

Sebago Lake Watershed Monitoring Programs

Crooked River Monitoring - 2025

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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 Crooked River 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 Crooked River Monitoring Program. 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 48 years. Since the Crooked contributes nearly 40% of the surface inflow to the lake, it is the most important tributary we monitor.

Methods

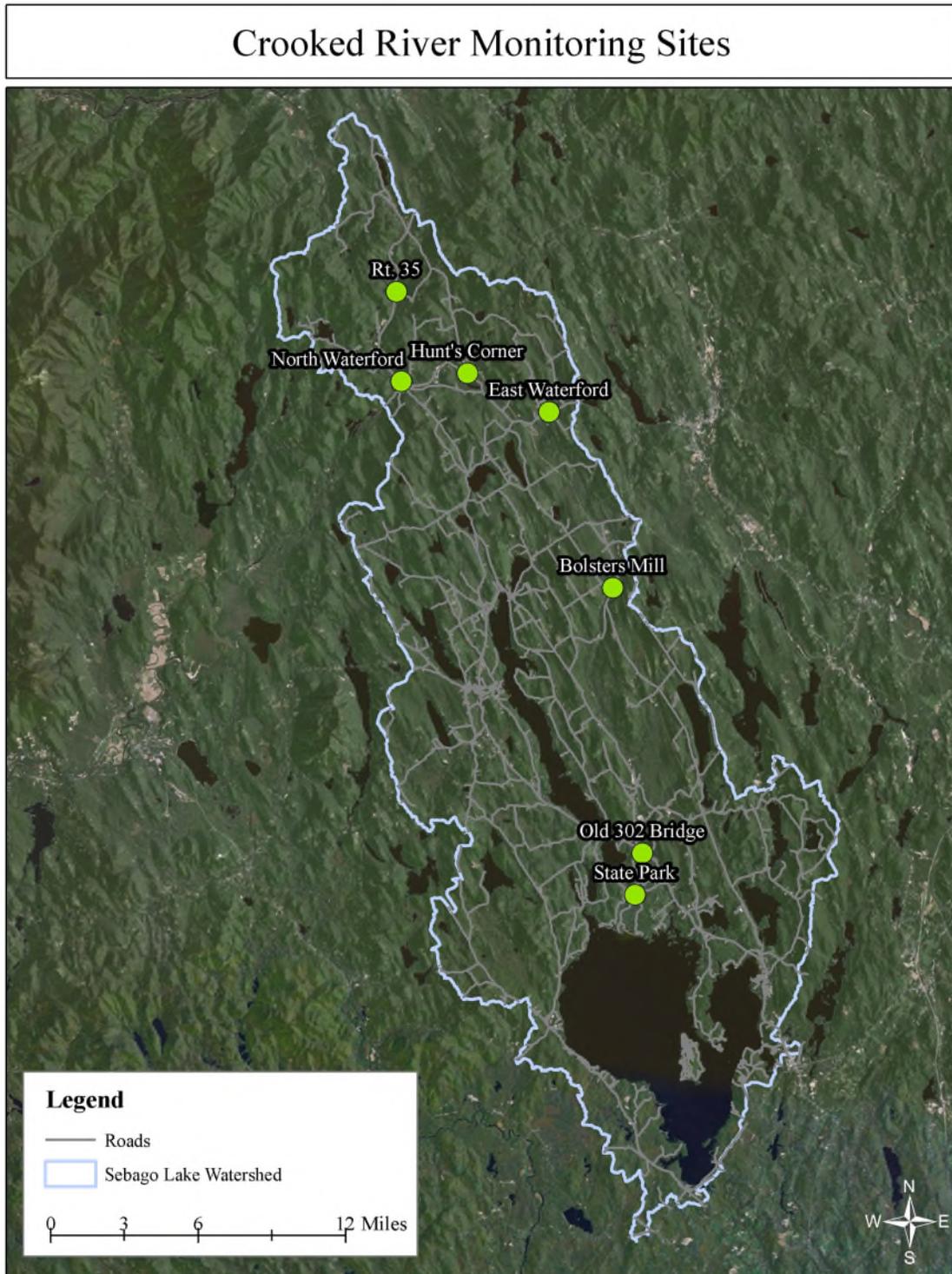
The Crooked River is monitored four times a year from the Sebago Lake State Park in Naples to a bridge on Rt. 35 in Albany Township for the following analytes: turbidity, total phosphorus, and *E. coli* bacteria. A total of seven sites are monitored as part of the program. These sites listed from North 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 2025 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 IDEXX 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 2025 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. Phosphorus 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.

While no total phosphorus concentrations exceeded the action level at the State Park in 2025, one sample did at the Bolster's Mills site with a reading of 62.6 ppb on June 16th. The cause of the high Bolster's Mills reading is unknown, though it was noted that pigeons were roosting under the bridge at the time of sampling.

To determine if 2025 data are normal results, the mean (M) and standard deviation (SD) are calculated for the State Park data set. A value that is within two standard deviations of the mean is considered normal, and those outside are outside of the normal range. In 2025 State Park total phosphorus levels ranged from 8.7 ppb to 27.1 ppb (Table 1) and all levels were within the normal range (M=16.1, +2SD=40.7) for data collected from 1977 to 2024 at the State Park.

Table 1. 2025 Total phosphorus (ppb) results for the State Park site on the Crooked River, Naples, ME. No total phosphorus samples exceeded the action level in 2025.

