The City of WORCESTER

Lake Quinsigamond 2022 Winter Monitoring Plan and Results Following the Sewer Overflow at the Lake Ave Pump Station

6.10.22

The Lakes and Ponds Program (L&P) is committed to preserving and protecting our Blue Spaces for recreational value and ecosystem services. We accomplish this through water quality monitoring, lake management, and community outreach activities.

I. BACKGROUND

On the morning of Sunday February 6th, the City of Worcester Department of Public Works and Parks (DPW&P) Sewer Operations staff responded to an alarm at the Lake Ave Pump Station to find the parking lot flooded and station overflowing into the lake. Further inspection showed that the dry well, which is where the 4 pumps and monitors are located, was full of water, and pumps were stopped. Crews worked around the clock to pump and dry out the dry well and restart one of the pumps, which ultimately occurred on the evening of the 7th, 36 hours after the incident began. During this time, 5.75 million gallons of untreated wastewater entered Lake Quinsigamond. While the details of why this happened are still under investigation, preliminary reports of the event and response can be found on the City of Worcester webpage.

II. INITIAL PUBLIC HEALTH RESPONSE

DPW&P alerted city officials and the Lakes and Ponds program within an hour of learning of the event, and the Program, in turn, contacted the Lake Quinsigamond Watershed Association, the Lake Quinsigamond Commission, as well as the Town of Shrewsbury, who reached out to their networks. The City of Worcester Department of Inspectional Services (DIS) released a Recreational Contact Advisory for the portion of the lake south of the Route 9 bridge, with the understanding that the lake has a low but measureable flow from north to south. The lake would remain closed until sampling results determined that there was no risk of exposure to concentrations of fecal bacteria above the recreational threshold.

III. ENVIRONMENTAL AND PUBLIC HEALTH CONCERNS

L&P began to consider the potential impact of the discharge event on the lake. Wastewater in recreational lakes is cause for concern from both a public health and ecosystem health perspective. Wastewater contains three elements that may be harmful to humans and lake wildlife: (1) fecal bacteria, (2) organic materials, and (3) other compounds of concern that people send down the drain. Each of these elements has different health and environmental effects, as well as analyses to measure them.

(1) *Fecal bacteria.* Fecal bacteria are the bacteria that are found in the intestine of warm blooded animals, and can make people sick if they come in contact with them. For this reason, the Commonwealth of Massachusetts has standards for fecal bacteria at bathing beaches that must be met for them to remain open. Fecal bacteria are measured using the indicator parameter *E. coli*, which is collected in a grab sample from a location. In the present overflow event, the lake was closed immediately on the assumption it exceeded recreational thresholds for bacteria.

While dangerous to come in contact with, fecal bacteria cannot live for very long outside of a warm blooded animal, and are degraded quickly in cold or sunny conditions. Previously neither

L&P nor other monitoring programs have ever witnessed threshold-exceeding concentrations ("exceedances") in the middle of any Worcester lake, even if beach closures were occurring near shore. Regardless, due to the volume of the discharge there was concern about the potential of bacteria surpassing thresholds and affecting winter recreational activities like ice fishing outside of the immediate proximity of the pump station.

(2) *Organic materials*. Organic materials contain nutrients like nitrogen and phosphorus that are the food sources of lake microorganisms, such as algae and bacteria. While nutrients are not inherently dangerous to humans or wildlife, if these organisms are active and able to digest them in high quantities, it may result in their excessive proliferation. As they grow and reproduce, they respire dissolved oxygen (DO) much faster than the larger organisms, like fish, and can deplete it in the short term, causing fish kills. Nutrient concentrations can be determined in grab samples of water using laboratory testing, and oxygen levels can be measured using handheld DO probes.

