MEMORANDUM

Project No.: 110125

February 20, 2015

To: Jessi Massingale, Floyd|Snider Inc
Megan McCullough, Floyd|Snider Inc

cc:

From:

John Strunk, LHG
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Jared Bean
Staff Hydrogeologist
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Re: **Lora Lake 2013-2014 Surface Water – Groundwater Baseline Monitoring, Data Summary Memorandum**

This memorandum summarizes surface water and groundwater baseline monitoring activities conducted during 2013 and 2014 related to the Port of Seattle's Lora Lake Parcel (Figure 1). The purpose of the monitoring activities was to obtain data to:

1) Advance understanding of the hydraulic functions of Lora Lake and Miller Creek;

2) Establish a baseline hydroperiod that the post-remedial action condition can be compared against; and

3) Provide the Washington State Department of Ecology (Ecology) with supporting information and a better understanding of water storage, hydraulic function, and flood desynchronization to inform remedial design of the Lora Lake Parcel.

Aspect Consulting LLC (Aspect) provided hydrologic monitoring services as part of a team managed by Floyd|Snider Inc under contract to the Port of Seattle. Other team members include Environmental Science Associates and SvR Design Company.

Hydrologic monitoring began in June 2013 and ended in November 2014. The attached Tables, Figures, and Appendices (listed at the end of the Memorandum) summarize the data collected.

Monitoring Network

The hydrologic monitoring system stations consisted of a network of wells, mini-piezometers, staff gages, and flow gaging stations. Station locations and monitoring frequency are described below and summarized in Table 1 and Figure 1.

Installation of new monitoring stations was conducted by or coordinated by Aspect. Locations of new monitoring stations were surveyed by Port of Seattle staff and transmitted to Aspect on July 19, 2013. Pre-existing monitoring stations (e.g., monitoring wells MW-1 through MW-17 upgradient of the Lora Lake Parcel) were previously surveyed and used for groundwater level monitoring and groundwater contour mapping (Figure 2). Invert elevation of the Lora Lake outlet culvert was surveyed by the Port of Seattle (2009). Locations of existing monitoring stations were previously surveyed. As stated in the Work Plan, prior to wetland design, the Port will complete an elevation survey of the berm.

Surface water and groundwater monitoring stations within the Lora Lake Parcel were outfitted with pressure transducer dataloggers to record water levels and water temperatures (Figure 5) at 15-minute intervals. Port of Seattle staff conducted approximately monthly site visits that consisted of manual water level measurements, datalogger downloads, and stream gaging, when appropriate. Groundwater elevations in monitoring wells upgradient of the Lora Lake Parcel were measured quarterly by Aspect.

New Monitoring Stations

Station purposes are described below.

- **Monitoring well MW-LL-1** was installed on May 25, 2013 by Cascade Drilling. Aspect logged the lithology and developed the well. MW-LL-1 was intended to be completed in wetland soils near the bottom elevation of the lake to evaluate hydraulic conductivity of the wetland soils and therefore enable estimation of groundwater discharge into and out of the lake. However, the boring encountered wetland soils to a depth of only 1 foot below ground surface (bgs) and glacial outwash from 1 foot to 20.5 feet bgs (total depth). MW-LL-1 is screened in outwash sediments from 8 feet to 18 feet bgs; the boring log is provided in Appendix A.

- **Miller Creek staff gages SG-MC-2 and SG-MC-3** were installed in Miller Creek. Port of Seattle staff conducted stream discharge measurements at the gages, and Aspect developed stage-discharge rating curves (Figure 7, Appendix B).

- **Mini-piezometers DP-MC-1A through DP-MC-3B** were driven into the Miller Creek streambed and the adjacent creek bank (see inset table below for station locations and total depths). These mini-piezometers, in conjunction with adjacent staff gages (SG-MC-2 and SG-MC-3), were used to evaluate stream discharge gaining/losing conditions and surface water – groundwater interactions. The mini-piezometers are 5.75 feet in length and have a drive point tip. The upper 3.8 feet are 2-inch-diameter steel pipes; the lower 1.95 feet are 2-inch-diameter wire-wrap screen. DP-MC-1A and DP-MC-3A experienced repeated siltation

and clogging of the screen. Both stations were bailed repeatedly but continued to accumulate silt throughout the baseline monitoring period. Evaluation and use of the DP-MC-1A and DP-MC-3A data should consider the repeated siltation and clogging, as well as the resultant likely erroneously high water elevation data.

Station ID	Location	Total Depth (feet below ground or streambed surface)
DP-MC-1A	Streambed	3.6
DP-MC-1B	Bank	5.3
DP-MC-2A	Streambed	3.3
DP-MC-2B	Bank	5.0
DP-MC-3A	Streambed	3.4
DP-MC-3B	Bank	4.4

- **Lora Lake staff gage SG-LL-1 and wetland staff gage SG-LL-2** were installed to document seasonal water level variability as well as lake and wetland response to precipitation events (e.g., detention/retention capacity of lake).

Pre-Existing Monitoring Stations

Station purposes are described below. Well logs for the monitoring wells listed below are compiled in Appendix B (except for the MW-LL-P1 well log, which the Port of Seattle staff have been unable to locate).

- **Stream gage SG-MC-1**, operated by King County, is a Miller Creek flow monitoring station upstream of SG-MC-2. Stream stage and discharge data were obtained online from the King County Hydrologic Information Center.

- **Monitoring wells MW-1 through MW-17** are located upgradient of Lora Lake along Des Moines Memorial Drive and within the Lora Lake Apartments Parcel. Water levels in all wells (except MW-13 – could not be located in the field) were monitored quarterly. Quarterly water level measurements from MW-1 through MW-14 (excluding MW-13) were used for groundwater contour mapping. The following well pairs allow for calculation of vertical hydraulic gradient: MW-1 and MW-16; MW-5 and MW-15; and MW-4 and MW-17.

- **Mini-piezometers HPA1-1, HPA1-3, and HPA1-4** are completed in shallow soils (maximum total depth of approximately 2 feet bgs) surrounding Lora Lake. These stations were installed by the Port of Seattle for wetland hydrology and vegetation monitoring. Quarterly water level data from HPA1-3 and HPA1-4 were used for groundwater contour mapping.

- **Monitoring wells HC99-B31 and MW-LL-P1** are located in the wetland on the south side of Lora Lake. HC99-B31 is completed below the wetland soils in outwash to a total depth of approximately 25 feet below the bottom of the wetland. As mentioned previously, Port of Seattle staff have been unable to locate a well log for MW-LL-P1; but it is our understanding that the well is completed in shallow wetland soils to a total depth of approximately 10 feet below the bottom of the wetland. Continuous water level data were monitored to evaluate surface water – groundwater interactions and Lake – wetland hydraulic functions. Pending confirmation of the MW-LL-P1 completion zone, HC99-B31 and MW-LL-P1 could be used to calculate vertical hydraulic gradient in the vicinity of the wetland.

- **Monitoring wells HC00-B310, HC00-B311, and HC00-B312** are located northeast of Lora Lake. Boring logs suggest that the wells are completed in outwash and/or alluvium. Quarterly water level data were used for groundwater contour mapping.

- **Precipitation as well as storm drain outfall** discharge at the northwest corner of Lora Lake were monitored by CARDNO TEC. These data were compiled to evaluate water balance parameters and understand hydraulic functioning of the lake in response to precipitation events.

Lora Lake Outlet Culvert Discharge Estimates

The Lora Lake outlet culvert connects Lora Lake and Miller Creek. SG-LL-1 documents Lake stage, and SG-MC-2 documents Creek stage immediately downstream of the culvert. The culvert is a 1-foot-diameter corrugated plastic pipe. Partial sediment and debris blockage of the Lora Lake outlet culvert was cleared on September 30, 2013.

A standard stage-discharge rating curve is not applicable to Lora Lake outlet culvert because discharge is influenced by both headwater (Lora Lake) and tailwater (Miller Creek) hydraulic conditions. The culvert inlet and outlet invert elevation is 263.14 feet (Port of Seattle, 2009).

Culvert discharge from Lora Lake to Miller Creek was roughly estimated as the difference in Miller Creek discharge between SG-MC-2 and SG-MC-1. Using this method, estimated culvert discharge during the dry season (low or no precipitation) ranges from approximately 0.1 to 0.5 cubic feet per second (cfs). This range is consistent with area-velocity measurements of culvert discharge (Table 3). For the area-velocity discharge measurements, velocity was measured at the culvert inlet with a SonTek Flowtracker. Flow area at the culvert inlet was estimated as the area of the culvert inlet multiplied by the fraction of the culvert inlet filled with water.

In wetter conditions (during and after precipitation events), use of the aforementioned culvert discharge estimation method is problematic for multiple reasons. For example, a few complicating factors include:

- At high flows, Miller Creek overtops a low spot in the berm separating Miller Creek and the northeast corner of Lora Lake. Port of Seattle staff have observed Miller Creek high flows overtopping the berm and flowing into Lora Lake while Lora Lake's outlet culvert discharges back to Miller Creek.

- Degree of recording interval synchronization between King County's SG-MC-1 datalogger and the Port's SG-MC-2 datalogger has not been evaluated.
- Culvert discharge is dependent on headwater and tailwater conditions, and Lora Lake and Miller Creek exhibit flashy stage changes associated with precipitation events.
- It is our understanding that SG-MC-1 is located in a weir or box culvert; the stage-discharge rating curve for SG-MC-1 should therefore be more robust than the rating curve for SG-MC-2 (especially at high flows). SG-MC-2 is subject to changes in hydraulic controls, especially at high flows; and there are few data points on which to calibrate the upper end of the rating curve.

Hydraulic Conductivity Analyses

Rising and falling head slug tests were conducted in six wells (MW-LL-1, MW-10, HC99-B31, HC00-B311, HPA1-1, and HPA1-3) to characterize hydraulic conductivity of subsurface materials (Table 2). As mentioned above, MW-LL-1 was intended to be completed and tested in wetland soils (e.g., peat), but the wetland soils extended to only 1 foot bgs. Slug tests of HPA1-1 and HPA1-3 were conducted to better evaluate hydraulic conductivity of the wetland soils.

The Bouwer and Rice method (Bouwer and Rice, 1976; Bouwer, 1989) was used to analyze the slug test data and estimate hydraulic conductivity. Data analysis guidelines from Butler (1998) were also followed. Hydraulic conductivity of MW-LL-1, MW-10, and HC99-B31 – completed in slightly silty to trace silt, sand and gravel outwash – ranged from 96 to 263 feet/day. Hydraulic conductivity of HC00-B311, completed in silty sand and sandy silt outwash or alluvium, ranged from 22 to 25 feet/day. Hydraulic conductivity of the HPA1-1 and HPA1-3, presumably completed in shallow wetland soils, ranged from 5 to 12 feet/day.

Groundwater Contour Mapping

Four rounds of quarterly manual water level measurements were conducted for the entire monitoring network to create groundwater contour maps and evaluate groundwater flow direction and gradient (Figures 2a through 2d). Groundwater flow direction within the monitored area is generally southward toward Lora Lake and Miller Creek. Groundwater gradient shown on the October 24, 2013 groundwater contour map from Des Moines Memorial Drive to Miller Creek averaged approximately 0.2. Flow direction and gradient show little seasonal variability.

Limitations

Work for this project was performed for Floyd|Snider Inc (Client), and this memorandum was prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This memorandum does not represent a legal opinion. No other warranty, expressed or implied, is made.

All reports prepared by Aspect Consulting for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk of that party, and without liability to Aspect Consulting. Aspect Consulting's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

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 Resources Research* Vol. 12, No. 3, pp. 423-428, 1976.

Bouwer, H., 1989, The Bouwer and Rice slug test--an update, *Ground Water*, Vol. 27, No. 3, pp. 304-309, 1989.

Butler, J. J. Jr., 1998, The design, performance, and analysis of slug tests. Boca Raton, FL: Lewis Publishers, 1998.

Port of Seattle, 2009, Lora Lake Wetland Topo CAD drawing – saved 3/25/2009. Department of Engineers, Survey-Mapping Services, 2009.

Attachments

Table 1 – Hydrologic Monitoring Point Inventory

Table 2 – Aquifer Hydraulic Conductivity Estimates from Slug Tests

Table 3 – Lora Lake Outlet Culvert Discharge Measurements

Table 4 (with Figure 4) – Precipitation

Figure 1 – Site Map

Figure 2a – Groundwater Elevation Contour Map – October 24, 2013

Figure 2b – Groundwater Elevation Contour Map – January 23, 2014

Figure 2c – Groundwater Elevation Contour Map – May 1, 2014

Figure 2d – Groundwater Elevation Contour Map – July 29, 2014

Figure 3 – Water Temperature

Figure 4 – Precipitation

Figure 5 – Groundwater Interactions with Lora Lake

Figure 6 – Overall Surface Water and Groundwater Interactions

Figure 7 – Stage-Discharge Rating Curves (SG-MC-2 and SG-MC-3)

Figure 8 – Miller Creek Flows

Figure 9 – Surface Water and Groundwater Interactions with Miller Creek

Appendix A – MW-LL-1 Well Log

Appendix B – Well Logs of Pre-Existing Monitoring Stations

Appendix C – Combined Monitoring Data and Graphs (Microsoft Excel File)

W:\110125 Lora Lake RI-FS Support\Deliverables\Data Summary Memo\Lora Lake Data Summary Memo.docx

TABLES

Table 1 - Hydrologic Monitoring Point Inventory

Project # 110125 Lora Lake RI/FS

SeaTac, WA

Surface Water Monitoring Points					
Station Name	Location	Installed prior to June 2013	Installed in June 2013 by Aspect	Monitoring frequency	
				15-Minute[1]	Quarterly[2]
SG-MC-1	Miller Creek	X		X	
SG-MC-2	Miller Creek		X	X	
SG-MC-3	Miller Creek		X	X	
SG-LL-1	Lora Lake		X	X	
SG-LL-2	Wetland		X	X	

Groundwater Monitoring Points					
Station Name	Location	Installed prior to June 2013	Installed in June 2013 by Aspect	Monitoring frequency	
				15-Minute[1]	Quarterly[2]
MW-1	Lora Lake Apartments	X			X
MW-2	Lora Lake Apartments	X			X
MW-3	Lora Lake Apartments	X			X
MW-4	Lora Lake Apartments	X			X
MW-5	Lora Lake Apartments	X			X
MW-6	Lora Lake Apartments	X			X
MW-7	Des Moines Memorial Drive	X			X
MW-8	Des Moines Memorial Drive	X			X
MW-9	Des Moines Memorial Drive	X			X
MW-10	Des Moines Memorial Drive	X			X
MW-11	Des Moines Memorial Drive	X			X
MW-12	Lora Lake Apartments	X			X
MW-13	Lora Lake Apartments	X			X
MW-14	Lora Lake Apartments	X			X
MW-15	Lora Lake Apartments	X			X
MW-16	Lora Lake Apartments	X			X
MW-17	Lora Lake Apartments	X			X
HPA1-1[3]	Bank of Lora Lake	X		X	
HPA1-3	Bank of Lora Lake	X		X	
HPA1-4	Bank of Lora Lake	X		X	
HC99-B31	Wetland	X		X	
HC00-B310	East of Lora Lake	X			X
HC00-B311	East of Lora Lake	X			X
HC00-B312	North of Lora Lake	X			X
MW-LL-P1	Wetland	X		X	
MW-LL-1	North of Lora Lake		X	X	
DP-MC-1A	Miller Creek		X	X	
DP-MC-1B	Bank of Miller Creek		X	X	
DP-MC-2A	Miller Creek		X	X	
DP-MC-2B	Bank of Miller Creek		X	X	
DP-MC-3A	Miller Creek		X	X	
DP-MC-3B	Bank of Miller Creek		X	X	

[1] 15-minute pressure transducer datalogger measurements; approximately monthly downloads and manual measurements.

[2] Quarterly manual measurements.

[3] 15-minute data not compiled by Aspect; quarterly data compiled.

Table 2 - Aquifer Hydraulic Conductivity Estimates from Slug Tests

Project # 110125 Lora Lake RI/FS

SeaTac, WA

Monitoring Well	MW-LL-1		MW-10		HC99-B31		HC00-B311		HPA1-1		HPA1-3	
Well Depth in Feet	**16**		**20**		**24**		**17**		**2**		**2**	
Screen Length in Feet	**10**		**10**		**10**		**10**		**1.5**		**1.5**	
Depth to Screen in Feet	**6**		**10**		**15**		**7**		**0.5**		**0.5**	
Depth to Aquitard in Feet	**25**		**25**		**25**		**25**		**25**		**25**	
Depth to Water in Feet	**2.7**		**13.5**		**-1.5**		**10.0**		**-0.5**		**0.5**	
Depth to Sandpack in Feet	**4**		**8**		**14**		**6**		**0.5**		**0.5**	
Slug Displacement (H_o) in Feet	**0.50**	**0.76**	**0.87**	**0.44**	**0.29**	**0.46**	**0.45**	**0.44**	**0.50**	**0.50**	**0.14**	**0.14**
Porosity (n)	**0.20**		**0.20**		**0.20**		**0.20**		**0.20**		**0.20**	
Radius of Casing (r_c) in Feet	**0.08**		**0.08**		**0.08**		**0.08**		**0.08**		**0.08**	
Radius of Borehole (r_w) in Feet	**0.18**		**0.18**		**0.18**		**0.18**		**0.09**		**0.09**	
Saturated Aquifer Thickness (H) in Feet	22		12		27		15		26		25	
Saturated Well Thickness (L_w) in Feet	13		7		27		7		3		2	
Effective Radius (r_{eff}) in Feet	0.18		0.18		0.18		0.18		0.09		0.09	
Effective Screen Length (L_e) in Feet	10.0		6.5		10.0		7.0		1.5		1.5	
Rising/Falling Head Test	Falling	Rising	Rising	Rising	Falling	Rising	Falling	Rising	Falling	Falling	Falling	Falling
Fully Submerged Sandpack	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	No
Transiently Exposed Sandpack	No	No	Yes	Yes	No	No	Yes	No	No	No	No	No
Transiently Exposed Screen	No	No	Yes	Yes	No	No	Yes	No	No	No	No	No
Partially Submerged Screen	No	No	Yes	Yes	No	No	Yes	No	No	No	No	No
Bouwer and Rice Parameters												
Normalized Head at t_1 (y_1) in Feet	0.70	0.69	0.68	0.69	0.66	0.69	0.70	0.70	0.79	0.70	0.70	0.65
Time - t_1 in Seconds	2	1.60	1.00	0.88	1.50	1.13	5.25	7.88	8.62	11.87	20.60	19.50
Normalized Head at t_2 (y_2) in Feet	0.40	0.40	0.39	0.41	0.40	0.40	0.40	0.41	0.49	0.40	0.40	0.40
Time - t_2 in Seconds	4	3.70	2.37	1.87	3.50	3.00	16.38	19.63	25.75	32.25	60.40	53.10
L_e/r_w	55.6		36.1		55.6		38.9		16.7		16.7	
Coefficient A [a]	3.2		2.6		3.2		2.7		2.0		2.0	
Coefficient B [a]	0.5		0.4		0.5		0.4		0.3		0.3	
Coefficient C [a]	2.8		2.2		2.8		2.3		1.4		1.4	
$\ln(R_e/r_w)$ [b]	2.9		2.4		3.4		2.4		1.8		1.6	
Calculated K in cm/sec	0.03	0.04	0.07	0.1	0.04	0.05	0.01	0.01	0.004	0.004	0.002	0.002
Calculated K in ft/day	96	103	206	263	119	139	25	22	12	11	5	5
Screened Interval Soil Type	**GP-GM, SP**		**SW, SP**		**SP-SM**		**SM, ML**		**(not logged)**		**(not logged)**	

Notes:

Hydraulic conductivity estimates from the Bouwer and Rice method (Bouwer and Rice, 1976; Bouwer, 1989).

Data analysis guidelines from Butler (1998).

Bold values are entered from field data and other values are calculated.

All depths are below ground surface.

[a] A, B, and C coefficients are calculated using regression equations of Van Rooy (1988).

[b] R_e/r_w is the effective radial distance over which y is dissipated, divided by the radial distance of well development.

[c] Soil classification interpreted from AB-CG-140-70.

Table 3 - Lora Lake Outlet Culvert Discharge Measurements

Project# 110125 Lora Lake RI/FS

Seattle, WA

Date[1]	Stage (ft)	Elevation (ft)	Approximate fraction culvert full	Flowtracker inlet velocity (ft/s)	Discharge estimate[2] (cfs)
10/1/2013	2.10	263.89	0.75	0.95	0.6
11/19/2013	2.26	264.05	0.91	1.44	1.0
2/20/2014	2.22	264.01	0.87	0.63	0.4
3/6/2014	3.00	264.79	1.00	1.58	1.2
5/1/2014	1.74	263.53	0.39	0.52	0.2
5/15/2014	1.62	263.41	0.27	0.37	0.1
7/29/2014	1.66	263.45	0.31	0.75	0.2
SG-LL-1 top elevation (ft)[2]		265.12		Min	0.1
Culvert bottom elevation (ft)[3]		263.14		Max	1.2

Notes:

[1] Lora Lake outlet culvert cleared of debris on 9/30/2013.

[2] Discharge estimate = (Flowtrack velocity)*πr^2*(fraction culvert full).

[3] Survey data from Port of Seattle; data received by email on 7/19/2013.

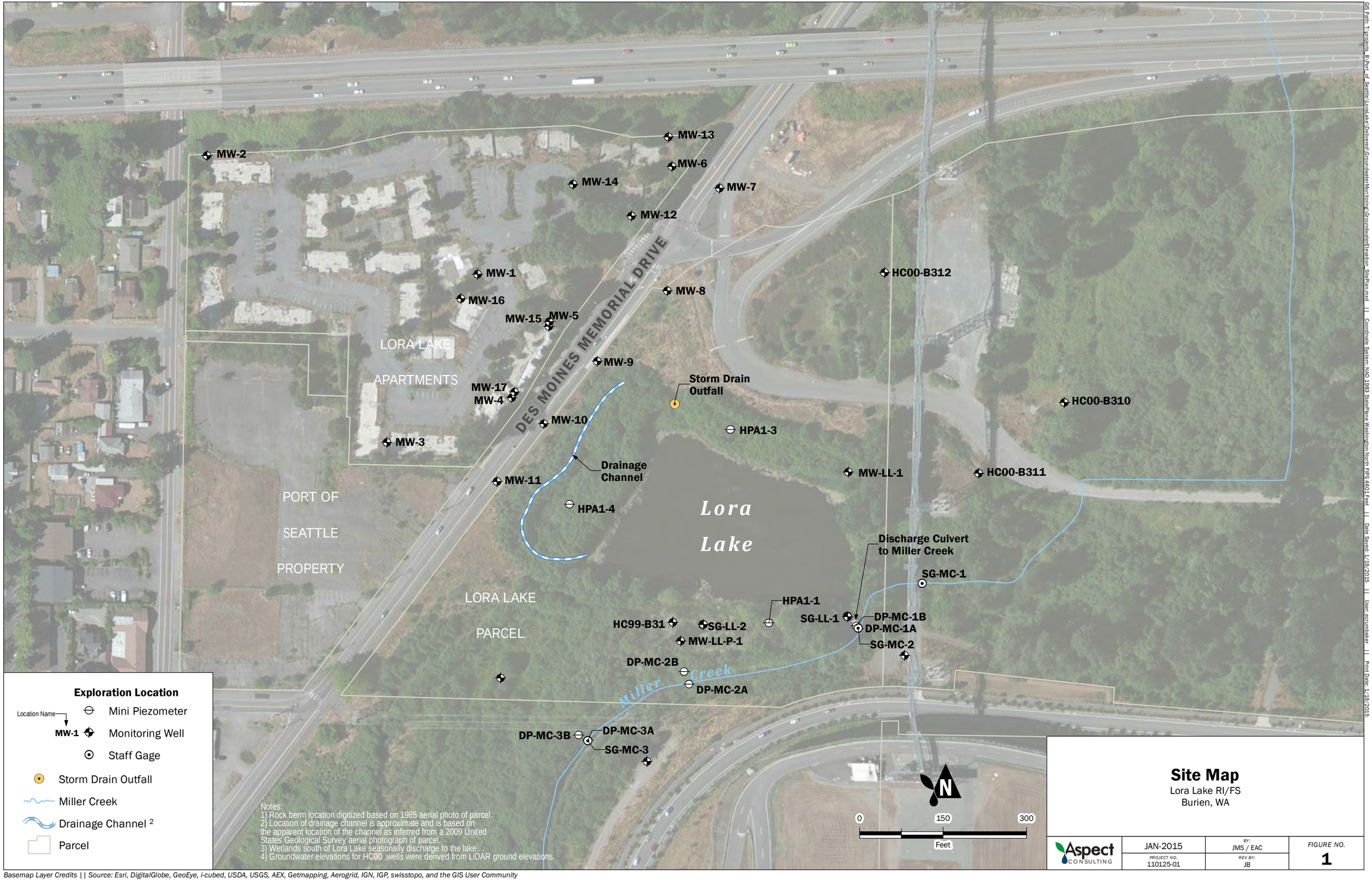
[4] Obtained from Port of Seattle survey document created 3/25/2009.

cfs = cubic feet per second

ft = feet

ft/s = feet per second

FIGURES



Exploration Location

Location Name → MW-1

- Mini Piezometer
- Monitoring Well
- Staff Gage
- Storm Drain Outfall
- Miller Creek
- Drainage Channel [2]
- Parcel

Notes:
1) Rock berm location digitized based on 1985 aerial photo of parcel.
2) Location of drainage channel is approximate and is based on the apparent location of the channel as inferred from a 2009 United States Geological Survey aerial photograph of parcel.
3) Wetlands south of Lora Lake seasonally discharge to the lake.
4) Groundwater elevations for HC00 wells were derived from LiDAR ground elevations.

