SAMMAMISH WATER QUALITY MONITORING

Annual Report 2021

In 2021, water-quality monitoring continued largely the same as in 2020. Streambed entombment monitoring was again not possible due to social-distancing requirements, but is expected to resume in June 2022. Upstream stream-health sites on Ebright and Pine Lake Creeks went dry earlier than expected and could not be sampled in spring 2021.

- **Ebright Creek watershed:** Stormwater outfalls continued to be monitored for flow and temperature using continuous gages, and sampled monthly for turbidity. Wetland water level also continued to be monitored continuously.
- **George Davis / Allen Lake wetlands:** Water level continued to be monitored continuously in this wetland complex, at the head of the George Davis and Allen Lake watersheds.
- **Rain gage on City Hall:** The rain gage on City Hall continued to provide precipitation data to help understand other monitoring results, and it also provided real-time information to help City staff respond to rain events.
- **Zackuse Creek:** A stream gage monitored streamflow and temperature. Each month, Zackuse was sampled for bacteria, nutrients, suspended solids, and conventionals (conductivity, pH, alkalinity), and once a year was sampled for stream health (stream bug diversity).
- **Upstream stream-health sites:** Upstream monitoring continued on Laughing Jacobs Creek to measure stream health (stream bug diversity) and detect changes over time. The upstream sites on Ebright and Pine Lake Creeks went dry earlier than expected and could not be monitored in 2021.
- **Riparian forest:** Riparian forest canopy cover was mapped in the Laughing Jacobs Creek watershed, using aerial imagery from 2019. King County staff calculated canopy cover for various stream reaches, both for the entire 60-m riparian zone as well as for 10-m and 20-m zones closest to the stream. These near-stream zones are especially important determinants of stream health.

Data and Graphing

Most data in this report are available to view or download online. Hydrologic data (streamflow, water level, rainfall) are all available on the King County Hydrologic Information Center website: https://green2.kingcounty.gov/hydrology/GaugeMap.aspx. Stream water-quality data are available on the King County Streams Monitoring website: https://green2.kingcounty.gov/streamsdata/. Other data may be requested from either City of Sammamish or King County staff.

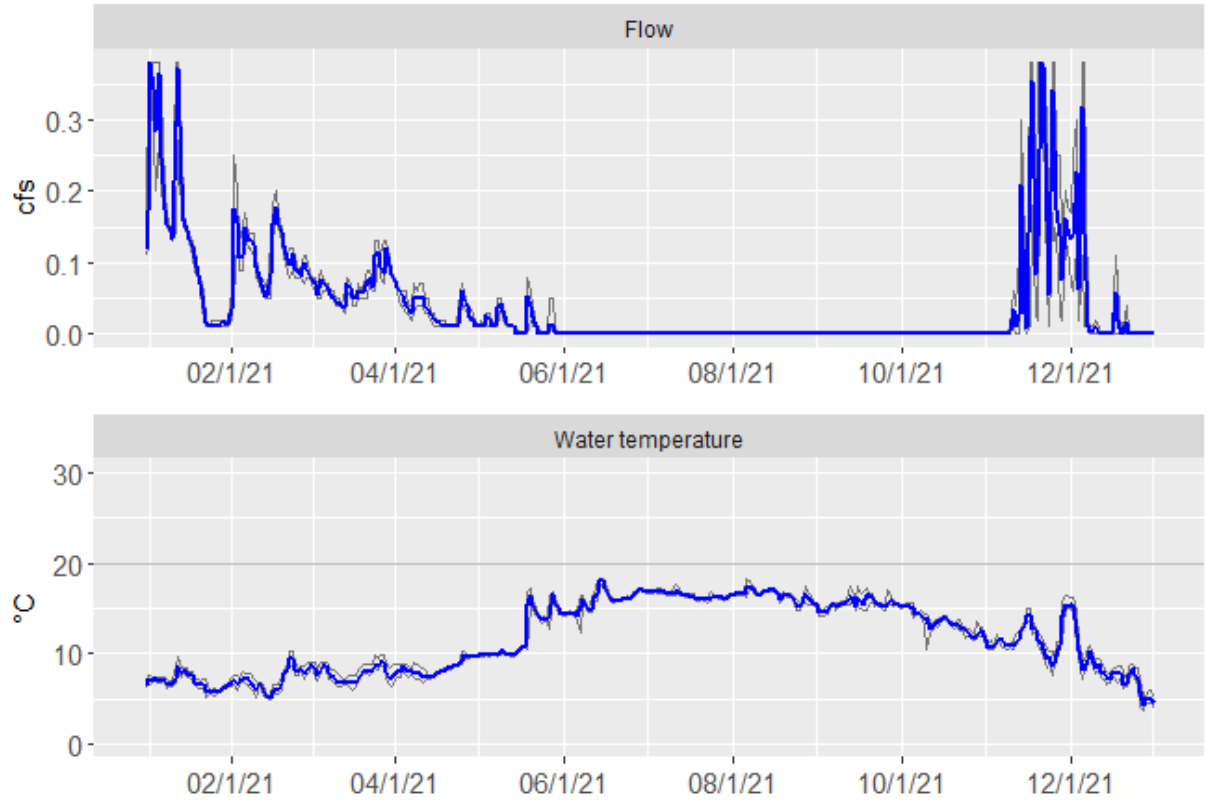
This report contains both discrete and continuous data. Discrete data were collected periodically (e.g., monthly water samples for lab analyses), and are graphed as blue dots connected by a blue line. In contrast, continuous data were collected by automated gages (e.g., flow, precipitation, temperature), usually every 15 minutes. For most continuous data in this report, the daily average is graphed as a blue line, and the daily maximum and minimum are graphed as thinner grey line (on days with very low variation, the thinner grey lines may be hidden behind the blue line).

Ebright Creek Watershed

Stormwater outfall flow, temperature, and turbidity continued to be monitored to detect potential impacts to habitat in Ebright Creek. Wetland water level was monitored to detect hydrologic impacts on the wetlands themselves. Flow, temperature, and water level were monitored using continuous gages, and turbidity was measured each month in grab samples.

