Water Quality Report: 2013
Quabbin Reservoir Watershed
Ware River Watershed

Morning dew on spider web (Bernadeta Susianti-Kubik, September 13, 2011)

June 2014

Massachusetts Department of Conservation and Recreation
Office of Watershed Management
Division of Water Supply Protection

ABSTRACT

This report is a summary of water quality monitoring results from 24 surface water stations established throughout the Quabbin Reservoir and Ware River watersheds and other special investigative samples. The Department of Conservation and Recreation (DCR), Division of Water Supply Protection, 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 pure water to future generations. The Environmental Quality Section maintains a comprehensive water quality monitoring program to ensure that Quabbin Reservoir and its tributaries meet state water quality standards. As part of this task, the Environmental Quality Section performs the necessary field work, interprets water quality data and prepares reports of findings. This annual summary is intended to meet the needs of the decision makers, the concerned public, and others whose decisions must reflect water quality considerations.

Quabbin Reservoir water quality in 2013 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 general trends and 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 natural attributes of the landscape.

The appendices to this report include field investigation reports, summary information on mean daily flows of gaged 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 DCR whose efforts are acknowledged below.

Acknowledgments

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In memoriam: David Worden, former DCR Limnologist who passed away much too soon on July 7, 2013. Dave initiated the monitoring and assessment of reservoir nutrients, phytoplankton, and aquatic ecology, and he will be missed as a colleague and friend.

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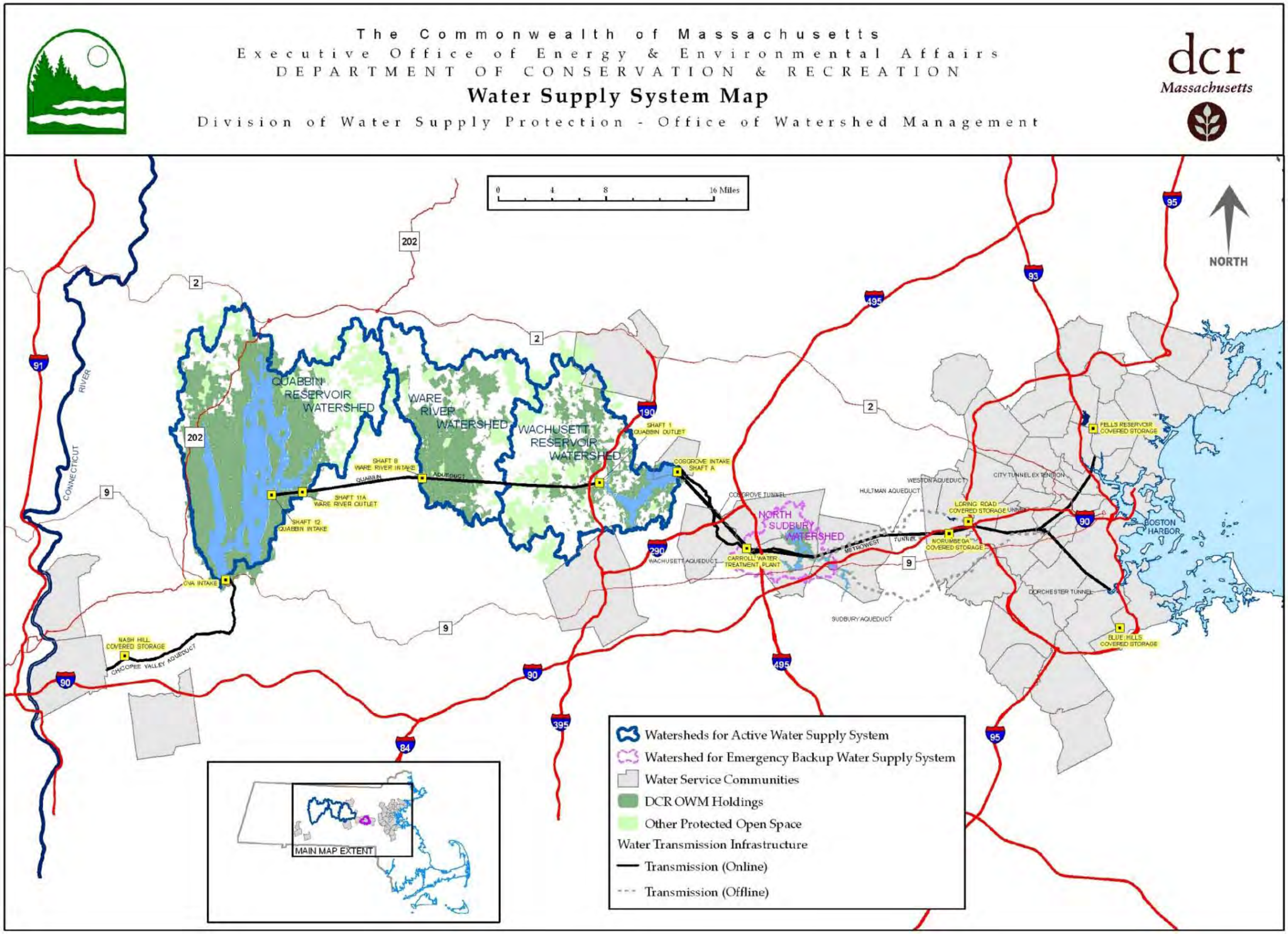


Figure 1. Quabbin Reservoir, Ware River, and Wachusett Reservoir Watershed System

1 INTRODUCTION

The Quabbin Reservoir, Ware River, and Wachusett Reservoir watershed system supplies drinking water to 51 communities, including 45 communities in the greater Boston and MetroWest region, three in western Massachusetts, and three as an emergency supply only. The Department of Conservation and Recreation (DCR) 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 DCR and MWRA monitor the water quantity and quality to deliver sufficient and safe drinking water. The watershed system and the MWRA service area are shown in **Figure 1**. This report summarizes the water quality monitoring performed by DCR in the Quabbin Reservoir and Ware River watersheds during 2013; a separate report summarizes the monitoring performed during 2013 in the Wachusett Reservoir watershed.

The three drinking water sources, Quabbin Reservoir, Ware River and Wachusett Reservoir, are interconnected via the Quabbin Aqueduct. The largest of the three sources, Quabbin Reservoir, is capable of holding 412 billion gallons of water. Because of Quabbin's size, it required seven years after the damming of the Swift River in 1939 before the reservoir was completely filled. The reservoir surface is best described as two interconnected fingers. The larger eastern finger stretches about 18 miles in length and has a maximum width of roughly four miles. The western finger stretches about 11 miles in length and has a maximum width of roughly one mile. In total, the reservoir surface area covers 39 square miles (25,000 acres) and contains 118 miles of shoreline. **Table 1** summarizes some basic facts and figures about Quabbin Reservoir.

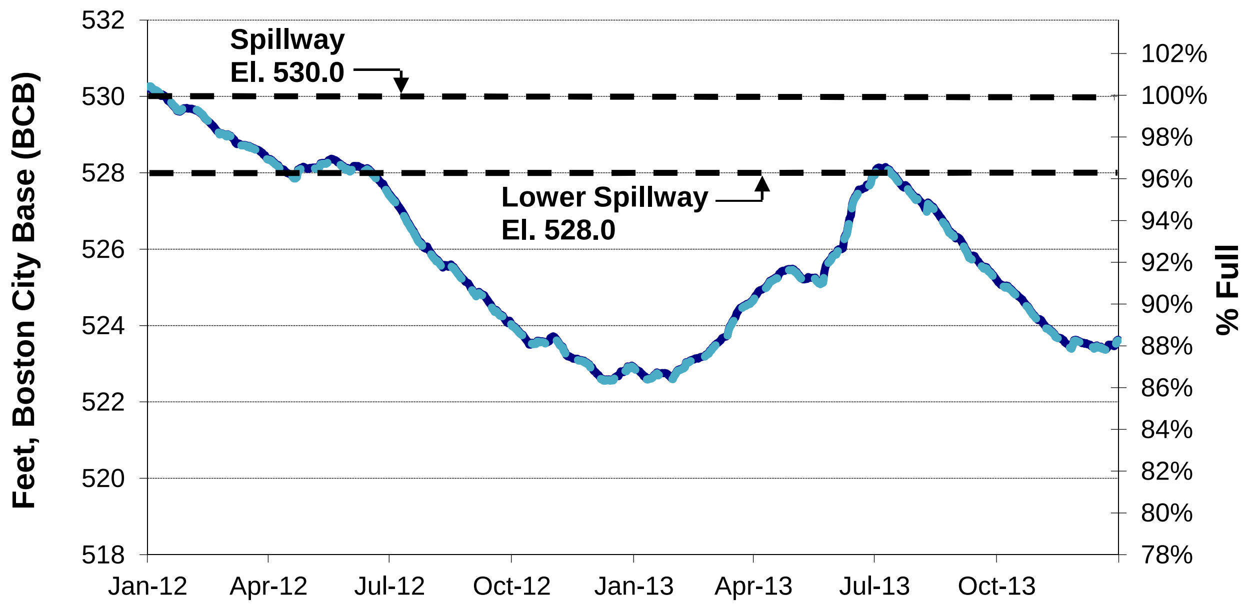
Quabbin Reservoir water transfers to Wachusett Reservoir via the Quabbin Aqueduct Intake at Shaft 12 typically account for more than half of the of MWRA's system supply. In 2013, transfers to Wachusett Reservoir totaled 48,906.31 million gallons (MG). In the 230 days that transfers occurred, the Quabbin Aqueduct delivered an average of 212.64 million gallons per day (MGD). A much 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 2013, the CVA delivered on average 7.73 MGD of flow to the CVA communities. The reservoir maintained a normal operating level throughout 2013. In 2013, the reservoir had a net storage gain of 5,475 MG, and operating levels experienced a maximum fluctuation of 5.55 feet. Daily fluctuations in reservoir water level during the past two years are shown in **Figure 2**.

The Quabbin Reservoir watershed covers 187.5 square miles (119,935 acres) and contains practically all of the towns of New Salem and Petersham, considerable portions of Pelham, Shutesbury, and Wendell, and much smaller portions of Orange, Hardwick, Phillipston, Belchertown, Ware and Athol. Nearly 90% of the watershed lands are forested, and the Department of Conservation and Recreation, Division of Water Supply Protection's Office of Watershed Management (DCR/DWSP) owns and controls 53,278 acres (56%) of watershed lands for water supply protection purposes.

Table 1. Quabbin Reservoir Facts and Figures

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	**DCR/DWSP Land**	53,278 acres, or 56% of Land Area
Surface Elevation, at Full Capacity	530 feet (Boston City Base)	**% DCR/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
Calendar Year:	***2013***	***2012***	***2011***
Maximum Reservoir Elevation (ft)	528.15 on July 9	530.21 on January 2 & 3	530.26 on December 23 & 28
Minimum Reservoir Elevation (ft)	522.60 (DCR data) on January 11	522.57 (DCR data) on December 9, 10, 14	523.65 (DCR data) on January 9 & 10
Total Diversions to Wachusett Reservoir	48,906.31 MG (230 days: 212.64 MGD)	63,975.32 MG (300 days: 213.25 MGD)	31,495.24 MG (171 days: 184.18 MGD)
Total Diversions to CVA	2,820 MG (365 days: 7.73 MGD)	2,936 MG (366 days: 8.02 MGD)	2,746 MG (365 days: 7.52 MGD)
Ware River Transfers	3,218.7 MG (22 days: 146.3 MGD)	168.6 MG (2 days: 84.3 MGD)	2,452.5 MG (10 days: 245.3 MGD)
Spillway Discharges	2.8 MG (3 days: 0.93 MGD)	9,585 MG (160 days: 59.9 MGD)	20,584 MG (214 days: 96.2 MGD)
Total Diversions to Swift River	9,034 MG (24.75 MGD)	27,678 MG (75.6 MGD)	37,306 MG (101.9 MGD)
Reservoir Ice Cover	Full reservoir ice cover not obtained.	Full reservoir ice cover not obtained.	Full reservoir ice cover not obtained.

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 daily flow.
Sources: Watershed Protection Plan Update (DCR, 2013a), DCR Civil Engineering Yield Data 2011-2013, MWRA Flow Data



Source: DCR Civil Engineering '12-'13

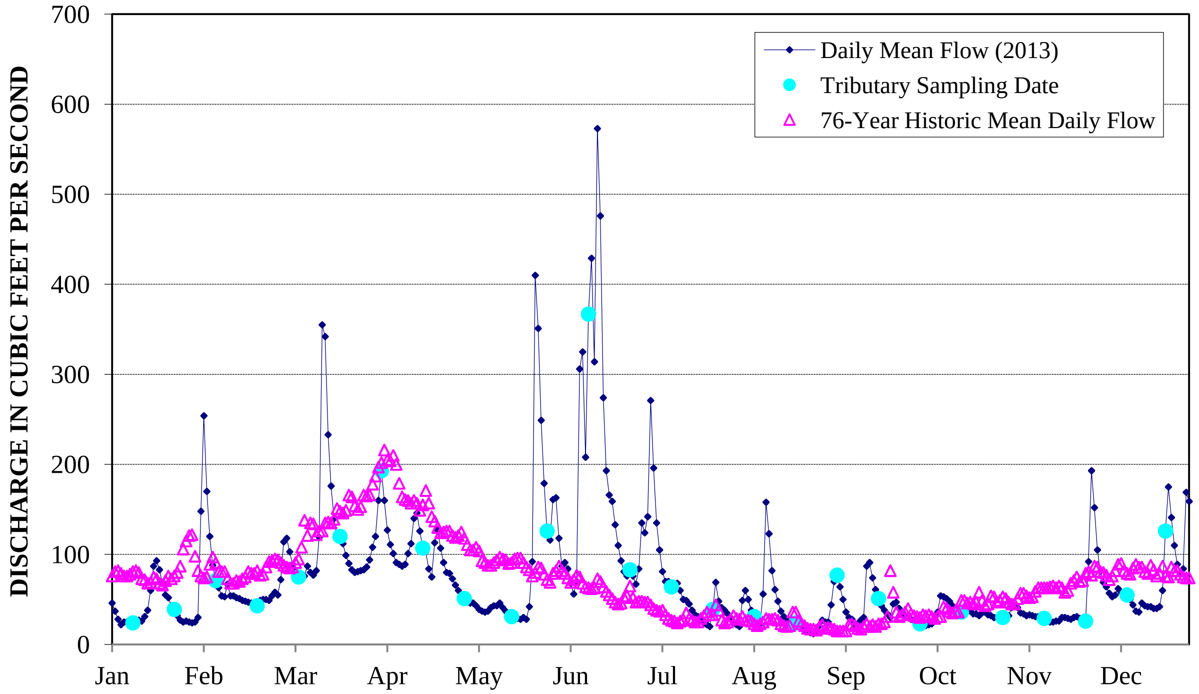
Figure 2. Quabbin Reservoir Daily Elevation, January 2012 - December 2013

Including the reservoir, DCR owns and controls 65% of the entire watershed area. Non-DCR owned lands can be characterized as sparsely populated and having limited agricultural sites, helping to maintain the pristine character often attributed to Quabbin Reservoir water. For more information on land use and ownership in the Quabbin Reservoir watershed, see the *2013 Watershed Protection Plan Update* (DCR, 2013a).

The eastern portion of the watershed and much of the Petersham area is drained by the East Branch of the 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 2013, mean daily flows for the East Branch Swift River in Hardwick averaged 75.0 cubic feet per second (cfs). **Figure 3** depicts the hydrograph for the East Branch Swift River as measured at the horseshoe dam located at the outlet of Pottapaug Pond. As shown in **Figure 3**, the flow in the East Branch Swift River was generally lower than the 76-year historical mean daily flow until mid-May, and then rose with above-average precipitation in May and June. Stream flow fell below the historical mean daily flow with drier conditions in the fall. Except for June, when a new maximum was recorded, monthly mean flows remained within the 76-year historical ranges.

The western part of the watershed is principally drained by the West Branch of the Swift River. This 14.10 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 2013, mean daily flows for the West Branch Swift River averaged 21.3 cfs. Monthly mean flow in June 2013 set a new historical maximum value for June of 63.1 cfs.



Source: U.S. Geological Survey website (provisional data accessed June 6, 2014).

Figure 3. East Branch Swift River near Hardwick, MA, January - December 2013

Water from Ware River may supplement Quabbin Reservoir supplies by being diverted into the Quabbin Aqueduct at Shaft 8 in Barre and directed west towards Quabbin Reservoir via gravity flow. Under the authority granted by Chapter 375 of the Massachusetts Acts of 1926, DCR is limited in the diversion of water from the Ware River to a 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 2013, Ware River transfers to Quabbin Reservoir totaled 3,218.7 MG over 22 days intermittently in January through early April. At the USGS stream gage near the Shaft 8 intake works, mean daily flows averaged 161 cfs in 2013.

Daily precipitation has been recorded at the Belchertown monitoring station for 75 years. In 2013, the annual precipitation of 47.82 was above the 75-year annual average of 46.25 inches (DCR, 2013b). Precipitation totals for January (1.79 inches), March (2.04 inches), and April (2.09 inches) were abnormally low, ranking among the lowest 20 percentile compared to the 75-year period-of-record for each respective month. May 2013 (6.04 inches) and June 2013 (8.16 inches) ranked among the highest 20 percentile for each month's historical record. The highest 24-hour rainfall of 2.61 inches occurred on August 10 (DCR, 2013b). Snowfall, with a total of 53.0 inches, was above the 35-year historical average of 48 inches (DCR, 2013b). Average temperature and total precipitation in Massachusetts were above average for the year 2013 compared to the 119-year period of record (NCDC, 2014; NRCC, 2014). Winter 2013 (December 2012 - February 2013) ranked as the fifteenth warmest (NRCC, 2014), with above average precipitation state-wide for the season. Temperature and precipitation were near normal for Spring (March - May) 2013, while Summer (June - August) 2013 ranked as the seventh warmest and sixth wettest on record (NRCC, 2014). Autumn (September - November) 2013 returned to near normal temperatures, but with below normal precipitation. Abnormally dry to moderate drought conditions in Massachusetts were observed in May 2013, ending by mid-June, and in October through early 2014 (DCR, 2014). In contrast to 2012, the 2013 hurricane season saw a total of 13 named storms, no major hurricanes, and just two hurricanes, neither of which made landfall in the U.S. (NCDC, 2014).

2 METHODOLOGY

This report presents water quality data results from routine sampling performed throughout the Quabbin Reservoir and Ware River watersheds. A comprehensive water quality monitoring program helps accomplish the following goals:

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.
3) To identify streams and water bodies that do not attain water quality standards 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 Station Locations

In 2013, 24 surface water monitoring stations were routinely monitored, including all major tributary inflows to Quabbin Reservoir, some minor tributaries flowing to the Quabbin Reservoir or Ware River, and selected locations within the Quabbin Reservoir. **Tables 2 and 3** present drainage area characteristics for the tributary surface water stations, and **Figures 4 and 5** depict locations of all surface water monitoring stations. Of the 24 monitoring stations, 11 stations were located within the Quabbin Reservoir watershed, and 10 tributary stations were located in the Ware River watershed to characterize this supplemental source water supply. As shown in **Figures 4** and **5**, each watershed is divided into sanitary districts, and water quality of each watershed is monitored with "core" sites and "EQA" sites. Core sites are long-term monitoring stations, while Environmental Quality Assessment (EQA) sites support ongoing evaluations of threats to water quality by sanitary district. The remaining three sampling stations are located within the reservoir and are monitored monthly during the months of April through December, weather-permitting, with samples collected from several depths at each location.

Table 2. Quabbin Reservoir Tributaries
2013 Surface Water Monitoring Stations

		Basin Characteristics		
Tributary and Monitoring Station Description	**DCR Sample Site #**	**Drainage Area[3] (sq. miles)**	**% Wetland Coverage[4]**	**% DCR/OWM Owned Land[5]**
CORE SITES [1]				
West Branch Swift River at Route 202	211	12.4	3.4%	45.8%
Hop Brook inside Gate 22	212	4.66	2.5%	38.7%
Middle Branch Swift River at Gate 30	213	9.0	8.2%	22.8%
East Branch of Fever Brook at West Street	215	3.94	11.9%	12.5%
East Branch Swift River at Route 32A	216	30.3	9.5%	1.6%
Gates Brook at mouth	Gates	0.93	3.0%	100%
Boat Cove Brook at mouth	BC	0.15	<1%	100%
FEVER BROOK SANITARY DISTRICT EQA SITES [2]				
West Branch Fever Brook at mouth	215B	4.45	9.0%	25.7%
Harvard Pond at inlet	215H	1.10	6.6%	<1%
East Branch Fever Brook at Camels Hump Road	215G	5.19	11.4%	13.2%
East Branch Fever Brook at road above mouth	215F	7.30	10.0%	25.9%

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: DCR 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: DCR Office of Watershed Management Geographic Information System, January 2014 revision.

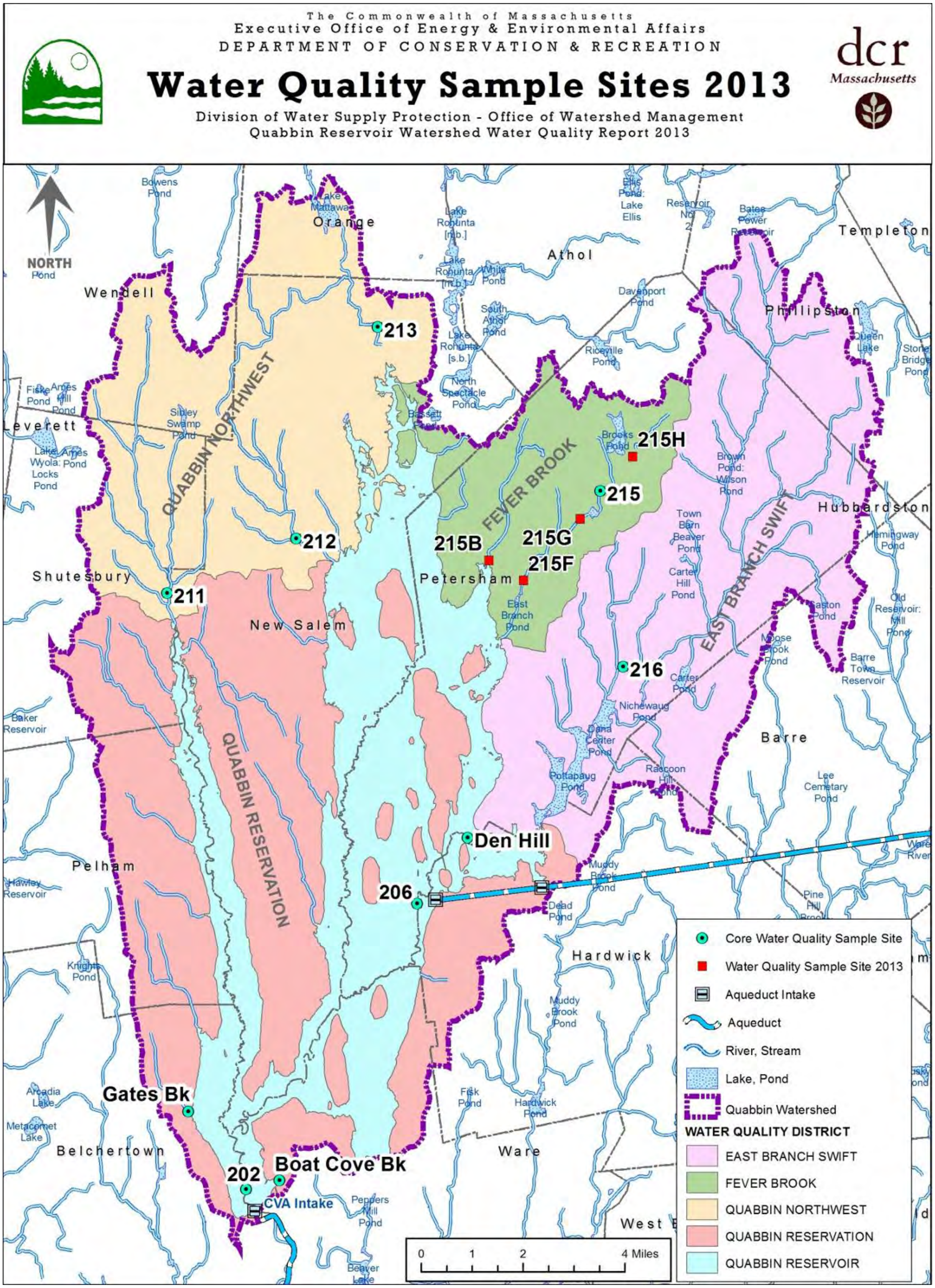


Figure 4. Hydrology, Sanitary Districts, and Water Quality Monitoring Sites for Calendar Year 2013 in the Quabbin Reservoir Watershed

Table 3. Ware River Tributaries
2013 Surface Water Monitoring Stations

		Basin Characteristics		
Tributary and Monitoring Station Description	**DCR Sample Site #**	**Drainage Area[4] (sq. miles)**	**% Wetland Coverage[5]**	**% DCR/OWM 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%
BURNSHIRT, CANESTO, & NATTY SANITARY DISTRICT EQA SITES [3]				
Queen Lake at road culvert below outlet	111	0.75	34.9%	0%
Burnshirt River at Stone Bridge	B4	6.44	19.4%	2.0%
Burnshirt River at Route 62	103	16.8	11.9%	20.7%
Canesto Brook at Williamsville Road	C2	4.58	4.46%	5.36%
Natty Pond Brook at Hale Road	N1	5.21	13.4%	38.4%

Notes:

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

[2]Before May 2007, Thayer Pond was monitored at the outlet (Site 121A). Because of continuous 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: DCR Office of Watershed Management Geographic Information System, April 2009 revision.

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

[6]Source: DCR Office of Watershed Management Geographic Information System, January 2014 revision.

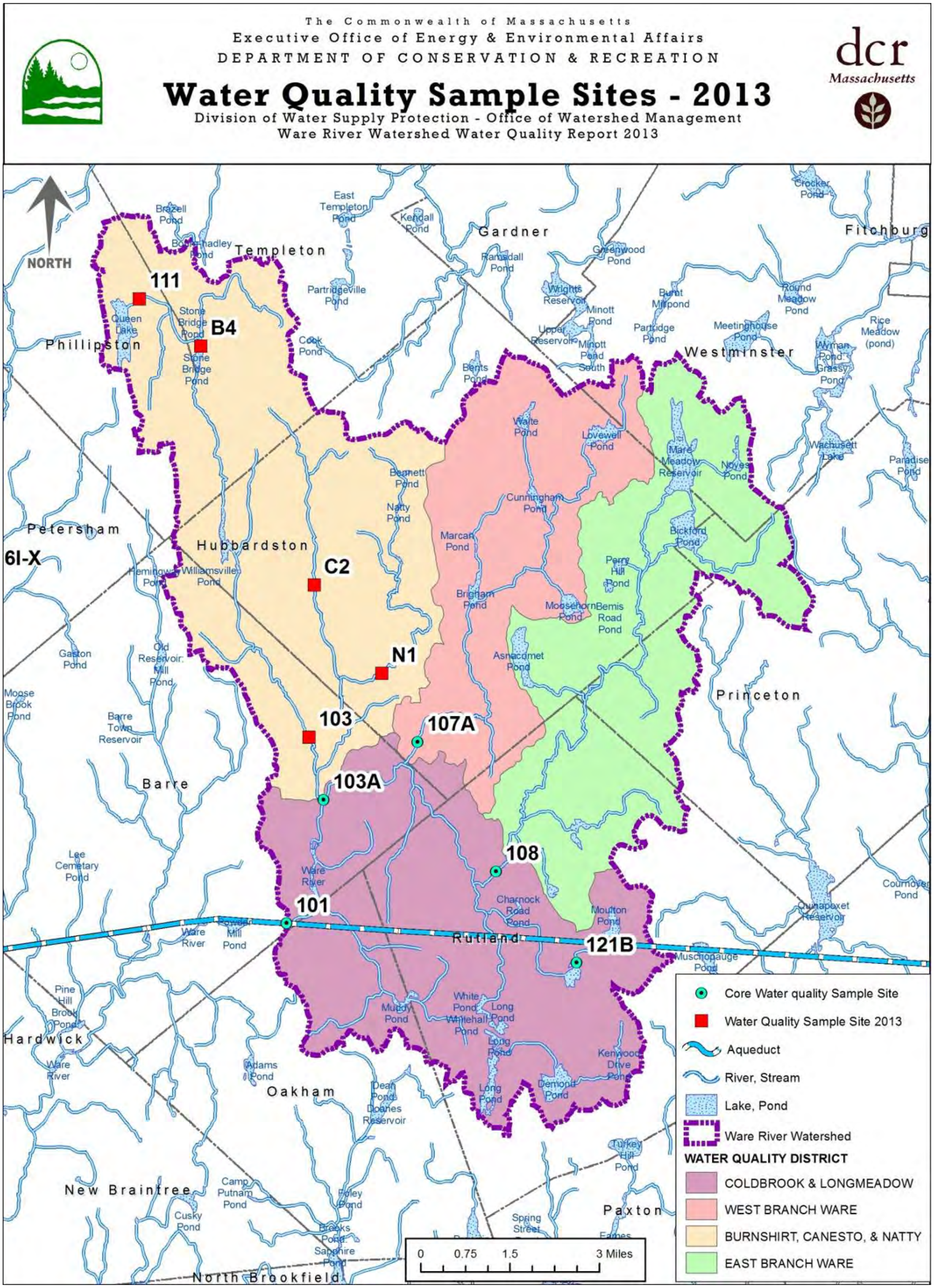


Figure 5. Hydrology, Sanitary Districts, and Water Quality Monitoring Sites for Calendar Year 2013 in the Ware River Watershed

2.2 Data Collection

Each tributary station is sampled biweekly, with sampling runs alternating between the Quabbin Reservoir watershed and the Ware River watershed. Samples are collected by hand early in the work week (typically Tuesday) regardless of weather conditions. The frequency of sampling gives a more complete assessment of tributary health, capturing variations from seasonal flow conditions, as well as both dry and wet weather flows. Tributary stream temperature, dissolved oxygen, pH, and specific conductance levels are determined in the field using a Eureka multiprobe meter. Data are stored digitally using a Eureka Amphibian personal digital assistant (PDA) and transferred to a Microsoft Access database.

In 2013, Quabbin staff collected 2,938 source water (tributary and reservoir) samples. Of those samples, 631 (21 percent) were collected for microbial analysis, 639 (22 percent) for physicochemical properties, and the remaining 1,668 samples (57 percent) were collected for nutrient analysis. Over 5,500 individual analyses were performed on these samples, of which 43 percent were nutrient analyses performed at the MWRA Central Laboratory at Deer Island. The remaining analyses were 41 percent physiochemical parameters (1,291) and 59 percent bacterial analyses (1,893) performed by MWRA staff at Quabbin Laboratory. MWRA staff at Quabbin Laboratory also processed and analyzed 365 microbiological samples collected at the Ware Disinfection Facility. In addition, over 2,100 physiochemical measurements (not including reservoir profiles) were collected in the field by DCR staff using a Eureka Manta Multiprobe. All records are maintained in permanent bound books and in a digital format (Microsoft Access database).

2.3 Analytical Procedures

Water quality parameters routinely analyzed include temperature, pH, alkalinity, dissolved oxygen, specific conductance, turbidity, total coliform bacteria, fecal coliform bacteria and *Escherichia coli* (*E. coli*) bacteria. **Table 4** lists the equipment and laboratory methods employed at Quabbin Laboratory.

Table 4. Quabbin Laboratory: Analytical and Field Methods

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

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

2.4 Measurement Units

Chemical concentrations of constituents in solution or suspension are reported in milligrams per liter (mg/L) or micrograms per liter (μg/L). Milligrams per liter is a unit expressing the concentration of chemical constituents in solution as weight (milligrams) of solute per unit of volume of water (liter). One milligram per liter is equivalent to 1,000 micrograms per liter. Bacteria densities are reported as number of presumptive colony forming units per 100 milliliters of water (CFU/100 mL) or, for methods using the enzyme substrate procedure, most probable number (MPN/100 mL). The following abbreviations are used in this report:

cfs	Cubic feet per second
CFU	Colony forming unit
MGD	Million gallons per day
MPN	Most probable number
NTU	Nephelometric turbidity units
PPM	Parts per million (1 mg/L ≈ 1 PPM)
TKN	Total Kjeldahl nitrogen
μS/cm	Microsiemens per centimeter
μmhos/cm	Micromhos per centimeter (1 μmhos/cm = 1 μS/cm)
UV_{254}	Ultraviolet absorbance at 254 nanometers

2.5 Monitoring Program Changes

Significant changes were made to the Quabbin tributary monitoring program beginning in 2005 (See DCR, 2006). The most significant change involved the establishment of special sample sites to provide supportive information for Environmental Quality Assessments (EQAs; previously also known as sanitary surveys) in selected sanitary districts of the Quabbin Reservoir and Ware River watersheds. At these "EQA" sites, data are collected biweekly on bacteria levels, physicochemical parameters, and nutrient levels for one to two years. Sampling for 2013 focused on the Fever Brook Sanitary District in the Quabbin watershed, as well as the Burnshirt, Canesto, and Natty Sanitary District in the Ware River watershed. The EQA sites for 2013, along with selected basin characteristics for each site, are listed in **Tables 2** and **3**.

The tributary sampling program maintains several long-term, "core" sites located on primary tributaries inside of each watershed (Quabbin and Ware River). These core sites are important because they capture significant flow information, and long-term historical data will continue to be maintained. For core sites, Quabbin Reservoir watershed sites include West Branch Swift River at Route 202, Hop Brook inside Gate 22, Middle Branch Swift River at Gate 30, East Branch Fever Brook at West Street, East Branch Swift River at Route 32A, and at the mouth of Gates Brook and Boat Cove Brook. Within the Ware River watershed, the core sites include Burnshirt River at Riverside Cemetery, West Branch Ware River at Brigham Road, East Branch

Ware River at Intervale Road, Thayer Pond inlet, and Ware River below the Shaft 8 intake. As of May 2007, the Thayer Pond sampling site was relocated from the pond outlet to the inlet because of continuous beaver activity at the outlet. Selected basin characteristics for each site are summarized in **Tables 2** and **3**.

For the reservoir monitoring program, routine plankton monitoring was implemented in September 2007, following odor complaints on the CVA water, an increase in chlorine demand at the Ware Disinfection Facility, and increasing numbers of smelt at the intake screens in August 2007. The plankton monitoring program includes sampling at 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 10-meter depths during non-stratified conditions. Sampling is conducted, weather and reservoir conditions permitting, twice per month from May through September and once per month from October through April. Calcium monitoring was started in 2010 at the three in-reservoir sampling stations (Site 202, Site 206, and Den Hill) to evaluate risk of aquatic invasive organisms colonization (e.g., zebra mussels). Begun on a monthly basis at three depths, calcium monitoring was reduced to a quarterly frequency at one depth because of the low concentrations and low variability at these in-reservoir sampling stations. Future calcium monitoring should focus more on coves where calcium concentrations may be higher.

2.6 Special Sampling During 2013

In 2013, special sampling was conducted to provide turbidity levels prior to, during, and/or after logging operations. See Section 3.3 for description of water quality monitoring for forestry operations. Summary reports for lots FL2042 and FL2043 are included in **Appendix A**.

3 RESULTS – SOURCE WATER QUALITY MONITORING

The U.S. EPA promulgated the Surface Water Treatment Rule (SWTR) in 1989 to ensure that public water supply systems using surface waters were providing safeguards against the contamination of water by viruses and other microbial pathogens such as *Giardia lamblia*. The regulations in effect 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 a surrogate parameter, turbidity, and an indicator organism, fecal coliform bacteria, to provide a relative measure of the sanitary quality of the water. 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.

The DCR and MWRA have maintained a waiver from the filtration requirement since 1989. To ensure compliance with the filtration waiver, the MWRA monitors daily the bacterial quality of Quabbin Reservoir water at a point prior to disinfection located inside the Ware Disinfection Facility. **Figure 6** depicts daily fecal coliform bacteria levels for July 2012 through December 2013. In 2013, fecal coliform bacteria averaged less than one colony per 100 mL and were not detected 79 percent of the time; median concentration was less than one colony per 100 mL. The maximum level, 72 colonies per 100 mL, occurred on January 31, most likely from gulls roosting on the reservoir. Except for that one instance, fecal coliform concentrations remained below 20 colonies per 100 mL in 2013. From July 2012 through December 2013, concentrations exceeded 20 colonies per 100 mL three times, all of which occurred within five weeks during winter, for a maximum of 1.63 percent exceeding the SWTR standard in any 6-month period. The 6-month running average of fecal coliform concentrations peaked at 1.39 colonies per 100 mL.

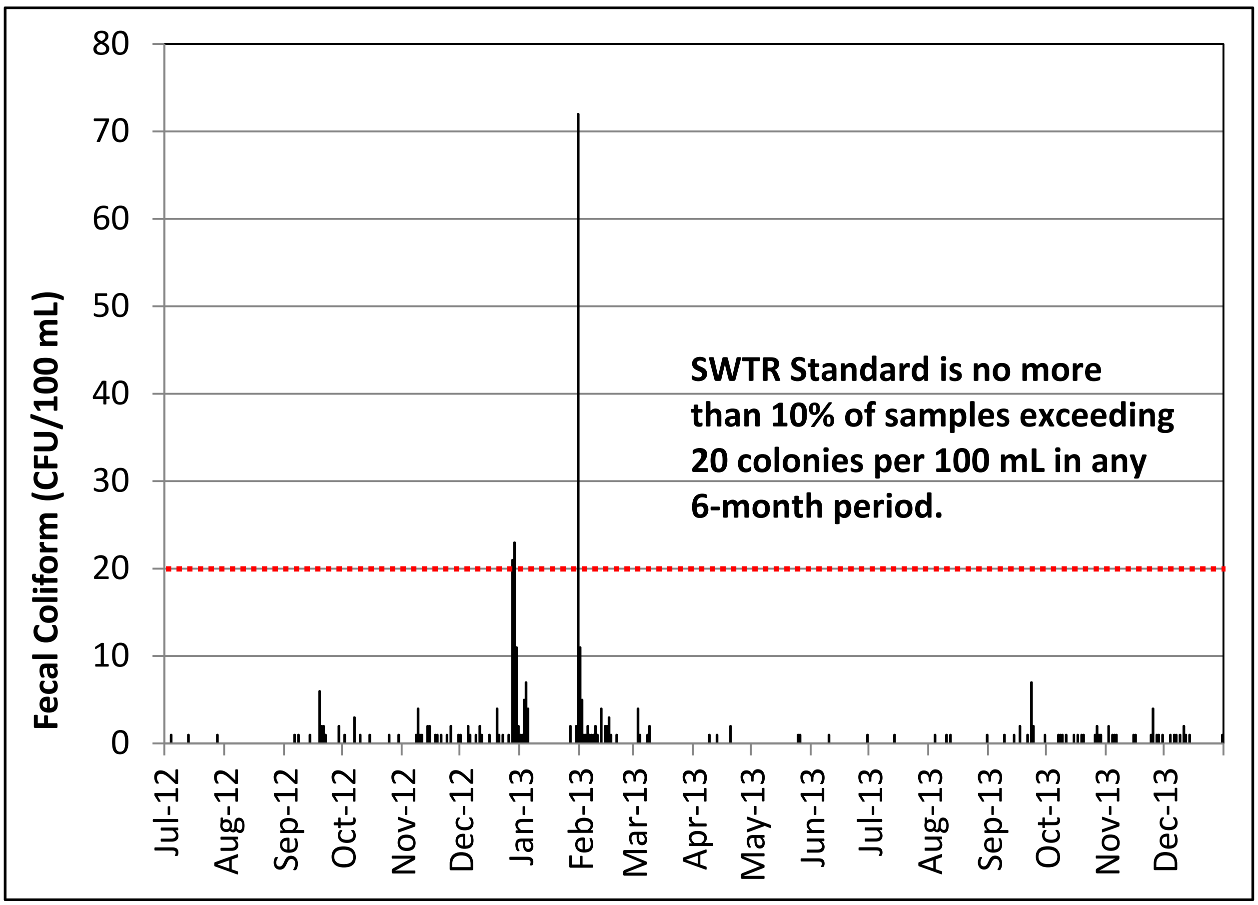


Figure 6. Fecal Coliform Bacteria Concentration prior to Disinfection, Quabbin Reservoir Source Water

For turbidity, the U.S. EPA SWTR standard is 5.0 NTU, while the Massachusetts Department of Environmental Protection (DEP) has adopted a more stringent performance standard of 1.0 NTU. MWRA monitors turbidity levels prior to disinfection using an on-line turbidity meter located inside the Ware Disinfection Facility. **Figure 7** depicts daily maximum and average turbidity levels for 2013 and includes a horizontal line marking the 1.0 NTU performance standard. For 2013, turbidity levels averaged 0.27 NTU, with the maximum turbidity of 1.12 NTU observed on February 9, a wind-driven event during Storm Nemo (MWRA, 2013). Turbidity at the Ware Disinfection Facility otherwise remained below 1.0 NTU and met source water requirements throughout 2013.

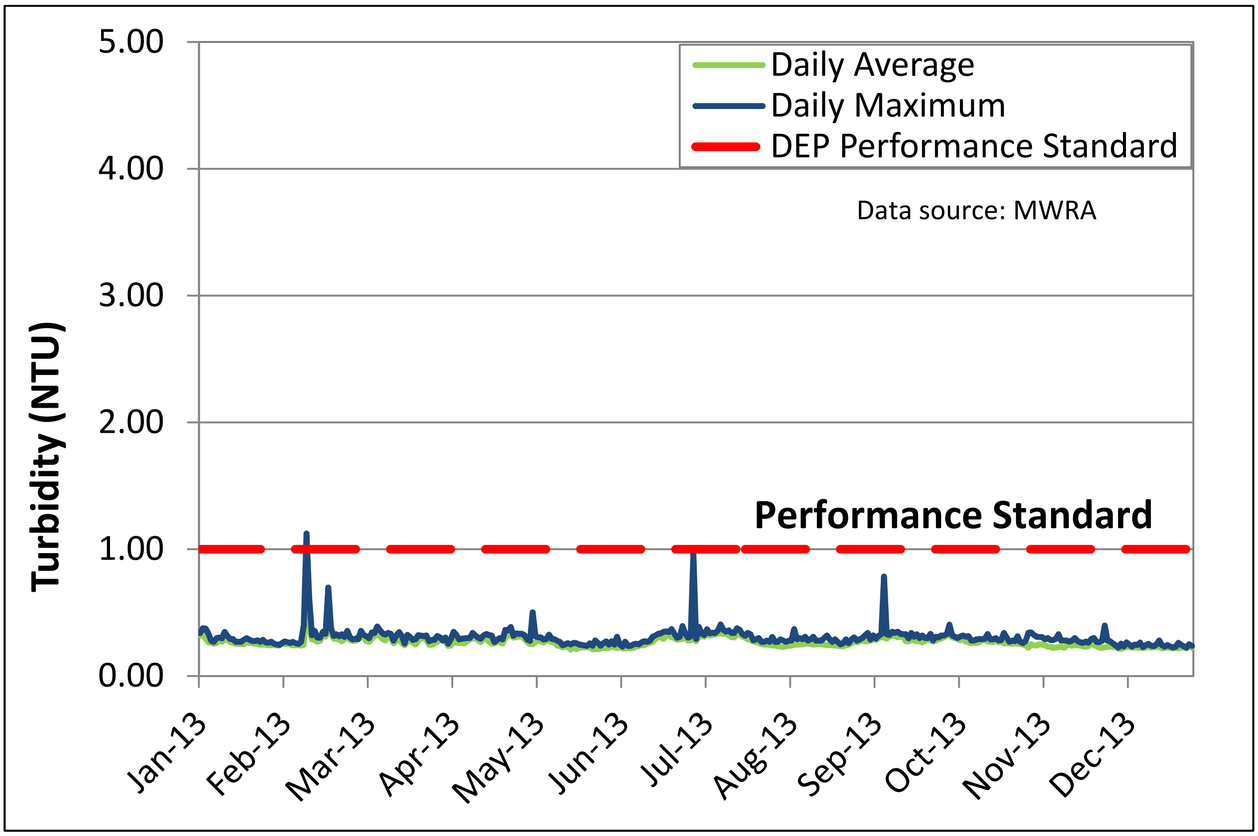


Figure 7. Quabbin Reservoir Source Water Turbidity (at Ware Disinfection Facility)

Giardia and *Cryptosporidium* monitoring on source water prior to disinfection is conducted biweekly. From January 2004 through January 2007, samples were collected from a tap located inside the Winsor Power Station. As of February 6, 2007, the sampling location was changed to a tap inside the Ware Disinfection Facility, partly because of valve repair work at the power station and because the disinfection facility is a better sampling location. *Giardia* and *Cryptosporidium* are of concern because their cysts have a high resistance 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. Sample collection and analysis follows protocols established under EPA

Method 1623. In 2013, 28 samples were collected by MWRA staff, and *Giardia* and *Cryptosporidium* were not detected in any samples. MWRA maintains a trigger level of 10 cysts per 100 L, above which MWRA notifies the Department of Public Health. Additional pathogen sampling is scheduled to continue for the next year to comply with the Long Term 2 Surface Water Treatment Rule, which was promulgated in January 2006. This rule establishes levels of treatment for *Cryptosporidium* based on mean levels detected in monitoring results.

3.1 Results – Reservoir Monitoring

Reservoir water quality data, collected by the DCR, documents consistently reliable source water quality that fully meets the stringent source water quality criteria stipulated under the Surface Water Treatment Rule. Water quality data are collected monthly except during periods of adverse weather and ice conditions in the winter. Three sampling stations that were routinely sampled in 2013 are profiled in **Table 5**. **Figure 4** may be referenced for the specific locations of each sample site.

Table 5. 2013 Quabbin Reservoir Water Quality Monitoring Sites

Site (Site ID)	Location	Latitude Longitude	Approximate Bottom Depth
Winsor Dam (QR202)	Quabbin Reservoir west arm, off shore of Winsor Dam along former Swift River riverbed.	N 42°17.115´ W 72°20.938´	42 meters
Shaft 12 (QR206)	Quabbin Reservoir at site of former Quabbin Lake, off shore of Shaft 12.	N 42°22.268´ W 72°17.015´	30 meters
Den Hill (QR10)	Quabbin Reservoir eastern basin, north of Den Hill	N 42°23.386´ W 72°16.008´	19 meters

Reservoir water inside the three distinct reservoir basins is sampled monthly from April through December, weather permitting. Water samples are collected at depth using a Kemmerer bottle, and samples are analyzed at Quabbin Laboratory for turbidity, alkalinity, and bacteria. Samples for total and fecal coliform bacteria are taken at the surface (0.5 meter), 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 grab samples are taken at the surface (0.5 meter), mid-depth, and within 2 to 3 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 to 3 meters of bottom). Weather and reservoir conditions are recorded on each survey. A standard 20-centimeter diameter, black-and-white Secchi disk is used to measure transparency.

Water column profiles of temperature, pH, dissolved oxygen, and specific conductance 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 B** 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. Quarterly sampling for nutrients was 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). The MWRA Central Laboratory provided analytical support for the measurement of total phosphorus, total Kjeldahl nitrogen, nitrate, ammonia, UV_{254}, silica, and calcium.

