URS

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| To: | Mike Gross, PE, U.S. Army Corps of Engineers – Portland District |
| From: | Mark Cecchini, Laura McWilliams, PhD, LG, and Jeff Wallace, RG |
| Date: | June 9, 2008 |
| Subject: | Groundwater Monitoring Well Installation Report<br>Bradford Island Upland Operable Unit Remedial Investigation<br>Cascade Locks, OR |

## Introduction

The United States Army Corps of Engineers (USACE) Portland District is performing a remedial investigation/feasibility study (RI/FS) at Bradford Island at Bonneville Dam, Oregon. This memorandum describes the methods and results of the monitoring well installation and aquifer testing in the Upland Operable Unit (OU) on the eastern portion of Bradford Island (site).

In accordance with Contract No W9128F-04-D-0001, Task Order No. DT07, six monitoring wells were installed and developed at the site from March 24 through April 8, 2008. One monitoring well was installed in a reference area south and east of the upland areas of potential concern (AOPCs), and five monitoring wells were installed in the Sandblast Area AOPC (Figure 1). Following the monitoring well installation, slug tests were conducted at three of the new wells to assess hydraulic conductivity of the aquifer.

All field activities were carried out in accordance with the *Draft Quality Assurance Project Plan (QAPP) Upland Operable Unit Remedial Investigation* (Upland QAPP, URS, 2008). The Bradford Island Technical Advisory Group (TAG) is currently reviewing the Upland QAPP. Based on consultation with the TAG, the USACE elected to install the monitoring wells (reported herein) and commence quarterly groundwater sampling (reported separately) prior to the finalization of this Upland QAPP to compress of the schedule by approximately 6 months.

## Drilling Methods

URS subcontracted Boart Longyear, Inc. to drill and install five monitoring wells in the Sandblast Area AOPC and one monitoring well in the reference area (Figure 1). A URS field geologist observed the drilling operations and well construction, and logged each borehole.

On March 24, 2008, Boart Longyear mobilized a CME-75 HT hollow-stem auger drill rig, support trucks, and ancillary tooling and equipment for well installation to the site. This drill rig was used to install MW-12, MW-14, and MW-15 in the Sandblast Area

AOPC. Upon completion of MW-12 on March 27, 2008, the hollow-stem auger rig was demobilized from the site due to a malfunctioning gearbox. The remaining Sandblast Area monitoring wells, MW-11 and MW-13, were installed with a Prosonic Truck-mounted sonic drill rig on April 2 and 3, 2008. The upgradient monitoring well, MW-10, was installed with a Prosonic Spider sonic drill rig on April 3 through 5, 2008.

Auger flights, sonic rig core barrels, sonic rig casing, and other down-hole equipment, such as split spoon samplers, were decontaminated with a steam cleaner prior to drilling and between borings. Soil cuttings and water generated during the drilling operations were contained in labeled 55-gallon drums. The drums were staged at the hazardous materials storage area (HMSA) for characterization and disposal by the USACE, per the instructions of the Bonneville Dam Environmental Compliance Coordinator (ECC).

A detailed description of each drilling technique used on the site is included in the subsections below. Logs of each boring are provided in Attachment A.

***Hollow-Stem Auger Drilling***

Three monitoring wells (MW-12, MW-14, and MW-15) were installed using the CME-75 HT hollow-stem auger drill rig. The borings were advanced with a 6-5/8 inch (in) inner diameter hollow stem auger with a center bit, which created a boring with an 11-in diameter. Soil samples were collected at 5-foot intervals using a standard 18 in split spoon sampler, driven by 140 pound, 30 in drop automatic hammer. Hammer blows on the split spoon sampler were counted, and N (blows per 12 inch driven) values for each split spoon interval are reported on the boring logs.

The URS field geologist used both auger cuttings and split spoon samples to log each boring, in accordance with procedures described in the Upland QAPP (URS, 2008). Additionally, bag headspace samples were collected from each split spoon sample and were field screened for volatile organic compounds (VOCs) using a calibrated MiniRae 2000 photo-ionization detector (PID). Field screening results are included on the boring logs (Attachment A).

Auger refusal, due to large cobbles or boulders in the Eagle Creek Formation, occurred at three boring locations (once at MW-14 and twice at MW-12). In each case of refusal, the drill rig was demobilized off the boring and moved to a new location approximately 5 feet away. The abandoned boreholes were backfilled with bentonite chips and resurfaced with topsoil or asphalt cold patch to match the original surface condition at that location. While drilling at a depth of 26.3 feet (ft) below ground surface (bgs) at MW-12, the gearbox for the auger drive on the CME-75 HT malfunctioned, preventing further drilling with that rig. However, it is likely that very little additional progress would have been made at MW-12, due to the siltstone that was encountered near the bottom of the boring. Water had been encountered and the objectives had been net so the monitoring well was installed.

***Sonic Drilling***

Three monitoring wells were installed using sonic drilling techniques. A track-mounted Prosonic Spider drill rig was used to access and install MW-10 in an upgradient location at the eastern end of Bradford Island. A truck-mounted Prosonic drill rig was used to install MW-11 and MW-13 in the Sandblast Area AOPC. All downhole equipment (i.e. casing, core, and drill stem) was decontaminated prior to drilling at each boring.

Both sonic drill rigs advanced a 4-in continuous core with cutting shoe by rotating the drill stem while vibrating it at a frequency in the 50 to 180 Hertz range. The core was advanced in intervals of 10 ft or less before being pulled from the hole. Plastic bags were then used to catch approximately 2.5 ft sections of disturbed sample from the core. Prior to logging the core samples, the URS field geologist identified and separated slough from the soil cuttings. A 6-in casing was then advanced into the 4-in pilot hole created by the core. Once the casing was in place, the continuous core was reinserted into the boring and the drilling process was repeated until the final depth of the boring was reached.

The URS field geologist logged each sonic boring, in accordance with procedures described in the Upland QAPP (URS, 2008), by examining the disturbed core samples. Bag headspace samples were collected at 5-ft intervals from the core samples and were field screened for VOCs using a calibrated Mini Rae 2000 PID. Field screening results are included on the boring logs (Attachment A).

## Summary of Lithologic Observations

In general, three lithologic units were encountered during drilling operations at the site: colluvium, weathered slide block, and slide block. The characteristics of each unit are as follows:

- *Colluvium*: Unconsolidated mixtures of gravel, sand, silt, and clay that overly the Eagle Creek Formation slide block. The mixtures generally become more fine-grained with depth. Also contains irregularly distributed cobbles and boulders with various degrees of weathering. Silt and clay lenses create the potential for small zones of perched water and semi-confined groundwater conditions in this interval.

- *Weathered Slide Block*: Semi-consolidated mixtures of gravel, sand, silt, and clay or weathered siltstone of the Eagle Creek Formation. Fractures in the siltstone are partially or completely filled with silts and clays. Also contains irregularly distributed cobbles and boulders with various degrees of weathering.

- *Slide Block*: Fresh to slightly weathered, dark grey or greenish-grey voncaniclastic siltstone of the Eagle Creek Formation. Also contains irregularly distributed cobbles and boulders with various degrees of weathering. Based on

the slug test results, the slide block material has low hydraulic conductivity. However, fractures as well as sand and gravel lenses in the siltstone may enhance the hydraulic conductivity in some intervals, as appears to be the case at the MW-14 location. The distribution, interconnectivity, and extent of these sand and gravel lenses are unknown.

Results from the PID field screening of grab soil samples were indistinguishable from background levels, with the exception of soils sampled from 2 to 11.5 ft bgs at MW-14. Although PID readings above the ground surface at MW-14 did not exceed background levels, a grab sample collected from the auger cuttings at 2 ft bgs yielded a bag headspace reading of 33.2 parts per million (ppm). Soil collected from a split spoon sampler driven from 5 to 6.5 ft bgs yielded a bag headspace reading of 17.6 ppm. The reading for soil collected from the 10 to 11.5 ft split spoon sample was 14.1 ppm. These readings were accompanied by a slight solvent-like odor in the soil cuttings from 0.1 ft bgs to 6 ft bgs. These screening results and the solvent-like odor may indicate the presence of vapor-phase VOCs in the colluvium immediately underlying the asphalt surface at MW-14.

The field screening measurements were collected from the headspace of a zip-lock bag containing soils that had been disturbed and brought above the ground surface with a split spoon sampler or sonic core barrel. Soil samples obtained from the sonic core barrel were further disturbed by heating due to vibration of the core barrel. The bag headspace method was designed as a screening approach to assess for the presence of VOC contamination in vadose (unsaturated) zone soils. The PID readings may not reflect the concentration of VOCs in the undisturbed soil and should not be interpreted as analytical data.

## Well Construction Methods

As described in the Upland QAPP (URS, 2008), each well was installed in accordance with Oregon Administrative Rules (OAR) 690-240 and in general accordance with USACE Engineer Manual EM 1110-1-4000 (November 1, 1998). In the case of discrepancies between the two, the Oregon rules took precedence.

Each monitoring well was constructed with 2-in schedule 40 polyvinyl chloride (PVC) 0.010-in slot screens and blank riser pipe. Oglebay-Norton 10-20 size quartz sand was used for the filter pack around each well screen. Baroid Hole Plug 3/8-in bentonite chips (hydrated as necessary) were used to create the seal above the filter pack in each boring. A concrete surface was placed above the bentonite seal. Wells installed in areas with a preexisting asphalt surface (MW-11, MW-13, MW-14, and MW-15) were completed with 8-in flush-to-grade surface monuments. MW-10 and MW-12 were completed with an approximately 2-ft square steel-reinforced concrete surface pad, a 6-in square aluminum monument extending approximately 3 feet above the ground surface, and three protective steel bollards installed around the monument. Table 1 presents general well

construction data for the new and existing wells at the site. Attachment B presents the well construction details for each well.

Monitoring well screened intervals were selected based on the occurrence of saturated material in each boring observed during drilling. In general, the monitoring wells were screened within two feet of the top of the saturated zone in each boring as determined at the time of drilling. The top of the screen at MW-12 was set six feet above the top of the saturated zone, just above the siltstone bedrock. During the well construction process the PVC screen and riser were handled with clean, disposable nitrile gloves to minimize the chance of contaminating the well. The top of the PVC riser pipe was capped or otherwise sealed during construction to avoid contaminating the well with well construction materials.

**Table 1**
**Bradford Island Upland Area**
**Monitoring Well Construction Data**

| Well ID | Measuring Point Elevation (ft msl) | Screened Interval (ft msl) | Screened Interval (ft bgs) | Top of Sand Pack (ft bgs) | Top of Bentonite Seal (ft bgs) |
|---|---|---|---|---|---|
| MW-1 | 105.5 | 83 – 73 | 20 – 30 | -- | -- |
| MW-2 | 116.56 | 92 – 82 | 22 – 32 | -- | -- |
| MW-3 | 115.21 | 102 – 92 | 11 – 21 | -- | -- |
| MW-4 | 114.79 | 104.5 – 84.5 | 8 – 28 | -- | -- |
| MW-5 | 114.07 | 102 – 77 | 35 – 10 | -- | -- |
| MW-6 | 113.02 | 85 – 80 | 25 – 30 | 24 | 1 |
| MW-7 | 106.92 | 99 – 74 | 5 – 30 | 3 | 1 |
| MW-8 | 115.29 | 59.5 – 54.5 | 53 – 58 | 50 | 1 |
| MW-9 | 115.16 | 97 – 92 | 15 – 20 | 9 | 1 |
| MW-10 | 133.20 | 82 – 72 | 47 – 57 | 43 | 1 |
| MW-11 | 98.12 | 73 – 63 | 26 – 36 | 24.5 | 1 |
| MW-12 | 100.62 | 81 – 71 | 16 – 26 | 14 | 1 |
| MW-13 | 97.55 | 72 -62 | 26 – 36 | 24 | 1 |
| MW-14 | 86.67 | 74 – 64 | 13 – 23 | 11 | 0.7 |
| MW-15 | 86.86 | 75 – 65 | 12 – 22 | 9.5 | 0.9 |

ft bgs: feet below ground surface
ft msl: feet above mean sea level
-- not available at this time

Each 2-in schedule 40 PVC well was constructed in 10-ft sections and then installed into the borehole with the screened interval at the depth specified by the field geologist. Once the well casing was set, filter pack sand was added to the annulus. As sand was added to

the boring, the casing (or hollow-stem auger) was pulled up to avoid bridging the sand between the steel casing and the PVC well. The 10-20 sand was added to a depth of one to three ft above the top of the well screen[1]. Bentonite was then added to the annulus to create a seal between the sand pack and ground surface. The bentonite chips were hydrated with water, at an approximate rate of 5 gallons of water per 100 lb of bentonite, as the seal was installed. Once the concrete pad and surface completion for each well was completed, the PVC riser pipe was cut to fit inside the flush mount or stick-up monument. The measuring point for each well was marked in permanent ink on the top edge of the riser pipe, generally on the north side. URS contracted WH Pacific to survey each well, with the horizontal coordinates, based on North American Datum of 1927 (NAD 27), and ground surface elevation, concrete pad elevation, and measuring point elevation, based on National Geodetic Vertical Datum of 1929 (NGVD 29).

## Well Development

Well development was performed by a URS field geologist using a decontaminated submersible pump. All purge water was placed into labeled drums for characterization and disposal by the USACE. URS monitored the progress of the development with a calibrated LaMotte 2020 turbidity meter and a calibrated YSI 556 water quality meter[2].

During development, the wells were periodically surged by vigorously moving the pump up and down across the screened interval in order to remove fine sediment from the well screen and filter pack. Wells were considered developed when one or more of the following criteria were met: stabilization of water quality parameters within 10 percent of previous readings, no significant decrease in turbidity after continual purging, or removal of more than 10 casing volumes. Development logs for each well are included in Attachment C.

## Slug Testing

### *Method*

On April 11, 2008, single-well slug tests were performed on four groundwater monitoring wells (MW-10, MW-11, MW-13 [falling head only], and MW-14) to assist in evaluating the hydrogeologic characteristics of the colluvium and slide block units at the Bradford Island site (Figure 1). Slug tests were accomplished by adding (or removing) a known volume (the slug) to (or from) a monitoring well to create a rapid rise (or fall) in water level. Slug tests were conducted in accordance with procedures outlined in the Upland QAPP (URS, 2008). The slug was constructed of prefabricated 1-1/2 in diameter solid

[1] The filter pack at MW-10 extends four ft above the screened interval (to 43 ft bgs), due to a miscommunication between the field geologist and driller.
[2] Water quality parameters were not recorded during the development of MW-10, -11, and -13 due to a malfunctioning YSI meter. Development was monitored based on turbidity measurements.

polyethylene and measured three feet in length. The slug was decontaminated prior to use in the first well, and was decontaminated between wells following procedures outlined in the Upland QAPP (URS, 2008). During each rising and falling slug test, water levels were measured as the well returned to static water level. The water-level change as a function of time was measured using a pressure transducer with internal data recorder (In-Situ Troll 700).

Slug test data were analyzed using the computer program AQTESOLV v 4.01 HydroSOLVE, Inc. The specific well parameters, initial hydraulic conditions, and test data were entered into the program and plotted as displacement versus time on a semi log scale. The Bouwer-Rice (1976) method for a single well slug test conducted in an unconfined aquifer was used to estimate the hydraulic conductivity. The AQTESOLV program uses an iterative process to generate the best fit straight line across the plotted data which yields an estimated hydraulic conductivity. The process was repeated for each individual slug test performed. Table 2 provides the AQTESOLV results. Data forms, transducer logs, and modeling results for each slug test are presented in Attachment D.

***Results***

The results of the slug tests performed on the newly installed monitoring wells are summarized in Table 2. Hydraulic conductivities for the wells screened in siltstone or silt, sand, and gravel mixtures (MW-10, MW-11, and MW-13) ranged from 0.01 to 0.18 feet per day (ft/day), similar to published hydraulic conductivities for fine-grained materials (Fetter, 2001).

**Table 2**
**Slug Test Results**

| Well ID | Hydraulic Conductivity (ft/day) | Screen Interval (ft bgs) | Lithology | Inferred Lithologic Unit |
|---|---|---|---|---|
| MW-10 Falling | 0.033 | 47 – 57 | Siltstone | Slide Block |
| MW-10 Rising | 0.019 | | | |
| MW-11 Falling | 0.027 | 26 – 36 | Sandy-SILT with Gravel | Weathered Slide Block |
| MW-11 Rising | 0.011 | | | |
| MW-13 Falling | 0.18 | 26 – 36 | Sandy-SILT with Gravel | Weathered Slide Block |
| MW-14 Falling | 285 | 13 – 23 | Siltstone; Sandy GRAVEL | Slide Block |
| MW-14 Rising | 170 | | | |

ft bgs: feet below ground surface
ft/day: feet per day

Measurement of hydraulic conductivity in MW-14 was complicated by its proximity to the Columbia River (see Figure 1). MW-14 is screened at an elevation of 64-74 ft msl, below the normal pool surface elevation (71.5 to 76.5 ft msl). The slug test results for both the rising and falling tests showed a very rapid recovery followed by a gradual elevation rise. The gradual elevation rise is assumed to be attributed to communication with the river. Therefore, only the first few seconds of response data were fitted using AQTESOLV (see Attachment D). Making this assumption, the hydraulic conductivity for MW-14 is estimated at 170 to 285 ft/day, at the high end of the range of published hydraulic conductivities for coarse-grained sand and gravel (Fetter, 2001). This may be because MW-14 is screened across a two foot interval of sandy gravel which is not present in the other wells.