Lake Quinsigamond suffers from DO stress, but generally only during the warmer months. There are several explanations for this: Lake water in the winter is colder and can therefore hold more DO. In the winter, metabolic activity is lower for organisms in general, meaning organisms have lower rates of respiration, and oxygen levels will not be depleted as quickly. If there is a localized low oxygen event, fish are able detect it and move to areas where DO is high. Because of these factors, L&P did not predict large scale fish kills to result from this event, but wanted to ensure that when the water warmed up, the situation did not change as organisms are more able to digest nutrients.

(3) *Other compounds.* Other compounds found in waste water include any item that has entered the sewer system. These compounds are generally found in much lower concentrations than the above parameters. One challenge to measuring these compounds is their varied nature, including metals, solvents, personal care products, and pharmaceuticals. After contacting Upper Blackstone Clean Waters (Worcester's sewage treatment facility) as well as a contracted laboratory, L&P determined that a suite of tests including 45 volatile organic compounds and 14 metals could be used as indicators of other contaminants.

While there are certainly dangerous items that are introduced into the sewer system, conversations with Massachusetts Fish and Wildlife (MassWildlife) indicated that the concern for the effect of these compounds was lower than the first two noted above. The dilution of these compounds in the sewer system, and then again in the greater lake, would likely make their concentrations largely undetectable. Exposure to these compounds generally needs to be chronic for negative effects on fish and wildlife to occur, and no long term consequences were expected.

IV. WATER QUALITY MONITORING PLAN AND CONSIDERATIONS

The Lakes and Ponds Program created a water quality monitoring plan in response to the incident with the intention to monitor the threats to the ecosystem and public health in the greater lake. Several of the parameters mentioned above are already monitored by L&P as part of its current Lakes and Ponds Water Quality Monitoring Plan between mid-April and December. However, several of the analytes were chosen in response to the abovementioned concerns related to the event. The Department of Inspectional

Services also created a sampling plan, with the intention to determine if the area of the lake adjacent to the pump station met recreational thresholds for fecal bacteria indicators.

Sampling was complicated by unreliable ice cover, and L&P's need to obtain equipment to sample through the ice. In reaching out to MassWildlife about sampling, they responded that there was no guidance for sampling in these conditions. Some time was spent procuring the proper equipment and determining the proper methods for sample collection, delaying the starting date of sampling until 10-Feb.

a. Sampling Locations

The Lakes and Ponds Program sampled at four in-lake locations as well as from the shoreline behind the pump station (see *Figures A* and *B*). Sites were chosen to assess the extent of the impact of the event with increasing distance from the pump station.

Figure A. L&P sampling locations, mid-lake looking north to the Rt 9 Bridge

Figure B. *L&P sampling locations, mid-lake looking south to Flint Pond*

b. Sampling Schedule

Sampling began on February 10th at the pump station. Samples were then collected on the following days through the ice: 11th, 14th, and 17th. After the 17th, the ice was no longer safe for access, and sampling was paused until ice out. Sampling resumed on March 9th from a kayak. Samples were taken on March 9th, March 23rd, March 31st, and concluded on April 13th. The seasonal Lakes and Ponds Program Water Quality Monitoring Program began its sampling on May 11th and results will be used to continue to assess the medium- and long-term effects of the event.

c. Sampling Parameters and Methodology

Samples collected through the ice involved the drilling of a hole with an ice auger. Collection occurred with a sampling pole through the hole, collecting water about one (1) foot below the bottom of the ice. Samples collected after ice out from the kayak were taken one (1) foot below the surface of the water.

Samples were collected for *E. coli*, total phosphorus (TP), nitrate (NO_3), ammonia (NH_3), metals, and volatile organic compounds. Probe measurements were then taken for dissolved oxygen (DO) at 5 foot increments starting just below the ice until about 30 feet or until the bottom of the lake was reached. Once sampling was occurring from the kayak, secchi clarity was examined at each of the in-lake locations. Samples were kept on ice and delivered to Alpha Analytical Laboratories in Westborough directly after sampling.

d. Sampling by the Department of Inspectional Services

The Department of Inspectional Services collected shoreline samples for *E. coli* bacteria behind the pump station almost daily starting on 9-Feb, until results achieved recreational standards. Samples were kept on ice and delivered to the City of Worcester Water Filtration Plant Laboratory in Holden directly after sampling.

