Puyallup River Tributaries Effectiveness Monitoring
Quarterly Report: July – September 2021

DEPARTMENT OF ECOLOGY
State of Washington

Abstract

July to September 2021 quarter marks the start of the third year of monitoring by Department of Ecology for a ten-year water quality effectiveness monitoring study. Monthly monitoring continued at the long-term status and trends sites at Boise Creek; Pussyfoot and Second Creek were not monitored this quarter, due to dry or stagnant conditions. Additional bacteria samples were collected to support source identification efforts by the City of Enumclaw. 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 once a month at the two Boise Creek status and trend sites: the downstream site on the mainstem (Boise_ST1) and the upstream tributary at the City of Enumclaw's stormwater flume (Boise_ST2). Ecology did not sample Pussyfoot and Second Creek, due to dry or stagnant conditions.
- Both Boise Creek sites did not meet bacteria standards, and Boise_ST2 exceeded both the geometric mean and threshold criteria.
- Source tracing along the City of Enumclaw's stormwater flumes revealed an incremental increase in *E. coli* along Lateral A, from upstream to downstream. This may have shown the influence of maintenance work along the lateral that disturbed sediment or a faulty septic system that was recently decommissioned in August, 2021.
- Boise_ST2 did not meet temperature and dissolved oxygen standards throughout the summer. This is likely due to the slow-moving nature of the site during summer.
- Both sites did not meet temperature standards during September, a crucial time for the start of salmon spawning.

[1] https://apps.ecology.wa.gov/publications/SummaryPages/1910040.html

Figure 1. Boise Creek sampling sites.

Precipitation and Flow

The summer season started with a dry July and no measureable precipitation. September had the highest accumulation of rain (monthly total of 3.23 inches) and the highest daily total (9/15/21; 1.01 inches).

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

Month	Total Precipitation (inches)	Average Discharge (cfs)
July	0	6.7
August	0.48	4.8
September	3.23	4.4

