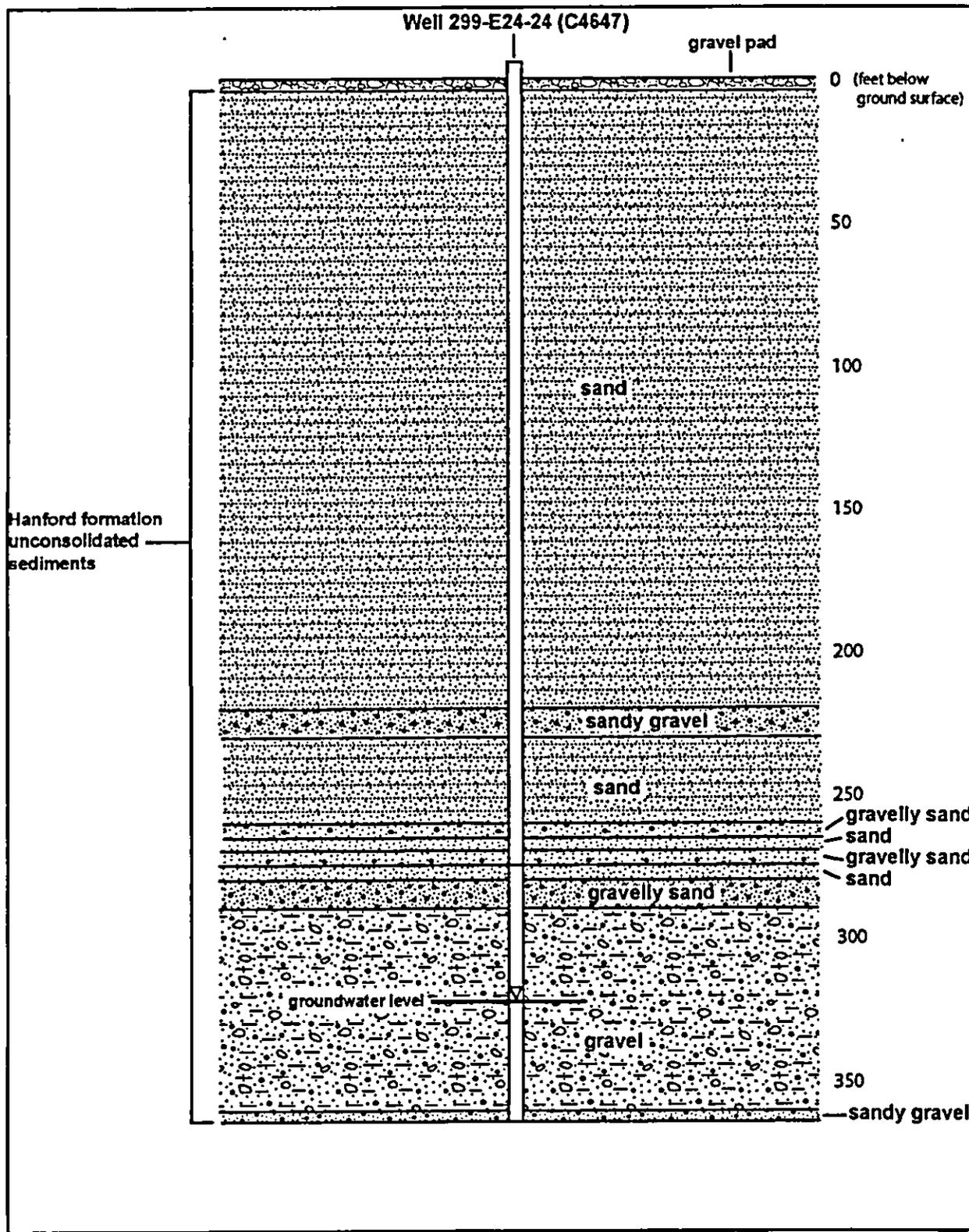
Generalized stratigraphy in the area of the IDF consists of sand-dominated facies of the Pleistocene Hanford Formation, together with gravelly sand or silt/clay interbeds to an approximate depth of 285 feet bgs followed by the gravel dominated facies to total depth. Unit E of the late Miocene to Pliocene Ringold Formation, which consists of moderately to well-cemented sandy gravels, lies beneath the Hanford formation but was not encountered during the drilling operations.

#### **7.1.1. Well 299-E24-24 (C4647)**

At this well, the sand dominated facies of the Hanford Formation was encountered from 5 ft. bgs to 290 feet bgs followed by the gravel dominated facies from 290 feet bgs to TD.

The interval from ground surface to 2 feet bgs consists of a crushed rock drill pad. From 2 to 5 feet bgs, a layer of intermixed very fine aeolian sand and crushed gravel from the gravel pad overlies a thin layer of very fine sand from 5 to 10 feet bgs. Medium to coarse sand with very sparse pebbles comprise the interval from 10 to 220 feet bgs. The interval from 220 to 230 feet bgs consists of sandy gravel, followed by medium to coarse sand from 230 to 260 feet bgs. A thin layer of gravelly sand forms the interval from 260 to 265 feet bgs with another layer of coarse sand from 265 to 270 feet bgs. The interval from 270 to 275 feet bgs consists of gravelly sand, and then a layer of medium to coarse sand follows from 275 to 280 feet bgs. Gravelly sand comprises the interval from 280 to 290 feet bgs. The interval from 290 to 360 consists of coarse to very coarse gravel. In this interval, the moisture content increased as depth increased. Sandy gravel forms the interval from 360 to 364 feet bgs (TD).

Figure 7-1 Subsurface Geology at Well 299-E24-24 (C4647).

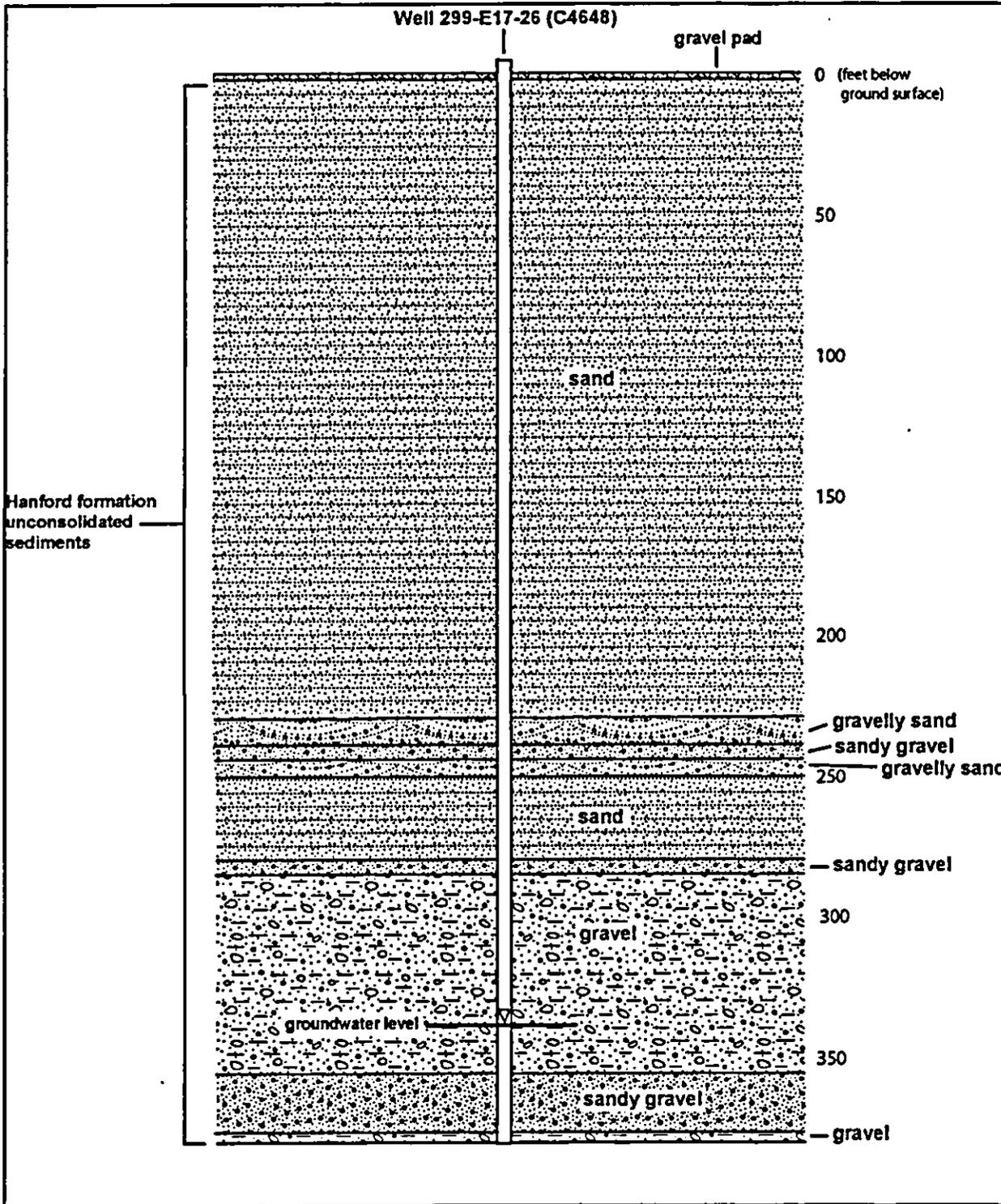


**7.1.2. Well 299 E24-24 (C4647)**

At this well, the sand dominated facies of the Hanford Formation was encountered from 5 ft. bgs to 280 feet bgs followed by the gravel dominated facies from 280 feet bgs to TD.