## References

Bouwer, H., and R.C. Rice, 1976. A slug test for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells. *Water Resource Research* 12:423- 28.

Fetter, C.W., 2001. *Applied Hydrogeology 4th Edition,* Prentice Hall, Upper Sandle River, New Jersey.

URS, 2008. *Draft Quality Assurance Project Plan*. Upland Operable Unit Remedial Investigation, Bradford Island. May 2008.

## Figures

Figure 1 – Bradford Island Monitoring Well Locations

## Tables

Table 1 – Bradford Island Upland Area Monitoring Well Construction Data
Table 2 – Slug Test Results

## Attachments

Attachment A- Boring Logs
Attachment B- Well Construction Diagrams
Attachment C- Well Development Data Forms
Attachment D- Slug Test Field Forms and Modeling Results

Columbia River

River Flow Direction

Drain Outfall #2

Drain Outfall #1

MW-14

MW-15

Landfill Access Road

MW-12

Sand Blast Building

Hazmat Storage

MW-13

MW-11

Hazmat Storage

Bradford Island

Water Tower Access Road

Service Center

Equipment Building

Lagoon

MW-7

MW-1

MW-6

MW-5

MW-8

MW-9

MW-4

MW-3

MW-2

Approximate Landfill Area

MW-10

REFERENCE AREA

Approximate Waterline at Mean Pool Elevation

50 0 50 100

SCALE IN FEET

Legend

MW-4 Previously Existing Monitoring Well Location

MW-10 New Monitoring Well Location

5 - Foot vertical elevation contour in feet (NGVD)

Notes:

1. Base map provided by USACE.

2. Mean pool elevation is approximately 74 feet (NGVD).

| No. | DATE | BY | REVISION |
|---|---|---|---|

| | | |
|---|---|---|
| JOB No. 25696679 | DESIGNED: LSM | PROJ. MANAGER: JTW |
| SCALE: 1"=100' | DRAWN BY: SB | APPROVED BY: LSM |
| | CHECKED BY: LSM | DATE: JUNE 2008 |

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**BRADFORD ISLAND**

**CASCADE LOCKS, OREGON**

BRADFORD ISLAND
MONITORING WELL LOCATIONS

DRAWING NUMBER: FIGURE 1

CAD FILE NUMBER: FIG 9

SHEET: OF

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O:\25692709 USACE\53-F0072173.00 Bradford1\Omaha DT-07\Well Installation Field Work\Well installation Tech memo\CAD\FIG 1.dwg May 28, 2008 - 3:06pm

**Project: Bradford Island**
**Project Location: Bonneville Dam, Oregon**
**Project Number: 25696679**

# Log of Boring MW-10



| | | | | | |
|---|---|---|---|---|---|
| Date(s) Drilled and Installed | **4/3 - 4/5/2008** | Geologist | **MC** | Reviewer | **NM** |
| Drilling Method | **Sonic** | Drilling Contractor | **Boart Longyear** | Total Depth of Borehole | **57.6 ft. [bgs]** |
| Sampling Method | **Continuous Core** | Drill Bit Size/Type | **4 in. core with 6 in. casing** | Approximete Surface Elevation | **129.28 ft. MSL** |
| Drill Rig Type | **Prosonic Spider** | Groundwater Level(s) | **16.53 ft. [bgs] [4/16/08]** | Hammer Data | **n/a** |
| Borehole Backfill | **Monitoring Well Installed** | Comments | **MSL: mean sea level, bgs: below ground surface** | Location | **Bradford Island Reference Area** |

| Elevation feet / Depth, feet | SAMPLES: Type | Number | Recovery, (feet) | Headspace PID, ppm | Graphic Log | Lithologic Log (USCS Code) | MATERIAL DESCRIPTION | Well Completion Schematic | FIELD NOTES AND WELL DETAILS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | **Basalt BOULDER**, dark grey, dry, hard, fresh. | | Stickup Monument<br>Concrete<br>2" Schedule PVC Riser |
| | | 1 | 4 | | | SM | **Silty SAND with Gravel [SM]**, brown to orange-brown, moist, loose, well-graded sand with root fragments. Moderate plasticity fines. Subrounded gravel with some hard, angular clasts, few cobbles. [Colluvium] | | |
| 5 | | | | 0.0 | | | *Light yellow-brown, no root fragments.* | | |
| | | 2 | 6 | | | ML | **Sandy SILT with Gravel [ML]**, brown, medium stiff, moist, low plasticity fines. Poorly-graded fine sand. Rounded gravel with few hard, angular clasts. [Colluvium] | | |
| 10 | | | | 0.0 | | | *Dark olive-brown, stiff, moderately plastic fines with yellow-brown, loose coarse-grained sand.* | | |
| 15 | | 3 | 10 | 0.2 | | | *Increasingly fine, angular gravel, moist to wet.* | | Baroid Hole Plug 3/8" Bentonite Chips [hydrated] |
| | | | | | | | **Basalt BOULDER**, dark grey, moist, hard, fresh. | | |
| 20 | | | | 0.0 | | | **SILTSTONE**, greenish-grey, dry, dense, friable, moderately weathered to soft silt and clay with irregularly-spaced 1/8-in [chloritic] laminae . Fine-grained matrix with rock texture. Trace fine, angular gravel-sized basalt clasts. [Weathered Slide Block] | | |
| 25 | | 4 | 10 | 0.3 | | | *Dry to moist.* | | |
| 30 | | | | | | | | | |

Report: PORT_ENV_WELL; File: BRADISL.GPJ; 6/6/2008 MW-10

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**Project: Bradford Island**
**Project Location: Bonneville Dam, Oregon**
**Project Number: 25696679**

# Log of Boring MW-10

Sheet 2 of 2

| Elevation feet | Depth, feet | SAMPLES: Type | SAMPLES: Number | SAMPLES: Recovery, (feet) | SAMPLES: Headspace PID, ppm | Graphic Log | Lithologic Log (USCS Code) | MATERIAL DESCRIPTION | Well Completion Schematic | FIELD NOTES AND WELL DETAILS |
|---|---|---|---|---|---|---|---|---|---|---|
| | 30 | | | | 0.2 | | | *Increased [chloritic] alteration throughout.* | | |
| | 35 | | 5 | 10 | 0.3 | | | *As above, with dark brown moderate plasticity clay laminae, up to 1/2", increasingly soft.* | | |
| | | | | | | | CL | **Sandy CLAY with Gravel [CL]**, dark brown-black, wet, soft, low plasticity. Trace subangular gravel. [Weathered Slide Block] | | |
| | 40 | | | | 0.6 | | | **SILTSTONE**, dark greenish-grey, moist to wet, dense, slightly weathered to stiff silt and clay with irregularly-spaced 1/8-in [chloritic] laminae. Fine-grained matrix with rock texture. Trace fine, angular gravel-sized basalt clasts. [Slide Block] | | |
| | | | 6 | 6 | | | | | | Oglebay Norton 10-20 Silica Sand |
| | 45 | | | | 0.0 | | | *Wet.* | | |
| | | | | | | | | **Basalt BOULDER**, dark grey, moist, hard, fresh. | | 0.010 in. - Slot Schedule 40 PVC screen |
| | | | 7 | 4 | | | | **SILTSTONE**, dark greenish-grey, moist to wet, dense, fresh with irregularly-spaced 1/8-in [chloritic] laminae. Trace fine, angular basalt gravel clasts partially weathered to silty sand. [Slide Block] | | |
| | 50 | | | | 0.1 | | | | | |
| | | | 8 | 7.6 | | | | | | Schedule 40 PVC Sump |
| | 55 | | | | | | | Boring terminated at a depth of 57.6' [bgs] on 4/5/2008 and a monitoring well was installed upon completion. | | |
| | 60 | | | | | | | | | |
| | 65 | | | | | | | | | |

Report: PORT_ENV_WELL; File: BRADISL.GPJ; 6/6/2008 MW-10

URS

**Project: Bradford Island**
**Project Location: Bonneville Dam, Oregon**
**Project Number: 25696679**

# Log of Boring MW-11



| | | | | | |
|---|---|---|---|---|---|
| Date(s) Drilled and Installed | **4/3/2008** | Geologist | **MC** | Reviewer | **NM** |
| Drilling Method | **Sonic** | Drilling Contractor | **Boart Longyear** | Total Depth of Borehole | **37.0 ft. [bgs]** |
| Sampling Method | **Continuous Core** | Drill Bit Size/Type | **4 in. core with 6 in. casing** | Approximete Surface Elevation | **99.45 ft. MSL** |
| Drill Rig Type | **Prosonic Truck Mount** | Groundwater Level(s) | **7.74 ft. [bgs] [4/15/08]** | Hammer Data | **n/a** |
| Borehole Backfill | **Monitoring Well Installed** | Comments | **MSL: mean sea level, bgs: below ground surface** | Location | **Bradford Island Sandblast Area** |

| Elevation feet / Depth, feet | SAMPLES: Type | Number | Recovery, (feet) | Headspace PID, ppm | Graphic Log | Lithologic Log (USCS Code) | MATERIAL DESCRIPTION | Well Completion Schematic | FIELD NOTES AND WELL DETAILS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | GM | **Asphalt**<br>**Silty GRAVEL [GM]**, dark brown, dry, rounded, well-graded gravel with few cobbles. Low plasticity, hard silt. [Colluvium] | | Flush to Grade Monument<br>Concrete |
| | | 1 | 7 | | | SM | **Silty SAND with Gravel [SM]**, brown to yellow-brown, dry to moist, low plasticity medium stiff fines. Rounded to subangular, well-graded gravel with some cobbles. [Colluvium]<br>*Trace gravel, no cobbles.* | | |
| 5 | | | | 0.2 | | | | | 2" Schedule PVC Riser |
| | | 2 | 5 | 1.2 | | MH | **Clayey SILT with Gravel [MH]**, orange-brown, moist, high plasticity hard fines with thinly laminated 1/8" orange-brown and yellow-brown zones. Rounded well-graded gravel with some cobbles and oxidized zones surrounding some clasts. [Colluvium]<br>*Fewer cobbles.* | | |
| 10 | | 3 | 3 | | | ML | **Clayey SILT with Gravel [ML]**, grey, moist, hard low plasticity fines. Rounded to subrounded gravel with some cobbles and trace well graded sand. [Weathered Slide Block] | | |
| 15 | | 4 | 2 | 0.3 | | | *Increasing sand, decreasing clay.* | | Baroid Hole Plug 3/8" Bentonite Chips [hydrated] |
| 20 | | 5 | 6 | 0.1 | | | **Basalt BOULDER**, dark grey, dry, hard and fresh. | | |
| | | 6 | 4 | 0.2 | | ML | **Sandy SILT with Gravel [ML]**, grey, moist, stiff low plasticity fines. Poorly graded medium to fine-grained sand. Rounded gravel with few cobbles. [Weathered Slide Block]<br>*Wet.* | | Oglebay Norton 10-20 Silica Sand<br>0.010 in. - Slot Schedule 40 PVC screen |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |



URS

**Project: Bradford Island**
**Project Location: Bonneville Dam, Oregon**
**Project Number: 25696679**

# Log of Boring MW-11

Sheet 2 of 2

| Elevation feet | Depth, feet | SAMPLES: Type Number | SAMPLES: | SAMPLES: Recovery, (feet) | SAMPLES: Headspace PID, ppm | Graphic Log | Lithologic Log (USCS Code) | MATERIAL DESCRIPTION | Well Completion Schematic | FIELD NOTES AND WELL DETAILS |
|---|---|---|---|---|---|---|---|---|---|---|
| | 30 | 7 | | 7 | 0.4 | | | *Increasing low plasticity clay, decreasing sand.* | | |
| | 35 | 8 | | 3 | 0.0 | | | Boring terminated at a depth of 37' [bgs] on 4/3/2008 and a monitoring well was installed upon completion. | | Schedule 40 PVC Sump |
| | 40 | | | | | | | | | |
| | 45 | | | | | | | | | |
| | 50 | | | | | | | | | |
| | 55 | | | | | | | | | |
| | 60 | | | | | | | | | |
| | 65 | | | | | | | | | |

Report: PORT_ENV_WELL; File: BRADISL.GPJ; 6/6/2008 MW-11

URS

**Project: Bradford Island**
**Project Location: Bonneville Dam, Oregon**
**Project Number: 25696679**

# Log of Boring MW-12

Sheet 1 of 1

| | | | | | |
|---|---|---|---|---|---|
| Date(s) Drilled and Installed | **3/26/2008** | Geologist | **MC** | Reviewer | **NM** |
| Drilling Method | **Hollow Stem Auger [HSA]** | Drilling Contractor | **Boart Longyear** | Total Depth of Borehole | **26.5 ft. [bgs]** |
| Sampling Method | **Split Spoon Sampler** | Drill Bit Size/Type | **6 5/8 in. I.D. HSA with center bit** | Approximete Surface Elevation | **96.93 ft. MSL** |
| Drill Rig Type | **CME-75 HT** | Groundwater Level(s) | **24.08 ft. [bgs] [4/15/08]** | Hammer Data | **140 lb. , 30 in. drop automatic hammer** |
| Borehole Backfill | **Monitoring Well Installed** | Comments | **MSL: mean sea level, bgs: below ground surface** | Location | **Bradford Island Sandblast Area** |

| Elevation feet / Depth, feet | SAMPLES: Type Number | Sampling Resistance, Blows/12 in. | Recovery, (feet) | Headspace PID, ppm | Graphic Log | Lithologic Log (USCS Code) | MATERIAL DESCRIPTION | Well Completion Schematic | FIELD NOTES AND WELL DETAILS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | GW | **Sandy GRAVEL with Silt [GW]**, grey-brown, dry to moist, subrounded to rounded well-graded gravel. Loose fine sand. Low plasticity silt. [Colluvium] | | Stickup Monument<br>Concrete<br>2" Schedule PVC Riser |
| 5 | 1 | 61/3 in. | .5 | 0.2 | | ML | **Gravelly SILT with Sand [ML]**, brown to orange-brown, moist, low plasticity, stiff silt. Rounded to subrounded, well-graded gravel with some cobbles. Loose fine sand. [Colluvium]<br>*Trace low plasticity clay.* | | Steel cable in auger cuttings from 4' to 5' bgs. |
| 10 | 2 | 10 | NR | NS | | | | | Baroid Hole Plug 3/8" Bentonite Chips [hydrated] |
| 15 | 3 | 39 | 0.3 | 0.4 | | CL | **Silty CLAY [CL]**, grey-brown, moist, low plasticity hard fines. Some rounded gravel and cobbles. [Colluvium] | | Oglebay Norton 10-20 Silica Sand<br>0.010 in. - Slot Schedule 40 PVC screen |
| | | | | | | CL | **Silty CLAY [CL]**, dark grey, moist, low plasticity, stiff fines. Little subangular to subrounded gravel. [Weathered Slide Block] | | |
| 20 | 4 | 22 | 0.5 | 0.5 | | ML | **Sandy SILT [ML]**, grey-green with yellow and grey mottling, moist, low plasticity, very stiff silt. Loose fine sand. Some angular gravel. [Weathered Slide Block]<br>*Wet.* | | |
| 25 | 5 | 61/8 in. | 0.3 | 0.2 | | | **SILTSTONE**, dark grey, wet, slightly weathered to low plasticity silt and clay in fractures. Fine grained matrix with some subrounded to subangular gravel clasts. [Slide Block] | | Schedule 40 PVC Sump |
| 30 | | | | | | | Boring terminated at a depth of 26.3' [bgs] due to auger refusal on 3/26/2008 and a monitoring well was installed upon completion. | | |