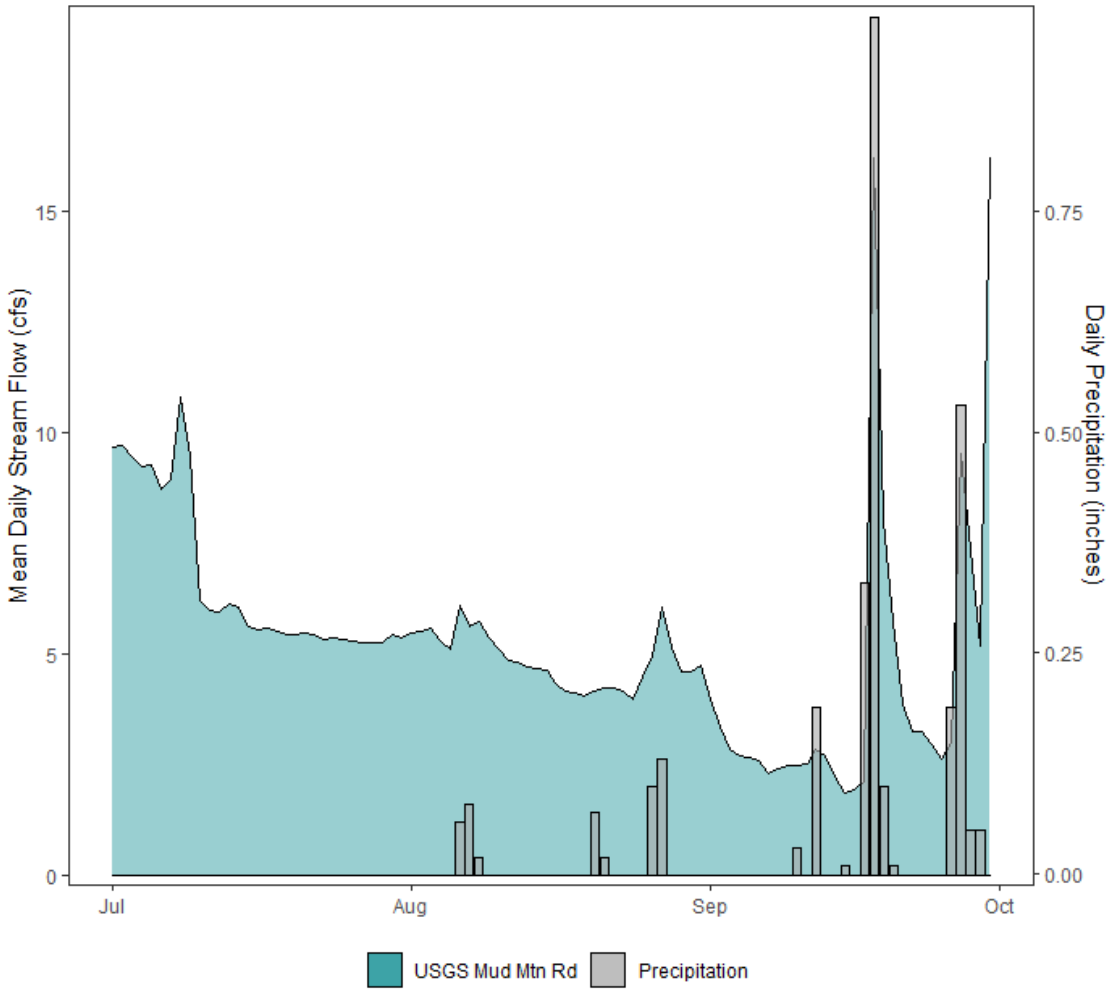

Figure 2. Mean daily stream flow (preliminary data from USGS site 12099600[2]) and daily precipitation (data from King County site 44u[3]) at Boise Creek at Mud Mountain Road station from July to September 2021.

Bacteria

Bacteria standards state that 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 exist) should exceed 320 cfu/100mL. Boise_ST1 and Boise_ST2 did not meet the first criteria, while Boise_ST2 did not meet the second criteria with a high *E. coli* level of 820 cfu/100L on 7/21/21.

Table 2. Comparison of *E. coli* statistics to bacteria standards.

Site	Geometric Mean (cfu/100mL)	Meets 1st Criteria?	Percent Over Threshold Criteria	Meets 2nd Criteria?
Boise_ST1	152	No	0%	Yes
Boise_ST2	355	No	33.3%	No

[2] https://waterdata.usgs.gov/wa/nwis/uv/?site_no=12099600&PARAmeter_cd=00060,00065
[3] https://green2.kingcounty.gov/hydrology/DataDownload.aspx

