



Portland Water District

Sebago Lake Watershed Monitoring Programs Tributary Monitoring (2019)

Kirsten Ness

Introduction

Sebago Lake is the primary drinking water supply for the greater Portland area. The Portland Water District (PWD) treats and delivers drinking water to over 200,000 people in 11 communities. PWD has a waiver from the filtration requirements of the federal Safe Drinking Water Act. There are many criteria for obtaining and keeping the waiver but one of the largest factors is the continued excellent water quality of Sebago Lake and PWD's watershed protection efforts. This waiver agreement requires ongoing monitoring of lake water quality.

PWD monitors Sebago Lake and the rivers and streams that drain to it through more than 10 monitoring and surveillance programs. In general, more samples are collected and tested for more parameters the closer one moves to the intake pipes, located in Lower Bay.

The water quality of Sebago Lake is influenced by many factors, one of which is the condition of the watershed. A watershed is the land area that drains to a water body. In the case of Sebago Lake, the watershed includes part or all of 24 towns from Standish to Bethel. The majority of the watershed is forested, and because forests act as a natural filter, the water quality of the lake is excellent.

The tributary run was created to be an indicator of conditions in the watershed. If problems arise on the land that drains to the lake, one would expect to see it in the tributaries first.

This report covers the Tributary Monitoring Program which includes 11 tributaries that drain to Sebago Lake. The Tributary Monitoring Program began in 1977 with the purpose of monitoring the health of the watershed.

Methods

Eleven tributaries to Sebago Lake are sampled at one location each for three parameters: total phosphorus, turbidity, and *Escherichia coli* (*E. coli*) bacteria (Figure 1). The tributaries include: 1952 Brook, Panther Run, State Park (Crooked River), Songo River, Muddy River, Northwest River, Rich Mill Outlet, Smith Mill, Sticky River, Standish Brook, and an un-named stream near St. Joseph's College. The State Park site is located on the Crooked River and is also part of the Crooked River Monitoring Program. Results for that site are discussed in the Crooked River report. The other ten tributaries will be discussed here.

Tributary sampling occurs monthly using a "dipper" that lowers sample bottles into the water, usually from a bridge over the tributary. *E. coli* and turbidity samples are collected monthly in sterile sample

bottles. Total phosphorus samples are collected four times per year (April, June, August, and October) in acid-washed glass flasks.

Total phosphorous samples are analyzed using the ascorbic acid method and a spectrophotometer in the Portland Water District's Water Quality Lab.

Turbidity is analyzed using a laboratory benchtop turbidimeter. In 2019, the Hach 2100N Turbidimeter was replaced with a Hach TU5200 Turbidimeter.

