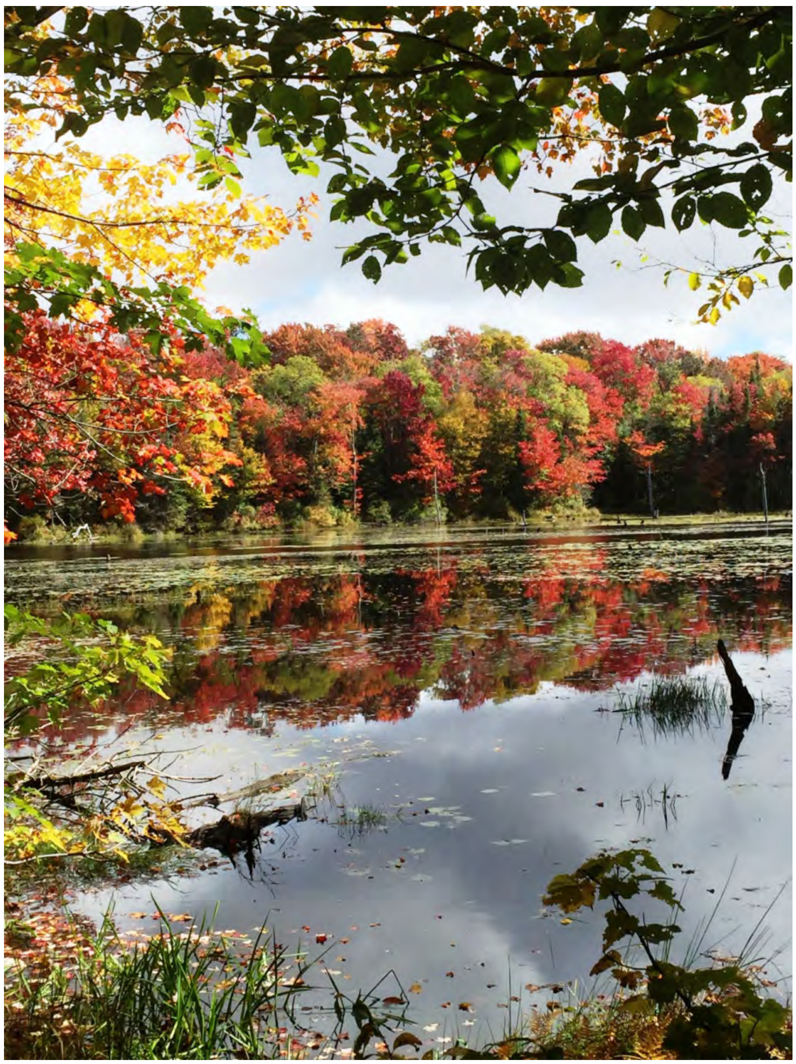
Water Quality Report: 2017
Quabbin Reservoir Watershed
Ware River Watershed



Blood Swamp in the fall (Bernadeta Susianti, 2017)

July 2018

Massachusetts Department of Conservation and Recreation
Office of Watershed Management
Division of Water Supply Protection
Quabbin/Ware Region

ABSTRACT

This report is a summary of water quality monitoring methods and results from 24 surface water sites located throughout the Quabbin Reservoir and Ware River watersheds, as well as other special assessment samples. The Department of Conservation and Recreation (DCR), Division of Water Supply Protection (DWSP), is the state agency charged with the responsibility of managing Quabbin Reservoir and its surrounding natural resources in order to protect, preserve, and enhance the environment of the Commonwealth and to assure the availability of safe drinking water to future generations. The Environmental Quality Section manages a comprehensive water quality monitoring program to ensure that Quabbin Reservoir water meets state drinking water quality standards. As part of this task, the Environmental Quality Section performs field work, interprets water quality data, and prepares reports of findings. This annual summary is intended to meet the needs of watershed managers, the interested public, and others whose decisions must reflect water quality considerations.

In 2017, Quabbin Reservoir water quality satisfied the requirements of the Filtration Avoidance Criteria established under the Environmental Protection Agency Surface Water Treatment Rule. Monitoring of tributaries is a proactive measure aimed at identifying trends and potential problem areas that may require additional investigation or corrective action. Compliance with state surface water quality standards among the tributaries varied, with minor exceedances attributed to higher pollutant loads measured during storm events, wildlife impacts on water quality, and/or natural attributes of the landscape.

The appendices to this report include field investigation reports, summary information on mean daily flows of gauged tributaries, water quality data summary tables, and plots of reservoir water quality results. Some of the ancillary data presented in this report has been compiled with the help of outside agencies (e.g., U.S. Geological Survey) and other workgroups within DWSP whose efforts are acknowledged below.

Acknowledgments

This report was prepared by the Environmental Quality Section of the DWSP-Quabbin/Ware Region. Gabrielle Kurth, Environmental Analyst III, was the primary author, with the format and content previously developed by Yuehlin Lee, Environmental Analyst IV, and Scott A. Campbell, Regional Engineer. The author acknowledges the following who contributed to this report:

The Massachusetts Water Resources Authority (MWRA), whose staff conducted nutrient, pathogen, and bacteriological analyses and whose staff contributed to the management of laboratory data and sample bottle preparation.

Peter Deslauriers, Environmental Analyst II, for sampling, field work, and managing field collection procedures. Peter retired in July 2017, after 38 years of service at DWSP.

Gary Moulton, Engineering Aide, for field work, sampling, and data management for boat decontamination programs.

Paul Reyes, Environmental Engineer II, for his assistance with field work, sampling, and database management.

Bernadeta Susianti, Environmental Engineer II, for field work and sampling.

Paula Packard, Aquatic Biologist II, for her work in monitoring potential invasive species and plankton, including sample collection and identification, and for coordinating boat decontamination programs.

Rebecca Faucher, Environmental Analyst III, for field work and report editing.

Jennifer McGuinness, Environmental Analyst III, for field work and sampling.

Philip Lamothe, GIS Specialist, who provided Geographical Information System data, maps, and support.

Joel Zimmerman, Regional Planner, for his assistance in final report production.

The U.S. Geological Survey, who, through a cooperative agreement established with the DWSP, provided tributary flow data appended to this report.

Matt Walsh of the MWRA, who provided flow data from MWRA facilities.

Scott Campbell, Jeff Gagner, Doug Williams, Steve Mansfield, Ann Pervere, and Kim Hulse from the Quabbin Civil Engineering Section who provided meteorological and reservoir yield data and figures reproduced in this report.

John Scannell, Director of the Division of Water Supply Protection. Dan Clark, the Regional Director, and Lisa Gustavsen the Assistant Regional Director, of the Quabbin/Ware Region.

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ABBREVIATIONS AND UNITS OF MEASUREMENT

The following abbreviations are used in this report:

AIS	Aquatic invasive species
BWTF	Brutsch Water Treatment Facility
DWSP	Department of Conservation and Recreation, Division of Water Supply Protection
EPA	Environmental Protection Agency
EQA	Environmental Quality Assessment
E. coli	*Escherichia coli*
MassDEP	Massachusetts Department of Environmental Protection
MWRA	Massachusetts Water Resources Authority
PDA	Personal digital assistant
SWTR	Surface Water Treatment Rule
TKN	Total Kjeldahl nitrogen
UV_{254}	Ultraviolet absorbance at 254 nanometers
USGS	U.S. Geological Survey
WDI	Winsor Dam Intake

Chemical concentrations of constituents in solution or suspension are reported in milligrams per liter (mg/L) or micrograms per liter (µg/L). These units express the concentration of chemical constituents in solution as mass (mg or µg) of solute per unit of volume of water (L). One mg/L is equivalent to 1,000 µg/L. Fecal coliform results are reported as the number of presumptive colony forming units per 100 milliliters of water (CFU/100 mL). Total coliform and *E.* coli are reported as the most probable number (MPN/100 mL).

The following units of measurement are used in this report:

cfs	Cubic feet per second
CFU	Colony-forming unit
°C	Degrees Celsius
µS/cm	Microsiemens per centimeter
MGD	Million gallons per day
mg/L	milligram/liter
MPN	Most probable number
NTU	Nephelometric turbidity units
ppm	Parts per million (1 mg/L ≈ 1 PPM)
S.U.	Standard Units (pH)

1 INTRODUCTION

The Quabbin Reservoir, Ware River, and Wachusett Reservoir watershed system supplies drinking water to 51 communities in Massachusetts. These include 45 communities in the greater Boston and MetroWest region, three in western Massachusetts, and three as emergency supplies. The Department of Conservation and Recreation, Division of Water Supply Protection (DWSP), monitors and manages the watersheds to protect the drinking water source, while the Massachusetts Water Resources Authority (MWRA) manages the infrastructure and provides treatment. Both DWSP and MWRA monitor the water quality and quantity to deliver safe and sufficient drinking water. The watershed system and the MWRA service area are shown in **Figure 1**. This report summarizes the water quality monitoring performed by DWSP in the Quabbin Reservoir and Ware River watersheds during 2017.

1.1 Description of Watersheds

The three drinking water sources, Quabbin Reservoir, Ware River, and Wachusett Reservoir, are interconnected via the Quabbin Aqueduct. The largest of the three sources is the Quabbin Reservoir, which has a capacity of 412 billion gallons. This relatively large size caused the initial filling of the reservoir after the Swift River was dammed in 1939 to take seven years. In plan view, the reservoir shape is best described as two interconnected fingers. The larger, eastern finger is approximately 18 miles in length with a maximum width of approximately four miles. The smaller, western finger is approximately 11 miles in length with a maximum width of approximately one mile. The total surface area of the reservoir is approximately 39 square miles (25,000 acres), with approximately 118 miles of shoreline. General facts and figures about Quabbin Reservoir are summarized in **Table 1**.

Table 1. Facts and Figures about the Quabbin Reservoir

FACTS ABOUT THE RESERVOIR		FACTS ABOUT THE WATERSHED	
Capacity	412 Billion Gallons	**Watershed Area**[1]	119,935 acres
Surface Area	24,469 acres	**Land Area**	95,466 acres
Length of Shore	118 miles	**Forest**[2]	84,210 acres, or 88% of Land Area
Maximum Depth	150 feet	**Forested Wetland**[2] + **Nonforested Wetland**	5,317 acres, or 5.6% of Land Area
Mean Depth	45 feet	**DWSP Land**	53,278 acres, or 56% of Land Area
Surface Elevation, at Full Capacity	530 feet (Boston City Base)	**% DWSP Owned**	56% of Land Area, or 65% of Watershed Area
Year Construction Completed	1939	**Avg. Reservoir Gain From 1” of Precipitation**	1.6 Billion Gallons

Table 1 (continued). Facts and Figures about the Quabbin Reservoir

Calendar Year	***2017***	***2016***	***2015***
Maximum Reservoir Elevation (ft)	524.30 on June 26 and 27	526.38 on May 16	528.37 on April 28
Minimum Reservoir Elevation (ft)	518.63 on January 1	518.53 on December 27	523.27 on December 14
Total Diversions to Wachusett Reservoir	32,274 MG (198 days: 163 MGD	53,843 MG (252 days: 213.66 MGD	53,192.36 MG (273 days: 194.84 MGD)
Total Diversions to CVA	2,563 MG (365 days: 7.02 MGD)	2,806 MG (366 days: 7.67 MGD)	2,773 MG (365 days: 7.60 MGD)
Ware River Transfers	6,120 MG (28 days: 219 MGD)	412 MG (4 days: 103 MGD)	90.6 MG (1 day: 90.6 MGD)
Spillway Discharges	0 MG	0 MG	168.7 MG (33 days: 5.11 MGD)
Total Diversions to Swift River	10,495 MG (28.75 MGD)	13,129 MG (35.87 MGD)	15,673 MG (42.9 MGD)
Reservoir Ice Cover	Minor, partial overnight coverage	Partial ice cover from February 11 through February 16.	Hl00% on February 3, complete ice cover on February 5, ice out on April 17.

Notes:
[1] Includes reservoir surface area.
[2] Land previously identified as forest has been reclassified more accurately as forested wetland.
(….) Denotes number of days and average flow for those days.
Sources: Watershed Protection Plan Update (DWSP, 2013), DWSP Civil Engineering Yield Data 2014-2017, MWRA Flow Data

The Quabbin Reservoir watershed encompasses 187.5 square miles (119,935 acres) and includes nearly all of the towns of New Salem and Petersham, considerable portions of Pelham, Shutesbury, and Wendell, and smaller portions of Orange, Hardwick, Phillipston, Belchertown, Ware and Athol. Nearly 90% of the watershed lands are forested, and DWSP owns and controls 53,278 acres (56%) of watershed lands for water supply protection purposes. Including the reservoir, DWSP owns and controls 65% of the entire watershed area. Non-DWSP owned watershed lands are characterized as rural-residential with few agricultural areas, which helps maintain the high quality of water in the Quabbin Reservoir. More information on land use and ownership in the Quabbin Reservoir watershed is presented in the *2013 Watershed Protection Plan Update* (DWSP, 2013a) and the *2017 Land Management Plan* (DWSP, 2018).

1.2 Major Tributaries

The main tributaries to the Quabbin Reservoir are the East Branch of the Swift River and the West Branch of the Swift River. Hydrographs and statistics of 2017 flows in these rivers are included in **Appendix A**.

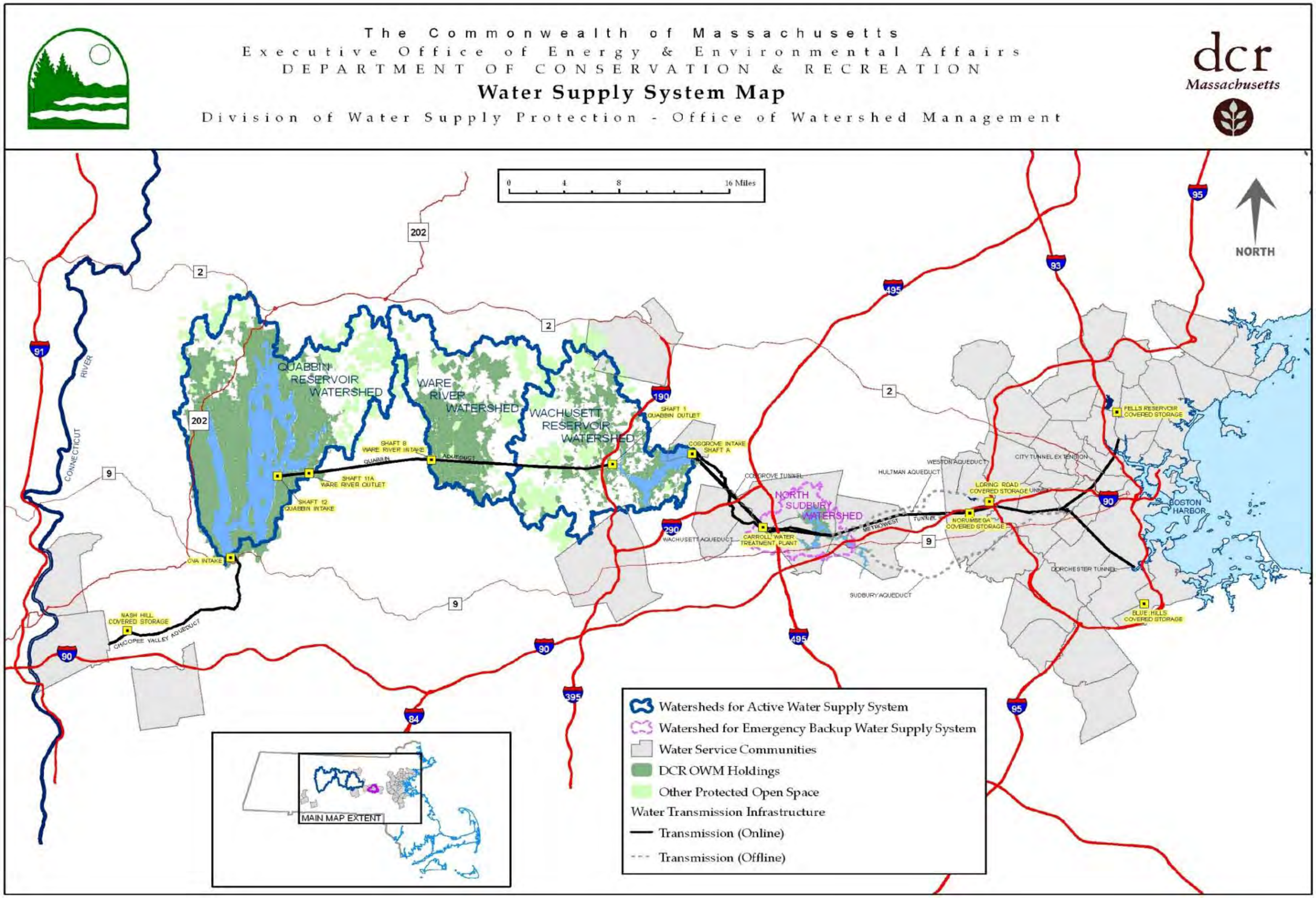


Figure 1. Quabbin Reservoir, Ware River, and Wachusett Reservoir Watershed System

The eastern portion of the watershed is drained by the East Branch Swift River. This 43.6 square mile subwatershed area is the largest stream tributary to Quabbin Reservoir. The U.S. Geological Survey (USGS), Water Resources Division, maintains stream gauges on the East Branch Swift River in Hardwick, the West Branch Swift River in Shutesbury, and the Ware River at the Intake Works in Barre. In 2017, mean daily flows for the East Branch Swift River in Hardwick averaged 44.3 million gallons per day (MGD) (68.5 cfs). The hydrograph for the East Branch Swift River as measured at the horseshoe dam located at the outlet of Pottapaug Pond is shown on **Figure 2**. As indicated, streamflow was generally normal to above normal from January through mid-March. Above-normal peaks in January through March reflect snowmelt and/or precipitation events. From mid-March through mid-May, streamflow was generally normal to below normal, with an above-normal peak in early April due to snowmelt and/or precipitation events. Normal and above-normal streamflows were observed from mid-May through the end of December, and above-normal flows were related to precipitation events.

The western part of the watershed is primarily drained by the West Branch Swift River. This 14.1-square-mile catchment area runs north-to-south between two well-defined, steeply sloped ranges. Steeply sloping ground, shallow soils, and a narrow drainage area combine to generate runoff that is extremely quick, and stream flows are typically characterized as flashy. In 2017, mean daily flows for the West Branch Swift River averaged 15.4 MGD (23.8 cfs). Monthly mean flows were generally near the normal range during 2017.

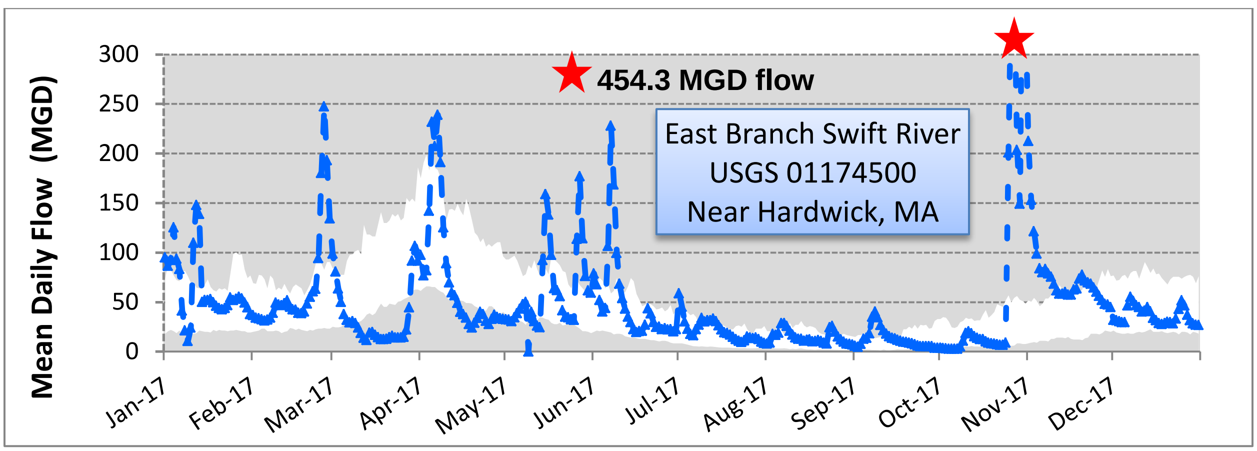


Figure 2. East Branch Swift River near Hardwick, MA, January-December 2017

Non-shaded region depicts "normal" (20 to 80 percentile) range of flows.
(Source: DWSP Civil Engineering from USGS data)

1.3 Water Transfers

Quabbin Reservoir water transfers to Wachusett Reservoir via the Quabbin Aqueduct Intake at Shaft 12 typically account for more than half of the of MWRA's system supply. In 2017, transfers to Wachusett Reservoir totaled 32,274 million gallons (MG). In the 198 days that transfers occurred, the Quabbin Aqueduct delivered an average of 163 MGD. A smaller amount of water is transferred directly to three western Massachusetts communities on a daily basis via the Chicopee Valley Aqueduct (CVA) from the Winsor Dam Intake (WDI). In 2017, the CVA delivered on average 7.02 MGD of flow to the CVA communities. The net storage gain of the reservoir was 23,551 MG, and the maximum difference in reservoir levels was 5.67 feet. Daily fluctuations in reservoir water level during the past two years are shown in **Figure 3**. As indicated, the reservoir operating level was below the normal operating status from at the start of 2017 through June 12, and the operating level remained within the normal range for the rest of 2017.

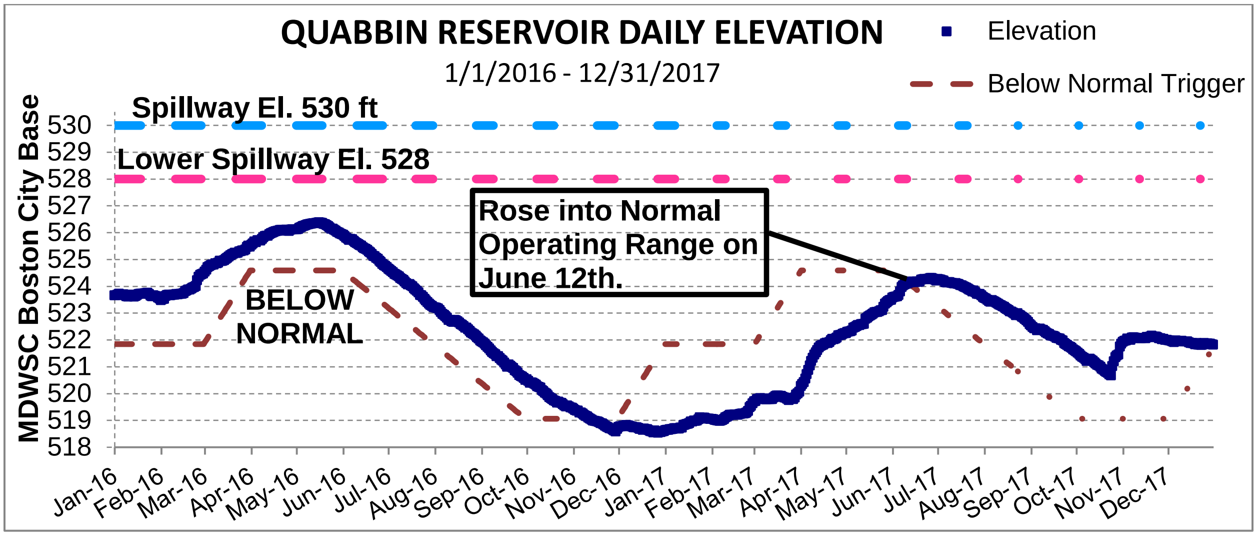


Figure 3. Quabbin Reservoir Daily Elevation, January 2015 - December 2016

(Source: DWSP Civil Engineering)

Water from Ware River may be used to augment Quabbin Reservoir supplies by being diverted into the Quabbin Aqueduct at Shaft 8 in Barre and directed west towards Quabbin Reservoir via gravity flow. DWSP and MWRA closely coordinate on diversion decisions. Under the authority granted by Chapter 375 of the Massachusetts Acts of 1926, the diversion of water from the Ware River is limited to the period from October 15 to June 15, and at no time is diversion allowed when the flow of the river at the diversion works is less than 85 MGD. Water from the Ware River enters the reservoir at Shaft 11A, located east of the baffle dams in Hardwick. In 2017, 6,120 MG were transferred from the Ware River to the Quabbin Reservoir between January and April. The average daily flow at the USGS stream gauge near the Shaft 8 intake works was 90 MGD (139 cfs) in 2017. The hydrograph and statistics of 2017 flow in the Ware River is included in **Appendix A**.

1.4 Climatic Conditions

In 2017, temperatures were close to average and precipitation was below average to average in Massachusetts. Near the Quabbin Reservoir, drought or abnormally dry conditions were observed from January through May 9, 2017. The months of May and October were abnormally wet, July and November were abnormally dry, and the other months were generally drier than average.

Daily precipitation has been recorded at the Belchertown monitoring station since 1939. In 2017, the total precipitation was 42.30 inches, which is close to the long-term average (46.13 inches). Monthly precipitation amounts were close to the long-term averages from January through April, then exceeded the long-term monthly averages by almost two inches in May. Precipitation amounts were then below average from June through September, and October precipitation exceeded the long-term average by almost five inches. November and December precipitation amounts were below the long-average average. Total snowfall for the year was approximately three inches below the long-term average.

Temperatures in Massachusetts were generally close to average in 2017, in comparison to the 122-year record (NCDC, 2018). January and February were relatively warm, with February being the warmest February in the Northeast since 1895. Spring (March-May) average temperatures ranged from 3.8 degrees below average in March to 4.8 degrees above average in April. Summer (June-August) temperatures were close to average. Fall temperatures (September-November) were 3.7 and 7.3 degrees above average in September and October, and close to average in November. December was relatively cold, with the average temperature 3.6 degrees below the long-term average.

The 2017 North Atlantic hurricane season was above average, with a total of 17 named storms (those that reached at least tropical storm strength). This number of named storms ranked as the ninth most on record. Ten of the 17 storms were hurricanes, six of which were major hurricanes. These totals were well above the long-term annual average of 12.1 named storms, 6.4 hurricanes, and 2.7 major hurricanes. The lack of El Nino conditions in the equatorial Pacific, with La Nina conditions developing near the end of the season, likely helped to boost the seasonal numbers (NCDC, 2018).

2 METHODOLOGY

This report presents water quality data results of regular monitoring performed throughout the Quabbin Reservoir and Ware River watersheds. The goals of the water quality monitoring program include:

1. To maintain long term water quality statistics in terms of public health protection.
2. To satisfy watershed control criteria applicable to the filtration avoidance requirements stipulated under the EPA’s Surface Water Treatment Rule (SWTR).
3. To identify streams and water bodies that do not attain water quality standards and where specific control measures may be initiated to eliminate or mitigate pollution sources.

4. To conduct proactive surveillance of water quality trends and support ongoing assessments of threats to water quality.

2.1 Sample Site Locations

In 2017, water quality was regularly monitored at 24 surface water monitoring sites in the Quabbin Reservoir and Ware River watersheds, as well as the Quabbin Reservoir itself. Sampling locations included major tributaries to Quabbin Reservoir, certain other tributaries flowing to the Quabbin Reservoir or Ware River, and other selected locations within the Quabbin Reservoir. The locations of surface water monitoring sites are shown on **Figures 4 and 5**, and drainage area characteristics for tributary monitoring sites are summarized in **Tables 2 and 3**. Of the 24 monitoring sites, 11 were located within the Quabbin Reservoir watershed and ten were located in the Ware River watershed. The other three sampling sites were located in the Quabbin Reservoir.

The tributary monitoring locations within each watershed include "core" sites and "Environmental Quality Assessment" (EQA) sites (See DWSP, 2006). Each watershed is divided into subwatersheds, referred to as sanitary districts, the locations of which are shown on **Figures 4 and 5**. Core sites are long-term monitoring sites located throughout the watershed that are included in the monitoring plan every year. These sites are important because they provide a long-term record of water quality data from primary tributaries within each watershed. EQA sites rotate to a different sanitary district on an annual basis, and EQA data are used to support annual assessments of potential threats to water quality within each sanitary district. EQA data provide a more focused, year-long assessment of water quality within a specific portion of each watershed.

In 2017 EQA sampling included sites in the Fever Brook Sanitary District (of the Quabbin Reservoir watershed) and the Burnshirt, Canesto, and Natty Sanitary District (of the Ware River watershed). The Quabbin EQA sites were previously monitored in 2013, and Sites 215B, 215F, and 215H were also monitored in 2007-08. The Ware River EQA sites were previously monitored in 2013, and Sites 103, B4, C2, and N1 were also monitored in 2009.

Table 2. Quabbin Reservoir Tributaries
2017 Surface Water Monitoring Sites

Tributary and Monitoring Site Description	DWSP Sample Site #	*Basin Characteristics* Drainage Area[3] (sq. miles)	% Wetland Coverage[4]	% DWSP Owned Land[5]
CORE SITES [1]				
West Branch Swift River at Route 202	211	12.4	3.4%	45.9%
Hop Brook inside Gate 22	212	4.66	2.5%	38.7%
Middle Branch Swift River at Gate 30	213	9.0	8.2%	23.1%
East Branch of Fever Brook at West Street	215	3.94	11.9%	12.8%
East Branch Swift River at Route 32A	216	30.3	9.5%	2.0%
Gates Brook at mouth	Gates	0.93	3.0%	100%
Boat Cove Brook at mouth	BC	0.15	<1%	100%
FEVER BROOK SANITARY DISTRICT EQA SITES [2]				
West Branch Fever Brook, at mouth	215B	4.45	9.0%	25.7%
Harvard Pond, at inlet	215H	1.10	6.6%	<1%
East Branch Fever Brook, at road above mouth	215F	7.30	10.0%	25.9%
East Branch Fever Brook, at Camel's Hump Road	215G	5.19	11.4%	13.2%

Notes:

[1]Core Sites: Samples collected biweekly for field parameters, turbidity, bacteria, and calcium. Samples for alkalinity, nutrient analysis, and UV_{254} collected quarterly.

[2]EQA Sites: Samples collected biweekly for field parameters, alkalinity, turbidity, bacteria, nutrients, UV_{254}, and calcium.

[3]Source: DWSP Office of Watershed Management Geographic Information System, June 2007 revision.

[4]Source: DEP Wetland Conservancy Program (interpreted from 1:12000 Spring 1992-93 photos, January 2009 revision).

[5]Source: DWSP Office of Watershed Management Geographic Information System, January 2015 revision.

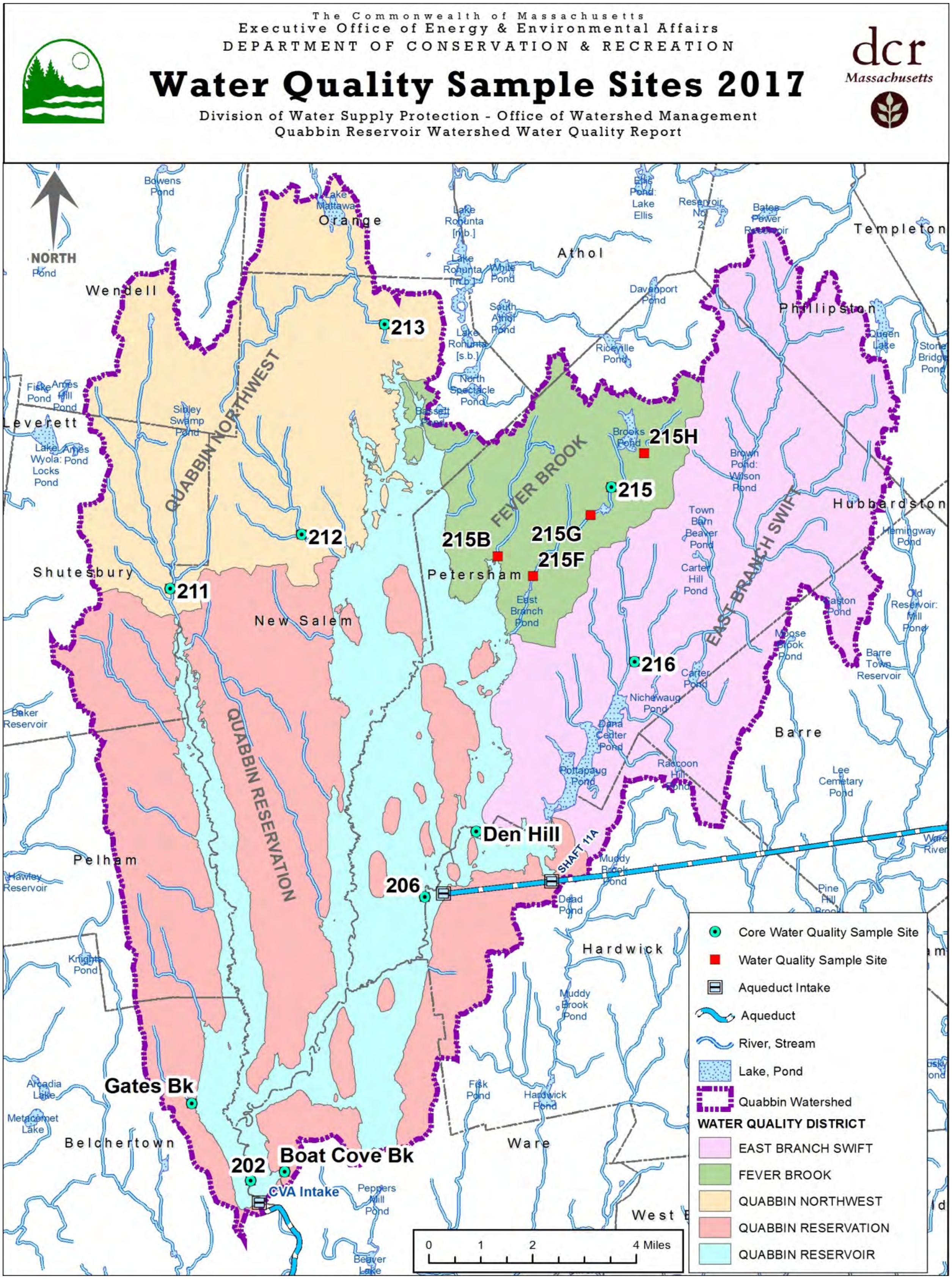


Figure 4. Hydrology, Sanitary Districts, and Water Quality Monitoring Sites for Calendar Year 2017 in the Quabbin Reservoir Watershed

Table 3. Ware River Tributaries
2017 Surface Water Monitoring Sites

Tributary and Monitoring Site Description	DWSP Sample Site #	Basin Characteristics: Drainage Area[4] (sq. miles)	% Wetland Coverage[5]	% DWSP Owned Land[6]
CORE SITES [1]				
Ware River at Shaft 8 (intake)	101	96.5	13.9%	37.8%
Burnshirt River at Riverside Cemetery	103A	31.1	10.5%	28.3%
West Branch Ware River at Brigham Road	107A	16.6	15.6%	45.8%
East Branch Ware River at Intervale Road	108	22.3	16.8%	12.6%
Thayer Pond at inlet [2]	121B	2.0	16.5%	3.1%
EAST BRANCH WARE SANITARY DISTRICT EQA SITES [3]				
Queen Lake, at road culvert below outlet	111	0.75	34.9%	0%
Burnshirt River, at Stone Bridge	B4	6.44	19.4%	2.0%
Burnshirt River, at Route 62	103	16.8	11.9%	20.7%
Canesto Brook, at Williamsville Road	C2	4.58	4.46%	5.36%
Natty Pond Brook, at Hale Road	N1	5.21	13.4%	38.4%

Notes:

[1]Core Sites: Samples collected biweekly for field parameters, turbidity, bacteria, calcium, and UV_{254} analysis. Samples for nutrient analysis collected quarterly.

[2]Before May 2007, Thayer Pond was monitored at the outlet (Site 121A). Because of ongoing beaver activity at Thayer Pond outlet, monitoring location was moved to Site 121B in May, 2007.

[3]EQA Sites: Samples collected biweekly for field parameters, alkalinity, turbidity, bacteria, nutrients, UV_{254}, and calcium.

[4]Source: DWSP Office of Watershed Management Geographic Information System, April 2009 revision.

[5]Source: DEP Wetland Conservancy Program (interpreted from 1:12000 Spring 1992-93 photos, April 2009 revision).

[6]Source: DWSP Office of Watershed Management Geographic Information System, January 2014 (core sites) or February 2011 (EQA sites) revision.

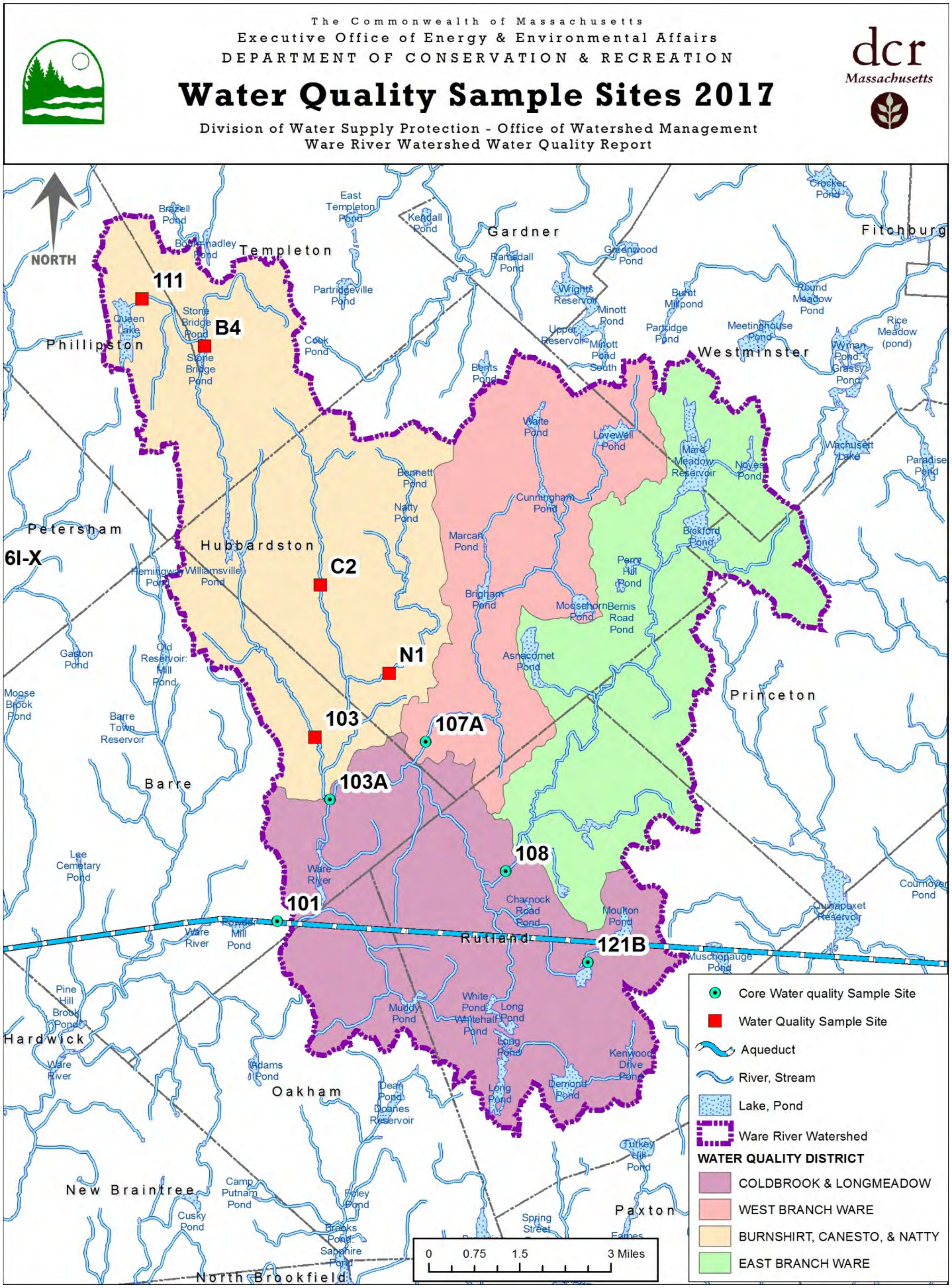


Figure 5. Hydrology, Sanitary Districts, and Water Quality Monitoring Sites for Calendar Year 2017 in the Ware River Watershed

2.2 *Sample Collection and Analysis*

2.2.1 Reservoir Sampling

Reservoir samples for bacteria and physicochemical parameters are collected from the three monitoring sites once per month from April through December, weather and reservoir conditions permitting. The sampling sites are located within three distinct sub-basins of the reservoir. Weather conditions, reservoir conditions, and water transparency are recorded on each survey.

Samples are collected from a boat, using a Kemmerer bottle to collect water from discrete depths. Bacteria samples are collected from the surface (0.5 meter), mid-depth (6 meters), and either the respective water supply intake depth (18 meters for Site 202, 24 meters for Site 206) or a deep sample (13 meters at Den Hill). Physicochemical samples are taken at the surface (0.5 meter), mid-depth, and within 2 meters of bottom when the reservoir is not thermally stratified. When the reservoir is stratified, physicochemical samples are collected from the surface (0.5 meters), mid-metalimnion (generally 9 to 14 meters), and deep (within 2 meters of bottom).

Water column profiles of temperature, pH, dissolved oxygen, and specific conductance data are measured *in situ* using a Eureka Manta Multiprobe. Readings are taken every meter during times of thermal stratification and mixing, and every three meters during periods of isothermy. See **Appendix A** for reservoir profiles. Field data are stored digitally using a personal digital assistant (PDA) and transferred to a database maintained by the Environmental Quality Section.

In addition, quarterly sampling for nutrients is performed at the onset of thermal stratification (May), in the middle of the stratification period (late July), near the end of the stratification period (October), and during a winter period of isothermy (December). Calcium monitoring began in 2010 to assess the risk of colonization by aquatic invasive organisms (*e.g.*, zebra mussels). Calcium concentrations below 12 mg/L, in combination with a pH of less than 7.4, indicate a low risk of zebra mussel colonization (see http://www.mass.gov/eea/docs/dcr/watersupply/lakepond/downloads/rrp/zebra-mussel.pdf). Calcium monitoring began on a monthly basis at three depths but was reduced to quarterly at one depth in 2012 because of the relatively low concentrations and low variability.

Besides chemistry and bacteria sampling, phytoplankton sampling has been performed since 2007. This monitoring program was implemented in response to odor complaints about CVA water, an increase in chlorine demand at the William A. Brutsch Water Treatment Facility (BWTF), and increasing numbers of smelt on the intake screens. Samples are collected, weather and reservoir conditions permitting, twice per month from May through September and once per month in other months. The samples are collected from Site 202 and Site 206, typically at two depths. Samples are collected near the middle and bottom of the epilimnion during stratified conditions, and at 3-meter and approximately 8- to 10-meter depths during non-stratified conditions.

2.2.2 Tributary Sampling

Samples are collected at tributary sites in each watershed on a biweekly basis, such that samples are collected from the Quabbin Reservoir watershed and the Ware River watershed on alternating weeks. Samples are collected early in the workweek (typically on Tuesdays) regardless of weather conditions. The goal of this relatively high sampling frequency is to provide a comprehensive assessment of tributary water quality that captures seasonal flow variations under a wide range of weather conditions.

At each tributary and reservoir sampling location, field parameters are measured using a Eureka Manta Multiprobe. Measured parameters include temperature, dissolved oxygen, pH, and specific conductance. Data are stored digitally using a PDA and transferred to a database.

2.2.3 Laboratory Analysis

Both tributary and reservoir samples are submitted to MWRA Laboratory for analysis. Reservoir samples are analyzed for alkalinity, turbidity, fecal coliform, and *E. coli*, on a monthly basis. In addition, reservoir samples are analyzed for nutrients, UV_{254}, and calcium (at mid-depth only) on a quarterly basis.

Tributary samples are analyzed for turbidity, *E. coli*, and calcium on a biweekly basis. Core samples are also analyzed for alkalinity, nutrients, and UV_{254} on a quarterly basis, except for Ware River watershed core samples, which are analyzed for UV_{254} on a biweekly basis. EQA samples are analyzed for alkalinity, nutrients, and UV_{254} on a biweekly basis. Laboratory methods are summarized in **Table 4**.

Table 4. MWRA Laboratory: Analytical and Field Methods

PARAMETER	STANDARD METHOD (SM)[1]
Turbidity	SM 2130 B
pH	Eureka Manta Multiprobe, SM 4500 H+ using Orion 920A+ pH Meter
Alkalinity	SM 2320 B (low level)
Conductivity	Eureka Manta Multiprobe
Temperature	Eureka Manta Multiprobe
Dissolved Oxygen	Eureka Manta Multiprobe
Total Coliform	SM 9223 (Enzyme Substrate Procedure)
Fecal Coliform	SM 9222D
Escherichia coli (E. coli)	SM 9223 (Enzyme Substrate Procedure)

[1]Standard Methods for the Examination of Water and Wastewater, 20th Edition (1998)

In 2017, Environmental Quality staff collected 659 source water (tributary and reservoir) samples for a variety of analyses. Over 4,900 analyses were performed on these samples, of which 45% were nutrient analyses performed at the MWRA Central Laboratory at Deer Island. The remaining analyses were 27% physiochemical parameters and 28% bacterial analyses performed at the MWRA Quabbin Laboratory. MWRA staff at the Quabbin Laboratory also processed and analyzed 365 microbiological samples collected at the BWTF. In addition, over 2,300 physiochemical measurements (not including reservoir profiles) were collected in the field by DWSP staff using a water quality multimeter. Records of these laboratory and field results are maintained in bound books and in a database.

2.3 Additional Monitoring

Other ongoing monitoring of the Quabbin Reservoir and associated watersheds includes that for aquatic invasive species (AIS) and forestry water quality. These programs are described in Sections 3.3 and 3.4, respectively.

3 RESULTS

The U.S. EPA promulgated the SWTR in 1989 to ensure that public water supply systems using surface waters were providing safeguards against the contamination of water by viruses and bacteria. The regulations require filtration by every surface water supplier unless strict source water quality criteria and watershed protection goals can be met. The DWSP and MWRA have maintained a waiver from the filtration requirement since 1989.

Source water quality criteria rely on an indicator organism, fecal coliform bacteria, as well as a surrogate parameter, turbidity, to provide a measure of the sanitary quality of the water. Specifically, the SWTR requires that fecal coliform concentrations at the intake of an unfiltered surface water supply shall not exceed 20 colony-forming units (cfu) per 100 ml in ninety percent of the samples in any six month period. There are two standards for turbidity levels at source water intakes. The SWTR requires that turbidity levels at the intake be below 5 NTU at all times. MassDEP regulations specify that water may only exceed one NTU only if it does not interfere with effective disinfection.

3.1 Results – Winsor Dam Intake

To ensure compliance with the SWTR, the MWRA monitors the bacterial quality of Quabbin Reservoir water on a daily basis at a point prior to disinfection, inside the BWTF, on a daily basis. Daily fecal coliform bacteria results from July 2016 through December 2017 are shown on **Figure 6**. As indicated, fecal coliform bacteria were not detected above 20 CFU/100 mL during this time period. In 2017, fecal coliform bacteria averaged less than one CFU/100 mL, and were not detected 86 percent of the time; the median concentration was less than one CFU/100 mL.

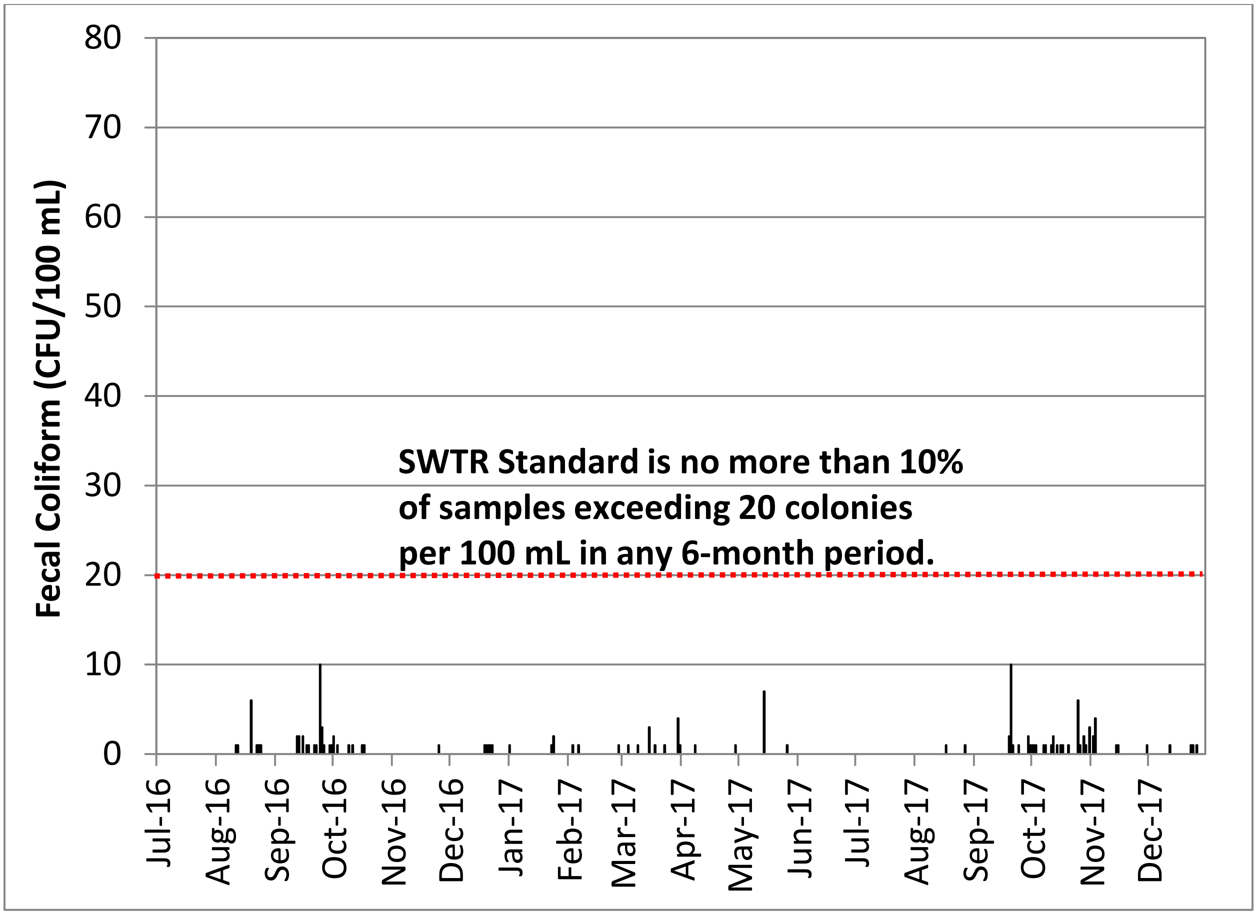


Figure 6. Fecal Coliform Bacteria Concentration prior to Disinfection, Quabbin Reservoir Source Water

Turbidity levels are monitored by MWRA prior to disinfection using an on-line turbidity meter located inside the BWTF. Daily average and maximum turbidity levels for 2017 are shown on **Figure 7**, with the red dashed line indicating the threshold of less than one NTU. As indicated, there were three instances of maximum daily turbidity levels exceeding the one NTU standard, but levels remained below five NTU. These occurred between February 9 and March 14, with levels ranging from 1.61 to 2.35 NTU. These occurrences of elevated turbidity were attributed to strong winds, and turbid conditions may have been exacerbated by the lack of ice cover. In all instances of elevated turbidity levels during 2017, water treatment was not impacted, and no violations of drinking water standards occurred. Chlorine residuals were maintained, contact times were well above required levels, and bacteria results were clean.

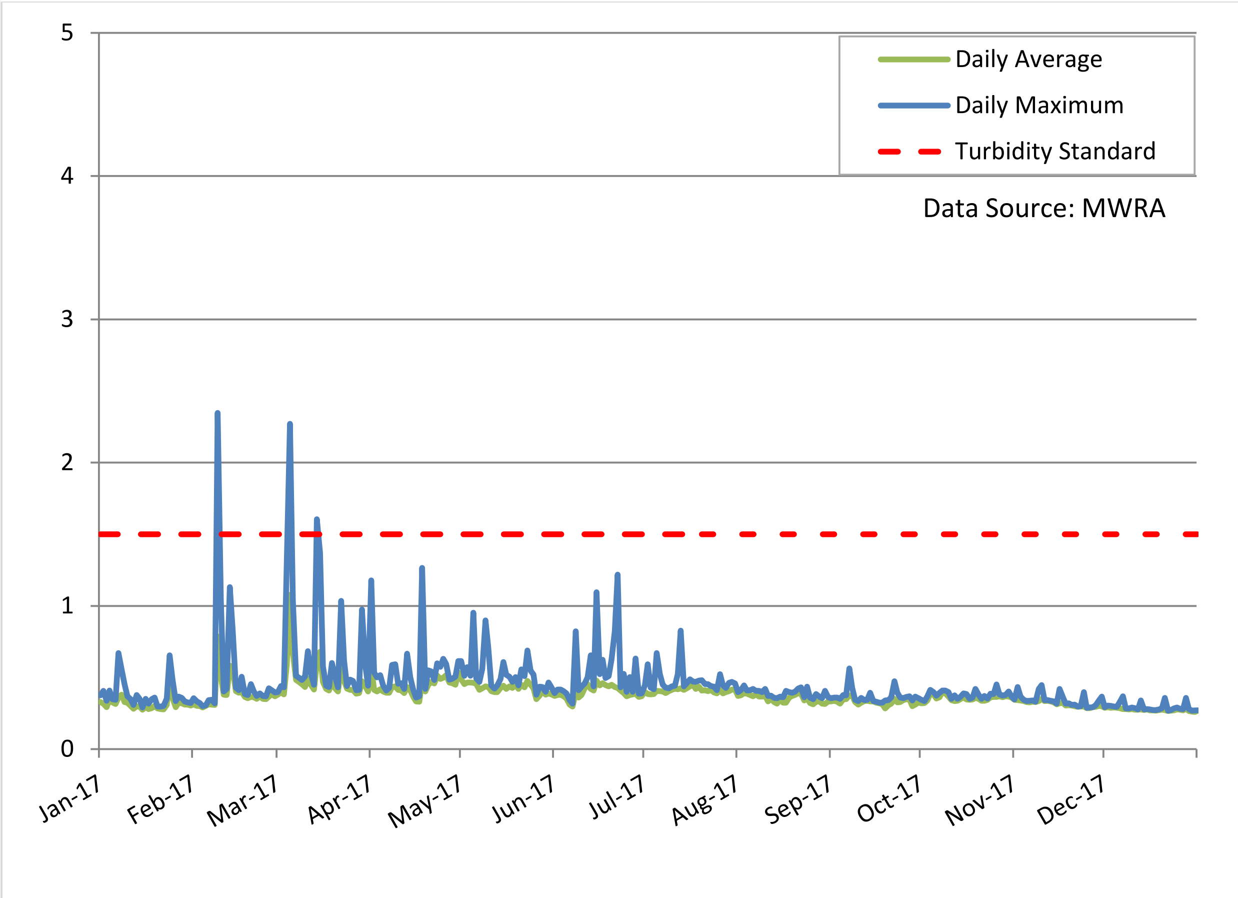


Figure 7. Quabbin Reservoir Source Water Turbidity (at the BWTF)

Giardia and *Cryptosporidium* monitoring on source water is conducted on a biweekly basis. *Giardia* and *Cryptosporidium* are of concern because their cysts are highly resistant to chlorine, infectivity doses are low, and life-cycles are longer than conventional microbial pathogens. Both pathogens have been linked to waterborne outbreaks of gastrointestinal disorders such as diarrhea, cramping and nausea. Samples of raw water are collected from the BWTF, and collection and analysis is performed in accordance with EPA Method 1623. In 2017, 26 samples were collected and analyzed. Neither *Giardia* nor *Cryptosporidium* were detected in 2017. Monitoring for these two pathogens in 2018 is continuing on the biweekly basis.

3.2 Results – Reservoir Monitoring

In 2017, reservoir water quality data documented consistently reliable source water quality that met the stringent source water quality criteria stipulated under the SWTR. Characteristics of the three sampling sites that were routinely sampled in 2017 are summarized in **Table 5**. Sample site locations are shown on **Figure 4**.

Table 5. 2017 Quabbin Reservoir Water Quality Monitoring Sites

Site (Site ID)	Location	Approximate Depth to Bottom
Winsor Dam (202)	Quabbin Reservoir west arm, off shore of Winsor Dam along former Swift River riverbed	42 meters
Shaft 12 (206)	Quabbin Reservoir at site of former Quabbin Lake, off shore of Shaft 12	28 meters
Den Hill	Quabbin Reservoir eastern basin, north of Den Hill	19 meters

General water quality at three sites monitored in 2017 is summarized in **Table 6**. The analytical data from each site are included in **Appendix B**, and profiles of water quality parameters with depth (as measured in the field) are included in **Appendix A**. Reservoir monitoring results are discussed below, along with a brief summary of the significance of each parameter to water quality.

Table 6. General Water Quality Ranges, 2017 Quabbin Reservoir Monitoring Sites.

Site ID	**Temper-ature** (°C)	**Dissolved Oxygen** (% Saturation)	**Turbidity** (NTU)	**pH** (standard units)	**Specific Conductance** (µS/cm)	**Secchi Disk Transparency** (meters)	**Fecal Coliform Bacteria** (CFU/100 mL)
202	5.25-25.3	59.8-116	0.230-0.481	4.8-7.5	40.6-50.3	7.1-11.9	<1-2
206	5.66-24.2	64.1-114	0.230-0.529	5.0-7.8	41.1-50.8	6.3-11.0	<1-1
Den Hill	6.34-25.5	13.0-113	0.320-1.130	5.3-6.8	46.2-71.2	3.5-8.4	<1-32

Source: Environmental Quality Database, 2017

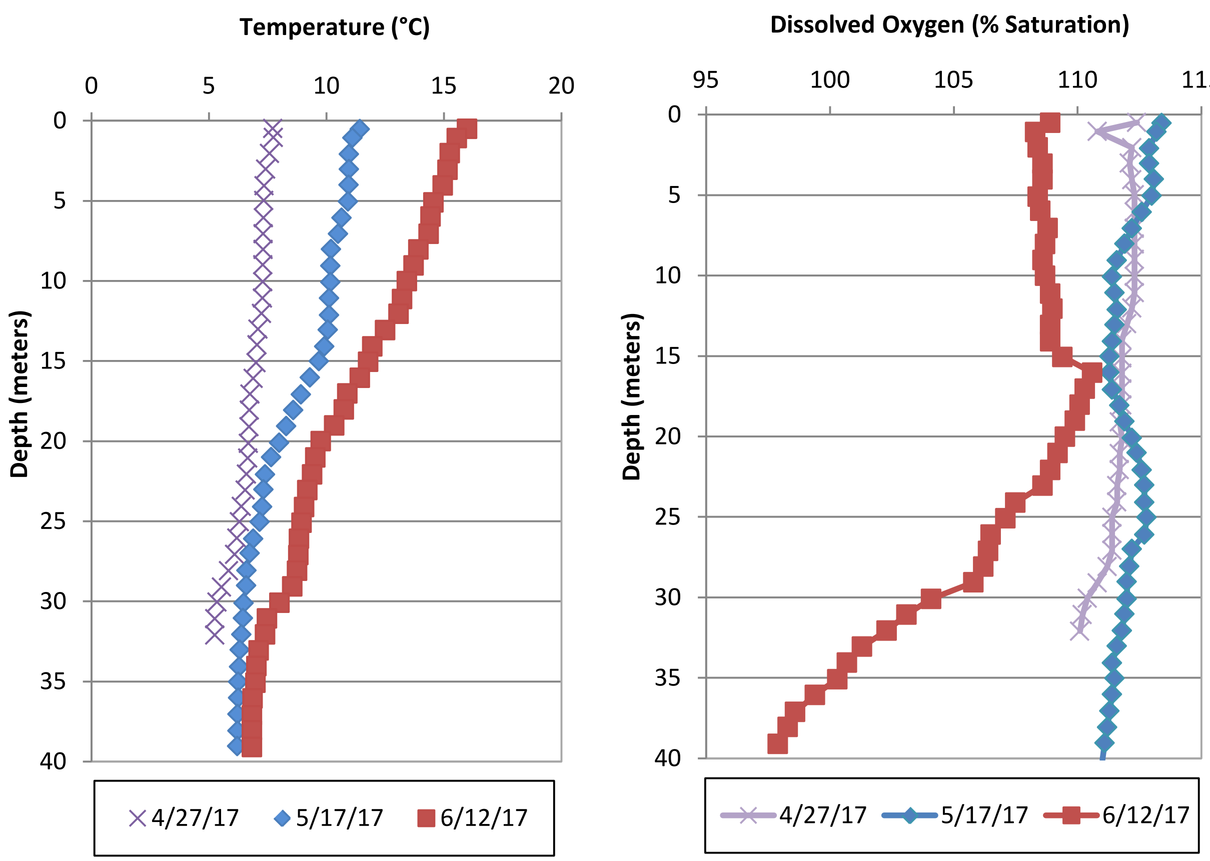
3.2.1 Temperature

The temporal zones that develop within the reservoir during the warmer months of spring and summer, referred to as the epilimnion, metalimnion and hypolimnion (listed in order from top to bottom), have distinct thermal, water flow, and water quality characteristics. This thermal stratification has a profound impact on many of the parameters monitored across the reservoir profile. Waters of the epilimnion are warm and well-mixed by wind-driven currents, and the epilimnion may become susceptible to algal growth due to the availability of sunlight and entrapped nutrients introduced to the partitioned layer of surface water. Within the metalimnion, the thermal and water quality transition occurs between the warmer surface waters and colder, deep waters. The deeper hypolimnic waters may become stagnant and serve as a sink for decaying matter and sediments that settle out from the upper layers of warmer water. Each year the reservoir becomes mixed due to the settling of cooler surface waters in the fall and following springtime ice-out when an isothermal water column is easily mixed by winds. A graphical portrayal of the thermal mixing and transition that occurs between isothermal and fully mixed to fully stratified conditions using profile data collected at Site 202 (Winsor Dam) is shown in

Figure 8. The temperature profiles from Site 202 and Site 206 indicate fall turnover likely occurred in November.