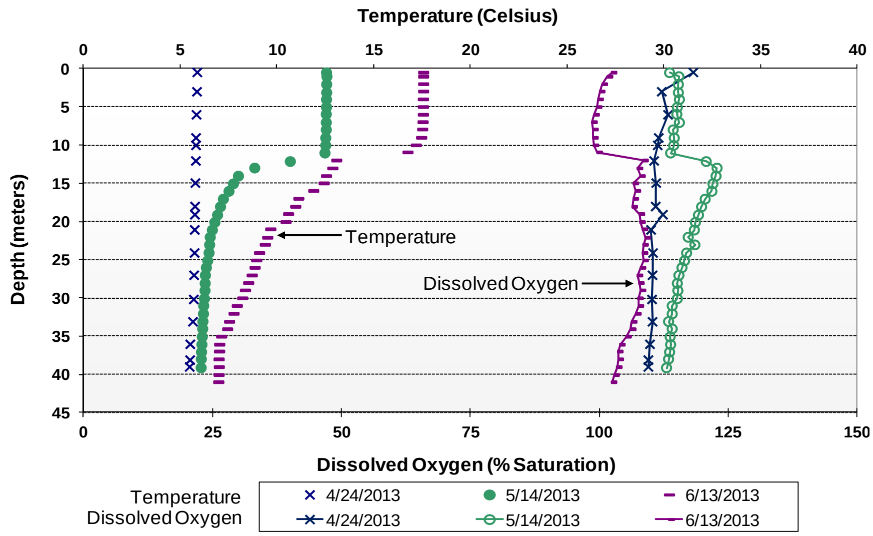
Table 6 presents an overview of reservoir water quality conditions at three stations routinely monitored in 2013. The complete data for individual stations are included in **Appendix C**. Provided below is a brief discussion of selected monitoring parameters and their significance to reservoir water quality conditions.

Table 6. General Water Chemistry Ranges, 2013 Quabbin Reservoir Monitoring Stations.

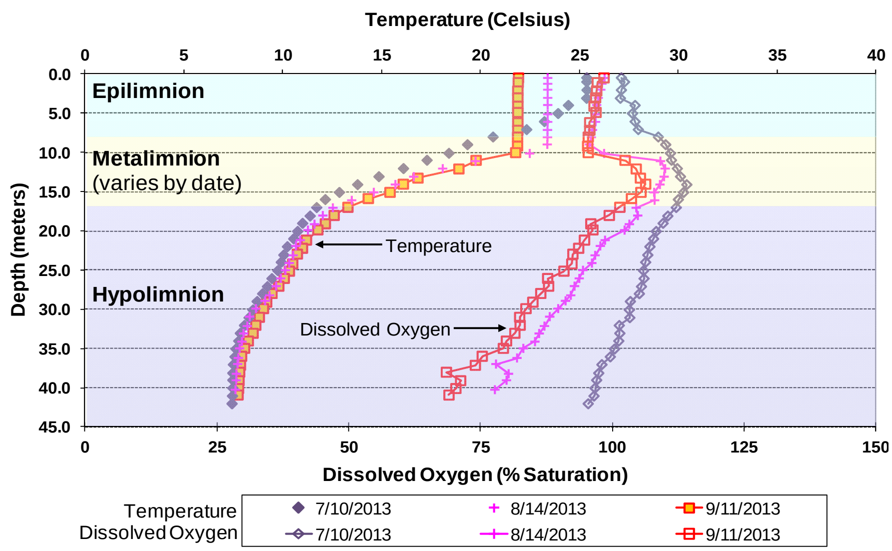
Reservoir Station (Site ID)	**pH (Field)** (units)	**Turbidity** (NTU)	**Dissolved Oxygen** (% Saturation)	**Secchi Disk Transparency** (meters)	**Total Coliform Bacteria** (MPN/100mL)	**Fecal Coliform Bacteria** (CFU/100mL)
Winsor Dam (QR202)	5.5-7.0	0.19-0.37	57-123	9.4-12.5	<10-1,850	<1-1
Shaft 12 (QR206)	5.6-6.8	0.23-0.43	62-117	7.4-12.2	<10-2,140	<1-1
Den Hill (QR10)	5.4-6.8	0.31-0.79	12-111	5.1-8.6	<10-650	<1-1

3.1.1 Temperature

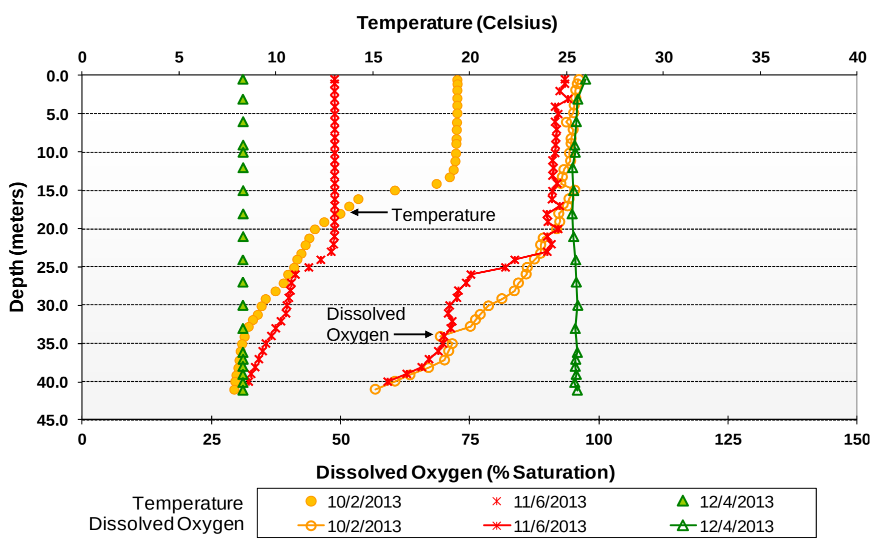
The thermal stratification that occurs in the reservoir has a profound impact on many of the parameters monitored across the reservoir profile. The temporal zones that develop within the reservoir during the warmer months of spring and summer, known as the epilimnion, metalimnion and hypolimnion (listed in order from top to bottom), have distinct thermal, water flow and water quality characteristics. 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 much 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. Profile data collected at Station 202 (Winsor Dam) are shown in **Figure 8** to graphically portray the thermal mixing and transition that occurs between isothermal and fully mixed to fully stratified conditions. Fall turnover probably occurred in early to mid-November, based on the temperature profiles for Station 202 and Station 206 (Shaft 12). The water column at each location was completely mixed to 13-15 meters depth on October 2 and 23-26 meters depth (fully mixed at Station 206) on November 6. Station 202 was fully mixed by December 4.



(a) April - June 2013



(b) July - September 2013



(c) October - December 2013

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

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 re-aeration factors 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 ultimately settle and re-mix the reservoir. In 2013, minimum levels of oxygen reached in the hypolimnion ranged from a low of 12 percent saturation at the Den Hill station to 62 percent saturation at the bottom depths at Station 206. Depletion levels are generally most pronounced in the latter stages of stratification (typically August through October). Dissolved oxygen reached a minimum of 6.65 mg/L at Station 202, 6.80 mg/L at Station 206, and 1.27 mg/L at Den Hill, all in the October 2013 monthly sampling. The seasonal development and breakdown of lake stratification are depicted in temperature and dissolved oxygen profiles shown in **Figure 8**. Complete profile data for all three reservoir monitoring stations are included in **Appendix B**.

3.1.3 Turbidity

Reservoir turbidity levels are historically very low and stable, reflective of the low productivity of the reservoir. In-reservoir turbidity levels monitored in 2013 ranged from 0.19 to 0.79 NTU. The highest turbidity measurement occurred in the deep sampling station at Den Hill, on September 11. Storm activity may have increased turbidity, with 0.18 inch of rainfall recorded at Barre Falls Dam in the day prior to reservoir sampling. Other typical causes of turbidity in the reservoir include algal blooms or shoreline erosion. From time to time, algae blooms may impart color and suspended organic particulates that will elevate levels of turbidity. Near-shore areas are also prone to elevated turbidity levels due to the action of waves that may resuspend shoreline sediment and deposits.

3.1.4 pH and Alkalinity

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. 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 6.19 across the three stations monitored in 2013.

Alkalinity serves as a water body's principal defense by neutralizing the effects of pH. Both pH and alkalinity have a long-term record of stability in the Quabbin Reservoir, but levels will fluctuate due to reservoir dynamics. Fluctuations may be caused through respiration by organisms as oxygen is consumed and carbon dioxide is released. The result will be an increase in alkalinity due to the input of carbon to the water. Photosynthetic activity in the epilimnion and metalimnion can decrease alkalinity and increase pH due to the consumption of free carbon dioxide and bicarbonate. Reservoir alkalinity is low and averaged 3.75 mg/L as $CaCO_3$ across the three reservoir stations with very little variation observed at depth. (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. If reporting alkalinity at pH 4.5, which was the method used historically, reservoir alkalinity averaged 5.53 mg/L as $CaCO_3$ across the three reservoir stations.)

3.1.5 Secchi Disk Transparency

Quabbin reservoir water has excellent clarity and visibility as evidenced by maximum Secchi disk readings that may approach 13 meters. Transparency is determined as the depth below the surface at which a 20-centimeter, black-and-white disk becomes indistinguishable to the naked eye. 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 2013, transparency was measured at a maximum of 12.5 meters at Site 202 on December 4.

Transparency at the Den Hill station is characteristically much lower, typically reflecting the contribution of large, nearby river inputs of the East Branch Swift and the Ware River (when diverting). The East Branch Swift River, estimated to contribute as much as 9 to 16 percent of the annual flow to the reservoir, is a significant source of color that reduces transparency. In 2013, transparency was measured at a minimum of 5.1 meters at Den Hill on November 6. Monthly transparency measurements and weather observations are noted in **Tables 7, 8,** and **9**.

Table 7. Transparency Measurements and Weather and Water Surface Observations in 2013, Quabbin Reservoir Site 202 (Winsor Dam).

Date	Transparency (m)	Water Color	Weather and Water Surface Observations
April 24, 2013	9.6	Blue-green	Overcast, 6°C (43°F), N wind 8 mph, 6" chop.
May 14, 2013	12.4	Blue-green	Mostly sunny, 11°C (52°F), N wind 5 mph, 5" chop.
June 13, 2013	10.4	Blue-green	Overcast with light rain, 14°C (57°F), NW wind 1 mph, 1" ripple.
July 10, 2013	9.4	Blue-green	Overcast, 24°C (75°F), S wind 4 mph, 4" ripple.
August 14, 2013	12.1	Green	Mostly sunny, 15°C (59°F), W wind 2 mph, 2" ripple.
September 11, 2013	10.6	Blue-green	Overcast with fog, 24°C (75°F), calm wind, calm water surface.
October 2, 2013	11.8	Blue-green	Mostly sunny, 23°C (73°F), W wind 0-1 mph, calm water surface.
November 6, 2013	10.5	Dark Green	Cloudy, 10°C (50°F), SW wind 1 mph, slight ripple.
December 4, 2013	12.5	Green	Mostly cloudy, 0°C (32°F),SE wind 1 mph, slight ripple.

Table 8. Transparency Measurements and Weather and Water Surface Observations in 2013, Quabbin Reservoir Site 206 (Shaft 12).

Date	Transparency (m)	Water Color	Weather and Water Surface Observations
April 24, 2013	10.9	Green	Sunny, 11°C (52°F), N wind 1 mph, slight ripple.
May 15, 2013	11.1	Green	Mostly sunny with high thin clouds, 13°C (55°F), S wind 5 mph, 6" chop.
June 13, 2013	9.9	Blue-green	Overcast with light rain, 15°C (59°F), calm wind, calm water surface.
July 10, 2013	10.3	Blue-green	Overcast, 24°C (75°F), SE wind 5 mph, 5" ripple.
August 14, 2013	12.2	Blue-green	Mostly cloudy, 16°C (61°F), W/NW wind 7 mph, 8" chop.
September 11, 2013	8.4	Green	Partly sunny, hazy, 25°C (77°F), S wind 2-3 mph, 6" chop.
October 2, 2013	7.5	Blue-green	Mostly sunny, 20°C (68°F), S wind 3 mph, 4" chop.
November 6, 2013	7.4	Green	Partly sunny, 10°C (50°F), SW wind 10 mph, 12" chop.
December 4, 2013	11.6	Green	Mostly cloudy and cool, 3°C (37°F), NE wind 1 mph, slight ripple.

Table 9. Transparency Measurements and Weather and Water Surface Observations in 2013, Quabbin Reservoir Site Den Hill

Date	Transparency (m)	Water Color	Weather and Water Surface Observations
April 24, 2013	6.1	Brown	Sunny, 12°C (54°F), SW wind 3 mph, 3” ripple.
May 15, 2013	6.4	Yellow-green	Cloudy, 15°C (59°F), SW wind 5-8 mph, 6-8” chop.
June 13, 2013	6.8	Blue-green, slightly brown	Overcast with light rain, 16°C (61°F), calm wind, calm water surface.
July 10, 2013	6.7	Brown	Overcast, 27°C (81°F), S wind 1 mph, very slight ripple.
August 14, 2013	6.5	Green	Mostly cloudy, 18°C (64°F), NW wind 7 mph, 6” chop.
September 11, 2013	7.0	Green	Sunny, hazy, 27°C (81°F), SW wind 1-2 mph, 4” chop.
October 2, 2013	8.0	Green	Mostly sunny, 24°C (75°F), SW wind 2 mph, 3” ripple.
November 6, 2013	5.1	Brown-green	Mostly sunny, 14°C (57°F), SW wind 7 mph, 6” chop.
December 4, 2013	8.6	Olive green	Mostly sunny, 4°C (39°F), N wind 2 mph, slight ripple.

3.1.6 Coliform and *E. coli* Bacteria

The term “coliform” is used to describe a group of bacteria based on biochemical functions and not on taxonomy. Both “total” coliform and “fecal” coliform bacteria have been used as indicators of fecal contamination, although total coliforms may include many species that are natural inhabitants of the aquatic system and the environment (Wolfram, 1996; Dutka and Kwan, 1980). The so-called “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, the term “fecal” coliform is somewhat of a misnomer, as some bacteria within this grouping may originate from environmental sources rather than fecal contamination (Toranzos and McFeters, 1997; Leclerc *et al.*, 2001). *E. coli* bacteria, which are normal inhabitants of the intestinal tracts of humans and other warm-blooded animals, are a better indicator of recent fecal pollution in temperate climates.

During 2013, in-reservoir coliform bacteria levels were monitored monthly at the routine reservoir stations beginning on April 24 and ending on December 4. Grab samples were collected from the surface (0.5 meter), 6-meter depth, and from the respective water supply intake depth at the two deep basin sites (Shaft 12 and Winsor Dam). At Den Hill, the deep sample is collected at 13 meters. In 2013, fecal coliform bacteria were detected in several reservoir samples, at a concentration of 1 colony per 100 mL. For Station 202, fecal coliform bacteria were detected in 0.5-meter and 6-meter samples in April, the 6-meter sample in July, and all three depths (0.5, 6, and 18 meters) in December. For Station 206, fecal coliforms were detected in the deep (24-meter) sample in April and were otherwise not detected. For the Den Hill station, fecal coliforms were detected in only one sample in 2013, the deep (13-meter) sample in December. *E. coli* were detected twice at the detection limit of 10 MPN/100 mL, for Station 202 samples at 6 meters in October and 18 meters in November. A seasonal gull population that roosts on the reservoir overnight has been identified as the primary contributor of fecal coliform 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 (reported on the magnitude of several years), fecal coliform and *E. coli* bacteria levels are normally very low, reflecting die-off and predation that occurs naturally.

Reservoir total coliform bacteria concentrations are much more dynamic, ranging from not detected (less than 10) to 2,140 colonies per 100 mL in 2013. The total coliform concentration of 2,140 MPN/100 mL was measured in the 6-meter sample from Station 206 on September 11, 2013. Because of the more ubiquitous nature of the total coliform bacteria, fecal coliform and *E. coli* are the preferred indicators for regulatory and monitoring purposes. This approach is consistent with the EPA Surface Water Treatment Rule which specified that when both total and fecal coliform bacteria are analyzed, the fecal coliform findings have precedent.

3.1.7 Reservoir Phytoplankton and Nutrient Dynamics

The nutrient database for Quabbin Reservoir established in the 1998-99 year of monthly sampling and subsequent quarterly sampling through 2012 is used as a basis for interpreting data generated in 2013 (see **Table 10**). Results of quarterly nutrient sampling in 2013 registered near the lower end of historical ranges. In particular, ammonia concentrations were near or below the detection limit of 5 µg/L (0.005 mg/L) in epilimnion and metalimnion samples at Station 202, all three depths at Station 206, and most epilimnion and metalimnion samples at Den Hill. Total phosphorus concentrations were below the detection limit of 5 µg/L (0.005 mg/L) in most samples at Station 202 and 206, and in all samples for December. Such low ammonia and phosphorus concentrations may be factors limiting growth of phytoplankton in 2013, continuing a trend from 2009. 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 2013 quarterly samples were comparable to those documented previously in the 2000 report on Quabbin nutrient and plankton dynamics. 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

Table 10. Quabbin Reservoir Nutrient Concentrations:
Comparison of Ranges from 1998-2012 Database to Results from 2013 Quarterly Sampling (after Worden, 2013)

Sampling Station	Ammonia (NH3; ug/L)		Nitrate (NO3; ug/L)		Silica (SiO2; mg/L)		Total Phosphorus (ug/L)		UV254 (Absorbance/cm)	
	1998-2012	Quarterly 2013	1998-2012	Quarterly 2013	1998-2012	Quarterly 2013	1998-2012	Quarterly 2013	1998-2012	Quarterly 2013
WD/202 (E)	<5 - 16	<5 - 7	<5 - 23	<5 - 10	0.84 - 2.40	1.64 - 1.83	<5 - 20	<5 - 5	0.017 - 0.029	0.019 - 0.022
WD/202 (M)	<5 - 29	<5	<5 - 27	<5 - 8	0.83 - 2.42	1.54 - 1.83	<5 - 13	<5	0.017 - 0.031	0.019 - 0.024
WD/202 (H)	<5 - 53	<5 - 15	<5 - 54	6 - 26	1.08 - 2.86	1.82 - 2.08	<5 - 44	<5 - 9	0.017 - 0.026	0.019 - 0.020
MP/206 (E)	<5 - 10	<5 - 7	<5 - 20	<5	0.84 - 2.24	1.43 - 1.74	<5 - 12	<5	0.017 - 0.031	0.019 - 0.023
MP/206 (M)	<5 - 34	<5	<5 - 44	<5	0.84 - 2.25	1.42 - 1.71	<5 - 12	<5 - 6	0.017 - 0.031	0.020 - 0.023
MP/206 (H)	<5 - 105	<5 - 6	<5 - 130	<5 - 13	1.02 - 3.27	1.67 - 1.87	<5 - 19	<5 - 6	0.018 - 0.031	0.019 - 0.021
Den Hill (E)	<5 - 19	<5 - 9	<5 - 45	<5 - 12	0.74 - 4.64	1.49 - 2.43	<5 - 27	<5 - 10	0.025 - 0.122	0.038 - 0.069
Den Hill (M)	<5 - 28	<5 - 9	<5 - 58	<5 - 12	0.84 - 4.37	1.62 - 2.50	<5 - 15	<5 - 6	0.027 - 0.139	0.037 - 0.060
Den Hill (H)	<5 - 84	7 - 16	<5 - 78	12 - 22	0.83 - 4.25	1.90 - 2.91	<5 - 15	<5 - 7	0.028 - 0.171	0.038 - 0.053

Notes: (1) 1998-2012 database composed of 1998-99 year of monthly sampling and subsequent quarterly sampling conducted through December 2012, except for measurement of UV254 initiated in 2000 quarterly sampling.
(2) 2013 quarterly sampling conducted May, July, October, and December.
(3) Water column locations are as follows: E = epilimnion/surface, M = metalimnion/middle, H = hypolimnion/bottom

metalimnion) and decomposition of sedimenting organic matter in the tropholytic zone (higher concentrations accumulating in the hypolimnion); 2) a lateral gradient in silica concentrations correlated to hydraulic residence time and mediated by diatom population dynamics; and 3) variably higher concentrations and intensities at the Den Hill monitoring station due to the loading effects of the East Branch Swift River.

Routine monitoring of phytoplankton was implemented in September 2007, with samples collected from two depths at Station 202 and Station 206. Samples are collected, weather and reservoir conditions permitting, twice per month in May through September and once per month in other months. In 2013, samples were collected according to this schedule, including a mild winter early in the year. Based on routine sampling in 2013, the most prevalent phytoplankton included the diatoms *Asterionella*, *Cyclotella*, and *Rhizosolenia*; the chlorophyte (green alga) *Gloeocystis*; and the cyanophytes (blue-green alga) *Microcystis and Aphanocapsa*. The phytoplankton species observed in Quabbin Reservoir are “typical of many oligotrophic, softwater systems located in the temperate zone” with low densities in 2013, averaging about 197 ASUs per mL at Site 202 and 171 ASUs per mL at Site 206 (Packard, 2014; see **Appendix A**). Diatoms dominated early in the year at Site 202, reaching 523 ASUs per mL in the 3-meter sample on April 24, and declined steadily thereafter. At Site 206, diatom density was surpassed by the chrysophyte *Dinobryon*, a potential taste and odor concern; no complaints were received, and *Dinobryon* decreased in subsequent sampling. Similar to the summer of 2012, phytoplankon densities were very low in July 2013 at both sites, with a minimum of 22 ASUs per mL in Site 202 and 39 ASUs per mL in Site 206. Cyanophyte density began increasing at both sites in late July, reaching a maximum of 414 ASUs per mL at Site 202 in December. Plankton monitoring is proposed to continue with the same schedule and locations in 2014.

Calcium analysis was added to the reservoir monitoring program in 2010. Because calcium varied little with depth and in monthly sampling during 2010 through 2011, sampling frequency was reduced from monthly to quarterly starting in 2012, and just one sample was collected, around mid-depth, per reservoir station. In quarterly sampling for 2013, calcium concentrations ranged from 1.94 mg/L to 2.44 mg/L at the three reservoir sites. See **Appendix C** for all reservoir data in 2013.

3.1.8 Calcium in Quabbin Reservoir Coves

In July 2009, zebra mussels were detected for the first time in Massachusetts, at Laurel Lake in the towns of Lee and Lenox. To assess risk of zebra mussel survival in coves of Quabbin Reservoir, water samples were collected in April 2011 for analysis of calcium, hardness, and alkalinity (see 2011 Water Quality Report for results of this sampling). Calcium concentrations ranged from 1.82 to 3.17 mg/L, below the apparent threshold of 8-12 mg/L, above which zebra mussels have survived (Hincks and Mackie, 1997; Jones and Ricciardi, 2005; Whittier *et al.*, 2008). Calcium concentrations in Quabbin Reservoir coves were also below the apparent threshold of 6 mg/L for Asian clams (Wittmann *et al.*, 2009). Greater efforts are needed to ensure that Quabbin Reservoir and its tributaries are protected from the spread of all invasive species, not just zebra mussels. See **Appendix A** for summary reports on the Quabbin boat inspection and boat ramp monitor programs, as well as aquatic macrophyte monitoring, in 2013.

Calcium results from routine monitoring of Quabbin Reservoir were summarized in Section 3.1.7, under ***Reservoir Phytoplankton and Nutrient Dynamics***. Results from routine tributary monitoring are discussed in Section 3.2.10, under ***Tributary Nutrient Dynamics***.

3.2 Results – Tributary Monitoring

Monitoring of tributary water quality is not required by the SWTR or other regulations. However, routine monitoring of the tributaries does serve 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, available at www.mass.gov/dcr/watersupply/watershed/dwmwq.htm, can help guide ongoing data evaluation in the Quabbin Reservoir and Ware River watersheds.

3.2.1 Bacteria

Historically, total and fecal coliform concentrations have been used as indicators of sanitary quality. Until 2007, Massachusetts Class A surface water quality standards stated that “fecal coliform concentrations shall not exceed an arithmetic mean of 20 colonies per 100 mL in any representative set of samples, nor shall more than 10% of the samples exceed 100 colonies per 100 mL” (314 CMR 4.05(3)(a)4.). Since then, the Class A bacterial standard has been revised to differentiate between water supply intakes, where fecal coliform concentrations “shall not exceed 20 fecal coliform organisms per 100 mL in all samples in any six month period,” and other Class A waters, which rely instead on *E. coli* bacteria as the indicator of sanitary quality. Water quality monitoring in the Quabbin Reservoir and Ware River tributary sites includes total coliform and fecal coliform bacteria, along with *E. coli* bacteria. The bacterial results for tributary sites are discussed below.

3.2.1.1 E. coli Bacteria

In 2013, the E. coli results ranged from less than 10 MPN/100 mL to 19,900 MPN/100 mL. The maximum concentration, recorded for Boat Cove Brook on July 23, occurred following heavy rainfall (0.34 inch by 7 AM, July 23, and 1.87 inches by 7 AM, July 24, reported at Belchertown) and high flow on the day of sampling, which likely flushed bacteria into the stream. Elevated bacterial counts were observed at several sites during this storm, following eight days of no rainfall, resulting in new maximum values at Sites 211, 212, and 213, along with Boat Cove

Brook. In addition, the Boat Cove Brook result of 19,900 MPN/100 mL was the highest recorded for *E. coli* in the Quabbin or Ware River watersheds since *E. coli* monitoring began in November 2005.

New historical maximum records for *E. coli* were also set at Site 215H in the Quabbin watershed and at Sites B4, 103, C2, and N1 in the Ware River watershed. At Site 215H, the new maximum of 331 MPN/100 mL was recorded on October 29, with very little rainfall in the week prior to sampling and fair flow during sampling; evidence of upstream beaver activity was noted on that date. The new maximum values at Site B4 (384 MPN/100 mL), Site 103 (122 MPN/100 mL), and C2 (809 MPN/100 mL) were recorded on July 2, after heavy rainfall the day prior to sampling (1.62 inches reported at Barre Falls Dam). The Site 103 maximum value was matched on October 8, after 0.56 inch of rainfall the day before sampling and 1.17 inches in the four days before sampling (as reported at Barre Falls Dam). The maximum value of 313 MPN/100 mL at Site N1 was recorded on August 27, following 0.34 inch of rainfall overnight.

In 2013, Site 111 was monitored for the first time since 2005. No previous *E. coli* data exist for this site, where the *E. coli* concentrations ranged from less than 10 to 122 MPN/100 mL in 2013. The highest concentration was recorded on November 5, when the flow at Site 111 was reported to be high. The most recent rainfall, totaling 0.69 inch at Barre Falls Dam, had occurred 4 to 5 days prior to sampling.

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.).

Based on the six-month geometric mean, no sites in the Quabbin or Ware River watersheds exceeded the Class A Standard based on the 6-month geometric mean. However, 8 of 11 Quabbin tributary sites and 8 of 10 Ware River tributary sites exceeded the Class A Standard of 235 colonies per 100 mL in individual samples. In the Quabbin watershed, this standard was exceeded at Gates Brook, Boat Cove Brook, and Sites 211, 212, 213, 215H, 215, and 216. The individual standard was exceeded on a total of four dates, most frequently on June 11 (seven sites) and July 23 (four sites). Of the Quabbin tributary sites, Site 213 exceeded the individual standard most frequently, with three occurrences: June 11, June 25, and July 23. Other Quabbin tributary sites exceeded the individual standard one or two times during 2013. In the Ware River watershed, the Class A standard of 235 colonies per 100 mL was exceeded at Sites 101, B4, C2, N1, 103A, 107A, 108, and 121B over five dates. The most number of sites affected was on July 2 (six sites) and October 8 (five sites). Site C2 exceeded this standard most frequently, with four occurrences in routine (biweekly) sampling: July 2, August 13 and 27, and October 8.

E. coli monitoring in the Quabbin Reservoir and Ware River watersheds was begun in November 2005. **Table 11** presents the geometric mean on an annual basis for the 2013 tributary sites, for both Quabbin and Ware River tributary sites. **Table 12** presents the percentage of samples by monitoring station that exceeded 126 MPN/100 mL in individual samples (note that the Class A standard of 126 colonies per 100 mL is based on a 6-month geometric mean). Similarly, **Table 13** presents the percentage of samples by monitoring station that exceeded 235 MPN/100 mL in individual samples. As noted in the tables, monitoring of the Quabbin EQA sites in 2007 began in May that year, while Site 121B in the Ware River watershed started in May that year, so the geometric means for 2007 may not be representative of the full year.

Overall, the *E. coli* geometric means for Quabbin tributary core sites have generally been comparable from 2010 through 2013, but slightly higher than in 2006-2009. As shown in **Table 11**, Site 213 has recorded the highest geometric means of the Quabbin core sites, likely related to storms and beaver activity. The geometric means at Quabbin EQA sites in 2013 were generally comparable to 2007-2008 levels. In the Ware River watershed, the geometric means for core sites 103A and 107A were slightly lower in 2009-2013 than in 2007-2008, while Sites 101 and 108 were generally comparable since *E. coli* monitoring began. The highest geometric means were recorded for Site 121B, which has had impacts from beaver activity. In Ware River EQA sites, geometric means were higher in 2013 than in previous monitoring in 2009, but any significance or cause is unclear at this time. (Note: Because of calculation errors, Site 101 geometric means were reported incorrectly in the 2012 Water Quality Report. All geometric means have been checked and corrected as needed for **Table 11**.)

As shown in **Table 12**, most samples in the Quabbin and Ware River watersheds were below 126 MPN/100 mL. At most, 17 percent of samples at Site 103A exceeded 126 MPN/100 mL during 2013, representing 4 of 24 samples collected. In **Table 13**, the highest percentage (15 percent) represents 4 out of 27 samples at Site C2 exceeding the single-sample Class A standard of 235 colonies per 100 mL.

Table 11. Annual Geometric Means of *E.* coli for 2013 Tributary Sites

Site #	Monitoring Station Description	Geometric Mean (MPN/100 mL)							
		2013	2012	2011	2010	2009	2008	2007	2006
Quabbin Reservoir Watershed Core Sites									
211	W. Br. Swift River at Rte. 202	17.6	19.3	16.8	23.2	14.3	15.3	18.0	13.5
212	Hop Brook inside Gate 22	21.4	27.6	27.4	28.6	16.5	18.0	23.0	14.1
213	M. Br. Swift River at Gate 30	42.7	49.3	48.3	60.5	35.6	22.4	28.2	22.6
215	E. Br. Fever Brook at West St.	20.7	22.8	21.5	23.5	18.6	14.5	19.8	15.6
216	E. Br. Swift River at Rte. 32A	20.4	18.7	31.1	23.0	16.6	22.7	24.8	15.8
Gates	Gates Brook at mouth	18.5	24.1	18.2	25.7	16.0	14.2	18.1	12.2
BC	Boat Cove Brook at mouth	24.6	31.8	19.9	34.4	17.6	23.3	21.8	24.7
Quabbin Reservoir Watershed EQA Sites									
215B*	W. Br. Fever Brook at mouth	15.1	N/A	N/A	N/A	N/A	21.0	23.5	N/A
215H*	Harvard Pond at inlet	23.3	N/A	N/A	N/A	N/A	17.8	17.8	N/A
215G**	E. Br. Fever Brk. at Camels Hump Rd.	13.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A
215F*	E. Br. Fever Brk. at road above mouth	18.1	N/A	N/A	N/A	N/A	16.0	31.1	N/A
Ware River Watershed Core Sites									
101	Ware River at Shaft 8 Intake	30.0	32.7	33.8	23.6	27.1	33.3	26.4	24.2
103A	Burnshirt River at Riverside Cemetery	28.9	25.1	28.7	39.0	23.8	43.6	42.0	32.3
107A	W. Br. Ware River at Brigham Rd.	24.6	21.8	20.9	24.1	24.2	47.5	49.0	20.4
108	E. Br. Ware at Intervale Rd.	32.1	23.6	35.4	34.3	26.4	33.1	28.4	24.2
121A***	Thayer Pond at outlet	N/A	N/A	N/A	N/A	N/A	N/A	11.2	14.8
121B***	Thayer Pond at inlet	27.6	47.3	31.3	60.3	22.7	43.8	47.2	N/A
Ware River Watershed EQA Sites									
111**	Queen Lake at culvert below outlet	14.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A
B4	Burnshirt River at Stone Bridge	33.3	N/A	N/A	N/A	13.8	N/A	N/A	N/A
103	Burnshirt River at Route 62	19.0	N/A	N/A	N/A	17.4	N/A	N/A	N/A
C2	Canesto Brook at Williamsville Rd.	29.1	N/A	N/A	N/A	18.1	N/A	N/A	N/A
N1	Natty Pond Brook at Hale Rd.	20.9	N/A	N/A	N/A	17.5	N/A	N/A	N/A

N/A Data not available.
* In 2007, monitoring at this site began May 2007.
** This site first monitored for E. coli in 2013.
*** Site 121A was monitored through April 2007, replaced by Site 121B (May 2007 - current).
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 Station Description	Samples > 126 MPN/100 mL							
		2013	2012	2011	2010	2009	2008	2007	2006
Quabbin Reservoir Watershed Core Sites									
211	W. Br. Swift River at Rte. 202	8%	12%	7%	12%	0%	4%	4%	0%
212	Hop Brook inside Gate 22	8%	12%	12%	12%	0%	4%	12%	4%
213	M. Br. Swift River at Gate 30	15%	19%	30%	31%	12%	7%	7%	0%
215	E. Br. Fever Brook at West St.	4%	8%	4%	8%	4%	4%	8%	0%
216	E. Br. Swift River at Rte. 32A	8%	4%	7%	8%	4%	7%	4%	0%
Gates	Gates Brook at mouth	4%	15%	8%	8%	4%	0%	4%	4%
BC	Boat Cove Brook at mouth	12%	15%	8%	25%	4%	15%	10%	12%
Quabbin Reservoir Watershed EQA Sites									
215B*	W. Br. Fever Brook at mouth	0%	N/A	N/A	N/A	N/A	7%	7%	N/A
215H*	Harvard Pond at inlet	4%	N/A	N/A	N/A	N/A	7%	0%	N/A
215G**	E. Br. Fever Brk. at Camels Hump Rd.	0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A
215F*	E. Br. Fever Brk. at road above mouth	4%	N/A	N/A	N/A	N/A	4%	13%	N/A
Ware River Watershed Core Sites									
101	Ware River at Shaft 8 Intake	15%	15%	19%	4%	4%	19%	4%	12%
103A	Burnshirt River at Riverside Cemetery	17%	4%	10%	23%	5%	24%	17%	4%
107A	W. Br. Ware River at Brigham Rd.	4%	4%	8%	8%	9%	30%	27%	4%
108	E. Br. Ware at Intervale Rd.	11%	0%	8%	4%	8%	8%	12%	0%
121A***	Thayer Pond at outlet	N/A	N/A	N/A	N/A	N/A	N/A	0%	5%
121B***	Thayer Pond at inlet	7%	23%	12%	38%	12%	19%	17%	N/A
Ware River Watershed EQA Sites									
111**	Queen Lake at culvert below outlet	0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A
B4	Burnshirt River at Stone Bridge	15%	N/A	N/A	N/A	0%	N/A	N/A	N/A
103	Burnshirt River at Route 62	0%	N/A	N/A	N/A	0%	N/A	N/A	N/A
C2	Canesto Brook at Williamsville Rd.	15%	N/A	N/A	N/A	4%	N/A	N/A	N/A
N1	Natty Pond Brook at Hale Rd.	7%	N/A	N/A	N/A	8%	N/A	N/A	N/A

N/A Data not available.
* In 2007, monitoring at this site began May 2007.
** This site first monitored for *E. coli* in 2013.
*** Site 121A was monitored through April 2007, replaced by Site 121B (May 2007 - current).

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

Site #	Monitoring Station Description	Samples > 235 MPN/100 mL							
		2013	2012	2011	2010	2009	2008	2007	2006
Quabbin Reservoir Watershed Core Sites									
211	W. Br. Swift River at Rte. 202	8%	0%	4%	0%	0%	4%	0%	0%
212	Hop Brook inside Gate 22	8%	12%	4%	4%	0%	4%	0%	0%
213	M. Br. Swift River at Gate 30	12%	8%	7%	12%	0%	4%	4%	0%
215	E. Br. Fever Brook at West St.	4%	0%	4%	0%	4%	0%	4%	0%
216	E. Br. Swift River at Rte. 32A	8%	4%	7%	4%	4%	7%	4%	0%
Gates	Gates Brook at mouth	4%	8%	4%	8%	0%	0%	0%	4%
BC	Boat Cove Brook at mouth	4%	15%	4%	8%	4%	11%	5%	4%
Quabbin Reservoir Watershed EQA Sites									
215B*	W. Br. Fever Brook at mouth	0%	N/A	N/A	N/A	N/A	4%	0%	N/A
215H*	Harvard Pond at inlet	4%	N/A	N/A	N/A	N/A	0%	0%	N/A
215G**	E. Br. Fever Brk. at Camels Hump Rd.	0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A
215F*	E. Br. Fever Brk. at road above mouth	0%	N/A	N/A	N/A	N/A	0%	6%	N/A
Ware River Watershed Core Sites									
101	Ware River at Shaft 8 Intake	7%	4%	8%	4%	0%	8%	0%	0%
103A	Burnshirt River at Riverside Cemetery	8%	4%	5%	4%	0%	8%	4%	0%
107A	W. Br. Ware River at Brigham Rd.	4%	0%	4%	8%	5%	15%	18%	0%
108	E. Br. Ware at Intervale Rd.	7%	0%	4%	4%	0%	4%	4%	0%
121A***	Thayer Pond at outlet	N/A	N/A	N/A	N/A	N/A	N/A	0%	0%
121B***	Thayer Pond at inlet	4%	8%	8%	23%	0%	12%	11%	N/A
Ware River Watershed EQA Sites									
111**	Queen Lake at culvert below outlet	0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A
B4	Burnshirt River at Stone Bridge	7%	N/A	N/A	N/A	0%	N/A	N/A	N/A
103	Burnshirt River at Route 62	0%	N/A	N/A	N/A	0%	N/A	N/A	N/A
C2	Canesto Brook at Williamsville Rd.	15%	N/A	N/A	N/A	0%	N/A	N/A	N/A
N1	Natty Pond Brook at Hale Rd.	7%	N/A	N/A	N/A	0%	N/A	N/A	N/A

N/A Data not available.
* In 2007, monitoring at this site began May 2007.
** This site first monitored for *E. coli* in 2013.
*** Site 121A was monitored through April 2007, replaced by Site 121B (May 2007 - current).

3.2.1.2 Fecal Coliform Bacteria

In 2013, fecal coliform bacteria concentrations generally fell within the historical range for each respective station. A new maximum concentration of 4,550 CFU/100 mL was recorded on July 23 for Site 213 (Middle Branch Swift River) in the Quabbin Reservoir watershed. Elevated fecal coliform levels were observed in all Quabbin tributary core sites on that day, following overnight rainfall (0.34 inch at Belchertown, 0.90 inch at New Salem) as well as heavy rainfall during sampling. An additional 24-hour rainfall of 1.87 inches was reported at Belchertown by 7 AM, July 24, while Orange Airport reported total daily rainfall of 1.36 inches for July 23 (midnight local time). In the Ware River watershed, a new maximum concentration of 660 CFU/100 mL was recorded at EQA site C2 (Canesto Brook) on July 2, when elevated fecal coliform levels were observed in many Ware River sites. Heavy rain was reported for the 24 hours prior to sampling at Belchertown (1.80 inches) and Barre Falls Dam (1.62 inches), and high flow was reported at all tributary monitoring sites in the Ware River watershed. No other sites in the Quabbin watershed or the Ware River watershed exceeded their respective historical maximum values during 2013.

3.2.1.3 Total Coliform Bacteria

During 2013, all analyses for total coliform bacteria concentrations 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, and the range of values appears to have shifted higher, although maximum values did not increase immediately at all sites. New maximum values were recorded in 2013 at Sites 215B and 215H in the Quabbin watershed, as well as Site B4 in the Ware River watershed. Samples collected from several sites had total coliform bacteria at levels too numerous to count (TNTC), indicating concentrations at greater than 24,200 MPN/100 mL. Median values in 2013 exceeded the historical medians in nine of eleven Quabbin watershed sites and in nine of ten Ware River sites. The increases in median total coliform concentrations do not necessarily mean a change in water quality – 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 Specific Conductance

Specific conductance is the measure of the ability of water to conduct an electrical current, which 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. One significant source of higher levels in tributaries is chloride found in deicing salts applied to highways and local roads (Shanley, 1994; Lent *et al.*, 1998), which may persist in watersheds for years after initial application (Kelly *et al.*, 2008). It is suspected that deicing salts contributed to elevated values of specific conductance, with peak values recorded in

2001 through 2004. In 2013, specific conductance values were generally comparable to the historical range. A slight increase in maximum value was noted at Middle Branch Swift River Site 213 in the Quabbin Reservoir watershed, as well as at Burnshirt River Site B4 and Canesto Brook (Site C2) in the Ware River watershed. For 2013, maximum values by watershed were recorded at Site 213, with a specific conductance of 144.7 µS/cm on July 23, and Thayer Pond (Site 121B), with 261.5 µS/cm on February 26.

3.2.3 Dissolved Oxygen

The oxygen concentration of Quabbin Reservoir tributaries and Ware River tributaries were generally quite high. The source of dissolved oxygen in a stream environment comes from re-aeration dynamics. Dissolved oxygen levels are depleted though the oxygen requirements of aquatic life, the decomposition of organic matter, and the introduction of foreign oxygen-demanding substances (i.e., chemical reducing agents). Temperature, stream flow, water depth, and the physical characteristics of the stream channel are the principal drivers of re-aeration. The Massachusetts Class A standard is a minimum of 6.0 mg/L. In 2013, dissolved oxygen concentrations ranged between 1.35 mg/L and 19.3 mg/L. The lowest concentrations were recorded at Sites B4, N1, and 121B in the Ware River watershed and at Site 215H in the Quabbin watershed. Dissolved oxygen levels were measured below the 6.0 mg/L threshold in 14 percent of the samples monitored within the Ware River watershed and 5.8 percent of the samples monitored within the Quabbin Reservoir watershed.

3.2.4 Temperature

In tributaries of the Quabbin Reservoir and Ware River watersheds, temperatures ranged between 0 and 27.3˚C. Temperature is an important parameter in its relation to dissolved oxygen because 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.

3.2.5 Turbidity

Turbidity is the relative measure of the amount of light-refracting and light-absorbing particles suspended in the water column. It is used as an indicator of water aesthetics and as a relative measure of the water's productivity. The Massachusetts drinking water standard is 5 NTU for source water (measured at the intake) and 1 NTU for finished water. In 2013, 1 out of 365 source water samples (0.3%) at the intake exceeded 1 NTU, during Storm Nemo (February 9). For non-intake samples, turbidity levels exceeded the 5 NTU standard in the Quabbin watershed at Site 212 on July 23 (9.18 NTU) and at Boat Cove Brook on July 23 (7.64 NTU) and December 23 (6.85 NTU). In the Ware River watershed, turbidity levels exceeded 5 NTU at Site N1 on July 16 (20.7 NTU) and July 30 (10.2 NTU), and at Site 121B on October 8 (7.49 NTU).

Turbidity of 20.7 NTU also marked a new maximum value at Site N1, where the previous high value of 8.09 NTU was recorded on August 18, 2009. Beaver activity and rainfall flushing were suspected causes of the elevated turbidity at Site N1 in 2013 (see investigation report in **Appendix A**). Other sites recording new maximum turbidity values in 2013 included Sites B4, C2, and 121B in the Ware River watershed and Sites 213 and 215F in the Quabbin watershed. All other sites monitored in 2013 remained within their historical ranges.

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. pH is a measure of 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 this are considered acidic with a decrease of one unit representing a 10-fold increase in acidity. Median pH values in 2013 were below the Class A water quality threshold of 6.5 units at 18 of 21 monitoring stations. Five sites in the Quabbin Reservoir watershed had median levels below 6.0, including Gates Brook, West Branch Fever Brook (Site 215B), Harvard Pond (also known as Brooks Pond; Site 215H), and East Branch Fever Brook at Sites 215 and 215G. In the Ware River watershed, median pH levels were below 6.0 at Burnshirt River at Sites B4 and 103; Canesto Brook (Site C2); Natty Pond Brook (Site N1); Burnshirt and Canesto River at Site 103A; and West Branch Ware River (Site 107A).

3.2.7 Alkalinity

Alkalinity, a relative measure of water's ability to neutralize an acid, was monitored at the EQA sites on a biweekly basis in 2013. Data from these 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). In 2013, the alkalinity concentrations were below the ARM endangered threshold value of 5 mg/L as $CaCO_3$ at all four EQA sites in the Quabbin watershed (Sites 215B, 215H, 215G, and 215F) and four of the five EQA sites (Sites B4, 103, C2, and N1) in the Ware River watershed. Alkalinity tended to peak around July through early September, with maximum values ranging from 3.65 mg/L (Site C2) to 9.86 mg/L (Site N1). New maximum values were set at Site 215B in the Quabbin Reservoir watershed and Site B4 in the Ware River watershed.

It should be noted that the alkalinity values cited above are what has been called "EPA" alkalinity in the Quabbin and Ware River water quality reports since 1990. Prior to 1990, alkalinity was tested to pH 4.5 only. Since 1990, alkalinity has been tested to two pH endpoints at Quabbin Laboratory, with the result at pH 4.5 being denoted as "standard" alkalinity, and the result at pH 4.2 being denoted as "EPA" alkalinity. The purpose of reporting results at both endpoints was to preserve the historical record. However, under Standard Method 2320B, waters of “low-level” alkalinity (less than 20 mg/L) should be reported using the pH 4.2 endpoint. As a result, some care needs to be taken in interpreting alkalinity using the historical records.

3.2.8 Tributary Nutrient Dynamics

Beginning in March 2005, sampling was begun on selected tributaries with the goal of establishing a nutrient database by sanitary district in each watershed. For the Quabbin Reservoir watershed in 2013, four EQA sites in the Fever Brook Sanitary District were monitored biweekly for nutrients and UV_{254}. Three of the four sites were previously monitored in May 2007 through December 2008, with the other site (Site 215G) having never been monitored before. For the Ware River watershed in 2013, five EQA sites in the Burnshirt, Canesto, and Natty Sanitary District were monitored, also biweekly for nutrients and UV_{254}. Except for Site 111, which was discontinued from routine monitoring in March 2005, the Ware River EQA sites were previously monitored January through December 2009. Core tributary stations have been monitored on a quarterly basis since March 2005. **Table 14** summarizes median values and range of 2013 data for all tributary monitoring sites in the Quabbin Reservoir watershed, and **Table 15** summarizes the data similarly for Ware River watershed sites.

In the Quabbin Reservoir watershed during 2013, nutrient concentrations generally remained within the historical ranges, with slight increases at some sites compared to previous monitoring since 2005. As shown in **Table 14**, nitrate concentrations ranged from less than 5 µg/L to 82 µg/L (<0.005 to 0.082 mg/L) at the EQA sites, compared to a maximum of 114 µg/L (0.114 mg/L) at the core sites. At Site 215F, the nitrate result of 82 µg/L (0.082 mg/L) on July 23 marked a new maximum value for this site, with a previous maximum of 79 µg/L (0.079 mg/L) during monitoring in 2007-2008. Storm flow and recent beaver activity are suspected factors in several elevated nutrient results at this site.

TKN, a measure of organic nitrogen plus ammonia, often constitutes a significant proportion of the total nitrogen present in a natural water body. In 2013, TKN concentrations at the Quabbin EQA sites ranged from 127 to 954 µg/L (0.127 to 0.954 mg/L), compared to a maximum of 424 µg/L (0.424 mg/L) at the core sites. New maximum values were recorded at two Quabbin sites, core Site 211 and EQA Site 215F. At Site 211, nitrate reached 417 µg/L (0.417 mg/L) on June 11, following 1.32 inches (as reported at Belchertown) of rain in the 24 hours prior to sampling. The previous maximum of 377 µg/L (0.377 mg/L) at Site 211 was recorded in June 2010. At Site 215F, the previous high TKN concentration of 444 µg/L (0.444 mg/L) was exceeded in July 2013, peaking at 472 µg/L (0.472 mg/L) on July 23. Rainfall of 0.99 inch was reported for the two days prior to the July 9 sampling, and a total of 2.21 inches was reported for July 22-23. Flushing of organic matter is suspected to be the primary cause of elevated TKN levels.

