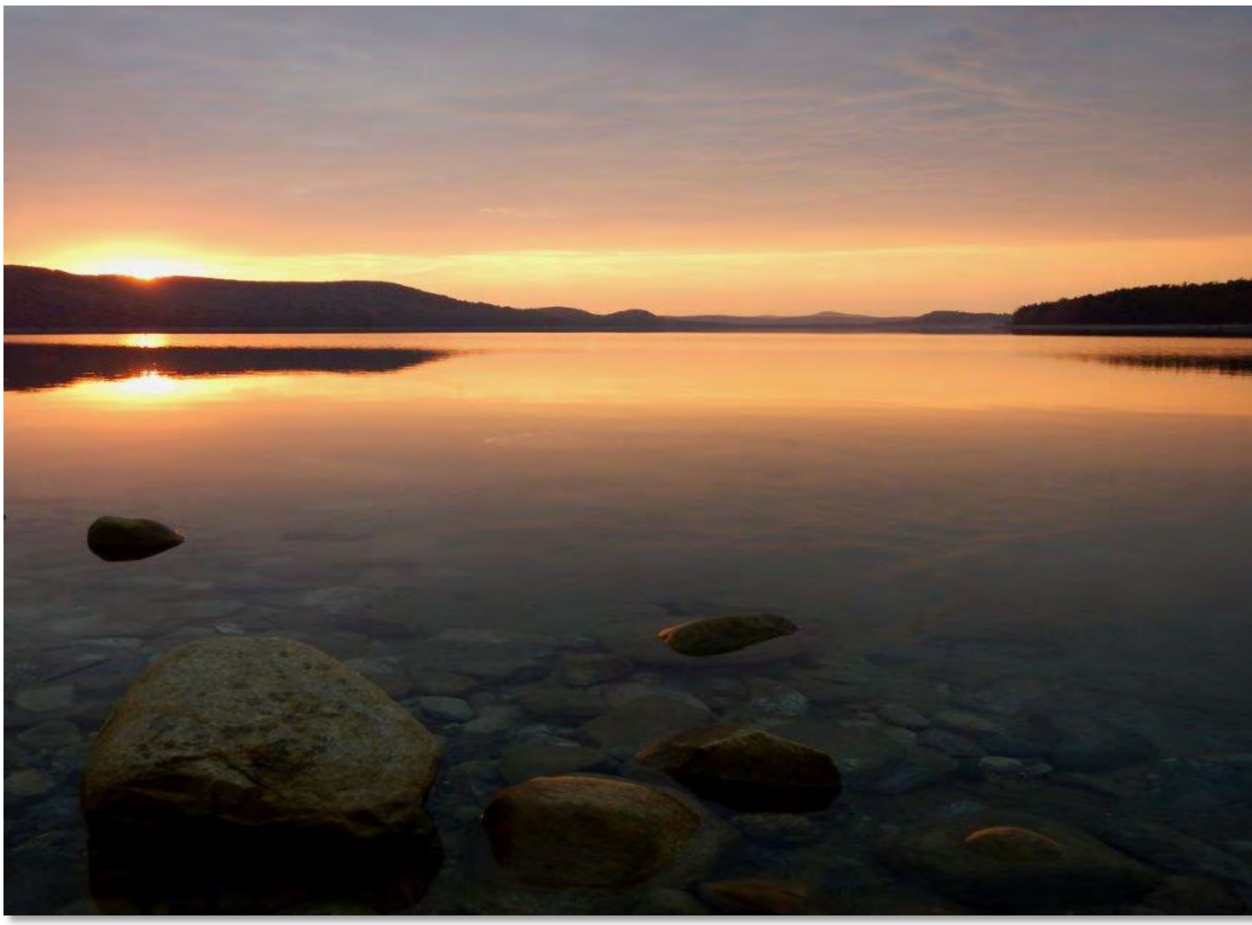
Water Quality Report: 2016
Quabbin Reservoir Watershed
Ware River Watershed



Sunrise from Gate 5 (Peter Deslauriers, 2016)

June 2017

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 26 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 2016, 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

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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
Escherichia coli	*E. coli*
MassDEP	Massachusetts Department of Environmental Protection
MWRA	Massachusetts Water Resources Authority
SWTR	Surface Water Treatment Rule
TKN	Total Kjeldahl nitrogen
UV_{254}	Ultraviolet absorbance at 254 nanometers
USGS	U.S. Geological Survey

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 2016.

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. Because of this relatively large size, the initial filling of the reservoir after the Swift River was dammed in 1939 lasted 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:	*2016*	*2015*	*2014*
Maximum Reservoir Elevation (ft)	526.38 on May 16	528.37 on April 28	529.26 on May 28
Minimum Reservoir Elevation (ft)	518.53 on December 27	523.27 on December 14	523.63 on January 1
Total Diversions to Wachusett Reservoir	53,843 MG (252 days: 213.66 MGD	53,192.36 MG (273 days: 194.84 MGD)	47,263.56 MG (224 days: 211.00 MGD)
Total Diversions to CVA	2,806 MG (366 days: 7.67 MGD)	2,773 MG (365 days: 7.60 MGD)	2,754 MG (365 days: 7.54 MGD)
Ware River Transfers	412 MG (4 days: 103 MGD)	90.6 MG (1 day: 90.6 MGD)	1,360.8 MG (8 days: 170.1 MGD)
Spillway Discharges	0 MG	168.7 MG (33 days: 5.11 MGD)	2,593 MG (55 days: 47.1 MGD)
Total Diversions to Swift River	13,129 MG (35.87 MGD)	15,673 MG (42.9 MGD)	12,460 MG (34.1 MGD)
Reservoir Ice Cover	Partial ice cover from February 11 through February 16.	H100% on February 3, complete ice cover on February 5, ice out on April 17.	H100% on January 23, complete ice cover on February 5, ice out on April 13.

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, 2013a), DWSP Civil Engineering Yield Data 2014-2016, 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).

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 2016 flows in these rivers are included in **Appendix A**.

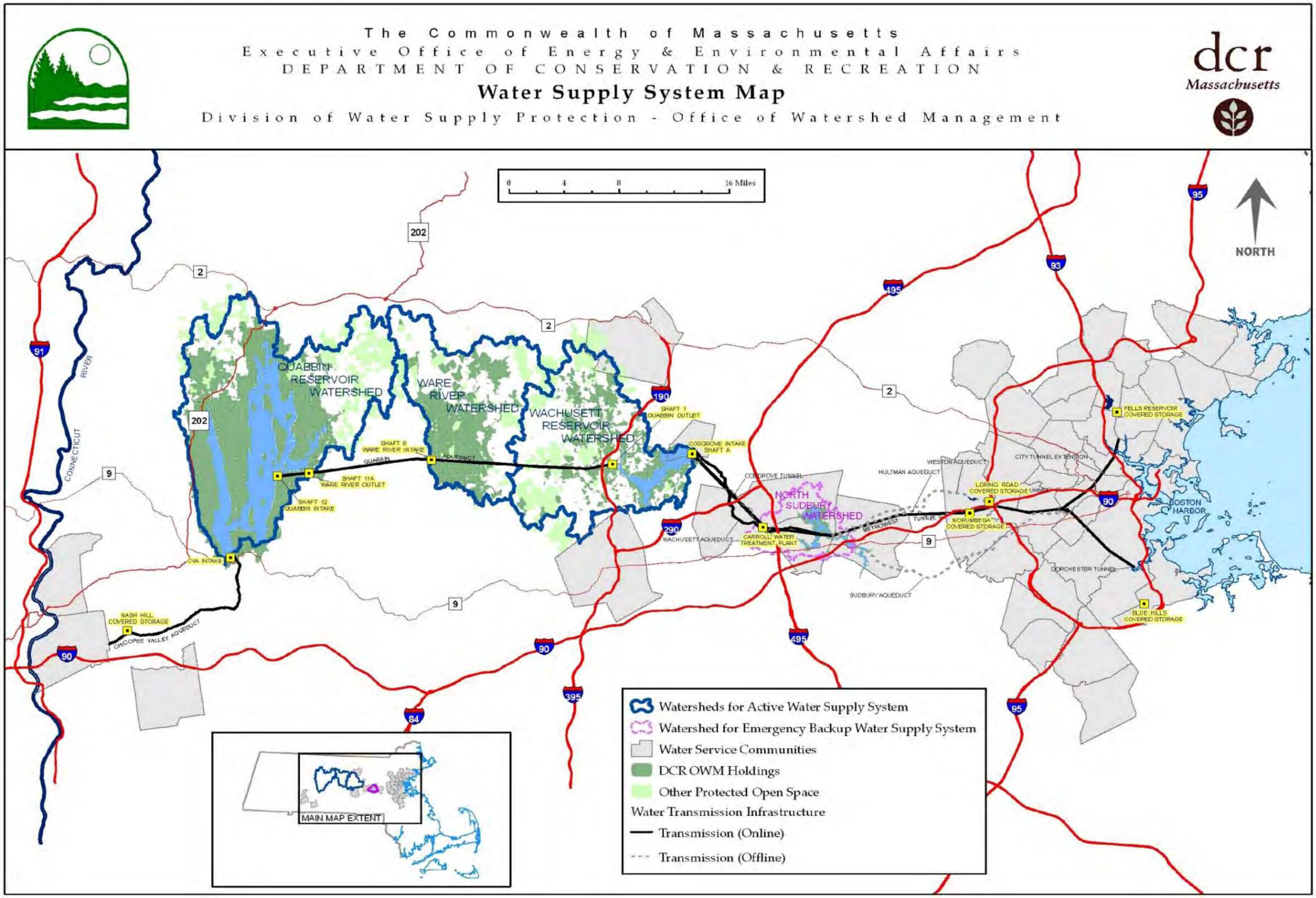


Figure 1. Quabbin Reservoir, Ware River, and Wachusett Reservoir Watershed System

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 gages 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 2016, mean daily flows for the East Branch Swift River in Hardwick averaged 44.3 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-June. Above-normal peaks in January through March reflect snowmelt and/or precipitation events. From mid-June through December, streamflow was generally lower than normal. Normal and above-normal streamflows were observed during December.

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 2016, mean daily flows for the West Branch Swift River averaged 10.8 MGD (16.7 cfs). Monthly mean flows were generally below normal during 2016.

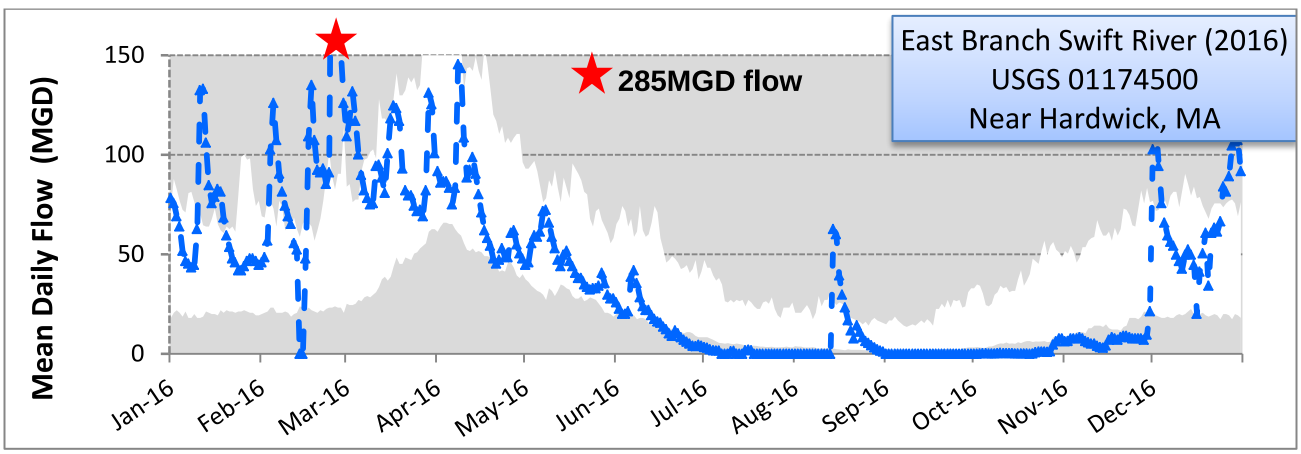


Figure 2. East Branch Swift River near Hardwick, MA, January-December 2016

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 2016, transfers to Wachusett Reservoir totaled 53,843 million gallons (MG). In the 252 days that transfers occurred, the Quabbin Aqueduct delivered an average of 213.66 million gallons per day (MGD). A smaller amount of water is transferred directly to three western Massachusetts communities on a daily basis via the Chicopee Valley Aqueduct (CVA) at Winsor Dam. In

2016, the CVA delivered on average 7.67 MGD of flow to the CVA communities. The net storage loss was 37,643 MG, and the maximum difference in reservoir levels was 7.85 feet. Daily fluctuations in reservoir water level during the past two years are shown in **Figure 3**. As indicated, the reservoir operating level dropped below normal operating status on November 13, 2016, and the operating level remained below normal for the rest of 2016.

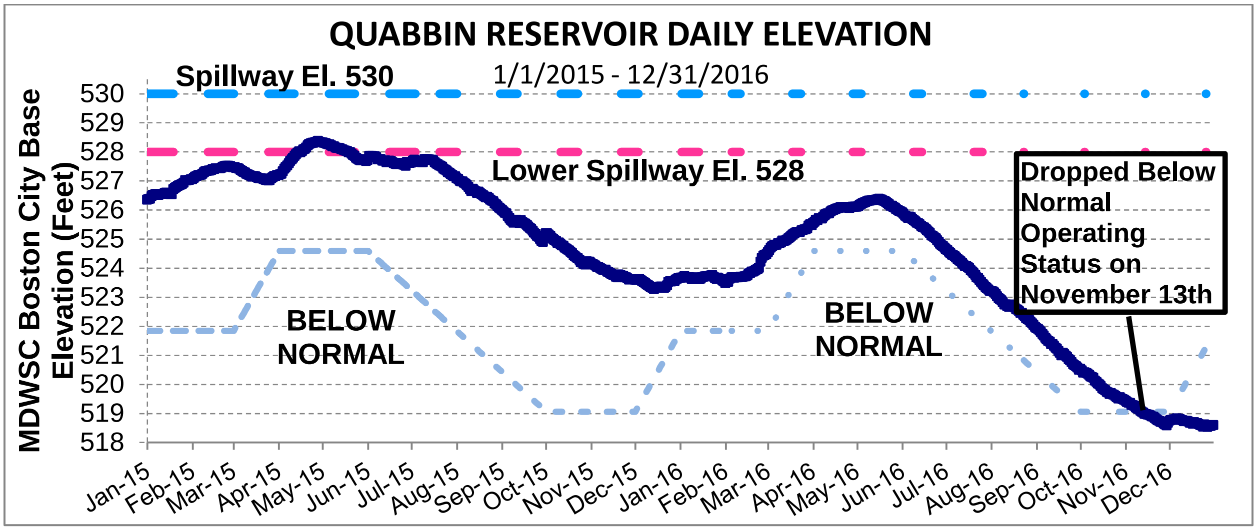


Figure 3. Quabbin Reservoir Daily Elevation, January 2015 - December 2016

(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 all 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 2016, 412 MG were transferred from the Ware River to the Quabbin Reservoir over a four-day period in March. The average daily flow at the USGS stream gauge near the Shaft 8 intake works was 57.0 MGD (88 cfs) in 2016. The hydrograph and statistics of 2016 flow in the Ware River is included in **Appendix A**.

1.4 Climatic Conditions

In general, temperatures were above average and precipitation was below average in Massachusetts during 2016. These conditions reflected the drought conditions throughout the Northeast. Near the Quabbin Reservoir, drought conditions were observed from June through December, 2016. Drought conditions were classified as moderate in June, severe from July through August, and extreme from September through December.

Daily precipitation has been recorded at the Belchertown monitoring station since 1939 (78 years). In 2016, the total precipitation was 32.38 inches, which is almost 14 inches less than the 78-year long-term average (46.24 inches). The only month in which precipitation exceeded the long-term average was February. Precipitation equaled the long-term average in August. Monthly precipitation totals were below the long-term average for the other ten months of the year. Moreover, monthly precipitation totals were below normal (i.e., below the 20th percentile for that month) for the months of January, April, May, June, and October. In addition, total snowfall for the year was approximately 14 inches below the long-term average.

Temperatures in Massachusetts were generally above average in 2016, in comparison to the 122-year record (NCDC, 2017). Only one average monthly temperature (April) was below the long-term average. Monthly averages ranged from 2.9 to 11.5 degrees above average during the winter (December, 2015 - February, 2016), and December, 2015 was the warmest December on record. Spring (March - May) average temperatures ranged from 5.7 degrees above average (March) to -1.0 degree below average (April). Summer (June - August) temperatures were hotter than average, and August, 2016 was the hottest August on record. Fall temperatures (September - November) ranged from 1.3 to 3.2 degrees above average, and September, 2016 was the fifth hottest September on record.

The 2016 North Atlantic hurricane season was below average to average, with a total of 15 named storms (those that reached at least tropical storm strength). Seven of the 15 storms were hurricanes, three of which were major hurricanes. The number of tropical storms (eight) was below the long-term annual average of 12.1, but the number of hurricanes and major hurricanes were close to long-term annual averages (6.4 and 2.7, respectively) (NCDC, 2017).

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, supporting ongoing evaluations of threats to water quality (referred to as Environmental Quality Assessments, or EQAs).

2.1 Sample Site Locations

In 2016, water quality was regularly monitored at 26 surface water monitoring sites in the Quabbin Reservoir and Ware River watersheds. Sampling locations included major tributaries to Quabbin Reservoir, certain minor 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 26 monitoring sites, 14 were located within the Quabbin Reservoir watershed and nine were located in the Ware River watershed. The other three sampling sites were located in different areas of 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 snapshot of water quality within a specific portion of each watershed.

In 2016 EQA sampling included sites in the Quabbin Northwest Sanitary District (of the Quabbin Reservoir watershed) and the East Branch Ware River Sanitary District (of the Ware River watershed). The Quabbin EQA sites were previously monitored in 2011 and 2012 as well as from March 2005 through April 2007. The Ware River EQA sites were previously monitored in 2012, as well as from May 2007 through December 2008.

Table 2. Quabbin Reservoir Tributaries
2016 Surface Water Monitoring Sites

		Basin Characteristics		
Tributary and Monitoring Site Description	**DWSP Sample Site #**	**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%
QUABBIN NORTHWEST SANITARY DISTRICT EQA SITES [2]				
West Branch Swift River (Sibley)	211E	3.85	3.0%	41.9%
West Branch Swift River (New Boston)	211F	6.84	4.0%	44.9%
West Branch Swift River (Cooleyville)	211G	1.73	2.1%	58.0%
Hop Brook at Gate 22	212A	0.95	2.1%	38.0%
Hop Brook at Gate 24	212B	3.39	2.7%	29.1%
Middle Branch Swift River at Fay Road	213A	7.5	7.8%	12.8%
Middle Branch Swift River at Elm Street	213B	4.78	4.9%	18.3%

Notes:

[1]Core Sites: Samples collected biweekly for field parameters, turbidity, bacteria, and calcium. Samples for 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.

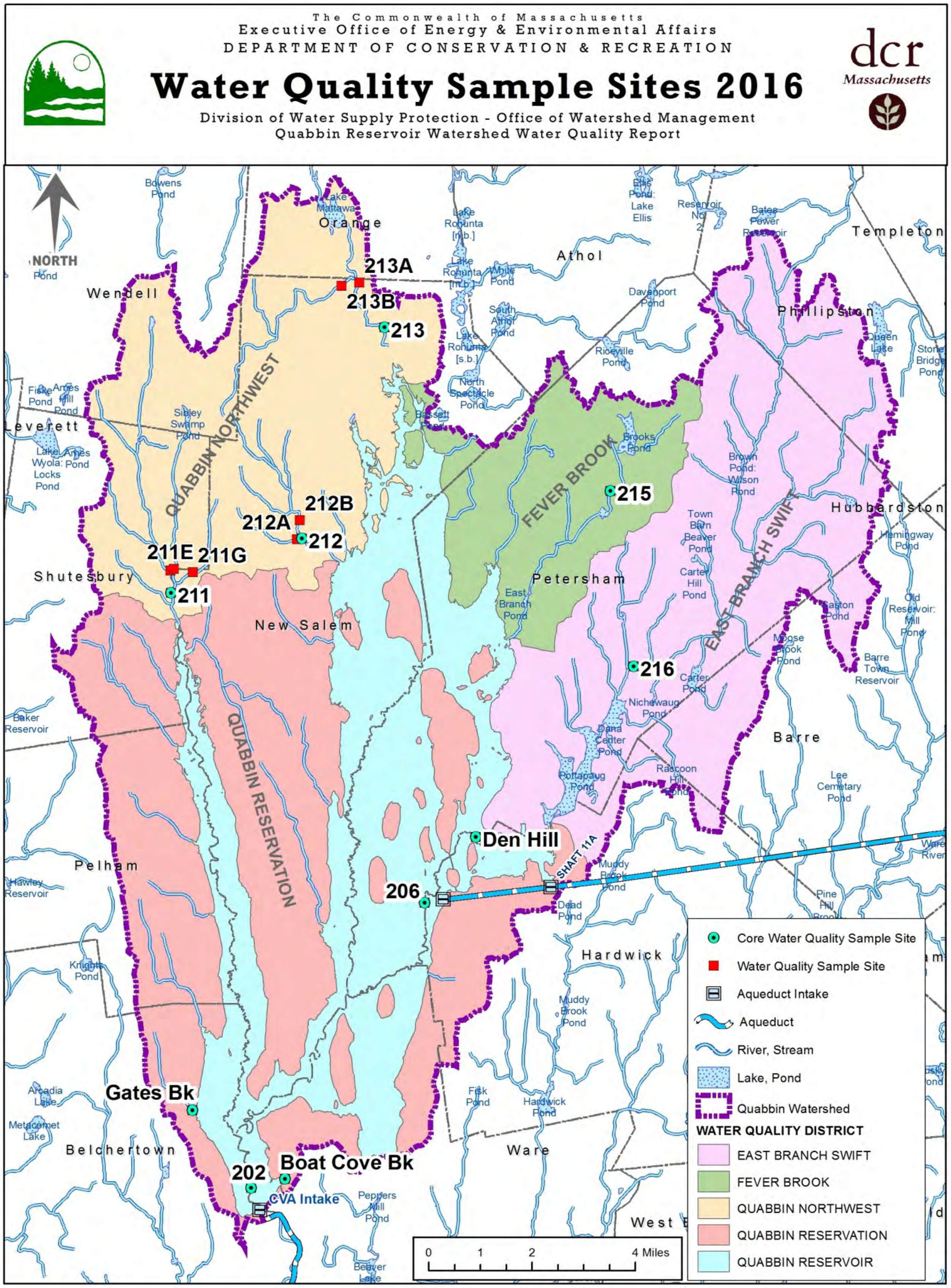


Figure 4. Hydrology, Sanitary Districts, and Water Quality Monitoring Sites for Calendar Year 2016 in the Quabbin Reservoir Watershed

Table 3. Ware River Tributaries
2016 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]				
Barre Falls Dam, upstream of dam	105	55.0	16.3%	34.1%
Whitehall Pond Outlet at Rutland State Park	110	5.29	17.6%	36.8%
Mill Brook at Charnock Hill Road	121	3.42	15.6%	9%
Moulton Pond Tributary at Britney Drive	121H	0.38	6.8%	0%

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 as of 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.

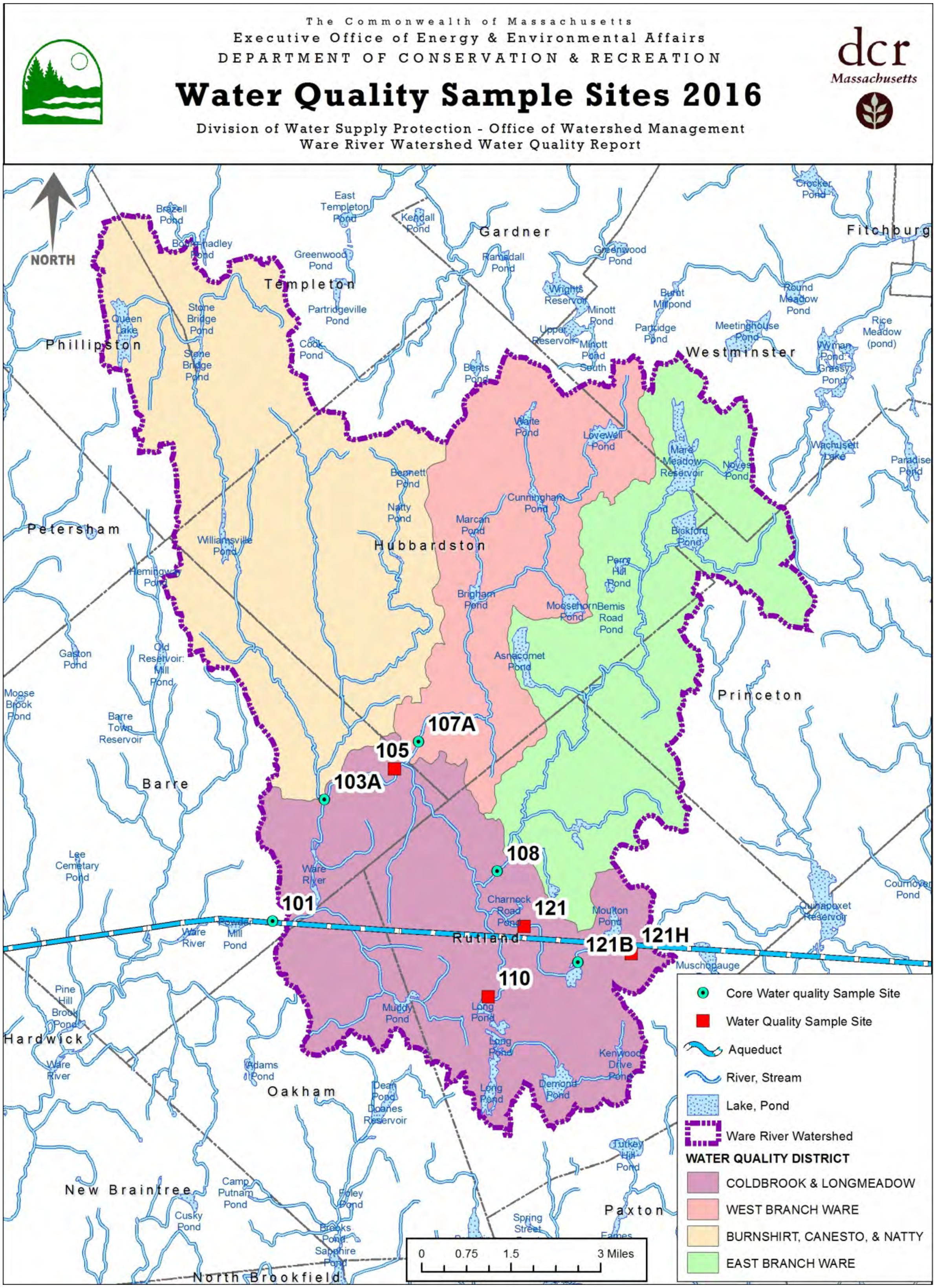


Figure 5. Hydrology, Sanitary Districts, and Water Quality Monitoring Sites for Calendar Year 2016 in the Ware River Watershed

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 computer 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). Reservoir 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 each tributary site 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 health 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 included temperature, dissolved oxygen, pH, and specific conductance. Data are stored digitally using a Eureka Amphibian personal digital assistant (PDA) and transferred to a Microsoft Access 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

In 2016, Environmental Quality staff collected 3,122 source water (tributary and reservoir) samples. Of those samples, 691 (22%) were collected for microbial analysis, 664 (21%) for physicochemical properties, and the remaining 1,767 samples (57%) were collected for nutrient analysis. Over 5,400 individual analyses were performed on these samples, of which 46% were nutrient analyses performed at the MWRA Central Laboratory at Deer Island. The remaining analyses were 51% physiochemical parameters (1,480) and 49% bacterial analyses (1,408) performed by MWRA staff at Quabbin Laboratory. MWRA staff at Quabbin Laboratory also processed and analyzed 366 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 Eureka Manta Multiprobe. All records are maintained in permanent bound books and in a digital format (Microsoft Access 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 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. 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. The DWSP and MWRA have maintained a waiver from the filtration requirement since 1989.

The SWTR standard for fecal coliform bacteria requires that no more than 10 percent of source water samples (prior to disinfection) over any six month period shall exceed 20 colonies per 100 mL. To ensure compliance, the MWRA monitors the bacterial quality of Quabbin Reservoir water at a point prior to disinfection, inside the BWTF, on a daily basis. Daily fecal coliform bacteria results from July 2015 through December 2016 are shown on **Figure 6**. As indicated, fecal coliform bacteria were detected above 20 CFU/100 mL in one sample during this time period. This result, 29 CFU/100 mL on January 4, was most likely related to an abrupt increase in gulls and strong winds from the north. In 2016, fecal coliform bacteria averaged less than one CFU/100 mL, and were not detected 84 percent of the time; the median concentration was less than one CFU/100 mL.

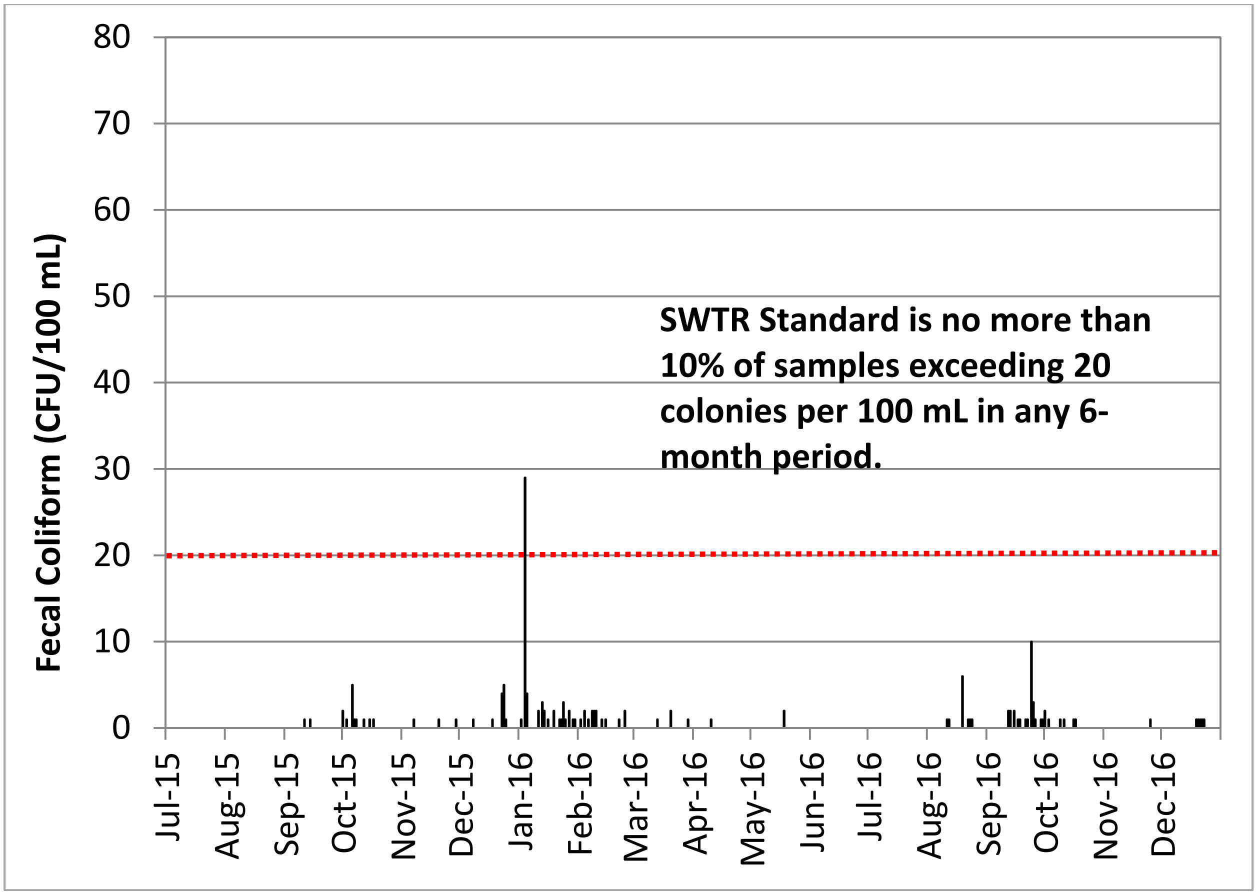


Figure 6. Fecal Coliform Bacteria Concentration prior to Disinfection, Quabbin Reservoir Source Water

The U.S. EPA SWTR maximum standard for turbidity is 5 NTU, while the Massachusetts Department of Environmental Protection (MassDEP) has adopted a more stringent performance standard of 1 NTU. MWRA monitors turbidity levels prior to disinfection using an on-line turbidity meter located inside the BWTF. Daily average and maximum turbidity levels for 2016 are shown on **Figure 7**, with the 1 NTU performance standard shown by the red dashed line. As indicated, turbidity exceeded the MassDEP performance standard two times during 2016, first on February 2 (2.28 NTU) and again on June 20 (1.16 NTU) (MWRA, 2017). In 2016, turbidity levels averaged 0.29 NTU. Both of these spikes were due to valve operations at the CVA intake, and were of short duration (30 minutes maximum) with no impacts on disinfection effectiveness.

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 2016, 26 samples were collected and analyzed. Neither *Giardia* nor *Cryptosporidium* were detected in 2016. Monitoring for these two pathogens in 2017 is continuing on the biweekly basis.

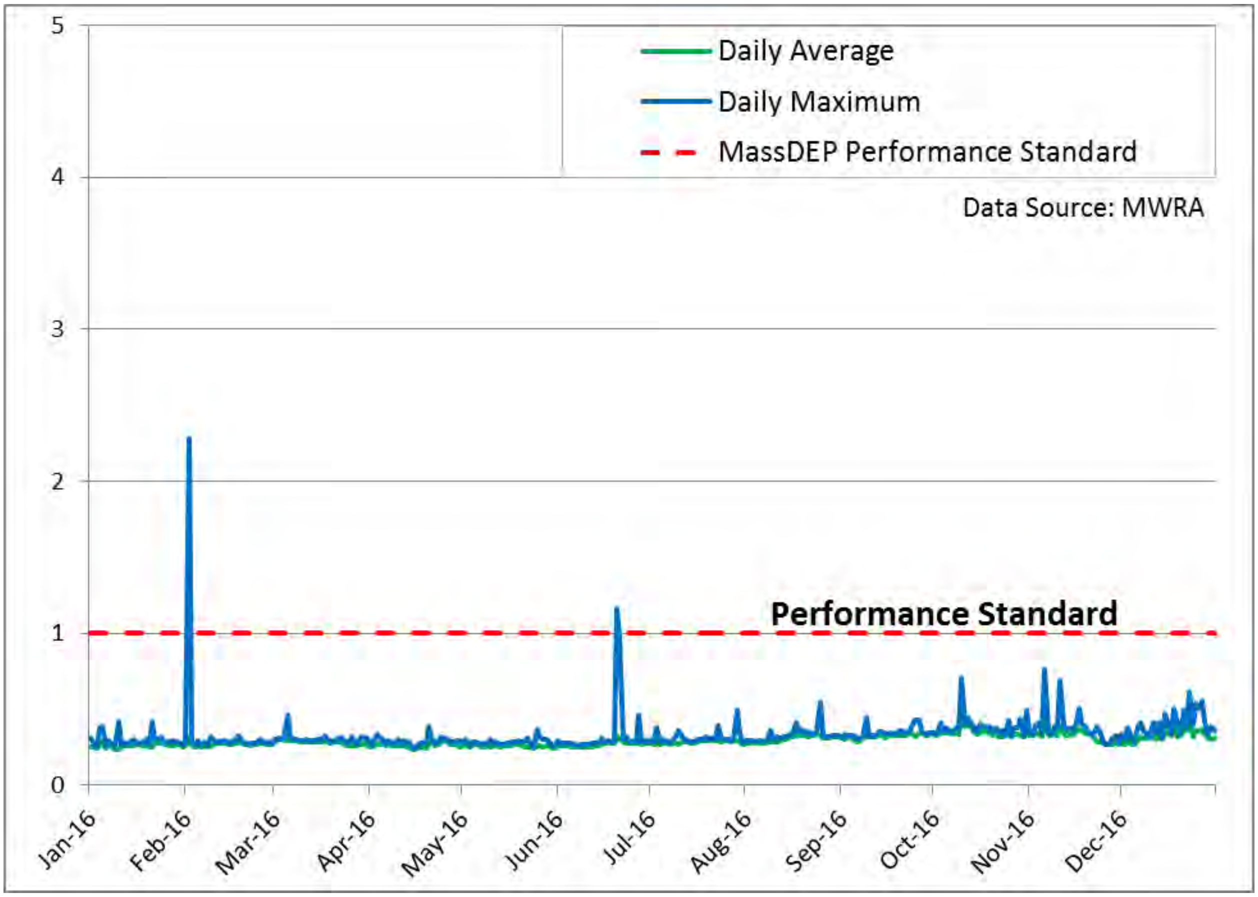


Figure 7. Quabbin Reservoir Source Water Turbidity (at the BWTF)

3.1 Results – Reservoir Monitoring

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 2016 are summarized in **Table 5**. Sample site locations are shown on **Figure 4**.

Table 5. 2016 Quabbin Reservoir Water Quality Monitoring Sites

Site (Site ID)	Location	Approximate Depth to Bottom
Winsor Dam (QR202)	Quabbin Reservoir west arm, off shore of Winsor Dam along former Swift River riverbed	42 meters
Shaft 12 (QR206)	Quabbin Reservoir at site of former Quabbin Lake, off shore of Shaft 12	28 meters
Den Hill (QR10)	Quabbin Reservoir eastern basin, north of Den Hill	19 meters

General water quality at three sites monitored in 2016 is summarized in **Table 6**. The analytical data from each site are included in **Appendix B**. Reservoir monitoring results are discussed below, along with a brief summary of the significance of each parameter to water quality. It should be noted that reservoir samples were collected twice in October due to a courier problem with certain samples. Samples collected on October 12, 2016 were analyzed for turbidity, alkalinity, fecal coliform, *E. coli*, and total coliform. Samples collected on October 20, 2016 were analyzed for turbidity, alkalinity, and nutrients.

Table 6. General Water Quality Ranges, 2016 Quabbin Reservoir Monitoring Sites

Reservoir Site (Site ID)	**Temper-ature** (°C)	**Dissolved Oxygen** (% Saturation)	**Turbidity** (NTU)	**pH (Field)** (units)	**Secchi Disk Transparency** (meters)	**Fecal Coliform Bacteria** (CFU/100mL)
Winsor Dam (202)	4.89-24.9	61-124	0.206-0.398	5.8-7.1	8.0-14.3	<1-1
Shaft 12 (206)	5.34-25.2	75-120	0.237-0.471	5.9-7.1	7.4-13.6	<1-1
Den Hill (10)	6.08-25.9	23-112	0.335-1.68	5.7-7.2	4.9-9.0	<1-7

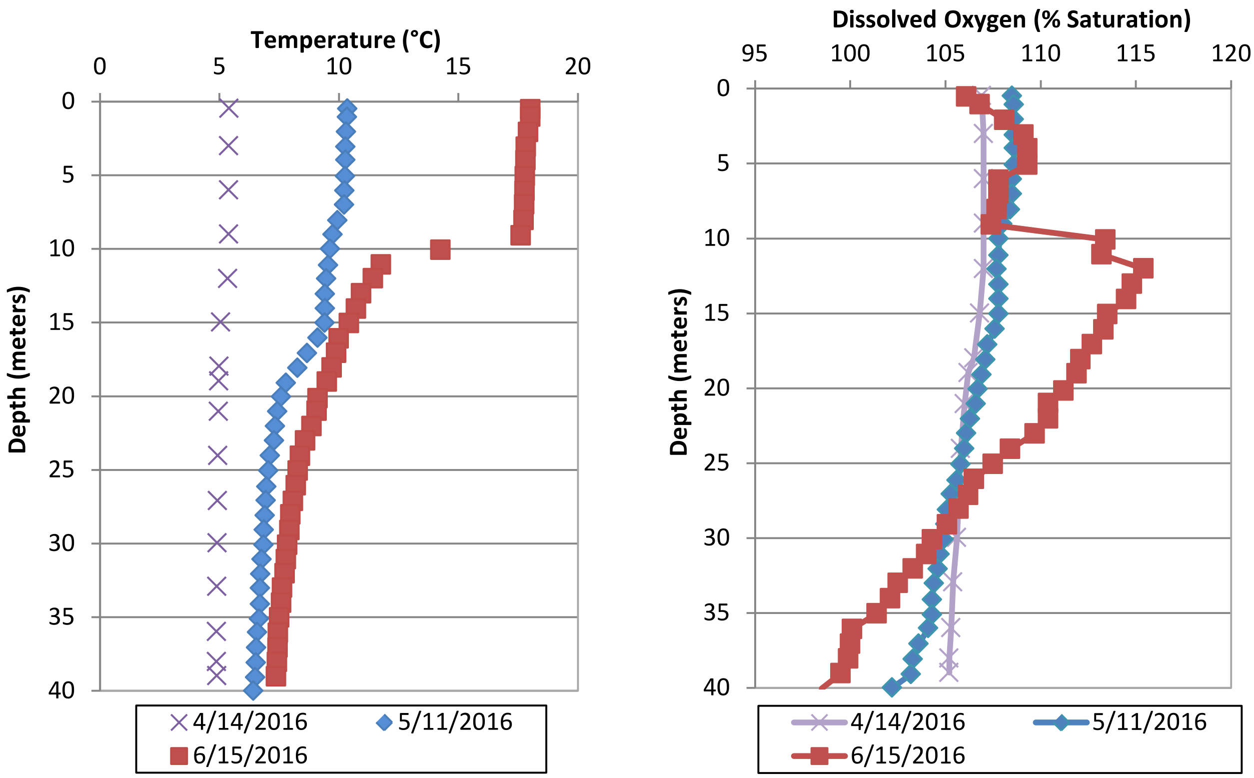
Source: Environmental Quality Database, 2016

3.1.1 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,** and profiles for the three sites are included in **Appendix A**. The Site 202 and Site 206 temperature profiles indicate fall turnover likely occurred in late October through November. The water column at 206 was mixed to 17 meters on October 20 and completely mixed on November 2. The water column at 202 was mixed to 21 meters on November 2 and completely mixed on December 6.

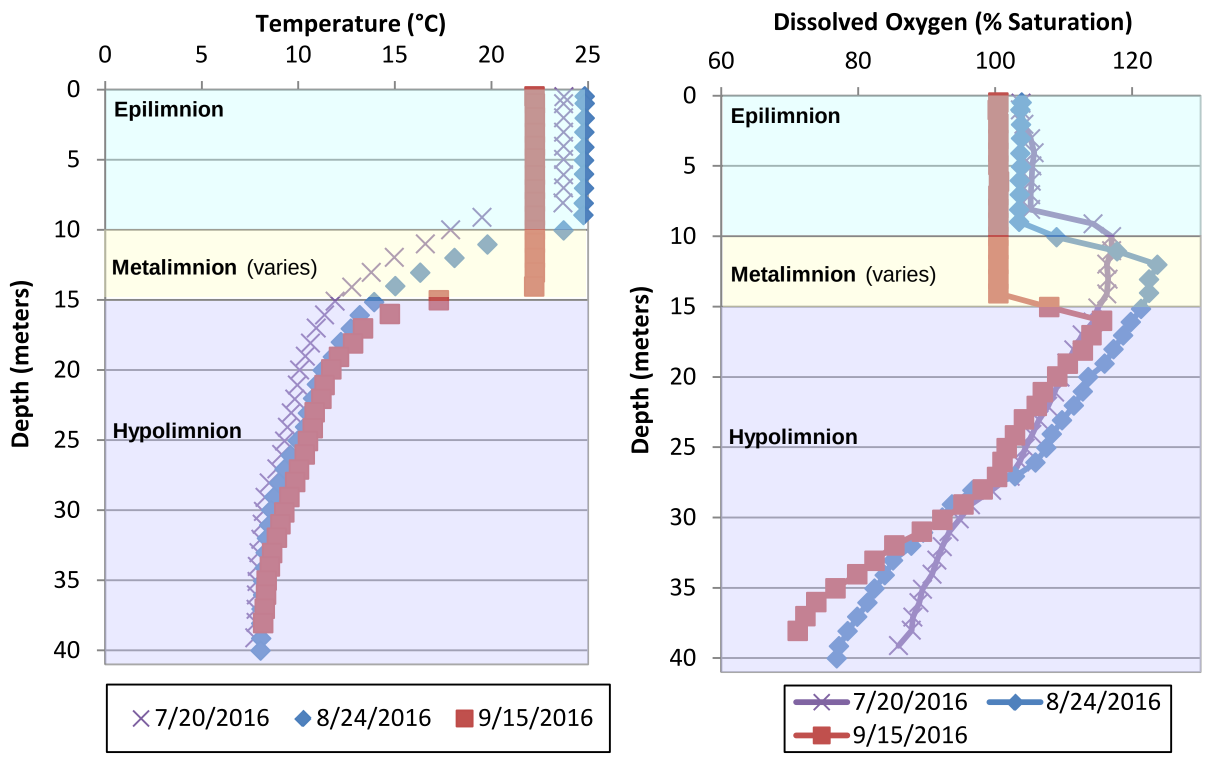
3.1.2 Dissolved Oxygen

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). Available oxygen also plays an important role in preventing the leaching of potentially harmful metals trapped among the bottom sediments. 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.

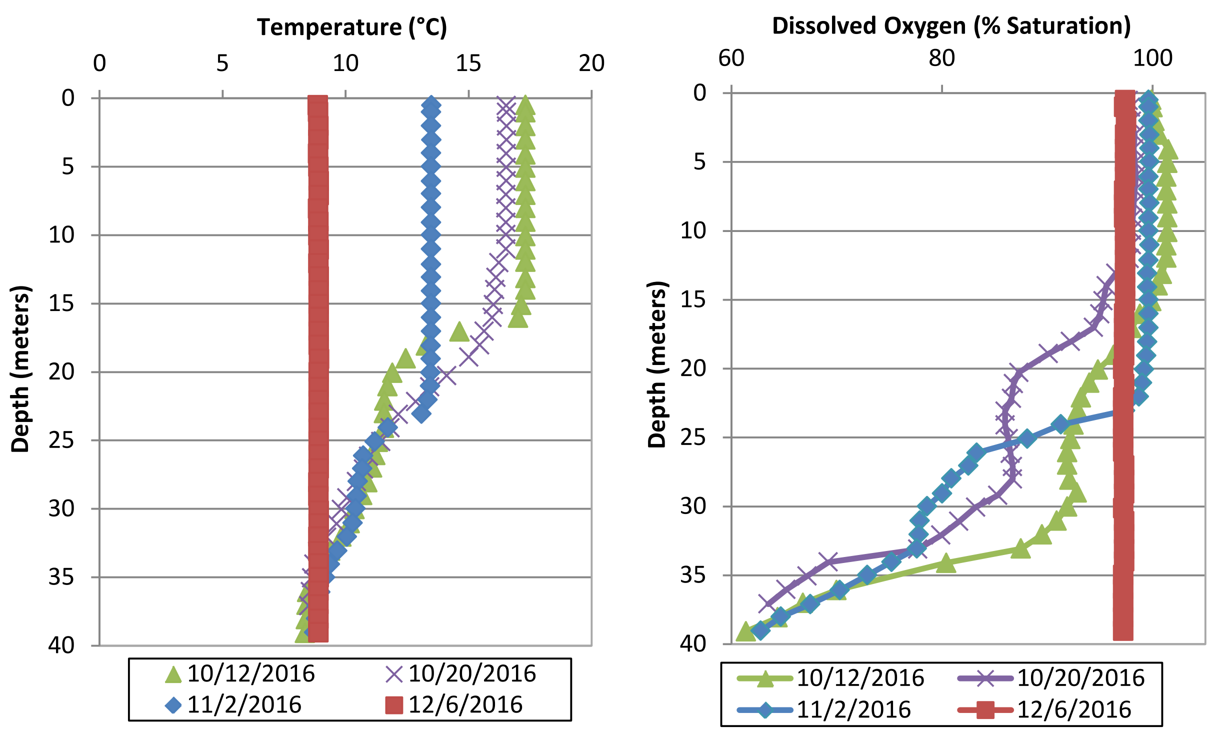


(a) April - June 2016

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



(b) July- September 2016



(c) October - December 2016

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

In 2016, minimum levels of oxygen measured in the hypolimnion ranged from 23 percent saturation at Den Hill (on October 12 at 16 meters) to 61 percent saturation at Site 202 (on October 12 at 39 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 2016 were 2.49 mg/L at Den Hill (on October 12 at 16 meters), 7.17 mg/L at Site 202 (on October 12 at 39 meters), and 7.96 mg/L at Site 206 (on October 20 at 25 meters). The seasonal development and breakdown of stratification for Site 202 are shown in **Figure 8**, and profiles for all three reservoir monitoring sites are included in **Appendix A**.

3.1.3 Turbidity

Reservoir turbidity levels are historically very low and stable, reflective of the low productivity of the reservoir. In 2016, measured turbidity levels ranged from 0.206 to 1.68 NTU. The highest turbidity level was measured at 16 meters depth on October 12 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 October 12 was likely due to storm activity, because 0.54 inch of rain was recorded at the Barre Falls Dam station on October 10, 2016. Near-shore areas are also prone to elevated turbidity levels due to the action of waves that may re-suspend shoreline sediment and deposits. Moreover, the reservoir was at relatively low levels during October due to drought conditions, which may have exposed more soil along the shoreline that could contribute sediment to turbidity via wave action.

3.1.4 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, 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 6.53 across the three sites monitored in 2016.

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 3.92 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 to a pH endpoint of 4.5, versus "EPA," representing alkalinity to a pH endpoint 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 5.58 mg/L as $CaCO_3$ across the three reservoir sites.

3.1.5 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 2016, the maximum measured transparency was 14.3 meters at Site 202 on May 11.

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 via Shaft 11A (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 2016, minimum transparency was measured at 4.9 meters at Den Hill on April 14. Monthly transparency measurements and weather observations are summarized in Tables 7, 8, and 9.

Table 7. Transparency Measurements and Weather and Water Surface Observations in 2016, Quabbin Reservoir Site 202 (Winsor Dam)

Date	Transparency (m)	Water Color	Weather and Water Surface Observations
April 14, 2016	8.0	Light green	Most sunny, 5°C (41°F), N wind 5 to 8 mph, 10 to 12″ chop.
May 11, 2016	14.3	Green	Sunny, 9°C (48°F), calm wind, calm water surface.
June 15, 2016	11.5	Light green	Mostly sunny, 20°C (68°F), SW wind 1 mph, slight ripple.
July 20, 2016	13.2	Blue-green	Mostly sunny, 22°C (72°F), calm wind, calm water surface
August 24, 2016	12.1	Blue-green	Sunny, 20°C (68°F), SW wind 1 mph, slight ripple.
September 15, 2016	10.4	Green	Sunny, 12°C (54°F), N wind 5 to 8 mph, 8 to 12″ chop.
October 12, 2016	8.9	Blue-green	Mostly sunny, 11°C (52°F), S wind 1 mph, slight ripple
October 20, 2016	8.0	Blue-green	Mostly sunny, 14°C (57°F), N wind 2 to 3 mph, 4 to 6″ chop.
November 2, 2016	9.3	Blue-green	Partly cloudy, 11°C (52°F), SW wind 1 mph, slight ripple.
December 6, 2016	9.7	Brown-green	Mostly sunny, 0°C (32°F), N wind 1 mph, slight ripple.

