

Puyallup River Tributaries Effectiveness Monitoring

Quarterly Report: July – September, 2023 (Year 5)



Abstract

Starting July of 2023, The Department of Ecology initiated the second intensive year of sampling for the 10-Year Puyallup River Tributaries Effectiveness Monitoring project. This report summarizes bacteria, nutrients, and conventional water quality parameter results from the first quarter (July through September, 2023) of Year 5. Sampling only occurred on the Boise Creek stations during this period, due to Pussyfoot and Second creeks being seasonally dry. The first, fifth and tenth years of this project include a greater frequency and spatial resolution of data collection; these years are referred to as Implementation years. During the years between Implementation years, referred to as Status and Trends monitoring years, only one downstream site on each of the three tributaries (Boise Creek, Second Creek and Pussyfoot Creek) is routinely monitored, with one additional upstream site on Boise Creek. During the Implementation monitoring, there are nine sites on Boise Creek, eight sites on Second Creek, and ten sites on Pussyfoot Creek. This increase in spatial resolution allows project partners to identify portions within each watershed where data may suggest pollution sources are entering the stream. More details concerning site locations, sample frequency, methods, etc. are described in the study's [Quality Assurance Project Plan](#)¹ (Brownlee 2019).

Report Summary

- Ecology collected samples and measurements twice per month at the nine established Boise Creek sites, except for Boise_I6 in August due to construction. Two additional sites on the Enumclaw Golf Course were sampled routinely as well. The remaining 18 sites on Second and Pussyfoot Creeks were dry for each visit during this period.
- Boise Creek sites Boise_G1, Boise_G2 and Boise_I5 were the only sites to meet water quality criteria for E. coli.
- Large increase of turbidity following the completion of the Boise Creek restoration project on the Enumclaw golf course.
- All sites failed to meet the criteria for dissolved oxygen on at least one occasion.

¹ <https://apps.ecology.wa.gov/publications/SummaryPages/1910040.html>

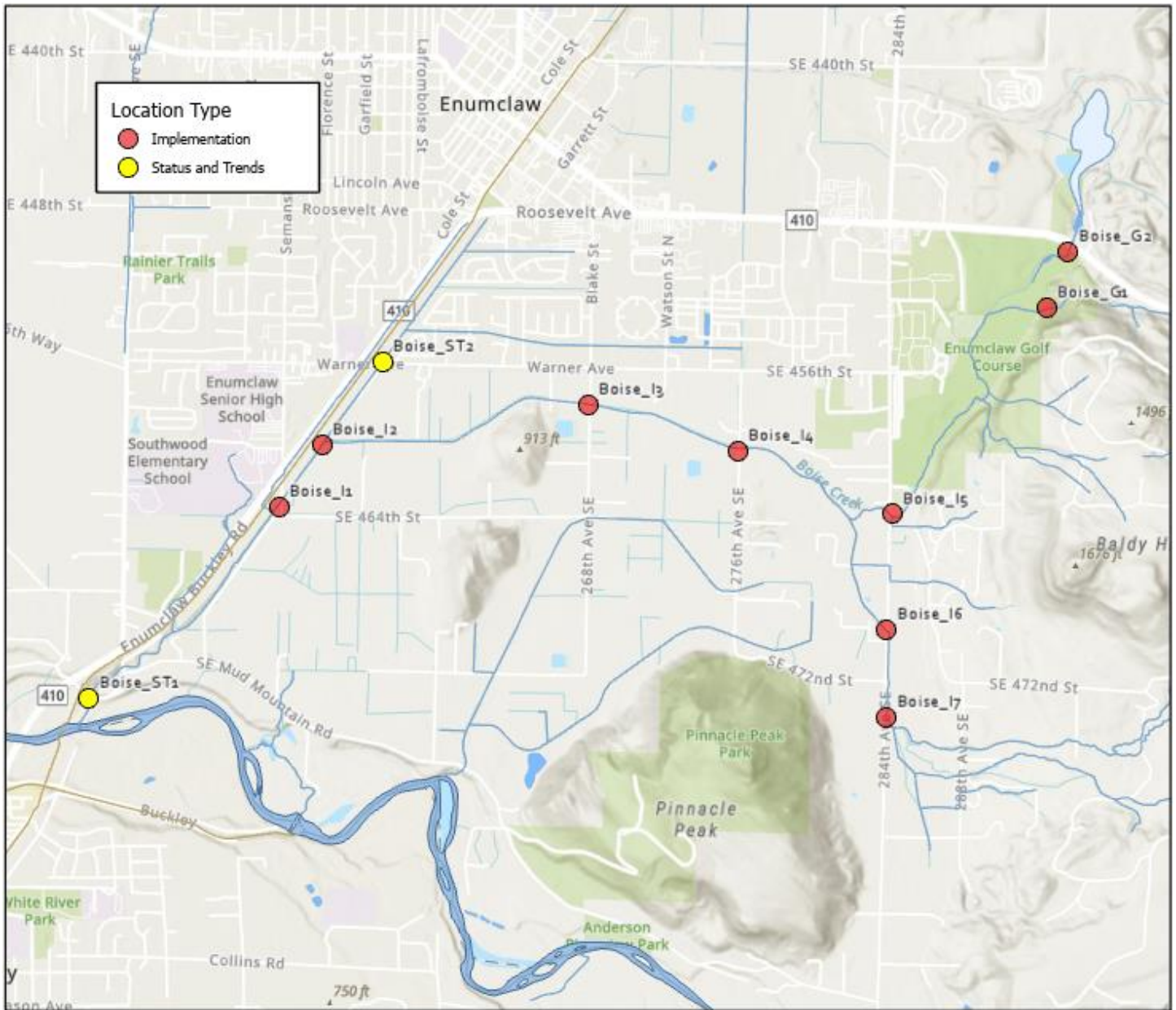


Figure 1. Boise Creek sampling sites during the first quarter of Year 5.

Precipitation and Flow

Based on preliminary data from the Boise Creek USGS stream gage, the period from July 1 through September 30, 2023 had significantly lower-than-average flows compared to a typical year. There was, however, significant precipitation in the second half of September (Table 1 and Figure 2).

