BHI-01531
Rev. 0

# Borehole Summary Report for the 2001 ILAW Site Characterization Well

***Prepared for the U.S. Department of Energy, Richland Operations Office***
***Office of Environmental Restoration***

***Submitted by: Bechtel Hanford, Inc.***

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# APPROVAL PAGE

**Title:** Borehole Summary Report for the 2001 ILAW Site Characterization Well

**Approval:** L. R. Curry, Groundwater/Vadose Zone Integration Project, Project Engineer

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BHI-DIS JLE 5/24/01

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# Borehole Summary Report for the 2001 ILAW Site Characterization Well

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CH2M HILL Hanford, Inc.

**Date Published**
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## FIGURE

# METRIC CONVERSION CHART

## Into Metric Units

| *If You Know* | *Multiply By* | *To Get* |
|---|---|---|
| **Length** | | |
| Inches | 25.4 | Millimeters |
| Inches | 2.54 | Centimeters |
| Feet | 0.305 | Meters |
| Yards | 0.914 | Meters |
| Miles | 1.609 | Kilometers |
| **Area** | | |
| sq. inches | 6.452 | sq. centimeters |
| sq. feet | 0.093 | sq. meters |
| sq. yards | .0836 | sq. meters |
| sq. miles | 2.6 | sq. kilometers |
| Acres | 0.405 | Hectares |
| **Mass (weight)** | | |
| Ounces | 28.35 | Grams |
| Pounds | 0.454 | Kilograms |
| Ton | 0.907 | metric ton |
| **Volume** | | |
| Teaspoons | 5 | Milliliters |
| Tablespoons | 15 | Milliliters |
| fluid ounces | 30 | Milliliters |
| Cups | 0.24 | Liters |
| Pints | 0.47 | Liters |
| Quarts | 0.95 | Liters |
| Gallons | 3.8 | Liters |
| Cubic feet | 0.028 | cubic meters |
| Cubic yards | 0.765 | cubic meters |
| **Temperature** | | |
| Fahrenheit | subtract 32, then multiply by 5/9 | Celsius |
| **Radioactivity** | | |
| Picocuries | 37 | Millibecquerel |

## Out of Metric Units

| *If You Know* | *Multiply By* | *To Get* |
|---|---|---|
| **Length** | | |
| millimeters | 0.039 | inches |
| centimeters | 0.394 | inches |
| meters | 3.281 | feet |
| meters | 1.094 | yards |
| kilometers | 0.621 | miles |
| **Area** | | |
| sq. centimeters | 0.155 | sq. inches |
| sq. meters | 10.76 | sq. feet |
| sq. meters | 1.196 | sq. yards |
| sq. kilometers | 0.4 | sq. miles |
| hectares | 2.47 | acres |
| **Mass (weight)** | | |
| grams | 0.035 | ounces |
| kilograms | 2.205 | pounds |
| metric ton | 1.102 | ton |
| **Volume** | | |
| milliliters | 0.033 | fluid ounces |
| liters | 2.1 | pints |
| liters | 1.057 | quarts |
| liters | 0.264 | gallons |
| cubic meters | 35.315 | cubic feet |
| cubic meters | 1.308 | cubic yards |
| **Temperature** | | |
| Celsius | multiply by 9/5, then add 32 | Fahrenheit |
| **Radioactivity** | | |
| millibecquerel | 0.027 | picocuries |

# 1.0 INTRODUCTION

This document describes the fiscal year 2001 field activities associated with drilling the characterization borehole (299-E24-21) at the northeast corner of the Immobilized Low-Activity Waste (ILAW) disposal site. The data obtained from this borehole will support current and future ILAW disposal site performance assessments.

## 1.1 PURPOSE AND SCOPE

Low-activity radioactive waste will be disposed of in the ILAW disposal site, which will be located in the 200 East Area of the Hanford Site. The first ILAW disposal site characterization borehole (299-E17-21) was drilled in April 1998. The geologic data, geophysical logging, hydrologic tests, and groundwater analyses for the 1998 borehole were reported in Reidel et al. (1998). The ILAW site performance assessment team and other interested parties concluded that a second borehole was needed near the northeast corner of the site to further evaluate the hydrologic and physical properties of the sediments (Figure 1).

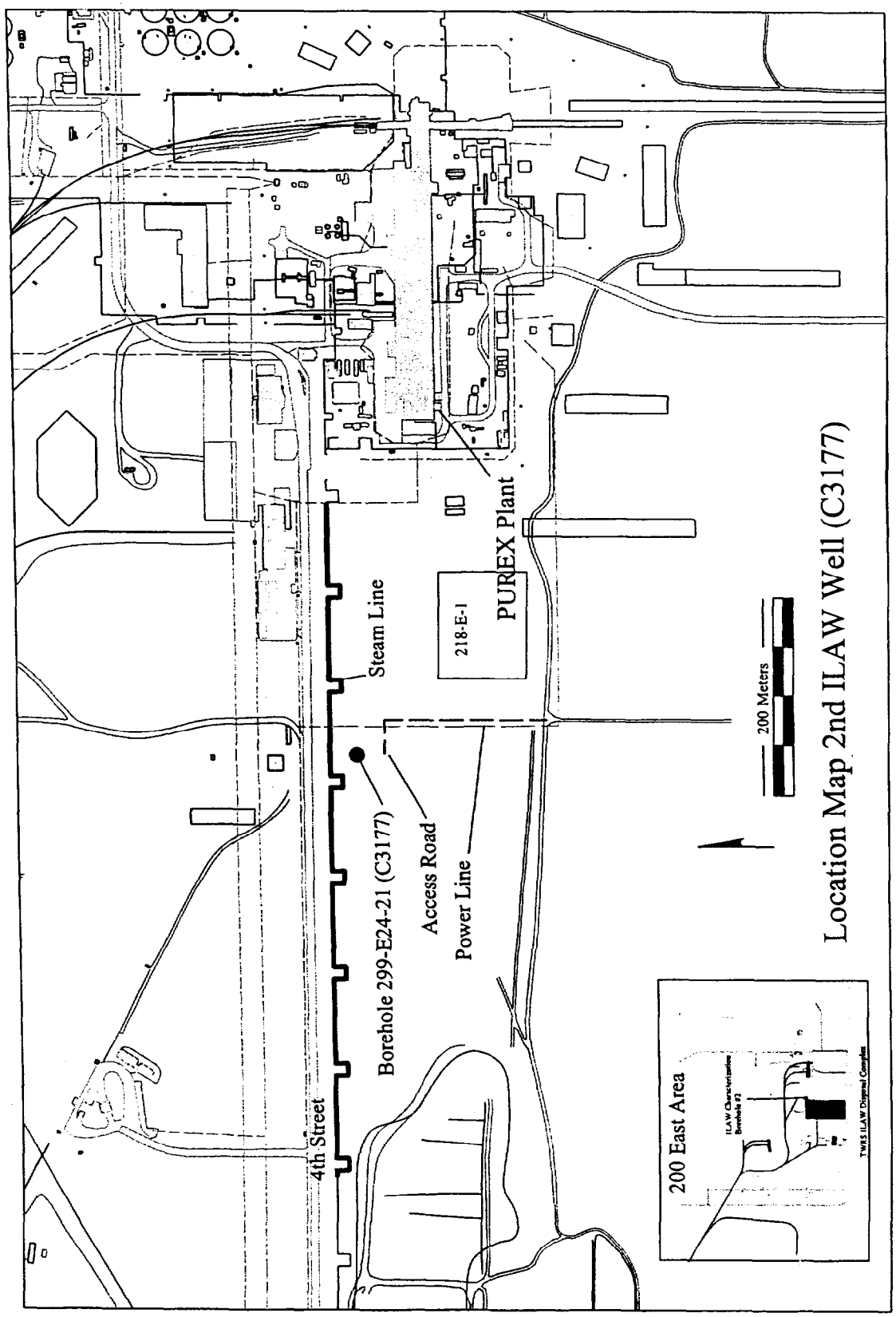
The objective of the vadose and saturated zone characterization is to provide data to develop a conceptual geohydrologic model of the ILAW disposal site for use in the Hanford Site ILAW performance assessment (Reidel 2000). The conceptual model will be used in the performance assessment to model the movement of moisture and contaminants through the vadose zone. The characteristics of the saturated zones, as well as the results of in situ testing, will be used in groundwater modeling. After drilling, the borehole was completed as a *Resource Conservation and Recovery Act of 1976* compliant groundwater monitoring well.