Table 14. Quabbin Reservoir Watershed Nutrient Concentrations: Comparison of Median Values and Ranges from 2013 Database

Sampling Station	**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**
Fever Brook Sanitary District												
215B W. Br. Fever Brook, at mouth	6	<5 - 29	353	179 - 581	<5	<5 - 20	15	7 - 28	0.263	0.155 - 0.457	2770	2160 - 3970
215H Harvard Pond, inlet	<5	<5 - 28	362	145 - 954	16	<5 - 74	21	11 - 53	0.206	0.094 - 0.331	2030	1540 - 2960
215G E. Br. Fever Brook, at Camels Hump Rd.	6	<5 - 43	388	182 - 713	6	<5 - 25	17	11 - 28	0.298	0.132 - 0.529	2100	1590 - 2880
215F E. Br. Fever Brook, at road above mouth	12	<5 - 82	298	127 - 472	<5	<5 - 15	16	10 - 47	0.240	0.138 - 0.454	2450	1750 - 3220
Core Sample Sites [(2)]	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Biweekly**
211 (W. Swift)	28	5 - 36	187	<100 - 417	<5	<5	14	11 - 24	0.128	0.075 - 0.257	2040	1370 - 2950
212 (Hop)	57	15 - 93	154	<100 - 314	<5	<5 - 34	17	12 - 31	0.098	0.056 - 0.246	4190	2380 - 5040
213 (M. Swift)	46	8 - 114	280	129 - 358	<5	<5 - 7	17	13 - 20	0.188	0.096 - 0.287	4290	2790 - 5880
215 (E. Fever)	5	<5 - 17	389	157 - 424	<5	<5	17	13 - 19	0.359	0.181 - 0.398	2250	1700 - 2880
216 (E. Swift)	23	11 - 54	327	146 - 393	<5	<5	18	14 - 30	0.293	0.156 - 0.384	3070	2350 - 3830
Gates Brook	<5	<5 - 7	123	<100 - 213	<5	<5	14	10 - 20	0.093	0.053 - 0.207	1270	908 - 1440
Boat Cove Brook	25	14 - 40	173	113 - 370	<5	<5	21	17 - 27	0.153	0.103 - 0.431	6850	4250 - 9970

Notes: (1) Biweekly sampling at EQA sites.
(2) Quarterly sampling conducted in March, June, September, and December. Biweekly for calcium in 2013.

Table 15. Ware River Watershed Nutrient Concentrations: Comparison of Median Values and Ranges from 2013 Database

Sampling Station	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**
Burnshirt, Canesto, & Natty Sanitary District												
111 Queen Lake at road culvert below outlet	42	5 - 154	234	130 - 492	<5	<5 - 37	12	<5 - 19	0.056	0.047 - 0.086	3140	2780 - 3960
B4 Burnshirt River at Stone Bridge	<5	<5 - 83	451	203 - 972	5	<5 - 88	19	10 - 34	0.435	0.213 - 0.784	2490	1890 - 3510
103 Burnshirt River at Rte. 62	9	<5 - 66	266	147 - 896	<5	<5 - 16	15	11 - 26	0.237	0.139 - 0.432	2060	1650 - 2620
C2 Canesto Brook at Williamsville Rd.	39	<5 - 219	238	<100 - 879	14	<5 - 64	17	10 - 34	0.180	0.085 - 0.559	2190	1640 - 2540
N1 Natty Pond Brook at Hale Rd.	9	<5 - 116	385	196 - 937	17	<5 - 101	23	11 - 80	0.290	0.166 - 0.631	3370	2450 - 4650
Core Sample Sites [2]	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Quarterly**	**Median**	**Range, Biweekly**
Shaft 8 (Intake)	22	11 - 27	282	193 - 500	6	<5 - 19	24	14 - 35	0.230	0.149 - 0.481	3280	2270 - 4390
103A (Burnshirt)	28	6 - 47	360	171 - 451	<5	<5 - 10	22	12 - 34	0.242	0.132 - 0.476	2480	1860 - 3930
107A (W. Ware)	25	<5 - 44	358	240 - 533	<5	<5 - 7	20	13 - 30	0.303	0.200 - 0.708	2970	2320 - 3450
108 (E. Ware)	28	10 - 50	322	203 - 528	<5	<5 - 18	20	11 - 24	0.224	0.130 - 0.382	3870	2650 - 4960
121B (Thayer)	24	<5 - 145	379	206 - 443	7	<5 - 9	12	10 - 26	0.192	0.095 - 0.331	9220	6320-12700

Notes: (1) Biweekly sampling at EQA sites.
(2) Quarterly sampling conducted in March, June, September, and December. Biweekly for UV_{254} and calcium in 2013.

Unlike the reservoir monitoring, ammonia has not been routinely monitored in the tributaries to Quabbin Reservoir. Ammonia concentrations in the Quabbin tributaries ranged from less than 5 to 74 µg/L (<0.005 to 0.074 mg/L) in 2013. The maximum concentration of 0.074 mg/L was detected on July 23 at Site 215H. This site, just downstream of wetlands, was originally monitored in 2007-2008 to provide water quality data representative of the headwaters in the East Fever Subdistrict. Site 215H showed greater variability and generally higher median concentrations of ammonia, TKN, and total phosphorus, compared to the other Fever District sites. Ammonia concentrations at the core sites were fairly comparable to previous ammonia data, given the differing sample frequencies: quarterly in 2012-13, versus monthly in 1998-99.

In many freshwater systems, phosphorus is the limiting nutrient in algal growth and can be a concern when excessive. Phosphorus concentrations ranged slightly more at the Quabbin EQA sites compared to the core sites, likely reflecting the greater sampling frequency, biweekly, versus quarterly for core sites. Overall, median phosphorus concentrations were generally comparable among all Quabbin watershed sites. A new maximum value of 47 µg/L (0.047 mg/L) was recorded at EQA Site 215F on July 23, during a storm event. All other Quabbin tributary sites remained within range of previous monitoring.

UV_{254}, which had not been routinely monitored at core sites in the Quabbin Reservoir watershed, was monitored quarterly at core sites in 2009 through 2013. 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, Amherst (Garvey *et al.*, 2001). While the monitoring frequency was quarterly in 2009-2013, compared to monthly in 1998-99, it appears that UV_{254} values tended to range slightly higher at core sites in 2009-13, 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 2009-13 do not necessarily mean any degradation of water quality. As shown in **Table 14**, UV_{254} values for 2013 ranged from 0.053 cm^{-1} (Gates Brook, on March 19) to 0.529 cm^{-1} (Site 215G, on July 9). This range reflects the different quality of waters, from oligotrophic to eutrophic, including productive wetlands (Reckhow, personal communication). The maximum UV_{254} value in the Quabbin watershed occurred after heavy rainfall (0.99 inch reported for July 7-8 at Belchertown). A new maximum UV_{254} value was recorded at Site 215F (0.454 cm^{-1}) following this storm as well, just above the previous high of 0.426 cm^{-1} in July 2008. New maximum values were also recorded at Gates Brook (0.207 cm^{-1}) and Site 212 (0.246 cm^{-1}), both on June 11.

Calcium monitoring was begun in 2010 to assess the relative risk of zebra mussel colonization in the Quabbin and Ware River watersheds. In the Quabbin watershed, calcium concentrations in 2013 ranged from 908 to 9,970 µg/L (0.908 to 9.97 mg/L) in core sites and from 1,540 to 3,970 µg/L (1.54 to 3.97 mg/L) in EQA sites. Except for Boat Cove Brook, calcium concentrations in Quabbin tributary sites remained below 8-12 mg/L, the apparent threshold for zebra mussel survival (Hincks and Mackie, 1997; Jones and Ricciardi, 2005; Whittier *et al.*, 2008). Calcium sources may include agricultural lime, some road deicers, and construction activity, as well as natural site geology and weathering processes.

Boat Cove Brook drains an area within Quabbin Park of no commercial, residential, or agricultural activity, yet calcium concentrations generally increased over the growing season, peaking at 9.97 mg/L on October 29. In a few instances at this site, calcium concentrations apparently decreased following storms (e.g., June 11, July 23, and September 1-2), but calcium concentrations did not always decrease following a storm (e.g., July 7-8). It is unclear what mechanism(s) contribute to the calcium levels observed in Boat Cove Brook. One possible source includes increased calcium mobilization (leaching) related to the forests' natural decline and lack of regeneration (Gustavsen, personal communication). Another possible cause may be related to the site's former usage as a staging area during construction of Quabbin Reservoir, possibly leaving it a disturbed site (Bishop, personal communication). However, because natural weathering and soil leaching can constitute a significant source of calcium (Likens *et al.*, 1977) and calcium had not previously been monitored in these tributaries, it is difficult to say whether these calcium levels are much higher than the natural, background conditions.

In the Ware River watershed, nutrient concentrations generally remained within the historical ranges during 2013. As shown in **Table 15**, nitrate concentrations ranged up to 219 µg/L (0.219 mg/L) in EQA sites, compared to a maximum of 145 µg/L (0.145 mg/L) in core sites. The maximum nitrate concentration of 0.219 mg/L occurred at Site C2 on February 12, which also marked a new historical maximum for this site. The elevated nitrate result was preceded by mixed precipitation (snow to rain, as reported at Barre Falls Dam) the day before, with higher stream flow during sampling. Site N1 also had a new historical maximum concentration for nitrate, 0.116 mg/L, which occurred on February 26. This result could be related to recent precipitation on February 23-24 and/or possible snowmelt.

TKN concentrations in Ware River core sites ranged from 171 to 533 µg/L (0.171 to 0.533 mg/L) during 2013, and less than 100 to 972 µg/L (<0.100 to 0.972 mg/L) in the EQA sites. For TKN, median values and overall ranges increased at the EQA sites in 2013 compared to the previous monitoring in 2009 of the Burnshirt, Canesto, and Natty District. New maximum TKN concentrations were observed in 2013 at Site B4 (0.972 mg/L), Site C2 (0.879 mg/L), and Site N1 (0.937 mg/L) on July 16; and at Site 103 (0.896 mg/L) on December 3. Before the elevated TKN levels on July 16, Barre Falls Dam was operating for flood control, and flows were high at all sites following heavy rainfall on July 1-2 (1.64 inches, as reported at Barre Falls Dam). Weather conditions were relatively dry from July 3 through 16, with total rainfall of 0.18 inch, and then drawdown at Shaft 8 for annual maintenance work began on July 15. Flushing of organic matter during stormflow and drawdown are suspected factors in the elevated TKN results on July 16. It is unclear if the elevated TKN result at Site 103 on December 3 was related to stormflow, as the last significant rainfall occurred on November 26-27 (1.99 inches, as reported at Barre Falls Dam). Evidence of recent beaver activity was noted in November and on December 3 within the Burnshirt, Canesto, and Natty District and may also have been a factor in the Site 103 TKN result.

Ammonia ranged from less than 5 to 101 µg/L (<0.005 to 0.101 mg/L) during 2013 in the Ware River watershed, with the higher concentrations found at the EQA sites. The maximum result of 0.101 mg/L was detected at Site N1 on January 29, and the ammonia concentration at Site B4 was also elevated on the same date. While snowfall was reported for the day before, it is unclear how streamflow and water quality would be affected; the factors causing the spike in ammonia are unknown. Ammonia has not been routinely monitored in the Ware River watershed, so no historical data are available for comparison.

Total phosphorus concentrations were generally comparable between Ware River EQA sites and core sites, with an overall range of less than 5 to 80 µg/L (<0.005 to 0.080 mg/L) in 2013. The highest concentration, 0.080 mg/L, also marked a historical maximum for Site N1, which occurred on July 16. At Site C2, a new maximum phosphorus concentration was recorded on July 30. The most recent rainfall had occurred July 25-26 (0.45 inch, as reported at Barre Falls Dam), but it is unclear if storms contributed to this elevated result.

Except for Site B4, with a higher median value, UV_{254} values were similar at core sites and EQA sites in the Ware River watershed. The highest values were observed at Site 107A (0.708 cm^{-1}) of the core sites and at Site B4 (0.784 cm^{-1}) of the EQA sites. New historical maximum values were noted at Sites B4 and N1 (0.631 cm^{-1}) on June 4 and at Sites C2 (0.559 cm^{-1}) and 103A (0.476 cm^{-1}) on July 2. Rainfall had been reported for the one to two days prior to sampling, a total of 0.47 inch on June 2-3 and 1.64 inches on July 1-2 (as reported at Barre Falls Dam), and stream flows were elevated during sampling, suggesting possible impacts from stormwater.

Calcium concentrations in the Ware River watershed ranged between 1.64 and 12.7 mg/L. Site 121B had concentrations within the apparent zebra mussel survival threshold of 8-12 mg/L, with 23 of 27 measurements above 8 mg/L. Calcium concentrations at Thayer Pond inlet in 2013 ranged from 6,320 µg/L (6.32 mg/L), on June 18, to 12,700 µg/L (12.7 mg/L), on October 8, a new historical high value for this site. The area surrounding Thayer Pond is primarily forested with some institutional, residential, commercial, and industrial use. It is not known if these calcium levels reflect natural, background conditions or potential water quality degradation. At Thayer Pond inlet, the median calcium concentration of 9.22 mg/L in 2013 was slightly higher than in previous years: 8.86 mg/L in 2012, 8.51 mg/L in 2011, and 9.17 mg/L in 2010.

Calcium had not been monitored before at the Burnshirt, Canesto, and Natty EQA sites. Concentrations in this sanitary district generally fluctuated between 2 and 4 mg/L in 2013, without an obvious or consistent peak. It is unknown whether these concentrations reflect natural background levels. Calcium monitoring will be continued in each sanitary district to help establish baseline data.

Comparing the two watersheds, nitrate concentrations had slightly higher median values and generally ranged higher in the Ware River watershed, with the highest nitrate concentration detected at Site C2 (0.219 mg/L on February 12). TKN ranged higher in the Ware River sites, with slightly higher median TKN concentrations. Ammonia was generally higher and more variable in the Ware River watershed. The range and median values of total phosphorus concentrations were higher in Quabbin tributary sites. UV_{254} values were higher overall, both medians and ranges, in the Ware River watershed, which may be related to the greater wetlands influence on water quality. However, within the Ware River watershed, UV_{254} did not necessarily correlate with sites draining a higher percentage of wetlands. Except for Boat Cove Brook and Thayer Pond inlet (Site 121B), calcium concentrations were fairly consistent in the Quabbin and Ware River watersheds, at 2 to 6 mg/L. The highest calcium concentrations were observed at Boat Cove Brook and Site 121B, where some or many results exceeded 8 mg/L, the apparent threshold for zebra mussel survival. It is not known how much of the calcium variation is attributable to geology, land use, or other factors.

3.2.9 Monitoring for the Invasive Diatom *Didymosphenia geminata*

In response to alerts about new infestations of the invasive diatom *Didymosphenia geminata* (“Didymo”) in New England, DCR staff implemented a monitoring program using 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 stations (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 station near the Shaft 8 Intake (Site 101) was selected.

Due to severe weather and the extreme changes in flow volume experienced 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. Emerging research suggests that Didymo does not readily grow on bare rock, preferring to colonize substrates that have a well established periphyton community. We can assume that it will be slow to colonize glass slides. Therefore, 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 2013, artificial substrates were not used in the West, Middle or East Branches of the Swift River. Rock scrapings were taken instead at these sites. Artificial substrates were still deployed at the catwalk behind the Shaft 8 building. Net samples were taken at the same location. 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 slightly protected from sudden changes in water volume. If the sampler was to be dislodged due to rising water levels, it could easily be retrieved from the hatchery screens. Samples of rock scrapings were analyzed from the Swift River outflow and Shaft 8 beginning in 2013.

Monitored sites were checked on a monthly basis (river stage and ice conditions permitting). Results to date have been negative for Didymo. Routine inspections, rock scraping, and renewal of artificial substrates will continue in 2014 and likely for years to come. This monitoring program will facilitate early detection of Didymo should it ever enter the rivers within the Quabbin or Ware watersheds.

3.3 Forestry Water Quality Monitoring

Forestry operations may have short and long term effects on water quality. Monitoring of operations and water quality is being conducted to ensure water quality standards are maintained. 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.

3.3.1 Short Term Monitoring

Short Term Forestry Monitoring involves monitoring logging operations through inspections and 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 immediate effects, and after completion to look for lasting effects. During 2013, the Environmental Quality Section increased monitoring of Forestry operations by developing criteria for lot reviews, inspections, sample sites, and database development. Field review of proposed DCR lots was conducted in the Ware River and Quabbin Watersheds. Macroinvertebrate sampling was conducted inside Gate 12 as part of baseline monitoring for lot operations. Water quality testing and field inspection occurred in Quabbin on one lot in 2013. Please see Appendix A for the summary field report for lot FL2042.

3.3.2 Long Term Monitoring

Two sites have been established in Middle Branch Dickey Brook and East Branch Underhill Brook 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, total phosphorus) and total suspended solids. As of January 2014, laboratory analyses of UV_{254}, ammonia, total organic carbon, and dissolved organic carbon were added to the monthly sampling program.

The monthly sampling has been conducted on the second Wednesday of each month since April 2002. While it provides data over a relatively long term, monthly grab sampling cannot be used to characterize stream response during storms. During 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, stream flow rate, and time of sample collection. The laboratory analyses will help characterize the range of nutrient and sediment concentrations in wet-weather 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 2013 in order to implement the Long Term Water Quality Forestry monitoring were: review of existing research reports and water quality data; evaluation and inspection of sites; defining proposed sampling activity and parameters; macroinvertebrate sampling downstream of East Branch Underhill Brook; and coordination with DCR Natural Resources section concerning past efforts and future timber harvesting. During 2013 monthly water quality samples were collected from Underhill Brook and Dickey Brook. Results are available upon request. Implementation of storm water sampling is scheduled for 2014.

4 PROPOSED SCHEDULE FOR 2014

Water sampling protocols, including field and analytical methods, will remain the same for 2014. Calcium monitoring will continue at all 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. For 2014, monitoring in the Quabbin Reservoir watershed has shifted to the East Branch Swift River Sanitary District, last monitored in 2007-2008 and 2010. Ware River watershed monitoring has changed to the West Branch Ware River Sanitary District, which was previously monitored in 2010.

Reservoir monitoring will continue on a monthly schedule in 2014 (April-December). No other changes are proposed for in-reservoir monitoring. Sampling at the three deep-water reservoir stations will continue, with temperature, dissolved oxygen, pH and conductivity profiles collected monthly. The reservoir nutrient sampling program that has been conducted quarterly since 2000 will be continued in 2014, and the plankton sampling program initiated in September 2007 will also be continued through 2014.

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APPENDIX A

Investigative Reports and Data

Water Quality Sampling at Forestry Lot 2042

Water Quality Sampling at Forestry Lot 2043

2013 Phytoplankton Monitoring at Quabbin Reservoir

2013 Quabbin Boat Inspection Programs

2013 Quabbin Boat Ramp Monitor Program

2013 Aquatic Macrophyte Assessments

Environmental Quality Field Reports

Sample Site 215B, 3/21/13

Sample Site N1, 7/31/13

Water Quality Results for Field Offices

Stockroom, June 2013

MEMORANDUM

To: Robert Bishop, Environmental Analyst IV
From: Paul Reyes
Date: January 20, 2014
Subject: FL2042 Forestry Lot Final Sampling Report

The Massachusetts Department of Conservation and Recreation manages forested lands through its Division of Watershed Protection (DWSP). The DWSP Forest Management Program allows silvicultural activities that focus on forest diversity (in terms of age and tree type) and regeneration so as to maximize water quality and quantity.

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

Normally water samples are collected prior to logging in order to set a baseline, during to measure the effects of ongoing logging operations, and after to determine whether there are any lasting effects.

This memorandum covers lot FL2042 inside of Gate 12 in Pelham. During the time the lot was monitored, there was very little precipitation, and there was either no flow, or very low flow in the stream. The attached map shows the proposed stream crossing.

Lot FL2042 was inspected 6 times, and at no time was logging activity observed, nor was a bridge used. The stream was running on only two occasions, and two background samples were collected. The results are listed below.

Turbidity results

Date	Sample Site	Result (NTU)
9-13-2013	S2	I.V.
12-30-2013	S2	0.345

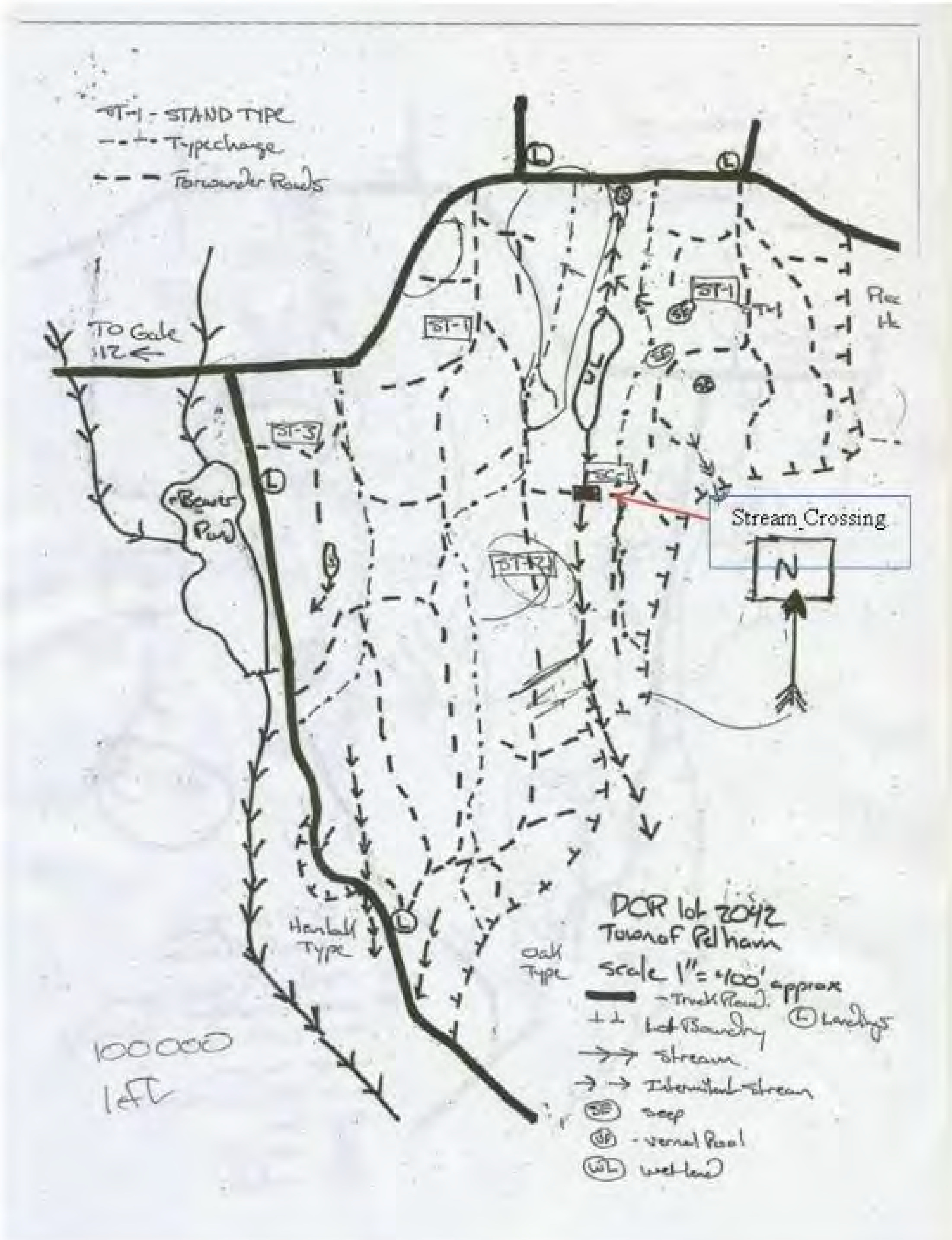
I.V.: Invalid result due to low flow

For comparison purposes, average turbidity at the Connecticut Valley Aqueduct (as measured at the Ware Disinfection Facility) averaged 0.262 NTU from January 1, 2013 through February, 27 2014, with a minimum of 0.178, a maximum of 1.124, and a median of 0.254 NTU respectively.

Another way to put these numbers in context is to compare them with the EPA's Surface Water Rule for unfiltered water sources. That standard states that raw water must have a turbidity of 5 NTU or less before disinfection.

There was no logging activity, nor was a bridge put in, and there was very little precipitation during the time the lot was monitored. Therefore, there is not much that can be concluded about how it was affected by logging. The difference in turbidity levels in the two samples collected could be caused by the fact that the second sample was collected after the ground froze, even though the flow was much higher than during the time the fist sample was taken.

Following are the field sheets from four of the six times the lot was inspected and some photographs.



Lot Map with Stream Crossing

Forestry Lot Water Sample Sheet

Sampler: Paul Reyes/Robert Bishop

Date: 8/25/13

Lot Number: 2042

Check All that Apply:

Stream Crossing:	x
Wetland Crossing:	
Photographs:	x
Drawings:	

Sample Site Number	BMPS (Y/N)	Other (Y/N)
S1	N	N
S2		

Comments:

No water flowing. Only one marked sample site was found (S2).

Forestry Lot Water Sample Sheet

Sampler: Paul Reyes

Date: 10/8/13

Lot Number: 2042

Check All that Apply:

Stream Crossing:	x
Wetland Crossing:	
Photographs:	x
Drawings:	

Sample Site Number	BMPS (Y/N)	Other (Y/N)
S1	N	N
S2	N	N

Comments:

2.26" of rain over the previous 4 days, some stagnant water on parts of the stream bed. No samples collected. Lot seems inactive.

Forestry Lot Water Sample Sheet

Sampler: Paul Reyes

Date: 9/13/13

Lot Number: 2042

Check All that Apply:

Stream Crossing:	x
Wetland Crossing:	
Photographs:	x
Drawings:	

Sample Site Number	BMPS (Y/N)	Other (Y/N)
S1	N	N
S2	N	N

Comments:

S1 found and reflagged, but no water flowing. Water flowing at S2, but shallow and low flow, sample collected.

Water Sample had a turbidity of 7.66 NTU. Turbidity probably affected by sediment stirred up during collection, invalid result.

Forestry Lot Water Sample Sheet

Sampler: Paul Reyes

Date: 12/30/13

Lot Number: 2042

Check All that Apply:

Stream Crossing:	x
Wetland Crossing:	
Photographs:	x
Drawings:	

Sample Site Number	BMPS (Y/N)	Other (Y/N)
S1	N	N
S2	N	N

Comments:

1.25" of rain over the previous day (1.99" over 6 days) over mostly frozen soil, medium flow. Turbidity of 0.345 NTU, inactive lot.

Sample Site

Dry Stream Bed

Stream after 2.26 of Rain Over Previous Four Days

Forestry Lot Water Sample Sheet

Sampler: Paul Reyes

Date: 5/29/14

Lot Number: 2042

Check All that Apply:

Stream Crossing:	x
Wetland Crossing:	
Photographs:	x
Drawings:	

Sample Site Number	BMPS (Y/N)	Other (Y/N)
S1	N	N
S2	N	N

Comments:

Post cutting sample, low flow, turbidity of 0.613 NTU.

MEMORANDUM

To: Robert Bishop, Environmental Analyst IV
From: Paul Reyes
Date: January 20, 2014
Subject: FL2043 Forestry Lot Final Sampling Report

The Massachusetts Department of Conservation and Recreation manages forested lands through its Division of Watershed Protection (DWSP). The DWSP Forest Management Program allows silvicultural activities that focus on forest diversity (in terms of age and tree type) and regeneration so as to maximize water quality and quantity.

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

Normally water samples are collected prior to logging in order to set a baseline, during to measure the effects of ongoing logging operations, and after to determine whether there are any lasting effects.

This memorandum covers lot FL2043, inside of Gate 12 in Pelham, and in which two stream crossings were used. During the time the lot was monitored, there was very little precipitation, with the exception of early October when 2.26” of rain fell over four days, in late November when 2.33” again fell over two days, and on December 29 when 1.25” fell. Following these rain events, there was flow in the stream only once when the site was inspected on December 30, 2013. By then the ground was frozen and most of the precipitation ended up on the streams.

Lot FL2043 was inspected 7 times, first on August 25, 2013, at which time neither of the bridges was in place. Afterward, it was inspected on September 13 and 19, October 8 and 18, November 18 and finally on December 30.

Turbidity results

Date	Sample Site	Result (NTU)
12-30-2013	S1	0.043
12-30-2013	S2	0.375
12-30-2013	S3	0.040
12-30-2013	S4	0.700

Although the increase in turbidity on the downstream sites (S2 and S4) are an order of magnitude higher than the upstream sites (S1 and S3), the actual values at all four sites are very low.

For comparison purposes, average turbidity at the Connecticut Valley Aqueduct (as measured at the Ware Disinfection Facility) averaged 0.262 NTU from January 1, 2013 through February, 27 2014, with a minimum of 0.178, a maximum of 1.124, and a median of 0.254 NTU respectively.

Another way to put these numbers in context is to compare them with the EPA’s Surface Water Rule for unfiltered water sources. That standard states that raw water must have a turbidity of 5 NTU or less before disinfection. Otherwise, filtration is required.

It is hard to arrive at any conclusions about the impact of logging on water quality at this particular lot because of the lack of data. Even during relatively heavy rain storms both streams had no flow, probably due unsaturated soils, and unfortunately there were no background samples to compare the four post logging ones to.

Following are field sample sheets with corresponding photographs.

Forestry Lot Water Sample Sheet

Sampler: Paul Reyes/Robert Bishop

Date: 8/25/13

Lot Number: 2043

Check All that Apply:

Stream Crossing:	**x**
Wetland Crossing:	
Photographs:	
Drawings:	

Sample Site Number	BMPS (Y/N)	Other (Y/N)
S1	N	N
S2	N	N
S3	N	N
S4	N	N

Comments:

No water flowing. Two separate stream crossings.

Forestry Lot Water Sample Sheet

Sampler: Paul Reyes

Date: 9/13/13

Lot Number: 2043

Check All that Apply:

Stream Crossing:	x
Wetland Crossing:	
Photographs:	
Drawings:	

Sample Site Number	BMPS (Y/N)	Other (Y/N)
S1	N	N
S2	N	N
S3	N	N
S4	N	N

Comments:

No water flowing. Two separate stream crossings. Bridges in place, but one not at marked crossing.

Forestry Lot Water Sample Sheet

Sampler: Paul Reyes

Date: 9/19/13

Lot Number: 2043

Check All that Apply:

Stream Crossing:	x
Wetland Crossing:	
Photographs:	
Drawings:	

Sample Site Number	BMPS (Y/N)	Other (Y/N)
S1	y	N
S2	y	N
S3	N	N
S4	N	N

Comments:

No water flowing. Two separate stream crossings. Bridge moved to marked crossing.

Forestry Lot Water Sample Sheet

Sampler: Paul Reyes

Date: 10/8/13

Lot Number: 2043

Check All that Apply:

Stream Crossing:	x
Wetland Crossing:	
Photographs:	x
Drawings:	

Sample Site Number	BMPS (Y/N)	Other (Y/N)
S1	Y	N
S2	Y	N
S3	N	N
S4	N	N

Comments:

2.26" of rain over the previous 4 days, no water on stream bed. No samples collected. Active lot

View from Upstream

Upstream View

Downhill View

Downstream View

Uphill View

Dry Streambed

Forestry Lot Water Sample Sheet

Sampler: Paul Reyes

Date: 10/18/13

Lot Number: 2043

Check All that Apply:

Stream Crossing:	x
Wetland Crossing:	
Photographs:	x
Drawings:	

Sample Site Number	BMPS (Y/N)	Other (Y/N)
S1	Y	N
S2	Y	N
S3	N	N
S4	N	N

Dry Streambeds

Images of Lower Bridge

Images of Upper Bridge

Forestry Lot Water Sample Sheet

Sampler: Paul Reyes

Date: 11/18/13

Lot Number: 2043

Check All that Apply:

Stream Crossing:	x
Wetland Crossing:	
Photographs:	x
Drawings:	

Sample Site Number	BMPS (Y/N)	Other (Y/N)
S1	Y	N
S2	Y	N
S3	N	N
S4	N	N

Dry Streambeds

Images of Lower Bridge

Images of Upper Bridge

Forestry Lot Water Sample Sheet

Sampler: Paul Reyes

Date: 12/30/14

Lot Number: 2043

Check All that Apply:

Stream Crossing:	x
Wetland Crossing:	
Photographs:	x
Drawings:	

Sample Site Number	BMPS (Y/N)	Other (Y/N)
S1	N	N
S2	N	N
S3	N	N
S4	N	N

High flow, no bridge, removed after either December 1st or 2nd.

Turbidity:

S1: 0.043 NTU

S2: 0.375 NTU

S3: 0.04 NTU

S4: 0.70 NTU

Images of Lower Stream Crossing

Lower Crossing after Bridge Removal

Upstream View

Downstream View

Images of Upper Stream Crossing

Upper Crossing after Bridge Removal

Upstream View

Downstream View

Forestry Lot Water Sample Sheet

Sampler: Paul Reyes

Date: 5/29/14

Lot Number: 2043

Check All that Apply:

Stream Crossing:	x
Wetland Crossing:	
Photographs:	x
Drawings:	

Sample Site Number	BMPS (Y/N)	Other (Y/N)
S1	N	N
S2	N	N

Low flow, no bridge, removed after either December 1st or 2nd.

Post Cutting Turbidity:

S1 (lower crossing): 0.151 NTU, low flow.

S2 (upper crossing): 0.478 NTU, low flow.

S1 (Lower Crossing)

S2 (Upper Crossing)

2013 Quabbin Reservoir Phytoplankton Monitoring

Paula Packard (March 17, 2014)

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, concentrating, and microscopically analyzing plankton are identical to those conducted at Wachusett Reservoir (see 2013 Wachusett annual report for details). Ice cover precluded the collection of plankton samples during the months of February and March.

TABLE 1 - QUABBIN PLANKTON MONITORING PROGRAM

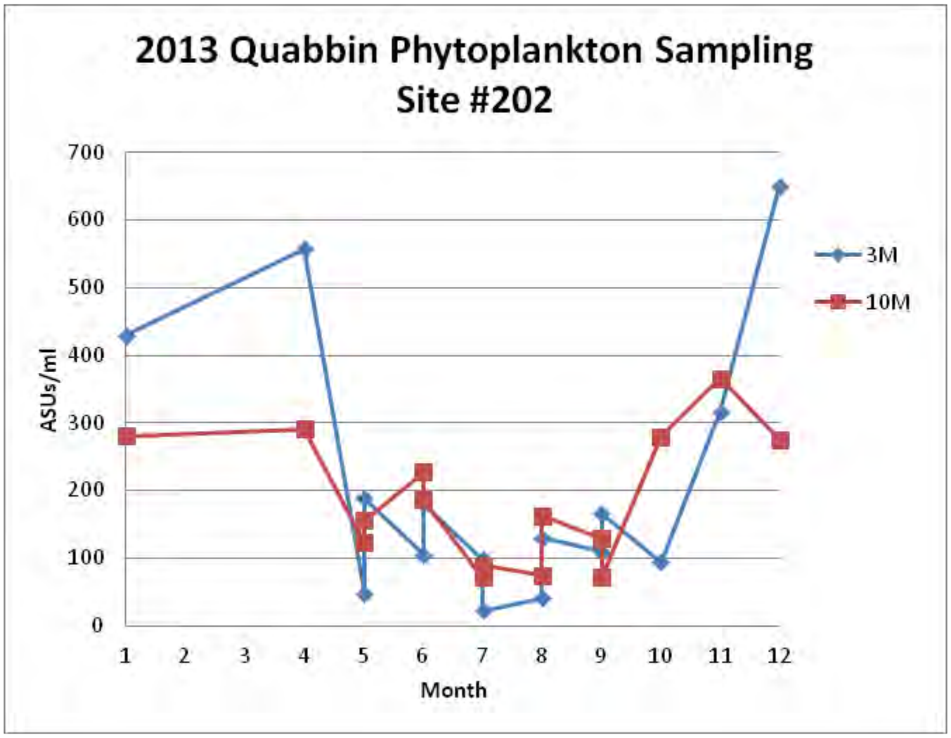
Sampling Stations	**Sampling Frequency**	**Field Tasks**
1) CVA/#202 (Winsor Dam) 2) Shaft 12/#206 (Mt. Pomeroy)	Twice per month from May - Sept. (weather permitting); then decreasing to Once per month from Oct. – April (weather and ice conditions permitting)	1) Multiprobe profile 2) Collection of two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

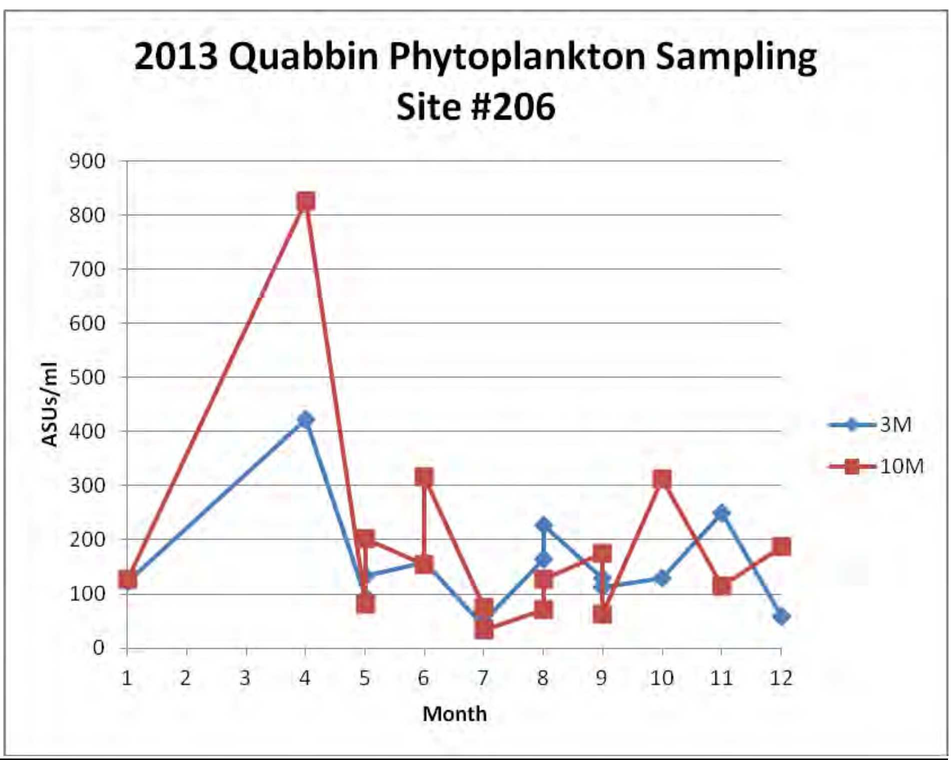
Results show that the Quabbin Reservoir supports a phytoplankton community typical of many oligotrophic systems located in the temperate zone. The most common organisms observed consisted of the diatoms *Asterionella*, *Cyclotella,* and *Rhizosolenia;* the chlorophyte (green alga) *Gloeocystis*; and the cyanophytes (blue-green alga) *Microcystis* and *Aphanocapsa*. Consistent with its status as an “ultra-oligotrophic” system (Wetzel, 1983), Quabbin phytoplankton densities, while still considered low, had averages for 2013 that were slightly higher than those documented in 2012. Sampling site #202 averaged 197 ASUs/ml and sampling site #206 averaged 171 ASUs/ml (see graphs below).

Diatoms dominated the phytoplankton community until mid-July. The highest diatom numbers (523 ASUs/ml) of the year were observed in April at sampling site #202. Diatom numbers declined steadily from then on, reaching their lowest point in August and remaining low throughout September.

April also brought an increase in *Dinobryon* (maximum of 447 ASUs/ml) at sampling site #206 bringing the total phytoplankton value for that sample to 826 ASUs/ml, the highest number for the year. There were no taste and odor complaints and subsequent sampling showed a steady decline of this alga. At the end of July, cyanophyte density began to increase, continuing the trend seen in 2012, where a proliferation of *Aphanocapsa* and *Microcystis* occurred during that month. In 2013, this trend continued through to the end of the year. However, by mid-November, numbers for organisms were more evenly distributed among all the taxa with diatom numbers increasing slightly over those found during the late summer and early fall months. Cyanophyte densities were observed to peak on December 4th at 414 ASUs/ml in the 3 meter sample collected at sampling site #202.

Interestingly, in 2013 exceptionally low levels of plankton were again documented. A July sample collected at sampling site #202, had a density of 22 ASU/ml and one taken from collection site #206 had a density of 39 ASU/ml. Plans for plankton monitoring in 2014 call for a continuation of the program outlined above.





<u>Reference Cited</u>

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

Results of Plankton Monitoring at Quabbin Reservoir
Sampling Station 202 (Winsor Dam)

Date	Depth	Diatoms	Chloro.	Chrysophytes					Cyanophytes		Dinoflag.	Other	Total
	(meters)	Total	Total	Total	*Chrysosph.*	*Dinobryon*	*Synura*	*Uroglenop.*	Total	*Anabaena*	Total	Total	Density
1/9/2013	**3**	420	9	0	0	0	0	0	0	0	0	0	**429**
1/9/2013	**10**	211	8	55	0	16	39	0	8	0	0	0	**281**
4/24/2013	**3**	523	17	17	0	0	0	17	0	0	0	0	**557**
4/24/2013	**10**	291	0	0	0	0	0	0	0	0	0	0	**291**
5/14/2013	**3**	14	0	0	0	0	0	0	34	0	0	0	**48**
5/14/2013	**10**	123	0	0	0	0	0	0	0	0	0	0	**123**
5/30/2013	**3**	98	90	0	0	0	0	0	0	0	0	0	**188**
5/30/2013	**10**	55	39	31	0	31	0	0	0	0	31	0	**156**
6/13/2013	**3**	75	30	0	0	0	0	0	0	0	0	0	**105**
6/13/2013	**11**	195	31	0	0	0	0	0	0	0	0	0	**227**
6/27/2013	**3**	164	0	0	0	0	0	0	16	0	0	0	**180**
6/27/2013	**9**	169	17	0	0	0	0	0	0	0	0	0	**186**
7/10/2013	**3**	98	0	0	0	0	0	0	0	0	0	0	**98**
7/10/2013	**10**	72	0	0	0	0	0	0	0	0	0	0	**72**
7/25/2013	**3**	14	0	0	0	0	0	0	7	0	0	0	**22**
7/25/2013	**10**	0	0	0	0	0	0	0	89	0	0	0	**89**
8/14/2013	**3**	0	8	8	0	0	0	0	24	0	0	0	**41**
8/14/2013	**10**	0	0	0	0	0	0	0	75	0	0	0	**75**
8/28/2013	**3**	0	49	0	0	0	0	0	81	0	0	0	**130**
8/28/2013	**12**	24	16	0	0	0	0	0	122	0	0	0	**163**
9/11/2013	**3**	45	0	0	0	0	0	0	63	0	0	0	**109**
9/11/2013	**10**	0	22	0	0	0	0	0	108	0	0	0	**129**
9/25/2013	**3**	0	35	0	0	0	0	0	131	0	0	0	**166**
9/25/2013	**10**	0	0	0	0	0	0	0	73	0	0	0	**73**
10/16/2013	**3**	8	0	0	0	0	0	0	86	0	0	0	**94**
10/16/2013	**10**	18	0	0	0	0	0	0	263	0	0	0	**280**
11/13/2013	**3**	0	0	0	0	0	0	0	317	0	0	0	**317**
11/13/2013	**10**	33	0	0	0	0	0	0	333	0	0	0	**366**
12/4/2013	**3**	160	76	0	0	0	0	0	414	0	0	0	**650**
12/4/2013	**10**	0	0	24	0	24	0	0	252	0	0	0	**276**

Results of Plankton Monitoring at Quabbin Reservoir
Sampling Station 206 (Shaft 12)

Date	Depth	Diatoms	Chloro.	Chrysophytes					Cyanophytes		Dinoflag.	Other	Total
	(meters)	Total	Total	Total	*Chrysosph.*	*Dinobryon*	*Synura*	*Uroglenop.*	Total	*Anabaena*	Total	Total	Density
1/9/2013	**3**	103	9	9	0	0	0	9	0	0	0	0	**122**
1/9/2013	**10**	118	0	0	0	0	0	0	9	0	0	0	**127**
4/24/2013	**3**	341	16	65	0	65	0	0	0	0	0	0	**423**
4/24/2013	**10**	358	21	447	0	447	0	0	0	0	0	0	**826**
5/15/2013	**3**	93	0	0	0	0	0	0	0	0	0	0	**93**
5/15/2013	**10**	8	16	33	0	33	0	0	24	0	0	0	**81**
5/30/2013	**3**	31	21	72	62	10	0	0	10	0	0	0	**134**
5/30/2013	**10**	169	0	34	0	34	0	0	0	0	0	0	**203**
6/13/2013	**3**	123	26	9	0	9	0	0	0	0	0	0	**158**
6/13/2013	**10**	65	33	0	0	0	0	0	57	0	0	0	**154**
6/27/2013	**3**	135	15	0	0	0	0	0	11	3	0	0	**161**
6/27/2013	**10**	296	17	0	0	0	0	0	4	4	0	0	**317**
7/10/2013	**3**	39	0	0	0	0	0	0	0	0	0	0	**39**
7/10/2013	**6**	53	23	0	0	0	0	0	0	0	0	0	**75**
7/25/2013	**3**	22	14	0	0	0	0	0	14	0	0	0	**50**
7/25/2013	**9**	0	14	0	0	0	0	0	21	0	0	0	**34**
8/14/2013	**3**	0	0	0	0	0	0	0	164	0	0	0	**164**
8/14/2013	**10**	0	13	0	0	0	0	0	59	0	0	0	**72**
8/28/2013	**3**	0	25	0	0	0	0	0	203	0	0	0	**228**
8/28/2013	**11**	0	17	0	0	0	0	0	110	0	0	0	**127**
9/11/2013	**3**	29	14	0	0	0	0	0	86	0	0	0	**129**
9/11/2013	**10**	35	0	0	0	0	0	0	140	0	0	0	**175**
9/25/2013	**3**	0	0	15	0	15	0	0	98	0	0	0	**113**
9/25/2013	**10**	23	0	0	0	0	0	0	39	0	0	0	**63**
10/16/2013	**3**	20	0	0	0	0	0	0	110	0	0	0	**130**
10/16/2013	**10**	117	31	0	0	0	0	0	164	0	0	0	**313**
11/13/2013	**3**	63	94	0	0	0	0	0	94	0	0	0	**250**
11/13/2013	**10**	22	0	22	0	0	0	0	72	0	0	0	**115**
12/4/2013	**3**	36	22	0	0	0	0	0	0	0	0	0	**58**
12/4/2013	**10**	65	8	16	0	16	0	0	98	0	0	0	**187**

2013 Quabbin Boat Inspection Programs

Paula Packard

March 27, 2014

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 minimizing the risk of transporting aquatic invasive species 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 boat washing program and the cold weather quarantine processes are in place to reduce the risks associated with boats being used in multiple locations some of which may be infested with invasive species.

In 2013, 189 boaters were inspected and decontaminated through the wash process, some for the first time. Several have been through our program as many as six times. A total of five boats did not pass inspection. Of those, one failed because of carpeted bunks. He removed the carpet, rescheduled and passed the second time. Three boaters failed because their boat motor exceeded the horse power rating regulations. One of these bought a new motor and returned for reinspection. The other two did not return. One boat motor did not start despite our best efforts. The boat owner fixed the problem and returned to pass the second time.

One hundred and five boats took advantage of our Cold Weather Quarantine Program (CWQ) in anticipation of the 2014 fishing season. CWQ was held on November 16th in New Salem and in Belchertown on November 9th and December 14th and 18th. A snow date was not needed. CWQ had been underutilized in past seasons by fishermen even though it was offered free of charge and at convenient times and locations. This year, we received very few complaints about not hearing of this program in a timely manner and the process seems to be becoming better known. Many fisherman who went through CWQ in 2013, 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 in the season while providing them with an easy means of getting their boats tagged at no cost.

Interestingly, each year we see the return of numerous anglers who have resisted our program. Again in 2013, some of the boaters who utilized the wash process and CWQ, did so for the first time since the boat access restrictions were implemented.

Quabbin Fishing areas had a total of 34,689 visits since the start of our boat decontamination program with 8,491 during the 2013 boating season.