V. RESULTS

Raw data are displayed and explained in this report. No statistical analysis has been performed. Subsequent ratings of "excellent", "good", "fair", and "poor" for reported values are based on the Massachusetts Department of Environmental Protections SMART Monitoring Watershed Report Card Criteria. For ease of interpretation, ratings have been color coded, with blue representing a rating of "excellent", green of "good", orange of "fair", and red of "poor" (see *Table 1*).

Table 1. *Parameter result ratings are color coded for ease of interpretation*

MassDEP SMART Monitoring Watershed Report Card Criteria
Excellent (Blue)
Good (Green)
Fair (Orange)
Poor (Red)

a. Bacteria

Shoreline bacteria. The initial result at the pump station on 9-Feb suggested that bacteria concentrations were declining as expected after the cessation of the event on the 7-Feb (see *Table 2*). However, subsequent sampling resulted in higher concentrations of bacteria. After several days of high results and no known bacteria inputs, the Sewer Division began an upstream investigation of the stormwater outfall near the station and discovered that a blocked sanitary sewer line was causing a discharge into the storm drain that emptied near the station. The sewer line was cleaned on 18-Feb, and subsequent sampling

resulted in decreasing bacteria concentrations in samples until recreational standards were achieved. The lake advisory was lifted on 24-Feb.

Open water bacteria. Open water bacteria concentrations remained below recreational thresholds (<235 MPN/100ml) and generally qualified as having water quality rankings of "excellent" (<12) and "good" (<126) (see *Table 3*). Open water bacteria concentrations were slightly elevated around the pump station (N1 and S3), but by 9-Mar, they were closer to those expected during routine sampling of the lake. Samples collected further south in the lake (S1 and S2) had almost no bacteria presence through all sampling events. These results suggest that despite conditions on the shore, the event did not pose recreational risk in the middle of the lake, most likely due to the bacteria's inability to live outside of a warm-blooded host for very long. These results align with previous observations of bacteria behavior at Lake Quinsigamond.

Table 2. *Shoreline E. coli results from samples collected by DIS*

DIS *E. coli* (CFU/100ml) results at Pumping Station	
9-Feb	330
10-Feb	2,350
11-Feb	2,000
14-Feb	5,300
15-Feb	6,100
16-Feb	20,000
17-Feb	10,300
18-Feb	2,700
22-Feb	400
23-Feb	200

Table 3. *Open water E. coli results from samples collected by L&P*

Open Water *E. coli* Results in MPN/100 ml								
Location	10-Feb	11-Feb	14-Feb	17-Feb	9-Mar	23-Mar	31-Mar	13-Apr
N1	NA	2	133	110	43	2	5	4
S3	NA	1	172	21	13	12	3	9
S2	NA	1	2	<1	9	1	1	5
S1	NA	2	1	<1	1	2	1	2

b. Organic Material

Nutrients. In general, nutrient concentrations for TP, NO_3, and NH_3 were in the "excellent" and "good" categories in the open water sampling locations on all sampling events (see *Tables 4-6*). Results for all analytes were elevated at the pump station. However, it is unknown if this is the result of the overflow event, or the subsequent discharge that resulted from the sewer line blockage.