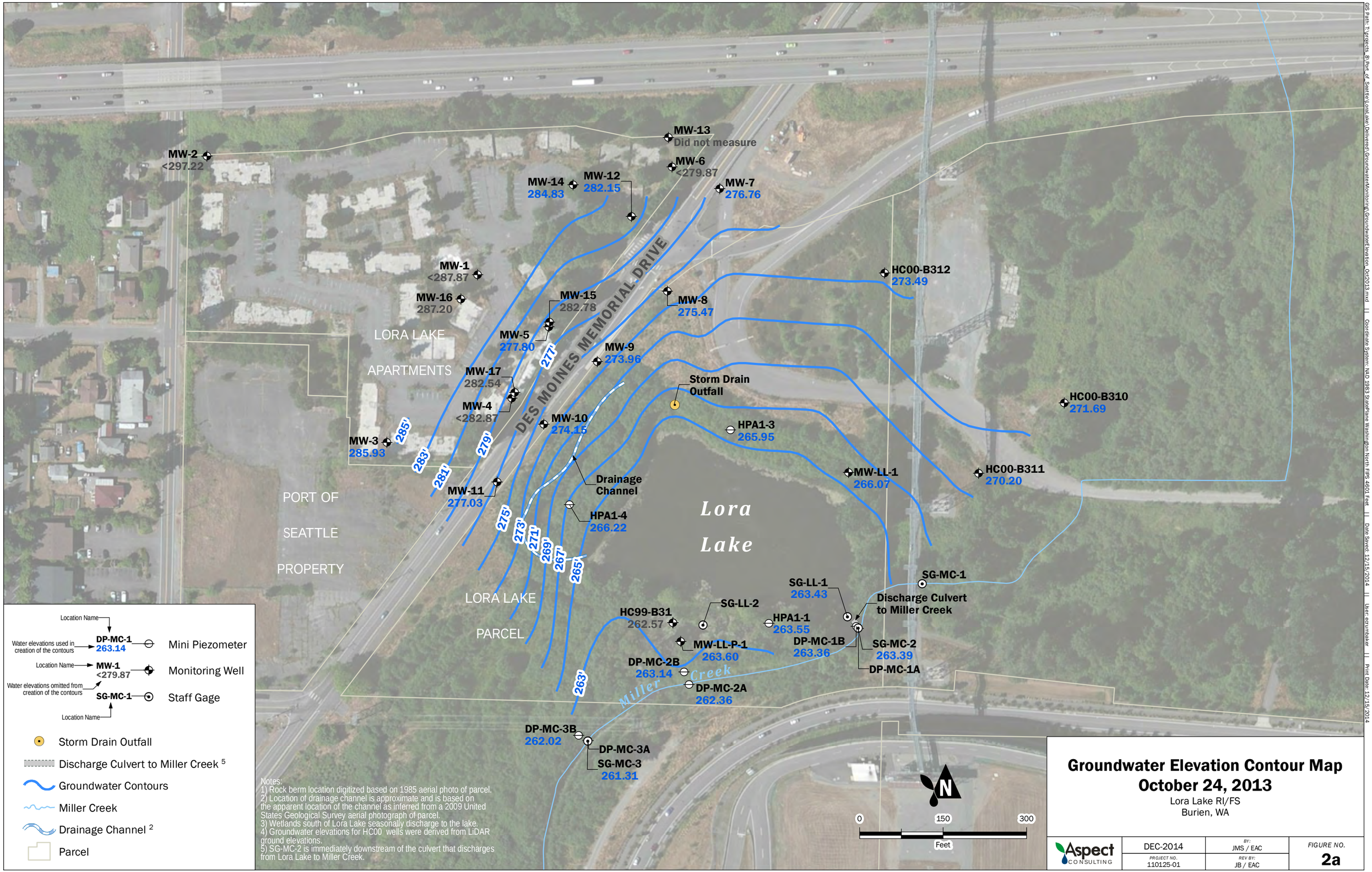
Site Map

Lora Lake RI/FS
Burien, WA

Aspect CONSULTING	JAN-2015	BY: JMS / EAC	FIGURE NO. 1
	PROJECT NO. 110125-01	REV BY: JB	

Basemap Layer Credits || Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

GIS Path: T:\projects_8\Port_of_Seattle\LoraLake\Delivered\Groundwater\Monitoring\GroundwaterElevation_SitePlan.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 1/19/2015 || User: ecrumbaker || Print Date: 1/19/2015



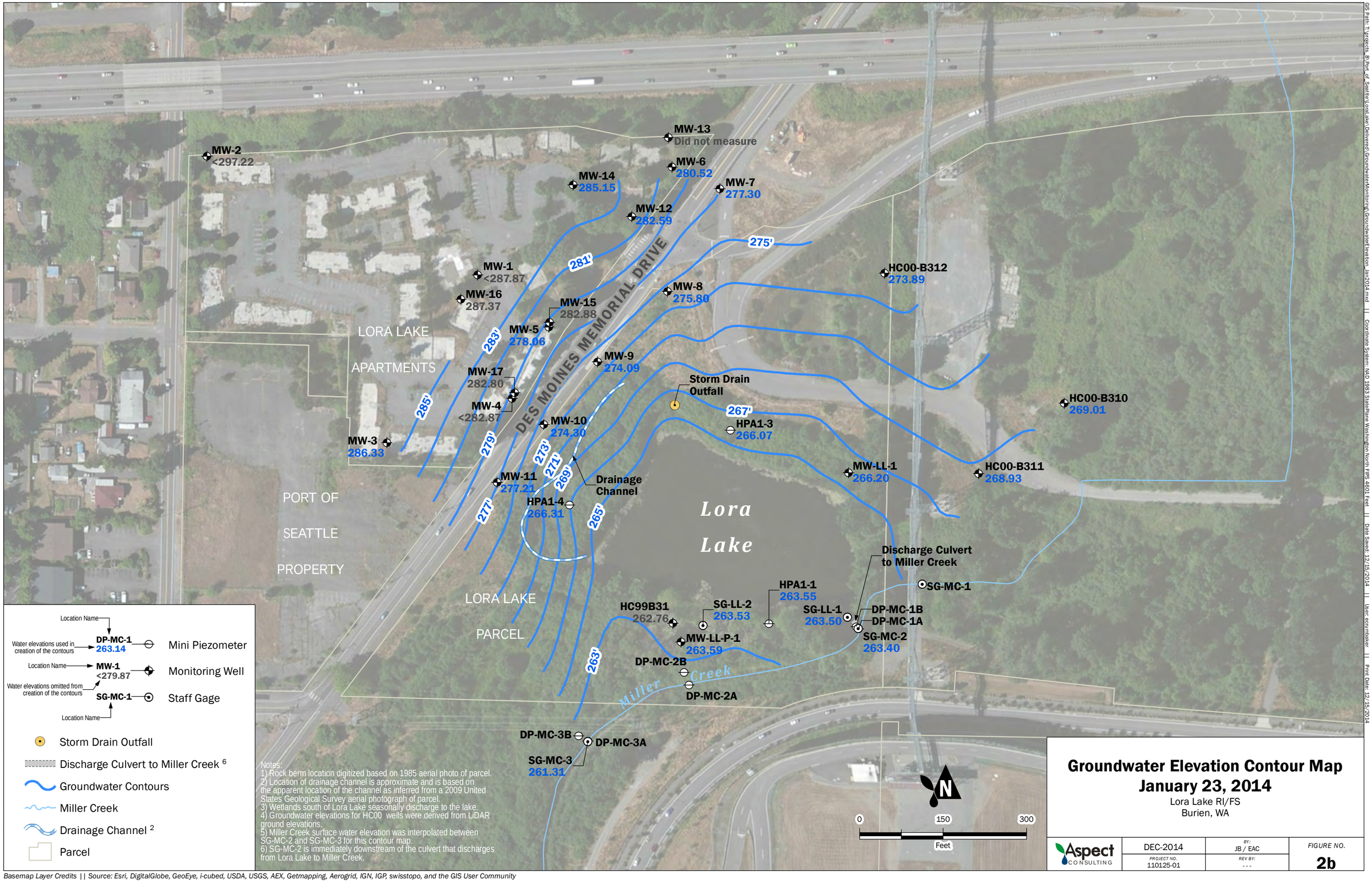
Groundwater Elevation Contour Map
October 24, 2013

Lora Lake RI/FS
Burien, WA

Aspect CONSULTING	DEC-2014	BY: JMS / EAC	FIGURE NO. 2a
	PROJECT NO. 110125-01	REV BY: JB / EAC	

Basemap Layer Credits || Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

GIS Path: T:\projects_8\Port_of_Seattle\LoraLake\Delivered\GroundwaterMonitoring\GroundwaterElevation_Oct2013.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 12/15/2014 || User: ezrumbaker || Print Date: 12/15/2014



Notes:
1) Rock berm location digitized based on 1985 aerial photo of parcel.
2) Location of drainage channel is approximate and is based on the apparent location of the channel as inferred from a 2009 United States Geological Survey aerial photograph of parcel.
3) Wetlands south of Lora Lake seasonally discharge to the lake.
4) Groundwater elevations for HC00 wells were derived from LiDAR ground elevations.
5) Miller Creek surface water elevation was interpolated between SG-MC-2 and SG-MC-3 for this contour map.
6) SG-MC-2 is immediately downstream of the culvert that discharges from Lora Lake to Miller Creek.

Groundwater Elevation Contour Map
January 23, 2014

Lora Lake RI/FS
Burien, WA

Aspect CONSULTING	DEC-2014	BY: JB / EAC	FIGURE NO. 2b
	PROJECT NO. 110125-01	REV BY: ---	

Basemap Layer Credits || Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

GIS Path: T:\projects_8\Port_of_Seattle\Lora Lake\Delivered\Groundwater\Monitoring\Groundwater Elevation_Jan2014.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 12/15/2014 || User: ecrumbaker || Print Date: 12/15/2014

MW-2
<297.22

MW-13
Did not measure

MW-6
280.52

MW-7
277.30

MW-14
285.15

MW-12
282.59

295'

293'

291'

289'

287'

285'

283'

281'

279'

277'

273'

271'

269'

267'

265'

275'

MW-1
<287.87

MW-16
287.37

MW-15
282.88

MW-8
275.80

HC00-B312
274.19

LORA LAKE

APARTMENTS

MW-5
278.06

MW-17
282.80

MW-9
274.09

DES MOINES MEMORIAL DRIVE

Storm Drain
Outfall

MW-4
<282.87

MW-10
274.30

HPA1-3
266.07

HC00-B310
269.01

MW-3
286.33

MW-11
277.21

Drainage
Channel

HPA1-4
266.31

MW-LL-1
266.20

HC00-B311
268.93

PORT OF

SEATTLE

PROPERTY

Lora

Lake

Discharge Culvert
to Miller Creek

SG-MC-1

SG-LL-1
263.50

LORA LAKE

PARCEL

HC99B31
262.76

SG-LL-2
263.53

HPA1-1
263.55

DP-MC-1B

SG-MC-2
263.40

MW-LL-P-1
263.59

DP-MC-1A

DP-MC-2B

Miller Creek

DP-MC-2A

DP-MC-3B

SG-MC-3
261.31

DP-MC-3A

Location Name
DP-MC-1
263.14
Water elevations used in creation of the contours
Mini Piezometer

Location Name
MW-1
<279.87
Water elevations omitted from creation of the contours
Monitoring Well

SG-MC-1
Location Name
Staff Gage

Storm Drain Outfall

Discharge Culvert to Miller Creek [6]

Groundwater Contours

Miller Creek

Drainage Channel [2]

Parcel

Notes:
1) Rock berm location digitized based on 1985 aerial photo of parcel.
2) Location of drainage channel is approximate and is based on the apparent location of the channel as inferred from a 2009 United States Geological Survey aerial photograph of parcel.
3) Wetlands south of Lora Lake seasonally discharge to the lake.
4) Groundwater elevations for HC00 wells were derived from LiDAR ground elevations.
5) Miller Creek surface water elevation was interpolated between SG-MC-2 and SG-MC-3 for this contour map.
6) SG-MC-2 is immediately downstream of the culvert that discharges from Lora Lake to Miller Creek.

N

0 150 300
Feet

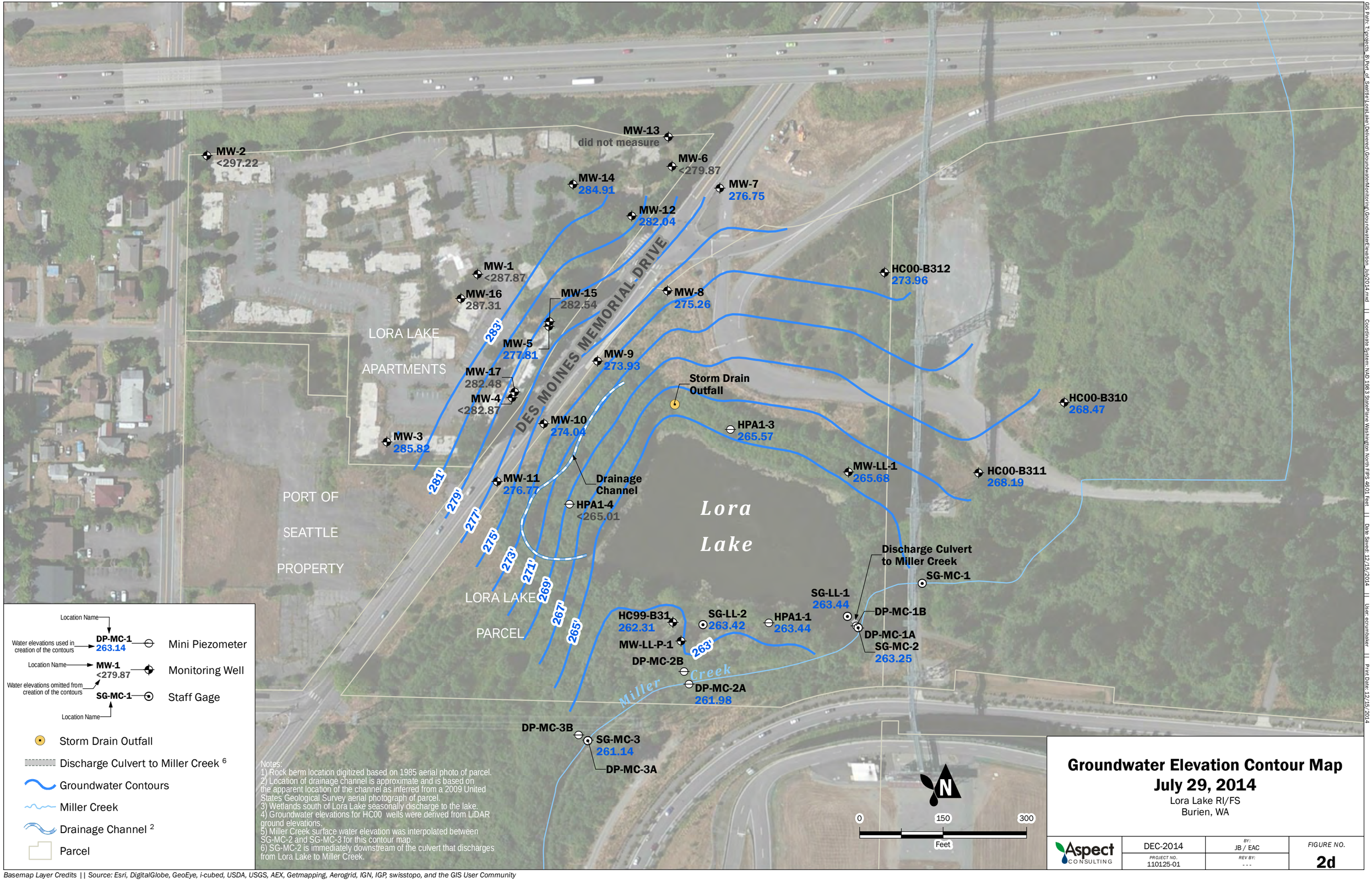
Groundwater Elevation Contour Map
May 1, 2014

Lora Lake RI/FS
Burien, WA

Aspect CONSULTING	DEC-2014	BY: JB / EAC	FIGURE NO. 2c
	PROJECT NO. 110125-01	REV BY: ---	

Basemap Layer Credits || Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

GIS Path: T:\projects_8\Port_of_Seattle\LoraLake\Delivered\GroundwaterMonitoring\GroundwaterElevation_May2014.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 12/15/2014 || User: ecrumbaker || Print Date: 12/15/2014



Location Name
DP-MC-1
263.14
Water elevations used in creation of the contours
Mini Piezometer

Location Name
MW-1
<279.87
Water elevations omitted from creation of the contours
Monitoring Well

SG-MC-1
Location Name
Staff Gage

Storm Drain Outfall

Discharge Culvert to Miller Creek [6]

Groundwater Contours

Miller Creek

Drainage Channel [2]

Parcel

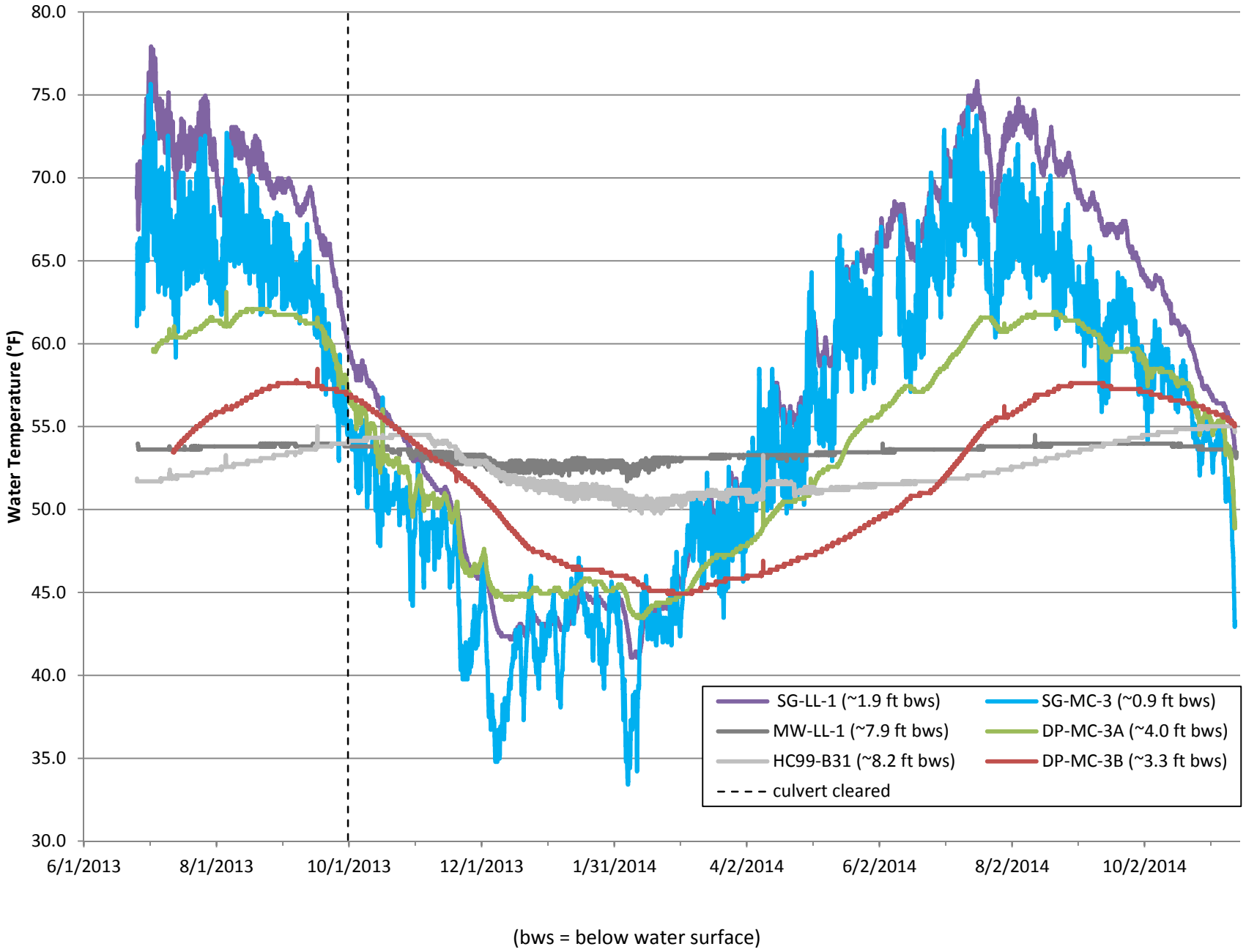
Notes:
1) Rock berm location digitized based on 1985 aerial photo of parcel.
2) Location of drainage channel is approximate and is based on the apparent location of the channel as inferred from a 2009 United States Geological Survey aerial photograph of parcel.
3) Wetlands south of Lora Lake seasonally discharge to the lake.
4) Groundwater elevations for HC00 wells were derived from LiDAR ground elevations.
5) Miller Creek surface water elevation was interpolated between SG-MC-2 and SG-MC-3 for this contour map.
6) SG-MC-2 is immediately downstream of the culvert that discharges from Lora Lake to Miller Creek.

Groundwater Elevation Contour Map
July 29, 2014
Lora Lake RI/FS
Burien, WA

Aspect CONSULTING

DEC-2014	BY: JB / EAC	FIGURE NO. 2d
PROJECT NO. 110125-01	REV BY: ---	

Basemap Layer Credits || Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



(bws = below water surface)

Aspect Consulting

1/16/2015

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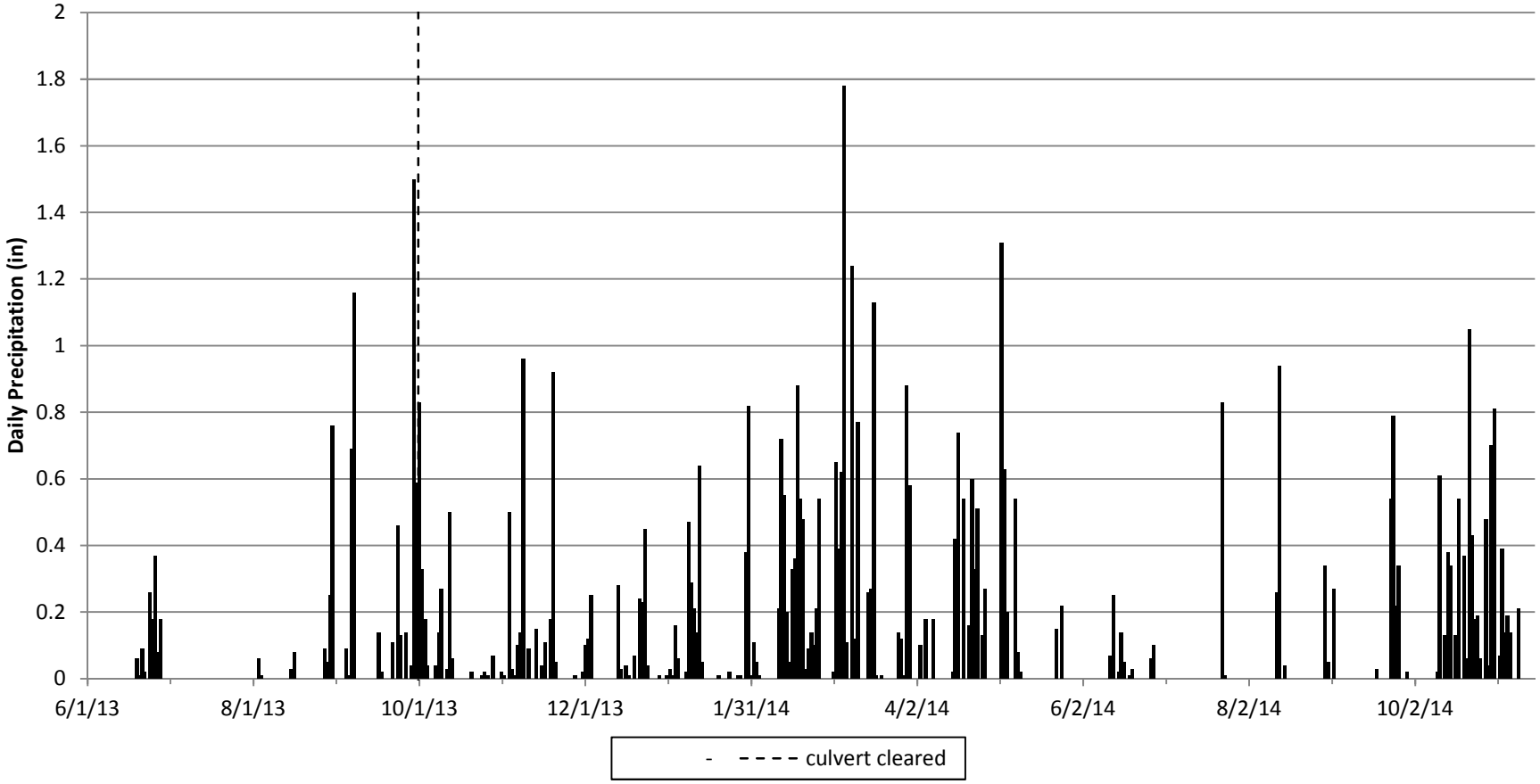
Figure 3 - Water Temperature