Data obtained from the drilling and well construction are summarized in Section 2.0. Section 3.0 describes the geology and hydrology of the ILAW disposal site. Field logs and the civil survey report are included as Appendices A through D. Data in this report are presented in the units in which they were measured.

# 2.0 TECHNICAL DATA

This section contains a description of how the well was drilled, where samples were collected, and the analyses performed on those samples. Additionally, the section discusses the conduct of well completion and development activities.

**Figure 1. Well Location Map.**



## 2.1 DRILLING SUMMARY

On March 14, 2001, the drilling pre-job meeting was held in Richland, Washington, after which the subcontractor crew mobilized to the well site and drilling began. Drilling and sampling continued until reaching a total depth of 335 ft below ground surface (bgs) on March 22, 2001. At this time well construction activities began, and the well was completed on March 28, 2001. Drilling was performed in accordance with the subcontract Exhibit "E," Drilling Specification (specification number 0200E-DP-G0001).

The diesel hammer (or Becker hammer) drilling method was used to drive 9-in. by 6-in. dual-string drill pipe. On March 14, 2001, drilling began and the borehole was advanced to 45 ft bgs, with 1-pint grab samples for geologic archive collected at 5-ft intervals. From this depth to 272.5 ft bgs, split tube samples were collected to provide a near-continuous record of the vadose zone sediments.

Split tube samplers consisted of two 2-ft sample bodies coupled together in series with a 0.5-ft drive shoe. The split tubes were 5-in. outside diameter (OD) and contained two 2-ft lexan liners 4 in. in diameter. Each sampler was driven on a 3.5-in.-diameter drill rod by either the surface diesel hammer or a downhole hammer. The drilling procedure consisted of driving each sampler about 4.5 ft ahead of the casing, then advancing the 9-in. OD casing 5 ft. As a result, for each 10 ft drilled, 8 ft of sample was collected in the lexan liners. The last split tube sampler was driven from 270 to 272.5 ft bgs. At this point it was no longer possible to drive split tube samplers in the gravel sequence of the Hanford formation.

From 272.5 ft to a total depth of 335 ft bgs, the casing was advanced with the Becker hammer and 1-pint grab samples were collected at 5-ft intervals. Stops were made for in situ air permeability testing, which is described in Section 2.3. At 315 ft bgs drilling was halted and a cutting containment system was set up in anticipation of encountering groundwater. Groundwater contaminants of concern at this location were tritium, iodine-129, and nitrate. All drill cuttings generated from below this depth were contained in 55-gal drums, with decanted groundwater pumped directly into a regulated purgewater containment tanker truck. Total depth was reached on March 22, 2001.

Table 1 summarizes the pertinent drilling information. All drilling activities were documented in accordance with BHI-EE-02, *Environmental Requirements,* Procedure 14.0, "Drilling, Maintaining, Remediating and Decommissioning Resource Protection Wells, Geoprobe and Geotechnical Soil Borings." A borehole log prepared for the well in accordance with BHI-EE-01, Procedure 7.0, "Geologic Logging," is provided in Appendix B.

## 2.2 SAMPLING SUMMARY

Split tube characterization samples were not necessary in the first 45 ft of drilling. The 9-in. by 6-in. dual-string casing was advanced with the Becker hammer and 1-pint grab samples were collected from the cyclone cuttings separator at 5-ft intervals. These samples were transferred to Pacific Northwest National Laboratory custody for geologic archive storage.

**Table 1. Drilling and Sampling Summary for Well 299-E24-21 (Well ID C3177).**

| | |
|---|---|
| Start of drilling date | March 14, 2001 |
| Drilling finish date | March 22, 2001 |
| Total drill depth | 335 ft |
| 5-ft interval archive samples | 0-45 ft , 275-335 ft |
| Split tube samples | 45-272.5 ft |
| Top of Hanford formation gravel | 270 ft |
| In situ air permeability tests | 220, 235, 251, 275, 280, 285, 290, 295 ft |
| Begin well construction | March 22, 2001 |
| Finish well construction | March 28, 2001 |
| Well screen interval | 312.19-332.19 ft |
| Water level | 312.45 ft (3-28-01) |
| Easting[a] | 574635.761 m |
| Northing[a] | 135698.200 m |
| Elevation (brass cap) | 217.849 m |

[a]brass cap

On March 15, 2001, split tube sampling was started at 45 ft. The sampler dimensions were 5-in. OD, 4-in. inner diameter (ID), and 4.5 ft in length. A 4-ft lexan liner was inserted to hold the sediment sample, made up of two 2-ft liners. Except for one occasion of no recovery (55 to 59.5 ft), sample recovery was generally 90% to 100%.

Upon opening the split tube samplers after retrieval, care was taken to keep the sediment as undisturbed as possible. Aluminum foil or plastic bubble wrap was used to pack any open spaces in the sample, in the event of less than 100% recovery. Information was written on the outside of the lexan liners, including an arrow indicating younging direction, depth at each end, borehole number, and time and date of collection. Plastic endcaps were fitted over each end and taped to provide a waterproof seal. The liners were then double bagged in plastic and placed in coolers on ice. A chain-of-custody form was initiated at this point, and samples were transferred to Pacific Northwest National Laboratory at the end of each day.

Sand-dominated sediments provided good recovery rates until approximately 237 ft bgs. The 235-ft sample was driven 2 ft and then reached refusal on cobble-sized gravel. No sediment was recovered at that depth. The casing was advanced to 240 ft and another split tube sampler was driven, this time by downhole hammer. Refusal was reached after 3.5 ft and 2 ft of sample recovered. The casing was advanced to 250 ft and another split tube was driven with a downhole hammer. Split tube samplers were then driven at 5-ft intervals again, with recovery rates slowly increasing until encountering the basal gravel sequence of the Hanford formation at 270 ft. The last sampler at 270 ft was driven 2.5 ft with full recovery of sandy gravel. At this point, split tube

sampling was discontinued due to increased probability of equipment failure while attempting to split tube sample the gravel. The drilling plan anticipated the refusal of split tube sample collection in this gravel unit. One-pint archive grab samples were collected from the cyclone separator from 275 ft to the total depth of 335 ft.