While these compounds are a part of the L&P monitoring program at Lake Quinsigamond, L&P has not historically sampled for them in the winter months. When compared to results in the summer months, TP is slightly elevated over summer averages near the pump station (N1 and S3), which may indicate the presence of organic inputs. However, NO_3 results are slightly elevated over summer averages in all

Table 4. *TP results collect at 5 locations over 8 sampling events by L&P*

Total Phosphorus Results in mg/l								
Location	10-Feb	11-Feb	14-Feb	17-Feb	9-Mar	23-Mar	31-Mar	13-Apr
Pump Station	0.015	0.062	0.040	0.059	NA	NA	NA	NA
N1	NA	<0.010	0.019	0.016	0.011	0.014	0.010	<0.010
S3	NA	<0.010	0.032	0.016	0.014	0.014	0.012	<0.010
S2	NA	<0.010	0.015	0.010	0.016	0.012	0.012	<0.010
S1	NA	<0.010	0.012	<0.010	0.013	0.013	0.012	<0.010

Table 5. *NH_3 results collect at 5 locations over 8 sampling events by L&P*

Ammonia Nitrogen Results in mg/l								
Location	10-Feb	11-Feb	14-Feb	17-Feb	9-Mar	23-Mar	31-Mar	13-Apr
Pump Station	0.135	0.126	<0.075	0.136	NA	NA	NA	NA
N1	NA	0.112	<0.075	0.177	0.220	0.140	NA	NA
S3	NA	0.096	0.075	0.098	0.138	0.114	NA	NA
S2	NA	0.097	0.154	<0.075	0.165	0.127	NA	NA
S1	NA	0.115	<0.075	0.124	0.231	0.232	NA	NA

Table 6. *NO_3 results collect at 5 locations over 8 sampling events by L&P*

Nitrate Nitrogen Results in mg/l								
Location	10-Feb	11-Feb	14-Feb	17-Feb	9-Mar	23-Mar	31-Mar	13-Apr
Pump Station	0.86	0.78	1.04	0.96	NA	NA	NA	NA
N1	NA	0.43	0.47	0.50	0.54	0.51	0.50	0.61
S3	NA	0.33	0.62	0.44	0.54	0.52	0.52	0.54
S2	NA	0.39	0.43	0.62	0.53	0.52	0.53	0.53
S1	NA	0.56	0.47	0.50	0.50	0.50	0.50	0.51

locations. This is suspected to be a natural lake phenomenon resulting from decreased metabolic activity in winter months. Only NH_3 results were consistent with summer averages. These comparisons must be made with caution based on the seasonality of lake dynamics on Lake Quinsigamond and more sampling is necessary to determine what normal nutrient concentrations are during winter months. Regardless, it does not appear that nutrient concentrations are at critical levels in the open water at this time.

Secchi clarity. After ice out, Secchi clarity was used as an indicator of turbidity due to suspended materials such as sediments, algae, and cyanobacteria resulting from the overflow event in the in-lake locations. All Secchi results were in the "good" categories, except for the three in-lake locations below the Rt 9 bridge on March 9th, which were rated as "fair" (see *Table 7*). All results are generally in line with observations of lake clarity in the summer months, when Sechhi depth ranges from 8 feet ("fair") to 13 feet ("good"), with southern basin results generally lower than northern basin results. However, it is not known how these results compare to the lake during other years at this time.

Table 7. *Secchi clarity was measured four times four in-lake locations in Lake Quinsigamond by L&P after ice-out.*

Secchi Clarity Results in ft									
Location	10-Feb	11-Feb	14-Feb	17-Feb	18-Feb	9-Mar	23-Mar	31-Mar	13-Apr
N1	NA	NA	NA	NA	NA	10	11	10.5	10.5
S3	NA	NA	NA	NA	NA	9	11.5	10	10.5
S2	NA	NA	NA	NA	NA	9.25	11.5	10	11
S1	NA	NA	NA	NA	NA	8.5	11.5	10	10.5

Oxygen. Dissolved oxygen was used as an indicator of metabolic activity by organisms driven by organic material introduced during the overflow event. Concentrations remained high throughout all of the sampling events (see *Table 8*). All results in every location were in the "excellent" (>11 mg/l) or "good" (9-11 mg/l) category. DO concentrations were slightly lower in the first days of sampling compared to later days, but always above 10 mg/l. These results suggest that while there may have been a small increase in metabolic activity directly after the event, it was not sustained nor was it significant to fish and aquatic life. Oxygen concentrations returned to "excellent" soon after the event. These results are in line with DO profiles taken in December of 2021, when the water column was fully oxygenated. To date, no fish kills have been observed or reported.

