
PACIFIC groundwater GROUP

March 26, 2018

Bill Teitzel
Lewis County Environmental Services
2025 N.E. Kresky Avenue
Chehalis, WA

Re: Centralia Landfill Third Quarter 2017 (2017 Q3) / Dry Season Compliance
Monitoring Report

Dear Bill:

This letter report summarizes the 2017 third quarter (2017 Q3) water quality monitoring event at the Centralia Landfill in Lewis County, Washington (Figure 1). Biannual groundwater and surface water quality monitoring are performed during the wet (first quarter) and dry (third quarter) seasons. Landfill gas monitoring is performed quarterly.

The Centralia Landfill (Site) is a closed municipal solid waste landfill that operated between 1958 and 1994. Cleanup activities at the landfill were completed under Cleanup Action Plan Consent Decree C91-5100 as executed in 2001 between the Washington State Department of Ecology (Ecology), Lewis County, the City of Chehalis, the City of Centralia, the City of Morton, the City of Mossyrock, the Town of Pe Ell, and the City of Vader. The final remedial action for the landfill included post-closure monitoring of groundwater and surface water, operation and maintenance of the landfill gas control system, and maintenance of the final landfill cover and surface water control systems. The selected remedy also provided for institutional controls and compliance monitoring.

2017 Q3 WATER QUALITY MONITORING EVENT

Representatives of the City of Centralia performed the 2017 Q3 water quality sampling event as described below. Analytical services were provided by Dragon Analytical Laboratory, Inc. (DAL), in Olympia, Washington. DAL subcontracted analysis of total organic carbon (TOC) to Edge Analytical in Burlington, Washington. Both DAL and Edge Analytical are Ecology-accredited laboratories.

MONITORING NETWORKS AND SAMPLE COLLECTION

The groundwater and surface water monitoring networks and the 2017 Q3 sampling event are described below.

CLEANUP LEVELS AND POINTS OF COMPLIANCE

Cleanup levels for groundwater and surface water were established in the Cleanup Action Plan using the Model Toxics Control Act (MTCA) Method B (WAC 173-340-705), which references Applicable, Relevant, and Appropriate Requirements (ARARs) based on applicable state and federal laws, in addition to providing methods for calculating cleanup levels based on toxic or carcinogenic risk. The following discussion of cleanup levels and points of compliance summarizes information detailed in the Second Periodic Review (Ecology, 2016).

Groundwater

Groundwater in the Upper Unit discharges to the Weyerhaeuser Ditch and Salzer Creek. Therefore, cleanup levels for groundwater in the Upper Unit were established considering both MTCA Method B groundwater *and* surface water standards. The cleanup levels in groundwater for the Centralia Landfill are based on primary drinking water standards for mercury and nitrate; and are based on secondary drinking water standards for chloride, pH, sulfate, TDS, manganese, iron, and zinc. The compliance limit for arsenic in groundwater for the Centralia Landfill, 0.5 µg/L (0.0005 mg/L), is based on the surface water ARAR described in the following section.

Groundwater in the Lower Unit does not discharge to surface water near the Centralia Landfill and therefore only groundwater ARARs were used to establish cleanup levels for this unit. The current Site cleanup levels for iron and manganese are based on federal and state secondary maximum contaminant levels for drinking water. The Second Periodic Review (Ecology, 2016) refers to a Site cleanup level for arsenic of 5 µg/L (0.005 mg/L) for groundwater in the Lower Unit, and the Cleanup Action Plan (unknown, 1999) states this is the MTCA Method A cleanup level based on background concentrations for the State of Washington. The Second Periodic Review (Ecology, 2016) acknowledges that if Site background concentrations of iron, manganese, and/or arsenic are higher than cleanup levels, then background-based alternative cleanup levels will be established. Ecology further states that since there is only one background monitoring well completed in the Lower Unit², continued and expanded background monitoring is required to make this evaluation.

The point of compliance for groundwater cleanup at the Centralia Landfill is the existing property boundary.

² The Second Periodic Review (Ecology, 2016) states there is only one background monitoring well completed in the Lower Unit; however, groundwater contours presented for September 2016 (Centralia Public Works, 2016) and for this report suggest that MW-1D and MW-3D are both located upgradient of the landfill.

Q3 sampling event (Figure 3), MW-2S is located downgradient of the landfill and MW-CNE-1S is located cross gradient. MW-2SU is located adjacent to the landfill (Figure 2). As stated above, water level data in the Upper Shallow Unit could not be contoured.

- The concentrations of dissolved arsenic in samples B-1S, B-1SU, B-2S, B-2SU, and MW-2S exceeded the Site compliance level of 0.0005 mg/L. Wells B-1S, B-2S, and MW-2S are located downgradient of the landfill (Figure 3). Additionally, the concentrations of total arsenic in all 2017 Q3 Upper Shallow/Shallow Unit wells exceeded the arsenic compliance level with the exceptions of samples collected at MW-1S and MW-3S, which are located upgradient of the landfill (Figure 3).
- The concentrations of dissolved iron exceeded the secondary groundwater standard (0.3 mg/L) in samples collected at Upper Shallow/Shallow Unit wells B-1SU, MW-2S, MW-2SU, and MW-CNE-1S. Well MW-2S is located downgradient of the landfill and MW-CNE-1S is located cross gradient (Figure 3). Well MW-2SU is located adjacent to the landfill (Figure 2). As stated above, water level data in the Upper Shallow Unit could not be contoured. Additionally, the concentrations of total iron in all 2017 Q3 Upper Shallow/Shallow Unit wells exceeded the iron cleanup level with the exceptions of samples collected at MW-1S and MW-3S, which are located upgradient of the landfill (Figure 3).
- The concentrations of dissolved manganese and total manganese exceeded the secondary groundwater standard (0.05 mg/L) in all samples collected in the Upper Shallow/Shallow Unit wells with the exceptions of samples B-2SU, MW-1S, and MW-3S. Wells MW-1S and MW-3S are located upgradient of the landfill (Figure 3).
- Concentrations of chloride, nitrate+nitrite, sulfate, dissolved mercury, total mercury, dissolved zinc, and total zinc were less than corresponding cleanup levels or were not detected in all samples collected from Upper Shallow/Shallow Unit wells in 2017 Q3.

Lower Unit

The Second Periodic Review (Ecology, 2016) compared dissolved arsenic, soluble iron, and manganese (unspecified) to corresponding cleanup levels. The following observations were made regarding the 2017 Q3 groundwater concentrations in the Lower Unit wells relative to cleanup levels for arsenic, iron, and manganese:

- The concentrations of dissolved and total arsenic in samples collected from B-6DR, MW-1D, and MW-2D were above the cleanup level of 0.005 mg/L referenced in the Second Periodic Review (Ecology, 2016). MW-1D is located north-east and upgradient of the Centralia Landfill while B-6DR and MW-2D are located adjacent to and/or downgradient of the landfill. During 2017 Q3, the dissolved arsenic and total arsenic concentrations in MW-1D (upgradient) were greater than the dissolved and total arsenic concentrations in B-6DR and MW-2D.

Technology Innovation (OSRTI). OLEM 9355.0-133. EPA-540-R-2016-001. September 2016.

Unknown Author. 1999. Exhibit B Cleanup Action Plan Centralia Landfill Lewis County, Washington. September 1999.

Washington State Department of Ecology (Ecology). 2016. Second Periodic Review Report Final Centralia Landfill Facility Site ID #: 1154. Southwest Region Office Toxics Cleanup Program. January 2016.

We are pleased to provide you with these monitoring services. Please call us if you have any questions

Sincerely,

Pacific Groundwater Group



Stephen P. Swope
Principal Hydrogeologist

Attachments: Table 1. Shallow Upper/Upper Groundwater Quality Summary, 2017 Q3
Table 2. Lower Unit Groundwater Quality Summary, 2017 Q3
Figure 1. Centralia Landfill Vicinity
Figure 2. Shallow Upper Aquifer Groundwater Elevations 2017 Q3
Figure 3. Upper Aquifer Groundwater Elevations 2017 Q3
Figure 4. Lower Aquifer Groundwater Elevations 2017 Q3
Appendix A. Water Quality Time Series Plots
Appendix B. Gas Probe Narrative and Gas Probe Data 2017 Q3