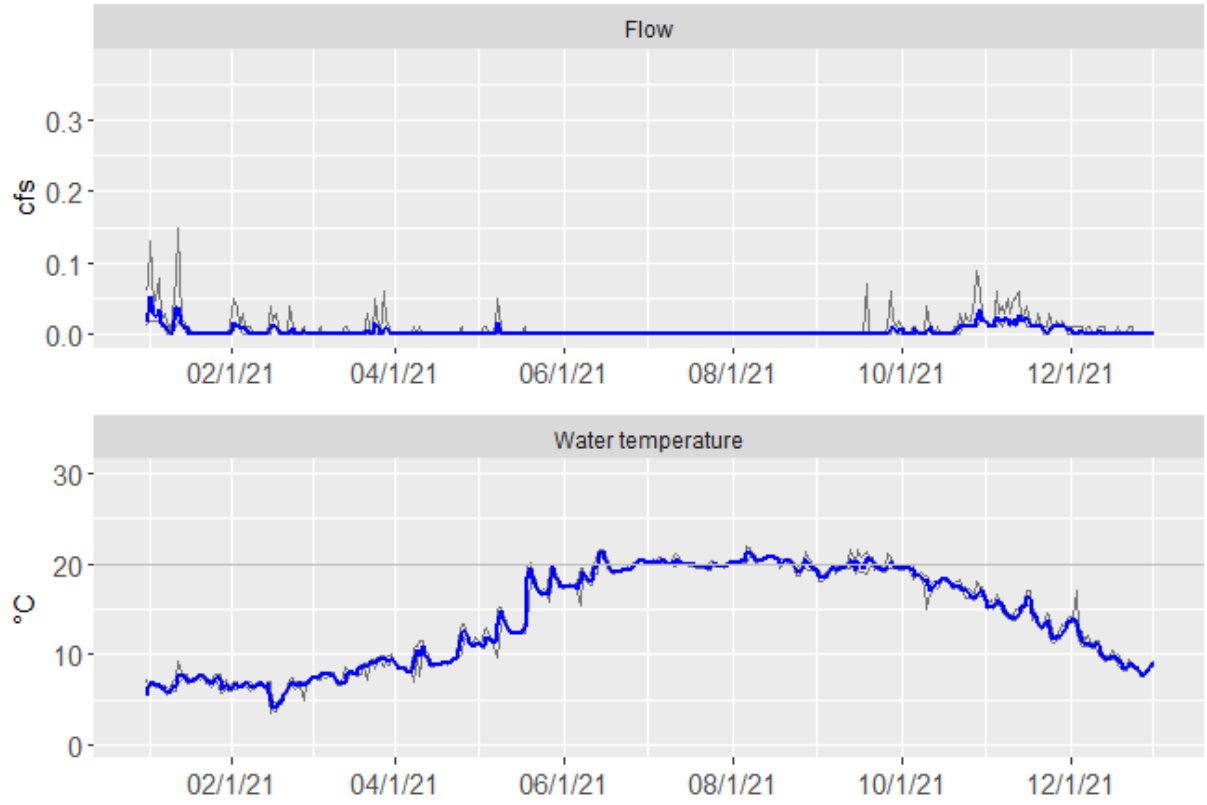
Outflow and Temperature

Chestnut Pond



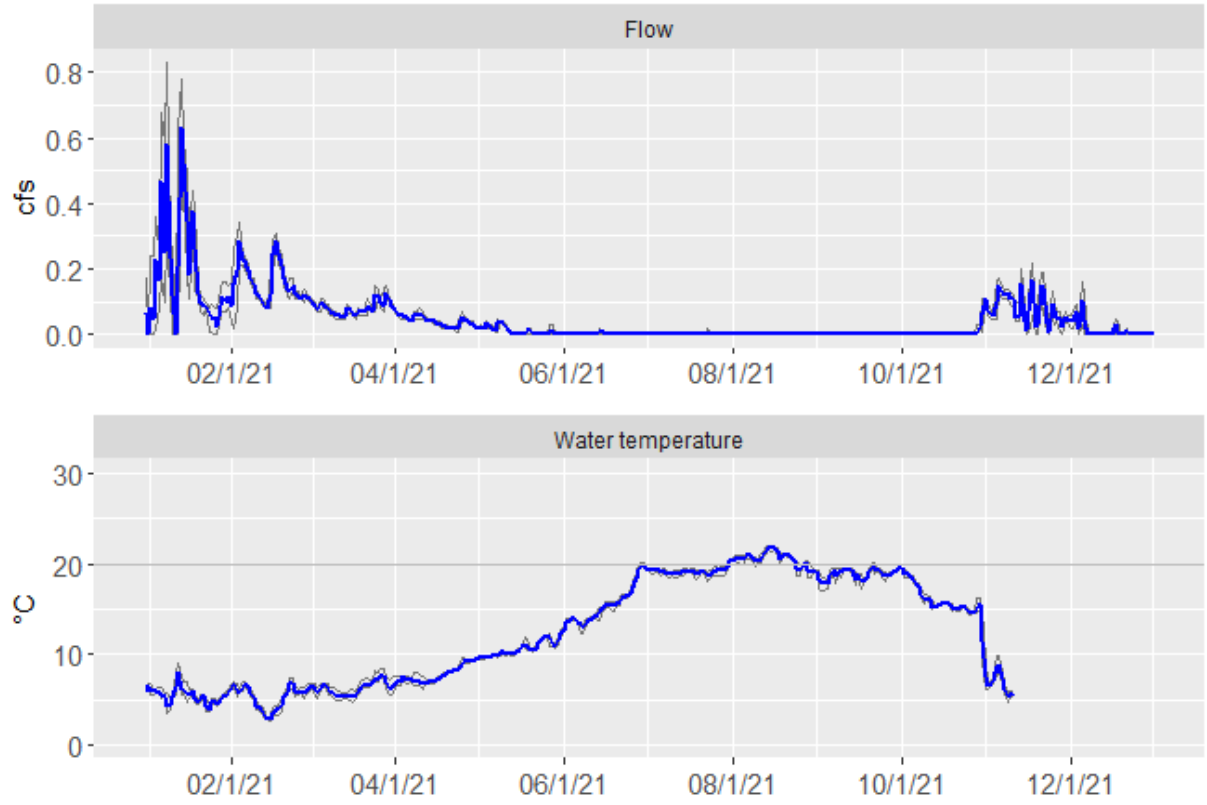
The blue line shows daily average values, and the thinner grey lines show daily maximum and minimum values.

Crossings - East pond



The blue line shows daily average values, and the thinner grey lines show daily maximum and minimum values.