## 2.3 AIR PERMEABILITY TESTING

In addition to collection of physical samples, in situ air permeability measurements were taken to collect data for vadose zone characterization. A subcontractor, Science and Engineering Associates, Inc., made these measurements.

In order to correlate these permeability measurements with data collected from the split tube samples, the first three test depths were collected in the sand-dominated sediments. For the first three intervals, the casing drive shoe was set at 220, 235, and 250 ft bgs. After split tube sampling was halted due to gravel, air permeability tests were performed at 275, 280, 285, 290, and 295 ft bgs.

Each air permeability test required that the drill rig stop for approximately 1 hour. During this time an airtight cap was threaded on the drive casing and air injected into the borehole. Airflow rates and temperature were measured, plus the pressure differential between the isolated zone and ambient air.

## 2.4 WELL COMPLETION

On March 22, 2001, work began to complete the borehole as a shallow "top of the water table" resource protection monitoring well. The permanent well casing was made of 4-in.-diameter, schedule 5, type 304L stainless steel. The screen was 4-in. 304L stainless steel, continuous wire wrap 0.020-in. slot. A 2-ft-long, 4-in.-diameter 304L stainless steel sump was placed below the well screen. The screen was set at a depth of 312 to 332 ft bgs, with a water level of 312.45 ft bgs.

When the stainless steel casing was installed, the drilling crew had difficulty connecting the 20-ft joints due to the poor quality of the threads. After filing the threads, the casing joints connected properly and well construction proceeded as planned.

The screen sandpack was composed of Colorado Silica sand, 10-20 mesh, installed from 335 ft to 300.1 ft. A bailer was used to surge the well to settle and compact the sandpack. Coated bentonite pellets (0.25-in. diameter) were placed from 300.1 to 290.0 ft. Granular bentonite, 8-20 mesh, was placed from 290 to 10 ft bgs.

On March 28, 2001, an electric submersible pump was installed for well development. With a depth to water of 312.45 ft bgs, the 3-Hp 15-stage pump produced 15 gal/min with no noticeable drawdown. The flow rate was limited by the size of the submersible pump. Monitored water quality parameters are shown in Table 2.

**Table 2. Well 299-E24-21 (C3177) Development Data Collected March 23, 2001.**

| Static Water Level (ft) (bgs) | Final Turbidity (NTU) | Final Conductivity (µS/cm) | Final pH (standard units) | Final Temp. (°C) | Final Flow Rate (gal/min) | Maximum Drawdown (ft) | Total Gallons Pumped |
|---|---|---|---|---|---|---|---|
| 312.45 | 1.11 | 578 | 7.68 | 17.3 | 15 | 0 | 650 |

NTU = nephelometric turbidity unit

The last 10 ft of the borehole annulus was sealed with a grout mixture of type I&II Portland cement with 5% powdered bentonite. Protective casing, a cement pad, and protective posts were installed to complete the surface installation. Table 3 summarizes the well completion information.

**Table 3. Completion Summary for Well 299-E24-21 (C3177).**

| Water Level (ft) (bgs) | Screen[a] | | | | Sandpack[b] | Seal[c] | | | Riser | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Screen Interval (ft bgs) | Screen Length (ft) | End Cap (ft) | Screen Material | Interval (ft)(bgs) | Bentonite Pellets (ft)(bgs) | Granular Bentonite | Portland Cement (ft)(bgs) | Riser Interval (ft)(bgs) | Riser Material |
| 312.45 | 312.19 - 332.19 | 20 | 2 | SS304L | 300.1- 335 | 290-300.1 | 10-290 | 0-10 | +2.0-312.19 | SS304L 4-in. diameter |

[a]Screen is 0.020 in. slot size, 4-in. diameter.
[b]Sandpack is 10-20 mesh silica sand.
[c]Seal is 0.25-in. coated bentonite pellets, 8-20 mesh granular bentonite, type I,II Portland cement.

## 2.5 CIVIL SURVEY

The results of the survey are summarized in Table 1, and the survey data report is included in Appendix D.

# 3.0 SUBSURFACE DESCRIPTION

## 3.1 GEOLOGY

The stratigraphy of the ILAW disposal site consists of the Hanford formation and Ringold Formation overlying the Columbia River Basalt Group (Reidel 2000). Surficial sediments are mainly eolian deposits consisting of reworked Hanford sands and silts. This borehole did not penetrate deeper than the basal gravel of the Hanford formation.

The sand-dominated sequence of the Hanford formation at this location continued from the surface to 270 ft bgs. With no eolian deposit on the surface, fine sand and silt with some pebbles persisted for the first 12 ft, becoming a coarse to medium sand. Sand continued with occasional fine to medium pebbles until a zone of sandy gravel from 237 to 241 ft bgs was encountered. Sand from 241 to 270 ft was more difficult to sample, showing a trace of calcium carbonate cementation. From 270 ft to 335 ft, the basal gravel sequence of the Hanford formation was encountered. Material encountered in this interval was clast-supported pebble-to-cobble gravel with minor amounts of sand in the matrix.

## 3.2 HYDROGEOLOGY

The uppermost aquifer in the vicinity of the ILAW disposal site is within the fluvial gravels of the Ringold Formation and flood deposits of the Hanford formation. The Elephant Mountain Member of the Columbia River Basalt Group forms the base of the unconfined aquifer. The saturated zone at this borehole from 312 ft bgs to the total drilled depth of 335 ft lies within the lower gravel sequence of the Hanford formation.

# 4.0 REFERENCES

Reidel, S. P., D. G. Horton, and K. D. Reynolds, 1998, *Immobilized Low-Activity Waste Site Borehole 299-E17-21*, PNNL-11957, Pacific Northwest National Laboratory, Richland, Washington

Reidel, S. P., 2000, *Second ILAW Site Borehole Characterization Plan*, PNNL-13283, Pacific Northwest National Laboratory, Richland, Washington.

BHI-EE-01, *Environmental Investigations Procedures,* Bechtel Hanford, Inc., Richland, Washington.

BHI-EE-02, *Environmental Requirements,* Bechtel Hanford, Inc., Richland, Washington.

WAC 173-160, 1990, "Minimum Standards for Construction and Maintenance of Wells," Washington Administrative Code, as amended.