Centralia2017Q3SummaryRpt_Final.docx

Table 1. Shallow Upper/Upper Groundwater Quality Summary, 2017 Q3

Parameter Group	Constituent	Units	CAP Cleanup Level	CAP Compliance Level	Groundwater Standards *	B-1S	B-1SU	B-2S	B-2SU	MW-1S	MW-2S	MW-2SU	MW-3S	MW-4S	MW-5S	MW-CNE-1S
Field Parameters																
Depth to Water		feet				11.6	12.21	11.73	12.42	13.38	8.96	9.93	13.11	10.45	10.44	9.74
Conventional Parameters																
Alkalinity, Carb as CaCO ₃	Alkalinity, Carb as CaCO ₃	mg/L CaCO ₃				200	210	180	180	66.5	440	389	40	89	135	397
	Ammonia as N, Total	mg/L as N				0.86	0.32	0.9	0.3 U	0.3 U	0.56	0.45	0.3 U	0.3 U	0.37	0.3 U
	Carbon, Total Organic	mg/L				0.86	4.11	1.42	0.72	0.19	10	10.1	0.46	1.11	1.42	8.58
	Chemical Oxygen Demand (COD)	mg/L				9.5j	68.7j	12.5j	12.5j	5 Uj	28.8j	45.1j	3.6j	0.66j	22.9j	28.8j
	Chloride	mg/L	250			6.5	23.3	11.8	2.8	1.9	213	200	4.9	1.6	8.5	62
	Hardness	mg/L CaCO ₃				127	268	238	169	89.3	378	412	56.5	61.5	114	497
	Nitrate+Nitrite as N	mg/L as N			10	0.1 U	0.1 U	0.1 U	0.1 U	2.5	0.25	0.21	1.7	0.1 U	0.1 U	2.8
	Solids, Total Dissolved	mg/L			500	130j	276j	300j	218j	152j	964j	804j	118j	24j	178j	578j
	Sulfate	mg/L			250	0.2 U	0.2 U	0.2 U	3.6	38.7	0.2 U	0.26	28.3	4.7	1.4	0.2 U
Dissolved Metals																
Arsenic, Dissolved	Arsenic, Dissolved	mg/L	0.00027	0.0005	0.00005	0.0108	0.00067	0.0172	0.0021	0.0005 U	0.0242	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U
	Calcium, Dissolved	mg/L				20.4j	32j	57.9j	21.3j	15.6j	27.2j	21.2j	11.7j	10.7j	25.8j	94j
	Iron, Dissolved	mg/L	0.3		0.3	0.05 U	5.19	0.05 U	0.05 U	0.05 U	7.69	15.4	0.05 U	0.05 U	0.184	21.7
	Magnesium, Dissolved	mg/L				11.7j	34j	21.3j	12.48j	7.65j	86.6j	78.2j	3.53j	7.5j	12j	65.7j
	Manganese, Dissolved	mg/L	0.05		0.05	0.856	3.95j	1.9	0.0041	0.0092	11.5j	8.77	0.003	0.243	0.925	2.6
	Mercury, Dissolved	mg/L			0.002	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U
	Potassium, Dissolved	mg/L				7.53j	3.6j	8.01j	1.75j	0.998j	12.1j	10.6j	0.938j	1.54j	5.17j	7.5j
	Sodium, Dissolved	mg/L				13.5	29.7	17.1	17.5	11.6	24.3	31.8	15.2	11.2	13.8	21.8
	Zinc, Dissolved	mg/L			5	0.0027	0.0079	0.0032	0.0041	0.0052	0.0034	0.0066	0.0015	0.0039	0.0069	0.0024
Total Metals																
Arsenic, Total	Arsenic, Total	mg/L	0.00027	0.0005	0.00005	0.0161	0.0088	0.0177	0.0022	0.0005 U	0.0329	0.0095	0.0005 U	0.00085	0.0058	0.0105
	Calcium, Total	mg/L				30.9	49.3	59.5	32.3	23.9	17.7	31	16.6	14.8	24.5	94.4
	Iron, Total	mg/L	0.3		0.3	0.943	18.4	1.04	0.609	0.05 U	13.3	32	0.05 U	0.307	9.3	29.5
	Magnesium, Total	mg/L				12	35.3	21.8	21.4	7.19	85.7	81.2	3.62	5.96	12.9	63.5
	Manganese, Total	mg/L	0.05		0.05	0.86	3.9	2.08	0.0257	0.0016	9.85	9.32	0.0037	0.188	1.29	2.82
	Mercury, Total	mg/L			0.002	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U
	Potassium, Total	mg/L				6.81	3.75	6.97	2.82	0.976	9.44	9.92	0.963	1.35	4.29	6.42
	Sodium, Total	mg/L			5	13.5	28.9	17.2	18	12	26	29.6	15.1	11.5	12.9	22
	Zinc, Total	mg/L				0.0056	0.0435	0.0061	0.007	0.0013	0.0045	0.0218	0.0044	0.0066	0.0402	0.0042

CAP = Cleanup Action Plan (September, 1999)

*Groundwater Primary Standards for Nitrate, Arsenic, and Mercury; Groundwater Secondary Standards for remaining parameters. Arsenic has a primary drinking water standard of 0.01 mg/L and a state ground water quality standard of 0.00005 mg/L. Groundwater Standards presented in this table are consistent with Centralia Landfill Second Periodic Review, Appendix 6.3 (Washington Department of Ecology, January 2016)

2017 Q3

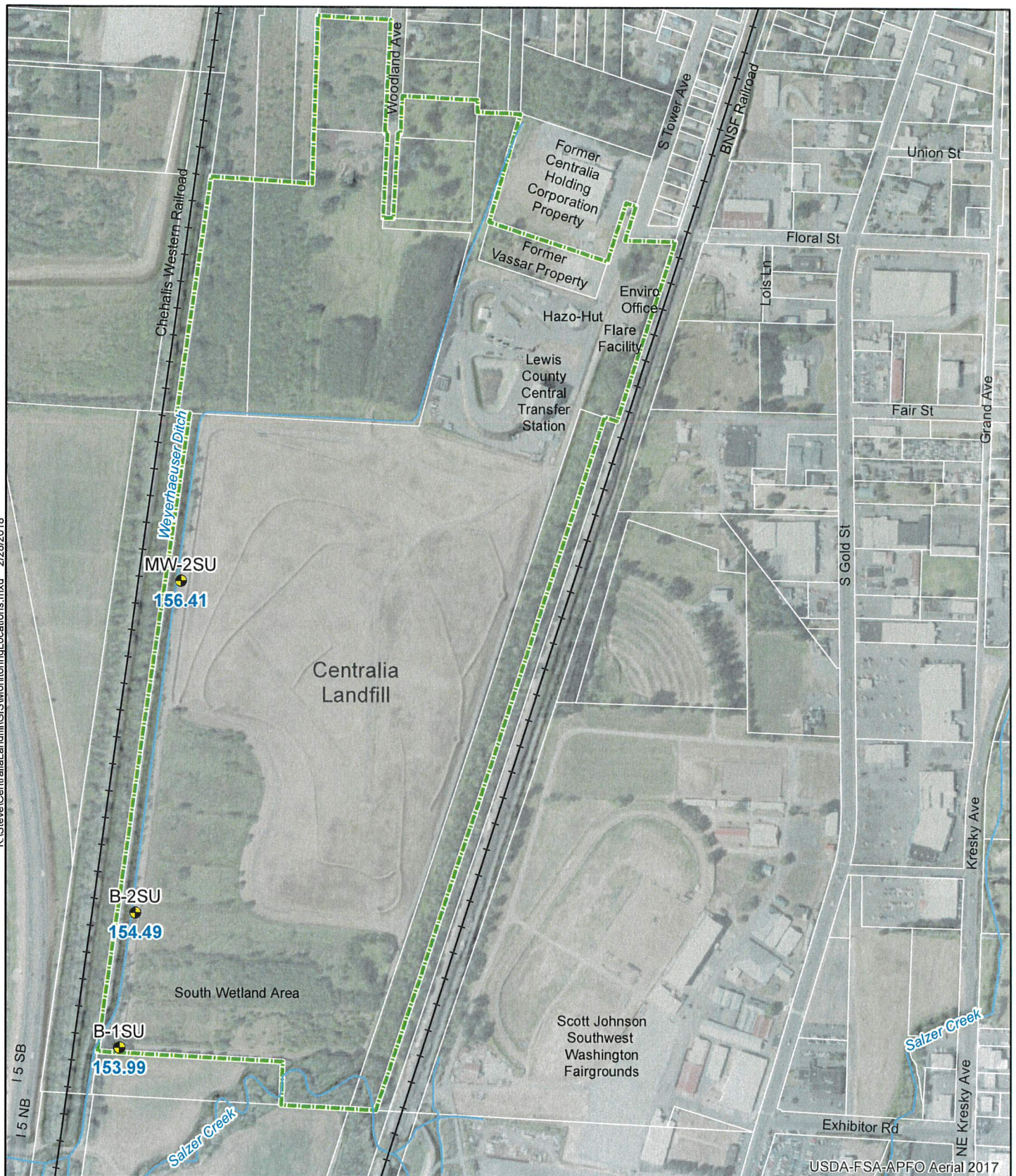
Page 1 of 1

Table 2. Lower Unit Groundwater Quality Summary, 2017 Q3

Parameter Group	Constituent	Units	CAP Cleanup Level	Groundwater Standards *	B-6DR	B-8DR	MW-1D	MW-2D	MW-3D	MW-CNE-1D
Field Parameters										
Depth to Water		feet			10.79	11.58	57.88	9.4	15.01	9.71
Conventional Parameters										
Alkalinity, Carb as CaCO ₃		mg/L CaCO ₃			130	200	142	150	124	140
Ammonia as N, Total		mg/L as N			1.4	0.73	1.7	1.8	0.72	0.52
Carbon, Total Organic		mg/L			2.27	1.78	3.48	1.8	1.06	1.5
Chemical Oxygen Demand (COD)		mg/L			8.1j	2.1j	2.1j	11j	3.6j	3.6j
Chloride		mg/L			11.2	5	5.3	10	5.8	6.2
Hardness		mg/L CaCO ₃			112	160	115	145	91.5	119
Nitrate+Nitrite as N		mg/L as N			0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Solids, Total Dissolved		mg/L			180j	272j	154j	230j	198j	200j
Sulfate		mg/L			0.36	22.6	0.78	0.2 U	0.2 U	0.31
Dissolved Metals										
Arsenic, Dissolved		mg/L	0.005	0.005	0.0071	0.0005 U	0.0091	0.0064	0.0005 U	0.0005 U
Calcium, Dissolved		mg/L			17.9j	24.41j	17.8j	24.7j	19.6j	21.13j
Iron, Dissolved		mg/L	0.3	0.3	0.0592	0.05 U	0.0914	1.91	1.46	0.05 U
Magnesium, Dissolved		mg/L			6.19j	15.5j	5.59j	7.56j	8.4j	5.1j
Manganese, Dissolved		mg/L	0.05	0.05	0.676	0.239	0.532	0.882	1.07	0.23
Mercury, Dissolved		mg/L			0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U
Potassium, Dissolved		mg/L			2.35j	2.76j	1.53j	1.99j	3.58j	1.67j
Sodium, Dissolved		mg/L			14.9	51	0.1 U	17.4	13.8	23.2
Zinc, Dissolved		mg/L			0.0018	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U
Total Metals										
Arsenic, Total		mg/L	0.005	0.005	0.00662	0.0005 U	0.0107	0.0063	0.0024	0.0005 U
Calcium, Total		mg/L			27.5	38.2	27.2	36.5	21.3	32.4
Iron, Total		mg/L	0.3	0.3	2.51	0.821	7.3	2.36	4.99	0.654
Magnesium, Total		mg/L			10.6	15.8	11.4	13.2	9.32	9.18
Manganese, Total		mg/L	0.05	0.05	0.71	0.242	0.727	0.882	1.23	0.245
Mercury, Total		mg/L			0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U	0.0001 U
Potassium, Total		mg/L			3.81	2.76	3	3.28	3.28	2.96
Sodium, Total		mg/L			14	48.9	27.6	17.9	15.1	24
Zinc, Total		mg/L			0.0103	0.0057	0.0455	0.0019	0.0015	0.0039