In past years, few, if any, boaters had heard about spiny water flea and the risks associated with this invasive zooplankton. To date, many still believe our boat decontamination program is due to the threat of zebra mussels. In 2012, we had an interesting change in how our program was perceived. Several boaters utilizing the boat decontamination program asked that we be extremely careful and thorough with our decontamination process because they had been to a water body infested with spiny water fleas. On several occasions, fisherman who had seen the effects of SWF, were overheard explaining to the other boaters the impacts they observed. This trend continued into 2013. 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 on site and were determined to be desiccated portions of terrestrial plants such as pine needles, bits of grass, as well as spider webs, exoskeletons of insects and leaves. 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 during our program, continue to pose significant risks. We must continue to pay close attention to the temperature of the water used during boat washing and that there is sufficient water pressure to ensure that all areas of the boat's hull, rollers, bunks and difficult to reach places of the trailer, are effectively washed. 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.

2013 Quabbin Boat Ramp Monitor Program

Paula Packard

March 17, 2014

DCR implemented a successful Boat Ramp Monitor Program in 2010 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.

During the 2011, 2012 and 2013 boating seasons, DCR did not have the funding to hire full time Boat Ramp Monitors. Because of time constraints, the rangers were also unable to assist with implementing this program, so coverage of ponds was reduced to what could be incorporated into a routine work week. Every opportunity to speak directly to boaters was taken and they were strongly encouraged to comply with our requests.

Since actual contact time with boaters was only several hours per week, the process was streamlined to encourage compliance with our requests with a minimum amount of effort. Self certification forms were prominently displayed in a box on the kiosk along with signage which clearly explained the procedures. A letter was drafted which explained our goals, concerns and expectations as well as directions for filling out a Self Certification Form. A blank form and a copy of this letter were placed on any vehicle that did not display a completed self certification form in the windshield. If a form was displayed, occasionally a note thanking them for helping us prevent the spread of AIS was left on the windshield.

Again this year, efforts were concentrated at Comet and Long Ponds. These two ponds have the highest number of boaters and therefore pose the greatest risks for the introduction of aquatic invasive species. Comet Pond in Hubbardston is pristine with no aquatic invasive species so most boaters were in complete agreement with our program and were 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 implementing a program to reduce the likelihood of introducing aquatic invasive species to Comet Pond, was relatively easy.

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 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 and 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 and their stems fragment. Fragments grow roots in a short period of time and pieces carried to areas with suitable substrate, take hold and colonize other locations, displacing and competing with 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.

If a water body is already infested with an aquatic invasive species and when some areas are choked up with weeds, it makes the self certification program more difficult to administer. As in previous years, many boaters argued that it was too late to protect Long Pond from invasive species. Many complained about weeds getting tangled up in their boat propellers and resisted our requests asking them to comply with the self certification process. To combat these arguments, the impacts created from the introduction of spiny water flea, Eurasian milfoil, hydrilla or many other aquatic invasive species were described. Very often people focus on the species they know about and do not consider the impacts associated with things they have never heard of so education continues to be the key to the success of this program. By focusing on the overall program and not the specific organisms we are concerned about, boaters are beginning to think about the impacts of moving boats from one area to another.

New regulations regarding the transporting of aquatic invasive species were recently passed in Massachusetts. Violations can lead to fines being assessed and provides some leverage to us as we try to prevent dispersal of AIS. Overall, the self certification program was successful.

2013 Quabbin and Ware River Aquatic Macrophyte Assessments

Paula D. Packard

March 19, 2014

During the 2013 field season, a total of 22 water bodies were assessed for the presence of aquatic invasive species. Of the 22, 9 were in the Quabbin watershed and 13 were located within the Ware River watershed. Surveys were conducted beginning on June 4, 2013 and ending on September 24, 2013. Many of the water bodies are monitored yearly while others are done as a component of the current Environmental Quality Analysis. Approximate 52 miles of shoreline was assessed for the presence of aquatic invasive species by visually observing the littoral zone from a kayak. See Table below for a complete list of water bodies assessed in 2013.

Ten water bodies contained *M. hetrophyllum* (variable water milfoil). In all of these water bodies, this plant was abundant and widely distributed. It is also well established in sections of the reservoir. Variable water milfoil is a plant that has expanded its range from more southern areas into New England. There are three subtypes of this milfoil. The Atlantic type tends to be slightly less aggressive, the southern type is very aggressive and there is believed to be a hybrid with characteristics somewhere between the two types. The types found at Quabbin or in other water bodies within the watersheds, have not yet been determined. Monitoring and assessment of this plant is ongoing but at this point, it is well established and removal or eradication would be relatively impossible.

Five water bodies had stands of common reed (*Phragmites australis*). Small patches of this invasive are cropping up in locations where they have not been found previously. *Phragmites*, once established, aggressively colonizes the shoreline and is impossible to eradicate using methods such as cutting below the surface of the water, hand pulling or covering with black plastic. Other methods are being researched but to date, the only method that seems to be effective is to use herbicides. *Phragmites* is apparently spreading through seed dispersal. As more plants mature to reproductive age, seed production and dispersal will increase. 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. 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.

In 2011, the presence of several pink water lily plants was documented along the northern shoreline of Comet Pond. Many biologists believe that pink water lilies are a color variation of *Nymphaea odorata*, the native white water lily very common to many of our ponds and lakes. USGS does not list the pink color phase of this plant in its invasive species data base. This population does not seem to be changing. Monitoring will be ongoing and if the status of this plant changes, recommendations for its removal will be made before plant numbers increase to levels where eradication becomes difficult.

This year, Queen Lake in Phillipston was the only water body surveyed that was infested with fanwort (*Cabomba caroliniana*) especially in the northern most end of the lake where several large, robust patches were documented. Queen Lake was treated for this invasive species as well as for variable water milfoil several years ago. The treatment appears to be successful because during the 2011 assessment, no milfoil was found and only two small fragments of fanwort were noted. In 2012 and 2013, variable water milfoil continued to be notably absent but fanwort numbers were greater. There are no plans to treat again in the near future so an increase in the presence of this invasive species is expected.

It was reported that fanwort had been documented in White Hall Pond but neither Dave Worden nor I found any in 2009 or 2010. Michelle Robinson, formerly of DCR Lakes & Ponds, had documented and reported to NHESP, a rare species of plant that closely resembles this invasive. The presence of the rare species and the absence of the aquatic invasive species, were confirmed in the 2011 survey. In the 2013 assessment, the rare plant was found in abundance.

Smaller types of watercraft are less likely to carry aquatic invasive species (AIS) but are not risk free. The potential introduction of aquatic invasive species through this means was realized this year 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. It is very likely that we will see additional plants coming up in the spring of 2014. This site will be revisited early in 2014 and with assistance from the Lakes and Ponds Program staff, hand harvesting will be used to remove plants. This effort will be ongoing until we are confident that *P. crispus* has been eradicated.

This AIS had not been observed during macrophyte assessments conducted prior to 2013. The fact that it was found before the infestation became widespread, will make eradication possible as long as efforts are sustained. Over the last several years, surveys have been timed to coincide with different periods of the growing season for example, if a water body was assessed early one year, it would be done mid or late season of the following year, mainly to document this exact type of plant, which may be present in large numbers early in the spring but undetectable midsummer.

Although Chinese Mystery snails are not plants, they were documented during the macrophyte surveys for the first time at Quabbin in 2011 so will be mentioned here. Numerous snails were found near the boat dock at Fishing Area 1. In 2012, additional snails were found near the hangar at the Quabbin Administration Building in Belchertown. No new infestations were documented in 2013. These snails displace native species of snails and are thought to compete for resources however; few studies have been done 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.

In field notes from previous surveys done at Connor Pond in Petersham and at the start of this macrophyte assessment, it was noted that Blue Flag Iris plants seemed to be rapidly colonizing the western shoreline of this water body. The survey this year coincided more closely to the final blooming stage of irises so searching yielded several dry, but distinct blossoms which unfortunately, explained the rapid spreading of plants. While Blue Flag Iris is present at Connor Pond, many of the plants initially identified as Blue Flag were actually Yellow Flag Iris, a relatively aggressive invasive species. A local said that one of the pond residents used to dig up and sell Yellow Iris bulbs but has discontinued that practice. It is possible that the resident initially planted the first Yellow Irises and is responsible for introducing this invasive plant and now that he is no longer digging bulbs, the plant is spreading at an accelerated rate. Methods may be available to curb population growth. Before the 2014 field season begins, this issue will be investigated further and DCR Lakes & Ponds Program contacted to see what recommendations they may have. To date, the only other location where this particular plant has been found is at the boat launch at Fishing Area 3 in Hardwick. Those plants were hand pulled and have not reappeared.

Purple Loosestrife (*Lithrum salicaria*) was found at six locations this year. 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, was found at Pepper Mill Pond, in the east branch of the Swift River and in a small tributary inside gate 16. This particular plant is also known as *Nasturtium microphyllum*. The identification of this new AIS was tentatively confirmed by consultants from ESS. In 2014, several plants will be allowed to grow to maturity. Flowers will be utilized to positively determine if this plant is actually an invasive species or if it is one of our native watercress. If found to be invasive, plants will be hand harvested. 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 (Forget-me-not) is not truly an aquatic plant but inhabits wet, disturbed shorelines. During the ESS survey, several small patches of this plant were found along the eastern shoreline. These infestations, as well as several others found at a later date, were removed by hand pulling. Populations will be monitored and removed as they are documented however extensive, shallow, underground root systems, the sheer number of plants, inaccessibility, as well as seed production and dispersal, will make complete eradication of this invasive species difficult. Known impacts associated with this plant are minimal at this time but as more information becomes available, it may become apparent that this species does indeed significantly impact ecosystems.

No additional aquatic invasive species were documented in 2013 and plans to assess water bodies in the Ware River and Quabbin watersheds are in place for the 2014 field season.

Water Body	**Location**
Bassett Pond	New Salem
Bennett	Hubbardston
Brigham Pond	Hubbardston
Comet Pond	Hubbardston
Connor	Petersham
Demond Pond	Rutland
Harvard Pond	Petersham
Long Pond (north)	Rutland
Long Pond	Rutland
Lake Mattawa	Orange
Middle Swift Impoundment	New Salem
Moosehorn Pond	Hubbardston
Natty Pond	Hubbardston
Pepper’s Mill Pond	Ware
Pottapaug Pond (East Swift Impoundment)	Petersham & Hardwick
Queen Lake	Phillipston
Sibley Swamp	Wendell
South Spectacle pond	New Salem
Stone Bridge Pond	Templeton
Ware River- Route 122 to Bridge	Barre
White Hall Pond	Rutland
Williamsville Pond	Hubbardston

Environmental Quality Field Report
Site Inspection of
Site 215B – West Branch Fever Brook at Mouth
March 21, 2013

EQ Case Number: EQ.QA013,003.lg,gm

Investigation:
On Wednesday, March 20, 2013 EQ staff were notified by MWRA laboratory of the detection of a Fecal Count of 50 CFU/100Ml and E. coli count of 52MPN/100mL from the sample collected at Site 215B (West Branch Fever Brook at mouth) on sampling run conducted 3/19/13 (**Figure 1**). A spring snow storm was occurring during this sample run.

This sample site is a EQA sample site within the Fever Brook Sanitary District.

In response, EQ staff, Lisa Gustavsen and Gary Moulton conducted a snowshoe-based site inspection of the site and area draining it on March 21, 2013 (**Figure 1**). The weather was partly cloudy with temperatures ranging from approximately 38-45 degrees F. The ground was covered with approximately 1 foot or more of snow.

Summary of observations:

- Weather conditions during the sampling may have influenced the sample.
- Wood ducks were observed in the open water of the sample site when we arrived on site.
- Pond above the sample site was predominately ice covered.
- Two beaver lodges and one beaver dam were observed above the sample site (**Photo 1**)
- Area appeared to have active aquatic wildlife in pond (**Photo 2**)
- Area visually inspected around the pond appeared to be free of any active recreational activity.
- West Branch Fever Brook was not ice covered entering the pond.
- National Grid did not appear to be working at this time period on the ROW intersecting the West Branch Fever Brook.

Conclusion:
Established wildlife presence (e.g., beaver and aquatic birds) in and above the sample area are likely contributors to the increase CFU and E.coli detections in the sample site. Recommend monitoring the sample site in the near term as well as the open water around it for evidence of possible gull roosting.

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Lt. Governor

Richard K. Sullivan, Jr., Secretary
Executive Office of Energy & Environmental Affairs

Edward M. Lambert Jr., Commissioner
Department of Conservation & Recreation

Figure 1 Inspection tracks (blue) with snowshoes/pond mostly frozen (3.21.13)

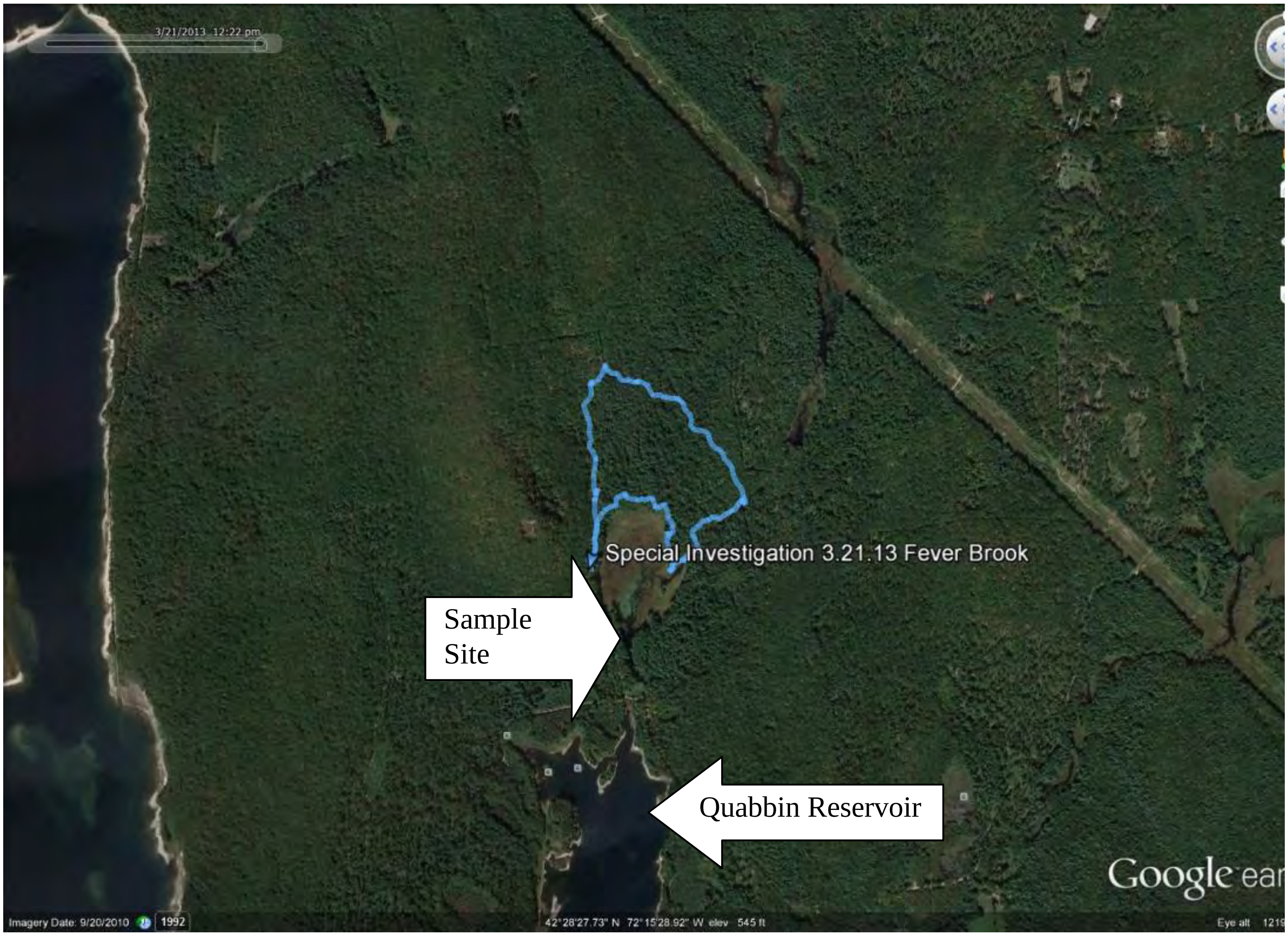

Photo 1 One of two beaver lodges observed in the pond (3/21/13)

Photo 2 Beaver and/or otter tracks in the ice of the pond

dcr
Massachusetts

Environmental Quality Field Report
Sample site N1 – Natty Pond Brook @ Hale Rd
7/31/13
WR 2013-W-19

EQ staff conducted a field investigation in response to elevated turbidity levels in surface water. Samples collected on 7/16/13 had elevated turbidity of 20 NTU. On Friday 7/17/13, EQ staff Bernadeta Susianti-Kubik conducted a field observation of the area draining to site N1.

On Monday 7/29/2013, water samples were taken on three different locations for turbidity comparison purposes. Sample N1 was taken at the regular tributary sampling site N1, Natty Pond Brook at Hale Rd. Sample N2 was taken on the upstream side of sample site N1 at Williamsville Rd. Sample N3 was taken further upstream at Natty Pond located off New Templeton Rd in Hubbardston, MA.

The investigations indentified the followings:

1. No work/construction was occurring around the perimeter of area draining to site N1.
2. The upstream of N1 is a large wetland area heavily populated with beavers.
3. Water samples taken on 7/29/13 suggested there were no significant difference in turbidity between N1 sample and the other upstream samples (<< 20 NTU).

Conclusion:
Weather.com observed 1.08 inch of rain in Hubbardston on 7/1/2013, and 0.26 inch was observed between July 9 and July 11, 2013.

Based on the investigation, beaver activities and flushing from rainfall are likely causes for the elevated turbidity level at site N1 on 7/16/13. No other obvious source of pollution was observed. If turbidity continues to be elevated in upcoming sampling events, further investigation is recommended.

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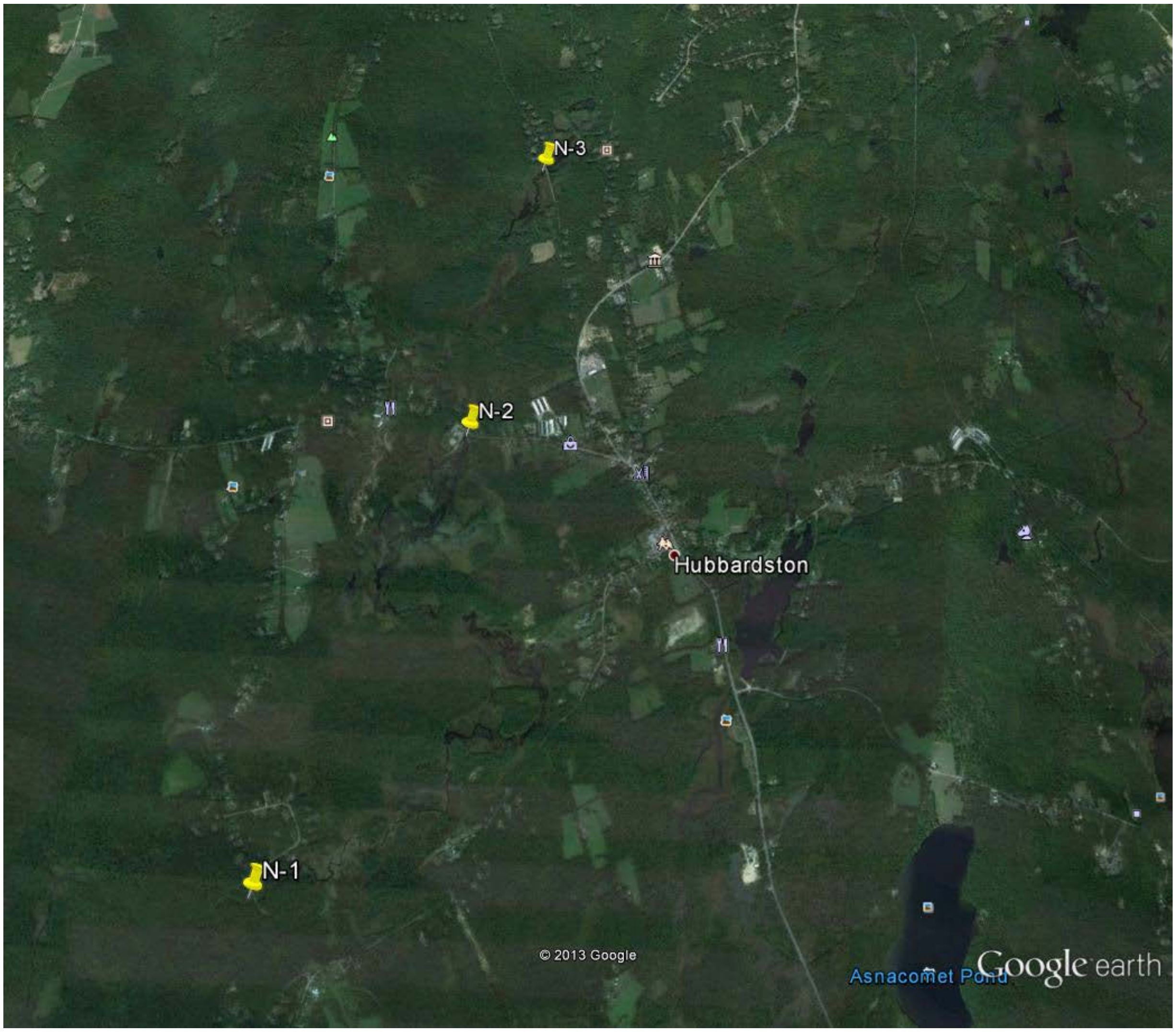
Photos

Water samples taken on 7/29/13

Natty Pond – upstream of sample site N1

Approximate sample locations on 7/29/13



dcr
Massachusetts

MEMORANDUM

To: Bill Pula

cc: Scott Campbell, Bob Bishop

From: Yuehlin Lee

Date: June 19, 2013

Subject: Water Quality Results for Stockroom

Water samples were collected at the Stockroom on Blue Meadow Road on April 22-23, 2013. Samples were taken from the kitchen tap ("KTAP": raw, untreated water) and from the tap dispensing water treated through the reverse osmosis (RO) unit ("Sink RO": treated water). Samples were analyzed for bacteria, volatile organic compounds (VOCs), copper, lead, sodium, nitrate, total dissolved solids, and secondary contaminants not tested in 2012 (aluminum, chloride, color, silver, and zinc). MWRA provided all laboratory services. Total coliform and *Escherichia coli* bacteria were analyzed at Quabbin Laboratory. Color was analyzed at Southboro Laboratory. All other parameters were analyzed at Deer Island Laboratory. See attached table listing all field and laboratory results.

As shown on the attached table, all contaminant concentrations met drinking water standards and guidelines in the RO-treated water. The RO unit provided good treatment for total dissolved solids, chloride, nitrate, copper, lead, sodium, and zinc. Copper and lead were significantly reduced through RO treatment, by a factor of 1,000. Sodium level dropped from 27,900 µg/L (27.9 mg/L) in the raw water to 6,940 µg/L (6.94 mg/L) in the RO-treated water.

For VOCs, methyl-tert-butyl ether (MTBE) was detected just above detection limit at 0.61 µg/L in the raw, untreated water. MTBE levels have been very low in the raw water during the most recent sampling events, which included detections of 0.62 µg/L in April 2010, 0.85 µg/L in July/August 2010, 0.53 µg/L in June 2012. Previous monitoring in 1999 through 2000 indicated MTBE levels of 27 to 38 µg/L. Chloromethane was detected in the RO sample at 0.70 µg/L, just above the detection limit, but not in the untreated water. This level is far below any known health concern level. The RO tap was retested on June 11, 2013, and ***chloromethane was not detected***.

Please call me at extension 158 if you have questions or require further. Thank you.

Water Quality at Stockroom
Samples Collected 4/22 - 4/23/13

Parameter	Units	Kitchen Tap, untreated KTAP	Treated (RO) Water Sink RO [1]	Drinking Water Standard or Guideline [2]	Remarks [3]
			Bacteria		
Total Coliform	MPN/100 mL	<1.00	<1.00	Absent	Total Coliform Rule
E. coli	MPN/100 mL	<1.00	<1.00	Absent	Total Coliform Rule
			Physical/Chemical Properties		
Color	Color Units	4	2	15	SDWR, SMCL
Total Dissolved Solids	mg/L	380	25.0	500 mg/L	SDWR, SMCL
			Inorganic Compounds		
Aluminum	ug/L	<5.00	<5.00	50-200 ug/L	SDWR, SMCL
Chloride	mg/L	195	10.9	250 mg/L	SDWR, SMCL
Copper	ug/L	1140	1.32	1,000 ug/L	SDWR, SMCL
Lead	ug/L	26.6	0.0700	15 ug/L	MCL (Action Level)
Nitrate	mg/L	0.453	<0.00500	10 mg/L	MCL
Silver	ug/L	<0.100	<0.100	100 ug/L	SDWR, SMCL
Sodium	ug/L	27900	6940	20,000 ug/L	MA ORSG
Zinc	ug/L	753	17.0	5,000 ug/L	SDWR, SMCL
			VOCs		
Benzene	ug/L	<0.500	<0.500	5 ug/L	MCL
Bromobenzene	ug/L	<0.500	<0.500	-	
Bromochloromethane	ug/L	<0.500	<0.500	-	
Bromodichloromethane	ug/L	<0.500	<0.500	80 ug/L	MCL, based on total trihalomethanes.
Bromoform	ug/L	<0.500	<0.500	80 ug/L	MCL, based on total trihalomethanes.
Bromomethane	ug/L	<0.500	<0.500	10 ug/L	MA ORSG
Butylbenzene, n-	ug/L	<0.500	<0.500	-	
Butylbenzene, sec-	ug/L	<0.500	<0.500	-	
Butylbenzene, tert-	ug/L	<0.500	<0.500	-	
Carbon tetrachloride	ug/L	<0.500	<0.500	5 ug/L	MCL
Chlorobenzene	ug/L	<0.500	<0.500	100 ug/L	MCL
Chloroethane	ug/L	<0.500	<0.500	-	
Chloroform	ug/L	<0.500	<0.500	70 ug/L	MA ORSG, for non-chlorinated supply.

Water Quality at Stockroom
Samples Collected 4/22 - 4/23/13

Parameter	Units	Kitchen Tap, untreated KTAP	Treated (RO) Water Sink RO [1]	Drinking Water Standard or Guideline [2]	Remarks [3]
Chloromethane	ug/L	<0.500	0.700	-	
Chlorotoluene, 2-	ug/L	<0.500	<0.500	-	
Chlorotoluene, 4-	ug/L	<0.500	<0.500	-	
Dibromo-3-chloropropane, 1,2-	ug/L	<0.500	<0.500	0.2 ug/L	MCL
Dibromochloromethane	ug/L	<0.500	<0.500	80 ug/L	MCL, based on total trihalomethanes.
Dibromoethane, 1,2-	ug/L	<0.500	<0.500	-	
Dibromomethane	ug/L	<0.500	<0.500	-	
Dichlorobenzene, 1,2-	ug/L	<0.500	<0.500	600 ug/L	MCL
Dichlorobenzene, 1,3-	ug/L	<0.500	<0.500	-	
Dichlorobenzene, 1,4-	ug/L	<0.500	<0.500	5 ug/L	MA MCL
Dichlorodifluoromethane	ug/L	<0.500	<0.500	1400 ug/L	MA ORSG
Dichloroethane, 1,1-	ug/L	<0.500	<0.500	70 ug/L	MA ORSG
Dichloroethane, 1,2-	ug/L	<0.500	<0.500	5 ug/L	MCL
Dichloroethene, 1,1-	ug/L	<0.500	<0.500	7 ug/L	MCL
Dichloroethene, cis-1,2-	ug/L	<0.500	<0.500	70 ug/L	MCL
Dichloroethene, trans-1,2-	ug/L	<0.500	<0.500	100 ug/L	MCL
Dichloropropane, 1,2-	ug/L	<0.500	<0.500	5 ug/L	MCL
Dichloropropane, 1,3-	ug/L	<0.500	<0.500	-	
Dichloropropane, 2,2-	ug/L	<0.500	<0.500	-	
Dichloropropene, 1,1-	ug/L	<0.500	<0.500	-	
Dichloropropene, 1,3- (Total)	ug/L	<0.500	<0.500	0.4 ug/L	MA ORSG
Dichloropropene, cis-1,3-	ug/L	<0.500	<0.500	0.4 ug/L	MA ORSG, for 1,3-dichloropropene.
Dichloropropene, trans-1,3-	ug/L	<0.500	<0.500	0.4 ug/L	MA ORSG, for 1,3-dichloropropene.
Ethylbenzene	ug/L	<0.500	<0.500	700 ug/L	MCL
Hexachlorobutadiene	ug/L	<0.500	<0.500	-	
Isopropylbenzene	ug/L	<0.500	<0.500	-	
Isopropyltoluene, 4-	ug/L	<0.500	<0.500	-	
Methylene chloride	ug/L	<0.500	<0.500	5 ug/L	MCL
Methyl-tert-butyl ether (MTBE)	ug/L	0.610	<0.500	70 ug/L	MA ORSG. 20-40 ug/L for odor & taste.

Water Quality at Stockroom
Samples Collected 4/22 - 4/23/13

Parameter	Units	Kitchen Tap, untreated KTAP	Treated (RO) Water Sink RO [1]	Drinking Water Standard or Guideline [2]	Remarks [3]
Naphthalene	ug/L	<0.500	<0.500	140 ug/L	MA ORSG
Propylbenzene, n-	ug/L	<0.500	<0.500	-	
Styrene	ug/L	<0.500	<0.500	100 ug/L	MCL
Tetrachloroethane, 1,1,1,2-	ug/L	<0.500	<0.500	-	
Tetrachloroethane, 1,1,2,2-	ug/L	<0.500	<0.500	-	
Tetrachloroethene	ug/L	<0.500	<0.500	5 ug/L	MCL
Toluene	ug/L	<0.500	<0.500	1000 ug/L	MCL
Trichlorobenzene, 1,2,3-	ug/L	<0.500	<0.500	-	
Trichlorobenzene, 1,2,4-	ug/L	<0.500	<0.500	70 ug/L	MCL
Trichloroethane, 1,1,1-	ug/L	<0.500	<0.500	200 ug/L	MCL
Trichloroethane, 1,1,2-	ug/L	<0.500	<0.500	5 ug/L	MCL
Trichloroethene	ug/L	<0.500	<0.500	5 ug/L	MCL
Trichlorofluoromethane	ug/L	<0.500	<0.500	-	
Trichloropropane, 1,2,3-	ug/L	<0.500	<0.500	-	
Trimethylbenzene, 1,2,4-	ug/L	<0.500	<0.500	-	
Trimethylbenzene, 1,3,5-	ug/L	<0.500	<0.500	-	
Vinyl chloride	ug/L	<0.500	<0.500	2 ug/L	MCL
Xylene, m,p-	ug/L	<0.500	<0.500	10000 ug/L	MCL, based on total xylenes.
Xylene, o-	ug/L	<0.500	<0.500	10000 ug/L	MCL, based on total xylenes.
Xylenes, Total	ug/L	<0.500	<0.500	10000 ug/L	MCL.

[1] VOCs were not detected in samples collected June 11, 2013.

[2] 1 mg/L = 1 ppm = 1000 ug/L = 1000 ppb

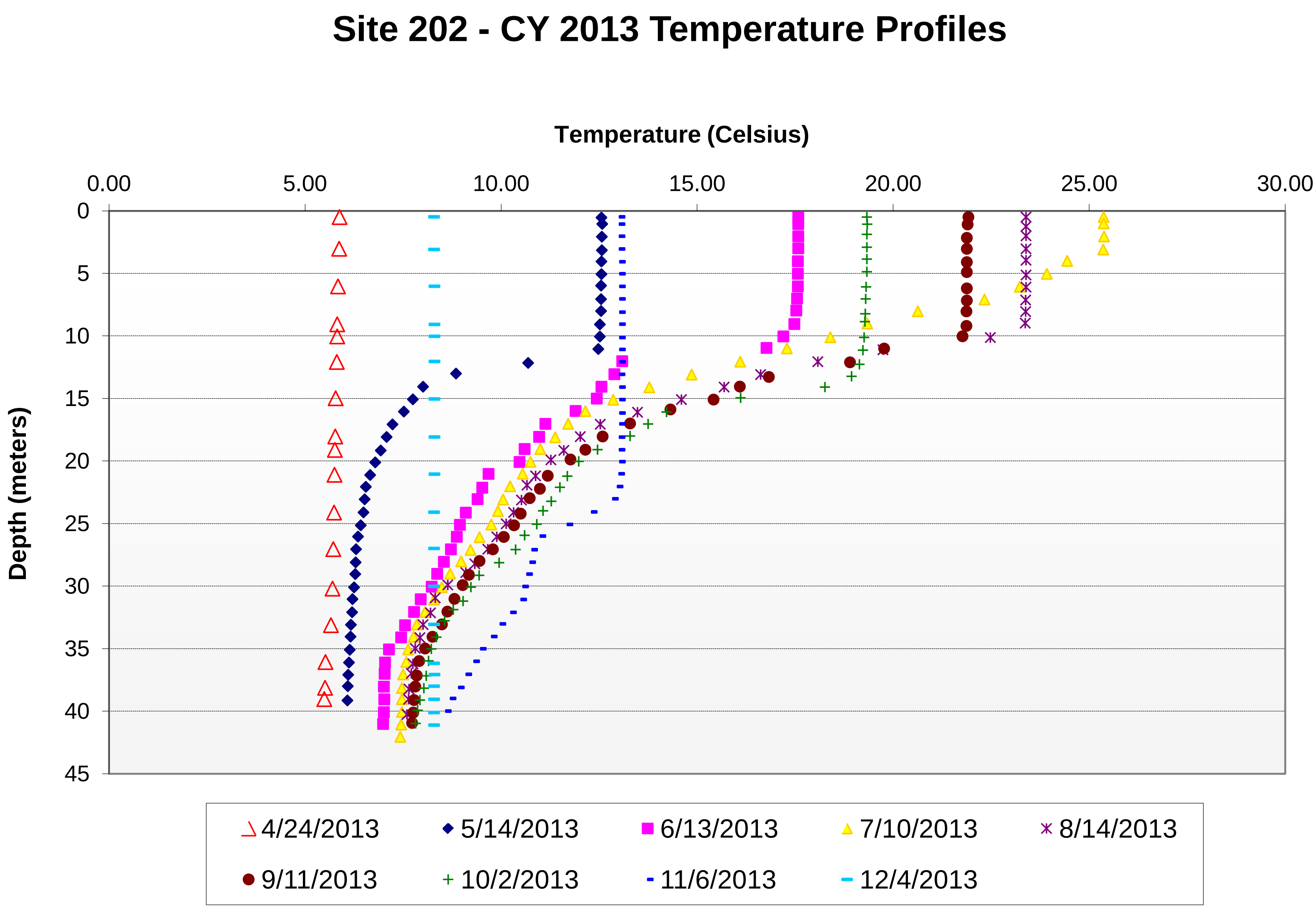
[3] MCL = Maximum Contaminant Level
SDWR = Secondary Drinking Water Regulations (federal)
SMCL = Secondary Maximum Contaminant Level (Massachusetts)
SDWR and SMCL are set for aesthetics, not health concerns.
MA ORSG = MA Office of Research and Standards Guidelines

APPENDIX B

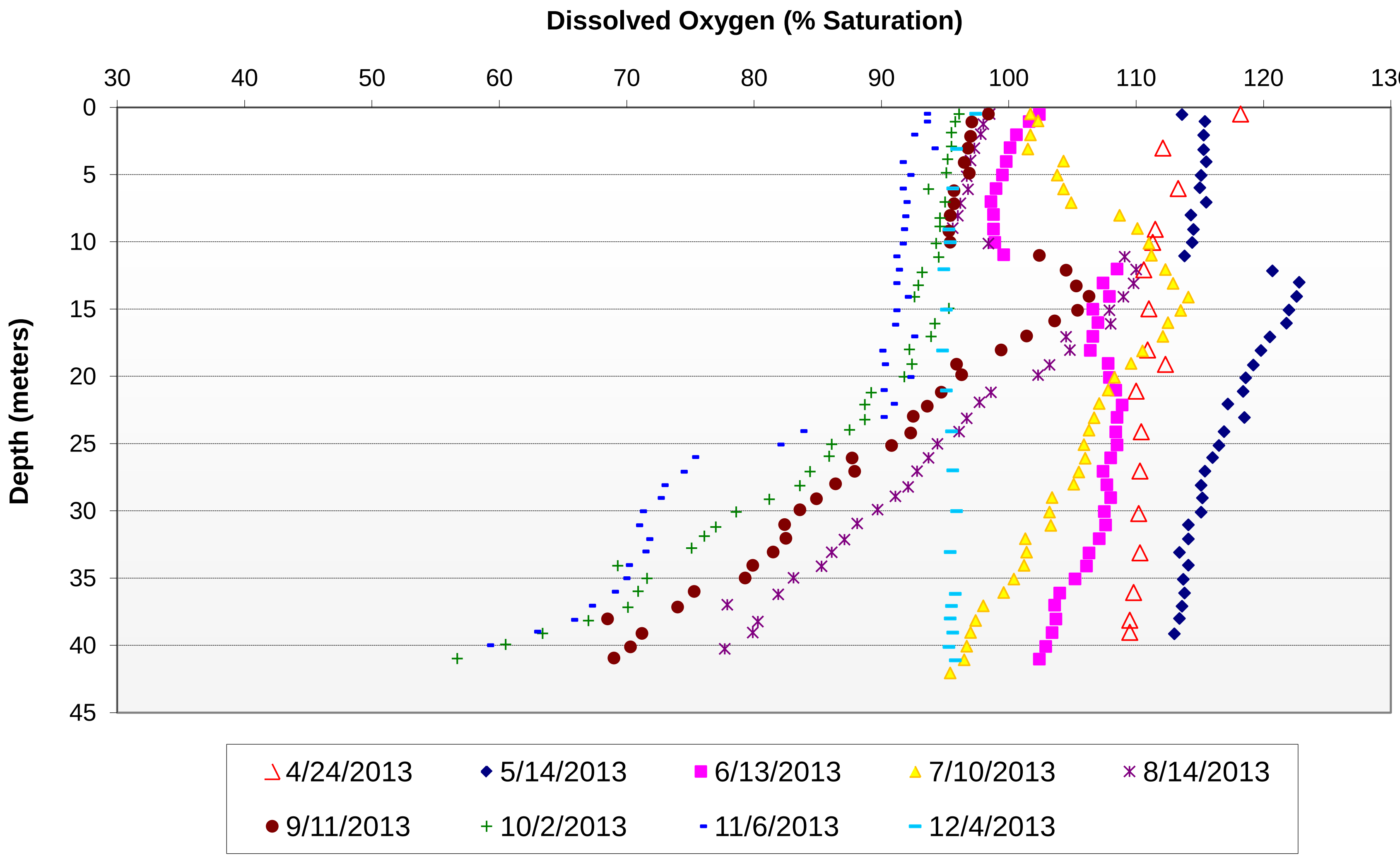
Selected Plots and Graphs

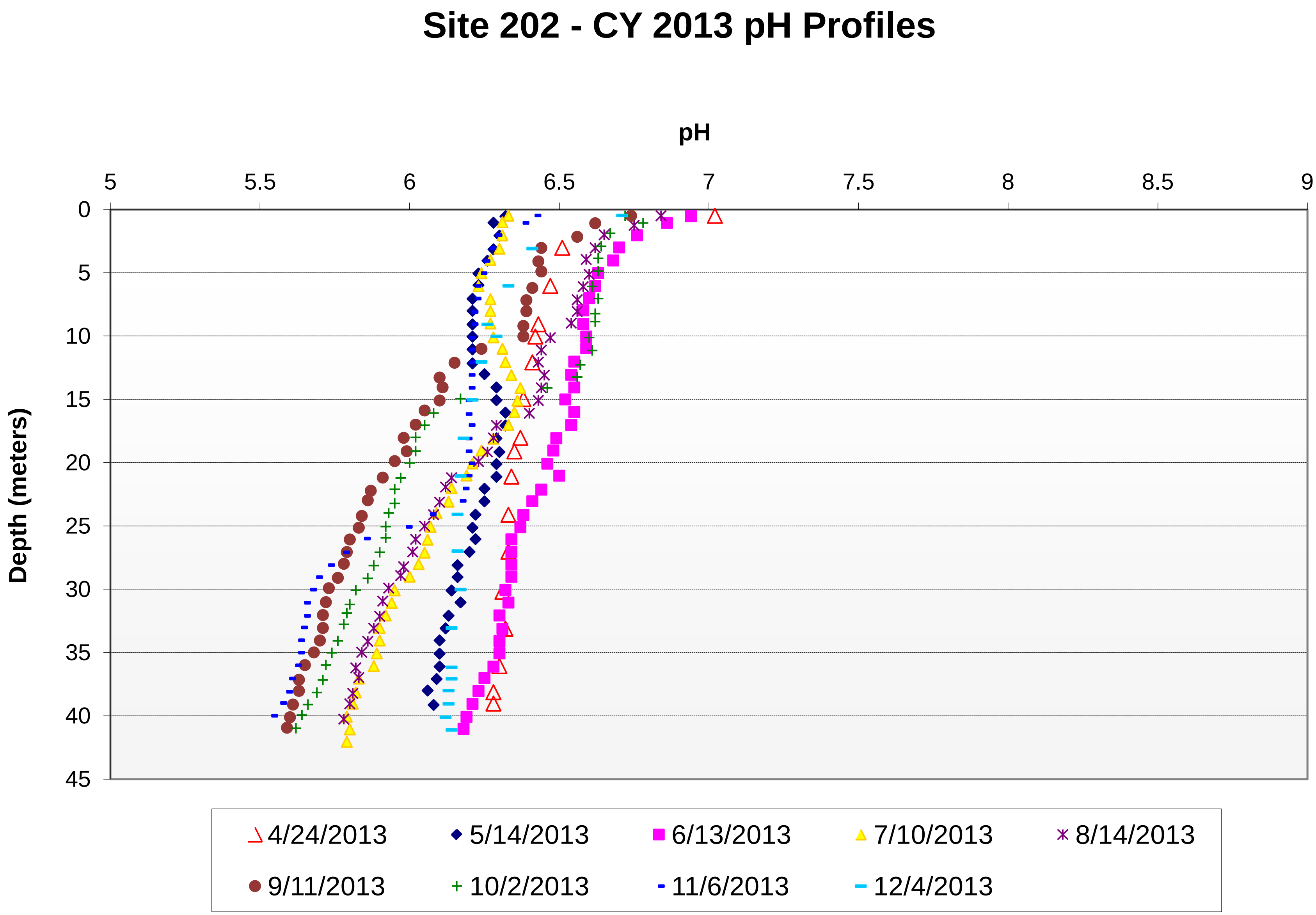
Quabbin Reservoir Profiles

Stream Hydrographs

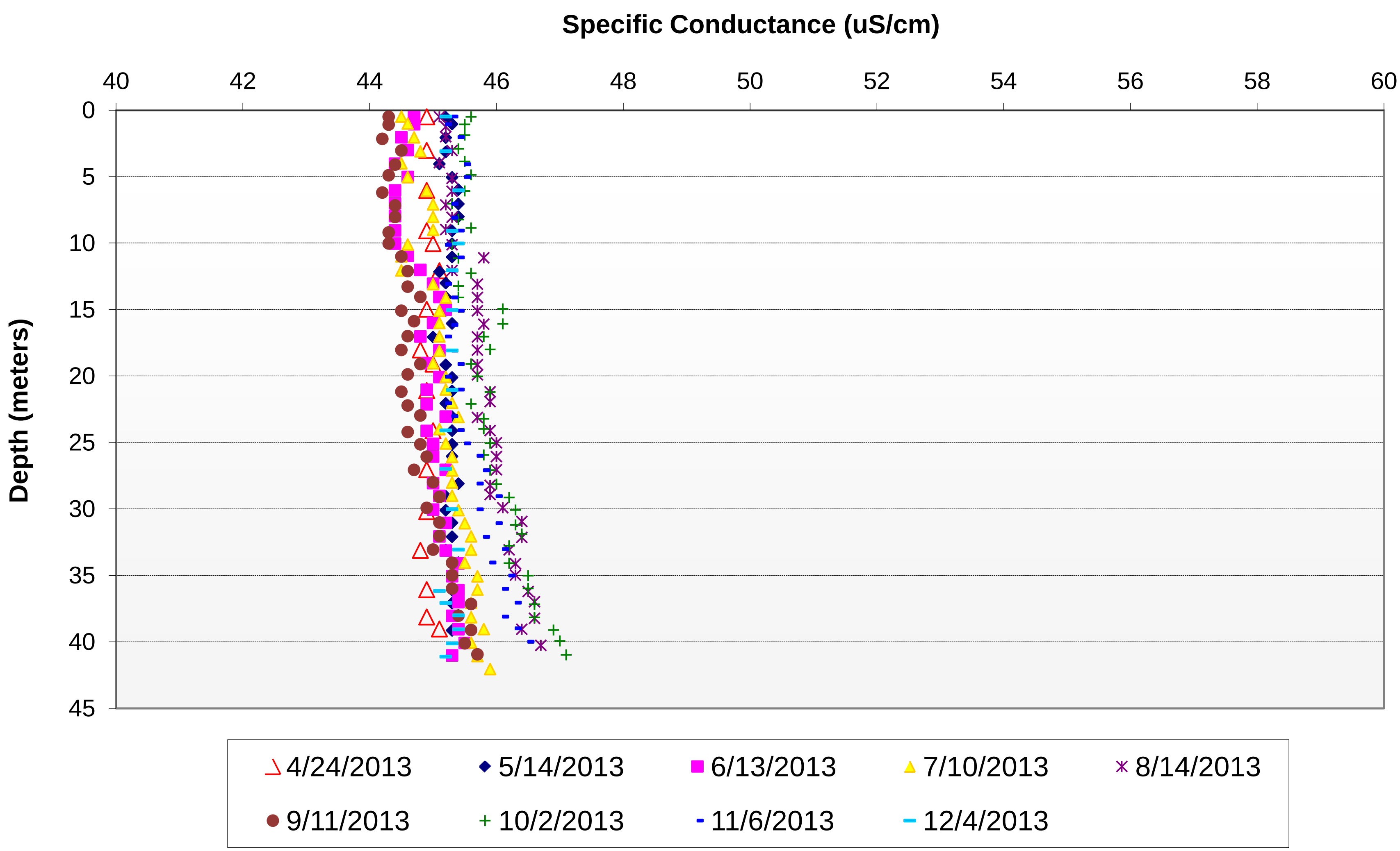

Site 202 - CY 2013 Temperature Profiles
Temperature (Celsius)
0.00
5.00
10.00
15.00
20.00
25.00
30.00
Depth (meters)
0
5
10
15
20
25
30
35
40
45
4/24/2013
5/14/2013
6/13/2013
7/10/2013
8/14/2013
9/11/2013
10/2/2013
11/6/2013
12/4/2013