Report: PORT_ENV_WELL; File: BRADISL.GPJ; 6/6/2008 MW-12

URS

**Project: Bradford Island**
**Project Location: Bonneville Dam, Oregon**
**Project Number: 25696679**

# Log of Boring MW-13

Sheet 1 of 2

| | | | | | |
|---|---|---|---|---|---|
| Date(s) Drilled and Installed | **4/2/2008** | Geologist | **MC** | Reviewer | **NM** |
| Drilling Method | **Sonic** | Drilling Contractor | **Boart Longyear** | Total Depth of Borehole | **37.0 ft. [bgs]** |
| Sampling Method | **Continuous Core** | Drill Bit Size/Type | **4 in. core with 6 in. casing** | Approximete Surface Elevation | **97.82 ft. MSL** |
| Drill Rig Type | **Prosonic Truck Mount** | Groundwater Level(s) | **16.62 ft. [bgs] [4/14/08]** | Hammer Data | **n/a** |
| Borehole Backfill | **Monitoring Well Installed** | Comments | **MSL: mean sea level, bgs: below ground surface** | Location | **Bradford Island Sandblast Area** |

| Elevation feet | Depth, feet | SAMPLES Type | SAMPLES Number | Recovery, (feet) | Headspace PID, ppm | Graphic Log | Lithologic Log (USCS Code) | MATERIAL DESCRIPTION | Well Completion Schematic | FIELD NOTES AND WELL DETAILS |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | | GM | **Asphalt** | | Flush to Grade Monument |
| | | | 1 | 7 | | | | **Silty GRAVEL [GM]**, brown, dry to moist, rounded, well-graded gravel with some cobbles. Matrix consists of low plasticity stiff, silt with trace loose fine sand. [Colluvium] | | Concrete |
| | | | | | | | | | | 2" Schedule PVC Riser |
| | | | | | | | | *Decreasing sand, increasing low plasticity clay, increasingly angular gravel.* | | |
| | 5 | | | | 0.6 | | ML | **Clayey SILT with Gravel [ML]**, mottled grey, brown, and greenish-grey, moist, low plasticity, medium stiff fines. Subangular to subrounded gravel with some cobbles. Fractures in matrix are filled with yellow-brown, low plasticity clay. [Weathered Slide Block] | | |
| | 10 | | | | 0.0 | | | *Brown, subrounded to rounded gravel, green low plasticity clay on fracture surfaces.* | | |
| | | | 2 | 9 | | | | | | |
| | | | | | | | ML | **Gravelly SILT with Sand [ML]**, brown fines with yellow-orange sand, dry, low plasticity, hard fines. Subangular to subrounded gravel with some rounded cobbles. Loose, poorly graded, medium-fine sand. [Weathered Slide Block] | | |
| | 15 | | | | 0.3 | | | | | Baroid Hole Plug 3/8" Bentonite Chips [hydrated] |
| | | | 3 | 5 | | | | | | |
| | 20 | | | | 0.6 | | ML | **Sandy SILT with Gravel [ML]**, grey to dark greenish grey, moist, low plasticity medium stiff silt. Loose, poorly graded fine sand. Subrounded to rounded gravel with some cobbles. [Weathered Slide Block] | | |
| | | | 4 | 5 | | | | | | |
| | 25 | | | | 0.5 | | | *Wet.* | | Oglebay Norton 10-20 Silica Sand |
| | | | | | | | | | | 0.010 in. - Slot Schedule 40 PVC screen |
| | 30 | | | | | | | | | |

Report: PORT_ENV_WELL; File: BRADISL.GPJ; 6/6/2008 MW-13

URS

**Project: Bradford Island**
**Project Location: Bonneville Dam, Oregon**
**Project Number: 25696679**

# Log of Boring MW-13

Sheet 2 of 2

| Elevation feet | Depth, feet | SAMPLES: Type Number | SAMPLES: | SAMPLES: Recovery, (feet) | SAMPLES: Headspace PID, ppm | Graphic Log | Lithologic Log (USCS Code) | MATERIAL DESCRIPTION | Well Completion Schematic | FIELD NOTES AND WELL DETAILS |
|---|---|---|---|---|---|---|---|---|---|---|
| | 30 | 5 | | 11 | 0.4 | | | *As above.* | | |
| | 35 | | | | 0.5 | | | | | Schedule 40 PVC Sump |
| | | | | | | | | Boring terminated at a depth of 37' [bgs] on 4/2/2008 and a monitoring well was installed upon completion. | | |
| | 40 | | | | | | | | | |
| | 45 | | | | | | | | | |
| | 50 | | | | | | | | | |
| | 55 | | | | | | | | | |
| | 60 | | | | | | | | | |
| | 65 | | | | | | | | | |

Report: PORT_ENV_WELL; File: BRADISL.GPJ; 6/6/2008 MW-13

URS

**Project: Bradford Island**
**Project Location: Bonneville Dam, Oregon**
**Project Number: 25696679**

# Log of Boring MW-14

Sheet 1 of 1

| | | | | | |
|---|---|---|---|---|---|
| Date(s) Drilled and Installed | **3/25/2008** | Geologist | **MC** | Reviewer | **NM** |
| Drilling Method | **Hollow Stem Auger [HSA]** | Drilling Contractor | **Boart Longyear** | Total Depth of Borehole | **24.0 ft. [bgs]** |
| Sampling Method | **Split Spoon Sampler** | Drill Bit Size/Type | **6 5/8 in. I.D. HSA with center bit** | Approximete Surface Elevation | **86.84 ft. MSL** |
| Drill Rig Type | **CME-75 HT** | Groundwater Level(s) | **13.11 ft. [bgs] [4/14/08]** | Hammer Data | **140 lb. , 30 in. drop automatic hammer** |
| Borehole Backfill | **Monitoring Well Installed** | Comments | **MSL: mean sea level, bgs: below ground surface** | Location | **Bradford Island Sandblast Area** |

| Elevation feet | Depth, feet | SAMPLES Type | SAMPLES Number | Sampling Resistance, Blows/12 in. | Recovery, (feet) | Headspace PID, ppm | Graphic Log | Lithologic Log (USCS Code) | MATERIAL DESCRIPTION | Well Completion Schematic | FIELD NOTES AND WELL DETAILS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | | | GW | **Asphalt** | | Flush to Grade Monument |
| | | | | | | 33.2 | | | **Sandy GRAVEL with Silt [GW]**, grey-brown, dry to moist, subrounded to rounded well-graded gravel with some cobbles. Matrix consists of loose fine sand and nonplastic silt. Slight solvent odor. [Colluvium] | | Concrete<br>Collected bag headspace sample from auger cuttings @ 2' due to odor. |
| | | | | | | | | GM | **Silty GRAVEL with Clay [GM]**, grey-brown, dry to moist, subrounded, well graded gravel with some cobbles. Low plasticity stiff fines. Slight solvent odor. [Colluvium] | | |
| | 5 | | 1 | 13 | .8 | 17.6 | | | *No odor @ 6 ft.* | | 2" Schedule PVC Riser<br>Baroid Hole Plug 3/8" Bentonite Chips [hydrated] |
| | 10 | | 2 | 5 | .3 | 14.1 | | CL | **Silty CLAY with Gravel [CL]**, mottled yellow, grey, and brown, moist, low plasticity, medium stiff fines. Subrounded, well graded gravel. [Colluvium] | | Oglebay Norton 10-20 Silica Sand |
| | | | | | | | | | *Wet.* | | 0.010 in. - Slot Schedule 40 PVC screen |
| | 15 | | 3 | 13 | .5 | 1.0 | | | **SILTSTONE**, greenish-grey, wet, slightly weathered to low plasticity silt and clay. Fine-grained matrix with rock texture and some subrounded to subangular gravel-sized clasts. [Slide Block] | | |
| | 20 | | 4 | 7 | .6 | 1.6 | | GW | **Sandy GRAVEL [GW]**, greenish-grey, wet, subrounded, well graded gravel with loose coarse sand. [Slide Block] | | |
| | | | | | | | | | **SILTSTONE**, greenish-grey, wet, moderately weathered to low plasticity, stiff silt and clay. Fine-grained matrix with rock texture and some subrounded to subangular gravel-sized clasts. [Slide Block] | | Schedule 40 PVC Sump |
| | 25 | | | | | | | | Boring terminated at a depth of 24' [bgs] on 3/25/2008 and a monitoring well was installed upon completion. | | |
| | 30 | | | | | | | | | | |

Report: PORT_ENV_WELL; File: BRADISL.GPJ; 6/6/2008 MW-14

URS

**Project: Bradford Island**
**Project Location: Bonneville Dam, Oregon**
**Project Number: 25696679**

# Log of Boring MW-15

Sheet 1 of 1

| | | | | | |
|---|---|---|---|---|---|
| Date(s) Drilled and Installed | **3/24/2008** | Geologist | **MC** | Reviewer | **NM** |
| Drilling Method | **Hollow Stem Auger [HSA]** | Drilling Contractor | **Boart Longyear** | Total Depth of Borehole | **22.9 ft. [bgs]** |
| Sampling Method | **Split Spoon Sampler** | Drill Bit Size/Type | **6 5/8 in. I.D. HSA with center bit** | Approximete Surface Elevation | **87.09 ft. MSL** |
| Drill Rig Type | **CME-75 HT** | Groundwater Level(s) | **13.28 ft. [bgs] [4/14/08]** | Hammer Data | **140 lb. , 30 in. drop automatic hammer** |
| Borehole Backfill | **Monitoring Well Installed** | Comments | **MSL: mean sea level, bgs: below ground surface** | Location | **Bradford Island Sandblast Area** |

| Elevation feet | Depth, feet | SAMPLES Type Number | Sampling Resistance, Blows/12 in. | Recovery, (feet) | Headspace PID, ppm | Graphic Log | Lithologic Log (USCS Code) | MATERIAL DESCRIPTION | Well Completion Schematic | FIELD NOTES AND WELL DETAILS |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | | | | | | GW | **Asphalt.** | | Flush to Grade Monument |
| | | | | | | | | **Sandy Gravel with Silt [GW]**, grey-brown, dry to moist, rounded well-graded gravel with cobbles. Loose poorly-graded fine sand. Nonplastic medium stiff silt. [Colluvium] | | Concrete |
| | | | | | | | | | | 2" Schedule 40 PVC Riser |
| | 5 | 1 | 14 | .4 | 1.2 | | | *Moist.* | | |
| | | | | | | | GM | **Silty GRAVEL [GM]**, grey-brown, moist, rounded, well-graded gravel with few cobbles. Low plasticity stiff to very stiff silt with trace clay. [Colluvium] | | Baroid Hole Plug 3/8" Bentonite Chips [hydrated] |
| | 10 | 2 | 24 | .5 | 1.0 | | | | | Oglebay Norton 10-20 Silica Sand |
| | | | | | | | | *Wet.* | | 0.010 in. - Slot Schedule 40 PVC screen |
| | | | | | | | CL | **Gravelly CLAY [CL]**, grey-brown, wet, low plasticity, hard clay with trace silt. Rounded, well graded gravel. [Weathered Slide Block] | | |
| | 15 | 3 | 31 | .9 | 0.6 | | | | | |
| | | | | | | | SM | **Basalt Boulder**, red-brown, wet, moderately weathered and highly fractured with low plasticity hard green clay infilling. [Weathered Slide Block] | | |
| | | | | | | | | **Silty SAND [SM]**, yellow-brown, wet, well-graded loose sand. Low plasticity soft silt. [Weathered Slide Block] | | |
| | 20 | 4 | 3 | .3 | 0.9 | | | | | Schedule 40 PVC Sump |
| | | | | | | | | Boring terminated at a depth of 22.9' [bgs] on 3/24/2008 and a monitoring well was installed upon completion. | | |
| | 25 | | | | | | | | | |
| | 30 | | | | | | | | | |

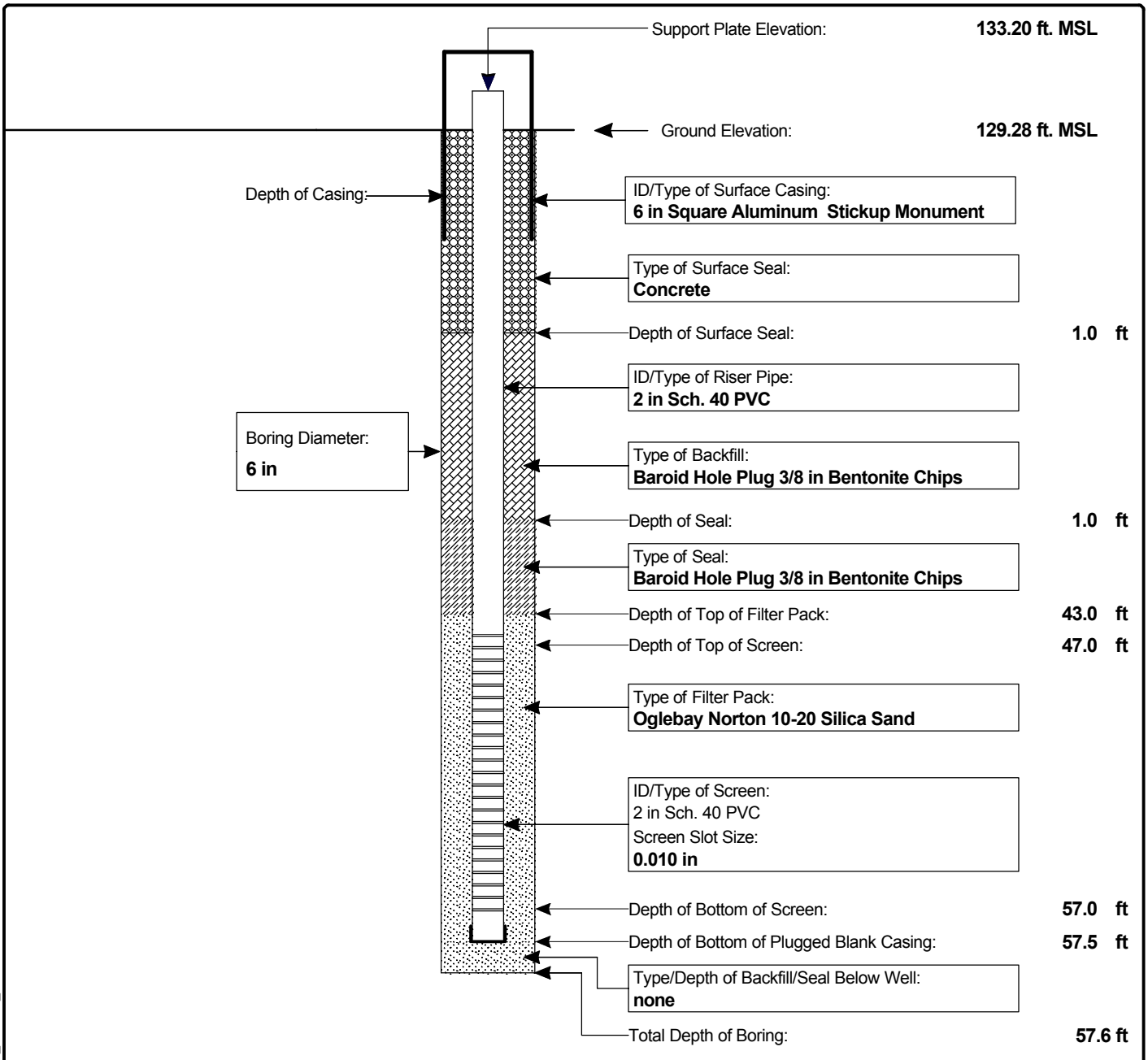
Report: PORT_ENV_WELL; File: BRADISL.GPJ; 6/6/2008 MW-15

URS

**Project: Bradford Island**
**Project Location: Bonneville Dam, Oregon**
**Project Number: 25696679**

# MONITORING WELL CONSTRUCTION LOG FOR WELL MW-10

| | | | | | |
|---|---|---|---|---|---|
| Well Location | **Bradford Island Reference Area** | | | Date Completed | **4/8/2008** |
| Installed By | **Boart Longyear** | Observed By | **MC** | Total Depth | **57.6 ft. bgs** |
| Method of Installation | **Sonic** | | | | |
| Screened Interval | **47-57 ft bgs** | Completion Zone | **45-57.6 ft bgs** | | |
| Remarks | | | | | |