CAP = Cleanup Action Plan (September, 1999)

*Groundwater Standards presented in this table are consistent with Centralia Landfill Second Periodic Review, Appendix 6.3 (Washington Department of Ecology, January 2016)



Monitoring Wells (with Measured Groundwater Elevation)

City Property

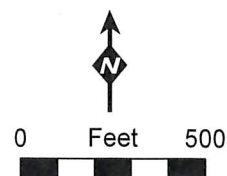


Figure 2

Shallow Upper Aquifer
Groundwater Elevations
2017 Q3

Centralia Landfill
Compliance Monitoring

PGG



USDA-FSA-APFO Aerial 2017

● Monitoring Wells (with Measured Groundwater Elevation)

— Groundwater Elevation Contours

➔ Estimated Flow Path

▭ City Property

* Water Level Elevation not used in contouring, suspect measurement error

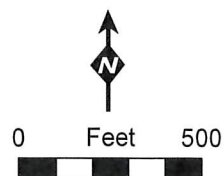
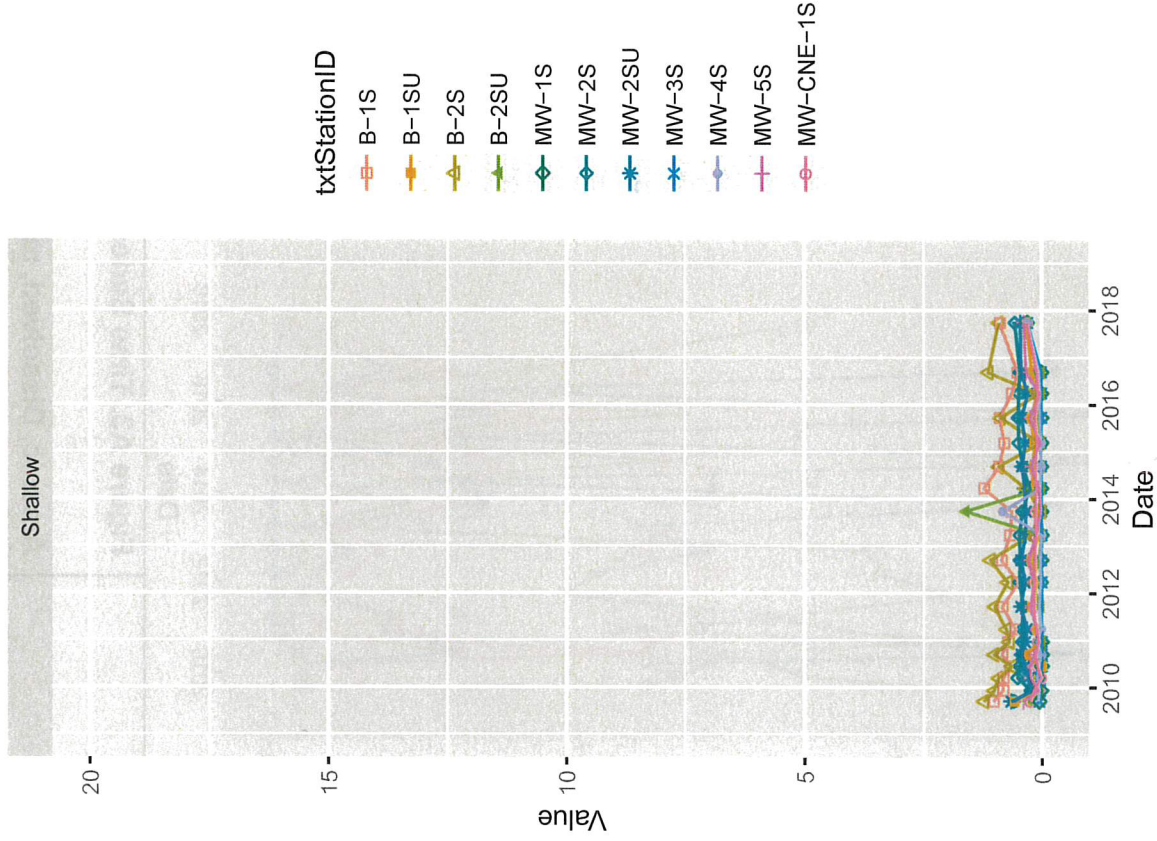
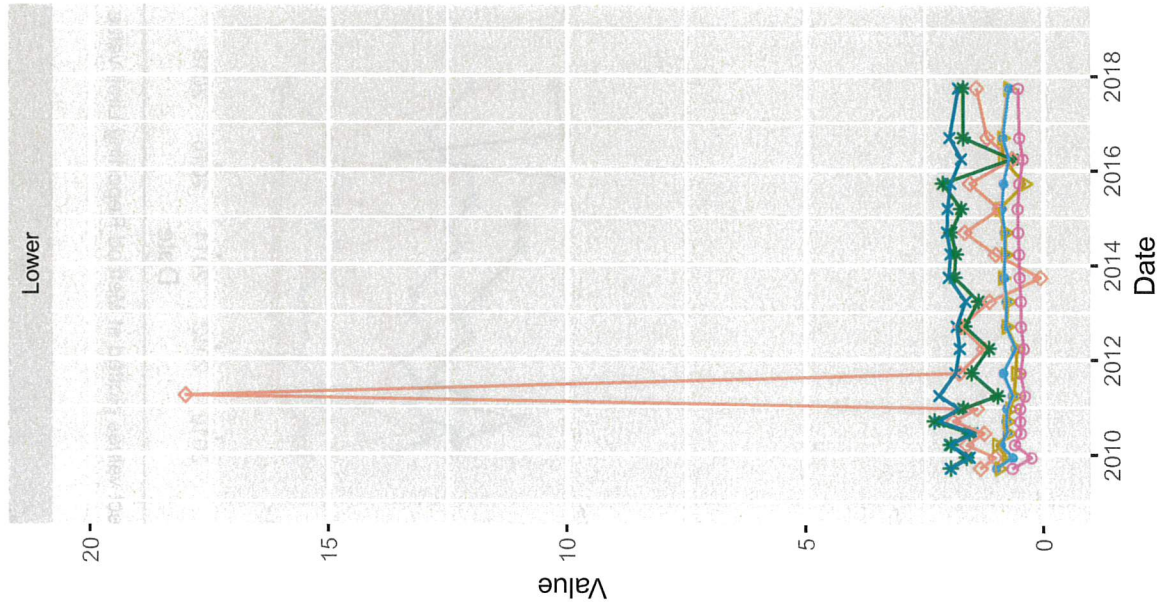


Figure 4

Lower Aquifer Groundwater Elevations 2017 Q3

Centralia Landfill
Compliance Monitoring

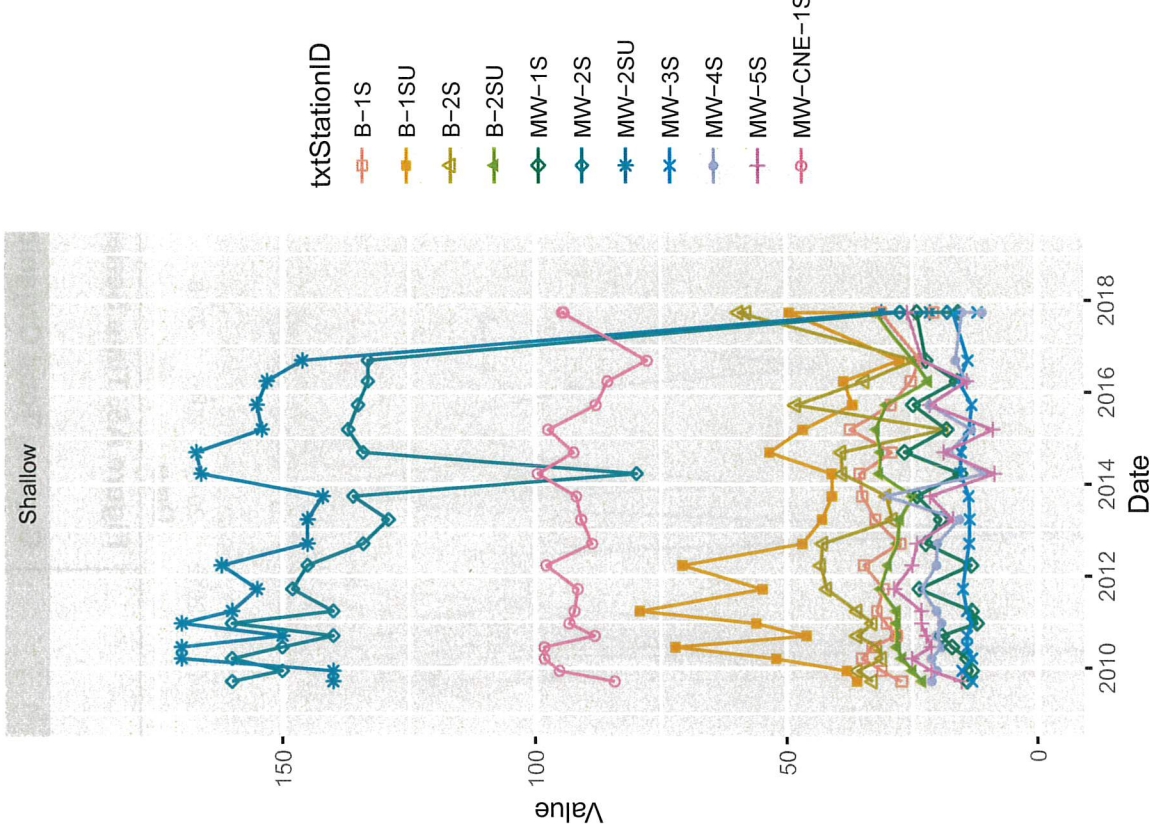
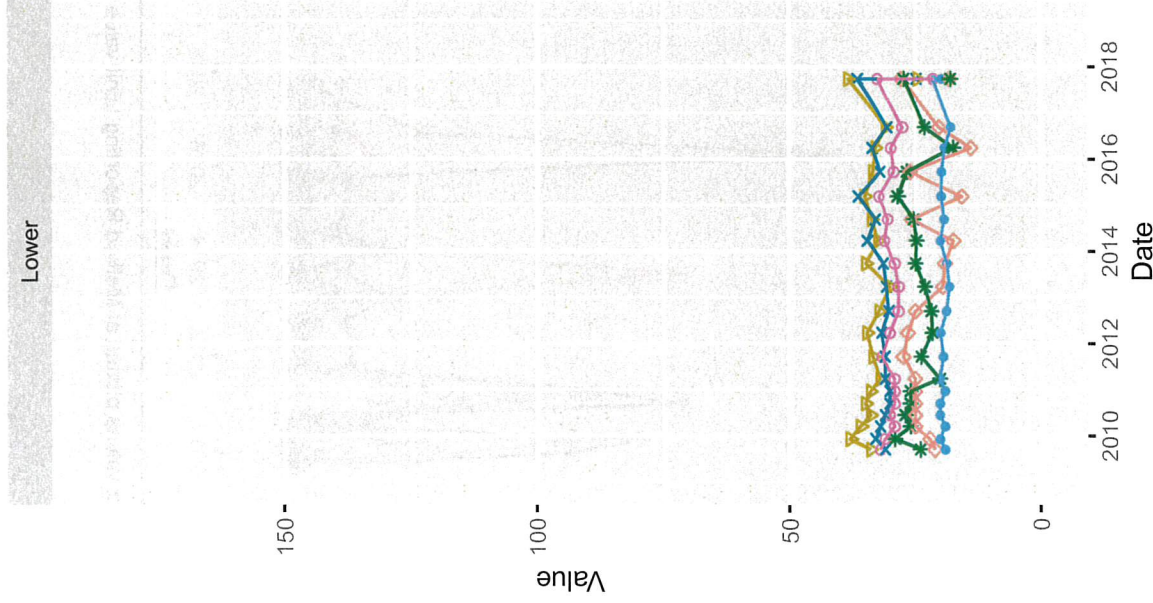
PGG