The interval from ground surface to 2 feet bgs consists of a crushed rock drill pad. From 2 to 5 feet bgs, a layer of intermixed very fine aeolian sand and crushed gravel from the gravel pad overlies a layer of very fine aeolian sand from 5 to 10 feet bgs. Moist, very fine aeolian sand is found from 10 to 15 feet bgs. The interval from 15 to 25 feet bgs consists of very fine to medium grained sand followed by medium to coarse grained sand from 25 to 50 feet bgs. A thin layer of medium to very coarse sand is found from 50 to 55 feet bgs. The interval from 55 to 70 feet bgs consists of coarse to very coarse sand overlying a layer of coarse sand with sparse pebbles from 70 to 75 feet bgs. Very fine to very coarse sand is found in the interval from 75 to 230 feet bgs. The interval from 230 to 235 feet bgs consists of sandy gravel followed by gravelly sand from 235 to 240 feet bgs. Sandy gravel is seen in the interval from 240 to 245 feet bgs, and gravelly sand from 245 to 250 feet bgs. The interval from 250 to 265 consists of coarse sand. From 265 to 280 feet bgs, there is a medium to coarse grained sand. Sandy gravel is seen in the interval from 280 to 285 feet bgs, overlying medium to very coarse gravel from 285 to 355 feet bgs. The interval from 355 to 375 consists of sandy gravel overlying coarse gravel from 375 to 379 feet bgs (TD).

Figure 7-2 Subsurface Geology at Well 299-E17-26 (C4648).



## 8.0 REFERENCES

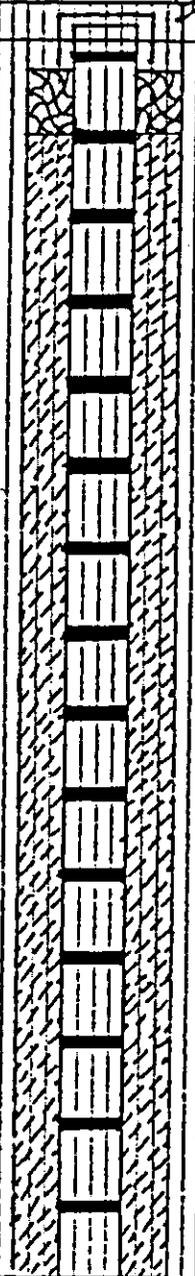
- CP-GPP-EE-01-6.3, Rev. 0, "*Well Development and Testing*," Fluor Hanford, Inc., Richland, Washington.
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- HNF-EP-0063, 2004, *Hanford Site Solid Waste Acceptance Criteria*, Rev. 10, Fluor Hanford, Inc., Richland, Washington.
- Izatt, R. D., 1990, Strategy for Handling and Disposing of Purgewater at the Hanford Site, Washington, letter 90-ERB-040, to P. T. Day, U.S. Environmental Protection Agency, and T. L. Nord, Washington State Department of Ecology, dated July 19, 1990, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Resource Conservation and Recovery Act of 1976, 42 U.S.C. s/s 321 et seq.
- Resource Conservation and Recovery Act of 1976*, 42 U.S.C. 6901, et seq.
- WAC 173-340, "Model Toxics Control Act – Cleanup" *Washington Administrative Code*, as amended.

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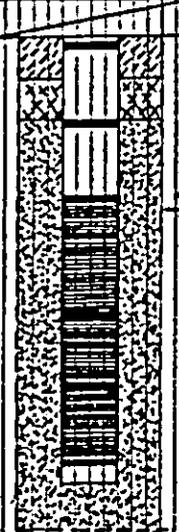
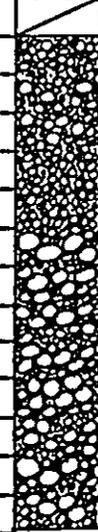
Appendix A: Well Summary Sheets

Well 299-E24-24 (C4647) – 3 pages

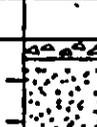
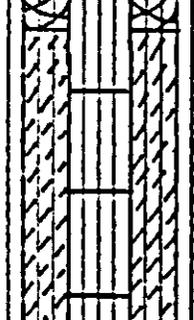
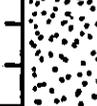
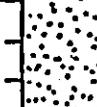
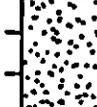
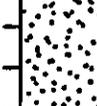
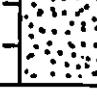
Well 299-E17-26 (C4648) – 4 pages

WELL SUMMARY SHEET		Start Date: 5-9-05	Page 1 of 3	
		Finish Date: 5-26-05		
Well ID: 24647		Well Name: 299-E24-24		
Location: 200 East, SW of Annex		Project: IDF Monitoring Wells		
Prepared By: N. Gwales	Date: 6/2/05	Reviewed By: L.D. Walker	Date: 6/7/05	
Signature: <i>[Signature]</i>		Signature: <i>[Signature]</i>		
CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram	Depth in Feet	Graphic Log / Lithologic Description	
Protective 6" S.S. Casing: + 3.00' → 2.00'		0	0' → 2': crushed rock drill pad.	
Concrete Aggregate: 0' → 3.0'			2' → 5': Sand (S) w/ crushed rock.	
Portland Cement Grout: 3.0' → 11.3'			5' → 220': Sand (S).	
Temporary Drill Casing: 9" x 6" Dual Wall, 0' → 364.1'				
Permanent Well Casing: 4" Sch. 5s, 304L, S.S. + 2.00' → 321.36'				
#0 Annular Bentonites: 11.3' → 305.5'				
			25	
			50	
			75	
			100	
		125		
All temporary drill casing removed from the ground.				

WELL SUMMARY SHEET		Start Date: 3-9-05	Page 2 of 3
		Finish Date: 5-26-05	
Well ID: C4647		Well Name: 299-E24-24	
Location: 260 East, SW of Purser		Project: IDF Monitoring Wells	
Prepared By: N. Boyles	Date: 6/2/05	Reviewed By: L.O. Walker	Date: 6/7/05
Signature: <i>N. Boyles</i>		Signature: <i>L.O. Walker</i>	
CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram	Depth in Feet	Graphic Log Lithologic Description
		150	
		175	
		200	
		225	220' → 230': Sandy Gravel (SG)
		250	230' → 250': Sand (S)
		275	250' → 260': Sand (S)
		300	260' → 265': gravelly Sand (GS)
		325	265' → 270': Sand (S)
		350	270' → 275': gravelly Sand (GS)
		375	275' → 280': Sand (S)
		400	280' → 290': gravelly Sand (GS)
		425	290' → 360': Gravel (G)

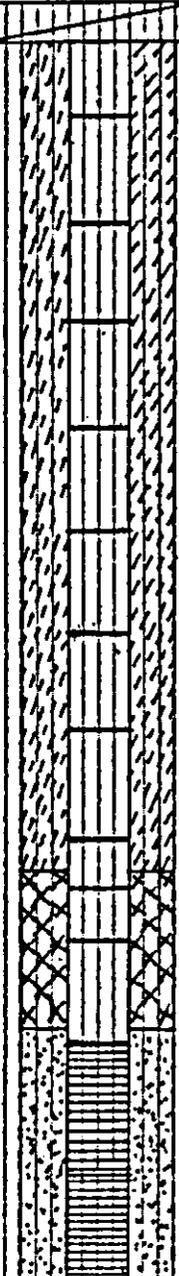
WELL SUMMARY SHEET		Start Date: 5-9-05	Page 3 of 3	
Well ID: C4247		Well Name: 249-E24-24		
Location: 200 East, SW of Purex		Project: IDF Monitoring Wells		
Prepared By: W. Bowles	Date: 6/7/05	Reviewed By: L.D. Walker	Date: 6/7/05	
Signature: <i>[Signature]</i>		Signature: <i>[Signature]</i>		
CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA		
Description	Diagram	Depth in Feet	Lithologic Description	
1/4" Bentonite Pellets: 305.5' → 310.9'		300		
Colorado Silica Sand, 10/20 mesh: 310.9' → 364.0'		325		W.L. = 322.70' bgs (5-27-05)
Wellscreen: 4", 304L, S.S., Cont. wire wrapped, 2x20" slot, 321.36' → 356.36'		350		360' → 364': Sandy Gravel (S.G.)
Tailpipe/Sump: 4", Sch. 5, 304L, S.S., w/ welded endcap, 356.36' → 358.36'		375		TD = 364'
Total Length of S.S. well = 360.36'				
<p><u>Note:</u> Ground Surface is referring to original drill pad elevation, not 4'x4' well pad.</p>				