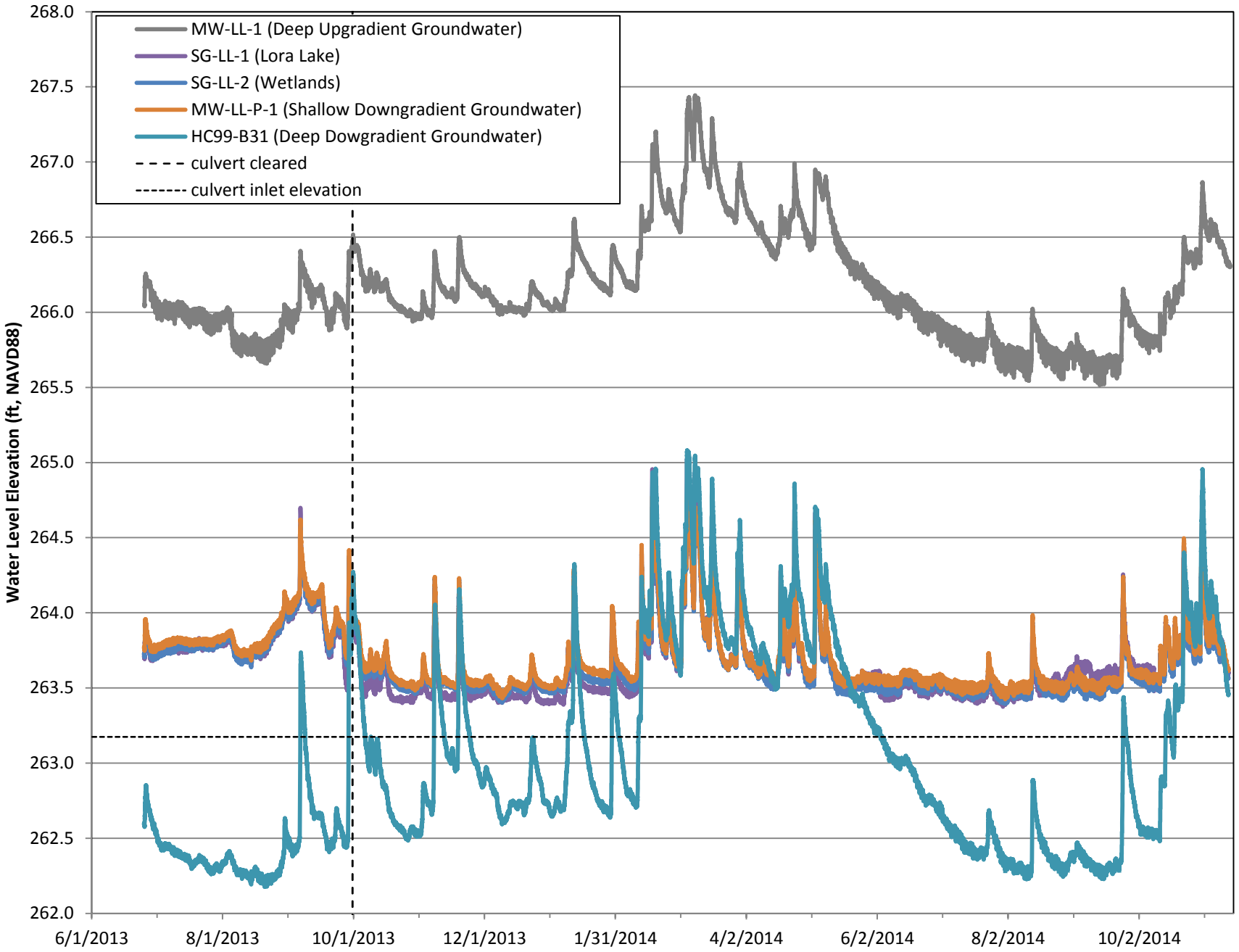
110125 Lora Lake RI/FS



	Monthly Precipitation Totals (in)												Avg.		Total	
	Jan	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**				
2013	-	-	-	-	2.4	1.3	0.0	1.3	5.1	2.6	3.3	1.9	3.3 [1]	3.6 [2]	40.1 [1]	43.4 [2]
2014	3.3	5.6	9.1	4.2	3.2	0.7	0.8	1.6	2.2	6.5	4.7	4.7				
1945-2003 Avg.	5.6	4.2	3.8	2.6	1.7	1.5	0.8	1.0	1.8	3.6	5.9	5.8	3.2		38.2	
Difference 2013 from Avg.	-	-	-	-	0.7	**-0.2**	**-0.8**	0.3	3.3	**-1.0**	**-2.6**	**-3.9**				
Difference 2014 from Avg.	**-2.3**	1.4	5.3	1.6	1.5	**-0.8**	0.1	0.6	0.5	3.0	**-1.2**	**-1.1**				

[1] May 2013 through April 2014.

[2] Using average of 2013 and 2014 monthly precipitation for the duplicate months (May - December).



Aspect Consulting

1/16/2015

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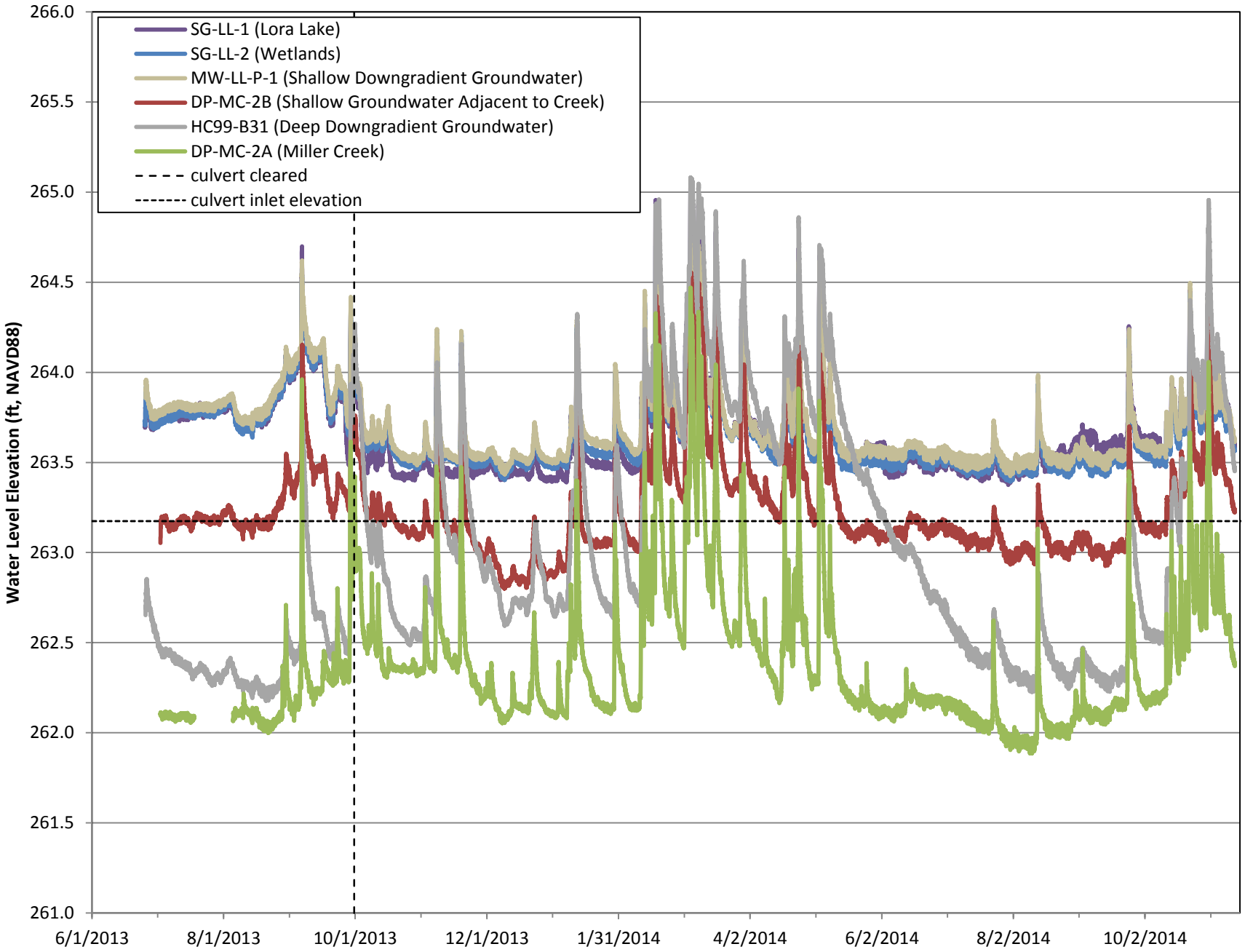
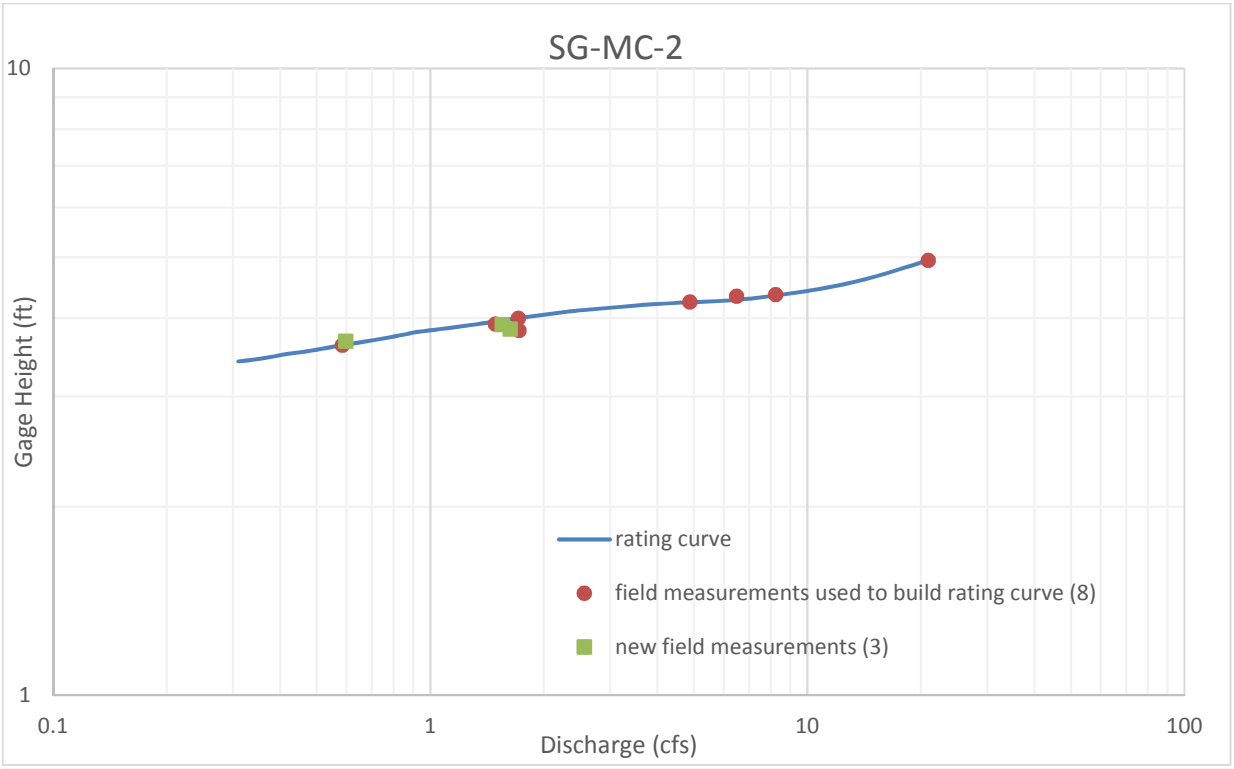
Figure 5 - Groundwater Interactions with Lora Lake

110125 Lora Lake RI/FS



Aspect Consulting
1/16/2015
P:\Port of Seattle\Lora Lake\Lake Fill Baseline Data\Field data\Combined Monitoring Data & Graphs.xlsx

Figure 6 - Overall Surface Water and Groundwater Interactions
110125 Lora Lake RI/FS



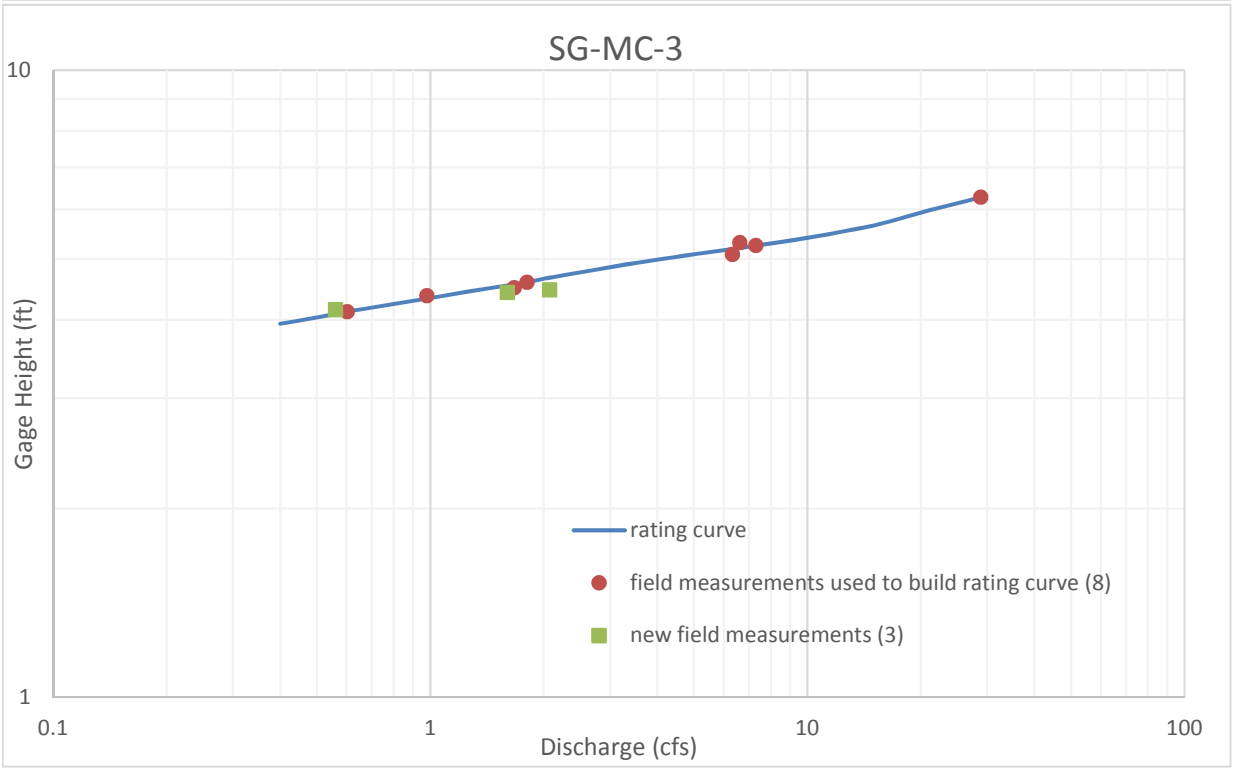
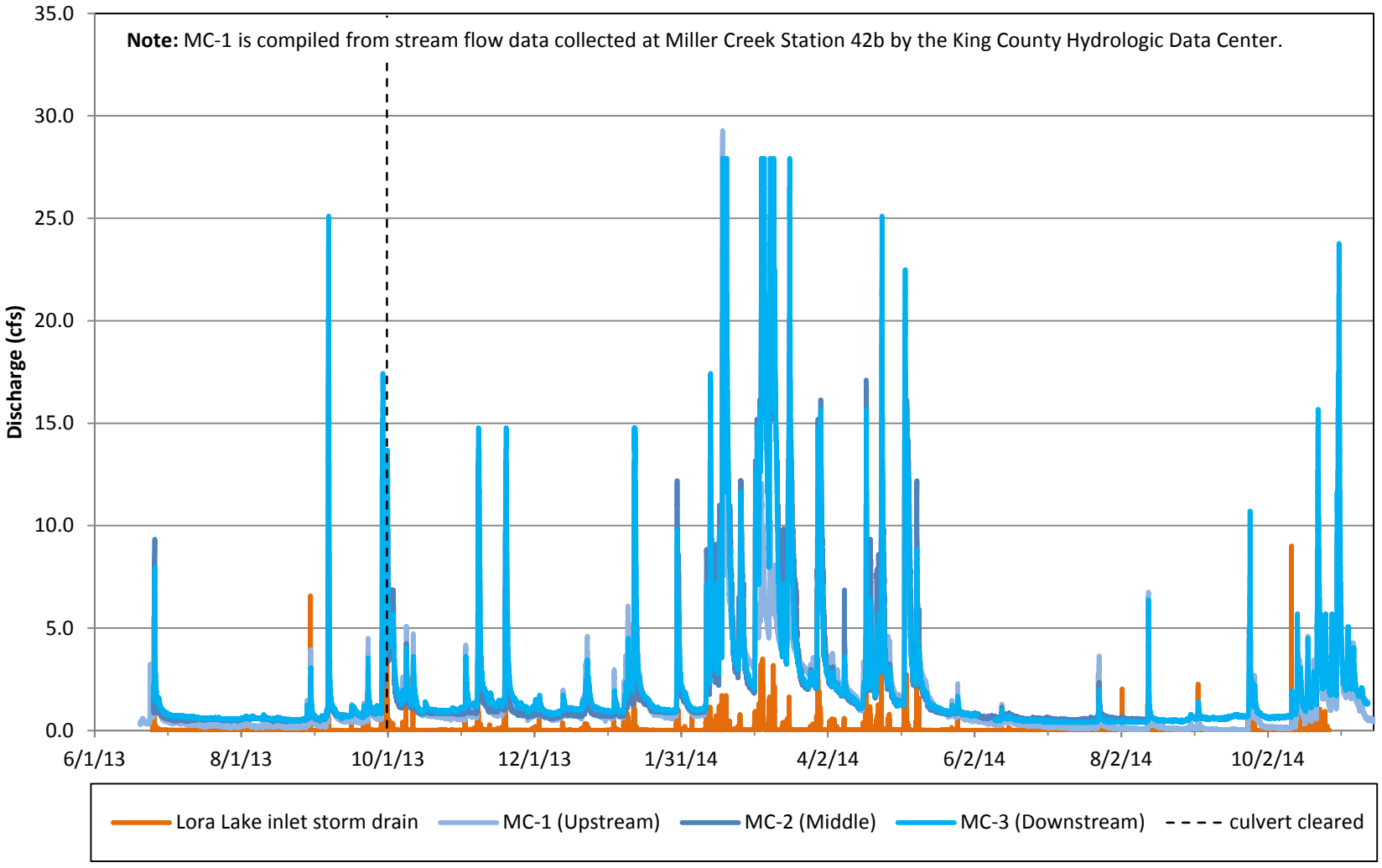
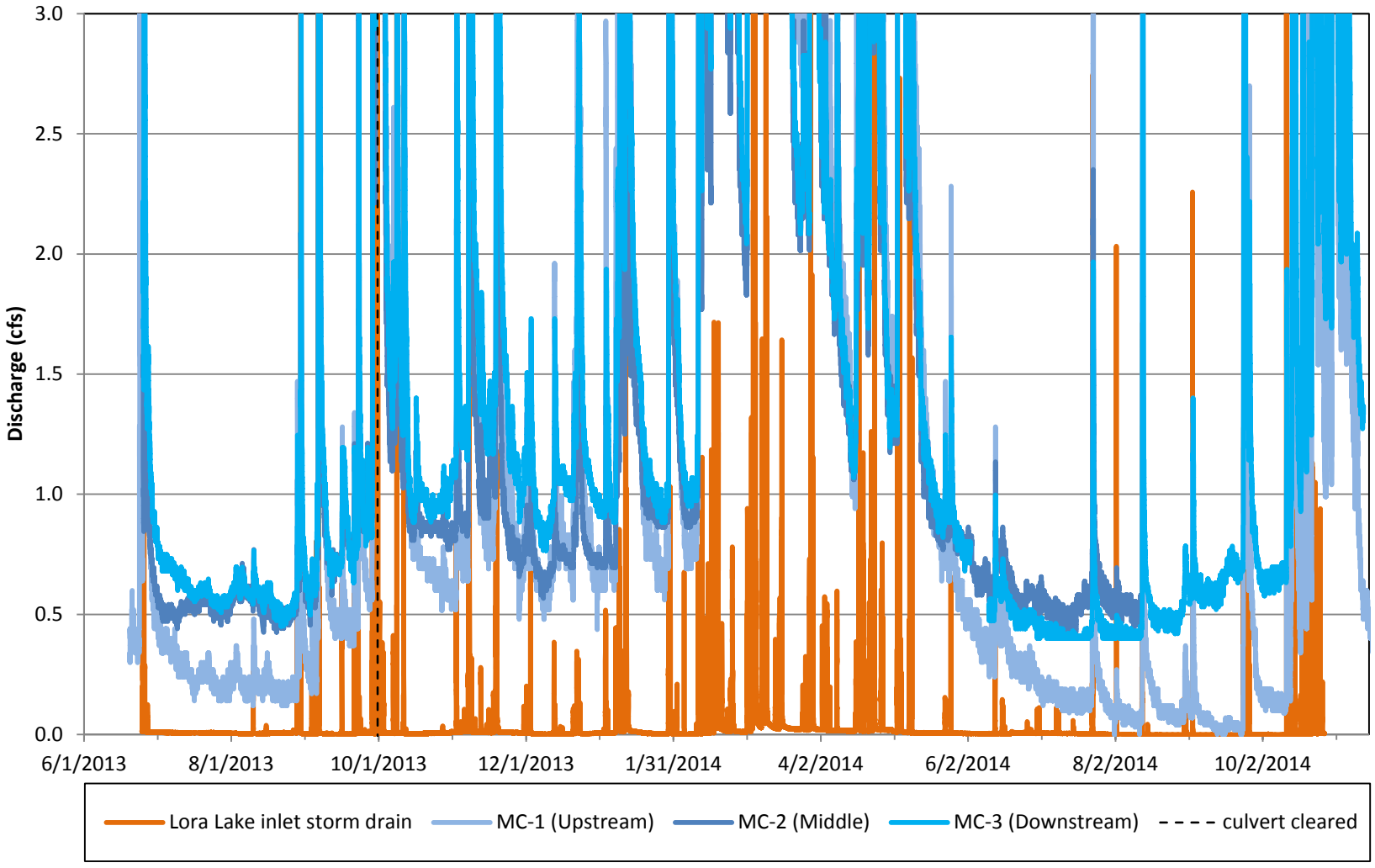