Non-detect values plotted at Method Reporting Limit value

Figure A2. Time Series

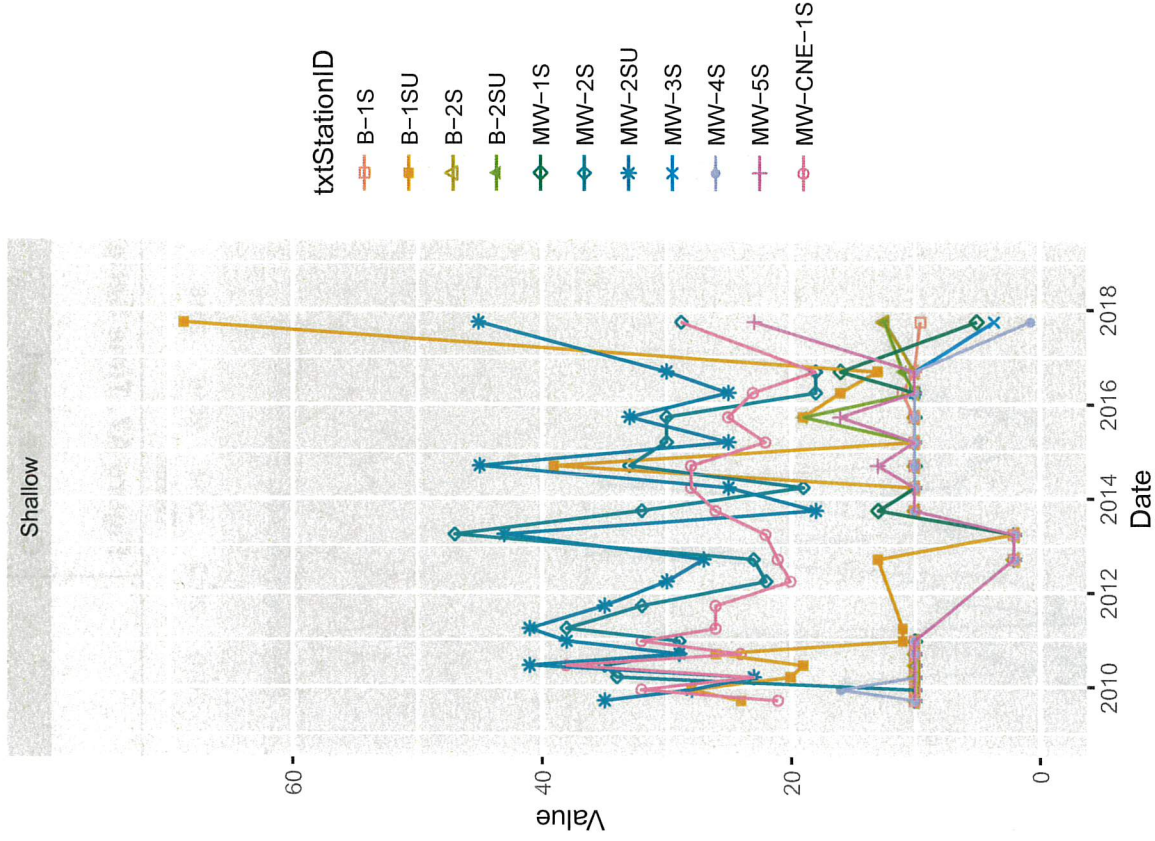
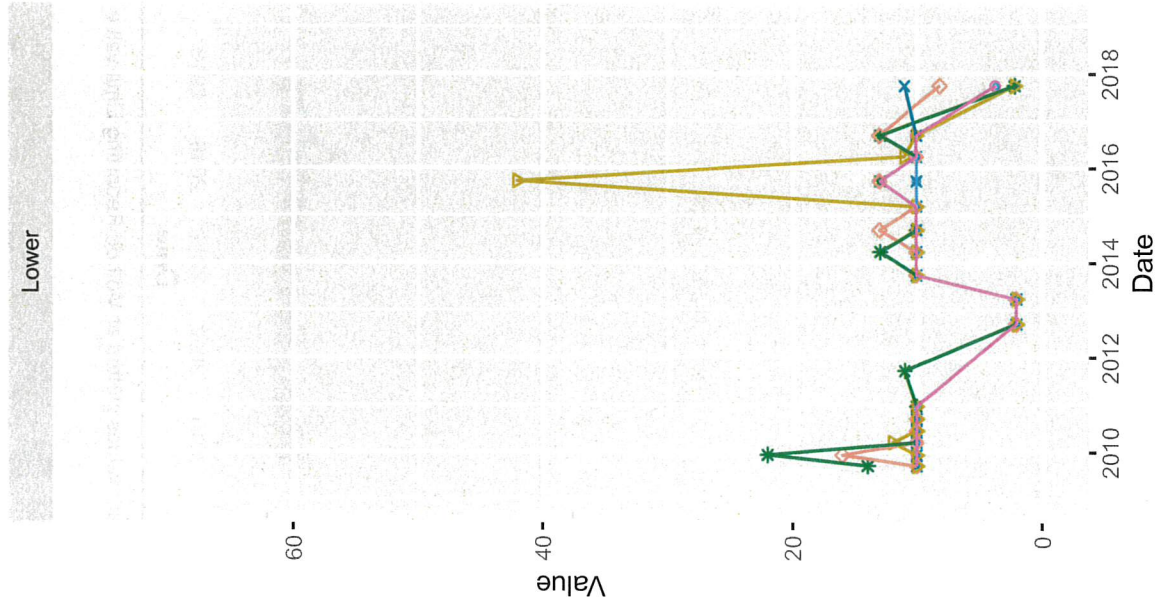
Ammonia as N, Total, mg/L as N



