Technical Memorandum

To: Andy Oien, City of Centralia

From: Glenn Mutti-Driscoll, Pacific Groundwater Group

Re: Nitrate Monitoring Well Installation

Date: October 30, 2019

The City of Centralia has concerns about the potential for nitrate contamination in the Centralia Outwash Gravel Aquifer (COGA), a shallow water supply aquifer underlying the City. Septic systems within the City limits and in unincorporated areas of its Urban Growth Area (UGA) overlie the COGA, as well as agricultural land uses, and may cause nitrate contamination within the shallow aquifer. Most septic systems overlying the COGA are in the Fords Prairie and Waunch Prairie. Most of the City's active production wells are also in the Fords Prairie, and therefore nitrogen loading in this part of the City is of greatest concern.

This memorandum documents the installation of six monitoring wells for the City of Centralia, five of which are located in the Fords Prairie vicinity and one in Waunch Prairie. The monitoring wells were located and designed with the primary intent of monitoring groundwater nitrate concentrations, but they also can be used for groundwater elevation monitoring or wellhead protection area monitoring. This work builds on a prior investigation (PGG, 2017) that reviewed historic groundwater nitrate concentrations in the Centralia area and recommended monitoring well locations based on the distribution of elevated groundwater nitrate concentrations, land use, and existing and potential future water supply sources. A groundwater nitrate monitoring network which includes both the recently installed monitoring wells and existing wells is proposed as part of this memo.

MONITORING WELL INSTALLATION

Six monitoring wells with depths ranging from 25 to 40 feet were installed between July 15 and July 17, 2019 in and around the City of Centralia (**Figure 1**). Relatively shallow completions were chosen so that nitrate concentrations near the water table (where they are expected to be highest) would be monitored. The monitoring wells were drilled by a licensed driller with Holocene Drilling using a sonic drill rig and were completed flush-to-ground. Each two-inch diameter PVC monitoring well was completed with10 feet of screen installed and was developed by Holocene Drilling. Right-of-way permits for drilling the wells were obtained by the City where needed, and utility locate services were provided by One-Call and CNI Locates. Well locations and elevations were surveyed by the City of Centralia Engineering Department. PGG geologically logged the boreholes and recorded

their as-built construction. Construction details for each well are summarized in **Table 1**, and well logs are included in **Appendix A**.

PROPOSED GROUNDWATER NITRATE MONITORING LOCATIONS

PGG in coordination with the City of Centralia identified the following wells as potential monitoring locations for a City-wide groundwater nitrate monitoring network:

- The six monitoring wells documented in this memo should be monitored.

- An irrigation well at the City's Waste Water Treatment Plant (WWTP) should be monitored since several agricultural and numerous septic parcels are upgradient of this area. Due to high aquifer yields near the WWTP, the vicinity has been identified as a preferred area for future water supply (PGG, 2016).

- High groundwater nitrate concentrations were documented near Trailer Village in the 1990s (PGG, 2017). Parcels that historically were on septic tanks in this area have since been connected to sewer, but more recent groundwater nitrate monitoring in this vicinity has not occurred. Additionally, this area is upgradient of the Eshom and Fords Prairie wells, and therefore MW-2 at Trailer Village (identified as MW-2 (Laundromat) on **Figure 1**) should be monitored.

- Unblended water samples from Fords Prairie Well 2 should be collected. Fords Prairie Well 2 is a primary water source for the City and has areas on septic drainfields upgradient of it and in close proximity.

- Unblended water samples from Tennis Court Well 2 should be collected. Tennis Court Well 2 is also a primary water source for the City and has numerous playing fields and a cemetery (which likely receive fertilizer) within its capture zone.

- Monitoring well AKB696 (located at the north end of Borst Park adjacent to Borst Avenue) should be included as a monitoring point since it is in the Tennis Court and Fords Prairie capture zones. Additionally, the Department of Ecology has historically monitored this well and it has an existing groundwater nitrate and water level data set.

- The K Street well should be monitored to provide additional information regarding groundwater nitrate concentrations near Waunch Prairie, and has a long data historic data set associated with it from prior City monitoring.