Figure 7 - Stage-Discharge Rating Curves

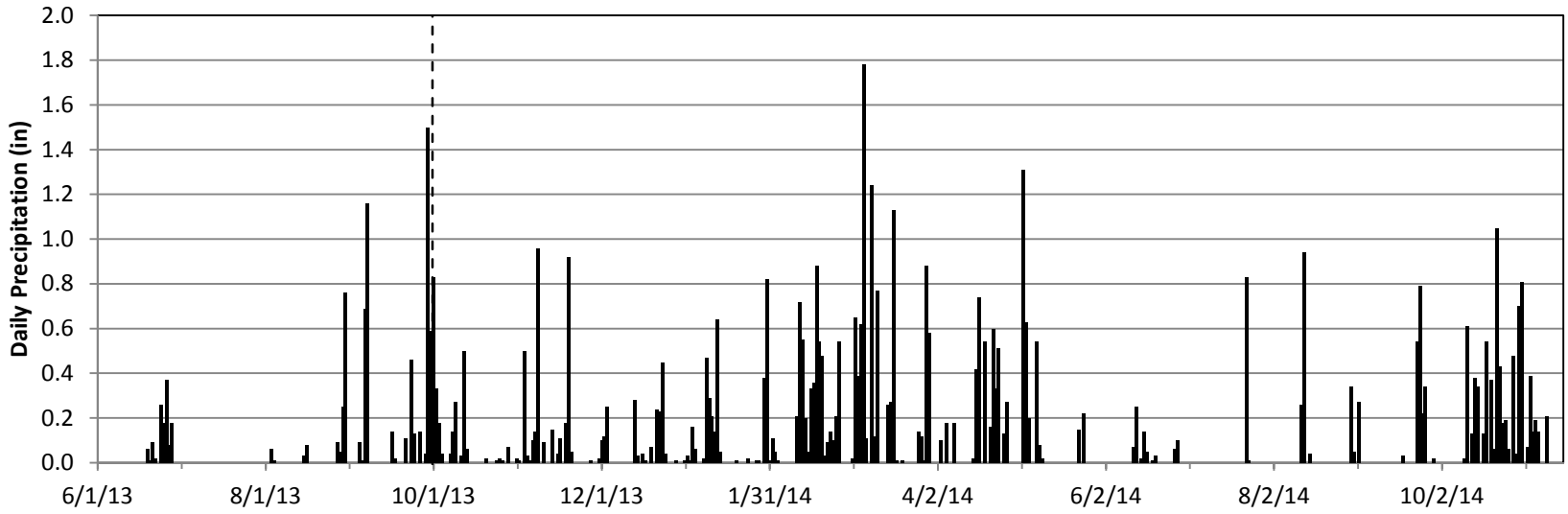
Overview of Flows in Miller Creek



Detailed Low Flows in Miller Creek



Precipitation



Aspect Consulting
1/28/2015
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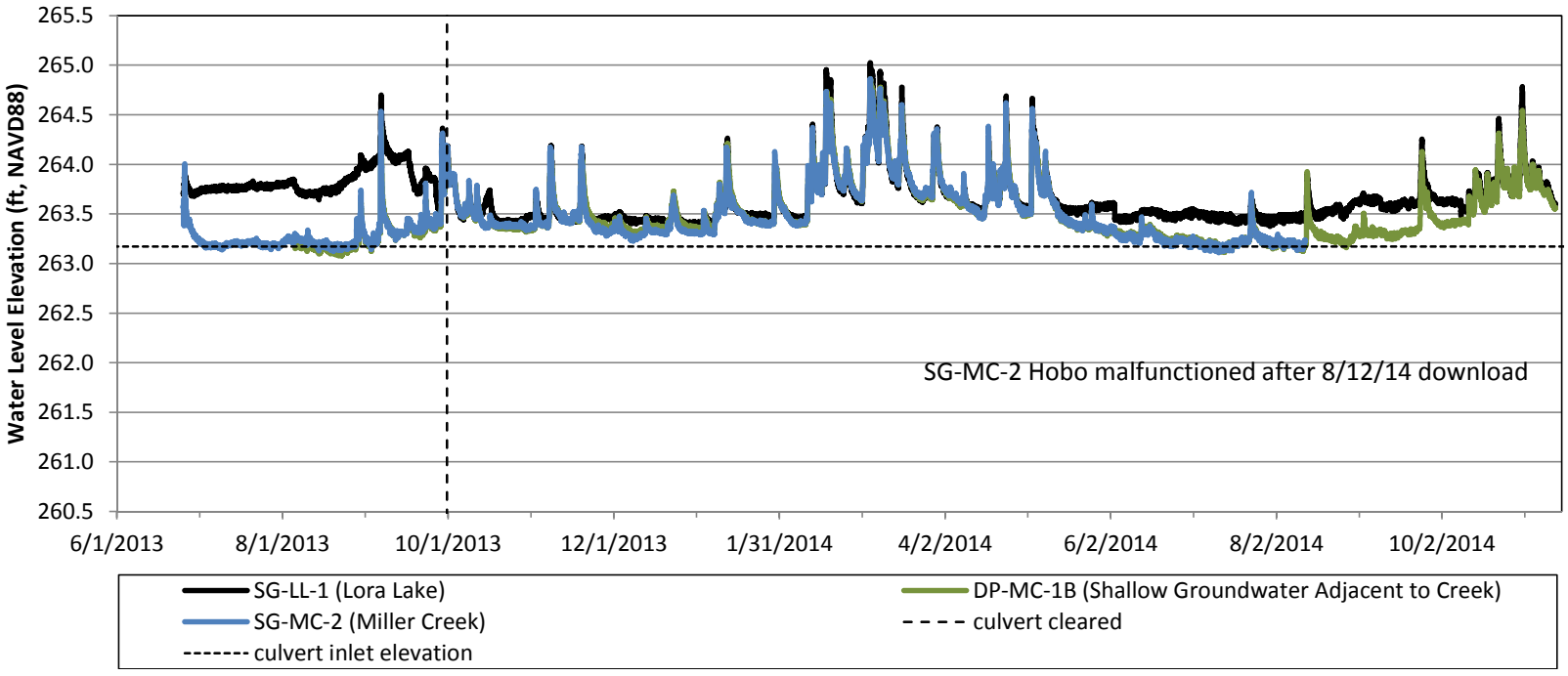
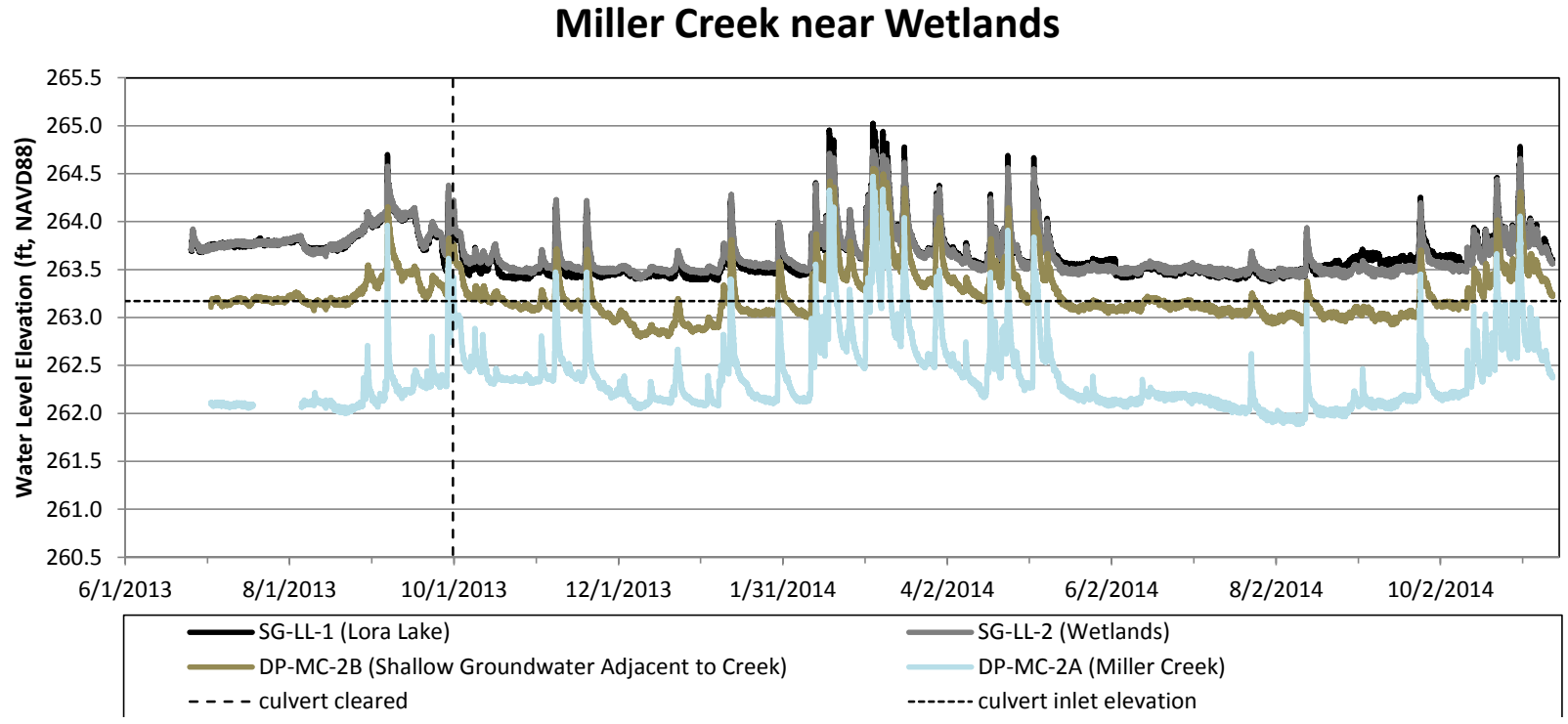
Figure 8 - Miller Creek Flows
110125 Lora Lake RI/FS

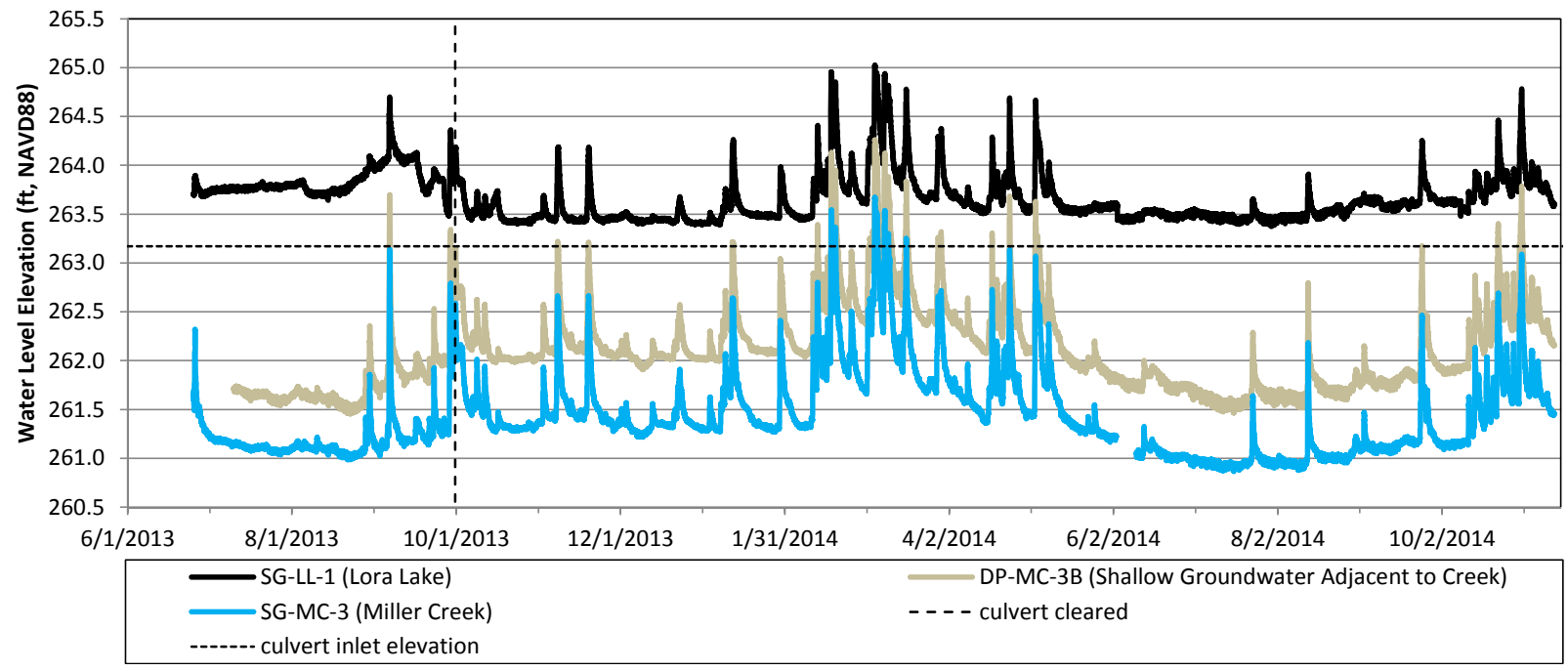
Miller Creek near Lora Lake Outflow



Miller Creek near Wetlands



Miller Creek downstream of Wetlands



Precipitation

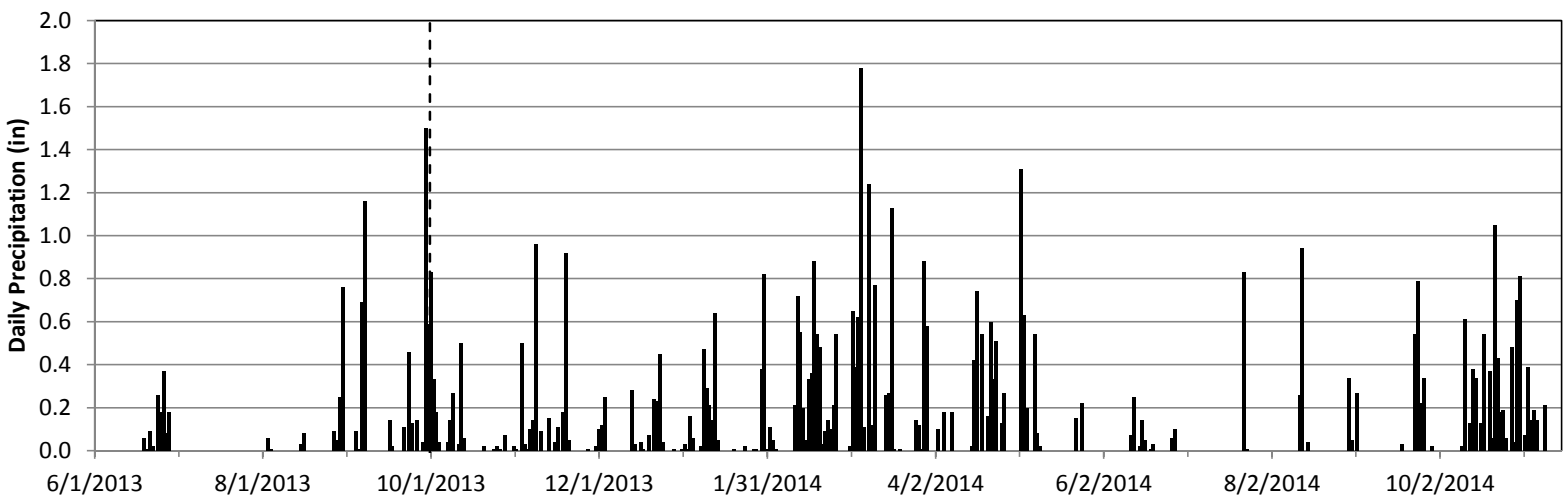


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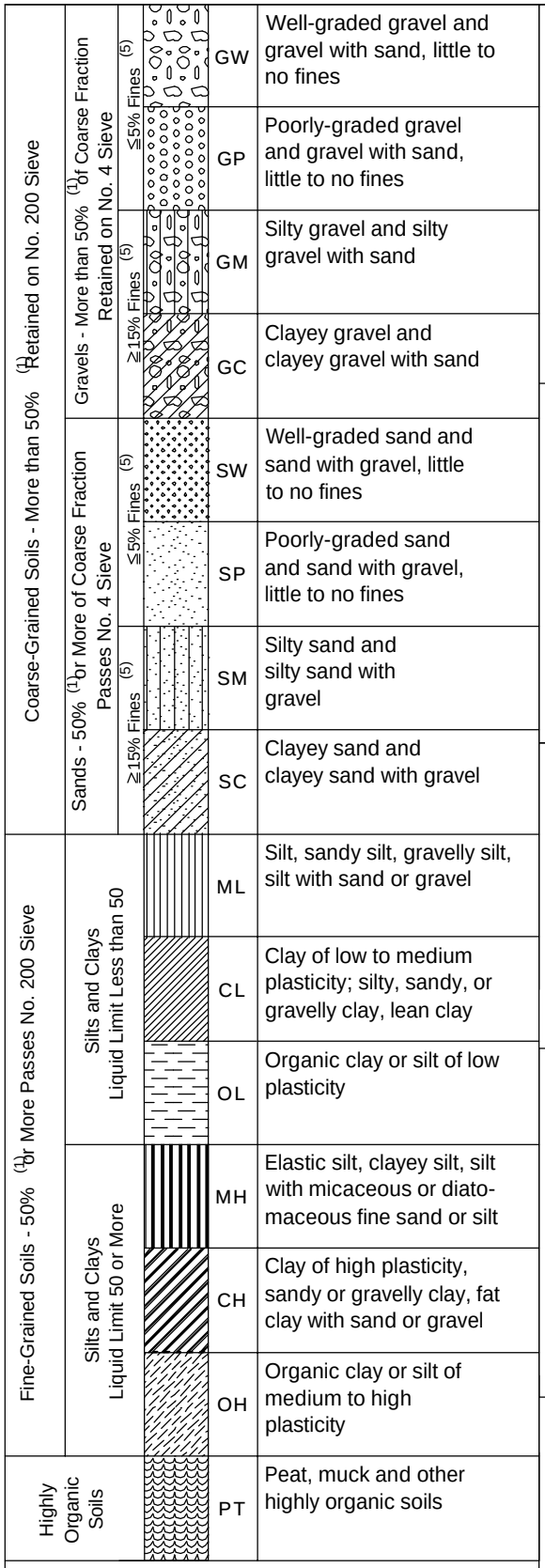
Figure 9 - Surface Water and Groundwater Interactions with Miller Creek
110125 Lora Lake RI/FS

APPENDIX A

MW-LL-1 Well Log



Terms Describing Relative Density and Consistency

	Density	SPT (2) blows/foot
Coarse-Grained Soils	Very Loose	0 to 4
	Loose	4 to 10
	Medium Dense	10 to 30
	Dense	30 to 50
	Very Dense	>50
	Consistency	**SPT (2) blows/foot**
Fine-Grained Soils	Very Soft	0 to 2
	Soft	2 to 4
	Medium Stiff	4 to 8
	Stiff	8 to 15
	Very Stiff	15 to 30
	Hard	>30

Test Symbols

FC = Fines Content
G = Grain Size
M = Moisture Content
A = Atterberg Limits
C = Consolidation
DD = Dry Density
K = Permeability
Str = Shear Strength
Env = Environmental
PiD = Photoionization Detector

Component Definitions

Descriptive Term	Size Range and Sieve Number
Boulders	Larger than 12"
Cobbles	3" to 12"
Gravel	3" to No. 4 (4.75 mm)
Coarse Gravel	3" to 3/4"
Fine Gravel	3/4" to No. 4 (4.75 mm)
Sand	No. 4 (4.75 mm) to No. 200 (0.075 mm)
Coarse Sand	No. 4 (4.75 mm) to No. 10 (2.00 mm)
Medium Sand	No. 10 (2.00 mm) to No. 40 (0.425 mm)
Fine Sand	No. 40 (0.425 mm) to No. 200 (0.075 mm)
Silt and Clay	Smaller than No. 200 (0.075 mm)

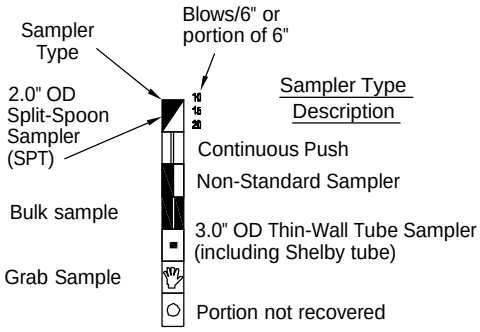
(3) Estimated Percentage

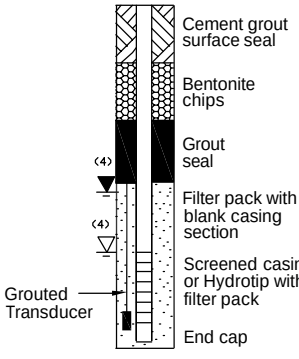
Percentage by Weight	Modifier
<5	Trace
5 to 15	Slightly (sandy, silty, clayey, gravelly)
15 to 30	Sandy, silty, clayey, gravelly)
30 to 49	Very (sandy, silty, clayey, gravelly)

Moisture Content

Dry - Absence of moisture, dusty, dry to the touch
Slightly Moist - Perceptible moisture
Moist - Damp but no visible water
Very Moist - Water visible but not free draining
Wet - Visible free water, usually from below water table

Symbols





(1) Percentage by dry weight
(2) (SPT) Standard Penetration Test (ASTM D-1586)
(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)
(4) Depth of groundwater — ATD = At time of drilling; Static water level (date); BGS = below ground surface
(5) Combined USCS symbols used for fines between 5% and 15% as estimated in General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

Aspect CONSULTING

Exploration Log Key

DATE:
DESIGNED BY:
DRAWN BY:
REVISED BY:
PROJECT NO.
FIGURE NO. A-1

Q:_ACAD Standards\Standard Details\Exploration Log Key A1.dwg

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
110125	MW-LL-1	1 of 1

Project Name: Lora Lake RI/FS
Location: Burien, WA
Driller/Equipment: Cascade Drilling / HSA Limited Access
Drilling Method/Hammer: D&M, 140 lb down-hole hammer, <30 inch drop

Ground Surface Elev:
Depth to Water (ft BGS): 0
Start/Finish Date: 6/25/2013

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	Blows/ 6"	N-value / Water Content % (0 10 20 30 40 50)	Material Type	Description	Depth (ft)
	Stick-up monument set in concrete						Grass, woody debris, and wetland soils	
							WEATHERED VASHON RECESSIONAL GLACIAL OUTWASH (Dense), wet, brown SAND (SP); fine to medium sand, trace organics - grass and thin roots	
5	Hydrated medium bentonite chips			16 50/6"				5
	2 inch diameter PVC casing						(Dense), wet, brown slightly silty, sandy GRAVEL (GP-GM); fine to coarse sand, predominantly fine round gravel, trace organics - grass and thin roots	
	2/12 sand filter pack							
10				50/6"			(Dense), wet, gray brown SAND (SP); fine to medium sand, trace coarse sand and fine gravel, trace organics, trace silt	10
	2 inch diameter 20-slot PVC screen							
15				50/6"			Becomes gray, no organics	15
	PVC end cap							
20				50/6"			Bottom of boring at 20.5 ft bgs	20

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon Ring Sampler

Drilling Method:
HSA: Hollow Stem Auger
MR: Mud Rotary

Logged by: JB
Approved by:

Figure No. A-2

GEOTECH BORING LOG LORA LAKE 110125.GPJ June 26, 2013

APPENDIX B

Well Logs of Pre-Existing Monitoring Stations

BORING & WELL CONSTRUCTION LOG

WELL MW-1 (BORING LLP-4 LOCATION)

GEOSCIENCE MANAGEMENT, INC.
ENVIRONMENTAL CONSULTING SERVICES
809 156TH STREET NE
ARLINGTON, WA 98223

PROJECT
Lora Lake Apartments

CLIENT
Port of Seattle

DRILLING COMPANY
Hollow-stem Auger

GEOLOGIST
H. W. Small, L.HG.

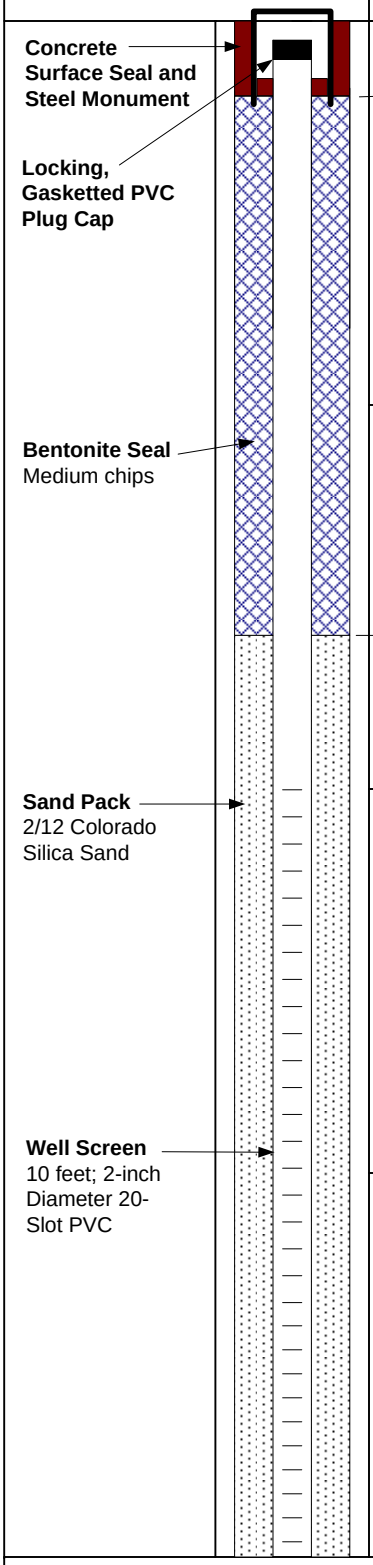
START DATE 10/25/2007 **END DATE** 10/25/2007

DRILLING METHOD
Hollow-stem Auger (4.25 ID x 9 OD)

SAMPLING METHOD
3-in. O.D. Split-Spoon Sampler

SURFACE COMPLETION
Flush-mount steel monument

Elevation Ground: Not Measured
Elevation TOC: Not Measured
Total Boring Depth: 20 Feet
Depth to Water ATD: 14 Feet



DEPTH (FEET)	SAMPLE ID	BLOW COUNT (PER 6 INCHES)	SAMPLE INTERVAL AND RECOVERY	PID READINGS (PPM)	USCS	
0						
1.0 Feet					FILL	Planter soil over: Gray, brown and black, damp, slightly silty, gravelly, medium to fine SAND (Fill). Occasional fragments of wood, debris, roots and organic matter to approximately 6 feet bgs.
5						
5.5 to 6.0	MW-1-5.5'	50/6"		10		Drove sample at 5.5 feet, but did not encounter target zone of substantial organics, as observed in boring LLP-4. Drove sample at 6.0 feet, but did not encounter target zone of substantial organics. Gravel in shoe.
6.0 to 6.5	MW-1-6'	50/6"		10		
7.0 to 8.0	MW-1-7'	10 20 22		5		Drilled to 7 feet and drove sample again, but did not encounter target zone of substantial organics. Brown, damp, trace to slightly silty, gravelly, medium to fine SAND (Native soil).
8 Feet						
10					SP	
				ATD		Water level approximately 14.0 feet below ground surface at time of drilling.
14.0 to 15.0	MW-1-14'	40 36 50		80	GP	Gray, wet, sandy gravel zone approximately 3-inch thick. Strong hydrocarbon-like odor, sheen on gravel.
15						
					SP	Gray, wet, trace to slightly silty, gravelly, medium to fine SAND.
20						Total depth = 20 feet.

Construction Notes: Installed 2-inch diameter PVC well screen from 20 to 10 feet (see as-built diagram this page). Completed at the ground surface in concrete pad with steel, traffic-rated well monument. No water added during drilling except to hydrate bentonite seal.