Non-detect values plotted at Method Reporting Limit value

Figure A4. Time Series

Calcium, mg/L

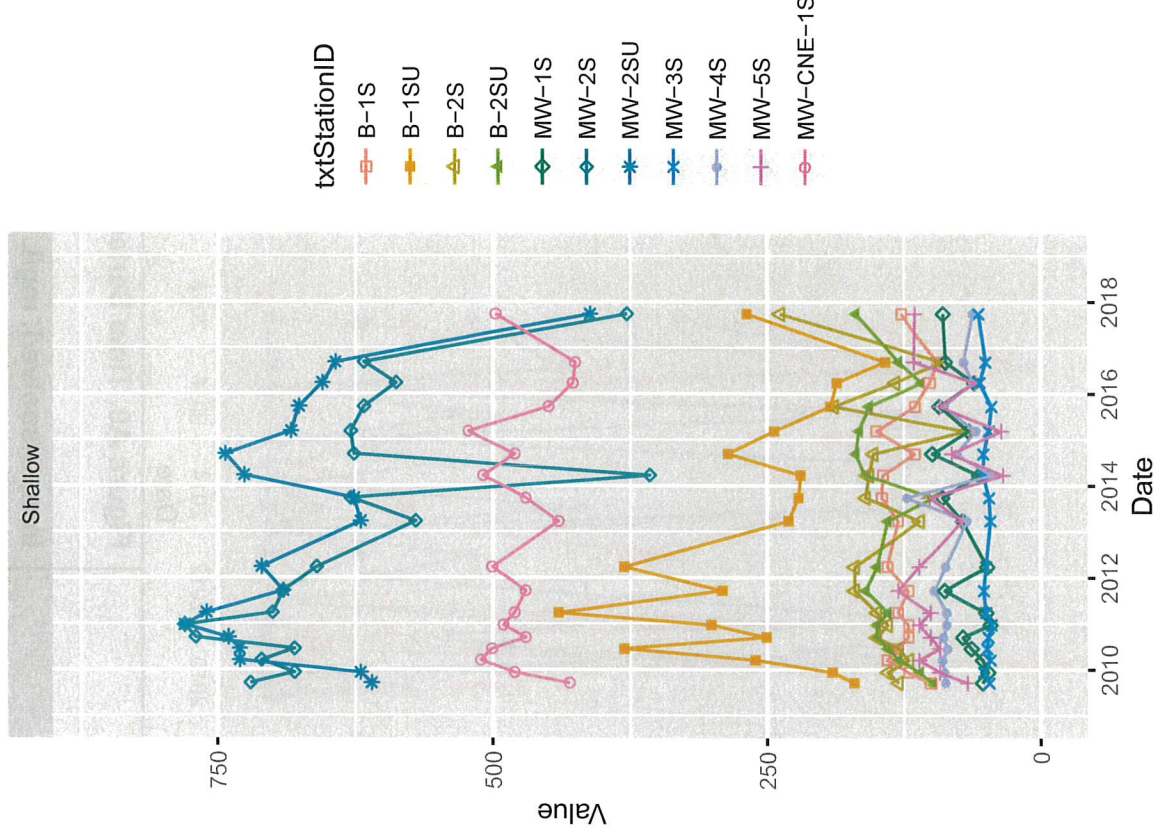
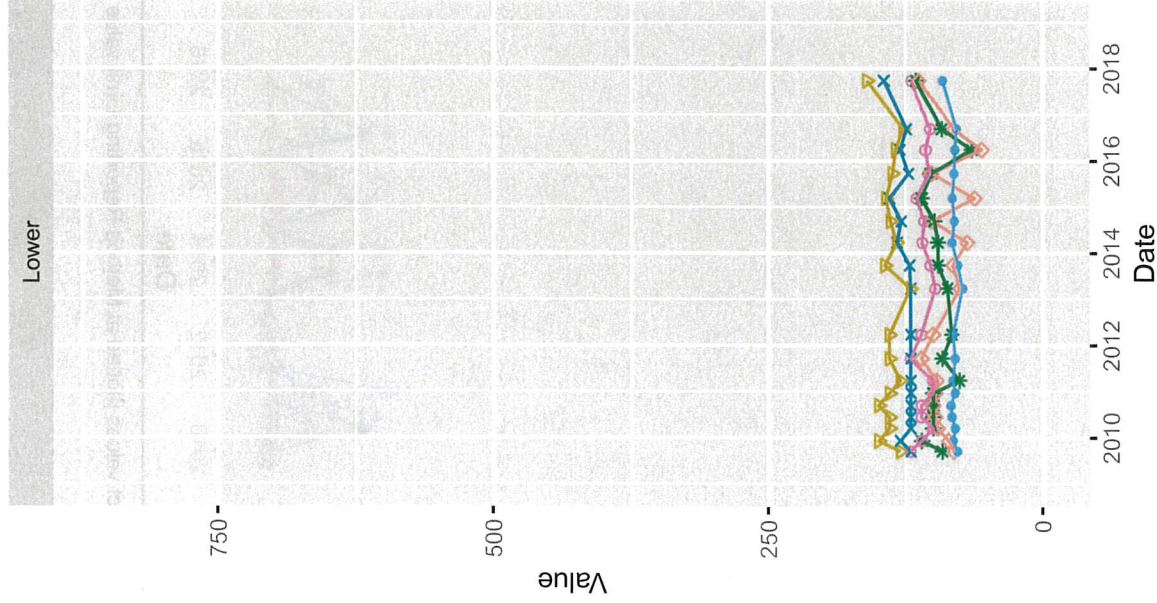