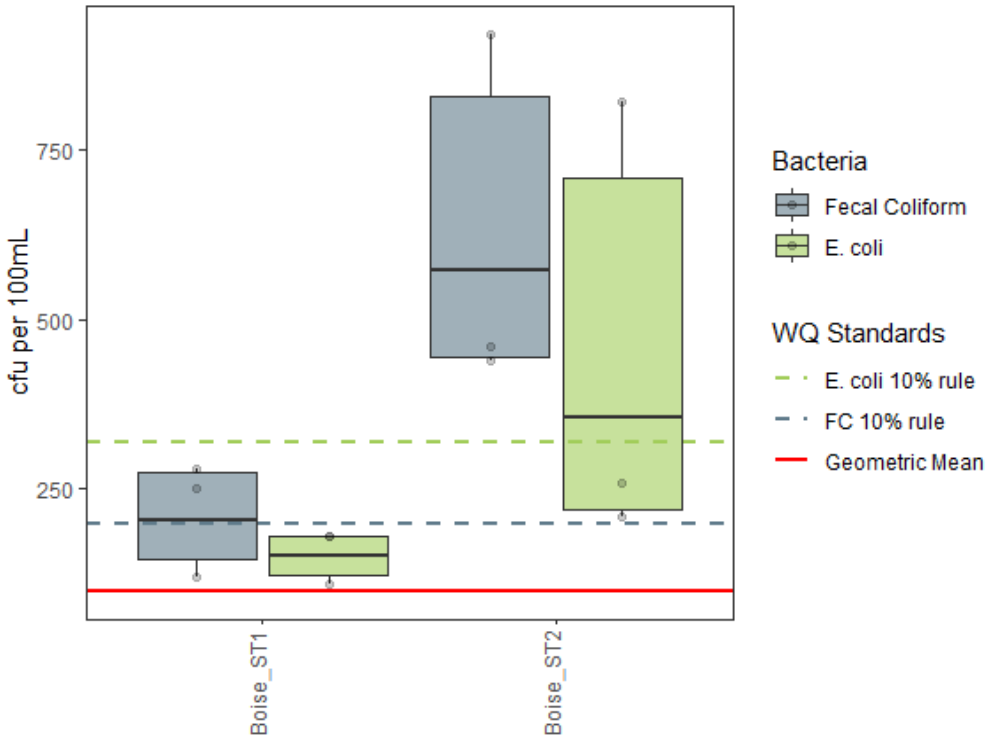

Figure 3. Bacteria levels from July to September 2021 with geometric mean (black solid line in boxplot). Water quality standards displayed as horizontal lines.

Source Tracing

Source tracing continued along the City of Enumclaw's stormwater flume, which connects as a tributary to Boise Creek. The stormwater flume flow became too low to sample during the summer, so most samples were collected along Lateral A (Boise_B4A, B7, B8, and B9). This lateral is the main source of surface water to the flume throughout the summer and is fed by a spring close to site Boise_B9.

In July, a maintenance crew hired by the drainage district was working along the laterals to cut vegetation on the side slopes. The disturbance may have caused silty sediment in Lateral A to be stirred up in the water column and released sequestered bacteria. This may explain for the high hit of 1200 cfu/100mL at the mouth of Lateral A, which influenced downstream levels.

The City of Enumclaw had also reported a successful decommissioning of a faulty septic system that bordered Lateral A in August 2021. This property is bracketed by sites Boise_B7 and Boise_B4A, and there was a detected increase in *E. coli* from 330 cfu/100mL (Boise_B7) to 1200 cfu/100mL (Boise_B4A) in July. Considering this property is a couple houses south of Lateral A, it is not clear whether this increase in bacteria shows the influence of the faulty septic system or the disturbance from vegetation maintenance as stated above.