# APPENDIX A

# WELL SUMMARY SHEETS

## WELL SUMMARY SHEET

Page 1 of 3
Date: 3-28-01

| | |
|---|---|
| Well ID: C3177 | Well Name: 299-E24-21 |
| Location: 500m west of Purex / 200E | Project: ILAW Site Characterization #2 |
| Prepared By: L.D. Walker Date: 3-28-01 | Reviewed By: DCWeekes Date: 4/11/01 |
| Signature: LDWalker | Signature: DCWeekes |

### CONSTRUCTION DATA

| Description | Diagram |
|---|---|
| Portland Cement 0' → 10.0' | |
| 6" SS protective casing set 1.0' above the well casing | |
| Temporary casing; 9" OD: 0' → 335' (9" x 6" dual string) | |
| Stainless steel well casing, sch. 5 type 304L; 4½" OD, 4" ID +2.0 → 312.19' | |
| Granular bentonite: 10.0' → 290.0' | |

### GEOLOGIC/HYDROLOGIC DATA

| Depth in Feet | Graphic Log | Lithologic Description |
|---|---|---|
| 0 | | Crushed rock surface pad 0 → 0.5' |
| | | 0.5' → 8': Silty SAND |
| | | 8' → 12': Gravelly SAND |
| 25 | | |
| | | 12' → 237': SAND |
| 50 | | |
| 75 | | 80': tr gravel |
| 100 | | |
| 125 | | 134': tr gravel |

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## WELL SUMMARY SHEET

Date: 3-28-01

| | |
|---|---|
| Well ID: C 3177 | Well Name: 299-E24-21 |
| Location: 500m west of Purex / 200E | Project: ILAW Site Characterization #2 |
| Prepared By: L. D. Walker Date: 3-28-01 | Reviewed By: DC Weekes Date: 4/11/01 |
| Signature: LD Walker | Signature: DC Weekes |

### CONSTRUCTION DATA

| Description | Diagram |
|---|---|
| Bentonite pellets, coated, 1/4" : 290.0' → 300.1' | |

### GEOLOGIC/HYDROLOGIC DATA

| Depth in Feet | Graphic Log | Lithologic Description |
|---|---|---|
| ~~150~~ 150 | | 12' → 237': SAND |
| 175 | | |
| 200 | | |
| 225 | | 224': tr gravel<br>229': tr gravel |
| | | 237' → 241': Sandy GRAVEL |
| 250 | | 241' → 270: SAND |
| | | 266': tr gravel |
| 275 | | 270' → 290': Sandy GRAVEL |

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## WELL SUMMARY SHEET

Date: 3-28-01

| | | | |
|---|---|---|---|
| Well ID: C3177 | | Well Name: 299-E24-21 | |
| Location: 500m west of Purex / 200E | | Project: ILAW site Characterization #2 | |
| Prepared By: L.D. Walker | Date: 3-28-01 | Reviewed By: DC Weekes | Date: 4/11/01 |
| Signature: LD Walker | | Signature: DC Weekes | |

### CONSTRUCTION DATA

| Description | Diagram |
|---|---|
| Silica Sand, 10-20 mesh: 300.1' → 335' | |
| Stainless Steel Wellscreen 0.020-in slot cont. wire-wrap type 304L 4½" OD/4" ID 312.19' → 332.19' | |
| SS 304L tailpipe with welded endcap 4½" OD / 4" ID 332.19' → 334.19' | |
| Total SS well From top of casing is 336.19' | |
| All depths in Feet below ground surface | |
| All temporary casing removed From ground | |

### GEOLOGIC/HYDROLOGIC DATA

| Depth in Feet | Graphic Log | Lithologic Description |
|---|---|---|
| 300 | | 290' → 335': GRAVEL |
| 325 | | TD = 335' |
| 350 | | Water Level: 312.45' bgs (3-28-01) |

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# APPENDIX B

# BOREHOLE GEOLOGIC LOG SHEETS

# BOREHOLE LOG

Page 1 of 12
Date: 3-14-01

Well ID: C3177 | Well Name: 299-E24-21 | Location: 500m West of Purex / 200 E
Project: ILAW Site Characterization #2 | Reference Measuring Point: Ground Surface

| Depth (Ft.) | Sample Type No. | Sample Blows Recovery | Graphic Log | Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl | Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level |
|---|---|---|---|---|---|
| 0 | | | | Crushed rock gravel, 0→0.5' | |
| | Becker Hammer | NA | | 0.5'→8': Silty SAND (mS) 75% Sand, 25% silt. Sand is fine to v. Fn. 10YR4/3 (brown), sl moist, well sorted, SA; 70% qtz/Feld, 30% basalt/other mafic. Max size ~1 mm | Becker Hammer 9 5/8"/6" casing |
| 5 | Grab-Archive | | | | 5': Grab sample (1-pint) For archive |
| | Grab-Archive | | | 8'→12': Gravelly SAND (gS) 10-15% Gravel, 85-90% Sand, tr silt. Gravel med. peb to v. Fn. Sand 40% v. cse, 40% cse, 20% med-Fn. 10YR4/2 (dk grayish-brown) sl. moist; mod sorted, SA-SR, 60% qtz/Feld, 40% basalt/mafics. max size ~2 cm. | 10': Grab-archive |
| 10 | | | | | |
| | Grab-Archive | | | | 15': Grab-archive |
| 15 | | | | 12'→237': SAND (S) similar to gS without gravel (or tr v. fn peb.) Sand predom cse-v. cse. | |
| | Grab-Archive | | | | 20': Grab-archive |
| 20 | | | | | |
| | Grab-Archive | | | 25': tr of silt now gone | 25': Grab-archive |
| 25 | | | | | |

Reported By: L.D. Walker | Reviewed By: M.L. Johnson
Title: Geologist | Title: STR
Signature: LD Walker | Date: 3-14-01 | Signature: Mark Johnson | Date: 3/29/01

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# BOREHOLE LOG

Page 2 of 12
Date: 3-14-01

Well ID: C3177 | Well Name: 299-E24-21 | Location: 500m West of Purex / 200E
Project: ILAW Characterization | Reference Measuring Point: Ground Surface

| Depth (Ft.) | Sample Type No. | Sample Blows Recovery | Graphic Log | Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl | Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level |
|---|---|---|---|---|---|
| 30 | Grab-Archive | NA | | SAND (S) similar to above | Becker Hammer |
| | Becker Hammer | | | 100% Sand. 50% v.cse, 40% cse, 10% med-fn. | 9 5/8"/6" casing |
| | | | | dk grayish brown, sl moist, mod-well sorted, SA, ~~60%~~ 70% qtz/feld, 30% basalt | 30': Grab-archive |
| 35 | Grab-Archive | | | | 35': Grab-archive |
| | | | | 34'-35': tr v. fn pebble | |
| | | | | | 40': Grab-archive |
| 40 | Grab-Archive | | | | |
| | | | | | 45': Grab-archive |
| | Grab-Archive | | | | End 3/14/01 |
| 45 | Split tube #1 | 100% ~~90%~~ rec. | | | Begin 3/15/01 |
| | | | | SAND (S) slightly finer than above. Predom cse-med 10YR5/2 (grayish brown) dry, mod sorted, SA; 70-80% qtz/feld, 20-30% basalt/other | ⊗ 45.0'→49.5': split tube; lexan liners collect 45'→49' (49-49.5 in drive shoe) - Archive From shoe |
| | Shoe | Archive | | | |
| 50 | Split tube #2 | 100% rec. | | | ¥ 50.0'→54.5': split tube #2 |
| | Shoe | | | | |
| 55 | Split tube #3 | 0% rec. | | | ¥ 55.0'→59.5': split tube #3 - no recovery |