Crossings - West wetland

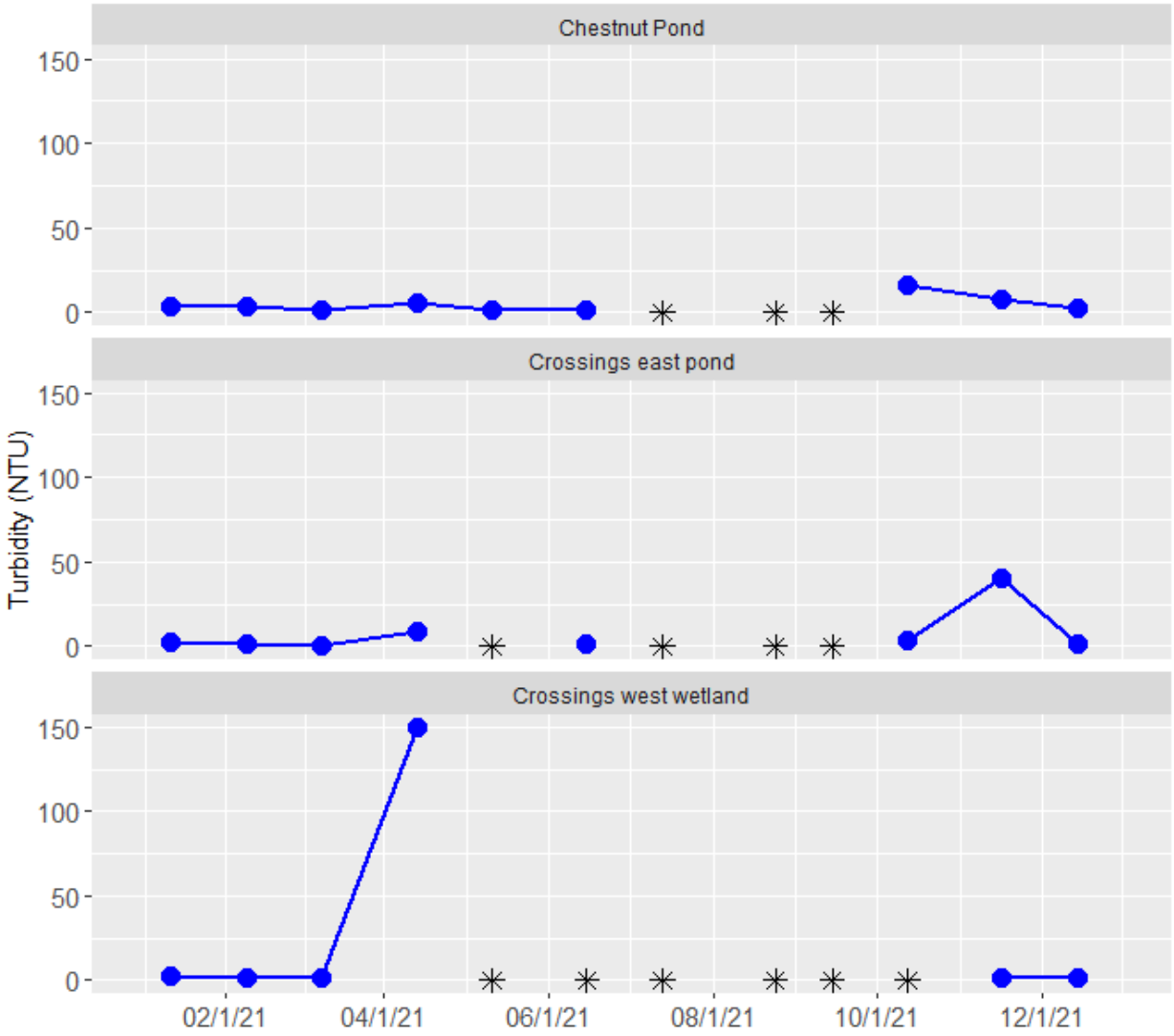


The blue line shows daily average values, and the thinner grey lines show daily maximum and minimum values.

Turbidity

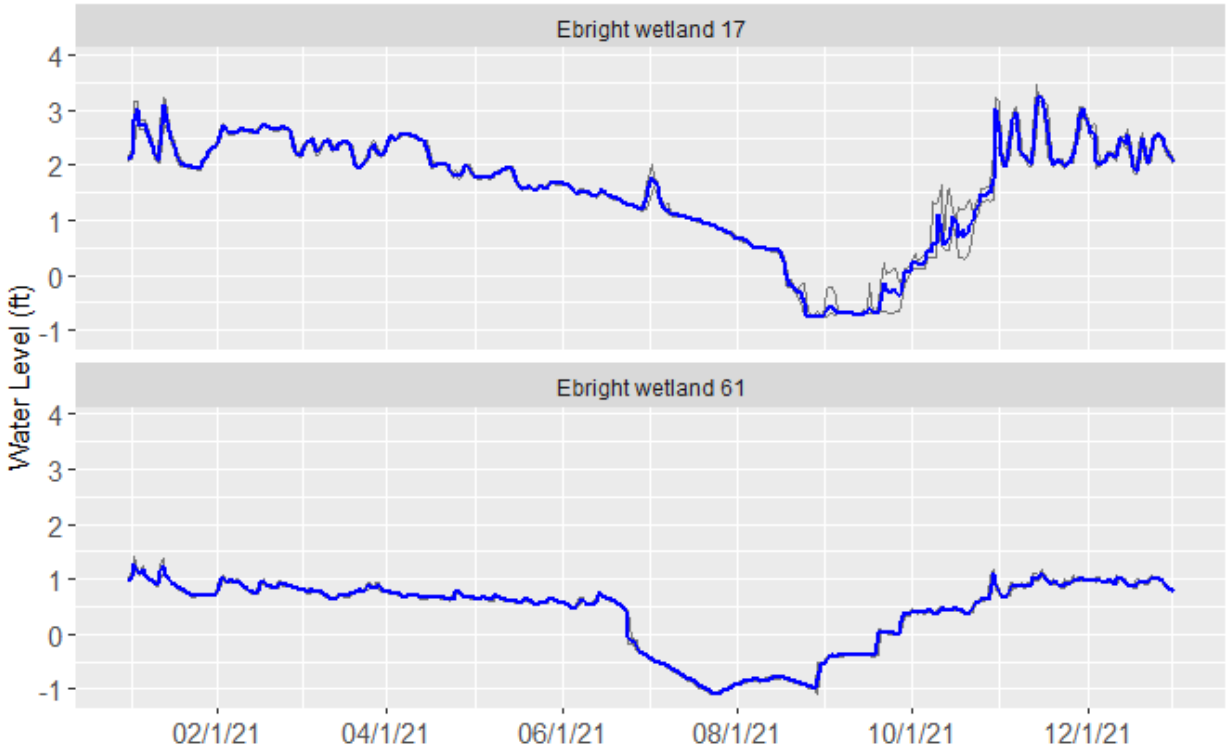
The three stormwater outfalls were visited each month. Unless the outfall was dry, samples were collected for laboratory turbidity analysis.

Turbidity was low in most samples in 2021, but not all. The Crossings west wetland outfall had high turbidity in April 2021, and the Crossings east wetland outfall had moderately high turbidity in November 2021. In both cases, flow was low at the time (<0.1 cfs), so the total amount of sediment loading from these outfalls was fairly low and likely not a substantial impact to the stream.