Non-detect values plotted at Method Reporting Limit value

Figure A6. Time Series

Chemical Oxygen Demand (COD), mg/L

pgg

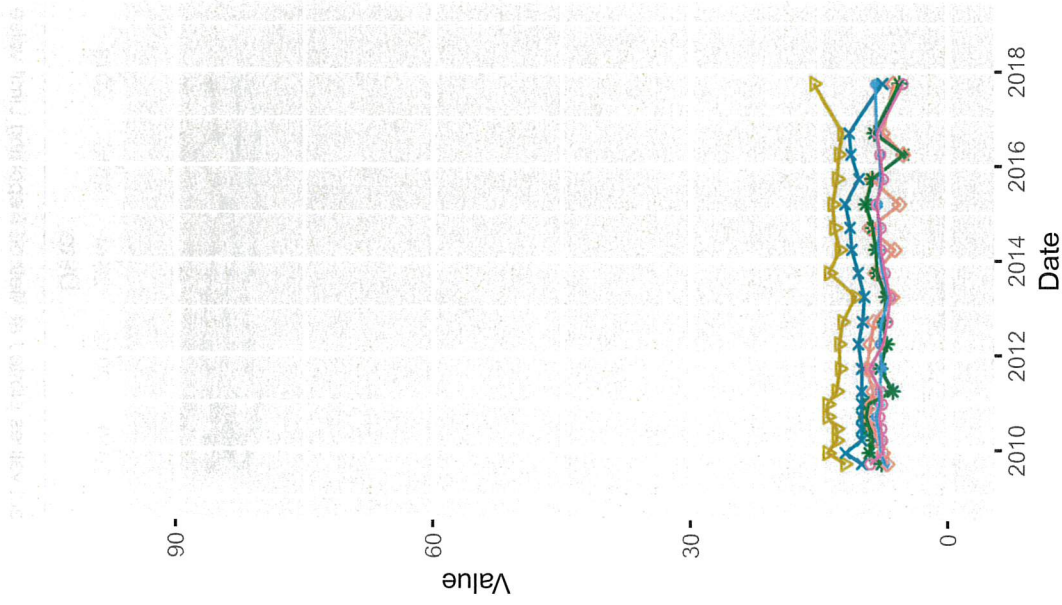


Non-detect values plotted at Method Reporting Limit value

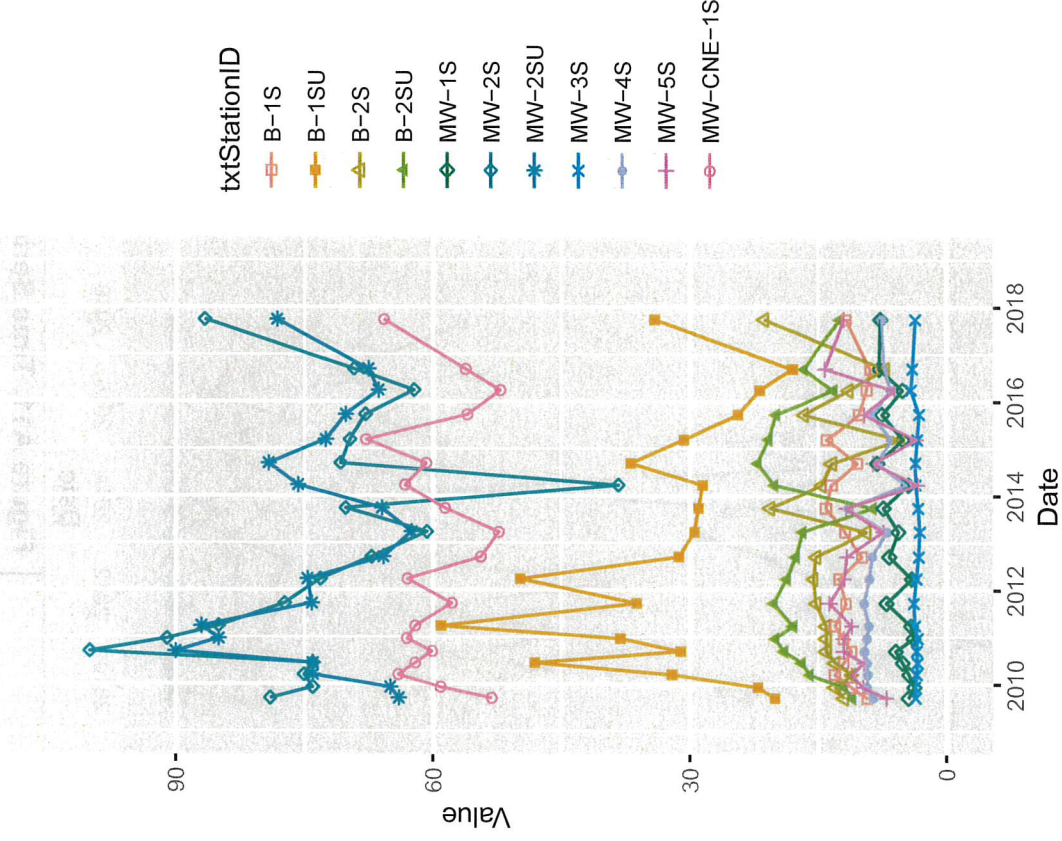
Figure A8. Time Series

Hardness, mg/L CaCO₃

Lower



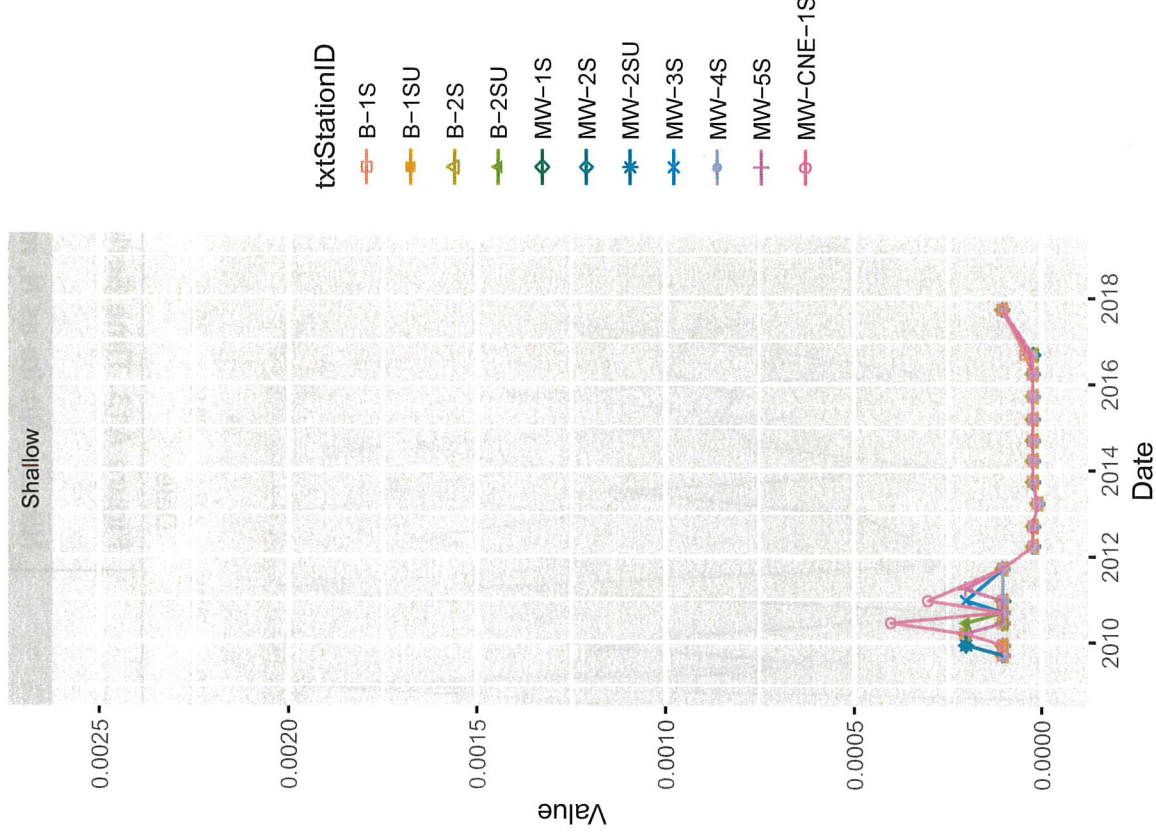
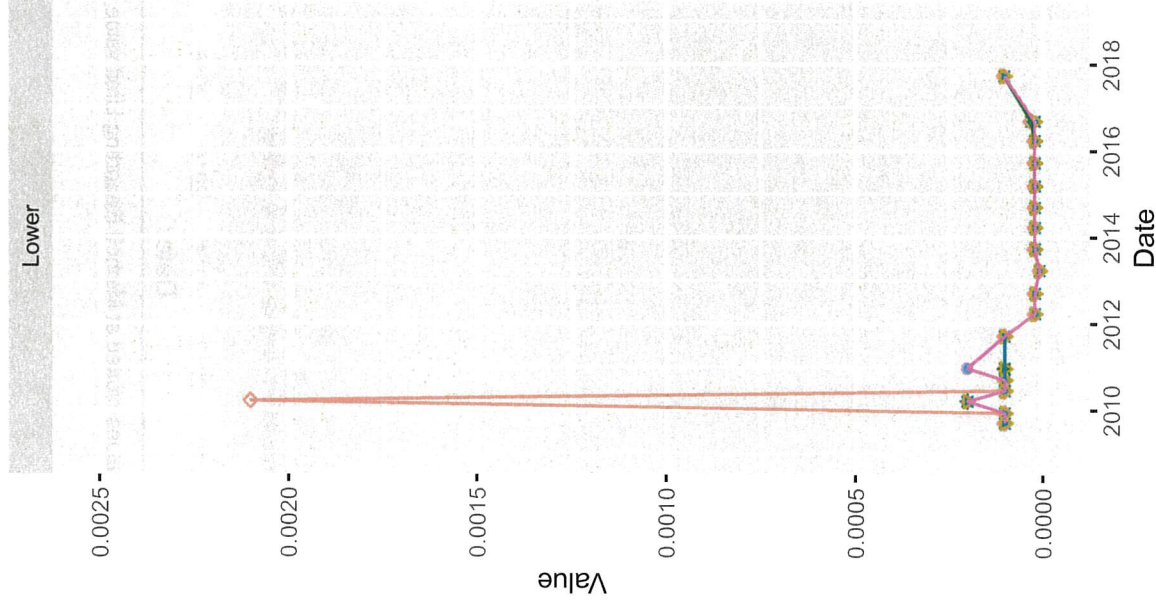
Shallow



Non-detect values plotted at Method Reporting Limit value

Figure A10. Time Series

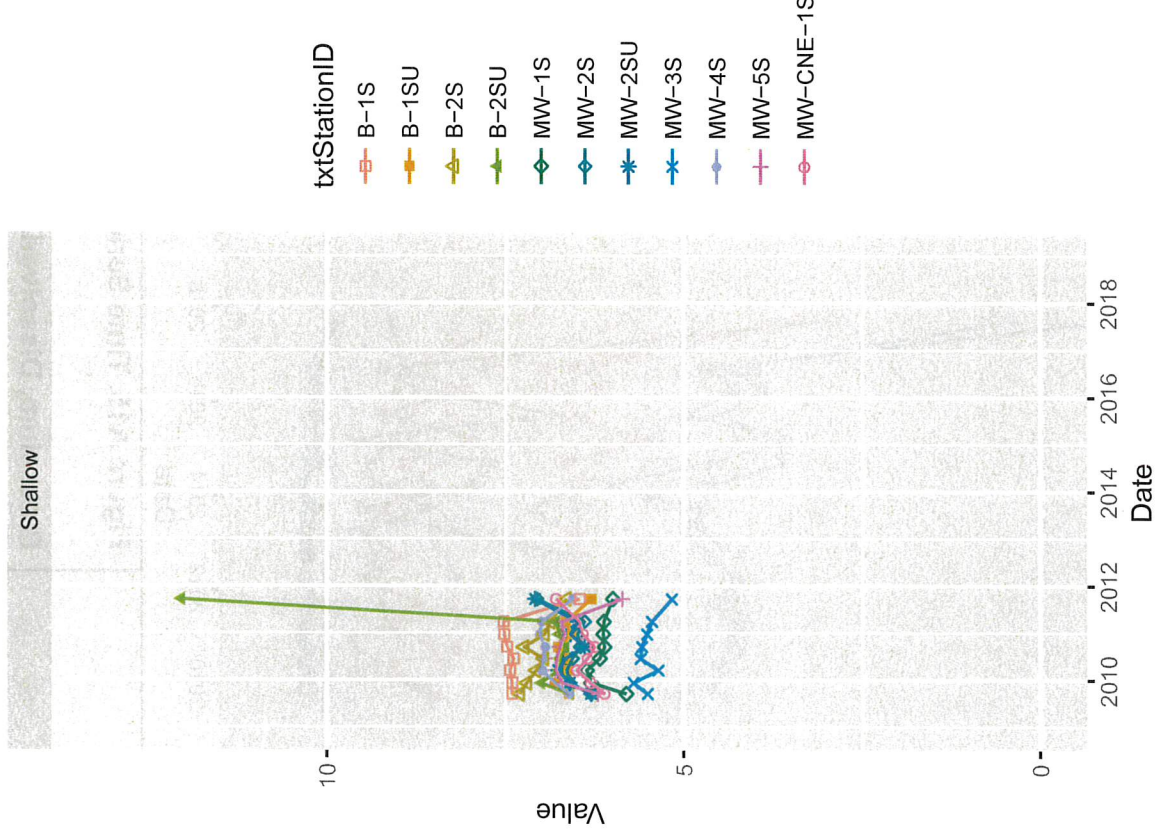
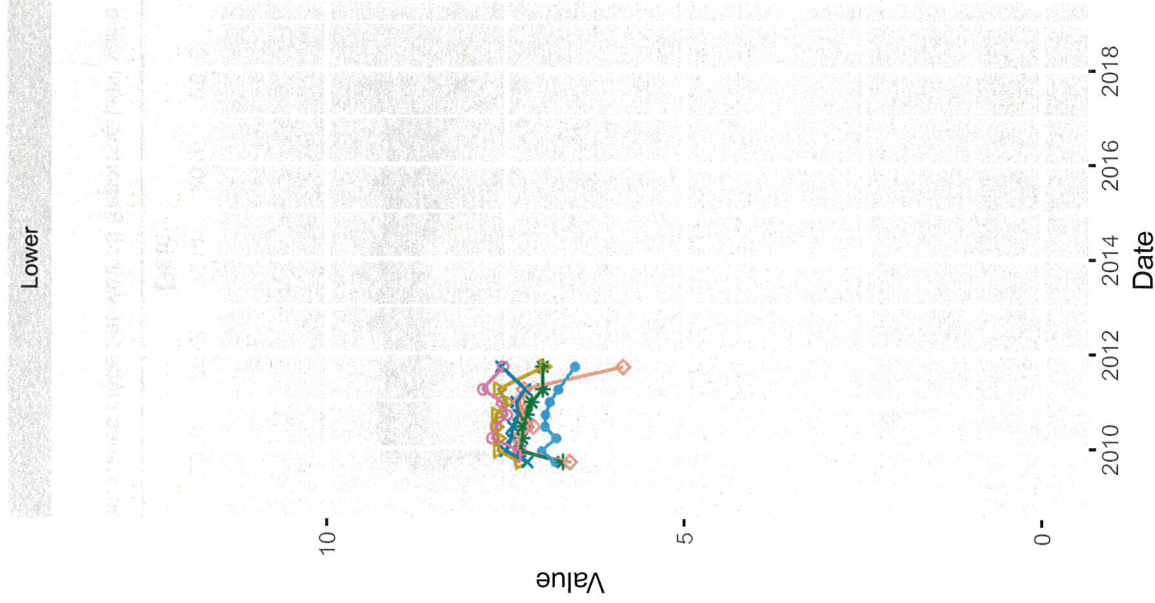
Magnesium, Dissolved, mg/L