Table 8. Transparency Measurements and Weather and Water Surface Observations in 2016, Quabbin Reservoir Site 206 (Shaft 12)

Date	Transparency (m)	Water Color	Weather and Water Surface Observations
April 14, 2016	7.8	Light green	Mostly sunny, 9°C (48°F), N wind 2 to 5 mph, 4 to 6″ chop.
May 11, 2016	13.6	Green	Sunny, 15°C (59°F), Calm wind, calm water surface.
June 15, 2016	9.2	Light green	Mostly sunny, 24°C (75°F), S wind 1 mph, slight ripple.
July 20, 2016	12.2	Green	Mostly sunny, 24°C (75°F), NW wind 1 mph, slight ripple.
August 24, 2016	9.0	Blue-green	Sunny, 25°C (77°F), S wind 3 to 5 mph, 6 to 8″ chop.
September 15, 2016	9.8	Blue-green	Sunny, 14°C (57°F), N wind 2 to 5 mph, 4 to 6″ chop.
October 12, 2016	7.4	Blue-green	Mostly sunny, 13°C (55°F), S wind 2 to 5 mph, 4 to 6″ chop
October 20, 2016	8.0	Green	Mostly sunny, 16°C (61°F), NE wind 2 to 3 mph, 4 to 6″ chop.
November 2, 2016	9.3	Green	Partly cloudy, 14°C (57°F), S wind 5 to 7 mph, 12″ chop.
December 6, 2016	10.3	Blue-green	Mostly sunny, 6°C (43°F), calm wind, calm water surface.

Table 9. Transparency Measurements and Weather and Water Surface Observations in 2016, Quabbin Reservoir Site Den Hill

Date	Transparency (m)	Water Color	Weather and Water Surface Observations
April 14, 2016	4.9	Brown-green	Mostly sunny, 9°C (48°F), N wind 2 to 5 mph, 4 to 6″ chop.
May 11, 2016	6.5	Brown	Sunny, 18°C (64°F), N wind 2 to 3 mph, 4 to 6″ chop.
June 15, 2016	7.8	Brown	Partly cloudy, 26°C (79°F), NW wind 1 mph, slight ripple.
July 20, 2016	8.7	Green	Mostly sunny, 24°C (75°F), NW wind 1 mph, slight ripple.
August 24, 2016	9.0	Blue-green	Sunny, 27°C (81°F), SW wind 1 mph, slight ripple.
September 15, 2016	7.4	Green	Mostly sunny, 16°C (61°F), N wind 1 to 2 mph, slight ripple.
October 12, 2016	7.3	Brown-green	Mostly sunny, 17°C (63°F), SW wind 1 to 3 mph, 2 to 4″ chop
October 20, 2016	6.5	Brown-green	Mostly cloudy, 17°C (63°F), SE wind 2 to 3 mph, 4 to 6″ chop.
November 2, 2016	7.4	Brown	Partly cloudy, 14°C (57°F), SW wind 1 to 3 mph, 2 to 4″ chop.
December 6, 2016	7.5	Olive-green	Mostly cloudy, 5°C (41°F), N wind 3 to 5 mph, 4 to 6″ chop.

3.1.6 Coliform and *E. coli* Bacteria

The term "coliform" describes a group of bacteria based on biochemical functions, not on taxonomy. Both "total" coliform and "fecal" coliform bacteria can indicate fecal contamination, but total coliforms may include many species that are natural inhabitants of the aquatic system and the environment (Wolfram, 1996; Dutka and Kwan, 1980). The "fecal" coliform group is a subset of the total coliform group that can grow at temperatures comparable to those in the intestinal tracts of warm-blooded animals (Toranzos and McFeters, 1997). Because of this ability to grow at elevated temperatures, the fecal coliform group may be considered a better indicator of recent fecal pollution. However, this group 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 therefore a better indicator of recent fecal pollution in temperate climates.

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 2016, fecal coliform bacteria were detected in several reservoir samples, and most detections were 1 CFU/100 mL. The only fecal coliform detection greater than 1 CFU/100 mL was the Den Hill 6-meter sample in September, in which the result was 7 CFU/100 mL. The other detections at Den Hill included the samples collected from 13 meters in September, October, and November. At Site 202, fecal coliform bacteria were detected in the 6-meter sample in September, as well as the 18-meter samples in September and December. At Site 206, fecal coliform bacteria were detected in the 24-meter sample in October. *E. coli* were detected two times in 2016 at the detection limit of 10 MPN/100 mL. These detections were in the 0.5-meter sample at Site 202 in December and in the 6-meter samples at Den Hill in June.

Reservoir total coliform bacteria concentrations are much more dynamic than fecal coliform and *E. coli*, and ranged from not detected (less than 10) to 4,880 MPN/100 mL in 2016. The total coliform concentration of 4,880 MPN/100 mL was measured in the 18-meter sample from Site 202 in September. 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.

3.1.7 Reservoir Nutrient Dynamics and Phytoplankton

The nutrient database for Quabbin Reservoir established in the 1998-99 year of monthly sampling and subsequent quarterly sampling through 2015 is used as a basis for interpreting data generated in 2016 (see **Table 10**). Results of quarterly nutrient sampling in 2016 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 all three depths at Site 202 and 206, as well as most of the samples at Den Hill. Total phosphorus concentrations were generally below or just above the detection limit of 5 µg/L, with a maximum of 11 µg/L detected at Den Hill in October. These low ammonia and phosphorus concentrations may be factors limiting the growth of phytoplankton in 2016. Typically, phosphorus is the limiting nutrient in Quabbin Reservoir and other lakes in temperate climates (Worden, 2000).

In general, the patterns of nutrient distribution in 2016 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

Table 10. Quabbin Reservoir Nutrient Concentrations:
Comparison of Ranges from 1998-2015 Database to Results from 2016 Quarterly Sampling (after Worden, 2013)

Sampling Site	Ammonia (NH3; µg/L) 1998-2015	Ammonia (NH3; µg/L) Quarterly 2016	Nitrate (NO3; µg/L) 1998-2015	Nitrate (NO3; µg/L) Quarterly 2016	Silica (SiO2; mg/L) 1998-2015	Silica (SiO2; mg/L) Quarterly 2016	Total Phosphorus (µg/L) 1998-2014	Total Phosphorus (µg/L) Quarterly 2016	UV254 (Absorbance/cm) 1998-2015	UV254 (Absorbance/cm) Quarterly 2016
WD/202 (E)	<5 - 16	<5	<5 - 23	<5 - 6	0.84 - 2.40	1.59 - 2.01	<5 - 20	<5 - 7	0.017 - 0.029	0.017 - 0.020
WD/202 (M)	<5 - 29	<5	<5 - 27	<5 - 6	0.83 - 2.42	1.67 - 2.12	<5 - 13	<5 - 5	0.017 - 0.031	0.017 - 0.019
WD/202 (H)	<5 - 53	<5 - 11	<5 - 54	<5 - 7	1.08 - 2.86	1.70 - 2.22	<5 - 44	<5 - 7	0.017 - 0.026	0.017 - 0.019
MP/206 (E)	<5 - 10	<5	<5 - 20	<5	0.84 - 2.24	1.51- 1.77	<5 - 12	<5	0.017 - 0.031	0.017 - 0.020
MP/206 (M)	<5 - 34	<5	<5 - 44	<5	0.84 - 2.25	1.50 - 1.75	<5 - 12	<5	0.017 - 0.031	0.017 - 0.026
MP/206 (H)	<5 - 105	<5	<5 - 130	<5	1.02 - 3.27	1.46 - 1.86	<5 - 19	<5 - 6	0.018 - 0.031	0.017 - 0.022
Den Hill (E)	<5 - 19	<5 - 12	<5 - 45	<5 - 12	0.74 - 4.64	1.40 - 2.57	<5 - 27	5 - 9	0.025 - 0.122	0.023 - 0.054
Den Hill (M)	<5 - 28	<5 - 14	<5 - 58	<5 - 11	0.84 - 4.37	1.24 - 2.30	<5 - 15	5 - 7	0.027 - 0.139	0.022 - 0.049
Den Hill (H)	<5 - 84	<5 - 12	<5 - 78	<5 - 11	0.83 - 4.25	1.59 - 2.48	<5 - 15	6 - 11	0.028 - 0.171	0.023 - 0.048

Notes: (1) 1998-2014 database composed of 1998-99 year of monthly sampling and subsequent quarterly sampling conducted through December 2014, except for measurement of UV254 initiated in 2000 quarterly sampling.
(2) 2015 quarterly sampling conducted May, July, October, and December.
(3) Water column locations are as follows: E = epilimnion/surface, M = metalimnion/middle, H = hypolimnion/bottom

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.

In 2016, 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* and *Aphanocapsa*. The phytoplankton species observed in Quabbin Reservoir are "typical of many oligotrophic systems located in the temperate zone" with low densities in 2016, averaging 164 ASU/mL at Site 202 and 176 ASU/mL at Site 206 (Packard, 2016; see **Appendix C**). Diatoms dominated early in the year, reaching 495 ASU/mL at Site 206 in April, and declined thereafter. The highest total phytoplankton concentration (592 ASU/mL at Site 202) was also observed in April. Cyanophyte density began increasing at both sites in late summer, reaching a maximum of 248 ASU/mL at Site 206 in September. Phytoplankton monitoring is proposed to continue with the same schedule and locations in 2017.

In quarterly sampling for 2016, calcium concentrations ranged from 1.93 mg/L to 2.18 mg/L at the three reservoir sites. These results are consistent with historical ranges for the reservoir, and the levels indicate a low risk of zebra mussel colonization in the reservoir.

3.2 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. Water quality data from 2000 through 2009 were reviewed in 2011 to evaluate longer-term trends in water quality monitoring and analysis. This 10-year data review (http://www.mass.gov/eea/docs/dcr/watersupply/watershed/quabbinwq2000to2009.pdf) can help guide ongoing data evaluation in the Quabbin Reservoir and Ware River watersheds.

3.2.1 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 includes total coliform, fecal coliform, and *E. coli* bacteria. In 2016, monitoring for fecal coliform was reduced from biweekly monitoring of tributaries in both watersheds to weekly monitoring of two Quabbin Reservoir tributaries from September (of 2016) through March (of 2017). This change was made to reduce laboratory workload and to reflect the use of *E. coli* as the sanitary indicator in the Class A standards for non-intake waters. The tributaries monitored for fecal coliform are the two located nearest to the CVA intake, Boat Cove Brook and Gates Brook. Fecal coliform monitoring was continued on a limited basis in these tributaries to assess for potential sources of fecal coliform near the CVA other than wintering gulls.

If elevated bacteria results are detected after tributary sampling that do not appear attributable 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**.

3.2.1.1 E. coli Bacteria

In 2016, the *E. coli* results ranged from less than 10 MPN/100 mL to 6,870 MPN/100 mL. The maximum concentration was detected in the Quabbin Reservoir watershed at Site 211 on August 2, and occurred following heavy rainfall during the early morning hours of that day. In total, approximately two inches of rain fell in the area during the three days prior to sampling. The maximum concentration detected in the Ware River watershed was 644 MPN/100mL at Site 121H on December 27.

New historical maximum values were recorded in 2016 for ten sites in the Quabbin Reservoir watershed and no sites in the Ware River watershed. Nine of the ten maximums were measured in samples collected on August 2 (after heavy rainfall, as described above). Historical maximums on August 2 included Sites 211 (6,870 MPN/100 mL), 212 (5,480 MPN/100 mL), 215 (2910 MPN/100 mL), 211E (231 MPN/100 mL), 211F (1,350 MPN/100 mL), 211G (2,380 MPN/100 mL), 212A (4,610 MPN/100 mL), 212B (5,480 MPN/100 mL), and 213B (798 MPN/100 mL). A follow up inspection with re-sampling was not performed because the storm event was the primary factor in the elevated results.

The tenth historical maximum was measured in the sample collected from 213A on April 26 (3,450 MPN/100 mL). This site (and Boat Cove Brook) was inspected and re-sampled, and the inspection report (**Appendix C)** indicated the elevated results were likely due to storm flushing.

The six-month, running geometric means of three sites in the Quabbin Reservoir watershed and two sites in the Ware River watershed exceeded 126 MPN/mL in late summer or fall of 2016. In the Quabbin Reservoir watershed, running geometric-mean exceedances occurred at Boat Cove Brook (September 27-December 20), Site 212 (October 11-December 7), and Site 213A (September 27-October 25). In the Ware River watershed, the exceedances occurred at Site 121H (October 18-November 1 and December 27) and Site 103A (November 1).

In addition, 13 of 14 Quabbin tributary sites and 6 of 9 Ware River tributary sites exceeded the Class A Standard of 235 colonies per 100 mL in at least one sample. The only sites where this standard was not exceeded were Site 211E in the Quabbin Reservoir watershed and Sites 101, 108, and 110 in the Ware River watershed. The individual standard was exceeded on ten dates: March 29 (Site 212B), April 26 (Site 213A and Boat Cove Brook), May 24 (Sites 213, 213A, and 215), June 7 (Boat Cove Brook), June 21 (Site 211), July 5 (Sites 211, 211F, 211G, 212 plus a follow-up sample, 212B, 215, and Boat Cove Brook), August 2 (all except Site 211E), August 16 (Sites 212, 212B, and 213A), September 13 (Sites 212A and 215), and September 27 (Sites 211, 212A, 212B, 213A, Boat Cove Brook, and Gates Brook). In the Ware River watershed, the individual sample standard was exceeded on nine dates: May 3 (Site 121H), June 28 (Sites 103A, 121B, and 121H), July 13 (Site 103A), July 26 (Site 103A), August 23 (Sites 121B and 121H), September 6 (Site 121H), September 20 (Sites 105, 107A, and 121H), October 4 (Site 121), and December 27 (Site 121H).

The geometric running average exceedances and the individual sample exceedances are likely due to flushing during storm events. As described above, samples collected on August 2 from Quabbin Reservoir tributaries were impacted by an early morning storm event. A number of other sample dates were also impacted by storm events, as documented in follow-up reports. These include March 29, April 26, May 24, June 7, September 6, and September 27. The Class A standard exceedances may also be related to drought conditions and warm air temperatures, as described below.

E. coli data from 2016 were compared to historical results from each tributary site. The annual geometric means are shown in **Table 11**. The percentage of samples by site that exceeded 126 MPN/100 mL in individual samples is presented in **Table 12.** Similarly, the percentage of samples by site that exceeded 235 MPN/100 mL in individual samples is presented in **Table 13**.

Overall, the *E. coli* geometric means for Quabbin tributary core sites have generally been comparable from 2010 through 2015, but slightly higher than in 2006-2009. As shown in **Table 11**, the highest geometric mean at Quabbin core sites in 2016 was at Site 212, which was most likely due to beaver activity. The geometric means at Quabbin EQA sites in 2016 were higher than those in previous sampling years (2011-2012). In the Ware River watershed, the geometric means for the core sites were generally comparable to previous sampling. At Ware River EQA sites, geometric means in 2016 were comparable to previous monitoring in 2012.

In addition to wildlife activity, the drought conditions and elevated air temperatures of 2016 may have contributed to higher *E. coli* levels, including the geometric running average and individual sample exceedances of the Class A standards. Drought conditions lead to reduced water flow in tributaries, which can cause decreased dilution and increased *E. coli* concentrations. Higher air temperatures promote higher water temperatures, which can allow bacteria to live and reproduce for longer periods of time and lead to higher concentrations.

Table 11. Annual Geometric Means of *E.* coli for 2015 Tributary Sites

Site #	Monitoring Site Description	Geometric Mean (MPN/100 mL)							
		2016	2015	2014	2013	2012	2011	2010	2009
Quabbin Reservoir Watershed Core Sites									
211	W. Br. Swift River at Rte. 202	35.9	17.7	18.5	17.6	19.3	16.8	23.2	14.3
212	Hop Brook inside Gate 22	60.8	43.4	23.3	21.4	27.6	27.4	28.6	16.5
213	M. Br. Swift River at Gate 30	43.0	37.3	43.3	42.7	49.3	48.3	60.5	35.6
215	E. Br. Fever Brook at West St.	38.1	16.5	22.0	20.7	22.8	21.5	23.5	18.6
216	E. Br. Swift River at Rte. 32A	28.0	17.7	18.6	20.4	18.7	31.1	23.0	16.6
Gates	Gates Brook at mouth	20.5	17.5	16.1	18.5	24.1	18.2	25.7	16.0
BC	Boat Cove Brook at mouth	60.7	35.5	31.8	24.6	31.8	19.9	34.4	17.6
Quabbin Reservoir Watershed EQA Sites									
211E	W. Br. Swift River (Sibley)	16.3	N/A	N/A	N/A	14.6	13.1	N/A	N/A
211F	W. Br. Swift River (New Boston)	30.1	N/A	N/A	N/A	15.8	15.5	N/A	N/A
211G	W. Br. Swift River (Cooleyville)	31.3	N/A	N/A	N/A	20.5	18.4	N/A	N/A
212A	Hop Brook at Gate 22	31.8	N/A	N/A	N/A	19.9	22.2	N/A	N/A
212B	Hop Brook at Gate 24	46.3	N/A	N/A	N/A	44.5	27.0	N/A	N/A
213A	M. Br. Swift River at Fay Rd.	67.6	N/A	N/A	N/A	60.3	50.7	N/A	N/A
213B	M. Br. Swift River at Elm St.	27.4	N/A	N/A	N/A	26.0	31.2	N/A	N/A
Ware River Watershed Core Sites									
101	Ware River at Shaft 8 Intake	21.9	23.4	22.5	30.0	32.7	33.8	23.6	27.1
103A	Burnshirt River at Riverside Cemetery	42.6	37.7	39.9	28.9	25.1	28.7	39.0	23.8
107A	W. Br. Ware River at Brigham Rd.	21.7	27.1	21.9	24.6	21.8	20.9	24.1	24.2
108	E. Br. Ware at Intervale Rd.	27.8	29.2	25.4	32.1	23.6	35.4	34.3	26.4
121B	Thayer Pond at inlet	36.4	32.7	24.7	27.6	47.3	31.3	60.3	22.7
Ware River Watershed EQA Sites									
105	Barre Falls Dam	18.9	N/A	N/A	N/A	19.6	N/A	N/A	N/A
110	Whitehall Pond Outlet	10.4	N/A	N/A	N/A	11.9	N/A	N/A	N/A
121	Mill Brook at Charnock Hill Rd.	23.6	N/A	N/A	N/A	18.8	N/A	N/A	N/A
121H	Moulton Pond Tributary	64.5	N/A	N/A	N/A	44.4	N/A	N/A	N/A

N/A 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.

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

Site #	Monitoring Site Description	% of Samples > 126 MPN/100 mL							
		2016	2015	2014	2013	2012	2011	2010	2009
Quabbin Reservoir Watershed Core Sites									
211	W. Br. Swift River at Rte. 202	19	4	4	8	12	7	12	0
212	Hop Brook inside Gate 22	21	18	4	8	12	12	12	0
213	M. Br. Swift River at Gate 30	22	19	12	15	19	30	31	12
215	E. Br. Fever Brook at West St.	30	0	4	4	8	4	8	4
216	E. Br. Swift River at Rte. 32A	4	4	4	8	4	7	8	4
Gates	Gates Brook at mouth	12	4	4	4	15	8	8	4
BC	Boat Cove Brook at mouth	33	19	22	12	15	8	25	4
Quabbin Reservoir Watershed EQA Sites									
211E	W. Br. Swift River (Sibley)	8	N/A	N/A	N/A	0	0	N/A	N/A
211F	W. Br. Swift River (New Boston)	19	N/A	N/A	N/A	8	0	N/A	N/A
211G	W. Br. Swift River (Cooleyville)	15	N/A	N/A	N/A	8	8	N/A	N/A
212A	Hop Brook at Gate 22	19	N/A	N/A	N/A	12	8	N/A	N/A
212B	Hop Brook at Gate 24	18	N/A	N/A	N/A	19	12	N/A	N/A
213A	M. Br. Swift River at Fay Rd.	31	N/A	N/A	N/A	42	15	N/A	N/A
213B	M. Br. Swift River at Elm St.	4	N/A	N/A	N/A	15	19	N/A	N/A
Ware River Watershed Core Sites									
101	Ware River at Shaft 8 Intake	4	8	12	15	15	19	4	4
103A	Burnshirt River at Riverside Cemetery	27	22	24	17	4	10	23	5
107A	W. Br. Ware River at Brigham Rd.	8	8	12	4	4	8	8	9
108	E. Br. Ware at Intervale Rd.	12	8	12	11	0	8	4	8
121B	Thayer Pond at inlet	21	19	19	7	23	12	38	12
Ware River Watershed EQA Sites									
105	Barre Falls Dam	4	N/A	N/A	N/A	0	N/A	N/A	N/A
110	Whitehall Pond Outlet	0	N/A	N/A	N/A	0	N/A	N/A	N/A
121	Mill Brook at Charnock Hill Rd.	12	N/A	N/A	N/A	4	N/A	N/A	N/A
121H	Moulton Pond Tributary	42	N/A	N/A	N/A	23	N/A	N/A	N/A

N/A 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							
		2016	2015	2014	2013	2012	2011	2010	2009
Quabbin Reservoir Watershed Core Sites									
211	W. Br. Swift River at Rte. 202	15	0	0	8	0	4	0	0
212	Hop Brook inside Gate 22	14	14	0	8	12	4	4	0
213	M. Br. Swift River at Gate 30	7	4	4	12	8	7	12	0
215	E. Br. Fever Brook at West St.	15	0	0	4	0	4	0	4
216	E. Br. Swift River at Rte. 32A	4	0	0	8	4	7	4	4
Gates	Gates Brook at mouth	8	0	4	4	8	4	8	0
BC	Boat Cove Brook at mouth	25	7	11	4	15	4	8	4
Quabbin Reservoir Watershed EQA Sites									
211E	W. Br. Swift River (Sibley)	0	N/A	N/A	N/A	0	0	N/A	N/A
211F	W. Br. Swift River (New Boston)	8	N/A	N/A	N/A	4	0	N/A	N/A
211G	W. Br. Swift River (Cooleyville)	7	N/A	N/A	N/A	4	4	N/A	N/A
212A	Hop Brook at Gate 22	12	N/A	N/A	N/A	0	4	N/A	N/A
212B	Hop Brook at Gate 24	18	N/A	N/A	N/A	19	8	N/A	N/A
213A	M. Br. Swift River at Fay Rd.	17	N/A	N/A	N/A	15	8	N/A	N/A
213B	M. Br. Swift River at Elm St.	4	N/A	N/A	N/A	12	12	N/A	N/A
Ware River Watershed Core Sites									
101	Ware River at Shaft 8 Intake	0	4	4	7	4	8	4	0
103A	Burnshirt River at Riverside Cemetery	12	4	12	8	4	5	4	0
107A	W. Br. Ware River at Brigham Rd.	4	4	4	4	0	4	8	5
108	E. Br. Ware at Intervale Rd.	0	8	0	7	0	4	4	0
121B	Thayer Pond at inlet	8	4	4	4	8	8	23	0
Ware River Watershed EQA Sites									
105	Barre Falls Dam	4	N/A	N/A	N/A	0	N/A	N/A	N/A
110	Whitehall Pond Outlet	0	N/A	N/A	N/A	0	N/A	N/A	N/A
121	Mill Brook at Charnock Hill Rd.	4	N/A	N/A	N/A	0	N/A	N/A	N/A
121H	Moulton Pond Tributary	23	N/A	N/A	N/A	15	N/A	N/A	N/A

N/A Data not available.

As shown in **Table 13**, most samples in the Quabbin and Ware River watersheds were below 235 MPN/100 mL. At most, 25% of samples at Boat Cove Brook and 23% at Site 121H (Moulton Pond tributary) were above the 235 MPN/100 mL threshold. These percentages both represent six samples from each site.

3.2.1.2 *Fecal Coliform Bacteria*

As described above, 2016 fecal coliform monitoring was performed on a weekly basis at two tributary sites (Boat Cove and Gates Brooks) beginning in September. Fecal coliform samples are collected on a daily basis at the CVA, and the data from these two tributaries provide a basis for assessing potential sources of fecal coliform at the CVA. The primary potential source of fecal coliform near the CVA is gulls during the fall, winter, and early spring. The gull control program is designed to prevent gulls from roosting in the vicinity of the CVA and therefore reduces the potential for fecal coliform bacteria in this area. In the event that elevated fecal coliform levels were detected in the CVA during the gull control 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 (from September through December, 2016) indicated fecal coliform bacteria levels were relatively low at these tributaries. The maximum level at Boat Cove Brook was 1,880 CFU/100 mL, and the maximum level at Gates Brook was 332 CFU/100 mL. Both maximums were in samples collected on September 27. Approximately 0.5 inch of rain fell during the morning of September 27, so the elevated result is likely related to rainfall. The next highest result from Boat Cove Brook was 690 CFU/100 mL, and the remaining samples from Boat Cove Brook ranged from 5 to 44 CFU/100 mL. The other samples from Gates Brook ranged from <1 to 67 CFU/100mL.

3.2.1.3 *Total Coliform Bacteria*

During 2016, analyses for total coliform bacteria were determined using an enzyme substrate procedure (Colilert method) instead of membrane filtration, the technique that had been used historically. No clear correlation between the two methods was found in side-by-side testing (DWSP, 2006; DWSP, 2013b). The range of values appears to have shifted higher, although maximum values did not increase immediately at all sites. Median values in 2016 exceeded the historical medians in 13 of 14 Quabbin Reservoir watershed sites and in five of nine Ware River sites. The increases in median total coliform concentrations do not necessarily mean a change in water quality, because most of these sites have water quality records dating back to the early 1990s, and the historical medians reflect the different laboratory method in use prior to November 2005.

3.2.2 Turbidity

As described above in Section 3.0, the MassDEP performance standard for drinking water is 1 NTU, and the U.S. EPA SWTR standard is 5 NTU. While not directly applicable (because the tributaries are not intakes), drinking water standards for turbidity were used as reference points in evaluating the tributary data.

In 2016, turbidity exceeded 5 NTU in one sample from the Quabbin Reservoir watershed and nine samples from the Ware River watershed. The elevated result in the Quabbin Reservoir watershed (9.86 NTU from Site 212A on August 2) was most likely related to heavy rain (which also led to elevated bacteria results, as described in Section 3.2.1.1). In the Ware River watershed, turbidity was above 5 NTU in four samples from Site 105 and five samples from Site 121. Most of these results ranged from approximately 5 to 6.7 NTU, and the maximum result was 7.65 NTU in the sample collected on October 4 at Site 121.

Minimum, maximum, and median turbidity results for each tributary monitored in 2016 are summarized in **Tables 14 and 15**. New maximum turbidities were measured at four sites in the Quabbin Reservoir watershed but no sites in the Ware River watershed. The new maximums were in samples collected on August 2 (2.32 NTU at Sites 211F and 9.86 NTU at Site 212A) and on August 30 (2.64 NTU at Site 211E and 3.53 NTU at Site 213A). As described above, heavy rain likely led to the elevated results on August 2.

Table 14. 2016 Range of Turbidity Results in Quabbin Reservoir Watershed Tributaries

SITE	MINIMUM		MAXIMUM		MEDIAN
	Result (NTU)	Date	Result (NTU)	Date	
211 (W. Br. Swift)	0.209	1/19	2.51	8/2	0.331
211E (W. Br. Swift, Sibley)	0.181	1/5	2.64	8/30	0.353
211F (W. Br. Swift, New Boston)	0.202	3/1	2.32	8/2	0.386
211G (W. Br. Swift, Cooleyville)	0.285	1/19	4.66	8/2	0.812
212 (Hop Brook)	0.436	5/10	4.54	8/2	0.799
212A (Hop Brook, Gate 22)	0.444	5/10	9.86	8/2	0.914
212B (Hop Brook, Gate 24)	0.223	11/22	3.56	8/2	0.509
213 (Mid. Br. Swift)	0.405	3/1	1.71	10/11	0.663
213A (Mid. Br. Swift, Fay Rd.)	0.425	10/11	3.53	8/30	0.990
213B (Mid. Br. Swift, Elm St.)	0.12	8/30	1.71	9/27	0.383
215 (E. Br. Fever)	0.36	2/2	3	8/2	0.812
216 (E. Br. Swift)	0.202	10/11	1.71	8/2	0.511
Boat Cove Brook	0.188	10/11	3.98	3/15	0.590
Gates Brook	0.126	12/7	1.92	8/2	0.241

Table 15. 2016 Range of Turbidity Results in Ware River Watershed Tributaries

SITE	MINIMUM Result (NTU)	MINIMUM Date	MAXIMUM Result (NTU)	MAXIMUM Date	MEDIAN
Ware River Watershed					
103A (Burnshirt)	0.375	3/8	3.92	6/14	1.12
105 (Barre Falls Dam, upstream of dam)	0.564	3/8	5.34	7/13	1.83
107A (W. Ware)	0.345	3/8	1.81	5/31	0.720
108 (E. Ware)	0.447	3/8	4.8	7/13	1.23
110 (Whitehall Pond outlet)	0.447	5/31	0.664	6/14	0.555
121 (Mill Brook at Charnock Hill Rd.)	0.342	3/8	7.65	10/4	0.937
121B (Thayer)	0.272	1/26	2.69	7/13	0.563
121H (Moulton Pond tributary at Britney Dr.)	0.36	11/29	3.8	11/15	0.876
101 (Shaft 8 Intake)	0.478	3/8	4.62	7/13	1.17

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 Quabbin Reservoir watershed are from Orange, MA, and data for the Ware River watershed 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. Quabbin Reservoir watershed tributaries generally peaked at approximately 2 to 4 NTUs, whereas Ware River watershed tributaries peaked between 1 and 5 NTUs. Moreover, the annual peak in Ware River watershed turbidities is wider (May through November) than Quabbin (June through October). This indicates the higher turbidities in the Ware River watershed generally persisted for a longer period of time in 2016. These differences may be a result of land use differences between the two watersheds, and are not necessarily indicative of long-term trends.

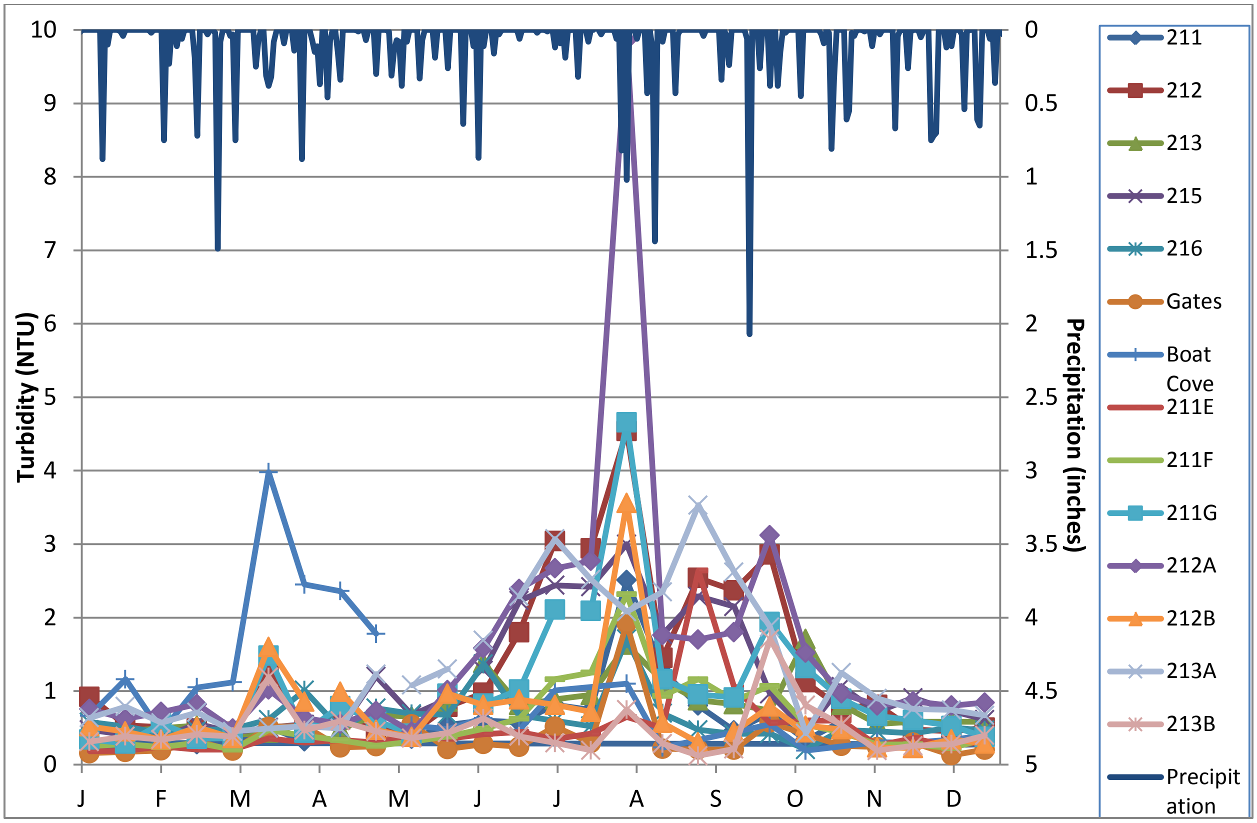


Figure 9. 2016 Turbidity and Precipitation Data, Quabbin Reservoir Watershed

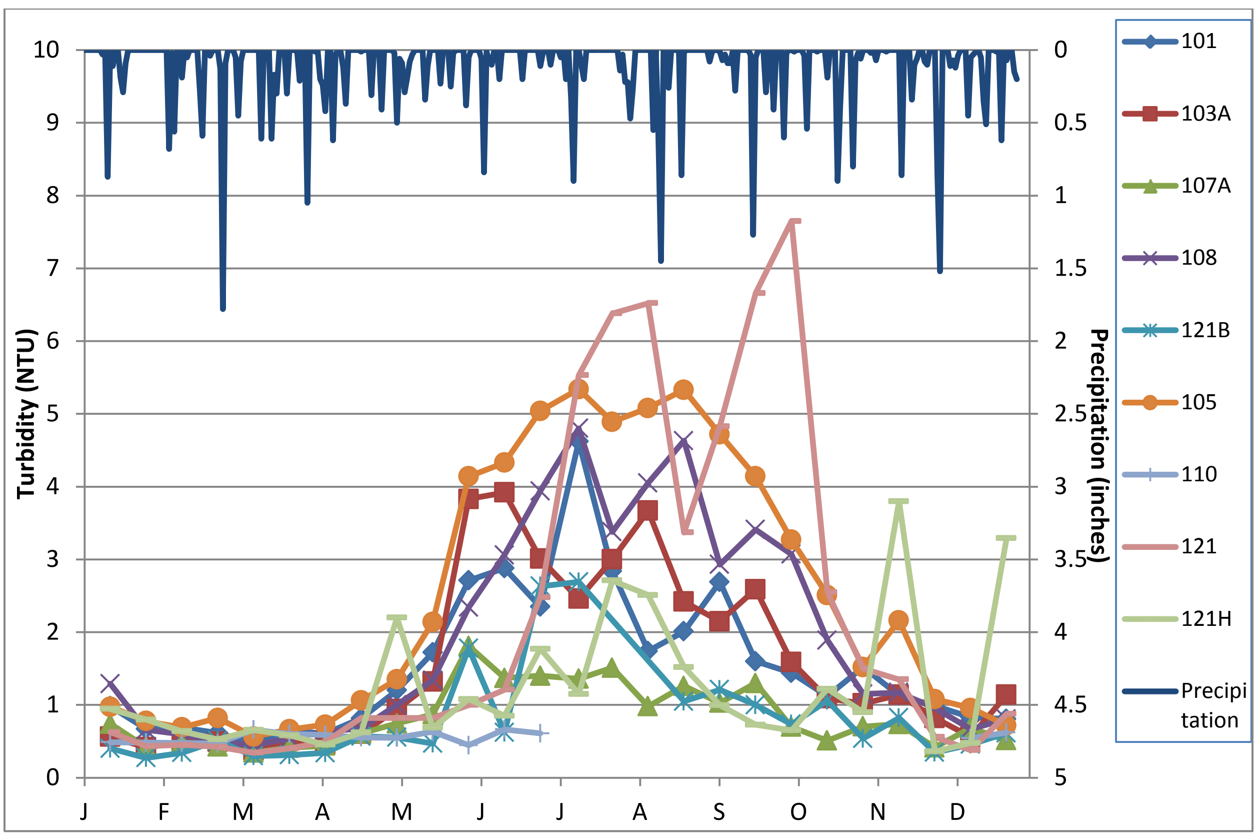


Figure 10. 2016 Turbidity and Precipitation Data, Ware River Watershed

3.2.3 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 streams may be indicative of contamination from septic system effluent, stormwater discharges or agricultural runoff. Another significant source of higher levels is chloride, 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). In 2016, specific conductance values were generally comparable to the historical range. Relatively small increases in maximum conductivities were measured in nine (213, BC, 211E, 211F, 211G, 212A, 212B, 213A, and 213B) of 14 Quabbin Reservoir watershed sites and four (121B, 105, 121, 121H) of nine Ware River watershed sites. The maximum conductivity measured in the Quabbin Reservoir watershed was 211 µS/cm at Site 211G (West Branch Swift River at Cooleyville Road) on November 22. The maximum conductivity measured in the Ware River watershed was 804 µS/cm at Site 121H (Moulton Pond Tributary at Britney Drive) on December 13.

3.2.4 Dissolved Oxygen

Dissolved oxygen in stream environments comes from re-aeration dynamics related to temperature, stream flow, water depth, and the physical characteristics of the stream channel. Depletion of dissolved oxygen can be related to the oxygen requirements of aquatic life, the decomposition of organic matter, and the introduction of foreign oxygen-demanding substances (*i.e.*, chemical reducing agents). The Massachusetts Class A standard is a minimum of 6.0 mg/L. In 2016, dissolved oxygen levels in Quabbin Reservoir and Ware River tributaries were relatively high. Ninety-four percent of samples from the Ware River watershed and 95% of samples from the Quabbin Reservoir watershed were above the 6.0 mg/L standard.

3.2.5 Temperature

Temperature is a critical parameter in determining 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, temperatures ranged between 0 and 25.8˚C throughout the year.

3.2.6 pH

Stream acidity is largely a function of the groundwater hydrogeology of the basins and their effectiveness in buffering the effects of acid precipitation. Median pH values in 2016 were below the Class A water quality threshold of 6.5 units at 11 of 23 monitoring sites. The medians at most of these sites ranged from 6.1 to 6.4. The lowest medians were at Sites 215 (East Branch Fever Brook) and 211F (West Branch Swift River at New Boston Road), both with medians of 5.9.

3.2.7 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 2016, alkalinity was below the ARM endangered threshold at five of seven EQA sites in the Quabbin Reservoir watershed (211E, 211F, 213B, 212A, and 212B) and one of four EQA sites in the Ware watershed (105). Alkalinity generally peaked between July and October, with the exception of one site. Site 110 apparently peaked in January, but this may reflect a lack of samples because there was insufficient water for sample collection from July 13 through November 29. Maximum values ranged from 4.59 mg/L (Site 211E) to 44.6 mg/L (Site 121). New maximum alkalinities were measured in samples from the West Branch Swift River (Sites 211E and 211F) as well as Hop Brook (Site 212A) and the Middle Branch Swift River (213A). No new maximum alkalinities were measured in samples from the Ware River watershed.

As described in Section 3.1.4, 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.

3.2.8 Tributary Nutrient Dynamics

Biweekly sampling for nutrients has been conducted on selected tributaries since March, 2005. The goal of this monitoring is to establish a database of nutrient data by sanitary district in both watersheds. In 2016, seven EQA sites in the Quabbin Northwest Sanitary District and four EQA sites in the Ware River Coldbrook and Longmeadow Sanitary District were monitored for nutrients and UV_{254}. The Quabbin EQA sites were previously monitored in 2011-12. Core tributary sites for both watersheds have been monitored for nutrients on a quarterly basis since March 2005. Median concentrations and data ranges of sites monitored in 2016 are summarized on **Table 16** (Quabbin Reservoir watershed) and **Table 17** (Ware River watershed).

3.2.8.1 Quabbin Reservoir Watershed

In the Quabbin Reservoir watershed, nutrient concentrations generally remained within the historical ranges, with slight increases at some sites compared to previous monitoring since 2005. As shown in **Table 16**, nitrate concentrations ranged from less than 5 µg/L to 311 µg/L at the EQA sites, compared to a maximum of 117 µg/L at the core sites. Maximum concentrations exceeded the historical maximum at two EQA sites. The new maximums were 232 µg/L at Site 212B on June 21 and 311 µg/L at Site 213B on July 5, exceeding historical maximums of 207 µg/L and 242 µg/L, respectively.

TKN, the sum of organic nitrogen plus ammonia, often constitutes a significant proportion of the total nitrogen present in a natural water body. In 2016, TKN concentrations at EQA sites ranged from 414 to 602 µg/L, compared to a maximum of 633 µg/L at the core sites. Maximum concentrations exceeded historical maximums at four EQA sites. Two new maximums were 420 µg/L (Site 211E) and 473 µg/L (Site 213B), both on July 19, which exceeded historical maximums of 405 and 472 µg/L. The other two new maximums were 414 µg/L (Site 211F) and 602 µg/L (Site 212A), which exceeded historical maximums of 389 and 439 µg/L, respectively.

Unlike the reservoir monitoring, ammonia has not been routinely monitored in the tributaries to Quabbin Reservoir. Ammonia concentrations in the tributaries ranged from less than 5 to 64 µg/L in 2016. The maximum concentration of 64 µg/L was detected on March 1 at Site 212B and on June 21 at Site 215; both these concentrations exceeded the historical maximums for the sites of 38 (in July, 2012) and 44 µg/L (in March, 2015), respectively. Other new maximum concentrations were measured in samples from Sites 211E (43 µg/L on August 30), 211 (16 µg/L on June 21), and 212 (39 µg/L on June 21). Previous maximums at these sites were 33 µg/L at 211E (in July, 2012), 6 µg/L at 211 (in June, 2014), and 34 µg/L at 212 (in March, 2013).

In many freshwater systems, phosphorus is the limiting nutrient in algal growth and can be a concern when excessive. Phosphorus concentrations were higher at EQA sites, up to 318 µg/L, compared to the core sites which ranged up to 38 µg/L. New maximum concentrations were measured in samples collected on June 21 from Sites 211G (235 µg/L), 212A (238 µg/L), and 213A (318 µg/L). Previous maximums at these sites were 192 µg/L (in August, 2005), 44 µg/L (in July, 2011), and 44 µg/L (in April and May, 2012). The phosphorus concentrations from these three sites on June 21 are elevated with respect to historical concentrations. The MWRA laboratory was consulted to determine whether there were analytical problems associated with these samples. The laboratory confirmed that the QA/QC data indicated the results were valid. No precipitation was measured in the area during the week before sampling, but approximately 0.0.2 to 0.06 inch was measured in the area on the day of sampling. It seems unlikely that the elevated phosphorus on this day can be attributed to precipitation. Phosphorus levels at these three sites ranged from approximately 10 to 40 µg/L during the remainder of the year, so the elevated results on June 21 are likely not indicative of a trend of decreasing water quality.

Table 16. Quabbin Reservoir Watershed Nutrient Concentrations: Comparison of Median Values and Ranges from 2016 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												
211E W. Br. Swift, Sibley	11	<5 - 46	205	117 - 420	<5	<5 - 43	11	6 - 19	0.120	0.068 - 0.276	1530	1170 - 1930
211F W. Br. Swift, New Boston	9	<5 - 131	164	<100 - 414	3	<5 - 26	11	<5 - 23	0.110	0.068 - 0.216	1865	1220 - 2580
211G W. Br. Swift, Cooleyville	63	<5 - 214	158	<100 - 459	<5	<5 - 10	17	8 - 235	0.071	0.025 - 0.249	6635	4160 - 8670
Hop Brook Sanitary District												
212A Hop Brook, Gate 22	16	<5 - 109	220	120 - 602	<5	<5 - 25	17	8 - 238	0.111	0.059 - 0.247	6030	3260 - 8580
212B Hop Brook, Gate 24	71	<5 - 232	156	<100 - 432	<5	<5 - 64	14	<5 - 40	0.074	0.033 - 0.253	5610	2920 - 8840
Middle Swift Sanitary District												
213A (Mid. Br. Swift, Fay Rd.)	35	<5 - 304	277	114 - 486	16	<5 – 58	18	5 – 318	0.156	0.060 - 0.346	5410	3690 - 8080
213B (Mid. Br. Swift, Elm St.)	70	<5 - 311	173	<100 - 473	<5	<5 - 11	13	7 - 43	0.126	0.054 - 0.261	3960	2140 - 7660
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)	66	15 - 117	170	143 - 242	5	<5 - 16	14	10 - 18	0.109	0.066 - 0.152	2440	1630-5000
212 (Hop Brook)	54	43 - 116	343	253 - 382	19	<5 - 39	24	11 - 28	0.109	0.084-0.156	5175	2850-8000
213 (Mid. Br. Swift)	15	<5 - 111	257	166 - 428	13	8 - 30	15	13 - 21	0.188	0.111 - 0.205	5320	3030 - 7480
215 (E. Br. Fever)	9	7 - 28	387	215 - 633	14	<5 - 64	19	11 - 38	0.237	0.215 - 0.353	2920	1640 - 3600
216 (E. Br. Swift)	42	6 - 86	290	162 - 417	<5	<5 - 9	15	10 - 26	0.199	0.126 - 0.253	3450	2290 - 12,300
Gates Brook	<5	<5 - 55	170	<100 - 592	<5	<5	15	8 - 20	0.099	0.058 - 0.115	1280	947-2640
Boat Cove Brook	59	11 - 99	209	193 - 351	<5	<5 - 7	22	12 - 28	0.192	0.096 - 0.333	7760	1330 - 13,100

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 2016 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												
105 Barre Falls Dam (upstream of dam)	<5	<5 - 31	336	209 - 579	<5	<5 - 40	20	14 - 40	0.243	0.170 - 0.359	4910	3110 - 5960
110 Whitehall Pond outlet	<5	<5 - 19	274	211 - 457	<5	<5 - 18	11	7 - 15	0.094	0.062 - 0.107	7430	6550 - 8280
121 Mill Brook at Charnock Hill Road	10	<5 - 92	391	213 - 766	9	<5 - 136	17	10 - 57	0.158	0.106- 0.266	12,950	9240 - 21,400
121H Moulton Pond Tributary at Britney Drive	497	<5 - 946	266	121 - 488	12	<5 - 42	17	9 - 45	0.085	0.048 - 0.282	17,750	12,900 - 27,000
Core Sample Sites [(2)]	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Biweekly**
101 (Shaft 8 Intake)	24	<5 - 34	290	132 - 405	3	<5 - 18	18	14 - 32	0.199	0.128 - 0.314	3985	3270 - 5020
103A (Burnshirt)	22	13 - 34	355	218- 495	7	<5 - 20	23	14 - 33	0.195	0.135 - 0.359	2910	2300 - 5020
107A (W. Ware)	26	<5 - 33	332	272 - 526	<5	<5 - 6	18	13 - 26	0.262	0.155 - 0.433	3675	2810 - 4480
108 (E. Ware)	33	<5 - 44	323	304 - 541	14	<5 - 32	24	13 - 33	0.232	0.145 - 0.313	5385	3390 - 6510
121B (Thayer)	11	<5 - 28	320	289 - 426	<5	<5 - 114	12	9 - 17	0.125	0.088 - 0.209	14,050	2870-27,300

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.

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 2009-2014, compared to monthly in 1998-99, UV_{254} values ranged slightly higher at core sites in 2009-2015, 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 2009-2015 do not necessarily mean any degradation of water quality. The UV_{254} values in 2016 ranged from 0.025cm^{-1} (Site 211G on January 16) to 0.353 cm^{-1} (Site 215 on June 21). 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 in samples collected from 211E (0.276 cm^{-1} on August 16) and 211G (0.249 cm^{-1} on February 16). The previous maximum values at these sites were 0.259 cm^{-1} in July, 2005 and 0.236 cm^{-1} in October, 2012, respectively.

Calcium concentrations ranged from 947 to 13,100 µg/L in core sites and from 1,170 to 8,840 µg/L in EQA sites. The 12 mg/L threshold was exceeded at only two Quabbin Reservoir watershed sites in 2016, Site 216 (East Branch Swift River) and Boat Cove Brook. Calcium was measured at 12,300 µg/L in the sample from Site 216 on October 11, and at 13,100 µg/L in the sample from Boat Cove Brook on November 8. The timing indicates these elevated levels are not likely due to road deicers. In addition to road deicers, calcium sources may include agricultural lime and construction activity, as well as natural site geology and weathering processes.

3.2.8.2 Ware River Watershed

In the Ware River watershed, nutrient concentrations in 2016 generally remained within the historical ranges. As shown in **Table 17**, the nitrate concentration was generally higher at EQA site 121H, where the maximum was 946 µg/L, compared to the core sites. While relatively high, the maximum result at 121H was below the historical maximum for this site (988 µg/L in January, 2008). No new nitrate maximums were detected in core site samples.

TKN concentrations at core sites ranged from 132 to 541 µg/L during 2016, and from 121 to 766 µg/L in the EQA sites. No new maximums were detected during 2016 at core or EQA sites.

Ammonia ranged from less than 5 to 136 µg/L, with the higher concentrations generally at the EQA sites. The maximum result of 136 µg/L was detected at Site 121 on July 26. Routine monitoring for ammonia began in 2012, so there is only one year of EQA site data prior to 2016 for comparison. New historical maximum concentrations were detected in samples from Site 105 (40 µg/L), Site 121 (136 µg/L), and Site 121B (114 µg/L). The previous maximums were 23 µg/L (in August, 2012), 44 µg/L (in July, 2012), and 91 µg/L (in March, 2015).

Total phosphorus concentrations were similar at core sites and EQA sites, and ranged from 7 to 57 µg/L. The maximum concentration, 57 µg/L, was detected in samples collected from Site 121 (Mill Brook at Charnock Hill Pond) on July 26 and November 15. This was the only new maximum total phosphorus concentration measured in 2016, and the previous maximum at this site was 49 µg/L (in June, 2008).

UV_{254} values were similar at core sites and EQA sites. The highest value for core sites was in a sample from Site 107A (0.433 cm^{-1}), and the highest value at an EQA site (0.359 cm^{-1}) was in a sample from Site 105. The lowest UV_{254} values were associated with pond sites: Whitehall Pond (Site 110), Moulton Pond (Site 121H), and Thayer Pond (Site 121B). No new maximum UV_{254} values were detected in 2016.

Calcium concentrations ranged from 2,300 to 27,300 µg/L. The highest levels were at Site 121H (27,000 µg/L), Site 121B (27,300 µg/L), and Site 121 (21,400 µg/L). It is not known whether the elevated levels reflect naturally-occurring conditions or potential water quality degradation. Calcium has only been sampled once before, in 2012, at the EQA sites. In 2012, calcium concentrations at Site 121H ranged from 8,330 µg/L to 14,900 µg/L, and the median was 11,200; concentrations at Site 121 ranged from 6,020 µg/L to 11,200 µg/L, with a median of 8,640 µg/L. The median calcium concentration at Site 121B (Thayer Pond) was 14,050 µg/L in 2016, which continues an increasing trend at this site since 2010 (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 water quality data from these three sites as well as the other EQA sites indicate an apparent increase in calcium concentration since 2012. The area around these sites 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 and/or lime applications to soil. The highest levels in 2016 occurred from late July through the end of the year, which may support lime applications as a cause. Calcium monitoring will be continued in each sanitary district to help establish a longer-term dataset.