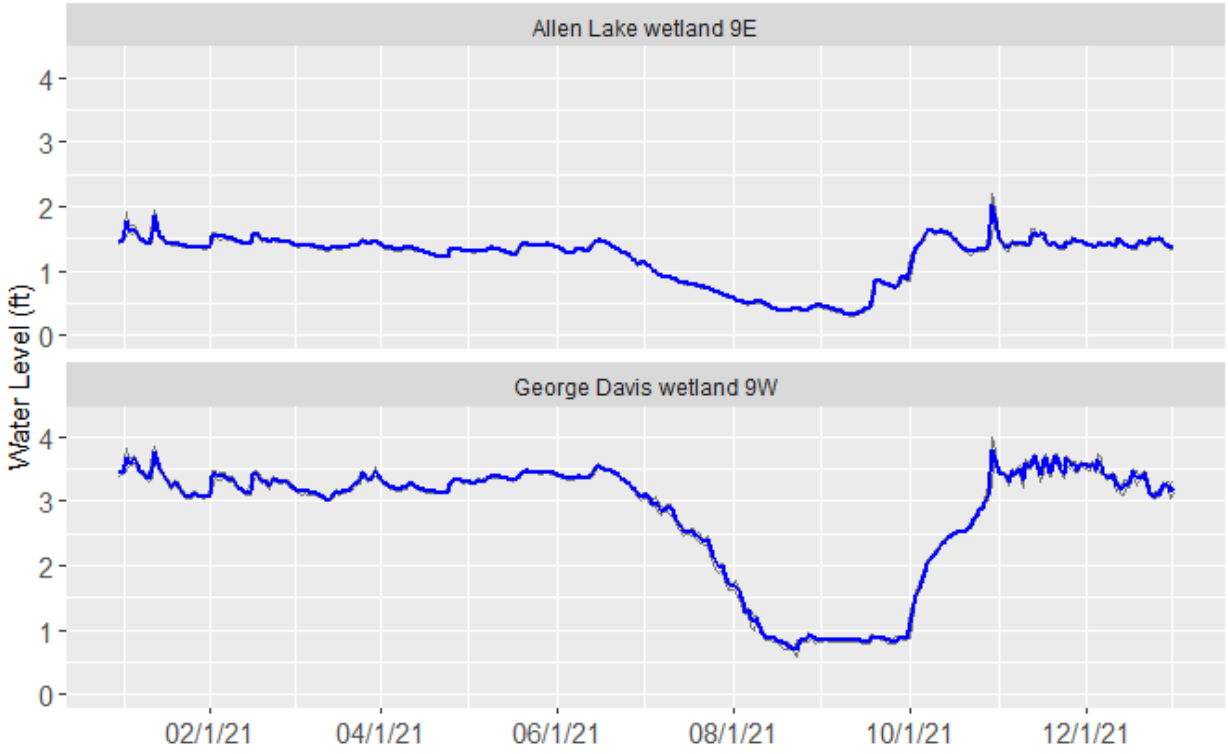
Blue dots show turbidity values, and black asterisks at zero turbidity indicate dates when the outfall was dry.

Wetland water level



The blue line shows daily average values, and the thinner grey lines show daily maximum and minimum values.

George Davis / Allen Lake Wetlands

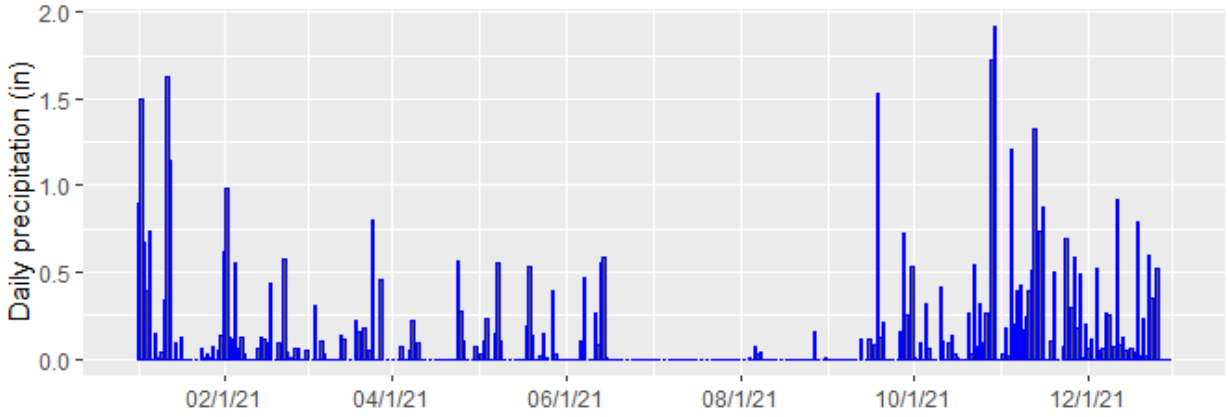


The blue line shows daily average values, and the thinner grey lines show daily maximum and minimum values.

Precipitation

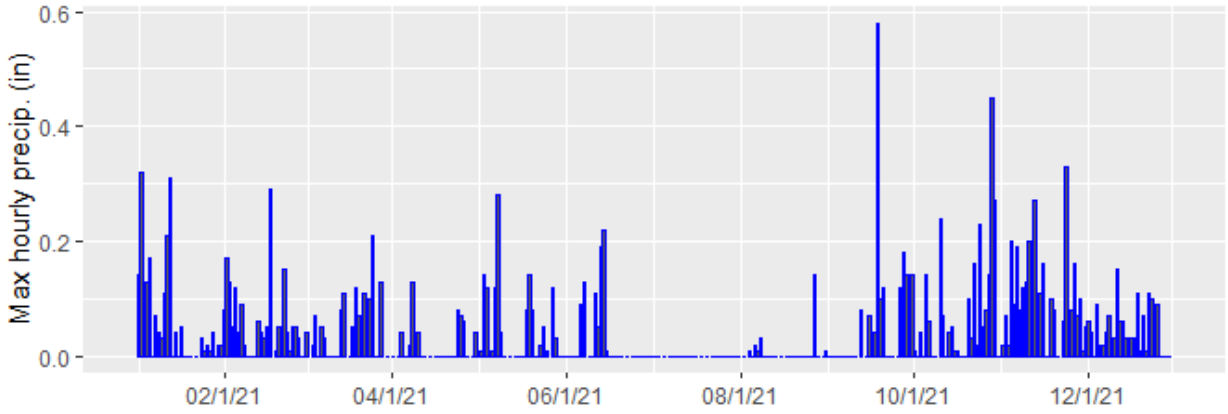
Precipitation (rain and snow) was measured by a rain gage on top of Sammamish City Hall.

Daily totals



Precipitation intensity

In addition to the total amount of precipitation during a rain or snow event, the precipitation intensity (inches per hour) also affects runoff, erosion, and other processes. As a measure of intensity, this graph shows each day's maximum hourly precipitation.



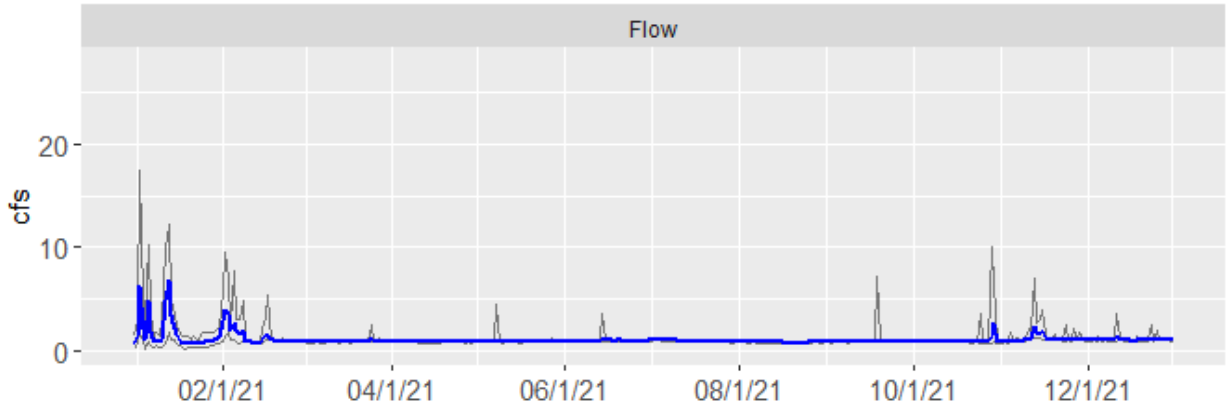
Note that the scale on the y-axis is considerably smaller than on the daily precipitation graph above.