E. coli samples are analyzed using the IDEXX Colilert method and are incubated at 35 degrees Celsius for 24 hours.

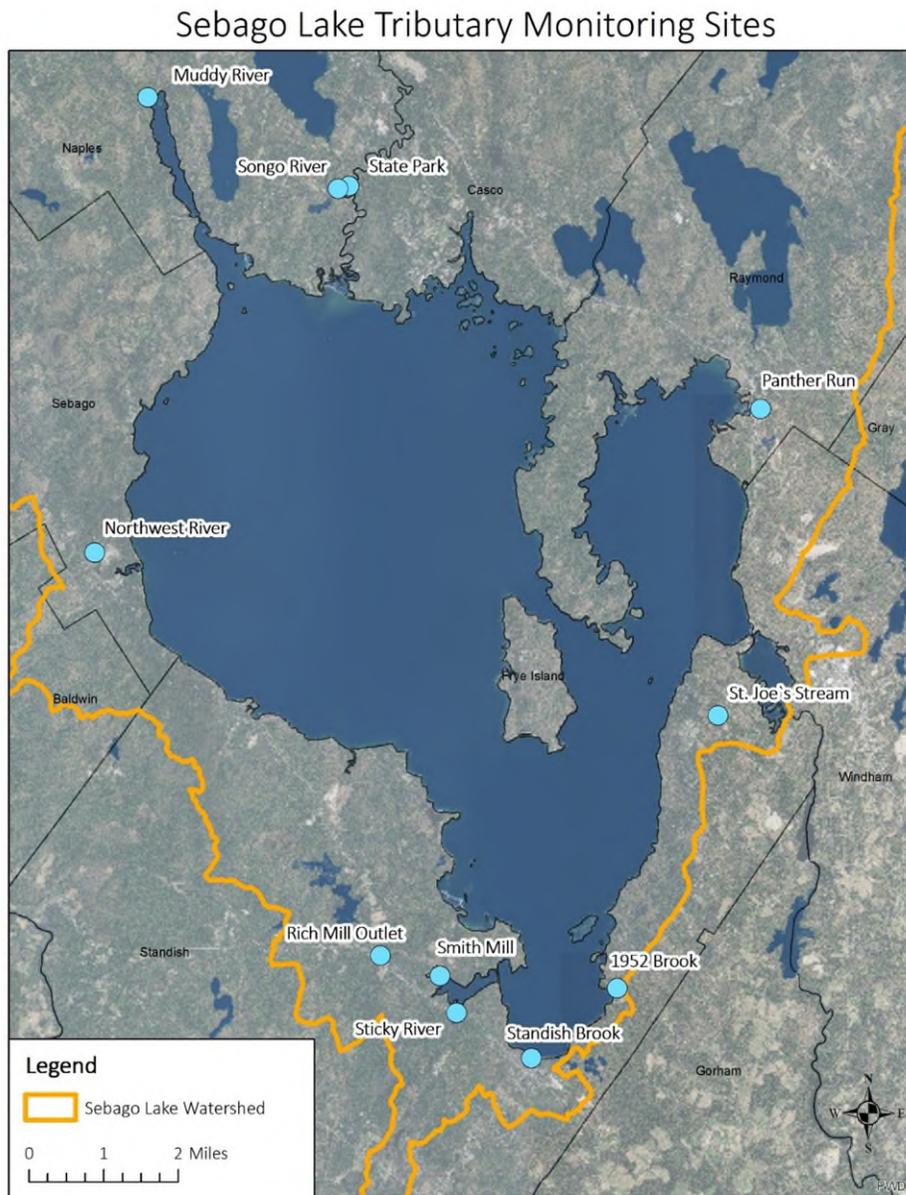


Figure 1: Tributary sampling sites location map for 2019.

Results and Discussion

Total Phosphorus

PWD measures phosphorus in the tributaries, because it is an important nutrient for plant growth. In lakes, the amount of the phosphorus in the water often limits the growth of algae. Increases in phosphorus in the water can lead to more algae growth and declines in water quality of a lake. Phosphorus levels tend to be higher in the tributaries than the lake but become diluted once the tributary waters reach Sebago Lake.

There are many forms of phosphorus in the environment. PWD measures total phosphorus, which includes both phosphates attached to sediment and dissolved forms of phosphorus. It is measured in parts per billion (ppb) or micrograms per liter (ug/L), and a reading of 35 ppb is the action level established by PWD. Sampling events that result in total phosphorus levels above 35 ppb are reviewed and appropriate corrective measures are taken if possible.

In 2019, total phosphorus levels exceeded the 35 ppb action level in St. Joe's stream during the June, August, and October sampling events (Table 1).

Table 1: Total phosphorus (ppb) results for 2019. Results above the action level are indicated by bolded text.

	1952 Brook	St. Joe's Stream	Panther Run	Songo River	Muddy River	Northwest River	Rich Mill	Smith Mill	Sticky River	Standish Brook
4/24/19	23.9	22.7	9.6	5.8	7.7	10.0	14.8	10.0	23.5	14.7
6/24/19	34.1	49.8	15.3	7.3	15.3	13.3	20.8	20.8	27.8	16.6
8/21/19	Dry	43.0	12.0	5.9	31.5	10.4	16.6	22.6	Flowing backwards	Dry
10/22/19	Stagnant	44.0	11.6	9.3	16.2	15.2	14.8	16.0	24.7	10.7

The causes of the high total phosphorus values in the St. Joe's stream are unknown. Often results above the action level are due to rain events but there were no significant storms prior to the June, August, or October sampling events. Because total phosphorus sampling has only been conducted on St. Joe's stream since 2017, there are not enough data to determine the typical range of values one might expect in the stream. The stream may have higher total phosphorus levels than the other tributaries.