3.2.8.3 Discussion

Nutrient concentrations between the two watersheds were generally comparable, with several exceptions. Nitrate levels were similar, with the exception of Site 121H, the Moulton Pond tributary near Britney Drive in the Ware River watershed, where the median nitrate concentration was 497 µg/L. Ranges and median TKN concentrations were higher at Ware River watershed sites. Ammonia concentrations at both watersheds were generally similar, with the exception of one elevated result (136 µg/L) at Site 121. Maximum total phosphorus levels were generally higher at Quabbin Reservoir watershed EQA sites than Ware River watershed EQA sites. UV_{254} results were generally similar at both watersheds. Ranges and medians of calcium concentrations were higher at Ware River watershed sites, and the cause of this may be attributed to a combination of land usage and geologic factors.

3.2.9 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.

In 2016, artificial substrates were not used in the West, Middle, or East Branches of the Swift River. Instead, rock scrapings were collected at these sites. Artificial substrates were still deployed at the catwalk behind the Shaft 8 building. In the Swift River outflow below Winsor Dam, artificial substrates were deployed near the McLaughlin Hatchery screens. This location has restricted public access and excellent water flow but is somewhat protected from sudden changes in water volume. In addition, if the sampler became dislodged, it could easily be retrieved from the hatchery screens.

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 scaled back in 2016. 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.

3.3 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 have 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 2016, and no brittle naiad plants were found.

No new AIS were observed in 2016 in the 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).

3.4 *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.

3.4.1 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 2016, 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 Quabbin Reservoir watershed for baseline and short-term monitoring. No problems were identified.

3.4.2 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 2016.

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 2016 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 five storms; and preliminary analysis of field data. Storm water sampling for up to four events is scheduled for 2017.

4 CONCLUSIONS

The 2016 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. Massachusetts was affected by drought conditions during 2016, with below average precipitation and above average temperatures. Annual geometric means of *E. coli* results in Quabbin Reservoir tributaries were generally higher than previous years, which may be a result of wildlife activity at certain sites (e.g., Site 212) and/or the drought conditions. Turbidity data indicated higher turbidity for a longer period of time 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 2017

Water sampling protocols, including field and analytical methods, will remain the same for 2017. 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 Fever Brook Sanitary District, previously monitored in 2013. Ware River watershed monitoring shift will shift to the Burnshirt, Canesto, & Natty Sanitary District, which was previously monitored in 2013.

Reservoir monitoring will continue on a monthly schedule in 2017 (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 2017.

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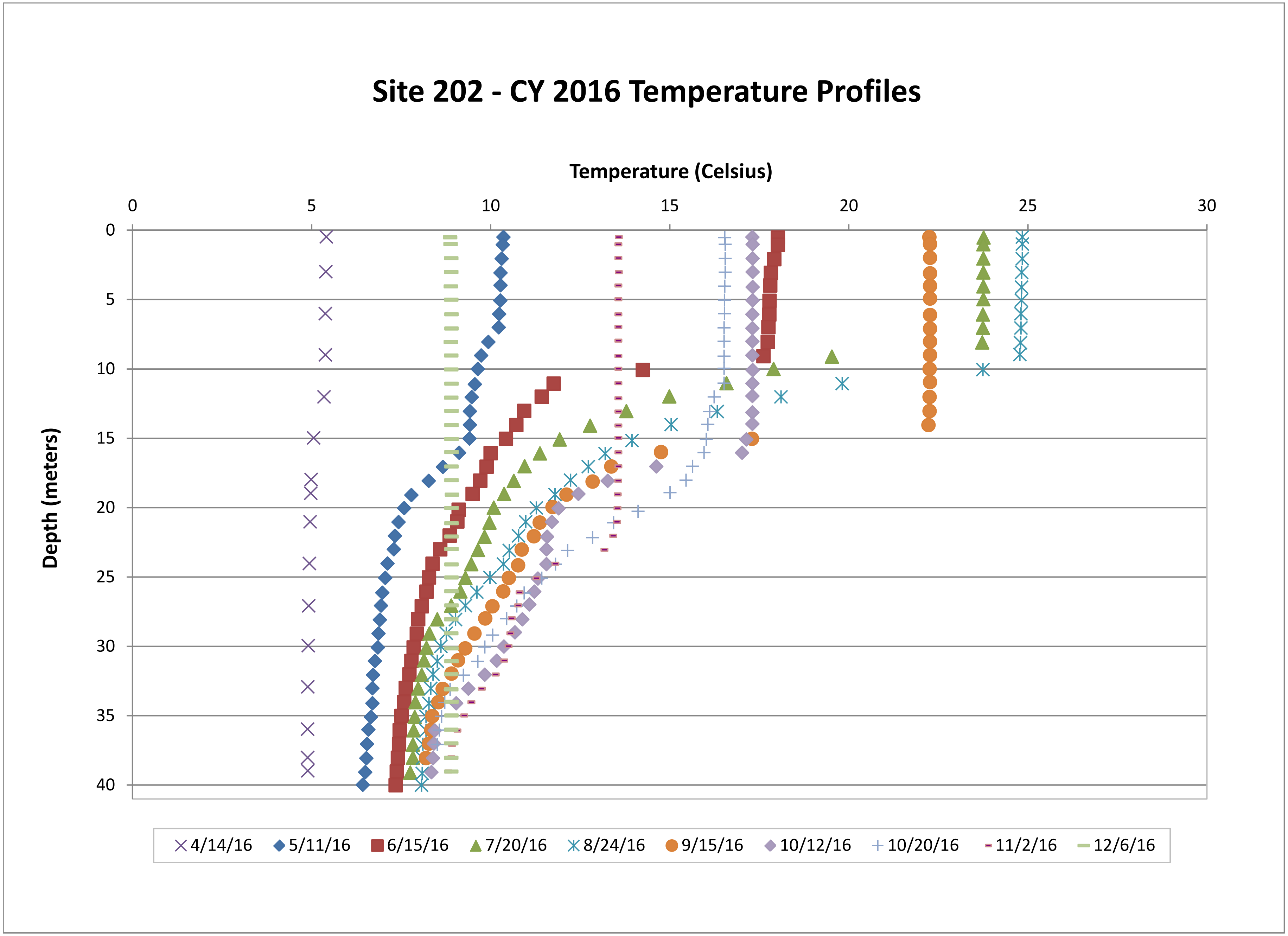
APPENDIX A

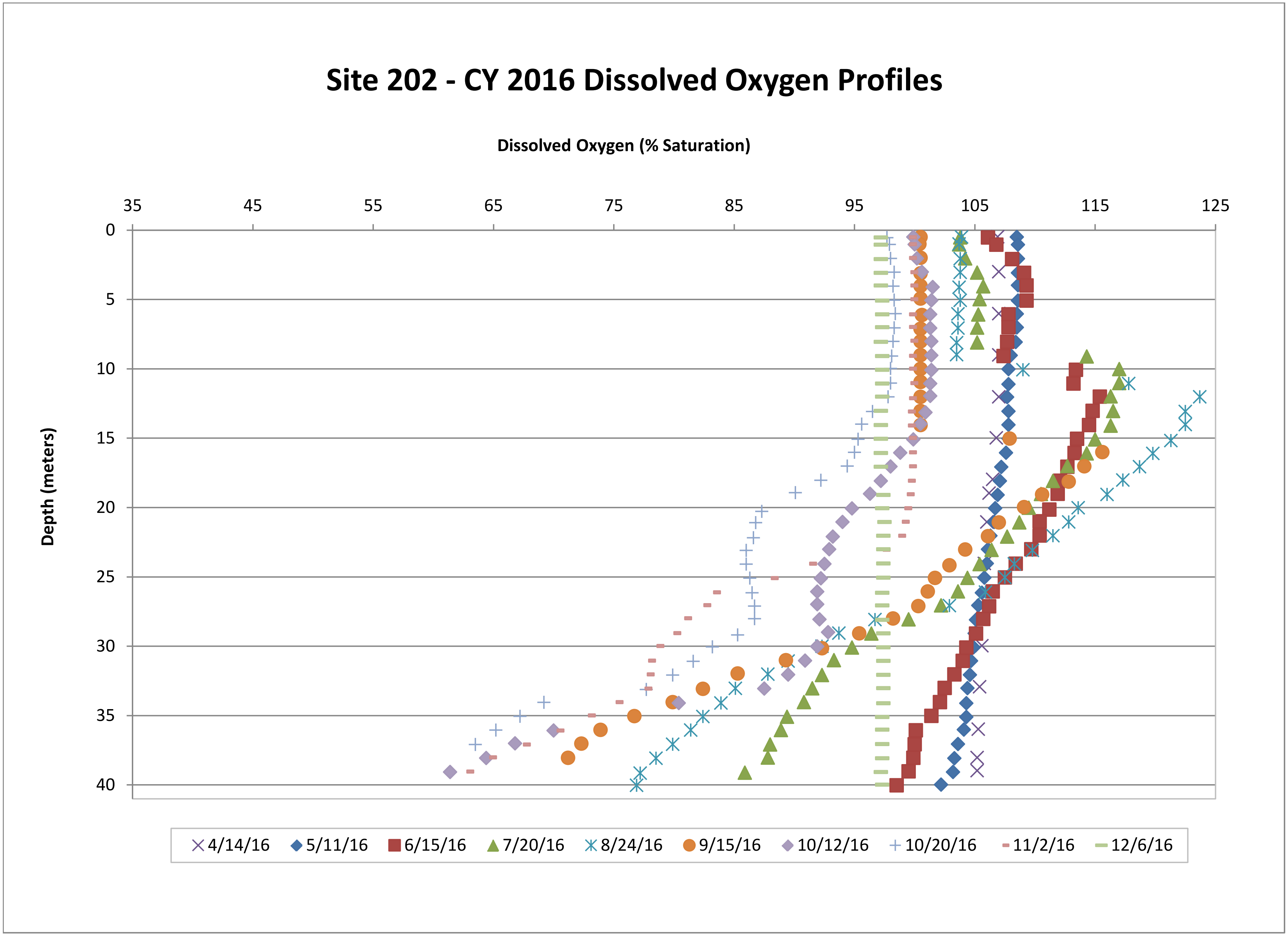
Selected Plots and Graphs

Quabbin Reservoir Profiles

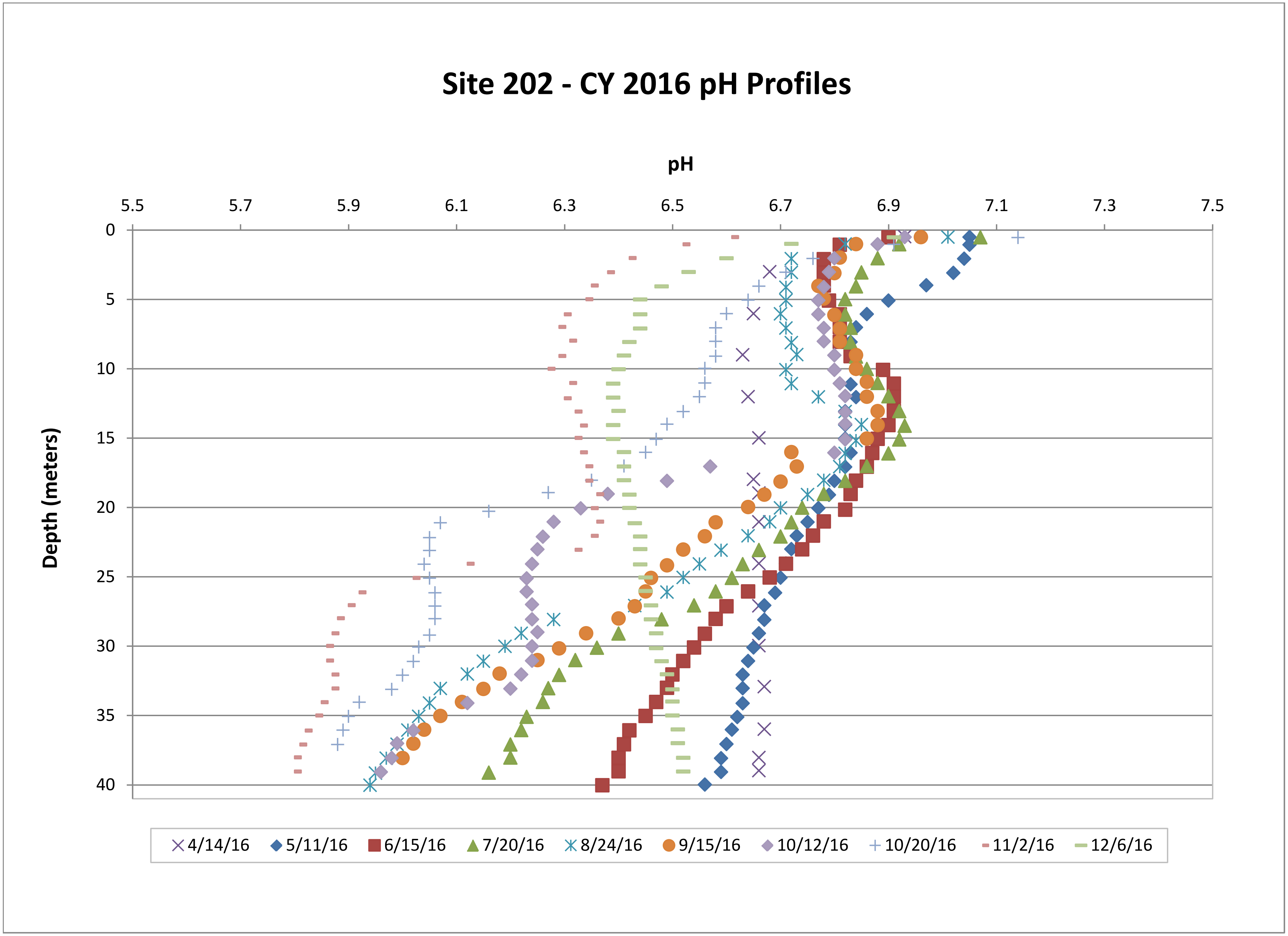
Stream Hydrographs

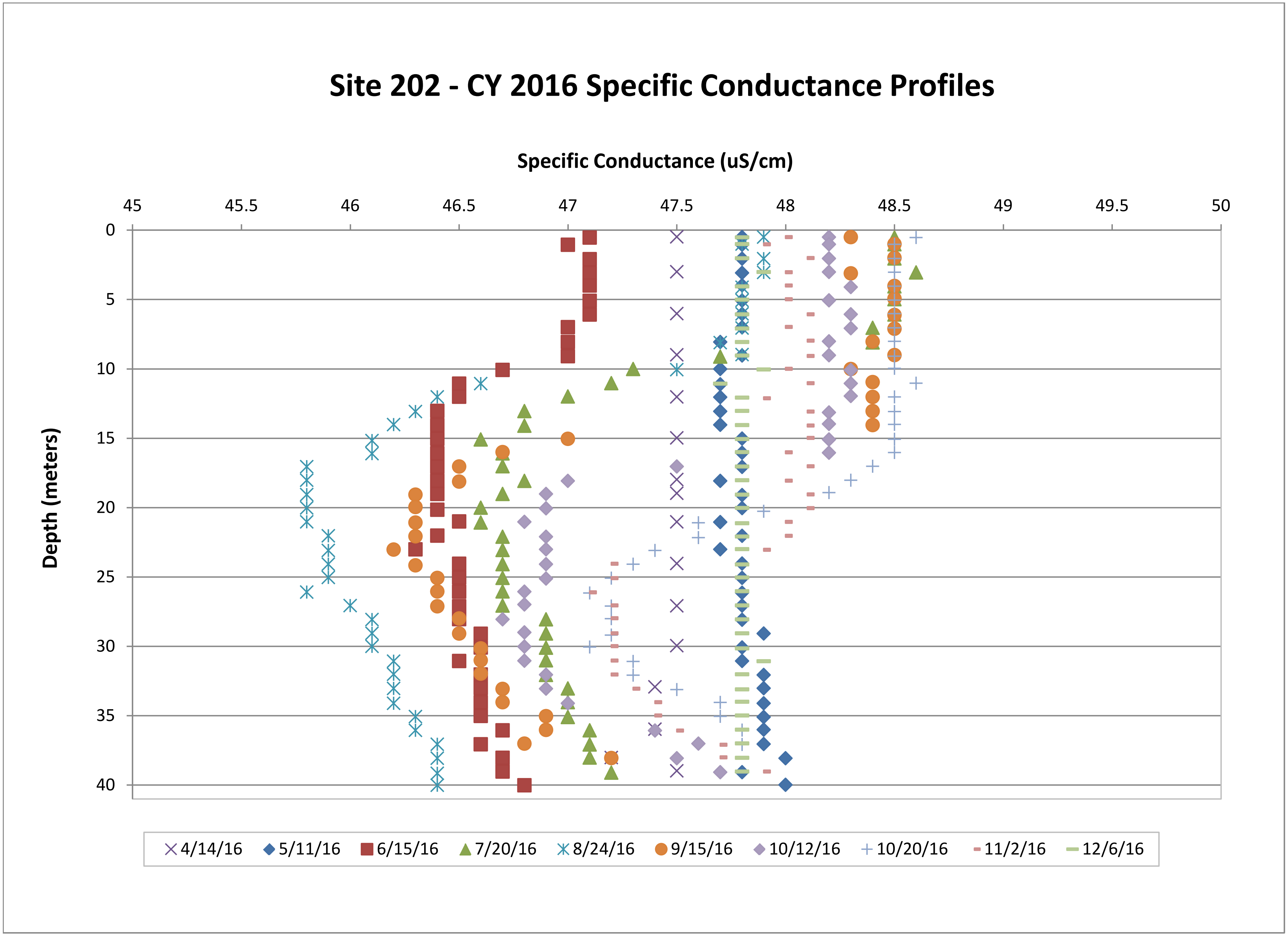


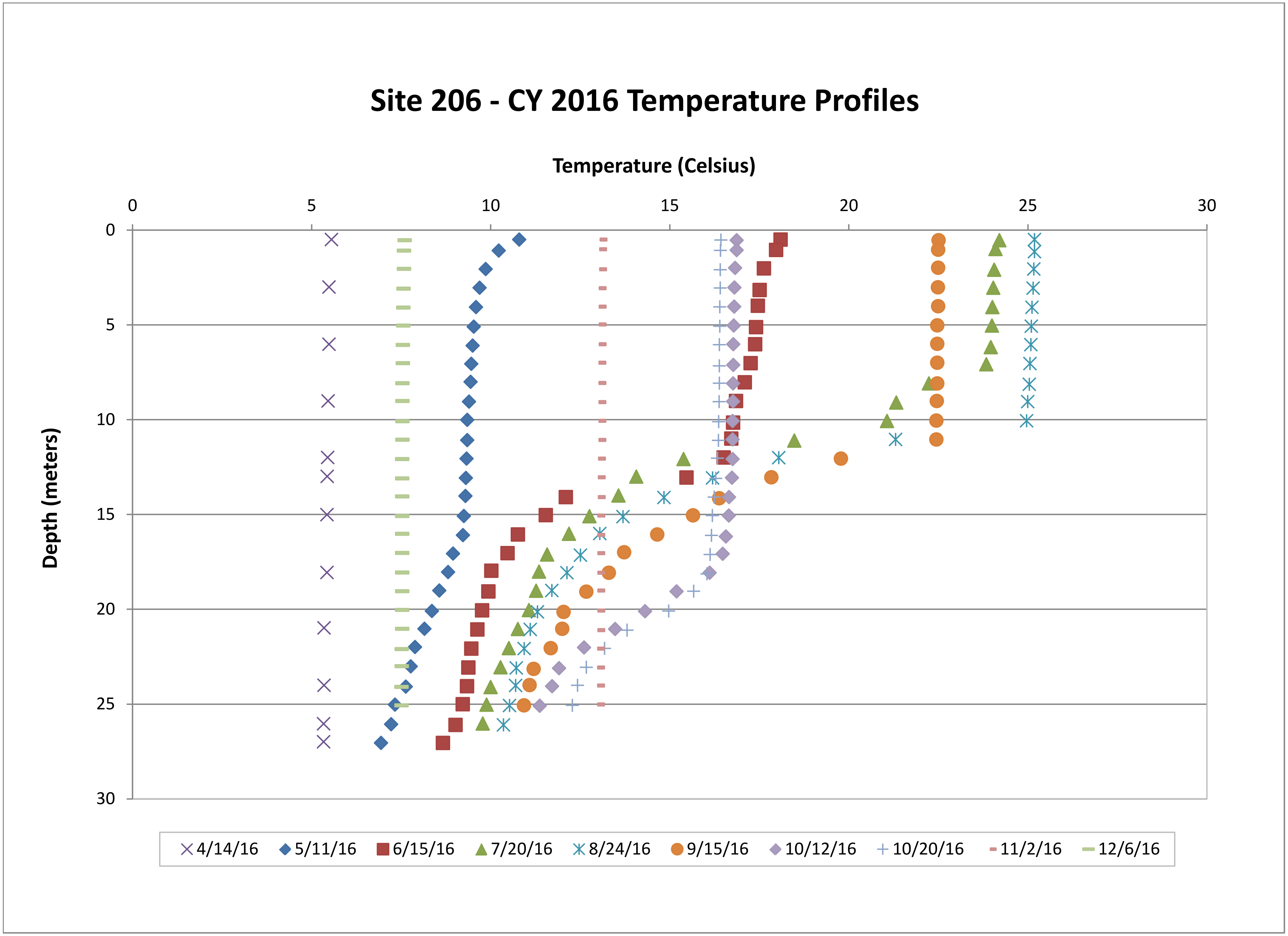
Site 202 - CY 2016 Temperature Profiles
Temperature (Celsius)
0
5
10
15
20
25
30
Depth (meters)
0
5
10
15
20
25
30
35
40
4/14/16
5/11/16
6/15/16
7/20/16
8/24/16
9/15/16
10/12/16
10/20/16
11/2/16
12/6/16



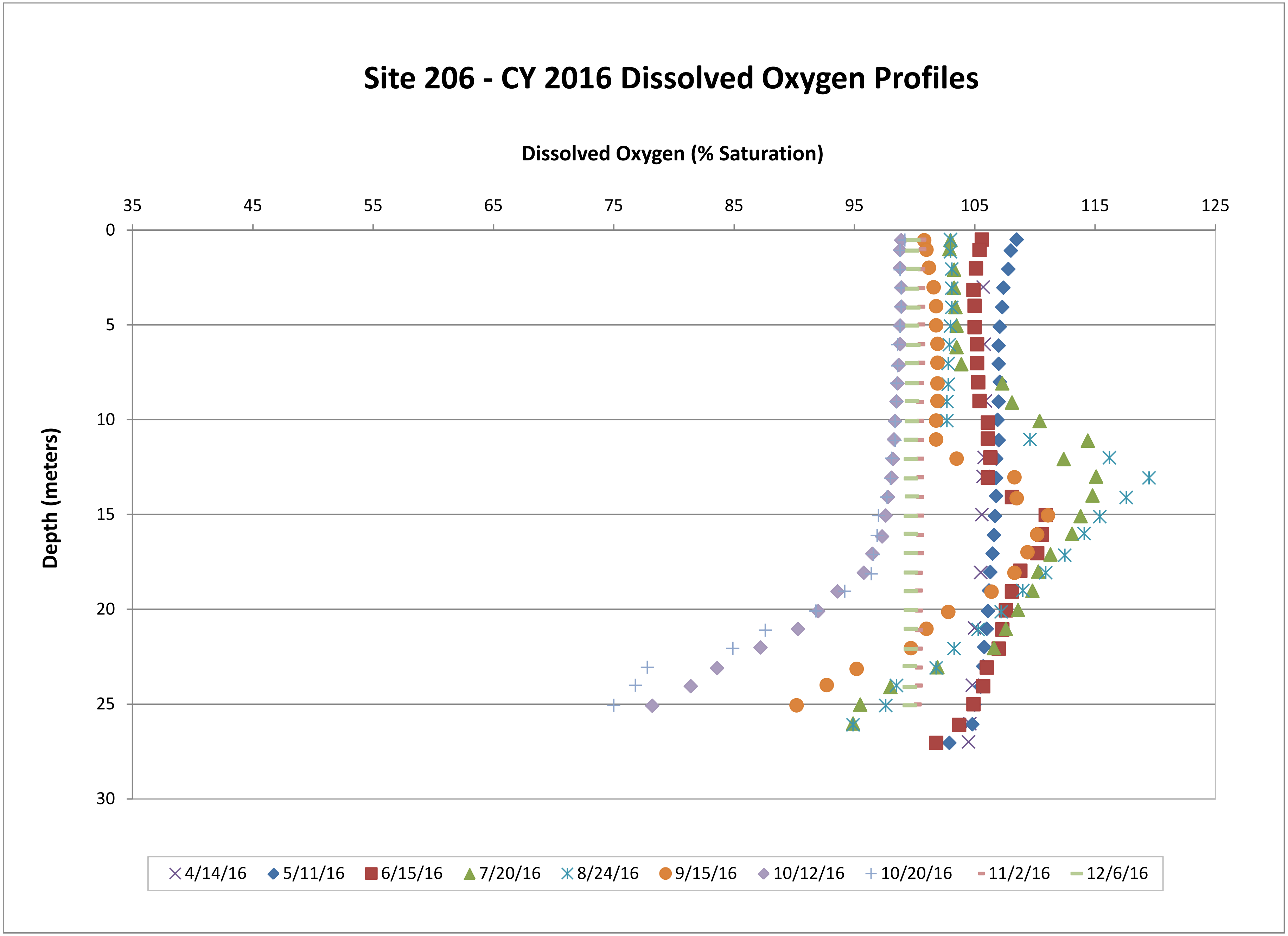
Site 202 - CY 2016 Dissolved Oxygen Profiles
Dissolved Oxygen (% Saturation)
35
45
55
65
75
85
95
105
115
125
Depth (meters)
0
5
10
15
20
25
30
35
40
4/14/16
5/11/16
6/15/16
7/20/16
8/24/16
9/15/16
10/12/16
10/20/16
11/2/16
12/6/16


Site 202 - CY 2016 pH Profiles
pH
5.5
5.7
5.9
6.1
6.3
6.5
6.7
6.9
7.1
7.3
7.5
Depth (meters)
0
5
10
15
20
25
30
35
40
4/14/16
5/11/16
6/15/16
7/20/16
8/24/16
9/15/16
10/12/16
10/20/16
11/2/16
12/6/16

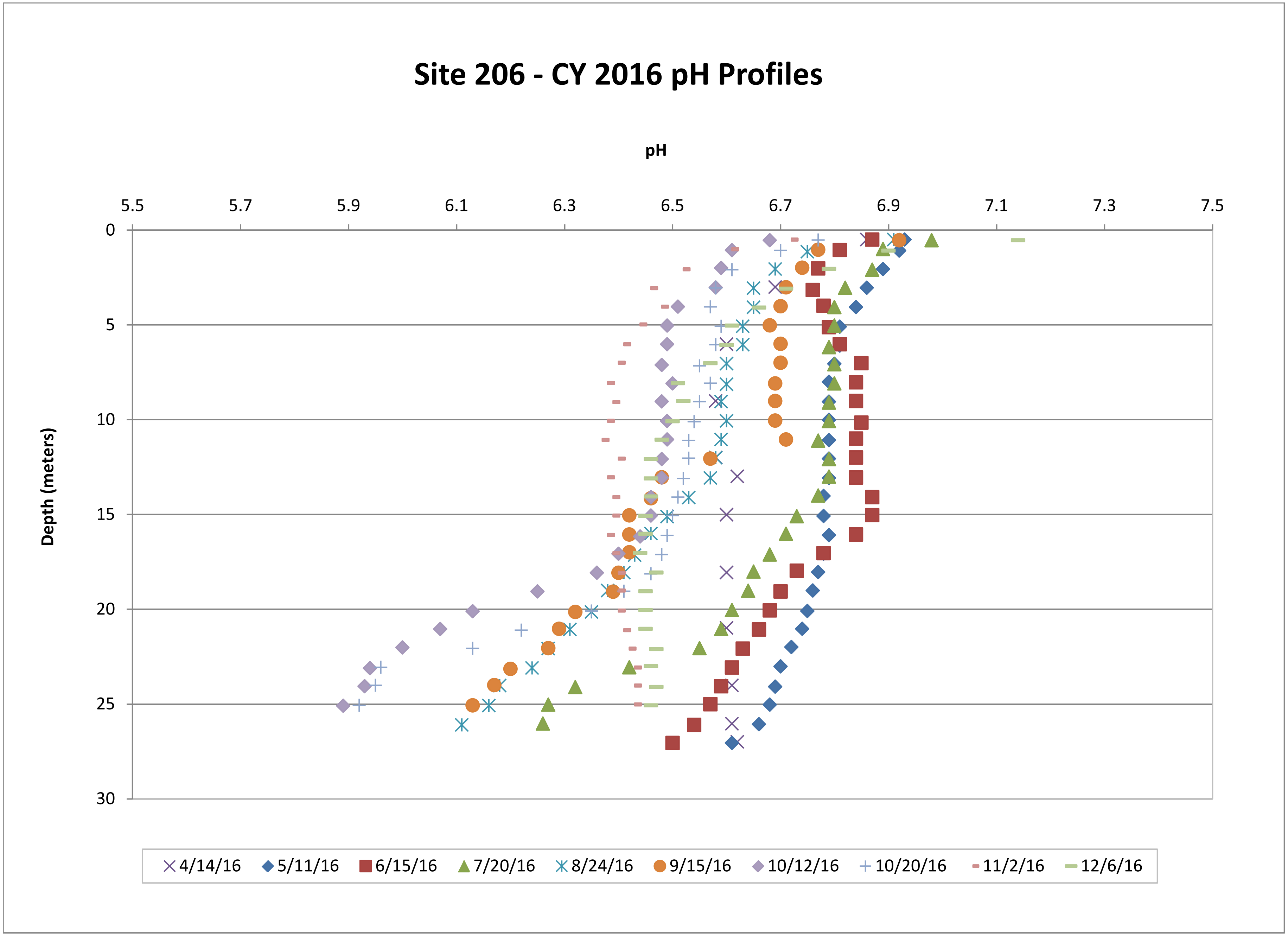

Site 202 - CY 2016 Specific Conductance Profiles
Specific Conductance (uS/cm)
45
45.5
46
46.5
47
47.5
48
48.5
49
49.5
50
Depth (meters)
0
5
10
15
20
25
30
35
40
4/14/16
5/11/16
6/15/16
7/20/16
8/24/16
9/15/16
10/12/16
10/20/16
11/2/16
12/6/16



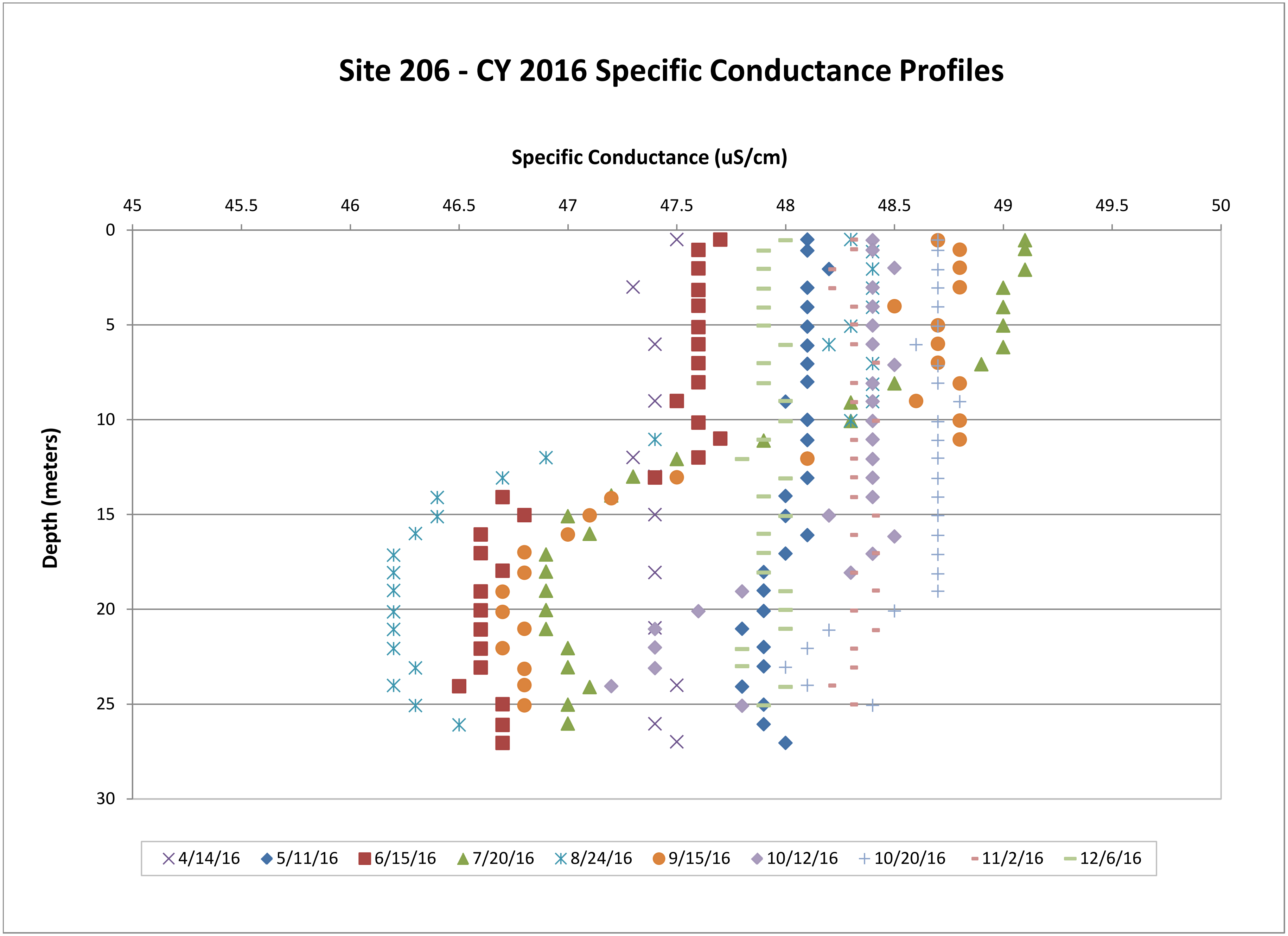
Site 206 - CY 2016 Temperature Profiles
Temperature (Celsius)
0
5
10
15
20
25
30
Depth (meters)
0
5
10
15
20
25
30
4/14/16
5/11/16
6/15/16
7/20/16
8/24/16
9/15/16
10/12/16
10/20/16
11/2/16
12/6/16



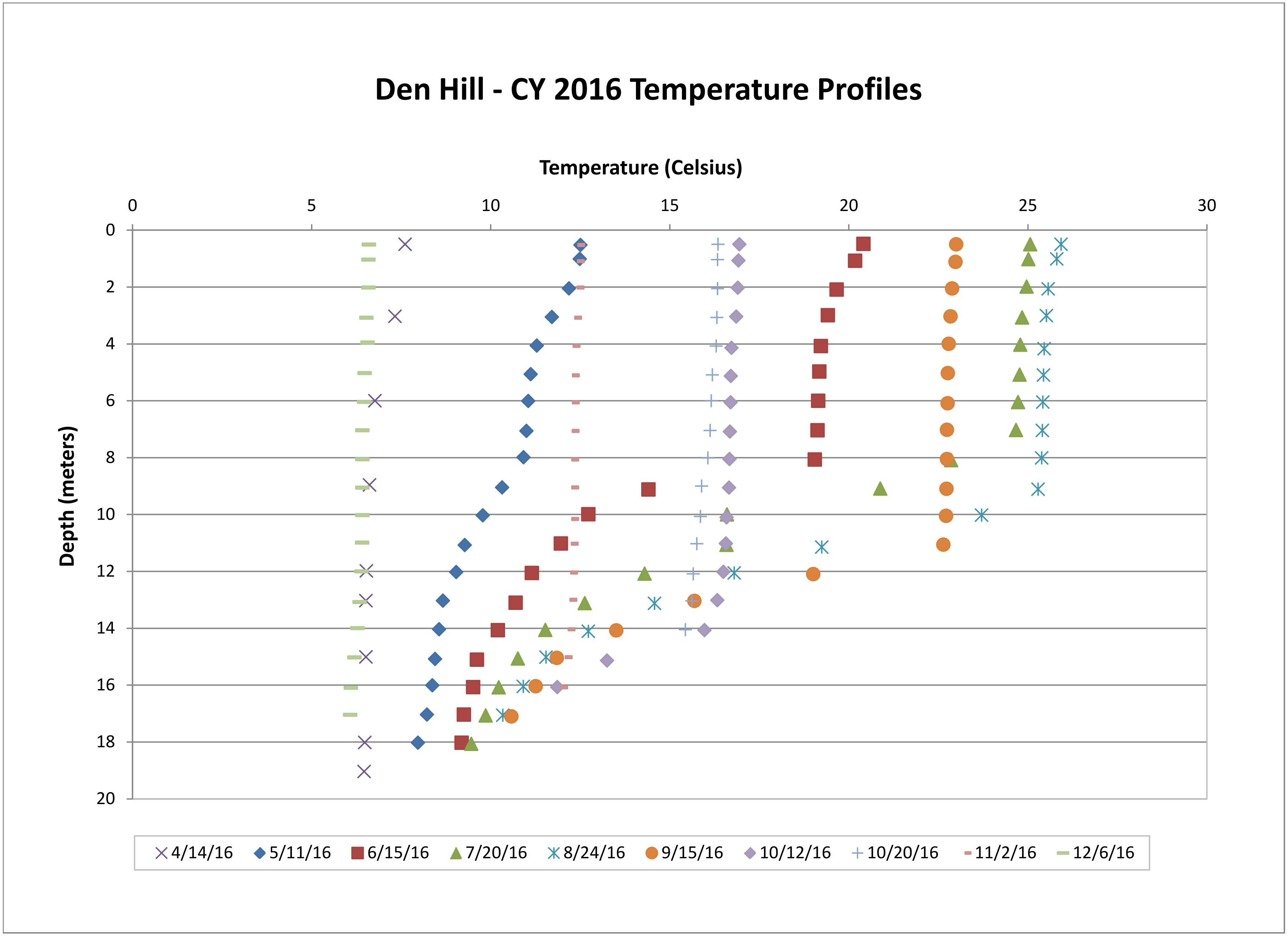
Site 206 - CY 2016 Dissolved Oxygen Profiles
Dissolved Oxygen (% Saturation)
35
45
55
65
75
85
95
105
115
125
Depth (meters)
0
5
10
15
20
25
30
4/14/16
5/11/16
6/15/16
7/20/16
8/24/16
9/15/16
10/12/16
10/20/16
11/2/16
12/6/16



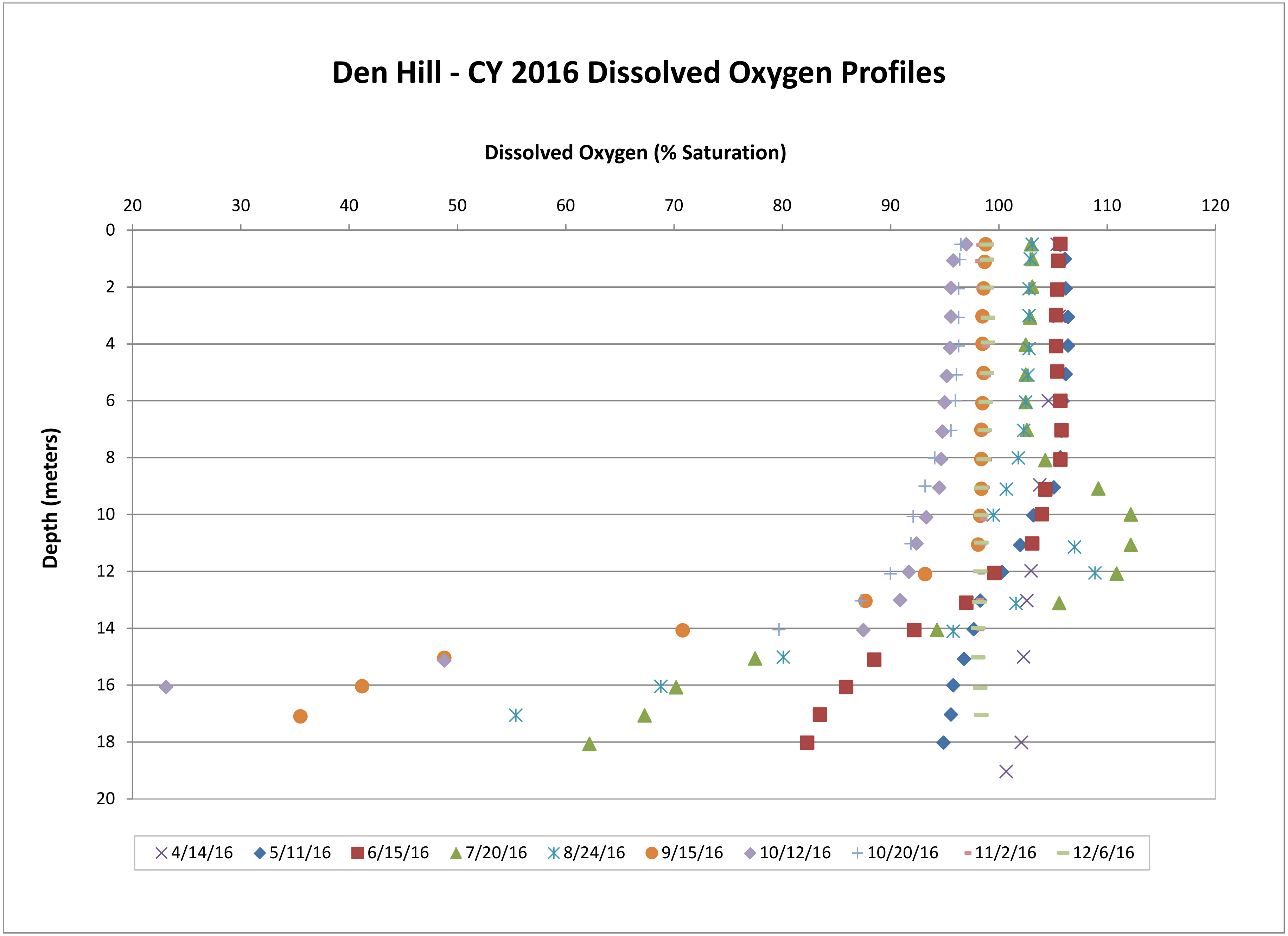
Site 206 - CY 2016 pH Profiles
pH
5.5
5.7
5.9
6.1
6.3
6.5
6.7
6.9
7.1
7.3
7.5
Depth (meters)
0
5
10
15
20
25
30
4/14/16
5/11/16
6/15/16
7/20/16
8/24/16
9/15/16
10/12/16
10/20/16
11/2/16
12/6/16



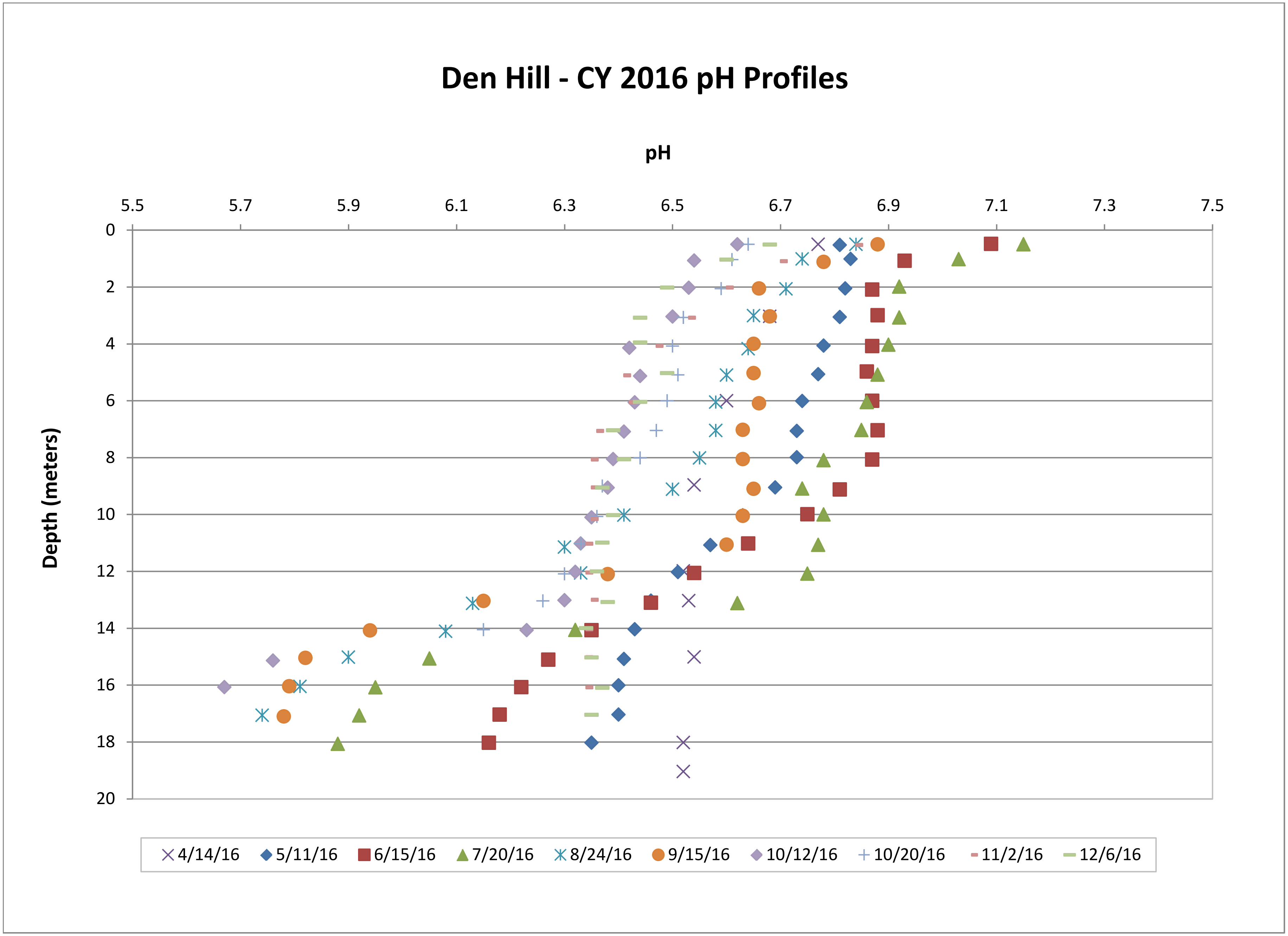
Site 206 - CY 2016 Specific Conductance Profiles
Specific Conductance (uS/cm)
45
45.5
46
46.5
47
47.5
48
48.5
49
49.5
50
Depth (meters)
0
5
10
15
20
25
30
4/14/16
5/11/16
6/15/16
7/20/16
8/24/16
9/15/16
10/12/16
10/20/16
11/2/16
12/6/16



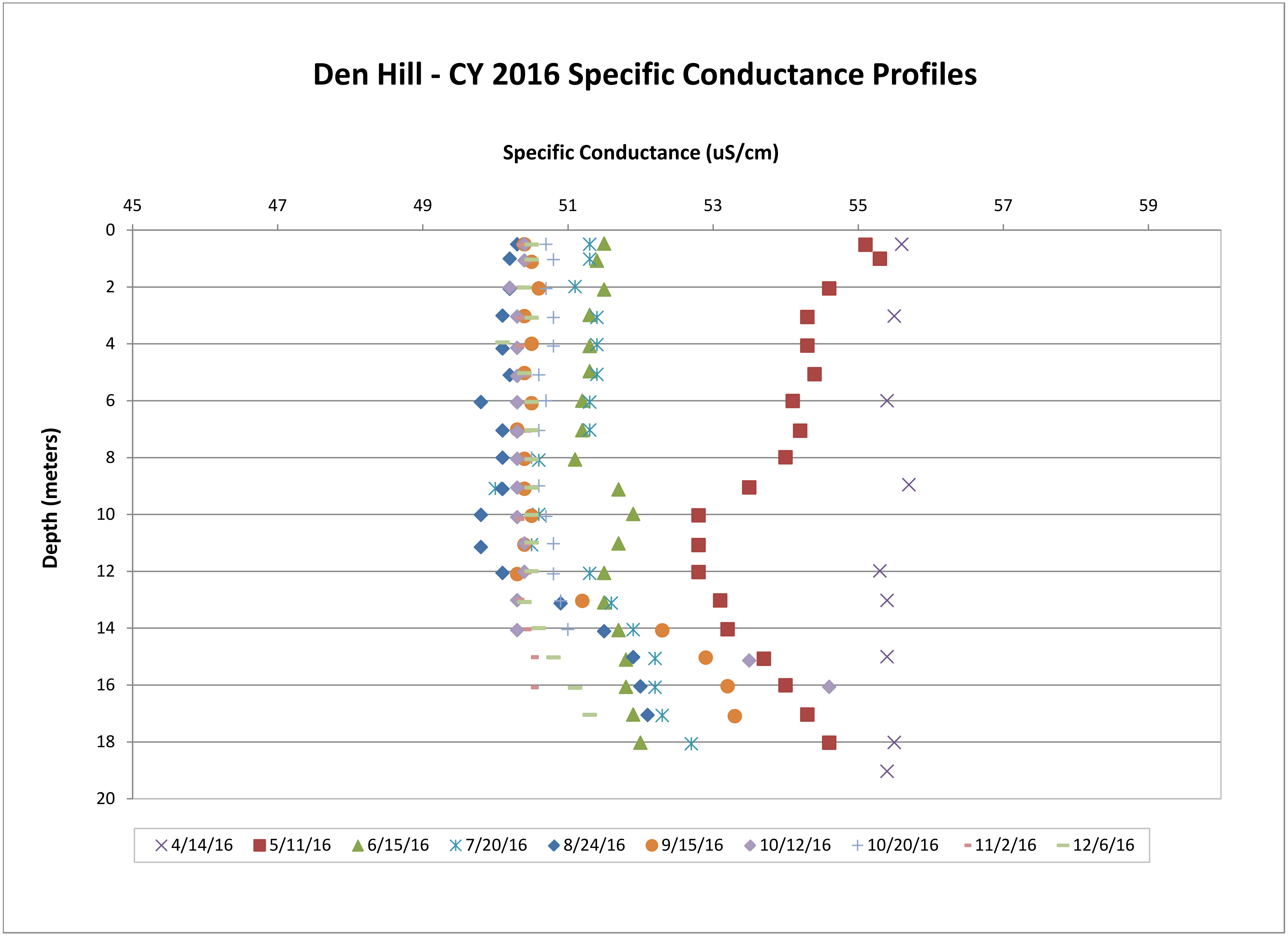
Den Hill - CY 2016 Temperature Profiles
Temperature (Celsius)
0
5
10
15
20
25
30
Depth (meters)
0
2
4
6
8
10
12
14
16
18
20
4/14/16
5/11/16
6/15/16
7/20/16
8/24/16
9/15/16
10/12/16
10/20/16
11/2/16
12/6/16



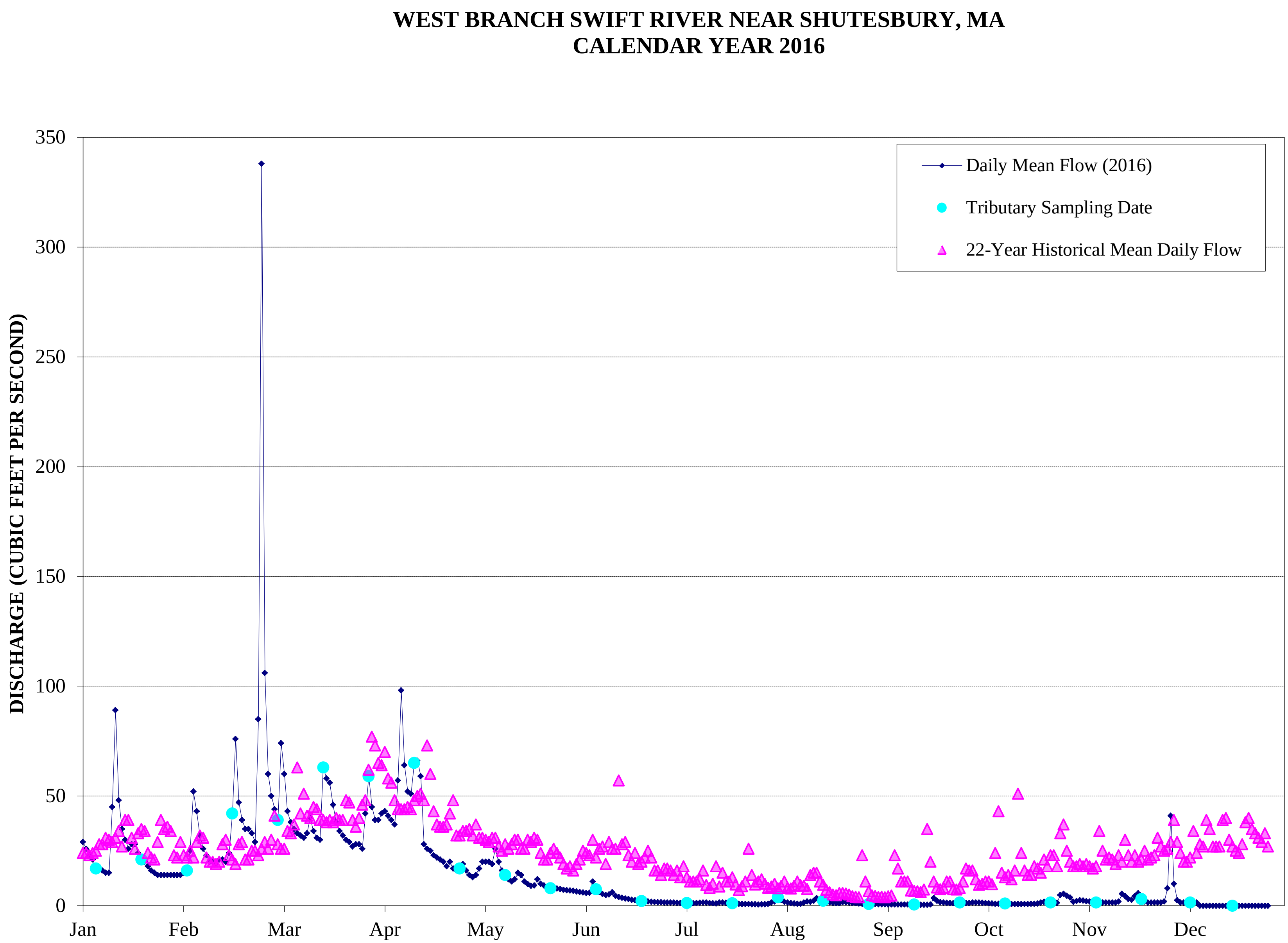
Den Hill - CY 2016 Dissolved Oxygen Profiles
Dissolved Oxygen (% Saturation)
20
30
40
50
60
70
80
90
100
110
120
Depth (meters)
0
2
4
6
8
10
12
14
16
18
20
4/14/16
5/11/16
6/15/16
7/20/16
8/24/16
9/15/16
10/12/16
10/20/16
11/2/16
12/6/16



Den Hill - CY 2016 pH Profiles
pH
5.5
5.7
5.9
6.1
6.3
6.5
6.7
6.9
7.1
7.3
7.5
Depth (meters)
0
2
4
6
8
10
12
14
16
18
20
4/14/16
5/11/16
6/15/16
7/20/16
8/24/16
9/15/16
10/12/16
10/20/16
11/2/16
12/6/16



Den Hill - CY 2016 Specific Conductance Profiles
Specific Conductance (uS/cm)
45
47
49
51
53
55
57
59
Depth (meters)
0
2
4
6
8
10
12
14
16
18
20
4/14/16
5/11/16
6/15/16
7/20/16
8/24/16
9/15/16
10/12/16
10/20/16
11/2/16
12/6/16



Note: Discharge could not be measured December 10-31 due to ice.