Groundwater nitrate samples should be collected quarterly for one to two years to create a baseline dataset so seasonal concentration variability can be observed. The baseline monitoring data can then be used to help refine the monitoring network through the identification of potential problem areas or areas where nitrogen loading appears minimal. Long-term monitoring frequencies can also be optimized based on the seasonality observed in the baseline data.

REFERENCES

Pacific Groundwater Group, 2016. Interim Drought Vulnerability Assessment to Optimize Existing Production Wells City of Centralia. Consultant's report for the City of Centralia. April 12, 2016.

Pacific Groundwater Group, 2017. City of Centralia Groundwater Nitrate Evaluation. Consultant's report for the City of Centralia. July 20, 2017.

Table 1. City of Centralia Monitoring Well Installation Summary

Well Name	Ecology Unique Well ID	Measuring Point Elevation (ft)	Vertical Datum	Latitude (NAD 83/91)	Longitude (NAD 83/91)	Stick Down from Monument Top (ft)	Screen Top (ft bgs)	Screen Bottom (ft bgs)	Total Depth (ft bgs)	Depth to Water (ft bmp)	Depth to Water Measurement Date
MW-3	BLT 951	170.74	NAVD88	46.7229731	-122.9808001	0.42	24.38	34.38	34.56	19.86	7/16/2019
MW-4	BLT 948	173.20	NAVD88	46.7349008	-122.9842750	0.38	24.57	34.57	34.9	22.94	7/16/2019
MW-5	BLT 953	167.18	NAVD88	46.7491858	-123.0034564	0.31	24.53	34.53	34.71	25.01	7/17/2019
MW-6	BLT 950	171.95	NAVD88	46.7251817	-122.9960924	0.45	30.02	40.02	40.2	26.42	7/16/2019
MW-7	BLT 952	193.13	NAVD88	46.7425288	-122.9473010	0.3	14.64	24.64	24.82	10.8	7/17/2019
MW-8	BLT 949	167.25	NAVD88	46.741869	-123.0023553	0.53	29.84	39.84	40.02	26.95	7/16/2019

Notes

bgs = below ground surface; bmp = below measuring point

Figure 1

Centralia Monitoring Wells and Proposed Groundwater Nitrate Monitoring Network

PgG

Waste Treatment Plant Well
Dry Creek
Chehalis River
MW-5
MW-8
Fords Prairie
Galvin Rd
Eshom Street Well
Fords Prairie #2
Fords Prairie #1
Eshom Rd
N Scheuber Rd
MW-4
Harrison Ave
Johnson Rd
MW-2 (Laundromat)
Borst Ave
MW-6
Oakland Ave
AKB696
Tennis Court Wells 1 & 2
MW-3
Fort Borst Lake
Hayes Lake
Borst Park Well 1
Borst Park Well 2
Chehalis River
Scammon Creek
Cooks Hill Rd
Plummer Lake
Yew St
Coffee Creek
Downing Rd
Downing St Well
State Route 507
Big Hanaford Rd
Hanaford Creek
MW-7
Skookumchuck River
Washington Street Wells 1 & 2
K Street Well
Riverside Park Well
W Reynolds Ave
N Tower Ave
North Tower Well
N Pearl St
W 4th St
W 1st St
W Main St
W Locust St
E Locust St
N Gold St
Marion St
China Creek
Little Hanaford Rd

- City Production Wells
- City Monitoring Wells
- Other Monitoring Wells
- Existing Wells Where Groundwater Nitrate Monitoring is Proposed
- Groundwater Flow Directions
- Mapped Extent of Centralia Outwash Gravel Aquifer
- Centralia Incorporated Area
- Centralia UGA

N

0 Feet 2,000

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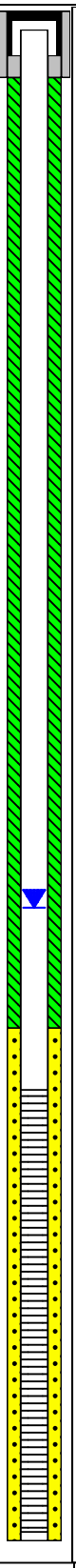
APPENDIX A
2019 GROUNDWATER NITRATE MONITORING WELL LOGS
CITY OF CENTRALIA