**NOTE: DIAGRAM IS NOT TO SCALE**

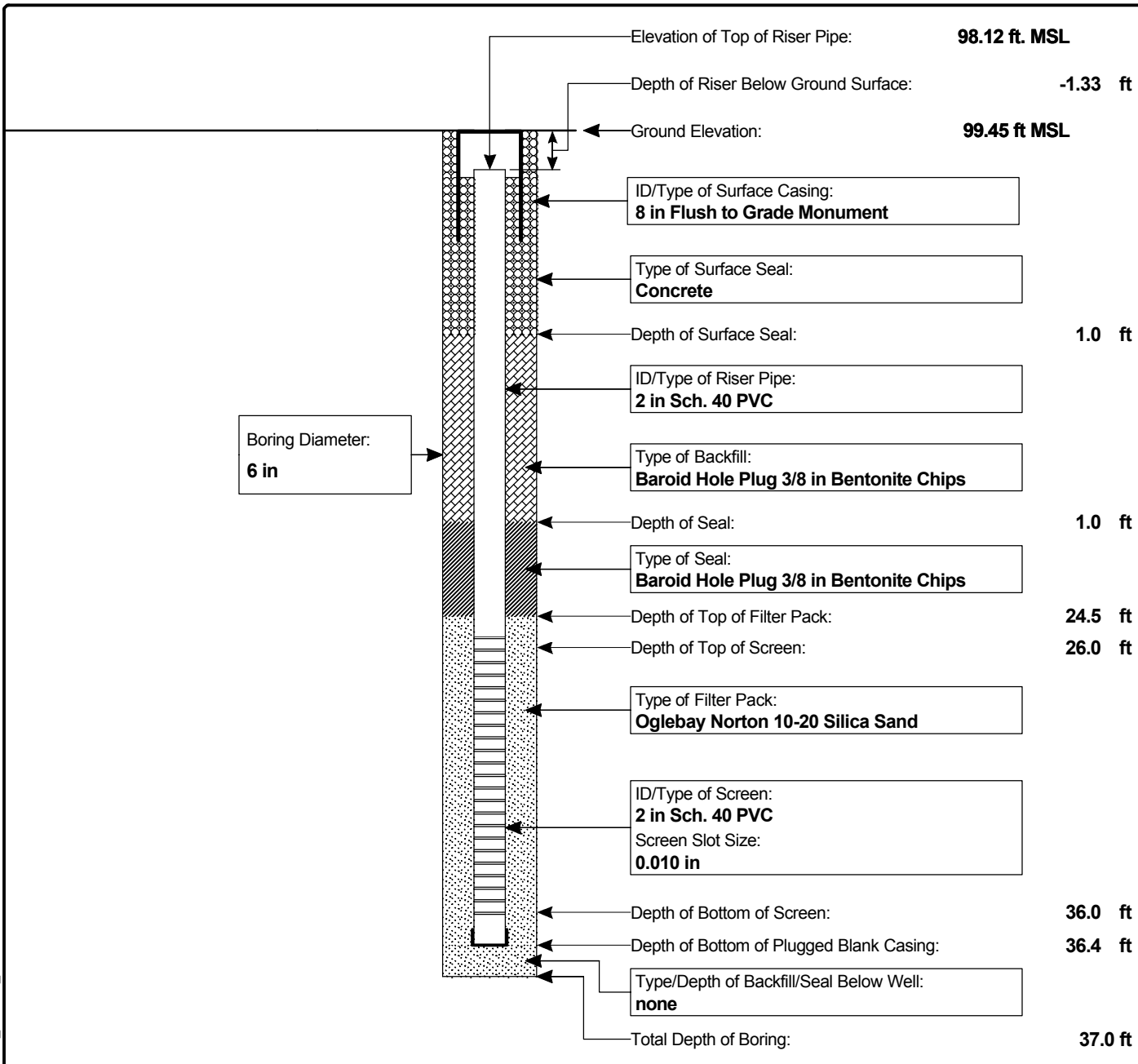
Report: PORT_ENV_WELL_ABOVE_GROUND; File: BRADISL.GPJ; 6/6/2008 MW-10

URS

**Project: Bradford Island**
**Project Location: Bonneville Dam, Oregon**
**Project Number: 25696679**

# MONITORING WELL CONSTRUCTION LOG FOR WELL MW-11

| | | | | | |
|---|---|---|---|---|---|
| Well Location | **Bradford Island Sandblast Area** | | | Date(s) Installed **4/3/2008** | Time |
| Installed By | **Boart Longyear** | Observed By | **MC** | Total Depth (ft) | **37.0 ft. bgs** |
| Method of Installation | **Sonic** | | | | |
| Screened Interval | **26-36 ft bgs** | Completion Zone | **26.5-37 ft bgs** | | |
| Remarks | | | | | |




**NOTE: DIAGRAM IS NOT TO SCALE**

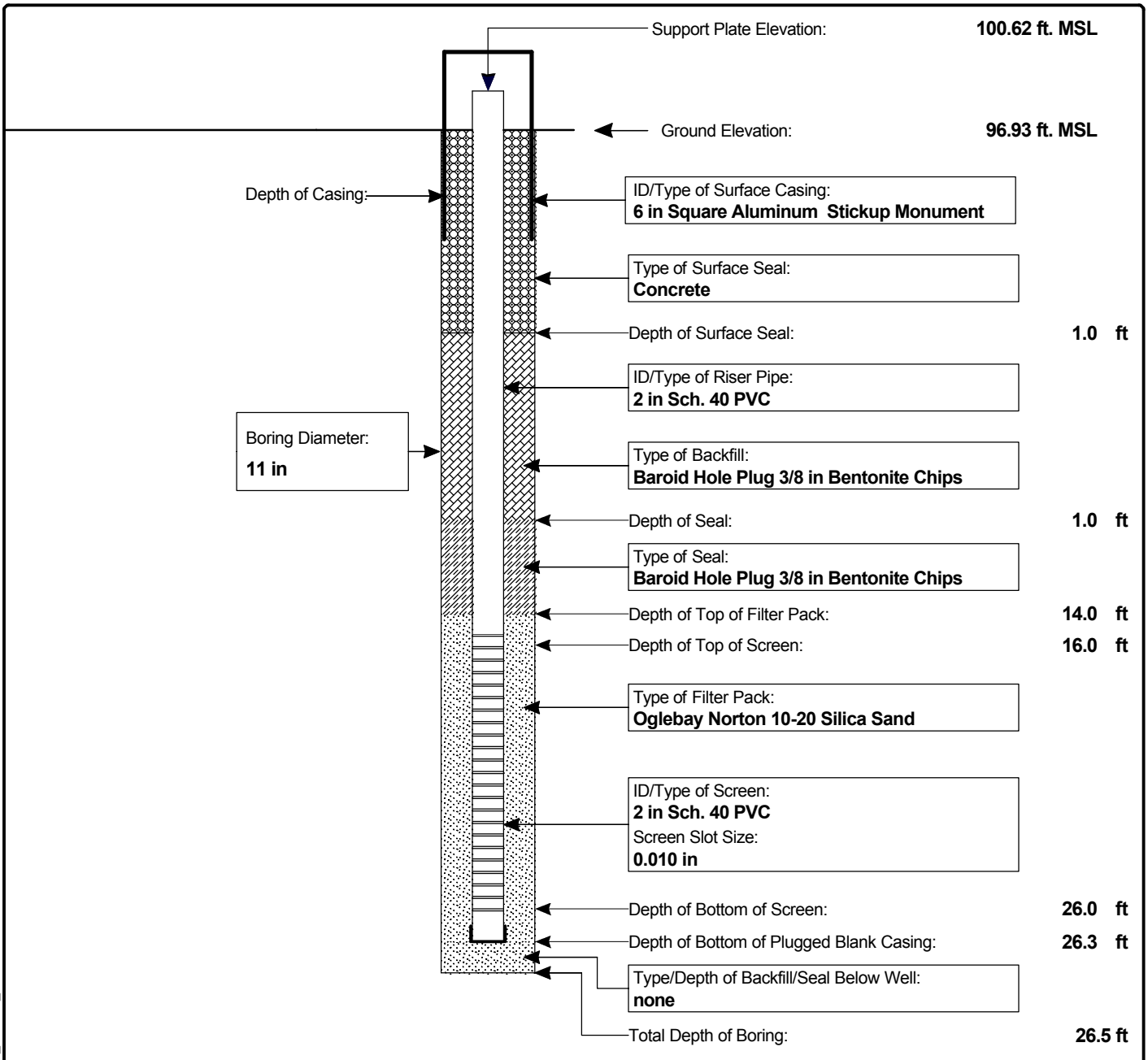
Report: ENV_WELL_CONSTR_BELOW_GROUND; File: BRADISL.GPJ; 6/6/2008 MW-11

URS

**Project: Bradford Island**
**Project Location: Bonneville Dam, Oregon**
**Project Number: 25696679**

# MONITORING WELL CONSTRUCTION LOG FOR WELL MW-12

| | | | | | |
|---|---|---|---|---|---|
| Well Location | **Bradford Island Sandblast Area** | | | Date Completed | **3/26/2008** |
| Installed By | **Boart Longyear** | Observed By | **MC** | Total Depth | **26.5 ft. bgs** |
| Method of Installation | **Hollow Stem Auger** | | | | |
| Screened Interval | **16-26 ft bgs** | Completion Zone | **22-26.3 ft bgs** | | |
| Remarks | | | | | |




**NOTE: DIAGRAM IS NOT TO SCALE**

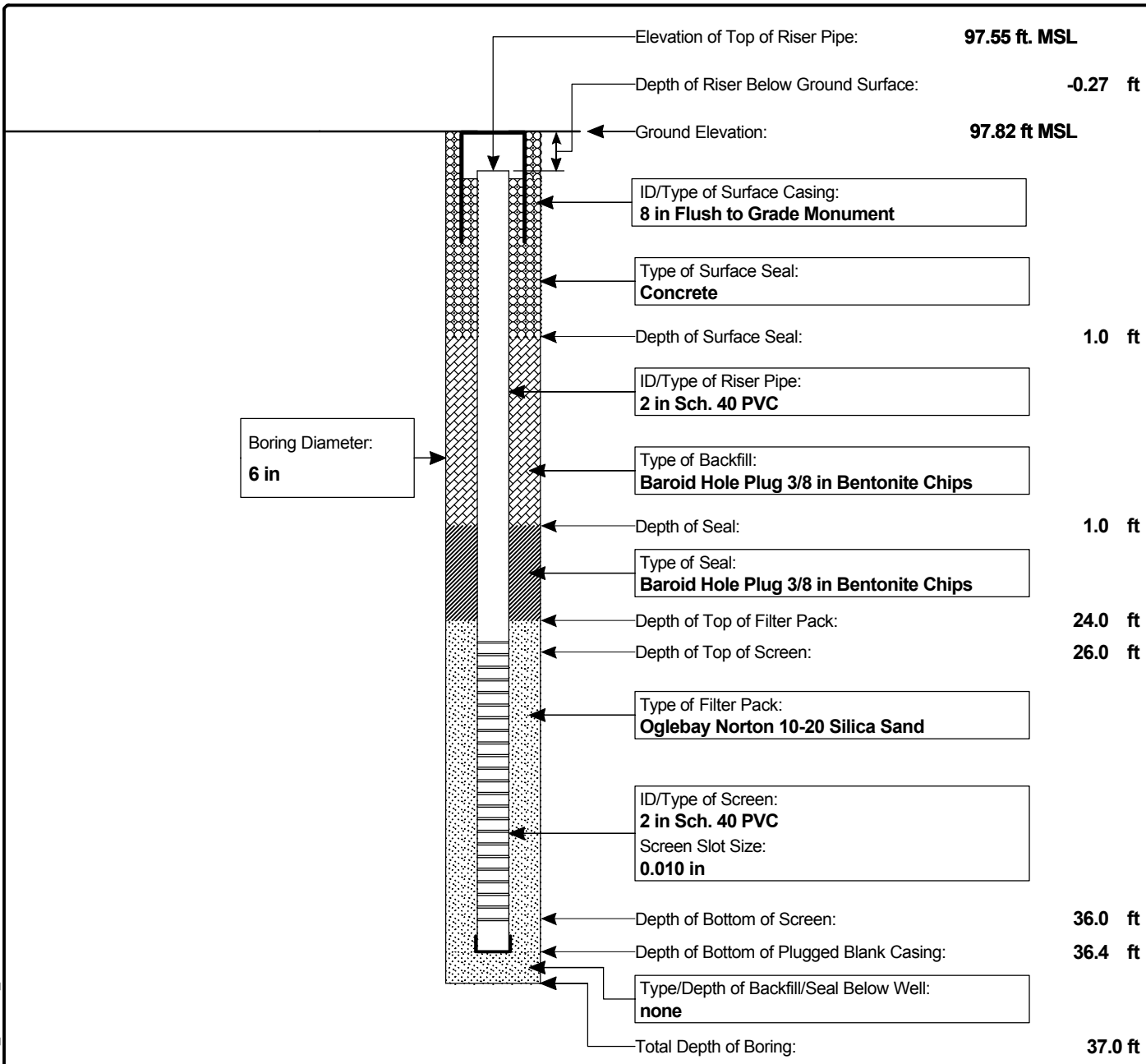
Report: PORT_ENV_WELL_ABOVE_GROUND; File: BRADISL.GPJ; 6/6/2008 MW-12

URS

**Project: Bradford Island**
**Project Location: Bonneville Dam, Oregon**
**Project Number: 25696679**

# MONITORING WELL CONSTRUCTION LOG FOR WELL MW-13

| | | | | | |
|---|---|---|---|---|---|
| Well Location | **Bradford Island Sandblast Area** | | | Date(s) Installed **4/2/2008** | Time |
| Installed By | **Boart Longyear** | Observed By | **MC** | Total Depth (ft) | **37.0 ft. bgs** |
| Method of Installation | **Sonic** | | | | |
| Screened Interval | **26-36 ft bgs** | Completion Zone | **26-37 ft bgs** | | |
| Remarks | | | | | |




**NOTE: DIAGRAM IS NOT TO SCALE**

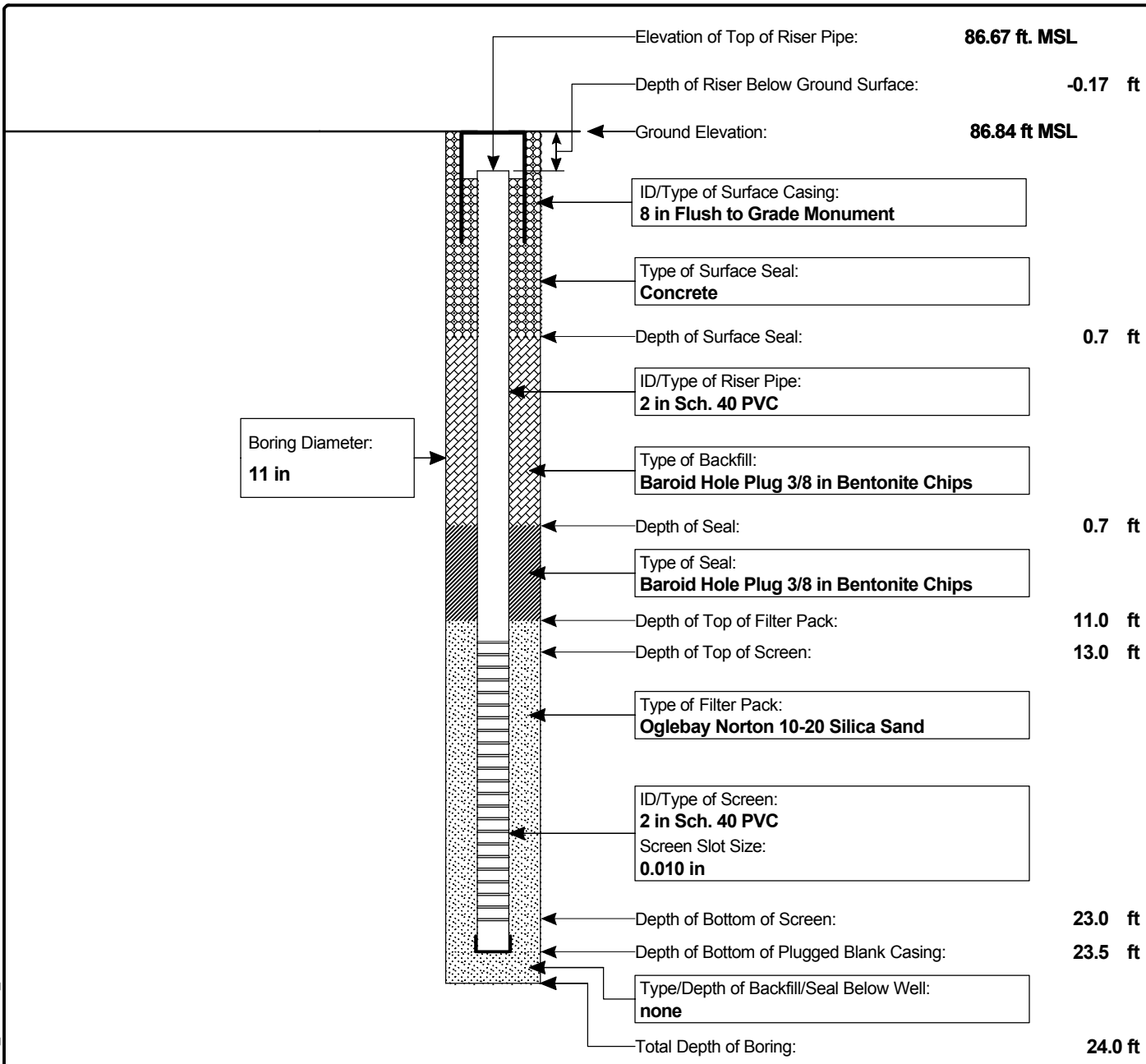
Report: ENV_WELL_CONSTR_BELOW_GROUND; File: BRADISL.GPJ; 6/6/2008 MW-13

