



Portland Water District

Sebago Lake Watershed Monitoring Programs Crooked River Monitoring (2020)

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Introduction

Sebago Lake is the primary drinking water supply for 200,000 people in 11 Greater Portland communities. Lake water was first pumped to Portland in 1869, from an intake located in the southernmost part of the lake, referred to as Lower Bay. In 1908, the Portland Water District was chartered by the Maine Legislature to provide water and wastewater services to the region. Since its inception, the District has been actively monitoring and working to protect Sebago Lake.

In 1993, the District was granted a waiver to the filtration requirements of the federal Safe Drinking Water Act based in part on the purity of the water and the effectiveness of watershed protection efforts. This waiver agreement requires ongoing monitoring of lake water quality. The District maintains more than 10 monitoring and surveillance programs throughout the watershed and lake. In general, as one moves closer to the intakes, more samples are collected and tested for more parameters.

The Crooked River originates at the southern end of Songo Pond in Bethel and meanders southward for approximately 38 miles to its junction with the Songo River near the State Park in Naples, Maine. The two rivers then wind two more miles to their outlet in the northernmost part of Sebago Lake. The District has monitored the Crooked River for over 40 years. Since the Crooked contributes nearly 40% of the surface inflow to the lake, it is the most important tributary we monitor.

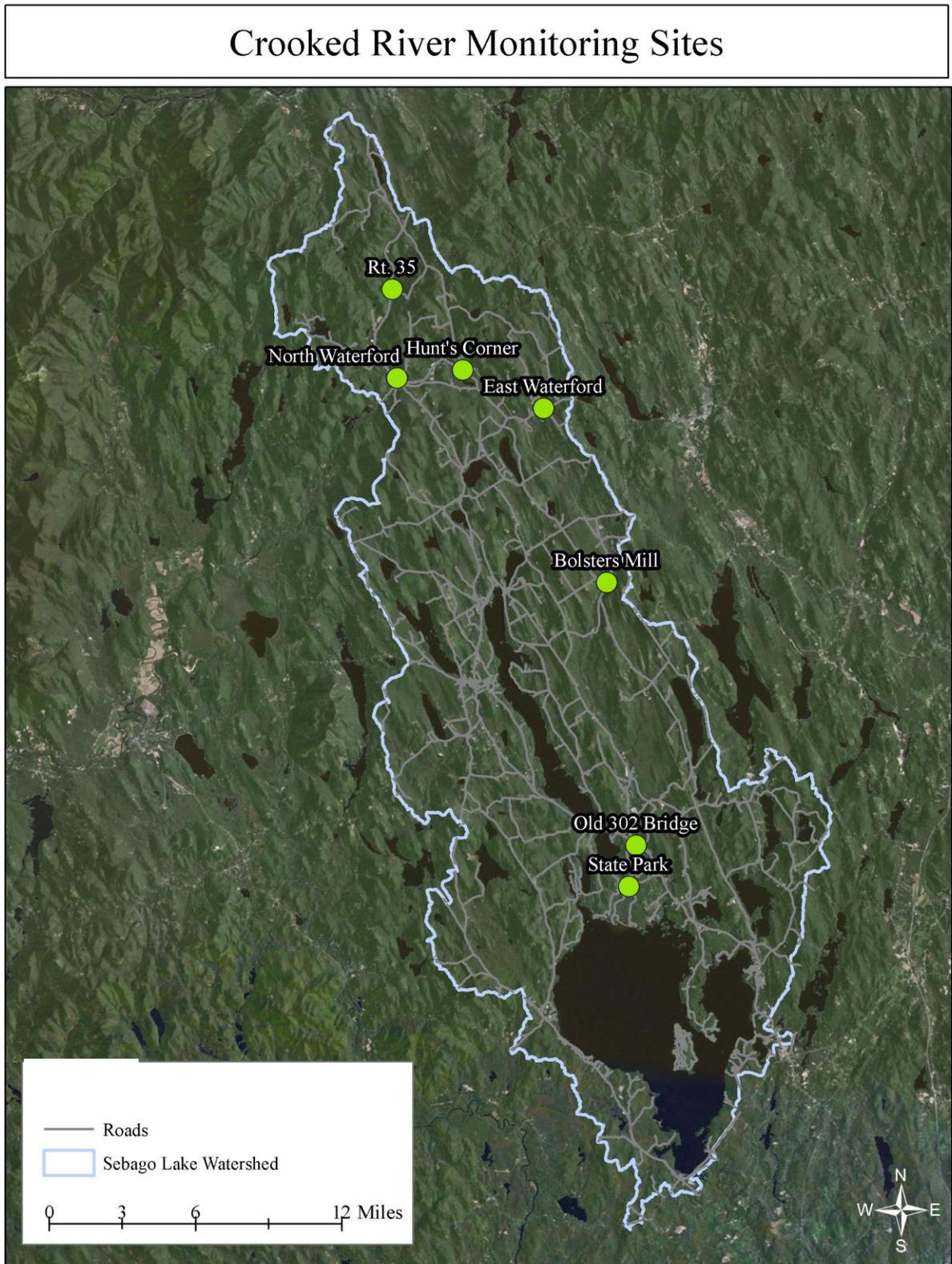
Methods

The Crooked River is monitored four times a year from the Sebago Lake State Park in Naples to a bridge on Rt. 35 in Albany for the following analytes: turbidity, total phosphorus, and *E. coli* bacteria. A total of seven sites are monitored as part of the program. These sites listed from North to South are as follows: Route 35, North Waterford, Hunt's Corner, East Waterford, Bolster's Mills, Old 302 Bridge, and State Park (see Figure 1). Of these sites, the southern-most sampling point (State Park) has been monitored for the longest period of time, and at the highest frequency. This is due in part to the fact that this site is also included in the Tributary Monitoring Program (see the 2020 Tributary Monitoring Report). For the purposes of this report, data from the State Park site will be used to characterize the Crooked River's overall contribution to Sebago Lake. All data collected from this site are presented.