Depth (ft)	Soil Description
0	Moist, dark brown, slightly gravelly, silty, SAND with organics (Topsoil)
1	Moist, brown, slightly silty, very gravelly, SAND (Fill). 1.4 - 2.1 ft: gray
2	
3	Moist, brown to dark brown, silty CLAY.
4	
5	
6	
7	Moist, brown, trace to slightly silty, fine SAND. Local pebbles.
8	Moist, brown, slightly silty, gravelly, fine-to-coarse SAND.
9	Moist, brown, silty, very gravelly, fine-to-coarse SAND.
10	Moist, brown, fine-to-coarse sandy, very silty, GRAVEL (silt-bound).
11	Very moist, dark brown, trace to slightly gravelly, slightly sandy, CLAY.
12	Very moist, brown, very clayey, very fine-to-coarse sandy, GRAVEL (clay-bound).
13	Very moist, brown, gravelly, fine-to-coarse SAND. Sand is predominately fine-to-medium.
14	Very moist, dark gray, silty, sandy, GRAVEL (silt-bound). Cobbles present.
15	
16	Wet, brown, slightly silty, fine-to-coarse sandy, GRAVEL.
17	Wet, brown, very gravelly, fine-to-coarse SAND.
18	Very moist, silty, sandy, GRAVEL (silt-bound).
19	Very moist, brown, very fine-to-coarse sandy, GRAVEL. Trace silty, local cobbles.
20	Moist, silty, fine-to-coarse sandy, GRAVEL & COBBLES (silt-bound).
21	Very moist, trace to slightly silty, gravelly, fine-to-coarse SAND. Sand predominately fine-to-medium.
22	Wet, brown, silty, gravelly, fine-to-coarse SAND. Local cobbles.
23	Interbeded layers of brown, fine-to-coarse sandy, GRAVEL and very gravelly, clean fine-to-coarse SAND. Layers approximately 0.5 to 1 ft thick, gravel layers are loose.
24	
25	
26	
27	Brown, fine-to-coarse SAND & GRAVEL. Clean.
28	
29	
30	Brown, fine-to-medium SAND. Clean, local fine gravel. 33.2 - 35 ft: slightly gravelly, local cobbles
31	
32	
33	
34	
35	



Sample Results

Flush-mount steel monument. PVC measuring point stickdown 0.42 ft.

0 - 1.5 ft: neat cement surface seal

1.5 - 23 ft: bentonite seal

0.42 - 24.4 ft: 2-inch PVC schedule 40 riser pipe. Joints threaded with o-rings.

0 - 35 ft: 6-inch diameter borehole

Depth to water (bgs): 20.28 ft, 7/16/19

23 - 35 ft: 12-20 silica sand filter pack

24.4 - 34.4 ft: 2-inch PVC schedule 40 screen, 10-slot (0.01-inch)

34.4 - 34.6 ft: 2-inch PVC schedule 40 end cap (flat), 0.18 ft length

35 ft: Bottom of hole

Latitude: 46.7229731 NAD83/91
Longitude: -122.9808001
Measuring Point Elevation: 170.74 ft NAVD88
Ecology UWID: BLT 951
Drilled: 07/16/2019
Location Description: Borst Park, east of ball diamonds & ~800' south of Pioneer Way

Driller: Zach Bailey, Holocene Drilling
Drilling Method: Sonic
Logged by: Glenn Mutti-Driscoll, PGG
Depth to Water (bmp): 19.86 ft, 7/16/19