Table 1. Total precipitation and average discharge at Boise Creek at Mud Mountain Road Station.

Month	Total Precipitation (inches)	Average Discharge, CFS (average for all years)
July	0.67	4.98 (13.0)
August	0.9	3.32 (8.3)
September	3.84	3.56 (8.8)

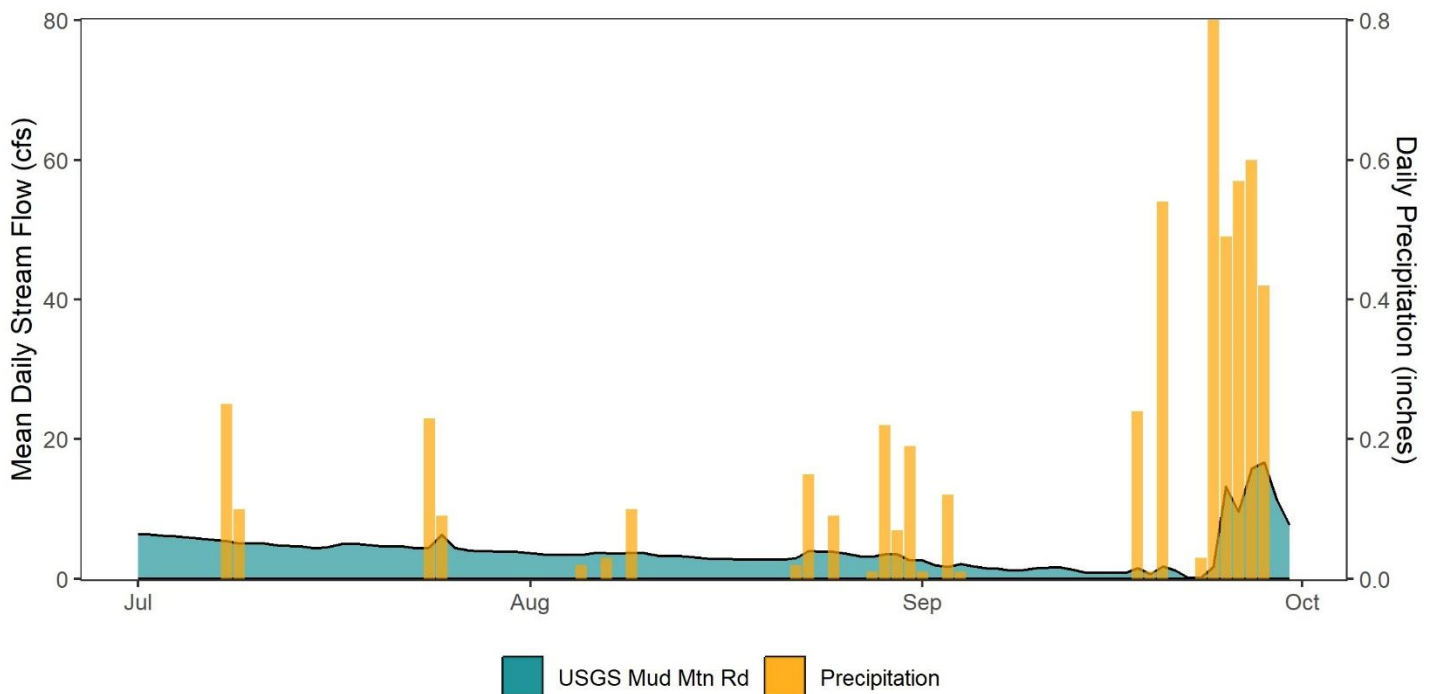


Figure 2. Mean daily stream flow (preliminary data from [USGS site 12099600](https://waterdata.usgs.gov/wa/nwis/uv/?site_no=12099600)²) and daily precipitation (data from [King County site 44u](https://green2.kingcounty.gov/hydrology/DataDownload.aspx)³) at Boise Creek at Mud Mountain Road station from July 1 – September 30, 2023.

Bacteria

Bacteria standards state 1) the geometric mean for *E. coli* must not exceed 100 cfu/100mL and 2) no more than 10 percent of all samples (or any single sample when less than ten sample points in an averaging period exist) should exceed 320 cfu/100mL. Figure 4 shows box plots for each site during this period.

The [Puyallup River Watershed Fecal Coliform TMDL](#) (Mathieu and James, 2011) sets more protective targets, based on the rollback method outlined in Appendix G of that document, using the fecal coliform indicator for the downstream Status and Trends sites on Boise and Pussyfoot creeks. During Quarter 1 of Year 5 none of the sites fully met these targets, and the following narrative will focus on the state water quality standards using *E. coli* mentioned above.

² https://waterdata.usgs.gov/wa/nwis/uv/?site_no=12099600&PARAMeter_cd=00060,00065

³ <https://green2.kingcounty.gov/hydrology/DataDownload.aspx>

During the first quarter of Year 5 the only sites to meet both components of the water quality criteria for *E. coli* were Boise_I5 (Boise Creek at 284th Ave), and the two sites located on the Enumclaw Golf Course, Boise_G1 and Boise_G2. All three of these stations are located upstream of most developed areas in the Enumclaw plateau (Figure 1), especially the two on the golf course. Boise_I6 (Beaver Creek at 284th Ave) did meet the criteria for 90th percentile, but failed to meet the geometric mean component of the criteria.

Boise_I7 (Beaver Creek at 284th Ave, upstream of Boise_I6) had elevated levels of bacteria during this period. During this period flows at the mouth of this tributary were low, averaging 0.32 CFS over the duration (King County, 2023). Ecology staff shared information with King County stormwater staff and collected investigative samples in the following period (October through December, 2023). King County also collected investigative samples. King County had been aware of this site in previous years and was unable to identify a likely source at that time.