Zackuse Creek

Zackuse Creek was monitored each month for bacteria, nutrients, and conventionals (conductivity, pH, and alkalinity). In addition, a gage measured streamflow and temperature continuously. Starting in 2020, Zackuse Creek was monitored annually for stream health by measuring benthic macroinvertebrate ("stream bug") diversity.

Streamflow

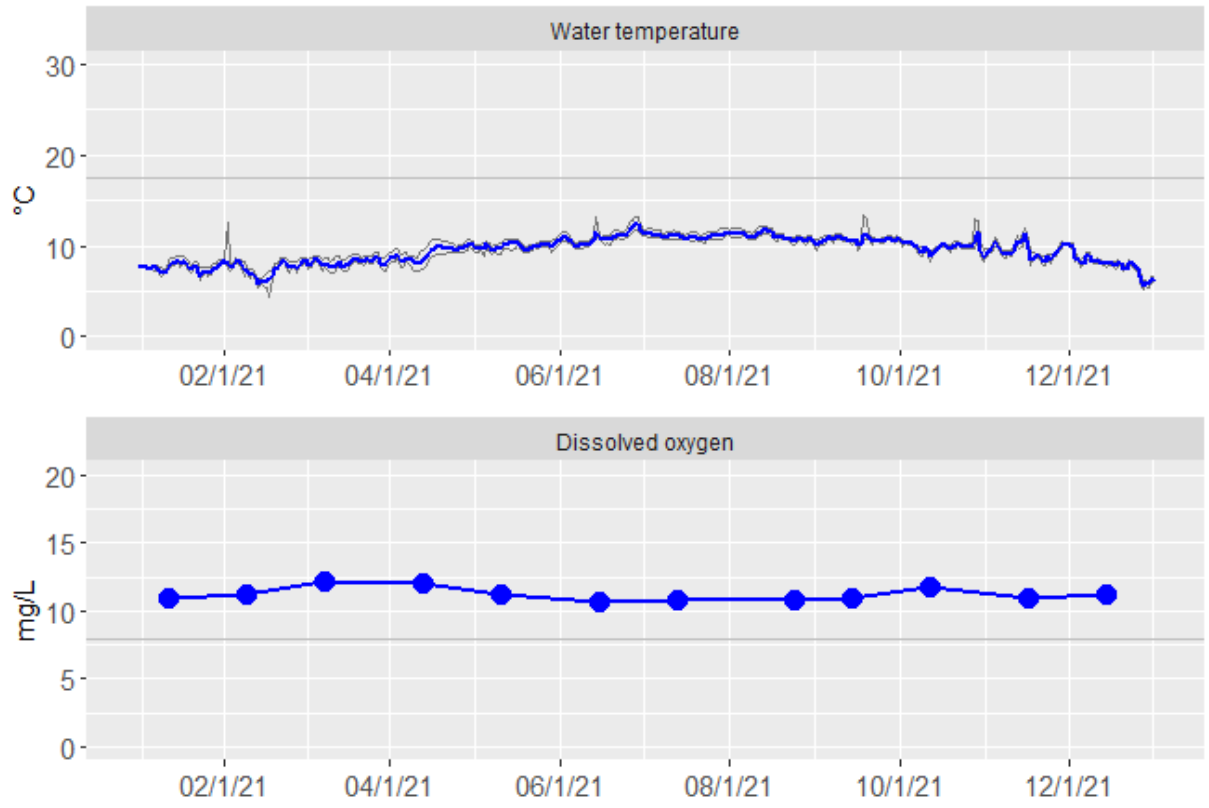
A gage near the mouth of Zackuse Creek measured streamflow and temperature continuously throughout the year.



The blue line shows daily average values, and the thinner grey lines show daily maximum and minimum values.

Temperature & Dissolved Oxygen

Good water conditions for salmon survival include temperatures cooler than 17.5°C and dissolved oxygen concentrations of at least 8 mg/L. In 2021, Zackuse Creek stayed cool and well-oxygenated throughout the year.



On the temperature plot, the blue line shows daily average values, and the thinner grey lines show daily maximum and minimum values

Biotic Stream Health

As an overall measure of stream health, Zackuse Creek was sampled once each summer for benthic macroinvertebrate ("stream bug") diversity.

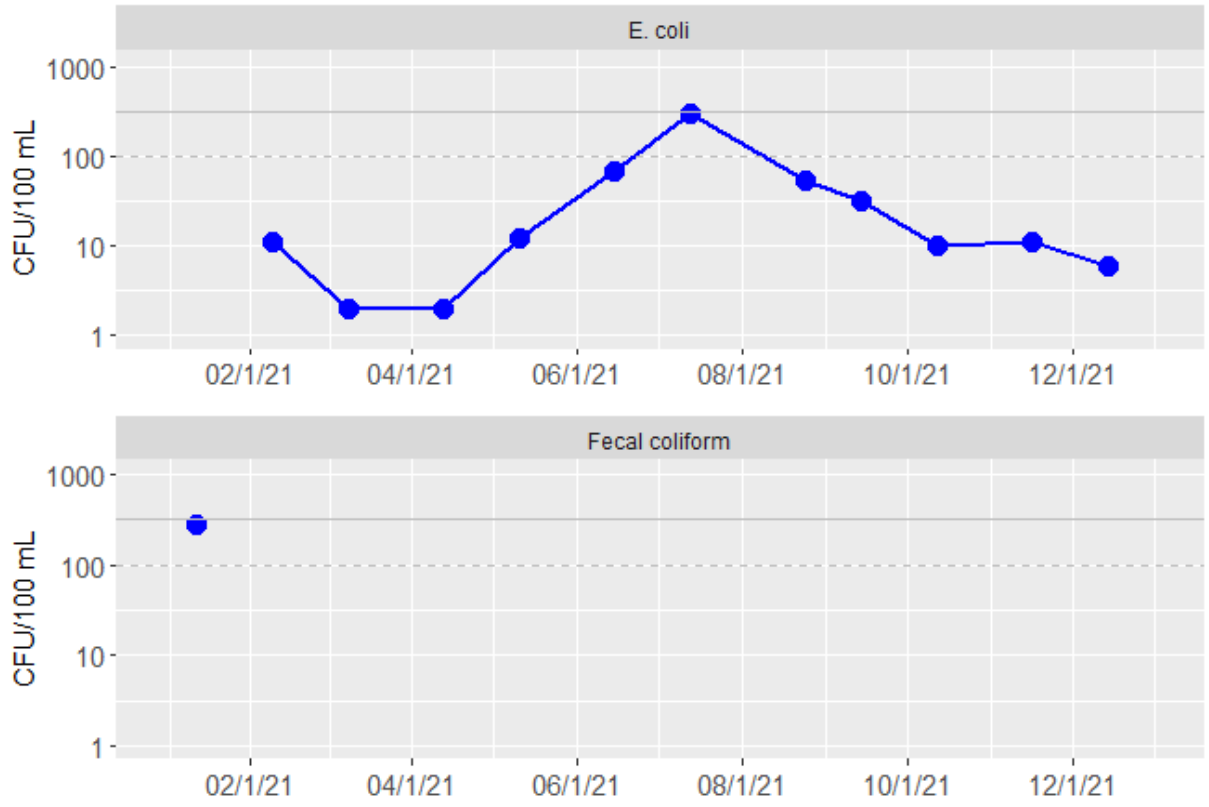
In 2021, Zackuse Creek's overall Benthic Index of Biotic Integrity (B-IBI) score was 22.4 (on a 0-100 scale). This score is generally interpreted as "poor" stream health. This section of Zackuse Creek was extensively restored in 2018, and we expect to see B-IBI scores increase over time as the stream settles into its new configuration. At least five years of data are recommended before assessing a trend.