MW-3
Boring Log and As-Built

Centralia Monitoring Wells
Task 4
JV1805.04

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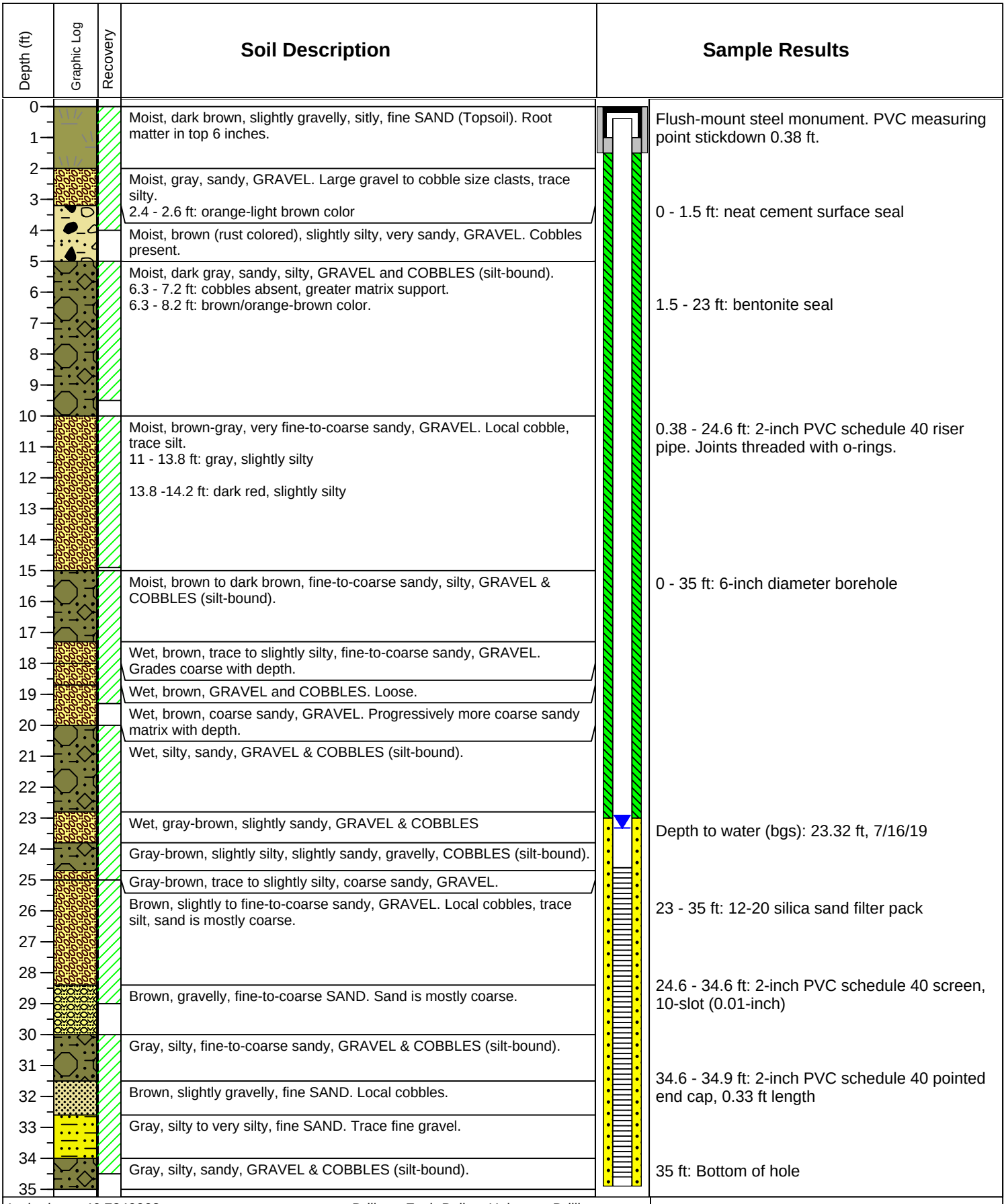

Latitude: 46.7349008 NAD83/91
Longitude: -122.9842750
Measuring Point Elevation: 173.20 ft NAVD88
Ecology UWID: BLT 948
Drilled: 07/15/2019
Location Description: 2600 W Reynolds Ave, 190' S of W Reynolds and 50' E of shop building

Driller: Zach Bailey, Holocene Drilling
Drilling Method: Sonic
Logged by: Glenn Mutti-Driscoll, PGG
Depth to Water (bmp): 22.94 ft, 7/16/19