Source: U.S. Geological Survey website (accessed May 22, 2017)

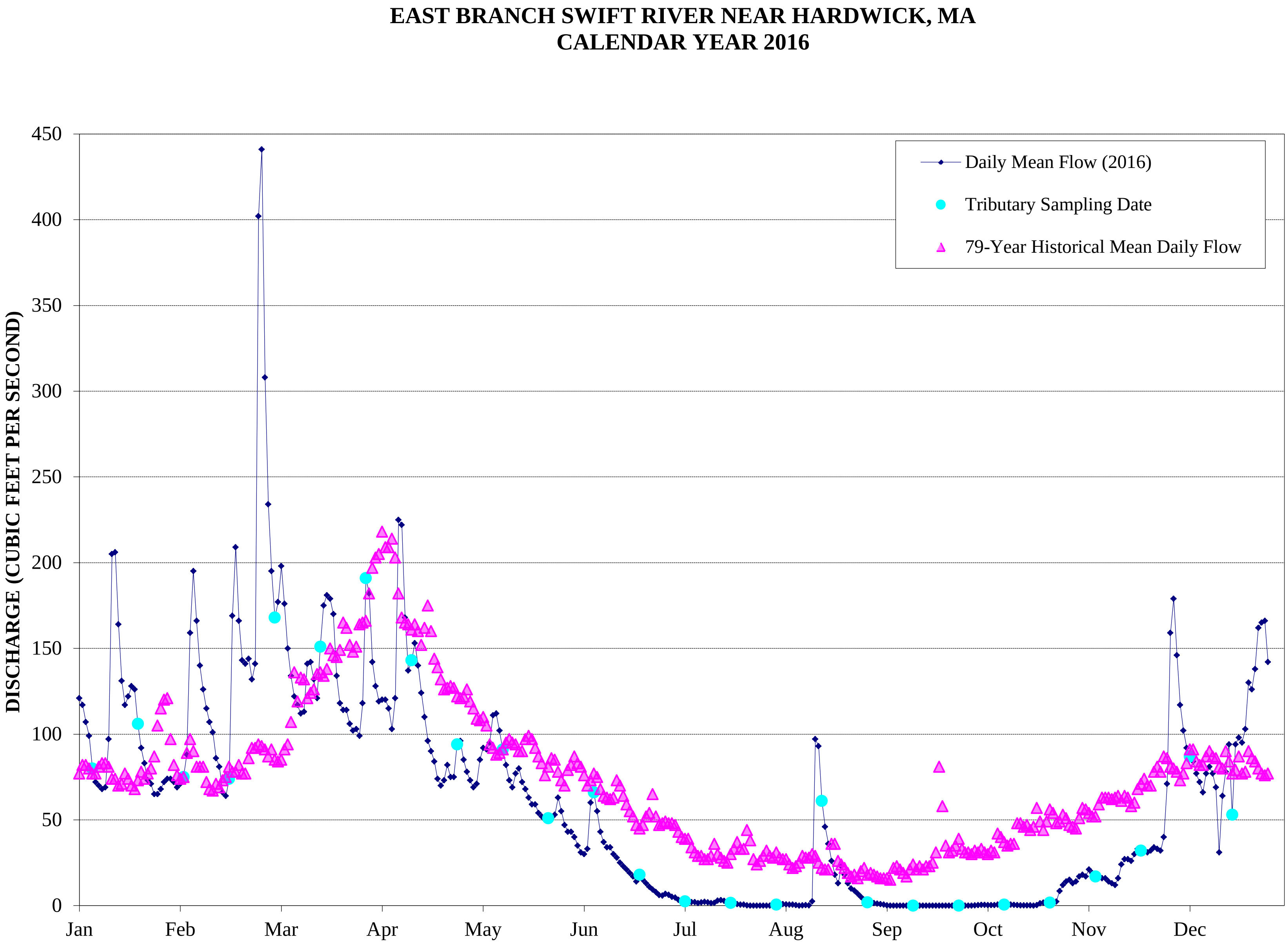
USGS 01174565: WEST BRANCH SWIFT RIVER NEAR SHUTESBURY, MA
January 1, 2016 - December 31, 2016
Daily mean discharge, cubic feet per second

DATE	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	29	15	39	39	14	6.5	1.4	1.9	0.73	1.4	1.8	*41*
2	26	16	74	42	17	6.2	1.3	3.8	0.7	1.5	2.1	*10*
3	23	25	60	43	20	6	1.2	2.6	0.65	1.4	2.5	*2.5*
4	21	52	43	41	20	5.8	1.1	1.8	0.61	1.3	2.4	*1.5*
5	17	43	38	39	20	5.9	1.2	1.5	0.55	1.2	2	*1.4*
6	17	32	35	37	19	11	1.2	1.2	0.51	1.1	1.9	*1.4*
7	16	26	33	57	26	7.5	1.1	1	0.53	1	1.7	*1.4*
8	15	23	32	98	20	6.2	1.2	0.93	0.55	0.94	1.5	*1.4*
9	15	20	31	64	16	5.3	1.3	0.9	0.56	0.91	1.4	*1.4*
10	45	20	33	52	14	4.9	1.5	1.4	0.55	0.98	1.4	*Ice*
11	89	19	40	51	12	5.1	1.5	1.9	0.54	0.98	1.4	*Ice*
12	48	21	34	65	11	6.1	1.2	1.8	0.62	0.89	1.4	*Ice*
13	35	21	31	66	12	4.5	1.1	2.2	0.53	0.83	1.4	*Ice*
14	30	20	30	59	15	4	0.96	3.5	0.45	0.78	1.4	*Ice*
15	26	24	63	28	14	3.6	1.4	2.7	0.41	0.77	1.9	*Ice*
16	28	42	58	26	11	3.3	1.4	2.2	0.39	0.77	5.4	*Ice*
17	28	76	56	25	9.9	3	1.3	1.9	0.41	0.78	4.4	*Ice*
18	24	47	46	23	9.1	2.7	1.1	1.6	0.5	0.81	3.1	*Ice*
19	21	39	38	22	9.2	2.5	1.1	1.3	3.5	0.86	2.7	*Ice*
20	20	35	34	21	12	2.3	0.95	1.2	2.2	0.9	4.4	*Ice*
21	18	35	32	20	10	2.1	0.88	1.1	1.6	0.98	5.7	*Ice*
22	16	33	30	18	9.2	2	0.82	1.7	1.4	1.5	*3*	*Ice*
23	15	29	29	20	8.1	1.9	0.77	1.6	1.3	1.8	*1.9*	*Ice*
24	14	85	27	17	8	1.8	0.73	1.4	1.2	1.5	*1.5*	*Ice*
25	14	338	28	16	8	1.7	0.7	1.2	1.1	1.4	*1.5*	*Ice*
26	14	106	28	17	7.8	1.6	0.68	1.1	1	1.5	*1.4*	*Ice*
27	14	60	26	19	7.6	1.6	0.6	0.97	1.5	1.3	*1.4*	*Ice*
28	14	50	42	16	7.3	1.5	0.61	0.87	1.5	4.9	*1.4*	*Ice*
29	14	44	59	14	7	1.5	0.69	0.79	1.2	5.5	*1.9*	*Ice*
30	14	--	45	13	6.9	1.4	0.86	0.74	1.2	4.5	*8*	*Ice*
31	14	--	39	--	6.8	--	1.4	0.72	--	3.7	--	*Ice*
MAX	**89**	**338**	**74**	**98**	**26**	**11**	**1.5**	**3.8**	**3.5**	**5.5**	**8**	**41**
MIN	**14**	**15**	**26**	**13**	**6.8**	**1.4**	**0.6**	**0.72**	**0.39**	**0.77**	**1.4**	**1.4**
MEAN	**23.7**	**48.1**	**39.8**	**35.6**	**12.5**	**4.0**	**1.1**	**1.6**	**0.9**	**1.6**	**2.5**	**6.9**
DEPARTURE FROM NORM	-4	22	-2	-11	-15	-19	-11	-7	-9	-17	-19	-22
	STATISTICS OF MONTHLY MEAN DATA FOR CALENDAR YEARS 1984 - 2015											
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	2.0	1.5	1.0	1.8	1.7	4.1
MEAN	28.1	26.3	42.3	46.5	27.9	23.2	12.0	8.4	9.9	18.7	21.6	29.4

Notes:

Source: U.S. Geological Survey website (accessed May 22, 2017)

1. *Italics* indicates provisional data, subject to revision; all other data are approved
2. Data from 1/1/2016 through 11/21/2016 are estimated values



Source: U.S. Geological Survey website (provisional data accessed May 22, 2017)

USGS 01174500: EAST BRANCH SWIFT RIVER NEAR HARDWICK, MA
January 1, 2016 - December 31, 2016
Daily mean discharge, cubic feet per second

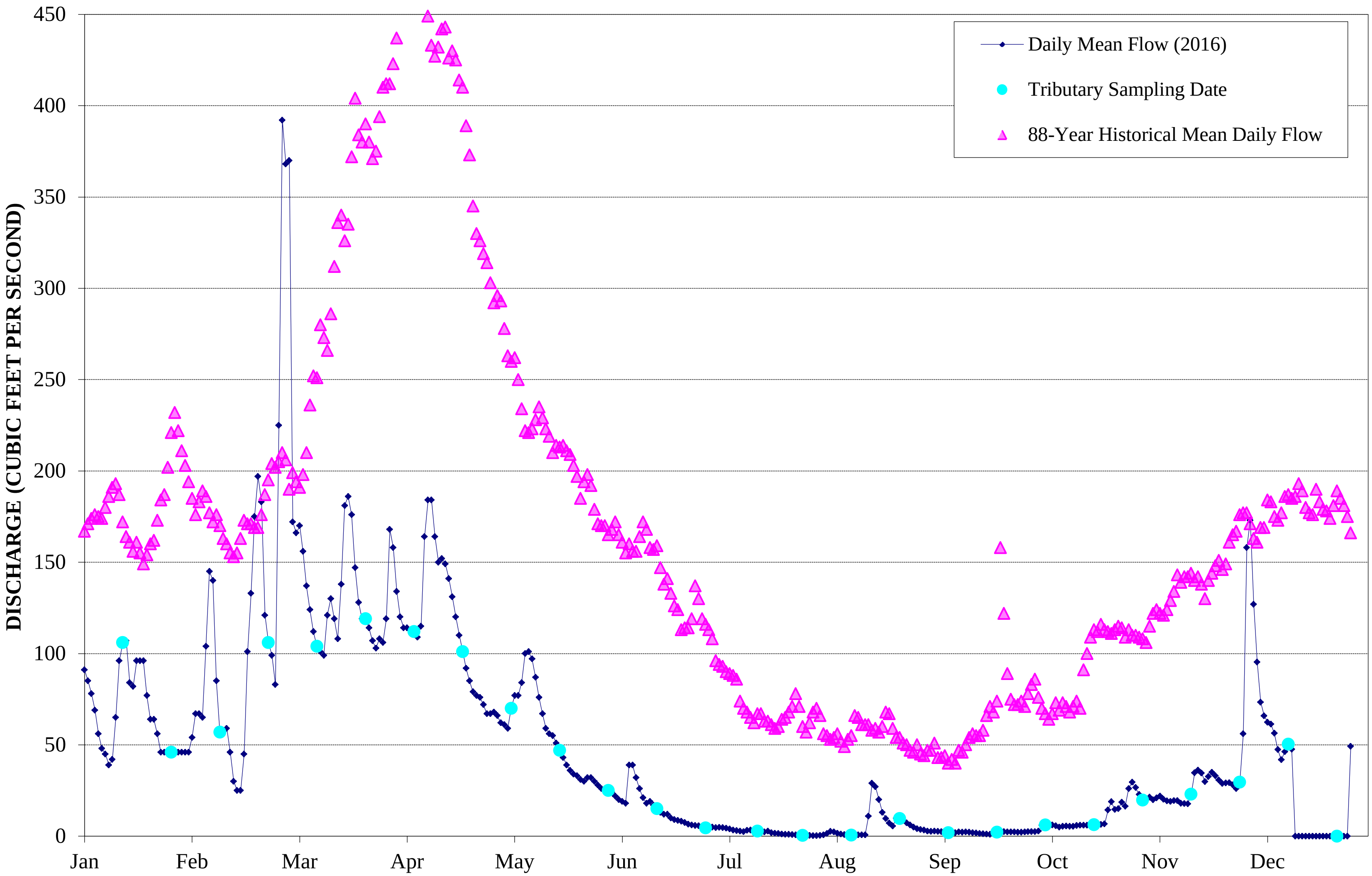
DATE	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	121	71	168	128	69	40	5.1	0	1.4	0	*13*	*159*
2	117	75	177	119	71	35	4.6	0.53	1.2	0.07	*14*	*179*
3	107	88	198	120	85	31	3.4	0.98	0.8	0.3	*17*	*146*
4	99	159	176	120	92	30	2.6	0.9	0.49	0.44	*18*	*117*
5	80	195	150	115	91	33	2.5	0.7	0.15	0.39	*17*	*102*
6	72	166	134	103	95	60	2.4	0.53	0	0.33	*21*	*92*
7	70	140	122	121	111	66	2	0.52	0	0.22	*19*	*87*
8	68	126	117	225	112	55	2	0.19	0	0.19	*17*	*84*
9	69	115	112	222	102	43	1.5	0	0	0.52	*17*	*77*
10	97	107	113	168	91	37	1.9	0.06	0	0.75	*16*	*72*
11	205	101	141	137	82	34	2.2	0.23	0	0.56	*16*	*66*
12	206	86	142	143	73	34	1.8	0.17	0	0.56	*14*	*77*
13	164	81	132	153	69	30	1.5	2.4	0	0.51	*13*	*81*
14	131	66	121	140	77	28	1.6	97	0	0.45	*12*	*77*
15	117	64	151	124	80	25	2.9	93	0	0.29	*16*	*69*
16	122	74	175	110	72	23	3.2	61	0	0.15	*24*	*31*
17	128	169	181	96	68	21	2.8	46	0	0.18	*27*	*64*
18	126	209	179	90	63	19	2	36	0	0.16	*27*	*78*
19	106	166	170	84	59	17	1.6	26	0	0.13	*26*	*94*
20	92	143	134	74	59	14	1.2	18	0	0.01	*30*	*53*
21	83	141	118	70	54	18	0.82	13	0	0.21	*33*	*94*
22	73	144	114	73	52	15	0.52	23	0	1.3	*32*	*98*
23	71	132	114	82	50	13	0.56	18	0	1.7	*32*	*95*
24	65	141	106	75	51	11	0.18	13	0	*1.8*	*31*	*103*
25	65	402	102	75	51	9.4	0	10	0	*1.7*	*32*	*130*
26	68	441	103	94	53	7.9	0.01	8.7	0	*1.7*	*34*	*126*
27	72	308	99	96	63	6.1	0	7	0	*2.3*	*33*	*138*
28	74	234	118	85	55	5.9	0	5.1	0	*8.5*	*32*	*162*
29	74	195	191	78	47	6.8	0	3.3	0	*12*	*40*	*165*
30	72	--	182	73	43	6.2	0	1.9	0	*14*	*71*	*166*
31	69	--	142	--	43	--	0	1.5	--	*15*	--	*142*
MAX	**206**	**441**	**198**	**225**	**112**	**66**	**5.1**	**97**	**1.4**	**15**	**71**	**179**
MIN	**65**	**64**	**99**	**70**	**43**	**5.9**	**0**	**0**	**0**	**0**	**12**	**31**
MEAN	**99.5**	**156.5**	**141.4**	**113.1**	**70.4**	**25.8**	**1.6**	**15.8**	**0.1**	**2.1**	**24.8**	**104.0**
DEPARTURE FROM NORM	17	75	5	-47	-21	-36	-31	-9	-27	-40	-39	22
	STATISTICS OF MONTHLY MEAN DATA FOR CALENDAR YEARS 1937 - 2015											
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	3.2	0.0	0.0	0.7	4.2	15.6
MEAN	82.7	81.1	136.1	160.2	91.2	62.3	32.9	24.5	27.3	42.4	63.9	82.4

Notes:

Italics indicates provisional data, subject to revision; all other data are approved

Source: U.S. Geological Survey website (accessed May 22, 2017)

MWRA INTAKE WORKS AT WARE RIVER IN BARRE, MA
CALENDAR YEAR 2016



Note: Discharge could not be measured December 15-30 due to ice.

Source: U.S. Geological Survey website (provisional data accessed May 22, 2017)

USGS 01173000: MWRA INTAKE WORKS AT WARE RIVER IN BARRE, MA January 1, 2016 - December 31, 2016 Daily mean discharge, cubic feet per second												
DATE	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1	91	54	172	120	61	24	4.6	0.71	2.6	2.5	*19.7*	*158*
2	85	67	166	114	59	22	4.8	1.5	2.8	2.8	*19.9*	*173*
3	78	67	170	114	70	20	4.7	2.6	2.6	*5.98*	*21.4*	*127*
4	69	65	156	113	77	19	4.4	2.3	2.5	*6.07*	*19.9*	*95.3*
5	56	104	137	112	77	18	3.9	1.6	2.1	*6.06*	*20.9*	*73.4*
6	48	145	124	109	84	39	3.4	1.1	1.8	*6.18*	*22*	*65.9*
7	45	140	112	115	100	39	3	0.89	1.8	*5.72*	*20.2*	*62.4*
8	39	85	104	164	101	32	2.7	0.72	1.8	*5.02*	*19.3*	*61.4*
9	42	57	101	184	97	26	2.5	0.57	2.3	*5.32*	*19*	*56.3*
10	65	58	99	184	87	21	3.2	0.51	2.2	*5.58*	*19.5*	*47.4*
11	96	59	121	164	76	18	3.3	0.66	2.3	*5.4*	*19.4*	*41.8*
12	106	46	130	150	67	19	3.1	0.65	2.2	*5.37*	*18*	*46.2*
13	107	30	119	152	59	17	2.8	0.63	1.9	*5.83*	*17.9*	*50.3*
14	84	25	108	149	56	15	2.4	11	1.7	*5.92*	*17.7*	*47.6*
15	82	25	138	141	55	13	2.3	29	1.5	*5.93*	*22.9*	*Ice*
16	96	45	181	131	51	12	2.8	27	1.3	*6.04*	*34.7*	*Ice*
17	96	101	186	120	47	12	1.9	20	1.1	*6.23*	*36.1*	*Ice*
18	96	133	176	110	43	10	1.6	13	1	*6.29*	*34.5*	*Ice*
19	77	175	147	101	39	9.1	1.4	9.7	1.3	*6.37*	*29.8*	*Ice*
20	64	197	128	92	36	8.6	1.1	7.2	2.1	*6.42*	*32.6*	*Ice*
21	64	183	119	85	34	8.2	1	5.6	2.4	*6.65*	*35*	*Ice*
22	56	121	119	79	33	7.5	0.96	9.8	2.4	*14.3*	*33.1*	*Ice*
23	46	106	114	77	31	6.6	0.87	9.7	2.3	*18.8*	*30.7*	*Ice*
24	46	99	107	76	30	6.1	0.69	8.6	2.3	*14.6*	*28.8*	*Ice*
25	46	83	103	72	32	5.8	0.57	7.3	2.3	*15.0*	*29.1*	*Ice*
26	46	225	108	67	32	5.7	0.47	6.1	2.2	*18.6*	*29.2*	*Ice*
27	46	392	106	67	30	4.9	0.39	4.9	2.2	*16.3*	*28.1*	*Ice*
28	46	368	119	68	28	4.5	0.34	4.1	2.3	*26.1*	*26.1*	*Ice*
29	46	370	168	66	26	4.9	0.32	3.7	2.4	*29.5*	*29.6*	*Ice*
30	46	--	158	62	25	4.9	0.3	3.3	2.4	*26.6*	*56.1*	*Ice*
31	46	--	134	--	25	--	0.41	2.7	--	*22.8*	--	*49.2*
MAX	**107**	**392**	**186**	**184**	**101**	**39**	**4.8**	**29**	**2.8**	**29.5**	**56.1**	**173**
MIN	**39**	**25**	**99**	**62**	**25**	**4.5**	**0.3**	**0.51**	**1**	**2.5**	**17.7**	**41.8**
MEAN	**66.3**	**125.0**	**133.2**	**111.9**	**53.8**	**15.1**	**2.1**	**6.4**	**2.1**	**10.3**	**26.4**	**77.0**
DEPARTURE FROM NORM	-114	-54	-190	-293	-160	-127	-69	-49	-63	-82	-113	-102
	STATISTICS OF MONTHLY MEAN DATA FOR CALENDAR YEARS 1937 - 2015											
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	7.9	13.9	29.1
MEAN	180.6	178.5	323.5	404.5	214.3	142.1	71.5	55.1	64.8	92.5	139.6	178.8

Notes:

Source: U.S. Geological Survey website (accessed May 22, 2017)

1. *Italics* indicates provisional data, subject to revision; all other data are approved
2. Data from 12/31/16 is estimated value

APPENDIX B

Water Quality Data Tables

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Units of measure, unless noted otherwise on each table:
Temperature (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 2016
(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
1/5/2016	-0.15	21.48	149	6.30	62.3	0.266			*0*	487						2540	
1/19/2016	0.00	14.49	101	6.51	56.0	0.209			10	496						2250	
2/2/2016	0.79	14.25	102	6.66	54.0	0.230			10	313						2120	
2/16/2016	0.03	13.96	97	6.31	64.6	0.273			20	336						2420	
3/1/2016	1.63	13.64	101	6.23	46.0	0.263			20	313						1720	
3/15/2016	4.51	12.53	98	6.25	53.7	0.509	3.48	1.83	10	1180		0.0144	0.0149	0.143	0.10082	1840	*0*
3/29/2016	4.60	11.83	94	5.67	60.8	0.315			41	563						1630	
4/12/2016	6.38	12.20	100	6.01	48.0	0.326			*0*	480						1940	
4/26/2016	8.50	11.44	99	6.27	59.0	0.296			10	862						2260	
5/10/2016	7.57	11.89	101	6.36	53.3	0.350			*0*	798						2210	
5/24/2016	14.26	9.85	98	6.38	68.4	0.538			52	3450						2530	
6/7/2016	16.22	9.50	100	6.22	52.3	0.598			41	2610						2220	
6/21/2016	18.04	8.72	93	6.39	84.6	0.573	8.45	6.62	410	4110		0.0176	0.111	0.242	0.11784	3570	0.0160
7/5/2016	17.16	8.82	93	6.46	107.4	0.811			345	17300						4140	
7/19/2016	17.62	8.46	90	6.45	123.5	0.743			85	6130						4290	
8/2/2016	17.37	8.93	95	6.44	86.3	2.51			6870		>24200					3510	
8/16/2016	19.37	8.18	90	6.15	76.6	1.27			135	17300						3300	
8/30/2016	15.86	7.97	82	6.25	153.0	0.801			10	12000						5000	
9/13/2016	12.17	9.46	89	6.40	151.7	0.462			41	3130						4680	
9/27/2016	12.02	9.48	89	6.43	107.5	0.698	8.63	7.04	529	13000		0.0132	0.117	0.183	0.066225	4070	0.00951
10/11/2016	6.50	11.53	94	6.68	81.8	0.331			20	882						3180	
10/25/2016	6.36	11.32	94	6.27	71.3	0.585			20	1920						3130	
11/8/2016	3.13	13.77	103	6.26	74.2	0.246			20	683						3060	
11/22/2016	1.66	14.95	111	6.30	56.8	0.256			20	706						2440	
12/7/2016	1.94	14.89	109	6.02	55.5	0.266			10	528						2370	
12/20/2016	-0.07	16.10	109	5.88	52.6	0.278	2.84	1.34	20	481		0.00972	0.0209	0.157	0.15221	2330	*0*
AVG.	8.21	11.91	99	6.29	75.4	0.539	5.85	4.21	337	3600		0.0137	0.0660	0.181	0.10927	2880	0.00638
MAX.	19.37	21.48	149	6.68	153.0	2.510	8.63	7.04	6870	17300		0.0176	0.117	0.242	0.15221	5000	0.0160
MIN.	-0.15	7.97	82	5.67	46.0	0.209	2.84	1.34	*<10*	313		0.00972	0.0149	0.143	0.066225	1630	*<0.005*
MEDIAN	6.44	11.68	98	6.30	63.5	0.341	5.97	4.23	20	862		0.0138	0.0660	0.170	0.10933	2490	*<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 2016
(211E) WEST BRANCH SWIFT RIVER, SIBLEY

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/5/2016	-0.10	20.94	145	6.05	25.6	0.181	4.02	2.22	*0*	373		0.0111	*0*	0.214	0.11476	1520	0.00575
1/19/2016	-0.01	14.56	101	6.35	24.4	0.187	3.32	1.57	*0*	426		0.0120	0.0137	0.235	0.092710	1400	*0*
2/2/2016	1.09	14.11	102	6.66	24.7	0.246	3.59	1.94	*0*	295		0.0116	0.0174	0.266	0.068345	1490	*0*
2/16/2016	-0.04	13.92	96	6.20	25.5	0.204	3.88	1.97	*0*	256		0.0120	0.0228	0.117	0.069415	1420	0.00645
3/1/2016	1.77	13.45	100	6.11	20.7	0.202	2.73	1.02	*0*	256		0.0116	0.00658	0.161	0.089705	1170	*0*
3/15/2016	4.77	12.41	97	6.16	20.4	0.355	2.80	1.06	52	733		0.0104	0.00606	0.235	0.098600	1290	*0*
3/29/2016	4.90	10.66	86	5.73	21.3	0.300	2.58	1.02	52	1040		0.0113	0.00508	0.134	0.10375	1200	*0*
4/12/2016	6.36	12.60	103	5.80	21.6	0.334	3.27	1.59	10	591		0.0071	0.0130	0.167	0.080270	1260	*0*
4/26/2016	8.43	11.04	96	6.22	22.9	0.301	3.51	1.78	10	1270		0.0141	0.00889	0.177	0.074010	1360	*0*
5/10/2016	7.55	11.67	99	6.64	22.6	0.398	3.59	1.97	*0*	1480		0.00646	*0*	0.155	0.081170	1330	*0*
5/24/2016	14.93	9.27	94	6.22	23.2	0.350	4.27	2.66	*0*	2220		0.0110	*0*	0.177	0.082250	1390	*0*
6/7/2016	16.96	8.49	90	6.12	22.7	0.413	5.32	3.39	41	6130		0.0128	0.0284	0.155	0.17494	1670	*0*
6/21/2016	21.18	7.76	88	6.17	22.7	0.442	4.65	2.84	10	10500		0.0136	0.0458	0.209	0.12128	1580	0.00556
7/5/2016	22.01	7.19	84	6.18	23.8	0.345	5.73	3.84	144	10500		0.0164	0.0444	0.197	0.14703	1650	0.0127
7/19/2016	22.82	5.50	65	5.99	24.2	0.421	5.38	3.85	*0*	5790		0.0150	0.0310	0.420	0.15578	1630	0.0314
8/2/2016	20.57	7.31	83	5.94	24.3	0.646	6.22	4.59	231	13000		0.0177	0.0453	0.282	0.16038	1690	0.0153
8/16/2016	22.83	7.03	83	5.78	24.7	0.499	4.69	3.00	52	5480		0.0166	0.0125	0.277	0.27550	1930	0.00849
8/30/2016	18.79	4.37	48	5.90	24.9	2.64	5.91	4.54	10	3870		0.0186	0.0199	0.320	0.16707	1720	0.0426
9/13/2016	16.43	6.29	65	5.88	23.7	1.05	5.97	4.23	*0*	3280		0.0103	0.0167	0.270	0.13444	1540	0.0158
9/27/2016	14.45	8.27	82	6.04	22.4	0.567	4.56	2.87	*0*	5170		0.0111	0.0196	0.312	0.11803	1490	0.0198
10/11/2016	8.04	9.59	82	6.11	23.3	0.597	4.68	3.04	*0*	2140		0.00559	*0*	0.144	0.10855	1470	0.00647
10/25/2016	7.31	9.26	79	5.92	28.3	0.600	5.08	3.30	20	3280		0.00907	*0*	0.200	0.22650	1780	*0*
11/8/2016	3.78	12.86	98	6.16	30.0	0.259	4.09	2.50	*0*	862		0.00736	*0*	0.165	0.13301	1560	*0*
11/22/2016	1.02	14.73	107	6.31	31.6	0.357	3.60	2.03	*0*	563		0.00879	0.00699	0.234	0.14545	1690	*0*
12/7/2016	1.89	14.70	108	5.96	32.1	0.248	2.84	1.07	10	464		0.00925	*0*	0.173	0.18030	1760	*0*
12/20/2016	-0.07	16.93	115	5.92	30.9	0.316	2.90	1.32	*0*	573		0.00891	0.00815	0.329	0.16406	1920	*0*
AVG.	9.53	10.96	92	6.10	24.7	0.479	4.20	2.51	25	3100		0.0115	0.0143	0.220	0.12951	1540	0.0066
MAX.	22.83	20.94	145	6.66	32.1	2.640	6.22	4.59	231	13000		0.0186	0.0458	0.420	0.27550	1930	0.0426
MIN.	-0.10	4.37	48	5.73	20.4	0.181	2.58	1.02	*<10*	256		0.00559	*<0.005*	0.117	0.068345	1170	*<0.005*
MEDIAN	7.43	10.85	95	6.11	24.0	0.353	4.06	2.36	*<10*	1380		0.0112	0.0107	0.205	0.11966	1530	*<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 2016
(211F) WEST BRANCH SWIFT RIVER, NEW BOSTON

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/5/2016	-0.32	15.65	108	5.56	36.1	0.253	3.43	1.71	*0*	581		0.0126	*0*	0.212	0.13139	1550	0.00786
1/19/2016	-0.07	14.79	103	5.96	33.5	0.276	2.34	0.670	10	455		0.0114	0.00941	*0*	0.11030	1440	*0*
2/2/2016	0.35	14.75	105	6.19	33.4	0.237	2.58	0.890	*0*	420		0.0117	0.0229	0.414	0.084995	1540	*0*
2/16/2016	-0.06	13.92	96	5.91	36.7	0.296	3.43	1.67	*0*	345		0.0124	0.0229	0.174	0.077630	1610	0.00899
3/1/2016	1.00	13.98	102	5.67	29.8	0.202	2.17	0.520	*0*	410		0.0123	0.00788	0.152	0.10568	1220	*0*
3/15/2016	4.26	12.64	98	5.74	28.9	0.469	2.44	0.840	10	1020		0.0118	0.00599	0.230	0.11904	1310	*0*
3/29/2016	4.33	10.70	85	5.46	30.8	0.392	2.00	0.630	20	727		0.0113	*0*	0.128	0.15552	1320	*0*
4/12/2016	6.17	12.31	100	5.37	32.7	0.330	3.65	1.47	*0*	609		0.0076	0.00629	*0*	0.10105	1290	*0*
4/26/2016	8.25	11.56	100	5.79	33.6	0.254	2.67	0.960	20	1500		0.00981	0.00607	*0*	0.091200	1350	*0*
5/10/2016	7.39	12.13	103	6.02	34.4	0.312	2.97	1.23	*0*	959		0.00593	*0*	0.151	0.10472	1400	*0*
5/24/2016	13.92	9.96	98	5.92	34.3	0.380	3.55	1.51	41	1720		0.00982	*0*	0.108	0.10957	1410	*0*
6/7/2016	16.22	9.40	99	5.86	32.2	0.485	3.84	2.06	52	1970		0.0145	0.00543	0.192	0.21620	1570	0.00523
6/21/2016	18.52	8.57	93	6.16	33.5	0.624	4.94	2.98	158	3650		0.0166	0.0726	0.170	0.17626	1780	0.0162
7/5/2016	18.11	8.12	87	6.26	37.3	1.16	13.5	11.5	712	19900		0.0225	0.131	0.204	0.16690	2030	0.0261
7/19/2016	19.35	7.87	87	6.30	37.3	1.25	7.13	5.38	31	4110		0.0195	0.107	0.407	0.15245	2090	0.0214
8/2/2016	18.02	8.74	94	6.23	34.1	2.32	7.19	5.50	1350	24200		0.0193	0.0879	0.269	0.17053	2090	0.0250
8/16/2016	20.08	8.58	96	6.02	38.7	0.935	4.61	2.80	134	7270		0.0125	0.0476	0.228	0.086793	2340	0.0137
8/30/2016	16.72	7.92	83	6.29	38.6	1.16	6.99	5.69	146	4880		0.0137	0.122	0.164	0.10005	2470	0.00663
9/13/2016	13.42	9.13	88	6.31	38.0	0.869	7.81	6.07	31	2380		0.00764	0.108	0.156	0.093180	2580	*0*
9/27/2016	13.14	9.62	92	6.18	39.3	1.07	4.93	3.36	98	2730		0.0109	0.0688	0.177	0.082120	2490	0.0122
10/11/2016	6.76	11.78	97	6.17	39.0	0.538	3.21	0.92	20	2010		*0*	0.0140	*0*	0.068275	2130	0.0103
10/25/2016	6.40	11.74	97	5.90	44.7	0.437	3.44	1.71	10	1780		*0*	*0*	0.127	0.12320	2490	0.00599
11/8/2016	3.14	14.52	108	5.94	42.8	0.272	3.30	1.73	*0*	602		0.00637	0.0105	0.148	0.083680	2420	0.00766
11/22/2016	1.54	15.35	113	5.57	43.0	0.273	2.70	1.08	20	512		0.00894	*0*	0.143	0.12538	2200	*0*
12/7/2016	1.96	15.06	111	5.13	43.7	0.224	2.39	0.700	*0*	594		0.00883	*0*	0.163	0.16842	2130	*0*
12/20/2016	-0.07	16.68	113	5.42	17.9	0.349	2.47	0.770	31	1140		0.00830	*0*	0.304	0.15965	1950	*0*
AVG.	8.41	11.75	98	5.90	35.6	0.591	4.22	2.48	111	3330		0.0110	0.0329	0.170	0.12170	1850	0.00643
MAX.	20.08	16.68	113	6.31	44.7	2.32	13.5	11.50	1350	24200		0.0225	0.131	0.414	0.21620	2580	0.0261
MIN.	-0.32	7.87	83	5.13	17.9	0.202	2.00	0.520	*<10*	345		*<0.005*	*<0.005*	*<0.100*	0.068275	1220	*<0.005*
MEDIAN	6.58	11.76	98	5.93	35.3	0.386	3.43	1.59	20	1320		0.0114	0.00865	0.164	0.10994	1870	0.00262

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.

QUABBIN LABORATORY RECORDS 2016
(211G) WEST BRANCH SWIFT RIVER, COOLEYVILLE

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/5/2016	-0.33	20.73	143	6.70	126.2	0.341	13.4	11.5	20	327		0.0408	0.0741	0.222	0.039420	6240	0.00524
1/19/2016	-0.08	14.68	102	7.07	126.8	0.285	11.1	9.39	10	132		0.0141	0.0600	0.191	0.038160	5420	*0*
2/2/2016	2.20	14.05	105	7.21	127.9	0.561	12.0	10.2	*0*	179		0.0169	0.0516	0.274	0.037600	5380	*0*
2/16/2016	-0.03	14.36	99	7.03	130.9	0.350	12.0	10.2	10	110		0.0158	0.0660	0.171	0.024875	5660	0.00596
3/1/2016	2.97	13.27	102	6.88	98.8	0.359	9.83	8.08	122	336		0.0172	0.0305	0.127	0.042180	4160	*0*
3/15/2016	4.85	12.56	99	6.92	129.2	1.48	9.00	7.31	10	602		0.0266	0.0314	0.245	0.091960	4430	*0*
3/29/2016	4.86	11.21	90	6.48	133.8	0.434	9.50	8.04	20	441		0.0158	0.0229	0.114	0.075935	4260	*0*
4/12/2016	6.93	12.15	101	6.63	123.9	0.795	10.9	9.10	20	350		0.0143	0.0332	0.129	0.048335	4630	*0*
4/26/2016	8.12	11.82	102	6.94	125.5	0.596	11.9	10.0	20	368		0.0173	0.0187	0.103	0.045125	4740	*0*
5/10/2016	7.55	12.18	104	6.90	135.0	0.417	12.4	10.5	*0*	538		0.0134	0.00918	0.110	0.050600	4980	*0*
5/24/2016	13.29	10.21	99	6.97	130.3	0.964	14.6	12.4	75	2760		0.0281	0.0202	0.164	0.068310	4930	0.00523
6/7/2016	15.28	9.83	101	6.96	141.4	0.828	15.0	13.1	148	2140		0.0265	0.0563	0.164	0.13410	5960	0.00810
6/21/2016	17.40	9.29	98	7.08	137.7	1.02	16.3	14.1	203	3650		0.235	0.126	0.168	0.098930	6460	0.00676
7/5/2016	17.81	9.05	97	7.07	152.5	2.11	18.7	16.7	1110	24200		0.0393	0.175	0.216	0.13487	6900	*0*
7/7/2016									31	2250							
7/19/2016	18.42	9.12	99	7.19	163.4	2.09	18.6	16.7	31	2310		0.0319	0.168	0.455	0.12071	6860	0.0100
8/2/2016	17.56	9.51	102	6.91	190.8	4.66	15.2	13.4	2380		>24200	0.0670	0.133	0.459	0.24895	7700	0.00810
8/16/2016	18.70	9.12	99	6.92	155.1	1.16	16.6	14.9	31	5170		0.0224	0.110	0.125	0.19890	6810	0.00902
8/30/2016	15.65	9.75	99	6.91	201.4	0.954	18.5	17.0	10	1470		0.0215	0.126	0.168	0.088050	7990	*0*
9/13/2016	12.89	10.57	101	6.82	192.0	0.913	18.5	16.6	20	1420		0.0165	0.104	0.130	0.081205	8010	*0*
9/27/2016	12.73	10.16	97	6.76	210.5	1.94	15.0	13.3	61	6870		0.0214	0.0952	0.189	0.10181	8150	*0*
10/11/2016	6.31	12.37	101	6.65	206.5	1.31	17.1	15.4	*0*	910		0.0104	0.0504	0.102	0.072905	8050	*0*
10/25/2016	5.78	12.01	98	6.56	208.7	0.892	16.5	14.7	*0*	581		0.0108	*0*	*0*	0.11242	8670	*0*
11/8/2016	3.05	14.65	109	6.33	206.9	0.662	16.4	14.5	*0*	265		0.00958	0.0273	0.101	0.056145	8330	*0*
11/22/2016	1.29	15.38	113	6.44	210.6	0.605	15.1	13.2	10	175		0.0107	0.0875	0.144	0.064330	8300	*0*
12/7/2016	2.31	14.96	111	6.21	182.1	0.524	13.2	11.5	20	285		0.0110	0.171	*0*	0.055875	7110	*0*
12/20/2016	-0.08	17.49	119	6.33	193.8	0.374	12.8	11.2	31	448		0.00848	0.214	0.151	0.052705	7930	*0*
AVG.	8.29	12.33	103	6.80	159.3	1.02	14.2	12.4	163	2240		0.0293	0.0793	0.170	0.084016	6460	0.00225
MAX.	18.70	20.73	143	7.21	210.6	4.66	18.7	17.0	2380	24200		0.235	0.214	0.459	0.24895	8670	0.0100
MIN.	-0.33	9.05	90	6.21	98.8	0.285	9.00	7.31	*<10*	110		0.00848	*<0.005*	*<0.100*	0.024875	4160	*<0.005*
MEDIAN	6.62	12.08	101	6.91	147.0	0.812	14.8	12.8	20	559.5		0.0171	0.0630	0.158	0.070608	6640	*<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 2016
(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
1/5/2016	-0.33	19.83	137	6.47	121.7	0.920			*0*	480						4910	
1/19/2016	-0.08	14.97	104	6.63	103.5	0.534			*0*	341						4300	
2/2/2016	0.74	14.46	104	6.84	98.4	0.508			10	305						3900	
2/16/2016	-0.02	13.94	96	6.60	107.4	0.490			10	218						4060	
3/1/2016	1.34	13.87	102	6.56	99.2	0.444			*0*	121						3020	
3/15/2016	4.40	12.67	99	6.66	93.1	1.23	6.05	4.33	63	816		0.0234	0.0464	0.382	0.11886	3370	*0*
3/29/2016	4.25	10.77	85	6.18	84.1	0.513			203	727						2850	
4/12/2016	6.84	12.09	100	6.27	94.7	0.610			31	455						3300	
4/26/2016	8.45	11.52	100	6.66	99.8	0.483			31	763						3960	
5/10/2016	7.92	11.91	102	6.55	99.0	0.436			41	717						3830	
5/24/2016	14.32	9.70	97	6.67	106.0	0.785			110	2050						4120	
6/7/2016	16.68	9.29	98	6.76	107.3	0.976			85	11200						4760	
6/21/2016	19.32	8.24	90	6.72	117.6	1.80	16.9	15.1	85	15500		0.0277	0.116	0.346	0.15575	6130	0.0387
7/5/2016	19.37	8.00	88	6.75	114.6	3.04			1130	24200						5990	
7/7/2016									426	12000							
7/19/2016	19.65	8.13	90	6.78	115.9	2.94			110	24200						6060	
8/2/2016	17.66	8.89	95	6.46	109.5	4.54			5480		>24200					5070	
8/16/2016	20.27	8.36	94	6.46	156.2	1.45			285		>24200					6910	
8/30/2016	16.71	8.97	94	6.72	106.7	2.54			121	9210						5920	
9/13/2016	14.08	9.48	93	6.59	90.0	2.37			86	3870						5280	
9/27/2016	13.58	9.28	90	6.40	127.7	2.86	13.9	11.8	73	11200		0.0249	0.0432	0.253	0.083710	6340	0.0379
10/11/2016	7.53	11.19	94	6.45	146.5	1.12			31	3260						6390	
10/25/2016	6.87	11.28	95	6.18	173.5	0.765			30	2250						8000	
11/8/2016	3.42	14.10	106	6.22	163.2	0.813			52	813						6690	
11/22/2016	1.29	15.35	113	6.15	174.1	0.477			185	839						6810	
12/7/2016	1.92	14.85	109	5.88	160.6	0.451			10	479						5820	
12/20/2016	-0.08	16.84	114	5.97	10.5	0.501	7.83	6.16	41	985		0.0112	0.0615	0.339	0.099470	6270	*0*
AVG.	8.70	11.85	100	6.48	114.6	1.29	11.2	9.35	323	5080		0.0218	0.0668	0.330	0.11445	5160	0.0192
MAX.	20.27	19.83	137	6.84	174.1	4.54	16.9	15.1	5480	24200		0.0277	0.116	0.382	0.15575	8000	0.0387
MIN.	-0.33	8.00	85	5.88	10.5	0.436	6.05	4.33	*<10*	121		0.0112	0.0432	0.253	0.083710	2850	*<0.005*
MEDIAN	7.20	11.40	98	6.56	107.4	0.799	10.9	8.98	63	839		0.0242	0.054	0.343	0.10917	5180	0.0190

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 2016
(212A) HOP BROOK AT GATE 22

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/5/2016	-0.33	18.53	128	6.53	123.8	0.753	10.1	8.30	*0*	420		0.0171	0.0162	0.225	0.094990	5520	0.0136
1/19/2016	-0.07	15.55	108	6.75	74.4	0.621	8.21	6.50	*0*	203		0.0170	0.0278	0.214	0.081170	5030	0.00705
2/2/2016						0.714	8.56	6.84	*0*	201		0.0139	0.0350	0.602	0.059190	4720	0.00692
2/16/2016	-0.06	13.32	92	6.57	111.4	0.820	10.3	8.32	*0*	121		0.0189	0.0522	0.165	0.070460	5160	0.0248
3/1/2016	1.06	13.96	102	6.76	86.8	0.488	5.63	3.92	*0*	231		0.0175	0.0163	0.214	0.078080	3270	*0*
3/15/2016	4.74	12.53	98	6.73	88.3	1.02	6.11	4.46	52	556		0.0203	0.0108	0.258	0.11050	3950	*0*
3/29/2016	4.52	10.22	81	6.49	81.7	0.634	6.50	5.04	10	379		0.0139	*0*	0.153	0.12846	3260	0.00545
4/12/2016	7.44	11.99	101	6.50	94.3	0.553	8.05	6.18	20	275		0.00950	0.00671	0.145	0.085850	3830	*0*
4/26/2016	9.67	11.18	100	6.78	105.0	0.728	9.99	8.30	*0*	538		0.0222	0.00518	0.193	0.086705	4520	*0*
5/10/2016	9.31	11.63	103	6.87	106.7	0.444	10.3	8.39	10	538		0.00987	*0*	0.185	0.089190	4740	*0*
5/24/2016	15.91	9.47	98	6.86	107.6	1.01	13.9	11.5	10	1250		0.0186	0.00871	0.125	0.12551	4770	*0*
6/7/2016	18.87	8.98	99	7.03	104.3	1.58	16.8	14.8	132	3650		0.0257	0.0152	0.447	0.24085	5840	0.00715
6/21/2016	19.53	8.70	96	7.13	120.2	2.39	21.2	21.2	41	1330		0.238	0.0498	0.285	0.21605	6950	0.00782
7/5/2016	19.00	8.63	95	7.15	128.0	2.67	24.4	24.4	10	3260		0.0259	0.0960	0.156	0.20015	7650	0.0120
7/19/2016	19.49	8.67	96	7.21	128.9	2.77	25.0	25.0	20	2360		0.0252	0.0942	0.333		7440	0.00574
8/2/2016	18.43	9.22	100	6.86	112.9	9.86	18.1	16.3	4610		>24200	0.0542	0.0511	0.388	0.24725	6800	0.00876
8/16/2016	20.77	8.71	99	6.86	117.6	1.76	14.8	13.0	134	6490		0.0218	0.0308	0.240	0.24120	6870	*0*
8/30/2016	16.44	9.27	96	7.01	119.8	1.70	25.6	25.6	98	1150		0.0178	0.109	0.249	0.14125	8580	*0*
9/13/2016	13.40	10.11	98	6.88	116.5	1.80	26.2	26.2	556	4610		0.0153	0.0938	0.259	0.11532	7620	*0*
9/27/2016	13.37	9.72	94	6.78	127.9	3.12	16.8	15.1	3870	24200		0.0238	0.0532	0.236	0.12168	7340	*0*
10/11/2016	7.92	11.69	99	6.64	129.7	1.52	15.0	13.2	10	860		0.00994	0.00713	0.175	0.086070	6980	*0*
10/25/2016	6.72	11.81	99	6.54	139.6	0.969	11.8	10.1	20	1260		0.00773	*0*	0.120	0.10174	7830	*0*
11/8/2016	3.66	14.40	109	6.37	131.9	0.804	11.3	9.59	10	480		0.00975	0.00568	0.127	0.079990	6800	*0*
11/22/2016	1.16	15.68	114	6.36	127.3	0.859	9.34	7.50	10	388		0.0128	0.00819	0.301	0.096670	6220	*0*
12/7/2016	1.87	15.16	111	6.05	126.6	0.802	9.42	7.74	10	393		0.0131	0.0134	0.185	0.11549	5730	*0*
12/20/2016	-0.08	16.68	113	6.14	10.1	0.843	10.6	8.86	41	538		0.0124	0.0286	0.343	0.11804	7190	0.00725
AVG.	9.71	11.55	100	6.71	108.9	1.59	13.6	12.2	372	2230		0.0266	0.0321	0.243	0.12527	5950	*<0.005*
MAX.	20.77	16.68	114	7.21	139.6	9.86	26.2	26.2	4610	24200		0.238	0.109	0.602	0.24725	8580	0.0248
MIN.	-0.08	8.63	81	6.05	10.1	0.444	5.63	3.92	*<10*	121		0.00773	*<0.005*	0.120	0.059190	3260	*<0.005*
MEDIAN	8.62	11.41	99	6.76	116.5	0.914	11.0	9.23	10	538		0.0173	0.0163	0.220	0.11050	6030	*<0.005*

<u>NOTES</u>

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 2016
(212B) HOP BROOK AT GATE 24