A-6003-643 (03/03)

WELL SUMMARY SHEET		Start Date: 5-23-05		Page 1 of 4	
Well ID: 24648		Well Name: 29-E17-26			
Location: 200 East, SW of Purex		Project: IPF Monitoring Wells			
Prepared By: Michael E. Carm		Date: 6-7-05		Reviewed By: L.D. Walker	
Signature: 		Signature: 			
CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA			
Description	Diagram	Depth In Feet	Graphic Log	Lithologic Description	
Portland Cement Grout: 0 - 11.19'		0		0 - 2': crushed rock drill pad	
Granular Bentonite: 11.19' - 322.10'		20			
Bentonite Pellets: 322.10' - 327.09'		40		2 - 230': Hanford fm. sand	
10-20 Colorado Silica Sand: 327.09' - 379.00'		60			
		80			
		100			
		120			
		140			
		160			
		180			

WELL SUMMARY SHEET		Start Date: 5-23-05		Page 2 of 4	
Well ID: C 4648		Well Name: 299-517-26		Finish Date: (6-29-05)	
Location: 200 E - SW of PUREX		Project: IDF Monitoring Well			
Prepared By: Michael E. Caven		Date: 6-7-05		Reviewed By: L.D. Walker	
Signature: <i>[Signature]</i>		Date: 6/30/05			
Signature: <i>[Signature]</i>		Signature: <i>[Signature]</i>			
CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA			
Description	Diagram	Depth in Feet	Graphic Log	Lithologic Description	
4" ID 304L stainless steel well casing: 2.25' above ground surface to 338.05'		120			
4" ID 10-20 slot 304 stainless steel well casing: 338.05' - 373.010'		140			
4" ID 304 L stainless steel well OF SUMP: 373.010 - 375.010'		160			
All depths are in feet below ground surface		180		2-230': Hanford fm. sand	
All temporary casing was removed from ground		200			
		220		230-240': Hanford fm. gravelly sand	

A-6003-643 (03/03)

WELL SUMMARY SHEET		Start Date: 5-23-05		Page 3 of 4		
Finish Date: 6-29-05						
Well ID: C4648		Well Name: 29A-E7-26				
Location: 200 E - SW of PUREX		Project: JDF Monitoring Well				
Prepared By: Michael E. Cavn	Date: 6-7-05	Reviewed By: L.D. Walker	Date: 6/30/05			
Signature: 		Signature: 				
CONSTRUCTION DATA		GEOLOGIC/HYDROLOGIC DATA				
Description	Diagram	Depth In Feet	Graphic Log	Lithologic Description		
		240		240-245': Hanford fm. sandy gravel		
				245-250': Hanford fm. gravelly sand		
				260	250-280': Hanford fm. sand	
				280	280-285': Hanford fm. sandy gravel	
				300	285-325': Hanford fm. gravel	
				320	..	
				340	325-355': Ringold 'E' gravel	
					355-375': Ringold 'E' sandy gravel	
Water level = 330.7' bgs (6-6-05)						

A-6003-643 (3/03)



**Appendix B: Borehole Logs Sheets**

**Well 299-E24-24 (C4647) – 5 pages**

**Well 299-E17-26 (C4648) – 5 pages**

BOREHOLE LOG					Page 1 of 5
Well ID: 24647			Well Name: 299-F24-24		Location: 200 East, SW of Purex
Project: IDP monitoring wells			Reference Measuring Point: Ground Surface		
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments
	Type No.	Blows Recovery			
0				0' to 2': Crushed rock & fill pad	Diesel hammer 9" x 6" dual wall casing.
2	Grab Archive			2' to 5': some crushed rock, mostly (45%) very fine wind-blown sands (9)	5' Grab Sample for archive.
5	Grab Archive			5' to 10': very fine sand (9)	10' Grab Sample for archive.
10	Grab Archive			10' to 15': medium to coarse sand (9) some angular pebble fragments, (25%)	15' Grab Sample for archive.
15	Grab Archive			15' to 20': medium sand (9) sparse pebbles (to 1/2") (25%)	20' Grab Sample for archive.
20	Grab Archive			20' to 25': medium sand (9)	25' Grab Sample for archive.
25	Grab Archive			25' to 30': medium to coarse sand (9)	30' Grab sample for archive.
30	Grab Archive			30' to 35': medium to coarse sand (9)	35' Grab sample for archive.
35	Grab Archive			35' to 40': coarse sand (9)	40' Grab sample for archive.
40	Grab Archive			40' to 45': coarse sand (9) w/ some small pebbles (to 1/4") (25%)	45' Grab/Archive.
45	Grab Archive			45' to 50': medium to coarse sand (9) well sorted, some (25%) medium.	50' Grab/Archive.
50	Grab Archive			50' to 55': coarse sand (9) w/ some sparse pebbles (to 1/2") (25%)	55' Grab/Archive.
55	Grab Archive			55' to 60': Medium to coarse sand (9) w/ some sparse pebbles (to 1/2") (25%)	60' Grab/Archive.
60	Grab Archive			60' to 65': Medium sand (9)	65' Grab/Archive.
65	Grab Archive			65' to 70': medium to coarse sand (9) mixed, well sorted.	70' Grab/Archive.
70	Grab Archive			70' to 75': Medium to coarse sand (9) mixed, poorly sorted.	75' Grab/Archive.

Reported By: N. Smiles	Reviewed By: L.D. Walker
Title: Geologist	Title: Geologist
Signature: [Signature]	Signature: [Signature]
Date: 5/9/05	Date: 6/6/05

BOREHOLE LOG

Well ID: ZMVF		Well Name: 249-E-21-24		Location: 200 East, SW of Purer			
Project: IDF Monitoring Wells				Reference Measuring Point: Ground Surface			
Depth (Ft.)	Sample Type No.	Blows Recovery	Graphic Log	Group Name, Grain Size Distribution, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl	Sample Description	Depth of Casing, Drilling Method, Method of Drying, Sampling Tool, Sampler Size, Water Level	Comments
80	44B		[Stippled pattern]	75' to 80': Medium to coarse Sand (S). Grate removed w/ some vesicle.	95' to 100' coarse Sand (S)	9" x 6" dual well ↓	Diavel Hammer casing.
	44C		[Stippled pattern]	80' to 85': Medium to coarse Sand (S) w/ some small pebble fragments (to 1/2") (45%)	95' to 100' coarse Sand (S)		80' grab/Archive.
	44D		[Stippled pattern]	85' to 90': Medium to coarse Sand (S).	95' to 100' coarse Sand (S)		85' grab/Archive.
	44E		[Stippled pattern]	90' to 95': Medium to coarse Sand (S). well sorted.	95' to 100' coarse Sand (S)		90' grab/Archive.
	44F		[Stippled pattern]	95' to 100': Medium to coarse Sand (S) w/ some pebbles (to 1/2") (45%)	95' to 100' coarse Sand (S)		100' coarse/Archive.
	44G		[Stippled pattern]	100' to 105': Medium Sand (S)	95' to 100' coarse Sand (S)		105' grab/Archive.
	44H		[Stippled pattern]	105' to 110': Medium Sand (S) w/ some coarse (45%)	95' to 100' coarse Sand (S)		110' grab/Archive.
	44I		[Stippled pattern]	110' to 115': Medium Sand (S).	95' to 100' coarse Sand (S)		115' grab/Archive.
	44J		[Stippled pattern]	115' to 120': Medium to coarse Sand (S) w/ small sartz.	95' to 100' coarse Sand (S)		120' grab/Archive.
	44K		[Stippled pattern]	120' to 125': Medium Sand (S). w/ some coarse (45%)	95' to 100' coarse Sand (S)		125' grab/Archive.
	44L		[Stippled pattern]	125' to 130': Medium Sand (S).	95' to 100' coarse Sand (S)		130' grab/Archive.
	44M		[Stippled pattern]	130' to 135': Medium Sand (S) w/ some coarse (45%).	95' to 100' coarse Sand (S)		135' grab/Archive.
	44N		[Stippled pattern]	135' to 140': Medium Sand (S)	95' to 100' coarse Sand (S)		140' grab/Archive.
	44O		[Stippled pattern]	140' to 145': Medium Sand (S). w/ some coarse.	95' to 100' coarse Sand (S)		145' grab/Archive.
	44P		[Stippled pattern]	145' to 150': Medium Sand (S)	95' to 100' coarse Sand (S)		150' grab/Archive.
	44Q		[Stippled pattern]	150' to 155': Medium Sand (S).	95' to 100' coarse Sand (S)		155' grab/Archive.