MW-4
Boring Log and As-Built

Centralia Monitoring Wells
Task 4
JV1805.04

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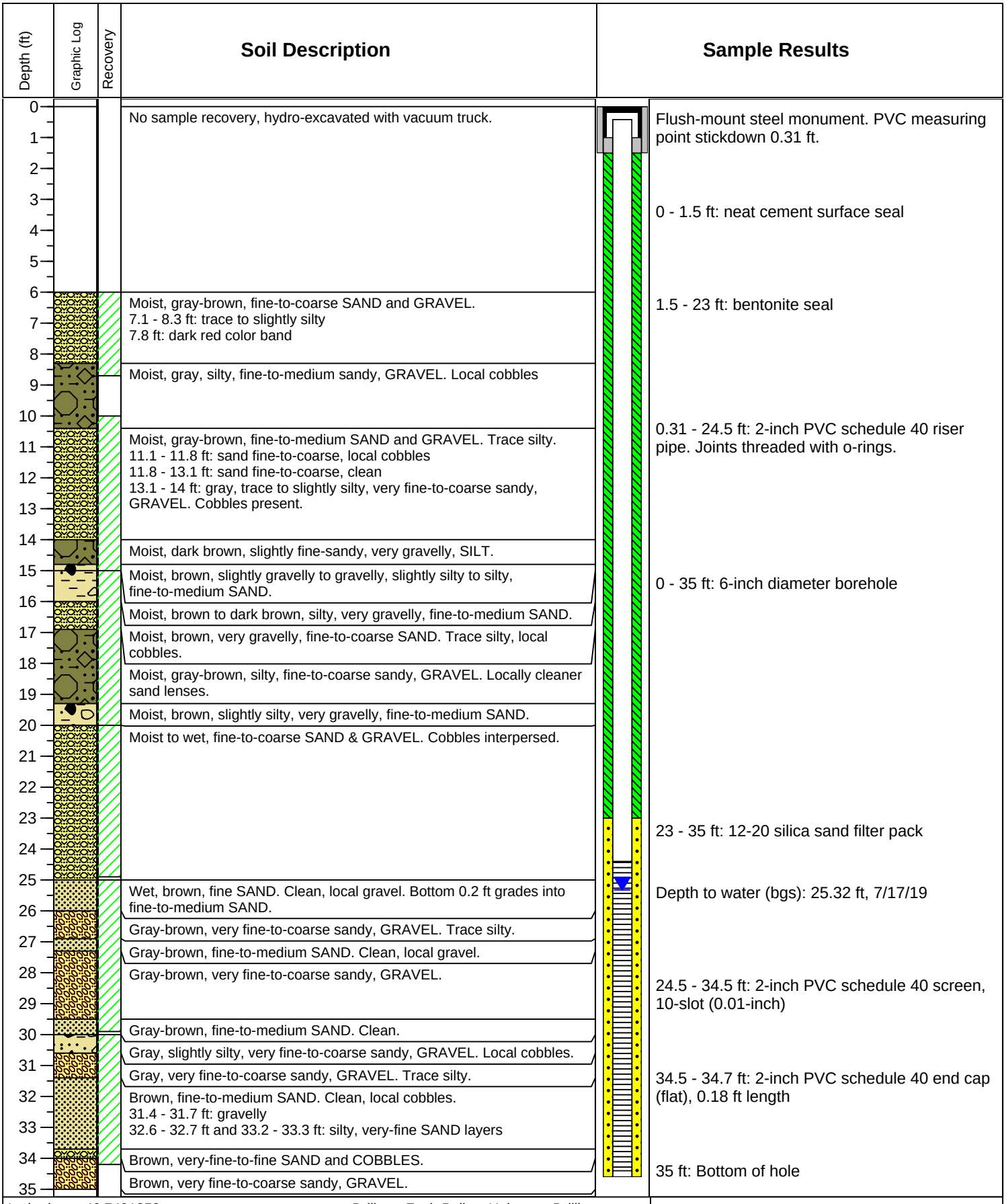

Latitude: 46.7491858 NAD83/91
Longitude: -123.0034564
Measuring Point Elevation: 167.18 ft NAVD88
Ecology UWID: BLT 953
Drilled: 07/17/2019
Location Description: 670' West of Harrison Ave on WWTP Access Rd