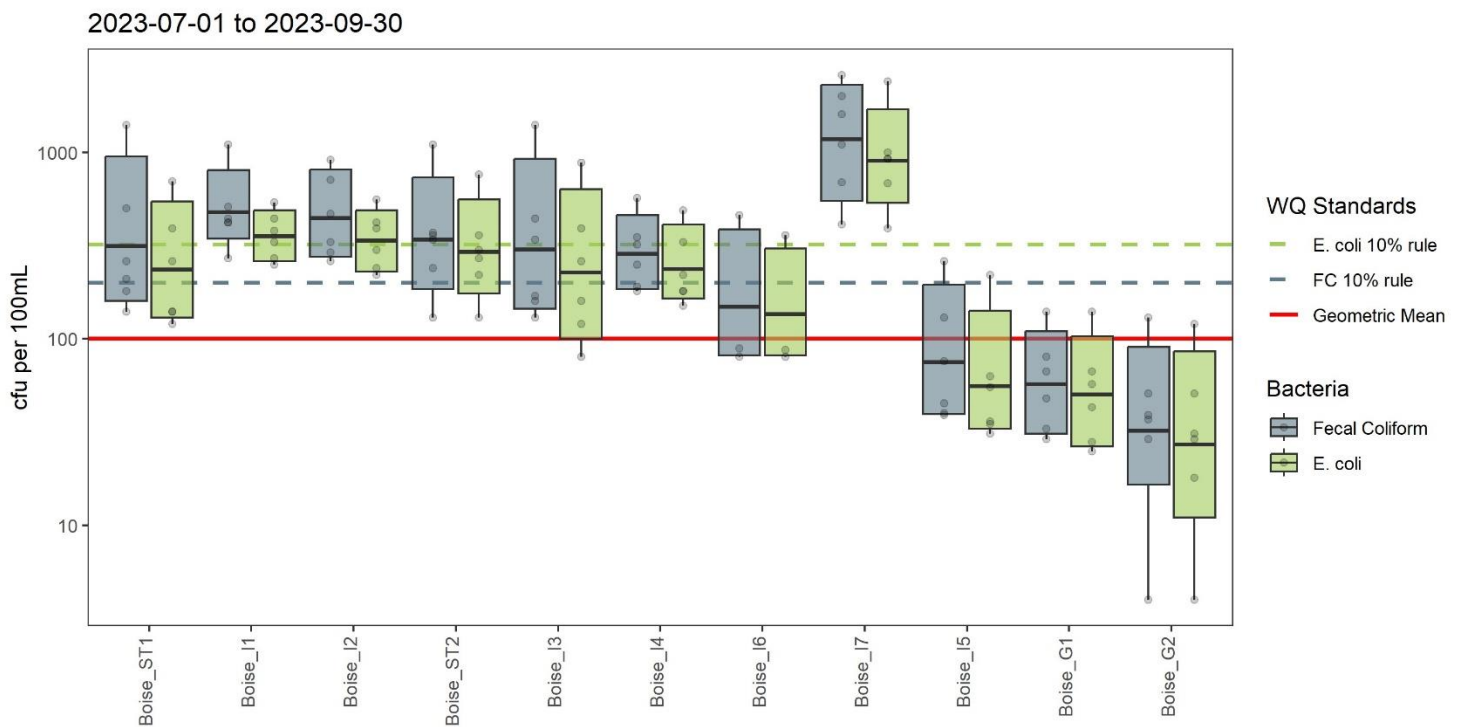


Figure 3. Bacteria levels from July through September of 2023 with geometric mean (black solid line in boxplot) and 90th percentile (top of colored boxes). Water quality standards displayed as horizontal lines. Sites are ordered from downstream to upstream, left to right.

Nutrients

Nutrient data was only collected at the two Status and Trends locations in the Boise Creek watershed. One station is near the mouth of the stream (Boise_ST1) and the other is near the downstream end of a stormwater conveyance ditch within the City of Enumclaw (Boise_ST2). Orthophosphate concentrations had a higher median value in Boise_ST2, but had considerably higher maximum values in the mainstem at Boise_ST1, while ammonia and nitrate-nitrite values tended to be lower in Boise_ST2 than in Boise_ST1 (Figures 5-7).

The [Lower White River pH TMDL](#) contains allocations for Soluble Reactive Phosphorous (SRP), with some language specifying load and wasteload allocations (LA and WLA) on Boise Creek. Using USGS stream discharge data for Boise Creek (station 12099600) and orthophosphate (OP) data from this period (OP is the primary constituent of SRP), Figure 4 shows approximate loading rates of OP near the mouth of Boise Creek. Figure 4 also shows the sum of the applicable WLA and LA based on seasonality and flow in the White River. During the sampling event in September, which occurred during the first major runoff event of the season, the estimated OP load greatly exceeded the allocation. Please note that the WLA, which is set to point source effluent (Enumclaw WWTP and MS4) cannot be accurately assessed from a downstream site such as Boise_ST1; Figure 4 is an approximation and is not considered a precise assessment of whether or not the applicable WLA is being met.