Reported By: L.D. Walker | Reviewed By: ~~AAL~~ ~~JCW~~ ~~Supervisor~~ DCWeekes
Title: Geologist | Title: Geologist
Signature: L.D. Walker | Date: 3-15-01 | Signature: DC Weekes | Date: 4/11/01

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# BOREHOLE LOG

Page 3 of 12
Date: 3-15-01

Well ID: C3177 | Well Name: 299-E24-21 | Location: 500m west of Purex / 200E
Project: ILAW Characterization | Reference Measuring Point: Ground Surface

| Depth (Ft.) | Sample Type No. | Sample Blows Recovery | Graphic Log | Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl | Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level |
|---|---|---|---|---|---|
| 60 | Grab-Archive | | | | Becker Hammer |
| | Split tube #4 | 100% rec. | | SAND (s) similar to above predom cse, 10YR 5/2 (gry brown) dry; Silt content tr-5%, mod-well sorted, SA; 70% qtz/Feld, 30% basalt, max size ~ 2mm | 9 5/8"/6" casing<br>60': Grab sample for archive |
| | Shoe | | | | 60' → 64.5': Split tube #4 |
| 65 | Split tube #5 | 100% rec. | | Sand- predom cse, tr silt, dry and very loose | 65' → 69.5': Split tube #5 |
| | Shoe | | | | |
| 70 | Split tube #6 | 100% rec. | | | 70' → 74.5': Split tube #6 |
| | Shoe | | | Sand as above - cse to v. cse. tr silt, dry, gry brown A-SA | |
| 75 | Split tube #7 | 100% rec. | | | 75' → 79.5': Split tube #7 |
| | Shoe | | | tr gravel 79': R, med-fn peb. | |
| 80 | Split tube #8 | 90% recov. | | | 80' → 84.5': Split tube #8 |
| | Shoe | | | | 85' → 89.5' Split tube #8 9 |
| 85 | Split tube #9 | 100% rec. | | Sand - similar to above 95-100% Sand, tr-5% silt tr v. fn peb; Sand 10% v. cse, 30% cse, 50% med, 10% fn-v. fn; dry, gray-brown, SA-A, mod sort; 60-70% qtz/feld, 30-40% basalt. | |

Reported By: L. D. Walker | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: LD Walker | Date: 3-15-01 | Signature: DC Weekes | Date: 4/11/01

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# BOREHOLE LOG

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Date: 3-15-01

Well ID: C3177 | Well Name: 299-E24-21 | Location: 500m west of Purex/200E
Project: ILAW Characterization | Reference Measuring Point: Ground Surface

| Depth (Ft.) | Sample Type No. | Sample Blows Recovery | Graphic Log | Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl | Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level |
|---|---|---|---|---|---|
| 90 | Split tube #10 | 100% rec. | | | Becker Hammer |
| | | | | SAND (S) similar to above | 9⅝"/6" casing |
| | | | | tr gravel, 100% sand, tr silt. | |
| | | | | Gravel is v. Fn peb. Sand 20% | 90'→94.5': |
| | Shoe | | | v. cse, 30% cse, 30% med, 20% Fn. | Split tube #10 |
| 95 | Split tube #11 | 100% rec. | | gry-brown, dry, mod sorted, | |
| | | | | A-SA; 70-80% qtz/Feld, 20-30% | 95'→99.5': |
| | | | | basalt + other mafics. Max size | Split tube #11 |
| | Shoe | | | ≈ 5mm | |
| 100 | Split tube #12 | 100% rec. | | 99': Sand predom Fn - v. Fn | 100'→104.5': |
| | | | | | Split tube #12 |
| | | | | Back to med-cse sand | |
| | Shoe | | | | |
| 105 | Split tube #13 | 100% rec. | | | 105'→109.5': |
| | | | | | Split tube #13 |
| | Shoe | | | | End 3/15/01 |
| | | | | | Begin 3/16/01 |
| 110 | Split tube #14 | 90% rec. | | SAND - similar to above | 110'→114.5': |
| | | | | 100% sand, tr silt. | Split tube #14 |
| | Shoe | | | 20% v.cse, 30% cse, 40% med, 10% | |
| 115 | Split tube #15 | 100% rec. | | Fn - v.Fn. 10YR6/2 (lt. brnish gray) | |
| | | | | dry, mod sorted, A-SA; 80% qtz/ | 115'→119.5': |
| | | | | Feld, 20% basalt/other, tr mica | Split tube #15 |
| | shoe | | | Max size ~ 2mm | |

Reported By: L. D. Walker | Reviewed By: D C Weekes
Title: Geologist | Title: Geologist
Signature: LD Walker | Date: 3/16/01 | Signature: DC Weekes | Date: 4/11/01

BHI-EE-183 (12/97)

# BOREHOLE LOG

Page 5 of 12
Date: 3-16-01

Well ID: C3177 | Well Name: 299-E24-21 | Location: 500 m West of Purex/200E
Project: ILAW Characterization | Reference Measuring Point: Ground Surface

| Depth (Ft.) | Sample Type No. | Sample Blows Recovery | Graphic Log | Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl | Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level |
|---|---|---|---|---|---|
| | | | | | Becker hammer |
| 120 | Split tube #16 | 100% rec. | | thin silt lens (<1 cm) near 121' | 9 5/8"/6" casing |
| | Shoe | | | SAND (S) similar to above | 120' → 124.5': |
| | | | | 100% Sand, tr silt. Sand | Split tube #16 |
| 125 | Split tube #17 | 100% rec. | | 5-10% v. cse, 40% cse, 30% med, | |
| | Shoe | | | 20-25% Fn-v. Fn. 10YR5/2 (gry-brn) | 125' → 129.5' |
| | | | | → at ~125', sl moist; mod-sorted, | Split tube #17 |
| 130 | Split tube #18 | 100% rec. | | SA-A; 80% qtz/feld, 20% basalt/other | |
| | Shoe | | | max size ~2 mm. tr mica. | |
| | | | | | 130' → 134.5': |
| | | | | tr silt near 130' | Split tube #18 |
| | | | | tr v. Fn peb. 132' | |
| 135 | Split tube #19 | 100% rec. | | 134': tr-5% gravel: v. Fn peb, A-SA, predom. basalt. | |
| | Shoe | | | | 135' → 139.5': |
| | | | | | Split tube #19 |
| 140 | Split tube #20 | 100% rec. | | SAND - similar to above | 140' → 144.5' |
| | Shoe | | | 100% Sand, tr silt | Split tube #20 |
| | | | | predom cse-med, gry-brown, | |
| 145 | Split tube #21 | 100% rec. | | dry to sl moist, SA-A | |
| | Shoe | | | | 145' → 149.5': |
| | | | | | Split tube #21 |

Reported By: L.D. Walker | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: LDWalker | Date: 3-16-01 | Signature: DC Weekes | Date: 4/11/01

BHI-EE-183 (12/97)