Sampling is performed using a "dipper" to lower acid-washed total phosphorus collection flasks and sterilized bacteria collection bottles into the water, usually from a bridge over the river. Total phosphorous samples are analyzed using the ascorbic acid method and a spectrophotometer in the District's water quality laboratory. *E. coli* samples are analyzed using the Colilert method and are incubated at 35 degrees Celsius for 24 hours. Turbidity is analyzed using a laboratory benchtop turbidimeter. In 2019, the Hach 2100N Turbidimeter was replaced with a Hach TU5200 Turbidimeter.

Data presented in this report pertain to data collected at the State Park sample site as a measure of the overall contribution of total phosphorus, *E. coli* bacteria, and turbidity from the Crooked River to Sebago Lake. Data from all seven sample sites for 2020 are included in the appendix of this report.

Figure 1.



Results and Discussion

Total Phosphorus

Phosphorus is one of the major nutrients needed for plant growth. It is generally present in relatively small amounts in temperate lakes. Phosphorous is often the limiting nutrient for algal growth in the system, meaning that as phosphorus increases, the amount of algae also increases. Phosphorus levels are generally higher in flowing tributaries than in a lake. When tributary water enters a lake, phosphorus becomes diluted and sediments with phosphorus attached settle out on the lake bottom. Total phosphorus includes phosphates attached to sediment as well as dissolved forms of phosphorus and is measured in parts per billion (ppb). A reading of 35 ppb is the action level established by the District. Sampling events that result in total phosphorus levels above 35 ppb are reviewed and appropriate corrective measures are taken if possible.

Total phosphorus has been monitored at the State Park sampling site since 1977, at Bolster's Mills, East Waterford, Hunt's Corner, North Waterford, and Route 35 since 1993, and at the Old 302 Bridge site since 1995.