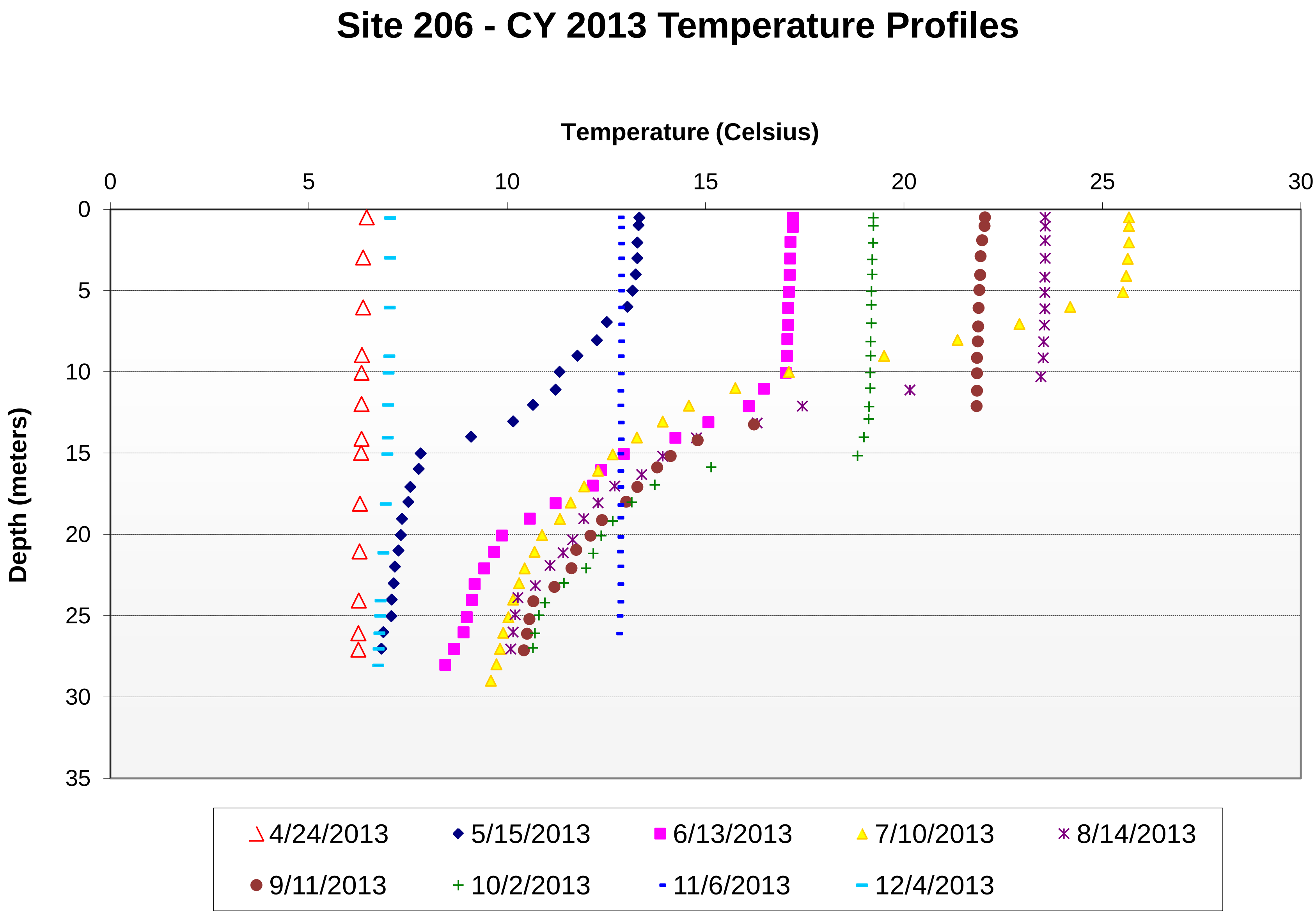
Site 202 - CY 2013 Dissolved Oxygen Profiles



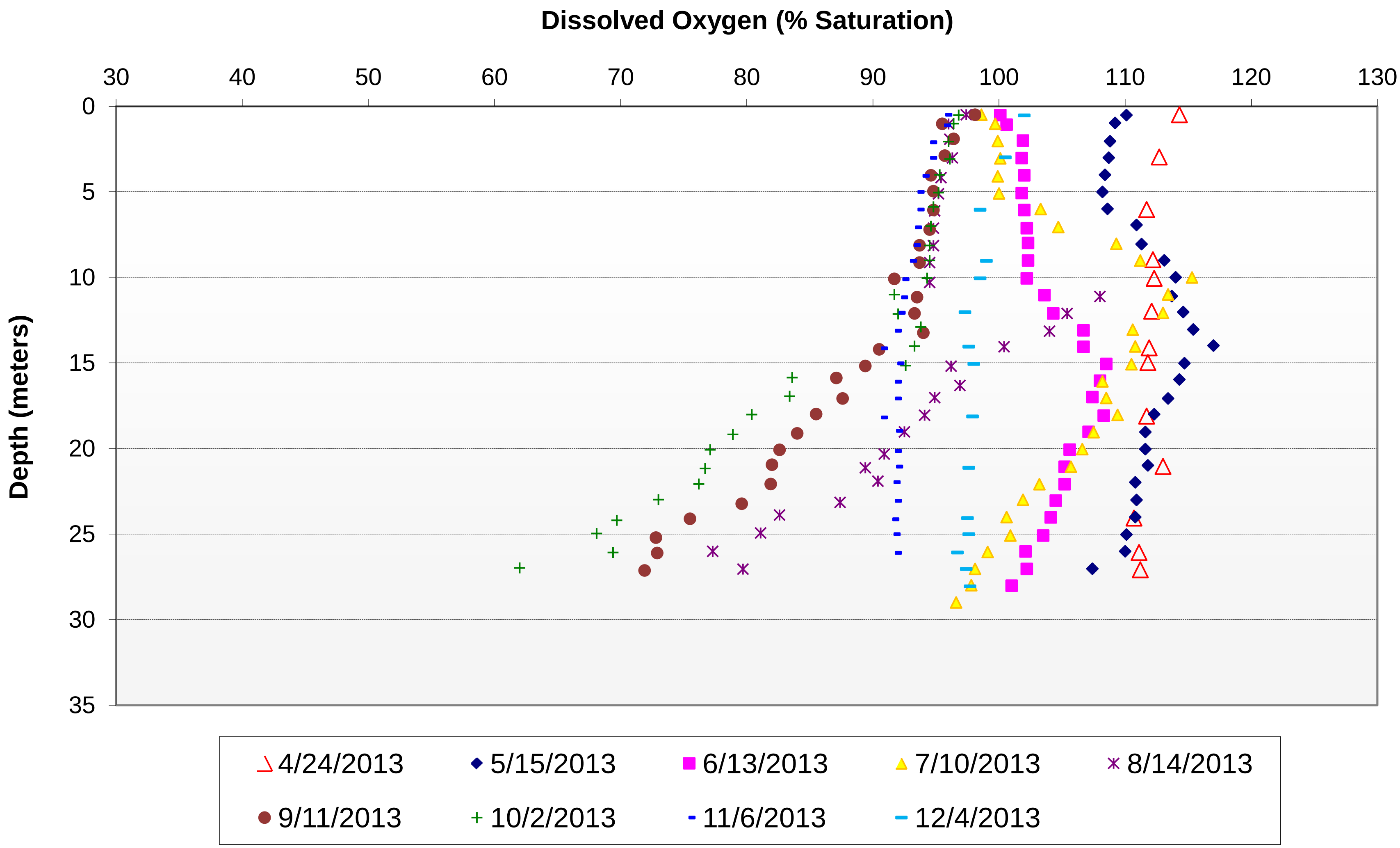

Site 202 - CY 2013 pH Profiles
pH
5
5.5
6
6.5
7
7.5
8
8.5
9
Depth (meters)
0
5
10
15
20
25
30
35
40
45
4/24/2013
5/14/2013
6/13/2013
7/10/2013
8/14/2013
9/11/2013
10/2/2013
11/6/2013
12/4/2013

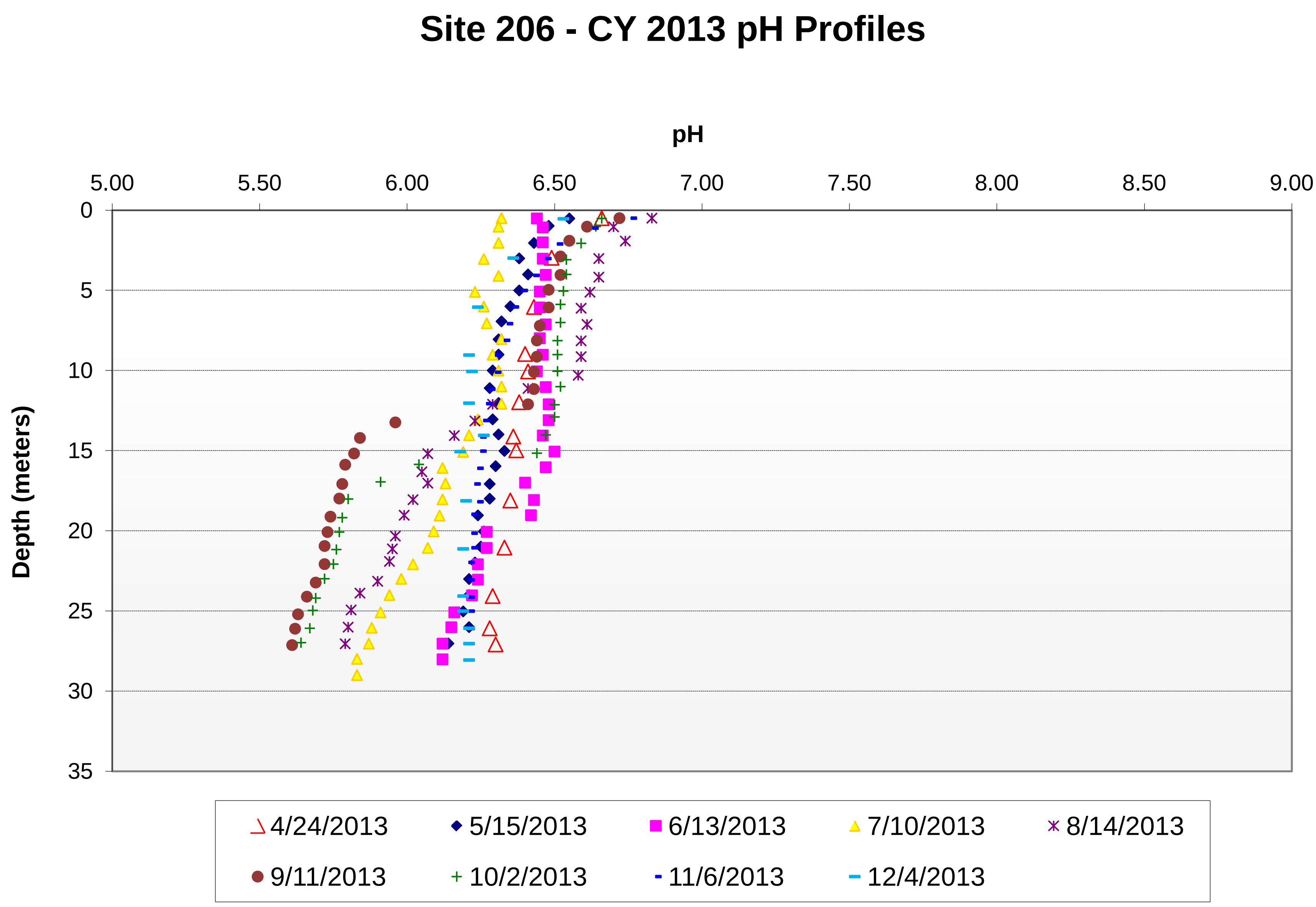
Site 202 - CY 2013 Specific Conductance Profiles

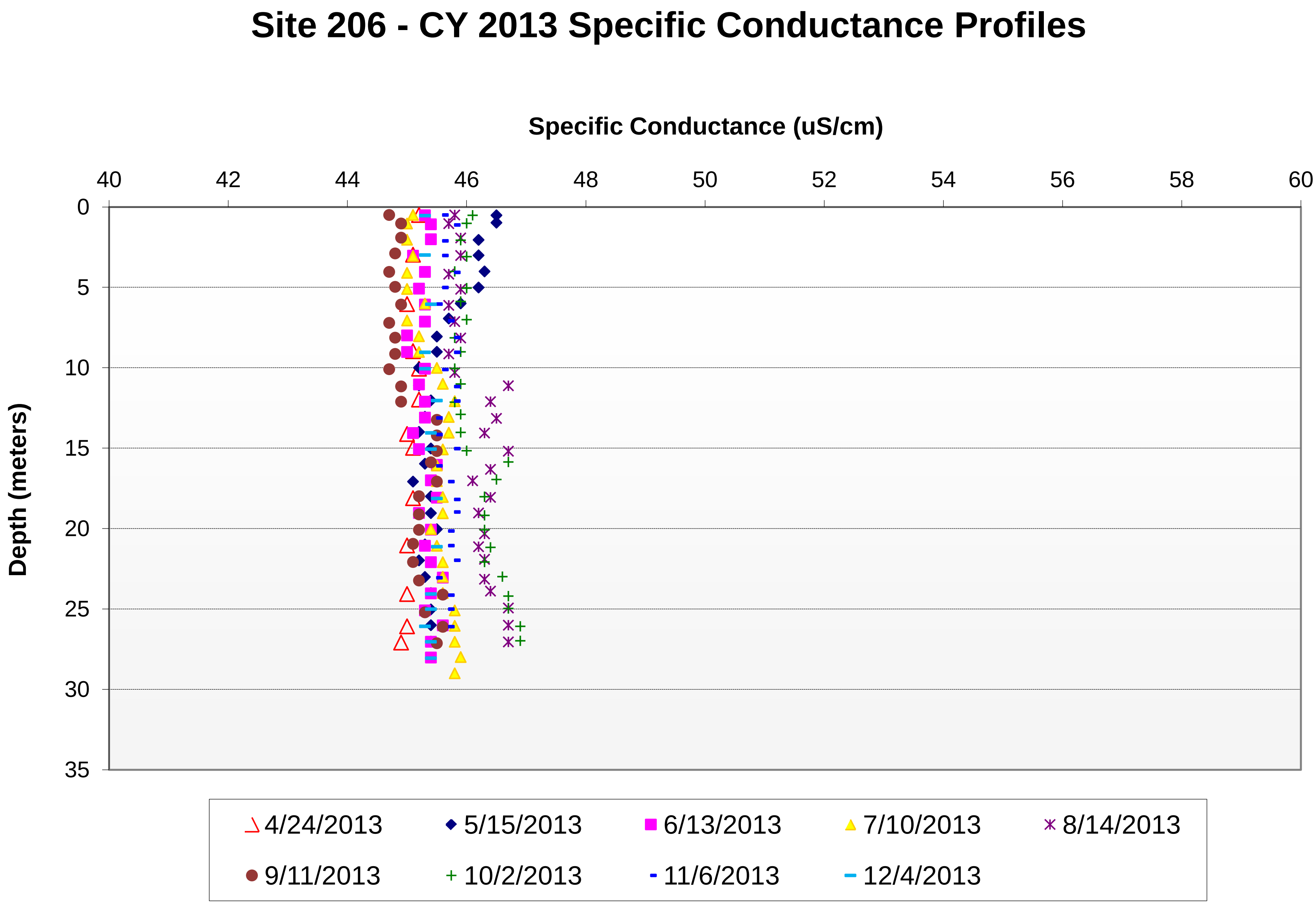



Site 206 - CY 2013 Temperature Profiles
Temperature (Celsius)
0
5
10
15
20
25
30
Depth (meters)
0
5
10
15
20
25
30
35
4/24/2013
5/15/2013
6/13/2013
7/10/2013
8/14/2013
9/11/2013
10/2/2013
11/6/2013
12/4/2013

Site 206 - CY 2013 Dissolved Oxygen Profiles

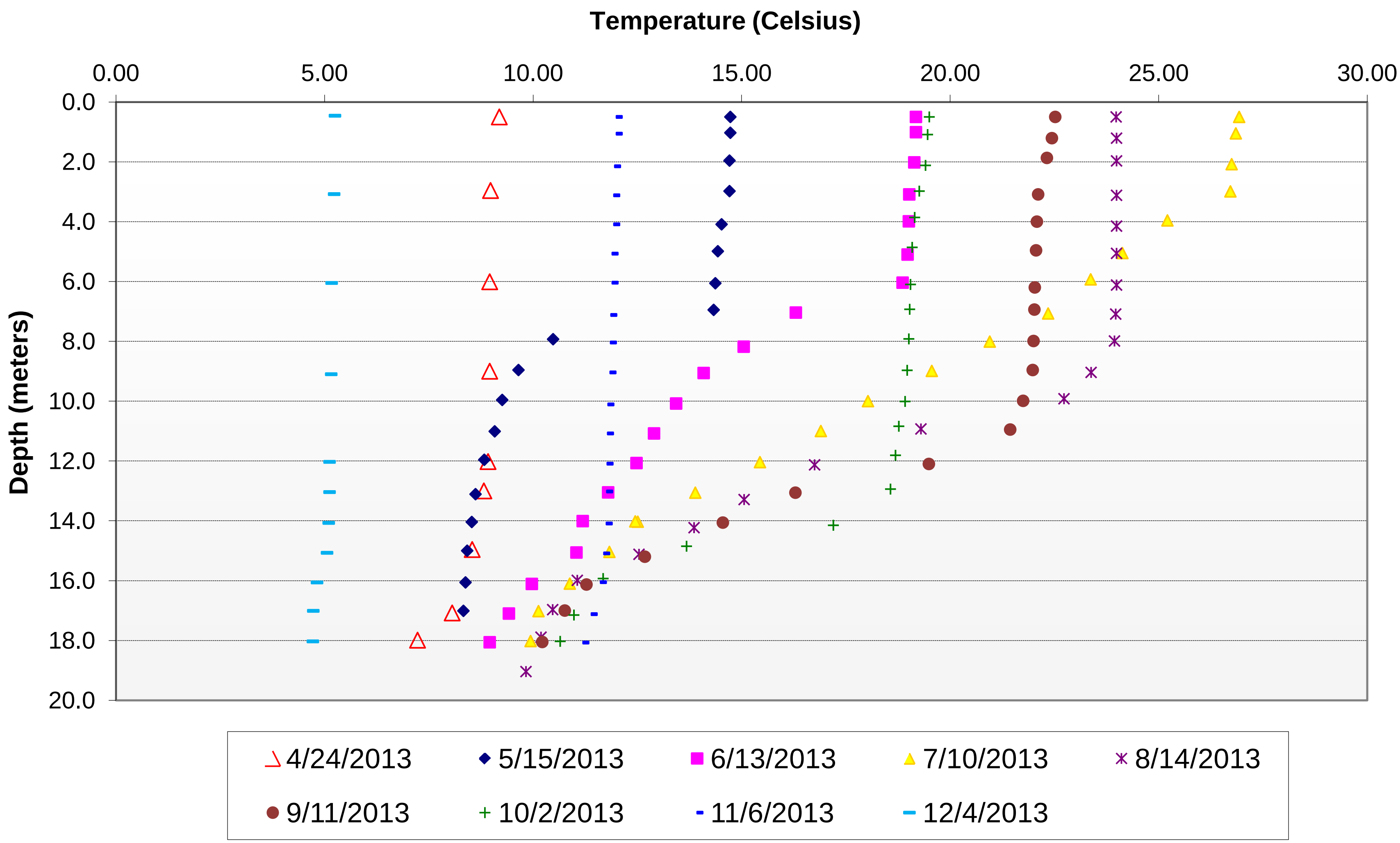



Site 206 - CY 2013 pH Profiles
pH
5.00
5.50
6.00
6.50
7.00
7.50
8.00
8.50
9.00
Depth (meters)
0
5
10
15
20
25
30
35
4/24/2013
5/15/2013
6/13/2013
7/10/2013
8/14/2013
9/11/2013
10/2/2013
11/6/2013
12/4/2013

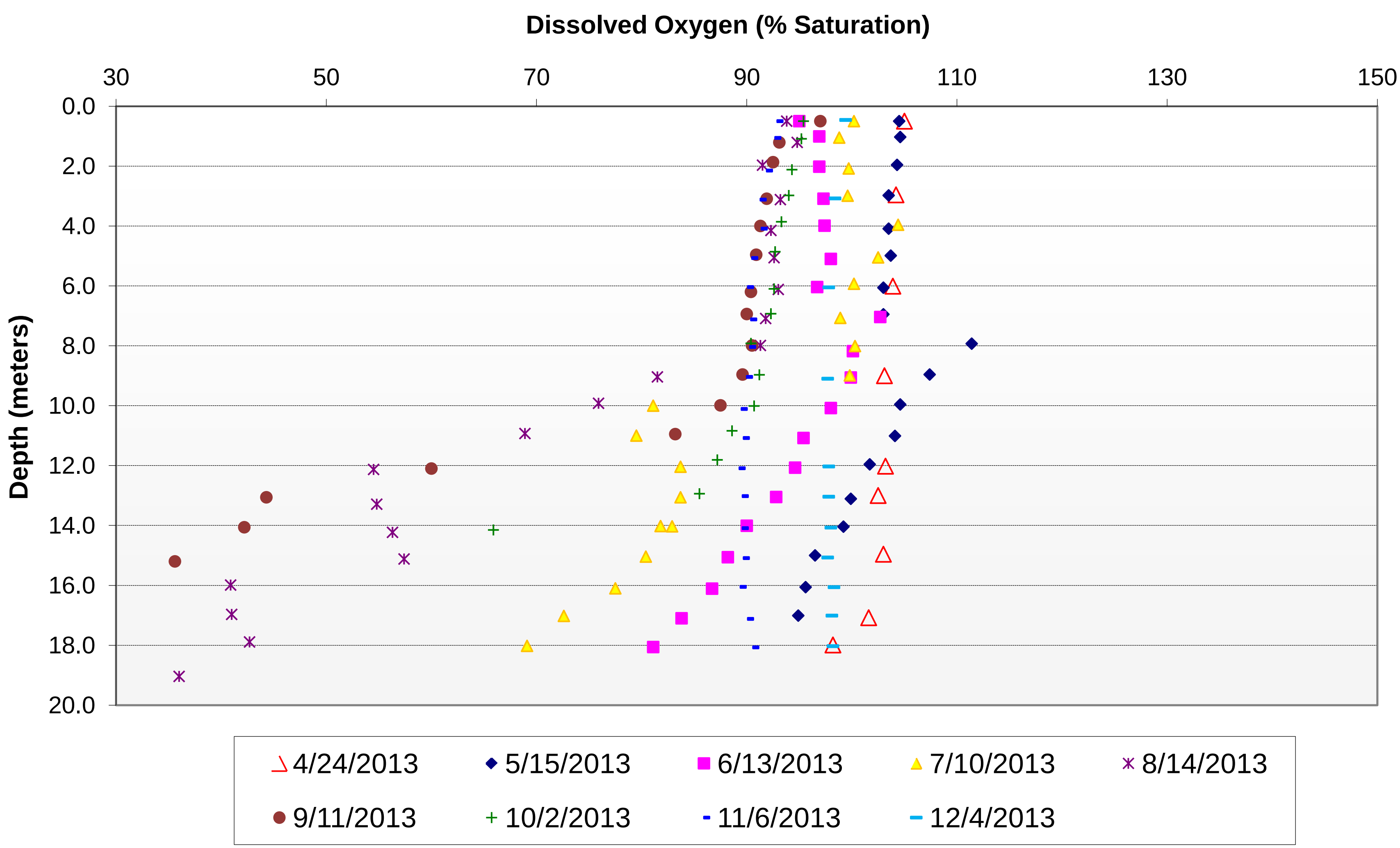


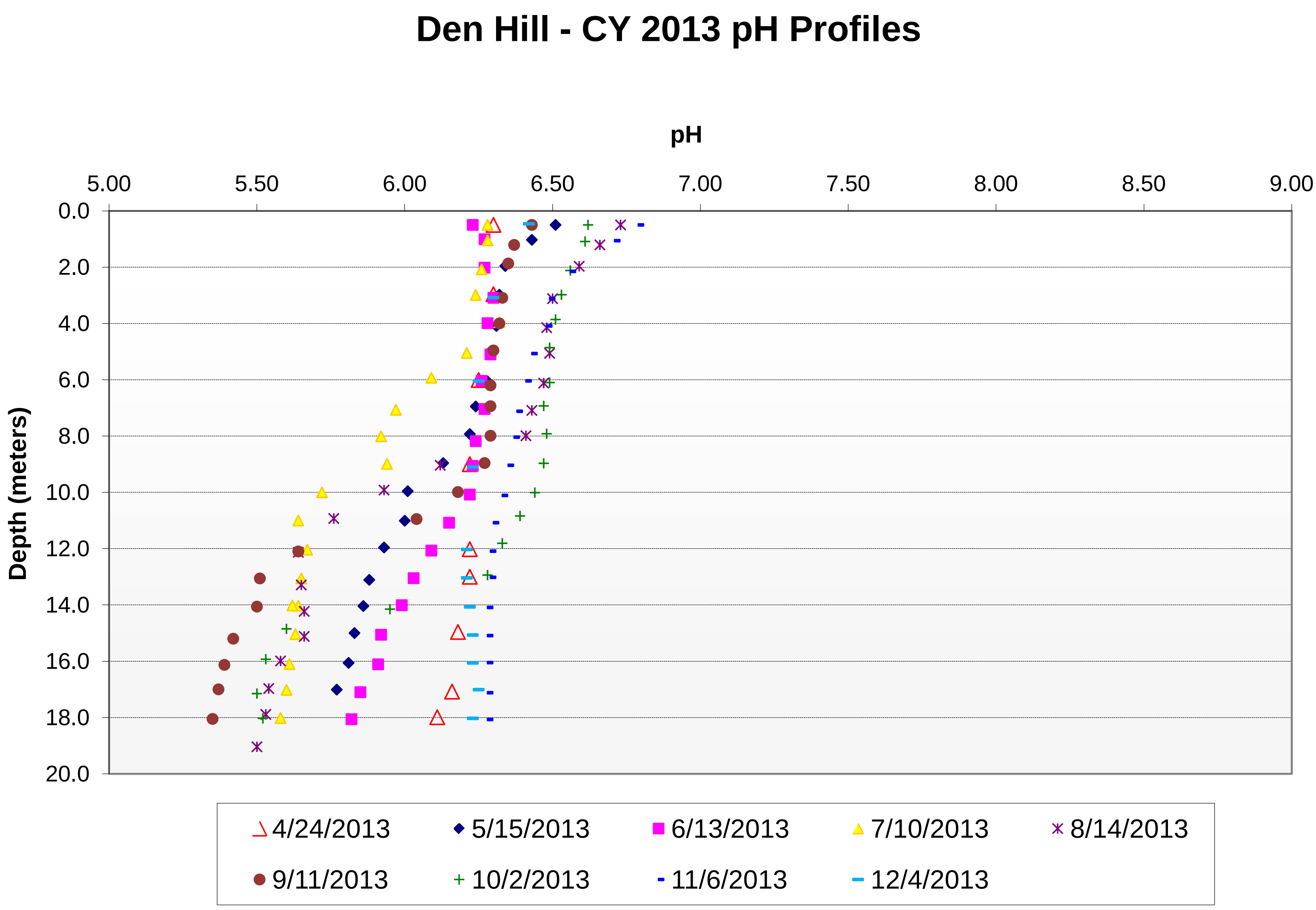
Site 206 - CY 2013 Specific Conductance Profiles
Specific Conductance (uS/cm)
40
42
44
46
48
50
52
54
56
58
60
Depth (meters)
0
5
10
15
20
25
30
35
4/24/2013
5/15/2013
6/13/2013
7/10/2013
8/14/2013
9/11/2013
10/2/2013
11/6/2013
12/4/2013

Den Hill - CY 2013 Temperature Profiles



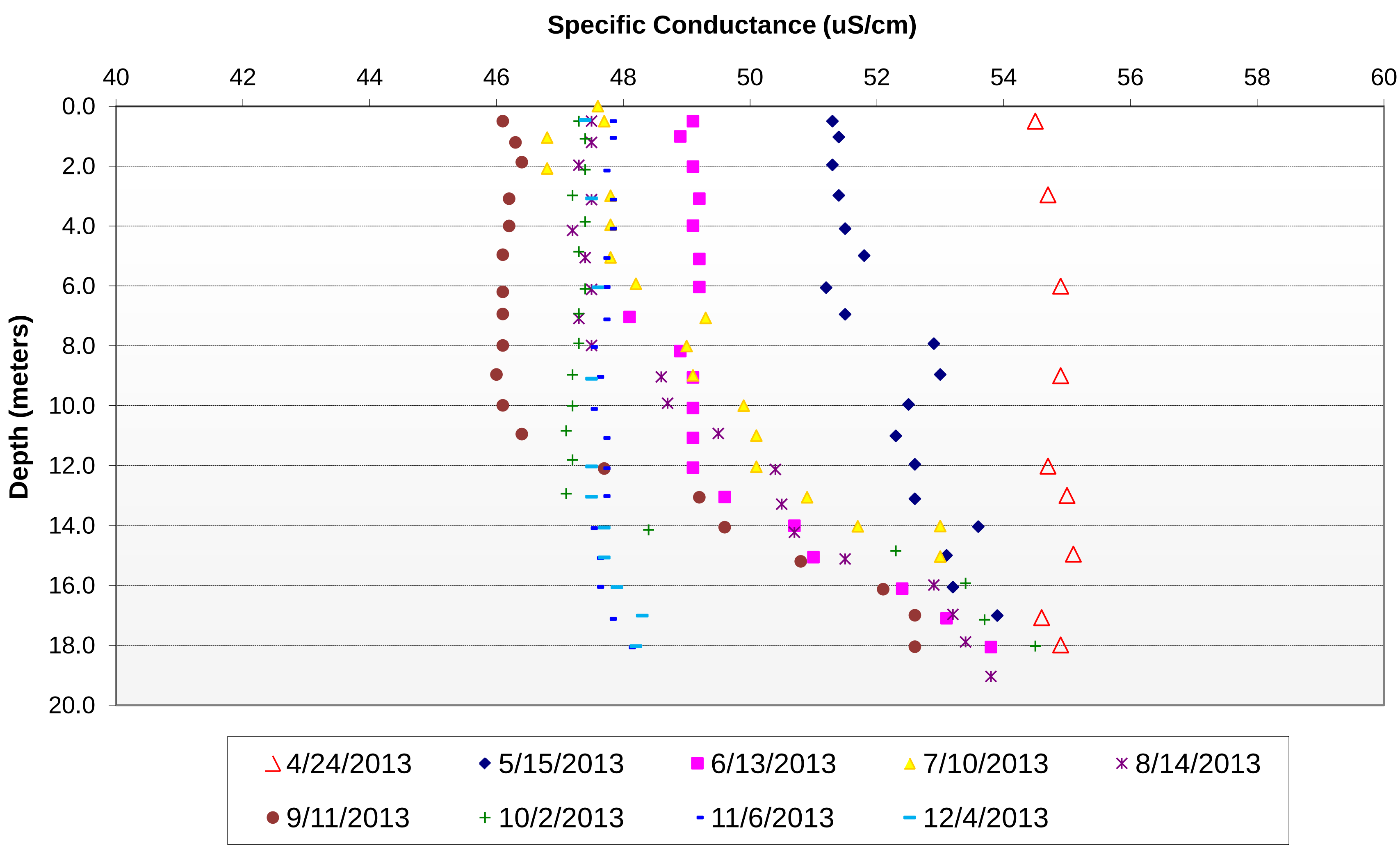
Den Hill - CY 2013 Dissolved Oxygen Profiles



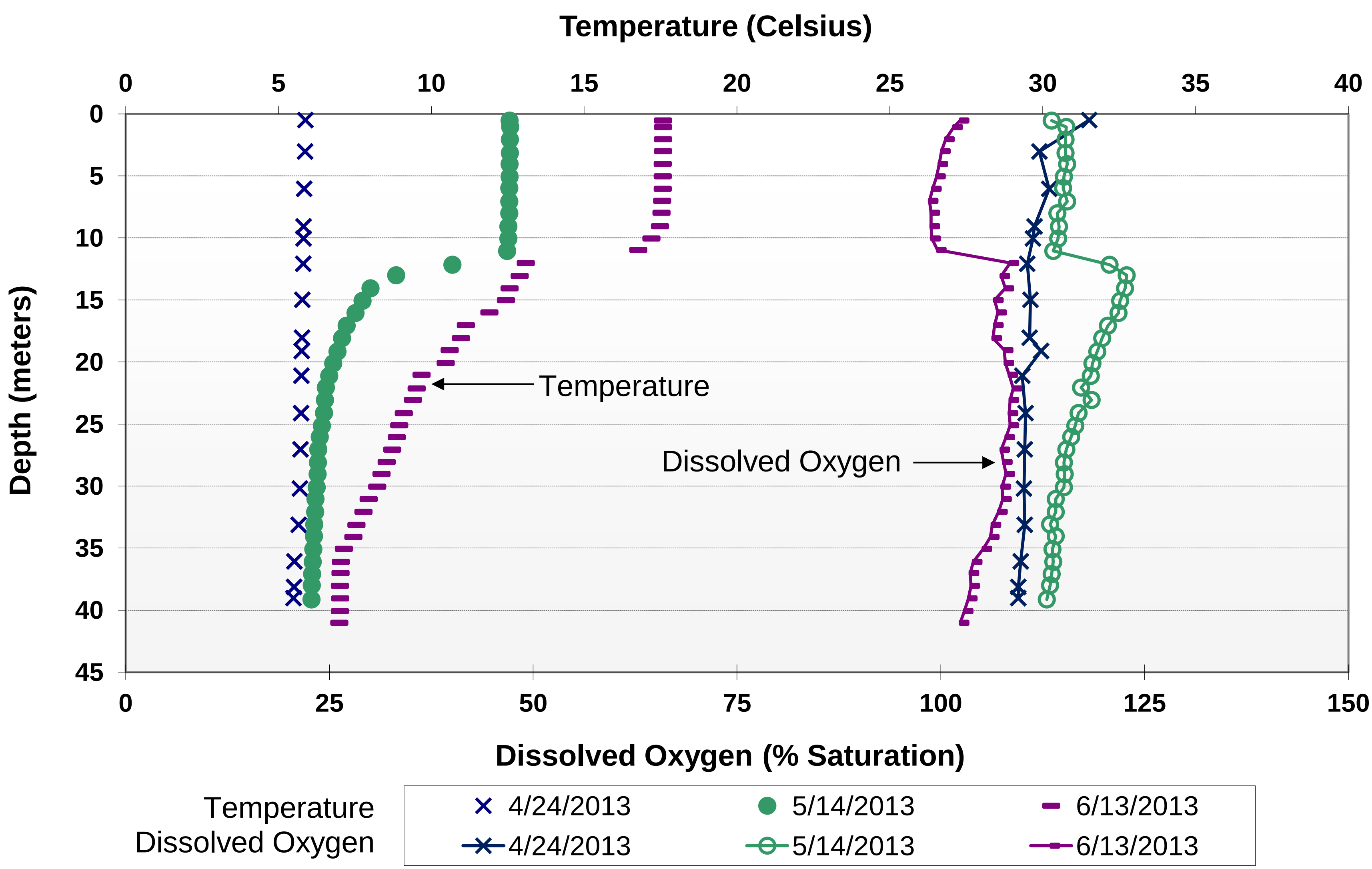


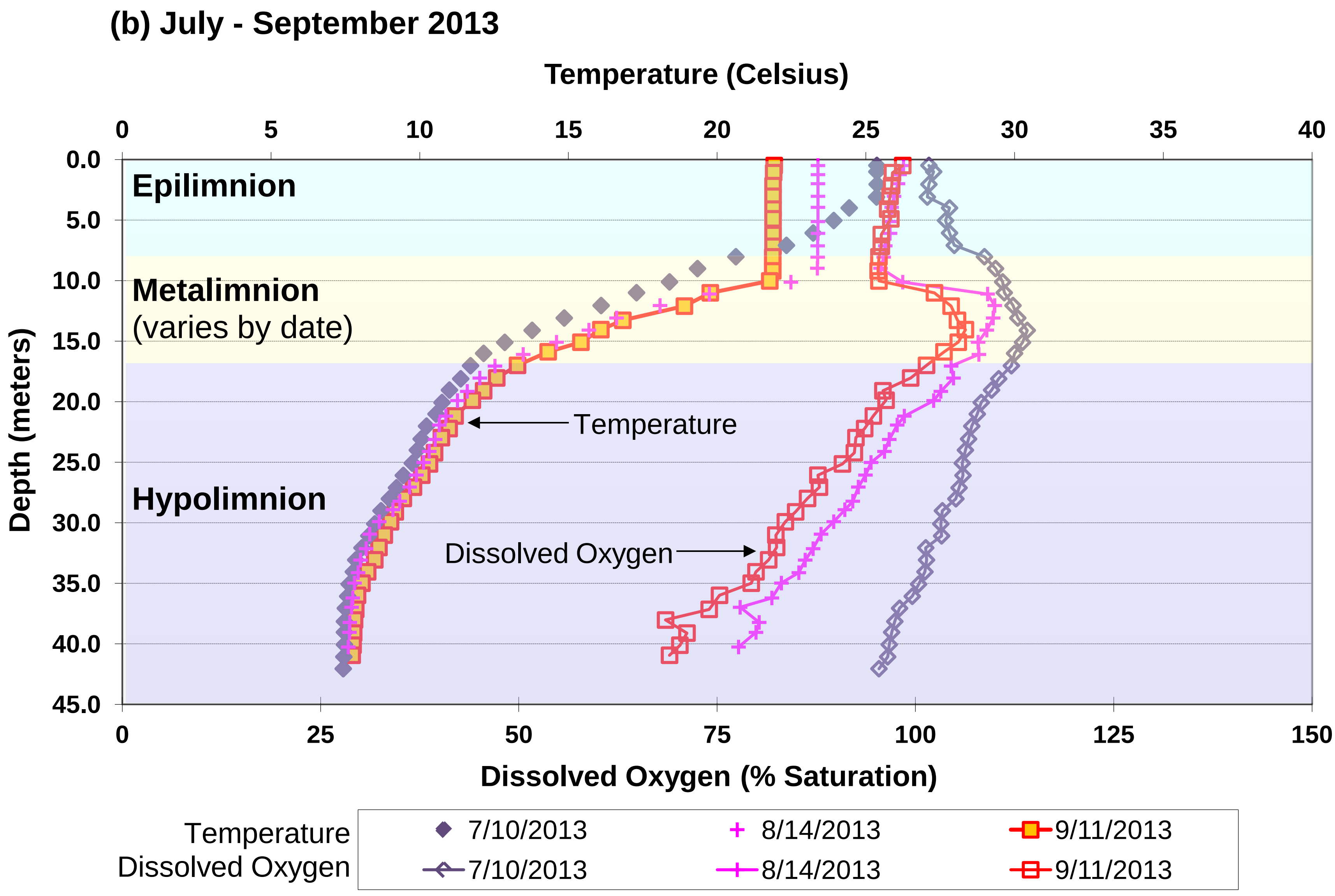
Den Hill - CY 2013 pH Profiles
pH
5.00
5.50
6.00
6.50
7.00
7.50
8.00
8.50
9.00
Depth (meters)
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
4/24/2013
5/15/2013
6/13/2013
7/10/2013
8/14/2013
9/11/2013
10/2/2013
11/6/2013
12/4/2013

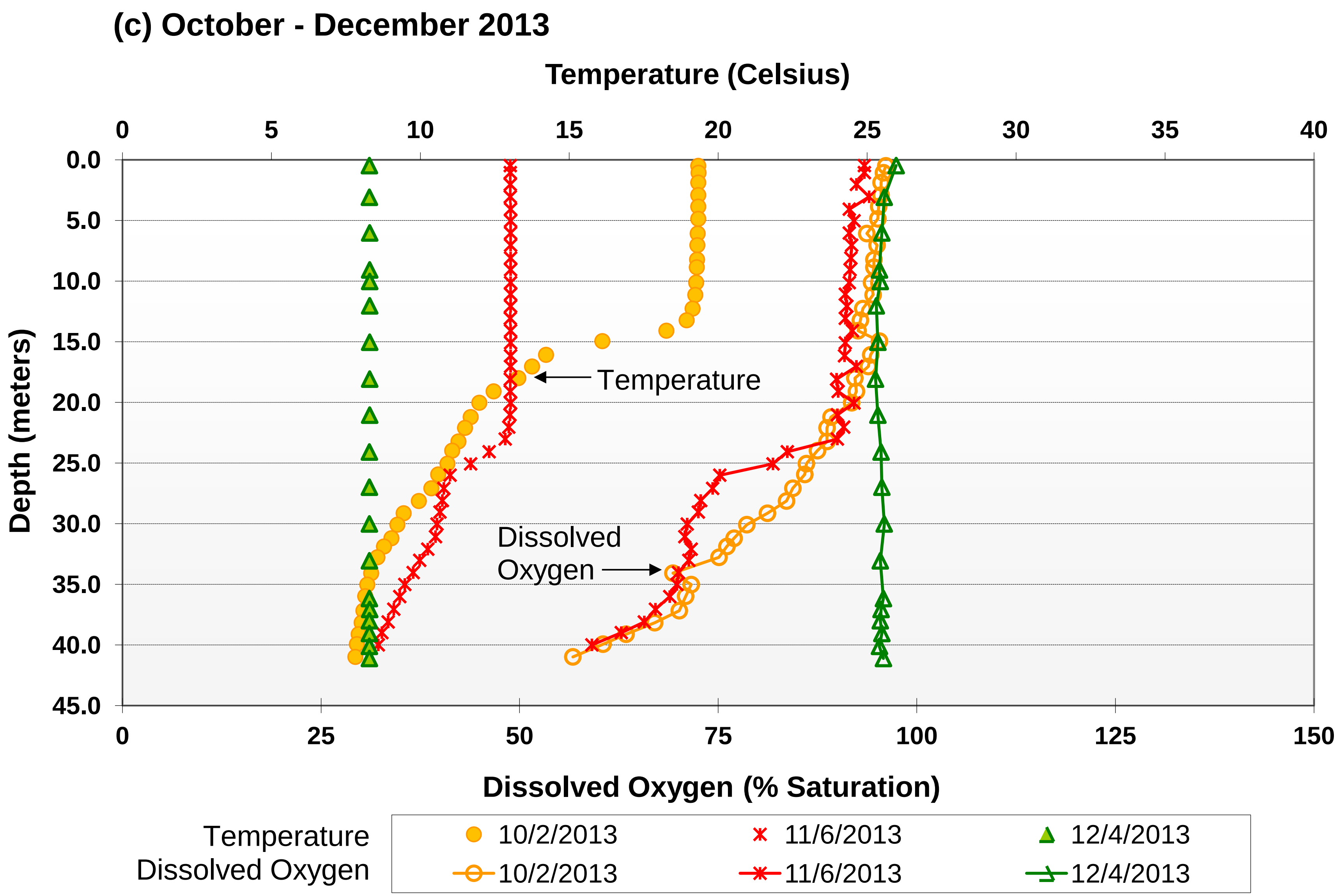
Den Hill - CY 2013 Specific Conductance Profiles

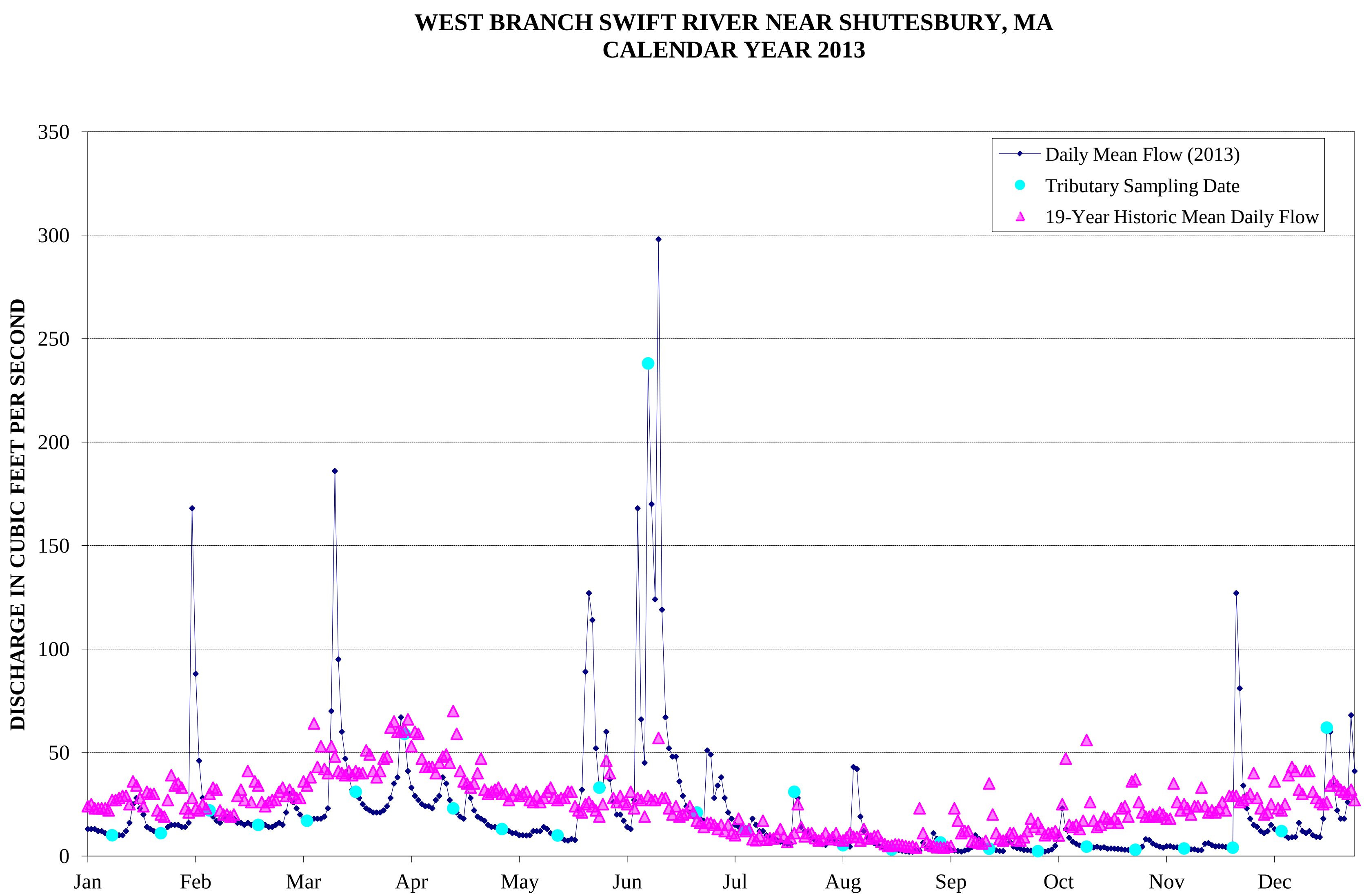


(a) April - June 2013




(b) July - September 2013
Temperature (Celsius)
0
5
10
15
20
25
30
35
40
Epilimnion
Metalimnion
(varies by date)
Hypolimnion
Temperature
Dissolved Oxygen
Depth (meters)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
0
25
50
75
100
125
150
Dissolved Oxygen (% Saturation)
Temperature
Dissolved Oxygen
7/10/2013
8/14/2013
9/11/2013
7/10/2013
8/14/2013
9/11/2013


(c) October - December 2013
Temperature (Celsius)
0
5
10
15
20
25
30
35
40
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
Depth (meters)
Temperature
Dissolved
Oxygen
0
25
50
75
100
125
150
Dissolved Oxygen (% Saturation)
Temperature
Dissolved Oxygen
10/2/2013
11/6/2013
12/4/2013
10/2/2013
11/6/2013
12/4/2013



Source: U.S. Geological Survey website (provisional data accessed June 6, 2014).