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/5/2016	-0.33	18.56	128	6.52	124.1	0.519	9.33	7.60	*0*	465		0.0150	0.0785	0.178	0.073230	4300	0.00661
1/19/2016	-0.07	15.46	107	6.89	37.1	0.449	7.44	5.77	*0*	275		0.0147	0.0965	0.127	0.063400	4120	*0*
2/2/2016						0.340	7.95	6.24	*0*	259		0.0118	0.0985	0.254	0.055520	3560	*0*
2/16/2016	-0.05	13.76	95	6.68	119.0	0.509	8.66	6.74	52	269		0.0150	0.117	0.180	0.044660	4080	0.0114
3/1/2016	1.24	13.76	101	6.76	107.0	0.360	6.36	4.60	20	331		0.0146	0.0830	0.175	0.062140	3270	0.0643
3/15/2016	4.37	12.56	98	6.75	97.7	1.60	5.85	4.18	98	1420		0.0224	0.0592	0.328	0.12419	3120	*0*
3/29/2016	4.16	10.22	81	6.34	88.5	0.855	5.88	4.38	706	1520		0.0163	0.0511	0.161	0.12419	2920	*0*
4/12/2016	6.84	11.98	99	6.48	103.7	0.991	7.23	5.41	31	602		0.0140	0.0795	0.114	0.078840	3200	*0*
4/26/2016	7.74	11.68	100	6.83	100.6	0.470	8.94	7.32	20	727		0.0135	0.0550	*0*	0.064675	3570	0.00573
5/10/2016	7.51	12.09	103	6.95	102.6	0.375	8.99	7.09	10	426		0.0102	0.0366	0.135	0.074945	3720	*0*
5/24/2016	13.54	9.87	97	6.84	107.8	0.965	11.8	9.56	75	3130		0.0188	0.0606	0.199	0.10541	3950	*0*
6/7/2016	16.06	9.49	99	6.91	110.2	0.809	12.2	10.3	96	3450		0.0194	0.0681	0.197	0.16611	4700	0.00753
6/21/2016	17.69	8.90	95	6.91	134.0	0.883	14.1	12.4	75	3450		0.0222	0.232	0.206	0.11231	5450	0.00868
7/5/2016	18.50	8.28	90	6.79	138.6	0.811	15.3	13.4	299	3870		0.0189	0.194	*0*	0.082910	6150	0.0179
7/19/2016	18.55	8.21	89	6.79	134.2	0.716	16.4	14.6	10	1960		0.0188	0.156	0.432	0.073050	5670	0.0125
8/2/2016	17.24	9.10	97	6.59	171.5	3.56	11.2	9.37	5480		>24200	0.0396	0.154	0.408	0.25300	6780	0.0620
8/16/2016	19.06	8.96	98	6.61	186.4	0.565	11.9	10.2	246	10500		0.0133	0.0953	0.125	0.11107	7180	*0*
8/30/2016	16.12	7.51	77	6.51	114.7	0.301	15.2	13.7	41	3450		0.0114	0.101	*0*	0.032660	5610	*0*
9/13/2016	13.38	9.18	89	6.62	136.7	0.446	15.7	13.8	85	2360		0.00698	0.0266	*0*	0.043750	6210	*0*
9/13/2016	17.53	7.06	74	6.37	165.7								0.0667				*0*
9/27/2016	13.04	9.90	95	6.69	166.7	0.791	12.8	11.2	480	8160		0.0105	0.144	0.150	0.061675	7410	*0*
10/11/2016	9.78	8.21	73	6.18	136.9	0.435			86	1940						5850	
10/11/2016	6.57	12.03	99	6.65	169.9	0.528	13.3	11.6	20	1080		*0*	0.0184	*0*	0.058430	7040	*0*
10/25/2016	5.86	11.88	97	6.58	207.9	0.478	11.2	9.31	10	1080		*0*	*0*	0.115	0.096940	8840	*0*
11/8/2016	3.02	14.54	108	6.51	203.8	0.231	11.0	9.51	20	496		0.00716	0.0233	*0*	0.053210	8250	*0*
11/22/2016	1.31	15.47	114	6.42	205.8	0.223	8.70	7.07	*0*	373		0.00884	0.0193	0.201	0.069390	7450	*0*
12/7/2016	2.35	14.76	110	6.20	177.4	0.341	8.12	6.35	*0*	341		0.00981	0.0412	0.113	0.084485	6150	*0*
12/20/2016	-0.08	16.17	110	6.13	9.5	0.286	7.33	5.19	20	801		0.00984	0.0710	0.177	0.094720	6560	*0*
AVG.	8.92	11.47	97	6.61	131.8	0.698	10.5	8.73	296	2028		0.0140	0.0825	0.153	0.087112	5374	0.00728
MAX.	19.06	18.56	128	6.95	207.9	3.56	16.4	14.6	5480	10500		0.0396	0.232	0.432	0.25300	8840	0.0643
MIN.	-0.33	7.06	73	6.13	9.5	0.223	5.85	4.18	*<10*	259		*<0.005*	*<0.005*	*<0.100*	0.032660	2920	*<0.005*
MEDIAN	7.51	11.68	98	6.62	134.0	0.509	10.2	8.46	31	1080		0.0138	0.0710	0.156	0.074088	5610	*<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 2016
(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
1/5/2016	0.01	16.60	116	6.09	94.0	0.467			*0*	341						3870	
1/19/2016	0.09	11.92	83	6.37	102.4	0.455			10	336						4000	
2/2/2016						0.497			31	226						3860	
2/16/2016	0.08	10.04	70	6.30	135.9	0.528			31	189						5150	
3/1/2016	1.42	11.81	87	6.42	94.3	0.405			10	173						3030	
3/15/2016	4.95	10.38	82	6.41	102.2	0.430	6.88	5.11	31	345		0.0131	0.0341	0.166	0.11108	3800	0.00895
3/29/2016	4.94	8.91	72	6.11	84.7	0.560			20	1350						3060	
4/12/2016	7.03	10.52	88	6.09	110.0	0.481			41	588						3660	
4/26/2016	10.97	8.55	79	6.23	119.0	0.673			86	1780						4300	
5/10/2016	12.08	8.79	83	6.37	106.7	0.652			31	1560						4110	
5/24/2016	17.79	7.29	78	6.26	126.4	0.854			426		>24200					4830	
5/27/2016									31		>24200						
6/7/2016	20.36	4.83	55	6.16	108.7	1.38			160	14100						5490	
6/21/2016	21.90	6.14	71	6.27	140.3	0.810	14.3	12.4	20	3260		0.0212	0.0154	0.428	0.19930	6360	0.0299
7/5/2016	22.47	6.22	73	6.36	156.0	0.886			31	2610						6970	
7/19/2016	22.91	5.43	64	6.32	157.7	0.947			10	2250						7010	
8/2/2016	21.06	5.48	63	6.20	167.0	1.63			780	7700						7480	
8/16/2016	23.57	5.16	62	6.09	130.7	1.14			122	4350						6570	
8/30/2016	19.93	6.06	68	6.27	159.8	0.872			31	4350						7010	
9/13/2016	15.46	5.51	56	6.24	127.8	0.821			31	1860						6880	
9/27/2016	15.12	7.34	74	6.22	141.8	0.733	14.5	12.8	183	2990		0.0158	0.0101	0.399	0.20460	6170	0.00841
10/11/2016	7.37	7.53	63	6.25	110.1	1.71	16.4	14.5	52	4110		0.0149	*0*	0.244	0.18815	6380	0.0132
10/25/2016	8.80	7.57	67	6.13	128.7	0.812			134	3080						6540	
11/8/2016	4.92	9.83	77	5.91	129.9	0.552			10	1920						6060	
11/22/2016	1.87	12.58	94	6.06	115.7	0.581			20	2100						5500	
12/7/2016	1.82	11.43	84	5.62	115.4	0.584			31	1250						4820	
12/20/2016	0.07	12.16	83	5.57	114.9	0.581	7.27	5.60	211	1530		0.0129	0.111	0.257	0.16715	4890	0.0132
AVG.	10.68	8.72	75	6.17	123.2	0.771	11.9	10.1	95	2570		0.0156	0.0341	0.299	0.17406	5300	0.0147
MAX.	23.57	16.60	116	6.42	167.0	1.71	16.4	14.5	780	14100		0.0212	0.111	0.428	0.20460	7480	0.0299
MIN.	0.01	4.83	55	5.57	84.7	0.405	6.88	5.11	*<10*	173		0.0129	*<0.005*	0.166	0.11108	3030	0.00841
MEDIAN	8.80	8.55	74	6.23	119.0	0.663	14.3	12.4	31	1860		0.0149	0.0154	0.257	0.18815	5320	0.0132

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 2016

(213A) MIDDLE BRANCH SWIFT RIVER AT FAY ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/5/2016	-0.17	17.47	121	6.39	89.7	0.640	12.4	10.5	*0*	644		0.0179	0.304	0.339	0.13567	5380	0.0180
1/19/2016	0.00	11.83	82	6.57	118.1	0.790	10.4	8.55	20	565		0.0227	0.211	0.409	0.086895	5360	0.0141
2/2/2016						0.570	9.39	7.62	20	384		0.0135	0.231	0.479	0.072465	4290	0.0105
2/16/2016	-0.04	10.37	72	6.50	120.1	0.710	10.4	7.49	10	199		0.0171	0.232	0.270	0.060205	5150	0.0197
3/1/2016	1.45	13.15	97	6.64	70.1	0.450	8.23	6.52	20	161		0.0167	0.0956	0.262	0.074780	4100	*0*
3/15/2016	4.43	11.78	92	6.60	68.5	0.490	8.78	7.03	10	712		0.0142	0.0782	0.218	0.12229	4260	*0*
3/29/2016	5.01	9.45	76	6.27	77.1	0.520	7.64	5.99	85	1200		0.0141	0.0577	0.182	0.15766	3690	*0*
4/12/2016	7.29	10.68	89	6.35	87.8	0.490	9.37	7.55	*0*	448		0.0107	0.0726	0.186	0.098400	4370	0.00729
4/26/2016	9.03	10.85	95	6.37	98.9	1.23	11.8	10.0	3450	7270		0.0263	0.0488	0.283	0.11449	5160	0.0270
4/28/2016									31	3450							
5/10/2016	10.18	9.53	86	6.60	104.6	1.08	11.2	9.27	41	5790		0.0157	0.0309	0.245	0.12115	4750	0.0124
5/24/2016	15.38	9.22	94	6.39	100.5	1.30	14.6	12.3	414	15500		0.0216	0.0276	0.270	0.15366	5240	0.0264
5/27/2016									31	14100							
6/7/2016	18.23	6.58	72	6.40	91.0	1.69	15.0	13.1	175	7270		0.0330	0.0219	0.383	0.27270	5650	0.0222
6/10/2016									121	3280							
6/21/2016	20.15	6.18	69	6.39	120.4	2.29	19.5	17.6	20	8160		0.318	0.0362	0.338	0.21190	6940	0.0536
7/5/2016	20.57	5.78	65	6.48	132.2	3.07	20.0	17.9	134	19900		0.0361	0.0346	0.304	0.19110	7390	0.0444
7/19/2016	21.31	4.99	57	6.49	131.7	2.52	22.2	22.2	96	7270		0.0290	0.0271	0.391	0.22930	7800	0.0577
8/2/2016	19.11	6.72	74	6.34	113.1	2.08	18.4	16.5	3130		>24200	0.0300	0.0245	0.334	0.21040	7350	0.0338
8/16/2016	21.00	5.27	60	6.20	102.7	2.35	18.4	16.3	246	13000		0.0298	0.00948	0.444	0.34580	7190	0.0437
8/30/2016	18.02	4.06	44	6.34	136.4	3.53	24.0	24.0	134	11200		0.0368	*0*	0.360	0.23370	8080	0.0560
9/13/2016	13.87	10.40	101	6.76	105.0	2.62	21.9	21.9	74	6490		0.0207	*0*	0.237	0.17516	7890	0.0468
9/27/2016	12.40	5.01	47	6.28	125.1	1.87	16.7	14.9	3260	14100		0.0243	0.0141	0.386	0.20975	6410	0.0223
10/11/2016	7.04	12.36	103	6.69	85.7	0.430	11.6	9.84	20	609		0.00524	0.0159	0.114	0.092210	5440	*0*
10/25/2016	6.73	8.72	73	6.27	104.9	1.25	13.3	11.3	31	2490		0.0148	*0*	0.251	0.29720	6970	0.00881
11/8/2016	3.97	11.83	90	6.36	119.8	0.900	11.9	10.2	20	1600		0.00883	0.0279	0.151	0.13416	6590	0.0129
11/22/2016	1.55	13.39	99	6.21	98.0	0.760	10.8	9.03	20	860		0.0122	0.0827	0.240	0.14796	5810	*0*
12/7/2016	1.73	13.77	101	6.10	97.0	0.742	10.8	8.94	63	1090		0.0128	0.147	0.162	0.16816	5290	0.00921
12/20/2016	-0.08	14.70	100	6.08	108.7	0.668	7.44	5.66	148	1790		0.0126	0.141	0.486	0.17690	5210	0.0135
AVG.	9.53	9.76	82	6.40	104.3	1.35	13.7	12.0	408	5340		0.0313	0.0758	0.297	0.16516	5840	0.0216
MAX.	21.31	17.47	121	6.76	136.4	3.53	24.0	24.0	3450	19900		0.318	0.304	0.486	0.34580	8080	0.0577
MIN.	-0.17	4.06	44	6.08	68.5	0.430	7.44	5.66	*<10*	161		0.00524	*<0.005*	0.114	0.060205	3690	*<0.005*
MEDIAN	7.29	10.37	86	6.39	104.6	0.990	11.9	10.1	41	2885		0.0175	0.0354	0.277	0.15566	5410	0.0161

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 2016

(213B) MIDDLE BRANCH SWIFT RIVER AT ELM STREET

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/5/2016	-0.32	20.23	140	6.55	72.1	0.310	6.52	4.79	*0*	464		0.0135	0.0821	0.251	0.13728	3080	0.00703
1/19/2016	-0.07	14.84	103	6.85	67.0	0.380	5.15	3.47	*0*	355		0.0125	0.0729	0.254	0.11109	2840	*0*
2/2/2016						0.340	5.51	3.81	20	488		0.0110	0.0853	0.347	0.089400	2590	*0*
2/16/2016	-0.04	14.49	100	6.74	68.8	0.410	7.23	5.36	10	323		0.0154	0.0895	0.146	0.079900	3240	0.0111
3/1/2016	0.87	14.28	103	6.63	53.0	0.380	4.06	2.32	*0*	253		0.0152	0.0459	0.147	0.10512	2140	*0*
3/15/2016	4.05	13.02	100	6.65	50.6	1.19	4.34	2.59	63	1540		0.0184	0.0332	0.309	0.17032	2300	*0*
3/29/2016	4.23	10.63	84	6.27	53.6	0.470	4.09	2.53	10	609		0.0126	0.0234	0.105	0.18620	2180	*0*
4/12/2016	6.50	12.42	102	6.39	59.7	0.590	5.58	3.75	110	767		0.00980	0.0471	0.134	0.11813	2430	*0*
4/26/2016	7.82	12.03	103	6.74	67.1	0.450	6.57	*0*	75	906		0.0146	0.0547	0.164	0.10479	3010	0.00524
5/10/2016	8.42	12.04	105	6.92	69.0	0.360	6.52	4.65	30	886		0.0104	0.0248	0.173	0.13361	2760	*0*
5/24/2016	13.54	10.21	100	6.81	77.6	0.430	9.17	6.95	10	1780		0.0165	0.0609	0.178	0.12637	3450	*0*
6/7/2016	16.17	9.69	101	6.77	67.5	0.630	8.37	6.44	52	3870		0.0213	0.0580	0.244	0.26080	3370	0.00706
6/21/2016	17.21	9.26	97	6.84	98.8	0.380	10.6	8.78	10	2720		0.0430	0.261	*0*	0.12739	5320	0.00620
7/5/2016	17.25	9.04	96	6.80	116.1	0.290	11.4	9.38	98	8660		0.0164	0.311	*0*	0.084035	6980	*0*
7/19/2016	18.74	9.10	99	6.93	105.9	0.190	12.1	9.97	20	1720		0.0161	0.220	0.473	0.091770	6210	0.00507
8/2/2016	17.40	9.40	100	6.74	80.1	0.750	11.3	9.59	798	24200		0.0196	0.149	0.159	0.17900	4610	*0*
8/16/2016	18.97	9.18	100	6.65	91.1	0.280	9.15	7.48	96	6870		0.0133	0.108	0.195	0.15635	6080	*0*
8/30/2016	16.71	9.63	100	6.82	115.5	0.120	12.1	10.6	10	2610		0.0116	0.255	0.132	0.053780	7660	*0*
9/13/2016	15.59	5.79	59	5.92	120.3	0.210	13.4	11.7	20	1250		0.00711	0.138	0.114	0.057465	6860	*0*
9/27/2016	12.59	10.14	96	6.73	94.7	1.71	11.0	9.34	41	1440		0.00813	0.0950	0.180	0.077300	6080	*0*
10/11/2016	8.63	8.98	77	6.07	128.5	0.810			63	2990						3070	
10/25/2016	6.71	12.05	101	6.57	92.8	0.540	8.02	6.19	*0*	631		0.00840	*0*	0.143	0.22790	6420	*0*
11/8/2016	3.40	14.93	112	6.53	90.1	0.190	8.28	6.62	10	315		0.00733	0.0195	0.121	0.10120	5510	*0*
11/22/2016	1.65	15.79	117	6.40	88.3	0.250	6.25	4.54	10	299		0.00959	0.0266	0.251	0.13945	5090	*0*
12/7/2016	2.24	15.21	113	6.23	89.8	0.277	5.47	3.8	20	327		0.0105	0.0584	0.174	0.14470	4470	*0*
12/20/2016	-0.07	15.94	108	6.10	93.5	0.395	5.01	3.28	98	1380		0.0125	0.0704	0.279	0.16793	4730	*0*
AVG.	8.73	11.93	101	6.59	84.5	0.474	7.89	5.917	64	2600		0.0142	0.0956	0.187	0.12925	4330	0.00167
MAX.	18.97	20.23	140	6.93	128.5	1.71	13.4	11.70	798	24200		0.0430	0.311	0.473	0.26080	7660	0.0111
MIN.	-0.32	5.79	59	5.92	50.6	0.120	4.06	*<0.500*	*<10*	253		0.00711	*<0.005*	*<0.100*	0.053780	2140	*<0.005*
MEDIAN	7.82	12.03	100	6.65	88.3	0.380	7.23	5.360	20	1078		0.0126	0.0704	0.173	0.12637	3960	*<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 2016

(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
1/5/2016	0.44	16.30	115	5.34	79.6	0.472			*0*	594						1740	
1/19/2016	0.44	13.28	94	5.90	81.3	0.402			*0*	512						1940	
2/2/2016	2.18	12.90	96	6.00	109.8	0.360			*0*	464						1910	
2/16/2016	0.19	11.48	80	5.82	98.5	0.554			*0*	457						1870	
3/1/2016	2.21	12.09	91	5.84	78.9	0.436			*0*	480						1640	
3/15/2016	6.01	10.72	87	5.87	93.3	0.505	3.17	1.38	10	987		0.0160	0.00746	0.215	0.22265	2050	*0*
3/29/2016	5.74	8.72	72	5.60	112.4	0.547			10	1180						2210	
4/12/2016	8.12	10.68	91	5.61	89.2	0.487			*0*	1420						1850	
4/26/2016	11.14	8.89	82	5.84	110.8	1.20			10	2610						2280	
5/10/2016	14.22	9.57	95	5.98	109.3	0.673			31	1720						2130	
5/24/2016	18.11	7.01	76	5.76	122.0	0.893			733	5170						2210	
5/27/2016									52	12000							
6/7/2016	19.74	6.61	74	5.85	95.5	1.28			75		>24200					2480	
6/21/2016	20.95	4.21	48	5.81	140.3	2.23	7.07	5.14	201	24200		0.0378	0.0100	0.633	0.35320	2870	0.0636
7/5/2016	20.69	5.50	62	5.93	148.8	2.44			318	12000						3010	
7/19/2016	21.53	6.28	72	6.03	141.6	2.42			201	19900						3010	
8/2/2016	18.56	6.82	74	5.97	126.1	3.00			2910		>24200					3080	
8/16/2016	22.18	5.81	68	5.71	111.9	1.77			211	15500						3010	
8/30/2016	18.76	4.54	49	5.80	124.6	2.29			41	17300						3360	
9/13/2016	16.35	10.05	103	6.66	99.2	2.15			256	24200						3010	
9/27/2016	13.65	7.88	77	6.12	120.8	0.961	7.61	5.76	228	17300		0.0226	0.0284	0.439	0.21490	3140	0.0279
10/11/2016	8.20	12.17	104	6.46	90.9	0.466			31	481						3600	
10/25/2016	7.89	8.04	69	6.06	132.8	1.06			10	2010						3490	
11/8/2016	4.24	11.40	88	6.09	151.6	0.718			*0*	602						3420	
11/22/2016	2.02	13.10	98	6.04	152.5	0.907			*0*	884						3410	
12/7/2016	3.29	12.44	95	5.66	150.4	0.730			*0*	988						2970	
12/20/2016	0.45	13.77	95	5.54	163.4	0.612	4.62	2.92	10	857		0.0110	0.00766	0.334	0.25075	3200	*0*
AVG.	10.28	9.63	83	5.90	116.8	1.14	5.62	3.80	198	6550		0.0219	0.01338	0.405	0.26038	2650	0.0229
MAX.	22.18	16.30	115	6.66	163.4	3.00	7.61	5.76	2910	24200		0.0378	0.0284	0.633	0.35320	3600	0.0636
MIN.	0.19	4.21	48	5.34	78.9	0.360	3.17	1.38	*<10*	457		0.0110	0.00746	0.215	0.21490	1640	*<0.005*
MEDIAN	8.16	9.81	84	5.86	112.2	0.812	5.85	4.03	10	1420		0.0193	0.00883	0.387	0.23670	2920	0.0140

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 2016
(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
1/5/2016	-0.32	19.77	136	6.25	55.1	0.576			10	556						3410	
1/19/2016	-0.05	14.75	103	6.64	87.6	0.517			*0*	359						3200	
2/2/2016	1.10	14.65	106	6.81	91.8	0.424			*0*	279						3360	
2/16/2016	-0.06	14.24	98	6.56	94.5	0.467			*0*	173						3310	
3/1/2016	2.36	13.66	103	6.53	70.3	0.482			*0*	226						2290	
3/15/2016	5.96	12.32	100	6.64	70.6	0.611	4.56	2.78	20	512		0.0172	0.0251	0.162	0.16913	2640	*0*
3/29/2016	5.83	9.18	76	6.08	75.5	1.01			10	833						2670	
4/12/2016	7.23	12.22	102	6.25	77.2	0.482			74	529						2570	
4/26/2016	10.08	11.27	102	6.49	83.4	0.766			10	780						2890	
5/10/2016	12.01	10.90	103	6.53	76.5	0.691			41	520						2910	
5/24/2016	16.16	9.79	101	6.70	85.4	0.680			20	2760						2820	
6/7/2016	20.64	8.87	102	6.72	87.6	1.37			75	5480						3490	
6/21/2016	21.40	8.93	102	6.71	90.8	0.668	8.81	6.96	63	2600		0.0258	0.0861	0.417	0.22910	3690	0.00861
7/5/2016	20.62	9.12	103	6.79	95.6	0.595			52	4570						3620	
7/19/2016	22.08	8.85	103	6.96	92.3	0.523			52	3080						3520	
8/2/2016	18.60	9.34	102	6.68	84.6	1.71			836	24200						2960	
8/16/2016	22.89	8.76	103	6.44	86.5	0.696			122	6130						3390	
8/30/2016	19.29	9.42	104	6.72	98.8	0.473			52	3080						4160	
9/13/2016	16.35	10.05	103	6.66	99.2	0.416			31	1990						4280	
9/27/2016	13.95	10.25	100	6.58	90.0	0.421	9.39	7.71	41	1670		0.0101	0.00643	0.297	0.12563	3740	*0*
10/11/2016	11.22	10.75	99	6.72	132.7	0.202			41	4350						12300	
10/25/2016	7.80	11.85	102	6.48	88.3	0.471			52	886						3900	
11/8/2016	4.60	14.39	112	6.36	105.3	0.451			10	288						4710	
11/22/2016	2.49	15.12	115	6.33	96.9	0.426			*0*	408						3940	
12/7/2016	2.67	15.00	112	5.93	103.1	0.504			10	420						3660	
12/20/2016	-0.07	16.33	111	6.04	125.4	0.466	6.66	4.91	20	987		0.0131	0.0586	0.283	0.25345	4490	*0*
AVG.	10.19	11.91	104	6.52	90.2	0.619	7.36	5.59	63	2600		0.0166	0.0441	0.290	0.19433	3770	*<0.005*
MAX.	22.89	19.77	136	6.96	132.7	1.71	9.39	7.71	836	24200		0.0258	0.0861	0.417	0.25345	12300	0.00861
MIN.	-0.32	8.76	76	5.93	55.1	0.202	4.56	2.78	*<10*	173		0.0101	0.00643	0.162	0.12563	2290	*<0.005*
MEDIAN	8.94	11.09	103	6.57	89.2	0.511	7.74	5.94	26	859.5		0.0152	0.0419	0.290	0.19912	3450	*<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

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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 2016
GATES BROOK, AT MOUTH

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/5/2016	-0.32	19.52	135	6.34	28.5	0.154			*0*	345						1570	
1/19/2016	-0.07					0.171			10	426						1340	
2/2/2016	1.84	14.33	106	6.73	25.7	0.192			*0*	441						1320	
2/16/2016	0.15	14.70	102	6.19	25.4	0.322			*0*	341						1230	
3/1/2016	2.53	13.63	103	5.67	22.6	0.186			*0*	272						947	
3/15/2016	5.26	12.62	100	5.78	22.2	0.512	2.19	0.51	*0*	1350		0.0149	*0*	0.140	0.10454	1150	*0*
3/29/2016	4.84	11.28	91	5.46	21.9	0.525			*0*	602						1150	
4/12/2016	7.07	12.22	102	5.62	22.5	0.233			*0*	583						1100	
4/26/2016	7.98	11.98	103	5.99	23.1	0.247			*0*	689						1170	
5/10/2016	7.00	12.39	104	6.15	23.0	0.544			*0*	776						1170	
5/24/2016	12.06	10.73	102	6.16	23.0	0.211			10	2760						1160	
6/7/2016	14.56	10.15	103	6.11	22.7	0.279			10	4610						1280	
6/21/2016	16.88	9.33	97	6.35	26.3	0.241	4.17	2.41	*0*	7270		0.0157	*0*	0.592	0.094290	1350	*0*
7/5/2016	17.73	8.78	94	6.62	27.4	0.516			109		>24200					1450	
7/19/2016	19.05	8.69	95	6.64	27.2	0.294			*0*	6020						1300	
8/2/2016	17.88	9.53	102	6.40	23.7	1.92			1660		>24200					1190	
8/16/2016	19.72	8.75	97	6.71	27.6	0.216			71	4610						1250	
8/30/2016	16.96	8.72	91	6.87	27.4	0.205			41	2720						1350	
9/13/2016	15.15	9.73	97	7.20	27.2	0.203			175	2760					0.115210	1190	
9/27/2016	13.78	9.91	97	6.85	26.8	0.570	4.77	3.05	384	13000		0.0204	0.0549	0.199		1190	*0*
10/25/2016	6.89	11.46	96	6.69	32.4	0.254			10	2190						1520	
11/8/2016	4.46	13.93	108	6.71	32.3	0.238			*0*	908						1420	
11/22/2016	1.89	15.32	114	6.77	34.5	0.298			10	388						1590	
12/7/2016	3.00	14.21	107	6.84	40.4	0.126			20	546						2060	
12/20/2016	-0.05	16.46	112	6.95	48.5	0.202	3.77	2.19	*0*	213		0.00804	*0*	*0*	0.058010	2640	*0*
AVG.	8.65	12.02	102	6.41	27.6	0.354	3.73	2.04	100	2340		0.0148	0.0137	0.233	0.093013	1360	*<0.005*
MAX.	19.72	19.52	135	7.20	48.5	1.92	4.77	3.05	1660	13000		0.0204	0.0549	0.592	0.11521	2640	*<0.005*
MIN.	-0.32	8.69	91	5.46	21.9	0.126	2.19	0.51	*<10*	213		0.00804	*<0.005*	*<0.100*	0.058010	947	*<0.005*
MEDIAN	7.00	11.72	102	6.51	26.6	0.241	3.97	2.30	*<10*	776		0.0153	*<0.005*	0.170	0.099415	1280	*<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 2016
BOAT COVE BROOK, NEAR MOUTH

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/5/2016	-0.25	18.45	128	6.59	86.1	0.665			*0*	305						8560	
1/19/2016	0.00	14.06	98	6.66	66.3	1.16			10	373						6170	
2/2/2016	1.98	13.89	103	7.04	70.8	0.445			189	426						6160	
2/16/2016	-0.05	14.27	99	7.02	62.3	1.05			20	1290						5330	
3/1/2016	2.94	13.45	103	7.03	50.9	1.12			*0*	132						4370	
3/15/2016	6.30	12.12	99	7.07	50.6	3.98	13.1	11.1	10	717		0.0238	0.0108	0.209	0.33310	4940	*0*
3/29/2016	6.06	9.13	76	6.33	53.3	2.45			20	496						4900	
4/12/2016	7.43	12.05	101	6.71	53.2	2.36			75	1100						4770	
4/26/2016	8.11	11.82	102	7.01	70.1	1.78			279	11200						6480	
4/28/2016									10	794							
5/10/2016	12.20	11.03	105	7.07	74.1	0.528			*0*	959						6580	
5/24/2016	13.93	10.24	101	7.21	83.2	0.480			*0*	2280						7200	
6/7/2016	17.47	9.28	100	7.14	85.9	0.633			1440	7700						8320	
6/9/2016									201	2480							
6/21/2016	18.52	9.12	98	7.23	107.0	0.472	29.2	29.2	20	1520		0.0199	0.0389	0.209	0.09637	10500	0.00665
7/5/2016	18.50	9.11	99	7.18	112.8	1.01			5480		>24200					11000	
8/2/2016	18.23	9.10	98	6.78	107.9	1.10			6490		>24200					9840	
8/16/2016	21.02	8.53	97	6.73	121.8	0.230			450	15500						12000	
9/27/2016	15.49	9.33	94	6.66	131.5	0.547	20.2	20.2	2760		>24200	0.0281	0.0791	0.351	0.18250	12100	*0*
10/11/2016	7.99	11.65	99	7.41	29.9	0.188			10	3260						1330	
11/8/2016	7.36	12.42	103	6.50	138.1	0.304			41	2990						13100	
11/22/2016	3.52	14.29	111	6.54	136.0	0.297			20	836						13000	
12/7/2016	4.36	13.81	108	6.23	113.8	0.338			*0*	1040						10200	
12/20/2016	-0.03	15.02	102	6.18	111.3	0.394	21.1	21.1	20	839		0.0118	0.0990	0.193	0.20075	9770	*0*
AVG.	8.69	11.92	101	6.83	87.1	0.979	20.9	20.4	731	2680		0.0209	0.0570	0.241	0.20318	8030	0.00166
MAX.	21.02	18.45	128	7.41	138.1	3.98	29.2	29.2	6490	15500		0.0281	0.0990	0.351	0.33310	13100	0.00665
MIN.	-0.25	8.53	76	6.18	29.9	0.188	13.1	11.1	*<10*	132		0.0118	0.0108	0.193	0.096370	1330	*<0.005*
MEDIAN	7.40	11.94	100	6.90	84.6	0.590	20.7	20.7	20	1040		0.0219	0.0590	0.209	0.19163	7760	*<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).
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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 2016
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
1/12/2016	-0.07	15.31	107	6.44	94.5	0.980			30	1550					0.24825	3360	
1/26/2016	0.00	15.14	105	6.65	115.9	0.671			10	327					0.20430	4560	
2/9/2016	-0.06	14.29	100	6.60	92.9	0.688			10	488					0.24390	3300	
2/23/2016	0.33	14.34	100	6.57	96.1	0.615			20	313					0.17656	3300	
3/8/2016	2.72	13.50	101	6.44	96.0	0.478			10	211					0.16095	3380	
3/22/2016	4.29	13.64	107	5.72	96.6	0.645	4.79	3.05	*0*	670		0.0147	*0*	0.188	0.17750	3270	*0*
4/5/2016	1.47	13.54	98	6.60	101.7	0.604			10	602					0.18585	3300	
4/19/2016	13.33	10.16	98	6.52	105.2	0.815			*0*	933					0.17231	3630	
5/3/2016	10.15	10.78	97	6.48	102.0	1.20			62	1110					0.18845	3590	
5/17/2016	11.77	11.37	107	6.61	102.2	1.72			30	1100					0.24255	3500	
5/31/2016	20.99	9.00	102	6.31	109.4	2.71			86	1990					0.30940	4630	
6/14/2016	17.27	9.71	104	6.64	110.1	2.88	9.60	7.69	75	1330		0.0318	0.0343	0.405	0.30445	4450	0.0176
6/28/2016	22.05	8.00	93	6.61	106.0	2.35			31	4880					0.25645	3860	
7/13/2016	21.21	8.27	95	6.50	103.2	4.62			173	8660					0.23695	3870	
7/26/2016	23.04	7.69	91	6.60	112.3	2.84			31	4110					0.19080	4390	
8/9/2016	20.7	7.99	91	6.49	104.0	1.74			41	4610					0.16729	3950	
8/23/2016	23.01	8.33	99	6.32	104.4	2.01			31	5170					0.31420	4370	
9/6/2016	19.5	8.21	91	6.70	105.6	2.69			20	3080					0.26830	4410	
9/20/2016	18.61	8.70	95	6.89	100.7	1.60	11.0	8.95	31	2610		0.0220	0.0151	0.132	0.13620	4040	0.00559
10/4/2016	13.74	9.84	97	6.87	98.1	1.44			*0*	17300					0.13957	4020	
10/18/2016	11.49	10.00	93	7.07	101.3	1.12			10	1850					0.12826	4130	
11/1/2016	6.32	12.36	102	6.42	121.1	1.52			20	1110					0.20395	5020	
11/15/2016	4.79	12.35	98	7.17	102.9	1.13			*0*	389					0.18420	3870	
11/29/2016	3.13	12.95	97	6.45	116.7	0.988			10	620					0.19405	4660	
12/13/2016	0.18	13.61	96	6.81	132.4	0.832			41	565					0.24465	4980	
12/27/2016	0.28	16.38	116	6.33	138.6	0.807	6.33	4.45	*0*	441		0.0144	0.0332	0.391	0.23220	5010	*0*
AVG.	10.39	11.36	99	6.57	106.5	1.53	7.93	6.04	30	2540		0.0207	0.0207	0.279	0.21198	4030	0.00580
MAX.	23.04	16.38	116	7.17	138.6	4.62	11.0	8.95	173	17300		0.0318	0.0343	0.405	0.31420	5020	0.0176
MIN.	-0.07	7.69	91	5.72	92.9	0.478	4.79	3.05	*<10*	211		0.0144	*<0.005*	0.132	0.12826	3270	*<0.005*
MEDIAN	10.82	11.08	98	6.59	103.6	1.17	7.97	6.07	20	1110		0.0184	0.0242	0.290	0.19900	3990	0.00280

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").
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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 2016
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
1/12/2016	-0.03	14.14	99	6.14	79.4	0.563			*0*	1400					0.24870	2460	
1/26/2016	0.01	13.56	94	6.24	86.6	0.417			10	246					0.17388	3040	
2/9/2016	-0.03	13.30	93	6.32	78.7	0.489			*0*	307					0.16085	2300	
2/23/2016	0.18	13.85	97	6.41	83.8	0.494			*0*	226					0.14808	2580	
3/8/2016	1.91	13.00	95	6.20	77.4	0.375			*0*	195					0.13498	2460	
3/22/2016	3.24	14.53	111	5.66	77.7	0.515	3.41	1.53	*0*	265		0.0140	0.0131	0.218	0.14911	2430	0.00687
4/5/2016	1.05	13.36	96	6.21	80.6	0.454			*0*	767					0.15480	2390	
4/19/2016	10.98	9.88	90	5.99	80.7	0.604			20	1610					0.15605	2580	
5/3/2016	9.35	9.87	87	6.16	85.6	0.942			41	2010					0.18260	2680	
5/17/2016	9.98	9.89	89	6.25	83.4	1.32			86	1660					0.19785	2540	
5/31/2016	19.02	6.62	72	5.95	80.4	3.83			228	4610					0.35875	2910	
6/14/2016	14.57	7.52	76	6.15	78.5	3.92	7.54	5.66	233	2720		0.0326	0.0335	0.318	0.31885	2870	0.0204
6/28/2016	20.58	5.66	64	6.04	74.4	3.01			563	6490					0.29575	2580	
7/13/2016	19.32	7.97	88	6.74	126.3	2.46			417	8160					0.28225	2920	
7/26/2016	23.10	5.31	63	5.99	82.6	3.00			288	10500					0.22490	4200	
8/9/2016	19.41	5.74	64	6.27	115.3	3.67			52	3870					0.20805	3250	
8/23/2016	17.73	8.42	90	6.48	108.0	2.42			216	8660					0.34790	3490	
9/6/2016	17.26	7.22	76	6.42	93.8	2.15			96	4350					0.21050	2910	
9/20/2016	18.68	7.61	83	6.38	92.1	2.59	12.2	10.1	228	9800		0.0283	0.0190	0.495	0.19775	5020	0.00624
10/4/2016	14.14	8.92	88	6.50	117.6	1.59			30	2720					0.16582	3350	
10/18/2016	10.83	7.60	70	5.92	89.7	1.09			109	1780					0.16000	4830	
11/1/2016	5.44	11.57	93	6.24	97.2	1.02			41	1210					0.19720	3180	
11/15/2016	3.73	11.85	91	6.39	92.1	1.14			*0*	884					0.14208	2990	
11/29/2016	1.63	12.71	92	6.13	99.8	0.820			*0*	631					0.13634	3040	
12/13/2016	0.03	13.81	97	6.18	85.0	0.561			*0*	393					0.19265	2780	
12/27/2016	-0.01	14.14	99	5.80	98.3	1.14	4.29	2.45	31	959		0.0176	0.0243	0.391	0.23695	3110	*0*
AVG.	9.31	10.31	87	6.20	90.2	1.56	6.86	4.94	103	2940		0.0231	0.0225	0.356	0.20702	3030	0.0084
MAX.	23.10	14.53	111	6.74	126.3	3.92	12.2	10.1	563	10500		0.0326	0.0335	0.495	0.35875	5020	0.0204
MIN.	-0.03	5.31	63	5.66	74.4	0.375	3.41	1.53	*<10*	195		0.0140	0.0131	0.218	0.13498	2300	*<0.005*
MEDIAN	9.67	9.89	90	6.21	85.3	1.12	5.92	4.06	36	1635		0.0230	0.0217	0.355	0.19493	2910	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 2016
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
1/12/2016	-0.07	13.75	96	6.03	98.1	0.741			41	1530					0.38980	3080	
1/26/2016	0.03	13.61	94	6.19	103.5	0.420			*0*	269					0.27325	3630	
2/9/2016	-0.06	13.22	92	6.22	103.9	0.491			*0*	288					0.26270	3160	
2/23/2016	0.28	14.21	99	6.23	103.1	0.428			10	331					0.24230	3150	
3/8/2016	2.16	13.48	99	6.12	89.8	0.345			*0*	238					0.22610	2900	
3/22/2016	3.01	13.11	100	5.41	90.3	0.410	4.13	2.22	*0*	565		0.0138	*0*	0.293	0.25435	2810	*0*
4/5/2016	1.59	13.41	98	6.29	94.1	0.440			*0*	613					0.26175	2890	
4/19/2016	11.88	10.27	96	6.11	97.3	0.608			20	1780					0.25410	3020	
5/3/2016	9.89	10.34	93	6.26	93.0	0.745			86	2910					0.26400	3110	
5/17/2016	11.28	10.38	97	6.42	99.8	0.870			20	2050					0.29700	2950	
5/31/2016	20.38	8.05	91	6.22	99.1	1.81			41	1780					0.43305	3800	
6/14/2016	15.45	9.37	96	6.51	105.7	1.37	7.08	5.24	20	1170		0.0260	0.0212	0.371	0.34565	3620	0.00563
6/28/2016	20.53	7.63	86	6.49	97.8	1.40			*0*	1990					0.30610	3910	
7/13/2016	20.15	8.16	91	6.46	96.2	1.36			144	1860					0.25720	3720	
7/26/2016	21.09	6.83	78	6.25	109.8	1.51			86	3450					0.21225	4400	
8/9/2016	16.87	8.48	89	6.38	114.7	0.980			10	1990					0.15507	4470	
8/23/2016	17.33	8.95	95	6.50	98.1	1.26			52	5480					0.41620	4080	
9/6/2016	17.74	8.61	92	6.54	100.7	1.03			20	2910					0.26215	3830	
9/20/2016	18.80	8.64	94	6.39	102.9	1.30	9.16	6.86	275	5790		0.0222	0.0313	0.272	0.26600	3910	*0*
10/4/2016	13.94	9.62	95	6.43	138.6	0.699			10	627					0.16443	4380	
10/18/2016	12.86	8.67	84	6.08	137.2	0.510			10	1180					0.25900	4420	
11/1/2016	4.43	12.97	101	5.89	127.2	0.704			*0*	1140					0.30285	4480	
11/15/2016	4.06	12.92	100	6.14	90.6	0.736			20	631					0.20315	3140	
11/29/2016	1.60	13.63	98	5.93	112.2	0.415			*0*	554					0.23765	3510	
12/13/2016	-0.03	14.63	102	5.54	110.1	0.684			10	538					0.30355	3820	
12/27/2016	-0.03	13.73	96	5.37	131.0	0.514	3.96	2.04	75	1140		0.0133	0.0334	0.526	0.31175	4150	*0*
AVG.	9.43	11.03	94	6.17	105.6	0.838	6.08	4.09	37	1650		0.0188	0.0215	0.366	0.27544	3630	*<0.005*
MAX.	21.09	14.63	102	6.54	138.6	1.81	9.16	6.86	275	5790		0.0260	0.0334	0.526	0.43305	4480	0.00563
MIN.	-0.07	6.83	78	5.37	89.8	0.345	3.96	2.04	*<10*	238		0.0133	*<0.005*	0.272	0.15507	2810	*<0.005*
MEDIAN	10.59	10.36	95	6.23	101.8	0.720	5.61	3.73	15	1175		0.0180	0.0263	0.332	0.26243	3680	*<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 2016
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
1/12/2016	-0.06	13.91	97	6.47	94.4	1.29			41	1970					0.23110	3530	
1/26/2016	0.03	13.40	93	6.48	117.2	0.657			10	299					0.18125	4740	
2/9/2016	-0.02	13.36	93	6.45	96.0	0.597			*0*	331					0.16111	3540	
2/23/2016	0.18	14.12	98	6.51	92.6	0.497			*0*	213					0.15008	3390	
3/8/2016	1.93	13.40	98	6.42	101.4	0.447			*0*	249					0.14528	3690	
3/22/2016	2.60	13.60	102	5.99	94.1	0.541	5.28	3.38	10	650		0.0132	0.0220	0.304	0.16593	3470	*0*
4/5/2016	0.81	13.63	97	6.55	97.2	0.638			*0*	459					0.16528	3530	
4/19/2016	11.78	9.70	90	6.24	98.9	0.676			10	1300					0.15709	3650	
5/3/2016	9.91	10.18	91	6.40	104.2	1.00			189	1440					0.17682	4060	
5/17/2016	11.69	9.40	88	6.53	106.7	1.34			31	1080					0.21260	4030	
5/31/2016	20.52	6.90	78	6.27	121.7	2.34			98	2380					0.27850	5440	
6/14/2016	16.41	8.02	84	6.41	116.9	3.06	11.6	9.6	85	1520		0.0312	0.0444	0.541	0.30240	5490	0.0316
6/28/2016	21.70	6.75	78	6.45	124.8	3.94			31	2490					0.29425	5880	
7/13/2016	21.01	7.28	83	6.45	126.0	4.80			10	3280					0.27430	5920	
7/26/2016	23.21	5.78	69	6.40	118.6	3.38			20	5480					0.22660	5860	
8/9/2016	20.03	6.75	76	6.33	121.7	4.05			52	2910					0.26110	5990	
8/23/2016	19.62	5.80	65	6.22	107.7	4.63			148	6870					0.31335	5330	
9/6/2016	18.84	8.13	89	6.46	111.2	2.93			20	2100					0.26500	5050	
9/20/2016	19.62	6.19	69	6.17	111.1	3.41	16.2	14.0	161	3260		0.0333	*0*	0.338	0.26200	5450	0.0152
10/4/2016	14.23	7.58	75	6.32	116.0	3.07			63	1560					0.22230	5260	
10/18/2016	13.04	7.12	69	6.08	122.1	1.89			20	906					0.21825	5750	
11/1/2016	6.00	10.44	85	6.07	137.2	1.15			97	932					0.24630	5910	
11/15/2016	4.67	11.92	94	6.21	131.4	1.17			30	862					0.24510	5680	
11/29/2016	2.27	12.26	90	6.10	138.0	0.959			31	663					0.23220	5640	
12/13/2016	0.09	13.73	96	5.77	143.1	0.668			10	583					0.30360	5880	
12/27/2016	0.19	13.82	97	5.93	151.5	0.808	7.72	5.84	10	776		0.0164	0.0432	0.307	0.24480	6510	0.0118
AVG.	10.01	10.12	86	6.30	115.5	1.92	10.2	8.21	45	1710		0.0235	0.0274	0.373	0.22833	4950	0.0147
MAX.	23.21	14.12	102	6.55	151.5	4.80	16.2	14.0	189	6870		0.0333	0.0444	0.541	0.31335	6510	0.0316
MIN.	-0.06	5.78	65	5.77	92.6	0.447	5.28	3.38	*<10*	213		0.0132	*<0.005*	0.304	0.14528	3390	*<0.005*
MEDIAN	10.80	9.94	89	6.37	116.5	1.23	9.66	7.72	25	1190		0.0238	0.0326	0.323	0.23165	5390	0.0135

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 2016
WARE RIVER AND TRIBUTARIES
(105) BARRE FALLS DAM, UPSTREAM OF DAM

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/12/2016	0.04	13.70	96	6.35	108.3	0.975	5.04	3.34	41	2910		0.0191	0.0296	0.236	0.28845	3660	0.00961
1/26/2016	0.60	12.93	91	6.27	140.3	0.779	6.95	5.07	*0*	404		0.0163	0.0302	0.402	0.23355	5060	*0*
2/9/2016	0.06	12.85	90	6.36	115.0	0.690	6.53	4.64	20	749		0.0194	0.0298	0.244	0.20950	3990	0.00616
2/23/2016	0.25	13.20	92	6.36	110.1	0.820	6.49	4.50	*0*	583		0.0194	0.0294	0.211	0.19575	3890	*0*
3/8/2016	2.56	12.79	95	6.37	111.7	0.564	5.05	3.28	*0*	279		0.0179	0.0170	0.280	0.18220	3920	*0*
3/22/2016	3.27	14.38	110	5.96	114.8	0.665	5.58	3.58	*0*	631		0.0145	*0*	0.336	0.19940	4020	*0*
4/5/2016	0.96	13.22	95	6.54	118.0	0.728	5.54	3.75	*0*	546		0.0158	0.00894	0.209	0.20110	3920	*0*
4/19/2016	12.78	9.17	87	6.24	121.1	1.06	6.99	5.12	10	1580		0.0136	*0*	0.304	0.19765	4180	*0*
5/3/2016	9.95	9.80	88	6.38	110.5	1.35	7.36	5.51	41	3450		0.0173	*0*	0.275	0.23295	4160	0.0402
5/17/2016	11.24	9.22	86	6.48	122.1	2.14	8.66	6.65	31	1670		0.0206	*0*	0.301	0.26765	4230	0.0124
5/31/2016	21.19	6.64	76	6.23	137.7	4.14	12.7	10.5	86	2250		0.0393	0.0180	0.510	0.35880	5960	0.0278
6/14/2016	16.96	8.13	86	6.53	137.5	4.33	11.5	9.54	31	1850		0.0345	0.0177	0.360	0.30380	5890	0.0146
6/28/2016	22.34	6.42	75	6.41	131.8	5.04	13.0	11.1	31	2600		0.0403	*0*	0.408	0.29540	5870	0.0110
7/13/2016	22.78	6.77	80	6.32	127.6	5.34	13.4	11.4	10	1610		0.0385	*0*	0.434	0.29295	5560	0.0120
7/26/2016	25.82	6.39	80	6.40	120.7	4.89	13.6	11.8	*0*	3650		0.0347	0.0101	0.362	0.30225	5540	0.0267
8/9/2016	22.93	7.06	84	6.41	128.2	5.08	12.9	11.0	*0*	4350		0.0331	0.0251	0.324	0.25890	5470	0.00865
8/23/2016	20.34	6.27	71	6.20	120.2	5.33	12.2	10.4	52	9210		0.0401	*0*	0.579	0.34980	5280	*0*
9/6/2016	19.32	8.12	89	6.53	105.2	4.72	11.9	10.2	*0*	4350		0.0317	*0*	0.488	0.27520	4760	*0*
9/20/2016	19.66	6.55	73	6.04	99.5	4.14	11.7	9.44	386	10500		0.0331	0.0135	0.371	0.21230	4410	*0*
10/4/2016	14.72	7.73	77	6.14	127.9	3.27	10.7	9.03	10	1290		0.0242	*0*	0.297	0.17018	5180	*0*
10/18/2016	13.52	8.46	83	6.02	123.6	2.51	10.4	8.79	10	1380		0.0198	*0*	0.555	0.17475	5070	*0*
11/1/2016	5.48	11.02	89	5.87	132.7	1.52	6.77	4.87	*0*	1850		0.0199	*0*	0.335	0.25890	5880	0.00616
11/15/2016	4.27	11.90	93	6.00	111.4	2.16	7.49	5.70	*0*	1680		0.0231	*0*	0.391	0.21290	4480	*0*
11/29/2016	2.00	12.47	91	6.07	133.8	1.08	7.96	5.94	*0*	1140		0.0148	*0*	0.331	0.22760	5530	*0*
12/13/2016	0.08	13.64	96	5.74	154.0	0.956	6.74	4.91	52	862		0.0168	*0*	0.324	0.29670	5840	0.00856
12/27/2016	0.12	13.40	94	5.73	182.7	0.72	7.02	5.15	20	1660		0.0174	0.0308	0.455	0.25210	3110	*0*
AVG.	10.51	10.09	87	6.23	124.9	2.50	9.01	7.12	32	2420		0.0244	0.0100	0.359	0.24811	4800	0.00707
MAX.	25.82	14.38	110	6.54	182.7	5.34	13.6	11.8	386	10500		0.0403	0.0308	0.579	0.35880	5960	0.0402
MIN.	0.04	6.27	71	5.73	99.5	0.564	5.04	3.28	*<10*	279		0.0136	*<0.005*	0.209	0.17018	3110	*<0.005*
MEDIAN	10.60	9.51	88	6.30	121.6	1.83	7.73	5.82	10	1665		0.0199	*<0.005*	0.336	0.24283	4910	*<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 2016
WARE RIVER AND TRIBUTARIES
(110) WHITEHALL POND OUTLET AT RUTLAND STATE PARK