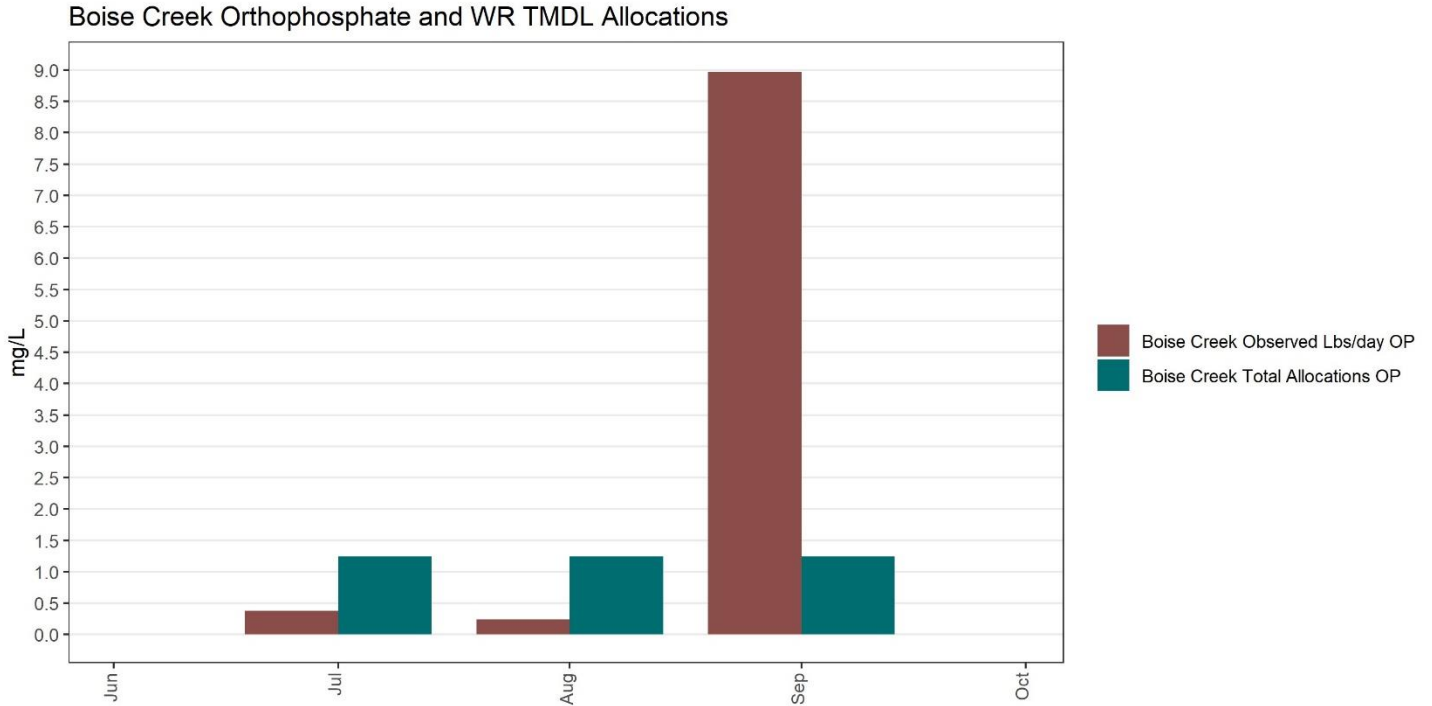


Figure 4. Orthophosphate loading at Boise Creek during Year 4 compared to approximate White River TMDL load allocations for Boise Creek (Gray and Mathieu, 2022).

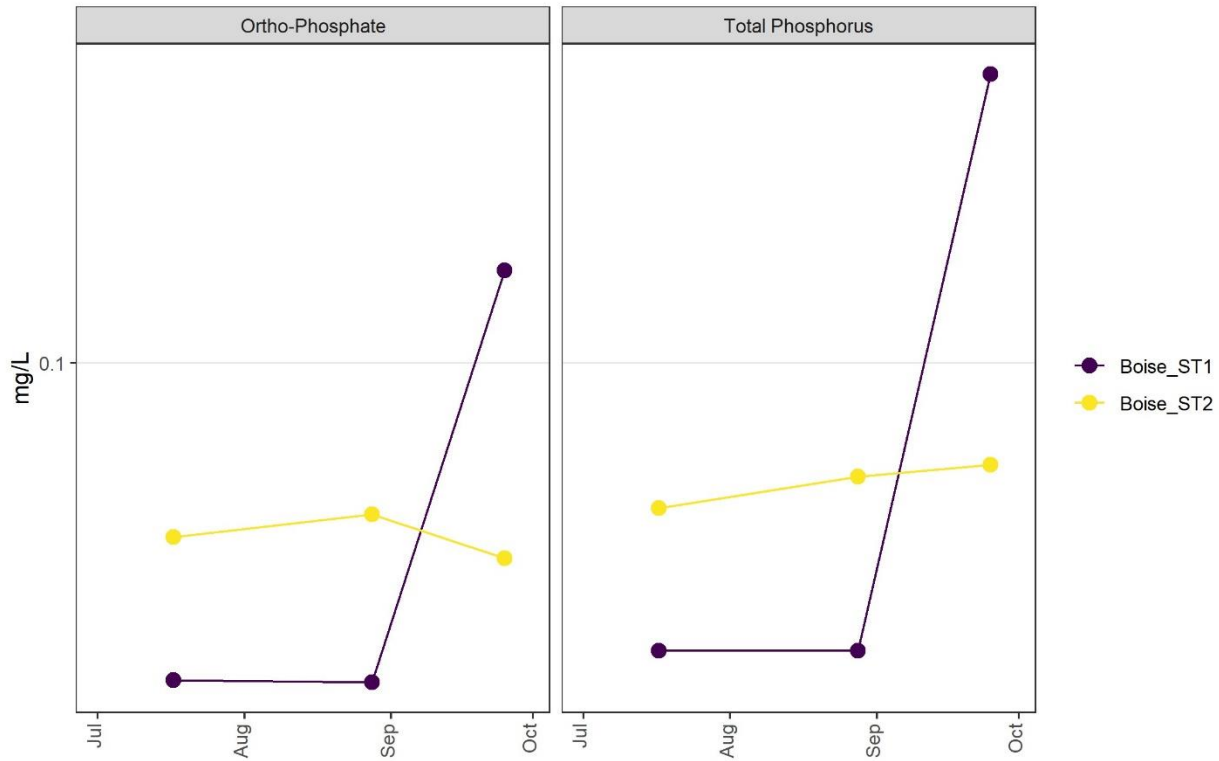


Figure 5. Concentration of monitored phosphorous species over time during the first quarter of Year 5.