Non-detect values plotted at Method Reporting Limit value

Figure A12. Time Series

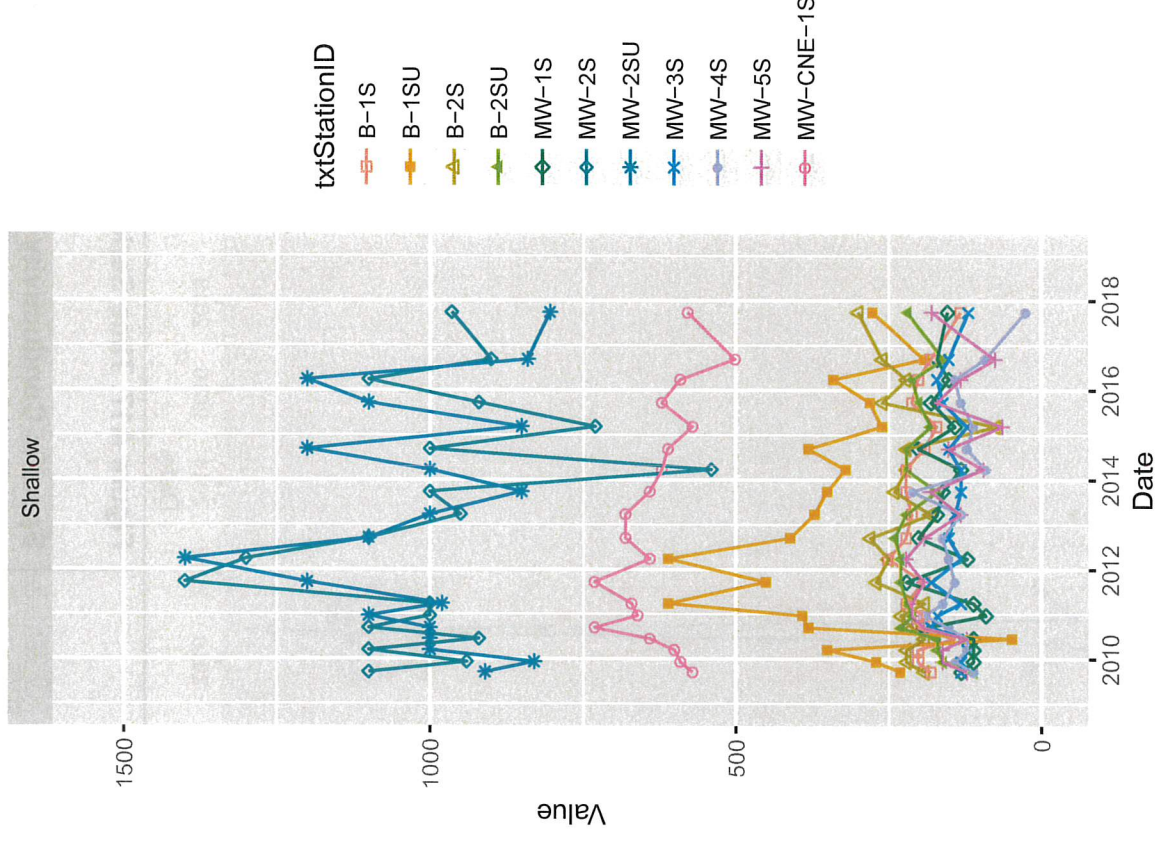
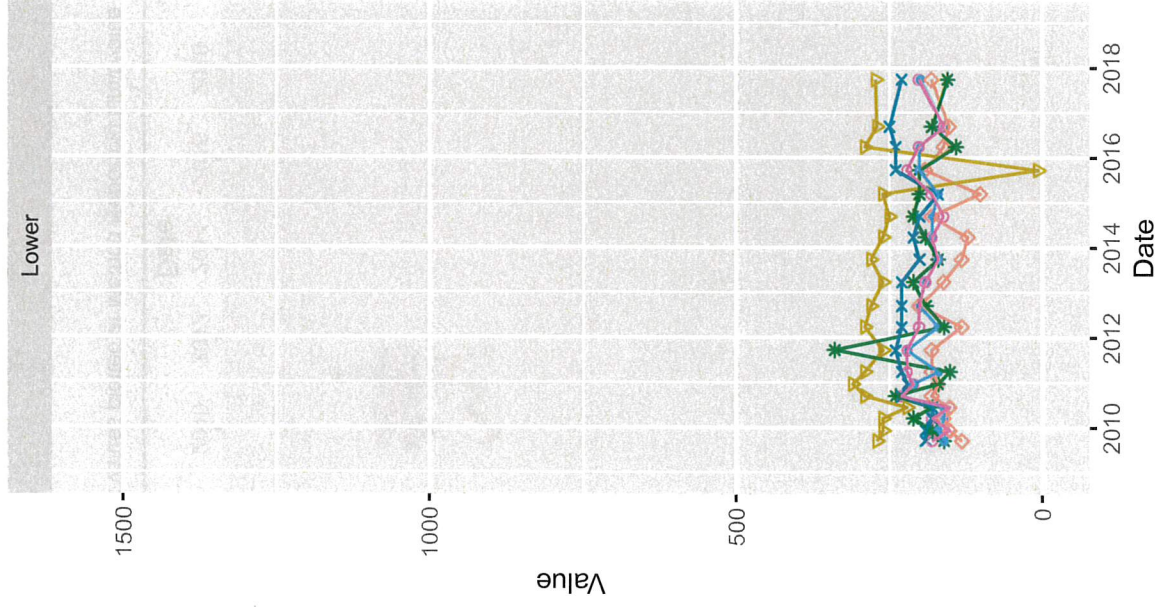
Mercury, Dissolved, mg/L



Non-detect values plotted at Method Reporting Limit value

Figure A14. Time Series

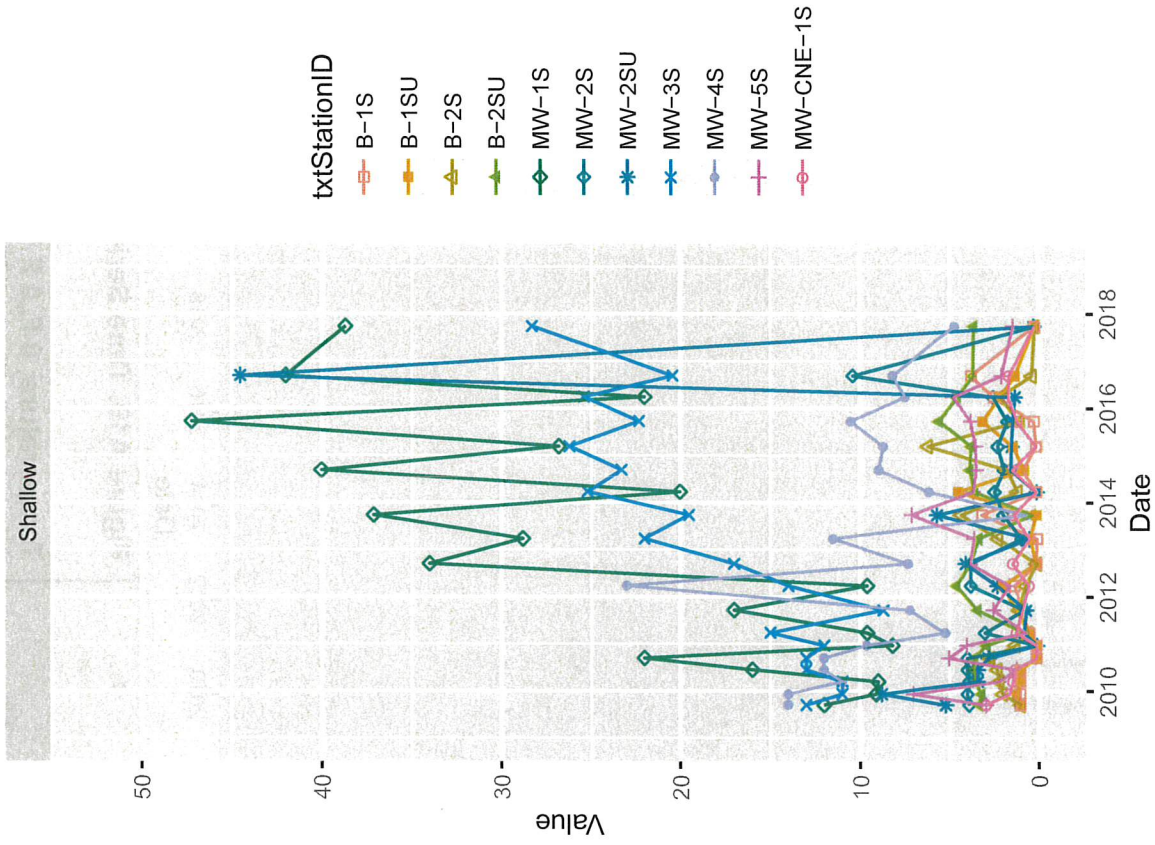
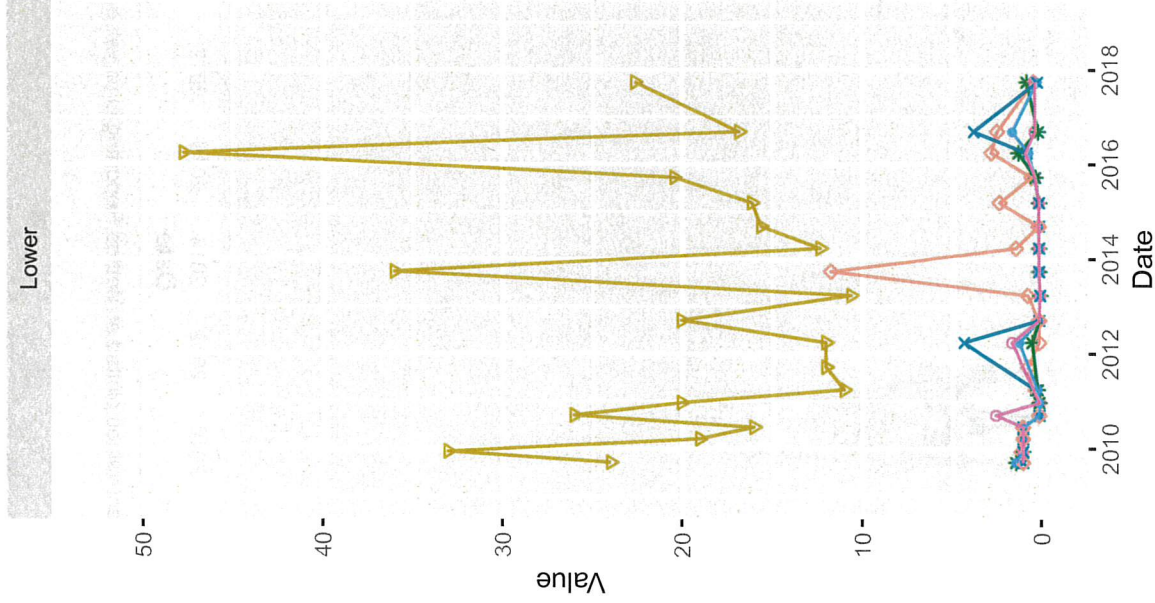
pH, Field, std. units