Driller: Zach Bailey, Holocene Drilling
Drilling Method: Sonic
Logged by: Glenn Mutti-Driscoll, PGG
Depth to Water (bmp): 25.01 ft, 7/17/19

MW-5
Boring Log and As-Built

Centralia Monitoring Wells
Task 4
JV1805.04

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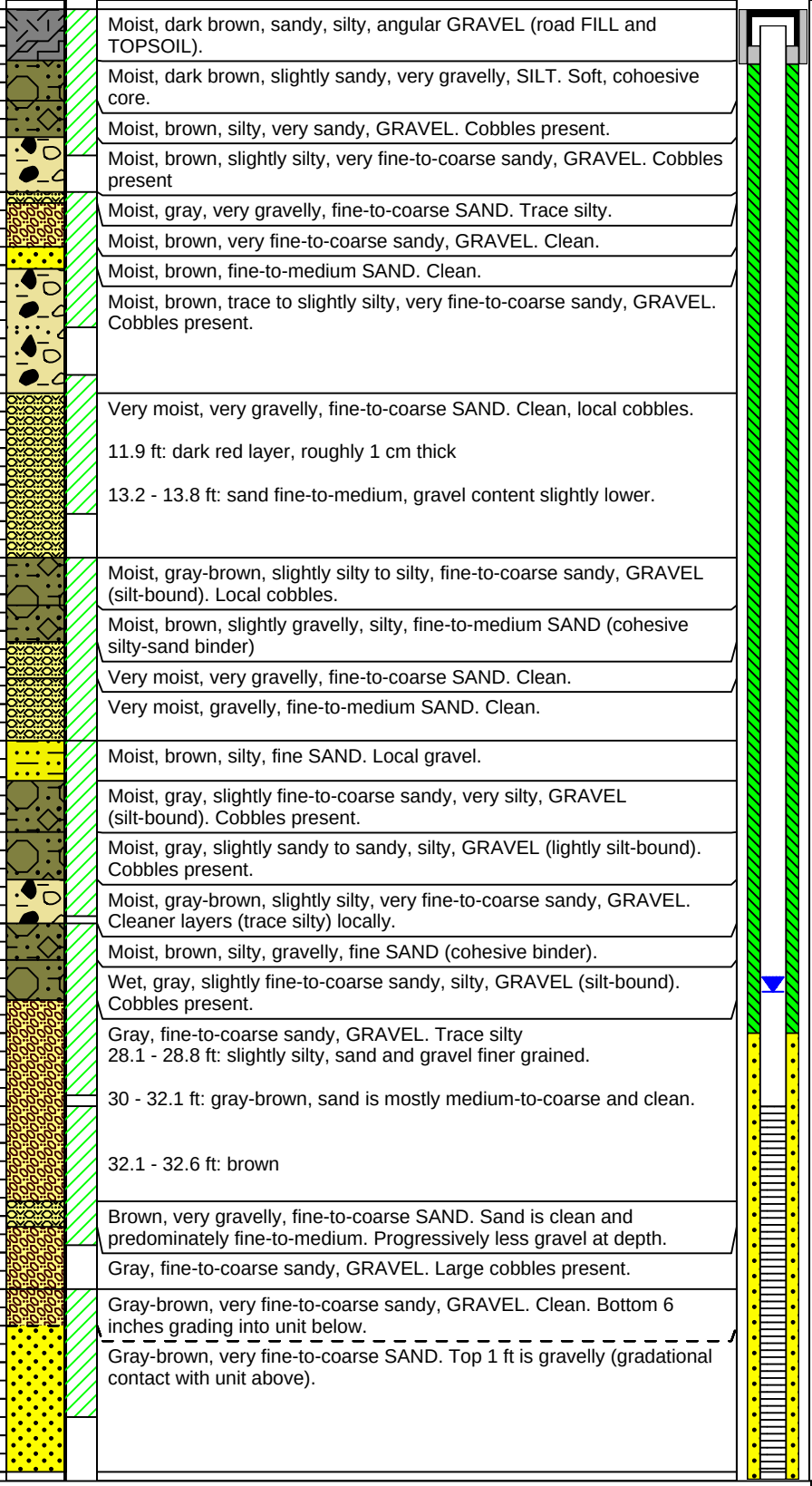