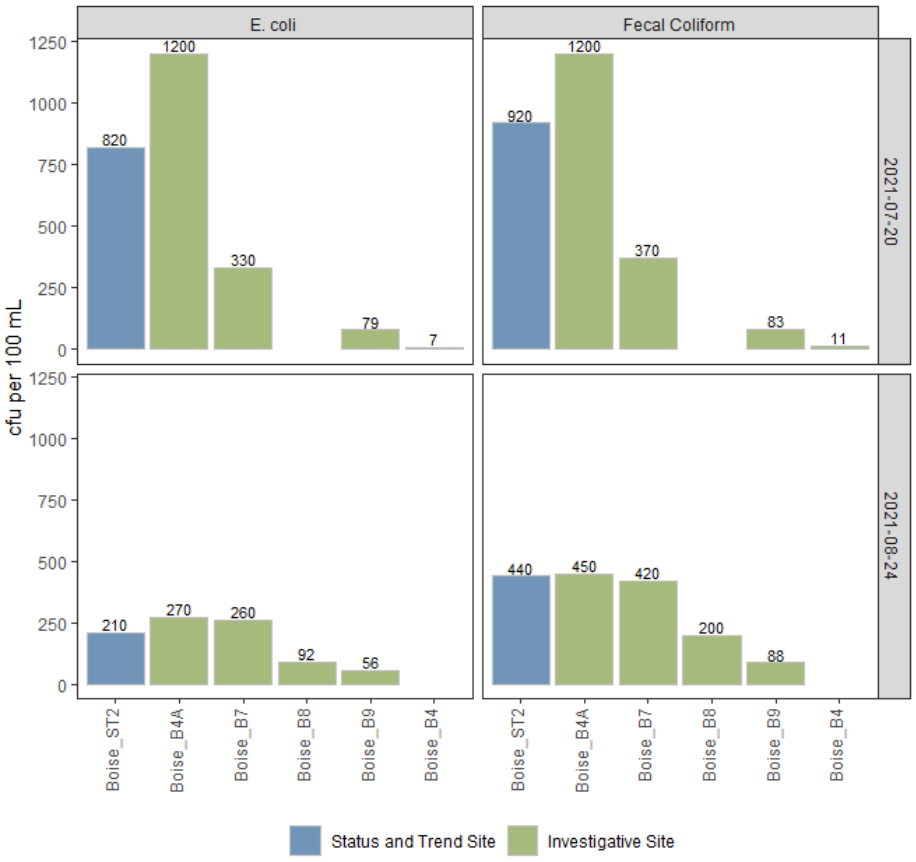

Figure 4. Bacteria levels at status and trend site (Boise_ST2) and upstream investigative sites. Boise_B4A, B7, B8, and B9 are along Lateral A, ordered from downstream to upstream. Boise_B4 is upstream of Lateral A on main flume.

Figure 5. Map of source tracing sites represented as *E. coli* geometric mean (geomean; cfu/100mL).

Nutrients

The Boise Creek tributary site (Boise_ST2) had higher nutrient levels than the downstream Boise Creek site near White River (Boise_ST1) for nitrogen and phosphorus.

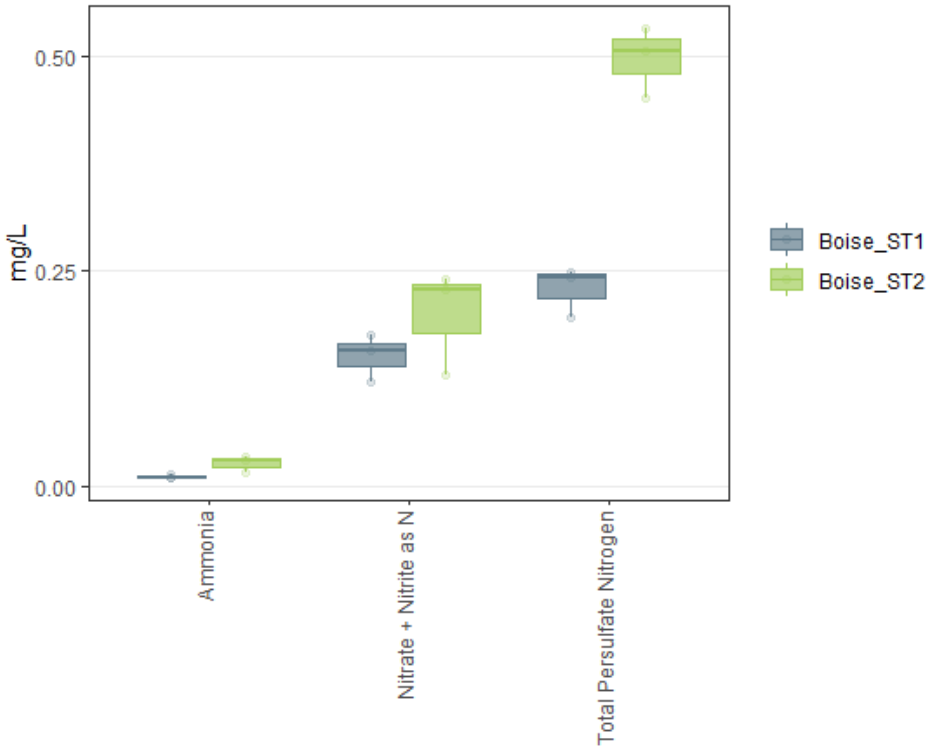

Figure 6. Nitrogen levels with median value represented as solid line in the boxplot.