USGS 01174565: WEST BRANCH SWIFT RIVER NEAR SHUTESBURY, MA
JANUARY 1, 2013 - DECEMBER 31, 2013
Daily Mean Discharge, cubic feet per second

DATE	Jan 2013	Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013	Jul 2013	Aug 2013	Sep 2013	Oct 2013	Nov 2013	Dec 2013
1	13 A	88 A	26 A	67 A	12 A	26 A	34 A	5.3 A	11 A	2.3 A	8.1 A	18 P
2	13 A:e	46 A:e	23 A	59 A	12 A	20 A	38 A	8.0 A	8.3 A	2.2 A	7.7 A	15 P
3	13 A:e	28 A:e	20 A	41 A	11 A	20 A	28 A	8.2 A	6.5 A	2.1 A	6.0 A	14 P
4	12 A:e	22 A:e	18 A	33 A	11 A	17 A	21 A	7.4 A	5.0 A	2.5 A	5.1 A	12 P
5	12 A	22 A:e	17 A	29 A	10 A	14 A	18 A	6.1 A	3.7 A	3.1 A	4.5 A	11 P
6	11 A	19 A:e	18 A	27 A	10 A	13 A	15 A	5.2 A	2.9 A	4.9 A	4.0 A	12 P
7	11 A	17 A:e	18 A	25 A	9.9 A	27 A	14 A	4.7 A	2.6 A	9.8 A	4.7 A	15 P
8	10 A	16 A:e	18 A	24 A	10 A	168 A	14 A	4.5 A	2.4 A	23 A	4.7 P	13 P
9	10 A	18 A:e	18 A	24 A	12 A	66 A	12 A	43 A	2.1 A	13 A	4.2 P	12 P
10	10 A	19 A:e	19 A	23 A	12 A	45 A	13 A	42 A	2.6 A	8.8 A	4.2 P	12 P
11	10 A	18 A:e	23 A	27 A	12 A	238 A	18 A	19 A	3.1 A	6.9 A	4.0 P	9.9 P:e
12	12 A	18 A:e	70 A	29 A	14 A	170 A	15 A	12 A	4.2 A	5.9 A	3.6 P	8.7 P:e
13	16 A	16 A	186 A	38 A	13 A	124 A	12 A	8.8 A	10 A	5.1 A	3.3 P	9.0 P:e
14	25 A	16 A	95 A	35 A	11 A	298 A	12 A	8.1 A	8.4 A	4.8 A	3.2 P	9.2 P
15	28 A	15 A	60 A	27 A	10 A	119 A	10 A	6.1 A	5.7 A	4.5 A	3.2 P:e	16 P
16	23 A	16 A	47 A	23 A	9.9 A	67 A	9.1 A	5.2 A	4.5 A	4.6 A	2.7 P:e	12 P
17	20 A	15 A	38 A	21 A	8.6 A	52 A	8.2 A	4.4 A	3.5 A	4.1 A	2.8 P:e	11 P
18	14 A:e	16 A:e	32 A	19 A	7.7 A	48 A	7.6 A	3.7 A	3.0 A	4.5 A	5.9 P	12 P
19	13 A:e	15 A	31 A	18 A	7.4 A	48 A	6.9 A	3.4 A	2.7 A	3.9 A	6.2 P	10 P
20	12 A:e	16 A	28 A	33 A	8.2 A	36 A	6.2 A	3.1 A	2.4 A	4.2 A	5.2 P	9.2 P
21	11 A:e	15 A	25 A	28 A	7.7 A	29 A	5.8 A	2.9 A	2.3 A	3.5 A	4.6 P	9.1 P
22	11 A:e	14 A	23 A	22 A	22 A	24 A	5.8 A	2.8 A	9.1 A	3.6 A	4.7 P	18 P
23	11 A:e	14 A	22 A	19 A	32 A	21 A	31 A	2.5 A	6.7 A	3.5 A	4.6 P	62 P
24	14 A:e	15 A	21 A	18 A	89 A	19 A	28 A	2.2 A	4.5 A	3.4 A	4.3 P:e	60 P
25	15 A:e	16 A	21 A	17 A	127 A	21 A	14 A	2.0 A	3.8 A	3.2 A	3.7 P:e	34 P:e
26	15 A	15 A	21 A	15 A	114 A	18 A	12 A	2.0 A	3.4 A	3.0 A	4.0 P	22 P:e
27	15 A	21 A	22 A	14 A	52 A	17 A	11 A	3.0 A	2.9 A	2.9 A	127 P	18 P:e
28	14 A	30 A	24 A	14 A	33 A	51 A	8.7 A	2.5 A	2.8 A	3.0 A	81 P	18 P
29	14 A		28 A	13 A	33 A	49 A	7.5 A	6.4 A	2.6 A	3.0 A	34 P	26 P
30	16 A		35 A	13 A	60 A	28 A	6.4 A	4.2 A	2.4 A	3.1 A	23 P	68 P
31	168 A		38 A		37 A		5.6 A	3.7 A		4.5 A		41 P:e
MAX	**168**	**88**	**186**	**67**	**127**	**298**	**38.0**	**43**	**11**	**23**	**127**	**68**
MIN	**10**	**14**	**17**	**13**	**7.4**	**13**	**5.6**	**2.0**	**2.1**	**2.1**	**2.7**	**8.7**
MEAN	**19.1**	**21.3**	**35.0**	**26.5**	**26.4**	**63.1**	**14.4**	**7.82**	**4.50**	**5.1**	**13**	**20**
DEPARTURE FROM NORM	-9	-7	-9	-19	-2	41	3	0	-6	-15	-10	-9
1984-2012	**STATISTICS OF MONTHLY MEAN DATA FOR CALENDAR YEARS 1984 - 2012**											
MEAN	27.6	27.9	44.5	45.8	28.3	22.2	11.3	8.1	10.8	20.3	23.2	29.4
MIN	2.6	7.2	14	13	11	3.7	2.0	1.5	1.0	1.8	1.7	4.1
MAX	68.6	86.3	103.2	83.0	78.1	52.8	32.0	29.3	52.9	115.3	54.5	75.3

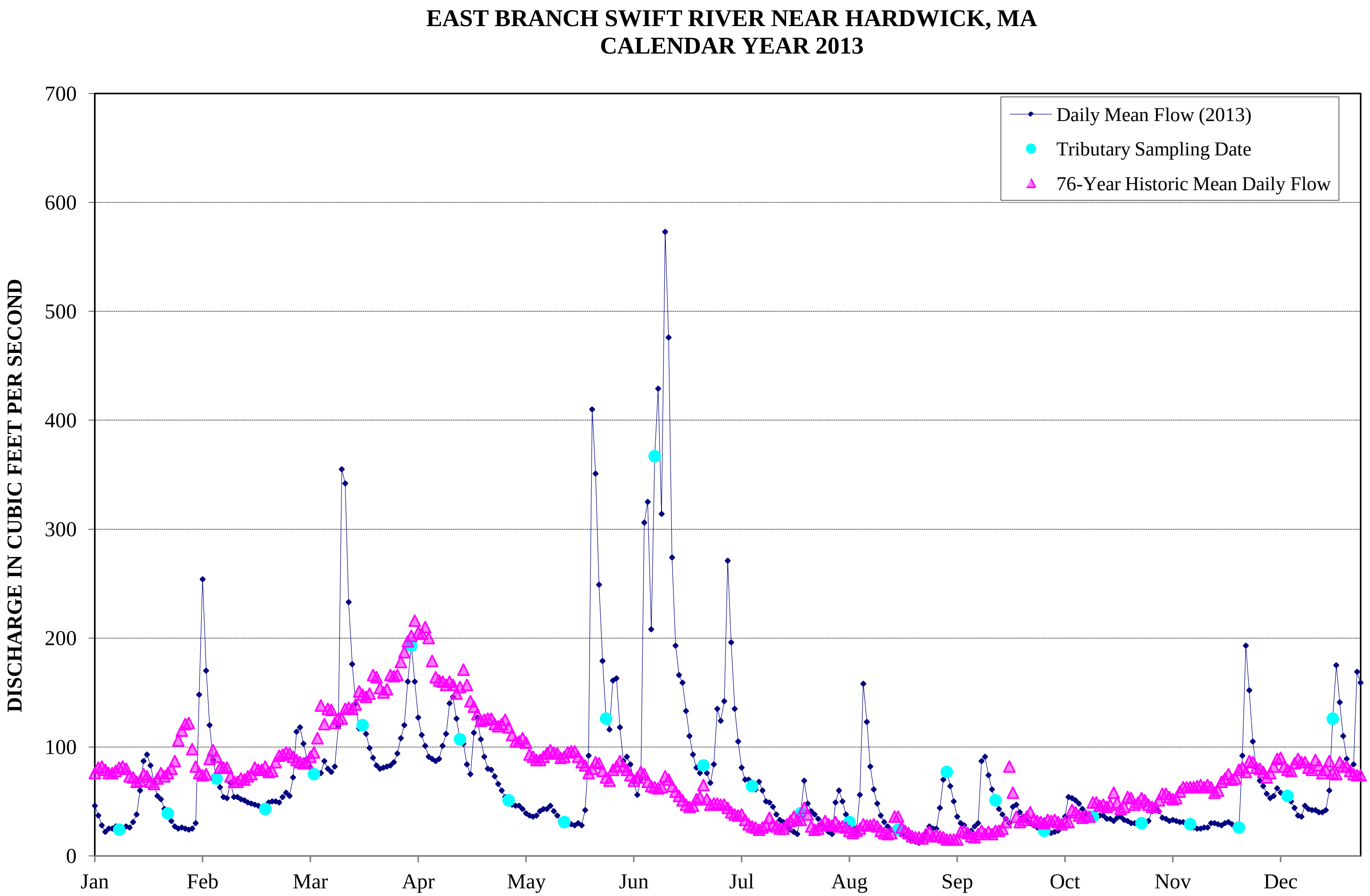
Notes:

Source: U.S. Geological Survey website (accessed June 6, 2014)

A = Approved data.

e = Estimated value.

P = Provisional data, subject to revision.



Source: U.S. Geological Survey website (provisional data accessed June 6, 2014).

USGS 01174500: EAST BRANCH SWIFT RIVER NEAR HARDWICK, MA JANUARY 1, 2013 - DECEMBER 31, 2013 Daily Mean Discharge, cubic feet per second												
DATE	**Jan 2013**	**Feb 2013**	**Mar 2013**	**Apr 2013**	**May 2013**	**Jun 2013**	**Jul 2013**	**Aug 2013**	**Sep 2013**	**Oct 2013**	**Nov 2013**	**Dec 2013**
1	46 A	254 A	118 A	160 A	47 A	118 A	142 A	20 A	44 A	23 A	41 A	81 P
2	37 A	170 A	103 A	193 A	46 A	87 A	271 A	49 A	70 A	22 A	43 A	69 P
3	28 A	120 A	89 A	160 A	46 A	91 A	196 A	60 A	77 A	21 A	41 A	64 P
4	22 A	88 A	81 A	127 A	43 A	84 A	135 A	50 A	64 A	22 A	35 A	57 P
5	25 A	71 A	75 A	111 A	39 A	68 A	105 A	38 A	50 A	23 A	34 A	53 P
6	25 A	63 A	74 A	101 A	37 A	56 A	81 A	31 A	36 A	28 A	32 P	55 P
7	27 A	54 A	76 A	91 A	36 A	70 A	70 A	26 A	30 A	36 A	33 P	62 P
8	24 A	53 A	87 A	89 A	37 A	306 A	70 A	23 A	28 A	54 A	32 P	58 P
9	24 A	67 A	80 A	87 A	41 A	325 A	64 A	56 A	22 A	53 A	31 P	56 P
10	27 A	54 A	77 A	89 A	43 A	208 A	61 A	158 A	23 A	51 A	31 P	55 P
11	26 A	54 A:e	82 A	101 A	43 A	367 A	68 A	123 A	27 A	48 A	30 P	50 P
12	31 A	52 A:e	119 A	112 A	46 A	429 A	60 A	82 A	30 A	43 A	29 P	44 P
13	38 A	51 A:e	355 A	140 A	41 A	314 A	50 A	61 A	87 A	39 A	26 P	37 P
14	60 A	49 A:e	342 A	146 A	37 A	573 A	49 A	48 A	91 A	37 A	25 P	36 P
15	87 A	48 A:e	233 A	126 A	32 A:e	476 A	45 A	37 A	74 A	36 A	25 P	46 P
16	93 A	47 A:e	176 A	107 A	31 A:e	274 A	38 A	31 A	61 A	36 A	26 P	43 P
17	83 A	46 A:e	140 A	103 A	29 A:e	193 A	33 A	27 A	51 A	37 A	26 P	42 P
18	68 A	44 A:e	117 A	84 A	29 A:e	166 A	31 A	24 A	43 A	37 A	30 P	42 P
19	55 A	43 A:e	120 A	75 A	28 A:e	159 A	27 A	23 A	38 A	34 A	30 P	40 P
20	52 A	49 A:e	112 A	113 A	30 A:e	133 A	24 A	24 A	34 A	34 A	29 P	40 P
21	43 A	50 A:e	99 A	127 A	28 A:e	110 A	22 A	21 A	30 A	32 A	28 P	42 P
22	39 A	50 A:e	90 A	107 A	42 A:e	93 A	20 A	18 A	45 A	35 A	30 P	60 P
23	32 A	49 A:e	83 A	91 A	92 A	81 A	39 A	17 A	47 A	36 A	31 P	126 P
24	27 A	54 A	80 A	80 A	410 A	76 A	69 A	14 A	40 A	33 A	29 P	175 P
25	25 A	58 A	81 A	79 A	351 A	83 A	48 A	13 A	36 A	32 A	26 P	141 P
26	26 A	55 A	82 A	73 A	249 A	76 A	41 A	12 A	32 A	30 A	26 P	110 P
27	25 A	72 A	83 A	66 A	179 A	67 A	38 A	15 A	30 A	30 A	92 P	89 P
28	24 A	114 A	86 A	60 A	126 A	84 A	34 A	21 A	28 A	30 A	193 P	78 P
29	25 A		94 A	54 A	116 A	135 A	30 A	27 A	26 A	30 A	152 P	84 P
30	30 A		108 A	51 A	161 A	124 A	25 A	25 A	24 A	30 A	105 P	169 P
31	148 A		120 A		163 A		22 A	25 A		32 A		159 P
MAX	**148**	**254**	**355**	**193**	**410**	**573**	**271**	**158**	**91**	**54**	**193**	**175**
MIN	**22**	**43**	**74**	**51**	**28**	**56**	**20**	**12.0**	**22**	**21**	**25**	**36**
MEAN	**42.6**	**70.7**	**118**	**103**	**86.4**	**181**	**64.8**	**38.7**	**43.9**	**34**	**45**	**73**
DEPARTURE FROM NORM	-40	-11	-19	-54	-4	120	33	15	17	-8	-20	-8
1937-2012	**STATISTICS OF MONTHLY MEAN DATA FOR CALENDAR YEARS 1937 - 2012**											
MEAN	82.4	81.7	137	158	90.4	60.5	31.5	24.0	27.0	42.2	64.3	80.9
MIN	5.3	19	46	35	31	6.9	3.2	0	0	0.7	4.2	16
MAX	240	258	292	421	189	175	179	127	390	244	177	264

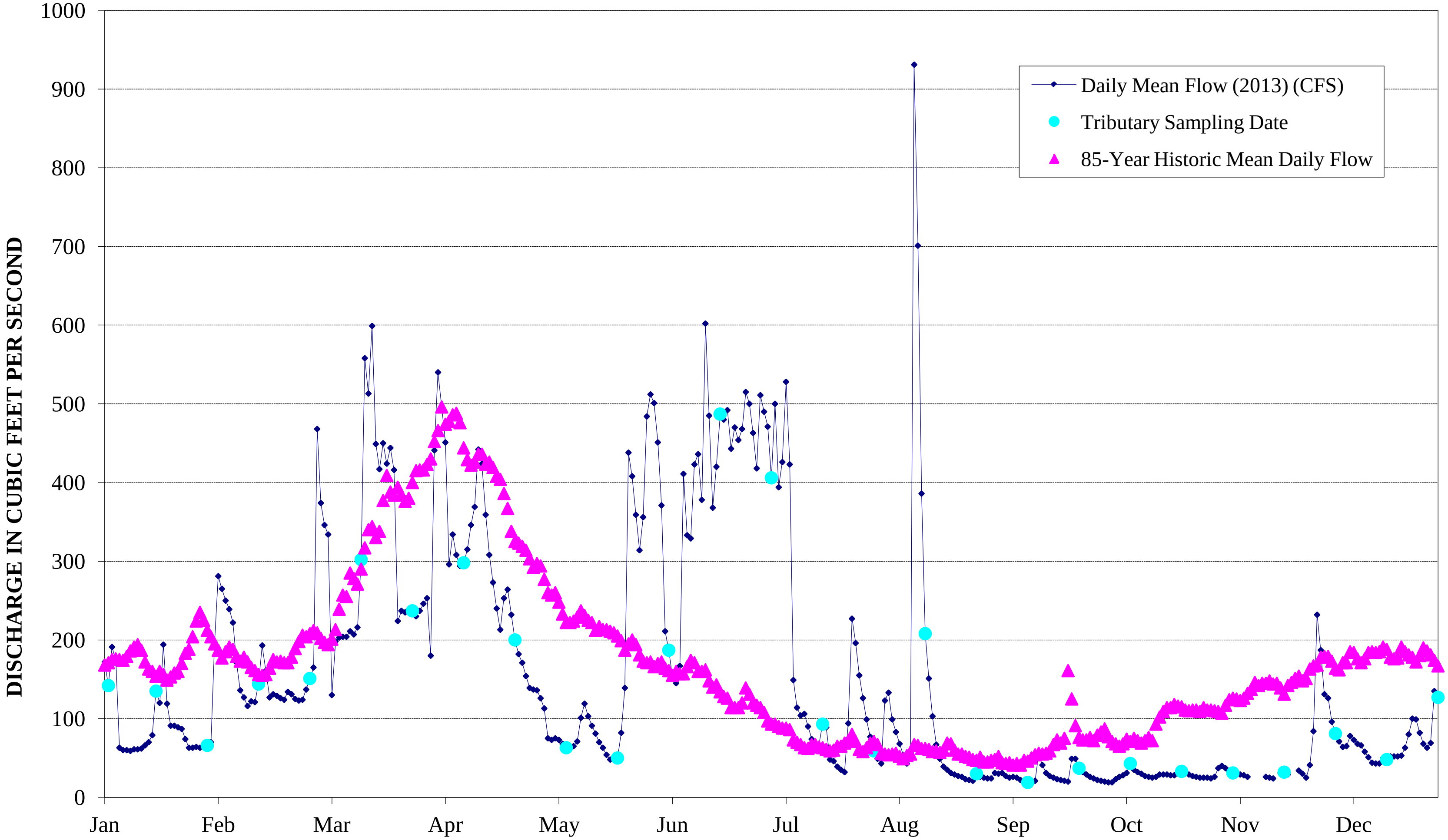
Notes:

A = Approved data.

e = Estimated value.

Source: U.S. Geological Survey website (accessed June 6, 2014)

MWRA INTAKE WORKS AT WARE RIVER IN BARRE, MA
CALENDAR YEAR 2013



Source: U.S. Geological Survey website (provisional data for new location, accessed June 6, 2014).

MWRA INTAKE WORKS AT WARE RIVER IN BARRE, MA JANUARY 1, 2013 - DECEMBER 31, 2013 Daily Mean Discharge, cubic feet per second												
DATE	**Jan 2013**	**Feb 2013**	**Mar 2013**	**Apr 2013**	**May 2013**	**Jun 2013**	**Jul 2013**	**Aug 2013**	**Sep 2013**	**Oct 2013**	**Nov 2013**	**Dec 2013**
1	172 A	281 A	374 A:e	441 A:e	113 A	451 A	471 A	43 A	31 A	20 A	37 A	126 P
2	142 A	265 A	346 A:e	540 A:e	75 A	371 A	406 A	123 A	30 A	19 A	40 A	96 P
3	191 A:e	250 A	334 A:e	495 A:e	73 A	211 A	500 A	133 A	31 A	19 A	37 A	81 P
4	174 A:e	239 A	130 A	451 A:e	75 A	187 A	394 A	99 A	27 A	23 A	33 A	71 P
5	63 A	222 A	198 A	296 A:e	73 A	154 A	426 A	83 A	25 A	26 A	31 A	64 P
6	60 A	171 A	203 A	334 A	68 A	145 A	528 A	68 A	26 A	28 A		65 P
7	60 A	136 A	204 A	308 A	63 A	167 A	423 A	54 A	25 A	31 A	29 P	78 P
8	59 A	127 A	204 A	294 A	62 A	411 A	149 A	43 A	22 A	43 A	28 P	73 P
9	61 A	116 A	211 A	298 A	65 A	333 A	114 A	57 A	19 A	35 A	26 P	68 P
10	61 A:e	122 A:e	207 A	315 A	71 A	329 A	104 A	931 A	19 A	32 A		66 P
11	62 A	121 A	216 A	346 A	101 A	423 A	106 A	701 A:e	20 A	30 A		58 P
12	66 A	144 A	302 A	369 A	119 A	436 A	90 A	386 A	21 A	27 A		51 P
13	70 A	193 A	558 A	442 A	103 A	378 A	74 A	208 A	55 A	26 A		44 P
14	79 A	161 A	513 A	424 A	91 A	602 A	68 A	151 A	41 A	25 A	26 P	43 P
15	135 A:e	127 A	599 A:e	359 A	81 A	485 A	67 A	103 A	31 A	26 A	25 P	43 P
16	120 A	131 A	449 A:e	308 A	70 A	368 A	93 A	67 A	27 A	29 A	24 P	50 P
17	194 A:e	129 A	417 A:e	273 A	63 A	420 A	89 A	49 A	25 A	29 A		48 P
18	119 A:e	126 A	450 A:e	240 A	54 A	487 A	48 A	39 A	23 A:e	29 A	31 P	52 P
19	91 A	124 A	424 A:e	213 A	48 A	480 A	46 A	35 A	22 A	28 A	32 P	52 P
20	91 A	134 A	444 A:e	253 A	50 A	492 A	39 A	31 A	21 A	28 A	29 P	52 P
21	89 A	131 A	416 A:e	264 A	50 A	443 A	35 A	29 A	20 A	30 A		53 P
22	87 A	125 A	224 A:e	232 A	82 A:e	470 A	32 A	27 A	49 A	33 A		63 P
23	74 A	123 A	237 A	200 A	139 A	454 A	94 A	26 A	49 A	30 A	34 P	80 P
24	63 A	124 A	235 A	182 A	438 A	468 A	227 A	23 A	37 A	29 A	30 P	100 P
25	63 A	137 A	239 A	171 A	408 A	515 A	196 A	22 A	32 A	27 A	25 P	99 P
26	64 A	151 A	237 A	154 A	359 A	500 A	155 A	21 A	29 A	26 A	41 P	82 P
27	63 A	165 A:e	230 A	139 A	314 A	463 A	126 A	30 A	26 A	25 A	84 P	68 P
28	64 A	468 A:e	237 A:e	137 A	356 A	418 A	99 A	26 A	24 A	25 A	232 P	63 P
29	66 A		246 A:e	136 A	484 A	511 A	77 A	25 A	22 A	25 A	187 P	69 P
30	70 A		253 A:e	126 A	512 A	490 A	59 A	24 A	21 A	24 A	131 P	135 P
31	197 A		180 A:e		501 A		49 A	24 A		26 A		127 P
MAX	**197**	**468**	**599**	**540**	**512**	**602**	**528**	**931**	**55**	**43**	**232**	**135**
MIN	**59**	**116**	**130**	**126**	**48**	**145**	**32**	**21**	**19**	**19**	**24**	**43**
MEAN	**96**	**169**	**307**	**291**	**166**	**402**	**174**	**119**	**28**	**28**	**54**	**72**
DEPARTURE FROM NORM	-86	-11	-21	-112	-49	262	103	64	-37.9	-65.9	-88	-107
1928-2012	**STATISTICS OF MONTHLY MEAN DATA FOR CALENDAR YEARS 1928 - 2012**											
MEAN	182	181	328	403	216	140	70.4	55.0	66.2	93.4	142	179
MIN	17.2	37.5	118	117	73.8	18.2	9.0	4.9	6.1	7.9	13.9	29.1
MAX	499	546	1066	963	438	503	337	319	893	467	497	570

Notes:

A = Approved data.

e = Estimated value.

Source: U.S. Geological Survey website (accessed June 6, 2014)

APPENDIX C

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 CaCO3)
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 2013
(211) WEST BR. SWIFT RIVER, ROUTE 202

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/8	0.09	15.34	106	6.15	45.5	0.244			*0*	*0*	529						2200	
1/22	0.06	16.54	114	6.02	42.8	0.187			*0*	*0*	441						2140	
2/5	0.12	15.32	108	5.74	39.7	0.292			*0*	*0*	428						1930	
2/19	0.16	15.93	111	6.49	36.3	0.173			*0*	*0*	313						1890	
3/5	0.67	14.57	104	6.62	36.1	0.205			*0*	*0*	249						1840	
3/19	0.17	15.88	110	6.16	40.3	0.266			2	*0*	203		0.0160	0.0287	*0*	0.075125	1740	*0*
4/2	1.86	15.52	115	6.01	32.6	0.291			2	*0*	213						1490	
4/16	5.34	13.95	111	6.04	36.6	0.245			*0*	*0*	420						1880	
4/30	9.93	11.79	105	6.48	43.6	0.463			*0*	*0*	697						2240	
5/16	9.23	11.13	99	5.87	45.9	0.291			*0*	*0*	1300						2210	
5/28	9.93	12.42	113	5.39	33.7	0.312			*0*	10	1480						1710	
6/11	13.52	10.46	101	5.15	26.2	2.24			220	368	12000		0.0242	0.00523	0.417	0.25670	1370	*0*
6/25	17.63	9.26	99	5.59	42.4	0.440			20	20	3650						1990	
7/9	19.27	9.09	100	5.75	56.5	0.425			*0*	20	3280						2740	
7/23	19.43	8.81	97	5.79	55.5	4.58			1220	1940		>24200					2890	
8/6	13.81	10.41	102	6.17	62.7	0.371			*0*	10	2490						2510	
8/20	15.57	9.85	100	5.97	60.9	0.311			10	20	1520						2950	
9/3	18.59	8.72	95	6.07	46.0	0.356			*0*	30	3130						2060	
9/17	10.39	11.85	107	6.12	53.9	0.357			*0*	20	1200		0.0128	0.0361	0.182	0.13192	2280	*0*
10/1	9.89	11.64	104	6.25	57.3	0.324			4	20	1140						2330	
10/15	11.47	11.90	110	5.98	46.9	0.335			4	*0*	1110						2020	
10/29	3.68	14.45	111	6.34	53.8	0.281			*0*	*0*	1130						2160	
11/12	4.58	14.03	111	6.19	46.6	0.229			2	*0*	657						2010	
11/26	0.78	15.74	111	6.06	47.7	0.227			*0*	*0*	644						2050	
12/10	1.60	15.60	113	6.18	43.0	0.225			*0*	*0*	645		0.0109	0.0265	0.192	0.12335	1880	*0*
12/23	0.28	16.72	117	5.72	34.6	0.457			20	41	1720						1510	
AVG.	7.62	12.96	107	6.01	44.9	0.543			58	96	1620		0.0160	0.0241	0.198	0.14677	2080	*<0.005*
MAX.	19.43	16.72	117	6.62	62.7	4.58			1220	1940	12000		0.0242	0.0361	0.417	0.25670	2950	*<0.005*
MIN.	0.06	8.72	95	5.15	26.2	0.173			*<10*	*<10*	203		0.0109	0.00523	*<0.100*	0.075125	1370	*<0.005*
MEDIAN	7.29	13.19	107	6.05	44.6	0.302			*<10*	*<10*	1110		0.0144	0.0276	0.187	0.12764	2040	*<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 2013
(212) HOP BROOK, GATE 22 ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/8	0.10	15.96	111	6.55	98.2	0.534			*0*	*0*	331						4410	
1/22	0.06	16.26	112	6.44	100.3	0.476			*0*	*0*	402						4200	
2/5	0.06	15.51	109	6.24	104.6	0.520			*0*	*0*	1200						4180	
2/19	0.13	16.24	113	6.78	90.4	0.374			*0*	10	231						3940	
3/5	0.75	14.38	103	7.00	102.5	0.369			*0*	20	161						3940	
3/19	0.06	15.25	105	6.39	104.9	0.541			*0*	10	199		0.0186	0.0930	*0*	0.055640	3290	0.0341
4/2						0.417			1	*0*	305						2870	
4/16	6.14	13.27	107	6.20	87.4	0.465			2	10	414						3540	
4/30	11.09	11.73	107	6.88	91.2	0.524			8	10	663						4110	
5/16	10.24	11.27	102	6.27	96.6	0.628			8	*0*	794						4080	
5/28	10.82	11.81	109	6.09	82.2	0.668			40	20	1300						3610	
6/11	13.23	10.19	98	5.90	56.8	2.38			210	279	10500		0.0314	0.0146	0.314	0.24595	2380	*0*
6/25	18.87	9.05	99	6.25	89.5	0.835			30	20	4350						3860	
7/9	20.67	9.04	102	6.12	92.8	1.63			*0*	75	10500						4400	
7/23	20.38	8.24	93	6.31	95.4	9.18			1380	2190		>24200					5040	
8/6	14.69	10.43	104	6.84	96.9	1.42			20	41	4570						4840	
8/20	16.24	9.81	101	6.52	99.0	1.18			70	41	12000						4820	
9/3	19.30	8.69	96	6.81	103.6	1.19			86.7	121	12000						4470	
9/17	10.88	11.97	110	6.78	104.4	0.930			*0*	10	2010		0.0157	0.0440	0.171	0.11510	4870	*0*
10/1	10.28	11.08	100	6.80	111.4	1.22			4	*0*	1780						4990	
10/15	11.74	12.12	113	6.61	104.4	1.15			*0*	*0*	3650						4820	
10/29	4.26	13.66	106	6.75	112.0	0.934			*0*	*0*	1330						4790	
11/12	4.98	13.39	107	6.61	105.1	0.803			2	*0*	1110						4650	
11/26	0.56	15.51	108	6.46	109.4	1.25			*0*	*0*	538						4860	
12/10	1.61	15.37	111	6.63	103.1	0.635			10	30	743		0.0121	0.0703	0.137	0.081610	3990	*0*
12/23	1.06	15.75	113	6.27	90.5	0.832			16	20	2850						3510	
AVG.	8.33	12.64	106	6.50	97.3	1.20			73	112	2960		0.0195	0.0555	0.156	0.12458	4170	0.00853
MAX.	20.67	16.26	113	7.00	112.0	9.18			1380	2190	12000		0.0314	0.0930	0.314	0.24595	5040	0.0341
MIN.	0.06	8.24	93	5.90	56.8	0.369			*<10*	*<10*	161		0.0121	0.0146	*<0.100*	0.055640	2380	*<0.005*
MEDIAN	10.24	12.12	107	6.52	99.0	0.818			2	10	1200		0.0172	0.0572	0.154	0.09836	4190	*<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 2013
(213) MIDDLE BR. SWIFT RIVER, GATE 30

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/8	0.26	12.59	88	6.11	88.6	0.702			*0*	*0*	546						4180	
1/22	0.20	14.19	98	5.89	87.4	0.629			2	*0*	457						3930	
2/5	0.18	14.12	99	5.87	86.9	0.571			4	31	733						3590	
2/19	0.19	13.69	96	6.45	79.2	0.478			6	20	228						3810	
3/5	0.32	12.84	91	6.74	78.5	0.551			1	10	160						3400	
3/19	0.36	13.63	94	6.20	86.9	0.466			4	20	148		0.0156	0.0813	0.129	0.095530	3040	0
4/2						0.489			11	31	359						2790	
4/16	7.94	10.66	90	6.00	84.9	0.415			4	*0*	602						3550	
4/30	14.06	8.03	79	5.97	100.2	0.849			44	52	3260						4360	
5/16	11.77	8.87	83	5.83	98.9	0.841			20	75	1960						4470	
5/28	12.78	8.72	85	5.75	80.1	0.529			*0*	41	1300						3480	
6/11	15.23	7.29	73	5.58	62.5	1.20			850	860	19900		0.0195	0.00766	0.358	0.28710	2840	0
6/25	21.46	4.81	55	5.69	98.2	1.53			220	288	6870						4220	
7/9	23.15	4.52	54	5.74	115.7	1.92			70	187	9800						5120	
7/23	22.02	6.15	72	5.98	144.7	3.17			4550	12000		>24200					5880	
8/6	17.70	7.32	78	6.19	110.1	1.16			60	63	4110						5200	
8/20	18.60	6.81	74	6.05	110.0	0.959			20	31	4160						5260	
9/3	21.27	5.04	58	6.12	98.8	1.60			40	85	6130						5580	
9/17	13.25	7.69	74	6.09	99.0	1.27			44	31	2060		0.0192	0.0106	0.336	0.23225	5100	0
10/1	12.57	8.13	77	6.20	96.1	1.00			16	20	839						4790	
10/15	12.09	8.58	80	6.00	74.3	1.05			16	31	1140						4560	
10/29	4.87	10.82	86	6.23	97.9	1.15			8	*0*	529						4730	
11/12	4.59	11.68	92	6.30	97.2	1.01			8	31	794						4610	
11/26	1.47	12.75	91	6.04	93.1	0.921			*0*	10	504						4840	
12/10	0.62	12.63	89	6.16	82.1	0.643			8	*0*	717		0.0131	0.114	0.223	0.14298	3600	0.00711
12/23	0.04	14.79	103	6.02	65.9	0.764			24	75	3870						3040	
AVG.	9.48	9.85	82	6.05	92.7	0.995			232	538	2850		0.0169	0.0534	0.262	0.18947	4230	*<0.005*
MAX.	23.15	14.79	103	6.74	144.7	3.17			4550	12000	19900		0.0195	0.114	0.358	0.28710	5880	0.00711
MIN.	0.04	4.52	54	5.58	62.5	0.415			<10	*<10*	148		0.0131	0.00766	0.129	0.095530	2790	*<0.005*
MEDIAN	11.77	8.87	85	6.04	93.1	0.885			14	31	839		0.0174	0.0460	0.280	0.18762	4290	*<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 2013

(215B) WEST BR. FEVER BROOK, AT MOUTH

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/8	1.21	13.19	94	6.00	101.9	0.460	7.91	6.07	*0*	*0*	279		0.0185	0.0115	0.290	0.29555	3970	0.00782
1/22	0.87	14.66	104	5.88	90.0	0.461	7.01	5.02	*0*	10	218		0.0140	0.0105	0.206	0.24980	3700	*0*
2/5	0.47	14.97	106	5.71	88.4	0.685	5.56	3.53	*0*	10	480		0.0183	0.0216	0.338	0.29025	3280	0.00912
2/19	0.42	14.16	100	6.14	69.0	0.396	6.48	4.67	*0*	*0*	173		0.0114	0.0286	0.199	0.19885	2990	0.0161
3/5	0.82	13.55	97	6.26	67.5	0.336	5.30	3.52	*0*	*0*	110		0.0114	0.0155	0.179	0.19340	2730	*0*
3/19	1.75	14.97	108	5.67	67.6	0.311	4.40	2.54	50	52	160		0.0145	*0*	0.187	0.19965	2160	*0*
4/2						0.417	4.60	2.70	*0*	*0*	377		0.0127	*0*	0.210	0.15536	2280	*0*
4/16	9.50	11.21	99	5.63	62.3	0.671	5.00	3.20	6	10	1010		0.0138	0.00570	0.384	0.19245	2540	*0*
4/30	15.38	8.86	89	5.87	67.0	0.513	6.06	4.21	*0*	*0*	2600		0.0104	0.00692	0.426	0.19885	2960	*0*
5/16	14.69	8.19	82	5.67	66.4	1.05	8.38	6.50	46.7	*0*	14100		0.0184	0.00734	0.352	0.21540	3140	0.00825
5/28	14.48	11.85	119	5.49	72.4	0.481	5.09	3.24	40	52	1110		0.0142	*0*	0.270	0.31955	2700	*0*
6/11	17.38	7.99	84	5.48	59.3	0.599	5.48	3.54	10	109	6130		0.0167	*0*	0.390	0.37410	2430	*0*
6/25	24.47	6.19	75	5.41	55.2	0.669	4.97	2.83	10	122	8660		0.0192	0.00784	0.474	0.35945	2470	0.00740
7/9	25.07	5.37	66	5.44	58.6	0.915	9.01	6.85	*0*	10	6130		0.0275	0.00979	0.548	0.45650	2840	0.0204
7/23	24.13	5.20	63	5.58	51.6	0.959	10.9	8.76	20	75	11200		0.0240	0.0185	0.500	0.41990	3330	0.0201
8/6	19.39	6.39	71	5.88	54.6	1.02	11.0	8.97	*0*	10	2040		0.0170	*0*	0.460	0.37120	3070	0.0130
8/20	19.88	6.15	68	5.56	61.5	0.435	8.11	6.04	*0*	10	1530		0.0145	0.00940	0.410	0.31655	2700	0.0148
9/3	22.30	6.12	72	5.82	59.2	0.723	9.74	7.74	10	20	9800		0.0170	*0*	0.353	0.29950	2950	*0*
9/17	14.85	7.90	79	5.82	56.7	0.606	8.99	6.86	8	*0*	1840		0.0155	*0*	0.361	0.28495	2720	*0*
10/1	13.54	7.67	75	5.87	58.8	0.317	9.15	7.10	*0*	*0*	399		0.0138	0.00983	0.581	0.23625	2600	0.00845
10/15	13.19	8.80	84	5.89	65.8	0.306	9.30	7.12	*0*	*0*	399		0.0100	*0*	0.248	0.23955	2770	0.00657
10/29	5.86	10.56	86	6.02	66.6	0.368	9.25	6.94	*0*	*0*	520		0.0151	*0*	0.353	0.23260	2680	0.00520
11/12	4.82	11.68	93	6.03	68.7	0.277	7.83	5.85	4	*0*	1110		0.0124	*0*	0.298	0.22065	2620	*0*
11/26	2.23	13.28	97	6.05	79.7	0.390	8.19	6.21	*0*	10	1110		0.00722	*0*	0.354	0.20680	2760	*0*
12/10	2.33	13.60	100	5.95	78.5	0.366	6.80	4.43	*0*	*0*	663		0.0116	0.00567	0.297	0.30510	2880	*0*
12/23	1.10	14.37	103	6.04	80.1	0.569	8.17	6.07	4	10	504		0.0215	0.0150	0.212	0.27690	3310	0.0133
AVG.	10.81	10.28	89	5.81	68.3	0.550	7.41	5.40	8	20	2790		0.0154	0.00707	0.342	0.27343	2870	0.00579
MAX.	25.07	14.97	119	6.26	101.9	1.05	11.0	8.97	50	122	14100		0.0275	0.0286	0.581	0.45650	3970	0.0204
MIN.	0.42	5.20	63	5.41	51.6	0.277	4.40	2.54	*<10*	*<10*	110		0.00722	*<0.005*	0.179	0.15536	2160	*<0.005*
MEDIAN	13.19	10.56	89	5.87	66.6	0.471	7.87	5.95	*<10*	10	1060		0.0145	0.00631	0.353	0.26335	2770	0.00260

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 2013
(215H) HARVARD POND INLET

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/8	1.58	10.40	75	5.48	79.4	0.864	5.72	3.92	*0*	20	697		0.0216	0.0114	0.309	0.18140	2960	0.0202
1/22	1.39	12.39	89	5.25	70.5	0.494	4.23	2.35	*0*	*0*	379		0.0140	*0*	0.185	0.12650	2450	0.00805
2/5	1.08	13.24	96	5.08	66.4	0.524	3.45	1.50	2	*0*	548		0.0159	0.0252	0.278	0.14036	2390	0.0122
2/19	0.69	12.17	86	5.47	58.4	0.460	4.25	2.51	*0*	*0*	350		0.0136	0.0254	0.191	0.11170	2170	0.0271
3/5	0.92	12.64	91	5.74	58.2	0.329	3.67	1.93	*0*	*0*	292		0.0105	0.0161	0.145	0.094440	2030	0.00861
3/19	2.17	13.59	99	5.39	55.5	0.291	3.09	1.31	*0*	*0*	185		0.0144	0.00922	0.146	0.10152	1730	*0*
4/2						0.310	3.00	1.22	*0*	10	402		0.0122	0.00804	0.152	0.10361	1540	*0*
4/16	9.65	11.23	99	5.33	42.0	0.501	3.38	1.57	*0*	*0*	1080		0.0149	0.00555	0.207	0.12590	1760	*0*
4/30	16.66	7.79	81	5.24	58.6	1.01	4.00	2.22	4	*0*	7270		0.0171	0.00685	0.432	0.16374	2140	0.00862
5/16	15.11	7.30	74	5.27	83.2	1.00	5.65	3.73	*0*	10	2760		0.0251	0.00537	0.392	0.20885	2480	0.0110
5/28	14.30	8.80	88	5.02	40.3	0.736	3.58	1.76	10	*0*	1670		0.0188	*0*	0.291	0.23290	1650	0.00641
6/11	16.15	7.19	74	5.06	42.2	0.707	4.23	2.32	30	41	3440		0.0207	*0*	0.371	0.24700	1810	*0*
6/25	23.84	4.81	58	4.86	44.1	1.35	7.38	5.22	10	20	3280		0.0288	*0*	0.444	0.25460	1670	0.0162
7/9	24.03	3.15	38	5.09	53.1	4.04	7.12	4.96	80	98	17300		0.0466	*0*	0.639	0.33075	1920	0.0253
7/23	22.77	2.53	30	5.15	63.5	4.66	8.91	6.73	60	97	13000		0.0532	0.00734	0.849	0.31740	2400	0.0744
8/6	18.46	3.83	42	5.35	66.4	2.61	6.93	4.90	10	20	3080		0.0415	*0*	0.731	0.26240	2180	0.0288
8/20	19.37	4.37	48	5.22	60.8	1.80	5.99	3.99	30	63	3870		0.0311	*0*	0.513	0.30430	2050	0.0319
9/3	22.11	4.18	49	5.39	51.4	2.34	6.69	4.66	20	31	9800		0.0376	*0*	0.954	0.29735	1990	0.0215
9/17	14.04	6.27	62	5.47	91.7	1.55	6.99	4.93	16	41	6130		0.0269	*0*	0.479	0.25810	2350	0.0164
10/1	13.21	5.94	58	5.58	75.8	1.85	7.30	5.12	32	75	2380		0.0308	0.00507	0.705	0.25320	2070	0.0435
10/15	12.67	6.30	60	5.55	59.4	1.50	7.12	5.07	8	52	3260		0.0233	*0*	0.436	0.24465	2130	0.0224
10/29	5.41	9.48	76	5.82	73.3	1.15	7.64	5.41	22	331	1520		0.0278	*0*	0.458	0.22230	2030	0.0289
11/12	5.13	10.64	85	5.85	66.4	1.00	6.48	4.42	2	*0*	882		0.0230	*0*	0.342	0.20385	1890	0.0160
11/26	2.65	10.90	81	5.63	66.2	1.07	6.57	4.61	2	20	583		0.0121	*0*	0.352	0.15200	2030	0.0163
12/10	2.63	11.43	85	5.54	55.7	0.673	4.86	2.77	2	20	638		0.0154	*0*	0.349	0.16424	1920	*0*
12/23	0.96	12.80	91	5.44	39.0	0.639	4.58	2.65	24	30	2220		0.0194	0.0283	0.192	0.14595	1580	0.00729
AVG.	10.68	8.53	72	5.37	60.9	1.29	5.49	3.53	14	38	3350		0.0237	0.00592	0.405	0.20189	2050	0.0173
MAX.	24.03	13.59	99	5.85	91.7	4.66	8.91	6.73	80	331	17300		0.0532	0.0283	0.954	0.33075	2960	0.0744
MIN.	0.69	2.53	30	4.86	39.0	0.291	3.00	1.22	*<10*	*<10*	185		0.0105	*<0.005*	0.145	0.094440	1540	*<0.005*
MEDIAN	12.67	8.80	76	5.39	59.4	1.00	5.69	3.83	6	20	1950		0.0212	*<0.005*	0.362	0.20635	2030	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.