Total phosphorus concentrations did not exceed the action level at the State Park in 2020. Elsewhere on the river, only one sample exceeded the action level in 2020. On 4/28/20 a reading of 54.7 ppb was obtained from Bolster's Mill the day after 0.7 inches of rain fell and while the river was experiencing high spring flows. In addition, two geese were spotted on the river, upstream of the sample site. The Bolster's Mill site was re-sampled on 5/19/20 and the total phosphorus had dropped below the action level with a reading of 13.6 ppb. During the time period of 1977 to 2019, total phosphorus levels at the State Park ranged from 5 ppb to 126 ppb. In 2020 State Park total phosphorus levels ranged from 8 ppb to 13 ppb (Table 1). This range in the data can often be attributed to the presence or absence of precipitation events that cause erosion of river banks and runoff from developed areas to enter the river.

Table 1. 2020 Total phosphorus (ppb) results for the State Park site on the Crooked River, Naples, ME. No total phosphorus samples exceeded the action level in 2020.

4/29/2020	13.0
6/8/2020	8.4
6/17/2020	12.2
8/17/2020	Flowing backwards
8/19/2020	Flowing backwards
10/7/2020	12.3
10/26/2020	13.2

***Escherichia coli* Bacteria**

E. coli bacteria is a type of fecal coliform bacteria found in the gastrointestinal tracts of warm-blooded animals. The presence of *E. coli* in water is a strong indication of recent sewage or animal waste contamination. Sewage may also contain many other types of disease-causing organisms such as Giardia, Cryptosporidium, typhoid, viral and bacterial gastroenteritis, and hepatitis A. Natural occurrences can also 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. *E. coli* levels tend to be higher in the tributaries but become diluted when the tributary water enters the lake. The District's action level for *E. coli* is 235 MPN/100 mL in accordance with the Maine Healthy Beaches Program. Sampling events that result in *E. coli* levels above 235 MPN/100mL are reviewed or re-sampled if the cause is unknown.

E. coli levels did not exceed the action level at the State Park or any other site on the Crooked River in 2020. During the time period of 2009-2020 *E. coli* levels ranged from 2 MPN/100 mL to 613 MPN/100 mL at the State Park. In 2020, *E. coli* levels ranged from 10 MPN/100 mL to 179 MPN/100 mL at the State Park (Table 2). On two sampling days in August the river was flowing backwards due to the drought and low water level in the river so it was not sampled.

Table 2. 2020 *E. coli* (MPN/100 mL) results for the State Park site on the Crooked River, Naples, ME. No *E. coli* samples from the State Park exceeded the action level in 2020.

1/22/2020	Frozen
2/11/2020	Frozen
4/28/2020	27
4/29/2020	10
5/26/2020	26
6/8/2020	133
6/17/2020	75
7/21/2020	179
8/17/2020	Flowing backwards
8/19/2020	Flowing backwards
9/14/2020	124
10/7/2020	48
10/26/2020	41
11/23/2020	39
12/18/20	Frozen

Turbidity

Turbidity refers to the amount of suspended particulate matter in the water. Turbidity measurements are performed through the use of a turbidimeter, in which a beam of light is passed through a water sample and the light output is measured 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. 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 rivers and lakes. Particulates also provide attachment sites for heavy metals such as cadmium, mercury and lead, and many toxic organic contaminants such as PCBs and many pesticides. 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 4.0 NTU or greater is the action level determined by the District’s Environmental Services Department. Values of 4.0 NTU or higher are reviewed, the site is resampled, and appropriate corrective measures are taken if possible.

In 2020 turbidity values ranged from 0.5 to 1.4 NTU at the State Park site (Table 3). No turbidity readings were above the action level at the State Park or any other site on the river. On two sampling days in August the river was flowing backwards due to the drought and low water level in the river so it was not sampled.

Table 3. 2020 Turbidity (NTU) results for the State Park site on the Crooked River, Naples, ME. No turbidity samples from the State Park exceeded the action level in 2020.