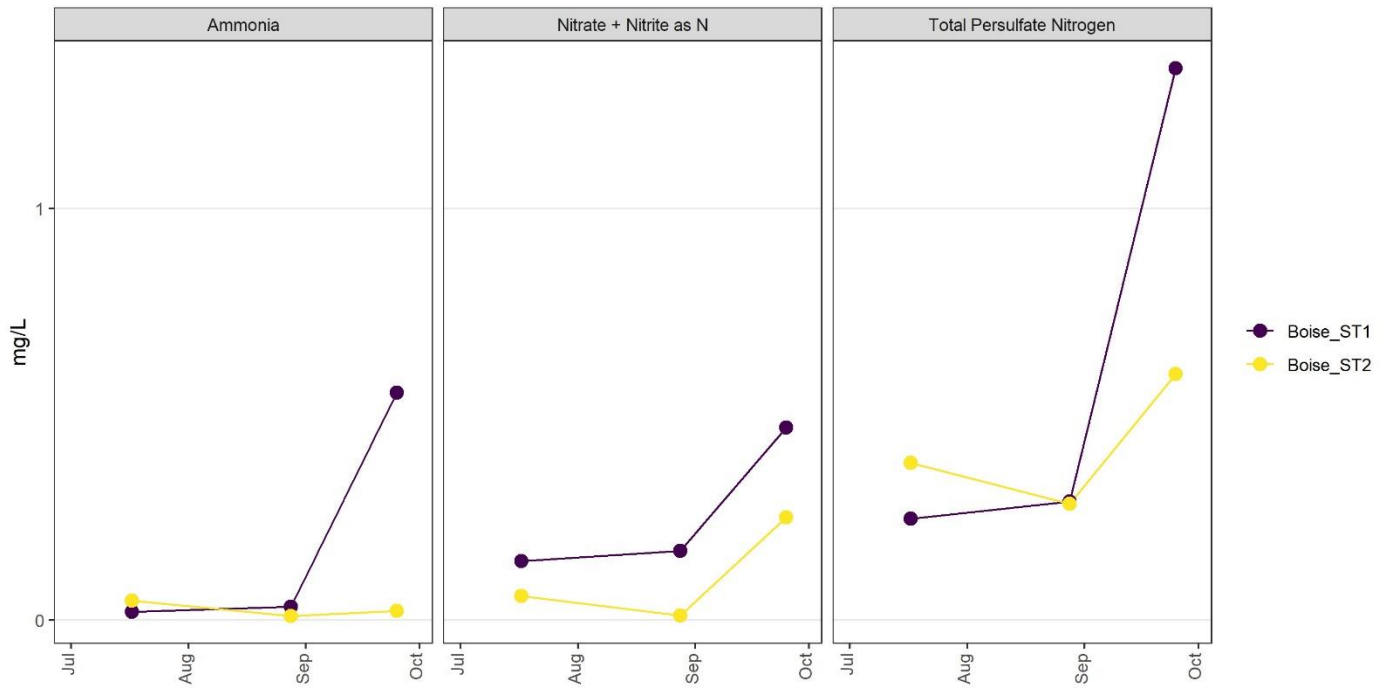


Figure 6. Concentration of monitored nitrogen species over time during the first quarter of Year 5.

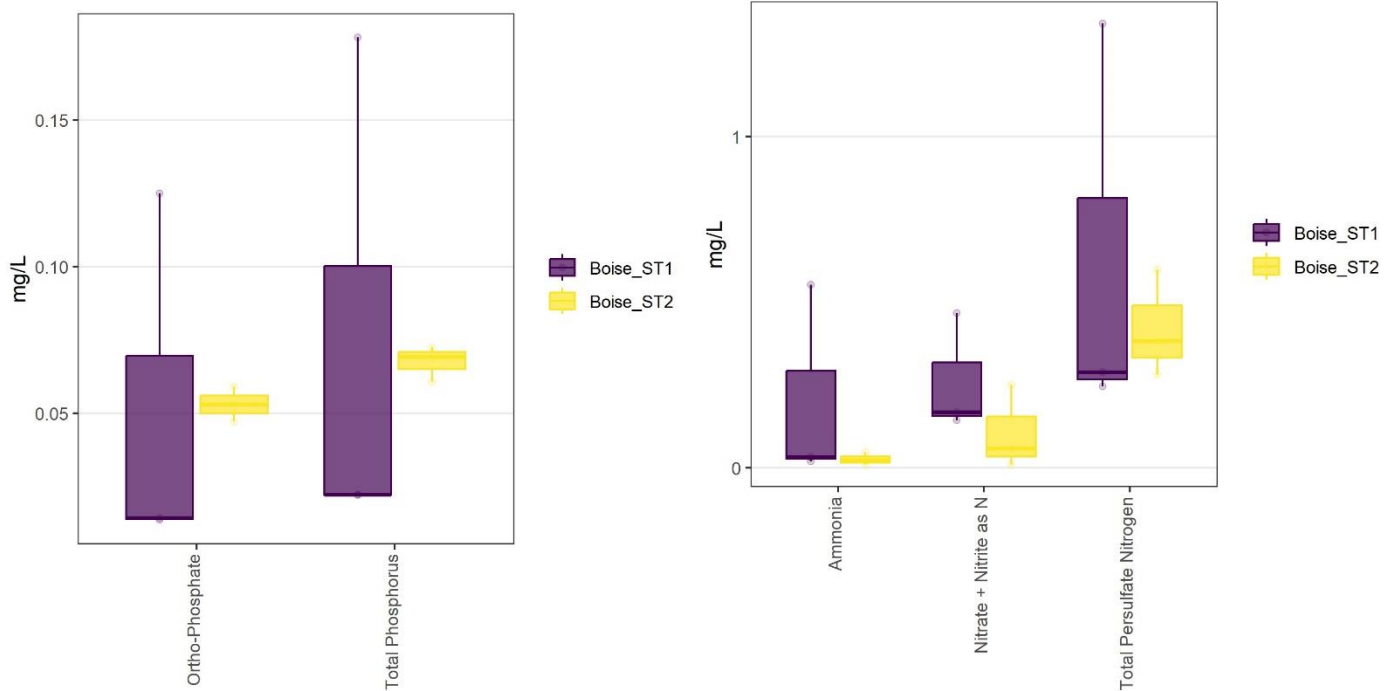


Figure 7. Box plots of phosphorous and nitrogen concentration with the median value represented as a solid line in the boxplot.