Reported By: J. Bosters  
 Title: Geologist  
 Signature: [Signature]

Reviewed By: L.D. Walker  
 Title: Geologist  
 Signature: [Signature]

Date: 5/9/05  
 Date: 6/6/05

BOREHOLE LOG					Page 3 of 5
Well ID: <u>CH47</u>		Well Name: <u>299-E24-24</u>		Location: <u>200 East, SW of Purex</u>	
Project: <u>TPF Monitoring Wells</u>				Reference Measuring Point: <u>Ground Surface</u>	
Depth (Fl.)	Sample		Graphic Log	Sample Description	Comments
	Type No.	Blows Recovery			
160	Grab Archive			155' to 160': Medium Sand (S)	Diesel Hammer, 9" x 6" dual well casing.
	Grab Archive			160' to 165': Medium Sand (S) w/ some fines.	160' Grab/Archive. 165' Grab/Archive.
170	Grab Archive			165' to 170': Medium Sand (S) w/ ~10% coarse sand.	170' Grab/Archive.
	Grab Archive			170' to 175': Medium Sand (S) w/ ~10% coarse sand.	175' Grab/Archive.
180	Grab Archive			175' to 180': Medium Sand (S) w/ ~10% coarse sand.	180' Grab/Archive.
	Grab Archive			180' to 185': Medium Sand (S) w/ 25% coarse	185' Grab/Archive.
190	Grab Archive			185' to 190': Medium Sand (S) w/ 25% coarse	190' Grab/Archive.
	Grab Archive			190' to 195': medium to coarse Sand (S) Increasing to coarse (~50%).	195' Grab/Archive.
200	Grab Archive			195' to 200': medium to coarse Sand (S) 25% coarse.	200' Grab/Archive.
	Grab Archive			200 to 205': <sup>(P)</sup> medium-medium Sand (S) w/ ~20% coarse.	205' Grab/Archive.
210	Grab Archive			205' to 210': Medium Sand (S) ~20% coarse.	210' Grab/Archive.
	Grab Archive			210' to 215': Coarse Sand (S) w/ ~10% medium & sparse pebbles (~5% to 1/4").	215' Grab/Archive.
220	Grab Archive			215' to 220': Medium to coarse Sand (S)	220' Grab/Archive.
	Grab Archive			220' to 225': sandy gravel (SG) ~40% med. to coarse sand w/ ~10% gravel/pebbles to ~1/4".	225' Grab/Archive.
230	Grab Archive			225' to 230': sandy gravel (SG) ~40% coarse sand w/ pebbles to ~1/4".	230' Grab/Archive.
	Grab Archive			230' to 235': coarse Sand (S) w/ sparse pebbles (~5% to 1/4").	235' Grab/Archive.

Reported By: <u>N. Bowles</u>	Reviewed By: <u>L.D. Walker</u>
Title: <u>Geologist</u>	Title: <u>Geologist</u>
Signature: <u>[Signature]</u>	Signature: <u>[Signature]</u>
Date: <u>5/9/05</u>	Date: <u>6/6/05</u>

BOREHOLE LOG					Page 4 of 5
				Date: 5/16/05 - Start 5/16/05 - Finish	
Well ID: C4647		Well Name: 299-E24-24		Location: 200 East, SW of Pucex	
Project: IDF Monitoring Wells			Reference Measuring Point: Ground Surface		
Depth (Ft)	Sample		Graphic Log	Sample Description	Comments
	Type No.	Blows Recovery			
240	Grab			235' to 240': Medium Sand (G) w/ ~100% coarse sand	Diesel Hammer. 9" x 6" dual wall casing.
	Grab			240' to 245': medium to coarse Sand (S) ~40% med. / ~60% coarse	240' Grab/Archive. 245' Grab/Archive.
250	Grab			245' to 250': Medium Sand (S) w/ ~10% coarse sand.	250' Grab/Archive.
	Grab			250' to 255': Medium to coarse Sand (S) w/ sparse pebbles (to 1/8")	255' Grab/Archive.
260	Grab			255' to 260': Medium to coarse Sand (S) Coarse Sand (S) w/ sparse pebbles (to 1/2")	260' Grab/Archive.
	Grab			260' to 265': gravelly sand (GS) ~90% of coarse sand w/ sparse med. to coarse pebbles (to ~1")	265' Grab/Archive.
270	Grab			265' to 270': Coarse Sand (S) w/ sparse pebbles (to 1/2"), 15% to	270' Grab/Archive.
	Grab			270' to 275': gravelly sand (GS) ~70% med. to coarse sand w/ ~3% coarse to very coarse pebbles	275' Grab/Archive.
280	Grab			275' to 280': med. to coarse sand (S) w/ sparse coarse pebbles (to 1")	280' Grab/Archive.
	Grab			280' to 285': gravelly sand (GS) w/ ~20% to 30% coarse/very coarse pebbles & ~5% small cobbles.	285' Grab/Archive.
290	Grab			285' to 290': gravelly Sand (GS) ~80% med. to coarse sand w/ coarse to very coarse pebbles & sparse silt/clay	290' Grab/Archive.
	Grab			290' to 295': coarse gravel (G) ~40% med. to coarse pebbles	295' Grab/Archive.
300	Grab			295' to 300': coarse gravel (G) Med. to very coarse pebbles.	300' Grab/Archive.
	Grab			300' to 305': coarse gravel (G) ~95% med. to very coarse pebbles	305' Grab/Archive.
310	Grab			w/ ~5% med/coarse sands, slightly cemented.	
	Grab			305' to 310': coarse gravel (G) Med. to very coarse pebbles w/ coarse silt cobbles.	310' Grab/Archive.
	Grab			310' to 315': coarse gravel (G) med. to coarse pebbles w/ sparse silt cobbles, showing more moisture.	315' Grab/Archive.

Reported By: N. Baskin		Reviewed By: L.D. Walker	
Title: Geologist		Title: Geologist	
Signature:	Date: 5/16/05	Signature:	Date: 6/6/05

BOREHOLE LOG					Page 5 of 5
Well ID: 24647					Date: 5/11/05 - Start
Well Name: 299-E24-24					Date: 5/11/05 - Finish
Project: IDF Monitoring Wells			Location: 200 East, SW of Pavex		
Reference Measuring Point: Ground Surface					
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments
	Type No.	Blows Recovery			
320	Grab Archive			315' to 320': coarse gravel (G) med. to v. lg. pebbles. Surface moisture	Piegel hammer. 9" x 6" dual wall casing.
	Grab Archive			320' to 325': coarse gravel (G). ~95% fine to v. coarse pebbles, most ~5% med. to v. coarse sand.	320' Grab/Archive 325' Grab/Archive.
330	Grab Archive	100%		325' to 330': v. coarse gravels (G) ~50% small to lg. cobbles (to ~6") ~50% med. to v. coarse pebbles (to ~4")	330' Grab/Archive 329.5' to 331.1' bgs ↳ Split-spoon sample for sieve-tray analysis.
	Grab Archive			330' to 335': v. coarse gravels (G) Similar to above (to ~4").	335' Grab/Archive
340	Grab Archive			335' to 340': v. coarse gravel (G) ~30% small to large cobbles (to ~4") ~70% med. to v. coarse pebbles.	340' Grab/Archive
	Grab Archive			340' to 345': v. coarse gravel (G) w/ some coarse sands (~5%) up to 4".	345' Grab/Archive.
350	Grab Archive			345' to 350': v. coarse gravel (G) to ~4". w/ some coarse sands (~5%).	350' Grab/Archive.
	Grab Archive	100%		350' to 355': v. coarse gravel (G) to ~3" w/ some coarse sands (~5 to 10%)	355' Grab/Archive. 351.52' to 356.22' bgs ↳ Split-spoon sample for sieve-tray analysis.
360	Grab Archive			355' to 360': v. coarse gravel (G) to ~6" ~80% med. to v. coarse pebbles w/ ~5% coarse sands & sparse large cobbles.	360' Grab/Archive.
	Grab Archive			360' to 364': sandy gravel (SG) ~60% med. to v. coarse pebbles ~35 to 40% v. coarse sand w/ sparse small cobbles (to ~4").	365' Grab/Archive.
			T.D. = 364.01' bgs		
				W.H. = 322.74' bgs (5/11/05)	