URS

**Project: Bradford Island**
**Project Location: Bonneville Dam, Oregon**
**Project Number: 25696679**

# MONITORING WELL CONSTRUCTION LOG FOR WELL MW-14

| | | | | | |
|---|---|---|---|---|---|
| Well Location | **Bradford Island Sandblast Area** | | | Date(s) Installed **3/25/2008** | Time |
| Installed By | **Boart Longyear** | Observed By | **MC** | Total Depth (ft) | **24.0 ft. bgs** |
| Method of Installation | **Hollow Stem Auger** | | | | |
| Screened Interval | **13-23 ft bgs** | Completion Zone | **13-24 ft bgs** | | |
| Remarks | | | | | |




**NOTE: DIAGRAM IS NOT TO SCALE**

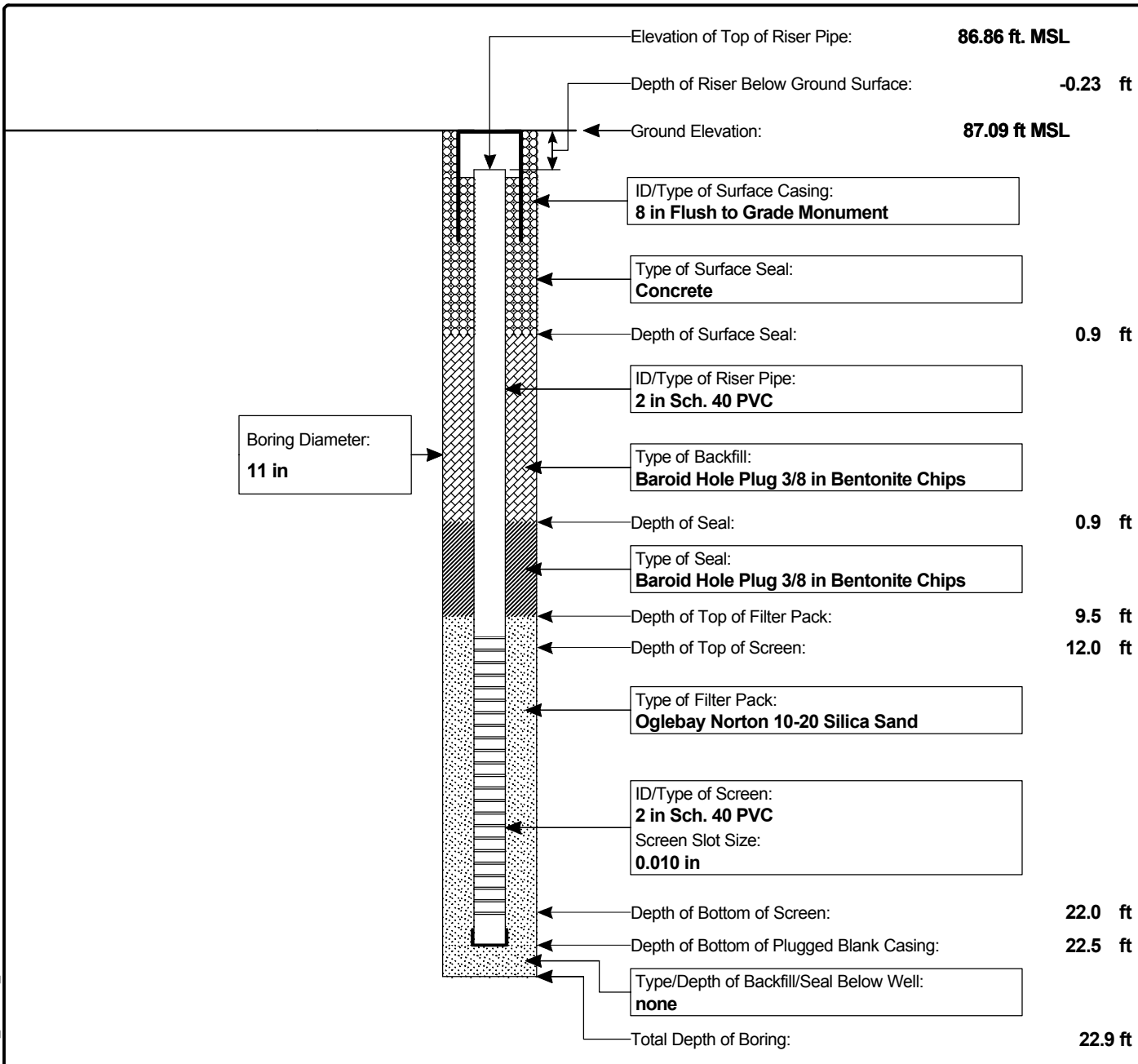
Report: ENV_WELL_CONSTR_BELOW_GROUND; File: BRADISL.GPJ; 6/6/2008 MW-14

URS

**Project: Bradford Island**
**Project Location: Bonneville Dam, Oregon**
**Project Number: 25696679**

# MONITORING WELL CONSTRUCTION LOG FOR WELL MW-15

| | | | | | |
|---|---|---|---|---|---|
| Well Location | **Bradford Island Sandblast Area** | | | Date(s) Installed **3/24/2008** | Time |
| Installed By | **Boart Longyear** | Observed By | **MC** | Total Depth (ft) | **22.9 ft. bgs** |
| Method of Installation | **Hollow Stem Auger** | | | | |
| Screened Interval | **12-22 ft bgs** | Completion Zone | **12-23 ft bgs** | | |
| Remarks | | | | | |




**NOTE: DIAGRAM IS NOT TO SCALE**

URS

Report: ENV_WELL_CONSTR_BELOW_GROUND; File: BRADISL.GPJ; 6/6/2008 MW-15

# Monitoring Well Development Field Log

Page 1 of 1

Well Number: 4/8/08

Date: MW-10

| Project Information | |
|---|---|
| Project Name: | Bradford Island Upland OU |
| URS Project Number: | - |

| General Information | |
|---|---|
| Field Team: | N. Moody |
| Purge Method: | Submersible Pump |
| Pump Intake Depth (ft btc): | Varies |
| Flow-Through Cell: | No |
| Decontamination Method: | 3 Stage |

Well Volume Calculation — Stick-up or Flush (circle one)

| Well Depth (ft bgs) | Well Depth (ft btc) | DTW (ft btc) | Water Column (ft) | Convert Factor (gal/ft) | One Well Volume (gal) |
|---|---|---|---|---|---|
| - | 57 | 10.70 | 46.3 | 0.18 | 8.3 |

3/4"=0.023 gal/ft 2"=0.17 gal/ft 4"=0.66 gal/ft 6"=1.5 gal/ft

| General Information | |
|---|---|
| Purge Water Disposition: | Drums onsite |
| Field Conditions: | cloudy 50s |

Comments:

Well Purge Data — Total Volume to Purge (gal) =

| Time | Volume Purged (gallons) | Purge Rate (gpm) | DTW (ft btc) | Conductivity (uS/cm) | Temp. (°C) | pH | ORP (mV) | D.O. (mg/L) | Turbidity (NTUs) | Clarity/Color/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1055 | Pump On | ~~1.0~~ NM | Initial 10.70' | - | ±3% | ±10% | ±0.1 | ±10mv | ±10% | <= Stabilization Criteria |
| 1100 | 10 5 | ~~1.0~~ NM | - | | | | | | 1065 | Brown/VC |
| 1105 | 20 10 | ~~1.0~~ NM | - | | | | | | - | Brown/VC |
| 1110 | 15 | 1.0 | - | | | | | | - | " |
| 1115 | 20 | 1.0 | - | | | | | | - | " |
| 1120 | 25 | 1.0 | - | | | | | | - | " |
| 1125 | 27.5 | 0.5 | - | | | N/A | | | - | " |
| 1130 | 30 | | - | | | | | | 7008 | " |
| 1135 | 32.5 | | - | | | | | | - | " |
| 1140 | 35 | | - | | | | | | - | " |
| 1145 | 37.5 | | - | | | | | | 409 | Cl/Brown |
| 1150 | 40 | | - | | | | | | 208 | Cl/Brown |
| 1155 | 42.5 | | - | | | | | | 65.2 | SC/ " |
| 1200 | 45 | | - | | | | | | 12.62 | AC/No color |
| 1205 | 50 | | - | | | | | | 8.65 | C/No color |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| | | | | | | | | | | |
| 1205 | Pump Off | - | Final N/A | | | | | | | |

Note: bgs= below ground surface btc=below top of casing DTW=depth to water gpm=gallons per minute
Clarity: VC=very cloudy Cl=cloudy SC=slightly cloudy AC=almost clear C=clear CC=crystal clear

# Monitoring Well Development Field Log

Well Number: MW-11

Page 1 of 1

Date: 4/4/08

| Project Information | |
|---|---|
| Project Name: | Bradford Island RI/FS |
| URS Project Number: | |

| General Information | |
|---|---|
| Field Team: | Mark Cecchini |
| Purge Method: | submersible pump |
| Pump Intake Depth (ft btc): | varies |
| Flow-Through Cell: | no |
| Decontamination Method: | soap, methanol, DI |

Well Volume Calculation — Stick-up or (Flush) (circle one)

| Well Depth (ft bgs) | Well Depth (ft btc) | DTW (ft btc) | Water Column (ft) | Convert Factor (gal/ft) | One Well Volume (gal) |
|---|---|---|---|---|---|
| 36.9 | 36.5 | 5.89 | 30.61 | 0.17 | 5.2 |

3/4"=0.023 gal/ft (2"=0.17 gal/ft) 4"=0.66 gal/ft 6"=1.5 gal/ft

| General Information | |
|---|---|
| Purge Water Disposition: | labeled 55gal. drum |
| Field Conditions: | 40's, overcast, rain, W wind |

Comments: Water quality parameters not recorded due to malfunctioning YSI meter.

Well Purge Data — Total Volume to Purge (gal) = 52

| Time | Volume Purged (gallons) | Purge Rate (gpm) | DTW (ft btc) | Conductivity (uS/cm) | Temp. (°C) | pH | ORP (mV) | D.O. (mg/L) | Turbidity (NTUs) | Clarity/Color/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Initial | | | | | | | <= Stabilization Criteria |
| 1221 | Pump On | 1221 | 5.89 | - | ±3% | ±10% | ±0.1 | ±10mv | ±10% | |
| 1226 | 4 | ~1.5 | — | | | | | | HIGH | Grey, VC |
| 1236 | 20 | " | 34.15 | | | | | | HIGH | Grey, VC |
| 1245 | 34 | pump shut off, well is dry | | | | | | | HIGH | Grey, VC |
| restart 1330 | 35 | " | 29.7 | | | | | | 2442 | brown-grey CL |
| 1336 | 36 | ~270 mL/min | — | | | | | | HIGH | Grey, VC |
| 1346 | 37 | " | — | pump off, well is dry | | | | | HIGH | Grey, VC |
| 1410 | 37 | " | 32.41 | | | | | | | |
| 1428 | 37 | " | 30.88 | | | | | | | |
| 1438 | 37 | " | 29.39 | | | | | | | |
| restart 1443 | 37 | ~1.5 | 29.0 | | | | | | 915 | SC, clear |
| 1448 | 44 | ~1.5 | 34.25 | | | | | | 303 | SC, clear |
| 1451 | 46 | ~250 mL/min | dry | pump off, well is dry | | | | | | |
| 1527 | 46 | — | 30.94 | | | | | | | |
| 1536 | 46 | — | 29.93 | | | | | | | |
| restart 1547 | 46 | ~1.5 | 29.30 | | | | | | 314 | SC, clear |
| 1550 | 49 | " | 33.90 | | | | | | 379 | SC, clear |
| 1554 | 52 | " | dry | pump off due to dry well | | | | | | |
| | | well developed after purging 10 well volumes and not observing turbidity improvement in 3 consecutive readings. | | | | | | | | |
| | Pump Off | | Final dry | | | | | | | |

Note: bgs= below ground surface btc=below top of casing DTW=depth to water gpm=gallons per minute
Clarity: VC=very cloudy Cl=cloudy SC=slightly cloudy AC=almost clear C=clear CC=crystal clear

## Monitoring Well Development Field Log

Well Number: MW-12

Page 1 of 1

Date: 3/27/08

| Project Information | |
|---|---|
| Project Name: | Bradford Island Upland OU RI |
| URS Project Number: | |

| General Information | |
|---|---|
| Field Team: | M. Cecchini |
| Purge Method: | submersible pump |
| Pump Intake Depth (ft btc): | varies |
| Flow-Through Cell: | yes |
| Decontamination Method: | soap, methanol, DI |

Well Volume Calculation — Stick-up or Flush (circle one)

| Well Depth (ft bgs) | Well Depth (ft btc) | DTW (ft btc) | Water Column (ft) | Convert Factor (gal/ft) | One Well Volume (gal) |
|---|---|---|---|---|---|
| 26.45 | 29.56 | 23.55 | 6.01 | 0.17 | 1.02 |

3/4"=0.023 gal/ft 2"=0.17 gal/ft 4"=0.66 gal/ft 6"=1.5 gal/ft

| General Information | |
|---|---|
| Purge Water Disposition: | labled drum @ haz. mat area |
| Field Conditions: | 40's, overcast, rain showers |

**Comments:**

**Well Purge Data** — Total Volume to Purge (gal) =

| Time | Volume Purged (gallons) | Purge Rate (gpm) | DTW (ft btc) | Conductivity (uS/cm) | Temp. (°C) | pH | ORP (mV) | D.O. (mg/L) | Turbidity (NTUs) | Clarity/Color/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1052 | Pump On | | Initial 23.55 | - | ±3% | ±10% | ±0.1 | ±10mv | ±10% | <= Stabilization Criteria |
| 1055 | 5 | ~1.5 | — | 317 | 15.48 | 6.78 | -52.0 | 8.77 | 148 | Cl, lt. brn |
| 1100 | — | — | — | surge | well | w/ | pump | across | water column | |
| 1105 | 10 | ~1.5 | — | 427 | 15.04 | 6.83 | -89.4 | 8.16 | 620 | CL, lt. brn |
| 1106 | pump off | well | is dry | | | | | | | |
| 1155 | pump on | 27.0 | | | | | | | | |
| 1157 | 13 | ~1.5 | — | 262 | 14.96 | 6.70 | -33.2 | 7.04 | 160 | SC, lt. brn |
| 1200 | 16 pump off | well | is dry | | | | | | | |
| 1243 | pump on | 26.9 | | | | | | | | |
| 1246 | 17 | ~1.0 | — | 242 | 14.77 | 6.57 | -89.0 | 8.61 | 116 | SC, lt. brn |
| 1249 | 20 | " | — | 241 | 14.62 | 7.24 | -92.3 | 6.54 | 21.9 | AC, v. lt. brn |
| 1250 | 20 | Pump off | well | is dry | | | | | | |
| | ↳ | Well developed, 20 casing volumes purged | | | | | | | | |
| | Pump Off | 1250 | Final dry | | | | | | | |

Note: bgs= below ground surface btc=below top of casing DTW=depth to water gpm=gallons per minute
Clarity: VC=very cloudy Cl=cloudy SC=slightly cloudy AC=almost clear C=clear CC=crystal clear

# Monitoring Well Development Field Log

36.05' + 3.5"

Well Number: MW-13

Page 1 of 1

Date: 4/3/08

| Project Information | |
|---|---|
| Project Name: | Bradford Island, upland RI |
| URS Project Number: | |
| **General Information** | |
| Field Team: | N. Moody |
| Purge Method: | Down hole, Pump |
| Pump Intake Depth (ft btc): | Varies |
| Flow-Through Cell: | ~~Yes~~ No (see comments) |
| Decontamination Method: | 3-Stage. |

| Well Volume Calculation | | | | Stick-up or (Flush) | (circle one) |
|---|---|---|---|---|---|
| Well Depth (ft bgs) | Well Depth (ft btc) | DTW (ft btc) | Water Column (ft) | Convert Factor (gal/ft) | One Well Volume (gal) |
| +3.5" | 36.05 | 16.31 | 19.74 | 0.17 | 3.36 |

3/4"=0.023 gal/ft 2"=0.17 gal/ft 4"=0.66 gal/ft 6"=1.5 gal/ft

| General Information | |
|---|---|
| Purge Water Disposition: | Drums onsite |
| Field Conditions: | Sunny 50s |