QUABBIN LABORATORY RECORDS 2013
(215) EAST BR. FEVER BROOK, WEST STREET

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/8	0.87	12.69	90	5.81	110.1	0.587			*0*	10	605						2660	
1/22	0.53	14.07	98	5.63	108.5	0.552			*0*	*0*	408						2880	
2/5	0.38	14.01	99	5.37	82.6	0.704			*0*	63	865						2310	
2/19	0.56	12.67	89	5.70	91.0	0.407			*0*	*0*	288						2590	
3/5	1.26	13.01	95	5.93	85.8	0.395			1	*0*	249						2280	
3/19	1.12	13.33	94	5.40	74.7	0.406			*0*	*0*	345		0.0146	0.0172	0.157	0.18060	1700	*0*
4/2						0.500			1	*0*	548						2020	
4/16	9.09	10.93	95	5.34	85.7	0.638			*0*	10	3450						2110	
4/30	15.60	9.54	97	5.77	90.3	0.575			*0*	*0*	5170						2210	
5/16	13.54	7.85	77	5.48	104.1	0.826			*0*	10	2490						2500	
5/28	14.41	8.93	90	5.25	90.4	0.576			*0*	20	1720						1960	
6/11	16.54	7.15	74	5.14	76.1	0.823			40	85	5790		0.0186	*0*	0.410	0.34965	1810	*0*
6/25	23.65	5.05	61	4.92	70.7	1.00			50	31	9800						1780	
7/9	24.57	4.80	59	5.07	73.9	1.01			60	52	5790						2000	
7/23	21.92	5.78	67	5.49	86.2	2.83			240	323		>24200					2560	
8/6	17.37	6.62	70	5.45	89.0	1.76			*0*	20	3650						2230	
8/20	17.87	6.63	71	5.31	96.2	0.679			40	31	1470						2130	
9/3	22.06	5.02	59	5.48	93.2	0.915			50	98	3650						2150	
9/17	13.12	7.60	73	5.45	93.1	0.640			24	41	3870		0.0188	*0*	0.424	0.39845	2040	*0*
10/1	11.77	8.54	80	5.72	109.0	0.707			4	*0*	908						2390	
10/15	12.58	7.72	73	5.66	110.2	0.739			4	20	888						2440	
10/29	4.56	11.04	87	5.88	116.1	0.774			2	*0*	909						2440	
11/12	5.07	11.54	92	5.90	107.1	0.697			*0*	*0*	565						2260	
11/26	2.54	11.98	88	5.75	122.9	0.755			10	31	457						2610	
12/10	1.92	12.59	92	5.71	85.5	0.574			8	20	697		0.0128	0.0106	0.367	0.36915	1990	*0*
12/23	1.06	13.67	98	5.70	96.8	0.864			*0*	10	1370						2410	
AVG.	10.16	9.71	83	5.53	94.0	0.805			21	34	2240		0.0162	0.00695	0.340	0.32446	2250	*<0.005*
MAX.	24.57	14.07	99	5.93	122.9	2.83			240	323	9800		0.0188	0.0172	0.424	0.39845	2880	*<0.005*
MIN.	0.38	4.80	59	4.92	70.7	0.395			*<10*	*<10*	249		0.0128	*<0.005*	0.157	0.18060	1700	*<0.005*
MEDIAN	11.77	9.54	88	5.49	91.0	0.701			1	15	909		0.0166	0.0053	0.389	0.35940	2250	*<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 2013

(215G) EAST BR. FEVER BROOK, AT CAMELS HUMP ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/8	1.33	13.82	99	5.79	99.2	0.609	5.83	4.02	*0*	20	341		0.0181	0.0173	0.302	0.30510	2810	0.0247
1/22	0.88	14.87	105	5.67	94.6	0.540	5.28	3.25	10	41	364		0.0152	0.0198	0.260	0.26605	2880	0.0177
2/5	0.86	14.66	105	5.36	75.6	0.628	4.43	2.38	*0*	*0*	480		0.0154	0.0433	0.392	0.28365	2370	0.0191
3/19	2.42	14.19	104	5.43	64.9	0.364	3.20	1.38	*0*	*0*	156		0.0143	0.0121	0.182	0.17046	1720	*0*
4/2						0.408	3.15	1.32	*0*	*0*	384		0.0133	*0*	0.222	0.13233	1970	*0*
4/16	9.69	11.12	98	5.36	66.9	0.546	3.52	1.72	*0*	*0*	1420		0.0140	*0*	0.300	0.19070	1940	*0*
4/30	15.71	9.64	98	5.80	71.9	0.522	4.03	2.23	*0*	*0*	2100		0.0109	0.00573	0.551	0.21000	2120	*0*
5/16	14.44	9.58	96	5.55	76.6	0.817	5.16	3.30	*0*	*0*	1220		0.0186	0.00788	0.376	0.26410	2180	0.00731
5/28	14.85	9.97	101	5.32	82.0	0.539	3.69	1.89	10	10	1050		0.0167	*0*	0.382	0.28320	1900	*0*
6/11	16.87	8.29	86	5.27	62.3	0.692	4.12	2.12	10	63	7270		0.0200	*0*	0.435	0.32660	1590	*0*
6/25	24.32	6.91	84	5.18	58.2	0.823	4.84	2.73	*0*	*0*	5790		0.0204	0.00671	0.410	0.38365	1720	0.00839
7/9	25.04	6.48	80	5.20	59.7	1.17	6.06	3.93	20	20	3870		0.0273	0.00593	0.567	0.52940	1900	0.0198
7/23	23.75	6.50	78	5.50	58.3	1.46	7.31	5.20	20	63	17300		0.0278	0.0257	0.522	0.45135	2380	0.0211
8/6	18.16	7.73	83	5.68	63.2	0.738	6.81	4.87	10	*0*	3870		0.0175	*0*	0.473	0.30260	2110	0.00528
8/20	19.32	7.29	80	5.44	74.4	0.558	5.40	3.50	10	*0*	4350		0.0165	0.00669	0.442	0.38980	2070	0.0114
9/3	22.03	6.71	78	5.72	77.2	0.974	7.10	4.93	*0*	*0*	7700		0.0204	*0*	0.428	0.33880	2200	*0*
9/17	14.03	9.16	90	5.65	68.6	0.648	6.22	4.07	20	10	3870		0.0187	*0*	0.390	0.36685	2150	*0*
10/1	13.29	8.95	87	5.81	79.2	0.774	6.67	4.49	8	20	2140		0.0171	*0*	0.633	0.31645	2020	0.00759
10/15	13.49	9.34	90	5.93	89.4	0.581	7.10	5.02	4	*0*	984		0.0146	*0*	0.355	0.30995	2300	0.00700
10/29	5.41	11.99	96	6.02	85.6	0.443	7.38	5.07	*0*	*0*	960		0.0175	*0*	0.362	0.29370	2150	0.00648
11/12	5.46	12.35	100	6.05	97.2	0.397	6.14	4.04	*0*	*0*	576		0.0152	*0*	0.296	0.25775	2070	*0*
11/26	1.45	14.17	101	5.99	93.6	0.500	6.32	4.37	*0*	*0*	520		0.0123	0.00552	0.713	0.25250	2080	*0*
12/10	2.70	13.45	100	5.78	76.1	0.549	5.86	3.67	*0*	10	683		0.0149	0.0104	0.386	0.31660	1990	*0*
12/23	1.04	14.45	103	5.81	73.5	0.687	5.92	3.82	8	10	909		0.0198	0.0301	0.255	0.27700	2440	0.0228
AVG.	11.59	10.51	93	5.62	76.0	0.665	5.48	3.47	5	11	2850		0.0174	0.00822	0.401	0.30077	2130	0.00744
MAX.	25.04	14.87	105	6.05	99.2	1.46	7.38	5.20	20	63	17300		0.0278	0.0433	0.713	0.52940	2880	0.0247
MIN.	0.86	6.48	78	5.18	58.2	0.364	3.15	1.32	*<10*	*<10*	156		0.0109	*<0.005*	0.182	0.13233	1590	*<0.005*
MEDIAN	13.49	9.64	96	5.67	75.6	0.595	5.85	3.75	*<10*	*<10*	1140		0.0169	0.00563	0.388	0.29815	2100	0.00588

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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EPAALK: Alkalinity MDL = 0.500 mg/L

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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 2013
(215F) EAST BR. FEVER BROOK, AT ROAD ABOVE MOUTH

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/8	0.19	15.35	107	6.42	85.3	0.489	6.79	4.98	2	*0*	520		0.0169	0.0269	0.346	0.24030	3030	0.00899
1/22	0.07	16.02	111	6.09	79.5	0.534	6.14	4.26	*0*	*0*	169		0.0143	0.0294	0.210	0.22065	2880	0.00580
2/5	0.10	15.94	112	5.92	71.8	0.568	4.96	2.96	6	20	677		0.0169	0.0488	0.404	0.26050	2450	0.00982
2/19	0.17	15.23	106	6.41	65.6	0.313	5.37	3.48	*0*	*0*	160		0.0128	0.0449	0.363	0.19175	2440	0.0116
3/5	0.85	14.49	104	6.27	61.5	0.324	4.70	2.96	*0*	*0*	86		0.0110	0.0276	0.160	0.17885	2240	*0*
3/19	0.80	15.39	108	5.79	57.2	0.299	3.64	1.86	2	*0*	135		0.0126	0.0121	0.127	0.15231	1750	*0*
4/2						0.381	3.90	2.07	*0*	*0*	323		0.0124	*0*	0.178	0.13822	1840	*0*
4/16	9.43	12.07	106	5.84	58.1	0.465	4.49	2.68	4	20	780		0.0121	*0*	0.131	0.16671	2190	*0*
4/30	14.73	10.08	100	6.00	64.3	0.468	5.75	3.99	4	10	1660		0.00994	0.00585	0.179	0.18125	2470	*0*
5/16	13.33	9.56	93	5.88	63.8	0.548	7.39	5.54	*0*	*0*	794		0.0139	0.0199	0.240	0.21235	2370	0.00767
5/28	13.99	10.51	105	5.67	70.7	0.553	4.91	3.03	*0*	10	2060		0.0150	0.00508	0.286	0.27900	2180	*0*
6/11	16.20	8.96	92	5.46	52.3	1.02	4.49	2.57	30	110	6870		0.0205	*0*	0.368	0.35430	1800	*0*
6/25	23.60	7.54	90	5.69	51.4	1.01	6.97	4.81	*0*	31	3450		0.0207	0.0115	0.433	0.35085	2180	0.00714
7/9	24.47	7.65	93	5.62	58.4	1.47	7.88	5.80	40	63	9210		0.0281	0.0395	0.461	0.45440	2430	0.0154
7/23	23.44	6.85	82	5.95	58.7	2.34	10.5	8.47	40	231		>24200	0.0466	0.0822	0.472	0.36780	3220	0.00568
8/6	18.21	8.92	96	6.24	55.4	0.954	8.17	6.18	20	10	2910		0.0192	0.0191	0.398	0.35465	2440	*0*
8/20	19.60	7.94	88	5.93	66.6	0.881	7.88	6.04	10	10	3130		0.0175	0.0236	0.397	0.28065	2600	0.00621
9/3	22.20	7.57	88	6.29	60.7	1.02	8.78	6.72	20	31	8160		0.0198	0.0110	0.361	0.32090	2650	*0*
9/17	13.68	10.18	100	6.15	66.9	0.652	7.76	5.69	4	20	1850		0.0179	0.00871	0.309	0.28350	2480	*0*
10/1	12.69	9.91	95	6.31	65.1	0.739	9.23	7.16	4	*0*	1550		0.0177	0.0151	0.323	0.21640	2530	*0*
10/15	12.90	10.31	98	6.25	68.4	0.554	8.86	6.90	*0*	*0*	960		0.0143	0.00574	0.245	0.24040	2680	*0*
10/29	5.11	13.54	108	6.46	70.0	0.483	9.16	6.96	*0*	*0*	934		0.0162	0.00671	0.196	0.18960	2500	*0*
11/12	5.24	12.49	100	6.25	79.2	0.452	7.61	5.61	48	41	627		0.0167	*0*	0.265	0.18945	2480	*0*
11/26	0.81	14.62	103	6.35	76.4	0.443	8.36	6.41	4	10	359		0.0121	0.00987	0.201	0.18020	2610	*0*
12/10	1.86	14.27	104	6.18	67.8	0.579	6.49	4.28	2	20	488		0.0146	0.00998	0.361	0.25940	2120	*0*
12/23	0.50	15.88	112	6.19	58.4	0.734	6.51	4.40	12	52	1140		0.0192	0.0393	0.242	0.24680	2310	0.00947
AVG.	10.17	11.65	100	6.06	65.3	0.703	6.80	4.84	10	27	1960		0.0173	0.0193	0.294	0.25043	2420	0.00338
MAX.	24.47	16.02	112	6.46	85.3	2.34	10.5	8.47	48	231	9210		0.0466	0.0822	0.472	0.45440	3220	0.0154
MIN.	0.07	6.85	82	5.46	51.4	0.299	3.64	1.86	*<10*	*<10*	86		0.00994	*<0.005*	0.127	0.13822	1750	*<0.005*
MEDIAN	12.69	10.51	100	6.15	65.1	0.554	6.88	4.90	4	10	934		0.0165	0.0118	0.298	0.24035	2450	*<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 2013
(216) EAST BR. SWIFT RIVER, ROUTE 32A

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/8	0.06	15.76	109	6.53	87.0	0.554			2	10	565						3750	
1/22	0.06	16.76	116	6.43	80.1	0.536			*0*	20	556						3630	
2/5	0.08	16.04	113	6.22	71.0	0.664			6	*0*	663						2830	
2/19	0.06	15.79	110	6.43	76.1	0.471			*0*	*0*	160						3200	
3/5	1.45	14.68	107	6.78	74.7	0.394			1	*0*	187						3200	
3/19	0.98	16.02	113	6.14	71.4	0.390			*0*	10	98		0.0151	0.0539	0.146	0.15579	2350	*0*
4/2						0.637			4	20	249						2360	
4/16	8.88	12.69	110	5.79	61.0	0.672			*0*	*0*	328						2510	
4/30	14.31	10.41	102	6.31	72.5	0.717			*0*	10	677						2800	
5/16	14.15	10.29	102	6.17	78.5	0.892			*0*	20	624						3340	
5/28	13.94	10.67	106	5.84	63.6	0.775			*0*	20	2700						2680	
6/11	15.77	9.56	97	5.84	54.1	1.55			340	364	9210		0.0301	0.0132	0.393	0.38435	2390	*0*
6/25	23.20	8.07	96	6.06	69.6	0.754			*0*	20	3440						2770	
7/9	23.25	8.30	99	6.02	70.5	0.873			10	*0*	2920						3100	
7/23	21.98	8.48	99	6.24	74.7	1.20			580	1010	24200						3540	
8/6	18.38	9.77	106	6.70	67.5	0.774			20	10	5480						2850	
8/20	19.19	9.29	102	6.27	69.4	0.549			10	31	5490						3050	
9/3	21.70	8.54	99	6.75	70.1	0.983			110	31	8160						2920	
9/17	13.61	10.92	107	6.48	64.1	0.643			12	41	1330		0.0208	0.0105	0.353	0.33475	2840	*0*
10/1	12.64	11.51	110	6.66	73.1	0.424			4	*0*	487						2950	
10/15	13.05	11.91	114	6.55	80.9	0.451			*0*	*0*	663						3150	
10/29	4.87	14.28	113	6.68	85.3	0.405			*0*	*0*	336						3830	
11/12	4.82	14.19	113	6.41	75.8	0.467			*0*	10	546						3170	
11/26	0.28	14.98	104	6.53	81.9	0.720			10	41	697						3150	
12/10	1.88	15.27	111	6.41	78.3	0.491			4	10	497		0.0135	0.0336	0.300	0.25100	3080	*0*
12/23	-0.01	16.64	115	6.29	76.4	1.26			4	62	2990						3190	
AVG.	9.94	12.43	107	6.34	73.1	0.702			43	67	2820		0.0199	0.0278	0.298	0.28147	3020	*<0.005*
MAX.	23.25	16.76	116	6.78	87.0	1.55			580	1010	24200		0.0301	0.0539	0.393	0.38435	3830	*<0.005*
MIN.	-0.01	8.07	96	5.79	54.1	0.390			*<10*	*<10*	98		0.0135	0.0105	0.146	0.15579	2350	*<0.005*
MEDIAN	12.64	11.91	107	6.41	73.1	0.654			3	10	663		0.0180	0.0234	0.327	0.29288	3070	*<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 2013
GATES BROOK, AT MOUTH

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/8	0.35	16.74	117	6.31	28.1	0.110			*0*	*0*	441						1440	
1/22	0.06	18.82	130	6.02	25.7	0.121			*0*	*0*	309						1380	
2/5	0.50	18.97	135	5.34	24.1	0.161			*0*	*0*	512						1270	
2/19	0.50	17.93	126	5.75	21.4	0.112			*0*	*0*	426						1100	
3/5	1.69	16.42	121	5.75	21.2	0.131			*0*	10	213						1130	
3/19	1.13	19.19	136	5.43	22.0	0.146			10	10	262		0.0130	*0*	*0*	0.052900	1010	*0*
4/2	2.69	15.91	121	5.98	22.8	0.134			2	*0*	359						1190	
4/16	5.56	14.49	116	5.99	21.9	0.138			*0*	10	295						1200	
4/30	9.14	13.74	120	5.98	22.9	0.125			*0*	*0*	880						1250	
5/16	9.75	11.79	106	5.86	23.3	0.111			*0*	31	789						1280	
5/28	9.84	12.77	116	5.09	20.5	0.212			10	*0*	860						1130	
6/11	12.82	11.70	112	4.56	19.0	0.935			60	86	4350		0.0195	*0*	0.213	0.20720	908	*0*
6/25	14.92	10.12	102	5.06	21.5	0.221			*0*	*0*	2910						1030	
7/9	17.78	10.14	108	5.22	20.8	0.950			50	96	24200						1240	
7/23	19.16	9.19	101	5.64	22.9	0.769			300	565		>24200					1150	
8/6	14.11	11.26	111	6.19	23.6	0.447			20	10	3450						1250	
8/20	16.24	10.18	105	6.09	24.2	0.198			*0*	75	3130						1350	
9/3	18.09	8.89	96	6.17	24.9	0.265			110	75	4110						1370	
9/17	10.74	11.48	105	6.30	25.5	0.190			8	*0*	1860		0.0158	0.00728	0.125	0.097760	1310	*0*
10/1	11.69	11.26	105	6.45	27.1	0.152			4	*0*	884						1440	
10/15	11.97	11.44	107	6.25	26.9	0.225			12	10	1500						1340	
10/29	5.26	14.32	114	6.68	27.7	0.145			*0*	*0*	988						1400	
11/12	5.49	13.51	109	6.52	27.4	0.162			*0*	10	1150						1350	
11/26	0.31	17.23	119	6.58	27.4	0.132			*0*	*0*	985						1350	
12/10	3.00	15.51	116	6.31	25.1	0.166			2	20	565		0.0100	*0*	0.121	0.087960	1310	*0*
12/23	4.76	14.32	113	5.84	22.1	0.312			24	63	1270						1270	
AVG.	7.98	13.74	114	5.90	23.8	0.260			24	41	2270		0.0146	0.00182	0.115	0.11146	1250	*<0.005*
MAX.	19.16	19.19	136	6.68	28.1	0.950			300	565	24200		0.0195	0.00728	0.213	0.20720	1440	*<0.005*
MIN.	0.06	8.89	96	4.56	19.0	0.110			*<10*	*<10*	213		0.0100	*<0.005*	<0.100	0.052900	908	*<0.005*
MEDIAN	7.35	13.63	114	5.99	23.5	0.162			1	10	884		0.0144	*<0.005*	0.123	0.092860	1270	*<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 2013
BOAT COVE BROOK, NEAR MOUTH

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/8	0.33	15.73	110	7.02	82.6	0.640			*0*	*0*	933						8130	
1/22	0.11	16.40	113	6.81	70.9	0.863			2	10	350						6570	
2/5	0.09	16.13	113	6.59	63.4	0.888			2	*0*	457						5850	
2/19	0.13	16.25	113	6.71	56.0	1.07			*0*	*0*	384						5300	
3/5	3.00	13.96	107	6.92	49.7	1.40			1	*0*	213						4550	
3/19	0.76	15.91	112	6.56	53.5	1.65			1	10	327		0.0213	0.0269	0.113	0.10277	4250	*0*
4/2						0.730			*0*	*0*	259						5400	
4/16	10.14	11.67	104	6.41	62.3	0.617			18	31	583						5690	
4/30	14.35	10.38	102	6.56	70.4	0.606			4	*0*	1940						6830	
5/16	14.43	10.35	103	6.53	75.6	0.519			*0*	*0*	959						7120	
5/28	13.68	11.10	110	6.44	59.2	0.935			*0*	*0*	1280						6020	
6/11	14.37	9.87	98	6.41	42.9	3.68			150	218	6870		0.0274	0.0137	0.370	0.43115	4260	*0*
6/25	19.51	8.91	99	6.67	67.2	0.868			*0*	*0*	2380						6490	
7/9	19.89	9.00	100	6.52	76.1	0.966			40	85	5790						7530	
7/23	21.05	8.68	99	6.46	52.6	7.64			11500	19900		>24200					5530	
8/6	17.20	9.91	105	7.34	95.9	0.801			30	10	3260						9130	
8/20	18.36	9.49	102	6.80	96.8	0.474			210	231	7700						9830	
9/3	19.76	9.19	102	7.25	89.7	0.581			80	63	6490						8970	
9/17	12.86	11.45	110	7.13	91.9	0.457			28	86	2190		0.0209	0.0233	0.182	0.15540	9260	*0*
10/1	14.34	11.48	114	7.36	99.1	0.491			*0*	*0*	1520						9760	
10/15	13.79	11.43	111	7.10	94.9	0.471			4	*0*	1260						9760	
10/29	6.34	13.38	110	7.14	100.1	1.03			*0*	*0*	749						9970	
11/12	4.30	14.45	113	6.97	97.3	0.275			*0*	*0*	464						9510	
11/26	0.14	15.04	104	6.98	91.8	0.333			4	*0*	1520						9120	
12/10	2.82	14.68	110	6.90	74.8	1.11			2	*0*	663		0.0170	0.0404	0.163	0.15157	6860	*0*
12/23	4.23	14.57	113	6.62	46.6	6.85			80	122	8660						4460	
AVG.	9.84	12.38	107	6.81	74.5	1.38			468	799	2290		0.0217	0.0261	0.207	0.21022	7160	*<0.005*
MAX.	21.05	16.40	114	7.36	100.1	7.64			11500	19900	8660		0.0274	0.0404	0.370	0.43115	9970	*<0.005*
MIN.	0.09	8.68	98	6.41	42.9	0.275			*<10*	*<10*	213		0.0170	0.0137	0.113	0.10277	4250	*<0.005*
MEDIAN	12.86	11.48	110	6.80	74.8	0.832			2	*<10*	1260		0.0211	0.0251	0.173	0.15349	6850	*<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").
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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 2013
WARE RIVER AND TRIBUTARIES
(101) WARE RIVER, AT SHAFT 8

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/2	0.11	16.13	113	6.40	94.7	0.782			2	*0*	677					0.23715	3420	
1/15	0.64	14.63	104	6.39	71.5	0.850			*0*	*0*	645					0.19625	3290	
1/29	0.25	16.80	117	6.24	95.6	0.883			4	*0*	201					0.19455	4390	
2/12	0.25	15.48	108	6.13	95.6	0.776			8	10	384					0.18095	3260	
2/26	0.38	15.25	107	6.28	102.2	0.661			1	10	109					0.16099	3630	
3/12	1.23	15.38	110	6.00	93.1	0.668			2	*0*	120					0.15376	3080	
3/26						0.550			2	10	201		0.0135	0.025	0.193	0.14854	2950	*0*
4/9	9.55	11.67	104	5.82	75.9	0.762			6	31	379					0.15226	2930	
4/23	10.14	11.48	101	5.97	79.2	1.06			8	*0*	1180					0.20310	2930	
5/7	16.44	10.54	109	5.93	88.6	1.75			8	20	1730					0.20910	3500	
5/21	19.13	9.52	104	6.08	90.5	2.26			20	41	1300					0.22955	3660	
6/4	20.87	8.56	98	5.78	79.9	2.63			40	52	5790		0.0348	0.0199	0.500	0.45865	3380	0.0187
6/18	17.29	9.32	99	5.55	61.4	1.48			40	52	3650					0.38600	2270	
7/2	20.74	8.37	95	5.67	60.4	1.91			150	288	8660					0.48075	2550	
7/16	25.45	7.34	90	5.90	81.9	4.04			150	259	14100					0.42070	3300	
7/30	23.06	9.04	107	6.27	85.0	4.81			140	132	13000					0.39255	3660	
8/13	20.93	8.84	101	6.13	69.9	1.71			50	134	15500					0.41560	2840	
8/27	22.45	8.21	96	6.20	77.6	1.68			80	63	5480					0.28125	3410	
9/10	16.92	9.85	103	6.31	89.4	2.77			50	63	2380					0.26190	3770	
9/24	14.72	10.30	103	6.36	82.6	1.91			44	86	3450		0.0269	0.0113	0.281	0.24040	3160	*0*
10/8	15.11	10.15	103	6.42	88.9	1.94			70	85	2910					0.22615	3600	
10/22	11.44	11.55	107	6.38	83.5	2.07			16	20	1050					0.26145	3260	
11/5	6.69	12.57	102	6.49	82.8	1.56			*0*	*0*	1610					0.21830	3100	
11/19	4.93	13.86	112	6.45	86.3	1.45			2	*0*	602					0.18460	3280	
12/3	1.15	15.46	111	6.23	90.2	0.986			8	51	2700					0.26295	3210	
12/17	-0.03	16.35	114	6.27	105.9	1.06			4	30	496		0.0209	0.0273	0.282	0.22335	3800	0.0116
12/31	-0.06	15.51	109	6.07	89.1	0.873			16	*0*	2910					0.23745	3030	
AVG.	10.76	12.01	105	6.14	84.7	1.63			34	53	3380		0.0240	0.0209	0.314	0.25994	3280	0.00758
MAX.	25.45	16.80	117	6.49	105.9	4.81			150	288	15500		0.0348	0.0273	0.500	0.48075	4390	0.0187
MIN.	-0.06	7.34	90	5.55	60.4	0.550			*<10*	*<10*	109		0.0135	0.0113	0.193	0.14854	2270	*<0.005*
MEDIAN	10.79	11.52	104	6.22	85.7	1.48			8	30	1610		0.0239	0.0225	0.282	0.22955	3280	0.00580

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 2013
WARE RIVER AND TRIBUTARIES
(111) QUEEN LAKE, AT ROAD CULVERT BELOW OUTLET

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/2	0.46	15.35	108	6.39	59.8	0.401	7.46	5.70	*0*	*0*	435		0.0106	0.0388	0.238	0.050220	2940	0.00753
1/15	1.58	16.84	122	6.65	55.1	0.351	7.32	5.46	4	*0*	341		0.00833	0.0696	0.206	0.052505	3140	0.00535
1/29	0.65	17.03	120	7.07	57.8	0.385	8.10	6.10	*0*	10	538		0.0105	0.0472	0.234	0.051270	3190	0.00643
2/12	0.35	19.33	136	6.69	101.9	0.428	7.20	5.36	*0*	*0*	471		0.0137	0.154	0.315	0.047435	3620	0.0369
2/26	1.17	16.97	122	6.70	79.6	0.323	7.77	5.92	6	41	262		0.00816	0.117	0.178	0.047515	3610	0.0216
3/12	1.54	17.42	125	6.50	75.4	0.509	7.13	5.20	*0*	10	591		0.0142	0.124	0.200	0.056310	3170	0.0109
3/26						0.375	8.00	6.16	29	30	256		0.0108	0.0403	0.212	0.052220	2850	*0*
4/9	6.57	13.01	108	6.58	61.7	0.444	6.50	4.83	2	*0*	327		0.0142	0.0843	0.130	0.056120	3470	0.00576
4/23	7.67	13.52	113	6.72	60.8	0.670	7.28	5.43	*0*	*0*	960		0.0124	0.0422	0.318	0.052020	3140	*0*
5/7	13.82	10.27	100	6.46	63.1	0.464	8.13	6.30	*0*	*0*	2100		0.0103	0.0683	0.310	0.054130	3380	0.00579
5/21	16.46	8.92	93	6.56	66.9	0.465	8.90	7.05	8	*0*	1940		0.0156	0.111	0.189	0.061330	3960	0.00823
6/4	18.02	8.94	97	6.31	58.8	0.518	7.85	6.12	12	20	14100		0.0128	0.0396	0.383	0.076950	3330	*0*
6/18	19.12	8.81	97	6.37	55.7	0.527	7.68	5.74	20	74	5170		0.0125	0.0142	0.267	0.079050	3000	0.00733
7/2	23.41	8.27	99	6.40	55.4	0.657	7.73	5.74	20	10	5790		0.0169	0.0276	0.316	0.085620	2850	0.00974
7/16	24.01	7.64	92	6.25	64.1	0.549	9.72	7.81	20	75	7700		0.0144	0.150	0.492	0.080525	3400	0.0103
7/30	20.90	8.90	101	6.84	62.2	0.662	9.19	7.29	10	10	4880		0.0194	0.111	0.281	0.070595	3360	0.00563
8/13	21.29	8.65	99	6.69	60.1	0.428	8.82	6.88	20	*0*	4610		0.0109	0.0367	0.303	0.067455	3070	*0*
8/27	21.40	8.38	96	6.40	60.7	0.352	9.17	7.23	20	10	2280		0.00998	0.0606	0.183	0.051050	3370	*0*
9/10	16.62	9.68	100	6.73	59.8	0.473	9.32	7.41	20	*0*	9800		0.0120	0.0610	0.157	0.052280	3250	*0*
9/24	12.80	10.73	103	6.75	61.2	0.407	8.93	7.07	12	10	1250		0.0116	0.0487	0.185	0.055585	3150	*0*
10/8	15.34	10.69	109	6.74	57.9	0.488	8.14	6.23	10	10	1530		0.0140	0.0110	0.247	0.068315	2790	*0*
10/22	12.80	11.08	106	6.73	58.6	0.445	8.32	6.41	4	10	1250		0.00770	0.00800	0.212	0.062740	2780	*0*
11/5	7.53	12.70	106	6.77	57.2	0.487	7.83	5.87	58	122	749		0.0131	0.00534	0.227	0.056705	2850	*0*
11/19	5.86	14.79	122	6.72	61.2	0.493	9.18	7.23	*0*	10	1270		0.0113	0.0303	0.201	0.061020	3140	*0*
12/3	2.03	18.45	136	7.11	58.4	0.312	8.08	6.11	*0*	*0*	373		*0*	0.0190	0.426	0.053855	2850	*0*
12/17	0.20	16.33	114	7.08	62.7	0.360	8.42	6.41	*0*	*0*	243		0.00998	0.0213	0.436	0.056365	2980	*0*
12/31	0.68	17.37	124	6.84	61.5	0.415	8.02	6.06	*0*	*0*	185		0.0119	0.0326	0.219	0.054820	3080	*0*
AVG.	10.47	12.70	109	6.66	63.0	0.459	8.16	6.26	10	17	2570		0.0118	0.0583	0.262	0.059778	3170	0.00524
MAX.	24.01	19.33	136	7.11	101.9	0.670	9.72	7.81	58	122	14100		0.0194	0.154	0.492	0.085620	3960	0.0369
MIN.	0.20	7.64	92	6.25	55.1	0.312	6.50	4.83	*<10*	*<10*	185		*<0.005*	0.00534	0.130	0.047435	2780	*<0.005*
MEDIAN	10.24	11.89	107	6.70	60.8	0.445	8.08	6.12	6	10	1250		0.0119	0.0422	0.234	0.056120	3140	*<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 2013
WARE RIVER AND TRIBUTARIES
(B4) BURNSHIRT RIVER, AT STONE BRIDGE

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/2	0.26	12.11	85	5.51	69.5	0.519	4.26	2.33	2	31	816		0.0170	0.0317	0.303	0.33620	2770	0.0165
1/15	0.27	12.52	88	5.74	65.7	0.538	3.50	1.62	6	10	1110		0.0133	0.0516	0.269	0.28520	2650	0.00974
1/29	0.19	11.40	79	6.05	74.8	1.09	6.01	4.00	2	31	988		0.0204	0.0465	0.451	0.34175	3510	0.0884
2/12	0.13	12.24	85	5.74	78.1	0.810	4.14	2.12	*0*	10	598		0.0184	0.0831	0.364	0.31765	2880	0.0727
2/26	0.14	12.38	86	5.53	89.6	0.209	4.23	2.22	2	*0*	504		0.0140	0.0757	0.303	0.29640	2890	0.0493
3/12	0.18	12.77	89	5.37	88.6	0.633	3.65	1.70	2	10	301		0.0158	0.0756	0.260	0.26760	2670	0.0185
3/26						0.521	3.45	1.54	*0*	*0*	359		0.0140	0.0494	0.235	0.21335	2420	0.00796
4/9	8.82	9.75	85	5.32	62.8	0.847	3.54	1.70	*0*	*0*	860		0.0186	0.00677	0.283	0.25665	2280	*0*
4/23	8.01	10.20	86	5.36	60.8	0.693	4.14	2.17	8	20	1940		0.0138	*0*	0.203	0.34660	2490	*0*
5/7	15.44	5.69	57	5.40	70.3	1.55	5.56	3.56	4	41	3450		0.0209	*0*	0.404	0.43515	2890	0.00519
5/21	15.28	7.70	78	5.36	120.1	1.36	6.10	3.97	20	52	3080		0.0245	*0*	0.476	0.50580	2970	*0*
6/4	16.97	4.25	45	4.99	54.0	1.24	5.64	3.54	40	52	6870		0.0263	*0*	0.632	0.78370	2400	*0*
6/18	17.92	4.84	52	4.96	46.6	0.928	4.53	2.42	60	74	4610		0.0204	*0*	0.427	0.48405	1890	*0*
7/2	21.67	2.52	29	5.12	53.9	1.73	6.96	4.68	250	384	19900		0.0326	*0*	0.634	0.71345	2320	0.00559
7/16	25.04	1.35	17	5.20	62.2	2.48	8.98	6.73	40	121	17300		0.0315	*0*	0.972	0.74470	3020	0.00579
7/30	21.90	2.70	31	5.60	60.8	2.05	8.99	6.96	113	201	14100		0.0342	*0*	0.742	0.63485	3280	*0*
8/13	19.40	2.91	32	5.17	52.3	0.813	6.00	3.69	130	84	6130		0.0194	*0*	0.587	0.73955	2380	*0*
8/27	20.82	2.15	24	5.04	59.0	1.03	8.03	5.76	90	161	8660		0.0251	*0*	0.495	0.61450	3140	*0*
9/10	15.32	4.27	43	5.57	62.3	1.00	9.16	6.95	30	63	2910		0.0252	*0*	0.495	0.51660	3020	*0*
9/24	11.80	5.59	53	5.48	58.9	0.828	6.87	4.64	16	20	4350		0.0229	*0*	0.474	0.54525	2410	*0*
10/8	13.91	5.02	49	5.49	57.3	1.15	6.65	4.45	113	262	6490		0.0262	*0*	0.560	0.58470	2280	*0*
10/22	10.39	6.99	63	5.53	59.3	0.911	6.20	4.02	*0*	20	2180		0.0172	*0*	0.429	0.47550	2240	0.00954
11/5	4.37	9.66	74	5.76	60.9	1.00	6.00	3.86	4	10	3130		0.0242	*0*	0.476	0.41605	2110	0.00570
11/19	6.34	11.63	97	5.56	57.2	0.915	5.49	3.37	8	20	2700		0.0173	*0*	0.596	0.37470	2210	*0*
12/3	2.03	13.35	98	5.47	59.1	0.415	4.08	1.99	2	52	2360		0.0100	0.0112	0.441	0.48745	2160	0.00500
12/17	0.50	7.26	51	5.45	76.9	0.692	5.95	3.82	2	*0*	984		0.0182	0.0239	0.730	0.42600	2760	0.0245
12/31	0.19	13.87	98	5.48	76.6	0.425	4.37	2.33	2	10	1220		0.0156	0.0402	0.306	0.36505	2380	0.0166
AVG.	9.90	7.89	64	5.43	66.8	0.977	5.65	3.56	35	64	4370		0.0206	0.0184	0.465	0.46328	2610	0.0126
MAX.	25.04	13.87	98	6.05	120.1	2.48	9.16	6.96	250	384	19900		0.0342	0.0831	0.972	0.78370	3510	0.0884
MIN.	0.13	1.35	17	4.96	46.6	0.209	3.45	1.54	*<10*	*<10*	301		0.0100	*<0.005*	0.203	0.21335	1890	*<0.005*
MEDIAN	9.61	7.48	69	5.48	61.6	0.911	5.64	3.56	6	31	2700		0.0194	*<0.005*	0.451	0.43515	2490	0.00519

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 2013
WARE RIVER AND TRIBUTARIES
(103) BURNSHIRT RIVER, AT ROUTE 62

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/2	0.07	15.55	109	5.69	66.2	0.422	3.78	1.94	2	*0*	512		0.0160	0.0197	0.266	0.23795	2530	*0*
1/15	0.73	15.28	108	6.41	58.8	0.518	3.64	1.78	2	10	677		0.0145	0.0293	0.189	0.20805	2200	*0*
1/29	0.11	15.35	106	6.12	60.9	0.438	4.40	2.54	*0*	10	480		0.0126	0.0376	0.286	0.18645	2620	*0*
2/12	0.09	15.14	105	5.77	65.5	0.617	3.64	1.79	*0*	*0*	332		0.0160	0.0639	0.240	0.18595	2210	0.00938
2/26	0.77	15.31	109	5.84	72.7	0.356	3.73	1.86	*0*	*0*	238		0.0122	0.0660	0.148	0.15719	2370	*0*
3/12	2.25	15.27	112	5.59	69.3	0.387	3.46	1.46	*0*	*0*	201		0.0150	0.0371	0.309	0.15816	2170	*0*
3/26						0.286	3.30	1.36	4	20	160		0.0123	0.0184	0.169	0.14486	1860	*0*
4/9	7.74	12.14	103	5.42	56.3	0.645	3.29	1.50	2	20	420		0.0125	*0*	0.147	0.13876	2000	*0*
4/23	9.70	11.98	105	5.56	58.7	0.589	3.60	1.72	10	*0*	1960		0.0109	*0*	0.262	0.17715	2150	*0*
5/7	14.26	10.04	99	5.73	59.7	0.676	4.19	2.44	8	*0*	1840		0.0116	*0*	0.191	0.18715	2270	*0*
5/21	17.81	9.01	96	5.84	60.2	0.904	4.96	3.05	24	20	2140		0.0146	0.00940	0.256	0.20310	2330	*0*
6/4	19.39	8.34	93	5.42	54.4	1.20	4.61	2.71	36	31	3260		0.0192	0.0125	0.484	0.42535	2130	*0*
6/18	17.02	8.45	89	5.21	55.7	0.648	3.73	1.73	70	41	1250		0.0166	0.00568	0.308	0.34570	1650	*0*
7/2	21.44	7.76	89	5.21	47.8	1.22	4.10	2.08	90	122	8160		0.0260	0.00906	0.513	0.43195	1870	*0*
7/16	24.06	7.89	95	5.77	50.7	1.31	5.58	3.61	*0*	20	4610		0.0205	0.0222	0.680	0.38735	2010	*0*
7/30	20.27	8.99	101	6.15	50.9	0.880	5.79	4.11	*0*	20	4610		0.0192	0.00846	0.530	0.30900	2000	*0*
8/13	20.09	8.73	98	5.88	49.2	0.733	5.68	3.72	20	63	3970		0.0167	0.00657	0.366	0.33580	1930	*0*
8/27	20.34	8.50	95	5.81	52.1	0.591	5.82	3.85	20	74	4110		0.0143	*0*	0.228	0.26175	2050	*0*
9/10	14.95	10.11	101	6.08	51.4	0.766	6.28	4.19	30	10	1790		0.0153	*0*	0.278	0.22095	2060	*0*
9/24	11.82	10.65	100	6.04	50.0	0.575	5.92	3.85	44	30	1670		0.0175	*0*	0.269	0.26050	1940	*0*
10/8	14.03	9.82	97	6.02	53.3	0.645	5.94	3.87	120	122	2760		0.0188	*0*	0.319	0.32410	1970	*0*
10/22	8.60	11.64	101	6.11	55.5	0.484	6.34	4.21	*0*	20	733		0.0124	*0*	0.210	0.25020	2010	*0*
11/5	4.20	13.89	106	6.16	57.4	0.407	5.93	4.09	*0*	*0*	620		0.0142	*0*	0.222	0.22990	1980	*0*
11/19	4.53	13.72	109	6.06	55.5	0.644	5.75	3.85	6	10	697		0.0120	*0*	0.229	0.22150	1950	*0*
12/3	1.96	14.16	104	5.74	60.3	0.534	4.58	2.63	4	10	1220		0.0133	0.0127	0.896	0.29025	2070	*0*
12/17	-0.06	15.08	105	5.73	63.3	0.481	4.79	2.87	2	20	417		0.0175	0.0239	0.430	0.26460	2260	0.00982
12/31	-0.08	16.07	112	5.72	65.8	0.421	3.90	1.95	4	10	645		0.0149	0.0298	0.238	0.23740	2210	0.0159
AVG.	9.85	11.88	102	5.81	57.8	0.644	4.69	2.77	18	25	1830		0.0154	0.0153	0.321	0.25115	2100	0.00130
MAX.	24.06	16.07	112	6.41	72.7	1.31	6.34	4.21	120	122	8160		0.0260	0.0660	0.896	0.43195	2620	0.0159
MIN.	-0.08	7.76	89	5.21	47.8	0.286	3.29	1.36	*<10*	*<10*	160		0.0109	*<0.005*	0.147	0.13876	1650	*<0.005*
MEDIAN	9.15	11.81	102	5.79	56.9	0.591	4.58	2.63	4	20	1220		0.0149	0.00906	0.266	0.23740	2060	*<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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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 2013
WARE RIVER AND TRIBUTARIES
(C2) CANESTO BROOK, AT WILLIAMSVILLE ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/2	0.25	14.11	99	5.54	65.8	0.364	3.60	1.84	*0*	*0*	882		0.0152	0.0790	0.187	0.11110	2540	0.0116
1/15	0.73	14.17	101	5.74	55.0	0.605	3.15	1.42	20	30	1400		0.0140	0.0866	0.167	0.17409	2340	0.00771
1/29	0.16	14.20	99	5.59	55.9	0.671	4.00	2.23	*0*	*0*	727		0.0142	0.102	0.136	0.085625	2480	0.0310
2/12	0.11	17.58	122	5.78	70.3	0.504	3.11	1.31	*0*	*0*	504		0.0127	0.219	*0*	0.084690	2250	0.0174
2/26	0.21	15.07	105	5.59	64.4	0.318	3.34	1.53	*0*	*0*	318		0.0116	0.189	0.134	0.086925	2270	0.0153
3/12	0.76	15.23	107	5.72	71.1	0.364	3.49	1.50	*0*	*0*	496		0.0136	0.200	0.164	0.10501	2490	0.00894
3/26						0.217	3.15	1.29	*0*	*0*	299		0.0119	0.174	0.142	0.086730	2310	*0*
4/9	5.52	12.65	102	5.53	54.8	0.348	2.84	1.18	*0*	*0*	359		0.0127	0.0803	0.115	0.12826	2010	*0*
4/23	5.90	12.21	97	5.37	61.5	0.412	3.37	1.50	2	*0*	771		0.0102	0.0385	0.316	0.11835	2290	*0*
5/7	10.95	9.03	82	5.43	63.8	0.713	3.94	2.19	*0*	*0*	2610		0.0102	0.00892	0.150	0.13805	2410	0.00501
5/21	15.48	7.92	80	5.58	62.9	1.69	4.41	2.54	8	*0*	5480		0.0175	0.00609	0.238	0.17950	2440	0.00671
6/4	15.06	8.74	89	5.15	56.6	1.47	3.96	2.11	24	52	6870		0.0177	0.0157	0.442	0.31910	2180	*0*
6/18	14.56	9.25	93	5.08	48.2	0.767	3.30	1.33	50	75	6130		0.0166	0.0132	0.291	0.24575	1640	*0*
7/2	17.87	7.61	82	4.96	47.3	1.70	3.38	1.17	660	809		>24200	0.0221	0.00827	0.431	0.55905	1880	0.00959
7/16	22.05	5.04	58	5.12	56.1	3.54	4.84	2.95	20	122	14100		0.0295	0.0447	0.879	0.36315	2030	0.0610
7/30	18.31	6.70	72	5.60	57.2	3.65	4.74	3.05	60	41	7700		0.0336	0.0431	0.556	0.28790	2190	0.0247
8/13	16.86	7.65	80	5.35	53.0	1.96	4.17	2.22	110	464	4350		0.0194	0.0227	0.398	0.31265	1950	0.00772
8/27	19.45	6.44	71	5.23	50.2	3.05	5.45	3.54	170	246	6870		0.0305	0.0209	0.295	0.25850	2040	0.0258
9/10	14.27	8.18	81	5.65	53.1	3.44	5.69	3.65	10	31	4610		0.0311	0.0197	0.327	0.28135	2120	0.0293
9/24	9.59	8.61	77	5.49	56.7	2.27	4.72	2.81	40	63	4610		0.0270	0.0137	0.320	0.28615	2010	0.0270
10/8	12.35	8.82	84	5.46	56.1	1.85	5.03	2.89	500	594	17300		0.0312	*0*	0.431	0.44795	2070	0.00502
10/22	8.10	9.50	81	5.68	62.9	2.47	5.51	3.49	16	31	1840		0.0246	0.0221	0.290	0.25865	2410	0.0643
11/5	3.23	12.01	89	5.66	59.6	1.24	4.62	2.71	2	*0*	1550		0.0203	0.0313	0.209	0.17290	2090	0.0318
11/19	4.02	12.68	100	5.68	60.2	1.44	4.59	2.81	4	20	1520		0.0151	0.0368	0.215	0.15101	2340	0.0224
12/3	1.38	14.37	104	5.56	59.7	0.547	3.45	1.50	*0*	*0*	1400		0.0130	0.0575	0.397	0.18620	2070	0.0143
12/17	0.08	13.59	95	5.59	65.3	1.01	4.23	2.35	*0*	*0*	717		0.0194	0.0806	0.191	0.12807	2230	0.0237
12/31	0.00	15.69	110	5.44	61.1	0.488	3.49	1.55	*0*	*0*	1110		0.0143	0.0913	0.235	0.21085	2160	0.0166
AVG.	8.36	11.04	91	5.48	58.8	1.37	4.06	2.17	63	95	3640		0.0189	0.0631	0.284	0.21361	2190	0.0173
MAX.	22.05	17.58	122	5.78	71.1	3.65	5.69	3.65	660	809	17300		0.0336	0.219	0.879	0.55905	2540	0.0643
MIN.	0.00	5.04	58	4.96	47.3	0.217	2.84	1.17	*<10*	*<10*	299		0.0102	*<0.005*	*<0.100*	0.084690	1640	*<0.005*
MEDIAN	7.00	10.76	91	5.55	58.4	1.01	3.96	2.19	4	*<10*	1540		0.0166	0.0385	0.238	0.17950	2190	0.0143

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 2013
WARE RIVER AND TRIBUTARIES
(N1) NATTY POND BROOK, AT HALE ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/2	0.16	10.49	73	5.55	100.1	0.685	6.03	4.12	*0*	*0*	631		0.0192	0.0333	0.318	0.23515	3360	0.0186
1/15	0.48	11.96	84	6.09	85.5	0.935	6.28	4.39	2	*0*	733		0.0213	0.0501	0.332	0.31190	3480	0.0253
1/29	0.12	9.41	65	5.79	105.0	1.13	8.73	6.80	*0*	*0*	332		0.0212	0.0636	0.385	0.24265	4650	0.101
2/12	0.09	9.53	66	5.66	111.4	0.664	6.21	4.25	*0*	*0*	275		0.0171	0.0952	0.301	0.21415	3810	0.0786
2/26	0.23	11.47	80	5.71	112.9	0.665	6.43	4.51	*0*	*0*	134		0.0146	0.116	0.284	0.20230	3810	0.0735
3/12	1.10	12.02	85	5.55	109.1	0.587	5.63	3.63	*0*	*0*	169		0.0175	0.108	0.211	0.20025	3580	0.0330
3/26						0.361	4.75	2.77	*0*	*0*	121		0.0143	0.0689	0.196	0.16557	3370	0.00582
4/9	7.66	8.83	75	5.23	87.9	0.403	4.19	2.41	2	*0*	538		0.0121	0.00831	0.239	0.17823	2960	0.00521
4/23	9.31	8.40	73	5.37	95.2	0.547	5.00	3.04	10	10	2190		0.0113	0.00837	0.263	0.24185	3150	0.00621
5/7	14.30	6.68	66	5.45	101.8	1.65	6.69	4.77	20	31	15500		0.0316	0.00838	0.416	0.37605	3590	0.0187
5/21	17.74	5.69	61	5.66	101.4	2.80	9.30	7.17	*0*	*0*	4880		0.0509	0.0272	0.541	0.48825	3880	0.0379
6/4	19.57	3.99	45	5.39	121.5	3.09	4.58	2.41	44	41	7700		0.0572	*0*	0.871	0.63125	3930	*0*
6/18	18.41	4.49	49	5.20	79.8	0.770	5.45	3.39	10	10	3450		0.0234	*0*	0.407	0.44070	2760	0.00705
7/2	22.10	2.78	32	5.31	82.0	4.18	8.42	6.19	20	30	8160		0.0500	*0*	0.590	0.60200	3360	0.0200
7/16	24.42	1.96	24	5.39	96.3	20.7	12.0	9.86	20	31	4880		0.0803	*0*	0.937	0.45380	4050	0.0382
7/30	21.25	3.26	37	5.67	85.3	10.2	9.67	7.72	30	63	5790		0.0599	0.00526	0.706	0.45965	3710	0.00749
8/13	19.52	4.54	50	5.51	76.4	1.61	7.83	5.68	30	30	3260		0.0269	*0*	0.439	0.39600	2610	0.00658
8/27	19.69	4.18	46	5.37	83.6	2.83	9.48	7.34	130	313	2850		0.0488	0.0165	0.485	0.35650	3580	0.0261
9/10	15.19	5.92	59	5.55	79.0	2.19	7.28	5.20	*0*	*0*	2720		0.0425	0.0194	0.395	0.29825	2900	0.0166
9/24	12.02	6.71	63	5.55	80.3	1.04	6.71	4.73	36	73	7270		0.0291	0.00653	0.359	0.29215	2690	0.00634
10/8	13.43	6.09	59	5.68	84.6	1.69	7.74	5.75	160	246	24200		0.0358	0.00761	0.441	0.29040	2970	0.0101
10/22	8.94	7.78	68	5.67	83.3	1.37	7.24	5.20	84	97	3610		0.0263	0.0105	0.351	0.28030	2680	0.0137
11/5	4.06	10.26	78	5.59	83.6	0.919	5.78	3.76	2	20	2760		0.0242	0.00745	0.317	0.23995	2450	0.00719
11/19	4.92	9.98	80	5.42	81.9	0.908	5.56	3.56	4	20	3450		0.0218	0.00892	0.449	0.22485	2460	0.0072
12/3	0.90	12.13	87	5.57	87.9	0.506	4.67	2.71	*0*	*0*	1410		0.0125	0.00906	0.415	0.22640	2500	0.00873
12/17	-0.01	9.15	64	5.50	98.8	0.830	6.72	4.71	*0*	*0*	717		0.0232	0.0172	0.303	0.22700	3370	0.0289
12/31	-0.06	11.37	80	5.63	101.9	1.02	7.43	5.39	*0*	*0*	884		0.0180	0.0367	0.327	0.30130	3540	0.0285
AVG.	9.83	7.66	63	5.54	92.9	2.38	6.88	4.87	22	38	4020		0.0300	0.0271	0.418	0.31766	3300	0.0236
MAX.	24.42	12.13	87	6.09	121.5	20.7	12.0	9.86	160	313	24200		0.0803	0.116	0.937	0.63125	4650	0.101
MIN.	-0.06	1.96	24	5.20	76.4	0.361	4.19	2.41	*<10*	*<10*	121		0.0113	*<0.005*	0.196	0.16557	2450	*<0.005*
MEDIAN	9.13	8.09	65	5.55	87.9	1.02	6.69	4.71	2	10	2760		0.0234	0.00906	0.385	0.29040	3370	0.0166

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 2013
WARE RIVER AND TRIBUTARIES
(103A) BURNSHIRT RIVER, AT RIVERSIDE CEMETERY