1/22/2020	Frozen
2/11/2020	Frozen
4/28/2020	0.8
4/29/2020	1.2
5/26/2020	1.0
6/8/2020	0.5
6/17/2020	1.1
7/21/2020	1.2
8/17/2020	Flowing backwards
8/19/2020	Flowing backwards
9/14/2020	1.1
10/7/2020	1.0
10/26/2020	0.9
11/23/2020	1.4
12/18/20	Frozen

Conclusion:

This sampling program provides a “snapshot” determination of the health of the Crooked River. Samples that exceed established action levels are re-sampled and investigated if necessary. Because sampling occurs four times a year, 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.

The total phosphorus levels in 2020 remained consistent with historical data, with one reading at the Bolster’s Mill above the 35 ppb action level. No other sites on the river had levels above 35 ppb in 2020.

E. coli bacteria levels obtained at the State Park in 2019 remained consistent with historical fecal coliform bacteria and *E. coli* data, with no readings above the 235 MPN/100 mL action level. No other sites on the River had any results over the action level, making it a particularly good sampling season.

Turbidity levels in the Crooked River in 2020 also remained within the historical range. No turbidity readings exceeded the action level.

Overall, the Crooked River appears to have generally stable water quality. Continued monitoring of the river is necessary as the Crooked River contributes more surface inflow to Sebago Lake than any other tributary and a reduction in water quality in the Crooked River could reduce water quality in the lake.

Appendix: Crooked River Data 2020

Sample Date	Site	Turbidity (NTU)	Total Phosphours (ppb)	<i>E. coli</i> (MPN/100mL)	Re-sample date	Total Phosphorus Re-sample
1/22/2020	State Park	Frozen		Frozen		
2/11/2020	State Park	Frozen		Frozen		
4/28/2020	State Park	0.8	Flask broke	27		
4/28/2020	Old 302 Bridge	0.7	13.5	19		
4/28/2020	Bolster's Mill	0.7	54.7	19	5/19/2020	13.6
4/28/2020	E. Waterford	0.7	12.9	22		
4/28/2020	Hunt's Corner	0.5	10.1	14		
4/28/2020	N. Waterford	1.1	11.0	11		
4/28/2020	Rte. 35	0.6	9.7	13		
4/29/2020	State Park	1.2	13.0	10		
5/26/2020	State Park	1.0		26		
6/8/2020	State Park	0.5	8.4	133		
6/8/2020	Old 302 Bridge	1.1	15.5	131		
6/8/2020	Bolster's Mill	1.1	17.0	36		
6/8/2020	E. Waterford	1.1	14.6	74		
6/8/2020	Hunt's Corner	0.9	15.7	70		
6/8/2020	N. Waterford	1.4	17.4	60		
6/8/2020	Rte. 35	1.3	15.8	62		
6/17/2020	State Park	1.1	12.2	75		
7/21/2020	State Park	1.2		179		
8/17/2020	State Park	Flowing backwards	Flowing backwards	Flowing backwards		
8/17/2020	Old 302 Bridge	0.8	11.0	115		
8/17/2020	Bolster's Mill	1.6	12.3	55		
8/17/2020	E. Waterford	1.1	8.8	88		
8/17/2020	Hunt's Corner	0.8	8.2	153		
8/17/2020	N. Waterford	1.0	9.7	81		
8/17/2020	Rte. 35	1.3	13.1	91		
8/19/2020	State Park	Flowing backwards	Flowing backwards	Flowing backwards		
9/14/2020	State Park	1.1		124		
10/7/2020	State Park	1.0	12.3	48		
10/26/2020	State Park	0.9	13.2	41		
10/26/2020	Old 302 Bridge	0.9	12.3	88		
10/26/2020	Bolster's Mill	1.1	12.8	43		
10/26/2020	E. Waterford	1.1	12.3	23		
10/26/2020	Hunt's Corner	0.9	12.2	21		

10/26/2020	N. Waterford	1.0	12.0	23		
10/26/2020	Rte. 35	1.1	12.9	29		
11/23/2019	State Park	1.4		39		
12/18/2019	State Park	Frozen		Frozen		