AECOM

Boring/Well Log

Well #: MW-2
Sheet 1 of 2

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-210**	Northing: **174871.1516** Easting: **1271948.3761**	Ground Elevation: **299.891 ft.**
Location: **Burien, WA**	Drill Rig Type: **HSA Limited Access**	MP Elevation: **-**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **15.5'**
Start Date & Time: **3/18/08 0800**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **3/18/08 0850**	Boring ID: **8.25"**	Seal: **Bentonite chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **R. Knecht/ C. Smith**	Screen: **0.010" slot Sch. 40 PVC 5-15 ft-bgs**

Sample Type & Number	Sample Depth Range	Sample % Rec	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: **USCS/ASTM**)	Elevation (ft.)	Comments & Samples
SS-1	0.0-1.5	66			0	(0.0-0.3) MULCH (0.3-1.5) SP: POORLY GRADED SAND, dark yellowish brown, fine, medium dense, moist. Trace rootlets, and fine, rounded, gravel. No odor or visible contamination.		Flush Mount Monument 2-inch Sch. 40 PVC riser from 0-5 ft-bgs
SS-2	1.5-3.0	72				(1.5-3.0) SP: POORLY GRADED SAND, light yellowish gray, fine, medium dense, moist. One large, long root, 1/8" in diameter. Trace coarse sand, and rounded, fine gravel, up to 0.5" in diameter. No odor or visible contamination.		0.0-0.5' Sampled for analytical 1.5-2.0' Sampled for analytical
						(3.0-4.0) Not Sampled.		Bentonite seal from 2 to 4 ft-bgs
SS-3	4.0-5.5	66			5	(4.0-5.5) SW: WELL GRADED SAND, yellowish gray grading to dark yellowish gray, fine to medium, dense, moist to wet. Trace fine gravel, up to 3/4" in diameter. No odor or visible contamination.	295	
						(5.5-6.5) Not Sampled.		
SS-4	6.5-8.0	75				(6.5-8.0) SW: WELL GRADED SAND, yellowish brown, fine to coarse, very dense, wet. Trace rounded, fine gravel, up to 3/4" in diameter. No odor or visible contamination.		6.5-8.0' Sampled for analytical

Remarks and Datum Used:

HSA - Hollow Stem Auger
Sch. - Schedule
Amb. - ambient air

AECOM - Environment
710 2nd Ave. Suite 1000
Seattle, WA 98104
Phone: (206) 624-9349
Fax: (206) 623-3793

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
03/18/08	**0944**	**6.46'**

AECOM

Boring/Well Log

Well #: MW-2
Sheet 2 of 2

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-210**	Northing: **174871.1516** Easting: **1271948.3761**	Ground Elevation: **299.891 ft.**
Location: **Burien, WA**	Drill Rig Type: **HSA Limited Access**	MP Elevation: **-**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **15.5'**
Start Date & Time: **3/18/08 0800**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **3/18/08 0850**	Boring ID: **8.25"**	Seal: **Bentonite chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **R. Knecht/ C. Smith**	Screen: **0.010" slot Sch. 40 PVC 5-15 ft-bgs**

Sample Type & Number	Sample Depth Range	Sample % Rec	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS/ASTM)	Elevation (ft.)	Comments & Samples
						(8.0-9.0) Not Sampled.		
SS-5	9.0-10.5	66			10	(9.0-10.5) SW: WELL GRADED SAND, grayish brown, fine to medium, very dense, wet. 10% coarse sand to fine gravel, up to 3/4" in diameter. 10% silt. No odor or visible contamination.	290	2-inch diameter 0.010 inch slot, Sch. 40 PVC screen from 5 to15 ft-bgs
						(10.5-11.5) Not Sampled.		
SS-6	11.5-13.0	83				(11.5-13.0) SP: POORLY GRADED SAND, brown to grayish brown, very fine, dense, wet. At 11.5-11.7', sub angular, fine to coarse sand, and coarse gravel, up to 2" long. At 12.25', 4" thick lense of fine sand. No odor or visible contamination.		10/20 silica sand pack from 4 to 15.5 ft-bgs
						(13.0-14.0) Not Sampled.		
SS-7	14.0-15.5	-			15	(14.0-15.5) SW: WELL GRADED SAND, brownish gray, fine to medium, very dense, wet.. Sharp contact at 15.3' with sub angular to sub rounded, medium sand. No odor or visible contamination.	285	14-15.5' Sampled for analytical Slight heaving sand

Remarks and Datum Used:

AECOM - Environment
710 2nd Ave. Suite 1000
Seattle, WA 98104
Phone: (206) 624-9349
Fax: (206) 623-3793

HSA - Hollow Stem Auger
Sch. - Schedule
Amb. - ambient air

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
03/18/08	**0944**	**6.46'**

AECOM

Boring/Well Log

Well #: MW-3
Sheet 1 of 3

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-210**	Northing: **174355.3983** Easting: **1272271.6255**	Ground Elevation: **300.36 ft.**
Location: **Burien, WA**	Drill Rig Type: **HSA Limited Access**	MP Elevation: **-**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **25.5'**
Start Date & Time: **3/18/08 1015**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **3/18/08 1115**	Boring ID: **8.25"**	Seal: **Bentonite chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **R. Knecht/ C. Smith**	Screen: **0.010" slot Sch. 40 PVC 13-23 ft-bgs**

Sample Type & Number	Sample Depth Range	Sample % Rec	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS/ASTM)	Elevation (ft.)	Comments & Samples
SS-1	0.0-1.5	66			0	(0.0-0.3) MULCH	300	Flush Mount Monument 2-inch diameter, Sch. 40 PVC riser from 0-13 ft-bgs
						(0.3-1.5) SP: POORLY GRADED SAND, dark yellowish brown to yellowish brown, fine, dense, moist. 10% medium to coarse sand and rounded, fine to coarse gravel, up to 1.5" long. Trace rootlets. No odor or visible contamination.		
SS-2	1.5-3.0	72				(1.5-3.0) SP: POORLY GRADED SAND, brown to slightly dark brown, fine, dense, moist. 10% medium to coarse sand. Trace, elongated, fine to coarse gravel, up to 1.5" long. No odor or visible contamination.		0.0-0.5' Sampled for analytical; mulch not included in sample
						(3.0-4.0) Not Sampled.		
SS-3	4.0-5.5	66			5	(4.0-4.6) SP: POORLY GRADED SAND, brown to dark brown, fine, dense, moist. 10% rounded to sub rounded, elongate, coarse sand and fine gravel, up to 0.5" long. No odor or visible contamination.	295	1.5-2.0' Sampled for analytical Bentonite seal from 2 to 11 ft-bgs
						(4.6-5.5) SW: WELL GRADED SAND, yellowish brown, fine to medium, dense, moist. Trace rounded, coarse sand and fine gravel, up to 0.5" in diameter. No odor or visible contamination.		
SS-4	6.5-8.0	75				(5.5-6.5) Not Sampled.		6.5-8.0' Sampled for analytical
						(6.5-7.5) SP: POORLY GRADED SAND, brown to dark brown, fine, very dense, moist. 20% medium to coarse sand. 10% rounded, fine gravel, up to 1/4" in diameter. No odor or visible contamination.		
SS-5	9.0-10.5	66			10	(7.5-8.0) SW: WELL GRADED SAND, yellowish brown, fine to medium. Trace rounded coarse sand and fine gravel, up to 1/2" long. No odor or visible contamination.		
						(8.0-9.0) Not Sampled.		

Remarks and Datum Used:

HSA - Hollow Stem Auger
Sch. - Schedule
Amb. - ambient air

AECOM - Environment
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Seattle, WA 98104
Phone: (206) 624-9349
Fax: (206) 623-3793

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
03/18/08	**1220**	**17.46'**

AECOM

Boring/Well Log

Well #: MW-3
Sheet 2 of 3

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-210**	Northing: **174355.3983** Easting: **1272271.6255**	Ground Elevation: **300.36 ft.**
Location: **Burien, WA**	Drill Rig Type: **HSA Limited Access**	MP Elevation: **-**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **25.5'**
Start Date & Time: **3/18/08 1015**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **3/18/08 1115**	Boring ID: **8.25"**	Seal: **Bentonite chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **R. Knecht/ C. Smith**	Screen: **0.010" slot Sch. 40 PVC 13-23 ft-bgs**

Sample Type & Number	Sample Depth Range	Sample % Rec	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS/ASTM)	Elevation (ft.)	Comments & Samples
					10		290	
SS-6	11.5-13.0	83				(9.0-10.5) SP: POORLY GRADED SAND, light yellowish gray, fine, very dense. 20% medium to coarse sand. Trace rounded, fine gravel, up to 3/4" long. No odor or visible contamination.		2-inch diameter, 0.010-inch slot, Sch. 40 PVC screen from 13 to 23 ft-bgs
						(10.5-11.5) Not Sampled.		
						(11.5-13.0) SW: WELL GRADED SAND, light grayish brown to brown, fine to medium, very dense. 15% coarse sand. 10-15% sub rounded to rounded, fine to coarse gravel, up to 1" in diameter. Trace silt and iron staining. No odor or visible contamination.		
SS-7	14.0-15.5	-				(13.0-14.0) Not Sampled.		14-15.5' Sampled for analytical
					15	(14.0-15.5) SP: POORLY GRADED SAND, yellowish brown, fine, very dense, moist to wet. Trace medium sand and silt. No odor or visible contamination.	285	10/20 silica sand pack from 11 to 23.5 ft-bgs
						(15.5-16.5) Not Sampled.		
SS-8	16.5-18	94				(16.5-18.0) SP: POORLY GRADED SAND, brownish gray, medium, very dense, moist to wet. 10-15% fine sand. Trace silt. No odor or visible contamination.		
						(18.0-19.0) Not Sampled.		
SS-9	19.0-20.5	77				(19.0-20.5) SW: WELL GRADED SAND, grayish brown to brown, fine to medium, very dense, wet. Trace silt and mica flakes. 10% winnowing. No odor or visible contamination.		
					20		280	

Remarks and Datum Used:

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Seattle, WA 98104
Phone: (206) 624-9349
Fax: (206) 623-3793

HSA - Hollow Stem Auger
Sch. - Schedule
Amb. - ambient air

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
03/18/08	**1220**	**17.46'**

AECOM

Boring/Well Log

Well #: MW-3
Sheet 3 of 3

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-210**	Northing: **174355.3983** Easting: **1272271.6255**	Ground Elevation: **300.36 ft.**
Location: **Burien, WA**	Drill Rig Type: **HSA Limited Access**	MP Elevation: **-**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **25.5'**
Start Date & Time: **3/18/08 1015**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **3/18/08 1115**	Boring ID: **8.25"**	Seal: **Bentonite chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **R. Knecht/ C. Smith**	Screen: **0.010" slot Sch. 40 PVC 13-23 ft-bgs**

Sample Type & Number	Sample Depth Range	Sample % Rec	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: **USCS/ASTM**)	Elevation (ft.)	Comments & Samples
						(20.5-21.5) Not Sampled.	280	
SS-10	**21.5-23.0**	**92**				(21.5-23.0) SP: POORLY GRADED SAND, gray to bluish gray, fine, very dense, wet. Abundant wood pieces. Trace large, mica flakes. 2mm thick lamination in soil layer. Very slight H2S-like odor. No visible contamination.		
						(23.0-24.0) Not Sampled.		
SS-11	**24.0-25.5**	**100**			**25**	(24.0-25.5) SW: WELL GRADED SAND, slightly yellowish brown ro gray, medium to fine, very dense, wet. Iron stained beds, up to 1/4" thick at top of interval. No odor or visible contamination.	275	heaving sand, filled top foot of SS-11 with slough

Remarks and Datum Used:

HSA - Hollow Stem Auger
Sch. - Schedule
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Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
03/18/08	**1220**	**17.46'**

AECOM

Boring/Well Log

Well #: MW-4
Sheet 1 of 3

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-210**	Northing: **174435.4039** Easting: **1272496.5424**	Ground Elevation: **294.562 ft.**
Location: **Burien, WA**	Drill Rig Type: **HSA Limited Access**	MP Elevation: **-**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **26'**
Start Date & Time: **3/17/08 1400**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **3/17/08 1515**	Boring ID: **8.25"**	Seal: **Bentonite chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **R. Knecht/ C. Smith**	Screen: **0.010" slot Sch. 40 PVC 11-25.75 ft-bgs**

Sample Type & Number	Sample Depth Range	Sample % Rec	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: **USCS/ASTM**)	Elevation (ft.)	Comments & Samples
SS-1	0.0-1.5	66			0	(0.0-1.5) SW: SAND, brown, fine to medium, medium dense, moist. 20% rounded, coarse sand to fine gravel. Trace silt and rounded, coarse gravel, up to 1" long. Abundant grass and rootlets from 0.0-0.2'. Moderate organic-like odor, no visible contamination.		Flush Mount Monument 2-inch diameter, Sch. 40 PVC riser from 0 to 11 ft-bgs
SS-2	1.5-3.0	72				(1.5-2.0) SP: POORLY GRADED SAND, brown, fine, medium dense, moist. 15% silt. Trace rounded, fine, gravel. Organic-like odor, no visible contamination.		
						(2.0-3.0) SP: POORLY GRADED SAND, yellowish brown with pockets of gray from 2.5-3', fine, medium dense, moist. 20% medium sand from 2-2.5'. Trace rounded, fine gravel. No odor or visible contamination.		0.0-0.5' Sampled for analytical
SS-3	4.0-5.5	66				(3.0-4.0) Not Sampled.		1.5-2.0' Sampled for analytical
					5	(4.0-5.5) SP: POORLY GRADED SAND, yellowish brown grading to light yellowish brown at 5.0', fine, medium dense, moist. 20% medium sand from 4-5'. Trace rounded, fine gravel, content decreases downhole. Trace rootlets at 4.5'. No odor or visible contamination.	290	Bentonite seal from 2 to 9 ft-bgs
SS-4	6.5-8.0	75				(5.5-6.5) Not Sampled.		
						(6.5-8.0) SP: POORLY GRADED SAND, yellowish brown, medium, very dense, moist. 20% rounded, fine to coarse gravel. Trace rootlets. No odor or visible contamination.		
						(8.0-9.0) Not Sampled.		

Remarks and Datum Used:	
	HSA - Hollow Stem Auger
	Sch. - Schedule
	-

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Seattle, WA 98104
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Fax: (206) 623-3793

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
03/17/08	**1644**	**15.70'**

AECOM

Boring/Well Log

Well #: MW-4
Sheet 2 of 3

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-210**	Northing: **174435.4039** Easting: **1272496.5424**	Ground Elevation: **294.562 ft.**
Location: **Burien, WA**	Drill Rig Type: **HSA Limited Access**	MP Elevation: **-**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **26'**
Start Date & Time: **3/17/08 1400**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **3/17/08 1515**	Boring ID: **8.25"**	Seal: **Bentonite chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **R. Knecht/ C. Smith**	Screen: **0.010" slot Sch. 40 PVC 11-25.75 ft-bgs**

Sample Type & Number	Sample Depth Range	Sample % Rec	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS/ASTM)	Elevation (ft.)	Comments & Samples
SS-5	9.0-10.5	66			10	(9.0-10.5) SW: WELL GRADED SAND WITH GRAVEL, brown to yellowish brown, fine to coarse, very dense, moist. 30% rounded to sub rounded, flat, elongate, fine to coarse gravel, up to 1" long. Slight sweet odor, no visible contamination.	285	9.5-10.5' Sampled for analytical
						(10.5-11.5) Not Sampled.		
SS-6	11.5-13.0	83				(11.5-13.0) SP: POORLY GRADED SAND, slightly yellowish brown grading to yellowish gray, fine, dense, moist. Few 0.5" thick lenses of very fine sand. Trace coarse sand. No odor or visible contamination.		2-inch diameter, 0.010-inch slot, Sch. 40 PVC screen from 11 to 25.75 ft-bgs
						(13.0-14.0) Not Sampled.		
SS-7	14.0-15.5	-			15	(14.0-15.5) SP: POORLY GRADED SAND, brownish gray, fine, very dense, moist. 10-15% silt. Trace mica. No odor or visible contamination.	280	14-15.5' Sampled for analytical 10/20 silica sand pack from 9 to 26 ft-bgs
						(15.5-16.5) Not Sampled.		
SS-8	16.5-18	94				(16.5-18.0) SP: POORLY GRADED SAND, gray to grayish brown, fine, very dense, moist. 20% medium sand at 16.75-17'. Little iron staining at 17.5-18'. At 17.9', 4mm thick black and iron stained bed. No odor or visible contamination.		

Remarks and Datum Used:

HSA - Hollow Stem Auger

Sch. - Schedule

-

AECOM - Environment
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Fax: (206) 623-3793

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
03/17/08	**1644**	**15.70'**

AECOM

Boring/Well Log

Well #: MW-4
Sheet 3 of 3

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-210**	Northing: **174435.4039** Easting: **1272496.5424**	Ground Elevation: **294.562 ft.**
Location: **Burien, WA**	Drill Rig Type: **HSA Limited Access**	MP Elevation: **-**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **26'**
Start Date & Time: **3/17/08 1400**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **3/17/08 1515**	Boring ID: **8.25"**	Seal: **Bentonite chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **R. Knecht/ C. Smith**	Screen: **0.010" slot Sch. 40 PVC 11-25.75 ft-bgs**

Sample Type & Number	Sample Depth Range	Sample % Rec	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: **USCS/ASTM**)	Elevation (ft.)	Comments & Samples
						(18.0-19.0) Not Sampled.		
SS-9	**19.0-20.5**	**77**			**20**	(19.0-20.0) SP: POORLY GRADED SAND, gray, fine, very dense, wet. 2.5" long, gray, friable, clay pocket with one white rock at 19.75'. No odor or visible contamination.	275	
						(20.0-20.5) SP: POORLY GRADED SAND, brown, fine, very dense, wet. Trace rounded, coarse sand. No odor or visible contamination.		
						(20.5-21.5) Not Sampled.		
SS-10	**21.5-23.0**	**92**				(21.5-23.0) SP: POORLY GRADED SAND, brown to slightly yellowish brown, fine, very dense, wet. Wood pieces and gray sand at top of interval. No odor or visible contamination.		
						(23.0-24.0) Not Sampled.		Slight heaving sand at bottom of borehole
SS-11	**24.0-25.5**	**100**			**25**	(24.0-25.5) SP: POORLY GRADED SAND, yellowish brown to brown, medium, very dense, wet. 25% winnowing. No odor or visible contamination.	270	
						(25.5-26.0) Not Sampled.		

Remarks and Datum Used:

HSA - Hollow Stem Auger

Sch. - Schedule

-

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Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
03/17/08	**1644**	**15.70'**

AECOM

Boring/Well Log

Well #: MW-5
Sheet 1 of 3

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-210**	Northing: **174563.4071** Easting: **1272562.8511**	Ground Elevation: **295.151'**
Location: **Burien, WA**	Drill Rig Type: **HSA Limited Access**	MP Elevation: **-**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **28'**
Start Date & Time: **3/17/08 1025**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **3/17/08 1210**	Boring ID: **8.25"**	Seal: **Bentonite chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **R. Knecht/ C. Smith**	Screen: **0.010" slot Sch. 40 PVC 13-28 ft-bgs**

Sample Type & Number	Sample Depth Range	Sample % Rec	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS/ASTM)	Elevation (ft.)	Comments & Samples
SS-1	0.0-1.5	66			0	(0.0-1.5) SP: POORLY GRADED SAND, brown to dark brown, fine, loose, moist. 15% rounded, fine gravel, 0.25-0.5" long. One rounded gravel, 3" in diameter. Trace straw. No odor or visible contamination.	295	Flush Mount Monument 2-inch diameter Sch. 40 PVC riser from 0 to 13 ft-bgs
SS-2	1.5-3.0	100				(1.5-3.0) SP: POORLY GRADED SAND, yellowish brown, fine, dense, moist. Trace coarse sand to fine gravel, rounded, up to 0.5" long. No odor or visible contamination.		0.0-0.5' Sampled for analytical
						(3.0-4.0) Not Sampled.		1.5-2.0' Sampled for analytical
SS-3	4.0-5.5	91			5	(4.0-5.5) SW: WELL GRADED SAND, yellowish brown, fine to medium, very dense, moist. 20% sub rounded, gravel, up to 1/2" in diameter. Gravel content increases to 30% with depth. No odor or visible contamination.	290	Bentonite seal from 2 to 11 ft-bgs
						(5.5-6.5) Not Sampled.		
SS-4	6.5-8.0	100				(6.5-8.0) SM: SILTY SAND, gray to slightly brownish gray, fine, very dense, moist. 20% silt. 10% rounded, sand and fine gravel. One gravel up to 2" long. No odor or visible contamination.		6.5-8.0' Sampled for analytical
						(8.0-9.0) Not Sampled.		
SS-5	9.0-10.5	75			10	(9.0-10.5) SW: WELL GRADED SAND, gray to brownish gray, fine to medium, very dense, moist to wet. Trace coarse sand, fine gravel, and 1" thick pockets of silt and very fine sand. Trace hydrocarbon-like odor in 0.5" thick silt lense at 10.5'. No visible contamination.	285	

Remarks and Datum Used:

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HSA - Hollow Stem Auger

Sch. - Schedule

-

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
03/17/08	**1332**	**20.27'**

AECOM

Boring/Well Log

Well #: MW-5
Sheet 2 of 3

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-210**	Northing: **174563.4071** Easting: **1272562.8511**	Ground Elevation: **295.151'**
Location: **Burien, WA**	Drill Rig Type: **HSA Limited Access**	MP Elevation: **-**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **28'**
Start Date & Time: **3/17/08 1025**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **3/17/08 1210**	Boring ID: **8.25"**	Seal: **Bentonite chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **R. Knecht/ C. Smith**	Screen: **0.010" slot Sch. 40 PVC 13-28 ft-bgs**

Sample Type & Number	Sample Depth Range	Sample % Rec	Soil and Rock Description (Classification Scheme: **USCS/ASTM**)	Elevation (ft.)	Comments & Samples
			(10.5-11.5) Not Sampled.	285	
SS-6	**11.5-13.0**	**88**	(11.5-12.75) SW: WELL GRADED SAND, fine to medium, very dense, moist. 15% rounded, fine to coarse gravel, up to 1.5" long. 2" thick, light gray silt lense at 12' with a slight hydrocarbon-like odor. Trace wood peices at 12.5', no odor. No visible contamination.		11.5-13.0' Sampled for analytical
SS-7	**14.0-15.5**	**77**	(12.75 - 13.0) ML-SM: SILT WITH SAND TO SILTY SAND, dark gray, fine, very dense. At 13', 20% rounded, fine gravel, from 1/4- 3/8" in diameter. Slight to moderate hydrocarbon-like odor, no visible contamination.		2-inch diameter, 0.010-inch slot, Sch. 40, PVC screen from 13 to 28 ft-bgs
			(13.0-14.0) Not Sampled.		
			(14.0-15.5) SP: POORLY GRADED SAND, dark gray, fine, medium dense, moist. 15% rounded, medium to coarse sand. Trace silt. No odor or visible contamination.	280	
SS-8	**16.5-18**	**72**	(15.5-16.5) Not Sampled.		10/20 silica sand pack from 11 to 28 ft-bgs
			(16.5-18.0) SP: POORLY GRADED SAND, gray to light gray, fine from 16.5-17', medium from 17-18', very dense, wet. Trace rounded, fine, gravel with medium sand. Trace silt with fine sand. No odor or visible contamination.		
			(18.0-19.0) Not Sampled.		
SS-9	**19.0-20.5**	**77**	(19.0-20.5) SW: WELL GRADED SAND, gray, medium to coarse, medium dense, wet . 10-15% sub rounded, fine gravel. At 20.25', silt lense, 0.5" thick, no plasticity. No odor or visible contamination.	275	

Well Completion Log / Graphic: 10 — 15 — 20

Remarks and Datum Used:

HSA - Hollow Stem Auger

Sch. - Schedule

-

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Fax: (206) 623-3793

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
03/17/08	**1332**	**20.27'**

AECOM

Boring/Well Log

Well #: MW-5
Sheet 3 of 3

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-210**	Northing: **174563.4071** Easting: **1272562.8511**	Ground Elevation: **295.151'**
Location: **Burien, WA**	Drill Rig Type: **HSA Limited Access**	MP Elevation: **-**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **28'**
Start Date & Time: **3/17/08 1025**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **3/17/08 1210**	Boring ID: **8.25"**	Seal: **Bentonite chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **R. Knecht/ C. Smith**	Screen: **0.010" slot Sch. 40 PVC 13-28 ft-bgs**

Sample Type & Number	Sample Depth Range	Sample % Rec	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS/ASTM)	Elevation (ft.)	Comments & Samples
							275	
						(20.5-21.5) Not Sampled.		
SS-10	21.5-23.0	66				(21.5-23.0) SW: WELL GRADED SAND, grayish brown grading to yellowish brown, sub angular to sub rounded, very dense, wet. 20% sub angular to rounded, elongated, fine to coarse, gravel. No odor or visible contamination.		
						(23.0-24.0) Not Sampled.		
SS-11	24.0-25.5	100			25	(24.0-25.5) SP: POORLY GRADED SAND, grayish brown, fine, very dense, wet. Trace medium sand and rounded, fine gravel. No odor or visible contamination.	270	
						(25.5-26.5) Not Sampled.		Slight heaving sand at bottom of borehole
SS-12	26.5-28	100				(26.5-28.0) SP: POORLY GRADED SAND, gray from 26.5-27.0', sharp contact to yellowish brown at 27.0', fine, very dense, wet. 15% gray, medium to coarse sand. Trace, soft, silt. 50% winnowing. No odor or visible contamination.		