Reported By: N. Bowles      Reviewed By: L.D. Walter  
 Title: Geologist      Title: Geologist  
 Signature: [Signature]      Date: 5/11/05      Signature: [Signature]      Date: 6/6/05

BOREHOLE LOG					Page <u>1</u> of <u>5</u>
Well ID: <u>44648</u>		Well Name: <u>299-E17-26</u>		Location: <u>200 East, SW of Punex.</u>	
Project: <u>IDF Monitoring Wells</u>				Reference Measuring Point: <u>Ground Surface</u>	
Depth (Fl.)	Sample		Graphic Log	Sample Description	Comments
	Type No.	Blows Recovery			
0				0' to 2': Coupled rock drill rod.	Diesel Hammer 9" x 6" dual wall casing.
2	Grab Archive			2' to 5': v. fine sand (s) w/ some sparse crushed rock.	5' Grab Sample for Archive.
5	Grab Archive			5' to 10': v. fine sand (s), with brown (dune) sand.	10' Grab/Archive.
10	Grab Archive			10' to 15': v. fine sand (s) same as previous, moist	15' Grab/Archive.
15	Grab Archive			15' to 20': v. fine to med. sand (s) ~ 20% med. grain, moisture	20' Grab/Archive.
20	Grab Archive			20' to 25': fine to med sand (s) ~ 40% med., moisture.	25' Grab/Archive.
25	Grab Archive			25' to 30': med. to coarse sand (s) ~ 40% coarse, some slight med.	30' Grab/Archive.
30	Grab Archive			30' to 35': med. to coarse sand (s) w/ some sparse v. coarse sand losing moisture.	35' Grab/Archive.
35	Grab Archive			35' to 40': med. to coarse sand (s) w/ some sparse v. coarse sand. No moisture	40' Grab/Archive.
40	Grab Archive			40' to 45': med. to coarse sand (s) ~ 75% coarse	45' Grab/Archive.
45	Grab Archive			45' to 50': med. to coarse sand (s) 75% coarse.	50' Grab/Archive.
50	Grab Archive			50' to 55': med. to v. coarse sand (s) w/ some v. sparse clay balls ?? (could be from pipe ramming)	55' Grab/Archive.
55	Grab Archive			55' to 60': coarse to v. coarse sand (s)	60' Grab/Archive.
60	Grab Archive			60' to 65': coarse to v. coarse sand (s) w/ some sparse pebbles (to 1/4")	65' Grab/Archive.
65	Grab Archive			65' to 70': coarse to v. coarse sand (s) well sorted, no pebbles.	70' Grab/Archive.
70	Grab Archive			70' to 75': coarse sand (s) w/ v. sparse pebbles (to 1/4")	75' Grab/Archive.
Reported By: <u>N. Bowles</u>				Reviewed By: <u>L.D. Walker</u>	
Title: <u>Geologist</u>				Title: <u>Geologist</u>	
Signature: <u>[Signature]</u>		Date: <u>5/23/05</u>		Signature: <u>[Signature]</u> Date: <u>6/30/05</u>	

BOREHOLE LOG					Page 2 of 5
Well ID: <u>C4148</u>		Well Name: <u>299-E17-26</u>		Location: <u>200 East, SW of Purser</u>	
Project: <u>IDF Monitoring Wells</u>			Reference Measuring Point: <u>Ground Surface</u>		
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments
	Type No.	Blows Recovery			
80	Grab Arch.			75' to 80': med. to cse sand (S)	80' Grab/Arch. Diesel Pump 9"x6" D.W. ↓
	Grab Arch.			w/ some v. sparse clay ? or silts	80' Grab/Arch. se.
	Grab Arch.			80' to 85': fine to med. sand (S)	85' Grab/Arch. se.
	Grab Arch.			w/ some (25%) coarse & (25%) fine	
90	Grab Arch.			85' to 90': fine to med. sand (S)	90' Grab/Arch.
	Grab Arch.			w/ some (45%) coarse & v. sparse small pebbles (to 1/4")	95' Grab/Arch.
	Grab Arch.			90' to 95': med. to v. cse sand (S)	
100	Grab Arch.			95' to 100': cse sand (S)	100' Grab/Arch.
	Grab Arch.			w/ 5% med. & 5% v. cse.	
	Grab Arch.			100' to 105': med. to v. cse sand (S)	105' Grab/Arch.
110	Grab Arch.			105' to 110': med. to cse sand (S)	110' Grab/Arch.
	Grab Arch.			w/ a 5% v. coarse	
	Grab Arch.			110' to 115': med. to cse sand (S)	115' Grab/Arch.
	Grab Arch.			w/ a 10% fines	
120	Grab Arch.			115' to 120': fine to med. sand (S)	120' Grab/Arch.
	Grab Arch.			some light moisture.	
	Grab Arch.		120' to 125': med. to v. coarse sand (S)	125' Grab/Arch.	
	Grab Arch.		w/ some v. sparse, v. small pebbles (to 1/4" & 1/2")		
130	Grab Arch.		125' to 130': med. to coarse sand (S)	130' Grab/Arch.	
	Grab Arch.		130' to 135': fine to med. sand (S)	135' Grab/Arch.	
	Grab Arch.		w/ some coarse (25%) & some v. fine (25%)		
140	Grab Arch.		135' to 140': fine to cse sand (S)	140' Grab/Arch.	
	Grab Arch.		w/ some (25%) v. cse.		
	Grab Arch.		140' to 145': v. fine to fine (S)	145' Grab/Arch.	
	Grab Arch.		w/ a 10% med.		
150	Grab Arch.		145' to 150': med. to cse sand (S)	150' Grab/Arch.	
	Grab Arch.		w/ 25% v. cse.		
	Grab Arch.		150' to 155': fine to med. sand (S)	155' Grab/Arch.	
	Grab Arch.		w/ some (25%) coarse.		

Reported By: <u>N. Bader</u>	Reviewed By: <u>L.D. Walker</u>
Title: <u>Geologist</u>	Title: <u>Geologist</u>
Signature: <u>[Signature]</u>	Signature: <u>[Signature]</u>
Date: <u>5/23/05</u>	Date: <u>6/30/05</u>

BOREHOLE LOG					Page <u>3</u> of <u>5</u>
Well ID: <u>C4648</u>		Well Name: <u>101-E17-26</u>		Location: <u>200 East, SW of Purax</u>	
Project: <u>IDF Monitoring Wells</u>			Reference Measuring Point: <u>Ground Surface</u>		
Depth (FL)	Sample		Graphic Log	Sample Description	Comments
	Type No.	Blows Recovery			
160	<u>4760</u>			<u>155' to 160': v. fine to med. sand (S)</u>	<u>160' Grab/Arch.</u> <u>Diesel Hov. 1" x 2" pipe</u>
	<u>4760</u>			<u>160' to 165': med. to coarse sand (S)</u> <u>w/ ~10% fines.</u>	<u>165' Grab/Arch.</u>
170	<u>4760</u>			<u>165' to 170': Coarse sand (S) w/</u> <u>~5 to 10% med. &amp; flakes of siltstone</u>	<u>170' Grab/Arch.</u> <u>(v. sparse).</u>
	<u>4760</u>			<u>170' to 175': fine to med sand (S)</u> <u>well sorted</u>	<u>175' Grab/Arch</u>
180	<u>4760</u>			<u>175' to 180': fine to med. sand (S)</u> <u>w/ ~5% coarse.</u>	<u>180' Grab/Arch.</u>
	<u>4760</u>			<u>180' to 185': med. coarse sand (S)</u> <u>~5% fine</u>	<u>185' Grab/Arch.</u>
190	<u>4760</u>			<u>185' to 190': med to coarse sand (S)</u> <u>~5% siltstone.</u>	<u>190' Grab/Arch.</u>
	<u>4760</u>			<u>190' to 195': med. sand (S)</u> <u>w/ v. sparse pebbles (to ~1")</u>	<u>195' Grab/Arch.</u>
200	<u>4760</u>			<u>195' to 200': fine to med. sand (S)</u> <u>w/ v. sparse pebbles (to ~1")</u>	<u>200' Grab/Arch</u>
	<u>4760</u>			<u>200' to 205': coarse to v. coarse sand (S)</u> <u>Increasing in basal</u>	<u>205' Grab/Arch.</u>
210	<u>4760</u>			<u>205' to 210': coarse sand (S)</u> <u>w/ ~5% v. coarse &amp; ~5% med.</u>	<u>210' Grab/Arch.</u>
	<u>4760</u>			<u>210' to 215': med. sand (S)</u> <u>w/ ~5% v. coarse &amp; ~5% med.</u>	<u>215' Grab/Arch.</u>
220	<u>4760</u>			<u>215' to 220': med. sand (S)</u> <u>(Same as above)</u>	<u>220' Grab/Arch.</u>
	<u>4760</u>			<u>220' to 225': coarse sand (S)</u> <u>(Same as above)</u>	<u>225' Grab/Arch.</u>
230	<u>4760</u>			<u>225' to 230': v. coarse sand (S)</u> <u>~10% med. to coarse, ~5%</u>	<u>230' Grab/Arch.</u>
	<u>4760</u>			<u>v. fine pebbles &amp; fine pebbles</u>	<u>235' Grab/Arch</u>
				<u>230' to 235': sandy gravel (G) (to ~1")</u>	