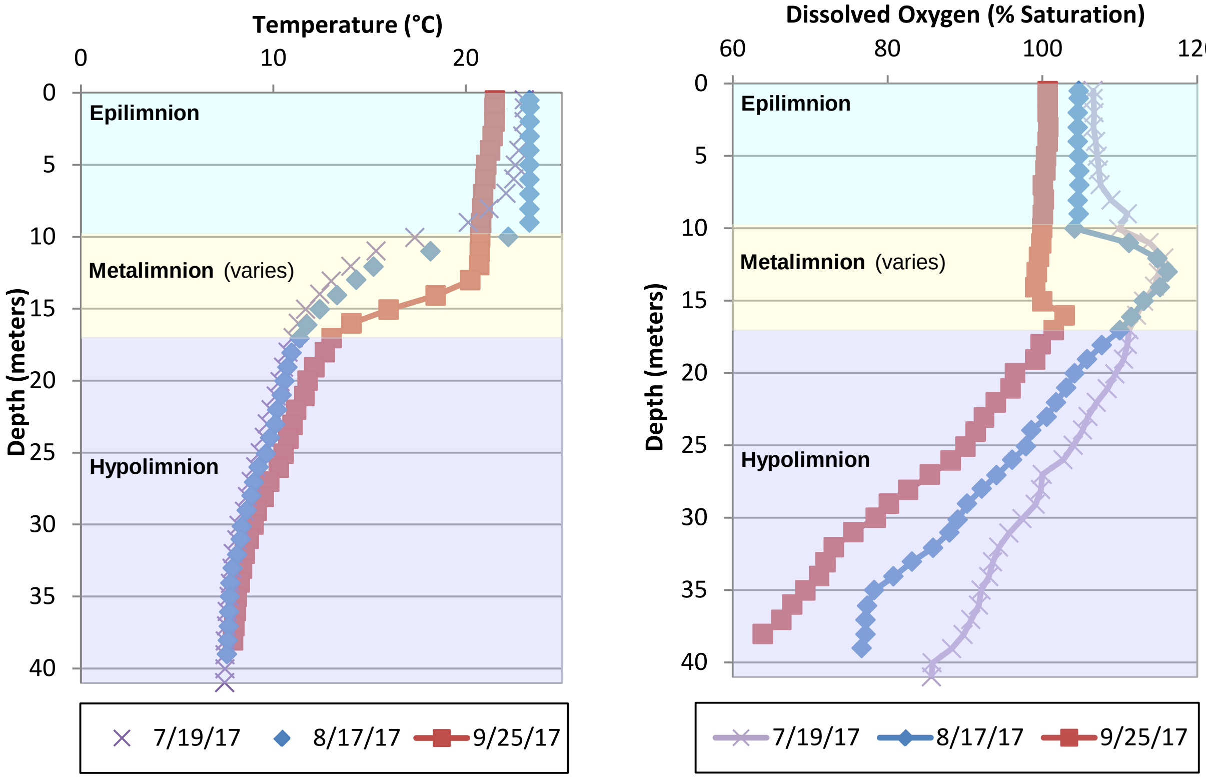
3.2.2 Dissolved Oxygen

Oxygen is essential to the survival of aquatic life (e.g., trout need a minimum of 5.0 mg/L, equivalent to 44 percent saturation at 10°C). Dissolved oxygen, or more specifically the loss of oxygen from the hypolimnion, is used as one index to characterize the trophic state of a lake. Because aeration inputs such as wind-driven turbulence, reservoir currents, and atmospheric diffusion diminish with depth, dissolved oxygen concentrations typically decrease with depth. Moreover, the sinking of decaying organic debris into the hypolimnion can be a major source of oxygen depletion in highly productive lakes because of the respiration requirements of microbial populations responsible for the decomposition of organic wastes. Hypolimnic oxygen reserves established in the spring are not replenished until the late fall, when cooling surface waters settle and re-mix the reservoir.

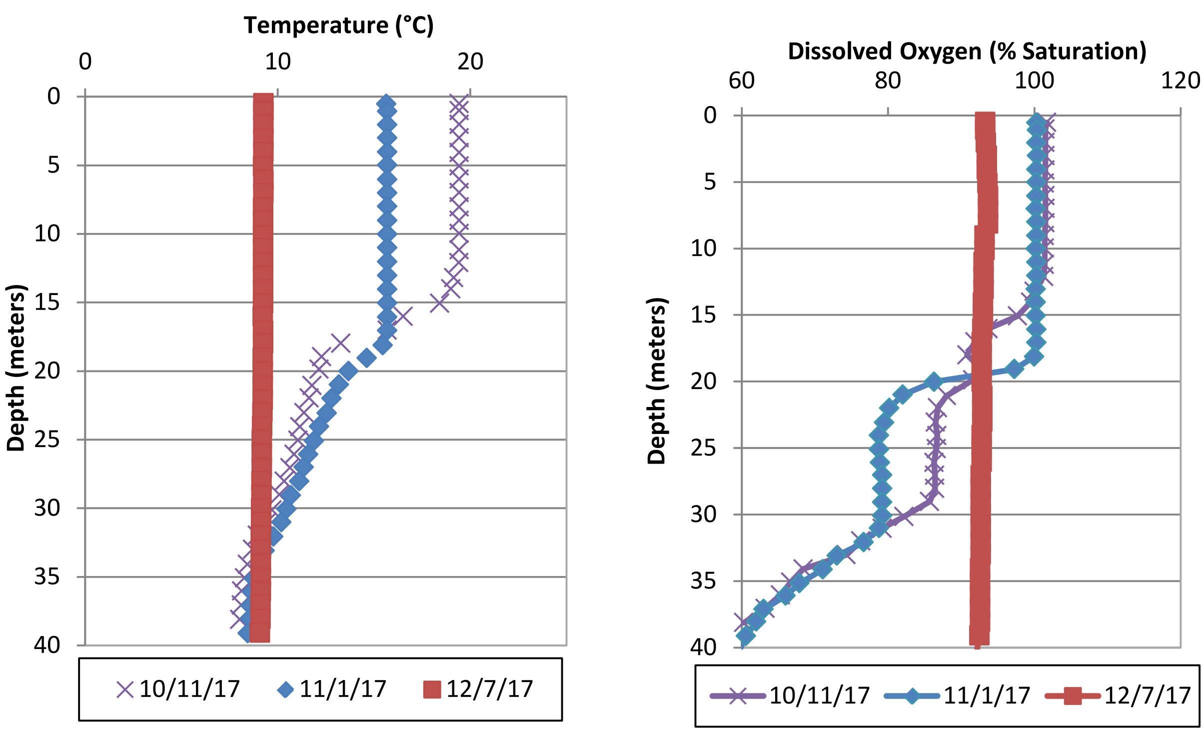


(a) April - June 2016

Figure 8. Temperature and Dissolved Oxygen Profiles at Quabbin Reservoir Site 202



(b) July- September 2017



(c) October - December 2017

Figure 8 (continued). Temperature and Dissolved Oxygen Profiles at Quabbin Reservoir Site 202

In 2017, minimum levels of oxygen measured in the hypolimnion ranged from 13 percent saturation at Den Hill (on October 11 at 15 meters) to 64 percent saturation at Site 206 (on November 11 at 26 meters). Depletion levels are usually most pronounced in the latter stages of stratification (typically August through October). In terms of mass concentration, the minimum dissolved oxygen levels in 2017 were 1.40mg/L at Den Hill (on October 11at 15meters), 6.70 mg/L at Site 202 (on November 11 at 40 meters), and 6.63 mg/L at Site 206 (on November 11 at 26 meters). The seasonal development and breakdown of stratification for Site 202 are shown in **Figure 8**.

3.2.3 Turbidity

Reservoir turbidity levels are historically very low and stable, reflective of the low productivity of the reservoir. In 2017, turbidity levels in reservoir samples ranged from 0.23 to 1.13 NTU. The highest turbidity level was measured at eight meters depth on April 27 at Den Hill. Typical causes of turbidity in the reservoir include storm activity, algal blooms, or shoreline erosion. A review of precipitation data from the week before sampling indicates the elevated turbidity on April 27 may have been due to storm activity, because 0.36 inch of rain was recorded at the Barre Falls Dam station on April 26, 2017.

3.2.4 pH and Alkalinity

The pH and alkalinity of a water body are important controlling factors of overall water quality. The pH is the number of hydrogen ions [H+], reported on a log scale of 0 to 14. The [H+] concentration of 7.0 represents neutral water, and levels below 7.0 are considered acidic with a decrease of one unit representing a 10-fold increase in acidity. Alkalinity is the buffering capacity of water, and is also described as the resistance to changes in pH.

Three processes principally reflected in reservoir pH and alkalinity dynamics are 1) direct acidic inputs (i.e., rainfall, dry deposition), 2) biological respiration, and 3) algal photosynthesis. The input of acid in the form of direct precipitation will consume alkalinity available in the water and reduce pH levels. Biological respiration by organisms can increase alkalinity levels as oxygen is consumed and carbon dioxide is released, increasing the amount of carbon in the water. Photosynthetic activity in the epilimnion and metalimnion can increase alkalinity and increase pH due to the consumption of free carbon dioxide and bicarbonate.

Reservoir pH is an important consideration because levels below 6 increase the solubility of persistent heavy metals such as mercury, allowing the metal to be incorporated into the water body and thus more likely to accumulate in the tissue of living organisms such as fish. As a result, most northeastern lakes like Quabbin Reservoir have posted fish consumption advisories that suggest limiting the quantity of fish consumed because of the presence of higher mercury levels in the fish. Quabbin Reservoir water is slightly acidic with a pH level that averaged 6.1 across the three sites monitored in 2017.

Both pH and alkalinity have a long-term record of stability in the Quabbin Reservoir, but levels fluctuate due to reservoir dynamics. Reservoir alkalinity is relatively low and averaged 3.99 mg/L as $CaCO_3$ across the three reservoir sites. Alkalinity levels generally ranged from approximately 3 to 4 mg/L as $CaCO_3$. Note that alkalinity in the annual water quality reports for Quabbin and Ware River have historically presented two sets of alkalinity data: "standard," which represented alkalinity titrated to a pH of 4.5, versus "EPA," representing alkalinity titrated to a pH of 4.2. Under Standard Method 2320B, waters of "low-level" alkalinity, which is less than 20 mg/L, should be reported using the pH 4.2 endpoint. The purpose of reporting results at both endpoints was to preserve the historical record. If reporting alkalinity at pH 4.5, in the method used historically, reservoir alkalinity averaged 5.72 mg/L as $CaCO_3$ across the three reservoir sites.

3.2.5 Specific Conductance

Specific conductance, the measure of the ability of water to conduct an electrical current, is dependent on the concentration and availability of mineral ions. Elevated levels in a water body may be indicative of contamination from septic system effluent, stormwater discharges, or agricultural runoff. Another significant source of higher levels is chloride, which is found in deicing salts applied to highways and local roads (Shanley, 1994; Lent *et al.*, 1998). Chloride may persist in watersheds for years after initial application (Kelly *et al.*, 2008). Specific conductance values measured in the reservoir have historically been low, and 2017 values were within the historical ranges. Measured values ranged from a minimum of approximately 40 µS/cm at Site 202 up to a maximum of approximately 71 µS/cm at Den Hill.

3.2.6 Secchi Disk Transparency

Secchi disk transparency is determined as the depth below the surface at which a 20-centimeter, black-and-white disk becomes indistinguishable to the naked eye. Quabbin Reservoir water has excellent clarity, as evidenced by Secchi disk readings that may exceed 13 meters. While sensitive to weather and reservoir conditions at the time of sampling, transparency can be greatly influenced by the level of phytoplankton activity. Historically, reservoir transparency measurements are consistent with the pattern of phytoplankton dynamics (Worden, 2000). In 2017, the maximum measured transparency was 11.9 meters at Site 202 on August 17.

Transparency at the Den Hill site is characteristically much lower than Sites 202 and 206, reflecting the contribution of large, nearby river inputs of the East Branch Swift River and the Ware River (when diverting). The East Branch Swift River, estimated to contribute as much as 9 to 16 percent of the annual flow to the reservoir, is a significant source of color that reduces transparency. In 2017, minimum transparency was measured at 3.5 meters at Den Hill on April 27. Monthly transparency measurements and weather observations are summarized in **Tables 7-9**.

Table 7. Transparency Measurements and Weather and Water Surface Observations in 2017, Quabbin Reservoir Site 202 (Winsor Dam).

Date	Transparency (m)	Water Color	Weather and Water Surface Observations
April 27, 2017	7.1	Brown-green	Cloudy, 15°C, no wind, calm water surface.
May 17, 2017	8.4	Blue-green	Mostly cloudy, 18°C, S wind 1 mph, calm water surface.
June 12, 2017	11.1	Blue-green	Sunny, 26°C, no wind, calm water surface.
July 19, 2017	9.6	Green	Mostly cloudy, 23°C, S wind 2 mph, 33 chop
August 17, 2017	11.9	Dark green	Mostly cloudy, 21°C, N wind 3 mph, 53 chop.
September 25, 2017	10.3	Blue-green	Sunny, 27°C, N wind 4 mph, 63 chop.
October 11, 2017	9.9	Blue-green	Cloudy, 17°C, N wind 8 mph,123 chop.
November 1, 2017	10.0	Dark green	Cloudy, 4°C, SE wind 4 mph, 33 chop.
December 7, 2017	11.1	Green	Sunny, -1°C, SE wind 4 mph, 33 chop.

Table 8. Transparency Measurements and Weather and Water Surface Observations in 2017, Quabbin Reservoir Site 206 (Shaft 12).

Date	Transparency (m)	Water Color	Weather and Water Surface Observations
April 27, 2017	6.3	Green	Cloudy, 17°C, calm wind, calm water surface.
May 17, 2017	7.5	Blue-green	Mostly cloudy, 18°C, S wind 2 to 5 mph, 4 to 63 chop.
June 12, 2017	11.0	Blue-green	Sunny, 26°C, S wind 5 mph, slight ripple, 43 chop.
July 19, 2017	9.9	Green	Mostly cloudy, 28°C, SSW wind 4 mph, 43 chop.
August 17, 2017	10.3	Green	Partly cloudy, 24°C, no wind, calm water surface.
September 25, 2017	10.7	Blue-green	Sunny, 30°C, N wind 2 mph, 53 chop.
October 11, 2017	8.3	Blue-green	Mostly cloudy, 19°C, N wind 8 mph, 103 chop
November 1, 2017	10.0	Blue-green	Cloudy, 6°C, E wind 3 mph, 33 chop.
December 7, 2017	9.7	Green	Sunny, 4°C, SW wind 8 mph, 123 chop.

Table 9. Transparency Measurements and Weather and Water Surface Observations in 2017, Quabbin Reservoir Site Den Hill

Date	Transparency (m)	Water Color	Weather and Water Surface Observations
April 27, 2017	3.5	Dark green	Cloudy, 18°C, W wind 1 mph, slight ripple.
May 17, 2017	5.2	Brown	Mostly sunny, 25°C, SW wind 3 to 5 mph, 4 to 63 chop.
June 12, 2017	5.3	Brown	Mostly sunny, 32°C, SW wind 3 mph, 33 chop.
July 19, 2017	6.9	Olive green	Partly cloudy, 28°C, SW wind 4 mph, 53 chop.
August 17, 2017	8.4	Dark green	Mostly sunny, 22°C, W wind 1 mph, calm water surface.
September 25, 2017	8.3	Green	Mostly sunny, 31°C, N wind 1 mph, 13 chop.
October 11, 2017	8.1	Green	Mostly cloudy, 20°C, N wind 4 mph, 43 chop
November 1, 2017	6.1	Brown	Cloudy, 8°C, E wind 2 mph, calm water surface.
December 7, 2017	5.3	Brown-green	Mostly sunny, 4°C, SW wind 8 mph, 63 chop.

3.2.7 Total coliform, Fecal Coliform, and *E. coli* Bacteria

The term "coliform" describes a group of bacteria based on biochemical functions, not on taxonomy. The presence of total coliform bacteria can indicate fecal contamination, but this group of bacteria also includes many species that are natural inhabitants of the aquatic system that can grow at a wide range of temperatures (Wolfram, 1996; Dutka and Kwan, 1980). The "fecal" coliform group is a subset of the total coliform group that can grow at more narrow range of temperatures that are comparable to those in the intestinal tracts of warm-blooded animals (Toranzos and McFeters, 1997). Because fecal coliform bacteria grow at elevated temperatures, these bacteria may be considered a better indicator of recent fecal pollution. However, this group also includes some bacteria that originate from environmental sources other than fecal contamination (Toranzos and McFeters, 1997; Leclerc *et al.*, 2001). *E. coli* bacteria, which are normal inhabitants of the intestinal tracts of humans and other warm-blooded animals, are a better indicator of recent fecal pollution in temperate climates. Because of the ubiquitous nature of total coliform bacteria, fecal coliform and *E. coli* are the preferred indicators of recent fecal pollution. This approach is consistent with the SWTR, which specifies that when both total and fecal coliform bacteria are analyzed, fecal coliform findings have precedent.

A seasonal gull population that roosts on the reservoir overnight has been identified as the primary contributor of fecal coliform and *E. coli* bacteria contamination to the reservoir. Other sources may include other waterfowl, semi-aquatic wildlife and tributary inputs. However, because of the long residence time of the reservoir (reportedly on the magnitude of several years), fecal coliform and *E. coli* bacteria levels are normally very low, reflecting microbial die-off and predation that occurs naturally.

In 2017, fecal coliform bacteria were detected in several reservoir samples, and most of these detections were at the Den Hill location. Of the detections at Den Hill, most ranged from 1 to 6 CFU/100 mL, but fecal coliform was detected at 32 CFU/100mL in the shallow sample (0.5 meter) in September. This result may be partly related to relatively warm air temperatures in September, as the high air temperature on the sampling date was 93°F. Fecal coliform was not detected in most samples from Sites 206 and 202, and the detections ranged from 1 to 2 CFU/100mL. At Site 206, fecal coliform bacteria were detected in the shallow (0.5-meter) sample in November. At Site 202, fecal coliform bacteria were detected in the shallow (0.5-meter) samples in September, October, and November, as well as the middle sample in October and November and the deep sample in July and November.

E. coli bacteria were detected several times in 2017 at the detection limit of 10 MPN/100 mL. *E.* coli bacteria were detected at 20 MPN/100 mL in one sample, collected from 0.5 meter in September at Den Hill. This is the same sample in which fecal coliform bacteria were detected at 32 CFU/100 mL, as described above.

Reservoir total coliform bacteria concentrations are much more dynamic than fecal coliform and *E. coli*, and ranged from not detected (less than 10) to 24,200 MPN/100 mL in 2017. The total coliform concentration of 24,200 MPN/100 mL was measured in the 18-meter sample from Site 202 in August.

3.2.8 Reservoir Nutrient Dynamics and Phytoplankton

The nutrient database for Quabbin Reservoir was established in 1998-99 with a year of monthly sampling, and quarterly sampling has been conducted since then. Results from 2017 are summarized and compared to historical data in **Table 10**. In general, the patterns of nutrient distribution in 2017 quarterly samples were consistent with those documented previously by Worden (2000). These patterns consist of the following: 1) prominent seasonal and vertical variations due to demand by phytoplankton in the trophogenic zone (low concentrations in the epilimnion and metalimnion) and decomposition of organic matter in the tropholytic zone (higher concentrations accumulating in the hypolimnion); 2) a lateral gradient in silica concentrations correlated to hydraulic residence time and mediated by diatom population dynamics; and 3) variably higher concentrations and intensities at the Den Hill monitoring site due to the loading effects of the East Branch Swift River.

Table 10. Quabbin Reservoir Nutrient Concentrations:
Comparison of Ranges from 1998-2016 Database to Results from 2017 Quarterly Sampling (after Worden, 2013)

Sampling Site	**Ammonia (NH_3; µg/L)**		**Nitrate (NO_3; µg/L)**		**Silica (SiO_2; mg/L)**		**Total Phosphorus (µg/L)**		**UV_{254} (Absorbance/cm)**	
	1998-2016	Quarterly 2017	1998-2016	Quarterly 2017	1998-2016	Quarterly 2017	1998-2016	Quarterly 2017	1998-2016	Quarterly 2017
202 (E)	<5 - 16	<5 - 6	<5 - 23	<5 - 7	0.84 - 2.40	1.32 - 1.64	<5 - 20	<5 - 7	0.017 - 0.029	0.018 - 0.020
202 (M)	<5 - 29	<5 - <5	<5 - 27	<5 - 7	0.83 - 2.42	1.27 - 1.63	<5 - 13	<5 - 7	0.017 - 0.031	0.018 - 0.022
202 (H)	<5 - 53	<5 - 8	<5 - 54	<5 - 9	1.08 - 2.86	1.57 - 1.82	<5 - 44	<5 - 6	0.017 - 0.026	0.017 - 0.020
206 (E)	<5 - 10	<5 - <5	<5 - 20	<5 - 5	0.84 - 2.24	1.33 - 1.50	<5 - 12	<5 - 5	0.017 - 0.031	0.019 - 0.020
206 (M)	<5 - 34	<5 - <5	<5 - 44	<5 - <5	0.84 - 2.25	1.19 - 1.48	<5 - 12	<5 - 5	0.017 - 0.031	0.019 - 0.023
206 (H)	<5 - 105	<5 - 7	<5 - 130	<5 - 9	1.02 - 3.27	1.39 - 1.72	<5 - 19	<5 - 7	0.017 - 0.031	0.019 - 0.020
Den Hill (E)	<5 - 19	<5 - 14	<5 - 45	<5 - 23	0.74 - 4.64	1.59 - 2.98	<5 - 27	<5 - 9	0.023 - 0.122	0.032 - 0.082
Den Hill (M)	<5 - 28	<5 - 15	<5 - 58	<5 - 24	0.84 - 4.37	1.61 - 2.84	<5 - 15	<5 - 9	0.022 - 0.139	0.031 - 0.084
Den Hill (H)	<5 - 84	<5 - 21	<5 - 78	6 - 25	0.83 - 4.25	2.11 - 2.98	<5 - 15	<5 - 8	0.023 - 0.171	0.031 - 0.085

Notes: (1) 1998-2016 database composed of 1998-99 year of monthly sampling and subsequent quarterly sampling conducted through December 2016, except that measurements of UV_{254} were initiated in 2000 quarterly sampling.
(2) 2017 quarterly sampling conducted May, July, October, and December.
(3) Water column locations are as follows: E = epilimnion/surface, M = metalimnion/middle, H = hypolimnion/bottom

Results of quarterly nutrient sampling in 2017 were generally consistent with historical data ranges. In particular, ammonia concentrations were near or below the detection limit of 5 µg/L in samples from the three depths at Site 202 and 206, as well as in most of the samples from Den Hill. Total phosphorus concentrations were generally below or just above the detection limit of 5 µg/L, with a maximum of 9 µg/L detected at Den Hill in October. These low ammonia and phosphorus concentrations may be factors limiting the growth of phytoplankton in 2017. Typically, phosphorus is the limiting nutrient in Quabbin Reservoir and other lakes in temperate climates (Worden, 2000).

The results of phytoplankton monitoring in 2017 are described in **Appendix C** (2017 Phytoplankton Monitoring at Quabbin Reservoir). In 2017, the most prevalent phytoplankton included the diatoms *Asterionella*, *Cyclotella,* and *Rhizosolenia*; the chlorophytes (green alga) *Gloeocystis* and *Sphaerocystis*; and the cyanophytes (blue-green alga) *Microcystis, Rhabdoderma,* and *Aphanocapsa*. These phytoplankton species are "typical of many oligotrophic systems located in the temperate zone." Phytoplankton densities were generally higher than in previous years. The average densities in 2017 at Sites 202 and 206 were 421 and 466 ASUs/mL. In comparison, the average densities at these sites in 2016 were 164 and 176 ASUs/mL, respectively. The highest diatom densities were observed in May, when almost three times as many diatoms were observed than in May of 2016. The relatively high densities in May, 2017 compared to May, 2016 may be related to the elevated turbidity levels from storms and strong winds observed during late winter and spring of 2017, as described in Section 3.1. Higher turbidity levels could lead to more nutrient availability, especially nutrients that tend to sorb onto sediment, such as phosphorus.

Finally, calcium concentrations ranged from 1.96 mg/L to 2.60 mg/L at the three reservoir sites. These results are consistent with historical ranges for the reservoir, and the levels indicate a relatively low risk of zebra mussel colonization in the reservoir.

3.3 Results – Tributary Monitoring

Monitoring of tributary water quality is not required by the SWTR or other regulations. DWSP performs routine monitoring of the tributaries in order to establish a baseline of water quality data, from which trends may be used to identify subwatersheds where localized activities may be adversely impacting water quality.

3.3.1 Bacteria

Massachusetts Class A surface water quality standards differentiate between bacteria standards for water supply intakes (which are discussed above in Section 3.0), and other Class A waters, which rely on *E. coli* bacteria as the indicator of sanitary quality. The Massachusetts Class A standard for non-intake waters states that

> the geometric mean of all *E. coli* samples taken within the most recent six months shall not exceed 126 colonies per 100 mL typically based on a minimum of five samples and no single sample shall exceed 235 colonies per 100 mL (314 CMR 4.05(3)(a)4.c.).

Water quality monitoring in the Quabbin Reservoir and Ware River watershed tributary sites primarily includes *E. coli* and total coliform bacteria. In addition, monitoring for fecal coliform is performed on a limited basis to assess for potential sources of fecal coliform, other than wintering gulls, near the WDI. Fecal coliform monitoring is conducted weekly on two Quabbin Reservoir tributaries, Boat Cove Brook and Gates Brook, from September through March.

If elevated bacteria results are detected after tributary sampling that cannot be attributed to a recent rain event, then a follow-up site inspection is performed and the site is re-sampled. These detections are sometimes attributable to wildlife activity or recent precipitation, and sometimes no apparent source is detected. Reports summarizing these inspections and the re-sample results are included in **Appendix C**.

3.3.1.1 E. coli Bacteria

In 2017, *E. coli* results ranged from less than 10 to 4,880 MPN/100 mL in the Quabbin Reservoir watershed and from less than 10 to 1,300 MPN/100 mL in the Ware River watershed. After both maximum values were detected, the sites were inspected and re-sampled, and the results and conditions are described in **Appendix C**. As indicated, the maximum concentration in the Quabbin Reservoir watershed was in a sample collected from Boat Cove Brook on June 6. The elevated result was likely due to approximately 1.5 inches of precipitation falling prior to and on the day of sampling. The maximum concentration detected in the Ware River watershed was collected from Site 111 on February 21. This elevated result was attributed to snow melting and flushing, and no potential source of pollution was observed.

New historical maximum values were recorded in 2017 for three sites in the Quabbin Reservoir watershed and one site in the Ware River watershed. Historical maximums in the Quabbin Reservoir watershed included Sites 215H (368 MPN/100 mL on June 6), 215G (448 MPN/100 mL on June 20), and 215B (399 MPN/100 mL on September 12). Follow-up investigations were not performed after the June results, but the June 6 result was probably related to precipitation (similar to the Boat Cove Brook result described above). The June 20 sample was also likely related to precipitation, as approximately 0.5 inch of precipitation fell in the area in the day before sampling. A follow-up investigation was conducted after the September 12 result, and is included in **Appendix C.** As indicated, the elevated level may have been related to animal activity because several beaver dams were observed upstream of the sample location, and evidence of animal activity (including matted down plants and bear scat) was observed in the area. The new historical maximum in the Ware River watershed was the result at Site 111 on February 21, which is described above.

Tributary *E. coli* data were compared to the Class A standards for non-intake waters. The six-month, running geometric means of one site, Boat Cove Brook, in the Quabbin Reservoir watershed exceeded 126 MPN/100 mL from August 1 through December 28. Follow-up assessments of this sample location are described below. No six-month, running geometric means exceeded 126 MPN/100 mL in samples from the Ware River watershed during 2017.

In addition, at least one sample from 8 of 11 Quabbin tributary sites and 6 of 10 Ware River tributary sites exceeded the Class A Standard for single samples of 235 colonies per 100 mL. The only sites where this standard was not exceeded were Sites 211, 216, and Gates Brook in the Quabbin Reservoir watershed and Sites B4, 103, C2, and N1 in the Ware River watershed. The standard was exceeded on the following dates:

- February 21 (Site 111);
- May 2 (Site 121B);
- May 16 (Site 111);
- June 6 (Sites 212, 213, 215, 215H, and Boat Cove Brook);
- June 20 (Sites 213, 215F, and 215G);
- July 5, 18, and 20 (Boat Cove Brook);
- July 25 (Sites 101, 121B, and 108);
- August 1 and 10 (Boat Cove Brook);
- August 15 (Site 215F and Boat Cove Brook);
- August 29 and 31 (Boat Cove Brook);
- September 12 (Site 215B);
- September 26 (Boat Cove Brook);
- October 10 (Sites 212 and 213);
- October 24 (Site 215H); and
- October 31 (Sites 107A and 108).

The single-sample exceedances were most frequently due to flushing during storm events and/or snow melt. Certain samples with elevated counts were assessed and attributed to flushing, as documented in the field reports for the February 21, May 16, and June 6 sample dates. The elevated result from Site 215B on September 12 was attributed to animal activity in the area, as described above.

As described above, samples collected from Boat Cove Brook indicated exceedances of the six-month, geometric running average standard as well as exceedances of the single sample standard for Class A water bodies. Follow-up assessments of this location are described in the field reports in **Appendix C**. As indicated, elevated counts were detected at this location during the summer and fall. Some elevated results were attributed to precipitation, but the results of other assessments were inconclusive. Follow-up assessments included looking for signs of animal activity and visually assessing the Tower septic field upstream of the sample location. Dense vegetation around the stream limited the ability of staff to visually assess conditions upstream of the sample location. Some evidence of animal activity, such as game trails and deer scat, were observed. In addition, no apparent problems related to the Tower septic leach field were observed. If elevated levels are detected at this site in 2018, assessments may include microbial source tracking to help identify the cause(s).

The *E. coli* data from 2017 were compared to data from the previous seven years at each tributary site, and the annual geometric means for these years are shown in **Table 11**. The percentages of samples by site that exceeded 126 MPN/100 mL in single samples are shown in **Table 12.** Similarly, the percentages of samples by site that exceeded 235 MPN/100 mL in single samples are shown in **Table 13**.

Overall, the *E. coli* geometric means for most Quabbin tributary core sites have been comparable from 2010 through 2017. The geometric mean at one site, Boat Cove Brook, was almost twice the geometric mean from 2016 and three to four times higher than earlier years. Work to assess for potential bacteria sources near this sample location is described above. The geometric means at Quabbin EQA sites in 2017 were higher than those in the previous sampling year (2013).

In the Ware River watershed, the geometric means for most core and EQA sites were higher than previous sampling. This may in part be due to flushing of streams from rainfall or snowmelt. The results of future sampling may help distinguish whether the higher levels in 2017 represent an upward trend.

As shown in **Table 13**, most samples in the Quabbin and Ware River watersheds were below 235 MPN/100 mL. The percentage of samples above this threshold ranged from zero to eleven at most sites. The percentage at Boat Cove Brook, 31%, was higher than the other sample locations. This percentage represents ten samples from the site during 2017.

Table 11. Annual Geometric Means of *E.* coli for 2017 Tributary Sites

Site #	Monitoring Site Description	Geometric Mean (MPN/100 mL)							
		2017	2016	2015	2014	2013	2012	2011	2010
Quabbin Reservoir Watershed Core Sites									
211	W. Br. Swift River at Rte. 202	23.2	35.9	17.7	18.5	17.6	19.3	16.8	23.2
212	Hop Brook inside Gate 22	41.9	60.8	43.4	23.3	21.4	27.6	27.4	28.6
213	M. Br. Swift River at Gate 30	39.4	43.0	37.3	43.3	42.7	49.3	48.3	60.5
215	E. Br. Fever Brook at West St.	31.4	38.1	16.5	22.0	20.7	22.8	21.5	23.5
216	E. Br. Swift River at Rte. 32A	23.6	28.0	17.7	18.6	20.4	18.7	31.1	23.0
Gates	Gates Brook at mouth	29.3	20.5	17.5	16.1	18.5	24.1	18.2	25.7
BC	Boat Cove Brook at mouth	108	60.7	35.5	31.8	24.6	31.8	19.9	34.4
Quabbin Reservoir Watershed EQA Sites									
215B	West Branch Fever Brook, at mouth	30.0	×	×	×	15.1	×	×	×
215H	Harvard Pond, at inlet	38.2	×	×	×	25.3	×	×	×
215F	East Branch Fever Brook, at road above mouth	32.6	×	×	×	18.1	×	×	×
215G	East Branch Fever Brook, at Camel’s Hump Road	24.8	×	×	×	13.4	×	×	×
Ware River Watershed Core Sites									
101	Ware River at Shaft 8 Intake	40.5	21.9	23.4	22.5	30.0	32.7	33.8	23.6
103A	Burnshirt River at Riverside Cemetery	56.2	42.6	37.7	39.9	28.9	25.1	28.7	39.0
107A	W. Br. Ware River at Brigham Rd.	34.9	21.7	27.1	21.9	24.6	21.8	20.9	24.1
108	E. Br. Ware at Intervale Rd.	57.1	27.8	29.2	25.4	32.1	23.6	35.4	34.3
121B	Thayer Pond at inlet	38.4	36.4	32.7	24.7	27.6	47.3	31.3	60.3
Ware River Watershed EQA Sites									
111	Queen Lake, at road culvert below outlet	46.5	×	×	×	14.3	×	×	×
B4	Burnshirt River, at stone bridge	23.0	×	×	×	33.3	×	×	×
103	Burnshirt River, at Rte. 62	26.1	×	×	×	19.0	×	×	×
C2	Canesto Brook, at Williamsville Road	42.9	×	×	×	29.1	×	×	×
N1	Natty Pond, at Hale Road	33.0	×	×	×	20.9	×	×	×

× Indicates data not available.

Detection limit for *E. coli* was 10 MPN/100 mL. Geometric mean was calculated using a value of 9.9 in place of non-detect samples (similar to Costa, 2007).

Table 12. Percentage of Samples Exceeding 126 Colonies *E. coli* per 100 mL

Site #	Monitoring Site Description	% of Samples > 126 MPN/100 mL							
		2017	2016	2015	2014	2013	2012	2011	2010
Quabbin Reservoir Watershed Core Sites									
211	W. Br. Swift River at Rte. 202	4	19	4	4	8	12	7	12
212	Hop Brook inside Gate 22	12	21	18	4	8	12	12	12
213	M. Br. Swift River at Gate 30	15	22	19	12	15	19	30	31
215	E. Br. Fever Brook at West St.	12	30	0	4	4	8	4	8
216	E. Br. Swift River at Rte. 32A	8	4	4	4	8	4	7	8
Gates	Gates Brook at mouth	4	12	4	4	4	15	8	8
BC	Boat Cove Brook at mouth	44	33	19	22	12	15	8	25
Quabbin Reservoir Watershed EQA Sites									
215B	West Branch Fever Brook, at mouth	8	×	×	×	0	×	×	×
215H	Harvard Pond, at inlet	12	×	×	×	4	×	×	×
215F	East Branch Fever Brook, at road above mouth	8	×	×	×	4	×	×	×
215G	East Branch Fever Brook, at Camel's Hump Road	4	×	×	×	0	×	×	×
Ware River Watershed Core Sites									
101	Ware River at Shaft 8 Intake	7	4	8	12	15	15	19	4
103A	Burnshirt River at Riverside Cemetery	19	27	22	24	17	4	10	23
107A	W. Br. Ware River at Brigham Rd.	4	8	8	12	4	4	8	8
108	E. Br. Ware at Intervale Rd.	15	12	8	12	11	0	8	4
121B	Thayer Pond at inlet	24	21	19	19	7	23	12	38
Ware River Watershed EQA Sites									
111	Queen Lake, at road culvert below outlet	11	×	×	×	0	×	×	×
B4	Burnshirt River, at stone bridge	0	×	×	×	15	×	×	×
103	Burnshirt River, at Rte. 62	0	×	×	×	0	×	×	×
C2	Canesto Brook, at Williamsville Road	4	×	×	×	15	×	×	×
N1	Natty Pond, at Hale Road	0	×	×	×	7	×	×	×

× Indicates data not available.

Table 13. Percentage of Samples Exceeding 235 Colonies *E. coli* per 100 mL

Site #	Monitoring Site Description	% of Samples > 235 MPN/100 mL							
		2017	2016	2015	2014	2013	2012	2011	2010
Quabbin Reservoir Watershed Core Sites									
211	W. Br. Swift River at Rte. 202	0	15	0	0	8	0	4	0
212	Hop Brook inside Gate 22	8	14	14	0	8	12	4	4
213	M. Br. Swift River at Gate 30	11	7	4	4	12	8	7	12
215	E. Br. Fever Brook at West St.	4	15	0	0	4	0	4	0
216	E. Br. Swift River at Rte. 32A	0	4	0	0	8	4	7	4
Gates	Gates Brook at mouth	0	8	0	4	4	8	4	8
BC	Boat Cove Brook at mouth	31	25	7	11	4	15	4	8
Quabbin Reservoir Watershed EQA Sites									
215B	West Branch Fever Brook, at mouth	4	×	×	×	0	×	×	×
215H	Harvard Pond, at inlet	8	×	×	×	4	×	×	×
215F	East Branch Fever Brook, at road above mouth	8	×	×	×	0	×	×	×
215G	East Branch Fever Brook, at Camel's Hump Road	4	×	×	×	0	×	×	×
Ware River Watershed Core Sites									
101	Ware River at Shaft 8 Intake	4	0	4	4	7	4	8	4
103A	Burnshirt River at Riverside Cemetery	4	12	4	12	8	4	5	4
107A	W. Br. Ware River at Brigham Rd.	4	4	4	4	4	0	4	8
108	E. Br. Ware at Intervale Rd.	8	0	8	0	7	0	4	4
121B	Thayer Pond at inlet	8	8	4	4	4	8	8	23
Ware River Watershed EQA Sites									
111	Queen Lake, at road culvert below outlet	7	×	×	×	0	×	×	×
B4	Burnshirt River, at stone bridge	0	×	×	×	7	×	×	×
103	Burnshirt River, at Rte. 62	0	×	×	×	0	×	×	×
C2	Canesto Brook, at Williamsville Road	0	×	×	×	15	×	×	×
N1	Natty Pond, at Hale Road	0	×	×	×	7	×	×	×

× Indicates data not available.

3.3.1.2 Fecal Coliform Bacteria

As described above, 2017 fecal coliform monitoring was performed on a weekly basis at two tributary sites (Boat Cove and Gates Brooks) from January through March, and then again from

September through December. Fecal coliform samples are collected on a daily basis at the WDI, and the weekly data from these two tributaries provide a basis for assessing potential sources of fecal coliform at the WDI. The primary potential source of fecal coliform near the WDI is gulls on the reservoir during the fall, winter, and early spring. The gull harassment program is designed to prevent gulls from roosting in the vicinity of the WDI and therefore reduces the potential for fecal coliform bacteria in this area. In the event that elevated fecal coliform levels were detected in the WDI during the gull harassment program, the weekly fecal coliform of Boat Cove and Gates Brooks would provide additional data about potential fecal coliform sources other than gulls.

Results from this monitoring program indicated fecal coliform bacteria levels were relatively low at these tributaries. The maximum level at Boat Cove Brook was >200 CFU/100 mL on September 7, and the maximum level at Gates Brook was 37 CFU/100 mL on September 7. Approximately 1.4 inch of rain fell during the day before the September 7 sample was collected, which indicates the result was likely related to rainfall.

3.3.1.3 Total Coliform Bacteria

Total coliform results in 2017 were generally consistent with historical ranges. New maximum levels were detected at only two sites, and both were in the Quabbin Reservoir watershed on June 20. These maximums were 12,000 MPN/100mL at Site 215F and 19,000 MPN/100mL at Site 215H. As described above, follow-up assessments were not performed for samples collected on June 20, and the elevated levels are likely related to precipitation.

3.3.2 Turbidity

As described in Section 3.0, the standards for turbidity are five NTU under the SWTR, and one NTU under MassDEP regulations (unless effective disinfection is maintained). While not directly applicable (because the tributaries are not drinking water intakes), drinking water standards for turbidity were used as reference points in evaluating the tributary data.

In 2017, turbidity exceeded 5 NTU in one sample from the Quabbin Reservoir watershed and one sample from the Ware River watershed. The elevated result in the Quabbin Reservoir watershed (8.70 NTU from Boat Cove Brook on June 6) was most likely related to heavy rain (which also led to elevated bacteria results, as described in Section 3.3.1.1). In the Ware River watershed, turbidity was above 5 NTU in two samples from Site 121B (5.20 NTU on August 22 and September 19).

Minimum, maximum, and median turbidity results for each tributary monitored in 2017 are summarized in **Tables 14 and 15**. Results were generally consistent with the historical ranges of turbidity levels. One new maximum turbidity result was measured in the Ware River watershed,

Table 14. 2017 Range of Turbidity Results in Quabbin Reservoir Watershed Tributaries

SITE	MINIMUM Result (NTU)	MINIMUM Date	MAXIMUM Result (NTU)	MAXIMUM Date	MEDIAN
211 (W. Br. Swift)	0.19	1/3	0.92	10/10	0.36
212 (Hop Brook)	0.33	1/17, 2/14	2.30	7/18	0.58
213 (Mid. Br. Swift)	0.33	3/15	2.00	10/10	0.72
215 (E. Br. Fever)	0.39	1/31	4.20	8/29	0.77
216 (E. Br. Swift)	0.37	1/17	1.80	6/6	0.53
Boat Cove Brook	0.25	8.29	8.70	6/6	0.64
Gates Brook	0.11	1/31	0.42	2/28	0.23
215B (W. Br. Fever Brook)	0.42	1/17, 3/28	1.20	6/6	0.61
215H (Harvard Pond, at inlet)	0.28	3/28	2.90	7/18	0.70
215F (E. Br. Fever Brook, at road above mouth)	0.39	1/31	1.70	8/29	0.66
215G (E. Br. Fever Brook, at Camel's Hump Road)	0.45	1/17	1.10	6/20, 7/18, 8/15, 8/29	0.75

Table 15. 2017 Range of Turbidity Results in Ware River Watershed Tributaries

SITE	MINIMUM Result (NTU)	MINIMUM Date	MAXIMUM Result (NTU)	MAXIMUM Date	MEDIAN
Ware River Watershed					
101 (Shaft 8 Intake)	0.43	3/21	4.00	7/25	1.15
103A (Burnshirt)	0.32	3/21	2.80	7/11	0.79
107A (W. Ware)	0.34	3/21	1.50	7/25	0.74
108 (E. Ware)	0.39	3/7	3.00	7/25	0.91
121B (Thayer Pond Inlet)	0.35	1/24	5.20	8/22, 9/19	0.61
111 (Queen Lake, at road culvert below outlet)	0.20	3/7	1.10	6/27, 11/14	0.51
B4 (Burnshirt River, at Stone Bridge)	0.28	3/21	1.60	6/27	0.59
103 (Burnshirt River, at Rte. 62)	0.30	2/7	1.50	7/25	0.60
C2 (Canesto Brook, at Williamsville Rd.)	0.28	3/7, 3/21	4.60	7/25	0.72
N1 (Natty Pond Brook, at Hale Rd.)	0.34	3/21	4.20	6/27	0.87

and no new maximum turbidities were measured in the Quabbin Reservoir watershed. The new maximum was 4.60 NTU in samples collected from Site C2 on July 25.

Turbidity results for Quabbin Reservoir watershed tributaries are plotted on **Figure 9**, and results for Ware River tributaries are plotted on **Figure 10**. Daily precipitation data from National Weather Service stations are shown on the graphs in dark blue. Precipitation data for the both

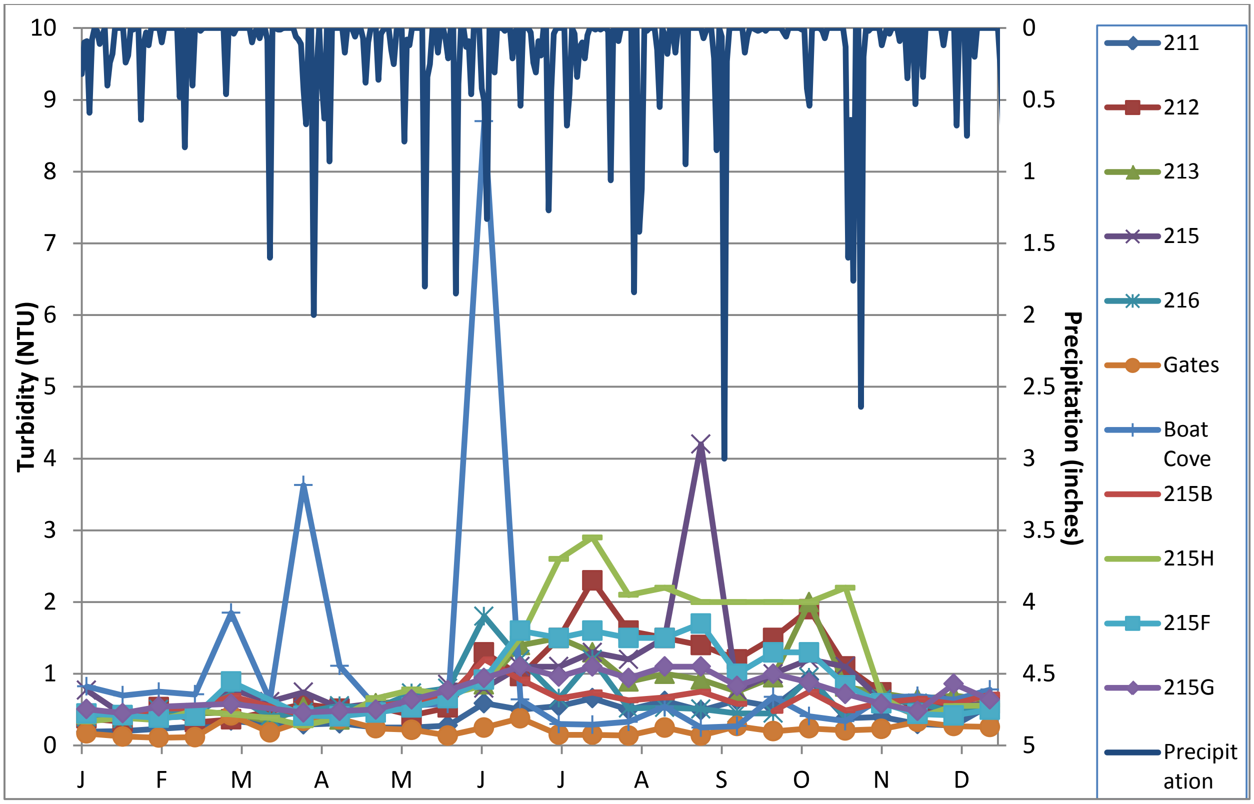


Figure 9. 2017 Turbidity and Precipitation Data, Quabbin Reservoir Watershed.

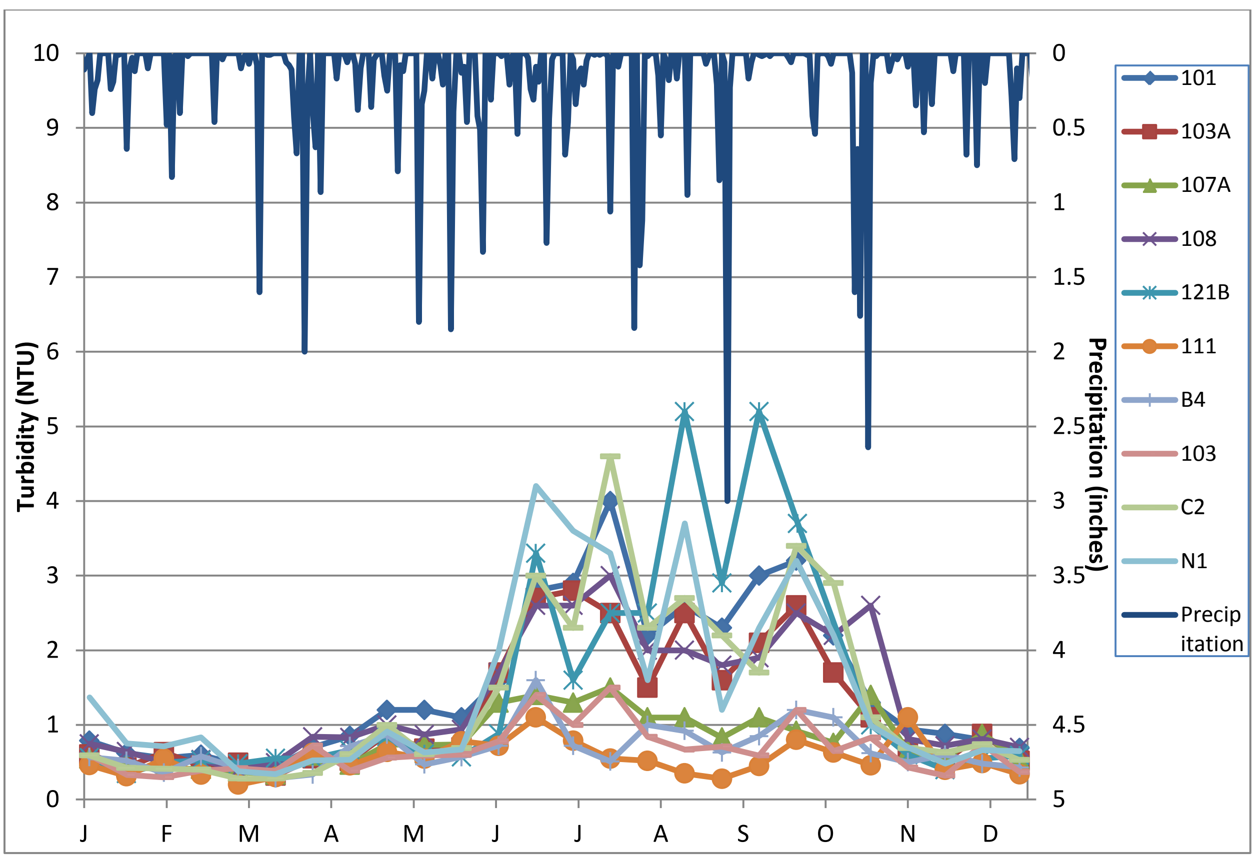


Figure 10. 2017 Turbidity and Precipitation Data, Ware River Watershed.

watersheds are from the Barre Falls Dam. As indicated, turbidity results generally peak during the summer months and are lowest during the winter. The higher levels in the summer may be due in part to precipitation occurring as rain instead of snow, more algal growth, and more sediment available for mobilization due to unfrozen ground.

The graphs illustrate the relative variability in turbidity between the two watersheds. Most Quabbin Reservoir watershed tributaries peaked around or below 2 NTUs, whereas the Ware River watershed tributaries were more variable and peaked between approximately 1 and 4 NTUs. Graphically, the annual peaks in both watersheds were of similar durations, from June through November. Therefore, turbidities were more variable in the Ware River watershed, but the timing of seasonal increases was similar in both watersheds. The differences may be a result of land use differences between the two watersheds, and are not necessarily indicative of long-term trends.

3.3.3 Specific Conductance

As described in Section 3.2.5, elevated levels of specific conductance in streams may be indicative of contamination from septic system effluent, stormwater discharges, agricultural runoff, or road salt runoff from deicing activities. In 2017, specific conductance values were generally comparable to the historical range. Relatively small increases in maximum conductivities were measured in three (215F, 215G, and 215H) of eleven Quabbin Reservoir watershed sites and three (101, C2, and N1) of ten Ware River watershed sites. The maximum conductivity measured in the Quabbin Reservoir watershed was 168 µS/cm at Site 212 (Hop Brook) on January 3 and October 10. The maximum conductivity measured in the Ware River watershed was 406 µS/cm at Site 121B (Thayer Pond Inlet) on February 21.

3.3.4 Dissolved Oxygen

Dissolved oxygen levels in stream environments are related to temperature, stream flow, water depth, and the physical characteristics of the stream channel. Depletion of dissolved oxygen can be due to the oxygen requirements of aquatic life, the decomposition of organic matter, and the introduction of oxygen-demanding substances (*i.e.*, chemical reducing agents). The Massachusetts Class A standard is a minimum of 6.0 mg/L. In 2017, dissolved oxygen levels in Quabbin Reservoir and Ware River tributaries were relatively high. Eighty-five percent of samples from the Ware River watershed and 93% of samples from the Quabbin Reservoir watershed were at or above the 6.0 mg/L standard.

3.3.5 Temperature

Temperature is a critical parameter in controlling how much dissolved oxygen can be available in aquatic environments. As temperature increases, the amount of oxygen that can be dissolved in water decreases. Moreover, higher temperatures increase the solubility of nutrients and may correlate well with an increase in the growth of filamentous green algae. In tributaries of the Quabbin Reservoir and Ware River watersheds, measured temperatures ranged between 0 and 24.1˚C throughout the year.

3.3.6 pH

The pH of a stream is largely a function of the groundwater hydrogeology of the basins and the effectiveness of the stream water in buffering the effects of acid precipitation. Median pH values in 2017 were below the Class A water quality threshold of 6.5 units at the 21 tributary monitoring sites. The medians at most of these sites ranged from 5.1 to 6.2. The lowest medians were at Sites N1, 215H, B4, and C2, with medians of 4.9, 4.8, 4.8, and 4.7, respectively.

3.3.7 Alkalinity

Alkalinity data from the EQA sites were compared to acid rain assessment criteria established under the Acid Rain Monitoring (ARM) Project at the University of Massachusetts. The ARM criteria are based on average results for the month of April (Godfrey *et al.*, 1996), and the ARM endangered threshold value is 5 mg/L. In 2017, alkalinity was below the ARM endangered threshold at the four EQA sites in the Quabbin Reservoir watershed (215B, 215H, 215F, 215G) and four of five EQA sites in the Ware watershed (B4, 103, C2, and N1).

Alkalinity generally peaked between late June and October. The data indicate alkalinity peaked a second time at Site 215F, to 18.33 mg/L in December. This value seems abnormally high, but the result was verified with the laboratory bench sheets. Maximum values ranged from 5.34 mg/L (Site 107A) to 34.4 mg/L (Boat Cove Brook). New maximum alkalinities were measured in samples from five sites in the Quabbin Reservoir watershed and five in the Ware River watershed. Quabbin Reservoir watershed sites included Gates Brook (9.1 mg/L on June 20), 215B (15.4 mg/L on September 14), 215F (18.3 mg/L on December 5), and 215G (6.39 mg/L on September 26). Ware River watershed sites included 103 (6.04 mg/L on October 3), 111 (10.5 mg/L on September 19), 121B (27.6 mg/L on September 19), B4 (7.45 mg/L on October 3), and C2 (8.19 mg/L on October 3).

As described in Section 3.2.4, care should be exercised when interpreting historical alkalinity data, because alkalinity analyses performed before 1990 were conducted using a pH endpoint of 4.5. Analyses performed since 1990 have included pH endpoints of both 4.5 and 4.2.

3.3.8 Tributary Nutrient Dynamics

Biweekly sampling for nutrients has been conducted on selected tributaries, including core sites, since March, 2005. The goal of this monitoring is to establish a database of nutrient data by sanitary district in both watersheds. In 2017, EQA sites in the Quabbin Reservoir and Ware River watersheds were monitored for nutrients and UV_{254} on a biweekly basis. Core sites in the

Quabbin Reservoir watershed were monitored for nutrients and UV_{254} on a quarterly basis, and core sites in the Ware River watershed were monitored for nutrients on a quarterly basis and UV_{254} on a biweekly basis. Both the Quabbin Reservoir watershed and Ware River watershed EQA sites were previously monitored in 2013. Median concentrations and data ranges of sites monitored in 2017 are summarized on **Table 16** (Quabbin Reservoir watershed) and **Table 17** (Ware River watershed).

3.3.8.1 Quabbin Reservoir Watershed

In the Quabbin Reservoir watershed, nutrient concentrations were generally within the historical ranges, with small increases at some sites compared to previous monitoring. As shown in **Table 16**, nitrate concentrations ranged from less than 5 µg/L to 45 µg/L at the EQA sites, compared to a maximum of 112 µg/L at the core sites. Nitrate levels were within historical ranges, and no new maximum nitrate levels were detected at the sites.

TKN, the sum of organic nitrogen plus ammonia, often constitutes a significant proportion of the total nitrogen present in a natural water body. In 2017, TKN concentrations at EQA sites ranged from less than 100 to 630 µg/L, compared to a maximum of 484 µg/L at the core sites. Maximum concentrations exceeded historical maximums at one EQA site. The new maximum level was 530 µg/L measured at Site 215F on June 20, which exceeded the historical maximum of 472 µg/L for this location.

Ammonia concentrations in the tributaries ranged from less than 5 to 73 µg/L in 2017. Levels were within historical ranges for most sites, but new maximum levels were detected at Sites 215B (28 µg/L on February 14) and 215F (16 µg/L on July 18). Previous maximums at these two sites were 20 µg/L (in July, 2013) and 15 µg/L (in July, 2013), respectively.

As described in Section 3.2.8, phosphorus is the limiting nutrient in algal growth in many freshwater systems, and it can be a concern when concentrations are excessive. Phosphorus levels in 2017 ranged from 7 to 36 µg/L. Concentrations were consistent with historical ranges, and no new maximum levels were detected.

UV_{254} has been monitored quarterly at core sites since 2009. A surrogate measure of organic matter, UV_{254} was previously analyzed at major tributaries to Quabbin Reservoir in 1998-1999, as part of a research study at University of Massachusetts (Garvey *et al.*, 2001). While the monitoring frequency was quarterly in 2009-2017, compared to monthly in 1998-99, UV_{254} values ranged slightly higher at core sites in 2009-2017, with greater variability. The lower UV_{254} values in 1998-99 may be related to lower-than-usual rainfall during that year of monitoring, so the higher values in 2009-2017 do not necessarily mean any degradation of water quality. The UV_{254} values in 2017 ranged from 0.064 cm^{-1} (at Gates Brook on December 5) to

Table 16. Quabbin Reservoir Watershed Nutrient Concentrations: Comparison of Median Values and Ranges from 2017 Database

Sampling Site	Nitrate (NO_3; µg/L)		Total Kjeldahl Nitrogen (TKN; µg/L)		Ammonia (NH_3; µg/L)		Total Phosphorus (µg/L)		UV_{254} (Absorbance/cm)		Total Calcium (µg/L)	
EQA Sample Sites [1]	**Median**	**Range, Biweekly**	**Median**	**Range, Biweekly**	**Median**	**Range, Biweekly**	**Median**	**Range, Biweekly**	**Median**	**Range, Biweekly**	**Median**	**Range, Biweekly**
West Branch Swift River Sanitary District												
215B W. Br. Fever Brook	10	<5 - 21	273	102 - 424	11	<5 - 28	15	9 - 23	0.254	0.146 - 0.492	3100	2320 - 4530
215H Harvard Pond inlet	<5	<5 - 12	294	121 - 630	8	<5 - 73	18	8 - 36	0.241	0.112 - 0.327	2140	1550 – 15,400
215F E. Br. Fever Brook, road above mouth	9	<5 - 45	230	<100 - 530	<5	<5 - 16	15	7 - 27	0.254	0.168 - 0.487	2740	2000 - 6640
215G E. Br. Fever Brook, Camel's Hump Rd.	7	<5 - 17	286	127 - 566	6	<5 - 25	16	7 - 27	0.296	0.183 - 0.447	2565	1880 - 3170
Core Sample Sites [2]	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Biweekly**
211 (W. Br. Swift)	23	14 - 72	143	139 - 169	3	<5 - 6	12	7 - 18	0.119	0.100 - 0.148	2355	1540 - 3550
212 (Hop Brook)	44	18 - 60	122	<100 - 190	4	<5 - 9	14	10 - 18	0.114	0.080 - 0.179	4950	2860 - 6810
213 (Mid. Br. Swift)	46	9 - 112	215	162 - 260	7	<5 - 14	14	10 - 21	0.183	0.089 - 0.238	4905	2270 - 6820
215 (E. Br. Fever)	7	<5 - 14	345	219 - 484	4	<5 - 48	18	13 - 28	0.301	0.220 - 0.478	2820	1810 - 3900
216 (E. Br. Swift)	33	<5 - 49	155	143 - 389	<5	<5	13	10 - 31	0.194	0.147 - 0.348	3635	2310 - 4670
Gates Brook	<5	<5 - 7	133	105 - 227	<5	<5	15	8 - 24	0.116	0.064 - 0.289	1285	1040 - 7500
Boat Cove Brook	11	<5 - 22	121	<100 - 242	<5	<5	16	11 - 19	0.138	0.083 - 0.358	7580	1260 - 13,900

Notes: (1) Biweekly sampling at EQA sites.
(2) Quarterly sampling conducted in March, June, September, and December, and biweekly sampling for calcium.