Table 8. *Dissolved Oxygen was tested for five times at four-five locations in Lake Quinsigamond by L&P (see next page).*

Oxygen Profiles (mg/l) February 11th					
Depth (ft)	N1	S3	S2	S1	Pumping Station
2	12.27	12.40	12.58	12.25	12.77
5	11.80	11.97	11.90	11.77	
10	10.83	11.93	11.80	11.50	
15	10.30		10.86	11.47	
20	10.76		11.16	11.40	
25	10.90		11.39	10.66	
30	10.78		11.34	10.64	
35	10.76		11.31		
40			11.50		

Oxygen Profiles (mg/l) February 14th					
Depth (ft)	N1	S3	S2	S1	Pumping Station
2	13.07	13.15	11.81	12.57	11.86
5	12.93	13.12	11.44	11.75	
10	12.32	12.73	11.71	11.96	
15	11.78		10.19	10.83	
20	11.68		11.79	10.77	
25	11.82		11.78	10.65	
30	11.70		11.77	11.01	
35	11.59		11.83		
40	11.38		11.67		

Oxygen Profiles (mg/l) February 17th					
Depth (ft)	N1	S3	S2	S1	Pumping Station
2	13.80	14.24	13.95	13.28	15.01
5	13.44	13.23	13.34	12.51	
10	12.35	13.22	12.73	12.60	
15	11.76	12.74	12.86		
20	12.17		12.93		
25	11.93		12.87		
30	11.84		12.71		
35	11.66		12.71		
40			11.98		

c. Other Compounds

Metals. Metals were not found in concerning concentrations in any sample collected (see *Table 10*). Of the 14 metals analyzed at each site, only aluminum, copper, cadmium, zinc, and one occurrence of lead were found in the open water locations, and none of them in concentrations that would be of concern, even by drinking water standards (see *Table 10*). Arsenic and lead were detected at the pump station on 17-Feb, but like the other compounds, they were not found in concentrations that would be concerning even in drinking water. These results suggest that, even if these compounds were present in the untreated waste water that entered the lake, they were no longer measureable by 14-Feb.

Table 8 (cont). *Dissolved Oxygen was tested for five times at four-five locations in Lake Quinsigamond by L&P.*

Oxygen Profiles (mg/l) March 9th					
Depth (ft)	N1	S3	S2	S1	Pumping Station
2	12.88	13.50	13.00	13.15	15.01
5	12.76	12.91	12.97	13.11	
10	12.70	12.74	12.86	12.98	
15	12.67	12.7	12.76	12.96	
20	12.65		12.66	12.57	
25	12.63		12.66	12.64	
30	12.59		12.53	12.66	
35	11.32			12.71	
40	10.91				

Oxygen Profiles (mg/l) April 13th					
Depth (ft)	N1	S3	S2	S1	Pumping Station
2	12.09	12.18	12.48	12.42	
5	12.09	12.07	12.52	12.55	
10	12.13	12.35	12.44	12.61	
15	12.11	12.12	12.47	12.44	
20	11.73		12.08	12.31	
25	11.52		11.92	11.92	
30	11.38		11.83	11.29	
35	11.14		11.53	11.00	
40	10.94		11.40		

Volatile Organic Compounds. Samples were collected on three occasions (4-Feb, 17-Feb, and 9-Mar) for 45 volatile organic compounds (see *Table 9*). Results for all compounds returned below detection limits (ND), suggesting that, even if these compounds are present in untreated sewage, they were no longer present by the first sampling date on 14-Feb. Previous testing for these compounds in open water in 2019 found similar results.