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/12/2016	3.75	13.03	101	7.14	252.5	0.489	13.6	11.7	*0*	288		0.0100	*0*	0.229	0.087980	7430	0.00527
1/26/2016	4.21	12.70	98	6.89	243.7	0.482	12.2	10.4	*0*	305		0.0124	*0*	0.457	0.10253	8050	*0*
2/9/2016	4.28	12.24	96	6.89	225.2	0.480	12.7	10.8	*0*	146		0.0134	*0*	0.241	0.095810	7850	*0*
2/23/2016	4.52	12.43	97	6.78	217.5	0.469	12.8	10.9	*0*	189		0.0121	*0*	0.211	0.092230	7470	*0*
3/8/2016	4.49	13.03	102	6.91	197.3	0.660	9.65	7.87	*0*	265		0.0147	*0*	0.304	0.10703	6990	*0*
3/22/2016	7.16	11.20	95	6.53	208.7	0.603	9.41	7.59	*0*	169		0.0104	*0*	0.333	0.094230	6700	*0*
4/5/2016	7.44	11.69	99	7.04	214.9	0.586	8.88	7.27	*0*	189		0.0117	*0*	0.238	0.095490	6910	*0*
4/19/2016	11.99	10.87	102	6.82	216.8	0.555	9.22	7.28	*0*	120		0.0103	*0*	0.274	0.098910	7020	*0*
5/3/2016	12.89	10.32	99	6.95	215.8	0.549	9.54	7.70	*0*	605		0.00891	*0*	0.256	0.090510	6960	*0*
5/17/2016	14.44	9.98	100	7.08	221.5	0.632	10.3	8.36	*0*	211		0.00871	*0*	0.249	0.090760	6550	0.00672
5/31/2016	22.68	8.35	98	6.89	239.5	0.447	11.2	9.08	20	3080		0.0111	*0*	0.288	0.094480	7870	0.00668
6/14/2016	19.78	8.71	98	6.94	237.9	0.664	11.6	9.72	*0*	1600		0.0113	*0*	0.381	0.096740	8280	0.00817
6/28/2016	23.73	7.53	90	6.85	240.4	0.610	12.3	10.5	*0*	8660		0.0153	0.0193	0.364	0.090600	7890	0.0180
12/13/2016	4.00	13.72	107	6.62	258.0	0.544	11.3	9.57	*0*	323		0.00861	*0*	0.271	0.063405	7200	0.00597
12/27/2016	4.50	13.26	105	6.52	275.0	0.619	11.6	9.89	10	520		0.00747	*0*	0.432	0.062475	7850	*0*
AVG.	9.99	11.27	99	6.86	231.0	0.559	11.09	9.24	2	1110		0.0111	0.0013	0.302	0.090879	7400	0.00339
MAX.	23.73	13.72	107	7.14	275.0	0.664	13.60	11.7	20	8660		0.0153	0.0193	0.457	0.10703	8280	0.0180
MIN.	3.75	7.53	90	6.52	197.3	0.447	8.88	7.27	*<10*	120		0.00747	*<0.005*	0.211	0.062475	6550	*<0.005*
MEDIAN	7.16	11.69	99	6.89	225.2	0.555	11.30	9.57	*<10*	290		0.0111	*<0.005*	0.274	0.094230	7430	*<0.005*

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 2016
WARE RIVER AND TRIBUTARIES
(121) MILL BROOK AT CHARNOCK HILL ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/12/2016	0.85	13.53	97	6.85	254.4	0.626	11.5	9.62	52	1620		0.0152	0.0121	0.213	0.14727	10100	0.0079
1/26/2016	0.79	12.94	91	6.80	312.8	0.434	15.4	13.40	10	256		0.0121	0.0154	0.397	0.12152	12900	0.00996
2/9/2016	0.66	12.65	90	6.79	266.7	0.45	13.6	11.6	20	428		0.0131	0.0129	0.248	0.10626	10300	0.00682
2/23/2016	2.21	12.78	94	6.83	258.4	0.425	11.8	9.96	148	384		0.0141	0.0164	0.285	0.10969	10500	*0*
3/8/2016	3.72	12.44	96	6.65	279.4	0.342	8.85	7.10	*0*	228		0.0126	0.00925	0.293	0.10888	10100	*0*
3/22/2016	4.07	12.44	97	6.33	286.0	0.405	8.95	7.12	10	839		0.0109	0.00516	0.284	0.11330	9240	*0*
4/5/2016	2.10	13.02	96	6.82	283.1	0.492	9.08	7.38	*0*	733		0.0169	0.0107	0.214	0.11258	9570	0.00718
4/19/2016	13.45	9.40	91	6.52	295.9	0.820	11.4	9.46	31	2010		0.0132	0.00694	0.257	0.12322	10200	*0*
5/3/2016	10.33	9.94	90	6.59	272.8	0.820	12.3	10.4	41	2610		0.0130	0.00726	0.229	0.12950	9920	*0*
5/17/2016	13.11	9.31	90	6.73	285.1	0.821	13.4	11.5	20	1530		0.0114	*0*	0.279	0.14789	9520	0.00711
5/31/2016	22.16	7.22	84	6.47	303.7	0.998	19.2	16.6	20	6130		0.0218	0.00564	0.358	0.20930	12200	0.0109
6/14/2016	17.85	7.96	86	6.58	317.3	1.21	16.8	14.7	20	1940		0.0215	0.00849	0.487	0.17983	12200	0.0136
6/28/2016	21.50	6.61	76	6.56	334.2	2.48	22.8	22.8	20	3450		0.0359	0.0110	0.464	0.24835	13700	0.0260
7/13/2016	21.54	6.77	78	6.68	351.1	5.53	28.4	28.4	10	3650		0.0403	0.0187	0.542	0.26625	14900	0.0448
7/26/2016	22.14	6.55	77	6.84	370.1	6.38	44.6	44.6	41	2850		0.0565	0.0922	0.675	0.23520	21400	0.136
8/9/2016	19.87	7.00	78	6.85	355.6	6.52	42.9	42.9	132	5480		0.0392	0.0510	0.535	0.26530	19900	0.0741
8/23/2016	20.17	7.54	85	6.60	286.4	3.37	24.4	24.4	109	7700		0.0420	0.00958	0.766	0.24730	12900	0.0284
9/6/2016	17.37	6.61	70	6.64	299.9	4.83	32.3	32.3	20	2480		0.0346	0.0868	0.551	0.17570	15700	0.103
9/20/2016	18.29	7.14	77	6.65	303.0	6.66	37.5	37.5	52	4610		0.0507	0.0691	0.540	0.19620	17000	0.0675
10/4/2016	13.65	8.61	84	6.80	303.8	7.65	35.0	35.0	282	5480		0.0349	0.0315	0.404	0.16309	16900	0.0376
10/18/2016	12.67	7.80	75	6.48	296.9	2.55	31.0	31.0	*0*	1280		0.0154	0.00810	0.511	0.15885	14300	0.0146
11/1/2016	6.38	11.17	92	6.28	295.9	1.50	15.9	14.0	10	2490		0.0222	*0*	0.385	0.17790	13000	0.00811
11/15/2016	5.38	10.86	87	6.29	326.0	1.35	16.8	14.9	10	1130		0.0565	*0*	0.591	0.17962	13200	0.00898
11/29/2016	3.62	11.38	87	6.20	389.6	0.56	14.3	12.1	*0*	759		0.0130	*0*	0.351	0.15452	14500	*0*
12/13/2016	1.25	13.94	101	6.08	401.2	0.378	12.8	11.0	10	813		0.0103	0.00624	0.325	0.14620	15600	0.00793
12/27/2016	1.55	12.94	95	6.06	337.9	0.876	15.0	13.2	10	2490		0.0164	0.00952	0.623	0.15689	14900	0.00664
AVG.	10.64	9.94	87	6.58	310.3	2.25	20.2	19.0	41	2440		0.0248	0.0194	0.416	0.16849	13260	0.0241
MAX.	22.16	13.94	101	6.85	401.2	7.65	44.6	44.6	282	7700		0.0565	0.0922	0.766	0.26625	21400	0.136
MIN.	0.66	6.55	70	6.06	254.4	0.342	8.85	7.10	*<10*	228		0.0103	*<0.005*	0.213	0.10626	9240	*<0.005*
MEDIAN	11.50	9.67	89	6.62	301.5	0.937	15.7	13.7	20	1980		0.0167	0.00955	0.391	0.15787	12950	0.00855

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 2016
WARE RIVER AND TRIBUTARIES
(121H) MOULTON POND TRIBUTARY AT BRITNEY DRIVE

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/12/2016	0.07	13.66	96	6.86	409.3	0.945	12.0	10.2	85	17300		0.0228	0.929	0.261	0.14649	15800	0.0295
1/26/2016	0.15	13.35	93	6.74	501.6	0.798	15.0	13.2	*0*	644		0.0157	0.907	0.304	0.054660	19000	0.0389
2/9/2016	0.00	13.18	92	6.85	532.9	0.637	13.5	11.5	10	1240		0.0170	0.742	0.238	0.085370	17400	0.0203
2/23/2016	0.41	14.07	99	6.89	500.7	0.527	12.8	10.8	*0*	1410		0.0160	0.834	0.301	0.085150	16400	*0*
3/8/2016	2.80	13.28	100	6.84	424.6	0.655	13.1	11.2	20	295		0.0177	0.946	0.225	0.078060	16000	0.00612
3/22/2016	2.12	13.14	98	6.60	476.2	0.583	13.0	11.2	10	455		0.0184	0.768	0.310	0.099760	16000	0.00783
4/5/2016	1.10	13.63	98	6.91	450.0	0.453	13.3	11.6	10	288		0.0100	0.731	0.179	0.10052	15000	0.0101
4/19/2016	9.36	11.04	97	6.70	407.9	0.619	16.3	14.4	10	880		0.0154	0.631	0.257	0.094460	14100	*0*
5/3/2016	8.43	10.94	95	6.83	335.9	2.20	17.1	15.2	279	2190		0.0199	0.359	0.294	0.16921	12900	*0*
5/17/2016	9.98	10.99	99	6.94	384.5	0.686	19.1	17.1	63	882		0.00985	0.399	0.270	0.11139	13300	0.00828
5/31/2016	16.46	8.74	91	6.76	397.1	1.08	26.1	26.1	146	3650		0.0262	0.354	0.301	0.18205	16300	0.0186
6/14/2016	12.20	9.68	93	6.87	443.2	0.852	26.0	26.0	41	2100		0.0169	0.496	0.251	0.10978	17800	0.0194
6/28/2016	17.14	7.76	82	6.71	447.8	1.77	26.9	26.9	355	15500		0.0310	0.441	0.310	0.28180	17100	0.0316
7/13/2016	17.04	8.24	87	6.78	549.4	1.15	26.7	26.7	63	5480		0.0222	0.498	0.223	0.080615	18900	0.0220
7/26/2016	19.35	6.89	76	6.45	562.5	2.71	23.3	23.3	218	24200		0.0395	0.536	0.309	0.072640	21200	0.0378
8/9/2016	16.48	8.07	84	6.59	617.6	2.51	22.8	22.8	185	13000		0.0301	0.477	0.261	0.063915	21700	0.0230
8/23/2016	15.36	8.92	91	6.76	426.2	1.52	26.1	26.1	554	19900		0.0255	0.267	0.481	0.16317	15600	0.0134
9/6/2016	15.25	7.62	77	6.48	590.9	0.997	21.2	21.2	443	10500		0.0151	0.519	0.187	0.051140	21900	0.0134
9/20/2016	16.97	8.01	84	6.66	671.6	0.728	26.9	26.9	327	19900		0.0157	0.312	0.321	0.085560	23400	0.0134
10/4/2016	12.38	9.08	87	6.78	662.0	0.650	25.1	25.1	199	3260		0.0126	0.320	0.166	0.056390	23000	0.00751
10/18/2016	12.56	6.13	59	6.42	700.4	1.22	27.5	27.5	52	8160		0.0203	*0*	0.370	0.21365	21200	0.00512
11/1/2016	4.39	12.26	96	6.51	540.1	0.899	22.2	22.2	30	839		0.0125	0.259	0.121	0.076465	22200	0.00532
11/15/2016	6.62	9.40	78	6.32	605.2	3.80	22.4	22.4	20	1230		0.0446	0.301	0.402	0.048405	23000	*0*
11/29/2016	3.47	11.93	91	6.41	555.2	0.360	19.3	17.2	10	683		0.0142	0.348	0.216	0.051540	23000	*0*
12/13/2016	0.66	14.41	103	6.33	803.7	0.478	13.7	12.0	218	1020		0.00941	0.556	0.229	0.076445	27000	0.00956
12/27/2016	2.59	13.58	102	6.34	594.1	3.29	10.5	8.55	644		>24200	0.0272	0.584	0.488	0.13655	17700	0.0417
AVG.	8.59	10.69	90	6.67	522.7	1.24	19.7	18.7	154	6200		0.0202	0.520	0.280	0.10674	18730	0.0147
MAX.	19.35	14.41	103	6.94	803.7	3.80	27.5	27.5	644	24200		0.0446	0.946	0.488	0.28180	27000	0.0417
MIN.	0.00	6.13	59	6.32	335.9	0.360	10.5	8.55	*<10*	288		0.00941	*<0.005*	0.121	0.048405	12900	*<0.005*
MEDIAN	8.90	10.97	92	6.73	517.3	0.876	20.3	19.2	63	2100		0.0174	0.497	0.266	0.085465	17750	0.0118

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 2016
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
1/12/2016	0.19	11.26	79.4	6.68	262.8	0.402			31	959					0.12220	11500	
1/26/2016	0.51	10.80	75.7	6.68	265.5	0.272			*0*	96					0.11371	12500	
2/9/2016	0.21	10.66	74.8	6.74	262.0	0.343			31	201					0.11279	11600	
2/23/2016	1.32	10.55	75.9	6.69	262.2	0.507			10	235					0.12713	11800	
3/8/2016	3.22	10.55	80.0	6.60	278.0	0.298			*0*	216					0.12143	11000	
3/22/2016	4.09	9.83	76.9	6.47	274.8	0.312	9.41	7.54	*0*	565		0.00874	0.00673	0.289	0.11658	10900	*0*
4/5/2016	2.23	10.31	76.4	6.67	264.5	0.340			10	435					0.11810	10400	
4/19/2016	11.47	6.33	58.6	6.22	266.4	0.570			*0*	1720					0.13450	11000	
5/3/2016	9.73	5.72	51.1	6.29	277.8	0.555			146	3440					0.14018	12000	
5/17/2016	12.10	6.16	58.4	6.37	276.9	0.470			41	2100					0.13084	11200	
5/31/2016	21.14	2.04	23.2	6.08	290.6	1.78			72	3310					0.17388	14200	
6/14/2016	16.40	4.41	46.2	6.22	290.0	0.622	17.6	15.6	52	2610		0.0136	*0*	0.344	0.13144	13900	*0*
6/28/2016	20.29	2.21	24.8	6.25	290.1	2.63			368	17300					0.17714	14400	
7/13/2016	19.55	3.27	36.2	6.25	301.2	2.69			148		>24200				0.20945	14800	
8/23/2016	16.60	3.52	36.9	5.98	388.5	1.05			269		>24200				0.14591	22200	
9/6/2016	18.70	4.91	53.4	6.40	333.8	1.21			*0*	14100					0.15117	16000	
9/20/2016	20.33	1.94	21.8	6.27	311.1	1.00	25.6	25.6	10	4610		0.0168	0.0145	0.426	0.13630	15100	0.114
10/4/2016	14.54	5.36	53.5	6.42	347.7	0.735			134	6870					0.10077	17800	
10/18/2016	14.01	6.22	61.5	6.22	413.2	1.06			*0*	4350					0.10971	25300	
11/1/2016	4.58	8.82	69.3	6.28	423.2	0.538			31	1500					0.13425	27300	
11/15/2016	5.02	10.57	84.2	6.38	382.3	0.823			63	1390					0.087550	20800	
11/29/2016	1.46	10.85	78.0	6.48	339.1	0.348			74	1070					0.10041	17600	
12/13/2016	0.74	11.96	85.4	6.26	323.2	0.457			41	1020					0.11446	15400	
12/27/2016	2.58	11.42	86.0	6.39	315.0	0.613	14.3	12.4	122	2280		0.0104	0.0284	0.296	0.11829	2870	*0*
AVG.	9.21	7.49	61	6.39	310.0	0.818	16.7	15.3	69	3200		0.0124	0.0124	0.339	0.13034	14650	0.0285
MAX.	21.14	11.96	86	6.74	423.2	2.69	25.6	25.6	368	17300		0.0168	0.0284	0.426	0.20945	27300	0.114
MIN.	0.19	1.94	22	5.98	262.0	0.272	9.41	7.54	*<10*	96		0.00874	*<0.005*	0.289	0.087550	2870	*<0.005*
MEDIAN	7.38	7.58	65	6.38	290.4	0.563	16.0	14.0	36	1610		0.0120	0.0106	0.320	0.124665	14050	*<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 2016
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY (BWTF)

DATE	TEMP. (°C)	pH	FECAL COLIFORM	TOTAL COLIFORM	*E. COLI*	TNTC
1/1/16	8.2	6.72	*0*	55	2	
1/2/16	8.0	6.68	1	60	1	
1/3/16	7.8	6.65	*0*	40	*0*	
1/4/16	7.7	6.63	29	59	26.2	
1/5/16	6.8	6.86	4	46	1	
1/6/16	7.1	6.63	*0*	41	2	
1/7/16	7.1	6.71	*0*	37	1	
1/8/16	6.8	6.62	*0*	30	1	
1/9/16	7.1	6.75	*0*	36	*0*	
1/10/16	6.9	6.63	*0*	26	*0*	
1/11/16	6.8	6.70	2	40	5.2	
1/12/16	6.2	6.85	*0*	13	1	
1/13/16	6.4	6.67	3	47	1	
1/14/16	6.3	6.72	2	22	*0*	
1/15/16	6.4	6.75	*0*	18	1	
1/16/16	6.3	6.83	1	21	1	
1/17/16	6.1	6.73	*0*	23	*0*	
1/18/16	6.1	6.74	*0*	17	1	
1/19/16	5.1	6.91	2	8	1	
1/20/16	5.5	6.70	*0*	23	1	
1/21/16	5.6	6.67	*0*	16	*0*	
1/22/16	5.2	6.76	1	18	1	
1/23/16	5.2	6.85	1	15	*0*	
1/24/16	4.3	6.74	3	25	1	
1/25/16	4.4	6.71	1	18	1	
1/26/16	4.5	6.88	*0*	11	*0*	
1/27/16	4.8	6.63	2	14	6.2	
1/28/16	4.7	6.52	*0*	8	*0*	
1/29/16	4.9	6.63	1	12	1	
1/30/16	4.7	6.60	1	13	*0*	
1/31/16	4.5	6.60	*0*	12	1	
2/1/16	4.5	6.63	*0*	4	1	
2/2/16	4.3	6.87	1	12	3.1	
2/3/16	4.5	6.55	*0*	12	*0*	
2/4/16	4.8	6.57	2	11	2	
2/5/16	4.9	6.60	*0*	13	*0*	
2/6/16	4.7	6.58	1	4	*0*	
2/7/16	4.3	6.63	*0*	5	*0*	
2/8/16	4.4	6.61	2	11	1	
2/9/16	3.4	6.92	2	17	4.1	
2/10/16	3.8	6.58	2	10	1	
2/11/16	3.9	6.62	*0*	8	*0*	
2/12/16	3.1	6.52	*0*	9	*0*	
2/13/16	3.5	6.55	1	5	*0*	
2/14/16	2.3	6.62	*0*	6	*0*	
2/15/16	2.4	6.55	1	4	*0*	
2/16/16	2.5	6.88	*0*	10	*0*	
2/17/16	2.8	6.58	*0*	5	1	
2/18/16	2.4	6.60	*0*	6	*0*	
2/19/16	2.3	6.61	*0*	7	*0*	
2/20/16	3.1	6.55	*0*	4	*0*	

QUABBIN LABORATORY RECORDS 2016
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY (BWTF)

DATE	TEMP. (°C)	pH	FECAL COLIFORM	TOTAL COLIFORM	*E. COLI*	TNTC
2/21/16	2.6	6.55	*0*	6	*0*	
2/22/16	2.7	6.61	1	8	*0*	
2/23/16	2.6	6.89	*0*	3	*0*	
2/24/16	2.7	6.58	*0*	4	*0*	
2/25/16	3.1	6.55	2	13	2	
2/26/16	3.0	6.51	*0*	7	1	
2/27/16	2.8	6.51	*0*	3	*0*	
2/28/16	2.8	6.55	*0*	11	*0*	
2/29/16	2.8	6.54	*0*	5	*0*	
3/1/16	2.5	6.76	*0*	3	*0*	
3/2/16	2.9	6.57	*0*	6	*0*	
3/3/16	3.1	6.47	*0*	10	*0*	
3/4/16	3.1	6.52	*0*	5	*0*	
3/5/16	2.6	6.41	*0*	10	*0*	
3/6/16	2.8	6.40	*0*	6	*0*	
3/7/16	2.8	6.50	*0*	6	*0*	
3/8/16	2.9	6.63	*0*	7	*0*	
3/9/16	3.1	6.60	*0*	5	*0*	
3/10/16	3.5	6.55	*0*	8	*0*	
3/11/16	3.8	6.50	*0*	2	*0*	
3/12/16	3.8	6.50	*0*	4	*0*	
3/13/16	3.9	6.58	1	4	*0*	
3/14/16	4.1	6.60	*0*	10	*0*	
3/15/16	3.7	6.89	*0*	6	*0*	
3/16/16	4.2	6.52	*0*	10	1	
3/17/16	4.7	6.60	*0*	4	*0*	
3/18/16	4.4	6.49	*0*	7	*0*	
3/19/16	4.7	6.51	*0*	10	*0*	
3/20/16	4.5	6.55	2	23	2	
3/21/16	4.3	6.89	*0*	12	*0*	
3/22/16	3.8	7.09	*0*	8	*0*	
3/23/16	4.7	6.45	*0*	7	*0*	
3/24/16	4.9	6.48	*0*	5	*0*	
3/25/16	5.2	6.49	*0*	12	*0*	
3/26/16	5.0	6.48	*0*	16	*0*	
3/27/16	5.2	6.50	*0*	12	1	
3/28/16	4.5	6.88	*0*	16	*0*	
3/29/16	4.4	6.91	1	12	*0*	
3/30/16	5.3	6.54	*0*	13	*0*	
3/31/16	5.4	6.55	*0*	10	*0*	
4/1/16	5.7	6.52	*0*	17	*0*	
4/2/16	5.9	6.52	*0*	13	*0*	
4/3/16	5.8	6.55	*0*	11	*0*	
4/4/16	5.7	6.53	*0*	16	*0*	
4/5/16	4.4	6.90	*0*	15	*0*	
4/6/16	5.7	6.53	*0*	10	*0*	
4/7/16	5.9	6.54	*0*	37	*0*	
4/8/16	5.8	6.52	*0*	12	*0*	
4/9/16	5.7	6.49	*0*	13	*0*	
4/10/16	5.9	6.57	1	16	*0*	
4/11/16	5.9	6.59	*0*	21	*0*	

QUABBIN LABORATORY RECORDS 2016
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY (BWTF)

DATE	TEMP. (°C)	pH	FECAL COLIFORM	TOTAL COLIFORM	*E. COLI*	TNTC
4/12/16	5.2	6.90	*0*	19	*0*	
4/13/16	6.0	6.56	*0*	20	*0*	
4/14/16	6.4	6.52	*0*	8	*0*	
4/15/16	6.7	6.56	*0*	20	*0*	
4/16/16	6.9	6.59	*0*	18	*0*	
4/17/16	7.1	6.57	*0*	28	*0*	
4/18/16	6.9	6.59	*0*	6	1	
4/19/16	7.1	6.92	*0*	39	*0*	
4/20/16	8.1	6.51	*0*	17	1	
4/21/16	7.7	6.54	*0*	16	*0*	
4/22/16	7.4	6.60	*0*	18	*0*	
4/23/16	7.1	6.63	*0*	22	*0*	
4/24/16	8.5	6.55	*0*	26	*0*	
4/25/16	8.5	6.56	*0*	13	*0*	
4/26/16	8.6	6.91	*0*	8	*0*	
4/27/16	8.7	6.59	*0*	45	*0*	
4/28/16	8.5	6.60	*0*	36	*0*	
4/29/16	8.1	6.70	*0*	12	*0*	
4/30/16	8.1	6.55	*0*	31	*0*	
5/1/16	7.8	6.54	*0*	11	*0*	
5/2/16	7.9	6.57	*0*	20	*0*	
5/3/16	8.6	6.94	*0*	11	*0*	
5/4/16	8.8	6.66	*0*	22	*0*	
5/5/16	9.3	6.60	*0*	25	1	
5/6/16	9.4	6.51	*0*	23	*0*	
5/7/16	9.5	6.58	*0*	22	*0*	
5/8/16	9.3	6.57	*0*	28	*0*	
5/9/16	9.6	6.60	*0*	99	*0*	
5/10/16	9.5	6.85	*0*	23	*0*	
5/11/16	9.0	6.59	*0*	11	*0*	
5/12/16	9.3	6.58	*0*	12	*0*	
5/13/16	8.8	6.58	*0*	21	*0*	
5/14/16	8.9	6.57	*0*	11	*0*	
5/15/16	8.7	6.53	*0*	11	*0*	
5/16/16	10.0	6.55	*0*	20	*0*	
5/17/16	10.1	6.97	*0*	11	*0*	
5/18/16	9.5	6.62	2	12	*0*	
5/19/16	9.0	6.54	*0*	11	*0*	
5/20/16	9.3	6.60	*0*	16	*0*	
5/21/16	9.9	6.56	*0*	12	*0*	
5/22/16	9.5	6.53	*0*	11	*0*	
5/23/16	9.9	6.58	*0*	24	*0*	
5/24/16	9.8	6.82	*0*	14	*0*	
5/25/16	9.9	6.56	*0*	20	*0*	
5/26/16	10.1	6.53	*0*	10	*0*	
5/27/16	10.1	6.60	*0*	8	*0*	
5/28/16	10.5	6.60	*0*	248	*0*	
5/29/16	10.3	6.58	*0*	13	*0*	
5/30/16	9.6	6.59	*0*	11	*0*	
5/31/16	10.6	6.98	*0*	13	*0*	
6/1/16	9.8	6.67	*0*	11	*0*	

QUABBIN LABORATORY RECORDS 2016
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY (BWTF)

DATE	TEMP. (°C)	pH	FECAL COLIFORM	TOTAL COLIFORM	*E. COLI*	TNTC
6/2/16	9.9	6.85	*0*	14	*0*	
6/3/16	10.3	6.89	*0*	15	*0*	
6/4/16	10.3	6.90	*0*	18	*0*	
6/5/16	10.5	6.93	*0*	16	*0*	
6/6/16	10.4	6.77	*0*	21	*0*	
6/7/16	10.2	6.81	*0*	20	*0*	
6/8/16	10.8	6.86	*0*	16	1	
6/9/16	10.5	6.88	*0*	13	*0*	
6/10/16	10.3	6.82	*0*	16	*0*	
6/11/16	10.6	6.90	*0*	18	*0*	
6/12/16	10.9	6.89	*0*	16	*0*	
6/13/16	11.1	6.87	*0*	20	*0*	
6/14/16	10.9	7.00	*0*	16	*0*	
6/15/16	11.2	6.82	*0*	20	*0*	
6/16/16	11.2	6.90	*0*	17	*0*	
6/17/16	12.1	6.93	*0*	17	*0*	
6/18/16	11.7	6.87	*0*	16	*0*	
6/19/16	11.5	6.83	*0*	18	*0*	
6/20/16	11.4	6.85	*0*	16	*0*	
6/21/16	11.2	6.97	*0*	5	*0*	
6/22/16	11.6	6.73	*0*	20	*0*	
6/23/16	11.9	6.88	*0*	10	*0*	
6/24/16	11.9	6.84	*0*	12	*0*	
6/25/16	12.0	6.94	*0*	10	*0*	
6/26/16	11.8	6.80	*0*	21	*0*	
6/27/16	11.7	6.80	*0*	13	*0*	
6/28/16	12.2	6.95	*0*	30	*0*	
6/29/16	11.7	6.84	*0*	38	*0*	
6/30/16	12.1	6.61	*0*	32	*0*	
7/1/16	12.0	6.70	*0*	38	*0*	
7/2/16	12.8	6.82	*0*	98	*0*	
7/3/16	11.9	6.78	*0*	41	*0*	
7/4/16	12.1	6.81	*0*	50	*0*	
7/5/16	12.4	6.97	*0*	47	*0*	
7/6/16	12.6	6.82	*0*	39	*0*	
7/7/16	12.3	6.78	*0*	28	*0*	
7/8/16	12.5	6.85	*0*	55	*0*	
7/9/16	12.9	6.77	*0*	47	*0*	
7/10/16	12.9	6.82	*0*	80	*0*	
7/11/16	12.5	6.77	*0*	46	1	
7/12/16	12.1	6.94	*0*	34	*0*	
7/13/16	12.2	6.76	*0*	31	*0*	
7/14/16	12.8	6.78	*0*	23	*0*	
7/15/16	13.0	6.80	*0*	33	*0*	
7/16/16	12.9	6.84	*0*	26	*0*	
7/17/16	12.8	6.75	*0*	16	*0*	
7/18/16	13.1	6.82	*0*	21	*0*	
7/19/16	13.2	6.94	*0*	27	*0*	
7/20/16	13.4	6.82	*0*	23	*0*	
7/21/16	13.2	6.65	*0*	14	*0*	
7/22/16	12.9	6.82	*0*	20	*0*	

QUABBIN LABORATORY RECORDS 2016
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY (BWTF)

DATE	TEMP. (°C)	pH	FECAL COLIFORM	TOTAL COLIFORM	*E. COLI*	TNTC
7/23/16	13.8	6.80	*0*	41	*0*	
7/24/16	13.5	6.82	*0*	69	*0*	
7/25/16	13.4	6.86	*0*	25	*0*	
7/26/16	14.1	6.96	*0*	32	*0*	
7/27/16	13.6	6.86	*0*	20	*0*	
7/28/16	13.3	6.75	*0*	25	*0*	
7/29/16	14.0	6.84	*0*	33	*0*	
7/30/16	13.7	6.80	*0*	33	*0*	
7/31/16	14.0	6.96	*0*	21	*0*	
8/1/16	12.0	6.71	*0*	43	*0*	
8/2/16	12.0	6.91	*0*	37	*0*	
8/3/16	12.1	6.75	*0*	44	*0*	
8/4/16	12.3	6.81	*0*	53	*0*	
8/5/16	12.1	6.82	*0*	166	*0*	
8/6/16	12.2	6.67	*0*	201	*0*	
8/7/16	12.7	6.72	*0*	517	*0*	
8/8/16	12.5	6.75	*0*	461	*0*	
8/9/16	13.1	7.04	*0*	291	*0*	
8/10/16	12.3	6.71	*0*	411	*0*	
8/11/16	12.5	6.62	1	461	*0*	
8/12/16	12.4	6.73	1	461	*0*	
8/13/16	13.3	6.88	*0*	411	*0*	
8/14/16	12.7	6.78	*0*	435	*0*	
8/15/16	12.3	6.77	*0*	548	*0*	
8/16/16	12.5	6.99	*0*	435	*0*	
8/17/16	11.9	6.70	*0*	1050	*0*	
8/18/16	12.7	6.77	*0*	613	*0*	
8/19/16	12.5	6.85	6	461	*0*	
8/20/16	12.5	6.83	*0*	613	*0*	
8/21/16	12.7	6.81	*0*	687	*0*	
8/22/16	13.1	6.81	1	488	*0*	
8/23/16	13.2	7.00	1	649	*0*	
8/24/16	13.1	6.78	1	866	*0*	
8/25/16	12.9	6.80	*0*	1120	*0*	
8/26/16	13.4	6.78	*0*	775	*0*	
8/27/16	13.5	6.83	*0*	428	*0*	
8/28/16	13.5	6.78	*0*	2420	*0*	
8/29/16	13.5	6.71	*0*		*0*	>2420
8/30/16	13.0	7.02	*0*	731	*0*	
8/31/16	12.9	6.69	*0*	870	*0*	
9/1/16	15.5	6.68	*0*	690	*0*	
9/2/16	15.3	6.58	*0*	1030	2	
9/3/16	15.0	6.57	*0*	977	*0*	
9/4/16	15.3	6.58	*0*	922	2	
9/5/16	15.9	6.70	*0*	1030	*0*	
9/6/16	22.6	6.93	*0*	2240	*0*	
9/7/16	18.6	6.63	*0*	2410	*0*	
9/8/16	17.1	6.70	*0*	1100	*0*	
9/9/16	15.2	6.62	*0*	1030	*0*	
9/10/16	16.9	6.60	*0*	1840	*0*	
9/11/16	15.5	6.80	*0*	870	*0*	

QUABBIN LABORATORY RECORDS 2016
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY (BWTF)

DATE	TEMP. (°C)	pH	FECAL COLIFORM	TOTAL COLIFORM	*E. COLI*	TNTC
9/12/16	16.9	6.69	2	2090	2	
9/13/16	15.8	6.85	2	2240	*0*	
9/14/16	15.1	6.71	*0*	2600	*0*	
9/15/16	19.6	6.61	2	4840	*0*	
9/16/16	16.8	6.70	*0*	2240	*0*	
9/17/16	15.8	6.79	1	2410	*0*	
9/18/16	15.3	6.55	1	1840	*0*	
9/19/16	16.7	6.65	*0*	2600	*0*	
9/20/16	17.6	6.75	*0*	3470	2	
9/21/16	17.1	6.58	1	2240	*0*	
9/22/16	17.9	6.62	1	1960	4	
9/23/16	16.2	6.57	*0*	1450	2	
9/24/16	20.9	6.73	10	2090	17.2	
9/25/16	20.4	6.68	3	1960	6.2	
9/26/16	19.4	6.65	1	1450	*0*	
9/27/16	16.2	6.69	*0*	821	*0*	
9/28/16	19.6	6.67	*0*	1370	2	
9/29/16	20.3	6.81	1	2410	2	
9/30/16	20.0	6.83	1	1540	2	
10/1/16	19.6	6.76	2	2090	*0*	
10/2/16	19.3	6.78	*0*	2600	*0*	
10/3/16	18.7	6.70	1	1450	*0*	
10/4/16	18.5	6.85	*0*	1030	*0*	
10/5/16	19.0	6.74	*0*	922	*0*	
10/6/16	18.7	6.73	*0*	1230	*0*	
10/7/16	18.5	6.65	*0*	1230	*0*	
10/8/16	18.4	6.69	*0*	1030	*0*	
10/9/16	18.6	6.73	1	1100	*0*	
10/10/16	18.2	6.67	*0*	1840	4	
10/11/16	17.3	6.89	1	615	*0*	
10/12/16	17.8	6.73	*0*	821	*0*	
10/13/16	16.9	6.67	*0*	651	*0*	
10/14/16	17.5	6.77	*0*	523	*0*	
10/15/16	17.2	6.71	*0*	370	*0*	
10/16/16	16.9	6.81	1	449	*0*	
10/17/16	16.1	6.60	1	303	*0*	
10/18/16	16.1	6.78	*0*	345	*0*	
10/19/16	16.0	6.45	*0*	236	*0*	
10/20/16	16.9	6.61	*0*	291	*0*	
10/21/16	16.3	6.70	*0*	236	*0*	
10/22/16	16.7	6.59	*0*	187	*0*	
10/23/16	16.6	6.65	*0*	308	*0*	
10/24/16	16.2	6.63	*0*	261	*0*	
10/25/16	15.4	6.84	*0*	1990	*0*	
10/26/16	15.5	6.59	*0*	308	*0*	
10/27/16	14.9	6.65	*0*	110	*0*	
10/28/16	14.7	6.68	*0*	116	*0*	
10/29/16	14.4	6.72	*0*	166	*0*	
10/30/16	14.2	6.65	*0*	210	*0*	
10/31/16	13.9	6.73	*0*	120	*0*	
11/1/16	13.7	6.82	*0*	118	*0*	

QUABBIN LABORATORY RECORDS 2016
MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY (BWTF)

DATE	TEMP. (°C)	pH	FECAL COLIFORM	TOTAL COLIFORM	*E. COLI*	TNTC
11/2/16	13.7	6.67	*0*	166	*0*	
11/3/16	13.8	6.67	*0*	107	*0*	
11/4/16	13.8	6.65	*0*	131	*0*	
11/5/16	13.6	6.63	*0*	111	*0*	
11/6/16	13.3	6.61	*0*	122	*0*	
11/7/16	13.1	6.72	*0*	172	*0*	
11/8/16	12.7	6.80	*0*	118	*0*	
11/9/16	12.8	6.69	*0*	166	*0*	
11/10/16	12.7	6.79	*0*	124	*0*	
11/11/16	12.6	6.64	*0*	155	*0*	
11/12/16	12.3	6.63	*0*	128	*0*	
11/13/16	12.0	6.64	*0*	113	*0*	
11/14/16	12.0	6.65	*0*	291	*0*	
11/15/16	12.2	6.75	*0*	93	*0*	
11/16/16	11.8	6.63	*0*	86	*0*	
11/17/16	11.8	6.64	*0*	60	*0*	
11/18/16	11.7	6.58	*0*	79	*0*	
11/19/16	11.7	6.62	*0*	91	*0*	
11/20/16	11.6	6.65	*0*	96	*0*	
11/21/16	11.2	6.79	*0*	82	*0*	
11/22/16	10.8	6.64	*0*	84	1	
11/23/16	10.4	6.64	*0*	91	*0*	
11/24/16	10.4	6.63	*0*	50	*0*	
11/25/16	10.4	6.67	1	58	*0*	
11/26/16	10.3	6.57	*0*	56	*0*	
11/27/16	10.3	6.60	*0*	64	*0*	
11/28/16	10.1	6.65	*0*	78	*0*	
11/29/16	10.0	6.75	*0*	56	1	
11/30/16	10.1	6.58	*0*	93	*0*	
12/1/16	9.9	6.61	*0*	72	*0*	
12/2/16	9.9	6.59	*0*	*0*	*0*	
12/3/16	9.8	6.58	*0*	70	1	
12/4/16	9.5	6.63	*0*	68	*0*	
12/5/16	9.3	6.75	*0*	49	1	
12/6/16	9.1	6.79	*0*	52	*0*	
12/7/16	9.3	6.61	*0*	68	*0*	
12/8/16	9.1	6.60	*0*	55	*0*	
12/9/16	9.0	6.60	*0*	39	*0*	
12/10/16	8.8	6.64	*0*	68	*0*	
12/11/16	8.4	6.63	*0*	42	*0*	
12/12/16	8.3	6.55	*0*	84	*0*	
12/13/16	8.1	6.83	*0*	40	*0*	
12/14/16	8.1	6.63	*0*	30	*0*	
12/15/16	8.1	6.68	*0*	27	*0*	
12/16/16	7.3	6.67	*0*	45	*0*	
12/17/16	7.4	6.66	*0*	38	*0*	
12/18/16	7.2	6.61	*0*	19	*0*	
12/19/16	7.0	6.62	1	32	*0*	
12/20/16	6.6	6.87	1	16	1	
12/21/16	6.8	6.61	1	21	*0*	
12/22/16	6.9	6.62	1	25	1	

QUABBIN LABORATORY RECORDS 2016

MWRA WILLIAM A. BRUTSCH WATER TREATMENT FACILITY (BWTF)

DATE	TEMP. (°C)	pH	FECAL COLIFORM	TOTAL COLIFORM	*E. COLI*	TNTC
12/23/16	6.7	6.61	1	12	*0*	
12/24/16	6.6	6.61	*0*	14	1	
12/25/16	6.5	6.61	*0*	26	1	
12/26/16	6.3	6.68	*0*	12	*0*	
12/27/16	5.8	6.83	*0*	23	*0*	
12/28/16	6.5	6.62	*0*	10	*0*	
12/29/16	6.1	6.60	*0*	16	*0*	
12/30/16	6.3	6.69	*0*	11	*0*	
12/31/16	6.1	6.68	*0*	9	*0*	
AVG.	10.0	6.70	*<1*	290	*<1 - <4*	
MAX.	22.6	7.09	29	4840	26.2	
MIN.	2.3	6.40	*<1*	*<1*	*<1 - <4*	
MEDIAN	10.1	6.67	*<1*	26	*<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.

QUABBIN LABORATORY RECORDS 2016
OTHER SAMPLING RESULTS

DRINKING WATER WELL SAMPLES FOR PUBLIC WATER SYSTEM (PWS) COMPLIANCE

DATE	LOCATION	ANALYTICAL PARAMETER	RESULT	UNITS	REMARKS
4/11/16	Administration Building Well	Nitrate	0.54	mg/L	Samples analyzed at MWRA Deer Island Laboratory.
7/28/16	Administration Building Well	Volatile organic compounds by EPA Method 524 (all constituents)	<0.5	ug/L	Sample analyzed at MWRA Deer Island Laboratory. (All results were less than method detection limits.)
4/14/16	Administration Building Kitchen	Lead	32.0	ug/L	Samples analyzed at MWRA Deer Island Laboratory.
		Copper	107	ug/L	
	Visitors Center Fountain	Lead	3.58	ug/L	
		Copper	270	ug/L	
	Laboratory Tap	Lead	1.51	ug/L	
		Copper	179	ug/L	
	Garage Fountain	Lead	3.34	ug/L	
		Copper	48.3	ug/L	
	3rd Floor Service Sink	Lead	2.18	ug/L	
		Copper	59.7	ug/L	
12/15/16	Administration Building Kitchen	Lead	22.2	ug/L	Samples analyzed at MWRA Deer Island Laboratory.
		Copper	74.9	ug/L	
	Visitors Center Fountain	Lead	3.45	ug/L	
		Copper	197	ug/L	
	Laboratory Tap	Lead	4.54	ug/L	
		Copper	125	ug/L	
	Garage Fountain	Lead	1.05	ug/L	
		Copper	16.7	ug/L	
	3rd Floor Service Sink	Lead	2.69	ug/L	
		Copper	71.6	ug/L	
Additional water quality testing was performed throughout 2016 to assess the elevated lead levels detected at the kitchen sink. See letter to MassDEP dated and January 3, 2017, in Appendix C for results and more information.					

QUABBIN LABORATORY RECORDS 2016
OTHER SAMPLING RESULTS

DRINKING WATER WELL SAMPLES - NOT FOR PWS COMPLIANCE

DATE	LOCATION	ANALYTICAL PARAMETER	RESULT	UNITS	REMARKS
June, 2016	Stockroom	Multiple	-	-	See memo dated August 4, 2016, 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
10/18/16	New Salem, Bathroom Sink	First Draw	3.01	582	Sample analyzed at MWRA Deer Island Laboratory.
		2-minute Flush	1.370	223	
10/19/16	Oakham, Kitchen Sink	First Draw	9.97	6.09	Sample analyzed at MWRA Deer Island Laboratory.
		RO Tap	0.639	<3.00	
10/18/16	Residence #1 (Forestry Office), Kitchen Sink	First Draw	8.65	458	Sample analyzed at MWRA Deer Island Laboratory.
		2-minute Flush	2.84	73.7	
10/18/16	Residence #2 (Conference Center), Kitchen Sink	First Draw	3.39	121	Sample analyzed at MWRA Deer Island Laboratory.
		2-minute Flush	1.4	26.7	
10/18/16	Residence #3 (Ranger Station), Kitchen Sink	First Draw	5.37	1040	Sample analyzed at MWRA Deer Island Laboratory.
		2-minute Flush	1.1	738	
		POU Filter	<0.0500	<3.00	

QUABBIN LABORATORY RECORDS 2016
ADMINISTRATION BUILDING BACTERIOLOGICAL ANALYSIS RESULTS

DATE	***E. coli* RESULT**	**TOTAL COLIFORM RESULT**
	Visitor Center Fountain	Visitor Center Fountain
1/4/2016	A	A
2/1/2016	A	A
3/7/2016	A	A
4/4/2016	A	A
5/2/2016	A	A
6/6/2016	A	A
7/11/2016	A	A
8/1/2016	A	A
9/12/2016	A	A
10/3/2016	A	A
11/28/2016	A	A
12/12/2016	A	A

NOTE: A = ABSENT
P = PRESENT

QUABBIN LABORATORY RECORDS 2016
(202) WINSOR DAM --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
4/14	0.5	8.0	5.41	13.40	106.9	6.93	47.5	202S	4/14/16	0.338	4.94	3.42	0	0	0									525.97
4/14	3		5.40	13.42	107.0	6.68	47.5																	
4/14	6		5.39	13.43	107.0	6.65	47.5	202M	4/14/16				0	0	0									
4/14	9		5.39	13.42	107.0	6.63	47.5																	
4/14	12		5.35	13.44	107.0	6.64	47.5																	
4/14	15		5.06	13.50	106.8	6.66	47.5																	
4/14	18		4.99	13.49	106.5	6.65	47.5	202D	4/14/16				0	0	20									
4/14	19		4.98	13.46	106.2	6.66	47.5	202M	4/14/16	0.295	5.36	3.63												
4/14	21		4.96	13.44	106.0	6.66	47.5																	
4/14	24		4.94	13.43	105.8	6.66	47.5																	
4/14	27		4.92	13.42	105.7	6.66	47.5																	
4/14	30		4.91	13.41	105.6	6.66	47.5																	
4/14	33		4.90	13.39	105.4	6.67	47.4																	
4/14	36		4.89	13.38	105.3	6.67	47.4																	
4/14	38		4.89	13.37	105.2	6.66	47.2	202D	4/14/16	0.307	5.33	3.68												
4/14	39		4.90	13.36	105.2	6.66	47.5																	
5/11	0.5	14.3	10.36	11.93	108.5	7.05	47.8	202S	5/11/16	0.329	5.65	3.83	0	0	10		0	0	0	0	2010	0.019550		526.33
5/11	1		10.34	11.95	108.6	7.05	47.8																	
5/11	2		10.31	11.96	108.6	7.04	47.8																	
5/11	3		10.28	11.97	108.6	7.02	47.8																	
5/11	4		10.28	11.97	108.6	6.97	47.8																	
5/11	5		10.27	11.97	108.6	6.90	47.8																	
5/11	6		10.24	11.97	108.5	6.86	47.8	202M	5/11/16				0	0	0									
5/11	7		10.23	11.97	108.5	6.84	47.8																	
5/11	8		9.94	12.04	108.4	6.83	47.7																	
5/11	9		9.74	12.05	108.0	6.84	47.8																	
5/11	10		9.64	12.06	107.8	6.84	47.7																	
5/11	11		9.56	12.08	107.8	6.83	47.7																	
5/11	12		9.47	12.10	107.7	6.84	47.7																	
5/11	13		9.42	12.12	107.8	6.82	47.7																	
5/11	14		9.42	12.12	107.8	6.82	47.7																	
5/11	15		9.41	12.13	107.8	6.82	47.8																	
5/11	16		9.12	12.18	107.6	6.83	47.8																	
5/11	17		8.67	12.28	107.2	6.82	47.8																	
5/11	18		8.27	12.38	107.1	6.80	47.7	202D	5/11/16				0	0	0									
5/11	19		7.79	12.50	106.9	6.79	47.8																	
5/11	20		7.59	12.54	106.7	6.77	47.8	202M	5/11/16	0.255	5.52	3.70					0	0	0.154	0	2120	0.019360	2010	
5/11	21		7.43	12.58	106.6	6.75	47.7																	
5/11	22		7.33	12.58	106.3	6.73	47.8																	
5/11	23		7.30	12.57	106.1	6.72	47.7																	
5/11	24		7.12	12.61	106.0	6.71	47.8																	
5/11	25		7.06	12.61	105.8	6.70	47.8																	
5/11	26		6.98	12.60	105.6	6.69	47.8																	
5/11	27		6.94	12.58	105.3	6.67	47.8																	
5/11	28		6.91	12.57	105.1	6.67	47.8																	
5/11	29		6.87	12.57	105.0	6.66	47.9																	
5/11	30		6.85	12.56	104.9	6.65	47.8																	
5/11	31		6.77	12.57	104.7	6.64	47.8																	
5/11	32		6.72	12.57	104.6	6.63	47.9																	
5/11	33		6.70	12.55	104.4	6.63	47.9																	
5/11	34		6.70	12.53	104.3	6.63	47.9																	
5/11	35		6.66	12.55	104.3	6.62	47.9																	
5/11	36		6.59	12.55	104.1	6.61	47.9																	
5/11	37		6.55	12.50	103.6	6.60	47.9																	
5/11	38		6.53	12.47	103.3	6.59	48.0																	
5/11	39		6.50	12.46	103.2	6.59	47.8	202D	5/11/16	0.303	5.37	3.61					0	0	0	0	2140	0.019060		
5/11	40		6.43	12.37	102.2	6.56	48.0																	

QUABBIN LABORATORY RECORDS 2016
(202) WINSOR DAM --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
6/15	0.5	11.5	18.02	9.80	106.1	6.90	47.1	202S	6/15/16	0.220	5.43	3.72	0	0	0									525.41
6/15	1		18.02	9.86	106.8	6.81	47.0																	
6/15	2		17.92	10.00	108.1	6.78	47.1																	
6/15	3		17.83	10.11	109.1	6.78	47.1																	
6/15	4		17.81	10.14	109.3	6.78	47.1																	
6/15	5		17.79	10.14	109.3	6.79	47.1																	
6/15	6		17.78	10.00	107.8	6.81	47.1	202M	6/15/16				0	0	0									
6/15	7		17.76	10.00	107.8	6.81	47.0																	
6/15	8		17.74	10.00	107.7	6.81	47.0																	
6/15	9		17.62	9.99	107.4	6.83	47.0																	
6/15	10		14.25	11.34	113.4	6.89	46.7	202M	6/15/16	0.338	5.74	3.97												
6/15	11		11.76	11.97	113.2	6.91	46.5																	
6/15	12		11.43	12.30	115.4	6.91	46.5																	
6/15	13		10.94	12.37	114.8	6.91	46.4																	
6/15	14		10.72	12.40	114.5	6.90	46.4																	
6/15	15		10.43	12.38	113.5	6.88	46.4																	
6/15	16		10.00	12.48	113.3	6.87	46.4																	
6/15	17		9.89	12.45	112.7	6.86	46.4																	
6/15	18		9.71	12.44	112.1	6.84	46.4	202D	6/15/16				0	0	10									
6/15	19		9.50	12.48	111.9	6.83	46.4																	
6/15	20		9.11	12.51	111.2	6.82	46.4																	
6/15	21		9.07	12.44	110.4	6.78	46.5																	
6/15	22		8.86	12.49	110.4	6.76	46.4																	
6/15	23		8.59	12.50	109.7	6.74	46.3																	
6/15	24		8.38	12.41	108.4	6.71	46.5																	
6/15	25		8.28	12.34	107.5	6.68	46.5																	
6/15	26		8.21	12.25	106.5	6.64	46.5																	
6/15	27		8.08	12.25	106.2	6.60	46.5																	
6/15	28		7.98	12.22	105.7	6.58	46.5																	
6/15	29		7.94	12.17	105.1	6.56	46.6																	
6/15	30		7.85	12.10	104.3	6.54	46.6																	
6/15	31		7.79	12.08	104.0	6.52	46.5																	
6/15	32		7.73	12.02	103.3	6.50	46.6																	
6/15	33		7.63	11.95	102.5	6.49	46.6																	
6/15	34		7.59	11.93	102.1	6.47	46.6																	
6/15	35		7.51	11.86	101.4	6.45	46.6																	
6/15	36		7.46	11.73	100.1	6.42	46.7																	
6/15	37		7.44	11.72	100.0	6.41	46.6																	
6/15	38		7.41	11.71	99.9	6.40	46.7																	
6/15	39		7.38	11.68	99.5	6.40	46.7	202D	6/15/16	0.230	5.55	3.87												
6/15	40		7.35	11.58	98.5	6.37	46.8																	
7/20	0.5	13.2	23.77	8.65	103.8	7.07	48.5	202S	7/20/16	0.253	5.69	4.01	0	0	20		0	0	0.118	0.00737	1770	0.017355		523.82
7/20	1		23.76	8.65	103.7	6.92	48.5																	
7/20	2		23.76	8.69	104.2	6.88	48.5																	
7/20	3		23.76	8.78	105.2	6.85	48.6																	
7/20	4		23.76	8.81	105.7	6.84	48.5																	
7/20	5		23.76	8.79	105.4	6.82	48.5																	
7/20	6		23.75	8.78	105.3	6.82	48.5	202M	7/20/16				0	0	31									
7/20	7		23.75	8.77	105.2	6.83	48.4																	
7/20	8		23.73	8.78	105.2	6.83	48.4																	
7/20	9		19.53	10.35	114.3	6.84	47.7																	
7/20	10		17.90	10.95	117.0	6.86	47.3																	
7/20	11		16.59	11.25	117.0	6.88	47.2																	
7/20	12		14.99	11.57	116.3	6.90	47.0	202M	7/20/16	0.269	5.39	3.75					0	0	0.12	0.00538	1710	0.018580	2070	
7/20	13		13.79	11.89	116.5	6.92	46.8																	
7/20	14		12.78	12.15	116.3	6.93	46.8																	
7/20	15		11.93	12.25	115.0	6.92	46.6																	
7/20	16		11.38	12.33	114.3	6.90	46.7																	
7/20	17		10.95	12.28	112.7	6.86	46.7																	
7/20	18		10.65	12.23	111.5	6.82	46.8	202D	7/20/16				0	0	10									