Remarks and Datum Used:

HSA - Hollow Stem Auger

Sch. - Schedule

-

AECOM - Environment
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Seattle, WA 98104
Phone: (206) 624-9349
Fax: (206) 623-3793

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
03/17/08	**1332**	**20.27'**

AECOM

Boring/Well Log

Well #: MW-6
Sheet 1 of 3

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-210**	Northing: **174850.9922** Easting: **1272784.1135**	Ground Elevation: **291.083'**
Location: **Burien, WA**	Drill Rig Type: **HSA Limited Access**	MP Elevation: **-**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20.5'**
Start Date & Time: **3/18/08 1344**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **3/18/08 1445**	Boring ID: **8.25"**	Seal: **Bentonite chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **R. Knecht/ C. Smith**	Screen: **0.010" slot Sch. 40 PVC 5-15 ft-bgs**

Sample Type & Number	Sample Depth Range	Sample % Rec	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS/ASTM)	Elevation (ft.)	Comments & Samples
SS-1	0.0-1.5	83			0	(0.0-1.5) SP: POORLY GRADED SAND, brown, fine, medium dense, moist. 20-25% silt. 10% medium to coarse sand. Trace fine gravel, up to 1/4" in diameter. Abundant rootlets throughout, grass on top. Moderate organic odor, no visible contamination.	290	Flush Mount Monument 2-inch diameter Sch. 40 PVC riser from 0 to 5 ft-bgs
SS-2	1.5-3.0	66				(1.5-3.0) SP: POORLY GRADED SAND, brown to slightly dark brown, fine, very dense, moist. 20% silt. Trace rounded, coarse sand to fine gravel. Little rootlets. Friable. Moderate organic odor, no visible contamination.		0.0-0.5' Sampled for analytical
						(3.0-4.0) Not Sampled.		
SS-3	4.0-5.5	66			5	(4.0-5.5) SP: POORLY GRADED SAND, slightly reddish brown, fine, loose, moist. 10-15% medium to coarse sand. Trace rounded, fine gravel, up to 3/4" in diameter. Trace rootlets in catcher. No odor or visible contamination.		1.5-2.0' Sampled for analytical
						(5.5-6.5) Not Sampled.	285	
SS-4	6.5-8.0	72				(6.5-8.0) SP: POORLY GRADED SAND, reddish brown grading to light reddish brown, fine, medium dense, moist. Trace fine gravel, up to 1/2" in diameter. No odor or visible contamination.		6.5-8.0' Sampled for analytical
						(8.0-9.0) Not Sampled.		
SS-5	9.0-10.5	94			10	(9.0-10.5) SP: POORLY GRADED SAND, gray with iron staining, fine, dense, moist. Trace organic matter and silt. No odor or visible contamination.		Bentonite seal

Remarks and Datum Used:

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Fax: (206) 623-3793

HSA - Hollow Stem Auger
Sch. - Schedule
Amb. - ambient air

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
03/18/08	**1553**	**12.51'**

AECOM

Boring/Well Log

Well #: MW-6
Sheet 2 of 3

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-210**	Northing: **174850.9922** Easting: **1272784.1135**	Ground Elevation: **291.083'**
Location: **Burien, WA**	Drill Rig Type: **HSA Limited Access**	MP Elevation: **-**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20.5'**
Start Date & Time: **3/18/08 1344**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **3/18/08 1445**	Boring ID: **8.25"**	Seal: **Bentonite chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **R. Knecht/ C. Smith**	Screen: **0.010" slot Sch. 40 PVC 5-15 ft-bgs**

Sample Type & Number	Sample Depth Range	Sample % Rec	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: **USCS/ASTM**)	Elevation (ft.)	Comments & Samples
					10			from 2 to 4 ft-bgs
						(10.5-11.5) Not Sampled.	280	
SS-6	11.5-13.0	92				(11.5-13.0) SP: POORLY GRADED SAND, gray, fine, very dense, wet. 25% sub angular, fine to coarse gravel. 10% coarse sand. Slight to moderate soapy-like to hydrocarbon-like odor, no visible contamination.		11.5-13.0' Sampled for analytical
						(13.0-14.0) Not Sampled.		2-inch diameter, 0.010-inch slot, Sch. 40 PVC screen from 5 to 15 ft-bgs
SS-7	14.0-15.5	100			15	(14.0-15.5) SW: WELL SORTED SAND, gray to brownish gray, fine to coarse, very dense, wet. 10-15% rounded, fine to coarse gravel, up to 2" in diameter. Trace to little iron mottles. Slight soapy-like to hydrocarbon-like odor, no visible contamination.		
						(15.5-16.5) Not Sampled.	275	10/20 silica sand pack from 4 to 16 ft-bgs
SS-8	16.5-18	61				(16.5-17.25) ML: SILT, gray to brownish gray, high plasticity, hard, wet. 15% clay. Slight soap-like odor, no visible contamination.		
						(17.25-18.0) SW: WELL GRADED SAND, gray, fine to coarse, very dense, wet. 25% rounded, fine gravel, up to 1/2" in diameter. Slight soap-like odor, no visible contamination.		Bentonite from 16 to 20.5 ft-bgs
						(18.0-19.0) Not Sampled.		
SS-9	19.0-20.5	55			20	(19.0-20.3) SW: WELL GRADED SAND, gray, fine to medium, very dense, wet. 10% silt and rounded, fine gravel, up to 1/4" in diameter. No odor or visible contamination.		19.0-20.5' Sampled for analytical

Remarks and Datum Used:

HSA - Hollow Stem Auger
Sch. - Schedule
Amb. - ambient air

AECOM - Environment
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Seattle, WA 98104
Phone: (206) 624-9349
Fax: (206) 623-3793

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
03/18/08	**1553**	**12.51'**

AECOM

Boring/Well Log

Well #: MW-6
Sheet 3 of 3

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-210**	Northing: **174850.9922** Easting: **1272784.1135**	Ground Elevation: **291.083'**
Location: **Burien, WA**	Drill Rig Type: **HSA Limited Access**	MP Elevation: **-**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20.5'**
Start Date & Time: **3/18/08 1344**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **3/18/08 1445**	Boring ID: **8.25"**	Seal: **Bentonite chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **R. Knecht/ C. Smith**	Screen: **0.010" slot Sch. 40 PVC 5-15 ft-bgs**

Sample			Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description Classification Scheme: **USCS/ASTM**	Elevation (ft.)	Comments & Samples
Type & Number	Depth Range	% Rec						
						(20.3-20.5) SP: POORLY GRADED SAND, black, fine, wet. No odor or visible contamination.		

Remarks and Datum Used:	
	HSA - Hollow Stem Auger
	Sch. - Schedule
	Amb. - ambient air

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Seattle, WA 98104
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Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
03/18/08	**1553**	**12.51'**

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Boring/Well Log

Well #: MW-7
Sheet 1 of 2

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-3000**	Northing: **174801.0531** Easting: **1272865.8926'**	Ground Elevation: **288.525'**
Location: **NE of Des Moines Memorial Dr.**	Drill Rig Type: **HSA**	MP Elevation: **287.907'**
Client: **Port of Seattle**	Method: **Split Spoon**	Total Depth: **25.5'**
Start Date & Time: **10/22/08 1110**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **10/22/08 1210**	Boring ID: **8.25"**	Seal: **Bentionie Chips**
Contractor: **Cascade Drilling**	Bit Type: **HSA Coring Bit**	Grout: **-**
Operator: **Dave**	Logged By: **R. Knecht**	Screen: **Sch. 40 PVC from 15-24.6 ft-bgs**

Sample Type &	Sample Depth Range	Sample % Rec	Sample Blows per 6"	Sample PID (ppm)	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS/ASTM)	Elevation (ft.)	Comments
							0	(0.0-5.0) Asphalt from 0-1'. Not sampled.		Flush mount monument.
									285	Bentonite chip plug from 1.5-13 ft-bgs. 2-inch, Sch. 40 PVC riser from 0.7-15 ft-bgs.
SS-1	5-6.5	66	12 18 20	-			5	(5.0-6.5) SP: POORLY GRADED SAND, dark brown to yellowish brown at 5.5', fine, dense, dry. 15% sub angular to rounded, fine gravel from 5-5.5'. 10% reddish brown silt with 1" thick mottles from 5.5-6.5'. No odor or visible contamination.		
								(6.5-10.0) Not sampled.	280	
SS-2	10-11.5	100	50/6"	-			10	(10.0-11.5) SW: WELL GRADED SAND, light yellowish brown, fine to medium, sub rounded to sub angular, equant, very dense, dry to moist. 20% rounded, elongate to equant, coarse gravel up to 2.5" long. Flat piece of concrete, 0.5" long. Trace coarse sand and silt. No odor or visible contamination.		
								(11.5-12.5) Not sampled.		
SS-3	12.5-14	33	50/6"	-				(12.5-14.0) SP: POORLY GRADED SAND, brown, fine, equant, very dense, moist. 20% rounded, fine gravel and coarse sand. 20% silt. No odor or visible contamination.	275	10/20 silica sand pack from 13-26.5 ft-bgs.
								(14.0-15.0) Not sampled.		
							15			

Remarks and Datum Used:

HSA = Hollow Stem Auger
Sch. = Schedule
ft-bgs = feel below ground surface

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Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater

Date	Time	Depth (ft.)
10/22/08	**1300**	**16.65'**
10/22/08	**1215**	**19'**

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Boring/Well Log

Well #: MW-7
Sheet 2 of 2

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-3000**	Northing: **174801.0531** Easting: **1272865.8926'**	Ground Elevation: **288.525'**
Location: **NE of Des Moines Memorial Dr.**	Drill Rig Type: **HSA**	MP Elevation: **287.907'**
Client: **Port of Seattle**	Method: **Split Spoon**	Total Depth: **25.5'**
Start Date & Time: **10/22/08 1110**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **10/22/08 1210**	Boring ID: **8.25"**	Seal: **Bentionie Chips**
Contractor: **Cascade Drilling**	Bit Type: **HSA Coring Bit**	Grout: **-**
Operator: **Dave**	Logged By: **R. Knecht**	Screen: **Sch. 40 PVC from 15-24.6 ft-bgs**

Sample Type &	Sample Depth Range	Sample % Rec	Sample Blows per 6"	Sample PID (ppm)	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS/ASTM)	Elevation (ft.)	Comments
SS-4	15-16.5	100	50/6"	-			15	(15.0-16.5) SW: WELL GRADED SAND, yellowish brown to dark brown, fine to medium, sub rounded to sub angular, equant, very dense, wet at 15.5'. 20-25% rounded to sub angular, fine gravel from 16.3-16.5'. Large, rounded, gravel up to 2" wide and long at 15.25'. No odor or visible contamination.		2-inch, 0.010-slot, sch. 40 PVC screen from 15-24.6 ft-bgs.
								(16.5-20.0) Not sampled.	270	15-16.5', sample collected for analytical.
SS-5	20-21.5	100	50/6"	-			20	(20.0-21.5) SP: POORLY GRADED SAND, brown to yellowish brown, fine, rounded, equant, very dense, wet. 20% medium sand. 15-20% sile. 10% rounded, fine gravel up to 1" long from 21.2-21.5'. Silty sand lense at 20.3'. No odor or visible contamination.		
								(21.5-25.0) Not Sampled.	265	2-inch PVC end cap from 24.6-25 ft-bgs.
SS-6	25-26.5	83	50/6"	-			25	(25.0-26.5) SP: POORLY GRADED SAND, dark gray, fine, very dense, wet. Trace medium to coarse sand and silt. Slight rotten egg-like odor, no visible contamination.		25-25.5', sample collected for analytical.

Remarks and Datum Used:

HSA = Hollow Stem Auger
Sch. = Schedule
ft-bgs = feel below ground surface

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Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
10/22/08	**1300**	**16.65'**
10/22/08	**1215**	**19'**

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Boring/Well Log

Well #: MW-8
Sheet 1 of 2

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-3000**	Northing: **174627.2741** Easting: **1272775.8574'**	Ground Elevation: **282.534'**
Location: **Seattle, WA**	Drill Rig Type: **Limited Access Track Rig**	MP Elevation: **287.907'**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20.5'**
Start Date & Time: **08/12/08 1357**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **08/12/08 1429**	Boring ID: **4.25"**	Seal: **Bentonite Chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **C. Smith**	Screen: **0.010-inch slot, Sch. 40 PVC**

Sample Type &	Sample Depth Range	Sample % Rec	Sample Blows per 6"	Sample PID (ppm)	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS/ASTM)	Elevation (ft.)	Comments
							0	(0.0-5.0) Not sampled.		Flush mount monument.
									280	Bentonite chip plug from 1.5-8 ft-bgs.
SS -1	5-6.5	80	7 8 17	0.4 aa= 0.4			5	(5.0-6.5) SW: WELL GRADED SAND, brown, fine to coarse, sub angular to sub rounded, medium dense, dry. Trace rootlets. No odor or visible contamination.		2-inch schedule 40 riser pipe from 0-10 ft-bgs.
								(6.5-10.0) Not sampled.	275	
										10/20 silica sand pack from 8-20.5 ft-bgs.
SS -2	10-11.5	46	50/6"	0.3 aa= 0.3			10	(10.0-10.4) SM: SILTY SAND, gray and brown, fine to medium, very dense, moist. 40% silt. Trace, angular, coarse sand. Trace rootlets. No odor or visible contamination.		
								(10.4-11.5) SP: POORLY GRADED SAND, brown, fine, very dense, moist. Trace coarse sand. One rounded peice of large gravel. No odor or visible contamination.		0.010-inch slot, 2-inch schedule 40 PVC screen from 10-20 ft-bgs.
								(11.5-12.5) Not sampled.	270	

Remarks and Datum Used:

aa = ambient air
ft-bgs = feet below ground suface
Sch. = schedule
HSA = Hollow Stem Auger

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Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater

Date	Time	Depth (ft.)
8/12/08	**1415**	**12'**

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Boring/Well Log

Well #: MW-8
Sheet 2 of 2

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-3000**	Northing: **174627.2741** Easting: **1272775.8574'**	Ground Elevation: **282.534'**
Location: **Seattle, WA**	Drill Rig Type: **Limited Access Track Rig**	MP Elevation: **287.907'**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20.5'**
Start Date & Time: **08/12/08 1357**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **08/12/08 1429**	Boring ID: **4.25"**	Seal: **Bentonite Chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **C. Smith**	Screen: **0.010-inch slot, Sch. 40 PVC**

Sample Type &	Sample Depth Range	Sample % Rec	Sample Blows per 6"	Sample PID (ppm)	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS/ASTM)	Elevation (ft.)	Comments
SS -3	12.5-14	80	50/6"	0.3 aa= 0.3				(12.5-14.0) SP: POORLY GRADED SAND, white, black, orange, and yellow grains, medium, sub rounded, very dense, wet. Trace coarse sand to large gravel. Trace, orange, iron oxide staining. One cobble, 3" in diameter. No odor or visible contamination.	270	12.5-14': Sampled for analytical.
							15	(14.0-19.0) Not sampled.	265	
SS -4	19-20.5	26	50/4"	0.3 aa= 0.3			20	(19.0-20.5) SW: WELL GRADED SAND, brown with white, black, and yellow grains, fine to medium, very dense, wet. Trace coarse sand. 10% winnowing. No odor or visible contamination.		Threaded end cap from 20-20.35 ft-bgs.

Remarks and Datum Used:

aa = ambient air
ft-bgs = feet below ground suface
Sch. = schedule
HSA = Hollow Stem Auger

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Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
8/12/08	**1415**	**12'**

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Boring/Well Log

Well #: MW-9
Sheet 1 of 2

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-3000**	Northing: **174474.2134** Easting: **1272627.3356'**	Ground Elevation: **283.698'**
Location: **Seattle, WA**	Drill Rig Type: **Limited Access Track Rig**	MP Elevation: **283.335'**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20.5'**
Start Date & Time: **08/12/08 1217**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **08/12/08 1240**	Boring ID: **4.25"**	Seal: **Bentonite Chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **C. Smith**	Screen: **0.010-inch slot, Sch. 40 PVC**

Sample Type &	Sample Depth Range	Sample % Rec	Sample Blows per 6"	Sample PID (ppm)	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS/ASTM)	Elevation (ft.)	Comments
							0	(0.0-5.0) Not sampled.		Flush mount monument. Bentonite chip plug from 1.5-8 ft-bgs.
									280	
SS -1	5-6.5	53	24 50/6"	0.4 aa= 0.4			5	(5.0-6.5) SM: SILTY SAND, brown, fine to medium, very dense, moist. At 5-5.3', trace coarse sand and rootlets, large 3", rounded, cobble. At 5.3-5.6', color grades to gray. No odor or visible contamination.		2-inch schedule 40 riser pipe from 0-10 ft-bgs.
								(6.5-10.0) Not sampled.		
									275	10/20 silica sand pack from 8-20.5 ft-bgs.
SS -2	10-11.5	-	21 25 30	0.3 aa= 0.3			10	(10.0-10.7) SW: WELL GRADED SAND, brown, fine to coarse, sub rounded, very dense, moist. Angular, crushed, dark gray boulder at 10.5'. No odor or visible contamination.		0.010-inch slot, 2-inch schedule 40 PVC screen from 10-20 ft-bgs.
								(10.7-11.5) SP: POORLY GRADED SAND, brown, fine, very dense, moist. Few 1/4" thick gray lenses at 11.1' and 11.3'. No odor or visible contamination.		
								(11.5-15.0) Not sampled.		

Remarks and Datum Used:

aa = ambient air
ft-bgs = feet below ground suface
Sch. = schedule
HSA = Hollow Stem Auger

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Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
8/12/08	**1230**	**14'**

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Boring/Well Log

Well #: MW-9
Sheet 2 of 2

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-3000**	Northing: **174474.2134** Easting: **1272627.3356'**	Ground Elevation: **283.698'**
Location: **Seattle, WA**	Drill Rig Type: **Limited Access Track Rig**	MP Elevation: **283.335'**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20.5'**
Start Date & Time: **08/12/08 1217**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **08/12/08 1240**	Boring ID: **4.25"**	Seal: **Bentonite Chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **C. Smith**	Screen: **0.010-inch slot, Sch. 40 PVC**

Sample Type &	Sample Depth Range	Sample % Rec	Sample Blows per 6"	Sample PID (ppm)	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS/ASTM)	Elevation (ft.)	Comments
									270	
SS -3	15-16.5	66	50/6"	0.3 aa= 0.3			15	(15.0-16.5) SP: POORLY GRADED SAND, brown with white, black and yellow grains, fine, very dense, wet. Trace silt. 15% winnowing. No odor or visible contamination.		15-16.5 ft-bgs: Sampled for analytical.
								(16.5-19) Not sampled.	265	
SS -4	19-20.5	-	50/6"	0.3 aa= 0.3			20	(19.0-20.5) SP: POORLY GRADED SAND, brown with white, black and yellow grains, fine, very dense, wet. Trace silt. 15% winnowing. No odor or visible contamination.		Threaded end cap from 20-20.35 ft-bgs.

Remarks and Datum Used:

aa = ambient air
ft-bgs = feet below ground suface
Sch. = schedule
HSA = Hollow Stem Auger

The RETEC Group, Inc.
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Seattle, WA 98134-1162
Phone: (206) 624-9349
Fax: (206) 624-2839

Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
8/12/08	**1230**	**14'**

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Boring/Well Log

Well #: MW-10
Sheet 1 of 2

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-3000**	Northing: **174386.6154** Easting: **1272561.6472'**	Ground Elevation: **284.397'**
Location: **Seattle, WA**	Drill Rig Type: **Limited Access Track Rig**	MP Elevation: **284.149'**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20.5'**
Start Date & Time: **08/12/08 1041**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **08/12/08 1115**	Boring ID: **4.25"**	Seal: **Bentonite Chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **C. Smith**	Screen: **0.010-inch slot, Sch. 40 PVC**

Sample Type &	Sample Depth Range	Sample % Rec	Sample Blows per 6"	Sample PID (ppm)	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS/ASTM)	Elevation (ft.)	Comments
							0	(0.0-5.0) Not sampled.		Flush mount monument. Bentonite chip plug from 1.5-8 ft-bgs.
									280	
SS -1	5-6.5	46	24 50/6"	0.3 aa= 0.3			5	(5.0-6.5) SP: POORLY GRADED SAND, orangish brown, medium, very dense, dry. Trace, angular, coarse sand to small gravel. Some fine sand and silt. No odor or visible contamination.		2-inch schedule 40 riser pipe from 0-10 ft-bgs.
								(6.5-10.0) Not sampled.		10/20 silica sand pack from 8-20.5 ft-bgs.
									275	
SS -2	10-11.5	44	21 25 30	0.3 aa= 0.3			10	(10.0-11.5) SW: WELL GRADED SAND, brown, fine to medium, very dense, moist. Some silt and coarse sand. No odor or visible contamination.		0.010-inch slot, 2-inch schedule 40 PVC screen from 10-20 ft-bgs.
								(11.5-12.5) Not sampled.		

Remarks and Datum Used:

aa = ambient air
ft-bgs = feet below ground suface
Sch. = schedule
HSA = Hollow Stem Auger

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Sample Type
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DP = Direct Push
SS = Split Spoon
C = Core

Groundwater

Date	Time	Depth (ft.)
8/12/08	**1115**	**13'**

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Boring/Well Log

Well #: MW-10
Sheet 2 of 2

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-3000**	Northing: **174386.6154** Easting: **1272561.6472'**	Ground Elevation: **284.397'**
Location: **Seattle, WA**	Drill Rig Type: **Limited Access Track Rig**	MP Elevation: **284.149'**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20.5'**
Start Date & Time: **08/12/08 1041**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **08/12/08 1115**	Boring ID: **4.25"**	Seal: **Bentonite Chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **C. Smith**	Screen: **0.010-inch slot, Sch. 40 PVC**

Sample Type &	Sample Depth Range	Sample % Rec	Sample Blows per 6"	Sample PID (ppm)	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS/ASTM)	Elevation (ft.)	Comments
SS -3	12.5-14	60	50/6"	0.3 aa= 0.3				(12.5-14.0) SP: POORLY GRADED SAND, brown, medium, sub rounded, very dense, moist to wet at 13'. Trace, fine sand and silt. No odor or visible contamination.		
								(14.0-18.5) Not sampled.	270	
							15			12.5-14 ft-bgs: Sampled for analytical.
SS -4	19-20.5	80	50/6"	0.3 aa= 0.3			20	(19.0-20.5) SP: POORLY GRADED SAND, brown with black, white, yellow, and orange grains, medium, sub rounded, very dense, wet. Trace silt. No odor or visible contamination.	265	Threaded end cap from 20-20.35 ft-bgs.

Remarks and Datum Used:

aa = ambient air
ft-bgs = feet below ground suface
Sch. = schedule
HSA = Hollow Stem Auger

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Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
8/12/08	**1115**	**13'**

ENSR | AECOM

Boring/Well Log

Well #: MW-11
Sheet 1 of 2

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-3000**	Northing: **174287.7124** Easting: **1272485.4391'**	Ground Elevation: **284.948'**
Location: **Seattle, WA**	Drill Rig Type: **Limited Access Track Rig**	MP Elevation: **284.36'**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20.5'**
Start Date & Time: **08/12/08 0930**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **08/12/08 1005**	Boring ID: **4.25"**	Seal: **Bentonite Chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **C. Smith**	Screen: **0.010-inch slot, Sch. 40 PVC**

Sample Type &	Sample Depth Range	Sample % Rec	Sample Blows per 6"	Sample PID (ppm)	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS/ASTM)	Elevation (ft.)	Comments
							0	(0.0-5.0) Not sampled.		Flush mount monument. Bentonite chip plug from 1.5-8 ft-bgs.
SS -1	5-6.5	100	50/2"	0.0			5	(5.0-6.5) SW: WELL GRADED SAND, dark brown, fine to medium, very dense, moist. Trace coarse sand. Few, angular gravel up to 1" in diameter. Few grass and rootlets. No odor or visible contamination.	280	2-inch schedule 40 riser pipe from 0-10 ft-bgs.
								(6.5-7.5) Not sampled.		
SS -2	7.5-9	100	50/6"	0.0				(7.5-9.0) SW: WELL GRADED SAND, dark brown, fine to medium, very dense, moist. Trace, angular, coarse sand and small gravel. Some rootlets. No odor or visible contamination.		10/20 silica sand pack from 8-20.5 ft-bgs.
								(9.0-10.0) Not sampled.		
SS -3	10-11.5	100	50/6"	0.0			10	(10.0-10.3) SW: WELL GRADED SAND, brown, fine to medium, very dense, moist. Trace coarse sand. No odor or visible contamination.	275	0.010-inch slot, 2-inch schedule 40 PVC screen from 10-20 ft-bgs.
								(10.3-11.5) SP: POORLY GRADED SAND, brown, medium, very dense, moist. No odor or visible contamination.		
								(11.5-12.5) Not sampled.		

Remarks and Datum Used:

ft-bgs = feet below ground suface
Sch. = schedule
HSA = Hollow Stem Auger

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Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
8/12/08	**0950**	**12.8'**

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Boring/Well Log

Well #: MW-11
Sheet 2 of 2

Project: **Lora Lake Apartments**	Monument: **Flush Mount**	Stick Up: **-**
Project #: **05482-025-3000**	Northing: **174287.7124** Easting: **1272485.4391'**	Ground Elevation: **284.948'**
Location: **Seattle, WA**	Drill Rig Type: **Limited Access Track Rig**	MP Elevation: **284.36'**
Client: **Port of Seattle**	Method: **HSA**	Total Depth: **20.5'**
Start Date & Time: **08/12/08 0930**	Casing ID: **2"**	Filter Pack: **10/20 Silica Sand**
Finish Date & Time: **08/12/08 1005**	Boring ID: **4.25"**	Seal: **Bentonite Chips**
Contractor: **Cascade Drilling Inc.**	Bit Type: **4.25" HSA**	Grout: **-**
Operator: **Curtis Askew**	Logged By: **C. Smith**	Screen: **0.010-inch slot, Sch. 40 PVC**

Sample Type &	Sample Depth Range	Sample % Rec	Sample Blows per 6"	Sample PID (ppm)	Well Completion Log	Graphic	Depth (ft.)	Soil and Rock Description (Classification Scheme: USCS/ASTM)	Elevation (ft.)	Comments
SS -4	12.5-14	100	60/5"	0.0				(12.5-14.0) SP: POORLY GRADED SAND, brown, medium, moist to wet at 12.8'. Trace coarse sand. No odor or visible contamination.		
								(14.0-15.0) Not sampled.		
SS -5	15-16.5	100	50/5"	0.0			15	(15.0-16.5) SP: POORLY GRADED SAND, brown, medium, very dense, wet. Trace silt at 16'. No odor or visible contamination.	270	12.5-13 ft-bgs: Sampled for analytical.
								(16.5-19.0) Not sampled.		
SS -6	19-20.5	100	50/6"	0.0			20	(19.0-20.5) SP: POORLY GRADED SAND, brown with white, black, orange and yellow grains, medium, sub angular, very dense, wet. Trace silt. 10% winnowing. No odor or visible contamination.	265	Threaded end cap from 20-20.35 ft-bgs.