Non-detect values plotted at Method Reporting Limit value

Figure A16. Time Series

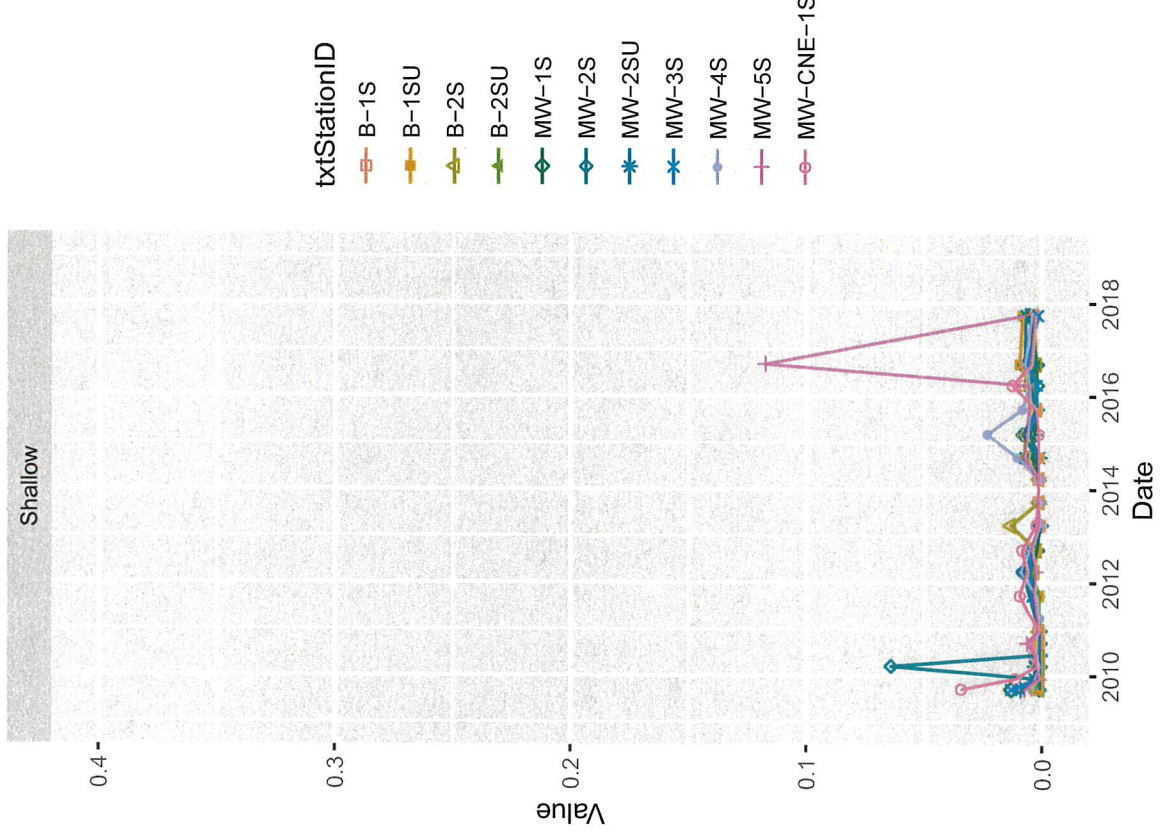
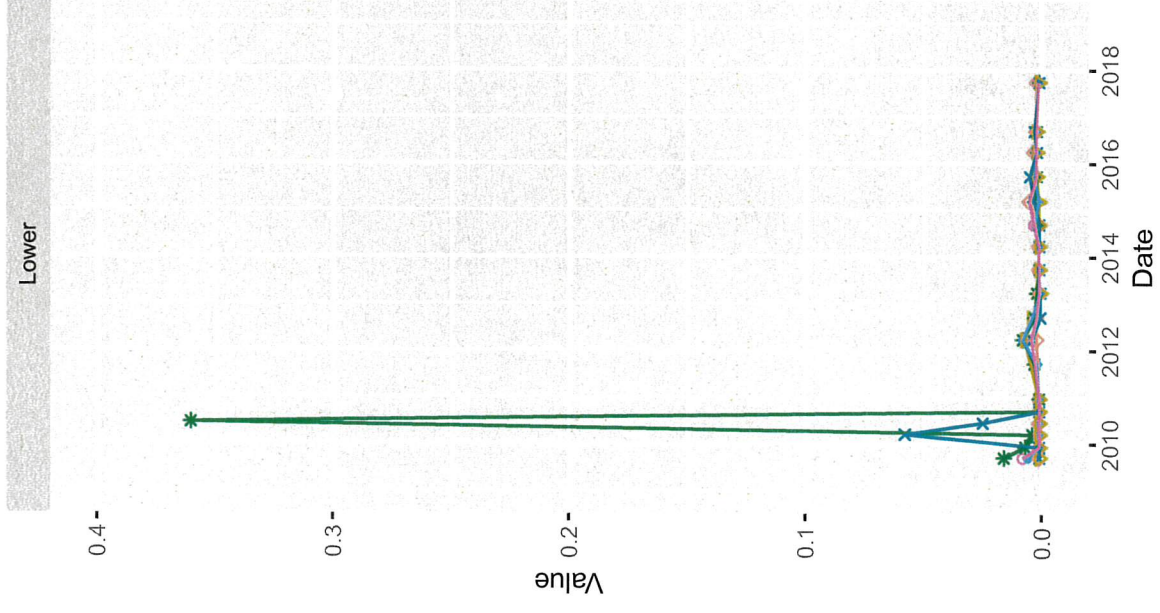
Solids, Total Dissolved, mg/L



Non-detect values plotted at Method Reporting Limit value

Figure A18. Time Series

Sulfate, mg/L



Non-detect values plotted at Method Reporting Limit value

Figure A20. Time Series

Zinc, Dissolved, mg/L

APPENDIX B

LANDFILL GAS MONITORING

The landfill gas collection system is composed of gas trenches, extraction well, and a collection manifold that carries the gas to a flare facility for destruction. Data is collected at regular intervals from the monitoring ports at the risers and wellheads, but is not included as part of this report. Gas monitoring probes located around the perimeter of the site provide feedback on the effectiveness of the gas collection system.

The Centralia Landfill Gas Probe Monitoring Program includes measurement of landfill gas below the surface of the landfill and at four probes located off the site. Landfill gas probes are tested quarterly unless flooding prohibits this. Some of the probes are underwater during flood events.

Fourteen perimeter probe wells were sampled. Magnehelic gauge and a portable gas, RKI Eagle 2 Multi-gas Monitor were used to test pressure and combustible gas by volume. Magnehelic was zeroed prior to use. The Eagle 2 was calibrated prior to each use. All calibration data is stored in the Eagle 2 electronic data base.

Measurements were collected by attaching a flexible hose to the hose-barb which is attached to the top of each probe well head. Percent LEL measurements were recorded after waiting at least one minute to allow for gas equilibration.

Perimeter gas probe data for this report were collected in 2017 quarter Three.

(Should only take
about an hour)

	Well Number	Time	Barometric Pressure	Probe Pressure inch	% LEL	% Oxygen	
09/12/2017	GP2	1358		30.2	0	0	20.9
09/12/2017	GP1	1342		30.2	0	0	20.9
09/12/2017	GP4A	1320		30.2	0	10	20.9
09/12/2017	GP4B	1305		30.2	0	0	20.9
09/12/2017	GP15	900		30.2	0	0	20.9
09/12/2017	GP11	912		30.2	0	0	20.9
09/12/2017	GP10	920		30.2	0	0	20.9
09/12/2017	GP12	928		30.2	0	0	20.9
09/12/2017	GP9	935		30.2	0	0	20.9
09/12/2017	GP13	940		30.2	0	0	20.9
09/12/2017	GP8	950		30.2	0	0	20.9
09/12/2017	GP7	957		30.2	0	0	20.9
09/12/2017	GP14	1008		30.2	0	0	20.9
09/12/2017	GP5R	1020		30.2	0	0	20.9

	Well Number	Time	Barometric Pressure	Probe Pressure inch	% LEL	% Oxygen	
12/07/2017	GP2	1335		30.49	0	0	20.9
12/07/2013	GP1	1338		30.49	0	0	20.9
12/07/2017	GP4A	FLOODED					
12/07/2017	GP4B	FLOODED					
12/07/2017	GP15	1340		30.49	0	0	20.9
12/07/2017	GP11	1440		30.49	0	0	20.9
12/07/2017	GP10	1435		30.49	0	0	20.9
12/07/2017	GP12	1414		30.49	0	0	20.9
12/07/2017	GP9	1403		30.49	0	0	20.9
12/07/2017	GP13	1408		30.49	0	0	20.9
12/07/2017	GP8	1427		30.49	0	0	20.9
12/07/2017	GP7	1419		30.49	0	0	20.9
12/07/2017	GP14	1357		30.49	0	0	20.9
12/07/2017	GP5R	1353		30.49	0	0	20.9