**Comments:** Soft bottom; YSI cable is jammed; therefore cannot connect to reader. Connector ∴ only turbidity possible.

**Well Purge Data** — **Total Volume to Purge (gal) =**

| Time | Volume Purged (gallons) | Purge Rate ~~(gpm)~~ | DTW (ft btc) | Conductivity (uS/cm) | Temp. (°C) | pH | ORP (mV) | D.O. (mg/L) | Turbidity (NTUs) | Clarity/Color/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| | Pump On | mL/m | Initial 16.31 | - | ~~±3%~~ | ~~±10%~~ | ~~±0.1~~ | ~~±10mv~~ | ~~±10%~~ | <= Stabilization Criteria |
| 1345 | | 1000 | – | – | – | – | – | – | HIGH | Grey/VC |
| 1350 | 2.5 | 1000 | – | ↓ | ↓ | ↓ | ↓ | ↓ | HIGH | " " |
| 1355 | 5 | 1000 | – | | | | | | HIGH | " " |
| 1400 | 7.5 | 1000 | – | | | | | | 7362 | Brown Grey/VC |
| 1405 | 10 | 1000 | – | | | | | | HIGH | " " |
| 1410 | 15 | 2000 | – | | | | | | 1370 | " " |
| 1415 | 20 | 2000 | – | | | | | | HIGH | " " |
| 1420 | 25 | ↓ | – | | | | | | HIGH | " " |
| 1425 | 30 | | – | | | | | | 400 | |
| 1430 | 32.5 | 1000 | – | ↓ | ↓ | ↓ | ↓ | ↓ | 78.0 | whiteish, cl |
| 1435 | – | – | – | Pumped almost dry, Stopped pump, wait | | | | | – | – |
| 1445 | 32.5 | 1000 | – | Pump back on | | | | | 176 | " " |
| 1450 | 35 | 1000 | – | – | – | – | – | – | 90.3 | " " |
| 1455 | 37.5 | 1000 | – | – | – | – | – | – | 35.9 | " SC |
| 1500 | 40 | 1000 | – | – | – | – | – | – | 28.0 | " AC |
| 1505 | 42.5 | 1000 | – | – | – | – | – | – | 22.9 | " AC |
| 1510 | 45 | 1000 | – | – | – | – | – | – | 19.3 | " AC |
| 1515 | 47.5 | 1000 | – | – | – | – | – | – | 17.8 | " AC |
| 1520 | 50 | 1000 | – | – | – | – | – | – | 14.5 | " AC |
| 1525 | 52.5 | 1000 | – | – | – | – | – | – | 12.8 | " C |
| 1530 | 55 | 1000 | – | – | – | – | – | – | 12.7 | " C |
| 1535 | 57.5 | 1000 | – | – | – | – | – | – | 12.7 | " C |
| 1540 | 60 | 1000 | – | – | – | – | – | – | 9.97 | " C |
| | | | | | Development complete. | | | | | |
| | | | | | | | | | | |
| 1542 | Pump Off | | Final 32.31' | TD = 36.05 at end also | | | | | | |

Note: bgs= below ground surface btc=below top of casing DTW=depth to water gpm=gallons per minute
Clarity: VC=very cloudy Cl=cloudy SC=slightly cloudy AC=almost clear C=clear CC=crystal clear

# Monitoring Well Development Field Log

**Well Number:** MW-14

Page 1 of 1

**Date:** 3/26/08

| Project Information | |
|---|---|
| Project Name: | |
| URS Project Number: | |
| **General Information** | |
| Field Team: | N. MOODY |
| Purge Method: | Sub. Pump |
| Pump Intake Depth (ft btc): | Varies |
| Flow-Through Cell: | Yes |
| Decontamination Method: | 3 Stage SOAP/Methanol/DI |

| Well Volume Calculation | | | Stick-up or Flush (circle one) | | |
|---|---|---|---|---|---|
| Well Depth (ft bgs) | Well Depth (ft btc) | DTW (ft btc) | Water Column (ft) | Convert Factor (gal/ft) | One Well Volume (gal) |
| ? | 23.451 | 12.54 | | | |

3/4"=0.023 gal/ft 2"=0.17 gal/ft 4"=0.66 gal/ft 6"=1.5 gal/ft

| General Information | |
|---|---|
| Purge Water Disposition: | DRUMS on site |
| Field Conditions: | Rainy 40s |

**Comments:**

**Well Purge Data** **Total Volume to Purge (gal) =**

| Time | Volume Purged (gallons) | Purge Rate (gpm) | DTW (ft btc) | Conductivity (mS/cm) | Temp. (°C) | pH | ORP (mV) | D.O. (mg/L) | Turbidity (NTUs) | Clarity/Color/ Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 1343 | Pump On | >2000 mL/m | Initial 12.54 | - | ±3% | ±10% | ±0.1 | ±10mv | ±10% | <= Stabilization Criteria |
| 1344 | | >2000 | — | — | — | — | — | — | HIGH | BROWN VC |
| 1350 | | 1000 | — | — | — | — | — | — | " | " " |
| Attach Flow cell → 1400 | | 1000 | — | 0.154 | 10.86 | 7.01 | -108.2 | 6.44 | HIGH | " " |
| 1410 | | 1000 | — | 0.152 | 10.76 | 6.81 | -115.3 | 5.18 | HIGH | " " |
| 1415 | | 1000 | — | 0.151 | 10.85 | 6.78 | -113.6 | 5.19 | HIGH | " " |
| 1420 | | 1000 | — | 0.149 | 10.86 | 6.76 | -112.1 | 5.29 | 1911 | Brown CL |
| 1425 | | 1000 | — | 0.147 | 10.74 | 6.74 | -110.1 | 5.38 | AtoH | " " |
| 1430 | | 1000 | — | 0.147 | 10.80 | 6.72 | -107.4 | 5.41 | 131 | Blown, SC |
| 1435 | | 1000 | — | 0.146 | 10.76 | 6.70 | -106.1 | 5.47 | 48.4 | Slight Brown, AC |
| 1440 | | 1000 | — | 0.147 | 10.82 | 6.70 | -105.4 | 5.46 | 39.2 | " " " |
| 1445 | | 1000 | — | 0.147 | 10.76 | 6.70 | -103.2 | 5.51 | 20.1 | AC, No color |
| 1450 | | 1000 | — | 0.145 | 10.66 | 6.68 | -102.4 | 5.54 | 13.1 | AC, No color |
| 1455 | ~60g | 1000 | — | — | — | — | — | — | 8.04 | C, No color |
| | | | — | Development complete | | | | | | |
| 1456 | Pump Off | — | Final 12.32' | | | | | | | |

Note: bgs= below ground surface btc=below top of casing DTW=depth to water gpm=gallons per minute
Clarity: VC=very cloudy Cl=cloudy SC=slightly cloudy AC=almost clear C=clear CC=crystal clear

# Monitoring Well Development Field Log

**Well Number:** MW-15

Page 1 of 1

**Date:** 3/26/08

| Project Information | |
|---|---|
| Project Name: | Upland OU AI |
| URS Project Number: | |
| **General Information** | |
| Field Team: | Nicky Moody |
| Purge Method: | Submersible Pump |
| Pump Intake Depth (ft btc): | varies |
| Flow-Through Cell: | Yes |
| Decontamination Method: | SOAP, METHANOL, DI |

| Well Volume Calculation | | | | Stick-up or Flush (circle one) | |
|---|---|---|---|---|---|
| Well Depth (ft bgs) | Well Depth (ft btc) | DTW (ft btc) | Water Column (ft) | Convert Factor (gal/ft) | One Well Volume (gal) |
| 22.40' | 22.10' | 13.03' | 9.07 | 0.17 | 1.54 |

3/4"=0.023 gal/ft 2"=0.17 gal/ft 4"=0.66 gal/ft 6"=1.5 gal/ft

| General Information | |
|---|---|
| Purge Water Disposition: | |
| Field Conditions: | CLOUDY 40s |

**Comments:** soft bottom @ initial TD = 22.10'
after development → TD = 22.11'

**Well Purge Data** **Total Volume to Purge (gal) =**

| Time | Volume Purged (gallons) | Purge Rate (~~gpm~~) mL/m | DTW (ft btc) | Conductivity (~~uS~~/cm) | Temp. (°C) | pH | ORP (mV) | D.O. (mg/L) | Turbidity (NTUs) | Clarity/Color/ Remarks | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | <= Stabilization Criteria | |
| 1043 | Pump On | | Initial 13.03' | - | ~~±3%~~ | ~~±10%~~ | ~~±0.1~~ | ~~±10mv~~ | ~~±10%~~ | | |
| 1047 | | 1000 | — | 0.224 | 10.35 | 7.20 | -106.9 | 2.51 | HIGH. | BROWN | VC |
| 1100 | 12 gallons | | — | | Removed | Flow cell ↑ purge rate | | | HIGH | BROWN | 1069 NTU |
| 1120 | 30 gal | 2000 | — | 0.164 | 10.01 | 6.88 | -72.0 | 5.60 | 985 | Brown. | VC |
| 1125 | — | 1000 | — | 0.162 | 9.97 | 6.59 | -105.5 | 5.36 | 153 | Brown | VC |
| 1130 | — | 1000 | — | 0.162 | 10.09 | 6.58 | -110.2 | 5.43 | 98.4 | Slightly brown | SC |
| 1135 | — | 1000 | — | 0.162 | 10.07 | 6.56 | -111.7 | 5.39 | 54.4 | AC | No color |
| 1140 | 50 gal | 1000 | — | 0.162 | 10.05 | 6.56 | -111.6 | 5.39 | 33.6 | AC | No color |
| 1145 | ~ 55 | 1000 | — | 0.162 | 10.05 | 6.55 | -111.4 | 5.38 | 26.7 | C | No color |
| 1146 | | 1000 | — | [Removed Flow | cell] | | | | 15.9 | C | " " |
| 1148 | | 1000 | - | | | | | | 16.1 | C | " " |
| 1150 | | 1000 | — | | | | | | 13.5 | C | " " |
| 1152 | ~ 60 gal | 1000 | — | | | | | | 11.4 | C | " " |
| 1154 | ~ 62 gal | 1000 | — | | | | | | 11.6 | C | " " |
| 1156 | ~ 64 gal | 1000 | — | | | | | | 9.06 | C | " " |
| | | | | | Development | Complete | <10 | NTU | | | |
| 1156 | Pump Off | 1000 | Final 12.92 | | | | | | | | |

Note: bgs= below ground surface btc=below top of casing DTW=depth to water gpm=gallons per minute
Clarity: VC=very cloudy Cl=cloudy SC=slightly cloudy AC=almost clear C=clear CC=crystal clear

**Bradford Island**

**Slug Test Data Form**

Project Site Bradford Island

Sampling Team Nicky Moody & Brent Bergeron

Well ID MW-10

Groundwater Elevation Before Test 113.70 ft msl

Test Date 4/11/08

Total Casing Depth 58.4 ft btoc

Measuring Point Top of Casing / DTW

Borehole Diameter 6"

Type of Test Falling / Rising Tests

Casing Diameter 2"

Transducer Make/Model InSitu / Level Troll 700

Screened Interval 10 feet long (47 - 57 ft bgs)

Data Logger Test Run No. MW10 Test 1

Sand Pack Interval —

Test Start Time 4/11/08 4:05:09 PM

Depth to Water 19.50 ft btoc w/ troll in well

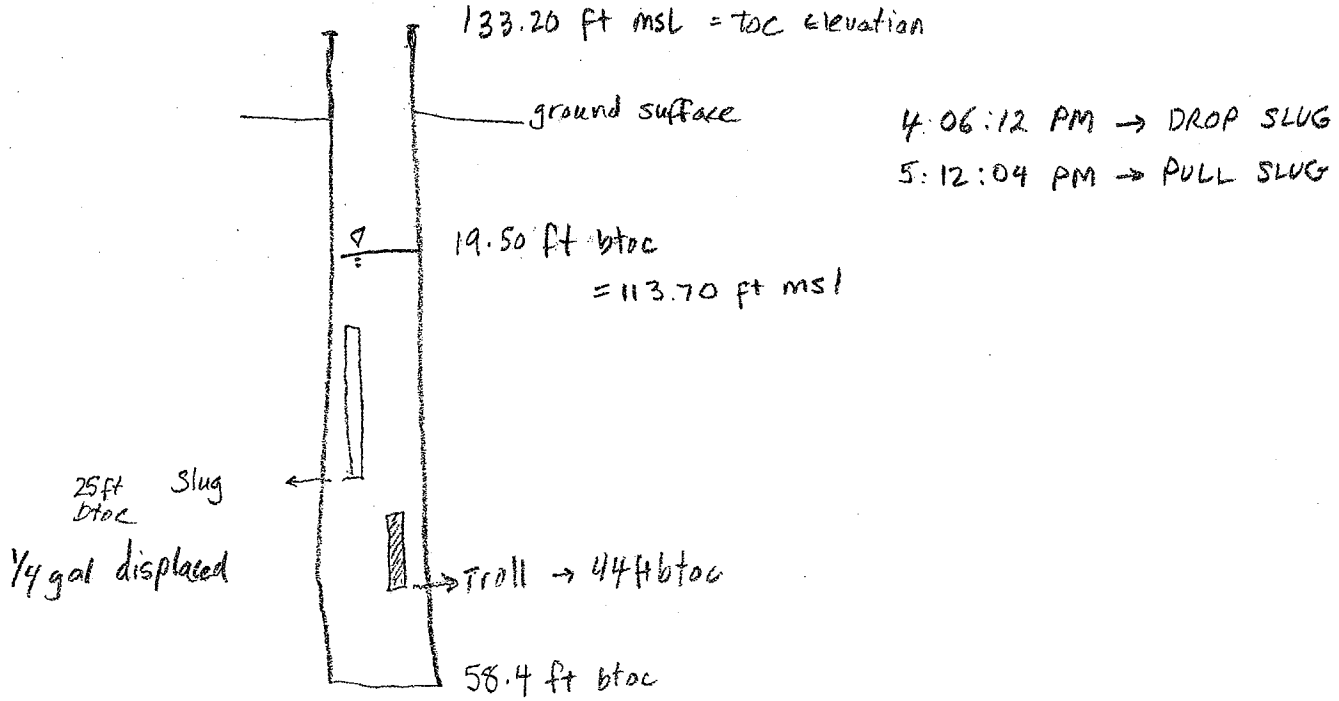
Test End Time 4/11/08 6:15:37 PM

Reference Depth 19.50 ft btoc w/ troll in well

(COMPUTER TIME = + 1 hr)

using water level meter

Lithology Tested



**Bradford Island**

**Slug Test Data Form**

Project Site Bradford Island

Sampling Team NM + BB

Well ID MW-11

Groundwater Elevation Before Test 98.12 ft msl - 5.43 ft = 92.69 ft MSL

Test Date 4/11/08

Total Casing Depth 36.55' ft btoc

Measuring Point Top of Casing (TOC)

Borehole Diameter 6"

Type of Test Falling / Rising Tests

Casing Diameter 2"

Transducer Make/Model Insitu level Troll 700

Screened Interval 10 ft long (26 - 36 ft bgs)

Data Logger Test Run No. MW11 Test 1

Sand Pack Interval —

Test Start Time 4/11/08 11:46:55 AM

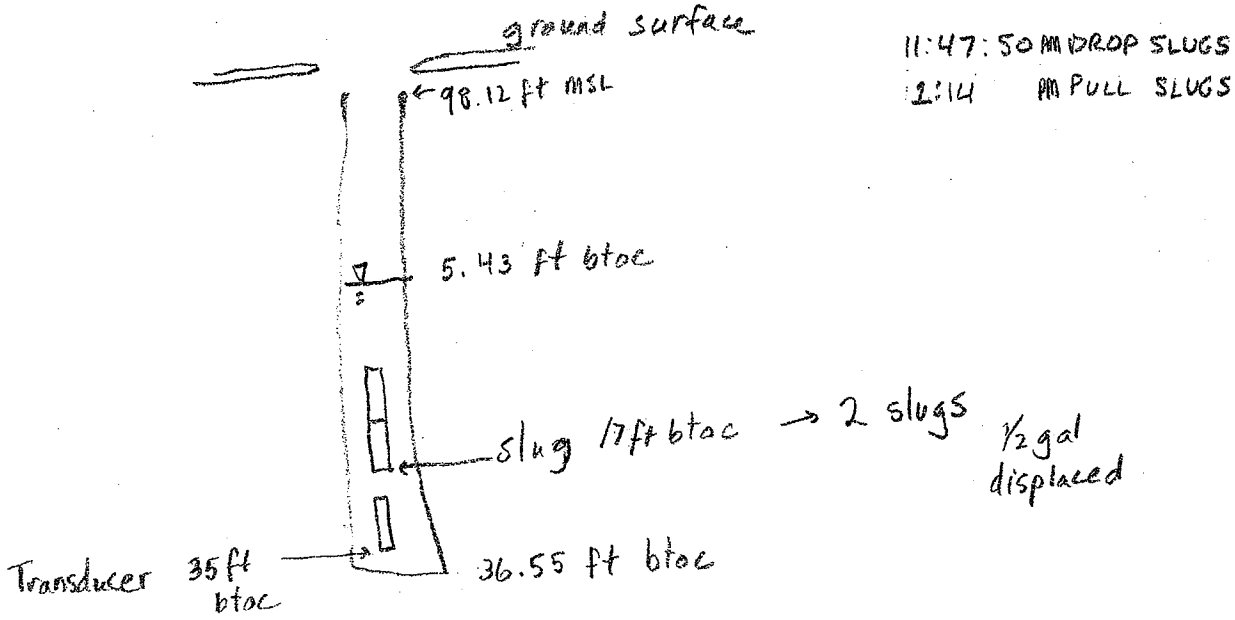
Depth to Water 5.43 ft btoc w/ troll in well