QUABBIN LABORATORY RECORDS 2016
(202) WINSOR DAM --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
7/20	19		10.38	12.20	110.5	6.78	46.7																	
7/20	20		10.09	12.17	109.5	6.74	46.6																	
7/20	21		9.97	12.11	108.7	6.72	46.6																	
7/20	22		9.83	12.04	107.7	6.70	46.7																	
7/20	23		9.65	11.95	106.4	6.66	46.7																	
7/20	24		9.46	11.89	105.4	6.63	46.7																	
7/20	25		9.30	11.83	104.4	6.61	46.7																	
7/20	26		9.16	11.78	103.6	6.58	46.7																	
7/20	27		8.90	11.69	102.2	6.54	46.7																	
7/20	28		8.51	11.48	99.5	6.48	46.9																	
7/20	29		8.29	11.19	96.4	6.40	46.9																	
7/20	30		8.21	11.02	94.8	6.36	46.9																	
7/20	31		8.14	10.86	93.3	6.32	46.9																	
7/20	32		8.08	10.76	92.3	6.29	46.9																	
7/20	33		7.98	10.70	91.5	6.27	47.0																	
7/20	34		7.90	10.64	90.8	6.26	47.0																	
7/20	35		7.88	10.48	89.4	6.23	47.0																	
7/20	36		7.85	10.42	88.9	6.22	47.1																	
7/20	37		7.83	10.32	88.0	6.20	47.1																	
7/20	38		7.83	10.30	87.8	6.20	47.1	202D	7/20/16	0.340	5.42	3.81					0.0108	0.00670	0.133	0.00685	2000	0.019055		
7/20	39		7.76	10.10	85.9	6.16	47.2																	
8/24	0.5	12.1	24.85	8.55	103.9	7.01	47.9	202S	8/24/16	0.231	5.43	4.11	0	0	295									522.33
8/24	1		24.85	8.54	103.7	6.82	47.8																	
8/24	2		24.85	8.54	103.8	6.72	47.9																	
8/24	3		24.83	8.55	103.8	6.72	47.9																	
8/24	4		24.83	8.54	103.7	6.71	47.8																	
8/24	5		24.82	8.54	103.8	6.71	47.8																	
8/24	6		24.81	8.53	103.6	6.70	47.8	202M	8/24/16				0	0	185									
8/24	7		24.81	8.53	103.6	6.71	47.8																	
8/24	8		24.80	8.53	103.5	6.72	47.7																	
8/24	9		24.78	8.53	103.5	6.73	47.8																	
8/24	10		23.75	9.16	109.0	6.71	47.5																	
8/24	11		19.82	10.68	117.8	6.72	46.6																	
8/24	12		18.11	11.61	123.7	6.77	46.4																	
8/24	13		16.33	11.93	122.5	6.82	46.3	202M	8/24/16	0.256	5.35	3.90												
8/24	14		15.04	12.26	122.5	6.85	46.2																	
8/24	15		13.95	12.43	121.3	6.84	46.1																	
8/24	16		13.20	12.48	119.8	6.82	46.1																	
8/24	17		12.73	12.50	118.7	6.81	45.8																	
8/24	18		12.23	12.49	117.3	6.78	45.8	202D	8/24/16				0	0	677									
8/24	19		11.80	12.47	116.0	6.75	45.8																	
8/24	20		11.28	12.36	113.6	6.70	45.8																	
8/24	21		10.98	12.36	112.8	6.68	45.8																	
8/24	22		10.78	12.28	111.5	6.64	45.9																	
8/24	23		10.52	12.17	109.8	6.59	45.9																	
8/24	24		10.36	12.04	108.3	6.55	45.9																	
8/24	25		9.98	12.05	107.5	6.52	45.9																	
8/24	26		9.62	11.98	105.9	6.49	45.8																	
8/24	27		9.30	11.72	102.9	6.43	46.0																	
8/24	28		9.02	11.10	96.7	6.28	46.1																	
8/24	29		8.76	10.83	93.7	6.22	46.1																	
8/24	30		8.61	10.70	92.3	6.19	46.1																	
8/24	31		8.51	10.39	89.5	6.15	46.2																	
8/24	32		8.39	10.23	87.8	6.12	46.2																	
8/24	33		8.33	9.93	85.1	6.07	46.2																	
8/24	34		8.28	9.81	83.9	6.05	46.2																	
8/24	35		8.20	9.65	82.4	6.03	46.3																	
8/24	36		8.20	9.52	81.4	6.01	46.3																	
8/24	37		8.11	9.37	79.9	5.99	46.4																	
8/24	38		8.10	9.21	78.5	5.97	46.4																	

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DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
8/24	39		8.09	9.06	77.2	5.95	46.4	202D	8/24/16	0.252	5.20	3.82												
8/24	40		8.07	9.03	76.9	5.94	46.4																	
9/15	0.5	10.4	22.25	8.62	100.5	6.96	48.3	202S	9/15/16	0.283	5.54	3.96	0	0	4350									521.22
9/15	1		22.27	8.62	100.4	6.84	48.5																	
9/15	2		22.27	8.62	100.5	6.81	48.5																	
9/15	3		22.27	8.62	100.5	6.80	48.3																	
9/15	4		22.27	8.62	100.5	6.77	48.5																	
9/15	5		22.27	8.62	100.5	6.78	48.5																	
9/15	6		22.27	8.63	100.6	6.80	48.5	202M	9/15/16				1	0	4880									
9/15	7		22.27	8.62	100.5	6.81	48.5																	
9/15	8		22.27	8.62	100.5	6.81	48.4																	
9/15	9		22.27	8.62	100.5	6.84	48.5																	
9/15	10		22.26	8.62	100.5	6.84	48.3																	
9/15	11		22.27	8.62	100.5	6.86	48.4																	
9/15	12		22.26	8.63	100.5	6.86	48.4																	
9/15	13		22.26	8.62	100.5	6.88	48.4																	
9/15	14		22.23	8.63	100.5	6.88	48.4																	
9/15	15		17.30	10.22	107.9	6.86	47.0																	
9/15	16		14.76	11.56	115.6	6.72	46.7	202M	9/15/16	0.332	5.29	3.71												
9/15	17		13.37	11.77	114.1	6.73	46.5																	
9/15	18		12.85	11.76	112.8	6.70	46.5	202D	9/15/16				1	0	4880									
9/15	19		12.12	11.72	110.6	6.67	46.3																	
9/15	20		11.73	11.68	109.1	6.64	46.3																	
9/15	21		11.37	11.54	107.0	6.58	46.3																	
9/15	22		11.21	11.48	106.1	6.56	46.3																	
9/15	23		10.87	11.37	104.2	6.52	46.2																	
9/15	24		10.77	11.26	102.9	6.49	46.3																	
9/15	25		10.51	11.19	101.7	6.46	46.4																	
9/15	26		10.35	11.17	101.1	6.45	46.4																	
9/15	27		10.05	11.16	100.3	6.43	46.4																	
9/15	28		9.85	10.98	98.2	6.40	46.5																	
9/15	29		9.55	10.74	95.4	6.34	46.5																	
9/15	30		9.29	10.46	92.3	6.29	46.6																	
9/15	31		9.09	10.16	89.3	6.25	46.6																	
9/15	32		8.91	9.76	85.3	6.18	46.6																	
9/15	33		8.66	9.47	82.4	6.15	46.7																	
9/15	34		8.54	9.21	79.9	6.11	46.7																	
9/15	35		8.37	8.88	76.7	6.07	46.9																	
9/15	36		8.34	8.57	73.9	6.04	46.9																	
9/15	37		8.28	8.39	72.3	6.02	46.8	202D	9/15/16	0.242	5.39	3.69												
9/15	38		8.20	8.28	71.2	6.00	47.2																	
10/12	0.5	8.9	17.31	9.54	99.9	6.93	48.2	202S	10/12/16	0.338	5.62	3.95	0	0	98									520.08
10/12	1		17.32	9.55	100.0	6.88	48.2																	
10/12	2		17.32	9.57	100.2	6.80	48.2																	
10/12	3		17.32	9.60	100.6	6.79	48.2																	
10/12	4		17.32	9.69	101.5	6.78	48.3																	
10/12	5		17.32	9.68	101.4	6.77	48.2																	
10/12	6		17.31	9.67	101.3	6.77	48.3	202M	10/12/16				0	0	97									
10/12	7		17.31	9.67	101.3	6.78	48.3																	
10/12	8		17.31	9.68	101.4	6.78	48.2																	
10/12	9		17.31	9.69	101.4	6.80	48.2																	
10/12	10		17.32	9.68	101.4	6.80	48.3																	
10/12	11		17.31	9.67	101.3	6.81	48.3																	
10/12	12		17.31	9.67	101.3	6.82	48.3																	
10/12	13		17.31	9.63	100.9	6.82	48.2																	
10/12	14		17.31	9.60	100.5	6.82	48.2																	
10/12	15		17.14	9.57	99.9	6.82	48.2																	
10/12	16		17.02	9.50	98.8	6.80	48.2																	
10/12	17		14.63	9.91	98.0	6.57	47.5																	
10/12	18		13.27	10.12	97.2	6.49	47.0	202M/D	10/12/16	0.371	5.61	3.87	0	0	134									

QUABBIN LABORATORY RECORDS 2016
(202) WINSOR DAM --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
10/12	19		12.45	10.22	96.3	6.38	46.9																	
10/12	20		11.90	10.18	94.8	6.33	46.9																	
10/12	21		11.71	10.14	94.0	6.28	46.8																	
10/12	22		11.58	10.08	93.2	6.26	46.9																	
10/12	23		11.56	10.05	92.9	6.25	46.9																	
10/12	24		11.56	10.02	92.5	6.24	46.9																	
10/12	25		11.32	10.03	92.2	6.23	46.9																	
10/12	26		11.22	10.03	91.9	6.23	46.8																	
10/12	27		11.08	10.06	91.9	6.24	46.8																	
10/12	28		10.89	10.13	92.1	6.24	46.7																	
10/12	29		10.68	10.26	92.8	6.25	46.8																	
10/12	30		10.37	10.23	91.9	6.24	46.8																	
10/12	31		10.17	10.16	90.9	6.24	46.8																	
10/12	32		9.84	10.08	89.5	6.22	46.9																	
10/12	33		9.38	9.97	87.5	6.20	46.9																	
10/12	34		9.04	9.24	80.4	6.12	47.0																	
10/12	36		8.44	8.16	70.0	6.02	47.4																	
10/12	37		8.42	7.79	66.8	5.99	47.6																	
10/12	38		8.39	7.52	64.4	5.98	47.5	202D	10/12/16	0.398	5.57	3.84												
10/12	39		8.35	7.17	61.4	5.96	47.7																	
10/20	0.5	8.0	16.54	9.45	97.7	7.14	48.6	202S	10/20/16	0.235	5.87	4.27					0	0	0.560	0	1590	0.016540		519.72
10/20	1		16.55	9.46	97.9	6.91	48.5																	
10/20	2		16.55	9.47	98.0	6.76	48.5																	
10/20	3		16.55	9.50	98.3	6.71	48.5																	
10/20	4		16.54	9.49	98.2	6.66	48.5																	
10/20	5		16.53	9.50	98.3	6.64	48.5																	
10/20	6		16.53	9.51	98.4	6.60	48.5																	
10/20	7		16.52	9.51	98.3	6.58	48.5																	
10/20	8		16.52	9.50	98.2	6.58	48.5																	
10/20	9		16.52	9.48	98.1	6.58	48.5																	
10/20	10		16.52	9.48	98.0	6.56	48.5																	
10/20	11		16.52	9.47	98.0	6.56	48.6																	
10/20	12		16.24	9.51	97.8	6.55	48.5																	
10/20	13		16.12	9.41	96.5	6.52	48.5																	
10/20	14		16.07	9.34	95.6	6.49	48.5																	
10/20	15		16.02	9.31	95.3	6.47	48.5																	
10/20	16		15.96	9.30	95.0	6.45	48.5																	
10/20	17		15.64	9.30	94.4	6.41	48.4																	
10/20	18		15.46	9.12	92.2	6.35	48.3																	
10/20	19		15.01	9.00	90.1	6.27	48.2	202M	10/20/16	0.245	5.48	3.88					0	0	0.154	0	1850	0.016595	2230	
10/20	20		14.12	8.88	87.3	6.16	47.9																	
10/20	21		13.43	8.97	86.8	6.07	47.6																	
10/20	22		12.85	9.06	86.6	6.05	47.6																	
10/20	23		12.15	9.15	86.0	6.05	47.4																	
10/20	24		11.81	9.23	86.0	6.04	47.3																	
10/20	25		11.43	9.33	86.3	6.05	47.2																	
10/20	26		10.94	9.46	86.5	6.06	47.1																	
10/20	27		10.73	9.53	86.7	6.06	47.2																	
10/20	28		10.45	9.59	86.7	6.06	47.2																	
10/20	29		10.06	9.52	85.3	6.05	47.2																	
10/20	30		9.84	9.34	83.2	6.03	47.1																	
10/20	31		9.64	9.20	81.6	6.02	47.3																	
10/20	32		9.24	9.10	79.9	6.00	47.3																	
10/20	33		8.87	8.93	77.7	5.98	47.5																	
10/20	34		8.72	7.98	69.2	5.92	47.7																	
10/20	35		8.63	7.76	67.2	5.90	47.7																	
10/20	36		8.57	7.54	65.2	5.89	47.8																	
10/20	37		8.51	7.35	63.5	5.88	47.8	202D	10/20/16	0.206	5.27	3.63					0	0	0.193	0	2220	0.019345		
11/2	0.5	9.3	13.49	10.26	99.6	6.61	48.0	202S	11/2/16	0.305	5.47	3.85	0	0	10									519.38
11/2	1		13.48	10.27	99.6	6.52	47.9																	

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DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
11/2	2		13.48	10.27	99.6	6.42	48.1																	
11/2	3		13.49	10.27	99.7	6.38	48.0																	
11/2	4		13.48	10.28	99.7	6.35	48.0																	
11/2	5		13.48	10.28	99.7	6.34	48.0																	
11/2	6		13.48	10.27	99.6	6.30	48.1	202M	11/2/16				*0*	*0*	*0*									
11/2	7		13.48	10.27	99.6	6.29	48.0																	
11/2	8		13.48	10.28	99.7	6.31	48.1																	
11/2	9		13.48	10.27	99.6	6.29	48.1																	
11/2	10		13.48	10.27	99.6	6.27	48.0																	
11/2	11		13.48	10.28	99.7	6.31	48.1																	
11/2	12		13.48	10.27	99.6	6.30	47.9																	
11/2	13		13.48	10.26	99.5	6.32	48.1																	
11/2	14		13.48	10.26	99.5	6.33	48.1																	
11/2	15		13.48	10.27	99.6	6.32	48.1																	
11/2	16		13.48	10.27	99.6	6.33	48.0																	
11/2	17		13.48	10.27	99.6	6.34	48.1																	
11/2	18		13.47	10.27	99.5	6.34	48.0	202M	11/2/16	0.286	5.29	3.64	*0*	*0*	10									
11/2	19		13.46	10.25	99.4	6.36	48.1																	
11/2	20		13.45	10.24	99.2	6.35	48.1																	
11/2	21		13.44	10.22	99.0	6.36	48.0																	
11/2	22		13.33	10.21	98.7	6.35	48.0																	
11/2	23		13.09	10.13	97.4	6.32	47.9																	
11/2	24		11.72	9.80	91.3	6.12	47.2																	
11/2	25		11.19	9.57	88.1	6.02	47.2																	
11/2	26		10.72	9.14	83.3	5.92	47.1																	
11/2	27		10.68	9.06	82.5	5.90	47.2																	
11/2	28		10.50	8.92	80.9	5.88	47.2																	
11/2	29		10.46	8.83	80.0	5.87	47.2																	
11/2	30		10.41	8.69	78.6	5.86	47.2																	
11/2	31		10.29	8.64	77.9	5.86	47.2																	
11/2	32		10.05	8.68	77.8	5.87	47.2																	
11/2	33		9.66	8.73	77.6	5.87	47.3																	
11/2	34		9.37	8.52	75.2	5.85	47.4																	
11/2	35		9.17	8.31	72.9	5.84	47.4																	
11/2	36		8.98	8.05	70.3	5.82	47.5																	
11/2	37		8.83	7.75	67.5	5.81	47.7																	
11/2	38		8.81	7.43	64.7	5.80	47.7	202D	11/2/16	0.277	5.22	3.55												
11/2	39		8.73	7.23	62.8	5.80	47.9																	
12/6	0.5	9.7	8.87	11.09	97.4	6.91	47.8	202S	12/6/16	0.337	5.94	4.20	*0*	10	41		*0*	0.00615	0.157	0.00629	1630	0.017325		518.82
12/6	1		8.88	11.07	97.3	6.72	47.8																	
12/6	2		8.90	11.08	97.5	6.60	47.8																	
12/6	3		8.90	11.08	97.4	6.53	47.9																	
12/6	4		8.89	11.08	97.4	6.48	47.8																	
12/6	5		8.90	11.07	97.4	6.44	47.8																	
12/6	6		8.91	11.07	97.4	6.44	47.8	202M	12/6/16				*0*	*0*	*0*									
12/6	7		8.91	11.07	97.3	6.44	47.8																	
12/6	8		8.89	11.06	97.3	6.42	47.8																	
12/6	9		8.90	11.07	97.3	6.41	47.8																	
12/6	10		8.90	11.07	97.4	6.40	47.9																	
12/6	11		8.91	11.07	97.4	6.39	47.7																	
12/6	12		8.90	11.07	97.4	6.39	47.8																	
12/6	13		8.91	11.08	97.4	6.40	47.8																	
12/6	14		8.91	11.07	97.4	6.39	47.8																	
12/6	15		8.91	11.07	97.4	6.39	47.8																	
12/6	16		8.91	11.07	97.3	6.41	47.8																	
12/6	17		8.91	11.07	97.3	6.41	47.8																	
12/6	18		8.91	11.06	97.3	6.41	47.8	202D	12/6/16				1	*0*	20									
12/6	19		8.92	11.05	97.3	6.42	47.8	202M	12/6/16	0.314	5.49	3.72					*0*	0.00617	0.141	0.00526	1670	0.016820	2030	
12/6	20		8.91	11.05	97.2	6.42	47.8																	
12/6	21		8.91	11.06	97.3	6.43	47.8																	

QUABBIN LABORATORY RECORDS 2016
(202) WINSOR DAM --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
12/6	22		8.91	11.05	97.2	6.44	47.8																	
12/6	23		8.91	11.05	97.2	6.44	47.8																	
12/6	24		8.91	11.05	97.2	6.44	47.8																	
12/6	25		8.91	11.05	97.2	6.45	47.8																	
12/6	26		8.91	11.05	97.2	6.45	47.8																	
12/6	27		8.91	11.06	97.3	6.46	47.8																	
12/6	28		8.90	11.06	97.3	6.46	47.8																	
12/6	29		8.90	11.06	97.3	6.47	47.8																	
12/6	30		8.91	11.06	97.2	6.47	47.8																	
12/6	31		8.91	11.06	97.3	6.48	47.9																	
12/6	32		8.90	11.06	97.3	6.49	47.8																	
12/6	33		8.90	11.07	97.3	6.50	47.8																	
12/6	34		8.91	11.06	97.3	6.50	47.8																	
12/6	35		8.91	11.05	97.2	6.50	47.8																	
12/6	36		8.90	11.05	97.2	6.51	47.8																	
12/6	37		8.90	11.05	97.2	6.51	47.8																	
12/6	38		8.90	11.05	97.2	6.52	47.8	202D	12/6/16	0.353	5.66	3.91					*0*	0.00562	0.132	0.00515	1700	0.016870		
12/6	39		8.90	11.05	97.2	6.52	47.8																	
	AVG.	10.5	11.94	10.64	99.1	6.52	47.4			0.291	5.47	3.82	<1	0	584	N/A	<0.005	0.00205	0.155	<0.005	1870	0.018038	2090	
	MAX.	14.3	24.85	13.50	123.7	7.14	48.6			0.398	5.94	4.27	1	10	4880	N/A	0.0108	0.00670	0.560	0.00737	2220	0.019550	2230	
	MIN.	8.0	4.89	7.17	61.4	5.80	45.8			0.206	4.94	3.42	<1	<10	<10	N/A	<0.005	<0.005	<0.100	<0.005	1590	0.016540	2010	
	MEDIAN	10.1	10.23	10.48	100.4	6.58	47.6			0.291	5.45	3.83	<1	<10	20	N/A	<0.005	0.00000	0.137	0.00258	1810	0.017968	2050	

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.

QUABBIN LABORATORY RECORDS 2016
(206) SHAFT 12 --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
4/14	0.5	7.8	5.56	13.18	105.6	6.86	47.5	206S	4/14/16	0.335	5.37	3.73	0	0										525.97
4/14	3		5.49	13.22	105.7	6.69	47.3																	
4/14	6		5.49	13.23	105.8	6.60	47.4	206M	4/14/16				0	0	0									
4/14	9		5.46	13.26	105.9	6.58	47.4																	
4/14	12		5.45	13.24	105.8	6.58	47.3																	
4/14	13		5.44	13.24	105.7	6.62	47.4																	
4/14	15		5.43	13.23	105.6	6.60	47.4																	
4/14	18		5.43	13.21	105.5	6.60	47.4	206M	4/14/16	0.328	5.07	3.59												
4/14	21		5.35	13.18	105.0	6.60	47.4																	
4/14	24		5.35	13.15	104.8	6.61	47.5	206D	4/14/16				0	0	0									
4/14	26		5.34	13.13	104.6	6.61	47.4	206D	4/14/16	0.317	5.14	3.62												
4/14	27		5.34	13.12	104.5	6.62	47.5																	
5/11	0.5	13.6	10.80	11.81	108.5	6.93	48.1	206S	5/11/16	0.407	5.65	3.86	0	0	0		0	0	0.189	0	1760	0.019795		526.33
5/11	1		10.23	11.92	108.0	6.92	48.1																	
5/11	2		9.86	11.99	107.8	6.89	48.2																	
5/11	3		9.69	12.00	107.4	6.86	48.1																	
5/11	4		9.59	12.02	107.3	6.84	48.1																	
5/11	5		9.53	12.01	107.1	6.81	48.1																	
5/11	6		9.50	12.01	107.0	6.81	48.1	206M	5/11/16				0	0	0									
5/11	7		9.46	12.02	107.0	6.80	48.1																	
5/11	8		9.44	12.04	107.1	6.79	48.1																	
5/11	9		9.40	12.04	107.0	6.79	48.0																	
5/11	10		9.35	12.04	106.9	6.79	48.1																	
5/11	11		9.35	12.05	107.0	6.79	48.1																	
5/11	12		9.33	12.04	106.8	6.79	48.1																	
5/11	13		9.31	12.04	106.8	6.79	48.1	206M	5/11/16	0.459	5.58	4.10					0	0	0.158	0	1750	0.026235	1930	
5/11	14		9.30	12.05	106.8	6.78	48.0																	
5/11	15		9.25	12.05	106.7	6.78	48.0																	
5/11	16		9.23	12.05	106.6	6.79	48.1																	
5/11	17		8.95	12.11	106.5	6.78	48.0																	
5/11	18		8.81	12.13	106.3	6.77	47.9																	
5/11	19		8.57	12.19	106.2	6.76	47.9																	
5/11	20		8.36	12.24	106.1	6.75	47.9																	
5/11	21		8.15	12.29	106.0	6.74	47.8																	
5/11	22		7.89	12.35	105.8	6.72	47.9																	
5/11	23		7.77	12.37	105.7	6.70	47.9																	
5/11	24		7.63	12.39	105.5	6.69	47.8	206D	5/11/16				0	0	10									
5/11	25		7.33	12.42	105.0	6.68	47.9																	
5/11	26		7.22	12.43	104.8	6.66	47.9	206D	5/11/16	0.270	5.55	3.77					0	0	0.139	0	1770	0.019405		
5/11	27		6.94	12.29	102.9	6.61	48.0																	
6/15	0.5	9.2	18.10	9.73	105.6	6.87	47.7	206S	6/15/16	0.237	5.61	3.92	0	0	10									525.41
6/15	1		17.97	9.74	105.4	6.81	47.6																	
6/15	2		17.63	9.78	105.1	6.77	47.6																	
6/15	3		17.51	9.79	104.9	6.76	47.6																	
6/15	4		17.46	9.81	105.0	6.78	47.6																	
6/15	5		17.41	9.82	105.0	6.79	47.6																	
6/15	6		17.39	9.84	105.2	6.81	47.6	206M	6/15/16				0	0	20									
6/15	7		17.26	9.87	105.2	6.85	47.6																	
6/15	8		17.10	9.91	105.3	6.84	47.6																	
6/15	9		16.85	9.97	105.4	6.84	47.5																	
6/15	10		16.77	10.05	106.1	6.85	47.6	206M	6/15/16	0.301	5.62	3.91												
6/15	11		16.72	10.06	106.1	6.84	47.7																	
6/15	12		16.51	10.12	106.3	6.84	47.6																	
6/15	13		15.47	10.33	106.1	6.84	47.4																	
6/15	14		12.10	11.35	108.1	6.87	46.7																	
6/15	15		11.54	11.79	110.9	6.87	46.8																	
6/15	16		10.76	11.97	110.6	6.84	46.6																	
6/15	17		10.47	12.01	110.2	6.78	46.6																	
6/15	18		10.02	11.98	108.8	6.73	46.7																	
6/15	19		9.94	11.93	108.1	6.70	46.6																	

QUABBIN LABORATORY RECORDS 2016
(206) SHAFT 12 --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
6/15	20		9.76	11.92	107.6	6.68	46.6																	
6/15	21		9.63	11.92	107.3	6.66	46.6																	
6/15	22		9.46	11.94	107.0	6.63	46.6																	
6/15	23		9.38	11.85	106.0	6.61	46.6																	
6/15	24		9.34	11.83	105.7	6.59	46.5	206D	6/15/16				0	0	41									
6/15	25		9.22	11.77	104.9	6.57	46.7																	
6/15	26		9.02	11.70	103.7	6.54	46.7	206D	6/15/16	0.305	5.59	3.84												
6/15	27		8.67	11.58	101.8	6.50	46.7																	
7/20	0.5	12.2	24.21	8.52	103.0	6.98	49.1	206S	7/20/16	0.264	5.48	3.86	0	0	281		0	0	0.132	0	1770	0.018480		523.82
7/20	1		24.10	8.53	102.9	6.89	49.1																	
7/20	2		24.06	8.56	103.3	6.87	49.1																	
7/20	3		24.04	8.57	103.3	6.82	49.0																	
7/20	4		24.01	8.58	103.4	6.80	49.0																	
7/20	5		24.00	8.59	103.5	6.80	49.0																	
7/20	6		23.97	8.60	103.5	6.79	49.0	206M	7/20/16				0	0	199									
7/20	7		23.84	8.65	103.9	6.80	48.9																	
7/20	8		22.24	9.21	107.3	6.80	48.5																	
7/20	9		21.33	9.45	108.1	6.79	48.3																	
7/20	10		21.07	9.70	110.4	6.79	48.3																	
7/20	11		18.48	10.58	114.4	6.77	47.9																	
7/20	12		15.39	11.08	112.4	6.79	47.5	206M	7/20/16	0.288	5.31	3.72					0	0	0.305	0	1500	0.019670	2080	
7/20	13		14.07	11.68	115.1	6.79	47.3																	
7/20	14		13.57	11.78	114.8	6.77	47.2																	
7/20	15		12.76	11.89	113.8	6.73	47.0																	
7/20	16		12.19	11.97	113.1	6.71	47.1																	
7/20	17		11.58	11.95	111.3	6.68	46.9																	
7/20	18		11.35	11.90	110.3	6.65	46.9																	
7/20	19		11.27	11.87	109.8	6.64	46.9																	
7/20	20		11.07	11.80	108.6	6.61	46.9																	
7/20	21		10.76	11.77	107.6	6.59	46.9																	
7/20	22		10.51	11.73	106.6	6.55	47.0																	
7/20	23		10.28	11.27	101.9	6.42	47.0																	
7/20	24		10.00	10.91	98.0	6.32	47.1	206D	7/20/16				0	0	31									
7/20	25		9.89	10.67	95.5	6.27	47.0	206D	7/20/16	0.345	5.49	3.83					0	0	0.279	0.00632	1760	0.022035		
7/20	26		9.78	10.63	94.9	6.26	47.0																	
8/24	0.5	9.0	25.19	8.42	103.0	6.91	48.3	206S	8/24/16	0.280	5.55	4.03	0	0	63									522.33
8/24	1		25.19	8.43	103.0	6.75	48.4																	
8/24	2		25.17	8.43	103.1	6.69	48.4																	
8/24	3		25.15	8.44	103.1	6.65	48.4																	
8/24	4		25.12	8.44	103.1	6.65	48.4																	
8/24	5		25.10	8.44	103.0	6.63	48.3																	
8/24	6		25.09	8.43	102.9	6.63	48.2	206M	8/24/16				0	0	31									
8/24	7		25.06	8.43	102.8	6.60	48.4																	
8/24	8		25.04	8.43	102.8	6.60	48.4																	
8/24	9		25.00	8.43	102.7	6.59	48.4																	
8/24	10		24.97	8.43	102.7	6.60	48.3																	
8/24	11		21.31	9.64	109.6	6.59	47.4																	
8/24	12		18.05	10.92	116.2	6.58	46.9																	
8/24	13		16.20	11.67	119.5	6.57	46.7	206M	8/24/16	0.297	5.23	3.85												
8/24	14		14.84	11.82	117.6	6.53	46.4																	
8/24	15		13.70	11.89	115.4	6.49	46.4																	
8/24	16		13.05	11.93	114.1	6.46	46.3																	
8/24	17		12.51	11.91	112.5	6.43	46.2																	
8/24	18		12.13	11.84	110.9	6.41	46.2																	
8/24	19		11.71	11.74	109.0	6.38	46.2																	
8/24	20		11.31	11.65	107.2	6.35	46.2																	
8/24	21		11.11	11.51	105.3	6.31	46.2																	
8/24	22		10.94	11.32	103.3	6.27	46.2																	
8/24	23		10.72	11.22	101.8	6.24	46.3																	
8/24	24		10.70	10.87	98.5	6.18	46.2	206D	8/24/16				0	0	0									

QUABBIN LABORATORY RECORDS 2016
(206) SHAFT 12 --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
8/24	25		10.53	10.80	97.6	6.16	46.3	206D	8/24/16	0.312	5.31	3.86												
8/24	26		10.36	10.55	94.9	6.11	46.5																	
9/15	0.5	9.8	22.51	8.61	100.8	6.92	48.7	206S	9/15/16	0.265	5.50	3.81	0	0	213									521.22
9/15	1		22.50	8.62	101.0	6.77	48.8																	
9/15	2		22.50	8.64	101.2	6.74	48.8																	
9/15	3		22.49	8.68	101.6	6.71	48.8																	
9/15	4		22.50	8.69	101.8	6.70	48.5																	
9/15	5		22.47	8.70	101.8	6.68	48.7																	
9/15	6		22.47	8.70	101.9	6.70	48.7	206M	9/15/16				0	0	279									
9/15	7		22.47	8.70	101.9	6.70	48.7																	
9/15	8		22.47	8.71	101.9	6.69	48.8																	
9/15	9		22.46	8.71	101.9	6.69	48.6																	
9/15	10		22.45	8.70	101.8	6.69	48.8																	
9/15	11		22.45	8.70	101.8	6.71	48.8																	
9/15	12		19.78	9.32	103.5	6.57	48.1																	
9/15	13		17.84	10.14	108.3	6.48	47.5	206M	9/15/16	0.350	5.54	3.85												
9/15	14		16.38	10.47	108.5	6.46	47.2																	
9/15	15		15.65	10.90	111.1	6.42	47.1																	
9/15	16		14.65	11.05	110.2	6.42	47.0																	
9/15	17		13.73	11.18	109.4	6.42	46.8																	
9/15	18		13.30	11.18	108.3	6.40	46.8																	
9/15	19		12.67	11.15	106.4	6.39	46.7																	
9/15	20		12.04	10.92	102.8	6.32	46.7																	
9/15	21		12.00	10.74	101.0	6.29	46.8																	
9/15	22		11.68	10.67	99.7	6.27	46.7																	
9/15	23		11.20	10.31	95.2	6.20	46.8																	
9/15	24		11.09	10.06	92.7	6.17	46.8	206D	9/15/16	0.330	5.52	3.88	0	0	31									
9/15	25		10.93	9.83	90.2	6.13	46.8																	
10/12	0.5	7.4	16.87	9.53	98.9	6.68	48.4	206S	10/12/16	0.370	5.77	4.08	0	0	135									520.08
10/12	1		16.87	9.53	98.8	6.61	48.4																	
10/12	2		16.83	9.53	98.8	6.59	48.5																	
10/12	3		16.81	9.54	98.9	6.58	48.4																	
10/12	4		16.80	9.54	98.9	6.51	48.4																	
10/12	5		16.79	9.54	98.8	6.49	48.4																	
10/12	6		16.78	9.54	98.8	6.49	48.4	206M	10/12/16				0	0	228									
10/12	7		16.78	9.53	98.7	6.48	48.5																	
10/12	8		16.77	9.52	98.6	6.50	48.4																	
10/12	9		16.77	9.51	98.5	6.48	48.4																	
10/12	10		16.76	9.50	98.4	6.49	48.4																	
10/12	11		16.76	9.50	98.3	6.49	48.4																	
10/12	12		16.76	9.48	98.2	6.48	48.4																	
10/12	13		16.74	9.48	98.1	6.48	48.4	206M	10/12/16	0.344	5.67	3.99												
10/12	14		16.66	9.47	97.8	6.46	48.4																	
10/12	15		16.65	9.45	97.6	6.46	48.2																	
10/12	16		16.57	9.44	97.3	6.44	48.5																	
10/12	17		16.48	9.38	96.5	6.40	48.4																	
10/12	18		16.12	9.38	95.8	6.36	48.3																	
10/12	19		15.19	9.35	93.6	6.25	47.8																	
10/12	20		14.31	9.36	92.0	6.13	47.6																	
10/12	21		13.48	9.37	90.3	6.07	47.4																	
10/12	22		12.61	9.21	87.2	6.00	47.4																	
10/12	23		11.91	8.97	83.6	5.94	47.4																	
10/12	24		11.72	8.78	81.4	5.93	47.2	206D	10/12/16	0.376	5.49	3.82	1	0	246									
10/12	25		11.37	8.50	78.2	5.89	47.8																	
10/20	0.5	8.0	16.43	9.61	99.2	6.77	48.7	206S	10/20/16	0.259	5.54	3.91					0	0	0.173	0	1560	0.016815		519.72
10/20	1		16.42	9.57	98.8	6.70	48.7																	
10/20	2		16.41	9.57	98.8	6.61	48.7																	
10/20	3		16.41	9.58	98.9	6.58	48.7																	
10/20	4		16.40	9.59	98.9	6.57	48.7																	
10/20	5		16.40	9.58	98.8	6.59	48.7																	

QUABBIN LABORATORY RECORDS 2016
(206) SHAFT 12 --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
10/20	6		16.39	9.56	98.6	6.58	48.6																	
10/20	7		16.39	9.56	98.6	6.55	48.7																	
10/20	8		16.39	9.55	98.5	6.57	48.7																	
10/20	9		16.38	9.55	98.5	6.55	48.8																	
10/20	10		16.37	9.55	98.4	6.54	48.7																	
10/20	11		16.36	9.55	98.4	6.53	48.7																	
10/20	12		16.34	9.53	98.1	6.53	48.7	206M	10/20/16	0.258	5.86	4.17					0	0	0.168	0	1670	0.016865	2190	
10/20	13		16.29	9.52	98.0	6.52	48.7																	
10/20	14		16.24	9.50	97.7	6.51	48.7																	
10/20	15		16.19	9.45	97.0	6.50	48.7																	
10/20	16		16.17	9.43	96.9	6.49	48.7																	
10/20	17		16.13	9.42	96.6	6.48	48.7																	
10/20	18		16.04	9.41	96.4	6.46	48.7																	
10/20	19		15.67	9.27	94.2	6.41	48.7																	
10/20	20		14.97	9.18	91.8	6.35	48.5																	
10/20	21		13.81	8.98	87.6	6.22	48.2																	
10/20	22		13.18	8.82	84.9	6.13	48.1																	
10/20	23		12.67	8.18	77.8	5.96	48.0																	
10/20	24		12.43	8.12	76.8	5.95	48.1	206D	10/20/16	0.308	5.33	3.68					0	0	0.180	0.00548	1860	0.018285		
10/20	25		12.28	7.96	75.0	5.92	48.4																	
11/2	0.5	9.3	13.06	10.45	100.4	6.72	48.3	206S	11/2/16	0.341	5.53	3.93	0	0	52									519.38
11/2	1		13.05	10.45	100.4	6.61	48.3																	
11/2	2		13.05	10.45	100.3	6.52	48.2																	
11/2	3		13.04	10.45	100.3	6.46	48.2																	
11/2	4		13.04	10.45	100.3	6.48	48.3																	
11/2	5		13.04	10.45	100.3	6.44	48.3																	
11/2	6		13.04	10.44	100.3	6.41	48.3	206M	11/2/16				0	0	31									
11/2	7		13.03	10.44	100.3	6.40	48.4																	
11/2	8		13.03	10.44	100.2	6.38	48.3																	
11/2	9		13.03	10.44	100.2	6.39	48.3																	
11/2	10		13.03	10.43	100.2	6.38	48.4																	
11/2	11		13.03	10.44	100.2	6.37	48.3																	
11/2	12		13.02	10.44	100.2	6.40	48.3	206M	11/2/16	0.328	5.48	3.79												
11/2	13		13.01	10.44	100.2	6.38	48.3																	
11/2	14		13.01	10.44	100.2	6.39	48.3																	
11/2	15		13.00	10.44	100.2	6.39	48.4																	
11/2	16		13.00	10.44	100.2	6.38	48.3																	
11/2	17		13.00	10.44	100.2	6.39	48.4																	
11/2	18		13.00	10.43	100.1	6.40	48.3																	
11/2	19		13.00	10.43	100.1	6.40	48.4																	
11/2	20		13.00	10.43	100.1	6.40	48.3																	
11/2	21		13.00	10.43	100.1	6.41	48.4																	
11/2	22		12.99	10.44	100.1	6.42	48.3																	
11/2	23		12.99	10.44	100.1	6.43	48.3																	
11/2	24		12.99	10.43	100.1	6.43	48.2	206D	11/2/16	0.316	5.41	3.76	0	0	98									
11/2	25		12.99	10.43	100.0	6.43	48.3																	
12/6	0.5	10.3	7.60	11.72	99.9	7.14	48.0	206S	12/6/16	0.471	5.73	4.01	0	0	10		0	0	0.147	0	1510	0.017010		518.82
12/6	1		7.58	11.72	99.8	6.90	47.9																	
12/6	2		7.58	11.73	99.9	6.79	47.9																	
12/6	3		7.57	11.73	99.8	6.71	47.9																	
12/6	4		7.56	11.73	99.9	6.66	47.9																	
12/6	5		7.56	11.73	99.8	6.61	47.9																	
12/6	6		7.55	11.74	99.9	6.60	48.0	206M	12/6/16				0	0	31									
12/6	7		7.55	11.73	99.8	6.57	47.9																	
12/6	8		7.54	11.73	99.8	6.51	47.9																	
12/6	9		7.54	11.73	99.8	6.52	48.0																	
12/6	10		7.54	11.73	99.8	6.50	48.0																	
12/6	11		7.54	11.72	99.7	6.48	47.9																	
12/6	12		7.53	11.72	99.7	6.46	47.8	206M	12/6/16	0.329	5.67	3.88					0	0	0.102	0	1530	0.017025	1960	
12/6	13		7.53	11.73	99.7	6.46	48.0																	

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DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
12/6	14		7.53	11.73	99.8	6.46	47.9																	
12/6	15		7.53	11.73	99.7	6.45	48.0																	
12/6	16		7.53	11.72	99.7	6.45	47.9																	
12/6	17		7.53	11.72	99.7	6.44	47.9																	
12/6	18		7.53	11.72	99.7	6.47	47.9																	
12/6	19		7.53	11.72	99.7	6.45	48.0																	
12/6	20		7.53	11.72	99.7	6.45	48.0																	
12/6	21		7.53	11.72	99.7	6.45	48.0																	
12/6	22		7.52	11.72	99.7	6.47	47.8																	
12/6	23		7.52	11.72	99.6	6.46	47.8																	
12/6	24		7.51	11.72	99.6	6.47	48.0	206D	12/6/16	0.316	5.64	3.86	*0*	*0*	20		*0*	*0*	0.126	*0*	1460	0.016990		
12/6	25		7.51	11.71	99.6	6.46	47.9																	
	AVG.	9.7	13.65	10.60	102.2	6.57	47.8			0.324	5.51	3.86	<1	<10	79	N/A	<0.005	<0.005	0.175	<0.005	1660	0.019051	2040	
	MAX.	13.6	25.19	13.26	119.5	7.14	49.1			0.471	5.86	4.17	1	<10	281	N/A	<0.005	<0.005	0.305	0.00632	1860	0.026235	2190	
	MIN.	7.4	5.34	7.96	75.0	5.89	46.2			0.237	5.07	3.59	<1	<10	<10	N/A	<0.005	<0.005	0.102	<0.005	1460	0.016815	1930	
	MEDIAN	9.3	13.00	10.45	101.9	6.58	48.0			0.317	5.54	3.86	<1	<10	31	N/A	<0.005	<0.005	0.163	<0.005	1710	0.018383	2020	

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.

QUABBIN LABORATORY RECORDS 2016
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DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
4/14	0.5	4.9	7.61	12.50	105.4	6.77	55.6	DENS	4/14/16	0.402	5.54	3.94	0	0	20									525.97
4/14	3		7.33	12.61	105.6	6.68	55.5																	
4/14	6		6.77	12.67	104.6	6.60	55.4	DENM	4/14/16				0	0	20									
4/14	9		6.62	12.62	103.8	6.54	55.7	DENM	4/14/16	0.432	5.49	3.87												
4/14	12		6.53	12.55	103.0	6.52	55.3																	
4/14	13		6.52	12.50	102.6	6.53	55.4	DEND	4/14/16				0	0	41									
4/14	15		6.52	12.47	102.3	6.54	55.4																	
4/14	18		6.49	12.46	102.1	6.52	55.5	DEND	4/14/16	0.444	5.42	3.79												
4/14	19		6.47	12.29	100.7	6.52	55.4																	
5/11	0.5	6.5	12.51	11.06	105.7	6.81	55.1	DENS	5/11/16	0.383	5.75	3.99	0	0	31		0	0	0.209	0.00649	2570	0.054295		526.33
5/11	1		12.49	11.11	106.1	6.83	55.3																	
5/11	2		12.19	11.20	106.2	6.82	54.6																	
5/11	3		11.71	11.34	106.4	6.81	54.3																	
5/11	4		11.29	11.45	106.4	6.78	54.3																	
5/11	5		11.12	11.47	106.2	6.77	54.4																	
5/11	6		11.05	11.46	105.9	6.74	54.1	DENM	6/15/16				0	0	10									
5/11	7		11.00	11.47	105.8	6.73	54.2																	
5/11	8		10.92	11.47	105.7	6.73	54.0																	
5/11	9		10.32	11.57	105.1	6.69	53.5	DENM	6/15/16	0.374	5.61	3.85					0	0	0.184	0.00537	2300	0.048910	2160	
5/11	10		9.78	11.50	103.2	6.63	52.8																	
5/11	11		9.28	11.51	102.0	6.57	52.8																	
5/11	12		9.04	11.39	100.3	6.51	52.8																	
5/11	13		8.67	11.26	98.3	6.46	53.1	DEND	5/11/16				0	0	10									
5/11	14		8.56	11.21	97.7	6.43	53.2																	
5/11	15		8.45	11.15	96.8	6.41	53.7																	
5/11	16		8.37	11.05	95.8	6.40	54.0																	
5/11	17		8.22	11.07	95.6	6.40	54.3	DEND	5/11/16	0.365	5.65	3.91					0.0101	0.0111	0.162	0.00697	2480	0.048180		
5/11	18		7.97	11.05	94.9	6.35	54.6																	
6/15	0.5	7.8	20.41	9.30	105.7	7.09	51.5	DENS	6/15/16	0.335	5.76	4.15	0	0	31									525.41
6/15	1		20.18	9.33	105.5	6.93	51.4																	
6/15	2		19.66	9.41	105.4	6.87	51.5																	
6/15	3		19.42	9.45	105.3	6.88	51.3																	
6/15	4		19.22	9.49	105.3	6.87	51.3																	
6/15	5		19.18	9.51	105.4	6.86	51.3																	
6/15	6		19.15	9.54	105.7	6.87	51.2	DENM	6/15/16				0	10	85									
6/15	7		19.13	9.55	105.8	6.88	51.2																	
6/15	8		19.05	9.55	105.7	6.87	51.1																	
6/15	9		14.41	10.40	104.3	6.81	51.7	DENM	6/15/16	0.424	5.69	4.02												
6/15	10		12.73	10.76	104.0	6.75	51.9																	
6/15	11		11.96	10.85	103.1	6.64	51.7																	
6/15	12		11.15	10.69	99.6	6.54	51.5																	
6/15	13		10.70	10.51	97.0	6.46	51.5	DEND	6/15/16				0	0	31									
6/15	14		10.20	10.11	92.2	6.35	51.7																	
6/15	15		9.62	9.84	88.5	6.27	51.8																	
6/15	16		9.51	9.57	85.9	6.22	51.8																	
6/15	17		9.25	9.36	83.5	6.18	51.9																	
6/15	18		9.19	9.25	82.3	6.16	52.0	DEND	6/15/16	0.339	5.60	3.86												
7/20	0.5	8.7	25.07	8.39	103.0	7.15	51.3	DENS	7/20/16	0.339	5.60	3.92	0	0	243		0	0	0.263	0.00508	1400	0.024390		523.82
7/20	1		25.02	8.40	103.1	7.03	51.3																	
7/20	2		24.97	8.41	103.1	6.92	51.1																	
7/20	3		24.84	8.41	102.9	6.92	51.4																	
7/20	4		24.79	8.38	102.5	6.90	51.4																	
7/20	5		24.77	8.39	102.5	6.88	51.4																	
7/20	6		24.73	8.40	102.5	6.86	51.3	DENM	7/20/16				0	0	185									
7/20	7		24.67	8.41	102.6	6.85	51.3																	
7/20	8		22.86	8.85	104.3	6.78	50.6																	
7/20	9		20.88	9.63	109.2	6.74	50.0																	
7/20	10		16.60	10.79	112.2	6.78	50.6																	
7/20	11		16.59	10.79	112.2	6.77	50.5	DENM	7/20/16	0.361	5.38	3.75					0	0	0.412	0.00666	1240	0.026490	2180	
7/20	12		14.30	11.20	110.9	6.75	51.3																	
7/20	13		12.63	11.07	105.6	6.62	51.6	DEND	7/20/16				0	0	882									
7/20	14		11.53	10.13	94.3	6.32	51.9																	
7/20	15		10.76	8.48	77.5	6.05	52.2																	

QUABBIN LABORATORY RECORDS 2016
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DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
7/20	16		10.23	7.78	70.2	5.95	52.2																	
7/20	17		9.86	7.52	67.3	5.92	52.3	DEND	7/20/16	0.422	5.73	4.04					0	0	0.389	0.0106	2140	0.033110		
7/20	18		9.46	7.02	62.2	5.88	52.7																	
8/24	0.5	9.0	25.93	8.31	103.1	6.84	50.3	DENS	8/24/16	0.372	5.47	4.02	0	0	767									522.33
8/24	1		25.81	8.32	102.9	6.74	50.2																	
8/24	2		25.57	8.35	102.8	6.71	50.2																	
8/24	3		25.52	8.35	102.8	6.65	50.1																	
8/24	4		25.46	8.36	102.8	6.64	50.1																	
8/24	5		25.44	8.36	102.7	6.60	50.2																	
8/24	6		25.42	8.35	102.5	6.58	49.8	DENM	8/24/16				0	0	908									
8/24	7		25.41	8.33	102.3	6.58	50.1																	
8/24	8		25.39	8.29	101.8	6.55	50.1																	
8/24	9		25.29	8.22	100.7	6.50	50.1																	
8/24	10		23.71	8.36	99.5	6.41	49.8																	
8/24	11		19.25	9.81	107.0	6.30	49.8																	
8/24	12		16.80	10.49	108.9	6.33	50.1																	
8/24	13		14.58	10.27	101.6	6.13	50.9	DENM/D	8/24/16	0.428	5.56	4.13	0	0	733									
8/24	14		12.73	10.09	95.8	6.08	51.5																	
8/24	15		11.55	8.67	80.1	5.90	51.9																	
8/24	16		10.91	7.56	68.8	5.81	52.0	DEND	8/24/16	0.443	5.80	4.29												
8/24	17		10.34	6.16	55.4	5.74	52.1																	
9/15	0.5	7.4	23.00	8.35	98.8	6.88	50.4	DENS	9/15/16	0.360	5.62	4.04	0	0	744									521.22
9/15	1		22.98	8.36	98.7	6.78	50.5																	
9/15	2		22.89	8.36	98.6	6.66	50.6																	
9/15	3		22.84	8.36	98.5	6.68	50.4																	
9/15	4		22.79	8.37	98.5	6.65	50.5																	
9/15	5		22.77	8.38	98.6	6.65	50.4																	
9/15	6		22.76	8.37	98.5	6.66	50.5	DENM	9/15/16				7	0	934									
9/15	7		22.74	8.37	98.4	6.63	50.3																	
9/15	8		22.74	8.37	98.4	6.63	50.4																	
9/15	9		22.73	8.37	98.4	6.65	50.4																	
9/15	10		22.72	8.36	98.3	6.63	50.5																	
9/15	11		22.64	8.35	98.1	6.60	50.4																	
9/15	12		19.01	8.53	93.2	6.38	50.3																	
9/15	13		15.69	8.60	87.7	6.15	51.2	DENM/D	9/15/16	0.434	5.57	3.92	1	0	1050									
9/15	14		13.51	7.27	70.8	5.94	52.3																	
9/15	15		11.85	5.21	48.8	5.82	52.9																	
9/15	16		11.26	4.46	41.2	5.79	53.2	DEND	9/15/16	0.783	5.97	4.30												
9/15	17		10.58	3.90	35.5	5.78	53.3																	
10/12	0.5	7.3	16.95	9.34	97.0	6.62	50.4	DENS	10/12/16	0.449	5.88	4.22	0	0	96									520.08
10/12	1		16.92	9.22	95.8	6.54	50.4																	
10/12	2		16.90	9.21	95.6	6.53	50.2																	
10/12	3		16.86	9.22	95.6	6.50	50.3																	
10/12	4		16.73	9.23	95.5	6.42	50.3																	
10/12	5		16.71	9.20	95.2	6.44	50.3																	
10/12	6		16.70	9.19	95.0	6.43	50.3	DENM	10/12/16				0	0	121									
10/12	7		16.68	9.17	94.8	6.41	50.3																	
10/12	8		16.67	9.16	94.7	6.39	50.3																	
10/12	9		16.66	9.14	94.5	6.38	50.3	DENM	10/12/16	0.516	5.66	4.01												
10/12	10		16.59	9.05	93.3	6.35	50.3																	
10/12	11		16.57	8.96	92.4	6.33	50.4																	
10/12	12		16.50	8.91	91.7	6.32	50.4																	
10/12	13		16.33	8.86	90.9	6.30	50.3	DEND	10/12/16				1	0	122									
10/12	14		15.97	8.60	87.5	6.23	50.3																	
10/12	15		13.25	5.08	48.8	5.76	53.5																	
10/12	16		11.86	2.49	23.1	5.67	54.6	DEND	10/12/16	1.68	6.57	4.71												
10/20	0.5	6.5	16.35	9.37	96.5	6.64	50.7	DENS	10/20/16	0.381	5.76	4.07					0	0	0.215	0.00875	1600	0.022895		519.72
10/20	1		16.34	9.36	96.4	6.61	50.8																	
10/20	2		16.34	9.35	96.3	6.59	50.7																	
10/20	3		16.32	9.35	96.3	6.52	50.8																	
10/20	4		16.30	9.35	96.3	6.50	50.8																	
10/20	5		16.19	9.36	96.1	6.51	50.6																	
10/20	6		16.16	9.35	96.0	6.49	50.7																	