Table 17. Ware River Watershed Nutrient Concentrations: Comparison of Median Values and Ranges from 2017 Database

Sampling Site	Nitrate (NO_3; µg/L)		Total Kjeldahl Nitrogen (TKN; µg/L)		Ammonia (NH_3; µg/L)		Total Phosphorus (µg/L)		UV_{254} (Absorbance/cm)		Total Calcium (µg/L)	
EQA Sample Sites (1)	**Median**	**Range, Biweekly**	**Median**	**Range, Biweekly**	**Median**	**Range, Biweekly**	**Median**	**Range, Biweekly**	**Median**	**Range, Biweekly**	**Median**	**Range, Biweekly**
West Branch Ware River Sanitary District												
111 Queen Lake, at road culvert below outlet	42	<5 - 161	175	<100 - 334	<5	<5 - 17	11	<5 - 20	0.066	0.047 - 0.505	3540	3080 - 4370
B4 Burnshirt River, at Stone Bridge	<5	<5 - 50	418	160 - 846	<5	<5 - 18	14	7 - 31	0.474	0.266 - 0.802	2675	1940 - 3450
103 Burnshirt River, at Rt. 62	7	<5 - 28	216	<100 - 473	<5	<5 - 8	12	7 - 23	0.247	0.153- 0.568	2170	1930 - 3060
C2 Canesto Brook, at Williamsville Road	13	<5 - 144	211	<100 - 416	7	<5 - 26	13	6 - 34	0.201	0.084 - 0.629	2575	2170 - 3360
N1 Natty Pond Brook, at Hale Road	8	<5 - 74	329	<100 - 705	12	<5 - 60	18	9 - 62	0.293	0.158 – 0.825	3695	2750 - 5200
Core Sample Sites (2)	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Biweekly**	**Median**	**Range, Biweekly**
101 (Shaft 8 Intake)	20	9 - 26	265	156 - 364	7	<5 - 11	22	8 - 42	0.293	0.142 - 0.563	4005	2370 – 10,100
103A (Burnshirt)	26	14 - 33	309	129- 441	8	6 - 16	19	7 - 33	0.270	0.150 - 0.622	3010	2170 - 4190
107A (W. Ware)	12	<5 - 35	315	134 - 392	<5	<5 - 7	17	9 - 22	0.350	0.070 - 0.772	3365	2260 - 4410
108 (E. Ware)	42	20 - 51	311	101 - 404	11	6 - 24	16	8 - 27	0.250	0.144 - 0.481	4480	2390 - 6310
121B (Thayer)	17	<5 - 44	477	231 - 678	7	<5 - 15	30	7 - 61	0.238	0.108 - 0.597	12,300	1150-16,200

Notes: (1) Biweekly sampling at EQA sites.
(2) Quarterly sampling conducted in March, June, September, and December, and biweekly sampling for UV_{254} and calcium.

0.492 cm^{-1} (at Site 215B on November 7). This range reflects the different quality of waters, from oligotrophic to eutrophic, including productive wetlands (Reckhow, personal communication). New maximum UV_{254} values were measured on June 20 in samples collected from Site 215 (0.478 cm^{-1}), Site 215F (0.487 cm^{-1}), and Gates Brook (0.165 cm^{-1}). The previous maximum values at these sites were 0.456 cm^{-1} in August, 2009, 0.454 cm^{-1} in July, 2013, and 0.207 in June, 2013, respectively.

Calcium concentrations ranged from 1,040 to 13,900 µg/L in core sites and from 1,550 to 15,400 µg/L in EQA sites. The 12 mg/L threshold was exceeded at two Quabbin Reservoir watershed sites in 2017, Site 215H (Harvard Pond inlet) and Boat Cove Brook. Calcium was measured at 15,400 µg/L in the sample from Site 215H on January 3, and this timing indicates the elevated level could have been related to the use of road deicers. In Boat Cove Brook, calcium was detected at levels ranging from 12,200 to 13,900 µg/L between September 12 and October 24. This timing indicates these elevated levels are not likely due to road deicers. Other potential sources of calcium include agricultural lime and construction activity, as well as natural site geology and weathering processes.

3.3.8.2 Ware River Watershed

In the Ware River watershed, 2017 nutrient concentrations were generally within historical ranges. As shown in **Table 17**, most maximum nitrate concentrations were higher at EQA sites than at core sites, but median values were similar at both types of site. The highest maximum, 161 µg/L at Site 111, was also a new maximum level for this site. The previous maximum nitrate level detected at this site was 154 µg/L in February, 2013. No new nitrate maximums were detected in samples from the other sites.

TKN concentrations at core sites ranged from 101 to 678 µg/L during 2017, and from less than 100 to 846 µg/L at EQA sites. Most concentrations were within historical ranges, but one new maximum level, 678 µg/L, was measured in the sample collected from Site 121B on September 19. The previous maximum TKN level detected at this site was 565 µg/L in August, 2008. No new maximums were detected at EQA sites.

Ammonia ranged from less than 5 to 60 µg/L, with generally similar levels at core and EQA sites. Results from 2017 were within the historical ranges, and no new maximum concentrations were detected.

Total phosphorus concentrations were similar at core sites and EQA sites, and ranged from less than 5 to 62 µg/L. Most results were within historical ranges, but new maximum concentrations were detected at three sites. These maximums were 20 µg/L at Site 111 on July 11; 61 µg/L at Site 121B on June 27; and 33.8 µg/L at Site C2 on October 3. Previous maximums at these sites were 19 µg/L at Site 111 in July, 2013; 35 µg/L at Site 121B in September, 2014; and 33.6 µg/L at Site C2 in July, 2013.

UV_{254} values were similar at core sites and EQA sites. Maximum concentrations exceeded the historical ranges in samples collected from seven sites. The new maximums were measured in samples from Sites 103, B4, and C2 (on October 31); 103A and 111 (on May 30), 121B (on August 22), and N1 (on September 19).

Calcium concentrations ranged from 1,150 to 16,200 µg/L. The highest levels were measured in samples from Site 101 (10,100 µg/L) and Site 121 B (16,200 µg/L). It is not known whether the elevated levels reflect naturally-occurring conditions or potential water quality degradation. The range and median of samples from 101 are consistent with historical values, and the elevated result may not be indicative a long-term water quality trend.

The median calcium concentration at Site 121B (Thayer Pond) was 12,300 µg/L in 2017, which was lower than the median in 2016 but follows a general trend of increasing calcium concentrations at this site since 2010. (Medians were 14,050 µg/L in 2016, 11,400 µg/L in 2015, 10,200 µg/L in 2014, 9,220 µg/L in 2013, 8,860 µg/L in 2012, 8,510 µg/L in 2011, and 9,170 µg/L in 2010.) The area around this site is primarily forested with some institutional, residential, commercial, industrial, and agricultural use. The cause of the higher calcium levels may be related to greater inputs from road deicing, lime applications to soil, and/or weathering processes. The highest levels in 2017 occurred from January through February, and then again from August through the end of the year, which may support a combination of the three factors as causes. Calcium monitoring will be continued in each sanitary district to help establish a longer-term dataset for trend analysis.

3.3.8.3 Discussion

Nutrient concentrations between the two watersheds were generally comparable, with several exceptions. Nitrate levels were similar among sites in both watersheds. TKN ranges and medians were mostly comparable, with the exception of higher median values at Sites B4 (418 µg/L) and 121B (477 µg/L) in the Ware River watershed. Ammonia concentrations at both watersheds were generally similar. Maximum and median total phosphorus levels were generally higher at Ware River watershed sites than at Quabbin Reservoir watershed sites. UV_{254} results were generally similar at both watersheds. Ranges and medians of calcium concentrations were comparable among sites in both watersheds, with the exception of increasing annual median calcium concentrations at Site 121B in the Ware River watershed site. The cause of this increase may be attributed to a combination of land usage and geologic factors.

3.3.9 Monitoring for the Diatom *Didymosphenia geminata*

In response to alerts about new infestations of the potentially invasive diatom *Didymosphenia geminata* ("Didymo") in New England, Environmental Quality staff implemented a program to monitor for Didymo in 2007. This program relies on both artificial substrates (consisting of glass slides mounted in special samplers) and natural substrates. Artificial substrates provide a surface for colonization by attached algae and other organisms (periphyton), and deployment of glass slides is a standard technique for investigation of this component of aquatic communities. Natural substrates were sampled by gently removing periphyton growth off of sections of rocks for analysis.

Artificial substrates were deployed in late 2007 at Quabbin on the three branches of the Swift River at existing sampling sites (West Branch Site 211 at Route 202, Middle Branch Site 213 at Gate 30, and East Branch Site 216 at Route 32A) and at a fourth location, downstream of Winsor Dam and a section of the Swift River popular for fly fishing, about one kilometer downstream of Route 9 off Enoch Sanford Road. On the Ware River, the sampling site near the Shaft 8 Intake (Site 101) was selected.

Due to severe weather and the extreme changes in flow volume over the last few years, sampling sites and methods were changed to facilitate consistent monitoring. Sudden, drastic changes in water levels adversely affected some of the samplers. Many were carried downstream while others were destroyed. Some research suggests that Didymo does not readily grow on bare rock, preferring to colonize substrates that have a well-established periphyton community. Therefore, it may be assumed that it will be slow to colonize glass slides. Beginning in 2013, slides were deployed for a two-month period to allow a sufficient time for colonization by periphyton. Weather patterns, and the growing evidence that Didymo prefers to grow on substrate that are covered in periphyton, led to the changes in sampling procedures.

Recent research has indicated that Didymo may be considered a native species that occasionally produces numerous stalks in response to low phosphorus concentrations (Taylor and Bothwell, 2014). These stalks can cause serious ecological impacts by smothering other stream-dependent organisms. With this reevaluation of Didymo as a native species with only occasional impacts, the program of routine inspections, rock scrapings, and renewal of artificial substrates was reduced beginning in 2016. Detection efforts were reduced even more in 2017. Monitored sites were checked several times during the year, and results were negative for Didymo. The monitoring program will likely continue at this reduced frequency to facilitate early detection of Didymo within the watersheds.

3.4 Aquatic Invasive Species Monitoring

AIS are "non-indigenous organisms that...have the ability to become established and spread rapidly within native aquatic communities" (DWSP, 2010). They generally have adaptations that enhance their survival and reproduction, as well as a lack of predators or diseases in the new environment to keep their populations in check. For the DWSP/MWRA system, the primary concerns that AIS pose are "loss of native species, habitat degradation, damage to infrastructure, disruption of ecosystem function, and impairments to water quality" (DWSP, 2010).

Because of the potential impacts, DWSP staff implemented various programs to monitor for and prevent the spread of AIS. These programs include boat inspections and decontamination, monitoring of boat ramps, and aquatic macrophyte surveys. Brief reports on these programs are included in **Appendix C**. Aquatic macrophyte surveys are conducted each summer at selected water bodies within the Quabbin and Ware River watersheds, as well as occasionally at water bodies outside of these watersheds that are in close proximity to Quabbin Reservoir.

In addition, aquatic macrophyte surveys were performed on the Quabbin Reservoir in 2006 and 2010, and have been conducted on an annual basis since 2013. DWSP Environmental Quality staff work with an MWRA consultant to conduct these surveys. Until 2014, the primary AIS finding was variable-leaf milfoil (*Myriophyllum heterophyllum*), which was documented in Quabbin Reservoir prior to 1973 (DWSP, 2010). In 2014, brittle naiad (*Najas minor*) was discovered in O'Loughlin Pond, also known as the regulating pond north of Fishing Area 2. The brittle naiad plants were removed, and an additional fragment barrier was installed to protect the reservoir. Since then, one primary fragment barrier was installed and is periodically checked to ensure it is functioning properly. The pond and the fragment barrier were surveyed by DWSP and the MWRA consultant in 2017, and no brittle naiad plants were found.

In 2017, swollen bladderwort was discovered in Quabbin Reservoir. A single plant was found in the far northern end, not far from the O'Loughlin Pond inflow, and was not found in any other areas of the reservoir during the 2017 survey. The 2018 survey will include additional efforts to assess whether this new AIS is still present in Quabbin Reservoir.

Other than swollen bladderwort, no new AIS were observed in Quabbin Reservoir or Ware River watersheds. In addition to variable-leaf milfoil, *Phragmites australis* (common reed) was observed in the Quabbin Reservoir. Other AIS observed in watershed ponds (but not in the reservoir) included *Cabomba caroliniana* (fanwort), *Potamogeton crispus* (curly leaf pond weed), *Iris pseudacorus* (yellow flag iris), *Lithrum salicaria* (Purple Loosestrife), *Rorippa microphylla* (One Row Yellowcress), and *Myosotis scorpioides* (True Forget-me-not).

3.5 Forestry Water Quality Monitoring

Timber harvesting operations may have short- and long-term effects on water quality. Monitoring of harvest operations and water quality is conducted to ensure water quality standards are maintained on DWSP lands. Short-term monitoring focuses on direct water quality impacts that can occur during logging, while long-term monitoring will involve evaluating water quality changes as the forest regenerates.

3.5.1 Short-term Monitoring

Short-term forestry monitoring involves monitoring logging operations through site inspections and targeted water quality sampling. Inspections and water quality sampling are conducted prior to start of logging in order to establish a baseline, during operations to monitor short-term effects, and after logging to assess for long-term effects. During 2017, the Environmental Quality Section reviewed forestry lot proposals, inspected sites, collected samples, and updated the forestry water quality monitoring database. Field review of proposed DWSP timber lots was conducted in the Ware River and Quabbin Reservoir watersheds. Water quality testing occurred on one lot in each watershed for baseline and short-term monitoring. No problems were identified.

3.5.2 Long-term Monitoring

Two sites have been established in Middle Branch Dickey Brook and East Branch Underhill Brook on Prescott Peninsula for long-term forestry monitoring, with monthly grab samples collected for over 10 years. These samples have been analyzed for nutrients (nitrate, nitrite, total Kjeldahl nitrogen, and total phosphorus) and total suspended solids. The samples have also been analyzed for UV_{254}, ammonia, total organic carbon, and dissolved organic carbon since January, 2014. The monthly sampling at Underhill Brook and Dickey Brook was continued throughout 2017.

The monthly sampling has been conducted on the second Wednesday of each month since April, 2002. While this schedule provides data over a relatively long term, monthly grab sampling cannot be used to characterize stream response during storms. In 2013, plans were made for periodic storm water sampling to complement the monthly sampling work performed to date. The goal of storm water sampling is to characterize the stream response during a targeted storm event. Primary data to be collected include rainfall depth and stream flow rate. Laboratory analyses of samples will help characterize the range of nutrient and sediment concentrations in storm-related flows. Ultimately, the hydrologic data and concentration data will be used to estimate nutrient and sediment loads delivered during storms.

Tasks that were accomplished during 2017 in order to implement the long-term forestry water quality monitoring were: annual re-installation of water level loggers and precipitation gauges; downloading of field data; monitoring of weather forecasts and staff availability; continued development of field procedures; sample and data collection for two storms; and data analysis. Storm water sampling for up to four events is scheduled for 2018.

4 CONCLUSIONS

The 2018 water quality data document continued excellent water quality in the Quabbin Reservoir, Quabbin Reservoir watershed, and Ware River watershed. Moreover, the requirements of the filtration avoidance criteria under the SWTR were satisfied. Air temperatures in 2017 were close to average, and precipitation was below average to average. Most annual geometric means of *E. coli* results in Ware River watershed tributaries were higher than previous years, and the annual geometric mean of one site in the Quabbin Reservoir watershed (Boat Cove Brook) was elevated compared to previous years. Additional assessments will be performed at Boat Cove Brook if elevated *E. coli* results occur in 2018. Turbidity data indicated generally higher maximum turbidities in tributaries in the Ware River watershed than the Quabbin Reservoir watershed, which may be a function of land use differences. Water quality monitoring is ongoing to assess and document water quality in the reservoir and watersheds.

5 PROPOSED SCHEDULE FOR 2018

Water sampling protocols, including field and analytical methods, will remain the same for 2018. Calcium monitoring will continue at tributary sites on a biweekly basis. UV_{254}, used as a surrogate measure for organic matter content in water, will continue to be monitored quarterly in Quabbin core tributary sites, biweekly in Ware River core tributary sites, and biweekly in all EQA sites. EQA monitoring in the Quabbin Reservoir watershed shifts to the East Branch Swift River Sanitary District, previously monitored in 2015. Ware River watershed monitoring shift will shift to the West Branch Ware River Sanitary District, which was previously monitored in 2015.

Reservoir monitoring will continue on a monthly schedule in 2018 (April-December). No other changes are proposed for in-reservoir monitoring. Sampling at the three deep-water reservoir sites will continue, with profiles of temperature, dissolved oxygen, pH, and conductivity collected monthly. The reservoir nutrient sampling program and the plankton monitoring program will also continue in 2018.

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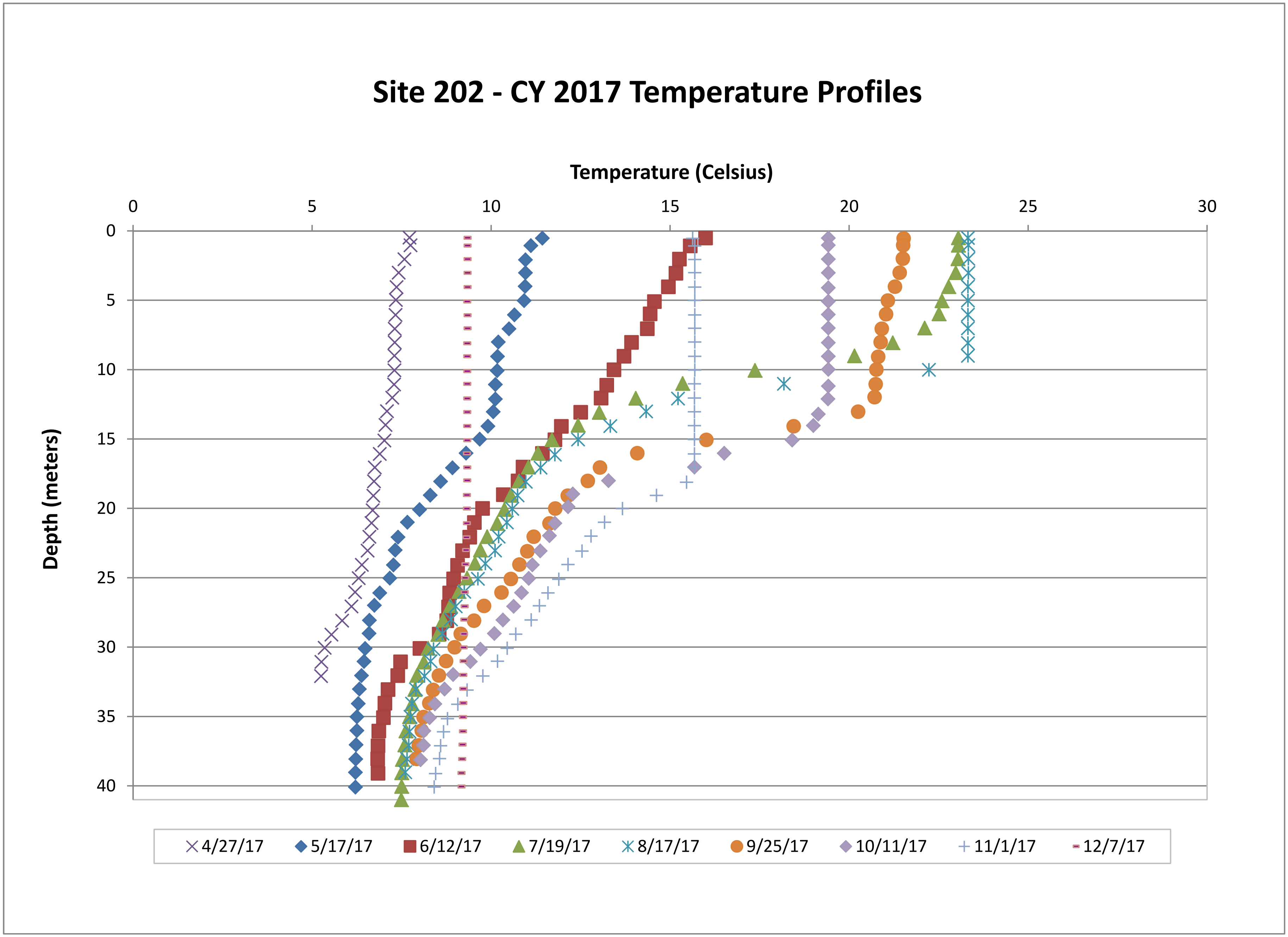
APPENDIX A

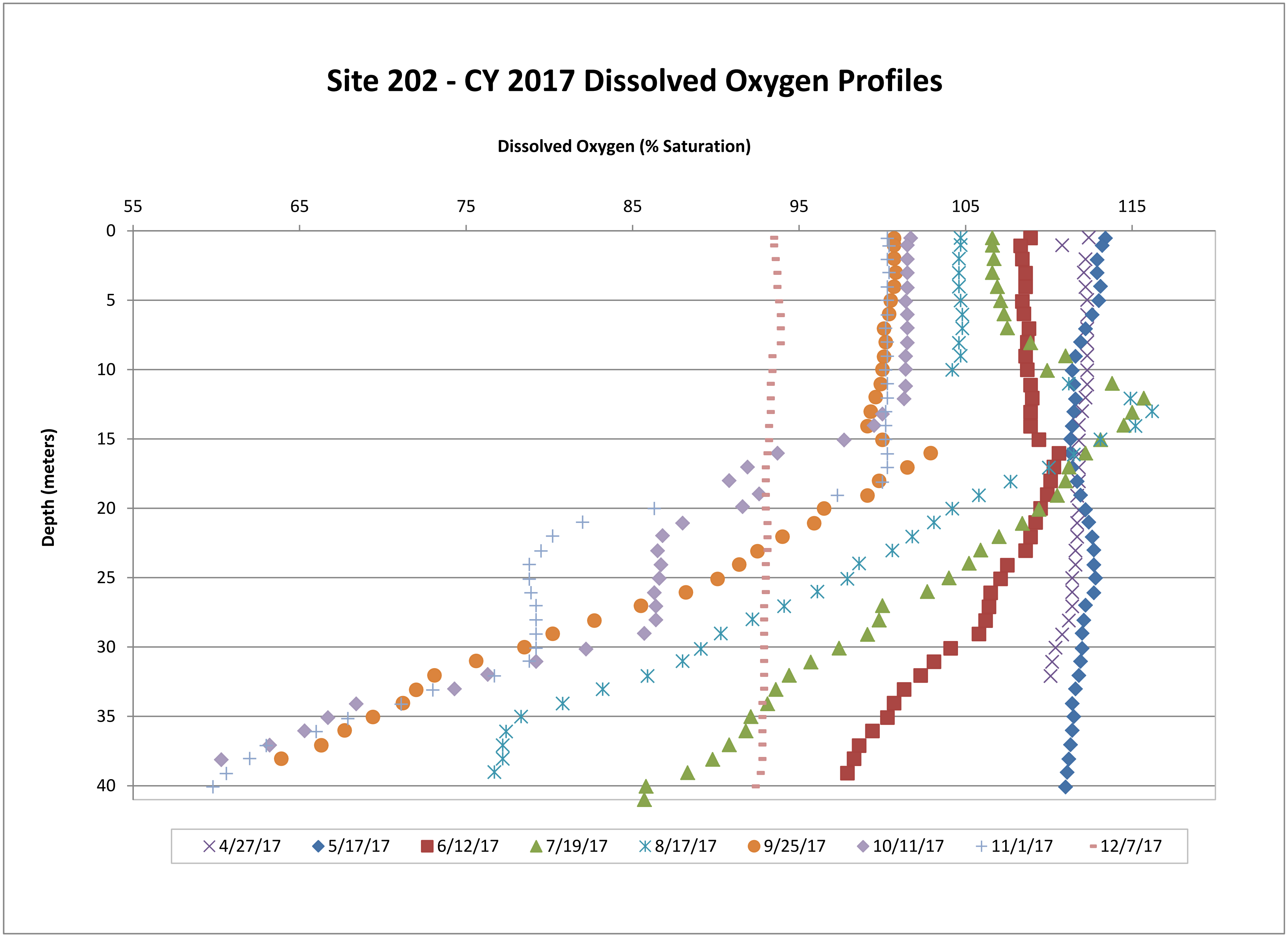
Selected Plots and Graphs

Quabbin Reservoir Profiles

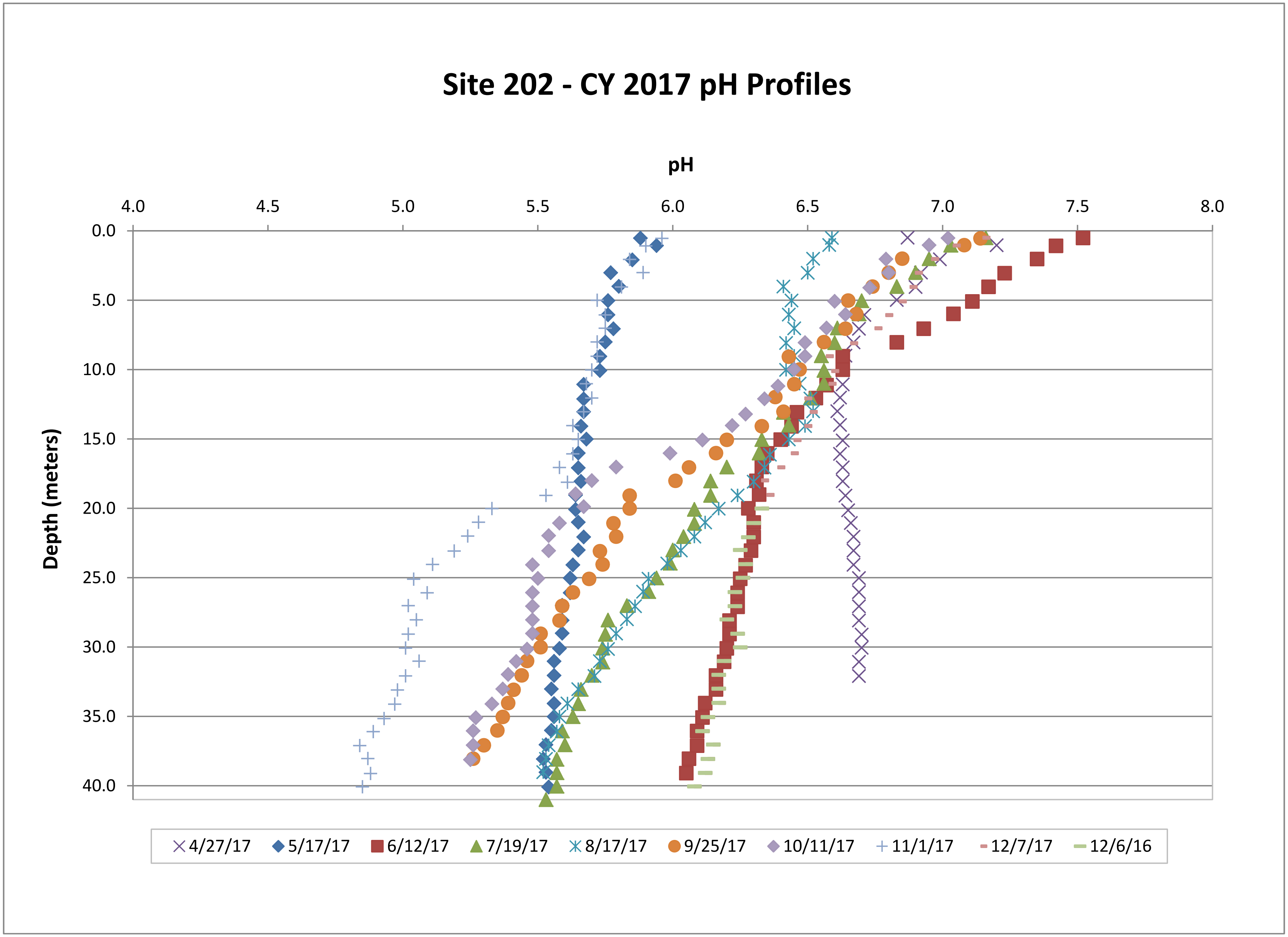
Stream Hydrographs



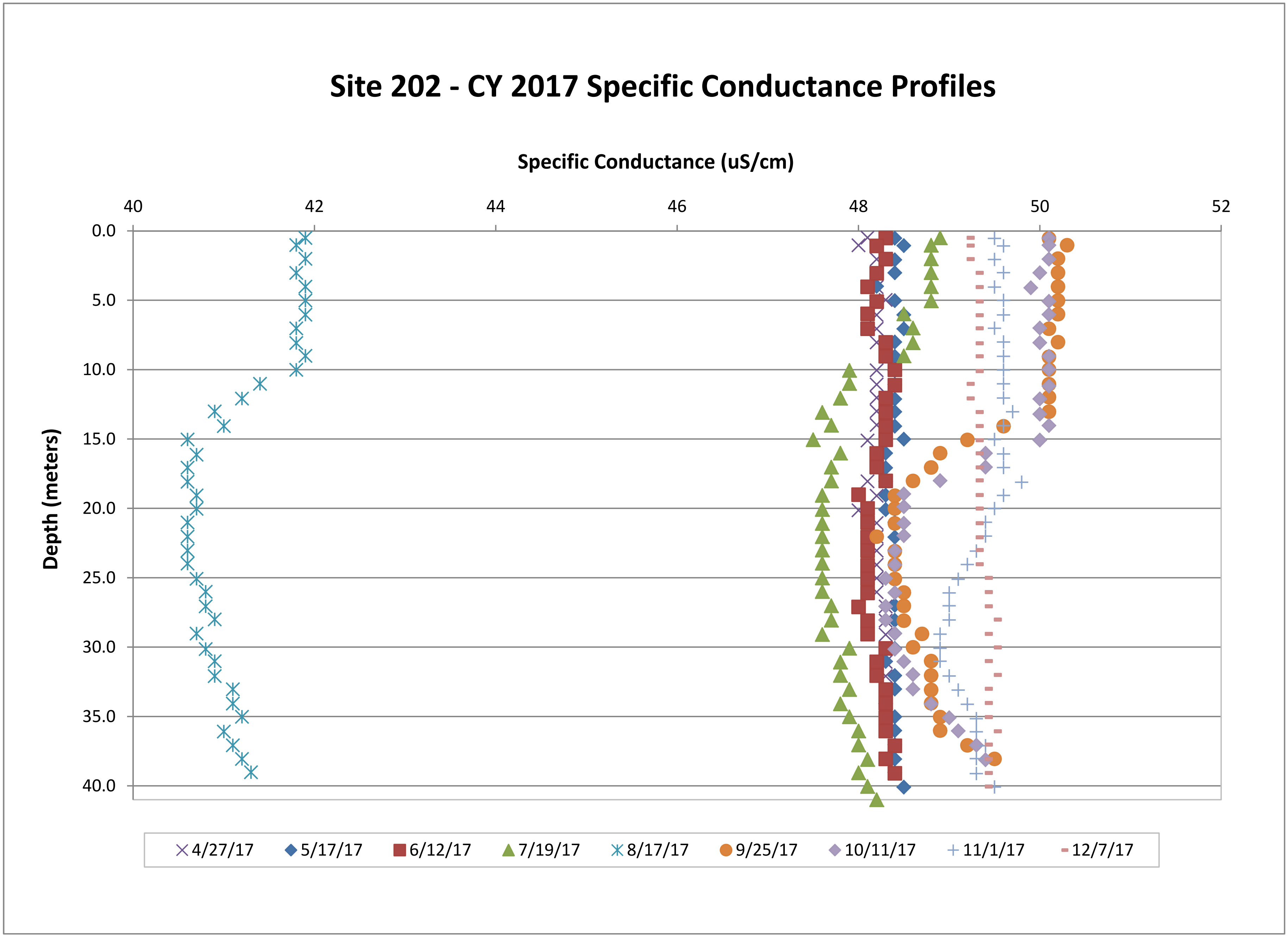
Site 202 - CY 2017 Temperature Profiles
Temperature (Celsius)
0
5
10
15
20
25
30
Depth (meters)
0
5
10
15
20
25
30
35
40
4/27/17
5/17/17
6/12/17
7/19/17
8/17/17
9/25/17
10/11/17
11/1/17
12/7/17



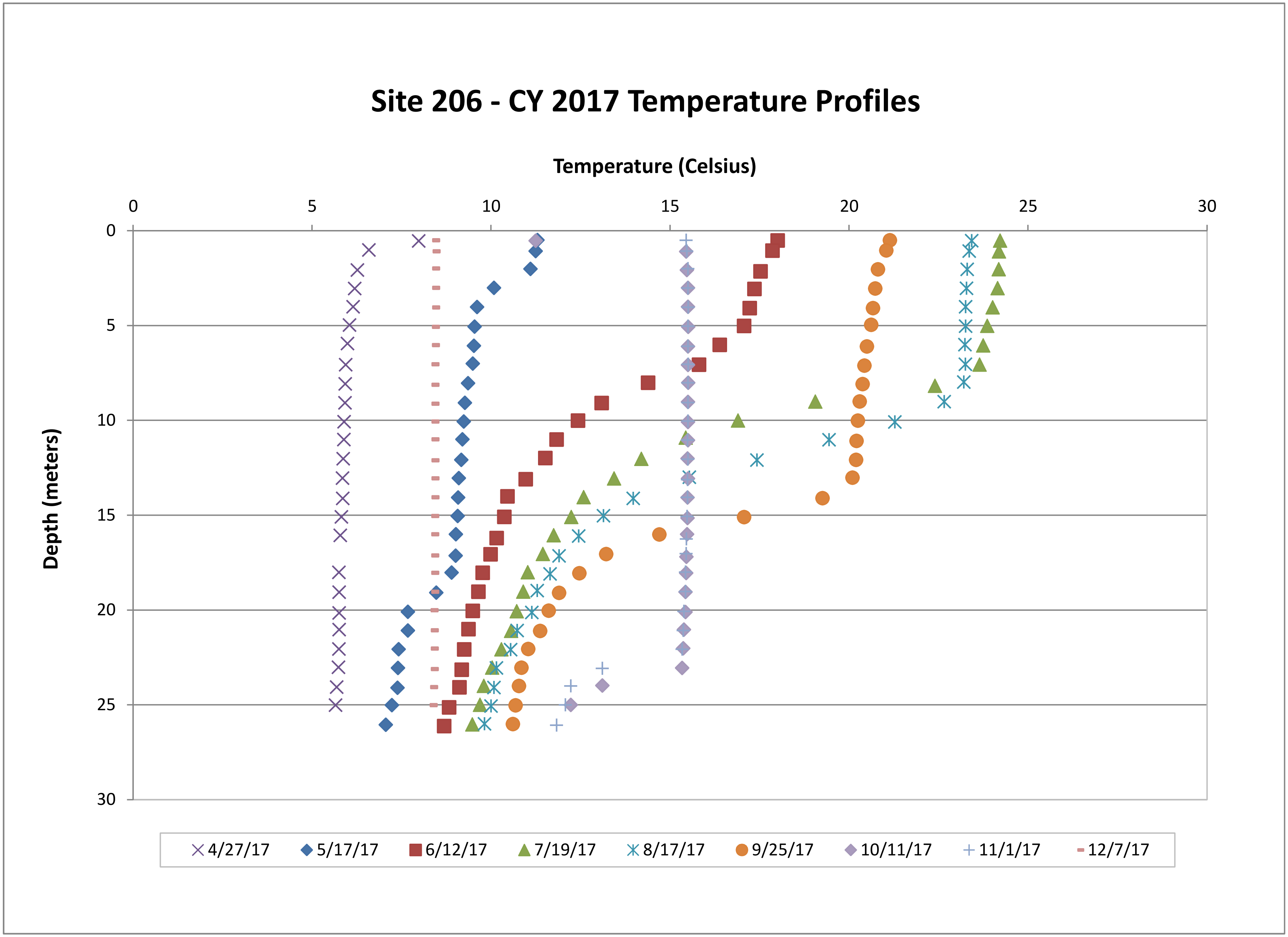
Site 202 - CY 2017 Dissolved Oxygen Profiles
Dissolved Oxygen (% Saturation)
55
65
75
85
95
105
115
0
5
10
15
20
25
30
35
40
Depth (meters)
4/27/17
5/17/17
6/12/17
7/19/17
8/17/17
9/25/17
10/11/17
11/1/17
12/7/17

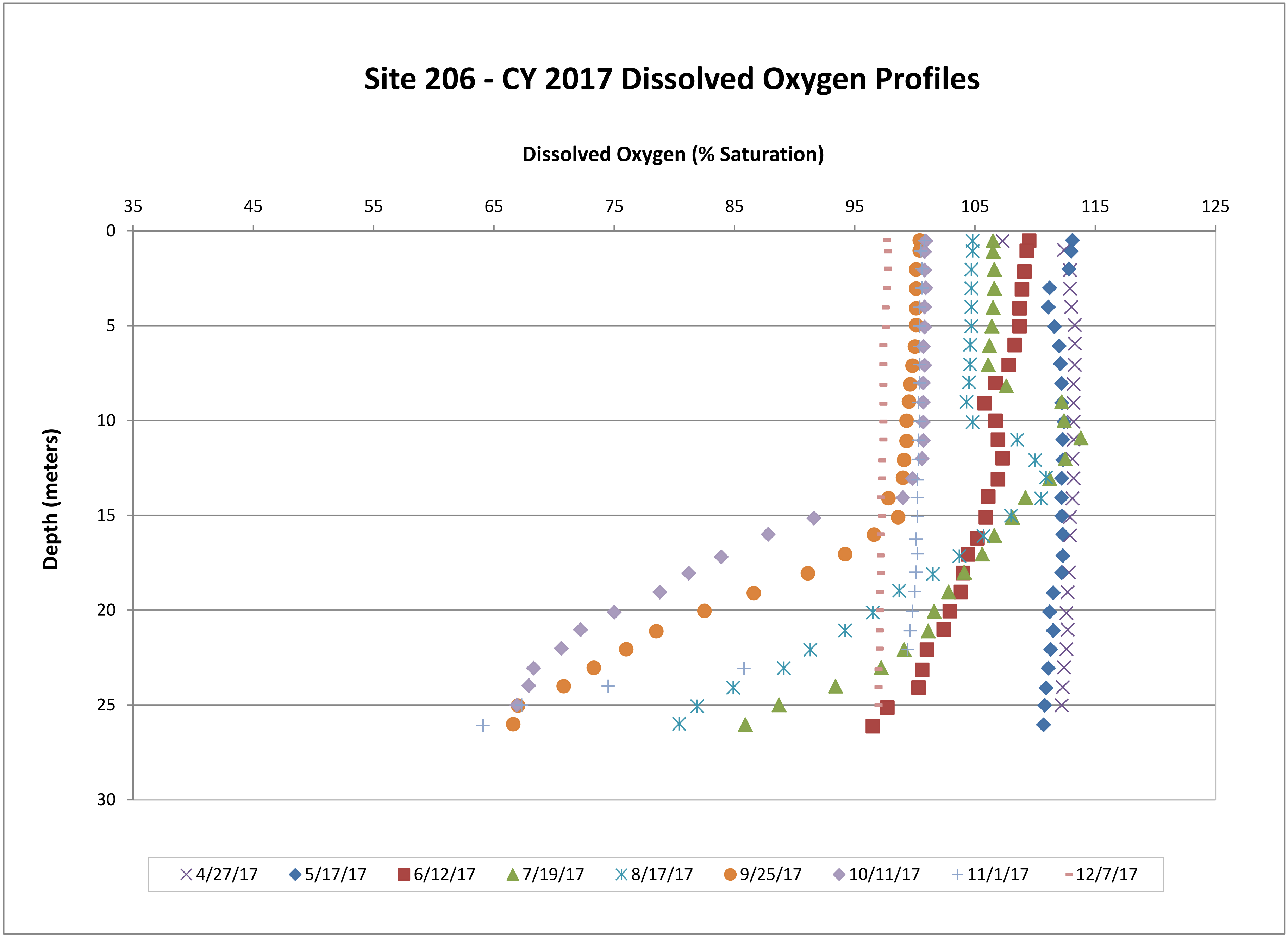


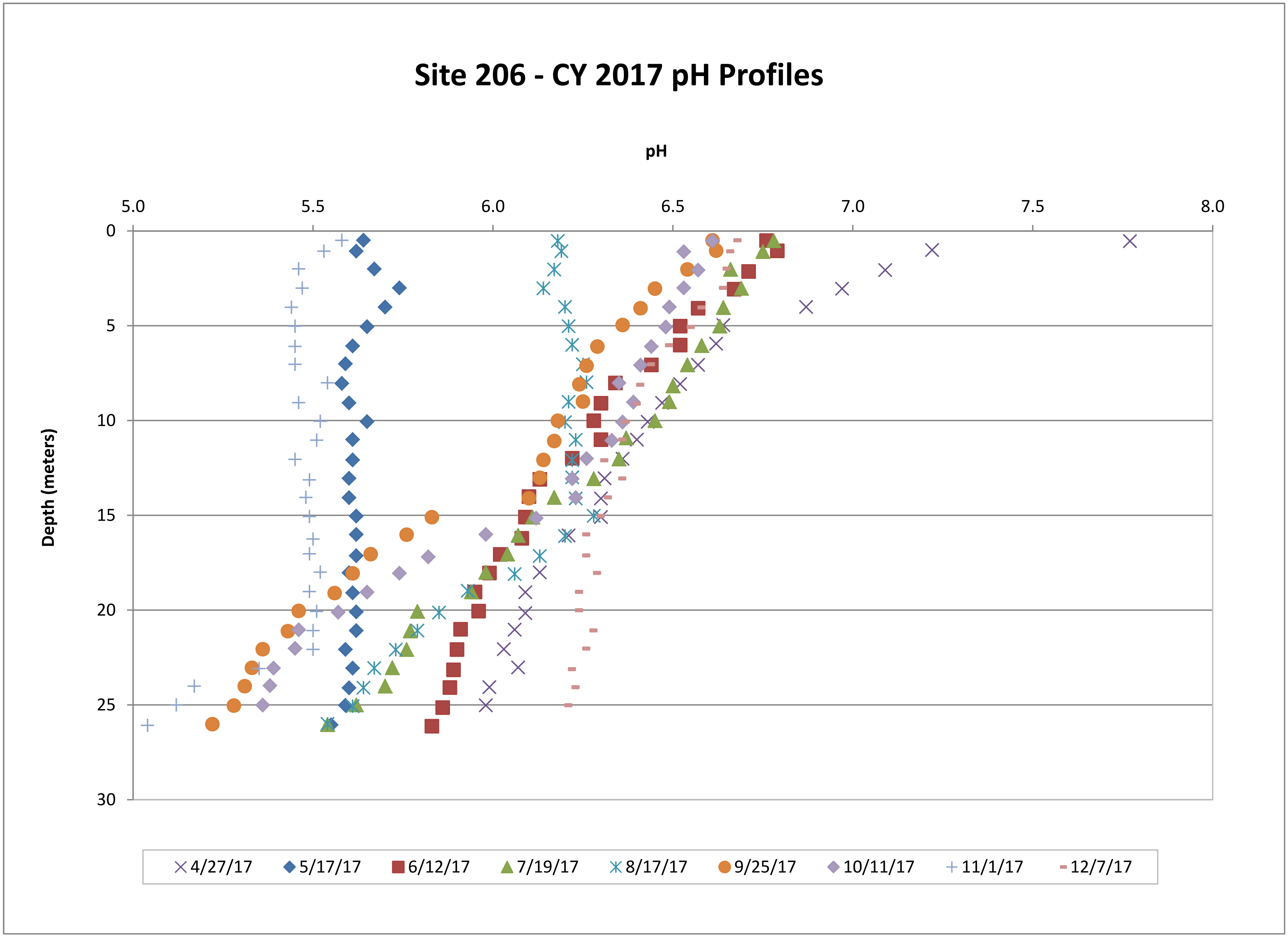
Site 202 - CY 2017 pH Profiles
pH
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
Depth (meters)
4/27/17
5/17/17
6/12/17
7/19/17
8/17/17
9/25/17
10/11/17
11/1/17
12/7/17
12/6/16



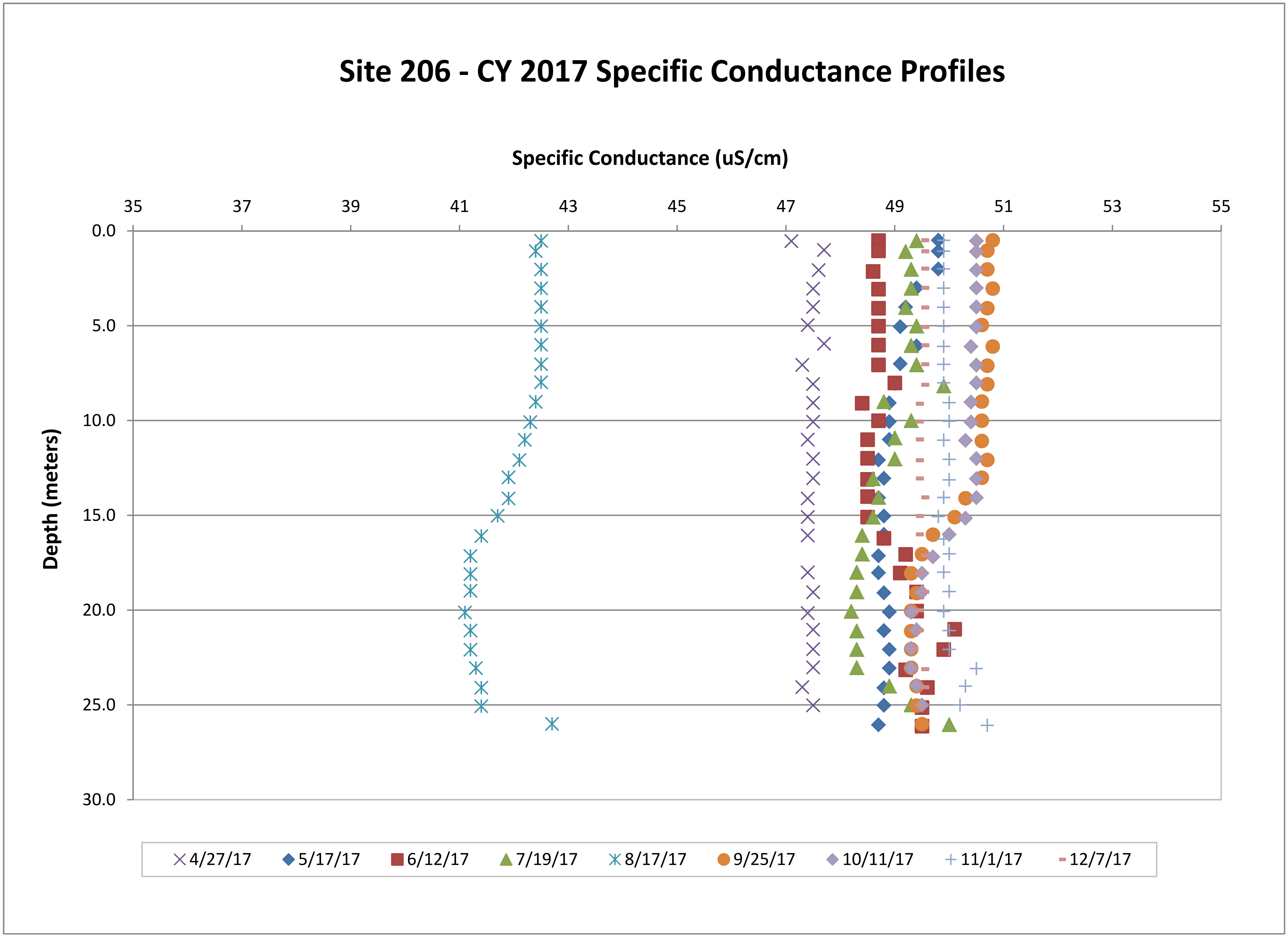
Site 202 - CY 2017 Specific Conductance Profiles
Specific Conductance (uS/cm)
40
42
44
46
48
50
52
Depth (meters)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
4/27/17
5/17/17
6/12/17
7/19/17
8/17/17
9/25/17
10/11/17
11/1/17
12/7/17


Site 206 - CY 2017 Temperature Profiles
Temperature (Celsius)
0
5
10
15
20
25
30
Depth (meters)
4/27/17
5/17/17
6/12/17
7/19/17
8/17/17
9/25/17
10/11/17
11/1/17
12/7/17

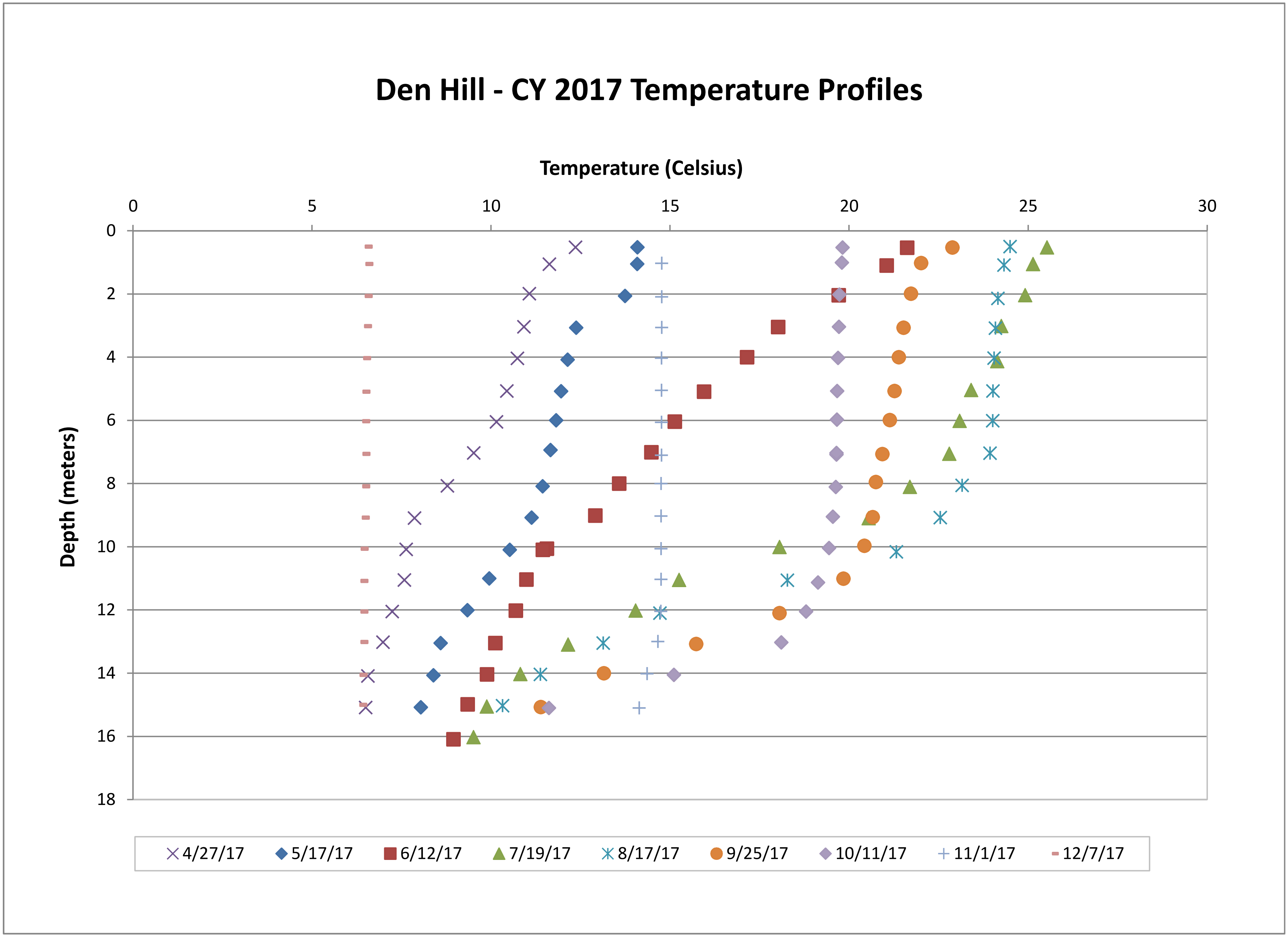

Site 206 - CY 2017 Dissolved Oxygen Profiles
Dissolved Oxygen (% Saturation)
35
45
55
65
75
85
95
105
115
125
Depth (meters)
0
5
10
15
20
25
30
4/27/17
5/17/17
6/12/17
7/19/17
8/17/17
9/25/17
10/11/17
11/1/17
12/7/17



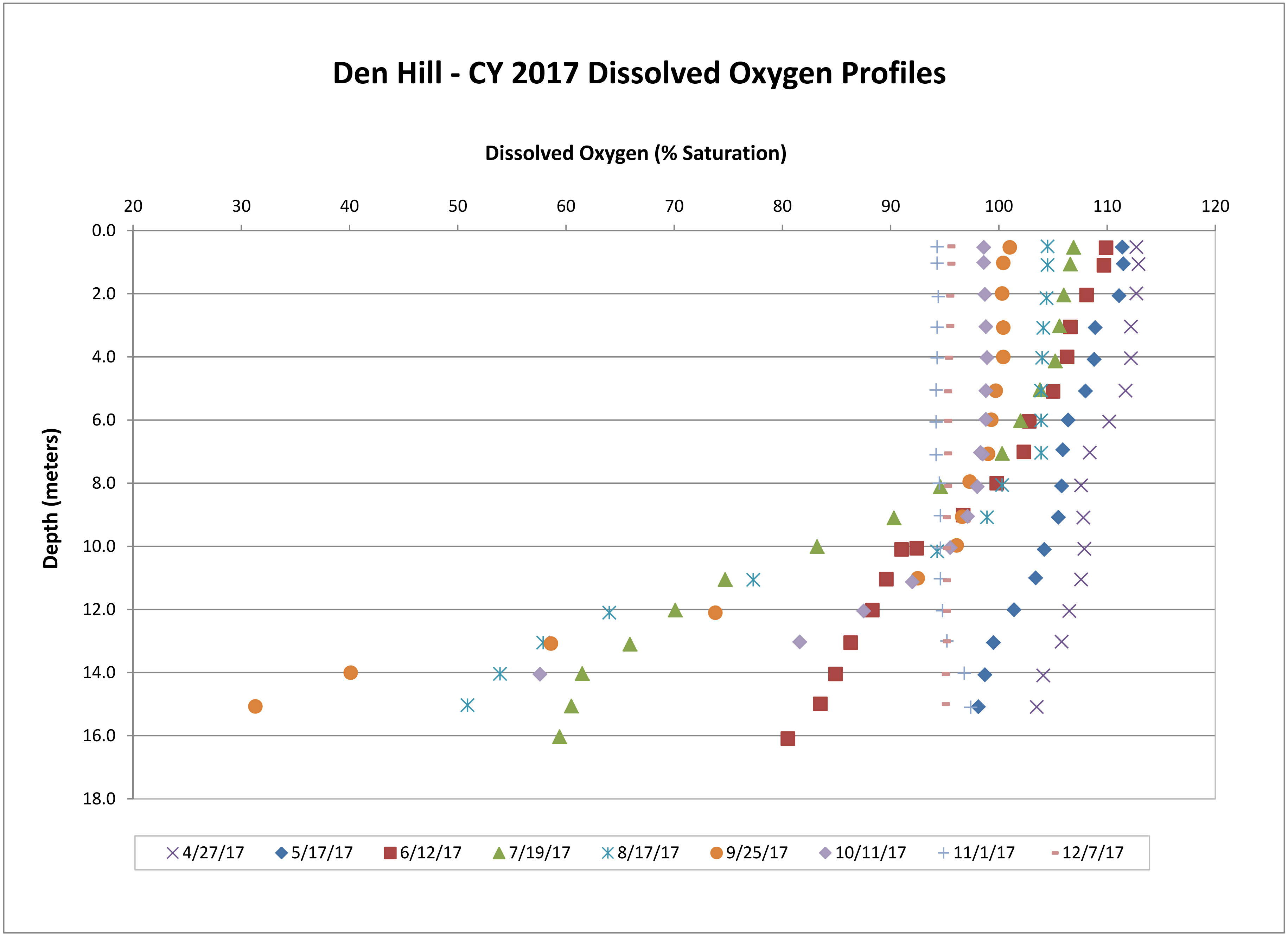
Site 206 - CY 2017 pH Profiles
pH
5.0
5.5
6.0
6.5
7.0
7.5
8.0
Depth (meters)
0
5
10
15
20
25
30
4/27/17
5/17/17
6/12/17
7/19/17
8/17/17
9/25/17
10/11/17
11/1/17
12/7/17