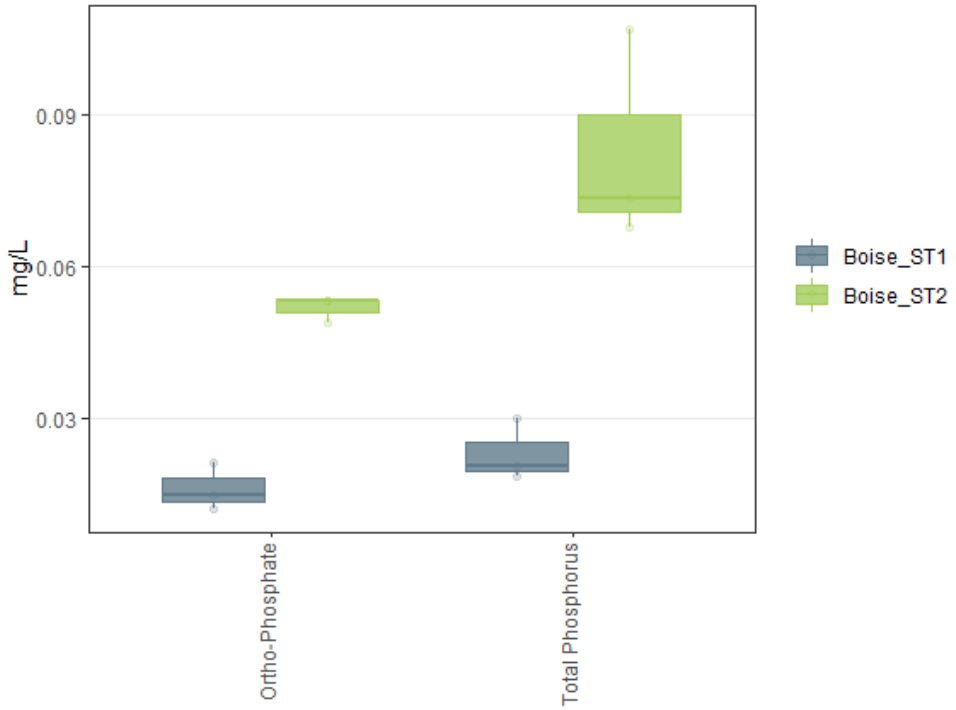

Figure 7. Phosphate levels with median value represented as solid line in the boxplot.

Water Quality Measurements

Temperature

Boise Creek has primary temperature criteria (i.e. should not be over 16°C) and secondary criteria (i.e. should not be over 13°C from September 1st to July 1st) in order to protect salmon spawning stages. Boise_ST2 exceed both criteria throughout the summer. Both sites did not meet standards in September, which is a crucial month for salmon spawning.

Dissolved Oxygen

Boise_ST2 did not meet dissoled oxygen standards. The relatively higher tempreature at this site may have affected dissolved oxygen levels.

Specific Conductivity, Turbidity and pH

Both sites met standards for turbidity and pH.