Latitude: 46.7251817 NAD83/91
Longitude: -122.9960924
Measuring Point Elevation: 171.95 ft NAVD88
Ecology UWID: BLT 950
Drilled: 07/16/2019
Location Description: In front of 3302 Mt Vista Rd

Driller: Zach Bailey, Holocene Drilling
Drilling Method: Sonic
Logged by: Glenn Mutti-Driscoll, PGG
Depth to Water (bmp): 26.42 ft, 7/16/19

MW-6
Boring Log and As-Built

Centralia Monitoring Wells
Task 4
JV1805.04

PgG

Depth (ft)	Soil Description	Sample Results
0	Moist, brown, gravelly, silty, SAND (topsoil).	Flush-mount steel monument. PVC measuring point stickdown 0.30 ft.
1		
2	Moist, brown, silty, sandy, GRAVEL & COBBLES.	
3	Moist, brown, silty, sandy, GRAVEL (silt-bound)	0 - 1.5 ft: neat cement surface seal
4		
5	Moist, dark brown, fine-to-coarse sandy, very silty, GRAVEL (silt-bound). Cobbles present.	1.5 - 13 ft: bentonite seal
6		
7		
8	Moist to wet, brown to dark brown, silty, fine-to-coarse sandy, GRAVEL (silt-bound). Cobbles present.	0.3 - 14.6 ft: 2-inch PVC schedule 40 riser pipe. Joints threaded with o-rings.
9		
10	Wet, brown, slightly silty, fine-to-coarse sandy, gravelly, COBBLES. Loose.	
11		Depth to water (bgs): 11.10 ft, 7/17/19
12	Brown, slightly silty to silty, gravelly, fine-to-coarse SAND.	
13	Brown, slightly silty to silty, fine-to-coarse sandy, GRAVEL. Cobbles present. Loose.	0 - 25 ft: 6-inch diameter borehole
14		
15	Brown, fine-to-coarse SAND & GRAVEL. Cobbles present.	13 - 25 ft: 12-20 silica sand filter pack
16		
17	Brown, slightly fine-to-coarse sandy, GRAVEL. Cobbles present, loose.	14.6 - 24.6 ft: 2-inch PVC schedule 40 screen, 10-slot (0.01-inch)
18		
19		
20	Brown-gray, very gravelly, fine-to-coarse SAND. Sand predominately medium-to-coarse. Trace silty.	
21		
22	Brown-gray, very fine-to-coarse sandy, GRAVEL. Sand is clean and predominately fine-to-medium.	24.6 - 24.8 ft: 2-inch PVC schedule 40 end cap (flat), 0.18 ft length
23	Brown-gray, fine sandy, GRAVEL & COBBLES. Trace silty.	
24	Brown-gray, gravelly, fine-to-coarse SAND. Sand is predominately coarse.	
25	Brown, GRAVEL. Loose.	25 ft: Bottom of hole