Full results and individual taxon scores for Zackuse Creek are available on the Puget Sound Stream Benthos website at: https://pugetsoundstreambenthos.org/Biotic-Integrity-Scores.aspx?k=ZAK

Bacteria

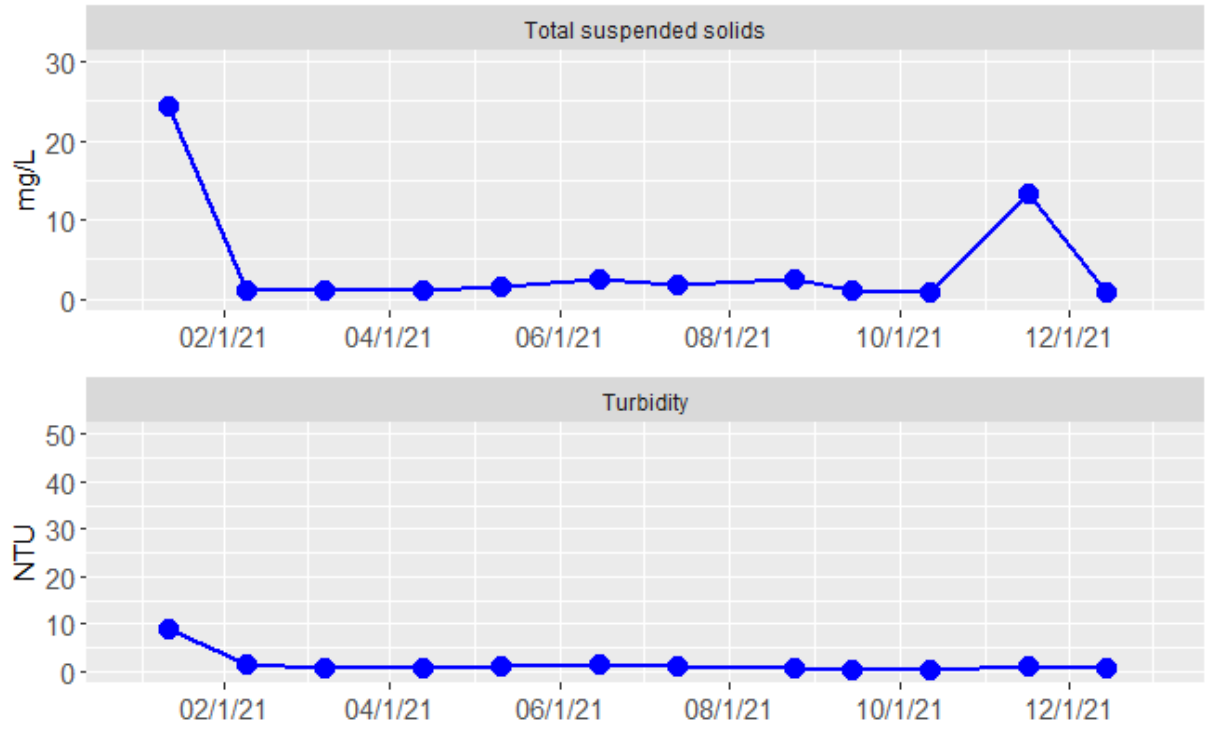
To meet Washington's recreational water-quality criteria, streams should average less than 100 CFU/100 mL of bacteria (dashed horizontal line in the graph below), with no more than 10% of samples above 320 CFU/100 mL (solid horizontal line). Zackuse Creek met this goal in 2021; samples in January and July had fairly high bacteria concentrations but still slightly below 320 CFU/100 mL. Isolated high bacteria concentrations like this are common in streams and tracking down periodic sources like this would be very difficult.

The King County microbiology lab measured fecal coliform in January 2021 before switching to *E. coli* for the rest of the year. This follows the change in Washington State's new recreational water-quality criteria, which call for measuring *E. coli* because it is a better predictor of the probability of getting sick from swimming.



Suspended sediment

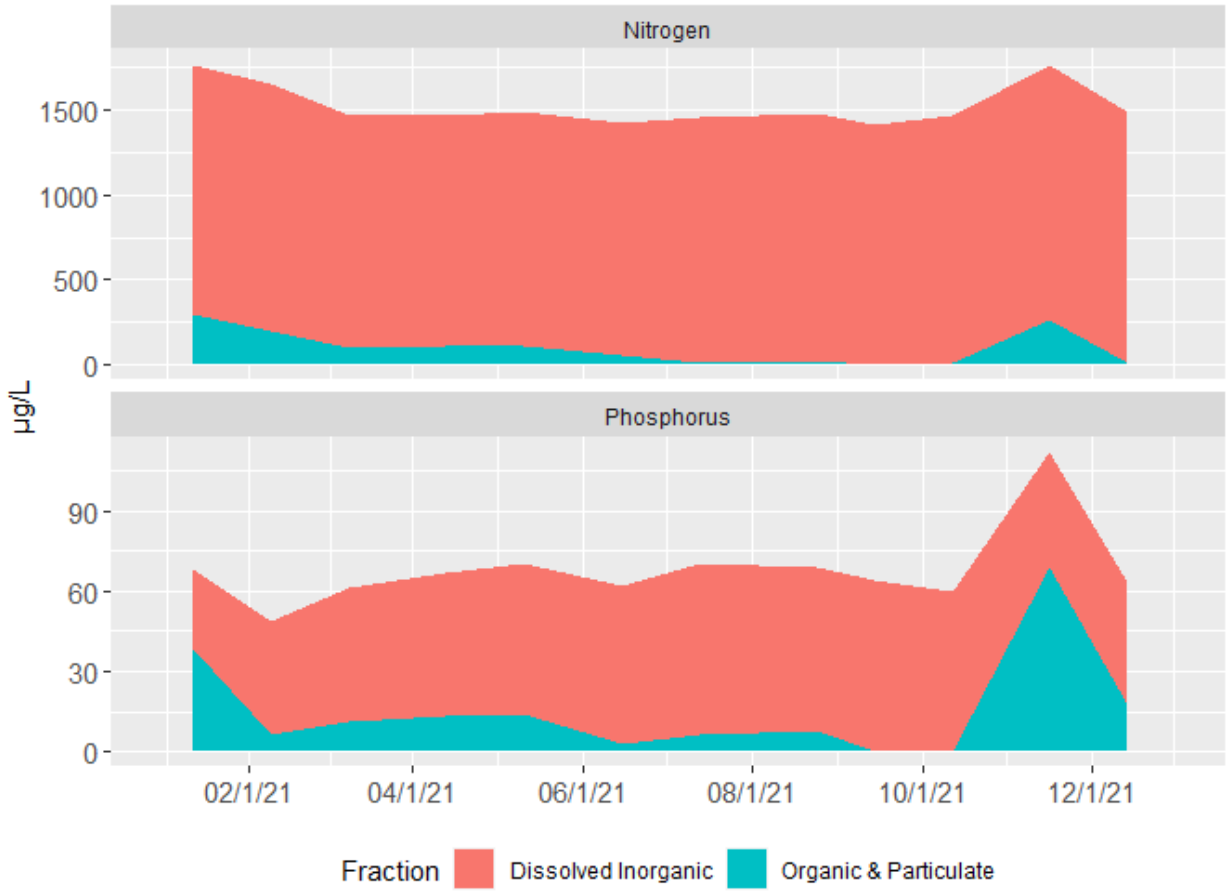
Sediment in the water was measured two ways: as the mass of total suspended solids (TSS), and as turbidity (an optical measurement). In 2021, suspended sediment values were reasonably low in Zackuse Creek. Note that these samples were collected only once per month and would not necessarily catch brief periods of high sediment during high-flow events.