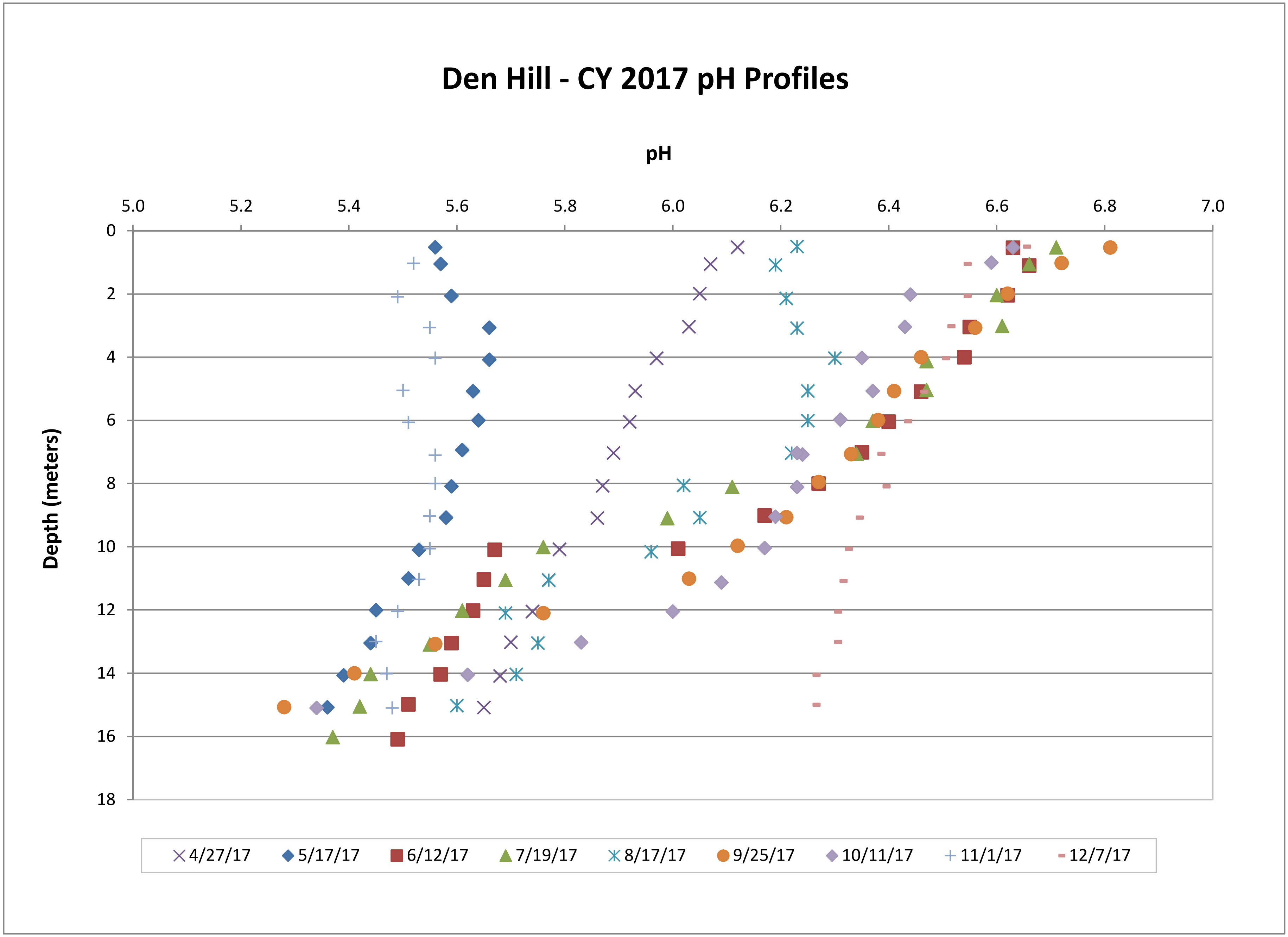


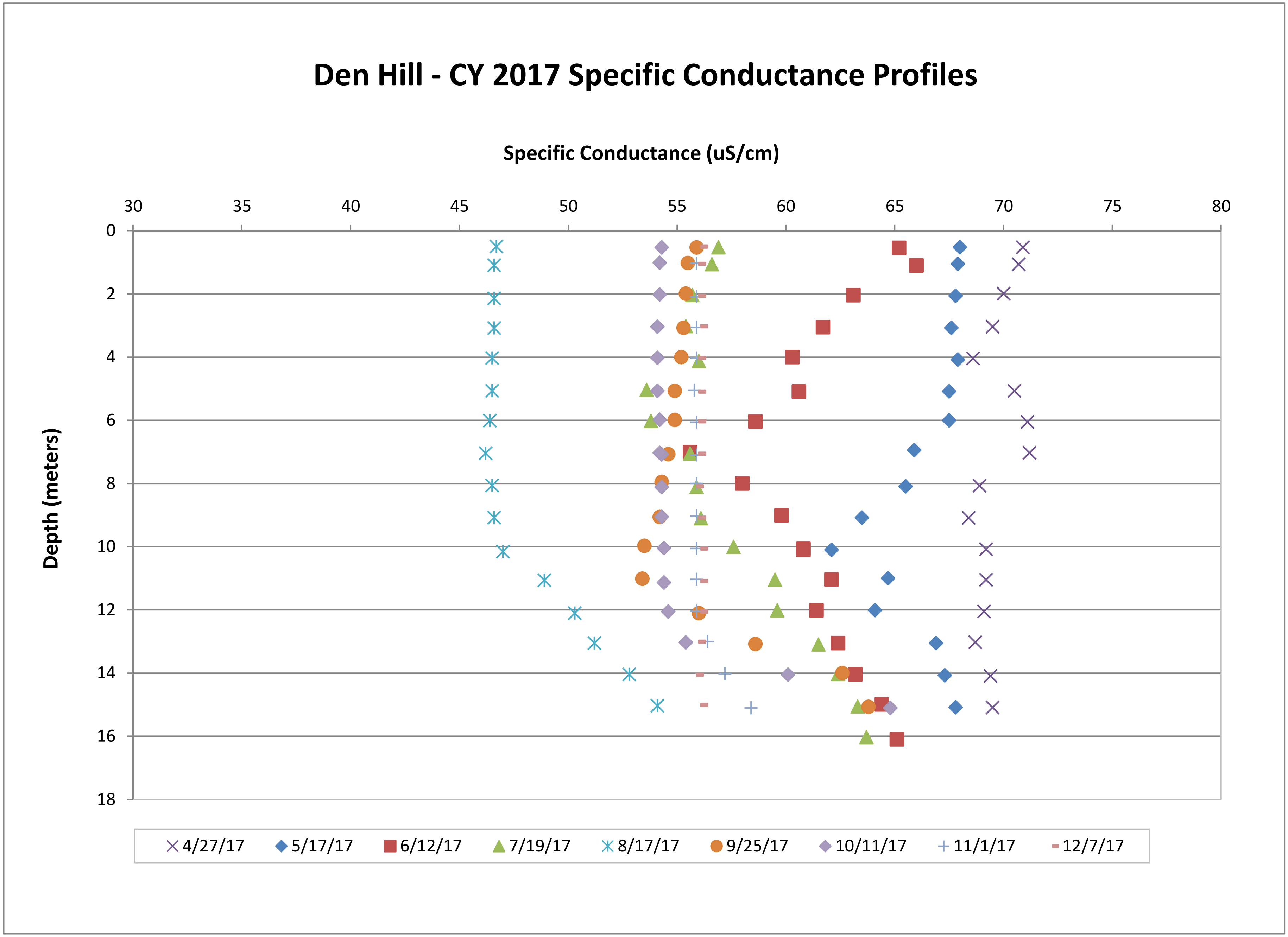
Site 206 - CY 2017 Specific Conductance Profiles
Specific Conductance (uS/cm)
35
37
39
41
43
45
47
49
51
53
55
Depth (meters)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
4/27/17
5/17/17
6/12/17
7/19/17
8/17/17
9/25/17
10/11/17
11/1/17
12/7/17



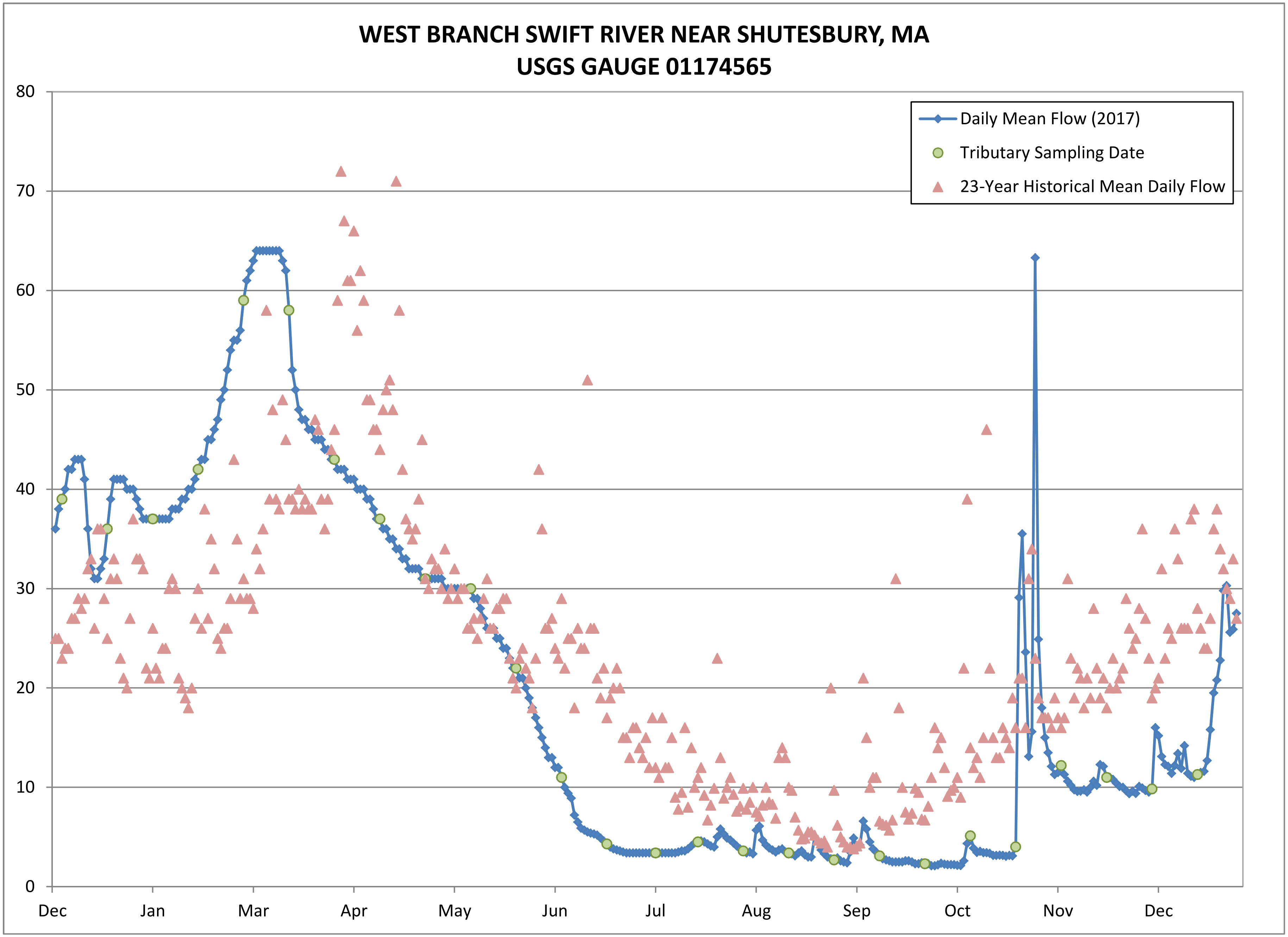
Den Hill - CY 2017 Temperature Profiles
Temperature (Celsius)
0
5
10
15
20
25
30
Depth (meters)
0
2
4
6
8
10
12
14
16
18
4/27/17
5/17/17
6/12/17
7/19/17
8/17/17
9/25/17
10/11/17
11/1/17
12/7/17


Den Hill - CY 2017 Dissolved Oxygen Profiles
Dissolved Oxygen (% Saturation)
20
30
40
50
60
70
80
90
100
110
120
Depth (meters)
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
4/27/17
5/17/17
6/12/17
7/19/17
8/17/17
9/25/17
10/11/17
11/1/17
12/7/17


Den Hill - CY 2017 pH Profiles
pH
5.0
5.2
5.4
5.6
5.8
6.0
6.2
6.4
6.6
6.8
7.0
Depth (meters)
0
2
4
6
8
10
12
14
16
18
4/27/17
5/17/17
6/12/17
7/19/17
8/17/17
9/25/17
10/11/17
11/1/17
12/7/17



Den Hill - CY 2017 Specific Conductance Profiles
Specific Conductance (uS/cm)
30
35
40
45
50
55
60
65
70
75
80
Depth (meters)
0
2
4
6
8
10
12
14
16
18
4/27/17
5/17/17
6/12/17
7/19/17
8/17/17
9/25/17
10/11/17
11/1/17
12/7/17



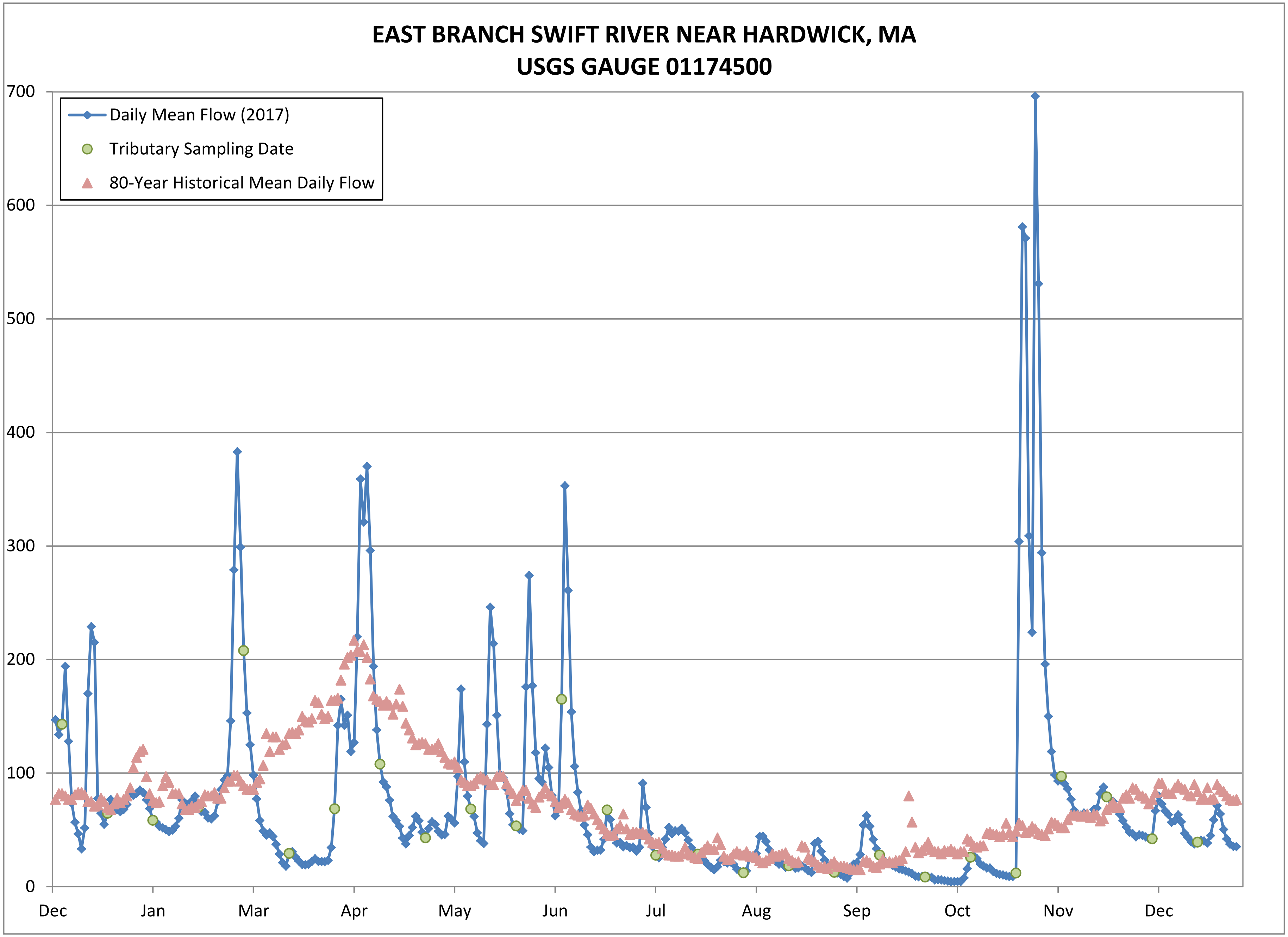
WEST BRANCH SWIFT RIVER NEAR SHUTESBURY, MA
USGS GAUGE 01174565
Daily Mean Flow (2017)
Tributary Sampling Date
23-Year Historical Mean Daily Flow
0
10
20
30
40
50
60
70
80
Dec
Jan
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

USGS 01174565: WEST BRANCH SWIFT RIVER NEAR SHUTESBURY, MA January 1, 2017 - December 31, 2017 Daily mean discharge, cubic feet per second												
DATE	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	36.2	36.6	60.6	41.4	30.4	13.8	3.4	3.58	2.53	2.36	*18*	*10.1*
2	37.7	36.7	62	41.1	30.3	13.3	3.4	3.42	2.39	2.27	*15*	*9.92*
3	39	36.9	63.1	40.7	30.2	12.9	3.4	3.51	3.48	2.22	*13.5*	*9.68*
4	40.2	37.1	63.6	40.4	30	12.4	3.4	3.32	4.89	2.22	*12.1*	*9.53*
5	41.6	37.4	64.2	40.1	29.9	11.8	3.4	5.69	3.89	2.22	*11.3*	*9.85*
6	42.1	37.6	64.4	39.8	29.9	11.1	3.4	6.06	4.18	2.16	*11.5*	*16*
7	42.6	37.9	64.4	39.2	29.8	10.3	3.4	4.66	6.55	2.14	*12.2*	*15.2*
8	42.8	38.3	64.4	38.5	29.8	9.39	3.4	4.18	5.77	2.61	*11.3*	*13.1*
9	42.7	38.7	64.2	38	29.7	8.86	3.4	3.91	4.55	4.35	*10.6*	*12.3*
10	40.9	39.1	64.1	37.4	29.5	7.19	3.4	3.69	3.79	5.12	*10.2*	*12.1*
11	36.2	39.7	64	36.9	28.9	6.51	3.43	3.54	3.49	3.88	*9.74*	*11.4*
12	31.9	40.4	63.3	36.4	27.5	5.94	3.49	3.67	3.08	*3.44*	*9.6*	*12.2*
13	30.9	41.1	61.6	35.9	26.8	5.65	3.56	3.81	2.77	*3.55*	*9.62*	*13.4*
14	31	41.8	57.7	35.4	26.2	5.48	3.64	3.49	2.72	*3.43*	*9.74*	*11.9*
15	31.8	42.6	52.4	34.8	25.8	5.41	3.8	3.38	2.59	*3.43*	*9.53*	*14.2*
16	33	43.5	49.9	34.3	25.5	5.34	4.13	3.31	2.51	*3.35*	*9.99*	*11.4*
17	35.9	44.5	48.4	33.8	25.1	5.16	4.4	3.11	2.49	*3.15*	*10.6*	*11.1*
18	39.4	45.4	47.4	33.3	24.7	4.89	4.53	3.42	2.47	*3.14*	*10.2*	*11*
19	41.1	46.2	46.9	32.8	24.4	4.61	4.63	3.57	2.51	*3.18*	*12.3*	*11.3*
20	41.2	47.1	46.4	32.4	24	4.32	4.46	3.2	2.59	*3.14*	*12.1*	*11.5*
21	41.1	48.8	46	32.1	23.1	4.03	4.31	2.97	2.61	*3.06*	*11*	*11.6*
22	40.8	50	45.4	31.8	22.2	3.81	4.06	3	2.45	*3.16*	*11*	*12.7*
23	40.2	51.6	44.9	31.5	21.9	3.7	4.01	4.89	2.3	*3.11*	*10.8*	*15.8*
24	39.9	53.5	44.5	31.3	21.5	3.6	5.04	4.5	2.31	*4.01*	*10.4*	*19.5*
25	39.6	54.7	44.1	31.2	20.7	3.51	5.84	3.66	2.39	*29.1*	*10.1*	*20.8*
26	39	55.4	43.7	31.1	19.7	3.42	5.3	3.26	2.27	*35.5*	*9.99*	*22.8*
27	38.3	56.5	43.3	30.9	18.6	3.4	4.89	2.99	2.28	*23.6*	*9.66*	*29.8*
28	37.4	58.9	42.8	30.8	17.7	3.4	4.75	2.82	2.14	*13.1*	*9.36*	*30.3*
29	36.9	--	42.4	30.7	16.8	3.4	4.42	2.74	2.11	*15.6*	*9.61*	*25.6*
30	36.8	--	42	30.6	15.9	3.4	4.09	2.86	2.22	*63.3*	*9.39*	*25.9*
31	36.7	--	41.7	--	14.8	--	3.77	2.64	--	*24.9*	--	*27.5*
MAX	**42.8**	**58.9**	**64.4**	**41.4**	**30.4**	**13.8**	**5.84**	**6.06**	**6.55**	**63.3**	**18**	**30.3**
MIN	**30.9**	**36.6**	**41.7**	**30.6**	**14.8**	**3.4**	**3.4**	**2.64**	**2.11**	**2.14**	**9.36**	**9.53**
MEAN	**38.2**	**44.2**	**53.3**	**35.2**	**24.9**	**6.7**	**4.0**	**3.6**	**3.1**	**9.0**	**11.0**	**15.5**
DEPARTURE FROM NORM	10	17	11	-11	-2	-16	-8	-4	-6	-9	-10	-13
	STATISTICS OF MONTHLY MEAN DATA FOR CALENDAR YEARS 1984 - 2016											
MAX	68.6	86.3	103.1	83	78	63	32	29.3	52.9	115.3	54.6	75.3
MIN	2.6	7.1	13.5	12.5	10.5	3.7	1.1	1.5	1.0	1.6	1.7	4.1
MEAN	27.9	27.2	42.2	46.1	27.3	22.4	11.5	8.1	9.5	18.0	20.9	28.7

Notes:

Source: U.S. Geological Survey website (accessed June 4, 2018)

1. *Italics* indicates provisional data, subject to revision; other data are approved
2. Data from 1/1/2017 through 7/19/2017 are estimated values

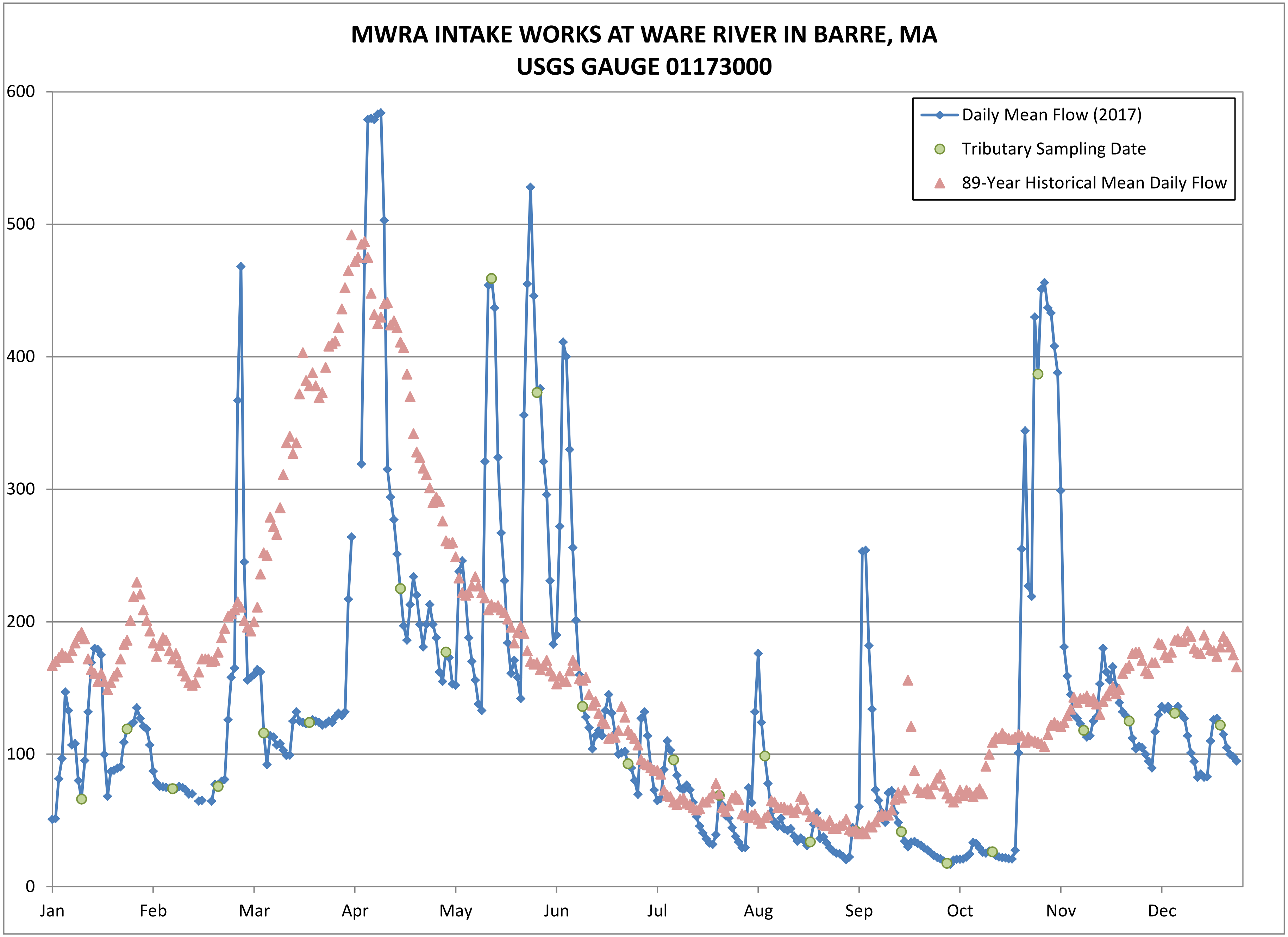

EAST BRANCH SWIFT RIVER NEAR HARDWICK, MA
USGS GAUGE 01174500
Daily Mean Flow (2017)
Tributary Sampling Date
80-Year Historical Mean Daily Flow
700
600
500
400
300
200
100
0
Dec
Jan
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

USGS 01174500: EAST BRANCH SWIFT RIVER NEAR HARDWICK, MA January 1, 2017 - December 31, 2017 Daily mean discharge, cubic feet per second												
DATE	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	*147*	*57*	*153*	*151*	*46*	*122*	*91*	*12*	*9.17*	*5.97*	*294*	*45.6*
2	*134*	*53*	*125*	*119*	*62*	*105*	*70*	*14*	*7.59*	*5.35*	*196*	*45.2*
3	*143*	*52*	*98.2*	*127*	*60*	*80*	*47*	*27*	*12*	*4.88*	*150*	*43.8*
4	*194*	*50*	*77.4*	*220*	*56*	*63*	*35*	*26*	*20*	*4.4*	*119*	*42.3*
5	*128*	*49*	*58.4*	*359*	*97*	*68*	*28*	*29*	*21*	*4.48*	*98.5*	*42.2*
6	*74*	*50*	*49.2*	*321*	*174*	*165*	*25*	*44*	*28*	*4.57*	*93*	*66.8*
7	*57*	*53*	*45.5*	*370*	*110*	*353*	*35*	*44*	*54*	*4.59*	*97.3*	*79.7*
8	*47*	*60*	*47.4*	*296*	*80*	*261*	*42*	*40*	*63*	*7.75*	*90.6*	*72.9*
9	*33*	*76*	*44.3*	*194*	*69*	*154*	*52*	*33*	*53*	*15.9*	*86.1*	*66.8*
10	*52*	*73*	*37.3*	*138*	*62*	*106*	*47*	*27*	*42*	*26*	*76.9*	*63.5*
11	*170*	*72*	*28.8*	*108*	*48*	*83*	*49*	*22*	*34*	*27.4*	*67.3*	*56.8*
12	*229*	*76*	*21.3*	*92*	*41*	*67*	*49*	*20*	*28*	*24.7*	*63.1*	*58.3*
13	*215*	*80*	*18.1*	*88*	*38*	*54*	*51*	*20*	*24*	*20.1*	*63*	*63.2*
14	*78*	*70*	*29.3*	*76*	*143*	*46*	*47*	*17*	*21*	*18.3*	*64.9*	*57.1*
15	*65*	*66*	*30.7*	*62*	*246*	*35*	*41*	*19*	*21*	*16.4*	*61.5*	*47*
16	*55*	*66*	*26*	*58*	*214*	*31*	*34*	*19*	*19*	*16.4*	*61.4*	*43.5*
17	*65*	*61*	*22.6*	*53*	*151*	*32*	*30*	*16*	*17*	*13.4*	*68.1*	*39.4*
18	*77*	*60*	*19.7*	*43*	*99*	*32*	*29*	*17*	*16*	*11.7*	*69.3*	*37.6*
19	*71*	*63*	*19.3*	*38*	*96*	*42*	*27*	*18*	*15*	*10.8*	*81.9*	*39.3*
20	*68*	*75*	*19.8*	*45*	*86*	*68*	*23*	*17*	*13.9*	*10.3*	*87.6*	*40.9*
21	*66*	*86*	*22.3*	*52*	*64*	*59*	*20*	*14*	*12.8*	*9.53*	*79.1*	*40.2*
22	*68*	*94*	*24.5*	*62*	*55*	*46*	*17*	*13*	*11.4*	*8.99*	*76.5*	*38.5*
23	*73*	*98*	*22.2*	*58*	*54*	*38*	*15*	*38*	*9.39*	*8.82*	*75.1*	*45*
24	*84*	*146*	*22.2*	*48*	*50*	*39*	*18*	*40*	*8.65*	*12.1*	*69.7*	*59*
25	*80*	*279*	*22*	*43*	*49*	*35*	*23*	*31*	*8.64*	*304*	*63.9*	*71.4*
26	*82*	*383*	*23.1*	*51*	*176*	*36*	*22*	*24*	*8.51*	*581*	*58.1*	*64*
27	*85*	*299*	*34.6*	*57*	*274*	*34*	*21*	*19*	*8.52*	*571*	*52.5*	*50.3*
28	*83*	*208*	*68.7*	*55*	*177*	*35*	*22*	*15*	*8.35*	*309*	*48*	*42.1*
29	*77*	--	*142*	*49*	*118*	*31*	*20*	*13*	*5.89*	*224*	*46.8*	*37.5*
30	*69*	--	*165*	*46*	*95*	*35*	*16*	*12*	*6.16*	*696*	*43.8*	*35.5*
31	*59*	--	*142*	--	*92*	--	*14*	*11*	--	*531*	--	*35.3*
MAX	**229**	**383**	**165**	**370**	**274**	**353**	**91.1**	**44.4**	**62.5**	**696**	**294**	**79.7**
MIN	**33**	**48.6**	**18.1**	**37.6**	**38**	**30.7**	**13.5**	**10.9**	**5.89**	**4.4**	**43.8**	**35.3**
MEAN	**94.4**	**101.9**	**53.5**	**116.0**	**102.6**	**78.5**	**34.1**	**22.9**	**20.2**	**113.2**	**86.8**	**50.7**
DEPARTURE FROM NORM	11	20	-83	-44	12	17	2	-1	-7	71	23	-32
	STATISTICS OF MONTHLY MEAN DATA FOR CALENDAR YEARS 1937 - 2016											
MAX	239.5	258.3	291.8	420.5	191.3	180.8	178.7	127.3	389.8	244.1	177	263.7
MIN	5.3	18.5	46.4	34.7	30.6	6.9	1.6	0.0	0.0	0.7	4.2	15.6
MEAN	82.9	82.1	136.2	159.6	90.9	61.9	32.5	24.4	27.0	42.4	63.9	82.4

Notes:

Source: U.S. Geological Survey website (accessed June 4, 2018)

1. *Italics* indicates provisional data, subject to revision
2. Flow data from the following dates are estimated values: 1/5-1/10, 1/15-1/17, and 4/28-5/8


MWRA INTAKE WORKS AT WARE RIVER IN BARRE, MA
USGS GAUGE 01173000
Daily Mean Flow (2017)
Tributary Sampling Date
89-Year Historical Mean Daily Flow
0
100
200
300
400
500
600
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

USGS 01173000: MWRA INTAKE WORKS AT WARE RIVER IN BARRE, MA January 1, 2017 - December 31, 2017 Daily mean discharge, cubic feet per second												
DATE	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	*50.8*	*87.2*	*245*	*132*	*155*	*321*	*127*	*29.4*	*23*	*21.1*	451	*106*
2	*51.3*	*78.4*	*156*	*217*	*177*	*296*	*132*	*29.5*	*20.4*	*19.3*	456	*105*
3	*81.4*	*75.6*	*158*	*264*	*173*	*231*	*114*	*74.6*	*22.4*	*17.6*	437	*100*
4	*96.8*	*75.4*	*160*	*NA*	*153*	*183*	*89.9*	*63.4*	*44.6*	*16.9*	433	*94.7*
5	*147*	*75*	*164*	*NA*	*152*	*190*	*73*	*132*	*41.9*	*20.1*	408	*89.7*
6	*133*	*74.3*	*162*	*319*	*238*	*272*	*65*	*176*	*60.3*	*20.7*	388	*117*
7	*107*	*74*	*116*	*472*	*246*	*411*	*66.7*	*124*	*253*	*20.7*	299	*130*
8	*108*	*74*	*92.1*	*579*	*220*	*400*	*88.5*	*98.6*	*254*	*20.9*	181	*136*
9	*80.1*	*75.6*	*114*	*580*	*188*	*330*	*110*	*77.8*	*182*	*22.4*	159	*134*
10	*66.1*	*74.8*	*113*	*579*	*170*	*256*	*103*	*56.3*	*134*	*24.6*	145	*136*
11	*95.3*	*73.2*	*107*	*583*	*156*	*201*	*95.7*	*48.8*	*73.1*	*33.3*	130	*132*
12	*132*	*69.9*	*108*	*584*	*138*	*160*	*84*	*45.5*	*65.1*	*32.7*	127	*131*
13	*169*	*70*	*103*	*503*	*133*	*136*	*74.5*	*51.7*	*56.5*	*29.2*	123	*136*
14	*180*	*NA*	*99*	*315*	*321*	*128*	*73.2*	*43.7*	*48.6*	*26*	118	*130*
15	*179*	*64.6*	*99.3*	*294*	*454*	*120*	*76.7*	*42.3*	*70.9*	*25.3*	113	*127*
16	*175*	*65.1*	*125*	*277*	*459*	*104*	*73.2*	*43.8*	*72.5*	*26.9*	114	*114*
17	*99.9*	*NA*	*132*	*251*	*437*	*114*	*63.8*	*38.3*	*55.7*	*26.4*	125	*101*
18	*68.2*	*NA*	*125*	*225*	*324*	*118*	*52.8*	*34.4*	*48.4*	*23.4*	128	*94.6*
19	*87*	*64.6*	*124*	*197*	*267*	*114*	*45.7*	*36.7*	*41.4*	*22.5*	153	*82.4*
20	*88*	*77.2*	*123*	*186*	*231*	*133*	*40.6*	*34.9*	*34.3*	*21.9*	180	*85.1*
21	*89.5*	*75.6*	*124*	*213*	*184*	*145*	*36.2*	*31.1*	*30.1*	*21.8*	162	*82.6*
22	*90.5*	*79.5*	*126*	*234*	*161*	*131*	*33*	*33.8*	*33.6*	*21*	156	*83*
23	*109*	*81*	*125*	*220*	*171*	*116*	*32*	*47*	*34.2*	*20.9*	166	*110*
24	*119*	*126*	*124*	*198*	*158*	*100*	*39.3*	*55.8*	*32.7*	*27.5*	151	*126*
25	*122*	*158*	*122*	*181*	*142*	*101*	*68.8*	*36.3*	*31.3*	*101.0*	139	*127*
26	*124*	*165*	*123*	*198*	*356*	*102*	*61.6*	*37.5*	*29.2*	*255*	132	*122*
27	*135*	*367*	*125*	*213*	*455*	*92.8*	*53.5*	*33.1*	*27.7*	*344*	129	*115*
28	*127*	*468*	*124*	*198*	*528*	*89.7*	*51.7*	*29.4*	*25.7*	*227*	125	*105*
29	*121*	--	*128*	*188*	*446*	*80.2*	*44.6*	*26.8*	*23.7*	*219*	112	*100*
30	*119*	--	*131*	*162*	*373*	*69.7*	*37.9*	*25.4*	*22.1*	*430*	104	*97.9*
31	*107*	--	*129*	--	*376*	--	*33.6*	*24.9*	--	*387*	--	*94.9*
MAX	**180**	**468**	**245**	**584**	**528**	**411**	**132**	**176**	**254**	**430**	**456**	**136**
MIN	**50.8**	**64.6**	**92.1**	**132**	**133**	**69.7**	**32**	**24.9**	**20.4**	**16.9**	**104**	**82.4**
MEAN	**111.5**	**110.8**	**129.2**	**305.8**	**262.6**	**174.8**	**69.1**	**53.6**	**63.1**	**81.5**	**201.5**	**111.1**
DEPARTURE FROM NORM	-68	-69	-194	-96	50	34	-2	-1	-1	-10	62	-68
	STATISTICS OF MONTHLY MEAN DATA FOR CALENDAR YEARS 1928 - 2016											
MAX	498.6	545.6	1066	962.7	437.8	502.8	337.4	319.4	893.4	466.6	497.3	569.7
MIN	17.2	37.5	117.6	117.4	73.8	18.2	9.0	4.9	6.1	5.5	13.9	29.1
MEAN	179.7	179.3	323.0	402.2	212.9	140.8	70.8	54.6	64.1	91.5	139.6	178.8

Notes:

Source: U.S. Geological Survey website (accessed June 5, 2018)

1. *Italics* indicates provisional data, subject to revision
2. Flow data from the following dates are estimated values: 1/5-1/10, 1/15-1/17, and 4/28-5/8
3. NA = data not available

APPENDIX B

Water Quality Data Tables

2017 QUABBIN LABORATORY RECORDS	Page No.

Units of measure, unless noted otherwise on each table:
Temperature (degrees Celsius)
Dissolved Oxygen: DOPPM (milligrams per liter, mg/L) or DOSAT (% saturation)
Specific Conductance (microsiemens per centimeter, uS/cm)
Turbidity (nephelometric turbidity units, NTU)
Alkalinity (mg/L as $CaCO_3$)
Fecal Coliform Bacteria (colony forming units per 100 milliliters, CFU/100mL)
E. coli (most probable number per 100 mL, MPN/100mL)
Total Coliform Bacteria (most probable number per 100 mL, MPN/100mL)
Nutrients (mg/L), except calcium (ug/L)
UV254 (absorbance per centimeter, 1/cm)
Depth (meters) and Elevation (feet, Boston City Base)

QUABBIN LABORATORY RECORDS 2017
(211) WEST BR. SWIFT RIVER, ROUTE 202

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/3/2017	0.78	14.63	106	6.34	55.7	0.192			10	373						2430	
1/17/2017	0.01	14.82	102	6.04	53.4	0.201			*0*	238						2340	
1/31/2017	-0.05	14.20	99	5.61	55.5	0.232			10	246						2370	
2/14/2017	-0.05	15.33	108	6.03	54.4	0.267			63	216						2350	
2/28/2017	1.63	14.09	101	4.96	42.2	0.347			10	216						1670	
3/15/2017	-0.07	15.38	105	4.93	37.5	0.292			*0*	169						2110	
3/28/2017	0.90	14.40	102	4.85	45.1	0.294	3.29	*1.64*	*0*	259		0.00726	0.0217	0.143	0.10439	1770	*0*
4/11/2017	6.64	12.26	101	4.86	44.2	0.309			41	384						1720	
4/25/2017	9.55	11.52	101	5.15	55.7	0.250			10	908						2050	
5/9/2017	7.79	12.20	105	5.01	48.6	0.250			41	1400						1900	
5/23/2017	11.15	11.18	103	5.04	54.1	0.280			10	1790						2370	
6/6/2017	11.04	10.60	98	4.79	38.3	0.590			134	5170						1540	
6/20/2017	17.24	9.18	97	5.30	61.8	0.500	5.61	3.8	63	2910		0.0108	0.0135	0.169	0.13267	2410	*0*
7/5/2017	16.10	9.59	99	5.94	77.5	0.550			20	2310						3070	
7/18/2017	19.21	8.84	97	5.72	79.7	0.660			10	2910						2970	
8/1/2017	16.48	9.24	96	5.87	98.6	0.50			31	2610						3550	
8/15/2017	17.18	9.11	96	5.59	72.8	0.62			63	5490						3370	
8/29/2017	12.95	10.05	96	5.79	84.0	0.490			*0*	1920						3070	
9/12/2017	12.32	10.22	96	6.12	60.9	0.630			10	1990						2410	
9/26/2017	16.87	8.96	94	5.72	85.5	0.540	8.2	6.32	20	2990		0.0134	0.0715	0.139	0.147750	3230	0.00573
10/10/2017	16.57	9.15	94	5.72	47.9	0.920			121	10500						2020	
10/24/2017	12.55	9.85	93	6.14	79.6	0.380			*0*	1280						3320	
11/7/2017	9.16	11.28	100	5.15	44.3	0.400			10	2480						2010	
11/21/2017	2.65	13.80	103	5.85	45.9	0.300			*0*	1080						1900	
12/5/2017	3.30	13.01	98	6.45	52.3	0.280	4.74	2.95	10	591		0.0182	0.0244		0.09992	2220	0.0057
12/19/2017	0.44	14.27	100	5.69	53.7	0.560			*0*	581						2360	
AVG.	8.55	11.81	100	5.56	58.8	0.417	5.46	3.68	26	1960		0.0124	0.0328	0.150	0.12118	2410	*<0.005*
MAX.	19.21	15.38	108	6.45	98.6	0.920	8.20	6.32	134	10500		0.0182	0.0715	0.169	0.14775	3550	0.0057
MIN.	-0.07	8.84	93	4.79	37.5	0.192	3.29	1.64	*<10*	169		0.00726	0.0135	0.139	0.099920	1540	*<0.005*
MEDIAN	9.36	11.40	100	5.71	54.3	0.364	5.18	3.38	10	1340		0.0121	0.0231	0.143	0.11853	2360	*<0.005*

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").

Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2017
(212) HOP BROOK, GATE 22 ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/3/2017	0.67	14.77	106.60	6.16	168.10	0.38			0	288						5680	
1/17/2017	-0.08	15.11	103.80	5.96	152.40	0.33			0	288						4870	
1/31/2017	-0.08	14.38	100.50	5.85	166.50	0.54			0	238						5220	
2/14/2017	-0.07	15.51	109.00	5.95	154.70	0.33			10	160						5260	
2/28/2017	2.09	14.10	102.80	5.63	128.20	0.36			41	203						3380	
3/28/2017	1.51	14.17	102.50	5.40	119.60	0.58	5.95	4.29	0	213		0.0102	0.0604	0.138	0.10774	3820	0
4/11/2017	7.38	12.13	102.00	5.31	111.60	0.52			109	402						3210	
4/25/2017	9.96	11.24	99.90	5.78	112.70	0.54			31	703						3840	
5/9/2017	7.79	12.18	104.70	5.46	99.00	0.42			20	771						3580	
5/23/2017	11.34	11.15	102.90	5.66	102.70	0.53			31	1250						3880	
6/6/2017	10.72	10.79	99.40	5.21	77.60	1.30			473	10500						2860	
6/20/2017	18.30	9.03	98.00	5.79	112.40	0.97	10.70	8.80	160	6130		0.018	0.0176	0.19	0.17918	4360	0
7/5/2017	17.18	9.45	99.90	5.74	136.00	1.50			31	13000						5730	
7/18/2017	19.96	8.73	97.30	5.92	144.80	2.30			75	14100						6480	
8/1/2017	17.49	9.16	96.90	5.95	147.20	1.60			31	3650						5830	
8/15/2017	17.87	9.05	96.60	5.86	129.20	1.50			74	4360						5900	
8/29/2017	13.17	10.04	96.10	5.85	149.50	1.40			10	1780						5770	
9/12/2017	12.85	10.24	97.40	6.04	149.50	1.20			0	1850						5970	
9/26/2017	17.91	8.98	96.00	6.04	161.70	1.50	17.50	15.60	31	2100		0.0165	0.0431	0	0.11978	6360	0.00879
10/10/2017	16.95	9.39	97.70	5.89	168.00	1.90			241	17300						5830	
10/24/2017	13.41	9.76	94.10	5.91	159.60	1.10			0	1500						6810	
11/7/2017	9.01	11.51	101.50	5.61	109.10	0.74			10	2100						4410	
11/21/2017	2.89	13.79	104.10	5.86	108.40	0.52			31	816						4130	
12/5/2017	3.45	13.21	99.50	6.17	112.10	0.56	9.31	7.68	0	435		0.0122	0.0449	0.105	0.079985	4670	0.00764
12/19/2017	0.14	14.42	100.50	5.75	120.40	0.58			20	512						4950	
AVG.	9.27	11.69	100	5.79	132.0	0.93	10.9	9.09	57	3390		0.0142	0.0415	0.108	0.12167	4910	0.0041
MAX.	19.96	15.51	109	6.17	168.1	2.30	17.5	15.6	473	17300		0.018	0.060	0.190	0.17918	6810	0.00879
MIN.	-0.08	8.73	94	5.21	77.6	0.325	5.95	4.29	*<10*	160		0.0102	0.0176	*<0.100*	0.079985	2860	*<0.005*
MEDIAN	9.96	11.24	100	5.85	129.2	0.580	10.0	8.24	31	1250		0.0144	0.044	0.122	0.11376	4950	0.0038

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2017

(213) MIDDLE BR. SWIFT RIVER, GATE 30

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/3/2017	0.21	11.18	80	5.78	125.7	0.443			*0*	471						5120	
1/17/2017	0.04	11.97	83	5.62	118.1	0.418			*0*	201						4660	
1/31/2017	0.06	11.70	82	5.66	129.3	0.475			*0*	216						4850	
2/14/2017	0.00	11.79	83	5.63	130.5	0.450			*0*	144						5140	
2/28/2017	0.84	12.47	88	5.37	92.3	0.463			20	295						3040	
3/15/2017	0.13	11.88	82	5.16	141.2	0.331			10	120						4960	
3/28/2017	0.47	13.04	92	5.34	96.1	0.533	6.02	4.32	98	464		0.0098	0.0769	0.162	0.12845	3490	0
4/11/2017	9.22	8.98	79	5.12	112.9	0.361			*0*	457						3580	
4/25/2017	12.75	8.07	77	5.35	125.8	0.590			20	2360						4380	
5/9/2017	9.87	8.77	79	5.26	106.5	0.620			161	2380						4050	
5/12/2017									30	2610							
5/23/2017	13.53	6.84	66	5.13	119.3	0.760			97	2100						4720	
6/6/2017	12.45	6.93	66	5.09	100.7	0.85			836	12000						3620	
6/20/2017	21.00	4.20	48	5.27	130.2	1.400	12.6	10.7	789	11200		0.0208	0.0153	0.26	0.23780	5460	0
7/5/2017	20.94	4.65	53	5.27	127.9	1.500			41	3080						5520	
7/18/2017	22.20	4.80	56	5.26	124.8	1.300			41	4880						5830	
8/1/2017	19.54	6.41	71	5.26	138.6	0.89			10	4110						5600	
8/15/2017	20.49	5.58	63	5.19	116.5	1.00			30	6870						6220	
8/29/2017	16.25	6.22	64	5.18	130.3	0.920			20	3080						5170	
9/12/2017	14.85	7.50	75	5.64	111.7	0.750			30	1420						4610	
9/26/2017	19.98	5.73	64	5.34	137.1	0.950	17.1	15.1	10	2480		0.0177	0.00886	0.215	0.23770	6820	0.0135
10/10/2017	17.08	4.70	49	5.26	134.3	2.00			546	9210						5930	
10/24/2017	12.20	7.14	67	5.31	131.5	0.820			10	683						5820	
11/7/2017	9.72	7.46	67	5.04	92.3	0.730			31	1920						3670	
11/21/2017	2.71	11.06	83	5.49	98.9	0.650			20	1460						2270	
12/5/2017	2.89	11.56	86	6.02	112.5	0.700	4.21	2.28	10	749		0.0111	0.112		0.08919	4690	0.0142
12/19/2017	0.50	11.49	81	5.80	126.0	0.630			10	389						5670	
AVG.	10.00	8.54	72	5.38	119.7	0.790	10.0	8.1	106	2790		0.0148	0.0533	0.212	0.17329	4800	0.0069
MAX.	22.20	13.04	92	6.02	141.2	2.00	17.1	15.1	836	12000		0.0208	0.112	0.260	0.23780	6820	0.0142
MIN.	0.00	4.20	48	5.04	92.3	0.331	4.21	2.28	*<10*	120		0.0098	0.00886	0.162	0.08919	2270	*<0.005*
MEDIAN	11.04	7.79	76	5.29	125.3	0.715	9.3	7.5	20	1920		0.0144	0.0461	0.215	0.18308	4910	0.0068

NOTES

Dissolved Oxygen: Sensor Response Factor occasionally out of range; age of sensor (5 years) suspected as cause. New multiprobe put into service in late 2015.

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").

Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

Field parameters not collected on 2/2/16 due to a problem with the PDA

QUABBIN LABORATORY RECORDS 2017
(215) EAST BR. FEVER BROOK, WEST STREET

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/3/2017	0.90	12.74	92	5.36	133.9	0.771			10	546						3250	
1/17/2017	0.99	12.89	91	5.27	119.0	0.43			*0*	201						3030	
1/31/2017	1.30	12.21	89	5.24	124.7	0.387			*0*	134						2870	
2/14/2017	0.12	12.34	87	5.25	133.7	0.416			*0*	122						3140	
2/28/2017	2.70	12.28	91	4.90	89.4	0.785			*0*	529						1890	
3/15/2017	0.33	13.44	93	4.76	112.1	0.613			*0*	238						2190	
3/28/2017	2.68	13.17	98	3.30	0.1	0.744	3.32	1.7	*0*	504		0.0158	0.0089	0.306	0.21955	2500	*0*
4/11/2017	10.24	9.67	87	4.58	86.8	0.529			10	602						1810	
4/25/2017	13.52	8.97	87	5.12	112.7	0.59			10	6870						2300	
5/9/2017	11.55	9.95	94	5.01	117.2	0.56			41	3870						2290	
5/23/2017	15.50	7.85	80	4.94	115.5	0.850			52	5170						2460	
6/6/2017	13.17	8.02	78	4.91	102.9	0.8			241	7270						2100	
6/20/2017	21.63	5.42	63	5.05	108.1	1.1	6.04	4.05	62	3130		0.0280	*0*	0.484	0.47815	2390	*0*
7/5/2017	20.45	7.25	82	4.93	120.0	1.1			20	1790						2770	
7/18/2017	21.01	6.79	77	5.19	129.9	1.3			86	3450						3200	
8/1/2017	18.41	6.11	66	5.32	123.5	1.2			20	9800						2970	
8/15/2017	18.67	6.66	72	5.20	115.7	1.50			135	19900						3460	
8/29/2017	14.04	6.15	60	5.21	129.2	4.2			10	5790						3300	
9/12/2017	13.50	8.03	78	5.30	155.1	0.77			10	2990						3520	
9/26/2017	19.20	4.07	45	5.13	152.9	1	8.65	6.62	41	8160		0.0207	0.0142	0.383	0.26520	3500	0.0479
10/10/2017	18.22	7.16	76	5.24	139.2	1.2			228	11200						3230	
10/24/2017	13.53	3.45	33	5.22	129.7	1.100			63	2760						3900	
11/7/2017	9.37	8.12	72	4.72	91.6	0.63			*0*	3260						2260	
11/21/2017	2.39	12.06	90	5.06	110.6	0.41			10	1210						3850	
12/5/2017	3.60	11.73	89	5.38	108.0	0.57	8.81	7.01	*0*	512		0.013	0.0059	0.219	0.33575	2480	0.0075
12/19/2017	0.81	11.91	85	4.85	109.4	0.570			10	364						2730	
AVG.	10.30	9.17	79	5.02	114.3	0.93	6.71	4.85	41	3860		0.0194	0.00726	0.348	0.32466	2820	0.0139
MAX.	21.63	13.44	98	5.38	155.1	4.20	8.81	7.01	241	19900		0.0280	0.0142	0.484	0.47815	3900	0.0479
MIN.	0.12	3.45	33	3.30	0.1	0.387	3.32	1.70	*<10*	122		0.0130	*<0.005*	0.219	0.21955	1810	*<0.005*
MEDIAN	12.36	8.55	83	5.13	116.5	0.771	7.35	5.34	10	2875		0.0183	0.00742	0.345	0.30048	2820	0.0038

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").

Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2017
(216) EAST BR. SWIFT RIVER, ROUTE 32A

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/3/2017	0.86	14.89	108	6.06	111.8	0.398			*0*	323						4200	
1/17/2017	-0.07	15.20	105	5.96	105.3	0.373			*0*	173						3810	
1/31/2017	-0.07	14.64	102	5.84	108.0	0.505			*0*	173						3880	
2/14/2017	-0.07	15.62	110	6.02	116.5	0.457			*0*	158						4340	
2/28/2017	3.00	13.04	97	4.77	43.8	0.717			20	450						2390	
3/15/2017	-0.06	15.84	108	5.34	115.2	0.402			10	197						3540	
3/28/2017	2.22	13.83	102	5.32	69.3	0.466	5.23	3.57	30	298		0.0119	0.0493	0.143	0.14724	3420	*0*
4/11/2017	9.90	11.78	105	5.33	80.3	0.554			10	235						2310	
4/25/2017	11.92	11.09	103	5.92	94.6	0.520			20	934						2880	
5/9/2017	11.16	11.39	106	5.69	83.0	0.73			30	933						3000	
5/23/2017	15.25	10.35	104	5.66	82.4	0.800			10	2250						2940	
6/6/2017	12.77	10.39	100	5.46	77.9	1.8			203	5480						2670	
6/20/2017	21.72	8.62	100	5.79	86.7	1.2	7.54	5.62	160	9210		0.0308	0.0223	0.389	0.34790	3280	*0*
7/5/2017	21.15	9.21	106	5.69	95.1	0.66			20	4350						3600	
7/18/2017	21.55	8.82	101	5.83	92.0	1.2			*0*	3080						3880	
8/1/2017	21.18	9.19	105	6.16	99.4	0.52			*0*	2250						3770	
8/15/2017	19.36	9.20	101	5.97	82.2	0.53			10	2720						3840	
8/29/2017	15.41	10.35	104	5.87	99.8	0.51			10	1250						3690	
9/12/2017	15.35	10.20	103	6.02	97.1	0.45			10	768						3670	
9/26/2017	20.27	9.21	103	6.11	109.9	0.45	10.6	8.62	*0*	798		0.0103	*0*	0.151	0.16430	4420	*0*
10/10/2017	18.02	9.47	101	5.97	103.1	0.95			97	3260						3980	
10/24/2017	15.14	9.98	100	5.83	105.9	0.390			*0*	738						4670	
11/7/2017	10.00	11.43	103	5.55	78.3	0.64			*0*	1410						2930	
11/21/2017	3.41	13.87	106	5.53	81.9	0.59			31	1020						2930	
12/5/2017	3.87	13.22	101	5.74	90.0	0.47	6.29	4.34	10	368		0.0131	0.0443	0.158	0.22385	3400	*0*
12/19/2017	0.05	14.71	102	5.44	95.7	0.59			31	504						3810	
AVG.	10.51	11.75	103	5.73	92.5	0.649	7.42	5.54	27	1670		0.0165	0.0290	0.210	0.22082	3510	*<0.005*
MAX.	21.72	15.84	110	6.16	116.5	1.80	10.60	8.62	203	9210		0.0308	0.0493	0.389	0.34790	4670	*<0.005*
MIN.	-0.07	8.62	97	4.77	43.8	0.373	5.23	3.57	*<10*	158		0.0103	*<0.005*	0.143	0.14724	2310	*<0.005*
MEDIAN	11.54	11.24	103	5.81	94.9	0.525	6.92	4.98	10	865.5		0.0125	0.0333	0.155	0.19408	3640	*<0.005*

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2017
GATES BROOK, AT MOUTH

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/3/2017	2.01	14.50	109	6.87	43.1	0.168			*0*	*0*	246						2980	
1/11/2017									1									
1/17/2017	0.78	14.81	104	6.55	33.2	0.125			1	*0*	145						1780	
1/25/2017									2									
1/31/2017	0.03	14.67	103	5.80	31.6	0.11			*0*	*0*	135						1740	
2/14/2017	0.30	15.24	108	5.96	31.7	0.116			*0*	*0*	187						1850	
2/22/2017									6									
2/28/2017	3.79	13.71	105	4.82	24.8	0.421			4	30	457						1360	
3/8/2017									*0*									
3/15/2017	0.10	15.70	108	5.59	26.2	0.185			*0*	*0*	213						1250	
3/22/2017									*0*									
3/28/2017	2.97	13.74	103	4.85	25.4	0.344	2.04	0	*0*	10	336		0.0082	*0*	0.133	0.10336	1390	*0*
4/11/2017	6.77	12.66	105	4.32	23.8	0.371				*0*	473						1130	
4/25/2017	8.50	12.04	103	4.95	23.2	0.24				41	754						1220	
5/9/2017	7.22	12.58	107	4.93	22.4	0.22				10	1150						1190	
5/23/2017	10.19	11.66	105	5.35	22.6	0.14				*0*	1850						1190	
6/6/2017	10.38	11.18	102	4.77	21.9	0.25				86	2610						1040	
6/20/2017	15.18	9.96	101	4.93	22.3	0.38	11.2	9.1		213	14100		0.0218	*0*	0.227	0.2888	7500	*0*
7/5/2017	15.35	10.00	102	6.65	23.4	0.150				10	7700						1190	
7/18/2017	17.85	9.43	101	5.70	24.2	0.150				20	6490						1290	
8/1/2017	16.94	9.59	100	5.83	25.4	0.140				*0*	2910						1190	
8/15/2017	17.70	9.36	100	5.65	22.1	0.250				98	13000						1390	
8/29/2017	14.21	10.11	99	6.06	27.2	0.14				10	2360						1280	
9/7/2017									37									
9/12/2017	13.39	10.36	100	6.80	26.3	0.27			2	*0*	959						1370	
9/21/2017									13									
9/26/2017	18.11	9.12	98	5.91	28.7	0.2	5.49	3.67	31	31	3130		0.0241	0.00695	0.105	0.12939	1410	*0*
10/3/2017									15									
10/10/2017	16.96	9.62	100	6.33	30.5	0.24			17	*0*	7700						1450	
10/18/2017									2									
10/24/2017	14.86	9.53	95	6.40	31.4	0.21			1	*0*	3440						1700	
11/1/2017				5.61					2									
11/7/2017	9.89	11.59	104	5.29	23.9	0.23			16	*0*	2760						1210	
11/15/2017									0									
11/21/2017	5.08	13.21	106	6.24	24.4	0.33			0	*0*	573						1110	
11/29/2017									0									
12/5/2017	5.58	11.55	92	7.75	24.7	0.27	2.73	0.93	0	*0*	473		0.0075	*0*		0.06385	1160	*0*
12/14/2017									0	*0*								
12/19/2017	2.88	13.18	99	6.20	25.1	0.26			*0*	*0*	379						1230	
12/28/2017									*0*	*0*								
AVG.	9.12	11.89	102	5.78	26.5	0.227	5.37	3.43	5	20	2870		0.0154	0.0017	0.155	0.146350	1640	*<0.005*
MAX.	18.11	15.70	109	7.75	43.1	0.42	11.20	9.10	37	213	14100		0.0241	0.00695	0.227	0.28880	7500	*<0.005*
MIN.	0.03	9.12	92	4.32	21.9	0.110	2.04	*<0.500*	<1	*<10*	135		0.00750	*<0.005*	0.105	0.063850	1040	*<0.005*
MEDIAN	9.20	11.63	103	5.80	25.0	0.225	4.11	2.30	1	*<10*	1055		0.0150	*<0.005*	0.133	0.116375	1290	*<0.005*

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).
EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.
Field parameters not collected on 1/19/16 due to a problem with the PDA

QUABBIN LABORATORY RECORDS 2017
BOAT COVE BROOK, NEAR MOUTH

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/3/2017	2.41	13.85	105	6.17	90.6	0.825			5	*0*	813						8730	
1/11/2017									18									
1/17/2017	0.18	14.48	100	6.26	85.4	0.7			3	31	350						7550	
1/25/2017									4									
1/31/2017	0.01	13.88	97	6.15	87.6	0.75			*0*	*0*	309						8070	
2/10/2017									2									
2/14/2017	-0.05	15.18	107	6.17	79.6	0.712			1	*0*	279						7730	
2/22/2017									3									
2/28/2017	4.92	12.90	101	5.93	57.9	1.85			*0*	*0*	327						4660	
3/8/2017									3									
3/15/2017	-0.04	14.40	99	5.69	68.6	0.633			1	*0*	173						6120	
3/22/2017									121									
3/28/2017	1.92	14.33	105	5.62	94.7	3.63	12.8	11.1	3	*0*	1080		0.0194	0.022	0.242	0.35775	4720	*0*
4/11/2017	11.33	10.96	101	5.78	53.9	1.110				10	345						4560	
4/25/2017	9.90	11.45	102	5.92	65.8	0.54				98	813						6070	
5/9/2017	9.58	11.52	103	5.93	65.9	0.56				10	1020						6380	
5/23/2017	13.35	10.54	102	5.84	69.8	0.58				20	4610						6690	
6/6/2017	11.13	10.77	100	5.69	45.0	8.7				4880		>24200					4650	
6/8/2017										199	4110							
6/20/2017	18.06	8.84	96	6.26	76.8	0.640	2.89	1		31	9210		0.0146	*0*	0.121	0.16517	1260	*0*
7/5/2017	17.91	9.17	99	6.38	101.3	0.300				355	9800						9780	
7/18/2017	19.48	8.96	99	6.61	110.8	0.290				717	9210						11800	
7/20/2017										512	15500							
8/1/2017	18.82	8.95	97	6.49	114.9	0.330				435	8660						11000	
8/10/2017										355	5480							
8/15/2017	18.10	8.85	95	6.18	96.1	0.540				794	15500						11400	
8/29/2017	15.11	9.07	91	6.30	120.7	0.250				1260	14100						11500	
8/31/2017										624	9210							
9/7/2017												>200						
9/12/2017	15.38	9.58	96	6.32	121.9	0.270			49	171	3650						12200	
9/21/2017									11									
9/26/2017	19.79	8.00	89	6.24	128.0	0.680	36.41	34.36	196	350	17300		0.0167	0.0122	*0*	0.08291	12800	*0*
10/3/2017									164									
10/10/2017	17.68	9.10	96	6.23	129.1	0.410			148	193	14100						12300	
10/18/2017									8									
10/24/2017	16.40	7.98	82	6.23	131.9	0.340			3	20	5170						13900	
11/1/2017									59									
11/7/2017	9.75	11.26	101	5.74	65.4	0.670			15	74	1620						6200	
11/15/2017									16									
11/21/2017	5.47	12.92	104	5.81	71.0	0.690			12	31	697						6820	
11/29/2017									6									
12/5/2017	5.17	12.40	98	5.91	79.8	0.640	18.4	16.4	4	10	313		0.0113	0.0104		0.11124	7610	*0*
12/14/2017									7									
12/19/2017	0.40	14.05	99	5.55	75.0	0.78			67	146	1130						7250	
12/28/2017									6									
AVG.	10.08	11.28	99	6.05	88.0	1.055	17.6	15.7	32	378	5340		0.0155	0.0112	0.121	0.17927	8140	*<0.005*
MAX.	19.79	15.18	107	6.61	131.9	8.70	36.4	34.4	196	4880	17300		0.0194	0.0220	0.242	0.35775	13900	*<0.005*
MIN.	-0.05	7.98	82	5.55	45.0	0.250	2.9	1.0	<1	*<10*	173		0.0113	*<0.005*	*<0.100*	0.082910	1260	*<0.005*
MEDIAN	10.52	11.11	99	6.16	82.6	0.640	15.6	13.8	6	86	3650		0.0157	0.0113	0.121	0.13821	7580	*<0.005*

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2017

(215B) WEST BRANCH FEVER BROOK AT MOUTH

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/3/2017	0.83	13.20	96	5.61	108.3	0.486	6.51	4.81	*0*	318		0.0133	0.0123	0.265	0.254100	4530	0.0107
1/17/2017	1.08	13.90	99	5.60	99.9	0.419	5.13	3.46	10	355		0.0096	0.0116	0.199	0.234400	3810	0.00504
1/31/2017	1.37	12.93	94	5.50	89.5	0.521	5.11	3.44	10	175		0.00902	0.0052	0.102	0.200500	3380	*0.00000*
2/14/2017	0.29	13.37	95	5.52	104.2	0.517	6.43	4.92	*0*	171		0.0138	0.0188	0.234	0.194050	4090	0.0278
2/28/2017	2.62	14.09	104	5.62	74.4	0.691	3.71	2.03	86	487		0.0126	0.00501	0.189	0.209950	2400	0.006
3/28/2017	2.54	13.20	98	4.95	87.4	0.422	5.18	3.66	31	605		0.00936	0.00856	0.172	0.14603	2870	*0*
4/11/2017	11.28	10.82	100	5.06	76.7	0.448	4.11	2.41	52	906		0.0099	*0*	0.187	0.1928	2320	*0*
4/25/2017	14.00	9.77	95	5.50	68.4	0.550	5.87	4.02	20	2850		0.01380	*0.00000*	0.315	0.215050	2570	*0*
5/9/2017	12.66	9.94	96	5.37	82.8	0.61	5.83	3.88	63	1550		0.0126		0.212	0.25745	2850	*0*
5/23/2017	16.99	8.43	88	5.35	82	0.67	6.9	4.96	41	1850		0.0129		0.394	0.298600	3060	*0*
6/6/2017	14.27	8.94	89	5.11	71.6	1.2	6.77	4.55	231	4610		0.0179	*0*	0.363	0.33630	2620	*0*
6/20/2017	22.96	6.63	79	5.16	72.1	0.92	8.74	6.75	98	7270		0.0215	*0*	0.36	0.41645	3140	*0*
7/5/2017	21.62	7.01	81	5.42	63.3	0.66	10.8	8.79	20	2380		0.0201	*0*	0.424	0.38415	3140	0.0123
7/18/2017	23.50	6.06	72	5.20	65.6	0.74	11.1	9.07	*0*	1900		0.0232	0.0076	0.394	0.3589	3530	0.0223
8/1/2017	21.45	5.28	61	5.20	63.2	0.63	10.9	8.9	10	3650		0.0165	0.00806	0.381	0.3146	3030	0.0169
8/15/2017	21.06	5.67	65	5.05	52.6	0.67	11	9.14	10	2700		0.0196	0.0126	0.315	0.27825	3230	0.0148
8/29/2017	16.98	5.32	55	5.34	61.7	0.75	11.7	9.8	*0*	1660		0.0186	0.0126	0.288	0.23995	3140	0.0194
9/12/2017	15.65	7.00	71	5.09	60.7	0.58	10.9	9.09	399	1660		0.00937	0.00995	0.365	0.2359	3020	0.0105
9/14/2017									20	2480							
9/26/2017	21.03	5.42	62	5.20	67.9	0.48	11.1	9.04	20	2010		0.0159	0.0212	0.308	0.2264	3360	0.0213
10/10/2017	18.22	8.16	87	5.27	65.1	0.75	11.0	9.04	52	5790		0.0135	0.0146	0.279	0.235350	3100	0.0133
10/24/2017	13.61	6.68	65	5.17	66.7	0.49	10.8	8.81	20	697		0.01450	0.0181	0.273	0.23965	3380	0.0164
11/7/2017	9.91	9.77	88	5.00	67.6	0.6	6.02	3.9	10	2490		0.0208	0.00809	0.244	0.492100	2810	0.015
11/21/2017	3.63	12.72	98	5.41	66	0.65	5.57	3.39	20	1180		0.023	0.0141	0.249	0.376950	2350	0.00809
12/5/2017	4.02	11.95	91	5.23	72.9	0.580	6.73	4.99	10	780		0.0146	0.0126	0.193	0.3251	2730	0.012
12/19/2017	1.49	12.91	93	5.13	89.7	0.71	7.03	5.24	*0*	279		0.0156	0.0214	0.19	0.32905	3280	0.01930
AVG.	11.72	9.57	85	5.28	75.2	0.63	7.8	5.9	47	1950		0.0153	0.0097	0.276	0.27968	3110	0.0100
MAX.	23.50	14.09	104	5.62	108.3	1.20	11.7	9.8	399	7270		0.023	0.0214	0.424	0.49210	4530	0.0278
MIN.	0.29	5.28	55	4.95	52.6	0.419	3.71	2.03	*<10*	171		0.00902	*<0.005*	0.102	0.146030	2320	*<0.005*
MEDIAN	13.61	9.77	89	5.23	71.6	0.610	6.8	4.96	20	1660		0.0145	0.0100	0.273	0.25410	3100	0.0107

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").

Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

Field parameters not collected on 2/2/16 due to a problem with the PDA

QUABBIN LABORATORY RECORDS 2017
(215H) HARVARD POND AT INLET

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/3/2017	1.16	11.84	87	4.98	71.3	0.336	5.55	3.85	*0*	644		0.0135	*0*	0.273	0.150650	15400	0.00709
1/17/2017	2.26	13.29	97	5.04	65.5	0.385	3.17	1.53	*0*	298		0.0098	*0*	0.226	0.155310	2350	*0*
1/31/2017	2.31	12.21	91	5.07	65.6	0.353	3.09	1.38	*0*	216		0.00791	*0*	0.122	0.130160	2240	*0*
2/14/2017	0.57	9.66	69	5.04	81.5	0.489	5.43	3.80	*0*	528		0.0152	*0*	0.265	0.172650	2720	0.0383
2/28/2017	3.29	13.11	99	5.03	83.6	0.437	5.76	4.02	*0*	336		0.0135	0.0119	0.179	0.146550	1550	0.00525
3/15/2017	2.45	13.07	96	4.70	69.1	0.39	3.50	1.80	*0*	355		0.0104	*0*	0.3	0.11791	2130	0.00631
3/28/2017	2.09	12.75	94	4.64	48.3	0.279	4.48	2.91	20	313		0.00954	0.00587	0.132	0.11206	1840	*0*
4/11/2017	11.95	10.28	96	4.77	56.2	0.389	2.54	1.02	*0*	727		0.0108	*0*	0.166	0.123840	1710	*0*
4/25/2017	13.56	8.37	81	4.85	64.6	0.660	4.01	2.18	20	7270		0.0161	*0.0000*	0.287	0.1893	2060	*0*
5/9/2017	12.72	8.90	86	4.83	47.4	0.780	4.45	2.57	233	5790		0.0161		0.281	0.2143	1770	*0*
5/23/2017	16.83	7.14	74	4.63	45.9	0.710	4.6	2.69	41	4610		0.0174		0.373	0.2791	1950	*0*
6/6/2017	13.67	7.88	78	4.73	46.6	0.840	4.8	2.7	368	4880		0.0181	*0*	0.343	0.2549	1570	*0*
6/20/2017	22.34	4.94	58	4.52	50.2	1.500	5.2	3.2	20	19900		0.0294	*0*	0.473	0.3098	1790	*0*
7/5/2017	21.56	4.50	52	4.62	54.8	2.600	6.5	4.5	20	3080		0.0354	*0*	0.557	0.325000	1960	0.0216
7/18/2017	22.15	2.97	35	4.70	63.4	2.900	7.2	5.3	10	2310		0.0351	*0*	0.554	0.327100	2270	0.0318
8/1/2017	20.32	4.60	52	4.86	66.4	2.10	7.2	5.10	*0*	1040		0.0333		0.63	0.32270	2140	0.0570
8/15/2017	20.44	4.47	50	4.68	55.9	2.200	6.7	4.7	52	2500		0.0349	0.00623	0.576	0.2934	2140	0.0496
8/29/2017	16.30	4.17	43	4.89	92.6	2.000	8.7	6.7	41	959		0.036		0.611	0.286500	2750	0.0573
9/12/2017	15.19	6.45	65	4.98	72.3	2.000	7.8	5.7	10	1110		0.02880	0.0083	0.561	0.274650	2400	0.0394
9/26/2017	20.67	4.60	52	4.96	101.1	2.000	9.5	7.5	41	2850		0.0342	0.00615	0.593	0.3177	3070	0.0584
10/10/2017	18.67	5.68	61	5.24	99.2	2.000	9.0	7.1	30	2910		0.0324	0.0106	0.557	0.2913	2860	0.0725
10/24/2017	15.33	6.71	67	5.16	102.9	2.200	9.2	7.2	364	2360		0.0306	0.00867	0.564	0.2855	3050	0.0412
11/7/2017	9.84	7.44	67	4.53	73.8	0.680	5.3	3.3	10	1500		0.0223	0.00574	0.208	0.326900	2340	0.00961
11/21/2017	3.48	11.07	85	4.72	48.0	0.390	4.2	2.51	*0*	1480		0.0234	0.00609	0.165	0.226150	1740	*0*
12/5/2017	3.77	10.84	82	5.11	52.5	0.550	5.6	3.66	*0*	613		0.0149	*0*	0.208	0.205950	1910	0.0087
12/19/2017	2.14	9.82	72	4.61	62.2	0.560	5.38	3.59	*0*	801		0.0153	0.00551	0.121	0.198200	2490	0.0087
AVG.	11.35	8.34	73	4.84	67.0	1.143	5.7	3.86	49	2668		0.0217	0.0034	0.359	0.232215	2700	0.01972
MAX.	22.34	13.29	99	5.24	102.9	2.90	9.5	7.5	368	19900		0.0360	0.0119	0.630	0.32710	15400	0.0725
MIN.	0.57	2.97	35	4.52	45.9	0.279	2.54	1.02	*<10*	216		0.00791	*<0.005*	0.121	0.112060	1550	*<0.005*
MEDIAN	13.14	8.13	73	4.84	65.1	0.695	5.4	3.63	10	1295		0.0178	*<0.005*	0.294	0.240525	2140	0.00790

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").

Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

Field parameters not collected on 2/2/16 due to a problem with the PDA

QUABBIN LABORATORY RECORDS 2017
(215F) EAST BRANCH FEVER BROOK, AT ROAD ABOVE MOUTH

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/3/2017	0.67	14.77	107	5.79	102.9	0.444	5.19	3.51	*0*	288		0.012	0.0084	0.241	0.2071	6640	*0.0000*
1/17/2017	0.17	14.92	103	5.68	91.1	0.423	4.59	2.87	*0*	226		0.00984	0.008	0.193	0.240850	2860	*0*
1/31/2017	0.13	14.32	101	5.65	87.1	0.387	4.58	3.06	31	213		0.00745	*0*	0.162	0.1973	2780	*0*
2/14/2017	-0.01	15.43	109	5.81	98.4	0.414	4.72	2.92	10	160		0.0129	0.016	0.224	0.1848	3470	*0*
2/28/2017	2.23	13.45	98	5.26	72.2	0.891	3.6	1.83	10	292		0.013	*0*	0.174	0.198300	2000	*0*
3/28/2017	2.44	13.23	98	5.27	75.5	0.416	3.38	1.7	20	223		0.00881	0.0112	0.119	0.17496	2410	*0*
4/11/2017	10.83	11.13	102	5.12	79.8	0.407	3.61	2.05	10	833		0.00955	*0*	0.15	0.16816	2100	*0*
4/25/2017	12.97	10.34	99	5.47	76.2	0.460	5.57	3.96	20	1520		0.01	*0*	0.23	0.207200	2440	*0.00000*
5/9/2017	11.37	10.92	102	5.41	83.4	0.53	5.07	3.1	*0*	733		0.00848		0.205	0.22295	2480	*0.0000*
5/23/2017	15.69	9.69	99	5.40	75.7	0.66	6.16	4.2	97	2190		0.0118		0.295	0.28015	2520	*0*
6/6/2017	13.40	9.87	97	5.27	65.3	0.92	5.62	3.46	110	4350		0.0152	*0*	0.324	0.31645	2020	*0*
6/20/2017	21.68	7.44	86	5.57	59.1	1.60	10.2	8.04	399	12000		0.0273	*0*	0.530	0.48725	2830	*0*
7/5/2017	20.77	8.19	93	5.44	70.6	1.5	11.4	9.45	*0*	7270		0.0246	0.0311	0.396	0.39505	3220	0.0091
7/18/2017	22.78	8.00	94	5.71	69.9	1.6	11.5	9.62	75	5010		0.0260	0.0446	0.289	0.34615	3570	0.016
8/1/2017	20.68	7.69	87	5.78	67.1	1.5	11.3	9.33	20	6870		0.0181	0.0432	0.31	0.2827	3040	0.0084
8/15/2017	20.50	7.51	85	5.61	57.1	1.5	10.9	8.75	464	11200		0.0247	0.035	0.244	0.29550	3460	0.0068
8/29/2017	16.50	7.89	81	5.68	67.8	1.7	12.0	10	10	6870		0.024	0.0271	0.259	0.28215	3140	0.0072
9/12/2017	14.71	9.17	91	5.47	54.0	1	9.73	7.76	20	2760		0.0130	0.0228	0.304	0.25370	2650	0.0106
9/26/2017	20.00	7.85	88	5.75	70.7	1.3	12.8	10.8	*0*	3650		0.0206	0.0305	0.24	0.28730	3570	0.0054
10/10/2017	17.92	8.56	91	5.64	61.7	1.30	9.17	7.17	74	5790		0.0188	0.00707	0.264	0.31455	2740	0.0072
10/24/2017	12.70	8.44	80	5.51	67.9	0.84	9.5	7.6	10	1860		0.0154	0.0216	0.154	0.20035	3090	0.0088
11/7/2017	9.90	11.06	100	5.20	52.9	0.59	4.96	3.06	10	1380		0.0181	0.0075	0.204	0.3873	2130	0.0089
11/21/2017	3.25	13.62	104	5.46	67.4	0.44	4.51	2.87	31	1010		0.0229	0.0087	*0*	0.2496	2180	*0*
12/5/2017	3.46	13.16	99	5.46	73.6	0.420	20.39	18.33	*0*	389		0.0112	0.0086	0.122	0.226750	2330	*0*
12/19/2017	0.42	14.06	99	5.32	81.4	0.5	5.99	4.13	*0*	399		0.0132	0.0175	0.13	0.25665	2650	0.00686
AVG.	11.01	10.83	96	5.51	73.2	0.87	7.9	6.0	57	3100		0.0159	0.0152	0.231	0.26653	2890	0.0038
MAX.	22.78	15.43	109	5.81	102.9	1.70	20.4	18.3	464	12000		0.0273	0.0446	0.530	0.48725	6640	0.016
MIN.	-0.01	7.44	80	5.12	52.9	0.387	3.38	1.70	*<10*	160		0.00745	*<0.005*	*<0.100*	0.16816	2000	*<0.005*
MEDIAN	12.70	10.34	98	5.47	70.7	0.660	6.0	4.1	10	1520		0.0132	0.0087	0.230	0.25370	2740	*<0.005*

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").

Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

Field parameters not collected on 2/2/16 due to a problem with the PDA

QUABBIN LABORATORY RECORDS 2017
(215G) EAST BRANCH FEVER BROOK, AT CAMEL'S HUMP ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/3/2017	1.12	13.61	99	5.36	119.7	0.507	3.29	1.65	10	341		0.0127	0.0051	0.284	0.2482	3170	*0.00000*
1/17/2017	1.45	13.64	98	5.34	106.3	0.452	4.2	2.52	*0*	199		0.0114	*0*	0.261	0.2812	3020	*0*
1/31/2017	1.59	12.85	94	5.27	103.2	0.543	3.93	2.29	10	156		0.0075	*0*	0.153	0.224000	2770	0.0051
2/28/2017	2.70	13.97	104	5.34	76.0	0.580	3.51	1.89	*0*	350		0.0139	0.0066	0.174	0.199750	1920	*0*
3/28/2017	2.71	12.14	91	4.86	115.2	0.460	2.99	1.34	*0*	231		0.00988	0.009	0.198	0.18245	2320	*0*
4/11/2017	11.55	10.68	99	4.81	84.4	0.483	2.91	1.23	*0*	794		0.0114	*0*	0.172	0.1836	1910	*0*
4/25/2017	13.52	9.89	95	5.19	92.2	0.500	3.98	2.16	31	2600		0.0129	*0*	0.257	0.23010	2320	*0*
5/9/2017	12.32	10.35	99	5.15	105.1	0.640	4.25	2.36	31	1420		0.01120		0.272	0.2392	2390	*0*
5/23/2017	16.60	8.85	92	4.97	92.5	0.770	4.75	2.86	31	3260		0.0159		0.566	0.3044	2470	*0.00000*
6/6/2017	14.15	9.25	92	5.06	79.8	0.940	4.24	2.15	52	4110		0.016	*0*	0.42	0.304	1880	
6/20/2017	22.17	7.22	85	4.92	68.6	1.100	5.32	3.11	448	7270		0.0247	*0*	0.421	0.447	2080	
7/5/2017	21.34	7.52	86	4.77	78.5	0.960	6.1	4.13	*0*	5790		0.0202	*0.0000*	0.442	0.40230	2180	0.00596
7/18/2017	22.72	7.01	82	5.08	87.8	1.100	6.93	4.99	*0*	7270		0.0266	0.009	0.374	0.35965	2760	0.02450
8/1/2017	20.63	6.52	74	5.25	81.0	0.940	7.91	5.87	31	5170		0.0177	0.0115	0.356	0.3321	2670	0.019
8/15/2017	20.51	6.57	74	5.12	66.5	1.100	6.87	5.03	10	8160		0.0262	0.017	0.321	0.327850	2740	0.02260
8/29/2017	16.19	7.47	76	5.13	72.5	1.100	8.06	5.97	31	6490		0.0258	0.0112	0.35	0.32835	2660	0.0167
9/12/2017	15.42	7.85	79	5.12	84.9	0.830	8.11	6.01	31	3260		0.0126	0.008	0.339	0.2962	2810	0.0119
9/26/2017	21.05	6.29	72	5.05	96.6	1.000	8.47	6.39	10	5480		0.0194	0.0095	0.322	0.290900	3130	0.0174
10/10/2017	18.72	8.20	88	5.33	94.5	0.880	7.52	5.69	63	5480		0.0152	0.0082	0.296	0.29635	2860	0.0115
10/24/2017	14.58	6.56	65	5.29	97.8	0.72	8.3	6.38	10	2480		0.0181	0.0107	0.223	0.280600	3100	0.0098
11/7/2017	9.83	9.93	89	4.73	67.3	0.580	4.3	2.32	20	984		0.0196	0.0064	0.268	0.44685	2220	0.0095
11/21/2017	3.26	12.81	98	4.97	89.5	0.480	4.26	2.26	10	908		0.01940	0.0103	0.191	0.30880	2130	0.0055
12/5/2017	3.90	11.74	89	4.80	89.9	0.860	4.92	3.02	20	448		0.0136	0.0057	0.127	0.27615	2460	*0*
12/19/2017	1.37	12.85	93	4.87	98.0	0.640	5.81	3.9	*0*	259		0.0155	0.0127	0.288	0.3255	2790	0.0133
AVG.	12.06	9.74	88	5.07	89.5	0.757	5.46	3.563	35	3040		0.0166	0.0064	0.295	0.29648	2530	0.00785
MAX.	22.72	13.97	104	5.36	119.7	1.10	8.5	6.39	448	8160		0.0266	0.0166	0.566	0.44700	3170	0.0245
MIN.	1.12	6.29	65	4.73	66.5	0.452	2.91	1.23	*<10*	156		0.00749	*<0.005*	0.127	0.182450	1880	*<0.005*
MEDIAN	13.84	9.57	90	5.10	89.7	0.745	4.84	2.940	10	2540		0.0157	0.0073	0.286	0.29628	2570	0.00571

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).
EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.
Field parameters not collected on 2/2/16 due to a problem with the PDA

QUABBIN LABORATORY RECORDS 2017
WARE RIVER AND TRIBUTARIES
(101) WARE RIVER, AT SHAFT 8

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/10/2017	0	15.86	108	5.93	142.3	0.788			20	560					0.2534	5480	
1/24/2017	0.04	14.43	101	6.12	131.0	0.622			10	455					0.19830	4710	
2/7/2017	0.14	16.13	112	5.97	139.7	0.556			*0*	305					0.18875	5410	
2/21/2017	0.17	15.72	111	5.76	129.0	0.598			10	226					0.17915	4400	
3/7/2017	1.32	14.16	101	5.66	124.5	0.469			10	169					0.19965	3940	
3/21/2017	1.56	13.95	101	6.10	122.8	0.434	5.01	3.4	20	85		0.0075	0.0095	0.202	0.14672	4320	*0*
4/4/2017	5.04	12.28	98	5.42	102.1	0.702			20	880					0.14232	9630	
4/18/2017	13.65	9.95	97	5.33	105.6	0.851			63	3260					0.15968	####	
5/2/2017	12.53	9.86	94	5.41	110.9	1.20			74	1520					0.2676	3620	
5/16/2017	10.18	11.20	103	5.30	91.2	1.2			228	7270					0.32670	3130	
5/19/2017									86	2280							
5/30/2017	13.62	10.32	102	5.11	90.1	1.1			63	3080					0.3373	3200	
6/13/2017	23.11	7.07	85	6.17	101.9	1.6			31	3080					0.34315	3610	
6/27/2017	21.12	9.47	108	5.51	109.6	2.8	9.15	7.17	41	4610		0.0421	0.0256	0.364	0.39510	4290	0.0099
7/11/2017	22.16	8.72	102	5.71	112.1	2.9			98	7700					0.38910	4310	
7/25/2017	17.22	9.61	102	5.72	101.7	4			345	19900					0.3478	4210	
8/8/2017	18.38	9.12	99	5.74	96.9	2.2			86	7270					0.46505	3700	
8/22/2017	20.53	8.76	98	6.16	105.2	2.6			98	4880					0.32155	4190	
9/5/2017	16.88	9.26	97	5.68	91.9	2.30			121	5480					0.23315	3530	
9/19/2017	19.15	8.67	95	5.75	101.4	3	9.36	7.29	41	3080		0.0278	0.0157	0.327	0.35345	4000	0.0114
10/3/2017	13.34	10.09	97	6.46	106.4	3.2			31	1200					0.31795	4010	
10/17/2017	12.61	9.96	95	6.84	107.7	2.20			10	1270					0.3423	4210	
10/31/2017	10.6	10.35	97	4.51	65.9	1.30			98	4610					0.56295	2370	
11/14/2017	3.09	13.22	99	5.82	93.7	0.94			20	908					0.33455	3730	
11/28/2017	2.04	13.20	97	6.65	97.2	0.88			10	350					0.2636	3400	
12/12/2017	0.89	13.93	99	6.60	98.6	0.8	5.29	3.6	31	703		0.0166	0.025	0.156	0.23555	3710	0.00502
12/26/2017	-0.04	14.22	98	5.59	118.0	0.69			*0*	504					0.21330	3880	
AVG.	9.97	11.52	100	5.81	107.6	1.54	7.20	5.37	62	3170		0.0235	0.0189	0.262	0.28916	4430	0.00658
MAX.	23.11	16.13	112	6.84	142.3	4.00	9.4	7.29	345	19900		0.0421	0.0256	0.364	0.56295	####	0.0114
MIN.	-0.04	7.07	85	4.51	65.9	0.434	5.01	3.40	*<10*	85		0.0075	0.0095	0.156	0.14232	2370	*<0.005*
MEDIAN	11.57	10.34	99	5.75	105.4	1.15	7.22	5.39	31	1520		0.0222	0.0204	0.265	0.29278	4010	0.00746

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).
EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2017
WARE RIVER AND TRIBUTARIES
(103A) BURNSHIRT RIVER, AT RIVERSIDE CEMETERY

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/10/2017	-0.04	13.60	93	5.38	104.0	0.605			*0*	309					0.24370	3520	
1/24/2017	-0.04	13.77	96	5.45	100.1	0.429			10	228					0.18205	3110	
2/7/2017	0.00	13.76	95	5.46	103.2	0.633			*0*	341					0.15242	3320	
2/21/2017	0.00	14.47	102	5.41	109.4	0.457			*0*	231					0.16049	3280	
3/7/2017	0.35	13.68	95	5.10	88.5	0.491			10	156					0.15274	2560	
3/21/2017	1.12	13.36	96	5.38	125.5	0.319	3.72	2.11	*0*	122		0.0070	0.029	0.271	0.1495	3030	0.00742
4/4/2017	3.59	12.65	97	4.98	87.0	0.551			*0*	383					0.15846	3030	
4/18/2017	11.22	10.08	93	4.87	90.1	0.519			*0*	959					0.20235	3390	
5/2/2017	11.45	9.80	91	5.02	91.2	0.88			119	2610					0.23250	2560	
5/16/2017	10.81	10.66	99	4.65	78.5	0.68			20	2100					0.28985	2450	
5/30/2017	12.94	10.14	99	4.78	76.6	0.7			10	3260					0.62165	2430	
6/13/2017	21.09	7.64	88	5.63	77.8	1.7			41	3260					0.3389	2540	
6/27/2017	17.58	8.44	90	5.20	81.2	2.7	6.6	4.65	96	6490		0.0331	0.0329	0.441	0.39475	3020	0.0164
7/11/2017	19.72	7.89	88	4.97	83.2	2.8			175	6870					0.36995	2910	
7/25/2017	15.98	8.33	86	5.27	80.4	2.50			169	11200					0.32695	3000	
8/8/2017	17.44	7.99	85	4.94	80.9	1.50			30	11200					0.42920	2800	
8/22/2017	20.46	8.12	91	5.38	105.9	2.5			134	5790					0.32435	4190	
9/5/2017	16.06	8.49	87	5.10	87.1	1.6			156	8160					0.25060	2890	
9/19/2017	18.61	7.82	85	5.14	92.7	2.1	7.77	5.86	275	7270		0.0244	0.0144	0.346	0.38305	3380	0.00772
10/3/2017	11.84	10.41	96	5.47	106.3	2.6			52	2250					0.3245	4030	
10/17/2017	9.87	7.86	71	5.18	86.5	1.7			122	2910					0.30735	3090	
10/31/2017	10.14	10.44	97	4.56	65.0	1.1			52	4610					0.55670	2170	
11/14/2017	3.40	12.71	96	5.11	75.1	0.67			52	1320					0.3245	2600	
11/28/2017	1.16	13.79	99	5.20	80.3	0.520			75	529					0.22605	2460	
12/12/2017	0.89	13.76	98	5.32	91.7	0.88	8.32	6.6	31	677		0.0132	0.0234	0.129	0.21225	2950	0.00555
12/26/2017	0.00	14.34	99	5.29	99.3	0.52			52	638					0.19090	3220	
AVG.	9.06	10.92	93	5.16	90.3	1.22	6.60	4.81	65	3230		0.0194	0.0249	0.297	0.28868	3000	0.0093
MAX.	21.09	14.47	102	5.63	125.5	2.80	8.3	6.6	275	11200		0.0331	0.0329	0.441	0.62165	4190	0.0164
MIN.	-0.04	7.64	71	4.56	65.0	0.319	3.72	2.11	*<10*	122		0.0070	0.0144	0.129	0.1495	2170	0.00555
MEDIAN	10.48	10.43	95	5.19	87.8	0.79	7.19	5.26	47	2175		0.0188	0.0262	0.309	0.27023	3010	0.0076

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).
EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2017
WARE RIVER AND TRIBUTARIES
(107A) WEST BR. WARE RIVER, AT BRIGHAM ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/10/2017	-0.01	12.97	88	5.36	129.6	0.547			*0*	355					0.29950	4410	
1/24/2017	-0.02	14.04	98	5.39	117.5	0.458			20	374					0.27525	3880	
2/7/2017	-0.05	14.52	100	5.54	114.5	0.417			*0*	309					0.22670	3930	
2/21/2017	0.08	13.97	98	5.22	132.5	0.411			10	521					0.24070	3830	
3/7/2017	1.64	13.79	99	5.21	98.3	0.371			30	318					0.26075	2960	
3/21/2017	1.73	13.54	99	5.54	102.4	0.335	3.71	2.02	10	313		0.0085	0.0139	0.24	0.21240	3360	0.00681
4/4/2017	3.11	12.54	95	4.97	100.1	0.588			10	288					0.16815	3270	
4/18/2017	11.36	10.38	96	4.83	90.0	0.468			41	2060					0.23520	3400	
5/2/2017	11.49	10.32	96	5.22	96.6	0.74			52	2480					0.38545	3000	
5/16/2017	11.39	10.16	96	4.48	84.5	0.730			41	6490					0.46365	2670	
5/30/2017	13.45	9.81	97	4.79	79.0	0.74			41	2490					0.06965	2830	
6/13/2017	22.42	7.85	93	5.89	86.5	1.3			75	2380					0.50825	3110	
6/27/2017	19.48	8.61	95	5.25	88.5	1.40	6.51	4.49	20	2850		0.0223	*0*	0.392	0.47025	3360	*0*
7/11/2017	21.73	8.32	96	5.13	93.9	1.3			86	5170					0.50320	3370	
7/25/2017	16.59	9.15	96	5.44	100.0	1.5			75	8660					0.47865	3720	
8/8/2017	18.95	8.41	92	5.03	96.9	1.100			62	5480					0.64375	3180	
8/22/2017	23.14	8.32	98	5.51	114.4	1.1			31	3450					0.42840	3820	
9/5/2017	17.63	8.97	95	5.25	138.6	0.83			52	1620					0.32725	4070	
9/19/2017	19.10	8.55	93	5.29	115.6	1.10	7.52	5.34	108	4880		0.0209	0.011	0.389	0.52515	3740	0.00602
10/3/2017	14.71	9.92	98	5.57	116.2	0.92			10	1140					0.35955	3730	
10/17/2017	9.99	10.58	95	5.35	119.5	0.760			52	1900					0.38155	3790	
10/31/2017	10.45	9.15	86	3.93	70.2	1.4			295	9210					0.77175	2260	
11/14/2017	3.75	12.98	99	5.25	90.2	0.65			30	1110					0.43785	3030	
11/28/2017	0.90	14.21	101	5.35	92.7	0.56			10	548					0.34070	2960	
12/12/2017	1.30	13.62	98	5.22	93.6	0.88	4.24	2.43	*0*	450		0.0135	0.0347	0.134	0.31100	3060	*0*
12/26/2017	-0.04	13.91	96	5.16	116.9	0.54			30	546					0.31100	3440	
AVG.	9.78	11.10	96	5.20	103.0	0.813	5.50	3.57	46	2520		0.0163	0.0149	0.289	0.37060	3390	*<0.005*
MAX.	23.14	14.52	101	5.89	138.6	1.50	7.52	5.34	295	9210		0.0223	0.0347	0.392	0.77175	4410	0.00681
MIN.	-0.05	7.85	86	3.93	70.2	0.335	3.71	2.02	*<10*	288		0.0085	*<0.005*	0.134	0.06965	2260	*<0.005*
MEDIAN	10.91	10.35	96	5.25	99.2	0.740	5.38	3.46	31	1760		0.0172	0.0125	0.315	0.35013	3370	0.00301

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).
EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2017

WARE RIVER AND TRIBUTARIES

(108) EAST BR. WARE RIVER, AT NEW BOSTON (INTERVALE ROAD)

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/10/2017	-0.01	13.41	91	5.61	151.8	0.75			10	323					0.27125	6310	
1/24/2017	-0.02	13.81	96	5.74	132.8	0.642			*0*	216					0.2107	4980	
2/7/2017	-0.05	14.16	98	5.77	135.0	0.498			*0*	160					0.18145	5350	
2/21/2017	0.04	13.90	98	5.51	133.7	0.534			*0*	171					0.17053	4870	
3/7/2017	1.39	13.58	97	5.53	122.4	0.392			10	201					0.20865	4260	
3/21/2017	0.77	13.59	96	5.63	122.4	0.491	5.15	3.48	*0*	199		0.0076	0.0509	0.225	0.14389	4600	0.00606
4/4/2017	4.43	12.28	96	5.34	96.0	0.84			20	305					0.15731	2390	
4/18/2017	12.57	10.22	97	5.35	99.5	0.833			20	1050					0.2166	2460	
5/2/2017	11.54	10.11	94	5.41	104.9	1.00			135	1620					0.24145	3680	
5/16/2017	11.76	10.71	102	5.05	88.6	0.87			52	3870					0.26630	3140	
5/30/2017	13.65	10.32	103	5.12	85.8	0.94			52	2050					0.22905	3190	
6/13/2017	22.99	7.58	91	6.27	97.7	1.7			122	1990					0.29190	3570	
6/27/2017	19.33	8.05	89	5.40	106.3	2.6	9.69	7.75	74	5480		0.0267	0.0354	0.396	0.33510	4540	0.0244
7/11/2017	21.53	7.53	87	5.24	97.3	2.60			52	5790					0.32955	4110	
7/25/2017	16.47	8.23	86	5.51	122.9	3			794		>24200				0.30720	5240	
8/8/2017	19.31	7.96	88	5.52	112.8	2			30	5480					0.30690	4840	
8/22/2017	21.64	6.73	77	5.27	114.3	2			161	5790					0.33265	4830	
9/5/2017	17.23	8.15	86	5.52	123.2	1.8			63	3080					0.20790	4980	
9/19/2017	19.49	6.58	72	5.25	109.8	1.9	10.6	8.6	98	4610		0.0198	0.0201	0.404	0.31215	4720	0.0113
10/3/2017	12.27	8.82	83	5.75	120.4	2.5			52	1780					0.25875	5130	
10/17/2017	11.13	8.97	83	5.61	123.7	2.2			52	1720					0.26675	5360	
10/31/2017	10.87	9.41	89	4.43	65.5	2.6			241	6870					0.48055	2620	
11/14/2017	3.01	12.95	97	5.11	99.1	0.81			31	1150					0.25975	3950	
11/28/2017	1.02	13.69	98	5.42	95.1	0.72			*0*	504					0.23340	3650	
12/12/2017	0.59	13.64	97	5.21	94.4	0.81	6.2	4.38	*0*	383		0.0122	0.0486	0.101	0.20610	4110	0.0112
12/26/2017	-0.03	13.90	96	5.33	117.5	0.7			41	512					0.19915	4420	
AVG.	9.73	10.70	92	5.42	110.5	1.37	7.9	6.05	81	2210		0.0166	0.0388	0.282	0.25481	4280	0.0132
MAX.	22.99	14.16	103	6.27	151.8	3.00	10.6	8.6	794	6870		0.0267	0.0509	0.404	0.48055	6310	0.0244
MIN.	-0.05	6.58	72	4.43	65.5	0.392	5.15	3.48	*<10*	160		0.0076	0.0201	0.101	0.14389	2390	0.00606
MEDIAN	11.34	10.27	95	5.42	111.3	0.91	7.95	6.07	47	1620		0.0160	0.0420	0.311	0.25010	4480	0.0113

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").

Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2017
WARE RIVER AND TRIBUTARIES
(121B) THAYER POND, AT INLET

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/10/2017	0.22	12.44	85.30	5.93	302.50	0.56			10	464					0.15912	16200	
1/24/2017	0.66	11.59	82.20	6.10	327.40	0.35			20	473					0.14917	14300	
2/7/2017	1.17	11.70	83.80	5.99	366.80	0.49			*0*	697					0.13602	16100	
2/21/2017	1.43	11.86	86.70	5.97	406.30	0.53			20	703					0.13092	15500	
3/7/2017	1.50	12.21	87.10	5.89	367.70	0.48			20	414					0.10802	13200	
3/21/2017	1.99	11.68	85.70	5.99	361.90	0.55	9.67	7.94	187	565		0.00653	0.0289	0.287	0.1102	13900	0.00797
4/4/2017	4.07	11.64	90.20	5.81	278.20	0.55			10	556					0.25305	2640	
4/18/2017	12.57	7.65	72.80	5.50	275.30	0.66			*0*	1720					0.32785	2720	
5/2/2017	11.75	6.20	58.10	5.58	274.80	0.84			313	3970					0.1977	10700	
5/16/2017	13.25	8.24	81.10	5.41	274.10	0.61			63	4350					0.17505	1150	*0*
5/30/2017	14.25	5.84	58.80	5.39	251.70	0.57			41	1440					0.2459	10900	
6/13/2017	24.08	1.47	18.00	6.02	245.30	0.88			63	13000					0.29235	11300	
6/27/2017	20.68	0.39	4.40	5.41	245.70	3.30	23.01	20.91	63	11200		0.061	*0*	0.666	0.40275	12300	0.0153
7/11/2017	20.81	0.84	9.50	5.19	249.20	1.60			146	7270					0.3967	12200	
7/25/2017	16.02	3.46	35.80	5.43	234.20	2.50			301	17300					0.24895	10300	
8/8/2017	18.91	1.26	13.70	5.63	249.80	2.50			75	13000					0.34205	12300	
8/22/2017	20.56	1.43	16.00	5.49	281.90	**5.20**			10	6130					0.59735	15100	
9/5/2017	16.17	6.86	70.80	5.60	266.40	2.90			10	1050					0.39905	13500	
9/19/2017	17.77	0.02	0.20	5.41	291.50	**5.20**	27.60	27.60	216	9210		0.047	0.00533	0.678	0.3925	14400	0.00511
10/3/2017	13.61	2.86	27.60	5.51	289.60	3.70			10	3450					0.32075	13800	
10/31/2017	11.25	4.30	41.10	5.21	216.80	1.00			155	7270					0.2127	10100	
11/14/2017						0.60			52	985					0.2264	10700	
11/28/2017	3.51	6.83	52.30	5.38	224.00	0.40			10	512					0.22815	10100	
12/12/2017	2.02	7.53	55.50	5.24	243.20	0.55	4.28	2.41	10	318		0.0128	0.0435	0.231	0.21265	9930	0.00655
12/26/2017	1.71	8.18	59.00	5.37	324.80	0.59			10	420					0.23785	13800	
AVG.	10.42	6.52	53	5.60	285.4	1.484	16.1	14.7	73	4260		0.0318	0.0194	0.466	0.26013	11490	0.0070
MAX.	24.08	12.44	90	6.10	406.3	5.20	27.6	27.6	313	17300		0.0610	0.0435	0.678	0.59735	16200	0.015
MIN.	0.22	0.02	0	5.19	216.8	0.348	4.28	2.41	*<10*	318		0.00653	*<0.005*	0.231	0.108020	1150	*<0.005*
MEDIAN	12.16	6.85	58	5.51	275.1	0.610	16.3	14.4	20	1440		0.0299	0.0171	0.477	0.23785	12300	0.0066

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").

Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2017
WARE RIVER AND TRIBUTARIES
(111) QUEEN LAKE, AT ROAD CULVERT BELOW OUTLET

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/10/2017	1.43	14.31	102	6.48	72.1	0.461	8.27	6.72	*0*	63		0.01	0.0329	0.206	0.04659	3500	*0*
1/24/2017	1.31	14.10	102	6.13	70.8	0.313	7.63	6.12	10	120		0.0103	0.0292	0.15	0.04931	3270	0.00524
2/7/2017	0.84	14.43	102	6.75	78.4	0.548	8.87	7.35	*0*	275		0.0075	0.0916	0.104	0.05465	3870	0.0148
2/21/2017	0.64	14.27	102	6.78	95.2	0.333	9.3	6.85	1300	1670		0.0123	0.161	0.22	0.06422	4370	0.0156
2/23/2017									171	269							
3/7/2017	1.44	13.88	99	5.96	79.0	0.199	6.09	4.50	31	161		0.0117	0.108	0.334	0.05324	3680	0.0166
3/21/2017	0.97	14.02	100	5.94	73.5	0.301	7.44	5.93	41	189		0.0071	0.0341	0.22	0.04946	3580	0.0104
4/4/2017	2.80	13.16	99	5.66	73.4	0.627	5.83	4.35	10	315		0.0157	0.0834	0.189	0.09034	3100	0.00547
4/18/2017	8.82	11.73	102	6.42	71.4	0.457	7.97	6.08	*0*	341		0.0097	0.0223	0.17	0.05745	3340	*0.0000*
5/2/2017	12.71	10.57	101	5.64	68.6	0.64	8.01	6.14	98	1210		0.0112	*0*	0.258	0.05959	3120	*0*
5/16/2017	11.46	11.01	104	5.46	68.7	0.55	7.94	6.16	315	985		0.0091	0.0074		0.06086	3420	*0*
5/30/2017	14.91	10.56	108	5.52	69.2	0.78	8.14	6.32	85	1850		0.0147	0.00673	0.259	0.50510	3460	*0*
6/13/2017	21.80	8.32	98	6.63	50.2	0.72	8.7	6.82	*0*	2190		0.0163	0.0206	0.264	0.07759	3630	*0.0000*
6/27/2017	17.63	8.79	94	6.03	78.4	1.1	11	9.14	20	5790		0.0199	0.145	0.3	0.09225	4270	0.0169
7/11/2017	20.58	8.58	97	4.85	0.2	0.79	10.7	8.8	75	8160		0.0201	0.129	0.211	0.09254	3920	0.0127
7/25/2017	17.61	8.98	96	6.93	72.2	0.55	10.1	8.3	84	5790		0.0097	0.0663	0.165	0.07587	3810	0.00779
8/8/2017	18.33	8.84	95	5.68	76.3	0.52	10.7	8.84	41	3450		0.0097	0.0676	0.12	0.07426	3910	*0*
8/22/2017	20.27	8.23	92	5.70	81.4	0.35	11.5	9.6	10	5480		0.0107	0.0741	0.124	0.06201	4110	*0*
9/5/2017	16.75	8.88	93	6.54	75.9	0.28	10.2	8.39	52	985		*0*	0.0427	0.123	0.05834	3750	*0*
9/19/2017	18.40	8.48	91	5.70	19.2	0.45	12.5	10.5	52	1370		0.0089	0.0451	0.164	0.06607	4220	*0*
10/3/2017	16.50	9.76	100	5.97	68.3	0.8	9.87	8.07	110	7270		0.0191	0.00565	0.225	0.06308	3370	*0*
10/17/2017	8.21	10.98	95	5.79	0.1	0.63	12	10.1	*0*	670		0.005	0.0519	0.135	0.06825	4030	0.0112
10/31/2017	10.86	10.77	102	6.61	63.7	0.46	7.68	5.87	31	2310		0.0143	0.0494	0.179	0.11202	3080	0.00675
11/14/2017	6.71	12.41	102	5.70	1.8	1.10	8.74	6.97	10	909		0.0099	0.0106	*0*	0.06845	3200	*0*
11/28/2017	2.24	13.92	103	6.21	70.9	0.4	8.54	6.74	10	279		0.007	0.042	0.101	0.06501	3290	0.00877
12/12/2017	1.52	13.94	101	5.87	2.4	0.49	12.2	10.20	*0*	144		0.0111	0.0286		0.06674	3310	0.00657
12/26/2017	1.02	13.93	99	7.35	73.8	0.34	8.7	6.89	30	197		0.0109	0.0306	0.126	0.06802	3430	0.00908
AVG.	9.84	11.42	99	6.09	59.8	0.55	9.18	7.37	96	1940		0.0112	0.0533	0.181	0.08466	3620	0.00569
MAX.	21.80	14.43	108	7.35	95.2	1.10	12.5	10.5	1300	8160		0.0201	0.161	0.334	0.50510	4370	0.0169
MIN.	0.64	8.23	91	4.85	0.1	0.199	5.83	4.35	*<10*	63		*<0.005*	*<0.005*	*<0.100*	0.04659	3080	*<0.005*
MEDIAN	9.84	11.00	100	5.97	71.2	0.51	8.72	6.87	31	985		0.0105	0.0424	0.175	0.06554	3540	0.0054

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").

Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2017
WARE RIVER AND TRIBUTARIES
(B4) BURNSHIRT RIVER AT STONE BRIDGE

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/10/2017	0.28	9.34	64	5.11	99.1	0.568	3.88	2.01	10	435		0.0105	0.0099	0.345	0.485550	3350	0.00871
1/24/2017	0.56	10.93	77	5.35	97.3	0.52	3.5	1.81	*0*	275		0.00951	0.0205	0.31	0.30335	2920	0.0051
2/7/2017	0.71	10.18	72	5.07	99.9	0.359	3.47	1.66	10	292		0.00888	*0*	0.243	0.430550	3370	*0*
2/21/2017	0.50	10.19	73	5.19	114.8	0.58	4.68	2.19	*0*	402		0.0131	0.0497	0.339	0.331350	3450	0.0182
3/7/2017	3.20	10.81	81	4.71	90.6	0.419	2.92	1.15	*0*	379		0.0146	*0*	0.467	0.390750	2600	0.0061
3/21/2017	2.00	10.48	77	4.93	92.3	0.284	2.89	1.11	*0*	336		0.00747	*0*	0.32	0.350750	2690	0.0051
4/4/2017	3.99	11.22	87	4.59	77.9	0.334	4.08	2.53	*0*	332		0.0103	0.0278	0.214	0.265800	2040	*0*
4/18/2017	13.63	7.57	74	5.23	70.6	0.714	3.87	1.89	*0*	2720		0.0133	*0*	0.338	0.392550	2160	*0*
5/2/2017	12.65	6.43	62	4.62	73.7	0.87	4.94	2.86	96	3870		0.0162	*0*	0.445	0.457000	2500	*0*
5/16/2017	10.53	9.26	86	4.26	63.1	0.47	3.3	1.28	20	4880		0.00983	*0*	0.308	0.475850	1940	*0*
5/30/2017	13.88	5.77	58	4.20	61.2	0.57	3.97	1.96	31	2490		0.0147	*0*	0.431	0.306150	2100	*0*
6/13/2017	23.44	2.39	29	5.22	60.6	0.72	5.17	3.09	75	9210		0.0208	*0*	0.432	0.614150	2180	*0*
6/27/2017	20.91	2.76	31	4.76	66.4	1.6	8.07	5.89	20	3450		0.0313	*0*	0.846	0.761550	3150	*0*
7/11/2017	21.49	2.70	31	4.41	63.5	0.72	6.87	4.85	*0*	3130		0.0267	*0*	0.548	0.655200	2660	0.0075
7/25/2017	18.18	3.33	36	4.87	72.3	0.51	9.51	7.3	31	4880		0.0272	*0*	0.614	0.656150	3120	0.0111
8/8/2017	18.54	2.79	30	4.75	74.7	1	7.52	5.23	20	6490		0.0235	*0*	0.557	0.613150	2810	*0*
8/22/2017	21.07	3.13	36	4.77	2.3	0.920	8.86	6.64	10	4350		0.0249	*0*	0.505	0.56225	2910	*0*
9/5/2017	15.14	5.98	60	5.37	61.1	0.63	7.96	5.89	10	3260		0.0121	*0*	0.404	0.471950	2530	*0*
9/19/2017	18.83	2.55	28	4.61	65.5	0.85	8.66	6.47	10	6870		0.0210	0.0064	0.514	0.520500	3020	0.0065
10/3/2017	11.91	2.72	25	5.03	69.3	1.200	9.63	7.45	10	2850		0.023	*0*	0.555	0.538700	3000	0.0062
10/17/2017	11.48	3.40	32	4.81	69.0	1.1	7.95	5.85	20	1840		0.01390	*0*	0.489	0.590950	2940	0.0128
10/31/2017	10.62	7.66	72	4.26	55.4	0.62	3.41	1.26	52	4880		0.02240	0.0086	0.451	0.802050	2090	0.01040
11/14/2017	2.62	8.07	60	4.64	64.9	0.5	4.21	2.13	*0*	1160		0.023	0.01	0.281	0.504650	2230	0.00712
11/28/2017	2.23	10.14	75	4.77	67.6	0.600	4.04	2.03	*0*	771		0.011	0.0114	0.195	0.435750	2490	*0.00000*
12/12/2017	1.12	10.38	75	4.93	69.2	0.480	4.13	2.19	122	933		0.0126	0.0106	0.238	0.365900	2540	*0.0000*
12/26/2017	0.07	11.73	81	6.28	104.5	0.43	4.21	2.3	20	1100		0.0123	0.0335	0.16	0.293700	2930	0.01240
AVG.	9.98	7.00	58	4.87	73.3	0.676	5.45	3.42	22	2750		0.0167	0.0072	0.406	0.483702	2680	0.00451
MAX.	23.44	11.73	87	6.28	114.8	1.600	9.63	7.5	122	9210		0.0313	0.0497	0.846	0.80205	3450	0.0182
MIN.	0.07	2.39	25	4.20	2.3	0.284	2.89	1.11	*<10*	275		0.00747	*<0.005*	0.160	0.265800	1940	*<0.005*
MEDIAN	11.05	7.62	63	4.79	69.3	0.590	4.21	2.25	10	2610		0.0143	*<0.005*	0.418	0.473900	2675	0.0025

NOTES

No flow observed at outlet between 6/28/16 and 12/13/16.

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").

Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2017
WARE RIVER AND TRIBUTARIES
(103) BURNSHIRT RIVER AT ROUTE 62

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/10/2017	-0.07	14.44	98.10	5.26	95.50	0.59	3.58	1.96	30	373		0.0124	0.00897	0.271	0.28975	3060	*0*
1/24/2017	0.10	14.67	102.40	5.41	91.00	0.33	3.18	1.60	*0*	231		0.00826	0.0105	0.203	0.21695	2770	*0*
2/7/2017	0.18	15.02	104.50	5.52	89.60	0.30	3.42	1.86	*0*	246		0.0082	0.01	*0*	0.1826	2870	*0*
2/21/2017	-0.06	14.87	104.10	5.24	100.50	0.39	4.33	1.59	10	323		0.0123	0.0256	0.218	0.17687	2830	*0*
3/7/2017	1.42	14.37	102.30	5.03	74.70	0.42	3.03	1.31	10	134		0.0116	0.00817	0.195	0.17375	2160	0.00515
3/21/2017	1.51	14.02	101.40	5.26	79.50	0.39	3.06	1.34	*0*	121		0.00708	*0*	0.186	0.15295	2470	*0*
4/4/2017	3.70	12.81	98.30	4.91	77.60	0.72	2.40	0.89	*0*	364		0.0131	0.00666	0.189	0.16866	1940	*0*
4/18/2017	11.93	10.79	101.10	4.80	73.00	0.39	3.35	1.42	10	2610		0.00895	*0*	0.206	0.20015	1950	*0*
5/2/2017	12.00	10.58	99.70	5.13	77.40	0.56	3.92	2.18	20	1990		0.0113	*0*	0.24	0.23885	2200	*0*
5/16/2017	10.66	11.04	102.30	4.53	67.20	0.59	3.46	1.56	52	2060		0.00974	*0*	0.218	0.2923	2180	*0*
5/30/2017	13.18	10.65	104.70	4.76	63.30	0.60	3.79	1.93	52	1560		0.0122	*0*	0.268	0.3702	1950	*0*
6/13/2017	21.61	8.18	95.40	5.78	64.10	0.78	4.34	2.39	20	1660		0.016	*0*	0.309	0.3608	1980	*0*
6/27/2017	18.74	9.16	99.80	5.10	62.90	1.40	5.28	3.34	51	3080		0.0212	0.0147	0.473	0.36425	2390	*0*
7/11/2017	20.21	8.94	100.20	5.08	62.90	1.00	5.14	3.33	97	4880		0.0207	0.0138	0.268	0.32485	2200	0.00708
7/25/2017	16.92	9.48	99.80	5.39	61.40	1.50	6.25	4.37	20	4610		0.0177	0.00703	0.303	0.3215	2130	*0*
8/8/2017	18.04	9.39	100.60	5.06	54.50	0.84	5.44	3.51	63	1920		0.0149	0.00537	0.293	0.33675	1970	*0*
8/22/2017	19.35	9.40	103.00	5.21	59.40	0.67	6.62	4.89	41	3440		0.0154	0.00547	0.201	0.22465	2090	*0*
9/5/2017	16.47	9.38	97.30	5.19	58.80	0.71	5.85	3.92	52	1990		0.00701	*0*	0.207	0.194	1930	*0*
9/19/2017	18.56	9.10	98.20	5.20	60.90	0.59	6.47	4.57	*0*	2220		0.0143	0.00863	0.282	0.26365	2100	*0*
10/3/2017	10.94	10.70	97.00	5.26	59.80	1.20	7.90	6.04	10	2100		0.0141	0.00693	0.158	0.25215	2270	*0*
10/17/2017	8.94	10.71	94.10	5.20	63.10	0.65	6.67	4.85	20	1420		0.0104	*0*	0.164	0.24185	2100	0.00736
10/31/2017	10.34	10.40	97.10	4.24	56.90	0.83	3.19	1.13	20	3870		0.0227	0.00605	0.32	0.56775	1960	0.008
11/14/2017	3.47	13.42	101.40	4.84	60.10	0.43	4.14	2.20	20	723		0.0208	0.0127	0.213	0.41745	2220	*0*
11/28/2017	1.84	14.06	103.00	5.16	63.90	0.32	3.96	1.99	31	465		0.0104	0.0156	*0*	0.2702	2120	*0*
12/12/2017	1.23	13.92	100.30	5.09	66.00	0.74	3.61	1.83	*0*	379		0.0111	0.0184	0.286	0.2409	2210	*0*
12/26/2017	-0.07	14.46	99.20	5.41	79.60	0.37	3.88	1.94	20	399		0.0111	0.0276	0.13	0.22625	2430	*0*
AVG.	9.27	11.69	100	5.12	70.1	0.67	4.5	2.6	25	1660		0.0132	0.0082	0.223	0.27192	2250	0.0011
MAX.	21.61	15.02	105	5.78	100.5	1.50	7.9	6.0	97	4880		0.0227	0.0276	0.473	0.56775	3060	0.008
MIN.	-0.07	8.18	94	4.24	54.5	0.299	2.40	0.89	*<10*	121		0.00701	*<0.005*	*<0.100*	0.15295	1930	*<0.005*
MEDIAN	10.50	10.75	100	5.18	64.0	0.597	3.9	2.0	20	1610		0.0123	0.00698	0.216	0.24700	2170	*<0.005*

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).
EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2017
WARE RIVER AND TRIBUTARIES
(C2) CANESTO BROOK AT WILLIAMSVILLE ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/10/2017	0.21	12.22	84	4.98	79.8	0.589	3.2	1.55	*0*	355		0.0108	0.0664	0.144	0.16726	2890	0.0115
1/24/2017	0.26	12.56	88	5.08	79.2	0.426	2.7	1.1	*0*	231		0.00709	0.112	0.153	0.131990	2690	0.00668
2/7/2017	0.31	12.68	89	5.12	81.8	0.413	2.94	1.42	*0*	216		0.0067	0.123	0.106	0.102540	2980	0.00744
2/21/2017	0.10	12.90	91	4.83	85.2	0.402	4.06	1.43	*0*	323		0.0122	0.124	0.157	0.120650	2730	0.011
3/7/2017	0.67	13.23	92	4.81	73.0	0.281	2.58	0.99	*0*	173		0.0119	0.117	0.152	0.115060	2400	0.00671
3/21/2017	0.29	12.77	89	5.05	80.1	0.281	2.9	1.2	*0*	213		0.00628	0.144	0.163	0.084360	2840	0.00662
4/4/2017	1.87	12.96	95	4.64	83.7	0.355	2.3	0.68	20	496		0.0091	0.107	0.104	0.12272	2380	*0*
4/18/2017	9.67	9.14	81	4.36	73.2	0.608	3.18	1.32	*0*	1370		0.00938	0.0309	0.149	0.137780	2330	*0*
5/2/2017	10.17	8.71	79	4.61	79.2	1.00	3.5	1.58	51	2610		0.0138	*0*	0.211	0.16790	2500	*0*
5/16/2017	8.75	10.12	90	4.20	70.3	0.61	3.02	1.02	52	3450		0.00953	*0*	0.201	0.27835	2380	*0*
5/30/2017	11.10	9.21	86	4.27	71.7	0.69	3.05	1.19	30	5790		0.0105	*0*	0.211	0.34615	2310	*0*
6/13/2017	19.55	5.77	65	5.15	70.6	1.5	3.6	1.8	75	8160		0.0177	*0*	0.263	0.23680	2320	*0*
6/27/2017	18.47	5.18	56	4.34	76.0	3	4.63	2.76	63	8660		0.0290	0.00522	0.319	0.30825	2600	0.0081
7/11/2017	20.49	5.94	67	4.51	73.4	2.3	4.41	2.5	30	7700		0.0335	0.0123	0.326	0.3984	2480	0.0086
7/25/2017	17.21	4.31	46	4.83	79.1	4.6	6.58	4.64	52	14100		0.0313	0.013	0.345	0.233550	2860	0.0182
8/8/2017	17.99	4.77	51	4.53	71.6	2.3	4.6	2.57	31	4110		0.0277	0.00811	0.372	0.3619	2530	*0.0000*
8/22/2017	20.16	4.78	53	4.59	76.1	2.7	5.96	4.05	*0*	5790		0.0298	0.00615	0.31	0.25925	2760	0.0068
9/5/2017	15.78	5.92	61	4.57	70.5	2.2	5.74	3.71	183	8660		0.0231	*0*	0.306	0.269850	2420	*0*
9/19/2017	19.02	4.53	49	4.72	79.0	1.7	6.59	4.61	41	9210		0.0282	0.00614	0.387	0.344600	2920	0.00653
10/3/2017	12.37	2.60	24	4.94	83.3	3.400	10.2	8.19	31	4350		0.0338	*0.000*	0.416	0.297900	3360	0.00685
10/17/2017	10.98	4.89	45	4.86	75.3	2.9	7	5.06	*0*	3970		0.0282	*0*	0.371	0.3629	2890	0.00779
10/31/2017	9.93	8.50	79	4.02	63.5	1.1	2.96	0.72	85	4110		0.0241	0.00771	0.385	0.6286	2170	0.0103
11/14/2017	2.92	11.19	83	4.55	74.5	0.69	3.74	1.97	*0*	1550		0.0274	0.0334	0.108	0.16072	2550	0.0152
11/28/2017	2.37	11.56	86	4.78	75.0	0.630	3.44	1.67	*0*	1330		0.0108	0.0403	*0*	0.137450	2410	0.00973
12/12/2017	1.22	12.25	88	4.62	78.1	0.74	3.54	1.7	*0*	1250		0.01250	0.0527		0.15183	2750	0.00839
12/26/2017	0.15	12.04	83	4.68	82.5	0.53	3.38	1.59	10	677		0.0112	0.0947	0.102	0.13216	2710	0.0255
AVG.	8.92	8.87	73	4.68	76.4	1.38	4.2	2.3	29	3800		0.0183	0.042	0.230	0.23304	2620	0.0070
MAX.	20.49	13.23	95	5.15	85.2	4.60	10.2	8.2	183	14100		0.0338	0.144	0.416	0.62860	3360	0.0255
MIN.	0.10	2.60	24	4.02	63.5	0.281	2.3	0.68	*<10*	173		0.00628	*<0.005*	*<0.100*	0.084360	2170	*<0.005*
MEDIAN	9.80	9.18	82	4.66	76.1	0.715	3.5	1.6	15	3030		0.0132	0.013	0.211	0.200725	2575	0.0068

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).
EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