# BOREHOLE LOG

Page 6 of 12
Date: 3-16-01

Well ID: C3177 | Well Name: 299-E24-21 | Location: 500m west of Purex / 200 E
Project: ILAW Characterization | Reference Measuring Point: Ground Surface

| Depth (Ft.) | Sample Type No. | Sample Blows Recovery | Graphic Log | Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl | Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level |
|---|---|---|---|---|---|
| 150 | | | | | Becker Hammer |
| | Split tube #22 | 100% rec. | | SAND (S) similar to above | 9 5/8" / 6" casing |
| | | | | 100% Sand, tr silt | |
| | | | | 20% v.cse-cse, 50% med, 30% fn-v.fn. 10YR5/2 (grayish brown), dry; | 150'→154.5': Split tube #22 |
| | Shoe | | | mod sorted, SA, 80% qtz/feld, 20% basalt/other, tr mica | |
| 155 | | | | | 155'→159.5': |
| | Split tube #23 | 90% rec. | | | Split tube #23 |
| | Shoe | | | | End 3/16/01 |
| 160 | | | | SAND - similar to above | Begin 3/17/01 |
| | Split tube #24 | 100% rec. | | predom cse-med | 160'→164.5': Split tube #24 |
| | Shoe | | | | |
| 165 | | | | | 165'→169.5': |
| | Split tube #25 | 100% rec. | | | Split tube #25 |
| | | | | tr gravel (med-cse peb, R-SR) | |
| | Shoe | | | seen when advancing casing. | |
| 170 | | | | | 170'→174.3': |
| | Split tube #26 | 100% rec. | | | Split tube #26 |
| | | | | | (liners: 170.0→173.8') |
| | Shoe | | | SAND (S) | |
| | | | | 100% sand, tr silt. | |
| 175 | | | | predom med, 10YR6/2 (lt. brn-gray), | 175'→179.5' |
| | Split tube #27 | 100% rec. | | dry, mod sorted, SA-A; 80% qtz/ | Split tube #27 |
| | | | | Feld, 20% basalt/other, tr mica, | |
| | shoe | | | tr max size 2-3 mm | |

Reported By: L.D. Walker | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: LD Walker | Date: 3-17-01 | Signature: DC Weekes | Date: 4/11/01

BHI-EE-183 (12/97)

# BOREHOLE LOG

Page 7 of 12
Date: 3-17-01

Well ID: C3177 | Well Name: 299-E24-21 | Location: 500m West of Purex / 200E
Project: ILAW Characterization | Reference Measuring Point: Ground Surface

| Depth (Ft.) | Sample Type No. | Sample Blows Recovery | Graphic Log | Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl | Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level |
|---|---|---|---|---|---|
| 180 | | | | | Becker hammer |
| | Split tube # 28 | 100% rec. | | SAND (S) - similar to above tr gravel, 100% sand, tr silt. | 9 5/8" / 6" casing |
| | | | | Gravel v. fn peb, A; Sand 20% | 180' → 184.5': |
| | Shoe | | | v. cse, 30% cse, 30% med, 20% fn. | Split tube #28 |
| 185 | | | | 10YR5/2 (grayish brown), dry, mod | |
| | Split tube # 29 | 100% rec. | | sorted, A-SA; 75% qtz/Feld, 25% | |
| | | | | basalt/other, max size ~ 5 mm. | 185.0' → 189.5': |
| | Shoe | | | | Split tube #29 |
| 190 | | | | | |
| | Split tube #30 | 100% rec. | | SAND - similar to above | 190' → 194.5' |
| | | | | | Split tube # 30 |
| | Shoe | | | | |
| ~~200~~ LAW | | | | | 195' → 199.5' |
| 195 | Split tube #31 | 100% rec. | | | Split tube # 31 |
| | | | | Sand predom. cse - v. cse | End 3-17-01 |
| | Shoe | | | dry and loose in the drive shoe | |
| ~~205~~ LAW | | | | | Begin 3-19-01 |
| 200 | Split tube #32 | 100% rec. | | | 200' → 204.5': |
| | | | | 204': tr gravel (fn-med peb) | Split tube #32 |
| | Shoe | | | in the drive shoe. | |
| ~~210~~ LAW | | | | | |
| 205 | Split tube #33 | 100% rec. | | | 205' → 209.5': |
| | | | | Sand med-cse, SA, dry | Split tube #33 |
| | Shoe | | | | |

Reported By: L.D. Walker | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: LD Walker | Date: 3-19-01 | Signature: DC Weekes | Date: 4/11/01

BHI-EE-183 (12/97)

# BOREHOLE LOG

Page 8 of 12
Date: 3-19-01

Well ID: C3177 | Well Name: 299-E24-21 | Location: 500 m west of Purex/200E
Project: ILAW Characterization | Reference Measuring Point: Ground Surface

| Depth (Ft.) | Sample Type No. | Sample Blows Recovery | Graphic Log | Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl | Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level |
|---|---|---|---|---|---|
| 210 | | | | | Becker Hammer |
| | Split tube #34 | 100% rec. | | SAND (S) similar to above. tr gravel, 100% sand. Gravel Fn-v. fn peb (at 212') SA, predom basalt; Sand 20% v. cse, 40% cse, 30% med, 10% fn-v. fn. 10YR5/2 (gry brown) sl moist 210'→212', then dry again. Mod sorted, SA-A; 70-80% qtz/feld, 20-30% basalt/other Max size ~ 1 cm | 9 5/8" / 6" casing 210'→214.5': Split tube #34 |
| | Shoe | | | | |
| 215 | Split tube #35 | 100% rec. | | | 215'→219.5': Split tube #35 |
| | Shoe | | | | ⊛First air permeability test performed with casing shoe at 220' |
| 220 | Air test | | | 219': tr gravel; v fn peb. | |
| | Split tube #36 | 90% rec. | | 224': tr-5% Gravel (fn-v. fn peb) SA-A; granitic, basalt, tr iron stain | 220'→224.5': Split tube #36 |
| | Shoe | | | | |
| 225 | Split tube #37 | 90% rec. | | 229': 5% Gravel; fn-v. fn peb. Sand predom cse-v. cse dry | 225'→229.5': Split tube #37 *driller says "Hard" |
| | Shoe | | | | |
| 230 | Split tube #38 | 90% rec. | | Sand similar to above, with Fn peb gravel increasing to 5-10%, occ. up to 2 cm | 230'→234.5': Split tub #38 ⊛Second in situ air perm. test performed with casing shoe at 235' |
| | Shoe | | | | |
| 235 | Air test | | | | Begin 3-20-01 |
| | Split tube #39 | 0% rec. | | Cse peb/sm cobble Fragments in split tube drive shoe - Predom Gravelly Sand when advance casing. | 235'→237': Split tube #39 Refusal |
| | refusal | | | | |

Reported By: L.D. Walker | Reviewed By: DCWeekes
Title: Geologist | Title: Geologist
Signature: LD Walker | Date: 3-20-01 | Signature: DC Weekes | Date: 4/11/01

BHI-EE-183 (12/97)