Reported By: U. Bowden Reviewed By: L.D. Walker

Title: Geologist Title: Geologist

Signature: [Signature] Date: 5/23/05 Signature: [Signature] Date: 6/30/05

BOREHOLE LOG					Page 4 of 5
Well ID: C4648		Well Name: 209-E17-26		Location: 20 East, SW of Puvex	
Project: IDF Monitoring Wells			Reference Measuring Point: Ground Surface		
Depth (Ft.)	Sample		Graphic Log	Sample Description	Comments
	Type	Blows Recovery			
240	Grab Arch.			235' to 240': Sandy Gravel (G) (to ~1/4") w/ ~5% v. cse sand (S) w/ ~20% med. (to 1/4")	240' Grab/Arch. Diesel Hammer, 1" x 1" D.W. 6
	Grab Arch.			240' to 245': Sandy Gravel (G) (to ~1/4") ~20% cse to v.cse sand.	245' Grab/Arch.
250	Grab Arch.			245' to 250': gravelly sand (G) w/ ~5% small basalt cobbles (broken).	250' Grab/Arch.
	Grab Arch.			250' to 255': gravelly sand (G) ~90% cse sand w/ ~5% med. (to 1/4")	255' Grab/Arch.
260	Grab Arch.			255' to 260': cse sand (S) w/ ~20% med.	260' Grab/Arch.
	Grab Arch.			260' to 265': cse sand (S) w/ ~20% med. & ~5% v.cse.	265' Grab/Arch.
270	Grab Arch.			265' to 270': med to cse sand (S)	270' Grab/Arch.
	Grab Arch.			270' to 275': med to cse sand (S) Same as above.	275' Grab/Arch.
280	Grab Arch.			275' to 280': med. to cse sand (S) Same as above w/ ~5% fines also.	280' Grab/Arch.
	Grab Arch.			280' to 285': Sandy Gravel (G) ~20% to 30% cse sand	285' Grab/Arch.
290	Grab Arch.			no fine to v. lg pebbles (~90%) & sparse (5%) cobbles to 6"	290' Grab/Arch.
	Grab Arch.			285' to 290': cse gravel (G) ~10% v.cse sand & cobbles to 6"	290' Grab/Arch.
300	Grab Arch.			290' to 295': v.cse gravel (G) lg. cobbles to 6" (~10%) w/ ~80% med to coarse pebbles	295' Grab/Arch.
	Grab Arch.			295' to 300': v.cse gravel (G) Same as above w/ ~5 to 10% sand	300' Grab/Arch.
310	Grab Arch.			300' to 305': cse gravel (G) w/ fract. cobble to 1/4". ~20% med. to coarse pebbles	305' Grab/Arch.
	Grab Arch.		305' to 310': v.cse gravel (G) (to 4") w/ 80% med. to v.cse pebbles ~10% cobbles	310' Grab/Arch.	
	Grab Arch.		310' to 315': v.cse gravel (G) (to 8") w/ 60% med. to cse pebbles & ~20% cobbles.	315' Grab/Arch.	

Reported By: D. Bostles  
 Reviewed By: L.D. Walker  
 Title: Geologist  
 Signature: [Signature] Date: 5/3/05  
 Title: Geologist  
 Signature: [Signature] Date: 6/30/05

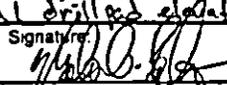
BOREHOLE LOG					Page 5 of 5	
Well ID: <u>C4648</u>		Well Name: <u>299-E17-26</u>		Location: <u>200 East, SW of Purex</u>		
Project: <u>IDF Monitoring Wells</u>			Reference Measuring Point: <u>Ground Surface</u>			
Depth (Fl)	Sample		Graphic Log	Sample Description	Comments	
	Type No.	Blows Recovery				
Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl						
Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level						
320	Grab Arch.			315' to 320': cse. gravel (G) (to ~4")	320' Grab/Arch.	
	Grab Arch.			~2% highly fractured pieces of lg. cobbles		
	Grab Arch.			~75% med. to v. cse. pebbles		
	Grab Arch.			320' to 325': cse. gravel (G) (to ~6")	325' Grab/Arch.	
330	Grab Arch.			Same as above but showing cementation		
	Grab Arch.			325' to 330': cse. gravel (G) (to ~5")	330' Grab/Arch.	
	Grab Arch.			~60 is med. cobbles w/		
	Grab Arch.			sparse lg. cse. pebbles (~5%) surround.		
	Grab Arch.			330' to 335': cse. gravel (G) w/	335' Grab/Arch.	
	Grab Arch.			some (~5% sand) highly cementation		
	Grab Arch.		& showing slight moisture inc. in salts.			
	Grab Arch.		335' to 340': v. cse. gravel (G) w/	340' Grab/Arch.		
	Grab Arch.		highly cemented coatings, damp.	Split-spoon sample: 2		
	Grab Arch.		~10% sm. to lg. basalt cobbles	343.5' to 344.5' big.		
350	Grab Arch.		340' to 345': v. cse. gravel (G) w/	Producing water @ 348' b.s.		
	Grab Arch.		~10 to 20% cse. to v. cse. pebbles to 6"	345' Grab/Arch.		
	Grab Arch.		345' to 350': v. cse. gravel (G) sm.	350' Grab/Arch.		
	Grab Arch.		to above, less fine (~5%)	350'		
	Grab Arch.		350' to 355': v. cse. gravel (G) (to ~6")	355' Grab/Arch.		
	Grab Arch.		inc. sandy (~20% cse. to v. cse.) Basalt inc.			
360	Grab Arch.		355' to 360': sandy gravel (SG)	360' Grab/Arch.		
	Grab Arch.		~30% med. to cse. sand. cobbles (to 6")			
	Grab Arch.		360' to 365': sandy gravel (SG)	365' Grab/Arch.		
	Grab Arch.		inc. sandy (~40%) fine to cse. ~20%			
	Grab Arch.		cobbles (up to 6") rest fine to v. cse. pebbles			
370	Grab Arch.		365' to 370': sandy gravel (SG) (to 6")	370' Grab/Arch.		
	Grab Arch.		same to above, but no fine sand.	Split-spoon sample (A)		
	Grab Arch.		370' to 375': sandy gravel (SG) (to ~4")	369.3' to 370.5' b.s.		
	Grab Arch.		~30% med. to cse. sand, 50% fine	375' Grab/Arch.		
	Grab Arch.		to v. cse. pebbles, sparse sm. cobbles			
380	Grab Arch.		375' to 379': cse. gravel (G) (to ~4")	379' Grab/Arch.		
	Grab Arch.		w/ ~20% med. to cse. sand.			
	Grab Arch.		sparse cobbles to 4" (5%)			
	Grab Arch.		mostly fine to v. cse. pebbles.	TD=379' (~378.85' b.s.)		
390						

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**Appendix C: Well Construction Summary Sheets**