Table 9. *45 volatile organic compounds tested for in 5 locations on Lake Quinsigamond by L&P all had undetectable results*

Volatile Organic Compounds Analyzed	
Methylene chloride	Vinyl chloride
1,1-Dichloroethane	Chloroethane
Chloroform	1,1-Dichloroethene
Carbon tetrachloride	trans-1,2-Dichloroethene
1,2-Dichloropropane	cis-1,2-Dichloroethene
Dibromochloromethane	Trichloroethene
1,1,2-Trichloroethane	1,2-Dichlorobenzene
2-Chloroethylvinyl ether	1,3-Dichlorobenzene
Tetrachloroethene	1,4-Dichlorobenzene
Chlorobenzene	p/m-Xylene
Trichlorofluoromethane	o-xylene
1,2-Dichloroethane	Xylenes, Total
1,1,1-Trichloroethane	Styrene
Bromodichloromethane	Acetone
trans-1,3-Dichloropropene	Carbon disulfide
cis-1,3-Dichloropropene	2-Butanone
Bromoform	Vinyl acetate
1,1,2,2-Tetrachloroethane	4-Methyl-2-pentanone
Benzene	2-Hexanone
Toluene	Acrolein
Ethylbenzene	Acrylonitrile
Chloromethane	Dibromomethane
Bromomethane	

CONCLUSIONS

Results from this study suggest that water quality has not been significantly adversely affected by the discharge event in the short term. Bacteria concentrations came down quickly after the event ended and did not cause exceedances of the recreational threshold in the middle of the lake. Nutrients associated with organic inputs were not

detected in very high concentrations, and oxygen levels appeared to be only slightly affected. No fish kills have been reported. Metals and volatile organic compounds that were tested for were generally not detected, and if they were, not in concerning concentrations.

These results do not suggest that these parameters were not found in more detrimental concentrations during the time of the discharge or in the days immediately following the event. However, by 14-Feb, they either were not being observed in concerning quantities, or improved over the following days. In the case of the bacteria, this improvement can be explained by the short lifespan of the organism outside of warm blooded animals. In the case of the organic material, it is expected that dilution of the discharge contributed to the lower concentrations that were observed. In the case of the other compounds, undetectable concentrations in the open water may be due to the low concentration of these compounds in the sewage in the first place.

Table 10. *Metals were tested for five times at five locations in Lake Quinsigamond by L&P.*