Remarks and Datum Used:

ft-bgs = feet below ground suface
Sch. = schedule
HSA = Hollow Stem Auger

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Sample Type
N = SPT
DP = Direct Push
SS = Split Spoon
C = Core

Groundwater		
Date	Time	Depth (ft.)
8/12/08	**0950**	**12.8'**

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Monitoring Well ID: MW-12

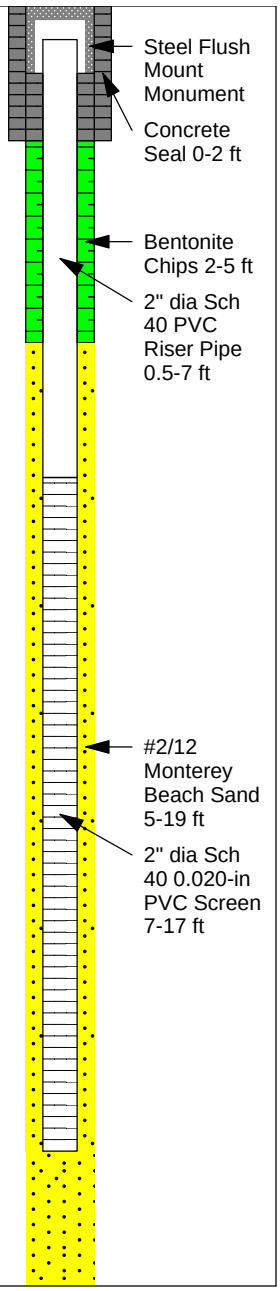
Drill Date: August 2, 2010
Logged By: Megan McCullough
Drilled By: Cascade Drilling
Drill Type: Hollow Stem Auger
Sample Method: 18" split spoon
Boring Diameter: 8 inches
Boring Depth (ft bgs): 19 ft
Groundwater ATD (ft bgs): 10 ft

Ground Surf Elev. & Datum: 287.13 ft
Coordinate System: NGVD29/NAD83
Latitude/Northing: 174762.0372 ft
Longitude/Easting: 1272711.531 ft
Casing Elevation: 286.53 ft

Client: Port of Seattle
Project: POS-LLA
Task Number: T 4010
Site Location: LL Apts Parcel
15001 Des Moines Memorial Dr.

Remarks:

SAMPLE INTERVAL	PID (ppm)	DRIVE / RECOVERY	BLOW COUNT	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS: (color, texture, moisture, MAJOR CONSTITUENT, odor, staining, sheen, debris, etc.)
MW12-0-0.5-080210	4.4		23 50/6"	0	SM	medium brown, dry, fine SILTY SAND with GRAVEL. bark and organics in top 4". no sheen, no odor.
MW12-1.5-2-080210	4.5		29 50/6"	1		
MW12-2-4-080210	3.7		22 50/4"	2		less silt with depth
MW12-4-5.5-080210	4.6		18 25 50/6"	3		1" layer of bark color grades to black
MW12-5.5-7.5-080210	3.5		16 23 34	4	SP-SM	gray, fine SAND with SILT and streaks of black staining. no odor.
MW12-8-9.5-080210	4.3		14 23 39	5	SP	light brown, moist, fine SAND with streaks of gray to orange (oxide). trace organics, no odor
MW12-10-11.5-080210	3.7		17 26 38	6	SW ML SW	medium gray to brown, fine to coarse SAND with small GRAVEL. 3" lense of light gray, wet SILT with iron oxide staining at 10.9 ft, no odor.
	3.1		17 34 50/3"	7	SM	light brown, wet, fine SILTY SAND. no odor
			50/3" 50/6"	8		no recovery at 15 ft- loose, wet material
MW12-17.5-19-0080210			14 28 35	9	SP	light brown, wet, fine SAND with trace silt. no odor.



Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Monitoring Well ID: MW-13

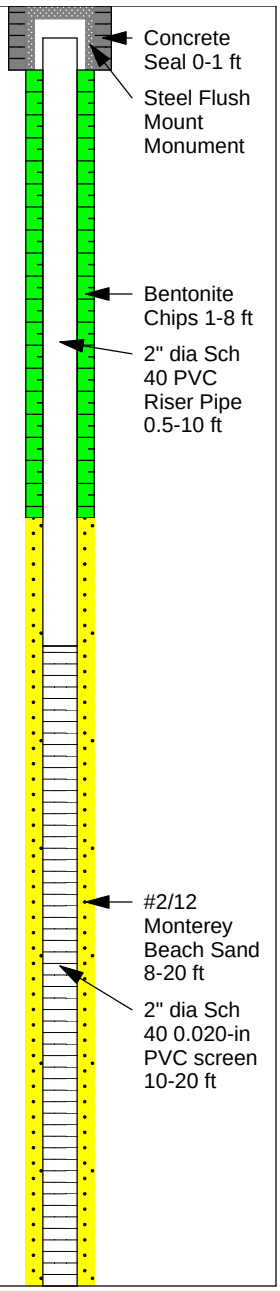
Drill Date: August 2, 2010
Logged By: Megan McCullough
Drilled By: Cascade Drilling
Drill Type: Hollow Stem Auger
Sample Method: 18" split spoon
Boring Diameter: 8 inches
Boring Depth (ft bgs): 20 ft
Groundwater ATD (ft bgs): 13.75 ft

Ground Surf Elev. & Datum: 289.89 ft
Coordinate System: NGVD29/NAD83
Latitude/Northing: 174904.8622 ft
Longitude/Easting: 1272777.633 ft
Casing Elevation: 289.43 ft

Client: Port of Seattle
Project: POS-LLA
Task Number: T 4010
Site Location: LL Apts Parcel
15001 Des Moines Memorial Dr.

Remarks:

SAMPLE INTERVAL	PID (ppm)	DRIVE / RECOVERY	BLOW COUNT	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS: (color, texture, moisture, MAJOR CONSTITUENT, odor, staining, sheen, debris, etc.)
MW13-0-0.5-080210	3.8		7 10 10	0–1	SM	medium brown to reddish brown, dry, fine SILTY SAND. no odor
MW13-1.5-2-080210	4.0		9 11 13	1–2	SP	grades to light brown/gray, dry, fine SAND with few small areas of oxide staining. no odor, no sheen.
MW13-2-4-080210	.5		10 14 17	2–4	ML	grades to light gray, dry, SILT with fine SAND. abundant oxide staining and woody debris (small rootlets and bark). no odor, no sheen.
MW13-4-6-080210	3.6		12 14 22	4–6		
	4.3		60/6"	6–8	SP-SM	light brown/reddish brown, moist, fine SAND with SILT and increasing GRAVEL (2-4.5" diameter). no odor, no sheen
MW13-10-11.5-080210	3.7		12 50/6"	8–10	ML	light brown/gray, moist SILT. trace organics, oxide stains, no sheen, no odor.
				10–11	SP	light brown/gray, fine SAND with GRAVEL. no odor, no sheen.
				11–13		no recovery at 12.5 ft- rock blocking sampler
MW13-14-14.5-080210	3.8		60/5"	13–15	SW	medium blue/gray, fine and coarse SAND in interbedded lenses. trace silt and gravel in coarse lenses. no odor, no sheen.
	3.5		60/6"			medium gray and wet with trace silt and gravel at 15 ft.. large 4" diameter rock in core. no odor, no sheen.
MW13-18.5-19.5-080210	2.8		21 50/6"	18–20		dark gray with abundant gravel and trace silt at 18.5 ft. no odor, no sheen



Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Monitoring Well ID: MW-14

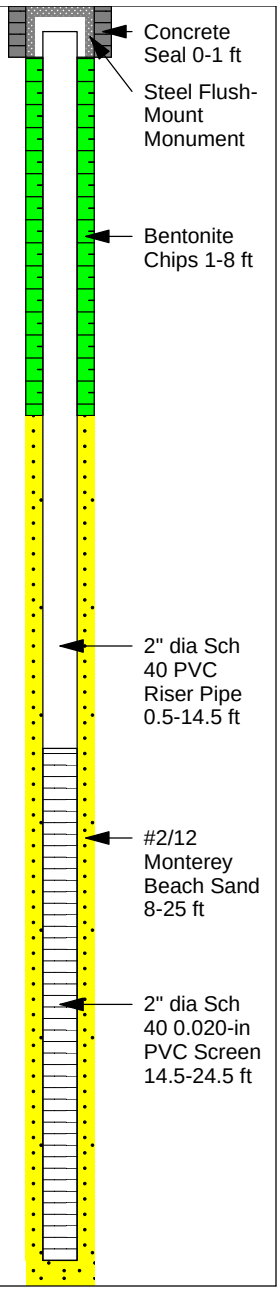
Drill Date: August 2, 2010
Logged By: Megan McCullough
Drilled By: Cascade Drilling
Drill Type: Hollow Stem Auger
Sample Method: 18" split spoon
Boring Diameter: 8 inches
Boring Depth (ft bgs): 25 ft
Groundwater ATD (ft bgs): 15.25 ft

Ground Surf Elev. & Datum: 297.19 ft
Coordinate System: NGVD29/NAD83
Latitude/Northing: 174819.3889 ft
Longitude/Easting: 1272606.284 ft
Casing Elevation: 296.94 ft

Client: Port of Seattle
Project: POS-LLA
Task Number: T 4010
Site Location: LL Apts Parcel
15001 Des Moines Memorial Dr.

Remarks:

SAMPLE INTERVAL	PID (ppm)	DRIVE / RECOVERY	BLOW COUNT	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS: (color, texture, moisture, MAJOR CONSTITUENT, odor, staining, sheen, debris, etc.)
MW14-0-0.5-080210	2.1		15 22 34	0	SM	2" of asphalt above medium brown, moist SILTY SAND with GRAVEL. no odor, slight sheen
	1.4		33 50/6"	1	SP	grades to reddish brown, fine SAND with GRAVEL and trace silt. no odor, no sheen.
MW14-1.5-2-080210	2.5		23	2		
	2.7		18	3		grades to coarse at 3 ft.. refusal on first 1.5-3 ft drive, poor recovery on second attempt. abundant gravel.
MW14-2-4-080210			40 24 28 30	4		no recovery 4-6 ft, multiple drives attempted. large cobbles and 2-4" diameter gravel in cuttings
	2.7		60/5"	8	SM	medium brown, moist, fine to medium SILTY SAND with GRAVEL. no odor, no sheen.
	2.1		100/6"	10	SP	brown/gray, moist, medium SAND with GRAVEL and few small silt clasts, small gravel ~30%. no sheen, no odor.
	2.5		28 36 36	12		light brown/gray and medium with trace silt at 12.5 ft. no odor, no sheen.
MW14-15-16.5-080210	2.8		15 38 50/5"	15		same as above at 15 ft. wet at 15.25 ft, grades to coarse at 16 ft with very slight sheen (1-2 small strands). no odor.
	3.4		12 22 38	18	SW	light brown/gray, wet, fine to medium SAND with trace silt. no odor, no sheen.
	2.7		17 28 25	20	SP	light brown, wet, fine SAND with grace silt and no gravel. no odor.
MW14-22.5-24-080210	3.6		15 21 30	23		same as above at 22.5 ft. no odor, no sheen.
				24		



Notes:
FT BGS = feet below ground surface
ppm = parts per million

--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Aspect CONSULTING

Monitoring Well Construction Log

Project Number	Well Number	Sheet
090134-001-04	MW-15	1 of 3

Project Name: Lora Lake Apartment Parcel RI/FS
Location: Burien, WA
Driller/Method: Cascade / Rotosonic
Sampling Method: Continuous core

Ground Surface Elev: --
Top of Casing Elev.: --
Depth to Water (ft BGS): 17.93
Start/Finish Date: 8/23/2010-8/24/2010

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Field Screening Observations	PID (ppm)	Density (psf)	Material Type	Description	Depth (ft)
1	Flush mount monument		No odor, sheen, or staining				**FILL** Dry, dark brown, slightly silty, slightly gravelly SAND (SP-SM); fine to medium sand, fine subrounded gravel, scattered organics (roots)	1
2	Neat cement (0-2')			2.0			Yellow-red/brown, fine to coarse gravel (1.5")	2
3	Centralizer (2.5')							3
4							Decrease in gravel	4
5			No odor, sheen, or staining	7.0 (50)			Dry, yellow-red/brown, slightly silty, very gravelly SAND (SP-SM); predominantly fine to medium sand, fine to coarse subrounded gravel (2.5")	5
6								6
7	Bentonite chips (2-44.5')							7
8								8
9		Soil: MW15-8-10-082310	Slight sheen, slight sweet odor, no staining	3.0 (37)			Slightly moist, gray, gravelly SAND (SP); predominantly medium sand, fine to coarse rounded to subrounded gravel (2.5")	9
10								10
11			No odor, sheen, or staining	5.0			Slightly moist, dark gray, silty, gravelly SAND (SM); fine to coarse sand, fine to coarse rounded to subrounded gravel (2.5")	11
12								12
13							Red brick	13
14			No odor, sheen, or staining	2.0 (4.0)			Slightly moist, dark gray, slightly silty SAND (SP-SM); trace fine to coarse rounded gravel (1"); predominantly fine to medium sand	14
15	2" Sch40 PVC riser, flush-thread, O-rings (0.3-47.25')						**GLACIAL OUTWASH (Qvr/Qva)** Moist, light gray, silty SAND (SM); trace fine gravel, predominantly fine to medium sand	15
16								16
17			No odor, sheen, or staining	2.5 (2)			Moist, light gray SAND (SP); trace fine gravel, predominantly medium sand	17
18	▼ 9/13/2010							18
19	▽ 8/26/2010		No odor, sheen, or staining	2.7 (7)				19
20								20
21								21
22		Soil: MW15-20-25-082310	No odor, sheen, or staining	2.8 (7.7)			Wet, light gray, slightly gravelly SAND (SP); predominantly coarse sand, fine gravel	22
23							SAND (SP); trace gravel, predominantly medium sand	23
24			No odor, sheen, or staining	(2.8)			Wet, light gray/brown, very gravelly SAND (SP); medium to coarse sand, fine to coarse gravel (3.5") Gravelly SAND (SP); predominantly medium sand; fine gravel	24

Sampler Type:
○ No Recovery
▮ Continuous Core

PID - Photoionization Detector
▼ Static Water Level
▽ Water Level (ATD)

Logged by: JMS
Approved by: JJS

PID concentration in parenthesis measured directly from sonic sample bag.

Figure No.

_MONITORING WELL_SONIC LORA LAKE.GPJ July 20, 2011

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Aspect CONSULTING

Monitoring Well Construction Log

Project Number	Well Number	Sheet
090134-001-04	MW-15	2 of 3

Project Name: Lora Lake Apartment Parcel RI/FS
Location: Burien, WA
Driller/Method: Cascade / Rotosonic
Sampling Method: Continuous core

Ground Surface Elev: --
Top of Casing Elev.: --
Depth to Water (ft BGS): 17.93
Start/Finish Date: 8/23/2010-8/24/2010

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Field Screening Observations	PID (ppm)	Density (psf)	Material Type	Description	Depth (ft)
26			No odor, sheen, or staining	(5.6)			Wet, brown SAND (SP); trace fine gravel, predominantly medium sand	26
27		Soil: MW15-25-30-082310						27
28							Wet, dark brown, very gravelly SAND (SP); fine to coarse gravel (4"), predominantly medium sand	28
29								29
30			No odor, sheen, or staining	(3.2)			Gravelly SAND (SP); fine to coarse gravel (1.5")	30
31								31
32		Soil: MW15-30-35-082310						32
33							Wet, dark brown SAND (SP); medium sand	33
34								34
35			No odor, sheen, or staining	2.0 (10)				35
36								36
37		Soil: MW15-35-40-082310						37
38							Dark brown/gray	38
39								39
40			No odor, sheen, or staining	(2.5)			Gray, medium sand, coarsens downward to 42.5'	40
41								41
42		Soil: MW15-40-45-082310					Fine sand	42
43			No odor, sheen, or staining	(1.6)			Medium sand, coarsens downward to 49'	43
44								44
45	2-12 sand (44.5-57.75')							45
46			No odor, sheen, or staining	(3.4)				46
47	Centralizer (46.75')							47
48			No odor, sheen, or staining	(5.9)				48
49		Soil: 49-50					Fine sand	49

Sampler Type:
- No Recovery
- Continuous Core

PID - Photoionization Detector
- Static Water Level
- Water Level (ATD)

Logged by: JMS
Approved by: JJS

PID concentration in parenthesis measured directly from sonic sample bag.

Figure No.

_MONITORING WELL_SONIC LORA LAKE.GPJ July 20, 2011

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Monitoring Well Construction Log

Project Number	Well Number	Sheet
090134-001-04	MW-15	3 of 3

Project Name: Lora Lake Apartment Parcel RI/FS
Location: Burien, WA
Driller/Method: Cascade / Rotosonic
Sampling Method: Continuous core

Ground Surface Elev: --
Top of Casing Elev.: --
Depth to Water (ft BGS): 17.93
Start/Finish Date: 8/23/2010-8/24/2010

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Field Screening Observations	PID (ppm)	Density (psf)	Material Type	Description	Depth (ft)
51	2" Sch40 PVC screen, flush-thread, O-rings, 0.010" slot (47.25-57.25')		No odor, sheen, or staining	(<1)			Slighlty moist to wet, gray SILT (ML)	51
52		Soil: MW15-50-55-082310					Wet, gray SAND (SP); predominantly fine sand	52
53			No odor, sheen, or staining	2.1 (5.5)				53
54								54
55							Slightly moist to wet, gray, clayey SILT (CL-ML)	55
56								56
57	Centralizer (57.25')	Soil: MW15-55-60-082310	No odor, sheen, or staining	(2.0)				57
58	2" Sch40 PVC sump (57.25-57.75')							58
59	Bentonite chips (57.75-60')							59
60							Bottom of boring at 60'.	60
61								61
62								62
63								63
64								64
65								65
66								66
67								67
68								68
69								69
70								70
71								71
72								72
73								73
74								74

Sampler Type:
- No Recovery
- Continuous Core

PID - Photoionization Detector
- Static Water Level
- Water Level (ATD)

Logged by: JMS
Approved by: JJS

PID concentration in parenthesis measured directly from sonic sample bag.

Figure No.

_MONITORING WELL_SONIC LORA LAKE.GPJ July 20, 2011

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Monitoring Well Construction Log

Project Number	Well Number	Sheet
090134-001-04	MW-16	1 of 2

Project Name: Lora Lake Apartment Parcel RI/FS
Location: Burien, WA
Driller/Method: Cascade / Rotosonic
Sampling Method: Continuous core

Ground Surface Elev: --
Top of Casing Elev.: --
Depth to Water (ft BGS): 11.54
Start/Finish Date: 8/24/2010-8/25/2010

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Field Screening Observations	PID (ppm)	Density (psf)	Material Type	Description	Depth (ft)
1	Flush mount monument; Neat cement (0-2')		No odor, sheen, or staining	3.3 (5.1)			**FILL** Dry, brown, very sandy GRAVEL (GW); fine to coarse sand, fine to coarse subrounded gravel (3"), scattered organics	1
2							Dry, brown/yellow-red, silty SAND (SM); trace fine gravel, predominantly medium sand; silt lense w/ trace gravel at 3'	2
3			No odor, sheen, or staining	1.4 (4.7)			Dry, brown, slightly silty, very gravelly SAND (SP-SM); fine to coarse subrounded gravel (3"), fine to coarse sand	3
4								4
5							Slightly moist, brown/dark brown	5
6							**GLACIAL OUTWASH (Qvr/Qva)**	6
7	Bentonite chips (2-34.75')		No odor, sheen, or staining	2.2 (4.7)			Slightly moist, red-brown/dark brown SAND (SP); trace silt; trace fine rounded gravel; medium sand Slightly moist, red-brown SAND (SP); medium sand	7
8								8
9							Moist, dark brown, SAND (SP); trace silt, medium sand	9
10			No odor, sheen, or staining	2.7 (1.7)				10
11	▽ 8/26/2010 ▼ 9/13/2010						Moist, red-brown, slightly silty SAND (SP-SM); medium sand	11
12								12
13		○	No odor, sheen, or staining	1.8 (1.8)				13
14							Wet	14
15	2" Sch40 PVC riser, flush-thread, O-rings (0.3-37.25')						Wet, dark brown SAND (SP); medium sand; gradational color change to gray at 18' Gray-purple sand pocket	15
16			No odor, sheen, or staining	1.9 (0.4)				16
17		Soil: MW16-15-20-082410						17
18							Gray, trace silt	18
19			No odor, sheen, or staining	2.3 (1.4)				19
20							Wet, gray-purple SAND (SP); medium sand	20
21								21
22		Soil: MW16-20-25-082410						22
23			No odor, sheen, or staining	1.7 (2.6)				23
24		○						24

Sampler Type:
○ No Recovery
▯ Continuous Core

PID - Photoionization Detector
▼ Static Water Level
▽ Water Level (ATD)

PID concentration in parenthesis measured directly from sonic sample bag.

Logged by: JMS
Approved by: JJS
Figure No.

_MONITORING WELL_SONIC LORA LAKE.GPJ September 27, 2010

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Monitoring Well Construction Log

Project Number	Well Number	Sheet
090134-001-04	MW-16	2 of 2

Project Name:	Lora Lake Apartment Parcel RI/FS	Ground Surface Elev	--
Location:	Burien, WA	Top of Casing Elev.	--
Driller/Method:	Cascade / Rotosonic	Depth to Water (ft BGS)	11.54
Sampling Method:	Continuous core	Start/Finish Date	8/24/2010-8/25/2010

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Field Screening Observations	PID (ppm)	Density (psf)	Material Type	Description	Depth (ft)
26							Wet, dark brown SAND (SP); trace silt, medium-fine sand	26
27		Soil: MW16-25-30-082410	No odor, sheen, or staining	0.6 (2.5)				27
28								28
29							Medium sand	29
30								30
31								31
32		Soil: MW16-30-35-082410						32
33								33
34			No odor, sheen, or staining	0.8 (3.2)				34
35	2-12 sand (34.75-48.5')							35
36							Wet, dark brown SAND (SP); medium-fine sand; fining downward to silt at 39'	36
37	Centralizer (36.75')							37
38								38
39		Soil (Dup): 39-40	No odor, sheen, or staining	1.5 (5.8)			Wet, light gray SILT (ML)	39
40	2" Sch40 PVC screen, flush-thread, O-rings, 0.010" slot (37.25-47.25')						Wet, gray, sandy SILT (ML); scattered organics	40
41		Soil: MW16-40-42-082410		0.9 (1.2)				41
42							Wet, gray, very silty SAND (SM); fine sand	42
43			No odor, sheen, or staining	0.5 (1.5)				43
44		Soil: MW16-42-47.5-082410						44
45								45
46								46
47	Centralizer (47.25')		No odor, sheen, or staining	0.5 (1.1)			Wet, gray, clayey SILT (CL-SM)	47
48	2" Sch40 PVC sump (47.25-47.75')							48
49							Bottom of boring at 49.5'	49

Sampler Type:
- ○ No Recovery
- ▮▮ Continuous Core

PID - Photoionization Detector
- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: JMS

Approved by: JJS

PID concentration in parenthesis measured directly from sonic sample bag.

Figure No.

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Monitoring Well Construction Log

Project Number	Well Number	Sheet
090134-001-04	MW-17	1 of 3

Project Name: Lora Lake Apartment Parcel RI/FS
Location: Burien, WA
Driller/Method: Cascade / Rotosonic
Sampling Method: Continuous core

Ground Surface Elev: --
Top of Casing Elev.: --
Depth to Water (ft BGS): 15.82
Start/Finish Date: 8/25/2010-8/26/2010

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Field Screening Observations	PID (ppm)	Density (psf)	Material Type	Description	Depth (ft)
1	Flush mount monument; Neat cement (0-2')		No odor, sheen, or staining	0.0			**FILL** Dry, brown, slightly silty, gravelly SAND (SW-SM): fine to coarse sand, fine to coarse rounded to subrounded gravel (2.5"), scattered organics (roots)	1
2								2
3			No odor, sheen, or staining	0.6			Dry, brown, gravelly SAND (SP); trace silt, predominantly medium sand, fine to coarse subrounded gravel (1.5"), occasional organics (wood)	3
4	2" Sch40 PVC riser, flush-thread, O-rings (0.3-42')							4
5		○					Yellow-red (oxidized), silty, gravelly SAND (SM) lense (6")	5
6			No odor, sheen, or staining	0.8			Yellow-red (oxidized), silty, gravelly SAND (SM) lense (6")	6
7	Bentonite chips (2-39.5')						Dry, brown, slightly silty, very gavelly SAND (SW-SM); fine to coarse sand, fine to coarse subrounded gravel (1.5")	7
8								8
9			No odor, sheen, or staining	0.4			Dry, yellow-red, slightly gravelly SAND (SP); trace silt, predominantly medium sand, fine rounded to subrounded gravel	9
10								10
11							Dry, dark brown, gravelly, silty SAND (SM); fine to coarse sand, fine rounded to subrounded gravel	11
12			No odor, sheen, or staining	1.3				12
13							**GLACIAL OUTWASH (Qvr/Qva)**	13
14			No odor, sheen, or staining	0.9			Slightly moist, dark brown SAND (SP); trace silt, medium-fine sand	14
15							Moist, dark brown SAND (SP); with red-brown, silty SAND (SM) lense	15
16	▼9/13/2010		No odor, sheen, or staining	0.9			Wet	16
17		Soil: MW17-15-20-082610					Wet, dark brown SAND (SP); trace silt; with silty SAND (SM) lense	17
18							Wet, dark brown SAND (SP); medium-fine sand; with scattered red-brown (oxidized) slightly silty SAND (SP-SM) pockets	18
19			No odor, sheen, or staining	0.8				19
20								20
21			No odor, sheen, or staining	1.3				21
22		○ Soil: MW17-20-25-082610						22
23								23
24			No odor, sheen, or staining	1.5			Brown, clayey silt laminae (0.25")	24

Sampler Type:
○ No Recovery
▮ Continuous Core

PID - Photoionization Detector
▼ Static Water Level
▽ Water Level (ATD)

PID concentration in parenthesis measured directly from sonic sample bag.

Logged by: JMS
Approved by: JJS
Figure No.