# BOREHOLE LOG

Page 9 of 12
Date: 3-20-01

Well ID: C3177 | Well Name: 299-E24-21 | Location: 500m west of Purex / 200E
Project: ILAW Characterization | Reference Measuring Point: Ground Surface

| Depth (Ft.) | Sample Type No. | Sample Blows Recovery | Graphic Log | Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl | Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level |
|---|---|---|---|---|---|
| 240 | Split tube #40 | Sample in liner | | 237'→241': Sandy GRAVEL | Becker Hammer |
| | Shoe | NA | | 40-50% Gravel, 50-60% Sand, | 9 5/8"/6" casing |
| | | | | tr silt. Gravel tr sm. cob, | |
| | | | | predom. fn-v.fn peb. Sand cse | 240'→243.5': |
| | | | | to v.cse. | Split tube #40 |
| 245 | | | | | Only lower liner |
| | | | | | recovered |
| | Grab Sample | | | 241'→270': SAND (s) | |
| | | | | tr gravel (v.fn peb), 100% sand, | 245'→250': 1-pint |
| | | | | tr silt. Sand 30% v.cse, 50% cse, | grab sample |
| 250 | | | | 20% med-v.fn. 10YR4/2 (dk grayish | |
| | ST #41 | 100% rec. | | brown), sl moist, mod sorted, A- | 251'→252.5': |
| | Shoe | Air test | | SA; 70-80% qtz/feld, 20-30% basalt, | Split tube #41 |
| | | | | tr mica, max size ~5mm, HCl rxn | (refusal) |
| | | | | weak to ~~none~~ ⇒ rxn visible w/ hand lens | |
| 255 | ST #42 | 100% rec. | | | 255'→256.3': |
| | Shoe | | | ⊗Third in situ air perm. test after ST #41 | S.T. #42 |
| | 1-pint | | | | one partial liner |
| | | | | tr cobble frags seen while | and 1-pint jar |
| | | | | advancing casing. | Filled from shoe |
| 260 | Split tube #43 | 100% rec. | | | 260'→264.0': |
| | | | | SAND - similar to above, becomes | Split tube #43 |
| | Shoe | | | finer - now predom med. | |
| | | | | Split tubes drive more easily | Begin 3-21-01 |
| 265 | | | | | 265'→269.0': |
| | Split tube #44 | 100% rec. | | | Split tube #44 |
| | | | | 266-267': Gravel tr-10% | 1-pt. grab sample |
| | | | | Fn-cse peb, R-SR | from drive shoe |
| | Shoe | | | sl moist, tr iron staining in sand | (269') |

Reported By: L.D. Walker | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: L.D. Walker | Date: 3-21-01 | Signature: DC Weekes | Date: 4/11/01

BHI-EE-183 (12/97)

# BOREHOLE LOG

Page 10 of 12
Date: 3-21-01

Well ID: C3177 | Well Name: 299-E24-21 | Location: 500m west of Purex / 200 E
Project: ILAW Characterization | Reference Measuring Point: Ground Surface

| Depth (Ft.) | Sample Type No. | Sample Blows Recovery | Graphic Log | Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl | Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level |
|---|---|---|---|---|---|
| 270 | Split tube #45 | 100% rec. | | 270' → 290': Sandy GRAVEL (SG) 40-50% Gravel, ~~5~~ 55cm 45-55% Sand, 5% Silt. Gravel 10% sm. cob, 50% v.cse-cse peb, 40% med-fn peb; Sand 20% v.cse. 40% cse, 40% med-v.fn; 10YR4/2 (dk grayish brown), moist, poorly sorted, gravel R-SR, sand SA; mix qtzite, basalt, granitic, other, max ~10cm weak rxn HCl. | Becker Hammer 9"/6" casing |
| | shoe | | | | |
| | Becker Hammer | NA | | | 270'→272.5': split tube #45 (refusal) |
| 275 | Grab Sample | Air test #4 | | | 275': Grab sample |
| | | | | | ⊛ 275' = 4th Air perm. test |
| 280 | Grab | Air test #5 | | Gravel content increase to 60-70% Silt decrease to trace | ⊛ 280' = 5th Air perm. test, and 1-pint grab sample |
| 285 | Grab | Air test #6 | | Gravel 70-80% predom cse-v.cse, R-SR peb. | ⊛ 285' = 6th air perm. test and 1-pt. grab sample |
| 290 | Grab | Air test #7 | | 290' → 335: GRAVEL (G) Gravel 80%, Sand 15-20%, silt tr-5%, 10% ~~5~~ cobble, similar to above with higher gravel percent. Gravel R-SR, predom v.cse-cse peb | ⊛ 290': 7th air perm. test and 1-pint grab sample |
| 295 | Grab | Air test #8 | | | ⊛ 295': 8th air perm. test and grab sample |
| | | | | | Begin 3-22-01 |

Reported By: L.D. Walker | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: LD Walker | Date: 3-22-01 | Signature: DC Weekes | Date: 4/1/01

BHI-EE-183 (12/97)

# BOREHOLE LOG

Page 11 of 12
Date: 3-22-01

Well ID: C3177 | Well Name: 299-E24-21 | Location: 500m west of Purex/200E
Project: ILAW Characterization | Reference Measuring Point: Ground Surface

| Depth (Ft.) | Sample Type No. | Sample Blows Recovery | Graphic Log | Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl | Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level |
|---|---|---|---|---|---|
| 300 | Grab Sample | | | | Becker Hammer |
| | Becker Hammer | NA | | GRAVEL (G) similar to above | 9"/6" casing |
| | | | | 80-90% gravel, 10-20% sand, | |
| | | | | tr-5% silt. Gravel 10% cobble, | 300': 1-pint grab |
| | | | | 40% v.cse peb, 40% cse, 10% med- | sample for archive |
| 305 | Grab Sample | | | Fn; Sand predom med-cse. | |
| | | | | 10YR 4/2 (dk grayish brown), sl | 305': grab sample |
| | | | | moist, poorly sorted; Gravel | |
| | | | | R-SR; mixture of qtzite, basalt, | |
| | | | | granitic, greenstone, other; max | |
| 310 | Grab Sample | | | size 10-15 cm, HCl rxn weak | 310': grab sample |
| | | | | to none | |
| | | | | | W.L. = 313.10' |
| | | | | | (3-22-01) |
| | | | | | 315': grab sample |
| 315 | Grab Sample | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | 320': grab sample |
| 320 | Grab Sample | | | 320' silt ~ 5% | |
| | | | | | |
| | | | | | |
| | | | | sl decrease in gravel size | |
| | | | | -predum cse-med gravel | 325': grab sample |
| 325 | Grab Sample | | | Open Framework gravel | |
| | | | | | |
| | | | | poor returns - air lost into | |
| | | | | loose formation | |
| | | | | v.cse-cse peb. | |

Reported By: L.D. Walker | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: LD Walker | Date: 3-22-01 | Signature: DC Weekes | Date: 4/11/01

BHI-EE-183 (12/97)