QUABBIN LABORATORY RECORDS 2016
DEN HILL --- RESERVOIR

DATE	DEPTH-M	Secchi-M	TEMPC	DOPPM	DOSAT	pH (Field)	SPCOND	SITE	DATE	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI	TNTC	NH3	NO3-	TKN	TPH	SiO2	UV254	Ca++	ELEV
10/20	7		16.13	9.32	95.6	6.47	50.6	DENM	10/20/16	0.401	5.83	4.15					*0*	*0*	0.280	0.00711	1570	0.022425	2080	
10/20	8		16.07	9.19	94.1	6.44	50.5																	
10/20	9		15.89	9.13	93.2	6.37	50.6																	
10/20	10		15.86	9.03	92.1	6.36	50.7																	
10/20	11		15.76	9.03	91.9	6.33	50.8																	
10/20	12		15.66	8.86	90.0	6.30	50.8																	
10/20	13		15.62	8.61	87.3	6.26	50.9																	
10/20	14		15.44	7.89	79.7	6.15	51.0	DEND	10/20/16	0.489	5.78	4.01					0.00687	*0*	0.159	0.00555	1640	0.023395		
11/2	0.5	7.4	12.44	10.34	98.0	6.84	50.3	DENS	11/2/16	0.505	5.95	4.28	*0*	*0*	20									519.38
11/2	1		12.43	10.34	97.9	6.70	50.4																	
11/2	2		12.42	10.35	98.0	6.60	50.3																	
11/2	3		12.35	10.40	98.4	6.53	50.3																	
11/2	4		12.31	10.42	98.5	6.47	50.3																	
11/2	5		12.29	10.44	98.6	6.41	50.4																	
11/2	6		12.29	10.43	98.5	6.42	50.4	DENM	11/2/16				*0*	*0*	10									
11/2	7		12.28	10.43	98.5	6.36	50.4																	
11/2	8		12.27	10.45	98.7	6.35	50.4	DENM	11/2/16	0.540	5.82	4.03												
11/2	9		12.27	10.43	98.5	6.35	50.4																	
11/2	10		12.27	10.42	98.3	6.35	50.3																	
11/2	11		12.26	10.41	98.2	6.34	50.4																	
11/2	12		12.24	10.40	98.1	6.34	50.4																	
11/2	13		12.22	10.40	98.0	6.35	50.3	DEND	11/2/16				1	*0*	41									
11/2	14		12.17	10.41	98.0	6.34	50.4																	
11/2	15		12.09	10.42	97.9	6.34	50.5																	
11/2	16		11.96	10.42	97.7	6.34	50.5	DEND	11/2/16	0.529	5.89	4.16												
12/6	0.5	7.5	6.60	11.90	98.9	6.68	50.5	DENS	12/6/16	0.511	5.87	4.11	*0*	*0*	30		0.0119	0.0120	0.163	0.00549	1640	0.026485		518.82
12/6	1		6.59	11.90	98.9	6.60	50.5																	
12/6	2		6.59	11.91	98.9	6.49	50.4																	
12/6	3		6.53	11.93	99.0	6.44	50.5																	
12/6	4		6.56	11.93	99.0	6.44	50.1																	
12/6	5		6.48	11.93	98.9	6.49	50.4																	
12/6	6		6.47	11.93	98.8	6.44	50.5	DENM	12/6/16				*0*	*0*	20									
12/6	7		6.42	11.92	98.7	6.39	50.5																	
12/6	8		6.42	11.91	98.6	6.41	50.5	DENM	12/6/16	0.489	6.03	4.30					0.0137	0.0114	0.182	0.00581	1620	0.026585	2180	
12/6	9		6.42	11.89	98.4	6.37	50.5																	
12/6	10		6.42	11.89	98.4	6.39	50.5																	
12/6	11		6.41	11.89	98.4	6.37	50.5																	
12/6	12		6.39	11.89	98.3	6.36	50.5																	
12/6	13		6.34	11.89	98.2	6.38	50.4	DEND	12/6/16				*0*	*0*	20									
12/6	14		6.28	11.90	98.1	6.34	50.6																	
12/6	15		6.20	11.93	98.1	6.35	50.8																	
12/6	16		6.10	11.98	98.3	6.37	51.1	DEND	12/6/16	0.473	6.00	4.23					0.0123	0.0114	0.196	0.00592	1590	0.026625		
12/6	17		6.08	11.99	98.4	6.35	51.3																	
	AVG.	7.3	14.57	9.76	96.1	6.50	51.5			0.480	5.74	4.07	<1	0	267	N/A	<0.005	<0.005	0.235	0.00665	1820	0.031982	2150	
	MAX.	9.0	25.93	12.67	112.2	7.15	55.7			1.68	6.57	4.71	7	10	1050	N/A	0.0137	0.0120	0.412	0.0106	2570	0.054295	2180	
	MIN.	4.9	6.08	2.49	23.1	5.67	49.8			0.335	5.38	3.75	<1	<10	10	N/A	<0.005	<0.005	0.159	0	1240	0.022425	2080	
	MEDIAN	7.4	12.73	9.51	98.5	6.50	50.7			0.430	5.74	4.04	<1	<10	41	N/A	<0.005	<0.005	0.203	0.00621	1630	0.0265375	2170	

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

2016 Phytoplankton Monitoring at Quabbin Reservoir

2016 Quabbin Boat Inspection Programs

2016 Quabbin Boat Ramp Monitor Program

2016 Aquatic Macrophyte Assessments

Field Report for Sample Sites 212 and 212B, 3/31/16

Field Report for Boat Cove Brook and Site 213A and, 4/28/16

Field Report for Sample Sites 213, 213A, and 215, 5/27/16

Field Report Boat Cove Brook, 6/9/16

Field Report for Boat Cove Brook, Site 212A, and Site 213A, 9/27/16

Water Quality Results for Stockroom, June 2016

2016 Lead Results and Assessment, Quabbin Administration Building

2016 Quabbin Reservoir Phytoplankton Monitoring

Paula Packard

March 9, 2017

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 meters and near the interface between the epilimnion and metalimnion at a depth generally around eight to ten meters. 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. A relatively mild winter allowed for collection of plankton samples for the entire year. Similar trends in plankton numbers and species composition have been observed annually with only very 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

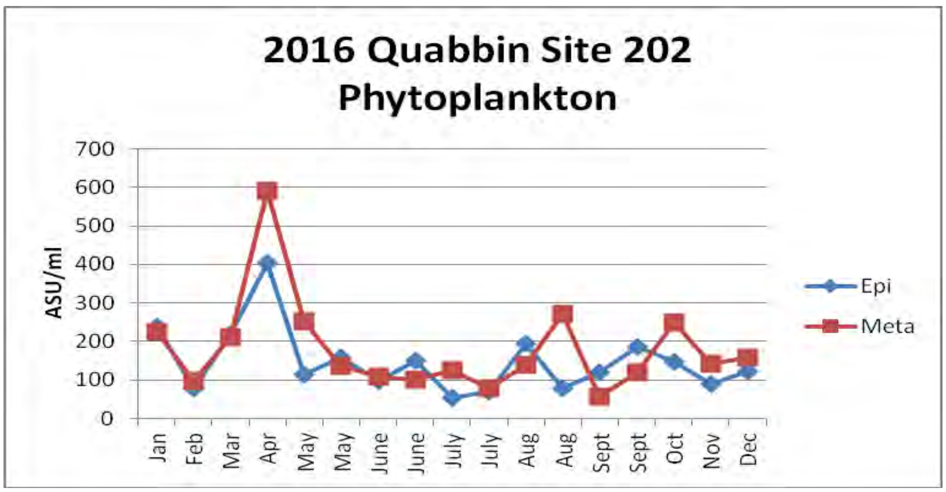
Results show that the Quabbin Reservoir supports a phytoplankton community typical of many oligotrophic systems located in the temperate zone. The most common organisms observed consisted of the diatoms *Asterionella*, *Cyclotella,* and *Rhizosolenia,* the chlorophytes (green alga) *Gloeocystis* and *Sphaerocystis*, and the cyanophytes (blue-green alga) *Microcystis* and *Aphanocapsa*. Consistent with its status as an "ultra-oligotrophic" system (Wetzel, 1983), Quabbin phytoplankton densities are still considered low, with averages for 2016 being very similar at both sites. Sampling site #202 averaged 164 ASUs/ml (up from 150 ASUs/ml) in 2016. Sampling site #206 averaged 176 ASUs/ml (down slightly from 181 ASUs/ml) in 2016. See graphs below.

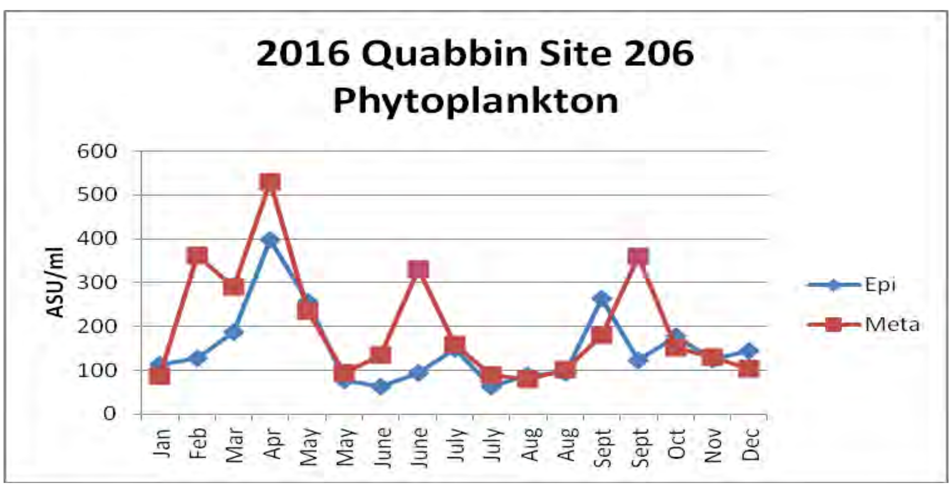
Diatoms dominated the phytoplankton community until mid-June when their numbers began to decline and samples became more diverse. The highest diatom numbers (495 ASUs/ml) of the year were observed in April at sampling site #206. Highest total phytoplankton numbers (592 ASUs/ml) were observed during this month as well. 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 trend seen for the last several years where a proliferation of *Aphanocapsa* and *Microcystis*, occurred at approximately that time of year. In 2016, as seen in previous years, this increase in cyanophytes was very brief. Cyanophyte densities, especially *Microcystis*, were observed to peak on September 29th at 248 ASU/ml in the metalimnion 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 again in 2016, exceptionally low levels of plankton were documented. The July sample collected at site #202 at 3 meters had a density of 53 ASU/ml.

Plans for plankton monitoring in 2017 call for a continuation of the program outlined above. Each Eureka unit has a chlorophyll a probe. One multiprobe has also been fitted with a phycocyanin probe. The chlorophyll a probes enable us to locate the presence of all algae whereas the phycocyanin probe exclusively indicates the presence of cyanobacteria. All algal species utilize chlorophyll a as a photosynthetic pigment molecule however only the cyanophytes produce phycocyanin. These two new tools continue to enable us to better locate a thin stratum of cyanaophytes in the water column.





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2016 Quabbin Boat Inspection Programs

February 3, 2017

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 2016, 162 boaters were inspected and decontaminated through the WWD process. This is up slightly from previous years. Five boats failed our inspection because of carpeted bunks. All five removed the carpet while at House of Wax where the Warm Weather Decontamination is held, and then passed upon reinspection. One boat was initially failed because the motor would not start. That person left briefly to have motor fixed at a nearby marina, returned right after and passed the inspection.

Four boats were failed because the horsepower of the motor exceeded half the horse power rating for the boat. One of these should not have been failed. He had a 25 HP four stroke motor which is allowed on a boat rated for 40 HP. This boater did return after we clarified the rules. Two boaters replaced their oversized motors with correctly sized ones. One boater did not return.

One hundred twenty boats were inspected and sealed through the Cold Weather Quarantine Program in anticipation of the 2017 fishing season. This number is slightly higher than in 2015. Many fishermen who went through CWQ in 2016 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 29st and November 10th in New Salem, and in Belchertown on November 5th and December 15th and 22nd. December 22nd was added as a snow date when a winter storm was forecast for the originally scheduled date of December 17th.

Interestingly, each year we see the return of numerous anglers who have resisted our program. Again in 2016, 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 89 boaters used the warm weather decontamination for the first time. Sixty-one boaters, who had never participated in CWQ, took advantage of the CWQ program this year. New participation in both programs was up slightly from 2015.

Quabbin Fishing areas had a total of 57,877 visits since the start of our boat decontamination program with 8,002 during the 2016 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 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 and were determined to be desiccated portions of aquatic or terrestrial plants, spider webs, exoskeletons of insects and fungi. No AIS were found.

Marine species or severely degraded freshwater plants pose little or 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.

2016 Quabbin Self-Certification/Boat Ramp Monitor Program

P. Packard

February 6, 2017

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. Boaters 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 in a box on the kiosk near each boat ramp, along with signage directing boaters to self-certify their watercraft before launching. A letter 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 on the windshield.

Since actual contact time with boaters continues to be 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. Most boaters were in complete agreement with our program and willing to comply with our requests for self-certification. The feelings for Comet Pond rival those expressed when people talk about the Quabbin Reservoir, so the ongoing program to reduce the likelihood of introducing aquatic invasive species to Comet Pond continues to be readily accepted.

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 more 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, and they may have areas that remain wet for longer periods of time.

Some types of plants use fragmentation as a means of spreading throughout a water body. Variable water milfoil (*M. heterophyllum*), the dominant species of plant found at Long Pond, utilizes fragmentation as one means of increasing its numbers. Toward the end of the growing season, these plants become brittle. Stems fragment and float to new locations rapidly grow roots. The fragments eventually colonize 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 any specific organism, boaters are beginning to think about the impacts of moving boats from one area to another, ultimately 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 was successful.

2016 Quabbin and Ware River Aquatic Macrophyte Assessments

Paula D. Packard

February 7, 2017

During the 2016 field season, a total of 27 water bodies were assessed for the presence of aquatic invasive species (AIS). Of the 27, 14 were in the Quabbin watershed and 13 were in the Ware River watershed. The West Arm of the reservoir, the three fishing areas and the Ware River above Shaft 8 were also surveyed in conjunction with assessments conducted by 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 10th and ended on October 19th 2016. Many water bodies within the watershed are monitored yearly while others are done as a component of the current Environmental Quality Assessment. Approximately 56 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. See Table below for a complete list of water bodies assessed in 2016.

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 for the presence of milfoil, plant density and distribution was reduced, indicating that the drawdown was successful. MWRA hired contractors to hand harvest milfoil that remained. Upon completion, not a single milfoil plant was observed. Contractors will also be hired to remove plants found in 2017.

The summer of 2016 was extremely dry so no drawdown was planned for the winter of 2016/2017 because of concerns over water conservation. Monitoring and assessment of this plant will be ongoing.

Phragmites australis (common reed) is an invasive species that is widely distributed in 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.

Six 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 as plant numbers slowly increase. Plants were found scattered along the north western littoral zone and were not confined to the northern end of the pond where they were initially found in 2011.

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, two water bodies were found to be infested with *Cabomba caroliniana* (fanwort): Queen Lake in Phillipston and Moulton Pond in Rutland. At Queen Lake, numerous rooted plants and fragments were found in the boat launch and beach area, along the western shoreline, and in the northeastern sections including several of the coves. Fanwort distribution appears to be increasing although densities remain low in areas where plants were observed. 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, 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. If HPPAs plans to treat for fanwort in 2017 come to fruition, the threat of fanwort being carried to the reservoir by waterfowl will be significantly reduced.

DCR, through MWRA, had ESS Consulting Group conduct an additional survey of the littoral zone of the reservoir along Richard's Ledges and south of Shaft 12 to monitor for the presence of fanwort. If waterfowl carrying plant fragments were to fly directly from Hardwick Pond to the Quabbin Reservoir, these are the most likely locations for the establishment of new infestations of fanwort. To date, none have been observed in the reservoir.

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 so 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. ESS Consulting Group was hired to prepare a Notice of Intent and to apply to MA Natural Heritage and Endangered Species Program regarding a state listed species of plant found in White Hall Pond. All permits have been submitted and a preliminary hearing has taken place with the Rutland Conservation Commission. Treatment is planned for May of 2017.

Chinese Mystery snails were documented during the 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. 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. Many plants were hand pulled at Pottapaug Pond and at Area 3; however, 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 will continue to worsen as plant density and distribution increases. Plans are in place to hand harvest plants in Pottapaug Pond and at

Boat Area 3 in June when they are in bloom and easier to locate among native plants. In 2017, the fragment barrier at Area 3 will be repositioned to more efficiently catch floating seed pods however; this will be an ongoing problem with no readily available solution

Lithrum salicaria (Purple Loosestrife) was found at three 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 all six 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 this year. It is now being found in many locations and has become widely distributed.

Interestingly and for reasons not yet fully understood, plant density does not seem to be increasing significantly in some areas where it is established. It is edible and may be kept in check by herbivores. This observation does not seem to be holding true for the population established in Peppers Mill Pond. The patch there had increased in size from several plants to large patch which is 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 is 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. To date, impacts from infestations of One Row Yellowcress seem to be minor. It is widespread throughout 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 10 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, 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 every two weeks during the 2016 field season. Complete macrophyte surveys were conducted on July 29, August 8, and September 2, 2016. No brittle naiad fragments or whole plants were found for the second year in a row.

No additional aquatic invasive species were documented in 2016. Plans to assess water bodies in the Ware River and Quabbin Reservoir watersheds are in place for the 2017 field season.

List of Water Bodies Surveyed in 2016.

Water Body	**Location**		**Water Body**	**Location**
Bassett Pond	New Salem		O'Loughlin Pond	New Salem
Brigham Pond	Hubbardston		Pepper's Mill Pond	Ware
Carter Pond	Petersham		Pottapaug Pond (East Swift Impoundment)	Petersham & Hardwick
Connor	Petersham		Prescott Peninsula – 7 ponds	New Salem
Demond Pond	Rutland		Queen Lake	Phillipston
Harvard Pond	Petersham		Sibley Swamp	Wendell
Long Pond – main body	Rutland		Thayer Pond	Rutland
Long Pond-upper	Rutland		Ware River- above Shaft 8	Barre
Mattawa Lake	Orange		West Arm of Reservoir	Pelham
Moosehorn Pond	Hubbardston		White Hall Pond	Rutland
Moulton Pond	Rutland			
Muddy Pond	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

Environmental Quality Field Report
Site 212 and 212B – March 31, 2016

EQ staff conducted a field investigation in response to elevated bacteria levels in surface water. Samples collected on 3/29/26 at sample site 212 had an *E.coli* count of 203 MPN/100 mL and at sample site 212B had an *E.coli* count of 706 MPN/100mL. Flow was listed as high flow at both locations. Most recent rainfall was on previous day. National Weather Service (NWS) reported 0.88 inch at ORE (Orange) on 3/28/16. A rain gage in South New Salem located at the intersection of Route 202 and Shutesbury Road approximately one mile from sample sites collected 0.95 inch on 3/28/16.

On Thursday 3/31/16 EQ staff Peter Deslauriers conducted a field inspection upstream of sample sites 212 and 212B and collected repeat bacteria samples at each site. The field inspection day was mostly cloudy with temperatures in the upper 50s. Conditions were dry since the 3/28/16 rain event. Staff collected a sample at site 212B. Water level had receded since 3/29/16 and level was listed as good flow on chain of custody sheet. After collecting sample staff began a foot inspection along west side of brook and walked approximately 80 yards upstream. Nothing unusual was noted. Staff drove to sample site 212 by way of Russell Road, Whitaker Road, Shutesbury Road, and Gate 22 Road. EQ staff collected a sample at site 212. Water level had receded and level was listed as good flow on chain of custody sheet. After collecting sample staff began a foot inspection along north side of brook to road culvert. Nothing unusual was noted. From Gate 22 Road a visual inspection was done looking upstream. There was a beaver dam approximately 60 yards upstream and an active beaver lodge approximately 100 yards upstream of road culvert. See photo 1. In mid-March, DCR maintenance staff removed beaver debris partially blocking road culvert. Beaver have recently begun blocking the culvert with new debris. See photo 2. Staff continued field survey by vehicle. Route travelled was west on Gate 22 Road, west on Shutesbury Road, north on Whitaker Road, north on Route 202, west on West Main Street, south on West Street, south on Route 202, and ending at Shutesbury Road. See Map. There are four Hop Brook sub-tributaries crossing Route 202 in this area. Vehicle slowed where tributaries crossed roads and area was inspected visually. Nothing unusual was observed. Watershed area is lightly populated and no farm animals were seen where horses or goats are occasionally seen. There was beaver impact past and present in many of the locations viewed.

Results received on 4/1/16 for samples collected on 3/31/16 are listed below.

Site 212
E.coli 10 MPN/100 mL

Site 212B
E.coli 41 MPN/100 mL

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Lt. Governor

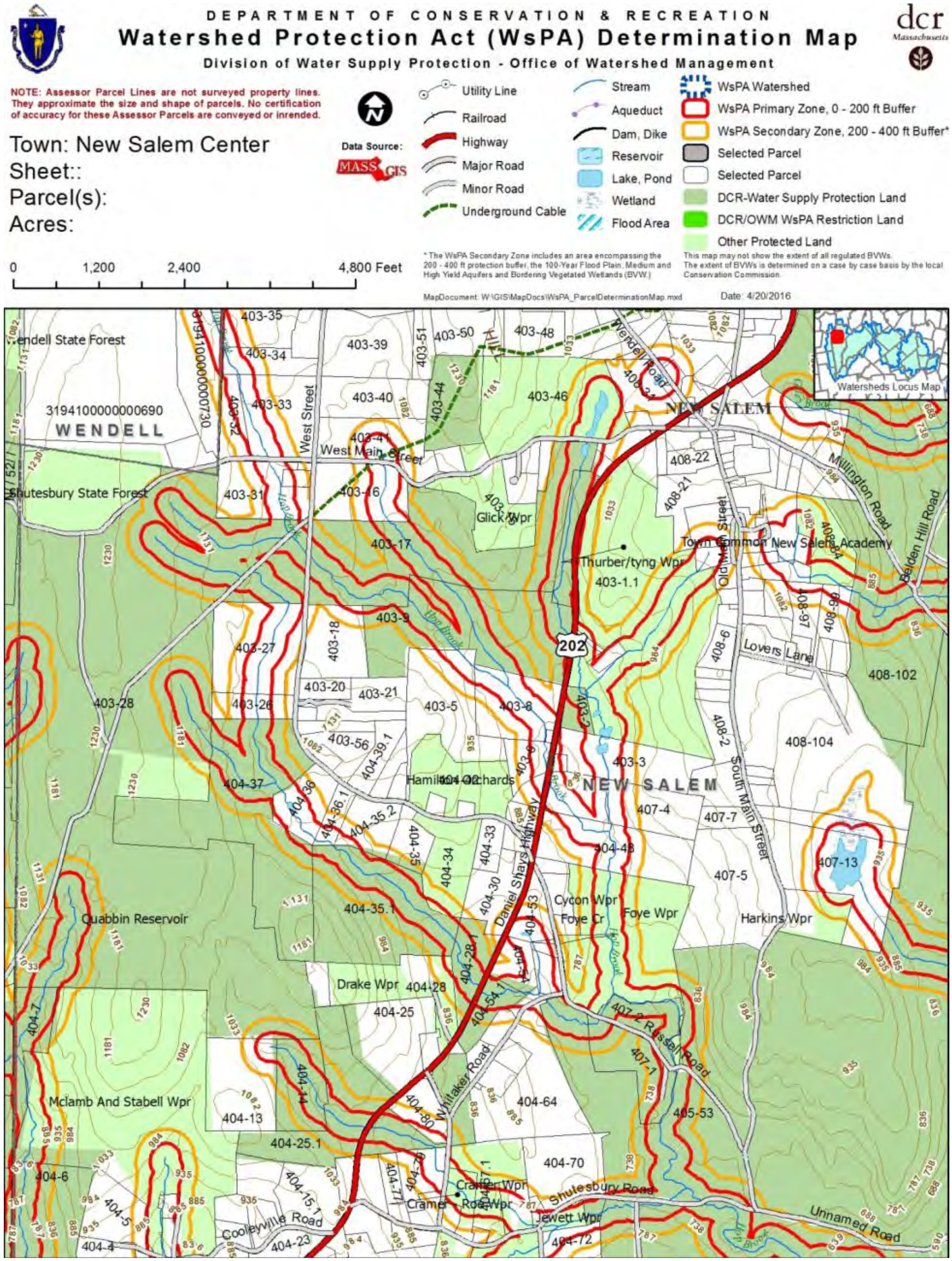
Matthew A. Beaton, Secretary, Executive
Office of Energy & Environmental Affairs

Leo Roy, Commissioner
Department of Conservation & Recreation

Based on results of repeat samples and field investigation, heavy rain on 3/28/16 and beaver activity upstream of sample sites likely caused elevated bacteria levels. Site 212 and 212B will continued to be monitored biweekly.

Photo 1. Dam and beaver lodge upstream Gate 22 Road culvert.

Photo 2. **Upstream side Gate 22 road culvert - fresh nip twigs and debris.**



Map. **Inspection area.**

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Environmental Quality Field Report
Tributary Sample Site 213A- Middle Branch Swift River at Fay Road
Tributary Sample Site BC- Boat Cove
4/28/2016

EQ staff conducted a field investigation and sampling in response to elevated bacteria levels in surface water. Samples collected on April 26, 2016 at sample site 213A had an E.coli count of 3448 MPN/100mL, and a count of 279 MPN/100mL at the Boat Cove site.

QRTRIB *E. coli* Counts >15

Date	Site	Location	E. coli Count MPN/100mL
4/26/2016	212	Hop Brook @ Gate 22 Road	31
4/26/2016	213	Middle Branch Swift River @ Gate 30	86
4/26/2016	BC	Boat Cove @ Mouth	279
4/26/2016	211F	West Branch Swift (New Boston) @ Cooleyville Road	20
4/26/2016	211G	West Branch Swift (Cooleyville) @ Cooleyville Ext. Road	20
4/26/2016	212B	Hop Brook @ Russell Road Gate 24	20
4/26/2016	213A	Middle Branch Swift River @ Fay Road	3448
4/26/2016	213B	Middle Branch Swift River @ Elm Street	75

The Boat Cove site was resampled on April 28, 2016. E. coli counts dropped from 279 to 10 MPN/100mL. This site has had occasional elevated counts during rain events and previous investigations have identified wildlife activity in the tributary. There were no issues identified during the resample. The decrease in E. coli counts on the re-sample confirms the elevated counts were storm related.

Site 213A tributary flow was characterized as good flow on the day of sampling (April 26, 2016). The most recent rainfall occurred on the day of sampling; rain started at approximately 7 am and continued during the day. Heavy rain started approximately one hour before collecting the sample at site 213A. Total rainfall for the day was approximately 0.25-0.50 inches (Figure 1).

On Thursday April 28, 2016, EQ staff Gary Moulton conducted a field inspection along the tributary upstream of sample site 213A. This tributary is surrounded by a large wetland complex. The inspection day was dry and sunny with temperatures in the mid 60’s.

The inspection proceeded on foot, beginning at sampling site 213A. Old scat was observed on rocks near the sample location. The inspection continued north along the wetland edge, then returned to the vehicle. The inspection continued at access to a wetland off Elm Street and followed the wetland edge easterly, then to the north. The route continued to the west along the edge of a cow pasture back to Elm Street.

The cow pasture is part of a farm located on Elm Street/Holtshire Road. A stream flows through the pasture and into the large wetland complex upstream of sample site 213A.

Samples were collected at three locations: the sample site, downstream of the cows in the pasture, and upstream of the cows. Results are included below.

Date	GPS ID	Sample ID	Sample location	E. coli Count MPN/100mL
4/28/2016	239	213 A	Regular trib sample site	31
4/28/2016	237	213 A1	Downstream of cows	4352
4/28/2016	238	213 A2	Upstream of cows	85

Weather was dry between the sampling events on April 26 and April 28. E.Coli counts at sample site 213A dropped from 3448 to 31 MPN/100mL during this time. The high counts on April 26 were likely due to storm flushing. It is possible that the scat near the sampling site was disturbed by foot traffic during sampling. Pieces of scat could have dislodged, fallen into the water and accidently contaminated the sample, though this is unlikely due to the level of experience of the samplers.

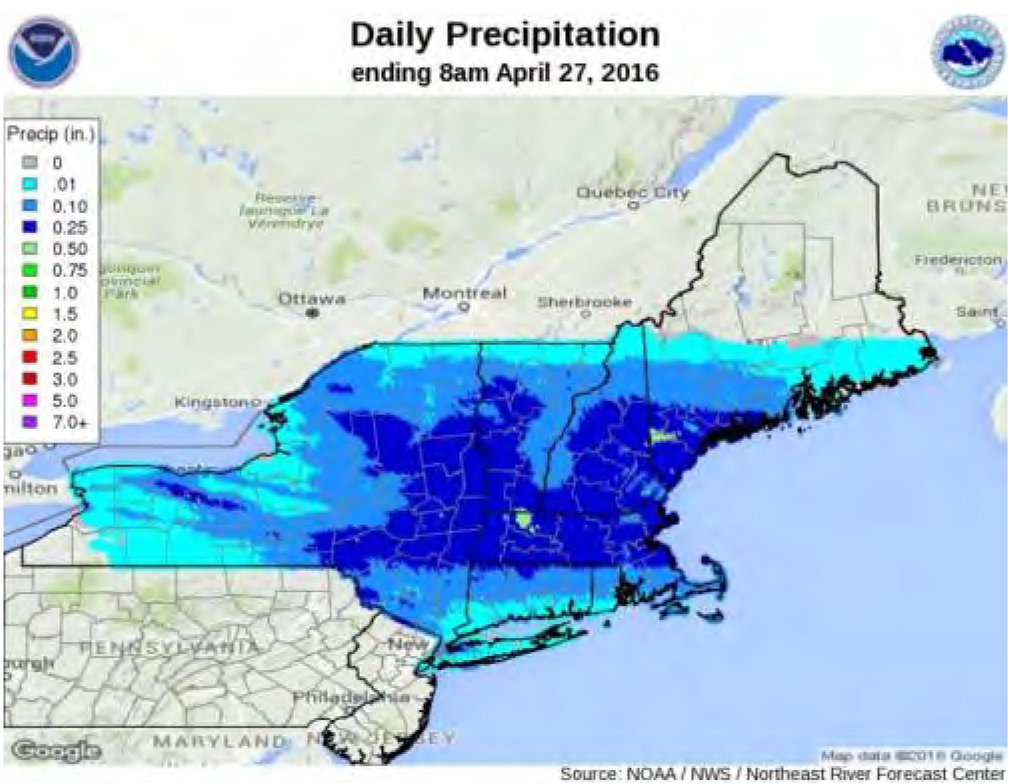
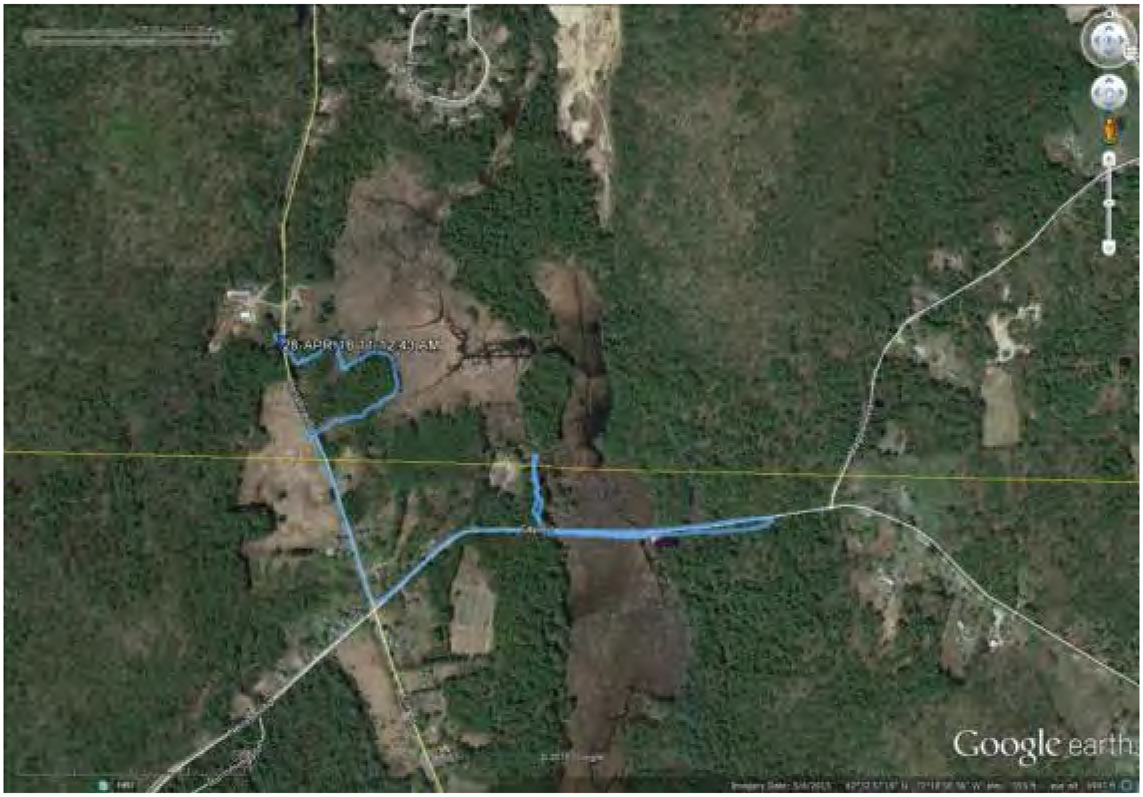
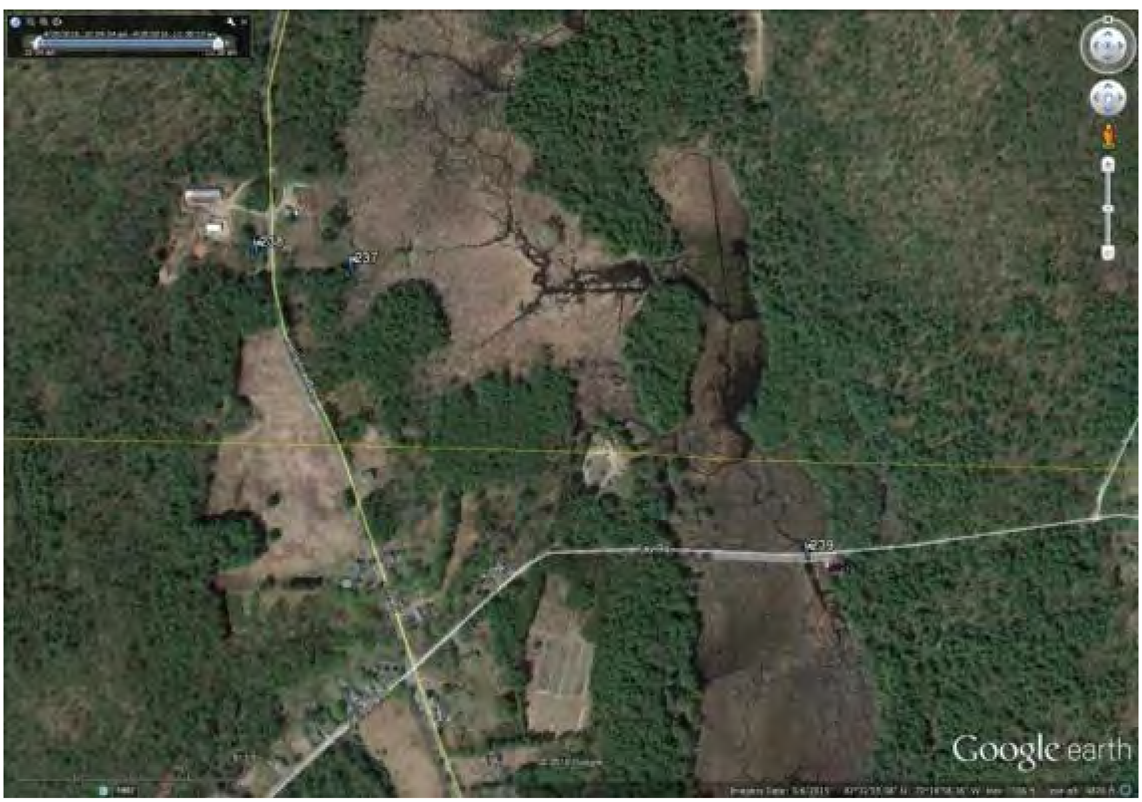


Figure 1- Precipitation Totals



Map 1- Google earth image of inspection track



Map 2- Investigation sample sites


Photo 1- Sample site 213A


Photo 2- Upstream of sample site 213A

Photo 3 – Scat on rocks at sample site 213A


.

Photo 4- Wetland

Photo 5- Stream in pasture

Photo 6- Downstream of pasture. Note cows.

Photo 7- Upstream of farm, west side of Elm Street.

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Environmental Quality Field Report
Sites 213, 213A, and 215 – May 27, 2016.

EQ staff conducted a field investigation in response to elevated bacteria levels in surface water. Samples collected on 5/24/16 at sample site 213 had an *E.coli* count of 426 MPN/100 mL, at sample site 213A an *E.coli* count of 414 MPN/100mL, and at sample site 215 an E.coli count of 733 MPN/100mL. Flow was listed as good flow at 213, fair flow at 213A, and good flow at 215. Most recent rainfall was morning of sample collection between 6 AM and 8 AM. National Weather Service (NWS) reported 0.26 inch at ORE (Orange) on 5/24/16.

On Friday 5/27/16 EQ staff Peter Deslauriers conducted a visual inspection near sample sites 213, 213A, and 215. Repeat bacteria samples were collected at each site. The field inspection day was mostly cloudy with temperatures in the lower 70s. Only a trace of rain was reported during previous 48 hours. Staff collected a sample at site 215. Water level was listed as good flow on chain of custody sheet. After collecting sample a visual inspection was done looking upstream and downstream of West Street road culvert. A pollen slick was visible on water and one adult goose with three goslings was seen approximately 35 yards upstream of sample site. Staff drove to sample site 213 and collected bacteria sample. Water level was listed as good flow on chain of custody sheet. A visual inspection was done upstream and downstream of the key stone bridge. Nothing unusual was noted. From Gate 30 a vehicle inspection was done on route to sample site 213A. Route travelled was north on Route 122, north on Route 202, and west on Fay Road. Approximately twelve cows were seen at farm located at intersection of Route 202 and Fay Road. Approximately 12 cows were seen at farm near intersection of Fay Road and Magoon Road (this location is slightly outside of watershed divide line). Staff collected bacteria sample at 213A. Water level was listed as fair flow on chain of custody sheet. Small amounts of natural organic decomposition sheen were visible on the upstream side of Jonathan's Bridge. Numerous dragonfly nymph exoskeletons were visible on stones along the downstream side. Vehicle inspection continued from site 213A west to Elm Street, north to Fairman Road, east to where Middle Branch Swift flows under road. At the O'Brien farm on Elm Street approximately 12 cows were seen in a pasture on the east side of road. A small stream flows through this pasture. Flow was low and piles of manure were visible. Nothing unusual was noted where Middle Branch Swift crossed Fairman Road.

Results received on 5/28/16 for repeat samples collected on 5/27/16 are listed below.

Site 213
  ***E.coli* 31 MPN/100 mL**
Site 213A
  ***E.coli* 31 MPN/100 mL**

COMMONWEALTH OF MASSACHUSETTS · EXECUTIVE OFFICE OF ENERGY & ENVIRONMENTAL AFFAIRS

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Governor

Karyn E. Polito
Lt. Governor

Matthew A. Beaton, Secretary, Executive
Office of Energy & Environmental Affairs

Leo Roy, Commissioner
Department of Conservation & Recreation

Site 215
E.coli **51 MPN/100ml**

Based on results of repeat samples and field investigation, early morning rain prior to sampling on 5/24/16 and the presence of wildlife or domestic animals upstream of sample sites possibly caused elevated bacteria levels. Sites 213, 213A, and 215 will continued to be monitored biweekly.

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Environmental Quality Field Report
Boat Cove Brook Sample Site – June 9, 2016

EQ staff conducted a field investigation in response to elevated bacteria levels in surface water. A sample collected on June 7, 2016, at the Boat Cove sample site had an *E.coli* count of 1,440 MPN/100 mL. Flow was listed as fair. Two days prior to sample collection, on June 5, 1.35" of rain had been measured at the Quabbin rain gage located by the Administration Building.

On Thursday, June 9, 2016, EQ staff Paul Reyes conducted a visual inspection near and at the sample site and collected a repeat bacteria sample. Rainfall totaling 0.19" fell on June 7, and 0.04" on June 8. The water flow was again fair. The *E. coli* from the second sample was 201 MPN/100 mL.

Nothing unusual was observed during the inspection on June 9. The 1.35" of rain on June 5 likely flushed bacteria from upstream of the sample site.

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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:**	9/27/2016
Samplers:	Peter Deslauriers and Gary Moulton	**Report date:**	10/3/2016
		Prepared by:	Pd
Reason for report:	Elevated bacteria counts detected in tributary samples, particularly in samples BC, 212A and 213A.		

Rainfall Data

Station	Amount	Date
DCR Belchertown CE	.50 inch	9/27/2016

Field observations at sample sites

Site ID number	*E. coli* result (MPN/100 ml)	Flow	Observations
Boat Cove	2,755	Very slow flow.	Water was crystal clear. Nothing unusual.
212A	3,873	Very slow flow.	Very slow flow. Water was cloudy. Evidence of beaver activity upstream.
213A	3,255		Manure pile near small brook at O'Brien farm on Elm Street. River otter scat near sample site.

Other notes, comments or observations

Please note: DCR CE staff check rain gage at 7:00 AM and record rainfall during the previous 24 hours. The .50 inch of rain listed above fell mostly between 5:00 AM and 7:00 AM on 9/27/2016 sample morning.

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MEMORANDUM

To: Bill Pula, Lisa Gustavsen, Yuehlin Lee

C: Scott Campbell, Rebecca Faucher, Kimberly Turner

From: Ellie Kurth

Date: August 4, 2016

Subject: Water Quality Results for Stockroom Well

Water samples were collected from the Stockroom well on June 8 and 30, 2016 to assess the water quality of the water supply 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. This sampling was scheduled to be performed prior to annual maintenance of the RO unit in order to characterize potential worst-case conditions of treated water quality. Annual maintenance on the RO unit was most recently performed on May 19, 2015, and a repair service that included a filter change was performed on December 7, 2015.

Both samples were analyzed for bacteria, volatile organic compounds (VOCs), nitrate, nitrite, copper, lead, sodium, iron, manganese, total dissolved solids (TDS), turbidity, and alkalinity. A first-draw sample was collected for metals analysis (to better assess lead and copper levels), and water was then flushed prior to collecting the remainder of the sample. A confirmatory first draw sample of untreated water for metals analysis was collected on June 30. MWRA provided laboratory services. Total coliform and *Escherichia coli* bacteria, turbidity, and alkalinity 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 66,400 µg /L to 22,900 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 detected above the MCL (Action Level), TDS was detected above the SMCL, and sodium was detected above the MA ORSG level. The elevated lead and sodium levels were detected in both the June 8 and the June 30 samples. The results indicate the RO system reduced lead levels from 23.2 μg /L in the untreated water to 1.42 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.

The results also indicate the RO system reduced TDS to well below the SMCL (from 986 mg/L to 157 mg/L).

No VOCs were detected. Methyl-tert-butyl ether (MTBE) **was not detected** in the raw or 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.

A summary of the sampling results was posted in the Stockroom on August 4, 2016. A copy of this posting is attached. As indicated, the posting includes information about the elevated sodium result in the RO-treated sample.

SUMMARY OF STOCKROOM WATER QUALITY DATA
Samples Collected June 8 and 30, 2016

Parameter	Units	Sample: Kitchen Tap, Untreated	Sample: Treated (RO) Water (Kitchen Sink)	Applicable Standard or Guideline[1]	Remarks [2]
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
Physical/Chemical Properties					
Alkalinity	mg/L	24.5	2.94	NS	
Total Dissolved Solids	mg/L	**986**	157	500	SMCL
Turbidity	NTU	0.235	0.064	1 NTU	MCL
Inorganic Compounds[3]					
Copper	ug/L	845/934	2.21	1,000	SMCL (Action Level is 1,300 ug/L)
Iron	ug/L	11.1/12.2	<6.00	300	SMCL
Lead	ug/L	**23.2/24.9**	1.42	15	MCL (Action Level)
Manganese	ug/L	2.03/2.36	0.46	50, 300, 1,000 [4]	SMCL, MA ORSG
Nitrate	mg/L	0.604	0.021	10	MCL
Nitrite	mg/L	<0.005	<0.005	1	MCL
Sodium	ug/L	**66,400/58,700**	**22,900**	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

SUMMARY OF STOCKROOM WATER QUALITY DATA
Samples Collected June 8 and 30, 2016

Parameter	Units	Sample: Kitchen Tap, Untreated	Sample: Treated (RO) Water (Kitchen Sink)	Applicable Standard or Guideline[1]	Remarks [2]
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] A confirmatory "first draw" sample of untreated water was collected on June 30 and analyzed for metals. The June 8 result is listed first, and the June 30 result is listed second.

[4] 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

January 3, 2017

Department of Environmental Protection
Western Regional Office
436 Dwight Street
Springfield, MA 01103

Attention: Deirdre Doherty

Re: Quabbin Administration Building, PWS 1024011
4th Quarter Results – Lead and Copper Monitoring
Lead and Copper Certification of Notice to Consumers
Actions Taken to Assess and Address Elevated Lead Levels

Dear Ms. Doherty:

Lead and copper sampling was conducted at the Quabbin Administration Building in December, 2016 in accordance with the Massachusetts Department of Environmental Protection (MassDEP) sampling schedule dated October 19, 2015. The schedule requires semiannual sampling of five approved taps. As described below, the 90th percentile results were below lead and copper action levels during this monitoring period. In addition, DCR staff have conducted work to assess elevated lead levels and address the problem in an ongoing effort to bring the system into compliance with the Lead and Copper Rule (LCR). This letter was prepared to provide both the fourth quarter results and a summary of ongoing work to assess and address elevated lead levels.

Lead and copper sampling and results

Lead and copper samples were collected on December 7, 2016 and analyzed by the Massachusetts Water Resources Authority Department of Laboratory Services.

The Lead and Copper- 90th Percentile Compliance Report (Form LCR-E) for this sampling is enclosed. As indicated, the 90th percentile values for lead and copper were below the applicable action levels. Lead was detected in the sample from the east wing kitchen tap at a concentration of 0.022 mg/l, but the average of this result with the next highest result was 0.013 mg/l, which is below the action level of 0.015 mg/l.

Follow up actions

After receipt of the laboratory data, informational notices were posted at taps throughout the building. A signed certification of notice to consumers and copies of posted notices are enclosed.

Diagnostic testing and kitchen sink fixture replacement

In an email dated July 13, 2016, MassDEP staff indicated it would be acceptable to conduct diagnostic lead and copper testing by collecting first-draw samples in 250-ml bottles instead of 1,000-ml bottles. The goal of the diagnostic testing was to assess elevated lead levels and whether flushing the water line regularly would reduce lead concentrations at the kitchen sink tap.

Department of Conservation and Recreation
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Charles D. Baker
Governor

Karyn E. Polito
Lt. Governor

Matthew A. Beaton, Secretary, Executive
Office of Energy & Environmental Affairs

Leo P. Roy, Commissioner
Department of Conservation & Recreation

DCR staff began a diagnostic testing program in August, 2016. The testing program initially included three weeks of twice-weekly sample collection on Tuesdays and Fridays in August and September. During the first week, samples were collected to establish baseline lead levels during the week. During the second and third weeks, DCR staff flushed the outside spigot near the sink for approximately 15 minutes on Mondays to assess the effect of weekly flushing on lead levels. Flushing was not performed after August 29, 2016.

The kitchen tap fixture was replaced with a new, "lead-free" fixture on August 31, 2016. Three more diagnostic samples were then collected in September and October, after fixture replacement.

The results of the diagnostic testing program are summarized in Table 1. As indicated, lead levels were lower in the weeks after the flushing program began, but not likely low enough to achieve LCR compliance. After the fixture was replaced, the lead level initially increased to 437 μg/l, which was likely due to the disturbance to the pipes during fixture replacement. Lead levels progressively decreased in subsequent tests.

Water quality monitoring

MassDEP requested that DCR perform ongoing water quality monitoring at the well and at the kitchen tap for one year. DCR staff have been monitoring water quality at these locations on a monthly basis since April, 2016. Measured parameters include alkalinity, conductivity, dissolved oxygen, pH (in the field and lab), and temperature (in the field and lab). In addition, the data are used to estimate dissolved inorganic carbon (DIC).

Water quality data are summarized in Table 2. As indicated, pH and DIC values are relatively stable in the distribution system and do not suggest a need for water treatment.

Future work

Future work will include semiannual LCR compliance testing and monthly water quality monitoring. The monthly water quality monitoring will continue through March, 2017 in order to obtain a full year of data.

If you have any questions about this matter, please contact Yuehlin Lee (ext. 301) or Ellie Kurth (ext. 158) at 413-323-6921.

Sincerely,

John Scannell, Regional Director
Department of Conservation and Recreation

Copy (via email): Jonathan Yeo, DCR
Judy Metcalf, Belchertown Board of Health

Enclosures: Lead and Copper – 90th Percentile Compliance Report, Form LCR-E
LCR Certification of Consumers and Schools/Early Education & Care Facilities
Informational Notices to Consumers Posted at Building Taps
Table 1: Summary of Lead and Copper Diagnostic Testing Data
Table 2: Summary of Water Quality Data and Estimated Dissolved Inorganic Carbon (DIC)