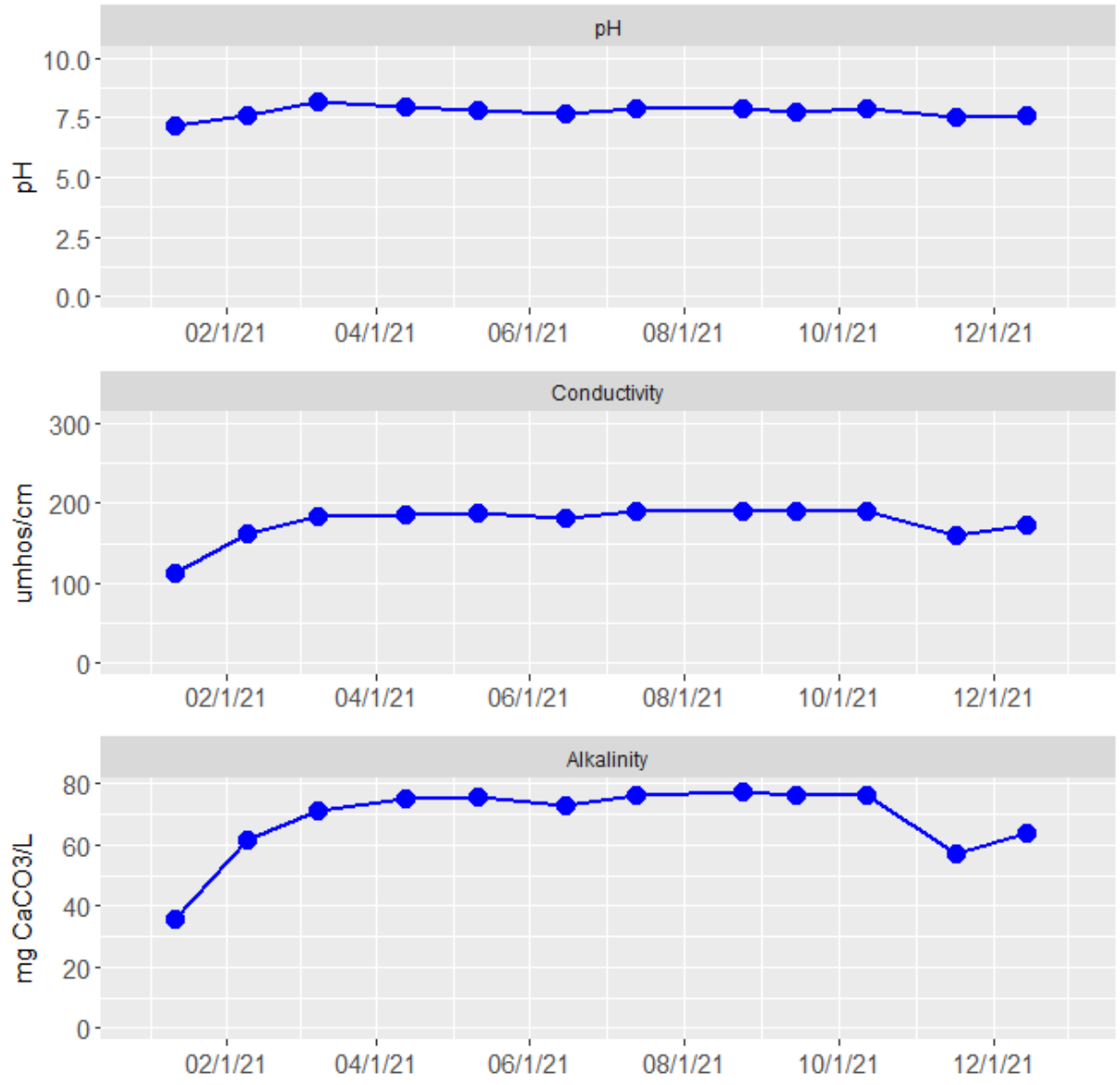
Nutrients

The following graphs show nitrogen and phosphorus concentrations, split out into two fractions: dissolved inorganic, and organic plus particulate. The dissolved-inorganic fraction can be taken up and used more readily by algae (many organic and particulate forms need to be decomposed first). These are stacked-area graphs; the total height of the colored area is the total concentration.

In 2021, Zackuse Creek continued to have fairly high nutrient concentrations. This is typical of streams in Sammamish and is not unique to Zackuse. Continuing to reduce nutrient inputs to these streams, especially phosphorus, would likely benefit Lake Sammamish. Lake Sammamish, designated a Water of Statewide Significance, has had a Lake Management Plan in place since 1994 to reduce phosphorus.



Conventionals



Upstream stream health

Starting in 2020, three new upstream sites were established for annual stream-health monitoring on Ebright, Laughing Jacobs, and Pine Lake Creeks. Benthic macroinvertebrate ("stream bug") diversity is measured at these new upstream sites each spring (May or early June). These three sites were chosen to help focus on portions of the watershed that are expected to develop or redevelop in the near future. Using data from these new upstream sites as well as from the existing monitoring sites near the stream mouth, we hope to detect whether this development/redevelopment has positive or negative effects on stream water quality.

These sites often go dry in the summer, so they are sampled before the usual macroinvertebrate summer sampling period of July-October. As a result, these sites' Benthic Index of Biotic Integrity (B-IBI) scores cannot be interpreted using the usual Excellent/Good/Fair/Poor thresholds. Those thresholds were developed for July-October samples, and for streams that do not dry up in the summer. Those thresholds are therefore not meaningful for these sites. We recommend focusing solely on how the B-IBI scores change over time rather than trying to interpret these scores as good or poor.

Unfortunately, in 2021 the sites on Ebright and Pine Lake Creeks went dry earlier than expected, and we were not able to sample those sites in 2021.

In 2021, the overall B-IBI score for Laughing Jacobs Creek was 6.1, compared to the 2020 score of 1.6. At least five years of data are recommended before assessing a trend.