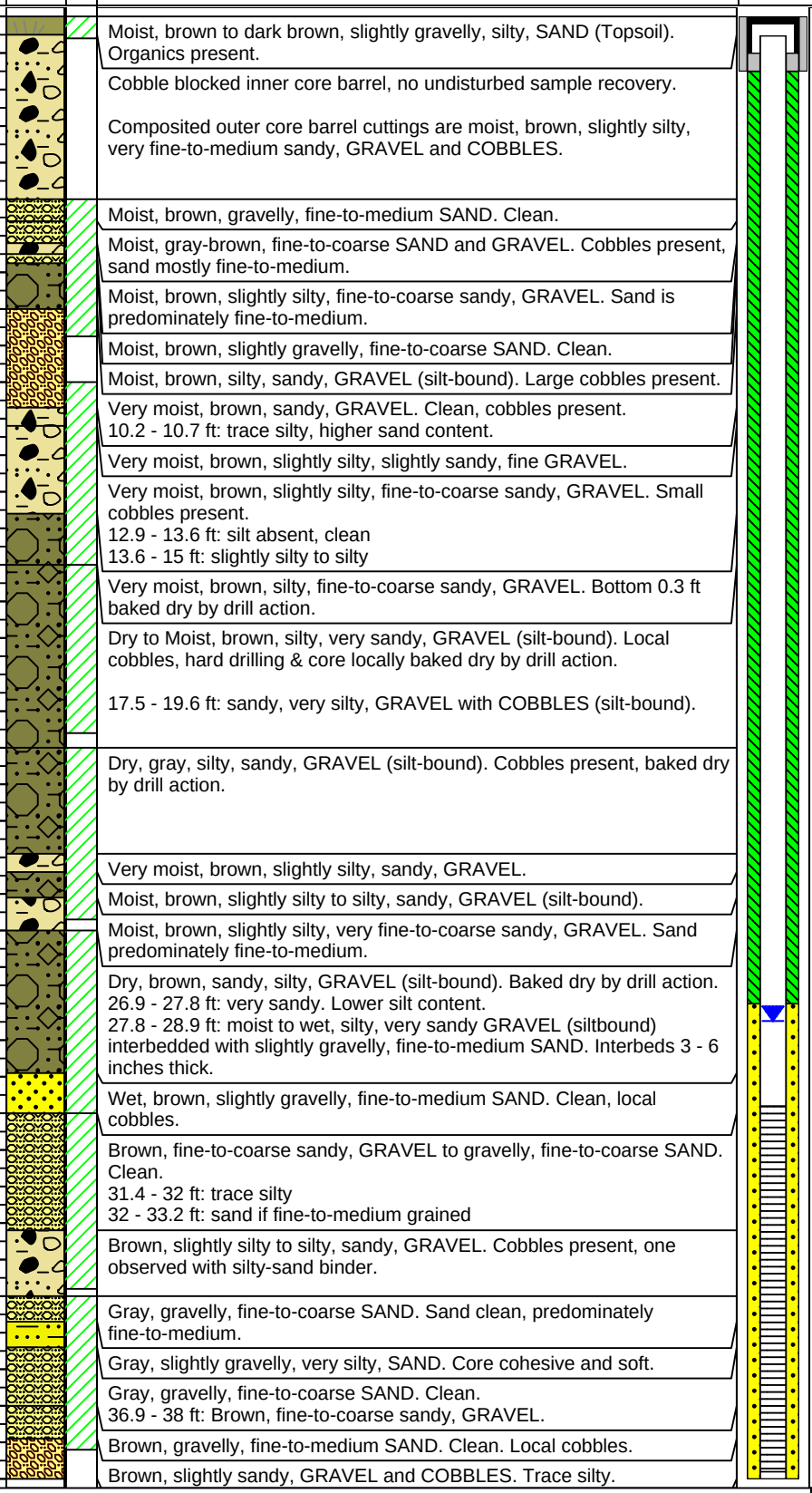
Latitude: 46.7425288 NAD83/91
Longitude: -122.9473010
Measuring Point Elevation: 193.13 ft NAVD88
Ecology UWID: BLT 952
Drilled: 07/17/2019
Location Description: 60 ft east of E Oakview Ave & Eureka Ave intersection

Driller: Zach Bailey, Holocene Drilling
Drilling Method: Sonic
Logged by: Glenn Mutti-Driscoll, PGG
Depth to Water (bmp): 10.80 ft, 7/17/19

MW-7
Boring Log and As-Built

Centralia Monitoring Wells
Task 4
JV1805.04

PgG



Latitude: 46.741869
Longitude: -123.0023553
NAD83/91
Measuring Point Elevation: 167.25 ft NAVD88
Ecology UWID: BLT 949
Drilled: 07/16/2019
Location Description: North side of intersection of Ives Rd & Lemar Lane

Driller: Zach Bailey, Holocene Drilling
Drilling Method: Sonic
Logged by: Glenn Mutti-Driscoll, PGG
Depth to Water (bmp): 26.95 ft, 7/16/19

MW-8
Boring Log and As-Built

Centralia Monitoring Wells
Task 4
JV1805.04

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