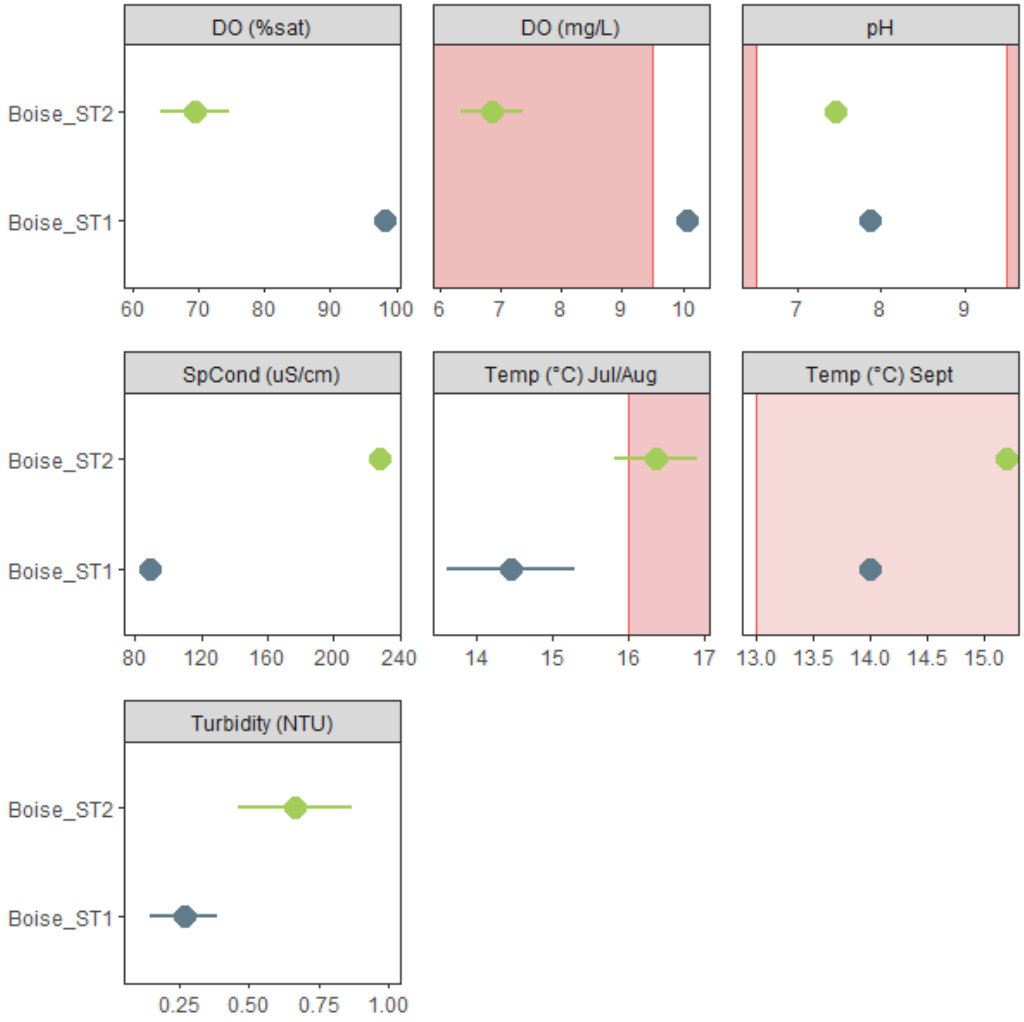

Figure 8. Average values for in-situ water quality parameters with standard deviation. Water quality exceedances marked in red.

References

Brownlee, A. 2019. Quality Assurance Project Plan: Puyallup River Tributaries Effectiveness Monitoring. Ecology publication 19-10-040.

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

Kahle, D and H. Wickham. ggmap: Spatial Visualization with ggplot2. The R Jour-l, 5(1), 144-161. URL http://jour-l.r-project.org/archive/2013-1/kahle-wickham.pdf

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://test-fortress.wa.gov/ecy/publications/SummaryPages/1110040.html

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

Appendix

Table A1. Preliminary results for all Boise, Pussyfoot and Second Creek sites. Dash marks represent that sample or measurement was not collected.