_MONITORING WELL_SONIC LORA LAKE.GPJ September 27, 2010

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Monitoring Well Construction Log

Project Number	Well Number	Sheet
090134-001-04	MW-17	2 of 3

Project Name:	Lora Lake Apartment Parcel RI/FS	Ground Surface Elev	--
Location:	Burien, WA	Top of Casing Elev.	--
Driller/Method:	Cascade / Rotosonic	Depth to Water (ft BGS)	15.82
Sampling Method:	Continuous core	Start/Finish Date	8/25/2010-8/26/2010

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Field Screening Observations	PID (ppm)	Density (psf)	Material Type	Description	Depth (ft)
26							Wet, dark brown/gray SAND (SP); medium sand	26
27		Soil: MW17-25-30-082610	No odor, sheen, or staining	1.4				27
28								28
29			No odor, sheen, or staining	1.2				29
30							Medium-fine sand	30
31			No odor, sheen, or staining	2.2				31
32		Soil: MW17-30-35-082610						32
33			No odor, sheen, or staining	1.1				33
34								34
35								35
36			No odor, sheen, or staining	0.6				36
37		Soil: MW17-35-40-082610						37
38								38
39			No odor, sheen, or staining	0.7				39
40	2-12 sand (39.5-52.5')						Wet, gray SAND (SP); medium sand	40
41	Centralizer (41.5')	Soil: MW17-40-42.5-082610	No odor, sheen, or staining	1.0				41
42								42
43					3500		Stiff, moist, gray, very clayey SILT (CL-ML)	43
44			No odor, sheen, or staining	0.5			Wet, gray SAND (SP); medium sand	44
45	2" Sch40 PVC screen, flush-thread, O-rings, 0.010" slot (42-52')				2500		Stiff, moist, gray, clayey SILT (CL-ML)	45
46			No odor, sheen, or staining	0.0				46
47		Soil: MW17-45-50-082610					Wet, gray, silty SAND (SM); fine sand	47
48							Wet, gray SAND (SP); trace silt, medium sand	48
49			No odor, sheen, or staining	0.0				49

Sampler Type:
- ○ No Recovery
- ▯ Continuous Core

PID - Photoionization Detector
- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: JMS

Approved by: JJS

PID concentration in parenthesis measured directly from sonic sample bag.

Figure No.

_MONITORING WELL_SONIC LORA LAKE.GPJ September 27, 2010

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Monitoring Well Construction Log

Project Number	Well Number	Sheet
090134-001-04	MW-17	3 of 3

Project Name:	Lora Lake Apartment Parcel RI/FS	Ground Surface Elev	--
Location:	Burien, WA	Top of Casing Elev.	--
Driller/Method:	Cascade / Rotosonic	Depth to Water (ft BGS)	15.82
Sampling Method:	Continuous core	Start/Finish Date	8/25/2010-8/26/2010

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Field Screening Observations	PID (ppm)	Density (psf)	Material Type	Description	Depth (ft)
51		Soil: 50-51	No odor, sheen, or staining	1.6	>5000		Very stiff, slightly moist, gray, very clayey SILT (CL-ML)	51
52	Centralizer (52') 2" Sch40 PVC sump (52-52.5')							52
53			No odor, sheen, or staining	1.5			Moist/very moist, gray, silty SAND (SM) lense (6"); very fine sand	53
54								54
55		◯			4000		Moist	55
56			No odor, sheen, or staining	2.0				56
57								57
58	Bentonite chips (52.5-60')				3000		Stiff, slightly moist/moist, gray, very clayey SILT (CL-ML); with silty SAND (SM) pockets at 58'	58
59		Soil: MW17-57.5-60-082610	No odor, sheen, or staining	2.1				59
60							Bottom of boring at 60'	60
61								61
62								62
63								63
64								64
65								65
66								66
67								67
68								68
69								69
70								70
71								71
72								72
73								73
74								74

Sampler Type:
◯ No Recovery
‖ Continuous Core

PID - Photoionization Detector
▼ Static Water Level
▽ Water Level (ATD)

Logged by: JMS
Approved by: JJS

PID concentration in parenthesis measured directly from sonic sample bag.

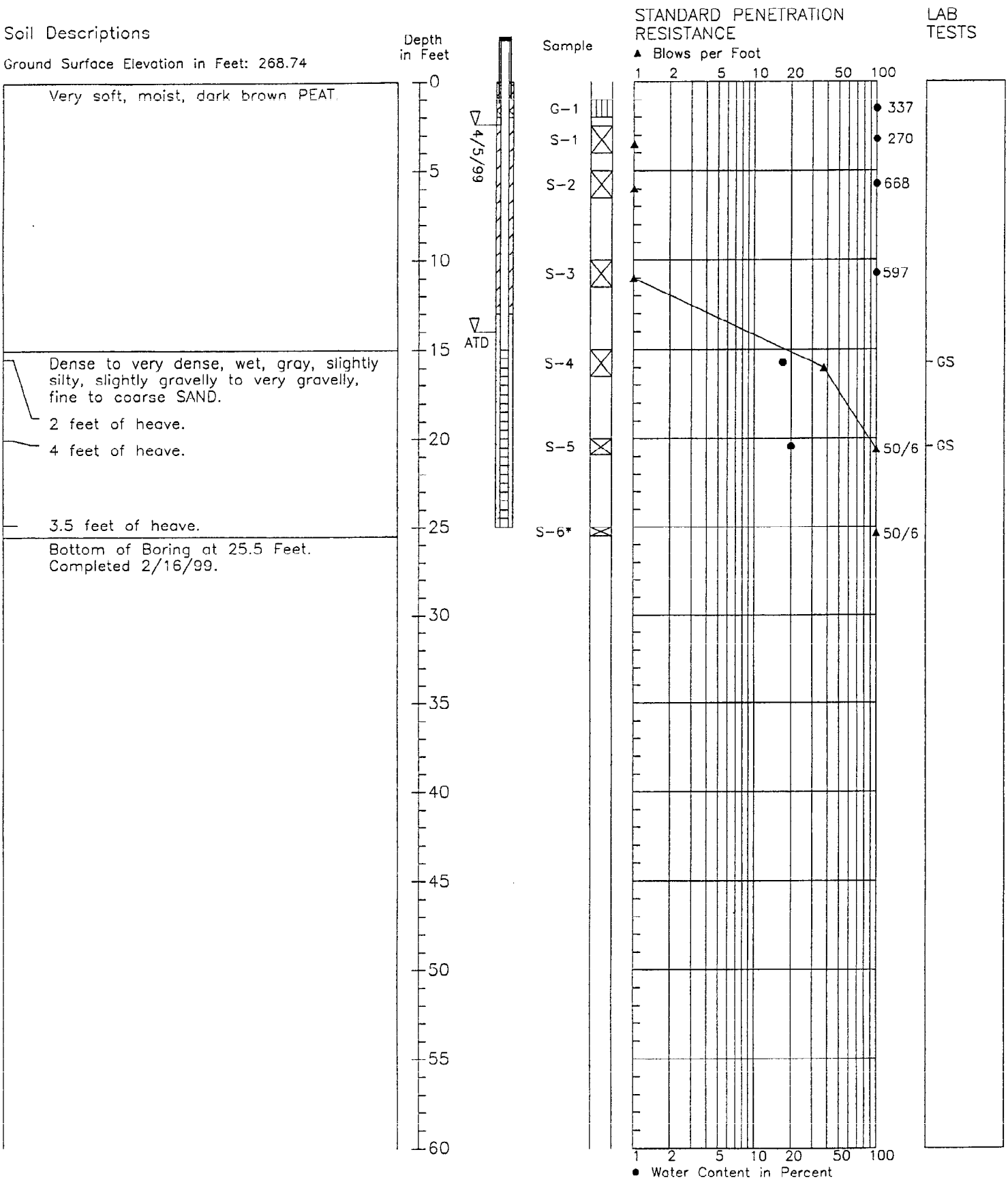
Figure No.

_MONITORING WELL_SONIC LORA LAKE.GPJ September 27, 2010

Boring Log HC99-B31

N 10,827.55, E 22,134.13

|| A_MW23 ||



1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Groundwater level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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J-4978-06 2/99

Figure A-2

3RDRW – B310
(1665)

Monitoring Well Log HC00-B310 || A_MW790 ||

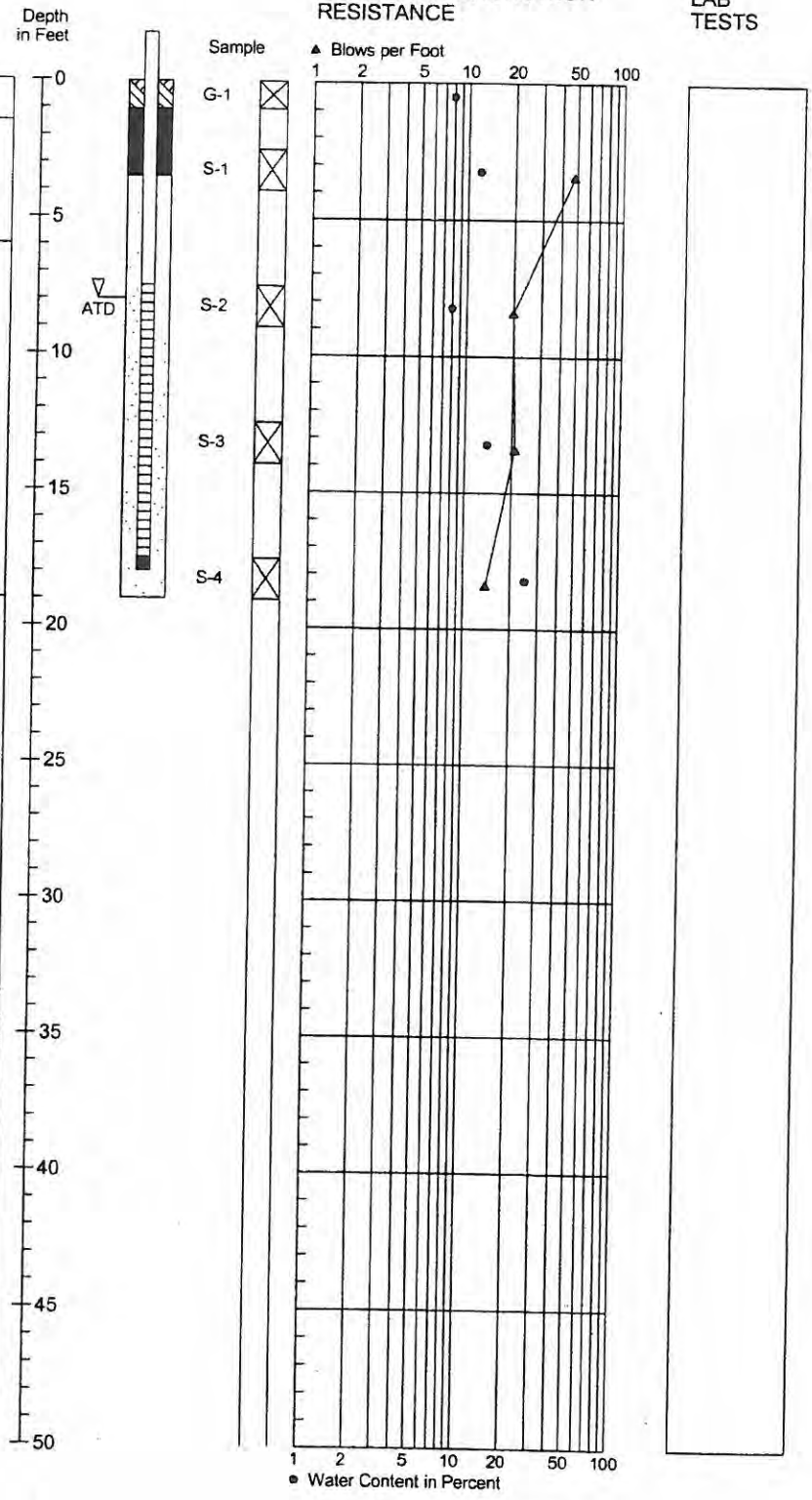
N 22648
E 11521
Soil Descriptions
Ground Surface Elevation in Feet: 276
Top of Casing Elevation in Feet: 278.09

(Stiff), moist, brown, slightly gravelly, sandy SILT with organic material (FILL).

Dense, moist, brown to gray, silty, gravelly fine to medium SAND with trace organics and asphalt pieces (FILL).

Medium dense, moist to wet, brown to gray, slightly silty to silty, non-gravelly to gravelly, fine to medium SAND.

Bottom of Boring at 19.0 Feet.
Completed 08/16/00.



BORING LOG 497831F.GPJ HC_CORP.GDT 9/1/00

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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4978-31 08/00

Figure F-3

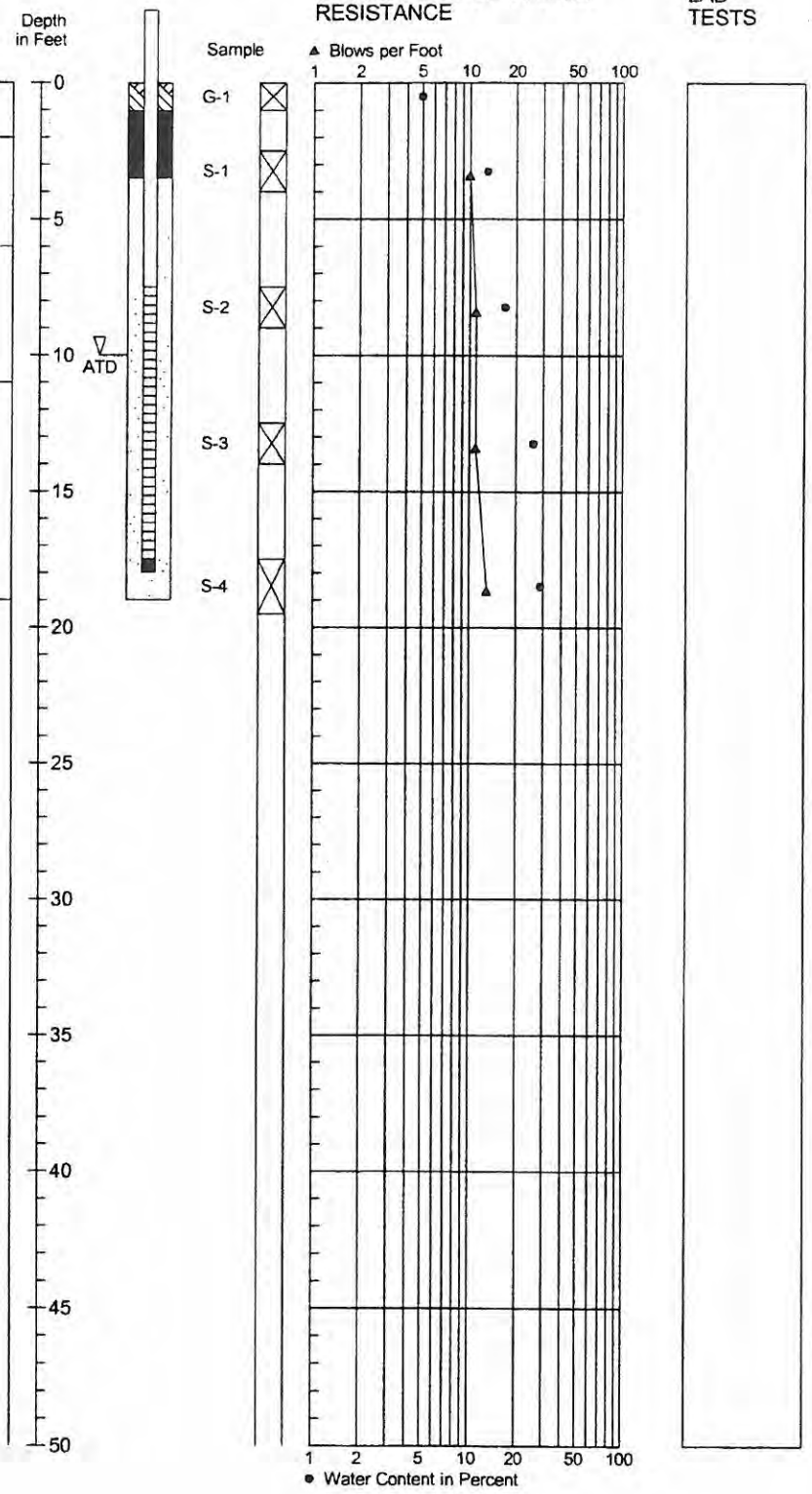
3RDRW_B3111
(1665)

Monitoring Well Log HC00-B311

|| A_MW792 ||

N 22417
E 11370
Soil Descriptions
Ground Surface Elevation in Feet: 274
Top of Casing Elevation in Feet: 277.48

(Stiff), dry to moist, brown, gravelly, sandy SILT with organics.	
Medium dense, moist, brown to gray, slightly gravelly, silty, fine to coarse SAND with organic material.	
Medium dense, moist to wet, gray, silty, fine to medium SAND.	
Stiff, wet, brown, sandy SILT.	
Bottom of Boring at 19.0 Feet. Completed 08/16/00.	



BORING LOG 497831F.GPJ HC_CORP.GDT 9/1/00

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

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4978-31 08/00

Figure F-4

2RDRW – B312

Monitoring Well Log HC00-B312

|| A_MW793 ||

(1665)

N 22773
E 11192
Soil Descriptions
Ground Surface Elevation in Feet: 284
Top of Casing Elevation in Feet: 283.79

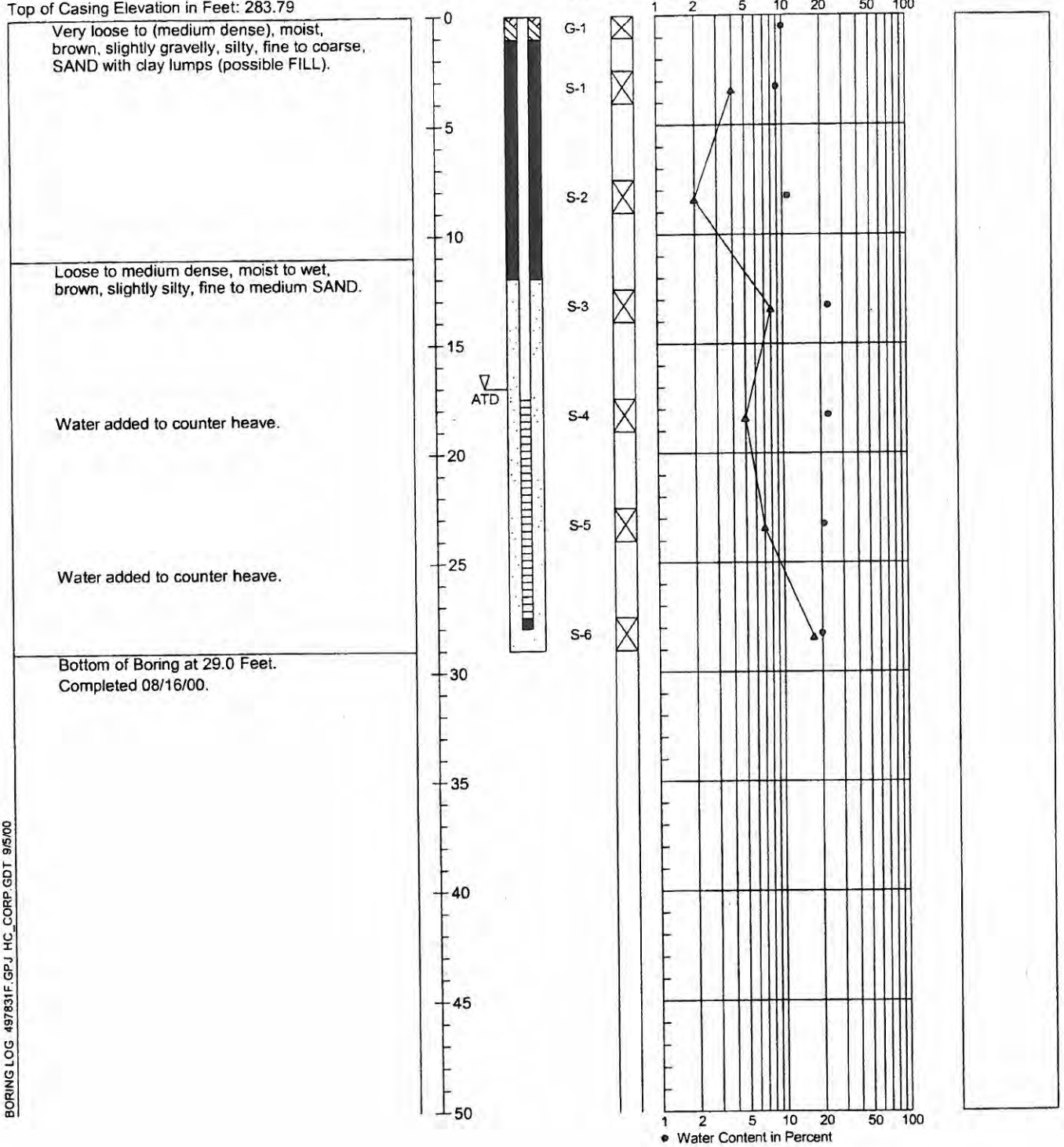
Very loose to (medium dense), moist, brown, slightly gravelly, silty, fine to coarse, SAND with clay lumps (possible FILL).

Loose to medium dense, moist to wet, brown, slightly silty, fine to medium SAND.

Water added to counter heave.

Water added to counter heave.

Bottom of Boring at 29.0 Feet.
Completed 08/16/00.



BORING LOG 497831F.GPJ HC_CORP.GDT 9/5/00

1. Refer to Figure A-1 for explanation of descriptions and symbols.
2. Soil descriptions and stratum lines are interpretive and actual changes may be gradual.
3. Ground water level, if indicated, is at time of drilling (ATD) or for date specified. Level may vary with time.

HARTCROWSER

4978-31 08/00

Figure F-5

Schematic of HPA1- mini-piezometers.

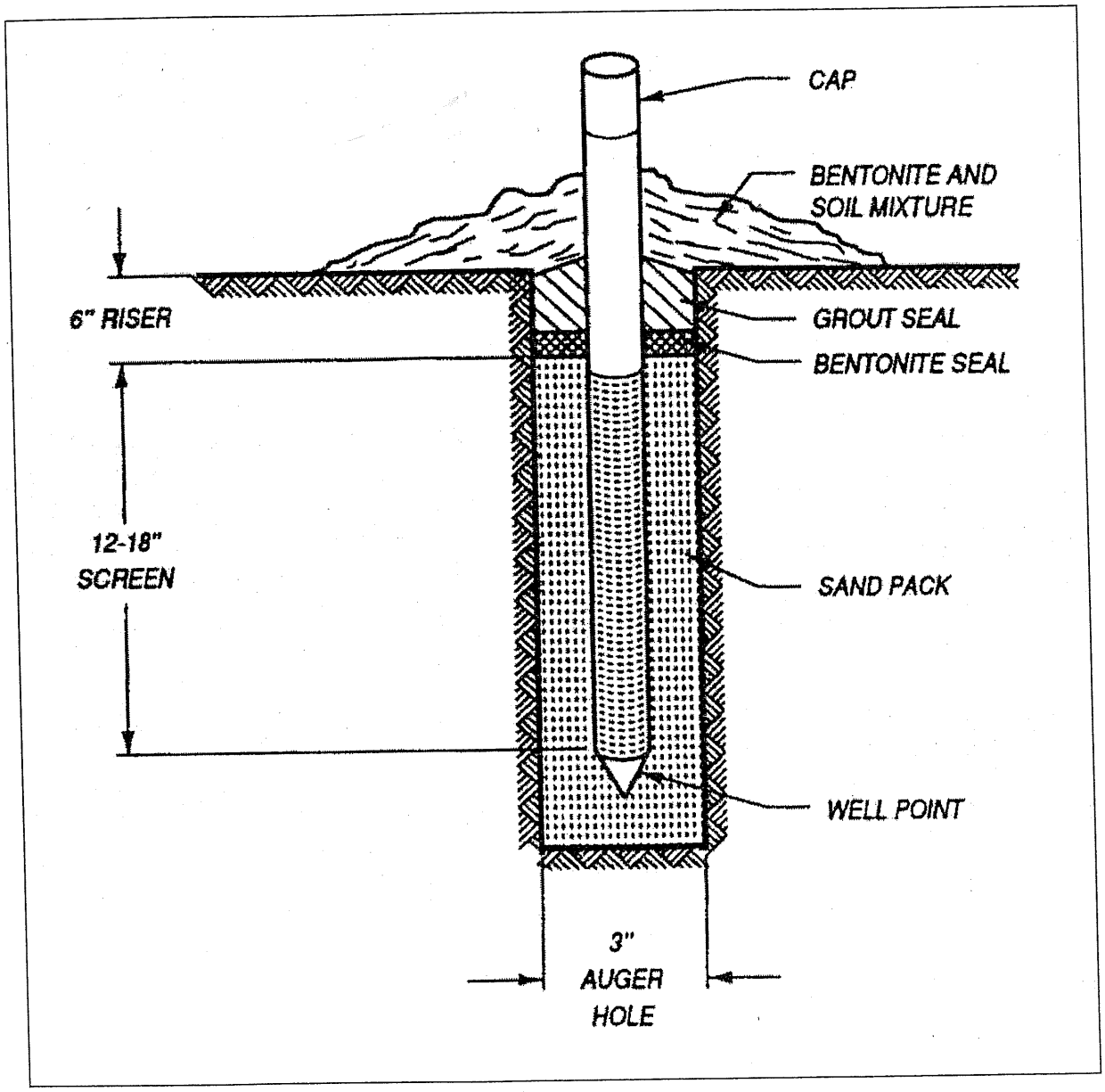


Figure 2-5. Groundwater Monitoring Well Design

APPENDIX C

Lora Lake hydro monitoring data and graphs (Microsoft Excel File)