Turbidity

Turbidity is the amount of suspended particulate matter in the water. In streams, the three major types of suspended particulates that contribute to turbidity are algae, detritus (dead organic material), and silt (inorganic or mineral suspended sediment). High turbidity decreases light penetration and facilitates eutrophication of lakes. Particulates also provide attachment sites for heavy metals such as cadmium, mercury and lead, many toxic organic contaminants such as PCBs, and many pesticides.

PWD measures turbidity using a turbidimeter, which is an instrument that passes a beam of light through a water sample and measures the light output on the other side. The greater the amount of suspended particulate matter in the water, the more the light beam is refracted and blocked, and the higher the turbidity reading. Turbidity is measured in NTU (nephelometric units). Generally, readings below 1 NTU indicate water that appears "clear" to the naked eye. Readings greater than 4 NTU indicate water that would appear cloudy or murky.

A reading of 4 NTU or greater is the action level established by the District. Values that exceed 4 NTU are reviewed and appropriate corrective measures taken if possible.

In 2019, 1952 Brook exceeded the action level for turbidity during the July sampling event (Table 2).

Table 2: Turbidity (ntu) results for 2019. Results above the action level are indicated by bolded text, and resampling results are indicated by italicized text.

	1952 Brook	St. Joe's Stream	Panther Run	Songo River	Muddy River	Northwest River	Rich Mill	Smith Mill	Sticky River	Standish Brook
1/15/19	Frozen	0.5	0.9	0.7	Frozen	1.0	0.6	1.2	Frozen	Frozen
2/19/19	Frozen	0.8	0.6	0.6	0.4	Frozen	0.9	0.6	Frozen	Frozen
3/13/19	Frozen	0.7	1.1	0.6	Frozen	0.4	0.9	0.6	Frozen	1.2
4/24/19	1.4	1.1	0.8	0.8	0.6	0.6	0.9	0.6	1.1	1.4
5/21/19	2.1	1.0	0.9	0.5	0.8	0.7	0.8	0.7	0.9	Lake flowing into brook
6/24/19	9.7	1.1	2.3	1.0	0.9	0.7	1.1	0.8	0.9	2.0
7/15/19	32.1	0.6	Flowing backwards	0.6	0.9	0.5	2.9	0.9	1.4	Not reaching lake
8/21/19	Dry	0.4	1.5	0.7	0.6	0.5	0.7	1.4	Flowing backwards	Dry
9/18/19	Dry	0.7	1.7	0.5	0.5	0.3	1.0	0.6	Flowing backwards	Dry
10/22/19	Stagnant	0.6	1.3	0.7	0.6	0.6	0.6	0.7	0.8	1.1
11/19/19	0.9	0.4	1.5	0.5	0.6	0.3	0.5	0.7	0.6	0.7
12/16/19	0.8	0.6	1.9	0.9	0.9	0.8	0.5	0.6	0.9	0.6

High turbidity levels in 1952 Brook can be attributed to large amounts of iron bacteria observed in the stream during the July sampling event. High turbidity results due to iron bacteria are typically not resampled because the presence of iron bacteria is a known cause of elevated turbidity levels in 1952 Brook.

***Escherichia coli* Bacteria**

E. coli is a type of fecal coliform bacteria that is found in the guts of warm-blooded animals and used as an indicator organism by water utilities. An indicator organism is a microorganism that is used to identify possible contamination and pathogens in a water sample. Because there can be multiple pathogens in water, it is not practical to test every sample for every pathogen, so *E. coli* is used to indicate the presence of pathogens in a water sample.