Test End Time 4/11/08 3:19:18 PM

Reference Depth 5.43 ft btoc w/ troll in well

computer: + 1 hr

Lithology Tested



**Bradford Island**

**Slug Test Data Form**

Project Site Bradford Island

Sampling Team NM + BB

Well ID MW-13

Groundwater Elevation Before Test 81.52 ft msl

Test Date 4/11/08

Total Casing Depth 36.0 ft btoc

Measuring Point Top of Casing/DTW

Borehole Diameter 6"

Type of Test Falling ONLY

Casing Diameter 2"

Transducer Make/Model Insitu level Troll 700

Screened Interval 10 ft long (26-36 ft bgs)

Data Logger Test Run No. MW13 Test 1

Sand Pack Interval —

Test Start Time 4/11/08 6:53:42 PM

Depth to Water 16.03 ft btoc w/troll in well

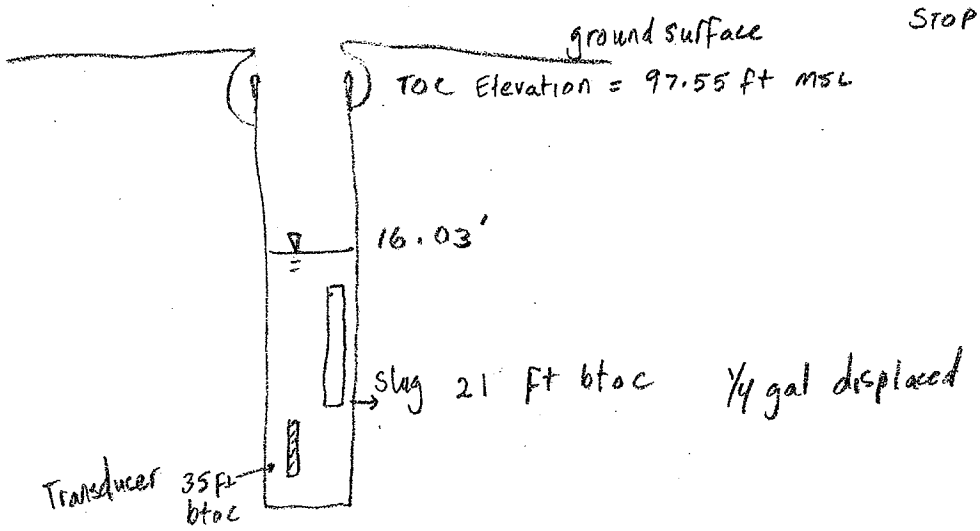
Test End Time 4/11/08 7:20:24 PM

Reference Depth 16.03 ft btoc " "

Computer Log = + 1 hr

Lithology Tested

DROP SLUGS @ 6:54:1 PM
STOP TEST



**Bradford Island**

**Slug Test Data Form**

Project Site: Bradford Island

Sampling Team: Brent Bergeron (BB), Nicky Moody (NM)

Well ID: MW-14

Groundwater Elevation Before Test: 86.67 ft MSL − 12.55 = 74.12 ft MSL

Test Date: 4/11/08

Total Casing Depth: 23.34 ft btoc

Measuring Point: Top of Casing / DTW

Borehole Diameter: 11"

Type of Test: Falling / Rising

Casing Diameter: 2"

Transducer Make/Model: Insitu Level Troll 700

Screened Interval: 10 ft (13 - 23 ft bgs)

Data Logger Test Run No.: Test 2 MW14

Sand Pack Interval: —

Test Start Time: 4/11/08 10:20:19 AM

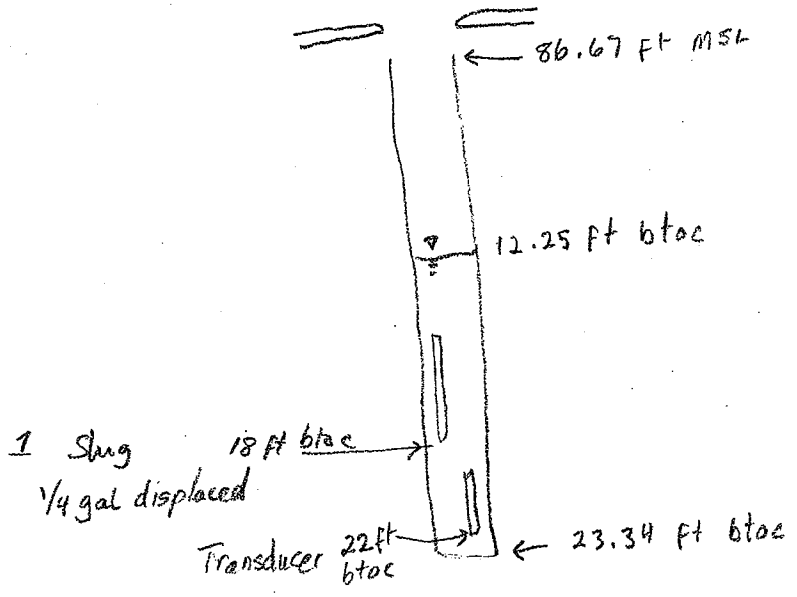
Depth to Water: 12.25 ft btoc w/ troll in well

Test End Time: 4/11/08 10:42:19 AM

Computer Log = + 1 hr

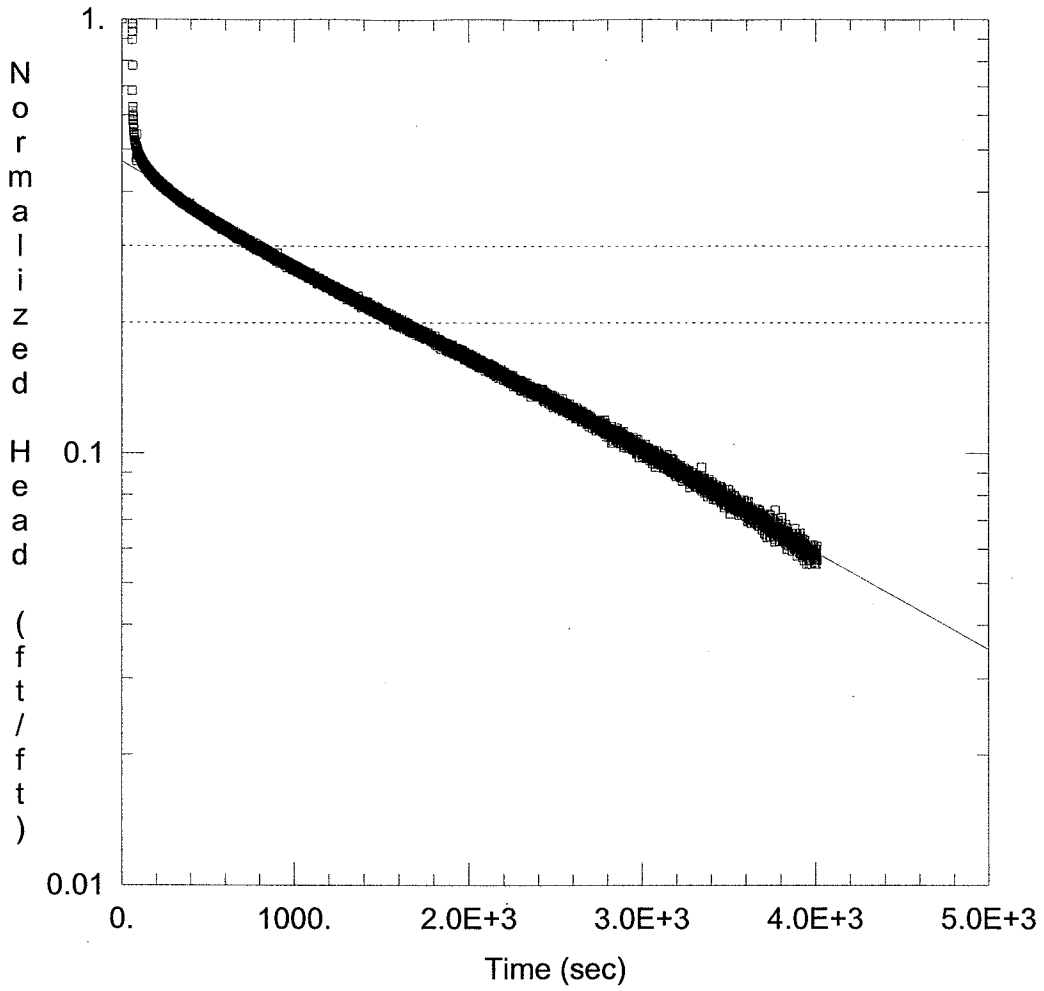
Reference Depth: 12.25 ft btoc w/ troll in well → Measured w/ water level meter

Lithology Tested: _____




10:21:15 AM DROP SLUG

10:30:34 AM PULL SLUG




## SLUG TESTING

Data Set: O:\...\MW-10 Falling.aqt
Date: 06/03/08 Time: 15:35:54

## PROJECT INFORMATION

Company: URS
Client: USACE
Project: 25696679.00005
Location: Bradford Isl.
Test Well: MW-10
Test Date: April 11, 2008

## AQUIFER DATA

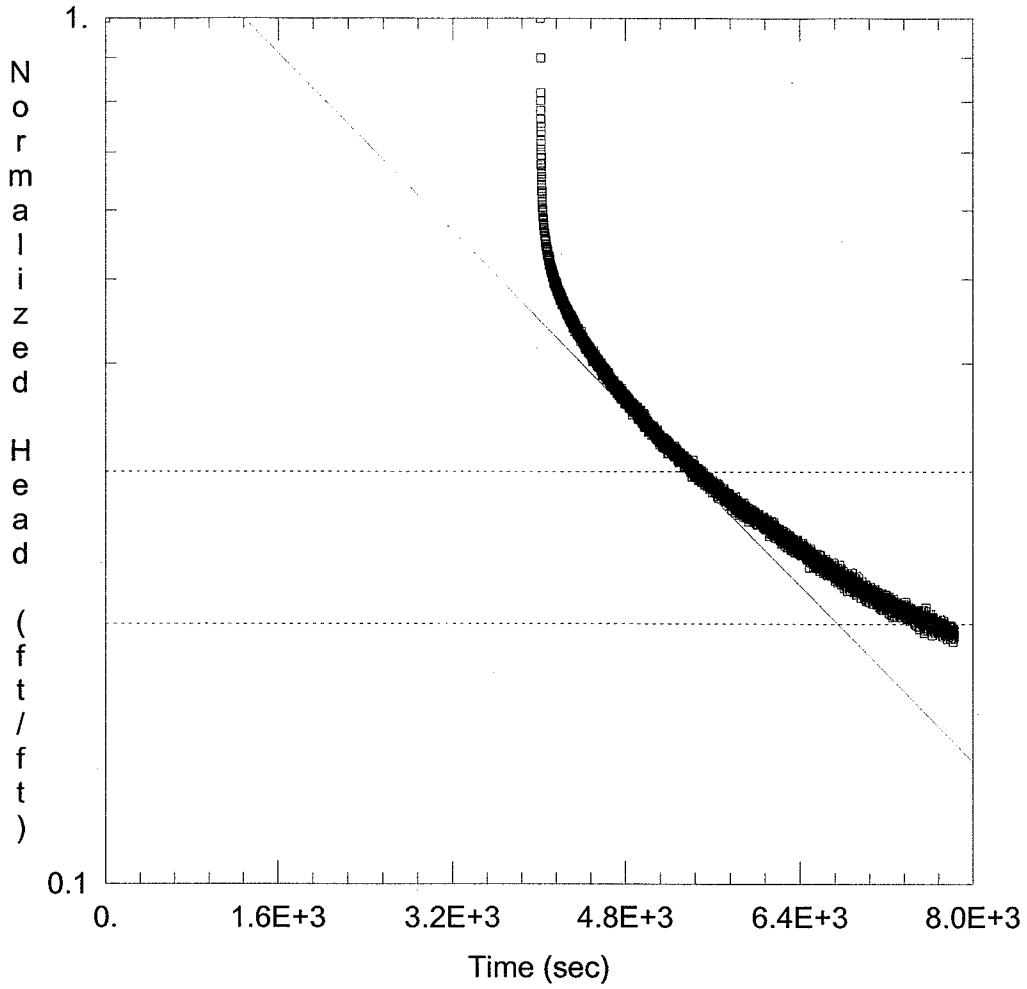
Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (MW-10)

Initial Displacement: 2.004 ft
Total Well Penetration Depth: 57. ft
Casing Radius: 0.08 ft
Static Water Column Height: 38.9 ft
Screen Length: 10. ft
Well Radius: 0.08 ft
Gravel Pack Porosity: 0.3

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.03259 ft/day
y0 = 0.9402 ft




## SLUG TESTING

Data Set: O:\...\MW-10-Rising.aqt
Date: 06/03/08 Time: 15:35:33

## PROJECT INFORMATION

Company: URS
Client: USACE
Project: 25696679.00005
Location: Bradford Isl.
Test Well: MW-10
Test Date: April 11, 2008

## AQUIFER DATA

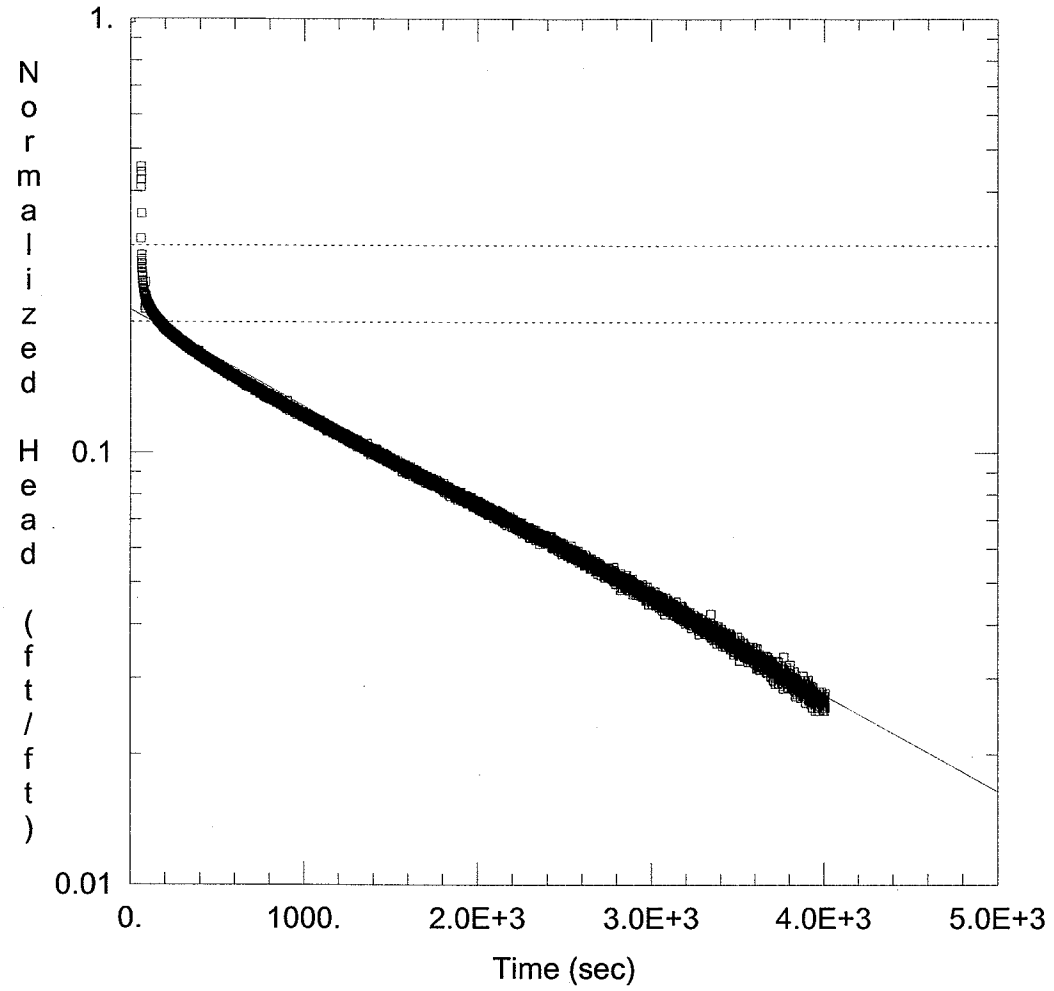
Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (MW-10)

Initial Displacement: 1.567 ft
Total Well Penetration Depth: 57. ft
Casing Radius: 0.08 ft
Static Water Column Height: 38.9 ft
Screen Length: 10. ft
Well Radius: 0.08 ft
Gravel Pack Porosity: 0.3