**Well 299-E24-24 (C4647) – 1 page**

**Well 299-E17-26 (C4648) – 1 page**

WELL CONSTRUCTION SUMMARY REPORT				Start Date: 5-9-05			
				Finish Date: 5-26-05			
				Page 1 of 1			
Well ID: <u>24647</u>		Well Name: <u>299-E24-24</u>		Approximate Location: <u>200 East, SW of Puxex</u>			
Project: <u>IDF monitoring wells</u>			Other Companies: <u>FH, GRAM</u>				
Drilling Company: <u>Layne Christensen Co.</u>			Geologist(s): <u>N. Bowles, M. Caron, &amp; Brantland</u>				
Driller: <u>A. Madue &amp; S. Madue</u> License #: <u>WA 2572</u>							
TEMPORARY CASING AND DRILL DEPTH			DRILLING METHOD	HOLE DIAMETER (in.) / INTERVAL (ft)			
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.	Auger:	Diameter _____ From _____ to _____			
<u>9 7/8" Double Wall CS.</u>	<u>0' - 364'</u>	<u>9 1/2" / 5 1/2"</u>	Cable Tool:	Diameter _____ From _____ to _____			
			Air Rotary:	Diameter _____ From _____ to _____			
			A.R. w/Sonic:	Diameter _____ From _____ to _____			
			Diesel Hammer	Diameter <u>9 1/2"</u> From <u>0'</u> to <u>364'</u>			
				Diameter _____ From _____ to _____			
*Indicate Welded (W) - Flush Joint (F-J) Coupled (C) & Thread Design				Diameter _____ From _____ to _____			
			Drilling Fluid: <u>Air</u>				
Total Drilled Depth: <u>364'</u>		Hole Dia @ TD: <u>9 1/2"</u>		Total Amt. Of Water Added During Drilling: <u>-N/A-</u>			
Well Straightness Test Results: <u>Pass (9/12/05 w/ 9" O.D. M.P.L.)</u>			Static Water Level: <u>522.70' bgs</u> Date: <u>5-26-05 5:27:05</u>				
GEOPHYSICAL LOGGING							
Sondes (type)	Interval	Date	Sondes (type)	Interval	Date		
<u>Spectral Gamma</u>	<u>0' - 364'</u>	<u>5/12/05</u>					
COMPLETED WELL							
Size/WL/Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack	Volume	Mesh Size
<u>4" Sch 52, 55304L 4mm</u>	<u>358.5' - 364.36'</u>	<u>F480</u>	<u>-N/A-</u>	<u>Silica Sand Filter Pack</u>	<u>364.0' - 310.9'</u>	<u>55 bags</u>	<u>1/20</u>
<u>4" 55304L 4mm</u>	<u>354.36' - 321.36'</u>	<u>F480</u>	<u>0.020"</u>	<u>Coarse Bentonite Filter</u>	<u>310.9' - 305.5'</u>	<u>3 bags</u>	<u>1/4"</u>
<u>4" Sch. 52, 55304L 4mm</u>	<u>321.36' - 220.0'</u>	<u>F480</u>	<u>-N/A-</u>	<u>Granular Bentonite</u>	<u>305.5' - 11.3'</u>	<u>101 bags</u>	<u>#8</u>
				<u>Portland Cement Grt.</u>	<u>11.3' - 3.0'</u>	<u>7 bags</u>	<u>-N/A-</u>
				<u>Ann. Ring Concrete Annular</u>	<u>3.0' - 0'</u>	<u>7 bags</u>	<u>-N/A-</u>
OTHER ACTIVITIES							
Aquifer Test:		Date:	Well Decommission:		Yes: No: Date:		
Description:			Description:				
WELL SURVEY DATA (if applicable)							
Washington State Plane Coordinates:			Protective Casing Elevation:				
			Brass Survey Marker Elevation:				
COMMENTS / REMARKS							
<p>Perme Pump Information: Annular Seal: 10 Red Plow 340 (10 SAF 340 - NE); set @ 340.02' bgs (incl. annular)</p> <p>Perme. distribution pipe info: 3/4" SS, Sch 40s, TP 304/304H; Tot. Length = 341.97' in 34 pieces.</p> <p>Ground Surface is referring to original drilled elevation, not 4" well pad.</p>							
Reported By:	Title:	Signature:		Date:			
<u>N. Bowles</u>	<u>Geologist</u>			<u>5/26/05 12:05</u>			

WELL CONSTRUCTION SUMMARY REPORT				Start Date: 5-23-05			
				Finish Date: 6-29-09			
				Page 1 of 1			
Well ID: 24648		Well Name: 299-E17-26		Approximate Location: 200 East, SW of Purax			
Project: IDF Monitoring Wells			Other Companies: FH, GRAM				
Drilling Company: Layne Christensen			Geologist(s): N. Bowles, L. Brouillard, M. Caron, R. Henderson				
Driller: A. Macke & S. Macke License #: WA 3375 WA 2645							
TEMPORARY CASING AND DRILL DEPTH			DRILLING METHOD		HOLE DIAMETER (in.) / INTERVAL (ft)		
*Size/Grade/Lbs. Per Ft.	Interval	Shoe O.D./I.D.	Auger:	Diameter _____ From _____ to _____			
9" x 6" Pvc Well C.G.	0' - 379'	9 1/2" / 5 1/2"	Cable Tool:	Diameter _____ From _____ to _____			
			Air Rotary:	Diameter _____ From _____ to _____			
			A.R. w/Sonic:	Diameter _____ From _____ to _____			
			Diavel Hammer:	Diameter 4 1/2" From 0' to 379'			
				Diameter _____ From _____ to _____			
*Indicate Welded (W) - Flush Joint (F) Coupled (C) & Thread Design				Diameter _____ From _____ to _____			
			Drilling Fluid: Air				
Total Drilled Depth: 379'		Hole Dia @ TD: 9 1/2"		Total Amt. Of Water Added During Drilling: -N/A-			
Well Straightness Test Results: passed 6-6-05			Static Water Level: 339.3' bgs Date: 9-31-05				
GEOPHYSICAL LOGGING							
Sondes (type)	Interval	Date	Sondes (type)	Interval	Date		
Spectral Gamma (SGLS)	0' - 379'	6/7/05 & 6/8/05					
COMPLETED WELL							
Size/WL/Material	Depth	Thread	Slot Size	Type	Interval Annular Seal/Filter Pack	Volume	Mesh Size
4" ID 304L SS Screen	373.00' - 375.00'	F480	N/A	Colorado Silica Sand	372.09' - 379.0'	39.5	10-20
4" ID 10-20 slot 304 SS Screen	379.00' - 373.00'	"	0.020" / 10-20	Bentonite Pellets	372.10' - 372.09'	2	3/4"
4" ID 304L S.S. casing	225.00' - 378.00'	"	N/A	Granular Bentonite	11.19' - 374.0'	115	
				Portland Cement	0 - 11.19'	5	
OTHER ACTIVITIES							
Aquifer Test:		Date:	Well Decommission:		Yes: No: Date:		
Description:			Description:				
WELL SURVEY DATA (if applicable)							
Washington State Plane Coordinates:			Protective Casing Elevation:				
			Brass Survey Marker Elevation:				
COMMENTS / REMARKS							
Reported By: N. Bowles / R. Henderson		Title: Geologist		Signature: [Signature] / Robin Henderson			
				Date: 6-27-05			

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**Appendix D: Well Development and Testing Data Sheets**

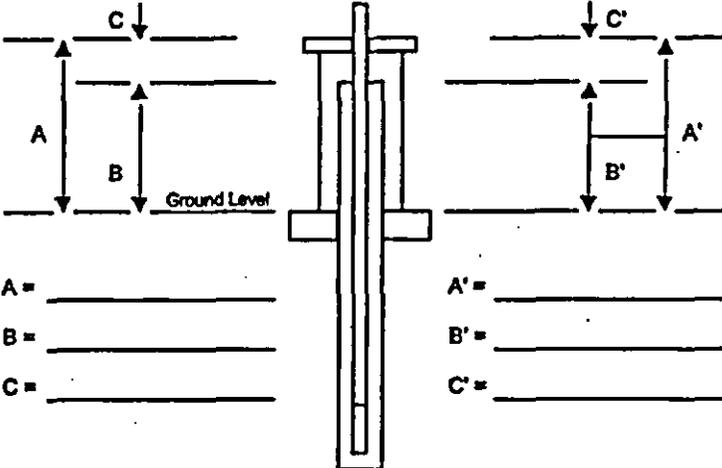
**Well 299-E24-24 (C4647) – 2 pages**

**Well 299-E17-26 (C4648) – 2 pages**

WELL DEVELOPMENT AND TESTING DATA				p. 1 of 2 (2)
Well Name: 249-E24-24		Well ID: C4647	Well Location: 200 East, SW of Punex	Date: 5/25/05
Reference Measuring Point (unless otherwise noted): TOP OF OUTER CASING (TOC) (6")				
Has the well been surveyed? <input type="radio"/> Yes <input checked="" type="radio"/> No		Does the well have a cement pad? <input checked="" type="radio"/> Yes <input type="radio"/> No		
<b>PART 1</b>		<b>PART 4</b>		
<b>STATIC WATER LEVEL:</b>		Last Recorded Measurements Date: -N/A-	Current Measurements Date: 5/25/05	
Start of Job 325.69' btoe (1")/ft (2)				
End of Job 325.60' btoe (1")/ft (2)				
<b>DEPTH TO BOTTOM:</b>				
Start of Job ~361.2' btoe (6")				
End of Job ~360.8' btoe (on 5/26/05)		A = -N/A-	A' = $\frac{60W}{300} 2.43'$	
<b>PART 2</b>		B = -N/A-	B' = 2.00	
<b>WELL DEVELOPMENT DATA</b>				
Pump Model F&W mod #4F27550/SHP				
Intake Depth 353.54' btoe (1")/ft (2)				
Starting Turbidity >1000 NTU				
Pump Start		Stop	Flow Rate	
1120		1153	3.33 gpm	
1156		1208	3.33 gpm	
1255		1338	2.99 gpm	
seep. 2		stop		
Total Pumped 110/40/1285 gallons		Are there any reference marks on the casing strings? <input type="radio"/> Yes <input checked="" type="radio"/> No		
Final Turbidity 0.55 NTU		<b>PART 5</b>		
XD SN/Range (PSI) #270 BT/20 PSI.		<b>COMMENTS:</b>		
<b>PART 3</b>		<p>#1 - Initial 24.143 ft H<sub>2</sub>O = XD First interval w/ pump intake @ 353.54' btoe Drawdown recorded @ test #01, Recovery as test stopped due to inadequate flow rate &amp; drawdown.</p> <p>#2 Try again - flow inadequate =&gt; Stopped</p> <p>#3 3<sup>rd</sup> Try - Initial XD = 24.370 ft H<sub>2</sub>O, Pump @ 353.54' btoe Drawdown recorded @ test #03, Recovery as test stopped Recovery due to check valve/backflow not working right.</p>		
<b>INSTANTANEOUS SLUG TEST</b>				
Static Water Level (TOC)				
Transducer Depth				
Baseline Start				
Injection Start				
Baseline Start				
Withdrawal Start				
Slug Volume				
XD SN/Range (PSI)				
Prepared by (print name): N. Bowles		Signature: 	Date: 5/25/05	
Reviewed by (print name): L.D. Walker		Signature: 	Date: 6-7-05	