Water Quality Measurements

Turbidity

Turbidity levels were observed in the range of zero to 23.2 NTU. Significant increases in Turbidity were observed in September following the completion of the Boise Creek restoration project on the golf course. Background levels just upstream of the restoration site had a median value of 1.5 NTU following the restoration project, while values at Boise_I5, less than half a river mile downstream of the golf course, had a median value of 19.93 NTU following the restoration (23.2 NTU on 9/14/2023). Water quality criteria for turbidity states that values shall not exceed 5 NTU over background, which is represented by the upstream location on the golf course in this case. Figure 8 shows a trend of turbidity decreasing as you move downstream of Boise_I5 (Boise_I6, Boise_I7, and Boise_ST2 are tributaries unaffected by the restoration work).

Dissolved Oxygen

Every site monitored during this period had at least one exceedance below the dissolved oxygen criteria of 10 mg/L. Boise_G1 only had one such instance, with a value of 9.75. All other sites had multiple instances below the water quality criteria. Boise_ST2 and both sites on Beaver Creek (Boise_I6 and Boise_I7) never met the water quality criteria during this period. Figure 8 shows a slight decreasing trend of DO starting at Boise_I5 going downstream.

Temperature, Specific Conductivity, and pH

Continuous temperature data, which was not collected during this period, is needed to properly compare with the temperature criteria. This section will compare discrete measurement data to the 7-day average daily maximum (7DADMax), though this is not a suitable method for evaluating a waterbody against the water

quality criteria for temperature. Discrete temperature measurements exceeded the supplemental spawning criteria for temperature on all Boise Creek sites (13°C 7DADMax, Sept 1-July 1), with the exception of Boise_G1. All sites had at least one discrete measurement exceed the 16° C 7DADMax which covers July 2 – August 31.

All pH measurements met water quality criteria (6.5 to 8.5 pH units).

The stormwater ditch (Boise_ST2) and Boise_G2 had consistently elevated specific conductivity values. Boise_G2 originates within a mining facility, and Boise_ST2 conveys stormwater.

Boise Creek In-Situ Parameters: Mean and Range

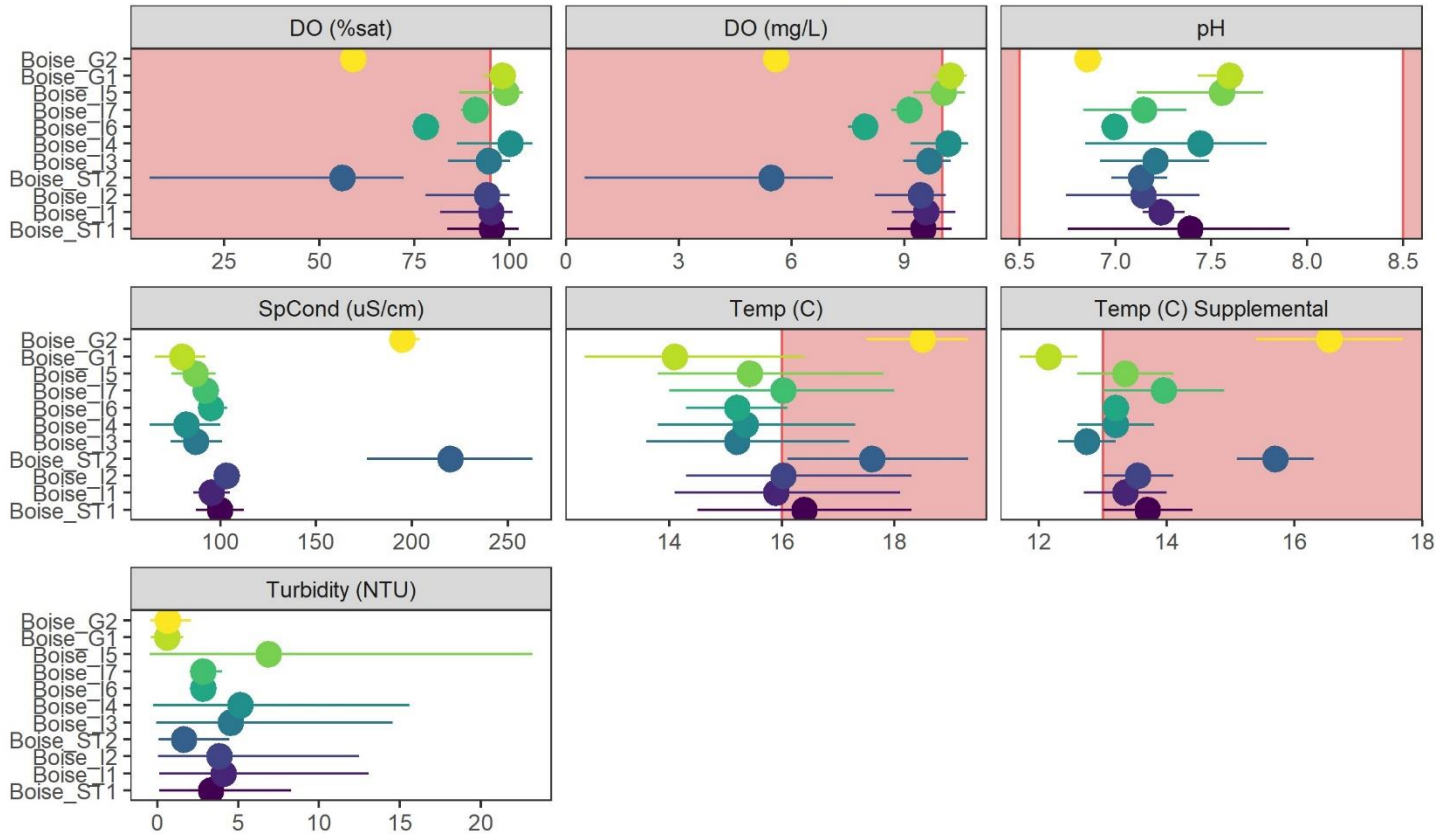


Figure 8. In-situ water quality parameters by site during the first quarter of Year 5, with water quality criteria marked in red. Note the supplemental spawning criteria for Boise Creek from Sept 1-July 1 (13°C).