QUABBIN LABORATORY RECORDS 2017
WARE RIVER AND TRIBUTARIES
(N1) NATTY POND BROOK AT HALE ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/10/2017	-0.02	8.40	57	5.24	143.2	1.37	7.0	5.25	10	313		0.014	0.0371	0.325	0.26960	5200	0.0496
1/24/2017	0.02	11.18	78	5.25	137.1	0.751	4.8	3.1	31	487		0.0101	0.0543	0.333	0.208400	4600	0.0187
2/7/2017	0.26	10.13	71	5.21	149.3	0.712	5.16	3.5	*0*	241		0.0110	0.061	0.172	0.184500	5100	0.0213
2/21/2017	0.01	10.22	72	5.06	149.0	0.834	7.09	4.48	10	313		0.0170	0.074	0.323	0.222000	4980	0.0599
3/7/2017	1.06	11.02	78	4.86	119.9	0.38	3.56	1.87	*0*	262		0.0129	0.0196	0.205	0.194650	3500	0.01010
3/21/2017	1.47	10.64	77	4.97	125.4	0.340	4.1	2.4	*0*	249		0.00881	0.0177	0.271	0.158050	4330	0.00958
4/4/2017	4.37	10.95	86	4.95	115.4	0.526	3.5	1.91	*0*	1090		0.0130	0.0294	0.265	0.1867	3270	*0*
4/18/2017	11.99	7.18	67	4.79	122.4	0.534	4.62	2.69	*0*	3450		0.0136	*0*	0.274	0.297150	3620	0.00696
5/2/2017	12.18	6.99	66	4.79	2.7	0.91	4.9	3.09	98	5480		0.0202	*0*	0.38	0.26860	3580	*0*
5/16/2017	11.09	8.38	79	4.50	89.1	0.63	3.86	2	10	3440		0.0123	*0*	0.270	0.2898	3510	*0*
5/30/2017	14.00	6.18	62	4.63	107.9	0.67	5.17	3.19	63	3080		0.0157	*0*	0.42	0.21295	3570	*0*
6/13/2017	22.50	3.49	41	5.64	118.8	2	8.6	6.8	41	5480		0.0616	*0*	0.545	0.48080	4440	*0*
6/27/2017	19.39	2.61	29	4.86	120.0	4.2	10.3	8.19	109	2910		0.0584	*0*	0.575	0.47550	4660	0.0391
7/11/2017	20.76	3.87	44	4.68	108.4	3.6	8.24	6.12	110	9210		0.0431	0.0064	0.403	0.4465	4010	0.0152
7/25/2017	16.82	5.47	58	4.97	110.8	3.3	7.75	5.79	121	9210		0.042	*0*	0.425	0.322700	3950	0.0195
8/8/2017	18.23	4.05	44	4.56	86.0	1.6	6.51	4.38	30	7270		0.0309	*0*	0.402	0.5951	3350	*0.0000*
8/22/2017	19.72	3.89	43	4.81	112.4	3.7	9.88	7.79	41	8160		0.0608	0.00539	0.448	0.4851	4130	0.0141
9/5/2017	15.88	7.17	73	4.88	102.7	1.2	4.79	2.85	31	8160		0.0183	*0*	0.285	0.332850	3090	0.00583
9/19/2017	18.43	3.67	39	4.69	108.2	2.3	9.16	6.85	31	9210		0.0464	0.00828	0.705	0.824900	4070	0.00905
10/3/2017	10.77	5.39	49	5.00	110.6	3.200	7.59	5.59	10	1140		0.0486	0.008	0.409	0.355650	3390	0.0264
10/17/2017	6.25	6.64	55	4.79	125.9	2.2	6.94	4.93	52	3300		0.0337	0.00727	0.377	0.3841	3650	0.0186
10/31/2017	10.02	7.70	71	4.45	87.4	0.99	4.09	2.11	31	2140		0.025	0.00839	0.341	0.5097	2750	0.01
11/14/2017	2.65	9.35	69	4.75	0.2	0.70	5.03	3.11	10	959		0.0263	0.017	0.197	0.36515	3440	0.0243
11/28/2017	0.97	10.79	77	5.04	98.9	0.480	4.36	2.45	*0*	556		0.0124	0.0239	*0*	0.239850	3260	0.0162
12/12/2017	0.71	11.01	78	4.76	46.9	0.66	4.07	2.3	*0*	364		0.01340	0.0225	0.14	0.1964	3740	0.0104
12/26/2017	-0.01	10.52	72	4.97	144.9	0.65	5.8	3.91	*0*	441		0.0145	0.0469	0.153	0.20265	4750	0.0409
AVG.	9.21	7.57	63	4.89	105.5	1.48	6.0	4.1	32	3340		0.0263	0.017	0.332	0.33498	3920	0.0164
MAX.	22.50	11.18	86	5.64	149.3	4.20	10.3	8.2	121	9210		0.0616	0.0741	0.705	0.82490	5200	0.0599
MIN.	-0.02	2.61	29	4.45	0.2	0.340	3.5	1.87	*<10*	241		0.00881	*<0.005*	*<0.100*	0.158050	2750	*<0.005*
MEDIAN	10.40	7.44	68	4.86	111.6	0.872	5.2	3.3	20	2530		0.0177	0.008	0.329	0.293475	3695	0.0123

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = varies, 1-10 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

2017 QUABBIN LABORATORY RECORDS
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY (BWTF)

DATE	TEMP. (°C)	pH	FECAL COLIFORM	TOTAL COLIFORM	*E. COLI*	TNTC
1/1/17	5.9	6.61	1	13	*0*	
1/2/17	5.9	6.68	*0*	15	*0*	
1/3/17	5.0	6.87	*0*	9	*0*	
1/4/17	5.8	6.57	*0*	20	*0*	
1/5/17	5.7	6.69	*0*	20	*0*	
1/6/17	5.7	6.68	*0*	18	*0*	
1/7/17	5.4	6.70	*0*	13	*0*	
1/8/17	4.6	6.63	*0*	9	*0*	
1/9/17	4.5	6.61	*0*	11	*0*	
1/10/17	4.0	6.86	*0*	11	*0*	
1/11/17	4.9	6.61	*0*	5	*0*	
1/12/17	4.7	6.67	*0*	10	*0*	
1/13/17	4.9	6.69	*0*	10	*0*	
1/14/17	4.4	6.58	*0*	11	*0*	
1/15/17	4.5	6.70	*0*	8	1	
1/16/17	4.5	6.72	*0*	11	*0*	
1/17/17	3.5	6.89	*0*	11	*0*	
1/18/17	4.2	6.61	*0*	65	*0*	
1/19/17	4.1	6.65	*0*	6	1	
1/20/17	4.2	6.62	*0*	13	*0*	
1/21/17	4.3	6.65	*0*	5	*0*	
1/22/17	4.2	6.61	*0*	7	1	
1/23/17	4.2	6.63	1	5	*0*	
1/24/17	3.4	6.91	2	8	*0*	
1/25/17	4.0	6.62	*0*	11	2	
1/26/17	3.9	6.66	*0*	6	*0*	
1/27/17	4.0	6.71	*0*	12	*0*	
1/28/17	3.6	6.63	*0*	5	*0*	
1/29/17	3.5	6.59	*0*	6	1	
1/30/17	3.5	6.59	*0*	2	*0*	
1/31/17	2.9	6.87	*0*	4	*0*	
2/1/17	3.1	6.58	*0*	4	*0*	
2/2/17	3.3	6.71	*0*	4	*0*	
2/3/17	3.5	6.70	1	9	*0*	
2/4/17	3.0	6.71	*0*	4	*0*	
2/5/17	2.8	6.68	*0*	3	*0*	
2/6/17	3.1	6.61	1	6	*0*	
2/7/17	3.0	6.87	*0*	1	*0*	
2/8/17	2.4	6.65	*0*	6	*0*	
2/9/17	2.7	6.77	*0*	5	*0*	
2/10/17	2.0	6.59	*0*	17	1	
2/11/17	2.1	6.61	*0*	3	*0*	
2/12/17	1.5	6.62	*0*	4	*0*	
2/13/17	1.5	6.60	*0*	2	*0*	
2/14/17	1.5	6.99	*0*	8	*0*	
2/15/17	1.4	6.65	*0*	4	*0*	
2/16/17	1.7	6.56	*0*	3	*0*	
2/17/17	1.6	6.61	*0*	3	*0*	
2/18/17	1.5	6.58	*0*	2	*0*	
2/19/17	1.6	6.63	*0*	2	*0*	
2/20/17	1.7	6.62	*0*	1	*0*	

2017 QUABBIN LABORATORY RECORDS
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY (BWTF)

DATE	TEMP. (°C)	pH	FECAL COLIFORM	TOTAL COLIFORM	*E. COLI*	TNTC
2/21/17	1.8	6.94	0	2	1	
2/22/17	2.4	6.63	0	4	0	
2/23/17	2.8	6.64	0	4	0	
2/24/17	2.8	6.62	0	3	0	
2/25/17	2.8	6.68	0	3	0	
2/26/17	2.6	6.65	0	5	1	
2/27/17	2.7	6.59	1	4	0	
2/28/17	2.6	6.89	0	3	0	
3/1/17	3.1	6.71	0	8	0	
3/2/17	3.3	6.68	0	6	0	
3/3/17	3.0	6.63	0	5	0	
3/4/17	2.8	6.62	1	3	0	
3/5/17	1.9	6.65	0	4	0	
3/6/17	1.9	6.61	0	3	1	
3/7/17	2.7	6.86	0	2	0	
3/8/17	2.8	6.65	0	5	1	
3/9/17	3.3	6.69	1	4	0	
3/10/17	3.3	6.67	0	5	0	
3/11/17	2.8	6.62	0	3	0	
3/12/17	2.4	6.65	0	5	0	
3/13/17	2.1	6.92	0	4	0	
3/14/17	2.4	6.61	0	4	0	
3/15/17	1.9	6.61	3	5	1	
3/16/17	1.6	6.59	0	4	0	
3/17/17	1.5	6.67	0	4	0	
3/18/17	1.9	6.65	1	2	0	
3/19/17	2.1	6.65	0	5	0	
3/20/17	1.9	6.62	0	4	0	
3/21/17	2.3	6.89	0	3	0	
3/22/17	2.3	6.60	0	24	0	
3/23/17	2.4	6.69	1	3	1	
3/24/17	2.6	6.65	0	1	0	
3/25/17	2.7	6.60	0	2	0	
3/26/17	2.8	6.59	0	3	0	
3/27/17	2.7	6.61	0	4	0	
3/28/17	2.4	6.84	0	4	0	
3/29/17	3.1	6.70	0	6	0	
3/30/17	2.8	6.59	4	4	1	
3/31/17	3.5	6.59	1	3	1	
4/1/17	3.2	6.57	0	3	0	
4/2/17	3.3	6.67	0	4	0	
4/3/17	3.4	6.69	0	5	0	
4/4/17	3.0	6.91	0	3	1	
4/5/17	4.0	6.68	0	7	0	
4/6/17	3.5	6.70	0	5	0	
4/7/17	3.6	6.61	0	2	0	
4/8/17	3.4	6.63	1	8	0	
4/9/17	3.6	6.65	0	16	0	
4/10/17	3.7	6.67	0	3	0	
4/11/17	3.8	6.84	0	5	0	
4/12/17	4.6	6.71	0	5	0	

2017 QUABBIN LABORATORY RECORDS
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY (BWTF)

DATE	TEMP. (°C)	pH	FECAL COLIFORM	TOTAL COLIFORM	*E. COLI*	TNTC
4/13/17	4.5	6.63	*0*	5	1	
4/14/17	5.1	6.64	*0*	12	*0*	
4/15/17	5.2	6.66	*0*	6	1	
4/16/17	5.5	6.68	*0*	5	*0*	
4/17/17	5.9	6.72	*0*	5	*0*	
4/18/17	5.4	6.87	*0*	1	*0*	
4/19/17	6.2	6.66	*0*	19	*0*	
4/20/17	6.1	6.59	*0*	31	*0*	
4/21/17	6.1	6.65	*0*	6	*0*	
4/22/17	6.7	6.60	*0*	7	*0*	
4/23/17	6.9	6.63	*0*	6	*0*	
4/24/17	6.8	6.67	*0*	15	*0*	
4/25/17	6.6	6.92	*0*	15	*0*	
4/26/17	8.0	6.71	*0*	8	1	
4/27/17	8.0	6.70	*0*	10	*0*	
4/28/17	7.7	6.69	*0*	7	*0*	
4/29/17	7.5	6.88	1	6	*0*	
4/30/17	8.9	6.67	*0*		*0*	
5/1/17	7.9	6.70	*0*	21	*0*	
5/2/17	7.1	6.86	*0*	20	*0*	
5/3/17	7.3	6.72	*0*	20	*0*	
5/4/17	8.7	6.79	*0*	14	*0*	
5/5/17	7.5	6.74	*0*	11	*0*	
5/6/17	9.3	6.71	*0*	19	*0*	
5/7/17	6.7	6.70	*0*	26	*0*	
5/8/17	7.8	6.73	*0*	12	*0*	
5/9/17	8.6	6.92	*0*	7	*0*	
5/10/17	8.9	6.71	*0*	12	*0*	
5/11/17	9.3	6.78	*0*	10	*0*	
5/12/17	9.2	6.98	*0*	22	*0*	
5/13/17	9.9	6.73	*0*	15	1	
5/14/17	10.1	6.72	7	54	6.3	
5/15/17	10.3	6.79	*0*	28	*0*	
5/16/17	10.3	7.09	*0*	25	*0*	
5/17/17	9.5	6.70	*0*	18	*0*	
5/18/17	9.5	6.75	*0*	17	*0*	
5/19/17	9.3	6.71	*0*	12	*0*	
5/20/17	10.9	6.70	*0*	20	*0*	
5/21/17	10.5	6.73	*0*	7	*0*	
5/22/17	9.4	6.72	*0*	8	*0*	
5/23/17	10.0	6.90	*0*	16	*0*	
5/24/17	10.5	6.71	*0*	15	*0*	
5/25/17	10.5	6.73	*0*	10	*0*	
5/26/17	13.2	6.72	1	38	*0*	
5/27/17	10.4	6.76	*0*	17	*0*	
5/28/17	10.0	6.70	*0*	7	*0*	
5/29/17	10.3	6.73	*0*	8	*0*	
5/30/17	10.5	6.88	*0*	12	*0*	
5/31/17	9.7	6.79	*0*	11	*0*	
6/1/17	10.3	6.79	*0*	8	*0*	
6/2/17	11.2	6.78	*0*	11	*0*	

2017 QUABBIN LABORATORY RECORDS
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY (BWTF)

DATE	TEMP. (°C)	pH	FECAL COLIFORM	TOTAL COLIFORM	*E. COLI*	TNTC
6/3/17	10.5	6.79	*0*	10	*0*	
6/4/17	10.6	6.75	*0*	86	*0*	
6/5/17	10.3	6.78	*0*	12	*0*	
6/6/17	14.0	6.88	*0*	26	*0*	
6/7/17	13.2	6.79	*0*	25	*0*	
6/8/17	10.3	6.70	*0*	10	*0*	
6/9/17	10.2	6.72	*0*	7	*0*	
6/10/17	10.7	6.71	*0*	5	*0*	
6/11/17	10.5	6.72	*0*	6	*0*	
6/12/17	12.1	6.68	*0*	8	*0*	
6/13/17	10.8	6.98	*0*	14	*0*	
6/14/17	12.1	6.78	*0*	13	*0*	
6/15/17	11.9	6.71	*0*	12	*0*	
6/16/17	11.7	6.67	*0*	12	*0*	
6/17/17	12.0	6.69	*0*	30	*0*	
6/18/17	11.7	6.68	*0*	29	*0*	
6/19/17	11.7	6.71	*0*	36	*0*	
6/20/17	11.4	6.85	*0*	41	*0*	
6/21/17	11.6	6.68	*0*	28	*0*	
6/22/17	11.5	6.62	*0*	93	*0*	
6/23/17	11.3	6.72	*0*	44	*0*	
6/24/17	11.7	6.56	*0*	44	*0*	
6/25/17	11.9	6.68	*0*	88	*0*	
6/26/17	11.3	6.67	*0*	47	*0*	
6/27/17	11.8	6.90	*0*	135	*0*	
6/28/17	11.9	6.63	*0*	51	*0*	
6/29/17	11.3	6.59	*0*	66	*0*	
6/30/17	11.9	6.67	*0*	56	*0*	
7/1/17	12.2	6.69	*0*	59	*0*	
7/2/17	12.4	6.60	*0*	36	*0*	
7/3/17	11.7	6.63	*0*	25	*0*	
7/4/17	11.9	6.65	*0*	47	*0*	
7/5/17	12.3	6.88	*0*	31	*0*	
7/6/17	13.3	6.62	*0*	26	*0*	
7/7/17	11.9	6.64	*0*	49	*0*	
7/8/17	11.8	6.61	*0*	40	*0*	
7/9/17	12.3	6.65	*0*	41	*0*	
7/10/17	11.7	6.65	*0*	96	*0*	
7/11/17	12.0	6.85	*0*	52	*0*	
7/12/17	12.3	6.62	*0*	50	*0*	
7/13/17	12.1	6.62	*0*	58	*0*	
7/14/17	12.4	6.65	*0*	77	*0*	
7/15/17	12.5	6.61	*0*	78	*0*	
7/16/17	12.1	6.61	*0*	73	*0*	
7/17/17	12.3	6.65	*0*	47	*0*	
7/18/17	12.5	6.89	*0*	40	*0*	
7/19/17	12.3	6.63	*0*	46	*0*	
7/20/17	12.6	6.69	*0*	39	*0*	
7/21/17	12.8	6.58	*0*	64	*0*	
7/22/17	13.1	6.57	*0*	72	*0*	
7/23/17	13.8	6.65	*0*	122	*0*	

2017 QUABBIN LABORATORY RECORDS
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY (BWTF)

DATE	TEMP. (°C)	pH	FECAL COLIFORM	TOTAL COLIFORM	*E. COLI*	TNTC
7/24/17	12.3	6.64	*0*	122	*0*	
7/25/17	12.3	7.09	*0*	192	1	
7/26/17	12.3	6.63	*0*	435	*0*	
7/27/17	11.9	6.60	*0*	260	*0*	
7/28/17	12.5	6.63	*0*	649	*0*	
7/29/17	13.0	6.58	*0*	2420	*0*	
7/30/17	12.6	6.59	*0*	2420	*0*	
7/31/17	12.3	6.61	*0*	1540	*0*	
8/1/17	13.1	6.91	*0*	2090	*0*	
8/2/17	12.9	6.64	*0*		*0*	>4840
8/3/17	12.6	6.51	*0*		*0*	>9680
8/4/17	13.2	6.52	*0*	6490	*0*	
8/5/17	13.3	6.59	*0*	13000	*0*	
8/6/17	12.9	6.62	*0*	19600	*0*	
8/7/17	13.1	6.53	*0*	11000	*0*	
8/8/17	13.6	6.89	*0*	11600	*0*	
8/9/17	12.9	6.58	*0*	18400	*0*	
8/10/17	13.2	6.53	*0*	19600	*0*	
8/11/17	13.3	6.55	*0*	11600	*0*	
8/12/17	13.1	6.58	*0*	24100	*0*	
8/13/17	12.9	6.62	*0*	24100	*0*	
8/14/17	13.2	6.59	*0*	24100	*0*	
8/15/17	13.2	6.85	*0*	24100	*0*	
8/16/17	13.1	6.56	*0*	19600	*0*	
8/17/17	12.8	6.57	1	24100	*0*	
8/18/17	13.3	6.62	*0*	18400	*0*	
8/19/17	14.1	6.61	*0*	16300	*0*	
8/20/17	13.1	6.60	*0*	22400	*0*	
8/21/17	13.4	6.58	*0*	17300	*0*	
8/22/17	13.6	6.78	*0*	26000	*0*	
8/23/17	13.6	6.53	*0*	15400	*0*	
8/24/17	13.9	6.63	*0*	9220	*0*	
8/25/17	13.5	6.62	*0*	11000	*0*	
8/26/17	13.3	6.57	*0*	7750	*0*	
8/27/17	14.1	6.55	1	6150	*0*	
8/28/17	13.9	6.53	*0*	7750	*0*	
8/29/17	14.3	6.84	*0*	3560	*0*	
8/30/17	15.3	6.60	*0*	4880	*0*	
8/31/17	13.9	6.60	*0*	4350	*0*	
9/1/17	14.5	6.55	*0*	2280	*0*	
9/2/17	13.7	6.50	*0*	2600	*0*	
9/3/17	14.1	6.60	*0*	2600	*0*	
9/4/17	13.9	6.58	*0*	1950	*0*	
9/5/17	13.7	6.71	*0*	3080	*0*	
9/6/17	15.3	6.55	*0*	1840	*0*	
9/7/17	14.4	6.56	*0*	1990	*0*	
9/8/17	14.3	6.58	*0*	1730	*0*	
9/9/17	14.5	6.61	*0*	1200	*0*	
9/10/17	16.4	6.72	*0*	921	*0*	
9/11/17	15.2	6.61	*0*	1300	*0*	
9/12/17	13.8	6.66	*0*	1410	*0*	

2017 QUABBIN LABORATORY RECORDS
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY (BWTF)

DATE	TEMP. (°C)	pH	FECAL COLIFORM	TOTAL COLIFORM	*E. COLI*	TNTC
9/13/17	14.5	6.62	*0*	1550	*0*	
9/14/17	14.2	6.60	*0*	1410	*0*	
9/15/17	15.5	6.65	*0*	613	*0*	
9/16/17	15.9	6.61	*0*	727	*0*	
9/17/17	14.7	6.60	*0*	1120	*0*	
9/18/17	14.7	6.57	*0*	1300	*0*	
9/19/17	17.9	6.77	2	488	*0*	
9/20/17	20.9	6.75	10	345	12.1	
9/21/17	20.9	6.86	1	185	3.1	
9/22/17	20.9	7.46	*0*	261	1	
9/23/17	20.8	6.87	*0*	196	*0*	
9/24/17	18.4	6.63	1	225	*0*	
9/25/17	17.9	6.60	*0*	308	*0*	
9/26/17	17.8	6.71	*0*	228	*0*	
9/27/17	18.3	6.63	*0*	172	*0*	
9/28/17	18.1	6.58	*0*	161	1	
9/29/17	20.3	6.78	2	488	5.1	
9/30/17	18.6	6.59	1	387	1	
10/1/17	19.5	6.63	1	186	1	
10/2/17	18.8	6.67	1	299	1	
10/3/17	18.2	6.58	1	326	*0*	
10/4/17	17.0	6.52	*0*	135	*0*	
10/5/17	16.9	6.48	*0*	120	*0*	
10/6/17	18.6	6.69	*0*	152	*0*	
10/7/17	18.8	6.58	1	194	*0*	
10/8/17	15.3	6.36	1	105	*0*	
10/9/17	18.4	6.54	*0*	135	*0*	
10/10/17	18.5	6.72	*0*	285	1	
10/11/17	19.2	6.64	1	137	2	
10/12/17	19.5	6.74	2	194	2	
10/13/17	19.2	6.73	*0*	210	1	
10/14/17	18.9	6.64	1	261	2	
10/15/17	18.7	6.63	*0*	137	*0*	
10/16/17	18.3	6.53	1	326	3.1	
10/17/17	17.9	6.86	1	228	*0*	
10/18/17	17.7	6.64	*0*	249	*0*	
10/19/17	18.2	6.65	*0*	308	*0*	
10/20/17	17.6	6.49	1	236	*0*	
10/21/17	18.0	6.61	*0*	228	*0*	
10/22/17	18.3	6.66	*0*	186	*0*	
10/23/17	18.0	6.67	*0*	326	1	
10/24/17	15.1	6.35	*0*	55	*0*	
10/25/17	17.3	6.52	6	236	12.2	
10/26/17	17.8	6.62	1	238	1	
10/27/17	17.6	6.61	*0*	152	2	
10/28/17	17.5	6.65	2	248	3	
10/29/17	16.4	6.41	1	122	*0*	
10/30/17	16.2	6.61	*0*	150	3.1	
10/31/17	16.0	6.69	3	308	4.1	
11/1/17	16.5	6.65	*0*	225	6.3	
11/2/17	16.1	6.61	2	172	2	

2017 QUABBIN LABORATORY RECORDS
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY (BWTF)

DATE	TEMP. (°C)	pH	FECAL COLIFORM	TOTAL COLIFORM	*E. COLI*	TNTC
11/3/17	15.8	6.50	4	155	*0*	
11/4/17	15.9	6.60	*0*	166	*0*	
11/5/17	15.7	6.63	*0*	138	1	
11/6/17	15.5	6.61	*0*	131	*0*	
11/7/17	15.1	6.72	*0*	79	*0*	
11/8/17	14.9	6.95	*0*	91	*0*	
11/9/17	14.5	6.64	*0*	77	*0*	
11/10/17	14.3	6.57	*0*	111	1	
11/11/17	13.6	6.60	*0*	66	*0*	
11/12/17	13.1	6.60	*0*	34	*0*	
11/13/17	13.0	6.61	*0*	35	*0*	
11/14/17	12.7	6.72	1	31	1	
11/15/17	12.6	6.62	1	32	*0*	
11/16/17	12.5	6.55	*0*	30	*0*	
11/17/17	12.2	6.60	*0*	32	*0*	
11/18/17	12.0	6.55	*0*	37	1	
11/19/17	11.9	6.54	*0*	41	*0*	
11/20/17	11.4	6.73	*0*	26	*0*	
11/21/17	11.5	6.64	*0*	35	*0*	
11/22/17	11.5	6.55	*0*	16	1	
11/23/17	11.2	6.54	*0*	17	*0*	
11/24/17	11.0	6.54	*0*	17	*0*	
11/25/17	10.9	6.58	*0*	13	*0*	
11/26/17	10.9	6.51	*0*	11	*0*	
11/27/17	10.5	6.61	*0*	11	*0*	
11/28/17	10.3	6.68	*0*	21	*0*	
11/29/17	10.3	6.59	*0*	12	*0*	
11/30/17	10.1	6.56	1	11	*0*	
12/1/17	10.0	6.53	*0*	15	*0*	
12/2/17	9.9	6.52	*0*	12	*0*	
12/3/17	9.8	6.55	*0*	13	*0*	
12/4/17	9.7	6.54	*0*	6	*0*	
12/5/17	9.6	6.71	*0*	10	*0*	
12/6/17	9.7	6.55	*0*	11	2	
12/7/17	9.4	6.53	*0*	16	*0*	
12/8/17	9.3	6.56	*0*	19	*0*	
12/9/17	9.2	6.55	*0*	22	1	
12/10/17	8.9	6.58	*0*	10	1	
12/11/17	8.8	6.62	*0*	10	*0*	
12/12/17	8.5	6.77	1	11	*0*	
12/13/17	8.3	6.60	*0*	16	*0*	
12/14/17	8.0	6.57	*0*	14	*0*	
12/15/17	7.8	6.60	*0*	12	*0*	
12/16/17	7.7	6.63	*0*	6	1	
12/17/17	7.5	6.62	*0*	12	1	
12/18/17	7.3	6.65	*0*	8	*0*	
12/19/17	7.1	6.81	*0*	6	*0*	
12/20/17	7.4	6.60	*0*	5	*0*	
12/21/17	7.1	6.61	*0*	3	*0*	
12/22/17	7.1	6.56	*0*	3	*0*	
12/23/17	6.9	6.60	1	2	*0*	

2017 QUABBIN LABORATORY RECORDS

MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY (BWTF)

DATE	TEMP. (°C)	pH	FECAL COLIFORM	TOTAL COLIFORM	*E. COLI*	TNTC
12/24/17	6.7	6.55	1	9	*0*	
12/25/17	6.6	6.63	*0*	5	*0*	
12/26/17	5.7	6.87	1	4	*0*	
12/27/17	6.2	6.64	*0*	8	*0*	
12/28/17	5.8	6.59	*0*	4	*0*	
12/29/17	5.4	6.60	*0*	6	2	
12/30/17	5.2	6.56	*0*	2	*0*	
12/31/17	5.2	6.63	*0*	7	2	
AVG.	9.7	6.67	*<1*	1320	*<1 - <4*	
MAX.	20.9	7.46	10	26000	12.2	
MIN.	1.4	6.35	*<1*	1	*<1 - <4*	
MEDIAN	10.4	6.64	*<1*	17.5	*<1 - <4*	

Notes:

Detection limit of 1 CFU/100 mL for Fecal Coliform.

Total Coliform detection limit = 1 MPN/100 mL.

E. coli detection limit varied from 1 to 2 MPN/100 mL based on dilution.

DRINKING WATER WELL SAMPLES FOR PUBLIC WATER SYSTEM (PWS) COMPLIANCE UNLESS OTHERWISE NOTED

DATE	LOCATION	ANALYTICAL PARAMETER	RESULT	UNITS	REMARKS
4/19/17	Administration Building Well	Nitrate	0.86	mg/L	Samples analyzed at MWRA Deer Island Laboratory.
		Nitrite	<0.005	mg/L	
		Iron	0.033	mg/L	
		Manganese	0.006	mg/L	
		Sodium	110	mg/L	
8/3/17	Administration Building Well	Volatile organic compounds by EPA Method 524	<0.5	ug/L	Sample analyzed at MWRA Deer Island Laboratory. All results were less than method detection limits.
8/8/17	Administration Building Well	Perchlorate	<1.0	ug/L	Sample analyzed at Barnstable County Health Laboratory.
12/5/17	Administration Building Well	Uranium	0.411	ug/L	Sample analyzed at MWRA Deer Island Laboratory. Result was reported to MassDEP, but this testing was not required for PWS compliance.
12/5/17	Administration Building Well	Gross alpha	2.31	pCi/L	Samples analyzed at GEL Laboratories, LLC. Results were reported to MassDEP, but this testing was not required for PWS compliance.
		Radium-226	0.449	pCi/L	
		Radium-228	0.446	pCi/L	
		Radon	1.43	pCi/L	
4/20/17	Administration Building Kitchen	Lead	15.2	ug/L	Samples analyzed at MWRA Deer Island Laboratory.
		Copper	101	ug/L	
	Visitors Center Fountain	Lead	5.79	ug/L	
		Copper	232	ug/L	
	Laboratory Tap	Lead	4.38	ug/L	
		Copper	171	ug/L	
	Garage Fountain	Lead	0.867	ug/L	
		Copper	6.78	ug/L	
	3rd Floor Service Sink	Lead	3.00	ug/L	
		Copper	75.1	ug/L	
11/29/17	Administration Building Kitchen	Lead	12.8	ug/L	Samples analyzed at MWRA Deer Island Laboratory.
		Copper	78.3	ug/L	
	Visitors Center Fountain	Lead	4.40	ug/L	
		Copper	288	ug/L	
	Laboratory Tap	Lead	5.20	ug/L	
		Copper	222	ug/L	
	Garage Fountain	Lead	0.97	ug/L	
		Copper	10.2	ug/L	
	3rd Floor Service Sink	Lead	2.86	ug/L	
		Copper	84.6	ug/L	

2017 QUABBIN LABORATORY RECORDS
OTHER SAMPLING RESULTS

DRINKING WATER WELL SAMPLES - NOT FOR PWS COMPLIANCE

DATE	LOCATION	ANALYTICAL PARAMETER	RESULT	UNITS	REMARKS
June, 2017	Stockroom	Multiple	-	-	See memo dated July 31, 2017 in Appendix C.
June, 2017	Ware River Field Office	Multiple	-	-	See memo dated July 31, 2017 in Appendix C.

OTHER DRINKING WATER WELL SAMPLES - LEAD AND COPPER TESTING (NOT FOR PWS COMPLIANCE)

DATE	LOCATION	Sample Type	LEAD (ug/L)	COPPER (ug/L)	REMARKS
12/20/17	New Salem, Bathroom Sink	First Draw	2.20	516	Samples analyzed at MWRA Deer Island Laboratory.
		2-minute Flush	0.565	79.8	
	Oakham, Kitchen Sink	First Draw	16.8	11.7	
		RO Tap	1.82	6.51	
	Residence #1 (Forestry Office), Kitchen Sink	First Draw	9.68	610	
		2-minute Flush	3.21	83.0	
	Residence #2 (Conference Center), Kitchen Sink	First Draw	2.89	156	
		2-minute Flush	0.506	60.6	
	Residence #3 (Ranger Station), Kitchen Sink	First Draw	12.2	2230	
		2-minute Flush	2.87	1240	
		POU Filter	<0.05	<3.0	

DATE	LOCATION	Sample Type	SODIUM (ug/L)	REMARKS
12/20/17	New Salem, Bathroom Sink	First Draw	28,600	Samples analyzed at MWRA Deer Island Laboratory.
		2-minute Flush	28,300	
	Residence #1 (Forestry Office), Kitchen Sink	First Draw	207,000	
		2-minute Flush	212,000	
	Residence #2 (Conference Center), Kitchen Sink	First Draw	5,360	
		2-minute Flush	5,300	
	Residence #3 (Ranger Station), Kitchen Sink	First Draw	187,000	
		2-minute Flush	183,000	
		POU Filter	199,000	

2017 QUABBIN LABORATORY RECORDS
ADMINISTRATION BUILDING BACTERIOLOGICAL ANALYSIS RESULTS

DATE	***E. coli* RESULT**	**TOTAL COLIFORM RESULT**
	Visitor Center Fountain	Visitor Center Fountain
1/9/2017	A	A
2/13/2017	A	A
3/6/2017	A	A
4/3/2017	A	A
5/1/2017	A	A
6/5/2017	A	A
7/10/2017	A	A
8/11/2017	A	A
9/11/2017	A	A
10/16/2017	A	A
11/13/2017	A	A
12/4/2017	A	A

NOTE: A = ABSENT
P = PRESENT

2017 QUABBIN LABORATORY RECORDS
(202) WINSOR DAM --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
4/27	0.5	7.1	7.72	13.21	112.4	6.87	48.1	202S	0.481	5.29	3.64	*0*	*0*	*0*									522.17
4/27	1		7.75	13.01	110.8	7.20	48.0																
4/27	2		7.58	13.23	112.2	6.99	48.2																
4/27	3		7.42	13.27	112.1	6.92	48.2																
4/27	4		7.36	13.30	112.2	6.90	48.2																
4/27	5		7.34	13.32	112.3	6.83	48.3																
4/27	6		7.33	13.33	112.3	6.71	48.2	202M				*0*	*0*	10									
4/27	7		7.31	13.33	112.3	6.69	48.2																
4/27	8		7.31	13.33	112.3	6.67	48.2																
4/27	9		7.30	13.33	112.3	6.64	48.3																
4/27	10		7.30	13.33	112.3	6.63	48.2																
4/27	11		7.29	13.33	112.3	6.63	48.2																
4/27	12		7.24	13.34	112.2	6.62	48.2																
4/27	13		7.09	13.36	112.0	6.61	48.2																
4/27	14		7.05	13.36	111.8	6.62	48.2																
4/27	15		7.02	13.36	111.8	6.63	48.1																
4/27	16		6.89	13.41	111.8	6.62	48.2																
4/27	17		6.75	13.46	111.8	6.63	48.2																
4/27	18		6.73	13.46	111.8	6.63	48.1	202D				*0*	*0*	*0*									
4/27	19		6.71	13.46	111.7	6.64	48.2	202M	0.386	5.44	3.76												
4/27	20		6.69	13.47	111.8	6.65	48.0																
4/27	21		6.66	13.47	111.7	6.66	48.2																
4/27	22		6.60	13.49	111.7	6.67	48.2																
4/27	23		6.55	13.50	111.6	6.67	48.2																
4/27	24		6.39	13.56	111.6	6.67	48.2																
4/27	25		6.30	13.56	111.4	6.69	48.2																
4/27	26		6.20	13.59	111.4	6.69	48.2																
4/27	27		6.10	13.63	111.4	6.69	48.3																
4/27	28		5.84	13.70	111.2	6.69	48.3																
4/27	29		5.54	13.75	110.8	6.70	48.3																
4/27	30		5.35	13.77	110.4	6.70	48.3																
4/27	31		5.26	13.78	110.2	6.69	48.3																
4/27	32		5.25	13.76	110.1	6.69	48.3																
4/27	33		PDA stopped communicating with probe at 32 ft																				
4/27	34																						
4/27	35																						
4/27	36																						
4/27	37							202D	0.396	5.60	3.96												
4/27	38																						

2017 QUABBIN LABORATORY RECORDS
(202) WINSOR DAM --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
5/17	0.5	8.4	11.43	12.02	113.4	5.88	48.4	202S	0.340	5.69	4.00	0	0	0		0	0	0.117	0	1640	0.018900		522.90
5/17	1		11.11	12.08	113.2	5.94	48.5																
5/17	2		10.96	12.09	112.9	5.85	48.4																
5/17	3		10.96	12.09	112.9	5.77	48.4																
5/17	4		10.95	12.11	113.1	5.80	48.2																
5/17	5		10.92	12.11	113.0	5.76	48.4																
5/17	6		10.65	12.15	112.6	5.76	48.5	202M				0	0	0									
5/17	7		10.50	12.15	112.2	5.78	48.5																
5/17	8		10.20	12.20	111.9	5.75	48.4																
5/17	9		10.18	12.17	111.6	5.73	48.4																
5/17	10		10.17	12.16	111.4	5.73	48.4																
5/17	11		10.12	12.18	111.5	5.67	48.4																
5/17	12		10.12	12.19	111.6	5.67	48.4																
5/17	13		10.06	12.20	111.5	5.67	48.4																
5/17	14		9.91	12.23	111.4	5.66	48.4																
5/17	15		9.68	12.29	111.3	5.68	48.5																
5/17	16		9.30	12.40	111.3	5.65	48.3																
5/17	17		8.92	12.53	111.4	5.65	48.3																
5/17	18		8.59	12.66	111.7	5.66	48.3	202D				0	0	10									
5/17	19		8.30	12.77	111.9	5.64	48.3																
5/17	20		8.00	12.89	112.2	5.64	48.3	202M	0.340	5.63	3.83					0	0	0.000	0	1630	0.018500	2120	
5/17	21		7.66	13.03	112.4	5.65	48.4																
5/17	22		7.40	13.13	112.6	5.67	48.4																
5/17	23		7.32	13.18	112.7	5.65	48.4																
5/17	24		7.27	13.19	112.7	5.63	48.4																
5/17	25		7.17	13.23	112.8	5.62	48.4																
5/17	26		6.89	13.32	112.7	5.62	48.5																
5/17	27		6.74	13.30	112.2	5.59	48.4																
5/17	28		6.60	13.34	112.1	5.59	48.4																
5/17	29		6.59	13.33	112.0	5.59	48.4																
5/17	30		6.48	13.37	112.0	5.58	48.4																
5/17	31		6.45	13.37	111.9	5.56	48.3																
5/17	32		6.38	13.38	111.8	5.56	48.4																
5/17	33		6.32	13.37	111.6	5.55	48.4																
5/17	34		6.29	13.36	111.4	5.56	48.3																
5/17	35		6.25	13.38	111.5	5.56	48.4																
5/17	36		6.25	13.37	111.4	5.55	48.4																
5/17	37		6.23	13.37	111.3	5.53	48.4																
5/17	38		6.22	13.36	111.2	5.52	48.4																
5/17	39		6.21	13.35	111.1	5.53	48.4	202D	0.360	5.75	3.92	0	0	10		0	0	0.175	0	1710	0.017355		
5/17	40		6.21	13.34	111.0	5.54	48.5																

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6/12	0.5	11.1	15.99	10.47	108.9	7.52	48.3	202S	0.270	5.57	3.85	0	10	31									524.13
6/12	1		15.56	10.50	108.3	7.42	48.2																
6/12	2		15.26	10.58	108.4	7.35	48.3																
6/12	3		15.16	10.62	108.6	7.23	48.2																
6/12	4		14.95	10.67	108.6	7.17	48.1																
6/12	5		14.56	10.74	108.4	7.11	48.2																
6/12	6		14.44	10.78	108.5	7.04	48.1	202M				0	0	41									
6/12	7		14.36	10.83	108.8	6.93	48.1																
6/12	8		13.92	10.92	108.7	6.83	48.3																
6/12	9		13.71	10.96	108.6	6.63	48.3																
6/12	10		13.43	11.04	108.7	6.63	48.4																
6/12	11		13.23	11.11	108.9	6.57	48.4																
6/12	12		13.07	11.16	109.0	6.53	48.3																
6/12	13		12.50	11.29	108.9	6.46	48.3																
6/12	14		11.96	11.43	108.9	6.44	48.3																
6/12	15		11.78	11.53	109.4	6.40	48.3																
6/12	16		11.43	11.75	110.6	6.35	48.2																
6/12	17		10.89	11.86	110.3	6.33	48.2																
6/12	18		10.75	11.89	110.1	6.31	48.3	202D				0	0	0									
6/12	19		10.34	11.98	109.9	6.32	48.0																
6/12	20		9.76	12.10	109.5	6.28	48.1	202M	0.420	5.46	3.75	0	0	41									
6/12	21		9.53	12.13	109.2	6.30	48.1																
6/12	22		9.40	12.14	108.9	6.30	48.1																
6/12	23		9.20	12.16	108.6	6.29	48.1																
6/12	24		9.06	12.08	107.5	6.27	48.1																
6/12	25		8.95	12.06	107.1	6.25	48.1																
6/12	26		8.84	12.03	106.5	6.24	48.1																
6/12	27		8.81	12.03	106.4	6.24	48.0																
6/12	28		8.76	12.02	106.2	6.21	48.1																
6/12	29		8.55	12.03	105.8	6.21	48.1																
6/12	30		8.01	12.00	104.1	6.20	48.3																
6/12	31		7.47	12.05	103.1	6.19	48.2																
6/12	32		7.39	11.97	102.3	6.16	48.2																
6/12	33		7.12	11.93	101.3	6.16	48.3																
6/12	34		7.03	11.89	100.7	6.12	48.3																
6/12	35		6.99	11.86	100.3	6.11	48.3																
6/12	36		6.86	11.79	99.4	6.09	48.3																
6/12	37		6.84	11.70	98.6	6.09	48.4																
6/12	38		6.83	11.66	98.3	6.06	48.3	202D	0.320	5.63	3.86												
6/12	39		6.84	11.62	97.9	6.05	48.4																

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7/19	0.5	9.6	23.05	9.00	106.6	7.16	48.9	202S	0.270	5.45	3.71	0	0	148		0	0	0	0.00663	1370	0.019260		523.96
7/19	1		23.05	9.00	106.6	7.03	48.8																
7/19	2		23.04	9.00	106.7	6.95	48.8																
7/19	3		22.98	9.01	106.6	6.90	48.8																
7/19	4		22.78	9.07	106.9	6.83	48.8																
7/19	5		22.59	9.12	107.1	6.70	48.8																
7/19	6		22.51	9.15	107.3	6.69	48.5	202M				0	0	95									
7/19	7		22.11	9.24	107.5	6.61	48.6																
7/19	8		21.22	9.52	108.9	6.60	48.6																
7/19	9		20.15	9.91	111.0	6.55	48.5																
7/19	10		17.37	10.38	109.9	6.56	47.9																
7/19	11		15.35	11.22	113.8	6.56	47.9	202M	0.360	5.63	3.72					0	0	0.112	0.00668	1270	0.021985	2000	
7/19	12		14.04	11.74	115.7	6.51	47.8																
7/19	13		13.02	11.94	115.0	6.41	47.6																
7/19	14		12.43	12.04	114.5	6.43	47.7																
7/19	15		11.70	12.10	113.1	6.33	47.5																
7/19	16		11.31	12.10	112.2	6.32	47.8																
7/19	17		11.04	12.07	111.2	6.20	47.7																
7/19	18		10.78	12.12	111.0	6.14	47.7	202D				1	0	31									
7/19	19		10.55	12.13	110.5	6.14	47.6																
7/19	20		10.37	12.06	109.4	6.08	47.6																
7/19	21		10.17	12.01	108.4	6.08	47.6																
7/19	22		9.89	11.93	107.0	6.04	47.6																
7/19	23		9.70	11.86	105.9	6.00	47.6																
7/19	24		9.55	11.83	105.2	5.99	47.6																
7/19	25		9.33	11.76	104.0	5.94	47.6																
7/19	26		9.10	11.67	102.7	5.91	47.6																
7/19	27		8.86	11.43	100.0	5.83	47.7																
7/19	28		8.66	11.46	99.8	5.76	47.7																
7/19	29		8.51	11.42	99.1	5.75	47.6																
7/19	30		8.24	11.30	97.4	5.74	47.9																
7/19	31		8.12	11.14	95.7	5.74	47.8																
7/19	32		7.93	11.03	94.4	5.70	47.8																
7/19	33		7.87	10.96	93.6	5.66	47.9																
7/19	34		7.79	10.92	93.1	5.65	47.8																
7/19	35		7.72	10.82	92.1	5.63	47.9																
7/19	36		7.62	10.81	91.8	5.59	48.0																
7/19	36		7.59	10.70	90.8	5.60	48.0																
7/19	37		7.52	10.60	89.8	5.57	48.1																
7/19	38		7.50	10.43	88.3	5.57	48.0																
7/19	39		7.50	10.13	85.8	5.57	48.1																
7/19	40		7.49	10.12	85.7	5.53	48.2	202D	0.320	5.79	4.05					0.0077	0.00852	0.108	0.00636	1820	0.017960		

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8/17	0.5	11.9	23.32	8.80	104.7	6.59	41.9	202S	0.230	5.11	3.65	*0*	*0*	323									523.10
8/17	1		23.33	8.80	104.7	6.58	41.8																
8/17	2		23.33	8.80	104.6	6.52	41.9																
8/17	3		23.33	8.80	104.6	6.50	41.8																
8/17	4		23.32	8.80	104.6	6.41	41.9																
8/17	5		23.32	8.81	104.7	6.44	41.9																
8/17	6		23.32	8.81	104.8	6.43	41.9	202M				*0*	*0*	414									
8/17	7		23.32	8.81	104.8	6.45	41.8																
8/17	8		23.32	8.80	104.6	6.42	41.8																
8/17	9		23.32	8.80	104.7	6.45	41.9																
8/17	10		22.23	8.95	104.2	6.42	41.8																
8/17	11		18.18	10.35	111.2	6.47	41.4	202M	0.240	5.20	3.60												
8/17	12		15.22	11.38	114.9	6.51	41.2																
8/17	13		14.33	11.73	116.2	6.52	40.9																
8/17	14		13.33	11.89	115.2	6.49	41.0																
8/17	15		12.43	11.91	113.1	6.43	40.6																
8/17	16		11.78	11.91	111.5	6.36	40.7																
8/17	17		11.38	11.86	110.0	6.34	40.6																
8/17	18		10.97	11.73	107.7	6.30	40.6	202D				*0*	*0*	24200									
8/17	19		10.74	11.58	105.8	6.24	40.7																
8/17	20		10.59	11.45	104.2	6.17	40.7																
8/17	21		10.44	11.37	103.1	6.12	40.6																
8/17	22		10.21	11.28	101.8	6.08	40.6																
8/17	23		10.11	11.17	100.6	6.03	40.6																
8/17	24		9.84	11.02	98.6	5.98	40.6																
8/17	25		9.63	11.00	97.9	5.91	40.7																
8/17	26		9.25	10.89	96.1	5.89	40.8																
8/17	27		9.01	10.73	94.1	5.86	40.8																
8/17	28		8.88	10.55	92.2	5.83	40.9																
8/17	29		8.64	10.39	90.3	5.79	40.7																
8/17	30		8.39	10.32	89.1	5.76	40.8																
8/17	31		8.31	10.21	88.0	5.73	40.9																
8/17	32		8.14	10.01	85.9	5.71	40.9																
8/17	33		7.90	9.75	83.2	5.65	41.1																
8/17	34		7.79	9.49	80.8	5.61	41.1																
8/17	35		7.75	9.21	78.3	5.58	41.2																
8/17	36		7.72	9.10	77.4	5.57	41.0																
8/17	37		7.70	9.09	77.2	5.54	41.1																
8/17	38		7.65	9.09	77.2	5.53	41.2	202D	0.240	5.25	3.65												
8/17	39		7.60	9.05	76.7	5.52	41.3																

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9/25	0.5	10.3	21.52	8.73	100.7	7.14	50.1	202S	0.310	5.70	3.96	1	*0*	41									521.80
9/25	1		21.51	8.73	100.7	7.08	50.3																
9/25	2		21.50	8.73	100.7	6.85	50.2																
9/25	3		21.41	8.76	100.8	6.80	50.2																
9/25	4		21.28	8.77	100.7	6.74	50.2																
9/25	5		21.08	8.79	100.5	6.65	50.2																
9/25	6		21.03	8.79	100.4	6.68	50.2	202M				*0*	*0*	41									
9/25	7		20.91	8.78	100.1	6.64	50.1																
9/25	8		20.88	8.79	100.2	6.56	50.2																
9/25	9		20.81	8.80	100.1	6.43	50.1																
9/25	10		20.76	8.80	100.0	6.47	50.1																
9/25	11		20.74	8.79	99.9	6.45	50.1																
9/25	12		20.71	8.77	99.6	6.38	50.1																
9/25	13		20.25	8.82	99.3	6.41	50.1																
9/25	14		18.45	9.13	99.1	6.33	49.6																
9/25	15		16.01	9.70	100.0	6.20	49.2	202M	0.340	5.71	3.98												
9/25	16		14.08	10.40	102.9	6.16	48.9																
9/25	17		13.04	10.50	101.5	6.06	48.8																
9/25	18		12.70	10.40	99.8	6.01	48.6	202D				*0*	*0*	52									
9/25	19		12.14	10.46	99.1	5.84	48.4																
9/25	20		11.79	10.26	96.5	5.84	48.4																
9/25	21		11.63	10.24	95.9	5.78	48.4																
9/25	22		11.19	10.14	94.0	5.79	48.2																
9/25	23		11.01	10.02	92.5	5.73	48.4																
9/25	24		10.79	9.95	91.4	5.74	48.4																
9/25	25		10.55	9.86	90.1	5.69	48.4																
9/25	26		10.29	9.71	88.2	5.63	48.5																
9/25	27		9.80	9.53	85.5	5.59	48.5																
9/25	28		9.52	9.27	82.7	5.58	48.5																
9/25	29		9.15	9.08	80.2	5.51	48.7																
9/25	30		8.98	8.92	78.5	5.51	48.6																
9/25	31		8.74	8.64	75.6	5.46	48.8																
9/25	32		8.54	8.40	73.1	5.44	48.8																
9/25	33		8.38	8.30	72.0	5.41	48.8																
9/25	34		8.27	8.24	71.2	5.39	48.8																
9/25	35		8.11	8.06	69.4	5.37	48.9																
9/25	36		8.06	7.86	67.7	5.35	48.9																
9/25	37		7.98	7.72	66.3	5.30	49.2	202D	0.270	6.04	4.23												
9/25	38		7.92	7.45	63.9	5.26	49.5																

2017 QUABBIN LABORATORY RECORDS
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DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
10/11	0.5	9.9	19.42	9.30	101.7	7.02	50.1	202S	0.320	5.90	4.13	2	0	30		0	0	0	0	1320	0.018135		521.26
10/11	1		19.42	9.28	101.5	6.95	50.1																
10/11	2		19.42	9.28	101.5	6.79	50.1																
10/11	3		19.42	9.28	101.5	6.80	50.0																
10/11	4		19.42	9.28	101.5	6.73	49.9																
10/11	5		19.42	9.28	101.4	6.60	50.1																
10/11	6		19.42	9.28	101.5	6.64	50.1	202M				2	10	63									
10/11	7		19.42	9.28	101.5	6.57	50.0																
10/11	8		19.42	9.29	101.5	6.49	50.0																
10/11	9		19.42	9.27	101.4	6.49	50.1																
10/11	10		19.42	9.27	101.4	6.45	50.1																
10/11	11		19.42	9.27	101.4	6.39	50.1																
10/11	12		19.41	9.27	101.3	6.34	50.0																
10/11	13		19.14	9.20	100.0	6.27	50.0																
10/11	14		19.00	9.18	99.5	6.22	50.1																
10/11	15		18.41	9.12	97.7	6.11	50.0																
10/11	16		16.51	9.10	93.7	5.99	49.4	202M	0.300	5.91	4.10					0	0	0.101	0	1350	0.018245	2190	
10/11	17		15.68	9.08	91.9	5.79	49.4																
10/11	18		13.28	9.46	90.8	5.70	48.9	202D				0	0	52									
10/11	19		12.28	9.86	92.6	5.64	48.5																
10/11	20		12.15	9.78	91.6	5.67	48.5																
10/11	21		11.78	9.48	88.0	5.58	48.5																
10/11	22		11.63	9.38	86.8	5.54	48.5																
10/11	23		11.37	9.41	86.5	5.54	48.4																
10/11	24		11.15	9.48	86.7	5.48	48.4																
10/11	25		11.05	9.49	86.6	5.50	48.3																
10/11	26		10.85	9.50	86.3	5.48	48.4																
10/11	27		10.63	9.55	86.4	5.48	48.3																
10/11	28		10.33	9.63	86.4	5.48	48.3																
10/11	29		10.09	9.60	85.7	5.48	48.4																
10/11	30		9.70	9.30	82.2	5.46	48.4																
10/11	31		9.42	9.02	79.2	5.42	48.5																
10/11	32		8.94	8.78	76.3	5.39	48.6																
10/11	33		8.70	8.61	74.3	5.37	48.6																
10/11	34		8.43	7.97	68.4	5.33	48.8																
10/11	35		8.28	7.80	66.7	5.27	49.0																
10/11	36		8.12	7.66	65.3	5.26	49.1																
10/11	37		8.11	7.42	63.2	5.26	49.3	202D	0.380	5.82	3.98					0.00664	0.00935	0	0	1740	0.01797		
10/11	38		8.03	7.10	60.3	5.25	49.4																

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DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
11/1	0.5	10.0	15.63	9.53	100.3	5.96	49.5	202S	0.330	5.77	4.08	2	0	20									521.92
11/1	1		15.69	9.53	100.4	5.90	49.6																
11/1	2		15.69	9.52	100.3	5.84	49.5																
11/1	3		15.69	9.53	100.4	5.89	49.6																
11/1	4		15.69	9.53	100.3	5.81	49.5																
11/1	5		15.69	9.53	100.3	5.72	49.6																
11/1	6		15.69	9.52	100.3	5.75	49.6	202M				2	0	20									
11/1	7		15.69	9.52	100.2	5.75	49.5																
11/1	8		15.69	9.52	100.3	5.72	49.6																
11/1	9		15.69	9.53	100.3	5.72	49.6																
11/1	10		15.69	9.52	100.2	5.70	49.6																
11/1	11		15.68	9.53	100.3	5.68	49.6																
11/1	12		15.68	9.53	100.3	5.70	49.6																
11/1	13		15.68	9.51	100.2	5.67	49.7																
11/1	14		15.68	9.51	100.2	5.63	49.6																
11/1	15		15.68	9.52	100.2	5.65	49.5																
11/1	16		15.68	9.52	100.3	5.63	49.6																
11/1	17		15.68	9.52	100.3	5.58	49.6																
11/1	18		15.46	9.54	100.0	5.61	49.8	202D				1	0	41									
11/1	19		14.62	9.46	97.3	5.53	49.6																
11/1	20		13.67	8.57	86.3	5.33	49.5	202M	0.350	6.21	4.50												
11/1	21		13.17	8.23	82.0	5.28	49.4																
11/1	22		12.79	8.11	80.2	5.24	49.4																
11/1	23		12.54	8.09	79.5	5.19	49.3																
11/1	24		12.15	8.09	78.8	5.11	49.2																
11/1	25		11.89	8.14	78.8	5.04	49.1																
11/1	26		11.59	8.21	78.9	5.09	49.0																
11/1	27		11.35	8.28	79.2	5.02	49.0																
11/1	28		11.12	8.32	79.2	5.05	49.0																
11/1	29		10.69	8.41	79.2	5.02	48.9																
11/1	30		10.45	8.46	79.2	5.01	48.9																
11/1	31		10.18	8.47	78.8	5.06	48.9																
11/1	32		9.77	8.33	76.7	5.01	49.0																
11/1	33		9.33	8.01	73.0	4.98	49.1																
11/1	34		9.07	7.85	71.1	4.97	49.2																
11/1	35		8.78	7.55	67.9	4.93	49.3																
11/1	36		8.67	7.35	66.0	4.89	49.3																
11/1	37		8.59	7.04	63.0	4.84	49.4																
11/1	38		8.56	6.93	62.0	4.87	49.3																
11/1	39		8.45	6.79	60.6	4.88	49.3	202D	0.260	5.74	4.03												
11/1	40		8.41	6.70	59.8	4.85	49.5																

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DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
12/7	0.5	11.1	9.25	10.71	93.3	7.15	49.2	202S	0.320	5.92	4.21	*0*	*0*	10		0.00554	0.00748	*0*	*0*	1470	0.019635		521.96
12/7	1		9.25	10.71	93.3	7.04	49.2																
12/7	2		9.25	10.72	93.4	6.96	49.2																
12/7	3		9.25	10.73	93.5	6.90	49.3																
12/7	4		9.25	10.73	93.5	6.88	49.3																
12/7	5		9.24	10.74	93.6	6.84	49.3																
12/7	6		9.25	10.75	93.7	6.79	49.3	202M				*0*	*0*	10									
12/7	7		9.25	10.75	93.7	6.75	49.3																
12/7	8		9.24	10.75	93.7	6.66	49.3																
12/7	9		9.24	10.70	93.2	6.57	49.3																
12/7	10		9.24	10.69	93.2	6.59	49.3																
12/7	11		9.24	10.69	93.1	6.58	49.2																
12/7	12		9.24	10.68	93.1	6.49	49.2																
12/7	13		9.24	10.68	93.1	6.51	49.3																
12/7	14		9.24	10.68	93.0	6.49	49.3																
12/7	15		9.24	10.67	93.0	6.45	49.3																
12/7	16		9.23	10.67	92.9	6.44	49.3																
12/7	17		9.24	10.65	92.8	6.39	49.3																
12/7	18		9.24	10.65	92.8	6.33	49.3	202D				*0*	*0*	*0*									
12/7	19		9.23	10.66	92.8	6.35	49.3																
12/7	20		9.23	10.66	92.8	6.33	49.3	202M	0.290	6.10	4.38					*0*	0.00652	*0*	*0*	1450	0.01956	2180	
12/7	21		9.23	10.66	92.9	6.30	49.3																
12/7	22		9.22	10.66	92.9	6.28	49.3																
12/7	23		9.21	10.67	92.9	6.25	49.3																
12/7	24		9.19	10.66	92.8	6.27	49.3																
12/7	25		9.18	10.67	92.8	6.26	49.4																
12/7	26		9.17	10.67	92.8	6.23	49.4																
12/7	27		9.17	10.66	92.7	6.23	49.4																
12/7	28		9.16	10.66	92.7	6.20	49.5																
12/7	29		9.15	10.66	92.7	6.24	49.4																
12/7	30		9.14	10.66	92.7	6.25	49.5																
12/7	31		9.14	10.66	92.7	6.19	49.4																
12/7	32		9.13	10.66	92.7	6.17	49.5																
12/7	33		9.13	10.66	92.7	6.17	49.4																
12/7	34		9.13	10.66	92.6	6.17	49.4																
12/7	35		9.12	10.66	92.6	6.13	49.4																
12/7	36		9.12	10.66	92.6	6.11	49.5																
12/7	37		9.11	10.66	92.6	6.15	49.4																
12/7	38		9.10	10.66	92.6	6.13	49.4																
12/7	39		9.08	10.66	92.5	6.12	49.4	202D	0.340	6.26	4.51					*0*	0.00653	*0*	*0*	1570	0.019745		
12/7	40		9.08	10.62	92.2	6.08	49.4																
	AVG.	9.9	11.55	10.66	99.0	6.08	47.9		0.325	5.69	3.96	0	1	887	N/A	<0.005	0.00320	0.051	<0.005	1530	0.018938	2120	
	MAX.	11.9	23.33	13.78	116.2	7.52	50.3		0.481	6.26	4.51	2	10	24200	N/A	0.0077	0.00935	0.175	0.00668	1820	0.021985	2190	
	MIN.	7.1	5.25	6.70	59.8	4.84	40.6		0.230	5.11	3.60	<1	<10	<10	N/A	<0.005	<0.005	<0.100	<0.005	1270	0.017355	2000	
	MEDIAN	10.0	9.66	10.66	100.7	6.13	48.4		0.320	5.70	3.96	<1	<10	31	N/A	<0.005	0.00000	0.000	<0.005	1520	0.018700	2150	

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").

Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = 1 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

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DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
4/27	0.5	6.3	7.98	12.66	107.3	7.77	47.1	206S	0.366	5.55	3.9	*0*	*0*	10									522.17
4/27	1		6.59	13.73	112.4	7.22	47.7																
4/27	2		6.27	13.9	112.9	7.09	47.6																
4/27	3		6.19	13.93	112.9	6.97	47.5																
4/27	4		6.15	13.96	113	6.87	47.5																
4/27	5		6.05	14.03	113.3	6.64	47.4																
4/27	6		5.99	14.05	113.3	6.62	47.7	206M				*0*	*0*	20									
4/27	7		5.94	14.06	113.3	6.57	47.3																
4/27	8		5.93	14.07	113.2	6.52	47.5																
4/27	9		5.92	14.06	113.2	6.47	47.5																
4/27	10		5.9	14.06	113.2	6.43	47.5																
4/27	11		5.89	14.07	113.2	6.40	47.4																
4/27	12		5.87	14.07	113.1	6.36	47.5																
4/27	13		5.85	14.08	113.2	6.31	47.5	206M	0.529	5.79	4												
4/27	14		5.86	14.07	113.1	6.30	47.4																
4/27	15		5.82	14.07	112.9	6.30	47.4																
4/27	16		5.79	14.07	112.9	6.21	47.4																
4/27	18		5.75	14.07	112.8	6.13	47.4																
4/27	19		5.76	14.05	112.7	6.09	47.5																
4/27	20		5.76	14.05	112.6	6.09	47.4																
4/27	21		5.76	14.05	112.7	6.06	47.5																
4/27	22		5.75	14.05	112.6	6.03	47.5																
4/27	23		5.74	14.03	112.4	6.07	47.5																
4/27	24		5.69	14.03	112.3	5.99	47.3	206D	0.434	5.71	3.98	*0*	*0*	20									
4/27	25		5.34	13.12	104.5	6.62	47.5																
5/17	0.5	7.5	11.30	12.02	113.1	5.64	49.8	206S	0.330	5.55	3.79	*0*	*0*	*0*		*0*	*0*	0.164	*0*	1460	0.021435		522.90
5/17	1		11.25	12.03	113.0	5.62	49.8																
5/17	2		11.10	12.05	112.8	5.67	49.8																
5/17	3		10.08	12.16	111.2	5.74	49.4																
5/17	4		9.61	12.29	111.1	5.70	49.2																
5/17	5		9.54	12.36	111.6	5.65	49.1																
5/17	6		9.52	12.41	112.0	5.61	49.4	206M				*0*	*0*	10									
5/17	7		9.49	12.44	112.1	5.59	49.1																
5/17	8		9.36	12.48	112.2	5.58	49.0																
5/17	9		9.27	12.51	112.2	5.60	48.9																
5/17	10		9.24	12.54	112.4	5.65	48.9																
5/17	11		9.20	12.54	112.3	5.61	48.9																
5/17	12		9.17	12.54	112.3	5.61	48.7																
5/17	13		9.10	12.56	112.2	5.60	48.8	206M	0.430	5.46	3.81					*0*	*0*	0.14	*0*	1480	0.019500	2150	
5/17	14		9.08	12.56	112.2	5.60	48.7																
5/17	15		9.07	12.57	112.2	5.62	48.8																
5/17	16		9.02	12.59	112.3	5.62	48.8																
5/17	17		9.01	12.59	112.3	5.62	48.7																
5/17	18		8.90	12.62	112.2	5.60	48.7																
5/17	19		8.47	12.68	111.5	5.61	48.8																
5/17	20		7.68	12.88	111.2	5.62	48.9																
5/17	21		7.68	12.92	111.5	5.62	48.8																
5/17	22		7.42	12.97	111.3	5.59	48.9																
5/17	23		7.40	12.96	111.1	5.61	48.9																
5/17	24		7.39	12.95	110.9	5.60	48.8	206D				*0*	*0*	98									
5/17	25		7.23	12.98	110.8	5.59	48.8	206D	0.37	6.14	4.08					*0*	*0*	0.158	*0*	1450	0.01856		
5/17	26		7.06	13.02	110.7	5.55	48.7																

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DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
6/12	0.5	11.0	18.01	10.08	109.5	6.76	48.7	206S	0.260	5.58	3.85	*0*	*0*	20									524.13
6/12	1		17.86	10.09	109.3	6.79	48.7																
6/12	2		17.53	10.15	109.1	6.71	48.6																
6/12	3		17.36	10.16	108.9	6.67	48.7																
6/12	4		17.23	10.18	108.7	6.57	48.7																
6/12	5		17.07	10.21	108.7	6.52	48.7																
6/12	6		16.39	10.32	108.3	6.52	48.7	206M				*0*	*0*	*0*									
6/12	7		15.81	10.39	107.8	6.44	48.7																
6/12	8		14.39	10.61	106.7	6.34	49.0																
6/12	9		13.09	10.82	105.8	6.30	48.4																
6/12	10		12.43	11.08	106.7	6.28	48.7																
6/12	11		11.83	11.26	106.9	6.30	48.5																
6/12	12		11.52	11.38	107.3	6.22	48.5																
6/12	13		10.97	11.48	106.9	6.13	48.5	206M	0.34	5.48	3.8												
6/12	14		10.46	11.53	106.1	6.10	48.5																
6/12	15		10.37	11.54	105.9	6.09	48.5																
6/12	16		10.16	11.52	105.2	6.08	48.8																
6/12	17		9.99	11.48	104.4	6.02	49.2																
6/12	18		9.77	11.49	104.0	5.99	49.1																
6/12	19		9.65	11.50	103.8	5.95	49.4																
6/12	20		9.49	11.45	102.9	5.96	49.4																
6/12	21		9.37	11.42	102.4	5.91	50.1																
6/12	22		9.25	11.30	101.0	5.90	49.9																
6/12	23		9.18	11.26	100.6	5.89	49.2																
6/12	24		9.12	11.25	100.3	5.88	49.6	206D				*0*	*0*	10									
6/12	25		8.83	11.04	97.7	5.86	49.5	206D	0.360	5.7	4.01												
6/12	26		8.69	10.94	96.5	5.83	49.5																
7/19	0.5	9.9	24.22	8.79	106.5	6.78	49.4	206S	0.260	5.68	3.85	*0*	*0*	41		*0*	*0*	0.127	0.00521	1330	0.019140		
7/19	1		24.19	8.80	106.5	6.75	49.2																
7/19	2		24.18	8.81	106.6	6.66	49.3																
7/19	3		24.15	8.82	106.6	6.69	49.3																
7/19	4		24.01	8.83	106.5	6.64	49.2																
7/19	5		23.86	8.85	106.4	6.63	49.4																
7/19	6		23.75	8.85	106.2	6.58	49.3	206M				*0*	*0*	183									
7/19	7		23.65	8.86	106.1	6.54	49.4																
7/19	8		22.40	9.19	107.6	6.50	49.9																
7/19	9		19.06	10.24	112.2	6.49	48.8																
7/19	10		16.90	10.72	112.4	6.45	49.3																
7/19	11		15.44	11.20	113.8	6.37	49.0	206M	0.380	5.63	3.96					*0*	*0*	0.12	0.00528	1190	0.022535	1960	
7/19	12		14.20	11.37	112.5	6.35	49.0																
7/19	13		13.44	11.43	111.2	6.28	48.6																
7/19	14		12.59	11.44	109.2	6.17	48.7																
7/19	15		12.24	11.42	108.1	6.11	48.6																
7/19	16		11.75	11.38	106.6	6.07	48.4																
7/19	17		11.45	11.36	105.6	6.04	48.4																
7/19	18		11.03	11.30	104.1	5.98	48.3																
7/19	19		10.90	11.19	102.8	5.94	48.3																
7/19	20		10.72	11.11	101.6	5.79	48.2																
7/19	21		10.56	11.10	101.1	5.77	48.3																
7/19	22		10.29	10.94	99.1	5.76	48.3																
7/19	23		10.03	10.80	97.2	5.72	48.3																
7/19	24		9.80	10.43	93.4	5.70	48.9	206D				*0*	*0*	20									
7/19	25		9.69	9.94	88.7	5.62	49.3	206D	0.370	5.71	3.94					0.00737	0.00604	0.147	0.00709	1390	0.020365		
7/19	26		9.48	9.67	85.9	5.54	50.0																

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DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
8/17	0.5	10.3	23.43	8.79	104.8	6.18	42.5	206S	0.230	5.47	3.85	*0*	*0*	717									523.10
8/17	1		23.36	8.80	104.8	6.19	42.4																
8/17	2		23.30	8.81	104.7	6.17	42.5																
8/17	3		23.28	8.81	104.7	6.14	42.5																
8/17	4		23.26	8.81	104.7	6.20	42.5																
8/17	5		23.26	8.81	104.7	6.21	42.5																
8/17	6		23.24	8.81	104.6	6.22	42.5	206M				*0*	*0*	663									
8/17	7		23.25	8.81	104.6	6.25	42.5																
8/17	8		23.21	8.81	104.5	6.26	42.5																
8/17	9		22.66	8.88	104.3	6.21	42.4																
8/17	10		21.28	9.16	104.8	6.20	42.3																
8/17	11		19.44	9.84	108.5	6.23	42.2																
8/17	12		17.43	10.39	110.0	6.22	42.1	206M	0.260	5.39	3.80												
8/17	13		15.54	10.90	110.9	6.22	41.9																
8/17	14		13.97	11.24	110.5	6.23	41.9																
8/17	15		13.14	11.19	108.0	6.28	41.7																
8/17	16		12.45	11.13	105.7	6.20	41.4																
8/17	17		11.90	11.05	103.7	6.13	41.2																
8/17	18		11.65	10.87	101.5	6.06	41.2																
8/17	19		11.29	10.67	98.7	5.93	41.2																
8/17	20		11.14	10.47	96.5	5.85	41.1																
8/17	21		10.73	10.32	94.2	5.79	41.2																
8/17	22		10.55	10.04	91.3	5.73	41.2																
8/17	23		10.15	9.88	89.1	5.67	41.3																
8/17	24		10.08	9.44	84.9	5.64	41.4	206D				*0*	*0*	19900									
8/17	25		10.00	9.12	81.9	5.61	41.4	206D	0.290	5.40	3.78												
8/17	26		9.82	9.00	80.4	5.54	42.7																
9/25	0.5	10.7	21.14	8.77	100.4	6.61	50.8	206S	0.310	5.79	4.03	*0*	*0*	31									521.80
9/25	1		21.04	8.78	100.4	6.62	50.7																
9/25	2		20.81	8.80	100.1	6.54	50.7																
9/25	3		20.73	8.81	100.1	6.45	50.8																
9/25	4		20.67	8.83	100.1	6.41	50.7																
9/25	5		20.62	8.83	100.1	6.36	50.6																
9/25	6		20.50	8.84	100.0	6.29	50.8	206M				*0*	10	52									
9/25	7		20.43	8.84	99.8	6.26	50.7																
9/25	8		20.38	8.83	99.6	6.24	50.7																
9/25	9		20.30	8.83	99.5	6.25	50.6																
9/25	10		20.25	8.83	99.3	6.18	50.6																
9/25	11		20.21	8.83	99.3	6.17	50.6																
9/25	12		20.20	8.81	99.1	6.14	50.7																
9/25	13		20.10	8.82	99.0	6.13	50.6																
9/25	14		19.26	8.87	97.8	6.10	50.3																
9/25	15		17.07	9.35	98.6	5.83	50.1																
9/25	16		14.70	9.63	96.6	5.76	49.7	206M	0.38	5.70	4.00												
9/25	17		13.22	9.71	94.2	5.66	49.5																
9/25	18		12.47	9.54	91.1	5.61	49.3																
9/25	19		11.90	9.19	86.6	5.56	49.4																
9/25	20		11.61	8.81	82.5	5.46	49.3																
9/25	21		11.37	8.43	78.5	5.43	49.3																
9/25	22		11.04	8.23	76.0	5.36	49.3																
9/25	23		10.85	7.97	73.3	5.33	49.3																
9/25	24		10.78	7.71	70.8	5.31	49.4	206D				*0*	*0*	41									
9/25	25		10.69	7.32	67.0	5.28	49.4	206D	0.360	5.95	4.09												
9/25	26		10.61	7.28	66.6	5.22	49.5																

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DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
10/11	0.5	8.3	19.42	9.23	100.9	6.61	50.5	206S	0.370	5.71	3.95	*0*	*0*	31		*0*	*0*	0.184	*0*	1380	0.018605		521.26
10/11	1		19.42	9.22	100.8	6.53	50.5																
10/11	2		19.41	9.22	100.8	6.57	50.5																
10/11	3		19.41	9.23	100.9	6.53	50.5																
10/11	4		19.40	9.23	100.8	6.49	50.5																
10/11	5		19.39	9.22	100.8	6.48	50.5																
10/11	6		19.40	9.22	100.7	6.44	50.4	206M				*0*	*0*	31									
10/11	7		19.39	9.22	100.8	6.41	50.5																
10/11	8		19.39	9.22	100.7	6.35	50.5																
10/11	9		19.38	9.22	100.7	6.39	50.4																
10/11	10		19.38	9.22	100.7	6.36	50.4																
10/11	11		19.38	9.22	100.7	6.33	50.3																
10/11	12		19.38	9.21	100.6	6.26	50.5																
10/11	13		19.34	9.14	99.8	6.22	50.5																
10/11	14		19.12	9.11	99.0	6.23	50.5																
10/11	15		16.92	8.81	91.6	6.12	50.3	206M	0.360	5.72	3.99					*0*	*0*	*0*	*0*	1400	0.019415	2220	
10/11	16		15.77	8.66	87.8	5.98	50.0																
10/11	17		14.44	8.51	83.9	5.82	49.7																
10/11	18		13.65	8.38	81.2	5.74	49.5																
10/11	19		12.89	8.28	78.8	5.65	49.5																
10/11	20		12.11	8.02	75.0	5.57	49.3																
10/11	21		12.02	7.74	72.2	5.46	49.4																
10/11	22		11.66	7.63	70.6	5.45	49.3																
10/11	23		11.55	7.40	68.3	5.39	49.3																
10/11	24		11.42	7.38	67.9	5.38	49.4	206D	0.370	5.86	4.07	*0*	*0*	20		0.00713	0.00947	0.116	*0*	1720	0.019545		
10/11	25		11.25	7.29	66.9	5.36	49.5																
11/1	0.5	10.0	15.45	9.62	100.8	5.58	49.9	206S	0.360	5.80	4.09	1	*0*	41									521.92
11/1	1		15.47	9.59	100.5	5.53	49.9																
11/1	2		15.50	9.59	100.6	5.46	49.9																
11/1	3		15.50	9.59	100.6	5.47	49.9																
11/1	4		15.51	9.57	100.4	5.44	49.9																
11/1	5		15.50	9.57	100.4	5.45	49.9																
11/1	6		15.50	9.57	100.4	5.45	49.9	206M				*0*	*0*	20									
11/1	7		15.51	9.57	100.4	5.45	49.9																
11/1	8		15.50	9.57	100.4	5.54	49.9																
11/1	9		15.50	9.56	100.3	5.46	50.0																
11/1	10		15.50	9.57	100.4	5.52	50.0																
11/1	11		15.49	9.57	100.3	5.51	49.9																
11/1	12		15.50	9.56	100.3	5.45	50.0																
11/1	13		15.49	9.56	100.2	5.49	50.0	206M	0.350	5.78	4.05												
11/1	14		15.49	9.56	100.2	5.48	49.9																
11/1	15		15.48	9.56	100.2	5.49	49.8																
11/1	16		15.46	9.55	100.1	5.50	49.9																
11/1	17		15.45	9.56	100.2	5.49	50.0																
11/1	18		15.43	9.56	100.1	5.52	49.9																
11/1	19		15.43	9.55	100.0	5.49	50.0																
11/1	20		15.39	9.54	99.8	5.51	49.9																
11/1	21		15.37	9.52	99.6	5.50	50.0																
11/1	22		15.34	9.51	99.4	5.50	50.0																
11/1	23		13.11	8.62	85.8	5.35	50.5																
11/1	24		12.23	7.64	74.5	5.17	50.3	206D				*0*	*0*	31									
11/1	25		12.08	6.92	67.3	5.12	50.2	206D	0.360	5.84	4.10												
11/1	26		11.83	6.63	64.1	5.04	50.7																

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DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
12/7	0.5	9.7	8.38	11.41	97.4	6.67	49.5	206S	0.330	5.68	3.96	*0*	*0*	10		*0*	0.00529	*0*	*0*	1500	0.020115		521.96
12/7	1		8.39	11.42	97.5	6.65	49.5																
12/7	2		8.38	11.42	97.5	6.64	49.5																
12/7	3		8.38	11.41	97.4	6.63	49.5																
12/7	4		8.38	11.40	97.3	6.57	49.5																
12/7	5		8.37	11.40	97.3	6.54	49.5																
12/7	6		8.37	11.38	97.1	6.48	49.5	206M				*0*	*0*	20									
12/7	7		8.36	11.39	97.1	6.43	49.5																
12/7	8		8.36	11.38	97.1	6.40	49.5																
12/7	9		8.36	11.38	97.1	6.39	49.4																
12/7	10		8.36	11.38	97.1	6.36	49.4																
12/7	11		8.36	11.38	97.1	6.35	49.4																
12/7	12		8.36	11.38	97.0	6.30	49.4																
12/7	13		8.36	11.37	97.0	6.35	49.4	206M	0.320	5.80	4.12					*0*	*0*	*0*	*0*	1460	0.0202	2200	
12/7	14		8.36	11.36	96.9	6.31	49.5																
12/7	15		8.35	11.37	97.0	6.29	49.4																
12/7	16		8.35	11.37	96.9	6.25	49.4																
12/7	17		8.35	11.36	96.9	6.25	49.5																
12/7	18		8.35	11.36	96.9	6.28	49.4																
12/7	19		8.35	11.35	96.8	6.23	49.5																
12/7	20		8.33	11.35	96.8	6.23	49.4																
12/7	21		8.34	11.35	96.8	6.27	49.4																
12/7	22		8.34	11.35	96.8	6.25	49.3																
12/7	23		8.34	11.35	96.7	6.21	49.5																
12/7	24		8.32	11.35	96.7	6.22	49.5	206D	0.280	5.81	4.12	*0*	*0*	10		*0*	0.0052	*0*	*0*	1510	0.020000		
12/7	25		8.31	11.35	96.7	6.20	49.4																
	AVG.	9.3	13.07	10.59	101.1	6.04	48.4		0.347	5.69	3.96	<1	0	817	N/A	<0.005	<0.005	0.096	<0.005	1440	0.019951	2130	
	MAX.	11.0	24.22	14.08	113.8	7.77	50.8		0.529	6.14	4.12	1	10	19900	N/A	0.00737	0.00947	0.184	0.00709	1720	0.022535	2220	
	MIN.	6.3	5.34	6.63	64.1	5.04	41.1		0.230	5.39	3.78	<1	<10	<10	N/A	<0.005	<0.005	<0.100	<0.005	1190	0.018560	1960	
	MEDIAN	9.9	11.55	10.43	100.8	6.13	49.3		0.360	5.71	3.98	<1	<10	20	N/A	<0.005	<0.005	0.124	<0.005	1455	0.019773	2175	

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").
Values in italics are below method detection limit (MDL).
EPAALK: Alkalinity MDL = 0.500 mg/L
Fecal coliform MDL = 1 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.
TPH: Total phosphorus MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).
NH3: Ammonia MDL = 0.005 mg/L.

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DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
4/27	0.5	3.5	12.36	11.99	112.7	6.12	70.9	DENS	0.978	5.28	3.34	0	0	20									522.17
4/27	1		11.63	12.22	112.9	6.07	70.7																
4/27	2		11.07	12.35	112.7	6.05	70																
4/27	3		10.92	12.34	112.2	6.03	69.5																
4/27	4		10.74	12.39	112.2	5.97	68.6																
4/27	5		10.44	12.43	111.7	5.93	70.5																
4/27	6		10.15	12.34	110.2	5.92	71.1	DENM				0	0	20									
4/27	7		9.52	12.33	108.4	5.89	71.2																
4/27	8		8.78	12.45	107.6	5.87	68.9	DENM	1.13	5.19	3.48												
4/27	9		7.86	12.76	107.8	5.86	68.4																
4/27	10		7.63	12.84	107.9	5.79	69.2																
4/27	11		7.58	12.82	107.6	5.77	69.2																
4/27	12		7.24	12.80	106.5	5.74	69.1																
4/27	13		6.98	12.79	105.8	5.7	68.7	DEND				0	0	31									
4/27	14		6.56	12.72	104.1	5.68	69.4	DEND	0.528	5.27	3.53												
4/27	15		6.50	12.67	103.5	5.65	69.5																
5/17	0.5	5.2	14.09	11.12	111.4	5.56	68.0	DENS	0.380	5.50	3.83	0	0	20		0	0	0.237	0.00662	2980	0.080185		522.90
5/17	1		14.08	11.13	111.5	5.57	67.9																
5/17	2		13.74	11.18	111.1	5.59	67.8																
5/17	3		12.38	11.29	108.9	5.66	67.6																
5/17	4		12.14	11.34	108.8	5.66	67.9																
5/17	5		11.96	11.30	108.0	5.63	67.5																
5/17	6		11.82	11.18	106.4	5.64	67.5	DENM				0	0	10									
5/17	7		11.66	11.17	105.9	5.61	65.9																
5/17	8		11.44	11.21	105.8	5.59	65.5	DENM	0.390	5.29	3.54					0	0	0.237	0.00717	2840	0.072625	2600	
5/17	9		11.13	11.26	105.5	5.58	63.5																
5/17	10		10.52	11.27	104.2	5.53	62.1																
5/17	11		9.95	11.34	103.4	5.51	64.7																
5/17	12		9.34	11.28	101.4	5.45	64.1																
5/17	13		8.59	11.27	99.5	5.44	66.9	DEND				0	0	0									
5/17	14		8.39	11.24	98.7	5.39	67.3	DEND	0.370	5.12	3.30					0	0.00734	0.203	0.00571	2980	0.070175		
5/17	15		8.04	11.27	98.1	5.36	67.8																
6/12	0.5	5.3	21.62	9.42	109.9	6.63	65.2	DENS	0.460	5.86	4.04	0	0	0									524.13
6/12	1		21.05	9.51	109.7	6.66	66.0																
6/12	2		19.71	9.62	108.1	6.62	63.1																
6/12	3		18.02	9.81	106.6	6.55	61.7																
6/12	4		17.15	9.97	106.3	6.54	60.3																
6/12	5		15.95	10.09	105.0	6.46	60.6																
6/12	6		15.13	10.06	102.8	6.40	58.6	DENM				0	0	0									
6/12	7		14.48	10.15	102.3	6.35	55.6																
6/12	8		13.58	10.10	99.8	6.27	58.0	DENM	0.590	5.58	3.85												
6/12	9		12.91	9.93	96.7	6.17	59.8																
6/12	10		11.56	9.79	92.4	6.01	60.8																
6/12	11		10.99	9.62	89.6	5.65	62.1																
6/12	12		10.69	9.55	88.3	5.63	61.4																
6/12	13		10.12	9.45	86.3	5.59	62.4	DEND				1	0	10									
6/12	14		9.89	9.36	84.9	5.57	63.2																
6/12	15		9.35	9.32	83.5	5.51	64.4	DEND	0.450	5.54	3.78												
6/12	16		8.95	9.06	80.5	5.49	65.1																

2017 QUABBIN LABORATORY RECORDS
DEN HILL --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
7/19	0.5	6.9	25.53	8.62	106.9	6.71	56.9	DENS	0.340	5.85	4.09	0	0	121		0	0	0.148	0.00731	1630	0.052330		523.96
7/19	1		25.14	8.65	106.6	6.66	56.6																
7/19	2		24.92	8.64	106.0	6.60	55.7																
7/19	3		24.25	8.71	105.6	6.61	55.4																
7/19	4		24.14	8.70	105.2	6.47	56.0																
7/19	5		23.41	8.70	103.8	6.47	53.6																
7/19	6		23.09	8.60	102.0	6.37	53.8	DENM				0	0	253									
7/19	7		22.80	8.51	100.3	6.34	55.6																
7/19	8		21.70	8.20	94.6	6.11	55.9																
7/19	9		20.55	8.00	90.3	5.99	56.1																
7/19	10		18.06	7.75	83.2	5.76	57.6																
7/19	11		15.25	7.38	74.7	5.69	59.5																
7/19	12		14.04	7.11	70.1	5.61	59.6	DENM	0.42	5.79	4.05					0.00878	0.00581	0.174	0.00768	2260	0.056825	2490	
7/19	13		12.15	6.97	65.9	5.55	61.5	DEND				0	0	97									
7/19	14		10.82	6.71	61.5	5.44	62.4																
7/19	15		9.88	6.74	60.5	5.42	63.3	DEND	0.400	5.60	3.76					0.0089	0.00653	0.189	0.00818	2340	0.050525		
7/19	16		9.51	6.68	59.4	5.37	63.7																
8/17	0.5	8.4	24.50	8.60	104.5	6.23	46.7	DENS	0.320	5.53	3.92	0	0	379									523.10
8/17	1		24.33	8.62	104.5	6.19	46.6																
8/17	2		24.16	8.64	104.4	6.21	46.6																
8/17	3		24.09	8.63	104.1	6.23	46.6																
8/17	4		24.05	8.62	104.0	6.30	46.5																
8/17	5		24.02	8.62	103.9	6.25	46.5																
8/17	6		24.01	8.63	103.9	6.25	46.4	DENM				0	0	388									
8/17	7		23.94	8.64	103.9	6.22	46.2																
8/17	8		23.16	8.46	100.3	6.02	46.5																
8/17	9		22.55	8.44	98.9	6.05	46.6																
8/17	10		21.32	8.24	94.3	5.96	47.0																
8/17	11		18.28	7.18	77.3	5.77	48.9	DENM	0.350	5.58	3.98												
8/17	12		14.72	6.41	64.0	5.69	50.3																
8/17	13		13.13	6.00	57.9	5.75	51.2	DEND				0	0	530									
8/17	14		11.38	5.82	53.9	5.71	52.8	DEND	0.550	5.56	3.79												
8/17	15		10.32	5.63	50.9	5.60	54.1																
9/25	0.5	8.3	22.89	8.53	101.0	6.81	55.9	DENS	0.370	6.02	4.24	32	20	97									521.80
9/25	1		22.01	8.62	100.4	6.72	55.5																
9/25	2		21.73	8.65	100.3	6.62	55.4																
9/25	3		21.52	8.70	100.4	6.56	55.3																
9/25	4		21.39	8.72	100.4	6.46	55.2																
9/25	5		21.27	8.68	99.7	6.41	54.9																
9/25	6		21.14	8.67	99.3	6.38	54.9	DENM				1	0	144									
9/25	7		20.93	8.68	99.0	6.33	54.6																
9/25	8		20.75	8.56	97.3	6.27	54.3																
9/25	9		20.66	8.51	96.6	6.21	54.2																
9/25	10		20.43	8.51	96.1	6.12	53.5																
9/25	11		19.84	8.29	92.5	6.03	53.4																
9/25	12		18.06	6.86	73.8	5.76	56.0																
9/25	13		15.73	5.71	58.6	5.56	58.6	DENM/D	0.630	6.07	4.30	0	0	109									
9/25	14		13.15	4.13	40.1	5.41	62.6	DEND	0.490	6.11	4.25												
9/25	15		11.39	3.36	31.3	5.28	63.8																

2017 QUABBIN LABORATORY RECORDS
DEN HILL --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
10/11	0.5	8.1	19.82	8.94	98.6	6.63	54.3	DENS	0.410	5.97	4.08	0	10	52		0	0	0	0.00000	1590	0.031895		521.26
10/11	1		19.80	8.95	98.6	6.59	54.2																
10/11	2		19.73	8.97	98.7	6.44	54.2																
10/11	3		19.72	8.99	98.8	6.43	54.1																
10/11	4		19.69	9.00	98.9	6.35	54.1																
10/11	5		19.67	8.99	98.8	6.37	54.1																
10/11	6		19.66	8.99	98.8	6.31	54.2	DENM				0	0	41									
10/11	7		19.65	8.95	98.3	6.23	54.2																
10/11	8		19.63	8.93	98.0	6.23	54.3	DENM	0.390	5.82	4.09					0	0	0.13	0	1610	0.030575	2310	
10/11	9		19.55	8.86	97.1	6.19	54.3																
10/11	10		19.44	8.73	95.5	6.17	54.4																
10/11	11		19.13	8.46	92.0	6.09	54.4																
10/11	12		18.80	8.11	87.5	6.00	54.6																
10/11	13		18.11	7.67	81.6	5.83	55.4	DEND				0	0	62									
10/11	14		15.11	5.76	57.6	5.62	60.1	DEND	0.490	6.14	4.31					0.00927	0.00592	0.144	0	2110	0.031005		
10/11	15		11.62	1.40	13.0	5.34	64.8																
11/1	0.5	6.1	14.75	9.14	94.3	5.59	55.9	DENS	0.720	6.30	4.52	2	0	364									521.92
11/1	1		14.77	9.14	94.3	5.52	55.9																
11/1	2		14.77	9.14	94.4	5.49	55.9																
11/1	3		14.77	9.13	94.3	5.55	55.9																
11/1	4		14.76	9.13	94.3	5.56	55.9																
11/1	5		14.76	9.13	94.2	5.50	55.8																
11/1	6		14.76	9.13	94.2	5.51	55.9	DENM				6	0	309									
11/1	7		14.76	9.13	94.2	5.56	55.9																
11/1	8		14.75	9.16	94.5	5.56	55.9	DENM	0.760	6.39	4.62												
11/1	9		14.75	9.16	94.6	5.55	55.9																
11/1	10		14.75	9.16	94.6	5.55	55.9																
11/1	11		14.75	9.16	94.6	5.53	55.9																
11/1	12		14.74	9.19	94.8	5.49	55.9																
11/1	13		14.66	9.24	95.2	5.45	56.4	DEND				1	10	292									
11/1	14		14.36	9.46	96.8	5.47	57.2	DEND	0.730	6.42	4.63												
11/1	15		14.14	9.56	97.4	5.48	58.4																

2017 QUABBIN LABORATORY RECORDS
DEN HILL --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
12/7	0.5	5.3	6.49	11.70	95.3	6.65	56.1	DENS	0.550	6.47	4.68	1	*0*	31		0.0139	0.0229	0.22	0.00855	2550	0.082065		521.96
12/7	1		6.51	11.69	95.3	6.54	56.0																
12/7	2		6.49	11.69	95.2	6.54	56.0																
12/7	3		6.47	11.69	95.2	6.51	56.1																
12/7	4		6.45	11.69	95.1	6.50	56.0																
12/7	5		6.43	11.69	95.0	6.46	56.0																
12/7	6		6.42	11.68	95.0	6.43	56.0	DENM				*0*	*0*	10									
12/7	7		6.43	11.68	95.0	6.38	56.0																
12/7	8		6.42	11.68	95.0	6.39	55.9	DENM	0.560	6.09	4.37					0.0146	0.0236	0.113	0.00894	2760	0.08363	2460	
12/7	9		6.41	11.68	94.9	6.34	56.0																
12/7	10		6.38	11.68	94.9	6.32	56.1																
12/7	11		6.37	11.69	94.9	6.31	56.1																
12/7	12		6.37	11.69	94.9	6.30	56.1																
12/7	13		6.37	11.69	94.9	6.30	56.0	DEND				*0*	*0*	20									
12/7	14		6.35	11.69	94.8	6.26	55.9	DEND	0.580	6.18	4.48					0.0206	0.02480	0.139	0.00751	2760	0.08471		
12/7	15		6.34	11.68	94.8	6.26	56.1																
	AVG.	6.3	14.86	9.53	94.8	5.99	58.6		0.531	5.80	4.03	2	1	126	N/A	0.00634	0.00808	0.161	0.00564	2370	0.060545	2470	
	MAX.	8.4	25.53	12.84	112.9	6.81	71.2		1.13	6.47	4.68	32	20	530	N/A	0.0206	0.0248	0.237	0.0089	2980	0.084710	2600	
	MIN.	3.5	6.34	1.40	13.0	5.28	46.2		0.320	5.12	3.30	<1	<10	<10	N/A	<0.005	<0.005	0.000	<0.005	1590	0.030575	2310	
	MEDIAN	6.1	14.73	9.14	98.5	6.02	56.0		0.490	5.82	4.05	<1	<10	52	N/A	0.00439	0.00587	0.161	0.00724	2445	0.0635	2475	

NOTES

STDALK is Alkalinity to pH 4.5 endpoint, and EPAALK to pH 4.2 endpoint. Alkalinity of less than 20 mg/L should be reported to pH 4.2 endpoint ("EPAALK").

Values in italics are below method detection limit (MDL).

EPAALK: Alkalinity MDL = 0.500 mg/L

Fecal coliform MDL = 1 CFU/100mL; E. coli and total coliform MDL = 10 MPN/100mL. "TNTC" indicates Too Numerous To Count.

TPH: Total phosphorus MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.

Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

NH3: Ammonia MDL = 0.005 mg/L.

APPENDIX C

Monitoring Reports, Inspection Reports, Field Reports, and Well Water Data

2017 Phytoplankton Monitoring at Quabbin Reservoir

2017 Quabbin Boat Inspection Programs

2017 Quabbin Self Certification and Boat Ramp Monitor Program

2017 Aquatic Macrophyte Assessments

Field Report for Sample Site 111, 2/21/17

Field Report for Sample Site 111, 5/23/17

Field Report Boat Cove Brook, 6/6/17

Field Report Boat Cove Brook, 7/18/17

Field Report for Sample Site 215B, 9/12/17

Memorandum; re: Boat Cove Brook, 8/11/17

Water Quality Results for Stockroom, June 2017

2017 Lead and Copper Results, Field Offices

2017 Monitoring Report for Forestry Lot 3138

2017 Monitoring Report for Forestry Lot WR17-17-03

2017 Phytoplankton Monitoring at Quabbin Reservoir

Paula Packard

February 5, 2018

Monitoring efforts focused on two locations (Table 1) with two grab samples collected at each as follows: in the epilimnion at a depth of three or four meters and near the interface between the epilimnion and metalimnion at a depth generally around eight to ten meters depending on dissolved oxygen, chlorophyll a and phycocyanin readings. Field and laboratory procedures for collecting and concentrating plankton are identical to those conducted at Wachusett Reservoir (see 2014 Wachusett annual report for details), however the method used for microscopic analysis and enumeration of phytoplankton at the Wachusett Reservoir has been changed slightly. The Quabbin Reservoir methods have remained consistent with those used in previous years.

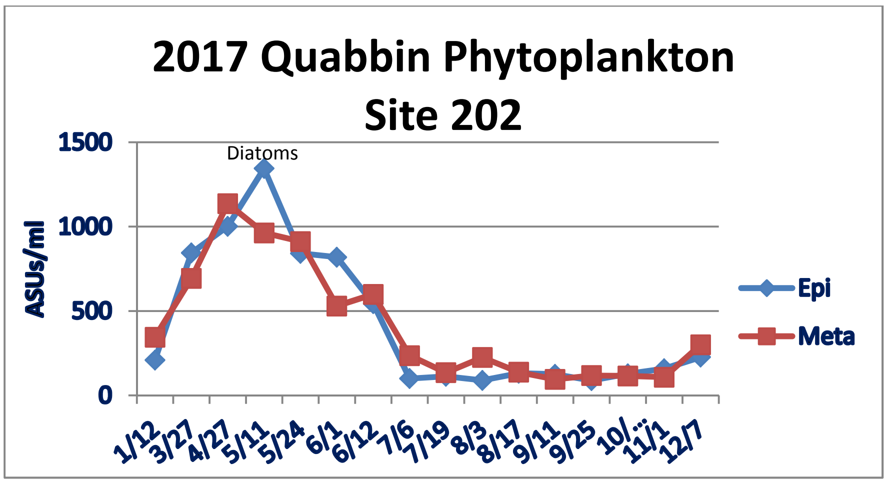
Plankton samples were collected each month excluding February due to ice cover. Similar trends in plankton numbers and species composition have been observed annually with only slight shifts in timing.

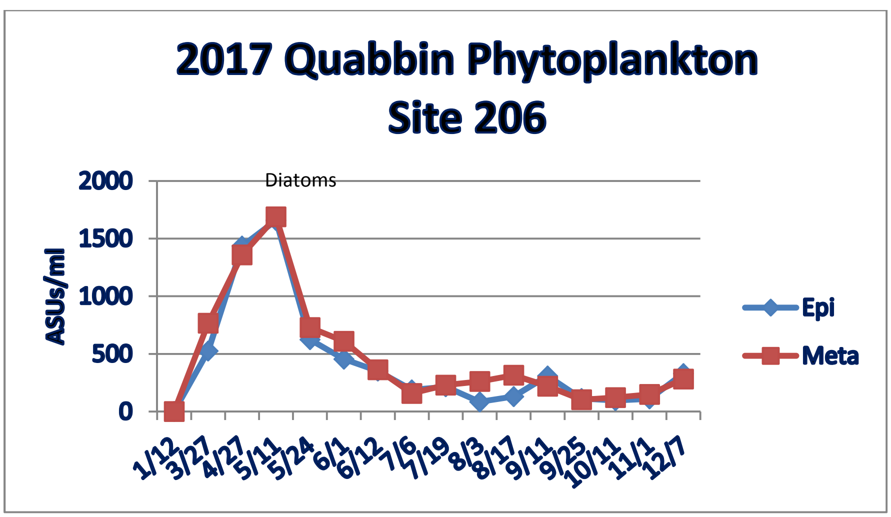
TABLE 1 - QUABBIN PLANKTON MONITORING PROGRAM		
Sampling Stations	**Sampling Frequency**	**Field Tasks**
1) CVA/#202 (Winsor Dam) 2) Shaft 12/#206 (Mt. Pomeroy)	Twice per month from May - Sept. (weather permitting); then decreasing to Once per month from Oct. – April (weather and ice conditions permitting)	1) Multiprobe profile 2) Collection of two grab samples: epilimnion and near epi-metalimnion interface 3) Secchi transparency

Results show that the Quabbin Reservoir supports a phytoplankton community typical of many oligotrophic systems located in the temperate zone. The most common organisms observed consisted of the diatoms *Asterionella*, *Cyclotella,* and *Rhizosolenia,* the chlorophytes (green alga) *Gloeocystis* and *Sphaerocystis*, and the cyanophytes (blue-green alga) *Microcystis, Rhabdoderma* and *Aphanocapsa*. Consistent with its status as an "ultra-oligotrophic" system (Wetzel, 1983), Quabbin phytoplankton densities are still considered low, with averages for 2017 being very similar at both sites. However, numbers at both locations were higher than those found during previous years of sampling. Site #202 averaged 421 ASUs/ml, up significantly from 164 ASUs/ml in 2016. Sampling site #206 averaged 466 ASUs/ml, up from 176 ASUs/ml in 2016. See graphs below.

Diatoms dominated the phytoplankton community until the end of June when their numbers began to decline and samples became more diverse. The highest diatom numbers (1683 ASUs/ml) of the year were observed in May at sampling site #206. There was close to a 3 fold increase in plankton numbers when compared to last year (592 ASUs) with the highest total phytoplankton numbers (1689 ASUs/ml) observed during this month as well, at sampling site #206. Diatom numbers declined steadily from then on, reaching their lowest point in August and remaining low throughout the remainder of the year. In August, cyanophyte densities began to increase, continuing the same trend as observed in the past, where a proliferation of *Aphanocapsa, Rhabdoderma* and *Microcystis*, occurred at approximately the same time period. In 2017, as seen in previous years, this increase in cyanophytes was very brief. Cyanophyte densities, especially *Rhabdoderma,* were observed to peak slightly earlier than in 2016, on September 11th at 236 ASU/ml in the epilimnion sample collected at sampling site #206. Subsequent sampling showed a decline of the cyanophytes and a more even representation of all taxa.

There were no taste and odor complaints during the year and unlike past years, no exceptionally low numbers of plankton were documented. Plans for plankton monitoring in 2018 call for a continuation of the program outlined above.





<u>Reference Cited</u>

Wetzel, R.G. 1983. <u>Limnology</u>, Second Edition. CBS College Publishing.

2017 Quabbin Boat Inspection Programs

January 30, 2018

Paula Packard

The Quabbin Boat Decontamination program was initiated in 2009, in response to a rise in the number of aquatic invasive species (AIS) nationwide as well as to the introduction of zebra mussels into a water body in Western Massachusetts. This program was designed to minimize the risk of transporting AIS into the reservoir while still allowing for recreational use for fishing. Many anglers prefer to use their own privately owned boats over the DCR boats for fishing at Quabbin, and while many boats are used exclusively at Quabbin, some anglers prefer to fish different water bodies as well. The Warm Weather Decontamination (WWD) program and the Cold Weather Quarantine (CWQ) processes are in place to reduce the risks associated with boats being used in multiple locations, some of which may be infested with aquatic invasive species.

In 2017, 165 boats were inspected and decontaminated through the WWD process. This is up slightly from last year. Two boats failed our inspection because of carpeted bunks. One removed the carpet and returned at a later date and passed inspection. One did not return for re-inspection. Several other boats had carpeted bunks but boaters removed the carpet while at House of Wax where the Warm Weather Decontamination is held, and then passed upon reinspection. One boat initially failed because the motor would not start. That person returned at a later date and passed the inspection.

One boat was failed because the horsepower of the motor exceeded half the horse power rating for the boat. The oversized motor was replaced with a correctly sized one and subsequently passed inspection.

One hundred and twenty six boats were inspected and sealed through the Cold Weather Quarantine Program in anticipation of the 2018 fishing season. This number is slightly higher than last year. Many fishermen who went through CWQ in 2017 have used this process each year since its inception. This has enabled them to fish at Quabbin for part of the season as well as other water bodies later on, while providing them with an easy means of getting their boats tagged at no cost.

CWQ was held on October 28th and November 9th in New Salem, and in Belchertown on November 4th, November 18th and December 14th. . Last year, 6 days of CWQ were offered. This year, there were 5 days of CWQ. Dates were moved up again in 2017 to avoid dealing with potential weather events and to appease some boaters who continue to request earlier dates. A snow date was set but not needed.

Interestingly, each year we see the return of numerous anglers who have resisted our program. Again in 2017, some of the boaters who utilized the WWD program and CWQ did so for the first time since the boat access restrictions were implemented. Approximately 70 boaters used the warm weather decontamination for the first time. Forty nine boaters, who had never participated in CWQ, took advantage of the program this year. New participation in both programs was down from 2016.

Quabbin Fishing areas had a total of 65,427 visits since the start of our boat decontamination program with 7,548 during the 2017 boating season.

In past years, few, if any, boaters had heard about spiny water flea and the risks associated with this invasive zooplankton. Presently, some boaters still believe our boat decontamination program is due mainly to the threat of zebra mussels. Beginning in 2012, we began to see an interesting change take place regarding how our program was perceived. Most boaters utilizing the decontamination program understand and support our efforts to minimize the risks associated with transport of AIS. Our programs continue to gain acceptance and have now gone from being an annoyance to something we are praised for. Other states have implemented inspection and decontamination programs and are also actively educating the public through outreach. This has indirectly aided us with our efforts to inform people about AIS and has improved public perception of our programs.

Samples of biological substances collected off of boats inspected during both the Boat Decontamination and Cold Weather Quarantine Programs were identified whenever possible. During the WWD, biologicals were found on 17 boats. Most samples were determined to be desiccated portions of aquatic or terrestrial plants.

Aquatic plants were found on 6 boats. Most plants documented during the inspection process were native species. *Eleocharis* (spike rush) was found on 4 boats, *Potamogeton* (water weed) and *Sparganium* (burr-reed) were found once each.

One AIS was documented. An otherwise clean boat, had pieces of *Cabomba* (fanwort) on the trailer. The boat owner was cautioned about spreading this aggressive AIS to other water bodies. He was also informed that we could have failed him but did not do so. Plant fragments on his trailer were small and therefore easily missed, so the opportunity to educate the boater was taken and extra care was used to decontaminate the boat and trailer.

Terrestrial plants were documented on 12 boats. Plants or portions of plants found include oak leaves, maple leaves and seeds, grass clippings, pine needles, sensitive fern, birch catkins and flowers.

Marine species or severely degraded freshwater plants pose little to no risk of being successfully introduced to Quabbin. However, seeds, microscopic organisms and small plant fragments that may go undetected continue to pose significant risks. We must continue to pay close attention to the temperature of the water used during boat washing and require sufficient water pressure to effectively wash all areas of the boat's hull, rollers, bunks and difficult-to-reach places of the trailer. Contact time of the water should also be noted and lengthened especially if the boat was recently launched at a site known to have aquatic invasive species of concern. Education, outreach and the boat decontamination/quarantine programs help to ensure that the Quabbin Reservoir remains free of new AIS infestations.

2017 Quabbin Self-Certification and Boat Ramp Monitor Program

P. Packard

January 31, 2018

In 2010, DCR implemented a successful Boat Ramp Monitor Program utilizing two full-time seasonal positions to educate boaters and to inspect watercraft at ponds with boat access. Monitors concentrated on Comet Pond in Hubbardston and Long Pond in Rutland but also spent some time at White Hall, Demond, Brigham and Moosehorn Ponds, as well as at Lake Mattawa and Queen Lake.

Beginning in 2011, DCR did not have the funding to hire full-time Boat Ramp Monitors so the process was streamlined to encourage compliance with our requests with a minimal amount of effort and staff. Every opportunity to speak directly to boaters was taken but because our presence was reduced, a self-certification program was begun. Forms were printed and distributed to boaters. They were asked to record where they launched their boat last, when, how they cleaned it and what, if any, aquatic invasive species (AIS) were in the place they last boated.

Self-certification forms continue to be prominently displayed at both Comet and Long Ponds in a box on the kiosk near each boat ramp, along with signage directing boaters to self-certify their watercraft before launching. Parking areas at both ponds were periodically checked throughout the boating season to see if each vehicle had a self-certification form on the windshield. A letter explaining our program with directions for filling out a Self-Certification Form, as well as a blank form, was placed on any vehicle that did not display a completed form.

Since actual contact time with boaters was limited to several hours per week, efforts were concentrated at Comet and Long Ponds. These two ponds are used by a large number of boaters and therefore are at risk for the introduction of aquatic invasive species.

Comet Pond in Hubbardston is pristine with no AIS to date. This AIS free status may change in the near future. A boat with numerous large, healthy fragments of *Cabomba* (fanwort) was launched during the 2017 season. A resident observed this and questioned the boater but despite her concerns, the boat was launched. This was reported to us. The boat owner was issued a warning by the DCR Rangers. Comet Pond will be closely monitored for the presence of *Cabomba* and other AIS and if observed, requests for quick action and removal of plants will be submitted however, prevention is far more effective and less costly than early intervention.

Unlike Comet Pond, where the use of large boat motors is prohibited, Long Pond is utilized by a variety of motor craft in a range of sizes from kayaks, canoes and small boats up to larger boats with powerful motors used to tow water skiers. Canoes and kayaks, although not completely risk-free, do not pose the same level of risk as motorized boats do for introducing invasive species because there are fewer places where AIS may be concealed plus they tend to dry completely between uses. Larger boats have more areas where organisms may remain undetected. They may have areas that remain wet for longer periods of time therefore the risk of introducing new invasive species to Long Pond is potentially greater. This fact was realized in 2016 with the introduction of *Utricularia inflata* (swollen bladderwort) to Long Pond. This AIS may have been introduced by water fowl but it is more likely that it was introduced as a stow away on a boat.

Some types of plants use fragmentation as a means of spreading throughout a water body. (*Myriophyllum heterophyllum*), variable leaf water milfoil, the dominant species of plant found at Long Pond, utilizes fragmentation as one means of dispersal. Toward the end of the growing season, these plants become brittle, stems fragment, float to new locations and rapidly grow roots eventually colonizing other locations. In their new location, they compete with and displace native species.

Motorized boats have the potential to effectively aid in the dispersal of plants that use this means of propagation. Boat activity at Long Pond has undoubtedly added to the number of variable water milfoil plants. At any time during the boating season, numerous milfoil fragments may be seen floating along the shore line especially near the launch areas. Repeated trips back and forth by boats towing water skiers chop up and disperse plant fragments. Areas of the littoral zone suitable for plant growth have been colonized and while there are many native species found at Long Pond, variable water milfoil is the dominant species of plant. This makes the self-certification program more difficult to administer because many of the impacts associated with AIS have already been realized. It is important that boaters not only think about the potential introduction of a new invasive species to Long Pond but also of the very real possibility of carrying fragments of milfoil from Long Pond to other water bodies.

Education continues to be the key to success for this program. By focusing on the overall program and not the specific organisms we are concerned about, boaters are beginning to think about the impacts of moving boats from one area to another, ultimate reducing the risk of introducing spiny water flea, Eurasian milfoil, hydrilla or many of the other aquatic invasive species of concern.   Overall, the self-certification program has been successful.

2017 Aquatic Macrophyte Assessments

Paula D. Packard

February 12, 2017

During the 2017 field season, a total of 24 water bodies were assessed for the presence of aquatic invasive species (AIS). Of the 24, 12 were in the Quabbin watershed and 12 were in the Ware River watershed. The West Arm of the reservoir, fishing area 2 and the Ware River above Shaft 8 were also surveyed. Assessments of the fishing areas were conducted in conjunction with ESS Consulting Group. ESS was hired by MWRA to assist DCR with early detection of AIS and have been surveying portions of the reservoir on an annual basis. Macrophyte assessments were begun on June 5th and ended on October 4th 2017. Many water bodies within the watershed are monitored yearly while others are done as a component of the current Environmental Quality Assessment. Approximately 39 miles of shoreline was assessed for the presence of AIS by visually observing the littoral zone from a kayak or small boat. This total does not include areas of the reservoir or the Ware River or shoreline walked due to inaccessibility by kayak. Three water bodies, Doubleday Pond, Camel's Hump Ponds and the Gate 36 Pond, were evaluated from the shoreline. Two were long distances from any road and impossible to access with a kayak and one was almost dry. See Table below for a complete list of water bodies assessed in 2017.

Eleven water bodies contained *Myriophyllum hetrophyllum* (variable leaf water milfoil). In these water bodies, this plant was abundant and widely distributed. It is also well established in sections of the reservoir and is an ongoing problem in the Ware River (ESS, 2016).

A drawdown of the Ware River was done over the winter of 2015/2016. Heavy precipitation and consistently high water levels hampered efforts. It seemed that the drawdown would not be effective however, when the area was assessed in July of 2016 for the presence of milfoil, plant density and distribution was reduced, indicating that the drawdown was successful. MWRA hired contractors to hand harvest milfoil not affected. Upon completion, not a single milfoil plant was observed.

A macrophyte survey was done of the same area in July of 2017. In locations where contractors harvested all or most plants in 2016, very few milfoil plants were found, however, upstream sections had dense, relatively large patches of milfoil in areas where it had not been previously observed. Plants had also become reestablished along the shoreline above the fragment barrier. Below the rail -road bridge, plants were sparse. Some previously infested areas were devoid of milfoil.

Contractors were again hired to hand harvest the milfoil. Upon completion and re-inspection, no milfoil plants were observed.

The summer of 2016 was extremely dry so no drawdown was planned for the winter of 2016/2017 because of concerns over water conservation. A drawdown was not done over the winter of 2017/2018 as well. Quabbin elevation was still below the normal operational band and MWRA was concerned about not being able to divert the Ware River within the authorized timeframe if they had done a drawdown. This may have been a missed window of opportunity due to an extended period of extreme cold in January but water conservation rose to a higher level of importance. Ideally, if conditions are suitable, a drawdown each winter may reduce the cost of labor associated with keeping milfoil numbers in check however, eradication is highly unlikely. Upriver infestations appear to be constantly providing new plant fragments. Depopulating the entire river above shaft 8 would be unpractical, daunting and extremely expensive. This is an ongoing issue with no foreseeable permanent solution.

Phragmites australis (common reed) is an invasive species which is widely distributed throughout the watershed and the reservoir. This species spreads using three different methods-seeds, stolons and rhizomes. As more plants mature to reproductive age, seed production and dispersal increases. Not only will plant numbers within a pond increase as seeds are spread but the likelihood of seeds being carried to other water bodies also increases. Stolons, runners that are on the top of the soil, and rhizomes, which grow beneath the soil surface, enable small patches to rapidly spread out, becoming larger with each successive year. A single seed that successfully germinates can form a large patch, eventually displacing native species. *Phragmites*, once established, aggressively colonizes the shoreline and is nearly impossible to eradicate using methods such as cutting below the surface of the water, hand pulling or covering with black plastic. To date, herbicide use has been the easiest and most effective means of reducing plant numbers. Some success has been documented using a combination of several different methods especially if stands are small and newly established. Ideally, small, isolated populations should be eradicated before they become firmly established. Early removal is far more effective, utilizes fewer resources and has less of an environmental impact. This is especially important in pristine water bodies such as Bassett Pond, which supports incredible biodiversity or in the reservoir before a monoculture is formed.

Four water bodies had stands of *Phragmites*. In the reservoir, it was widely distributed. In the watershed, small patches of this invasive have cropped up in locations where they had not been found previously.

In 2011, the presence of several pink water lily plants was documented along the northern shoreline of Comet Pond. USGS does not list the pink color phase of this plant in its invasive species data base, most likely because the pink color phase is thought to be a color variant of the native *Nymphaea odorata*. The density and distribution in this water body does seem to be changing slightly each year. In the past, plant numbers were increasing. In 2017, no pink lilies were observed. There are two impossible explanations- one is that residents have begun to remove plants when they see them or timing of the survey may have been during a time when there were no blossoms. The second explanation is unlikely because lilies typically bloom continuously towards the end of summer. Several pink water lily plants were also found in Lake Mattawa. Hardware stores and nurseries carry several different color phases of water lilies. These colorful pond lilies may begin to crop up in more locations because pond residents are probably unaware of the risks associated with the introduction of non native plants. Monitoring will be ongoing.

Of the water bodies assessed, Queen Lake in Phillipston was the only one water body was found to be infested with *Cabomba caroliniana* (fanwort). At Queen Lake, numerous rooted plants and fragments were found in the boat launch and beach area, along the western shoreline, and in the north eastern sections including several of the coves. Fanwort distribution and density appeared to be increasing significantly since 2016. Plants were especially abundant in the large cove on the eastern shoreline. If this trend continues unchecked, fanwort may become more problematic.

Hardwick Pond is approximately 2.5 miles from the Quabbin Reservoir and despite being off watershed, periodic monitoring for AIS is ongoing. The threat of waterfowl carrying viable fragments of fanwort to the reservoir is significant and because many birds travel between Hardwick Pond and the Quabbin Reservoir, additional measures are being taken both by landowners at the pond and by DCR. Residents at Hardwick Pond formed a non-profit pond association called the Hardwick Pond Preservation Association (HPPA) and then hired consultants to assess the AIS issues. The consultants provided quotes and made recommendations. HPPA has also been in contact with Senator Ann Gobi and her office staff and have been working closely with DCR Lakes and Ponds Program in an effort to acquire some funding to treat the pond for AIS.

To assist HPPA with their efforts, in 2016, a letter of support was written to the Hardwick Preservation Pond Association, the Hardwick Select Board and Senator Ann Gobi's office. In this letter from DCR, we stated our concerns with this AIS being in such close proximity to the reservoir and made them aware of our support of the HPPA's plans to treat for this aggressive species. While DCR Water Supply Protection was unable to provide them with monetary consideration, this letter may assist HPPA in the acquisition of funding from sources outside their group. HPPA's plans to treat for fanwort in 2017 did not come to fruition, but the group is hopeful that they will be able to carry out plans in 2018. If successful, the threat of fanwort being carried to the reservoir by waterfowl will be significantly reduced.

Smaller types of watercraft are less likely to carry AIS but are not risk free. The potential introduction of aquatic invasive species through this means was realized in 2013 with the introduction of *Potamogeton crispus* (curly pond weed), to White Hall Pond in Rutland. A small patch of this AIS was found near the access road, a sample taken and identification confirmed. Tom Flannery, from the DCR Lakes & Ponds Program, removed the plants soon after they were found. Using dive gear, he found additional infestations near the swimming area as well as a small patch on the other side of the pond. All visible plants were removed however, *P. crispus* grows predominantly early in the season, senesces during the summer months, and then towards fall, has a moderate growth spurt. As expected, additional plants were found in the spring of 2014. Staff from the Lakes and Ponds Program hand harvested observed plants. Plant numbers increased significantly in2015 and no removal efforts were made. Over the winter tentative plans were made to contract with a consulting firm to have them assess the situation, make recommendations and harvest or treat the pond. In 2016, ESS Consulting Group acquired all necessary permits and treatment was conducted in May of 2017. The treatment reduced but did not eliminate the curly pond weed. Plants numbers rebounded after treatment and were numerous along the road and dam and scattered in other areas.

An additional AIS called *Utricularia inflata* (swollen bladderwort), was documented at White Hall Pond, Long Pond and at Boat Launch Area 2 during macrophyte surveys. This plant has been on our radar but was not observed previously. Swollen bladderwort produces a large, robust floating section which has brown, hair like surface roots and swollen floatation arms. It produces a yellow flower which grows on a long stem. *Utricularia radiata* (little floating bladderwort) our native, very similar bladderwort, also has a floating section with a short stemmed yellow flower. This plant is very delicate and small in comparison.

The below water portion of swollen bladderwort is virtually indistinguishable from another native bladderwort, *Utricularia macrorhiza* (common bladderwort). This similarity will make any efforts at hand harvesting difficult at best unless the plants are in bloom and easily identifiable. The 2018 surveys will probably result in findings that this AIS is more widely distributed than previously thought.

Chinese Mystery snails were documented during macrophyte surveys for the first time at Quabbin in 2011 and are an invasive species so will be mentioned here. Numerous snails were found near the boat dock at Fishing Area 1 where snail numbers continue to be high despite predation by ducks. In 2012, snails were found near the hangar at the Quabbin Administration Building in Belchertown. Snails were also documented in Long Pond in Rutland during the 2016 survey and also at Lake Mattawa in 2017. These snails displace native species of snails and are thought to compete for resources; however, few studies have been conducted so actual impacts have not been adequately determined. Snails may serve as the intermediate host for some parasites but to date, no problems have been associated with their presence, although there is anecdotal evidence that they are an intermediate host for a fish parasite that has been recently observed.

In 2013, *Iris pseudacorus* (Yellow Flag Iris) a relatively aggressive invasive species that very closely resembles our native species of iris, Blue Flag Iris, was documented at Connor Pond in Petersham where it has colonized large stretches of the western shoreline and has become densely distributed in many small coves. This plant continues to spread at an accelerated rate. It is now found along the shores of the East Branch Swift, in Pottapaug Pond and occasionally at the boat launch at Fishing Area 3 in Hardwick. A steady supply of seed pods will continue to be produced and released from the plants established in Connor Pond. These pods have the ability to float along with water currents. The infestation continues to worsen as plant density and distribution increases. In 2018, the fragment barrier at Area 3 will be repositioned to more effectively catch floating seed pods however; this will be an ongoing problem with no readily available solution

Lithrum salicaria (Purple Loosestrife) was found at two locations this year as well as in the reservoir. This plant is somewhat difficult to notice when not in bloom so it is possible that the presence of this invasive may be more widespread than believed. Ongoing annual surveys, conducted at different times of the season, may facilitate documentation of infestations not previously observed. At the time of the survey, populations were sparse at both locations. Sparse populations of purple loosestrife are not conducive to the introduction of *Galerucella*, the predatory beetle that is widely used to control this invasive plant. Because this beetle feeds exclusively on purple loosestrife, to be an effective method of control, plant numbers must be significant enough to support a reproducing population.

Rorippa microphylla or One Row Yellowcress had been previously found at Pepper Mill Pond, the east branch of the Swift River, and in a small tributary inside gate 16. It was also documented in Demond and Harvard Ponds last year. It is widely distributed.

Interestingly and for reasons not yet fully understood, plant density does not seem to be increasing significantly in some areas where has been established and in some locations, it was not detected at all during the 2017 macrophyte survey. It is edible and may be kept in check by herbivores. In the past, this observation did not seem to be holding true for the population established in Peppers Mill Pond. In 2016, the patch there had increased in size from several plants to large patch which was approximately 50 by 10 feet in size. One possible explanation is related to the water depth where plants were growing. This plant tends to grow mostly in shallow water where herbivores can easily feed. In Peppers Mill Pond, the patch of One Row Yellowcress was in a relatively deep section of the pond where herbivory would be difficult for many animals except for beavers, muskrats or other wildlife that are excellent divers. Interestingly, not a single one Row yellowcress plant was found in Peppers Mill Pond during the 2017 survey.

To date, impacts from infestations of One Row Yellowcress seem to be minor. It is widespread throughout the Quabbin and Ware River watersheds and all of New England and has subsequently been found in the Wachusett watershed. It is most likely being transported as seeds by wildlife, water currents, and possibly with gear used by anglers.

Myosotis scorpioides (True Forget-me-not) is not truly an aquatic plant but inhabits wet, disturbed shorelines. It was first documented at Quabbin approximately 11 years ago and is found throughout New England. During the 2013 macrophyte survey conducted by ESS Group, Inc., several small patches of this plant were found along the eastern shoreline of Pottapaug Pond (ESS, 2014). These infestations, as well as several others found at a later date by DCR staff, were removed by hand pulling. Additional plants have been documented in Pottapaug Pond each year. Forget-me-nots were also found in the upper section of Long Pond, Pepper's Mill Pond, Connor Pond, Lake Mattawa, in a small pond inside Gate 20, Demond and Brigham Ponds. Populations will be monitored and if possible, removed as they are documented. However, plants multiply by seed production and spread by an extensive, shallow, underground root system. These reproductive methods make complete eradication of this invasive species difficult. Known impacts associated with this plant are minimal at this time.

Najas minor (brittle naiad) was documented by ESS Group in 2014 at O'Loughlin Pond. Plants were harvested using diver assisted suction harvesting (DASH). Brittle naiad plants closely resemble the native naiads, and the difference between the seeds of the native and invasive plants are virtually indiscernible to the birds that feed on them. Literature indicates that 25 or more species of waterfowl readily consume the seeds, which can remain viable through the gut of the bird and are therefore easily transported. This is most likely the method of introduction to O'Loughlin Pond.

The infestation was small and dealt with quickly but to be certain that no infestation remained, the fragment barrier at Boat Area 2 was checked approximately every two weeks during the 2017 field season. Complete macrophyte surveys were conducted on August 8th and September 27, 2017. No brittle naiad fragments or whole plants were found for the third year in a row.

No additional aquatic invasive species were documented in 2017. Plans to assess water bodies in the Ware River and Quabbin Reservoir watersheds are in place for the 2018 field season.