E. coli levels tend to be higher in the tributaries than the lake but the levels become diluted once the tributary water enters the lake. Natural occurrences can cause elevated *E. coli* levels. Examples include significant precipitation events that wash pollution from impervious surfaces and areas of development (animal feces, etc.) into the river, and the erosion of soil into the river since a small percentage of fecal bacteria is associated with soil.

The District's action level for *E. coli* is 235 CFU/100mL in accordance with the recommended level for beach closure under the Maine Healthy Beaches Program. Sampling events that result in *E. coli* levels above 235 CFU/100mL are reviewed or re-sampled if the cause is unknown.

In 2019, two tributaries exceeded the action level during the June sampling event, 1952 Brook exceeded the action level during the July sampling event, and St. Joe’s Stream exceeded the action level during the November sampling event (Table 3).

Table 3: *E. coli* (MPN/100mL) data for 2019. Results above the action level are indicated by bolded text, and resampling results are indicated by italicized text.

	1952 Brook	St. Joe’s Stream	Panther Run	Songo River	Muddy River	Northwest River	Rich Mill	Smith Mill	Sticky River	Standish Brook
1/15/19	Frozen	10	1	0	Frozen	2	0	1	Frozen	Frozen
2/19/19	Frozen	1	0	0	6	Frozen	59	23	Frozen	Frozen
3/13/19	Frozen	201	3	1	Frozen	5	10	1	Frozen	1
4/24/19	3	6	9	1	5	12	10	11	22	40
5/21/19	9	79	2	11	57	16	7	Laboratory error	11	Lake flowing into brook
6/24/19	96	22	727	77	77	88	70	54	17	411
6/26/19										125
7/15/19	325	15	Flowing backwards	96	29	7	110	86	4	Not reaching lake
7/17/19	243									
8/21/19	Dry	10	73	78	8	75	26	148	Flowing backwards	Dry
9/18/19	Dry	2	9	25	1	34	17	74	Flowing backwards	Dry
10/22/19	Stagnant	39	15	9	24	38	6	7	48	161
11/19/19	50	378	50	1	63	5	11	16	5	27
11/20/19		<i>187</i>								
12/16/19	28	16	20	6	58	75	7	11	108	16

The *E. coli* level was high at Panther Run during the 6/24/19 sampling event. PWD staff did not resample the tributary because high levels have been recorded annually during June sampling events since 2015. In 2017, PWD staff conducted a survey of the land that borders the tributary, as well as a survey of the stream itself upstream of the sample site. In 2018, PWD staff repeated the instream survey upstream of the sample site. During both surveys, the likely cause of the high *E. coli* levels was determined to be water fowl upstream of the sample site. The *E. coli* levels fell below the action level during the August sampling event in 2019. If the *E. coli* levels had remained high during the August sampling event, additional sampling and investigation would have been conducted.

The *E. coli* level was high in Standish Brook during the June sampling event. Often, results above the action level are due to weather events prior to sampling but there was no precipitation in the days preceding sampling. The cause of the high result is unknown, and the *E. coli* level fell below the action level upon resampling.

The *E. coli* level was high in 1952 Brook during the July sampling event. The brook was resampled and the level remained high, likely due to low water levels in the brook during the sampling events. The water level was too low for an additional resample, and the brook was dry during the August and September sampling events. The *E. coli* level was below the action level during the November sampling event.

The *E. coli* level was high in St. Joe's Stream during the November sampling event. There was a rain event the day before and the day of sampling which is the likely cause of the high result. The *E. coli* level fell below the action level upon resampling.

Conclusion

This sampling program provides a "snapshot" determination of the health of the major tributaries to Sebago Lake. Samples that exceed established action limits are investigated and re-sampled if necessary. Because sampling occurs on a monthly basis, it is difficult to determine a continuous water quality trend from the data. Rather, this program reflects the variability of water quality in response to both environmental and human factors.

In 2019, weather and other events were the most likely causes of exceedances of action levels in some tributaries. The number of exceedances in 2019 were within the normal range and the overall water quality in the tributaries remained high during the sampling events in 2019. However, continued monitoring of the tributaries is necessary. The tributaries empty directly into Sebago Lake, and reductions in water quality in these streams could affect the health of the lake.