WELL DEVELOPMENT AND TESTING DATA				P 1 of 2																					
Well Name: 299-E17-26	Well ID: C4648	Well Location: 200E SW of Pwex	Date: 6-27-05																						
Reference Measuring Point (unless otherwise noted): TOP OF OUTER CASING (TOC)																									
Has the well been surveyed? <input type="radio"/> Yes <input checked="" type="radio"/> No		Does the well have a cement pad? <input checked="" type="radio"/> Yes <input type="radio"/> No																							
<b>PART 1</b>		<b>PART 4</b>																							
<b>STATIC WATER LEVEL:</b>		<div style="display: flex; justify-content: space-between;"> <div style="border: 1px solid black; padding: 5px;">Last Recorded Measurements Date:</div> <div style="border: 1px solid black; padding: 5px;">Current Measurements Date: 4-28-05</div> </div>																							
Start of Job 339.75' bgs																									
End of Job 339.80' bgs																									
<b>DEPTH TO BOTTOM:</b>																									
Start of Job NOT MEASURED																									
End of Job 374.9' bgs																									
<b>PART 2</b>		<table style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="3" style="text-align: center;"><b>WELL DEVELOPMENT DATA</b></td> </tr> <tr> <td>Pump Model</td> <td colspan="2">FEW mod. # 412750/BP</td> </tr> <tr> <td>Intake Depth</td> <td colspan="2">~370' bgs</td> </tr> <tr> <td>Starting Turbidity</td> <td colspan="2">41.2 NTU</td> </tr> <tr> <td>Pump Start</td> <td>Stop</td> <td>Flow Rate</td> </tr> <tr> <td>1407</td> <td>1441</td> <td>~20 gpm</td> </tr> <tr> <td colspan="3" style="text-align: center;"><del>NOT USED</del></td> </tr> </table>			<b>WELL DEVELOPMENT DATA</b>			Pump Model	FEW mod. # 412750/BP		Intake Depth	~370' bgs		Starting Turbidity	41.2 NTU		Pump Start	Stop	Flow Rate	1407	1441	~20 gpm	<del>NOT USED</del>		
<b>WELL DEVELOPMENT DATA</b>																									
Pump Model	FEW mod. # 412750/BP																								
Intake Depth	~370' bgs																								
Starting Turbidity	41.2 NTU																								
Pump Start	Stop	Flow Rate																							
1407	1441	~20 gpm																							
<del>NOT USED</del>																									
<b>WELL DEVELOPMENT DATA</b>		<table style="width: 100%; border-collapse: collapse;"> <tr> <td>A =</td> <td colspan="2">N/A</td> </tr> <tr> <td>B =</td> <td colspan="2">N/A</td> </tr> <tr> <td>C =</td> <td colspan="2">N/A</td> </tr> </table>			A =	N/A		B =	N/A		C =	N/A													
A =	N/A																								
B =	N/A																								
C =	N/A																								
Total Pumped 680 gallons		<table style="width: 100%; border-collapse: collapse;"> <tr> <td>A' =</td> <td colspan="2">2.40'</td> </tr> <tr> <td>B' =</td> <td colspan="2">1.30'</td> </tr> <tr> <td>C' =</td> <td colspan="2">1.10'</td> </tr> </table>			A' =	2.40'		B' =	1.30'		C' =	1.10'													
A' =	2.40'																								
B' =	1.30'																								
C' =	1.10'																								
Final Turbidity 1.99 NTU		<p>Are there any reference marks on the casing strings? <input type="radio"/> Yes <input type="radio"/> No</p>																							
XD SN/Range (PSI) #2748 DJ / 20 BE		<b>PART 5</b>																							
<b>PART 3</b> N/A		<b>COMMENTS:</b>																							
<b>INSTANTANEOUS SLUG TEST</b>		<p>Interval 1: initial H. H<sub>2</sub>O = 28.574 = ΔX</p> <p>Drawdown recorded as test #1, test failed</p> <p>Recovery test not performed due to temporary probe failure</p> <p>Final ΔX = 28.436 ft. H<sub>2</sub>O</p>																							
Static Water Level (TOC)		<table style="width: 100%; border-collapse: collapse;"> <tr> <td>Prepared by (print name): Robin Henderson</td> <td>Signature: Robin Henderson</td> <td>Date: 10-29-05</td> </tr> <tr> <td>Reviewed by (print name): L.D. Walker</td> <td>Signature: L.D. Walker</td> <td>Date: 6-30-05</td> </tr> </table>			Prepared by (print name): Robin Henderson	Signature: Robin Henderson	Date: 10-29-05	Reviewed by (print name): L.D. Walker	Signature: L.D. Walker	Date: 6-30-05															
Prepared by (print name): Robin Henderson	Signature: Robin Henderson				Date: 10-29-05																				
Reviewed by (print name): L.D. Walker	Signature: L.D. Walker				Date: 6-30-05																				
Transducer Depth																									
Baseline Start																									
Injection Start																									
Baseline Start																									
Withdrawal Start																									
Slug Volume																									
XD SN/Range (PSI)																									

WELL DEVELOPMENT AND TESTING DATA			p. 2 of 2	
Well Name: 299-E17-210	Well ID: C4648	Well Location: 200E SW of Purex	Date: 6-27-05	
Reference Measuring Point (unless otherwise noted): TOP OF OUTER CASING (TOC)				
Has the well been surveyed? <input type="radio"/> Yes <input checked="" type="radio"/> No		Does the well have a cement pad? <input checked="" type="radio"/> Yes <input type="radio"/> No		
<b>PART 1</b>		<b>PART 4</b>		
<b>STATIC WATER LEVEL:</b>		<div style="display: flex; justify-content: space-between;"> <div style="border: 1px solid black; padding: 5px;">                     Last Recorded Measurements Date:                 </div> <div style="border: 1px solid black; padding: 5px;">                     Current Measurements Date:                 </div> </div> 		
Start of Job 339.75' bgs				
End of Job 339.80' bgs				
<b>DEPTH TO BOTTOM:</b>				
Start of Job Not measured				
End of Job 374.9' bgs				
<b>PART 2</b>		A = _____ B = _____ C = _____		
<b>WELL DEVELOPMENT DATA</b>		A' = _____ B' = _____ C' = _____		
Pump Model FW not # 452000/518		Are there any reference marks on the casing strings? <input type="radio"/> Yes <input type="radio"/> No		
Intake Depth ~ 355' bgs				
Starting Turbidity 256.0 NTU				
Pump Start	Stop			Flow Rate
1456	1546			~18 gpm
<del>Not used</del>				
Total Pumped 900 gallons		<b>PART 5</b>		
Final Turbidity 4.91 NTU		<b>COMMENTS:</b>		
XD SN/Range (PSI) 11748 15 / 20 PSI		Interval 2: initial $\Delta x = 14.157$ ft. H <sub>2</sub> O Final $\Delta x = 14.121$ ft. H <sub>2</sub> O Drawdown recorded as test 03 Recovery recorded as test 04		
<b>PART 3</b> N/A				
<b>INSTANTANEOUS SLUG TEST</b>				
Static Water Level (TOC)				
Transducer Depth				
Baseline Start				
Injection Start				
Baseline Start				
Withdrawal Start				
Slug Volume				
XD SN/Range (PSI)				
Prepared by (print name): Robin Henderson		Signature: Robin Henderson		
Reviewed by (print name): L.D. Walker		Signature: L.D. Walker		
		Date: 6-29-05		
		Date: 6-30-05		

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