Water Body	**Location**	**Water Body**	**Location**
Bassett Pond	New Salem	Lovewell Pond	Hubbardston
Boat Area 2 shoreline	New Salem	Mattawa Lake	Orange
Brigham Pond	Hubbardston	Moosehorn Pond	Hubbardston
Camel's Hump	Petersham	Natty Pond	Hubbardston
Comet Pond	Philipston	O'Loughlin Pond	New Salem
Connor	Petersham	Pepper's Mill Pond	Ware
Demond Pond	Rutland	Pottapaug Pond (East Swift Impoundment)	Petersham & Hardwick
Doubleday Pond	Petersham	Queen Lake	Phillipston
Dugway Pond	Petersham	Stone Bridge Pond	Hubbardston
Gate 36 Pond	Petersham	Ware River-above Shaft 8	Barre
Gauco Pond	Petersham	West Arm of Reservoir	Pelham
Harvard Pond	Petersham	White Hall Pond	Rutland
Long Pond –main body	Rutland	Willaimsville Pond	Hubbardston
Long Pond-upper	Rutland		

Literature cited

ESS Group, 2014. Aquatic Macrophyte Surveys-MWRA/DCR Source and Emergency Reservoirs 2014

ESS Group, 2016. Aquatic Macrophyte Surveys-MWRA/DCR Source and Emergency Reservoirs 2016

dcr
Massachusetts

Environmental Quality Field Report
Sample site 111 – Queen Lake @ Road Culvert Below Outlet
2/23/2017
WR 2017-W-17

EQ staff conducted a field investigation in response to elevated bacteria count in surface water. Samples collected on 2/21/2017 had elevated E. Coli count of 1296 MPN/100mL.
On Thursday, 2/23/2017, EQ staff Bernadeta Susianti re-sampled and conducted field inspection of the area draining to 111.

The investigation identified the following:

1. Water level was fair
2. Snow melt has started.

Conclusion:

During the routine tributary sampling on 2/21/2017, it was noted that above freezing temperatures occurred five days prior to and/or during sampling event.
Weather.com listed the temperatures ranges from 36-55 degrees F from 02/17/2017 to 02/21/2017.

Based on the field investigation, snow melting and flushing was likely the cause for the elevated E. Coli level at site 111 on 2/21/2017. No other obvious source of pollution was observed. The re-sample result taken on 2/23/2017 showed a significant decrease of 171 MPN/100 mL.

If E. Coli count continues to be elevated in upcoming sampling events, further investigation is recommended.

***E. coli* Counts >15**

Date	Site	Location	*E. coli* Count MPN/100mL
2/21/17	111	Queen Lake @ Road Culvert below Outlet	1296
2/23/17	111	Re-sample Queen Lake @ Road Culvert below Outlet	171

Photos

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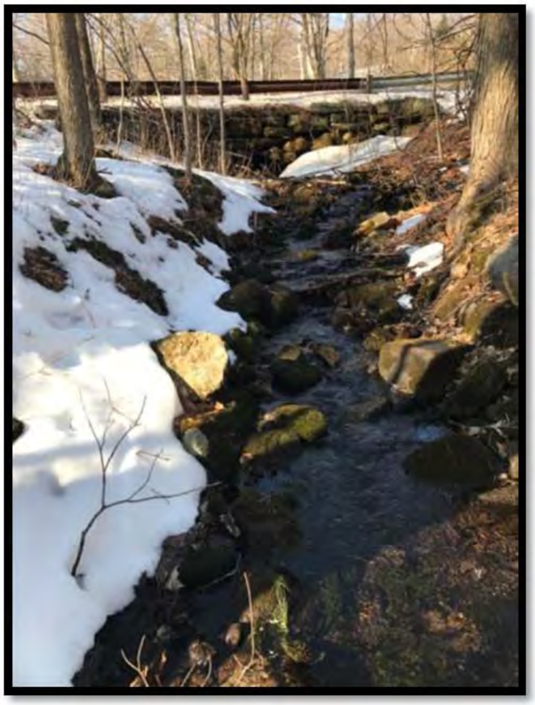


Sampling Site 111

Upstream of Sampling Site 111

dcr Massachusetts

Environmental Quality Field Report
Sample Site 101 – Ware River @ Shaft 8 Below Water Intake Works
Sample site 111 – Queen Lake @ Road Culvert Below Outlet
5/23/2017
WR 2017-W-24

EQ staff conducted a field investigation in response to elevated bacteria counts in surface water. Samples collected at sample sites 101 and 111 on 5/16/2017 had elevated E. coli counts of 228 MPN/100mL and 315 MPN/100mL.

On Friday, 5/19/2017, EQ staff Bernadeta Susianti re-sampled and conducted field inspection of the area draining to sample sites 101and 111.

Conclusion:
Barre and Templeton areas had received total precipitation of 1.83 and 1.74 inches, respectively, two days before the tributary run on 5/16/17. It was noted that high water level and flow occurred in all the sample sites due to the storm event. During the re-sampling event on 5/19/17, water level and flow had decreased. A smaller scale rain event was observed. Barre and Templeton had received totals of .28 and .35 inches of rain, respectively from 05/17/17 to 05/19/17.

Based on the field investigation, flushing from the storm was likely the cause for the elevated E. coli level at both sites. No other obvious source of pollution was observed. The re-sample results taken on 5/19/2017 showed decreased levels of bacteria.

If E. coli count continues to be elevated in upcoming sampling events, further investigation is recommended.

***E. coli* Counts >15**

Date	Site	Location	*E. coli* Count MPN/100mL
5/16/17	101	Ware River @ Shaft 8 below Water Intake Works	228
5/16/17	111	Queen Lake @ Road Culvert below Outlet	315

***E. coli* Counts >15 Re-sampling**

Date	Site	Location	*E. coli* Count MPN/100mL
5/19/17	101	Ware River @ Shaft 8 below the Intake Works	86
5/19/17	111	Queen Lake @ Road Culvert below Outlet	197

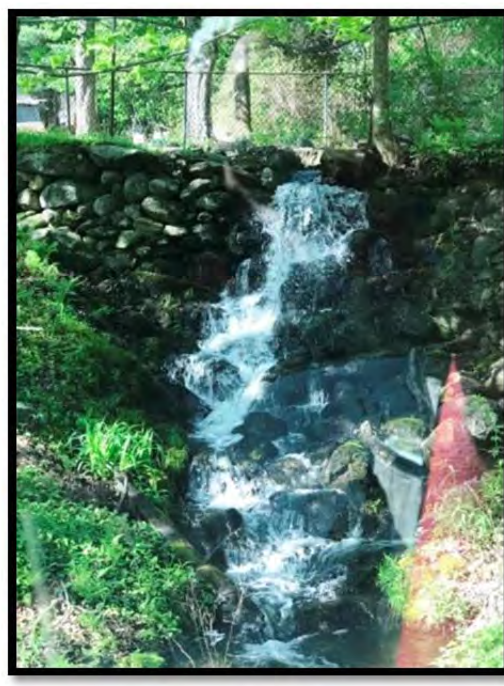
Photos

C:\Users\Bernadeta\Documents\WR CASES\2017\2017-W-24

Sample site 111.
Photo was taken during the tributary run.
(5/16/17)

Sample site 101.
High water mark shown on the gauge.
(5/19/17)

Sample site 111.
(5/19/17)



Upstream of sample site 111.
(5/19/17)

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WATERSHED SAMPLING FOLLOW-UP REPORT

To be completed when additional documentation of field conditions is warranted or requested.

Watershed:	Quabbin	**Sampling date:**	6/6/17, 6/8/17
Samplers:	EK & GM	**Report date:**	7/20/17
		Prepared by:	EK
Reason for report:	Elevated bacteria result in Boat Cove sample, especially relative to the other results		

Rainfall Data

Date	Amount	Station
6/5/17	0.23	Belchertown
6/6/17	0.42	Belchertown
6/7/17	1.08	Belchertown

Field observations at sample sites

Date	Site ID	E. Coli (MPN/100mL)	Observations
6/6/17	Boat Cove	4,884	High flow
6/8/17	Boat Cove	199	Nothing unusual observed, flow still relatively high

Other notes, comments or observations

Rainfall data are measured at 7 am each day, so amounts are from 7 am the day before through 7 am the day of measurement. (Some of the rainfall reported for 6/7 likely fell on 6/6.)

Based on the amount of rain received in the days prior to and on the day of June 6, the elevated result seems likely related to heavy precipitation. The decrease in measured E. coli in the repeat sample also supports this, and is not indicative of an ongoing bacteria source at this location.

dcr
Massachusetts

WATERSHED SAMPLING FOLLOW-UP REPORT

To be completed when additional documentation of field conditions is warranted or requested.

Watershed:	Quabbin	**Sampling date:**	7/18/17, 7/20/17
Samplers:	7/18: RF & GM 7/20: EK	**Report date:**	7/26/17
		Prepared by:	EK
Reason for report:	Elevated bacteria result in Boat Cove sample, especially relative to the other results from that day		

Rainfall Data

Date	Amount (inches)	Station
7/15/17	0.12	Belchertown
7/16/17	0	Belchertown
7/17/17	0	Belchertown
7/18/17	trace	Belchertown
7/19/17	0.05	Belchertown
7/20/17	0	Belchertown

Field observations at sample sites

Date	Site ID	E. Coli (MPN/100mL)	Observations
7/18/17	Boat Cove	717	Fair flow
7/20/17	Boat Cove	512	Nothing unusual observed, fair flow

Other notes, comments or observations

Rainfall data are measured at 7 am each day, so amounts are from 7 am the day before through 7 am the day of measurement.

Relatively little rain fell in the area during the days prior to the 7/18 sample day, so it is not clear the elevated result was related to precipitation. The *E. coli* level dropped in the 7/20 sample, but not to levels similar to those observed in other tributaries.

When the repeat sample was collected, staff assessed the area on foot and with binoculars to try to determine the cause of the elevated result. Nothing unusual was observed, but observations in this area are limited by thick brush.

From: Moulton, Gary (DCR)
Sent: Thursday, September 14, 2017 12:11 PM
To: Lee, Yuehlin (DCR); Faucher, Rebecca (DCR)
Cc: Kurth, Gabrielle (DCR); Packard, Paula (DCR)
Subject: RE: QRTRIB 9/12/17 E. coli counts >15 215B

I sampled today 9/14/17 at 9:45 am. It may end up with another high count. I decided to go up to the 10 ac dam to look for beaver sign and as I was walking down to 215B I saw 5 otter coming upstream and over the dam. I did get pictures, but they need to be blown up to see the otter and the picture quality is poor. Also there are 4 dams within less than 100 yds upstream of the sample site. The 1st small dam being 10 feet up from the sample site. Then there are 2 more small dams before you get to the 4th big dam.

From: Lee, Yuehlin (DCR)
Sent: Thursday, September 14, 2017 8:05 AM
To: Moulton, Gary (DCR); Faucher, Rebecca (DCR)
Cc: Kurth, Gabrielle (DCR)
Subject: RE: QRTRIB 9/12/17 E. coli counts >15

Thanks, Gary, and thanks for going out today to collect samples at 215B and BLA3.

From: Moulton, Gary (DCR)
Sent: Thursday, September 14, 2017 7:41 AM
To: Lee, Yuehlin (DCR); Faucher, Rebecca (DCR)
Cc: Kurth, Gabrielle (DCR)
Subject: RE: QRTRIB 9/12/17 E. coli counts >15

Sample site 215B has two beaver dams just above the sample site. The first one upstream is small and holds back very little water, and the 2nd dam upstream holds back about a ten acre pond. When Paula went down to the site before me she commented on 4 or 5 frogs there. She also noticed the turtle head plants that were matted down, possible by some animal. Could be beaver or otter, or moose deer or bear. On Aug, 29th I did see bear scat on the road where we park the truck to walk down to the site.

From: Lee, Yuehlin (DCR)
Sent: Wednesday, September 13, 2017 2:30 PM
To: Moulton, Gary (DCR); Faucher, Rebecca (DCR)
Cc: Kurth, Gabrielle (DCR)
Subject: FW: QRTRIB 9/12/17 E. coli counts >15

Good news is Boat Cove has come down a little. Bad news is Fever Brook E. coli is elevated.

Gary, any observations about Site 215B that might explain the E. coli? Seems like we did not have recent rain there.

dcr
Massachusetts

MEMORANDUM

To: Yuehlin Lee

Copy: Ellie Kurth

From: R. Faucher

Date: August 11, 2017

Subject: Boat Cove *E.coli* results

The Boat Cove sample site has had episodes of elevated *E.coli* counts in the past few years. The tributary sample collected on July 18, 2017 had an *E.coli* count of 717 MPN/100mL. This site was resampled on July 20, 2017; the result was 512 MPN/100mL. The next routine tributary sample was collected August 1, 2017, with a result of 435 MPN/100mL. Rainfall was not significant in the days preceding the elevated *E.coli* results.

On August 9, 2017, Wildlife Biologist Kiana Koenen inspected the stream above the boat cove. She noted thick vegetation around the stream and old pond. No signs of beaver were noted.

On August 10, 2017, EQ staff R. Faucher and Ellie Kurth conducted an inspection of the Boat Cove location and collected two samples from this area. Sample BC-A was collected from the northern tributary and sample BC was collected from the regular Boat Cove sample site (Figure 1). The inspection day was clear and hot, with temperatures in the 80's. There was no rainfall in the previous 24 hours.

<u>Sample site BC-A</u>
Deer runs and piles of deer scat were observed in the area around BC-A, the northern boat cove tributary. This tributary was not flowing; stagnant water was sampled. Vegetation was thick in areas. The sample collected on August 10, 2017 had an *E.coli* count of 10 MPN/100mL.

<u>Sample site BC</u>
Although this tributary is heavily vegetated, there was a small path to the sample location, likely worn by biweekly tributary sampling. On August 10, 2017, this site had light flow. Upstream, the vegetation is dense and the tributary barely visible. The *E.coli* sample result was 355 MPN/100mL.

Sample ID	Location	Flow	*E. coli* MPN/100mL (7.18.17)	*E. coli* MPN/100mL (8.10.17)
BC-A	northern tributary	no flow	--	10
BC	regular sample site	light flow	717	355

After collecting samples, staff continued the investigation of the Boat Cove basin by entering the watershed through gate WR-25, traveling north near the powerline and continuing north on Webster

Road. Staff attempted to access an area west of the powerline, but road access was blocked by downed trees and thick vegetation.

Staff inspected the area of the tower septic system. The area downhill and south of the septic system was inspected for visual evidence of septic breakout or issues. No issues were noted. There were no tributaries observed and no evidence of recent water flow.

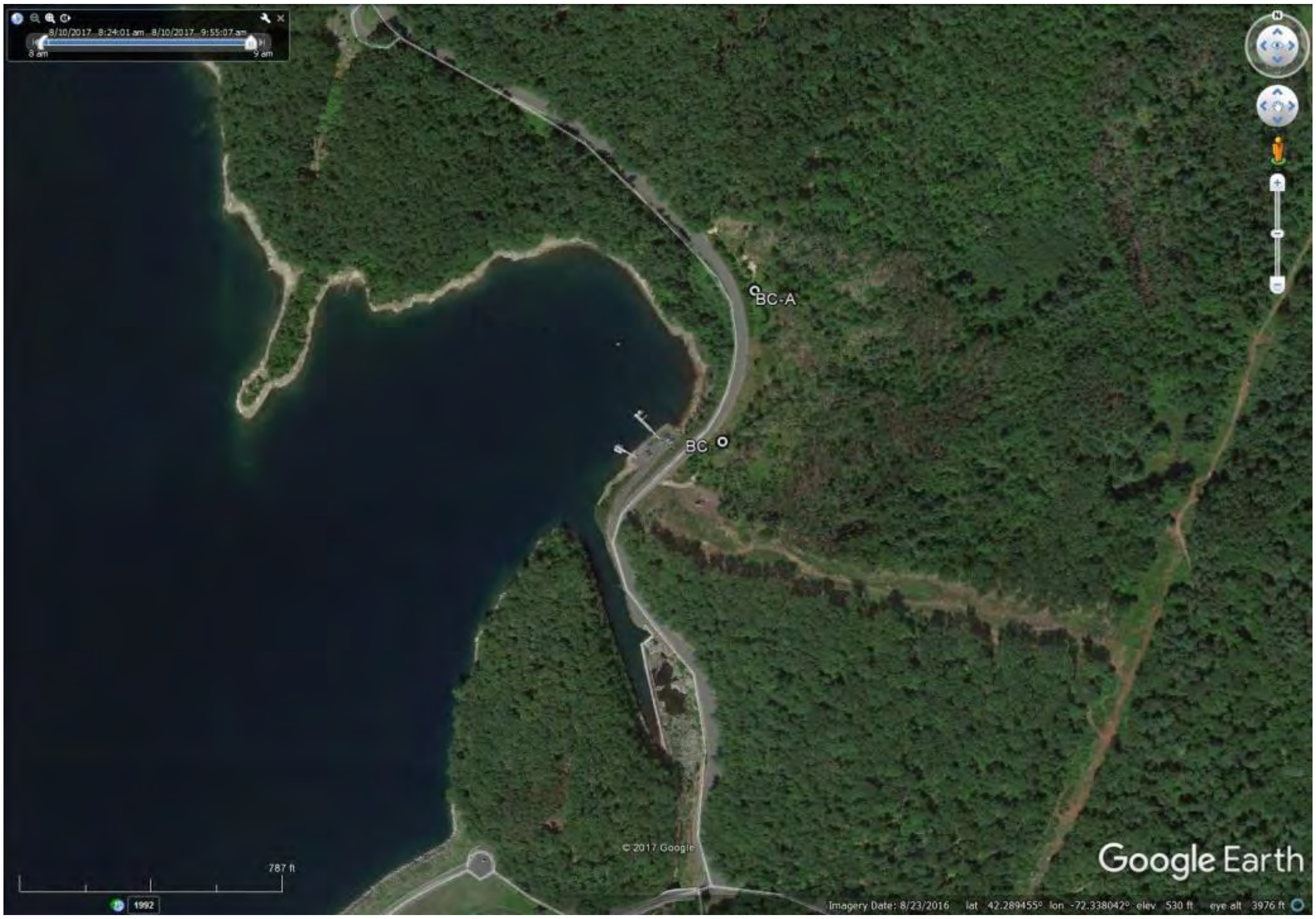


Figure 1. Sample locations BC-A and BC

Photo 1. Path from road to site BC-A

Photo 2. Deer scat near BC-A

Photo 3. Sample site BC-A

Photo 4. Sample site BC

Figure 2. Partial track of field survey

dcr
Massachusetts

MEMORANDUM

To: John Scannell, Lisa Gustavsen, Yuehlin Lee

C: Scott Campbell, Kimberly Turner

From: Ellie Kurth

Date: July 31, 2017

Subject: Water Quality Results for Stockroom Well

Water samples were collected from the Stockroom on June 13 and July 10, 2017 to assess the water quality of the well. A sample of raw, untreated water was collected from the kitchen tap, and a sample of treated water from the reverse osmosis (RO) system was collected from the RO tap at the kitchen sink. The 2017 sampling was performed after annual maintenance of the RO unit had been performed. Annual maintenance on the RO unit was performed on May 12, 2017.

Both samples collected on June 13 were analyzed for bacteria, volatile organic compounds (VOCs), copper, lead, sodium, iron, and manganese. An untreated water sample, collected on July 10, was also analyzed for nitrate. A first-draw sample was collected for metals analysis (to conservatively assess lead and copper levels), and water was then flushed prior to collecting the remainder of the sample. MWRA provided laboratory services. Total coliform and *Escherichia coli* bacteria were analyzed at Quabbin Laboratory and other parameters were analyzed at Deer Island Laboratory.

Analytical results were compared to primary maximum contaminant levels (MCLs), secondary maximum contaminant levels (SMCLs), and Massachusetts Office of Research and Standards Guidelines (MA ORSGs). The results are summarized on the attached table. As indicated, the **RO-treated results were below MCLs and SMCLs, but sodium exceeded the MA ORSG**. The MA ORSG is designed to be protective of people on sodium-restricted diets. The level is based on an 8-ounce serving of water providing 5 mg (or less) of sodium. Sodium was reduced significantly by the RO system (from 64,200 µg /L to 48,100 µg/L), but the level in the RO-treated water was still above the MA ORSG level of 20,000 µg/L. Consumers on sodium-restricted diets should consult their physician about drinking water from the Stockroom.

In the **untreated** water sample, lead was also detected above the MCL (Action Level). The results indicate the RO system reduced lead levels in first-draw samples from 24.0 µg /L in the untreated water to 2.00 µg /L in the RO-treated water, which is well below the Action Level of 15 µg /L. Elevated lead levels are typically due to water sitting in building plumbing and/or faucet fixture for an extended period of time (e.g., overnight). Because of this, lead concentrations in water are usually significantly lower after the tap has run for several minutes.

No VOCs, including methyl-tert-butyl ether (MTBE), were detected in the raw or the RO-treated water. MTBE has historically been detected at relatively low levels (just above the detection limit) in the raw water, but it has not been detected in raw or treated samples since 2013.

The results were also compared to the results from 2016. In 2016, testing was performed approximately one month prior to the servicing of the RO unit. As described above, the 2017 testing was performed approximately one month after the RO unit was serviced. The data can therefore be used to compare potential differences in water quality between relatively new filters and filters that have been in use for some time. The analytical results from both years were similar, with the exception of sodium in the treated water. In 2016, the sodium level in the treated water was 22,900 μg/L, but in 2017 it was 48,100 μg /L. The sodium concentration in the untreated water was similar both years; it was 66,400 μg /L in 2016 and 64,200 μg/L in 2017. The results indicate the RO system reduced sodium concentrations in the water, but with varying levels of effectiveness. Other than this issue, the RO system appears to be effective reducing contaminant levels, whether recently serviced or as long as a year since servicing.

A summary of the sampling results was posted in the Stockroom on July 31, 2017. A copy of this posting is attached.

SUMMARY OF STOCKROOM WATER QUALITY DATA
Samples Collected June 13 and July 10, 2017

Parameter	Units	Sample		Applicable Standard or Guideline[1]	Remarks [2]
		Kitchen Tap, Untreated	Treated (RO) Water (Kitchen Sink)		
Bacteria					
Total Coliform	MPN/100 mL	<1.00	<1.00	Zero	Total Coliform Rule
E. coli	MPN/100 mL	<1.00	<1.00	Zero	Total Coliform Rule
Inorganic Compounds					
Copper	ug/L	967	1.79	1,000	SMCL (Action Level is 1,300 ug/L)
Lead	ug/L	**24.0**	2.00	15	MCL (Action Level)
Manganese	ug/L	3.31	0.56	50, 300, 1,000 [3]	SMCL, MA ORSG
Nitrate	mg/L	<0.005	--	10	MCL
Sodium	ug/L	**64,200**	**48,100**	20,000	MA ORSG
VOCs					
Benzene	ug/L	<0.500	<0.500	5	MCL
Bromobenzene	ug/L	<0.500	<0.500	NS	
Bromochloromethane	ug/L	<0.500	<0.500	NS	
Bromodichloromethane	ug/L	<0.500	<0.500	zero	MCLG
Bromoform	ug/L	<0.500	<0.500	zero	MCLG
Bromomethane	ug/L	<0.500	<0.500	10	MA ORSG
Butylbenzene, n-	ug/L	<0.500	<0.500	NS	
Butylbenzene, sec-	ug/L	<0.500	<0.500	NS	
Butylbenzene, tert-	ug/L	<0.500	<0.500	NS	
Carbon tetrachloride	ug/L	<0.500	<0.500	5	MCL
Chlorobenzene	ug/L	<0.500	<0.500	100	MCL
Chloroethane	ug/L	<0.500	<0.500	NS	
Chloroform	ug/L	<0.500	<0.500	70	MA ORSG (for non-chlorinated supplies)
Chloromethane	ug/L	<0.500	<0.500	NS	
Chlorotoluene, 2-	ug/L	<0.500	<0.500	NS	
Chlorotoluene, 4-	ug/L	<0.500	<0.500	NS	
Dibromo-3-chloropropane, 1,2-	ug/L	<0.500	<0.500	0.2	MCL
Dibromochloromethane	ug/L	<0.500	<0.500	60	MCLG
Dibromoethane, 1,2-	ug/L	<0.500	<0.500	NS	
Dibromomethane	ug/L	<0.500	<0.500	NS	
Dichlorobenzene, 1,2-	ug/L	<0.500	<0.500	600	MCL

Dichlorobenzene, 1,3-	ug/L	<0.500	<0.500	NS	
Dichlorobenzene, 1,4-	ug/L	<0.500	<0.500	5	MA MCL
Dichlorodifluoromethane	ug/L	<0.500	<0.500	1,400	MA ORSG
Dichloroethane, 1,1-	ug/L	<0.500	<0.500	70	MA ORSG
Dichloroethane, 1,2-	ug/L	<0.500	<0.500	5	MCL
Dichloroethene, 1,1-	ug/L	<0.500	<0.500	7	MCL
Dichloroethene, cis-1,2-	ug/L	<0.500	<0.500	70	MCL
Dichloroethene, trans-1,2-	ug/L	<0.500	<0.500	100	MCL
Dichloropropane, 1,2-	ug/L	<0.500	<0.500	5	MCL
Dichloropropane, 1,3-	ug/L	<0.500	<0.500	NS	
Dichloropropane, 2,2-	ug/L	<0.500	<0.500	NS	
Dichloropropene, 1,1-	ug/L	<0.500	<0.500	NS	
Dichloropropene, 1,3- (Total)	ug/L	<0.500	<0.500	0.4	MA ORSG
Ethylbenzene	ug/L	<0.500	<0.500	700	MCL
Hexachlorobutadiene	ug/L	<0.500	<0.500	NS	
Isopropylbenzene	ug/L	<0.500	<0.500	NS	
Isopropyltoluene, 4-	ug/L	<0.500	<0.500	NS	
Methylene chloride	ug/L	<0.500	<0.500	5	MCL
Methyl-tert-butyl ether (MTBE)	ug/L	<0.500	<0.500	70	MA ORSG (SMCL = 20-40 ug/L)
Naphthalene	ug/L	<0.500	<0.500	140	MA ORSG
Propylbenzene, n-	ug/L	<0.500	<0.500	NS	
Styrene	ug/L	<0.500	<0.500	100	MCL
Tetrachloroethane, 1,1,1,2-	ug/L	<0.500	<0.500	NS	
Tetrachloroethane, 1,1,2,2-	ug/L	<0.500	<0.500	NS	
Tetrachloroethene	ug/L	<0.500	<0.500	5	MCL
Toluene	ug/L	<0.500	<0.500	1,000	MCL
Trichlorobenzene, 1,2,3-	ug/L	<0.500	<0.500	NS	
Trichlorobenzene, 1,2,4-	ug/L	<0.500	<0.500	70	MCL
Trichloroethane, 1,1,1-	ug/L	<0.500	<0.500	200	MCL
Trichloroethane, 1,1,2-	ug/L	<0.500	<0.500	5	MCL
Trichloroethene	ug/L	<0.500	<0.500	5	MCL
Trichlorofluoromethane	ug/L	<0.500	<0.500	NS	
Trichloropropane, 1,2,3-	ug/L	<0.500	<0.500	NS	
Trimethylbenzene, 1,2,4-	ug/L	<0.500	<0.500	NS	
Trimethylbenzene, 1,3,5-	ug/L	<0.500	<0.500	NS	
Vinyl chloride	ug/L	<0.500	<0.500	2	MCL
Xylenes, Total	ug/L	<1.000	<1.000	10,000	MCL.

Bold typeface indicates exceedance of applicable standard or guideline

NS = No standard

[1] 1 mg/L = 1 ppm = 1000 ug/L = 1000 ppb

[2] MCL = Maximum Contaminant Level (Primary drinking water standard)
SMCL = Secondary Maximum Contaminant Level (Secondary drinking water standard)
SMCLs are guidance values set to limit aesthetic problems (e.g., taste, odor, color); these standards are not health-based.
MA ORSG = MA Office of Research and Standards Guidelines
MCLG = Maximum Contaminant Level Goal (Non-enforceable public health goal below which there is no known or expected risk to health.)

[3] Manganese SMCL for aesthetic concerns is 50 ug/L. Manganese MA ORSG for the general population is 300 ug/L for lifetime exposure, with exposure over 1,000 ug/L limited to ten days. For babies less than 1 year, exposure over 300 ug/L should be limited to ten days due to concerns for differences in manganese content in human milk and formula and the possibility of a higher absorption and lower excretion in young infants.

dcr
Massachusetts

POSTED: July 31, 2017

Water is safe to drink!

Water samples were collected on June 13 and July 10, 2017 from both taps at the kitchen sink. The tap on the left has untreated water. Water in the right tap has been treated using reverse osmosis (RO). Test results indicated:

- LEAD, COPPER, and SODIUM were greatly reduced using the RO unit,
- MTBE (a gasoline additive) was not detected in either tap.

Summary of Results- Major Parameters

PARAMETER	RESULT (RO-TREATED WATER)	DRINKING WATER STANDARD OR GUIDELINE	REMARKS
Lead	2.00 ppb	15 ppb Action Level	Lead in untreated water (23.2 ppb) exceeded the Action Level
Copper	1.79 ppb	1,300 ppb Action Level, 1,000 ppb for odor and taste	Copper is much lower in RO tap than untreated water (895 ppb).
Sodium	48.1 ppm	20 ppm Guideline Level Level is based on an 8 oz. serving of water. (20 ppm in 8 oz. of water = 5 mg of sodium.)	The RO system greatly reduces sodium, but the treated sample still exceeded the state guideline level. This guideline is meant to be protective of people on sodium-restricted diets. Please consult your physician about consuming this water if you are on a sodium-restricted diet.
Methyl tertiary butyl ether (MTBE)	Not detected (less than 0.5 ppb)	70 ppb Guideline Level; 20-40 ppb for odor and taste thresholds	Not detected in treated or untreated water.

ppb = parts per billion *ppm = parts per million*

Untreated water from the kitchen tap is safe for applications such as dishwashing**.** For drinking water, use treated water from the PUR filter on the kitchen tap or the RO system. The PUR filter removes lead and copper, and RO system provides enhanced treatment. RO-treated water can be obtained from either the RO tap at the kitchen sink or the chiller/hot water dispenser. Test results have shown that RO treatment continues to work well approximately one year after annual maintenance.

If you have questions about the test results, please call Ellie at x158 or Yuehlin at x301.

dcr
Massachusetts

MEMO

To: Dan Clark, Regional Director

Copy: Y. Lee, S. Campbell, and L. Gustavsen

From: Gabrielle Kurth

Date: February 1, 2018

Subject: 2017 Lead and copper results from DCR offices

Drinking water samples were collected from five DCR field offices and from the Quabbin Administration Building on December 20, 2017 for lead and copper testing. Sampling locations included the New Salem and Oakham offices, as well as the three offices on Blue Meadow Road (Residence #1, Forestry Office; Residence #2, Conference Center; and Residence #3, Ranger Station). In addition, samples were collected from the East Wing kitchen tap in the Administration Building.

The sampling program was designed to target worst-case conditions by collecting “first draw” samples from taps early in the morning, after water was allowed to sit in the plumbing system overnight. Water that is left stagnant in the building pipes for an extended period of time (approximately six to twelve hours) typically contains higher concentrations of lead and copper than water that has been in the pipes for shorter periods of time.

In addition, a second sample from each tap was also collected after the first draw sample in order to assess conditions more typical of what a person may consume during the work day. These samples were collected from reverse osmosis (RO) or point-of-use (POU) filters, where available, or a two-minute flush sample was collected to simulate conditions more typical of what a person might be consuming during regular building use throughout the day. The Oakham office has an RO system, and the kitchen tap at Residence #3 (Ranger Station) has a PUR® POU filter. The RO system was installed in Oakham to reduce manganese levels and has been effective at reducing lead and copper concentrations as well. The PUR® filter has been certified by NSF International to reduce lead and numerous other drinking water contaminants.

With one exception, samples were collected into 1,000-ml bottles, which is standard for lead and copper testing programs. The first draw sample from the Administration Building kitchen tap was considered an informational test, not for regulatory compliance, and was therefore collected into a 250-ml bottle. The flushed sample at this location was collected into a 1,000-ml bottle. Lead and copper samples collected in 1,000-ml bottles allow for better comparison to regulatory action levels.

Analytical results were compared to EPA's drinking water action levels and secondary standards, as applicable. Drinking water action levels apply to contaminants such as lead and copper, which typically enter drinking water through plumbing materials. A secondary standard for copper was established by EPA to address potential aesthetic effects, such as taste and odor. Secondary standards and are not health-based standards.

The results are summarized in the attached table. As indicated, lead concentrations in first draw samples from the field offices ranged from 2.20 parts per billion (ppb) in New Salem to 16.8 ppb in Oakham. With the exception of the Oakham sample, first draw lead concentrations from the field offices were below the action level of 15 ppb. After flushing the tap for two minutes, lead levels at all the sample sites were well below the action level. Specifically, levels were reduced by at least 67%, with concentrations in the field offices ranging from 0.51 ppb at Residence #2 (Conference Center) to 3.21 ppb at Residence #1 (Forestry Office). The lead concentration in the Administration Building tap decreased to 4.59 ppb after flushing, which is a 76% reduction from the first draw sample. The latest round of results reaffirm that ***the simplest form of protection against the exposure to lead in tap water is flushing the water line (for about 2 minutes) prior to consumption***. In addition, the RO system at Oakham reduced the lead concentration by 89% to 1.82 ppb. At Residence #3, the point-of-use filter reduced lead concentration to below the detection limit of 0.05 ppb.

With the exception of Residence #3, copper levels in first draw and flushed samples from the field offices and the Administration Building were below both the action level (1,300 ppb) and the secondary standard (1,000 ppb). Copper was detected above the action level in the first draw sample from Residence #3, and the two-minute flush reduced copper by 44% to 1,240 ppb, also above the secondary standard. Consumption of unfiltered, flushed water at Residence #3 may produce taste and/or objectionable staining complaints, but is not expected to increase risks to public health. At other field offices, flushing the line for a short period of time (for about 2 minutes) has been shown to reduce copper in unfiltered water to a concentration below the action level. Copper was not detected in the sample from the PUR filter, which was an effective reduction of more than 99%. The results indicate the filter is effective at reducing copper to well below the action level and secondary standard.

If you have any questions regarding this information, please call me at extension 158. Bernadeta Susianti assisted this project by collecting the samples from the Oakham office, and MWRA Laboratory provided analytical services.

Lead and Copper Sampling Results for DCR/OWM Field Offices, Quabbin/Ware Section

Collection Date	Facility	Location Description	Sample Type	LEAD (ug/L)[1]	LEAD % Reduction vs. First Draw	COPPER (ug/L)[1]	COPPER % Reduction vs. First Draw
12/20/17	NEW SALEM	New Salem Bathroom Sink	First Draw	2.20	74%	516	85%
			2-minute Flush	0.57		79.8	
12/20/17	OAKHAM	Oakham Kitchen Sink	First Draw	**16.8**	89%	11.7	44%
			RO Tap[2]	1.82		6.51	
12/20/17	MDC-RES1	Residence #1 (Forestry Office), Kitchen Sink	First Draw	9.68	67%	610	86%
			2-minute Flush	3.21		83.0	
12/20/17	MDC-RES2	Residence #2 (Conference Center), Kitchen Sink	First Draw	2.89	82%	156	61%
			2-minute Flush	0.51		60.6	
12/20/17	MDC-RES3	Residence #3 (Ranger Station), Kitchen Sink	First Draw	12.2	76%	**2,230**	44%
			2-minute Flush	2.87		**1,240**	
			POU Filter[3]	<0.05	>99%	<3.00	>99%
12/20/17	QUAB-ADB	Administration Building Kitchen Sink (East Wing)	First Draw[4]	**18.8**	76%	76.7	-28%
			2-minute Flush	4.59		97.9	
			DRINKING WATER ACTION LEVEL	***15*** [5]		***1,300***[5]	
			SECONDARY STANDARD[6]	***--***		***1,000***	

Notes:

[1] Micrograms per liter (ug/L) is equivalent to parts per billion (ppb).

[2] A reverse osmosis (RO) system in use at this location.

[3] Point-of-use (POU) filter; a PUR filter is in use at this location.

[4] First draw sample from QUAB-ADB was collected into 250-ml bottle. (Other samples were collected into 1,000-ml bottles.)

[5] **Bold** typeface indicates sample concentration exceeds drinking water action level or secondary standard.

[6] Secondary standards are based on aesthetic effects, such as taste and odor, and are not health-based standards.

MEMORANDUM

To: Yuehlin Lee, Environmental Analyst IV
From: Paul Reyes
Date: June 29, 2018
Subject: Forestry Lot 3138 Update

The Massachusetts Department of Conservation and Recreation, Division of Watershed Protection (DWSP), manages forested lands to protect water quality as part of comprehensive watershed protection and land management plans. The DWSP Forest Management Program allows silvicultural activities that focus on forest diversity (in terms of age and tree type) and regeneration for resilient forests that naturally filter water pollutants.

Environmental Quality staff members are charged with monitoring the effects of forestry on soil and water by conducting periodic inspections of forestry lots and collecting water samples for turbidity measurements from streams affected by logging. Turbidity is a measure of suspended matter in water, and the affected streams are those which are spanned by a temporary bridge used for transporting equipment and timber.

Weather and road conditions allowing, monthly background samples are collected upstream and downstream from the stream crossing prior to logging in order to set a baseline. Samples are then collected during harvesting, followed by post-harvest sampling.

This memorandum covers Lot 3138, inside of Gate 27 in New Salem, and in which one stream crossing, SC-1, was sampled. The other stream crossing, at an intermittent brook (SC-2) was not sampled. See **Figure 1** for stream crossing locations.

Background Phase

Background sampling at Lot 3138 began on September 15, 2014. Further sampling was conducted on a monthly basis through June 30, 2016. After that, during the months of July, August and September of 2016, there was no flow on the stream. Very low flows resumed in October and further sampling was conducted on October 31 and December 14, 2016. **Table 1** shows the results of turbidity testing. These results are also shown in **Figure 2**. Site S1 was upstream of stream crossing SC-1, and Site S2 was downstream.

Active Logging Phase

Samples were taken on December 29, 2016, during active logging. No other samples were collected during this phase.

Post-Logging Phase

Post-logging, monthly sampling attempts were made from January 2017 through March 2018. During this period, samples were successfully collected, except for November 2017 because of extremely low flow, and January 2018 because the site was inaccessible because of snow.

Discussion

A total of 29 attempts to collect water samples were made from September 14, 2014 to March 30, 2018. Out of the 29 attempts, 24 were successful. In general, turbidity at downstream Site S2 was comparable to or lower than turbidity at upstream Site S1. Turbidity at S1 ranged from 0.10 to 0.76 NTU during the background phase, while S2 turbidity ranged from 0.09 to 0.68 NTU. During active logging, S1 and S2 turbidities were comparable, at 0.10 and 0.07 NTU, respectively. Post-logging, turbidity ranged from 0.09 to 0.78 NTU at Site S1, and 0.10 to 0.77 NTU at Site S2.

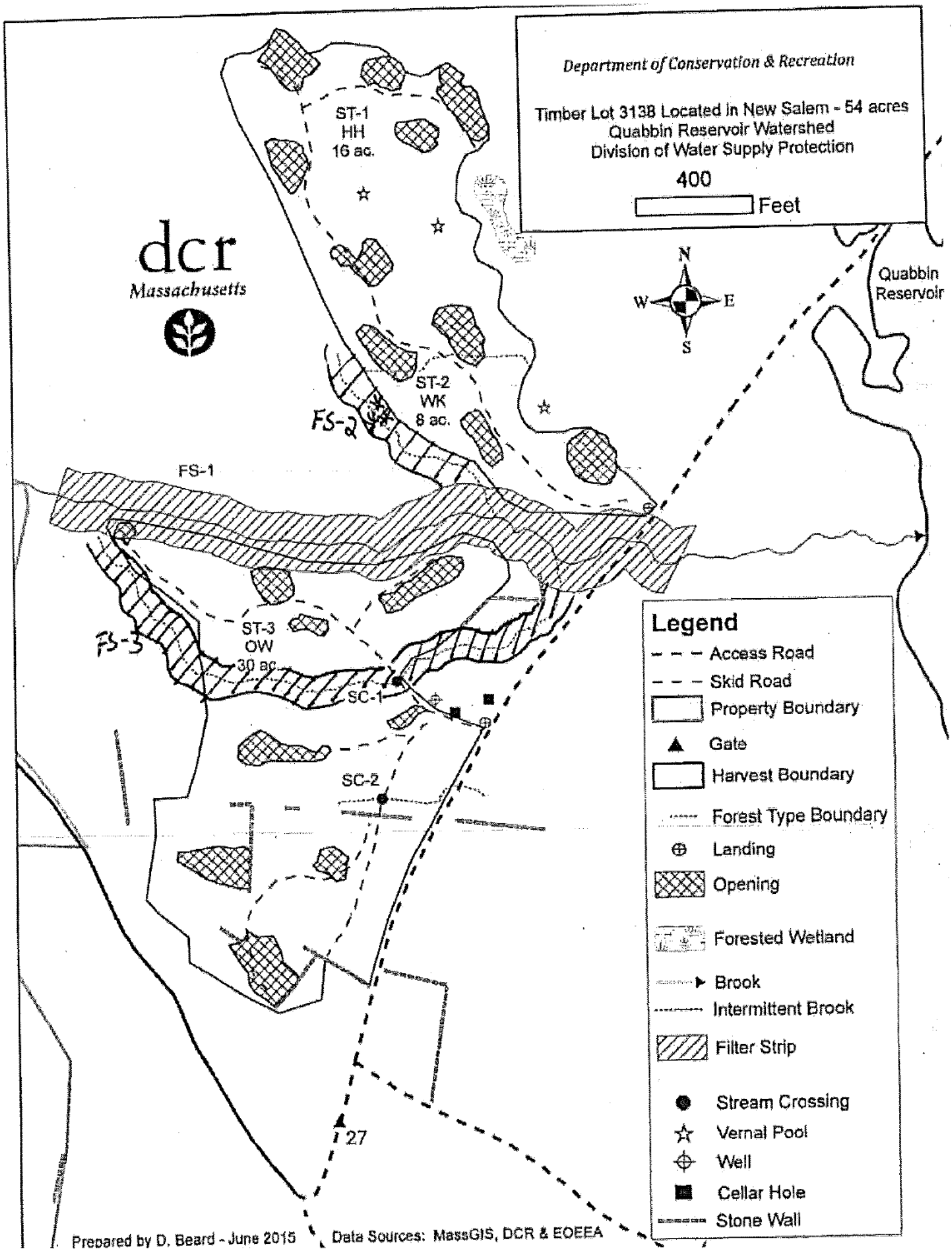


Figure 1. Forestry/Timber Lot 3138.

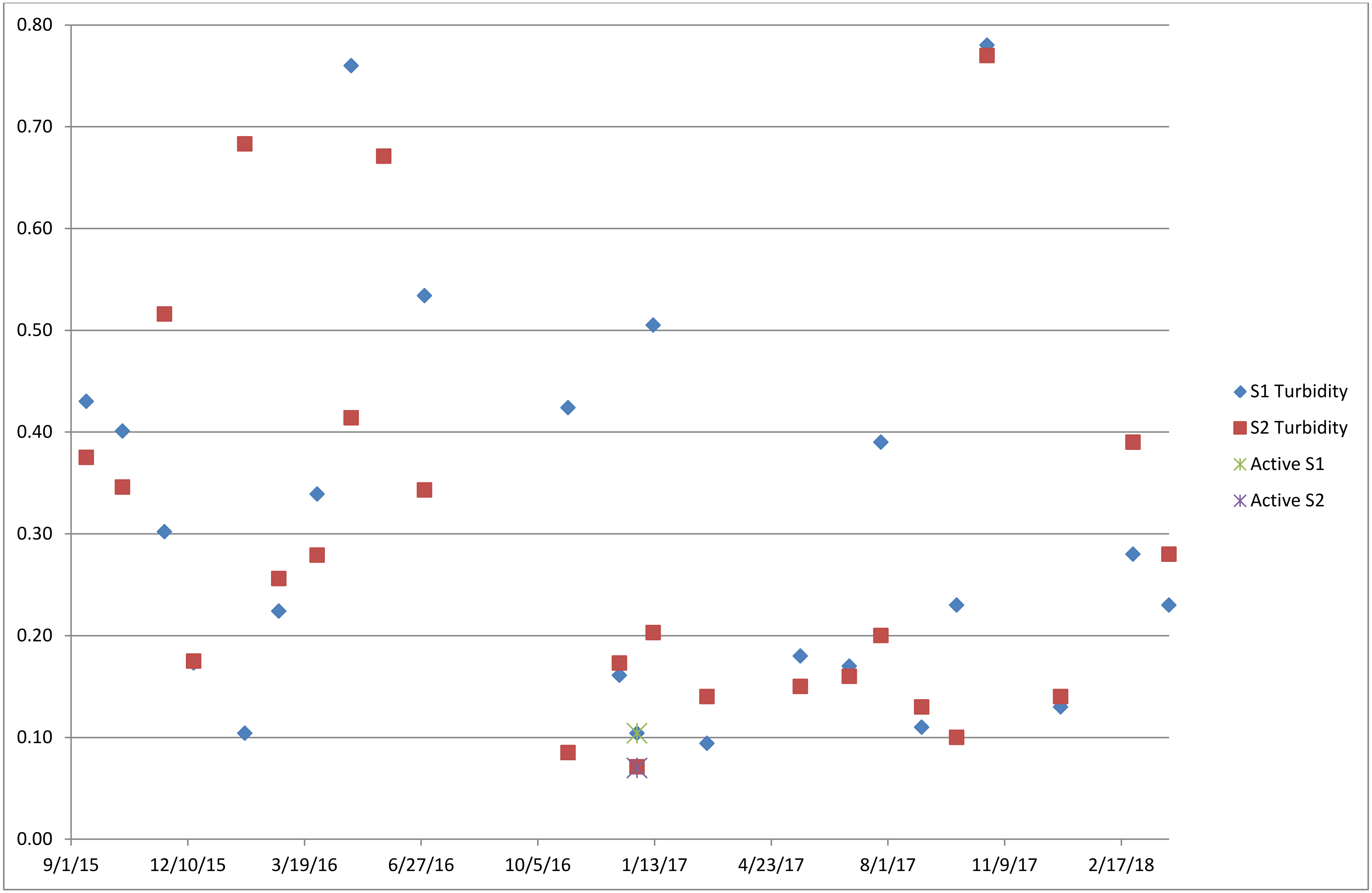


Figure 2. Turbidity upstream (Site S1) and downstream (Site S2) of stream crossing SC-1.

Table 1. Forestry Lot 3138 turbidity during background phase, active logging phase, and post-harvesting phase.

Active Lot?	Sample Date	Sample Site Number	Type of Sample	Turbidity	Flow? (Yes/No)	Pictures? (Yes/No)	BMPs	Comments	Lot Number	Precipitation Previous 7 Days
No	9/14/15	S1	Background	0.43	Yes	Yes	None	Good Flow	3138	3.20"
No	9/14/15	S2	Background	0.38	Yes	Yes	None	Good Flow	3138	3.20"
No	10/15/15	S1	Background	0.40	Yes	No	None	Good Flow	3138	0.45"
No	10/15/15	S2	Background	0.35	Yes	No	None	Good Flow	3138	0.45"
No	11/20/15	S1	Background	0.30	Yes	No	None	Good Flow	3138	0.63"
No	11/20/15	S2	Background	0.52	Yes	No	None	Good Flow	3138	0.63"
No	12/15/15	S1	Background	0.17	Yes	No	None	Good Flow	3138	0.51"
No	12/15/15	S2	Background	0.18	Yes	No	None	Good Flow	3138	0.51"
No	1/28/16	S1	Background	0.10	Yes	No	None	Good Flow	3138	0.00"
No	1/28/16	S2	Background	0.68	Yes	No	None	Good Flow	3138	0.00"
No	2/26/16	S1	Background	0.22	Yes	No	None	Good Flow	3138	2.16"
No	2/26/16	S2	Background	0.26	Yes	No	None	Good Flow	3138	2.16"
No	3/30/16	S1	Background	0.34	Yes	No	None	Good Flow	3138	1.22"
No	3/30/16	S2	Background	0.28	Yes	No	None	Good Flow	3138	1.22"
No	4/28/16	S1	Background	0.76	Yes	No	None	Medium Flow	3138	0.43"
No	4/28/16	S2	Background	0.41	Yes	No	None	Medium Flow	3138	0.43"
No	5/26/16	S1	Background	0.67	Yes	No	None	Low Flow	3138	0.47"
No	5/26/16	S2	Background	0.67	Yes	No	None	Low Flow	3138	0.47"
No	6/30/16	S1	Background	0.53	Yes	Yes	None	Very low flow	3138	0.19"
No	6/30/16	S2	Background	0.34	Yes	Yes	None	Very low flow	3138	0.19"
No	7/28/16	S1	Background		No	No	None	No precipitation during the previous 13 days.	3138	0"
No	7/28/16	S2	Background		No	No	None	No precipitation during the previous 13 days.	3138	0"
No	8/26/16	S1	Background		No	No	None	0.13" on 8/20, 0.38" on 8/21, 0.80" 8/22 and 0.01" 8/23.	3138	1.31"

Table 2 (cont'd). Forestry Lot 3138 turbidity during background phase, active logging phase, and post-harvesting phase.

Active Lot?	Sample Date	Sample Site Number	Type of Sample	Turbidity	Flow? (Yes/No)	Pictures? (Yes/No)	BMPs	Comments	Lot Number	Precipitation Previous 7 Days
No	8/26/16	S2	Background		No	No	None	0.13" on 8/20, 0.38" on 8/21, 0.80" 8/22 and 0.01" 8/23.	3138	1.31"
No	9/29/16	S1	Background		No	No	None	0.05 on 9/23, 0.53 on 9/27, and 0.01 9/28.	3138	0.59"
No	9/29/16	S2	Background		No	No	None	0.05 on 9/23, 0.53 on 9/27, and 0.01 9/28.	3138	0.59"
No	10/31/16	S1	Background	0.42	Yes	No	None	Extremely low flow, barely a trickle.	3138	0.74"
No	10/31/16	S2	Background	0.09	Yes	No	None	Extremely low flow, barely a trickle.	3138	0.74"
No	12/14/16	S1	Background	0.16	Yes	Yes	None	Very low flow, 2.25" of rain and snow over previous 14 days.	3138	.07"
No	12/14/16	S2	Background	0.17	Yes	Yes	None	Very low flow.	3138	.07"
Yes	12/29/16	S1	Active/Crossing	0.10	Yes	No	In Place	Good Flow	3138	0.44"
Yes	12/29/16	S2	Active/Crossing	0.07	Yes	No	In Place	Good Flow	3138	0.44"
No	1/12/17	S1	Post Harvesting	0.51	Yes	Yes	None	Good Flow	3138	0.53"
No	1/12/17	S2	Post Harvesting	0.20	Yes	Yes	None	Good Flow	3138	0.53"
No	2/27/17	S1	Post Harvesting	0.09	Yes	No	None	Good Flow	3138	.051"
No	2/27/17	S2	Post Harvesting	0.14	Yes	No	None	Good Flow	3138	.051"
No	5/18/17	S1	Post Harvesting	0.18	Yes	No	None	Good Flow	3138	.183"
2	5/18/17	S2	Post Harvesting	0.15	Yes	No	None	Good Flow	3138	.183"
No	6/29/17	S1	Post Harvesting	0.17	Yes	Yes	None	Low Flow	3138	0.85"
No	6/29/17	S2	Post Harvesting	0.16	Yes	Yes	None	Low Flow	3138	0.85"
No	7/26/17	S1	Post Harvesting	0.39	Yes	No	None	Low Flow	3138	1.04"
No	7/26/17	S2	Post Harvesting	0.20	Yes	No	None	Low Flow	3138	1.04"

Table 3 (cont'd). Forestry Lot 3138 turbidity during background phase, active logging phase, and post-harvesting phase.

Active Lot?	Sample Date	Sample Site Number	Type of Sample	Turbidity	Flow? (Yes/No)	Pictures? (Yes/No)	BMPs	Comments	Lot Number	Precipitation Previous 7 Days
No	8/30/17	S1	Post Harvesting	0.11	Yes	No	None	Very low flow	3138	.46"
No	8/30/17	S2	Post Harvesting	0.13	Yes	No	None	Very low flow	3138	.46"
No	9/29/17	S1	Post Harvesting	0.23	Yes	Yes	None	Good Flow	3138	0"
No	9/29/17	S2	Post Harvesting	0.10	Yes	Yes	None	Good Flow	3138	0"
No	10/25/17	S1	Post Harvesting	0.78	Yes	No	None	Low Flow	3138	.254"
No	10/25/17	S2	Post Harvesting	0.77	Yes	No	None	Low Flow	3138	.254"
No	11/27/17	S1	Post Harvesting		Yes	No	None	Very low flow, no sample collected	3138	0.26"
No	11/27/17	S2	Post Harvesting		Yes	No	None	Very low flow, no sample collected	3138	0.26"
No	12/27/17	S1	Post Harvesting	0.13	Yes	No	None	Very low flow, no sample collected	3138	0.43"
No	12/27/17	S2	Post Harvesting	0.14	Yes	No	None	Very low flow, no sample collected	3138	0.43"
No	1/29/18	S1	Post Harvesting				None	Inaccessible	3138	0.88"
No	1/29/18	S2	Post Harvesting				None	Inaccessible	3138	0.88"
No	2/27/18	S1	Post Harvesting	0.28	Yes	Yes	None	Low flow	3138	0.92"
No	2/27/18	S2	Post Harvesting	0.39	Yes	Yes	None	Low flow	3138	0.92"
No	3/30/18	S1	Post Harvesting	0.23	Yes	Yes	None	Low flow	3138	0.05"
No	3/30/18	S2	Post Harvesting	0.28	Yes	Yes	None	Low flow	3138	0.05"

Photo 1. Forestry Lot 3138 Stream Crossing Prior to Active Logging.

Photo 2. Upstream Site S1.

Photo 3. Downstream Site S2.

MEMORANDUM

To: Yuehlin Lee, Environmental Analyst IV

From: Bernadeta Susianti

Date: June 11, 2018

Subject: Monitoring Report for Forestry Lot WR17-17-03

The main purpose of the DWSP forest management program in Quabbin and Ware River watersheds is to conduct silviculture which supports and maximizes water quality. Present management focuses on forest diversity and regeneration.

As a compliance measure to protect soil and water quality, EQ section staff conducts short-term forestry monitoring program which collects water samples to measure and monitor turbidity at the stream affected by the logging activities. Turbidity is a measure of the amount of suspended sediment in water column.

Forestry Lot WR-17-17-3 is located in Coldbrook Road, Oakham, MA. Three sample locations were determined on the stream where the crossing was located. One sample location was located at the far upstream of the crossing (SS_1), one at right above the crossing (SS_2), and one was located far downstream of the crossing (SS_3).

Monthly sampling events were conducted through three different phases; prior, during, and post active work. "Prior" sampling events were conducted in the three months prior to the active logging work occurred and served as baseline turbidity data. The post-work sampling was conducted for a 12-month period after the active work ended. The short-term forestry monitoring program at this specific lot occurred from March 2017 to June 2018.

The results of the turbidity sampling (in NTU) are shown on Table 1 below. The locations of the sample sites are shown on Figure 1.

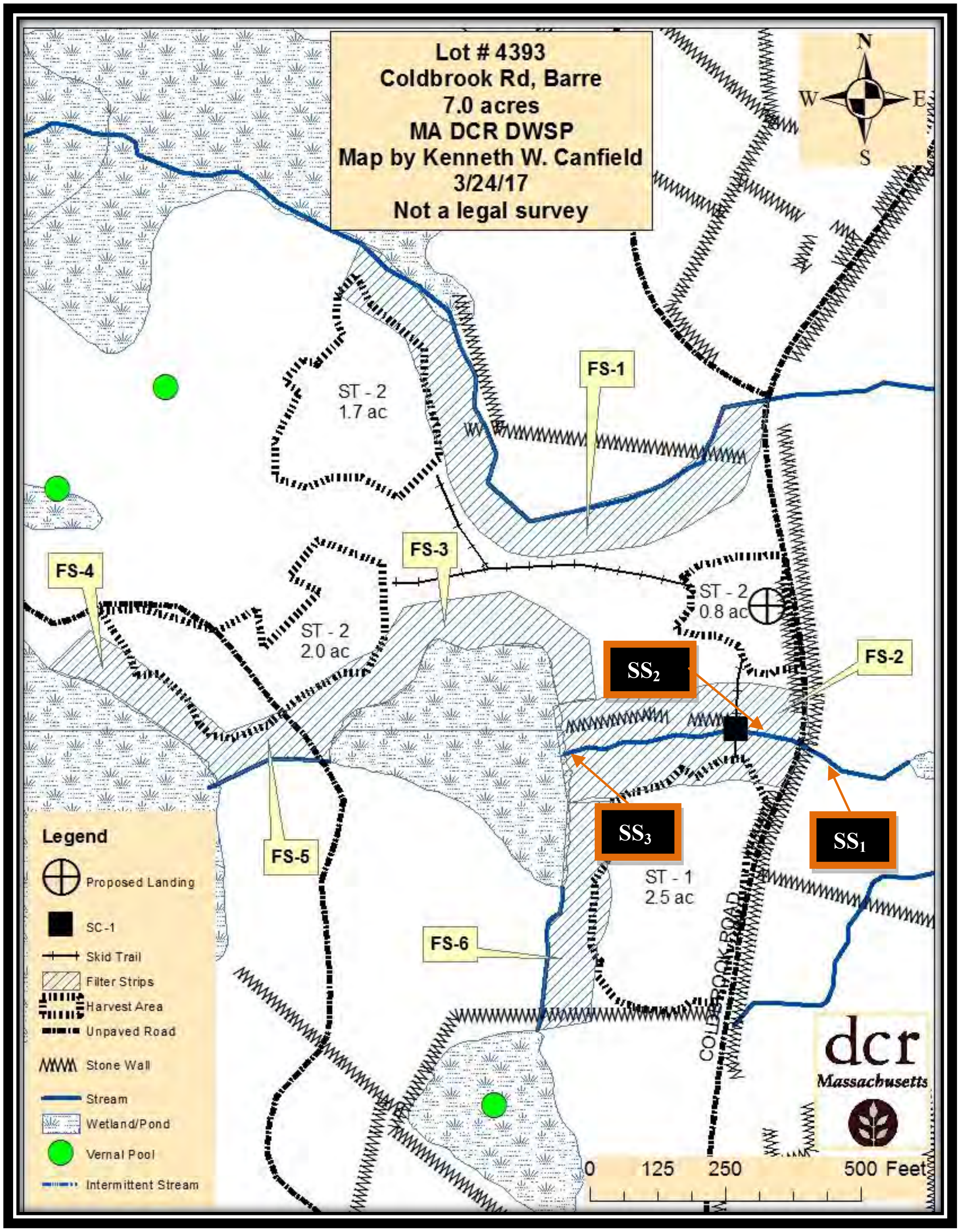
Table 1. Turbidity Results (NTU)

Sample Phase	Sample Date	SS_1 Upstream	SS_2 Upstream Just above the crossing	SS_3 Far Downstream
Baseline	March 3, 2017	0.269	0.403	0.205
	April 21, 2017	0.304	0.316	0.187
	May 15, 2017	0.453	0.441	0.332
Active Work	June 19, 2017	0.246	0.23	0.133
Post Monitoring	July 13, 2017	0.396	0.344	***Not sampled- no flow***
	August 18, 2017	***NOT SAMPLED- Dry stream***		
	Sept 11, 2017	0.305	0.723	0.199
	Oct 31, 2017	0.293	0.333	0.342
	Nov 21, 2017	0.193	0.180	0.211
	Dec 13, 2017	0.317	0.424	0.206
	Jan 19, 2018	0.236	0.791	0.324
	Feb 23, 2018	0.266	0.267	0.330
	Mar 23, 2018	0.135	0.155	0.140
	Apr 18, 2018	0.198	0.194	0.186
	May 17, 2018	0.414	0.486	0.429
	June 6, 2018	0.348	0.330	0.276

The lowest turbidity of 0.133 NTU was measured at the far downstream location of SS_3 during active logging work on June 19, 2017. The highest turbidity was observed at SS_2, just above the crossing at 0.791 NTU during post monitoring period on January 19, 2018.

For comparison purposes, turbidity at Shaft 8 in March 2017 through April 2018 ranged from 0.4 to 4.0 NTU. The highest turbidity for year 2017 was 4.0 NTU which was recorded in July 25, 2017. Based on the Ten Year Water Quality Data Review 2000-2009 report, the lowest turbidity observed in Ware River Sampling Sites was 0.15 NTU at Asnacomet Pond outlet and the highest was 55 NTU at Moulton Pond Tributary at Britney Dr during the 10 year period. Variations in turbidity can be affected by many factors such as storm events, beaver dam breach, construction works, etc.

Figure 1. Sampling Locations



SS_1 : Sampling Location 1 - Upstream of crossing

SS_2 : Sampling Location 2 - Just above the crossing

SS_3: Sampling Location 3 – Far downstream

ATTACHMENTS

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SS_1 (April 21, 2017)

SS_2 (April 21, 2017)

SS_3 (April 21, 2017)

Stream Crossing (June 16, 2017)

Stream Crossing (June 26, 2017)

Stream Crossing (May 16, 2018)