	Metals in mg/l													
	Aluminum	Antimony	Arsenic	Beryllium	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Thallium	Zinc
14-Feb														
Pump Station	0.03534	<0.004	<0.001	<0.001	<0.0002	<0.001	0.00147	<0.001	<0.0002	<0.002	<0.005	<0.0004	<0.001	0.01589
N1	0.06042	<0.004	<0.001	<0.001	<0.0002	<0.001	0.00157	<0.001	<0.0002	<0.002	<0.005	<0.0004	<0.001	0.0317
S3	0.03382	<0.004	<0.001	<0.001	<0.0002	<0.001	0.00103	<0.001	<0.0002	<0.002	<0.005	<0.0004	<0.001	0.01746
S2	0.02335	<0.004	<0.001	<0.001	<0.0002	<0.001	<0.001	<0.001	<0.0002	<0.002	<0.005	<0.0004	<0.001	<0.01
S1	0.02463	<0.004	<0.001	<0.001	<0.0002	<0.001	0.00107	<0.001	<0.0002	<0.002	<0.005	<0.0004	<0.001	0.01572
17-Feb														
Pump Station	0.2268	<0.004	0.00131	<0.001	<0.0002	<0.001	0.00295	0.00219	<0.0002	<0.002	<0.005	<0.0004	<0.001	0.01138
N1	0.07504	<0.004	<0.001	<0.001	0.00027	<0.001	0.0019	<0.001	<0.0002	<0.002	<0.005	<0.0004	<0.001	0.02274
S3	0.05106	<0.004	<0.001	<0.001	<0.0002	<0.001	0.00105	<0.001	<0.0002	<0.002	<0.005	<0.0004	<0.001	0.01431
S2	0.07045	<0.004	<0.001	<0.001	<0.0002	<0.001	0.00155	<0.001	<0.0002	<0.002	<0.005	<0.0004	<0.001	0.01364
S1	0.01868	<0.004	<0.001	<0.001	<0.0002	<0.001	<0.001	<0.001	<0.0002	<0.002	<0.005	<0.0004	<0.001	0.01594
9-Mar														
Pump Station	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N1	0.02307	<0.004	<0.001	<0.001	<0.0002	<0.001	0.00102	<0.001	<0.0002	<0.002	<0.005	<0.0004	<0.001	0.01482
S3	0.02484	<0.004	<0.001	<0.001	<0.0002	<0.001	<0.001	<0.001	<0.0002	<0.002	<0.005	<0.0004	<0.001	<0.01
S2	0.02345	<0.004	<0.001	<0.001	<0.0002	<0.001	<0.001	<0.001	<0.0002	<0.002	<0.005	<0.0004	<0.001	0.015
S1	0.01606	<0.004	<0.001	<0.001	<0.0002	<0.001	<0.001	<0.001	<0.0002	<0.002	<0.005	<0.0004	<0.001	<0.01
23-Mar														
Pump Station	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
31-Mar														
Pump Station	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N1	0.02146	<0.004	<0.001	<0.001	<0.0002	<0.001	0.00200	<0.001	<0.0002	<0.002	<0.005	<0.0004	<0.001	0.02074
S3	0.02229	<0.004	<0.001	<0.001	<0.0002	<0.001	0.00225	<0.001	<0.0002	<0.002	<0.005	<0.0004	<0.001	0.01799
S2	0.02385	<0.004	<0.001	<0.001	<0.0002	<0.001	0.00219	0.00114	<0.0002	<0.002	<0.005	<0.0004	<0.001	0.02262
S1	0.01467	<0.004	<0.001	<0.001	<0.0002	<0.001	0.00190	<0.001	<0.0002	<0.002	<0.005	<0.0004	<0.001	0.01907
13-Apr														
Pump Station	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
N1	0.02354	<0.004	<0.001	<0.001	<0.0002	<0.001	0.00207	<0.001	<0.0002	<0.002	<0.005	<0.0004	<0.001	0.02267
S3	0.02009	<0.004	<0.001	<0.001	<0.0002	<0.001	0.00185	<0.001	<0.0002	<0.002	<0.005	<0.0004	<0.001	0.02277
S2	0.01665	<0.004	<0.001	<0.001	<0.0002	<0.001	0.00178	<0.001	<0.0002	<0.002	<0.005	<0.0004	<0.001	0.02376
S1	0.01171	<0.004	<0.001	<0.001	<0.0002	<0.001	0.00165	<0.001	<0.0002	<0.002	<0.005	<0.0004	<0.001	0.02074

VI. FUTURE MONITORING

While acute risks to public health and wildlife appear to have passed, there are ongoing concerns about the medium- and long-term effects of the event on the lake. The Lakes and Ponds Program began its seasonal Lake Water Quality Monitoring Program on May 11th, in which it will continue to collect samples in the southern basin of the lake on a twice monthly basis, in addition to continue to make observations in the area immediately around the Pump Station. In addition, a continuous water quality monitoring

device was deployed adjacent to the Pump Station to collect and transmit data on cyanobacteria activity. All results will be shared monthly at Lake Quinsigamond Commission and/or Lake Quinsigamond Watershed Association Meetings, written up in the annual Lakes and Ponds Water Quality Report, and presented at the 2022 State of the Lakes event.

For more information on Lake Quinsigamond or the Lakes and Ponds Program, please visit WorcesterMA.gov/BlueSpace or email GreenWorcester@worcesterMA.gov.