References

- Brownlee, A. 2019. Quality Assurance Project Plan: Puyallup River Tributaries Effectiveness Monitoring. Ecology publication 19-10-040.
- Gray, D. and Mathieu, N. 2022. Lower White River pH Total Maximum Daily Load. Washington State Department of Ecology, Olympia, WA. Publication No. 22-10-011. <https://apps.ecology.wa.gov/publications/SummaryPages/2210011.html>
- Mathieu, N. and James, C. 2011. Puyallup River Watershed: Fecal Coliform Total Maximum Daily Load – Water Quality Improvement Report and Implementation Plan. Washington State Department of Ecology, Olympia, WA. Publication No. 11-10-040. <https://testfortress.wa.gov/ecy/publications/SummaryPages/1110040.html>
- Dickes, B. 2015. Pussyfoot Creek and Second Creek Fecal Coliform Characterization Monitoring: Two Tributaries to the White River. Washington State Department of Ecology, Olympia, WA. Publication No. 15-10-048. <https://testfortress.wa.gov/ecy/publications/SummaryPages/1510048.html>
- U.S. Geological Survey. Boise Creek at Buckley, WA - Monitoring location 12099600. USGS Water Data for the Nation. <https://waterdata.usgs.gov/monitoring-location/12099600/#parameterCode=00060&period=P7D&showMedian=true>
- Water Quality Program, 2018. Water Quality Program Policy 1-11: Washington’s Water Quality Assessment Listing Methodology to Meet Clean Water Act Requirements. Ecology publication 18-10-035. <https://fortress.wa.gov/ecy/publications/SummaryPages/1810035.html>
- Water Quality Standards for Surface Waters of the State of Washington Section 173-201A. <https://apps.leg.wa.gov/WAC/default.aspx?cite=173-201A>
- King County (2023). King County Hydrologic Information Center, 69G - Beaver CR near Boise Confluence Stream Gauge https://green2.kingcounty.gov/hydrology/GaugeMetaData.aspx?G_ID=2166

Appendix

Table A1. Preliminary results for all Boise Creek sites. Blank cells represent that a sample or measurement was not collected.

Study_Specific_Location_ID	Field_Collection_Start_Date	Field_Collection_Start_Time	Temperature, water	Dissolved Oxygen Percent Saturation	Dissolved Oxygen	Conductivity, Specific (at 25 deg C)	pH	Turbidity	E. coli	Fecal Coliform	Total Persulfate Nitrogen	Nitrate + Nitrite as N	Ammonia	Ortho-Phosphate	Total Phosphorus
Boise_G1	7/10/2023	13:50:00	12.8	98.8	10.46	73.5	7.57	0.7	43	48					
Boise_G2	7/10/2023	14:00:00	17.5	60.6	5.8	193.2	6.82	0.37	29	29					
Boise_I1	7/10/2023	11:03:00	14.1	100.7	10.35	86	7.14	0.89	250	270					
Boise_I2	7/10/2023	11:20:00	14.3	98.7	10.09	101.5	7.22	0.75	220	260					
Boise_I3	7/10/2023	11:58:00	13.6	98.6	10.23	78.2	7.31	0.76	160	170					
Boise_I4	7/10/2023	12:40:00	13.8	103	10.65	77	7.66	0.57	150	180					
Boise_I5	7/10/2023	13:25:00	13.8	102	10.54	74.5	7.64	0.68	35	40					
Boise_I6	7/10/2023	13:07:00	14.3	78.8	8.06	90.5	7.01		87	89					
Boise_I7	7/10/2023	12:55:00	14	90.8	9.35	89.8	7.24		390	410					
Boise_ST1	7/10/2023	10:46:00	14.5	100.6	10.26	87.2	7.6	0.97	140	210					
Boise_ST2	7/10/2023	11:45:00	16.1	72.1	7.1	212.8	7.02	4.46	220	240					
Boise_G1	7/17/2023	13:50:00	14.7	99.2	10.06	75.5	7.64	0.55	67	80					
Boise_G2	7/17/2023	14:00:00	18	58.3	5.52	196.7	6.79	0.9	4	4					
Boise_I1	7/17/2023	11:22:00	16.1	99.7	9.82	90	7.23	0.91	380	420					
Boise_I2	7/17/2023	11:40:00	16.3	99.9	9.8	103.5	7.35	0.65	300	330					
Boise_I3	7/17/2023	12:35:00	15.6	100.1	9.95	81.7	7.49	0.55	260	340					
Boise_I4	7/17/2023	13:01:00	16.1	106	10.45	80.5	7.79	0.42	490	570					
Boise_I5	7/17/2023	13:32:00	16.2	102.9	10.12	78.1	7.64	0.58	63	76					
Boise_I6	7/17/2023	13:20:00	16.1	76.1	7.5	90.9	6.99	2.67	80	80					
Boise_I7	7/17/2023	13:10:00	16.3	91.7	8.99	87.2	7.31	2.67	920	1600					
Boise_ST1	7/17/2023	11:03:00	16.7	102.4	9.97	91.4	7.91	0.96	260	260	0.2	0.14	0.02	0.01	0.02
Boise_ST2	7/17/2023	11:58:00	18	69.7	6.59	219	7.16	0.5	130	130	0.4	0.06	0.05	0.05	0.06
Boise_G1	8/14/2023	13:50:00	16.4	99.6	9.75	81.5	7.67	-0.4	57	67					
Boise_G2	8/14/2023	14:04:00	19.2	59.6	5.51	204.2	6.89	-0.5	18	37					
Boise_I1	8/14/2023	11:10:00	18.1	97.6	9.21	98.7	7.36	0.11	270	440					
Boise_I2	8/14/2023	11:30:00	18.3	98.5	9.26	101.9	7.44	0.03	240	290					
Boise_I3	8/14/2023	12:08:00	17.2	93.5	9.01	90.5	7.11	-0.1	120	160					
Boise_I4	8/14/2023	12:25:00	17.3	103.6	9.95	89.6	7.44	-0.3	180	190					
Boise_I5	8/14/2023	13:15:00	17.8	103.4	9.82	84.9	7.67	-0.5	31	39					