# BOREHOLE LOG

Page 12 of 12
Date: 3-22-01

Well ID: C3177 | Well Name: 299-E24-21 | Location: 500m west of Purex / 200E
Project: ILAW Characterization | Reference Measuring Point: Ground Surface

| Depth (Ft.) | Sample Type No. | Sample Blows Recovery | Graphic Log | Sample Description: Group Name, Grain Size Distribution, Soil Classification, Color, Moisture Content, Sorting, Angularity, Mineralogy, Max Particle Size, Reaction to HCl | Comments: Depth of Casing, Drilling Method, Method of Driving Sampling Tool, Sampler Size, Water Level |
|---|---|---|---|---|---|
| 330 | Grab Sample | | | GRAVEL (G) - similar to above 90% gravel, 5-10% sand, tr-5% silt. R gravel, appears to be open framework predom v. cse-med peb. | Becker Hammer 9"/6" casing; 330': grab sample |
| 335 | Grab Sample | | | | 335': grab sample |
| | | | | TD= 335' bgs | |
| 340 | | | | | |
| 345 | | | | | |
| 350 | | | | | |

Reported By: L.D. Walker | Reviewed By: DC Weekes
Title: Geologist | Title: Geologist
Signature: LD Walker | Date: 3-22-01 | Signature: DC Weekes | Date: 4/11/01

BHI-EE-183 (12/97)

# APPENDIX C

# WELL CONSTRUCTION SUMMARY REPORT

# WELL CONSTRUCTION SUMMARY REPORT

Start Date: 3-14-01
Finish Date: 3-28-01
Page 1 of 1

| | | | |
|---|---|---|---|
| Specification No.: | Rev. No.: 0200E-SP-G0001 | Well Name: 299-E24-21 | Temp. Well No.: C3177 |
| ECNs: N/A | | Approximate Location: 500m west of Purex / 200E | |
| Project: ILAW Characterization | | Other Companies: BHI, CHI | |
| Drilling Company: Layne Christensen | | Geologist(s): L. Walker | |
| Driller: Christian Davis | | | |

**TEMPORARY CASING AND DRILL DEPTH**

| *Size/Grade/Lbs. Per Ft. | Interval | Shoe O.D./I.D. |
|---|---|---|
| FJ 9"x6" dual ~~well~~ String | 0 - 335' | 9 3/4"/5 1/2" |
| | - | |
| | - | |
| | - | |
| | - | |

*Indicate Welded (W) - Flush Joint (FJ) Coupled (C) & Thread Design

**DRILLING METHOD/HOLE DIAMETER**

| | |
|---|---|
| Auger: | Diameter From ____ to ____ |
| Cable Tool: | Diameter From ____ to ____ |
| Air Rotary: | Diameter From ____ to ____ |
| A.R. w/Sonic: | Diameter From ____ to ____ |
| Perc. Diesel Hammer | Diameter From 0' to 335' |
| | Diameter From ____ to ____ |
| | Diameter From ____ to ____ |

Drilling Fluid: Air

Total Drilled Depth: 335' | Hole Dia @ TD: 9 3/4" | Total Amt. Of Water Added During Drilling: NA

Well Straightness Test Results: not performed | Static Water Level: 312.45' | Date: 3-28-01

**GEOPHYSICAL LOGGING**

| Sondes (type) | Interval | Date | Sondes (type) | Interval | Date |
|---|---|---|---|---|---|
| | - | | | - | |
| | - | | | - | |
| | - | | | - | |

**COMPLETED WELL**

| Size/Wt./Material | Depth | Thread | Slot Size | Type | Interval Annual Seal/Filter Pack | Volume | Mesh Size |
|---|---|---|---|---|---|---|---|
| 4" ID SS304L Tailpipe | 332.19 - 334.19 | F480 | NA | Silica Sand | 300.1 - 335' | 22 bag | 10-20 |
| 4" ID SS304L screen | 312.19 - 332.19 | F480 | 0.020" | Coated Bentonite Pellets | 290.0 - 300.1 | 3 buck. | 1/4" |
| 4" ID SS304L casing (sch 5) | +2.0 - 312.19 | F480 | NA | Granular Bentonite | 10.0 - 290.0 | 130 bag | 8-20 |
| | - | | | Portland Cement | 0 - 10.0 | 15 bag | NA |
| | - | | | | - | | |

**OTHER ACTIVITIES**

| | | | | | |
|---|---|---|---|---|---|
| Aquifer Test: Pumping well development | Date: 3-28-01 | Well Abandoned: | Yes: | No: | Date: |
| Description: 3-Hp electric sub. pump | | Description: | | | |
| Final Flow rate 15 gpm with no drawdown | | | | | |

**WELL SURVEY DATA**

| | |
|---|---|
| Date: | Protective Casing Elevation: |
| Washington State Plane Coordinates: | Brass Cap Elevation: |

**COMMENTS/REMARKS**

Vol. calcs: Silica Sand - 22 x 0.535 $Ft^3$ = 11.77 $Ft^3$; Bent. Pellets - 3 x 0.62 = 1.86 $Ft^3$;
Gran. Bent - 130 x 0.71 = 92.3 $Ft^3$; Portland Cement - 15 x 1.285 = 19.275 $ft^3$

| | | | |
|---|---|---|---|
| Reported By: L.D. Walker | | Reviewed By: D C Weekes | |
| Title: Geologist | Date: 4-4-01 | Title: Geologist | Date: 4/11/01 |
| Signature: L D Walker | | Signature: D C Weekes | |

BHI-EE-181 (12/97)

# APPENDIX D

# WELL SURVEY DATA REPORT

# Survey Data Report

| | |
|---|---|
| ERC Project: 22192 | Prepared By:<br>Company: Rogers Surveying, Inc. |
| Date of Survey: May 22, 2001 | Surveyor: Gary B. Wagner |
| ERC Point of Contact:<br><br>MR. ROBERT BONE | Survey Company Point of Contact: Gary B. Wagner |
| Description of Work:<br><br>Well Survey-20 NEW WELLS IN 200 E, 200 WEST AND 200 D AREAS<br>WORK RELEASE "N"<br>0000X-MR-G0099 | Horizontal Datum: **NAD83(91)**<br>Vertical Datum: **NAVD88**<br>Units: **Meters**<br>Hanford Area Designation: 200E |

Coordinate System: **Washington State Plane Coordinates (South Zone)**

| | | |
|---|---|---|
| Horizontal Control Monuments: | "PUG"<br>HVC-01 | U.S.C. & G.S.<br>GPS NETWORK CONTROL POINT BY ROGERS SURVEYING |
| Vertical Control Monuments: | HSWB-077 | Corps of Engineers |

| Wellname: | Easting | Northing | Elevation | |
|---|---|---|---|---|
| (per BHI-EE-01)<br>**C 3177** | 574635.761 | 135698.200 | | Center of Casing |
| | | | 218.643 | "X" on rim |
| | 574635.812 | 135698.530 | 217.849 | Brass Cap |
| | | | | |

Notes:
CASING ELEVATION TAKEN ON "V" NOTCH ON NORTH RIM OF 6-1/2" DIAM. STEEL CASING

Surveyor Statement:

I, Gary B. Wagner, a Professional Land Surveyor in the State of Washington, (Registration No. 30440) hereby certify that this report is based on a field survey performed in May, 2001, under my direct supervision and that the data contained hereon is true and correct.

Certified by: GARY B. WAGNER
STATE OF WASHINGTON
30440
REGISTERED
PROFESSIONAL LAND SURVEYOR
EXPIRES 11-09-01

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