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.01851 ft/day
y0 = 2.287 ft




## SLUG TESTING

Data Set: O:\...\MW-11 Falling.aqt
Date: 06/03/08 Time: 16:13:02

## PROJECT INFORMATION

Company: URS
Client: USACE
Project: 25696679.00005
Location: Bradford Isl.
Test Well: MW-11
Test Date: April 11, 2008

## AQUIFER DATA

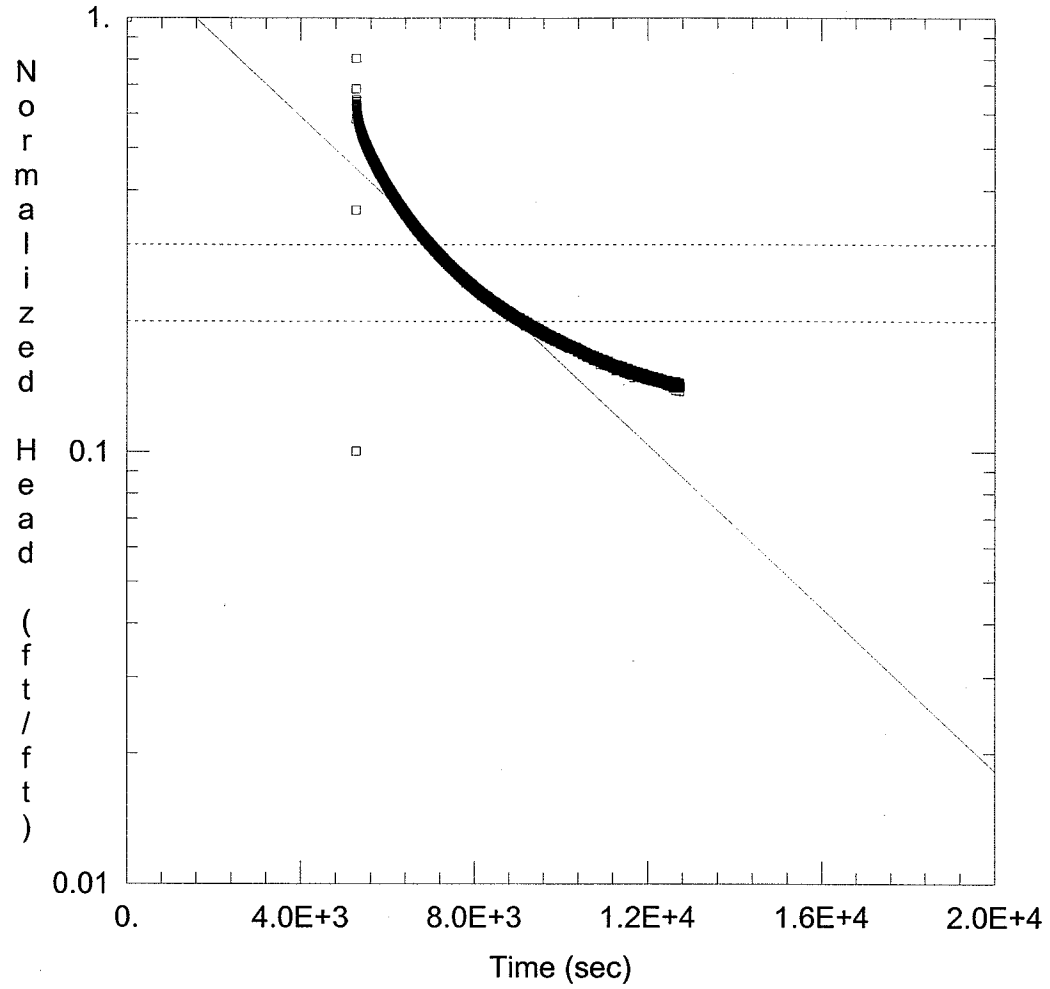
Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (MW-11)

Initial Displacement: 4.4 ft
Total Well Penetration Depth: 30.57 ft
Casing Radius: 0.08 ft
Static Water Column Height: 31.1 ft
Screen Length: 10. ft
Well Radius: 0.08 ft
Gravel Pack Porosity: 0.3

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.02663 ft/day
y0 = 0.9402 ft




## SLUG TESTING

Data Set: O:\...\MW-11 Rising.aqt
Date: 06/03/08 Time: 16:13:25

## PROJECT INFORMATION

Company: URS
Client: USACE
Project: 25696679.00005
Location: Bradford Isl.
Test Well: MW-11
Test Date: April 11, 2008

## AQUIFER DATA

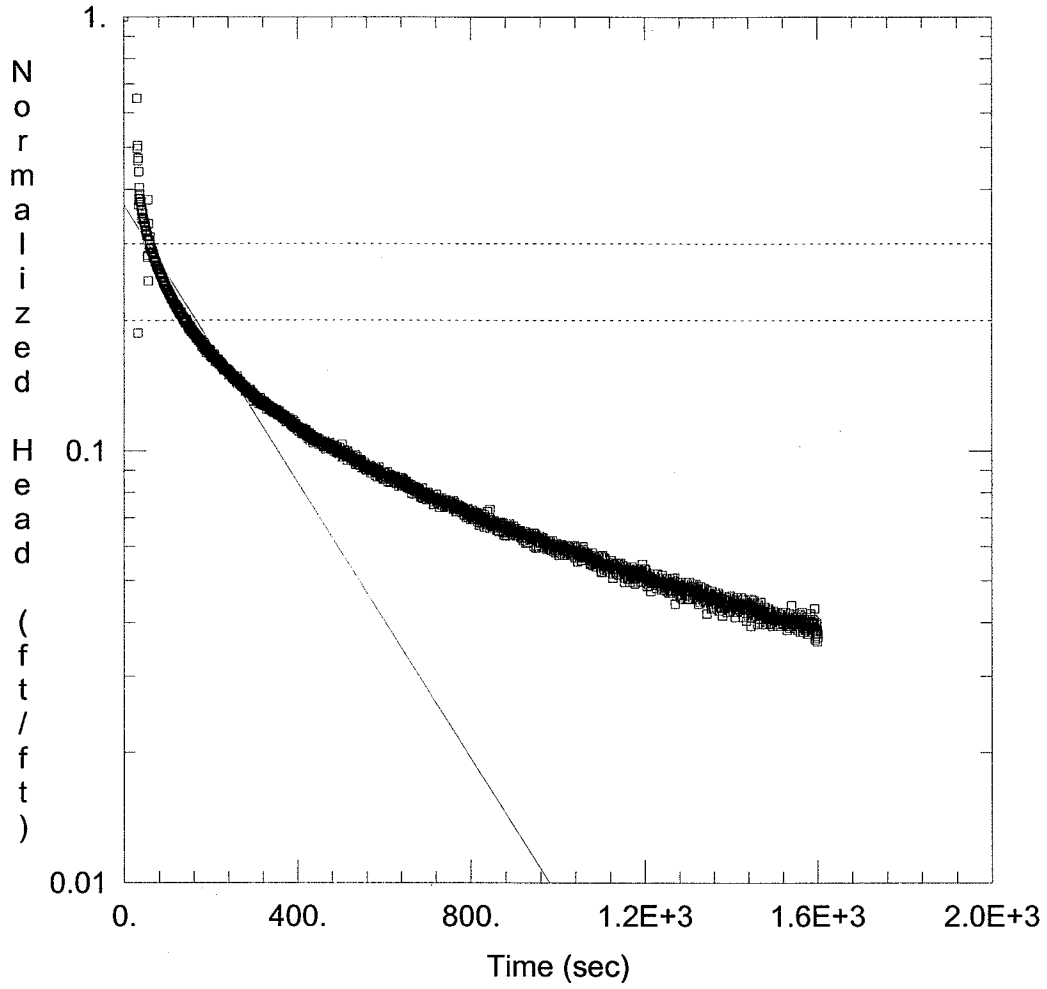
Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (MW-11)

Initial Displacement: 3.9 ft
Total Well Penetration Depth: 30.57 ft
Casing Radius: 0.08 ft
Static Water Column Height: 31.1 ft
Screen Length: 10. ft
Well Radius: 0.08 ft
Gravel Pack Porosity: 0.3

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0113 ft/day
y0 = 5.504 ft




## SLUG TESTING

Data Set: O:\...\MW-13 Falling.aqt
Date: 06/03/08 Time: 16:12:42

## PROJECT INFORMATION

Company: URS
Client: USACE
Project: 25696679.00005
Location: Bradford Isl.
Test Well: MW-13
Test Date: April 11, 2008

## AQUIFER DATA

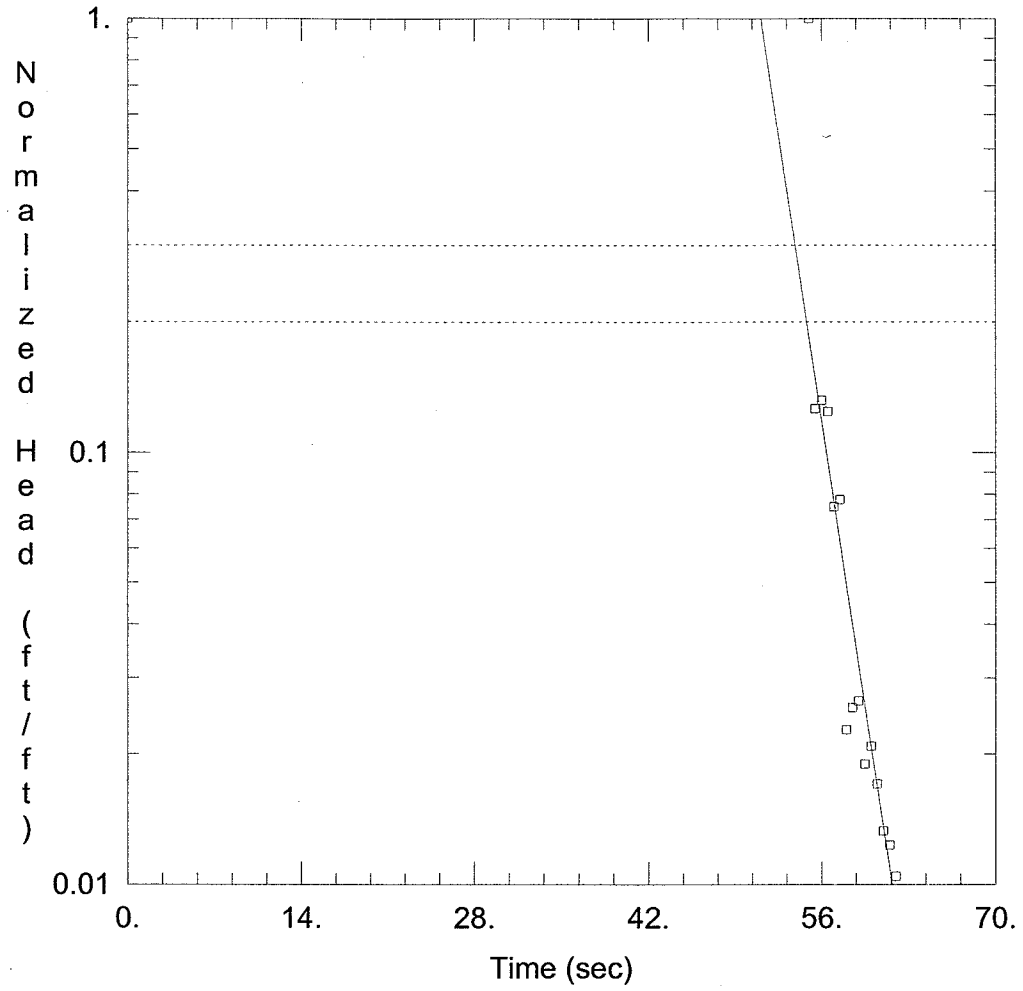
Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (MW-13)

Initial Displacement: 2.6 ft
Total Well Penetration Depth: 20. ft
Casing Radius: 0.08 ft
Static Water Column Height: 20.97 ft
Screen Length: 10. ft
Well Radius: 0.08 ft
Gravel Pack Porosity: 0.3

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.1821 ft/day
y0 = 0.9557 ft




## SLUG TESTING

Data Set: O:\...\MW-14 Falling.aqt
Date: 06/03/08 Time: 16:34:28

## PROJECT INFORMATION

Company: URS
Client: USACE
Project: 25696679.00005
Location: Bradford Isl.
Test Well: MW-14
Test Date: April 11, 2008

## AQUIFER DATA

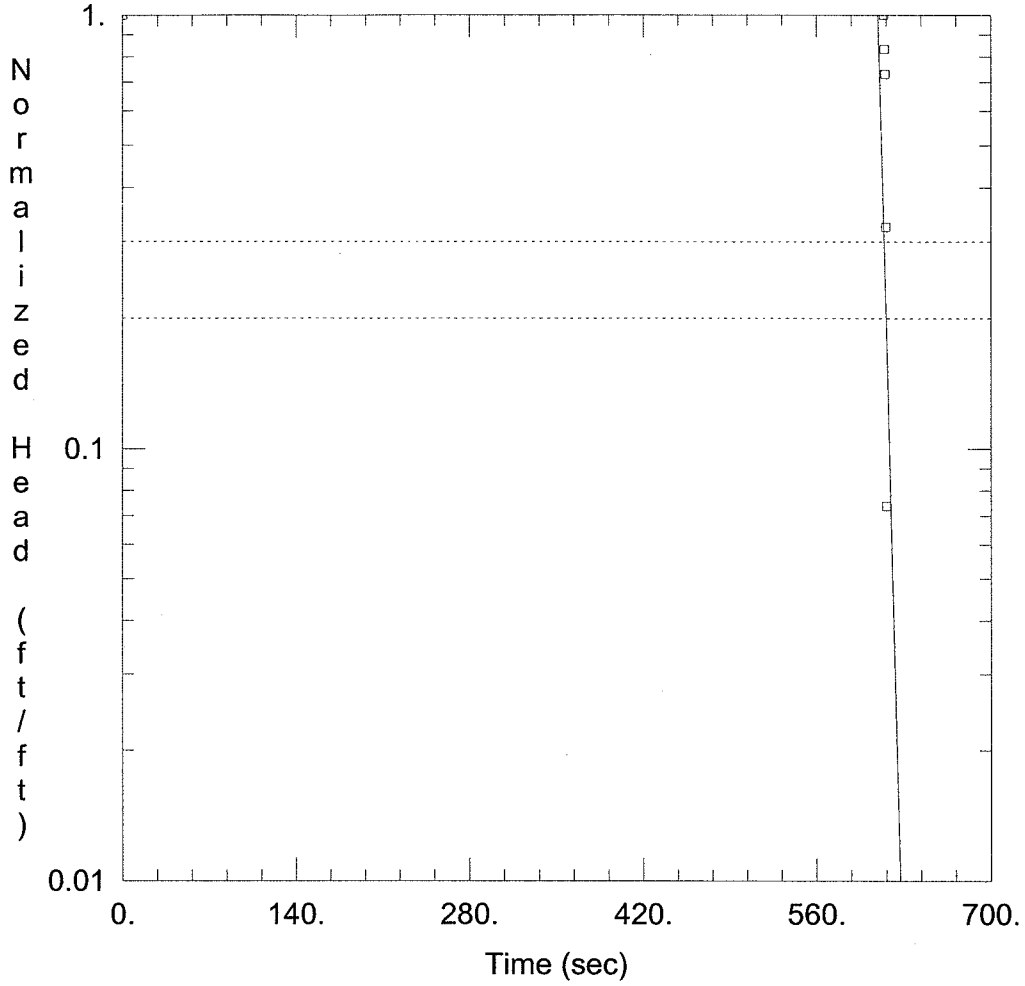
Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (MW-14)

Initial Displacement: 1.054 ft
Total Well Penetration Depth: 11. ft
Casing Radius: 0.08 ft
Static Water Column Height: 11.1 ft
Screen Length: 10. ft
Well Radius: 0.46 ft
Gravel Pack Porosity: 0.25

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 285.2 ft/day
y0 = 4.761E+9 ft




## SLUG TESTING

Data Set: O:\...\MW-14 Rising.aqt
Date: 06/03/08 Time: 16:34:50

## PROJECT INFORMATION

Company: URS
Client: USACE
Project: 25696679.00005
Location: Bradford Isl.
Test Well: MW-14
Test Date: April 11, 2008

## AQUIFER DATA

Saturated Thickness: 50. ft
Anisotropy Ratio (Kz/Kr): 0.1

## WELL DATA (MW-14)

Initial Displacement: 0.542 ft
Total Well Penetration Depth: 11. ft
Casing Radius: 0.08 ft
Static Water Column Height: 11.1 ft
Screen Length: 10. ft
Well Radius: 0.46 ft
Gravel Pack Porosity: 0.25

## SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 170.2 ft/day
y0 = 2.85E+68 ft