Full results and individual taxon scores are available on the Puget Sound Stream Benthos website:

- Ebright Creek data: https://pugetsoundstreambenthos.org/Biotic-Integrity-Scores.aspx?k=EBR
- Laughing Jacobs Creek data: https://pugetsoundstreambenthos.org/Biotic-Integrity-Scores.aspx?k=LJU
- Pine Lake Creek data: https://pugetsoundstreambenthos.org/Biotic-Integrity-Scores.aspx?k=PINE

Riparian canopy cover

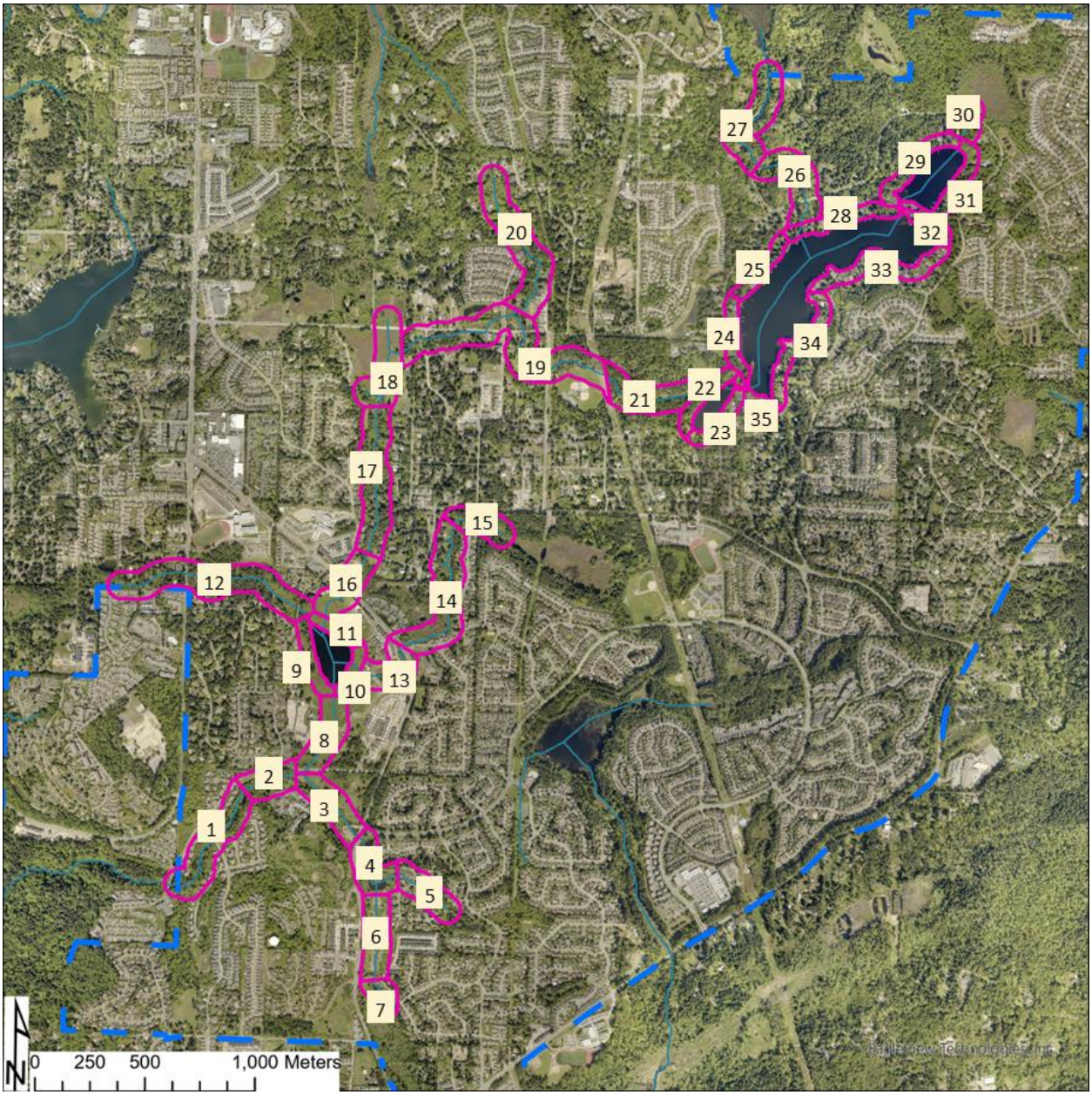
We measured riparian tree canopy cover for the basin containing Laughing Jacobs Creek and Beaver Lake, using aerial photos taken in 2019. Tree cover (presence/absence) was mapped within 60 m (200 ft) of streams and shorelines, on a grid of points 5 m apart. Full results are provided separately as a GIS file and high-resolution PDF map.

Total canopy cover in the riparian zone was 54%. We also divided the watershed into multiple reaches; in each reach, we calculated canopy cover for the entire 60-m riparian area plus 20-m and 10-m zones closest to the streams. Canopy cover within 10-20 meters of the stream is especially important for certain ecological functions such as shading and sediment reduction, helping keep the stream cool and clear for salmon and other animals. A map of the reaches is shown below, followed by a table of the canopy cover results for each reach.

Tree canopy cover was variable across this basin. Some reaches were well forested, especially the portions nearest to the stream, while other reaches had lower canopy cover and were mostly houses or fields. Wetland areas also had low canopy cover, as expected.

Repeated monitoring (currently planned for every 5 years) will be especially important to track canopy cover gains and losses over time, assess the effectiveness of ordinances and policies, and identify important areas to focus conservation and restoration work.

Map of watershed showing individual numbered reaches:



Canopy cover for each reach:

Reach	Land Cover	60 m	20 m	10 m
1	riparian buffer near homes	66	97	99
2	riparian buffer near homes	66	93	97
3	wetlands	38	54	67
4	wetlands	37	27	27
5	trees in neighborhood	31	24	23
6	wetlands	21	9	10
7	wetlands	54	47	34
8	fields	23	31	43
9	lake shoreline	43	48	45
10	lake shoreline	6	12	14
11	lake shoreline	31	31	24
12	trees and few homes	70	73	70
13	stormwater pond	12	18	24
14	riparian buffer near homes	53	72	74
15	riparian buffer near homes	77	81	81
16	fields and development	28	33	40
17	riparian buffer near homes	80	86	87
18	wetlands	19	15	12
19	trees in neighborhood	48	58	61
20	trees and few homes	65	79	83
21	trees	88	87	83
22	lake shoreline	83	92	93
23	lake shoreline	40	68	79
24	lake shoreline	65	100	100
25	lake shoreline	67	*NA*	*NA*
26	trees and homes	75	83	86
27	wetlands	76	67	55
28	lake shoreline	52	80	72
29	lake shoreline	61	27	33
30	trees and homes	76	92	96
31	lake shoreline	58	56	47
32	lake shoreline	78	60	45
33	lake shoreline	34	*NA*	*NA*
34	lake shoreline	59	*NA*	*NA*
35	lake shoreline	43	50	43

Note that along the lake shorelines, the 10-m and 20-m zones refer to areas within 10 or 20 m of a stream, respectively, not areas within 10 or 20 m of the lake shoreline. In contrast, the 60-m zone is areas within 60 m of either a stream or the lake shoreline. Some riparian areas along the lake shorelines do not contain a stream, and therefore those reaches do not include results for the 10-m or 20-m zones (shown as NAs).