Site	Date	Fecal Coliform (cfu/100mL)	E. coli (cfu/100mL)	Ammonia (mg/L)	Nitrate + Nitrite as N (mg/L)	Total Persulfate Nitrogen (mg/L)	Ortho-Phosphate (mg/L)	Total Phosphorus (mg/L)	Temperature, water ©	Barometric pressure	Conductivity, Specific (at 25 deg °C)	Dissolved Oxygen (mg/L)	Dissolved Oxygen Percent Saturation (%)	pH	Turbidity (NTU)
Boise_ST1	7/20/21	120	110	0.01	0.175	0.242	0.0124	0.0187	15.3	29.5	81.5	9.78	97.6	7.81	0.2
Boise_ST2	7/20/21	920	820	0.034	0.227	0.506	0.0535	0.107	16.9	29.39	226.2	6.65	68.7	7.48	0.7
Boise_B4A	7/20/21	1200	1200	-	-	-	-	-	-	-	-	-	-	-	-
Boise_B7	7/20/21	370	330	-	-	-	-	-	-	-	-	-	-	-	-
Boise_B9	7/20/21	83	79	-	-	-	-	-	-	-	-	-	-	-	-
Boise_B4	7/20/21	11	7	-	-	-	-	-	-	-	-	-	-	-	-
Psyft_ST1	7/20/21	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Second_ST1	7/20/21	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	7/20/21	460	400	-	-	-	-	-	-	-	-	-	-	-	-
Boise_ST1	8/24/21	280	180	0.01	0.121	0.195	0.0151	0.0207	13.6	29.25	90.2	10.24	98.5	7.94	0.1
Boise_ST2	8/24/21	440	210	0.015	0.128	0.45	0.0489	0.068	15.8	29.22	225.9	7.82	79	7.59	1
Boise_B4A	8/24/21	450	270	-	-	-	-	-	-	-	-	-	-	-	-
Boise_B7	8/24/21	420	260	-	-	-	-	-	-	-	-	-	-	-	-
Boise_B8	8/24/21	200	92	-	-	-	-	-	-	-	-	-	-	-	-
Boise_B9	8/24/21	88	56	-	-	-	-	-	-	-	-	-	-	-	-
Psyft_ST1	8/24/21	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Second_ST1	8/24/21	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Boise_ST1	9/13/21	250	180	0.013	0.157	0.249	0.0213	0.03	14	29.52	94.7	10.18	98.8	7.85	0.5
Boise_ST2	9/13/21	460	260	0.03	0.24	0.532	0.0533	0.0735	15.2	29.41	233	6.1	60.8	7.3	0.3
Psyft_ST1	9/13/21	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Second_ST1	9/13/21	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Contact information

Water Quality Program

Southwest Regional Office
Author: Molly Gleason
P.O. Box 47600
Olympia, WA 98504-7600
Phone: 360-584-2753

Related Information

- This report is available on the Puyallup Partnership webpage[4].
- Data for this project is available in Ecology's EIM Database,[5] Study ID: EFF_PRT.
- Data is displayed on Puyallup River Tributaries Effectiveness Monitoring StoryMap[6].
- Bacteria data is displayed on Whatcom Conservation District StoryMap[7].

ADA accessibility

The Department of Ecology is committed to providing people with disabilities access to information and services by meeting or exceeding the requirements of the Americans with Disabilities Act (ADA), Section 504 and 508 of the Rehabilitation Act, and Washington State Policy #188.

To request an ADA accommodation, contact Ecology by phone at 360-584-2753 or email at molly.gleason@ecy.wa.gov. For Washington Relay Service or TTY call 711 or 877-833-6341. Visit Ecology's website for more information.

[4] https://www.ezview.wa.gov/site/alias__1962/37699/puyallup_river_watershed_improvement_project.aspx
[5]https://apps.ecology.wa.gov/eim/search/Eim/EIMSearchResults.aspx?ResultType=EIMStudyTab&StudyUserIdSearchType=Contains&StudyUserIds=EFF_PRT
[6] https://waecy.maps.arcgis.com/apps/MapSeries/index.html?appid=20f291f848cb48fd8c879704f5464461
[7] https://www.arcgis.com/apps/webappviewer/index.html?id=5395274198aa4365b96fbaf01b4db43b&extent=-13894004.8062%2C6045956.0065%2C-13306968.4289%2C6336110.9659%2C102100