4/7/2025	27.1
4/14/2025	11.9
6/9/2025	24.5
6/16/2025	14.3
8/4/2025	14.5
8/25/2025	8.7
10/6/2025	13.4
10/27/2025	20.9

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.

While no *E. coli* levels exceeded the action level at the State Park in 2025, one sample did at the Hunt's Corner site with a reading of 411 MPN/100mL on October 6th. The site was re-sampled on October 8th during a rain event and, not surprisingly, the result was over the action level with a reading of 345 MPN/100 mL. The site was re-sampled a second time on October 14th and the *E. coli* had dropped below the action level to 120 MPN/100mL. The cause of the first elevated reading was unknown but Maine was experiencing extreme drought conditions at the time and the water level in the river was unusually low. Additionally, the site is just downstream from a wetland where waterfowl could be contributing to elevated results. To determine if 2025 data are normal results, the mean (M) and standard deviation (SD) are calculated for the State Park data set. A value that is within two standard deviations of the mean is considered normal, and those outside are outside of the normal range. In 2025 *E. coli* levels ranged from 11 MPN/100 mL to 225 MPN/100 mL at the State Park (Table 2). One 2025 result was outside of the normal range (M=57, +2SD=203) for data collected from 2009 to 2024 at the State Park.

Table 2. 2025 *E. coli* (MPN/100 mL) results for the State Park site on the Crooked River, Naples, ME. No *E. coli* samples exceeded the action level in 2025.

1/27/2025	Frozen
2/10/2025	Frozen
3/31/2025	14
4/7/2025	16
4/14/2025	20
5/12/2025	152
6/9/2025	225
6/16/2025	53
7/23/2025	142
8/4/2025	84
8/25/2025	74
9/25/2025	44
10/6/2025	49
10/27/2025	19
11/8/2025	11
12/22/2025	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 including 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.

No turbidity readings exceeded the action level at the State Park or any other sites on the Crooked River in 2025. To determine if 2025 data are normal results, the mean (M) and standard deviation (SD) are calculated for the State Park data set. A value that is within two standard deviations of the mean is considered normal, and those outside are outside of the normal range. In 2025 turbidity values ranged from 0.5 NTU to 1.8 NTU at the State Park (Table 3). No turbidity results collected at the State Park were outside the normal range (M=1.5, +2SD=4.1) for data collected from 1977 to 2024 at the State Park.

Table 3. 2025 Turbidity (NTU) results for the State Park site on the Crooked River, Naples, ME. No turbidity samples exceeded the action level in 2025.

1/27/2025	Frozen
2/10/2025	Frozen
3/31/2025	0.5
4/7/2025	1.8
4/14/2025	0.6
5/12/2025	2
6/9/2025	1.8
6/16/2025	1.2
7/23/2025	1.2
8/4/2025	1.6
8/25/2025	0.85
9/25/2025	0.8
10/6/2025	0.98
10/27/2025	0.9
11/8/2025	0.7
12/22/2025	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 under various weather conditions, 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.

Overall, water quality remained high during the sampling events in 2025. 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 2025

Sample Date	Site	<i>E. coli</i> (MPN/100mL)	Turbidity (NTU)	Total Phosphours (ppb)
3/31/2025	State Park	14	0.54	
4/7/2025	State Park	16	1.82	27.1
4/7/2025	Old Rt 302 Bridge	6	1.01	20.3
4/7/2025	Bolsters Mills	12	0.68	11.1
4/7/2025	E. Waterford	3	0.99	10.1
4/7/2025	Hunts Corner	5	0.57	10.6
4/7/2025	N. Waterford	0	0.39	9.2
4/7/2025	Route 35	3	0.34	8.5
4/14/2025	State Park	20	0.60	11.9
5/12/2025	State Park	152	2.02	
6/9/2025	State Park	225	1.84	24.5
6/16/2025	State Park	53	1.23	14.3
6/16/2025	Old Rt 302 Bridge	45	1.36	14.8
6/16/2025	Bolsters Mills	31	1.53	62.6
6/16/2025	E. Waterford	32	1.50	15.9
6/16/2025	Hunts Corner	51	1.01	17.7
6/16/2025	N. Waterford	131	0.97	13.7
6/16/2025	Route 35	44	0.99	10.7
7/23/2025	State Park	142	1.24	
8/4/2025	State Park	84	1.59	14.5
8/4/2025	Old Rt 302 Bridge	72	0.79	12.4
8/4/2025	Bolsters Mills	43	1.00	16.2
8/4/2025	E. Waterford	77	1.06	11.5
8/4/2025	Hunts Corner	115	0.77	11.2
8/4/2025	N. Waterford	120	0.94	11.7
8/4/2025	Route 35	30	0.99	13.8
8/25/2025	State Park	74	0.85	8.7
9/24/2025	State Park	44	0.80	
10/6/2025	State Park	49	0.98	13.4
10/6/2025	Old Rt 302 Bridge	17	0.56	11.7
10/6/2025	Bolsters Mills	10	0.86	11.8
10/6/2025	E. Waterford	20	0.79	10.1
10/6/2025	Hunts Corner	411	0.78	10.3
10/6/2025	N. Waterford	45	0.68	15.9
10/6/2025	Route 35	4.1	0.68	11.7
10/8/2025	Hunts Corner	345		
10/14/2025	Hunts Corner	120		
10/27/2025	State Park	19	0.87	20.9
11/18/2025	State Park	11	0.7	