Boise_I7	8/14/2023	12:53:00	18	91.2	8.64	97.9	6.93		920	1100						
Boise_ST1	8/14/2023	10:50:00	18.3	100	9.41	101.2	7.78	0.1	120	140						
Boise_ST2	8/14/2023	11:53:00	19.3	5.5	0.5	217.9	7.22	0.07	270	360						
Boise_G1	8/28/2023	14:07:00	12.5	100	10.65	92	7.6	0.7	25	33						
Boise_G2	8/28/2023	14:15:00	19.3	57.6	5.3	193.4	6.93	0.47	31	39						
Boise_I1	8/28/2023	11:48:00	15.3	97.2	9.74	102.8	7.36	0.94	440	510						
Boise_I2	8/28/2023	12:07:00	15.2	97.2	9.76	106.9	7.08	0.95	390	470						
Boise_I3	8/28/2023	13:14:00	14.4	96.1	9.82	98.1	7.36	2.15	80	130						
Boise_I4	8/28/2023	13:27:00	14.2	103.9	10.68	63.1	7.35	0.74	220	320						
Boise_I5	8/28/2023	13:51:00	13.9	102.5	10.6	95.2	7.77	0.61	36	45						
Boise_I7	8/28/2023	13:39:00	15.8	91.9	9.11	96.6	7.21	2.4	2400	2600						
Boise_ST1	8/28/2023	11:03:00	16.1	98.5	9.71	106.9	7.37	1.71	140	180	0.3	0.17	0.03	0.01	0.02	
Boise_ST2	8/28/2023	12:24:00	17	64.1	6.19	231.6	7.15	1.42	300	370	0.3	0.01	0.01	0.06	0.07	
Boise_G1	9/11/2023	14:15:00	12.6	97.3	10.34	92.2	7.67	0.37	28	29						
Boise_G2	9/11/2023	14:23:00	17.7	60.7	5.78	192	6.81	0.37	51	51						
Boise_I1	9/11/2023	11:55:00	14	93.7	9.65	105.2	7.15	8.65	330	420						
Boise_I2	9/11/2023	12:13:00	14.1	92	9.46	106.6	7.03	8.06	420	710						
Boise_I3	9/11/2023	12:41:00	13.2	94.3	9.9	101.1	6.92	9.25	390	440						
Boise_I4	9/11/2023	13:30:00	13.8	97.7	10.12	100.2	7.57	13.7	180	250						
Boise_I5	9/11/2023	13:58:00	14.1	96.3	9.91	97.5	7.49	23.2	55	130						
Boise_I7	9/11/2023	13:45:00	14.9	93.4	9.44	96.2	7.37	4.02	1000	2000						
Boise_ST1	9/11/2023	11:34:00	14.4	83.6	8.53	112.2	6.92	7.87	390	500						
Boise_ST2	9/11/2023	12:28:00	16.3	68.3	6.69	263.1	7.27	1.4	360	340						
Boise_G1	9/25/2023	14:48:00	11.7	93.1	10.09	65.9	7.43	1.61	140	140						
Boise_G2	9/25/2023	14:37:00	15.4	56.2	5.61	191.4	6.88	2.08	120	130						
Boise_I1	9/25/2023	12:35:00	12.7	81.7	8.66	90.3	7.19	13.1	540	1100						
Boise_I2	9/25/2023	12:47:00	13	78	8.22	99.3	6.74	12.5	560	910						
Boise_I3	9/25/2023	13:40:00	12.3	83.8	8.96	74	7.06	14.5	880	1400						
Boise_I4	9/25/2023	13:50:00	12.6	86.1	9.16	83.5	6.84	15.6	330	350						
Boise_I5	9/25/2023	14:20:00	12.6	86.7	9.23	92.5	7.11	16.6	220	260						
Boise_I6	9/25/2023	14:13:00	13.2	78.7	8.26	103.7	6.98	2.98	360	460						
Boise_I7	9/25/2023	14:00:00	13	87.2	9.18	85.6	6.83	2.22	680	690						
Boise_ST1	9/25/2023	12:02:00	13	86.5	9.11	99.8	6.75	8.28	700	1400	1.3	0.47	0.55	0.13	0.18	
Boise_ST2	9/25/2023	13:04:00	15.1	56.5	5.69	176.6	6.98	2	760	1100	0.6	0.25	0.02	0.05	0.07	

Table A2. Dates with total daily precipitation of at least 0.1 inches (data from [King County site 44u](#)⁴).

Date	Precipitation (inches)
7/8/2023	0.25
7/9/2023	0.1
7/24/2023	0.23
8/9/2023	0.1
8/23/2023	0.15
8/29/2023	0.22
8/31/2023	0.19
9/3/2023	0.12
9/18/2023	0.24
9/20/2023	0.54
9/24/2023	0.8
9/25/2023	0.49
9/26/2023	0.57
9/27/2023	0.6
9/28/2023	0.42

⁴ <https://green2.kingcounty.gov/hydrology/DataDownload.aspx>

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Related Information

- This report is available on the [Puyallup Partnership webpage](#)⁵.
- Data for this project is available in Ecology's [EIM Database](#),⁶ Study ID: EFF_PRT.
- Data is displayed on [Puyallup River Tributaries Effectiveness Monitoring StoryMap](#)⁷.
- Bacteria data is displayed on [Whatcom Conservation District StoryMap](#)⁸.

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⁵ https://www.ezview.wa.gov/site/alias__1962/37699/puyallup_river_watershed_improvement_project.aspx

⁶ https://apps.ecology.wa.gov/eim/search/Eim/EIMSearchResults.aspx?ResultType=EIMStudyTab&StudyUserIdSearchType=Contains&StudyUserIds=EFF_PRT

⁷ <https://waecy.maps.arcgis.com/apps/MapSeries/index.html?appid=20f291f848cb48fd8c879704f5464461>

⁸ <https://www.arcgis.com/apps/webappviewer/index.html?id=5395274198aa4365b96fbaf01b4db43b&extent=-13894004.8062%2C6045956.0065%2C-13306968.4289%2C6336110.9659%2C102100>