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/2	0.20	14.50	102	5.79	78.3	1.27			*0*	*0*	959					0.20785	2950	
1/15	0.21	14.22	99	5.99	64.5	0.722			2	10	820					0.20660	2490	
1/29	0.14	14.55	101	6.16	74.4	0.629			*0*	*0*	275					0.17029	3230	
3/26						0.355			*0*	10	135		0.0121	0.0470	0.171	0.13180	2260	*0*
4/9	7.86	11.61	99	5.46	64.9	0.546			2	10	395					0.13770	2150	
4/23	8.64	11.75	100	5.57	68.4	0.730			*0*	20	1660					0.17636	2470	
5/7	14.71	9.70	96	5.98	85.4	0.186			24	31	3450					0.23130	3280	
5/21	18.54	8.20	89	5.98	87.0	2.81			20	31	2720					0.25255	3930	
6/4	18.22	8.29	90	5.54	63.9	2.23			68	158	7700		0.0336	0.0174	0.451	0.44865	2650	0.00515
6/18	17.02	8.22	87	5.28	54.4	0.834			10	41	2760					0.32720	1860	
7/2	20.43	7.36	83	5.43	55.6	2.34			270	262	17300					0.47615	2080	
7/16	22.93	7.44	87	5.69	62.9	2.97			50	41	6490					0.37245	2490	
7/30	19.63	8.88	99	6.09	66.3	2.48			90	75	5480					0.33430	2610	
8/13	18.76	8.53	93	5.87	57.4	1.27			10	63	4610					0.33890	2170	
8/27	19.43	7.51	83	5.64	61.8	1.70			140	134	7700					0.24495	2490	
9/10	13.67	9.32	91	5.93	62.9	1.76			50	30	3650					0.20900	3530	
9/24	10.90	9.85	91	5.91	63.4	1.08			40	63	2990		0.0234	0.00569	0.439	0.26095	2380	*0*
10/8	13.49	8.68	85	5.77	61.3	1.27			190	241	9210					0.34230	2320	
10/22	8.68	10.87	95	6.14	77.8	1.28			24	10	3450					0.25160	2820	
11/5	2.89	13.20	97	6.00	66.8	0.703			*0*	10	538					0.21005	2300	
11/19	4.67	12.35	99	5.90	64.1	0.810			*0*	*0*	1840					0.19040	2290	
12/3	1.52	14.47	105	5.79	66.0	0.596			6	31	1330					0.25275	2140	
12/17	0.00	14.14	98	5.78	74.2	0.814			*0*	10	609		0.0196	0.0393	0.280	0.22095	2510	0.0100
12/31	-0.04	15.74	110	5.79	73.8	0.597			6	*0*	1300					0.23915	2410	
AVG.	10.54	10.84	95	5.80	67.6	1.25			42	53	3640		0.0222	0.0273	0.335	0.25976	2580	0.00379
MAX.	22.93	15.74	110	6.16	87.0	2.97			270	262	17300		0.0336	0.0470	0.451	0.47615	3930	0.0100
MIN.	-0.04	7.36	83	5.28	54.4	0.186			*<10*	*<10*	135		0.0121	0.00569	0.171	0.13180	1860	*<0.005*
MEDIAN	10.90	9.85	96	5.79	64.9	0.957			10	31	2740		0.0215	0.02835	0.360	0.24205	2480	0.00258

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 2013
WARE RIVER AND TRIBUTARIES
(107A) WEST BR. WARE RIVER, AT BRIGHAM ROAD

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/2	0.16	14.06	98	5.70	85.1	0.610			4	*0*	554					0.31260	2980	
1/15	0.13	14.45	101	6.08	80.6	0.715			2	10	820					0.28945	2940	
1/29	0.12	13.54	94	5.88	74.8	0.593			*0*	*0*	368					0.25820	3220	
2/26	0.13	14.60	102	5.78	121.9	0.513			*0*	10	259					0.23355	3290	
3/12	1.50	14.56	105	5.63	103.7	0.505			2	*0*	388					0.23585	2810	
3/26						0.316			3	10	292		0.0132	0.0438	0.240	0.19985	2600	*0*
4/9	7.57	11.85	101	5.45	70.3	0.795			16	41	504					0.22480	2480	
4/23	8.84	11.67	100	5.59	73.4	0.808			32	41	1780					0.27335	2740	
5/7	16.06	9.37	96	5.83	79.9	0.961			16	31	2010					0.27305	3030	
5/21	19.39	8.47	93	5.96	80.6	1.49			8	10	2910					0.31035	3320	
6/4	18.77	8.33	91	5.64	78.7	1.86			56	86	4880		0.0298	0.0112	0.533	0.58325	3250	*0*
6/18	17.70	6.22	67	5.14	59.4	0.817			70	73	5790					0.50625	2320	
7/2	21.61	6.35	73	5.32	69.6	1.66			230	422	24200					0.70760	2590	
7/16	25.61	7.15	88	5.84	74.8	2.16			*0*	41	3650					0.51045	2950	
7/30	21.90	8.61	100	6.16	75.0	1.61			20	20	2760					0.50940	3180	
8/13	19.96	8.40	94	5.93	70.1	1.20			20	10	3650					0.52185	2620	
8/27	20.92	8.19	93	5.90	82.1	1.11			10	*0*	5480					0.32910	3260	
9/10	14.79	10.25	102	6.03	85.7	0.993			40	20	2760					0.29175	3180	
9/24	11.73	10.60	100	6.04	109.9	0.884			4	85	2060		0.0210	*0*	0.368	0.40575	3450	*0*
10/8	13.83	10.20	100	6.04	87.9	0.897			30	41	1350					0.38565	3050	
10/22	9.05	12.40	109	6.10	66.1	0.773			20	31	1110					0.28580	2370	
11/5	3.33	14.08	105	6.15	77.7	0.534			14	62	546					0.26440	2510	
11/19	4.62	13.54	108	6.15	89.8	0.644			28	52	794					0.22410	2860	
12/3	1.52	14.95	108	5.88	87.9	0.624			4	10	2190					0.35830	2640	
12/17	-0.04	12.75	89	5.67	93.3	0.618			*0*	*0*	496		0.0187	0.0392	0.348	0.29595	3000	0.00651
12/31	-0.06	14.82	104	5.80	100.0	0.773			10	20	2310					0.33975	3190	
AVG.	10.37	11.18	97	5.83	83.1	0.941			25	43	2840		0.0207	0.0236	0.372	0.35117	2920	0.00163
MAX.	25.61	14.95	109	6.16	121.9	2.16			230	422	24200		0.0298	0.0438	0.533	0.70760	3450	0.00651
MIN.	-0.06	6.22	67	5.14	59.4	0.316			*<10*	*<10*	259		0.0132	*<0.005*	0.240	0.19985	2320	*<0.005*
MEDIAN	9.05	11.67	100	5.88	80.6	0.802			12	20	1900		0.0199	0.0252	0.358	0.30315	2970	*<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 2013
WARE RIVER AND TRIBUTARIES
(108) EAST BR. WARE RIVER, AT NEW BOSTON (INTERVALE ROAD)

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/2	0.19	14.89	104	5.93	82.0	0.593			*0*	*0*	457					0.19980	3310	
1/15	0.32	14.51	102	6.27	69.0	0.674			4	*0*	528					0.18085	3340	
1/29	0.13	14.17	98	6.20	89.9	0.719			2	10	327					0.18760	4750	
2/12	0.11	18.52	129	6.12	91.2	0.620			*0*	*0*	209					0.15580	3520	
2/26	0.36	14.96	105	6.21	91.8	0.562			1	*0*	135					0.14897	3570	
3/12	1.15	14.87	106	6.03	90.5	0.456			*0*	*0*	121					0.14607	3320	
3/26						0.427			*0*	10	228		0.0111	0.0495	0.203	0.13005	2930	*0*
4/9	9.77	11.19	100	5.61	65.9	0.669			4	*0*	602					0.13202	2880	
4/23	8.62	11.66	99	5.92	73.3	0.839			4	*0*	1350					0.17818	3060	
5/7						1.88			104	146	2490					0.20695	3920	
5/8	17.54	4.55	48	6.16	232.6													
5/21	20.03	7.24	81	5.92	90.2	2.24			30	109	2910					0.22495	3960	
6/4	19.70	7.63	85	5.70	69.6	2.13			28.6	30	3650		0.0236	0.0136	0.528	0.33710	3450	*0*
6/18	18.95	7.84	86	5.63	59.3	1.17			60	74	1920					0.28485	2650	
7/2	22.40	6.97	82	5.79	74.5	2.89			220	256		>24200				0.38190	3410	
7/16	25.54	5.58	69	5.85	85.0	3.61			30	85	7270					0.33700	3870	
7/30	21.70	7.73	89	6.21	80.8	2.78			50	74	7700					0.35915	3890	
8/13	19.90	7.47	83	6.16	76.9	1.98			30	41	6130					0.36910	3610	
8/27	21.67	7.02	81	5.81	79.4	1.93			140	120	15500					0.25855	3640	
9/10	15.85	8.10	82	6.04	88.9	2.68			10	*0*	2310					0.25215	4460	
9/24	12.82	8.81	85	6.16	102.2	1.98			52	74	5790		0.0238	0.00968	0.312	0.21460	4550	*0*
10/8	14.77	7.11	71	6.11	100.0	2.12			260	441	3080					0.27615	4960	
10/22	9.60	10.39	92	6.25	100.1	1.89			60	110	3870					0.22680	4390	
11/5	3.83	13.15	100	6.25	100.9	1.27			6	41	1620					0.24275	4150	
11/19	5.45	12.32	101	6.30	96.8	2.52			12	41	3450					0.20405	4260	
12/3	2.03	13.81	102	6.14	96.8	0.876			12	*0*	2910					0.26750	4130	
12/17	-0.05	13.92	97	6.06	103.6	1.00			*0*	*0*	441		0.0171	0.0430	0.332	0.22420	4720	0.0177
12/31	-0.06	15.52	109	6.10	94.1	1.14			4	31	1850					0.20560	3900	
AVG.	10.47	10.77	92	6.04	91.7	1.54			42	63	2960		0.0189	0.0289	0.344	0.23454	3800	0.00443
MAX.	25.54	18.52	129	6.30	232.6	3.61			260	441	15500		0.0238	0.0495	0.528	0.38190	4960	0.0177
MIN.	-0.06	4.55	48	5.61	59.3	0.427			*<10*	*<10*	121		0.0111	0.00968	0.203	0.13005	2650	*<0.005*
MEDIAN	9.69	10.79	95	6.11	90.1	1.27			12	31	2120		0.0204	0.0283	0.322	0.22420	3870	*<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 2013
WARE RIVER AND TRIBUTARIES
(121B) THAYER POND, AT INLET

DATE	TEMPC	DOPPM	DOSAT	pH	SPCOND	TURB	STDALK	EPAALK	FECCOLI	Ecoli	TOTCOLI COLILERT	TNTC	TPH	NO3-	TKN	UV254	Ca++	NH3
1/2	0.32	13.16	93	6.46	208.3	0.657			2	*0*	754					0.16358	9060	
1/15	1.45	13.45	97	6.78	178.0	0.617			4	*0*	1450					0.19175	8480	
1/29	0.62	13.14	92	6.59	190.5	0.732			2	*0*	323					0.21865	10600	
2/12	1.43	13.17	95	6.43	255.0	0.876			12	31	712					0.14732	10200	
2/26	3.05	12.46	94	6.48	261.5	0.797			1	*0*	341					0.15358	10400	
3/12	3.49	12.53	95	6.24	260.5	0.643			*0*	*0*	275					0.14159	9300	
3/26						0.555			3	10	211		0.0108	0.145	0.206	0.12869	7050	0.00660
4/9	10.12	9.69	87	6.01	244.5	0.673			*0*	*0*	663					0.094750	9100	
4/23	8.62	8.53	73	6.18	224.2	0.623			6	10	1420					0.11197	9190	
5/7						1.28			28	63	5170					0.14876	10300	
5/8	18.35	7.56	81	6.00	92.2													
5/21	19.16	4.12	45	5.90	236.7	1.28			30	122	4610					0.16223	10800	
6/4	19.05	5.63	62	5.90	172.1	1.25			128	122	6130		0.0125	0.0230	0.409	0.24100	8250	0.00834
6/18	19.63	5.80	65	5.95	124.2	0.982			40	75	4610					0.27230	6320	
7/2	23.41	3.40	41	5.77	131.4	1.25			80	85		>24200				0.28320	6580	
7/16	27.30	4.44	57	6.00	156.1	2.45			80	336	24200					0.27625	7820	
7/30	21.51	4.87	56	6.29	153.6	2.19			20	52	19900					0.29640	8770	
8/13	19.58	4.04	45	6.17	161.4	1.65			10	20	15500					0.24895	8720	
8/27	20.63	3.54	40	5.85	170.7	2.35			30	63		>24200				0.25660	10500	
9/10	15.03	4.41	44	5.92	167.8	1.76			*0*	*0*	14100					0.24025	9280	
9/24	12.61	2.67	26	6.01	170.7	1.74			120	211	19900		0.0260	*0*	0.443	0.26825	9840	*0*
10/8	13.67	1.37	13	6.21	202.1	7.49			53.3	62	9800					0.33145	12700	
10/22	8.79	3.43	30	5.99	187.2	2.44			*0*	*0*	3260					0.24230	9490	
11/5	4.42	8.28	64	6.32	193.3	0.768			2	*0*	529					0.13981	9220	
11/19	5.45	8.40	69	6.24	196.6	1.16			12	52	3450					0.13021	10400	
12/3	1.74	11.27	82	6.25	192.9	0.459			4	10	2100					0.14499	8480	
12/17	0.69	7.24	51	5.99	207.7	0.491			*0*	10	620		0.0102	0.0259	0.348	0.13565	9860	0.00878
12/31	0.62	11.22	80	6.23	205.5	0.502			14	31	794					0.22220	9040	
AVG.	10.80	7.61	64	6.16	190.2	1.40			25	51	5630		0.0149	0.0485	0.352	0.19973	9250	0.00593
MAX.	27.30	13.45	97	6.78	261.5	7.49			128	336	24200		0.0260	0.145	0.443	0.33145	12700	0.00878
MIN.	0.32	1.37	13	5.77	92.2	0.459			*<10*	*<10*	211		0.0102	*<0.005*	0.206	0.094750	6320	*<0.005*
MEDIAN	9.46	7.40	64	6.18	191.7	0.982			10	20	2100		0.0117	0.0245	0.379	0.19175	9220	0.00747

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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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 2013
MWRA WINSOR DISINFECTION STATION

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WDFR	1/1	6.5	6.62	1	32	4.1	
WDFR	1/2	5.5	6.89	1	27	5.2	
WDFR	1/3	6.0	6.61	5	36	12.1	
WDFR	1/4	6.0	6.66	7	20	9.7	
WDFR	1/5	6.0	6.60	4	32	4.1	
WDFR	1/6	5.9	6.67	*0*	16	1	
WDFR	1/7	6.0	6.61	*0*	16	1	
WDFR	1/8	5.1	6.62	*0*	13	1	
WDFR	1/9	5.7	6.61	*0*	16	*0*	
WDFR	1/10	5.8	6.67	*0*	12	1	
WDFR	1/11	5.8	6.60	*0*	8	*0*	
WDFR	1/12	5.9	6.53	*0*	6	1	
WDFR	1/13	5.8	6.68	*0*	4	*0*	
WDFR	1/14	5.9	6.55	*0*	12	*0*	
WDFR	1/15	5.1	6.83	*0*	4	*0*	
WDFR	1/16	5.7	6.67	*0*	11	*0*	
WDFR	1/17	5.6	6.60	*0*	8	1	
WDFR	1/18	5.7	6.61	*0*	4	*0*	
WDFR	1/19	5.6	6.60	*0*	6	*0*	
WDFR	1/20	5.4	6.62	*0*	4	*0*	
WDFR	1/21	5.0	6.55	*0*	4	*0*	
WDFR	1/22	3.8	6.68	*0*	4	1	
WDFR	1/23	4.3	6.64	*0*	4	*0*	
WDFR	1/24	4.0	6.51	*0*	5	*0*	
WDFR	1/25	3.4	6.67	*0*	4	1	
WDFR	1/26	3.5	6.69	*0*	4	*0*	
WDFR	1/27	3.1	6.68	2	8	2	
WDFR	1/28	3.1	6.68	*0*	2	1	
WDFR	1/29	2.6	6.87	*0*	5	4.1	
WDFR	1/30	3.3	6.64	2	8	7.3	
WDFR	1/31	4.4	6.57	72	96	69.7	
WDFR	2/1	3.9	6.63	11	27	14.5	
WDFR	2/2	3.3	6.62	5	8	4.1	
WDFR	2/3	3.3	6.57	1	12	4.1	
WDFR	2/4	3.3	6.60	1	6	1	
WDFR	2/5	2.8	6.86	2	2	*0*	
WDFR	2/6	3.2	6.62	1	6	2	
WDFR	2/7	3.2	6.64	1	6	1	
WDFR	2/8	3.3	6.65	1	4	1	
WDFR	2/9	1.5	6.67	2	16	8.5	
WDFR	2/10	2.0	6.65	1	8	4.1	
WDFR	2/11	2.3	6.64	*0*	3	2	
WDFR	2/12	1.9	6.68	4	7	4.1	
WDFR	2/13	2.1	6.65	*0*	3	1	
WDFR	2/14	2.3	6.64	2	4	3.1	
WDFR	2/15	2.4	6.65	2	3	1	
WDFR	2/16	2.5	6.63	3	2	*0*	
WDFR	2/17	2.2	6.56	1	8	2	
WDFR	2/18	1.8	6.64	*0*	2	1	
WDFR	2/19	2.1	6.82	*0*	4	4.1	
WDFR	2/20	2.0	6.65	1	3	1	

QUABBIN LABORATORY RECORDS 2013
MWRA WINSOR DISINFECTION STATION

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WDFR	2/21	1.9	6.67	*0*	2	*0*	
WDFR	2/22	2.1	6.63	*0*	*0*	*0*	
WDFR	2/23	2.1	6.65	*0*	*0*	*0*	
WDFR	2/24	1.9	6.58	*0*	1	1	
WDFR	2/25	1.9	6.63	*0*	1	1	
WDFR	2/26	2.1	6.86	*0*	1	*0*	
WDFR	2/27	2.3	6.64	*0*	*0*	*0*	
WDFR	2/28	2.2	6.63	*0*	2	2	
WDFR	3/1	2.6	6.59	*0*	1	*0*	
WDFR	3/2	2.4	6.56	*0*	*0*	*0*	
WDFR	3/3	2.1	6.62	4	7	5.2	
WDFR	3/4	2.1	6.62	1	2	2	
WDFR	3/5	1.8	6.86	*0*	3	1	
WDFR	3/6	2.6	6.59	*0*	1	1	
WDFR	3/7	2.3	6.61	*0*	3	*0*	
WDFR	3/8	2.2	6.63	1	4	2	
WDFR	3/9	2.1	6.63	2	8	4.1	
WDFR	3/10	2.5	6.63	*0*	4	1	
WDFR	3/11	2.6	6.62	*0*	2	1	
WDFR	3/12	2.6	6.72	*0*	*0*	*0*	
WDFR	3/13	2.7	6.62	*0*	1	*0*	
WDFR	3/14	2.6	6.61	*0*	1	*0*	
WDFR	3/15	2.6	6.58	*0*	5	*0*	
WDFR	3/16	2.8	6.55	*0*	3	*0*	
WDFR	3/17	2.6	6.57	*0*	2	*0*	
WDFR	3/18	2.6	6.60	*0*	*0*	*0*	
WDFR	3/19	2.8	6.65	*0*	*0*	*0*	
WDFR	3/20	2.2	6.88	*0*	3	*0*	
WDFR	3/21	2.7	6.59	*0*	1	*0*	
WDFR	3/22	2.7	6.61	*0*	2	*0*	
WDFR	3/23	2.8	6.61	*0*	*0*	*0*	
WDFR	3/24	2.5	6.61	*0*	*0*	*0*	
WDFR	3/25	2.7	6.62	*0*	2	1	
WDFR	3/26	2.7	6.76	*0*	3	*0*	
WDFR	3/27	3.0	6.61	*0*	2	*0*	
WDFR	3/28	3.1	6.71	*0*	2	*0*	
WDFR	3/29	3.1	6.90	*0*	2	*0*	
WDFR	3/30	3.5	6.63	*0*	2	*0*	
WDFR	3/31	3.7	6.60	*0*	2	*0*	
WDFR	4/1	3.8	6.58	*0*	1	*0*	
WDFR	4/2	3.2	6.81	*0*	2	*0*	
WDFR	4/3	3.7	6.60	*0*	1	*0*	
WDFR	4/4	3.8	6.60	*0*	3	*0*	
WDFR	4/5	4.2	6.60	*0*	2	*0*	
WDFR	4/6	4.3	6.56	*0*	1	*0*	
WDFR	4/7	4.4	6.57	*0*	*0*	*0*	
WDFR	4/8	4.5	6.59	*0*	*0*	*0*	
WDFR	4/9	4.3	6.90	1	*0*	*0*	
WDFR	4/10	5.2	6.57	*0*	*0*	*0*	
WDFR	4/11	5.8	6.67	*0*	1	*0*	
WDFR	4/12	5.7	6.71	*0*	2	*0*	

QUABBIN LABORATORY RECORDS 2013
MWRA WINSOR DISINFECTION STATION

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WDFR	4/13	5.7	6.60	1	2	1	
WDFR	4/14	5.9	6.67	*0*	4	*0*	
WDFR	4/15	5.8	6.63	*0*	4	*0*	
WDFR	4/16	5.0	6.87	*0*	2	*0*	
WDFR	4/17	6.0	6.65	*0*	4	1	
WDFR	4/18	6.2	6.70	*0*	2	*0*	
WDFR	4/19	6.1	6.60	*0*	1	*0*	
WDFR	4/20	6.4	6.56	2	8	1	
WDFR	4/21	6.4	6.58	*0*	6	*0*	
WDFR	4/22	6.8	6.67	*0*	4	*0*	
WDFR	4/23	7.0	6.81	*0*	1	*0*	
WDFR	4/24	7.2	6.70	*0*	6	*0*	
WDFR	4/25	7.0	6.67	*0*	12	*0*	
WDFR	4/26	7.0	6.88	*0*	2	*0*	
WDFR	4/27	7.4	6.63	*0*	2	*0*	
WDFR	4/28	7.7	6.67	*0*	9	*0*	
WDFR	4/29	7.3	6.65	*0*	2	*0*	
WDFR	4/30	6.8	6.83	*0*	5	*0*	
WDFR	5/1	7.4	6.71	*0*	4	*0*	
WDFR	5/2	8.2	6.66	*0*	8	*0*	
WDFR	5/3	9.4	6.86	*0*	5	*0*	
WDFR	5/4	9.1	6.62	*0*	7	*0*	
WDFR	5/5	7.9	6.67	*0*	6	*0*	
WDFR	5/6	7.3	6.94	*0*	9	*0*	
WDFR	5/7	8.2	6.67	*0*	3	*0*	
WDFR	5/8	7.9	6.72	*0*	6	*0*	
WDFR	5/9	8.1	6.71	*0*	6	*0*	
WDFR	5/10	8.2	6.61	*0*	5	*0*	
WDFR	5/11	8.2	6.63	*0*	2	*0*	
WDFR	5/12	7.9	6.70	*0*	5	*0*	
WDFR	5/13	9.1	6.68	*0*	7	*0*	
WDFR	5/14	8.1	6.95	*0*	3	*0*	
WDFR	5/15	8.3	6.63	*0*	8	*0*	
WDFR	5/16	7.9	6.76	*0*	1	*0*	
WDFR	5/17	8.8	6.72	*0*	5	*0*	
WDFR	5/18	9.5	6.73	*0*	6	*0*	
WDFR	5/19	9.0	6.73	*0*	4	*0*	
WDFR	5/20	9.8	6.62	*0*	4	*0*	
WDFR	5/21	10.0	6.87	*0*	4	*0*	
WDFR	5/22	10.9	6.67	*0*	8	1	
WDFR	5/23	9.5	6.67	*0*	8	*0*	
WDFR	5/24	9.4	6.73	*0*	6	*0*	
WDFR	5/25	13.6	6.65	1	28	3.1	
WDFR	5/26	13.2	6.66	1	49	2	
WDFR	5/27	11.9	6.63	*0*	15	*0*	
WDFR	5/28	12.0	6.88	*0*	16	*0*	
WDFR	5/29	10.5	6.68	*0*	10	*0*	
WDFR	5/30	10.5	6.57	*0*	7	1	
WDFR	5/31	11.9	6.56	*0*	16	*0*	
WDFR	6/1	12.4	6.64	*0*	12	*0*	
WDFR	6/2	12.1	6.59	*0*	11	*0*	

QUABBIN LABORATORY RECORDS 2013
MWRA WINSOR DISINFECTION STATION

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WDFR	6/3	12.3	6.67	0	14	0	
WDFR	6/4	11.4	6.86	0	14	1	
WDFR	6/5	12.4	6.63	0	6	0	
WDFR	6/6	11.2	6.63	0	6	0	
WDFR	6/7	11.7	6.76	0	9	0	
WDFR	6/8	16.5	6.73	0	52	2	
WDFR	6/9	11.6	6.74	0	6	0	
WDFR	6/10	12.1	6.71	1	17	0	
WDFR	6/11	12.4	6.81	0	5	0	
WDFR	6/12	12.3	6.79	0	8	0	
WDFR	6/13	12.5	6.73	0	11	0	
WDFR	6/14	15.5	6.73	0	53	1	
WDFR	6/15	11.7	6.72	0	5	0	
WDFR	6/16	12.1	6.74	0	7	0	
WDFR	6/17	11.9	6.77	0	7	0	
WDFR	6/18	12.0	6.88	0	12	0	
WDFR	6/19	12.5	6.82	0	20	0	
WDFR	6/20	11.8	6.81	0	12	0	
WDFR	6/21	12.4	6.92	0	8	0	
WDFR	6/22	12.4	6.79	0	16	0	
WDFR	6/23	12.4	6.71	0	14	0	
WDFR	6/24	12.7	6.74	0	6	0	
WDFR	6/25	12.3	6.88	0	6	0	
WDFR	6/26	12.7	6.92	0	9	0	
WDFR	6/27	12.7	6.67	0	7	0	
WDFR	6/28	12.5	6.69	0	10	0	
WDFR	6/29	12.7	6.55	0	11	0	
WDFR	6/30	12.7	6.71	1	8	0	
WDFR	7/1	12.5	6.64	0	13	0	
WDFR	7/2	12.3	6.83	0	6	0	
WDFR	7/3	12.8	6.74	0	13	0	
WDFR	7/4	12.4	6.65	0	11	0	
WDFR	7/5	12.7	6.67	0	10	0	
WDFR	7/6	12.9	6.67	0	18	0	
WDFR	7/7	12.5	6.70	0	14	0	
WDFR	7/8	13.0	6.89	0	24	0	
WDFR	7/9	13.0	6.69	0	18	0	
WDFR	7/10	12.7	6.59	0	23	0	
WDFR	7/11	12.7	6.69	0	32	1	
WDFR	7/12	12.9	6.63	0	25	0	
WDFR	7/13	12.9	6.67	0	24	0	
WDFR	7/14	13.1	6.61	1	34	0	
WDFR	7/15	12.3	6.62	0	21	0	
WDFR	7/16	12.9	6.81	0	44	0	
WDFR	7/17	12.9	6.61	0	46	0	
WDFR	7/18	13.0	6.54	0	80	0	
WDFR	7/19	12.8	6.65	0	105	0	
WDFR	7/20	13.5	6.62	0	73	0	
WDFR	7/21	13.0	6.70	0	75	0	
WDFR	7/22	13.3	6.78	0	111	0	
WDFR	7/23	13.1	6.77	0	96	0	

QUABBIN LABORATORY RECORDS 2013
MWRA WINSOR DISINFECTION STATION

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WDFR	7/24	12.7	6.59	0	72	0	
WDFR	7/25	13.7	6.65	0	121	0	
WDFR	7/26	13.5	6.65	0	99	0	
WDFR	7/27	12.8	6.50	0	96	0	
WDFR	7/28	13.5	6.52	0	96	0	
WDFR	7/29	13.5	6.67	0	99	0	
WDFR	7/30	12.8	6.78	0	102	0	
WDFR	7/31	12.7	6.54	0	101	0	
WDFR	8/1	13.1	6.75	0	99	0	
WDFR	8/2	13.9	6.83	0	155	0	
WDFR	8/3	13.0	6.43	0	192	0	
WDFR	8/4	13.7	6.56	1	132	0	
WDFR	8/5	13.3	6.80	0	111	2	
WDFR	8/6	13.2	6.82	0	99	0	
WDFR	8/7	14.1	6.59	0	161	0	
WDFR	8/8	13.4	6.60	0	133	0	
WDFR	8/9	13.3	6.72	0	228	0	
WDFR	8/10	14.3	6.64	1	387	0	
WDFR	8/11	13.3	6.74	0	276	0	
WDFR	8/12	13.6	6.87	1	435	0	
WDFR	8/13	14.0	6.72	0	308	0	
WDFR	8/14	13.7	6.72	0	291	0	
WDFR	8/15	13.3	6.44	0	272	0	
WDFR	8/16	13.9	6.54	0	291	0	
WDFR	8/17	14.3	6.52	0	225	1	
WDFR	8/18	14.1	6.65	0	308	0	
WDFR	8/19	13.6	6.73	0	365	0	
WDFR	8/20	14.0	6.62	0	866	0	
WDFR	8/21	13.9	6.58	0	345	0	
WDFR	8/22	14.1	6.57	0	548	0	
WDFR	8/23	14.9	6.54	0	1990	0	
WDFR	8/24	14.1	6.52	0	870	0	
WDFR	8/25	14.5	6.55	0	821	0	
WDFR	8/26	14.0	6.60	0	977	0	
WDFR	8/27	15.1	6.75	0	2090	0	
WDFR	8/28	14.7	6.53	0	1460	0	
WDFR	8/29	15.3	6.57	0	2450	0	
WDFR	8/30	14.5	6.53	0	1230	4	
WDFR	8/31	14.9	6.50	1	1300	0	
WDFR	9/1	15.4	6.59	0	1380	0	
WDFR	9/2	14.9	6.58	0	1550	0	
WDFR	9/3	14.7	6.63	0	1840	0	
WDFR	9/4	14.8	6.42	0	1460	0	
WDFR	9/5	15.0	6.38	0	1550	0	
WDFR	9/6	14.9	6.52	0	1100	0	
WDFR	9/7	14.8	6.46	0	1230	0	
WDFR	9/8	15.4	6.37	0	1640	0	
WDFR	9/9	14.2	6.56	1	1640	4	
WDFR	9/10	13.8	6.55	0	1380	0	
WDFR	9/11	15.1	6.42	0	2320	4	
WDFR	9/12	14.6	6.43	0	1230	0	

QUABBIN LABORATORY RECORDS 2013
MWRA WINSOR DISINFECTION STATION

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WDFR	9/13	15.2	6.63	0	2750	4	
WDFR	9/14	15.7	6.34	1	2320	0	
WDFR	9/15	15.1	6.45	0	2190	0	
WDFR	9/16	15.1	6.44	0	3470	0	
WDFR	9/17	17.8	6.62	2	1300	4	
WDFR	9/18	14.3	6.40	0	1380	0	
WDFR	9/19	15.0	6.38	0	2600	0	
WDFR	9/20	15.1	6.39	0	3920	0	
WDFR	9/21	14.5	6.35	1	2910	0	
WDFR	9/22	14.9	6.19	0	5650	0	
WDFR	9/23	16.1	6.43	7	4180	4	
WDFR	9/24	14.7	6.50	2	3680	8	
WDFR	9/25	14.5	6.43	0	3920	4	
WDFR	9/26	16.2	6.43	0	2600	4	
WDFR	9/27	17.2	6.46	0	1640	0	
WDFR	9/28	16.5	6.65	0	1840	4	
WDFR	9/29	16.6	6.42	0	1950	0	
WDFR	9/30	15.7	6.34	1	1740	0	
WDFR	10/1	16.1	6.47	0	1950	0	
WDFR	10/2	16.0	6.31	0	1300	0	
WDFR	10/3	16.0	6.31	0	2910	4	
WDFR	10/4	16.1	6.37	0	4810	0	
WDFR	10/5	17.0	6.38	0	4480	0	
WDFR	10/6	16.5	6.36	0	2070	0	
WDFR	10/7	16.6	6.43	1	5200	0	
WDFR	10/8	16.9	6.56	1	3470	0	
WDFR	10/9	18.5	6.49	1	2320	4	
WDFR	10/10	18.4	6.62	0	1640	4	
WDFR	10/11	18.5	6.66	1	1950	0	
WDFR	10/12	18.4	6.67	0	913	4	
WDFR	10/13	18.3	6.69	0	1050	0	
WDFR	10/14	17.7	6.58	0	1460	0	
WDFR	10/15	16.9	6.67	1	857	0	
WDFR	10/16	17.4	6.55	0	1160	0	
WDFR	10/17	16.7	6.41	1	716	0	
WDFR	10/18	14.9	6.25	0	1040	0	
WDFR	10/19	16.6	6.34	1	944	0	
WDFR	10/20	15.9	6.35	1	953	0	
WDFR	10/21	16.6	6.44	0	465	0	
WDFR	10/22	14.8	6.37	0	749	0	
WDFR	10/23	16.5	6.51	0	1040	0	
WDFR	10/24	16.5	6.63	0	1840	0	
WDFR	10/25	16.1	6.59	0	3270	0	
WDFR	10/26	15.9	6.72	1	2450	0	
WDFR	10/27	14.8	6.51	2	1040	0	
WDFR	10/28	15.1	6.70	1	2320	8	
WDFR	10/29	14.7	6.82	1	2750	0	
WDFR	10/30	14.5	6.63	0	2750	0	
WDFR	10/31	14.3	6.52	0	2070	0	
WDFR	11/1	12.6	6.12	0	713	0	
WDFR	11/2	14.0	6.50	2	3080	0	

QUABBIN LABORATORY RECORDS 2013
MWRA WINSOR DISINFECTION STATION

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WDFR	11/3	14.1	6.56	*0*	3680	*0*	
WDFR	11/4	13.3	6.59	1	1440	*0*	
WDFR	11/5	13.5	6.70	1	1380	*0*	
WDFR	11/6	13.2	6.55	1	1380	8	
WDFR	11/7	13.0	6.65	*0*	2450	*0*	
WDFR	11/8	12.9	6.57	*0*	953	*0*	
WDFR	11/9	12.6	6.49	*0*	1740	*0*	
WDFR	11/10	12.5	6.50	*0*	1640	*0*	
WDFR	11/11	12.1	6.52	*0*	996	*0*	
WDFR	11/12	12.2	6.61	*0*	1300	*0*	
WDFR	11/13	11.5	6.53	*0*	1160	*0*	
WDFR	11/14	11.1	6.48	*0*	740	*0*	
WDFR	11/15	11.3	6.48	1	714	*0*	
WDFR	11/16	11.3	6.48	1	818	*0*	
WDFR	11/17	11.1	6.41	*0*	663	*0*	
WDFR	11/18	11.1	6.43	*0*	782	*0*	
WDFR	11/19	11.3	6.71	*0*	744	4	
WDFR	11/20	10.8	6.40	*0*	542	*0*	
WDFR	11/21	10.5	6.50	*0*	806	4	
WDFR	11/22	10.5	6.49	*0*	689	*0*	
WDFR	11/23	10.4	6.51	*0*	384	4	
WDFR	11/24	9.9	6.39	1	1950	*0*	
WDFR	11/25	9.5	6.48	4	489	8	
WDFR	11/26	9.8	6.60	*0*	420	*0*	
WDFR	11/27	9.5	6.56	1	689	4	
WDFR	11/28	9.3	6.60	1	744	4	
WDFR	11/29	9.1	6.57	*0*	445	8	
WDFR	11/30	8.9	6.67	1	432	4	
WDFR	12/1	8.7	6.46	*0*	1460	*0*	
WDFR	12/2	8.7	6.48	*0*	384	*0*	
WDFR	12/3	8.8	6.77	*0*	448	*0*	
WDFR	12/4	8.7	6.61	1	307	*0*	
WDFR	12/5	8.5	6.51	*0*	307	4	
WDFR	12/6	8.6	6.58	1	289	*0*	
WDFR	12/7	8.5	6.54	1	215	4	
WDFR	12/8	8.3	6.55	*0*	202	*0*	
WDFR	12/9	8.2	7.02	1	188	*0*	
WDFR	12/10	8.1	6.74	*0*	263	*0*	
WDFR	12/11	7.9	6.60	2	242	*0*	
WDFR	12/12	7.7	6.51	1	198	*0*	
WDFR	12/13	7.5	6.63	*0*	84	*0*	
WDFR	12/14	7.3	6.60	1	148	2	
WDFR	12/15	7.1	6.54	*0*	128	6.2	
WDFR	12/16	6.8	6.54	*0*	133	*0*	
WDFR	12/17	6.8	6.68	*0*	110	*0*	
WDFR	12/18	6.3	6.59	*0*	111	2	
WDFR	12/19	6.3	6.63	*0*	110	*0*	
WDFR	12/20	6.4	6.65	*0*	99	*0*	
WDFR	12/21	6.3	6.63	*0*	141	*0*	
WDFR	12/22	6.4	6.51	*0*	69	*0*	
WDFR	12/23	6.3	6.51	*0*	56	*0*	

QUABBIN LABORATORY RECORDS 2013
MWRA WINSOR DISINFECTION STATION

SITE	DATE	TEMPC	pH	FECCOLI	TOTCOLI COLILERT	Ecoli	TNTC
WDFR	12/24	5.8	6.29	*0*	82	3	
WDFR	12/25	6.1	6.63	*0*	41	*0*	
WDFR	12/26	5.9	6.53	*0*	35	*0*	
WDFR	12/27	5.4	6.85	*0*	36	*0*	
WDFR	12/28	5.9	6.58	*0*	42	*0*	
WDFR	12/29	5.9	6.55	*0*	30	*0*	
WDFR	12/30	5.3	6.78	*0*	140	*0*	
WDFR	12/31	5.0	6.86	1	37	*0*	
	AVG.	9.6	6.62	*<1*	530	*<1 - <4*	
	MAX.	18.5	7.02	72	5650	69.7	
	MIN.	1.5	6.12	*<1*	*<1*	*<1 - <4*	
	MEDIAN	10.5	6.62	*<1*	24	*<1 - <4*	

Notes:
Detection limit of 1 CFU/100 mL for Fecal Coliform.
For Total Coliform, only presumptive results are presented here.
Detection limits varied from 1 to 4 MPN/100 mL for Total Coliform and *E. coli* based on dilution.

QUABBIN LABORATORY RECORDS 2013
OTHER SAMPLING RESULTS

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

DATE	LOCATION	ANALYTICAL PARAMETER	RESULT	UNITS	REMARKS
4/22/13	Administration Building Kitchen	Nitrate	0.564	mg/L	Sample analyzed at MWRA Deer Island Laboratory.
7/16/13	Administration Building Kitchen	Volatile Organic Contaminants	<0.5	ug/L	Sample analyzed at MWRA Deer Island Laboratory. All results were less than method detection limits.

DRINKING WATER WELL SAMPLES - NOT FOR PWS COMPLIANCE

DATE	LOCATION	ANALYTICAL PARAMETER	RESULT	UNITS	REMARKS
April 2013	Stockroom	Multiple	-	-	See memo dated June 19, 2013, in Appendix A.

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

DATE	LOCATION	Sample Type	LEAD (ug/L)	COPPER (ug/L)	REMARKS
10/8/13	New Salem, Bathroom Sink	First Draw	4.03	587	Sample analyzed at MWRA Deer Island Laboratory.
		2-minute Flush	1.04	238	
10/8/13	Oakham Kitchen Sink	First Draw	5.01	14.3	Sample analyzed at MWRA Deer Island Laboratory.
		2-minute Flush	1.66	<3.00	
10/8/13	Residence #1 (Forestry Office), Kitchen Sink	First Draw	4.71	363	Sample analyzed at MWRA Deer Island Laboratory.
		2-minute Flush	2.72	124	
10/8/13	Residence #2 (Conference Center), Kitchen Sink	First Draw	4.31	113	Sample analyzed at MWRA Deer Island Laboratory.
		2-minute Flush	1.95	57.5	
10/8/13	Administration Building, Kitchen Sink	First Draw	4.63	105	Sample analyzed at MWRA Deer Island Laboratory.
		Admin. Cooler with POU filter	<0.0500	<3.00	
10/9/13	Residence #3 (Ranger Station), Kitchen Sink	First Draw	7.41	1670	Sample analyzed at MWRA Deer Island Laboratory.
		2-minute Flush	2.05	875	
		POU Filter	<0.0500	<3.00	

QUABBIN LABORATORY RECORDS 2013
ADMINISTRATION BUILDING BACTERIOLOGICAL ANALYSIS RESULTS

DATE	***E. coli* RESULT**	**TOTAL COLIFORM RESULT**
	Visitor Center Fountain	Visitor Center Fountain
1/7/2013	A	A
2/4/2013	A	A
3/4/2013	A	A
4/1/2013	A	A
5/6/2013	A	A
6/3/2013	A	A
7/1/2013	A	A
8/5/2013	A	A
9/3/2013	A	A
10/7/2013	A	A
11/4/2013	A	A
12/2/2013	A	A

NOTE: A = ABSENT
P = PRESENT

QUABBIN LABORATORY RECORDS 2013
(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
4/24	0.5	9.6	5.88	14.86	118.2	7.02	44.9	202S	4/24/13	0.236	5.09	3.45	1	0	0									525.43
4/24	3.0		5.87	14.10	112.1	6.51	44.9																	
4/24	6.0		5.84	14.25	113.3	6.47	44.9	202M	4/24/13				1	0	0									
4/24	9.1		5.82	14.03	111.5	6.43	44.9																	
4/24	10.0		5.82	14.01	111.3	6.42	45.0																	
4/24	12.1		5.81	13.93	110.6	6.41	45.1																	
4/24	15.0		5.78	13.99	111.0	6.38	44.9																	
4/24	18.0		5.77	13.98	110.9	6.37	44.8	202D	4/24/13				0	0	0									
4/24	19.1		5.76	14.16	112.3	6.35	45.0	202M	4/24/13	0.270	5.27	3.65												
4/24	21.1		5.75	13.87	110.0	6.34	44.9																	
4/24	24.1		5.74	13.92	110.4	6.33	45.0																	
4/24	27.0		5.72	13.92	110.3	6.33	44.9																	
4/24	30.2		5.70	13.92	110.2	6.31	44.9																	
4/24	33.1		5.66	13.94	110.3	6.32	44.8																	
4/24	36.1		5.52	13.92	109.8	6.30	44.9																	
4/24	38.1		5.51	13.90	109.5	6.28	44.9	202D	4/24/13	0.276	5.19	3.54												
4/24	39.0		5.49	13.90	109.5	6.28	45.1																	
5/14	0.5	12.4	12.56	11.88	113.6	6.32	45.2	202S	5/14/13	0.298	5.31	3.44	0	0	0		0.00671	0.00651	0.142	0	1830	0.019475		525.25
5/14	1.1		12.58	12.06	115.4	6.28	45.3																	
5/14	2.1		12.57	12.05	115.3	6.30	45.2																	
5/14	3.2		12.57	12.05	115.3	6.28	45.2																	
5/14	4.1		12.56	12.08	115.5	6.26	45.1																	
5/14	5.1		12.56	12.03	115.1	6.23	45.3																	
5/14	6.0		12.55	12.03	115.0	6.23	45.4	202M	5/14/13				0	0	0									
5/14	7.1		12.55	12.08	115.5	6.21	45.4																	
5/14	8.0		12.55	11.95	114.3	6.21	45.4																	
5/14	9.1		12.52	11.98	114.5	6.21	45.3																	
5/14	10.1		12.52	11.97	114.4	6.21	45.3																	
5/14	11.1		12.48	11.91	113.8	6.21	45.3																	
5/14	12.2		10.69	13.17	120.7	6.21	45.1																	
5/14	13.0		8.85	14.00	122.8	6.25	45.2																	
5/14	14.1		8.01	14.26	122.6	6.29	45.2																	
5/14	15.1		7.75	14.29	122.0	6.29	45.2																	
5/14	16.1		7.52	14.35	121.8	6.32	45.3																	
5/14	17.1		7.23	14.30	120.5	6.32	45.0																	
5/14	18.1		7.08	14.26	119.8	6.29	45.1	202D	5/14/13				0	0	0									
5/14	19.2		6.93	14.24	119.2	6.30	45.2																	
5/14	20.1		6.79	14.21	118.6	6.29	45.3	202M	5/14/13	0.190	5.39	3.57					0	0.00575	0.143	0	1810	0.020060	2180	
5/14	21.1		6.66	14.25	118.4	6.29	45.3																	
5/14	22.1		6.55	14.14	117.2	6.25	45.2																	
5/14	23.1		6.52	14.31	118.5	6.25	45.3																	
5/14	24.1		6.49	14.12	116.9	6.22	45.3																	
5/14	25.1		6.42	14.09	116.5	6.21	45.3																	
5/14	26.0		6.35	14.06	116.0	6.22	45.3																	
5/14	27.1		6.30	14.00	115.4	6.20	45.2																	
5/14	28.1		6.29	13.98	115.1	6.16	45.4																	
5/14	29.0		6.28	13.99	115.2	6.16	45.2																	
5/14	30.1		6.25	13.99	115.1	6.14	45.2																	
5/14	31.0		6.21	13.89	114.1	6.17	45.3																	
5/14	32.1		6.20	13.89	114.1	6.13	45.3																	
5/14	33.1		6.17	13.82	113.4	6.12	45.2																	
5/14	34.0		6.16	13.90	114.1	6.10	45.4																	
5/14	35.1		6.14	13.86	113.7	6.10	45.3																	
5/14	36.1		6.12	13.88	113.8	6.10	45.3																	
5/14	37.1		6.10	13.86	113.6	6.09	45.3																	
5/14	38.0		6.09	13.84	113.4	6.06	45.4	202D	5/14/13	0.251	5.34	3.52					0	0.00589	0.155	0	1840	0.019715		
5/14	39.1		6.08	13.80	113.0	6.08	45.3																	
6/13	0.5	10.4	17.58	9.68	102.4	6.94	44.7	202S	6/13/13	0.333	5.18	3.51	0	0	10									526.88
6/13	1.1		17.58	9.61	101.6	6.86	44.7																	
6/13	2.0		17.58	9.51	100.6	6.76	44.5																	
6/13	3.0		17.58	9.46	100.1	6.70	44.6																	
6/13	4.0		17.57	9.44	99.8	6.68	44.4																	
6/13	5.0		17.57	9.41	99.5	6.63	44.6																	

QUABBIN LABORATORY RECORDS 2013
(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
6/13	6.0		17.57	9.37	99.0	6.62	44.4	202M	6/13/13				0	0	20									
6/13	7.0		17.55	9.33	98.6	6.60	44.4																	
6/13	8.0		17.53	9.35	98.8	6.58	44.4																	
6/13	9.1		17.48	9.36	98.8	6.58	44.4																	
6/13	10.0		17.20	9.43	98.9	6.59	44.4																	
6/13	11.0		16.77	9.58	99.6	6.59	44.6																	
6/13	12.0		13.09	11.30	108.5	6.55	44.8																	
6/13	13.1		12.89	11.23	107.4	6.54	45.0																	
6/13	14.1		12.56	11.37	107.9	6.55	45.1																	
6/13	15.0		12.44	11.27	106.6	6.52	45.2																	
6/13	16.0		11.90	11.45	107.0	6.55	45.0																	
6/13	17.0		11.13	11.61	106.6	6.54	44.8																	
6/13	18.1		10.97	11.63	106.4	6.49	45.1	202D	6/13/13				0	0	10									
6/13	19.0		10.60	11.89	107.8	6.48	44.9																	
6/13	20.1		10.47	11.93	107.9	6.46	45.1																	
6/13	21.0		9.68	12.21	108.4	6.50	44.9	202M	6/13/13	0.240	5.33	3.66												
6/13	22.1		9.52	12.32	108.9	6.44	44.9																	
6/13	23.1		9.40	12.31	108.5	6.41	45.2																	
6/13	24.1		9.10	12.38	108.4	6.38	44.9																	
6/13	25.1		8.95	12.44	108.5	6.37	45.0																	
6/13	26.1		8.87	12.40	108.0	6.34	45.0																	
6/13	27.1		8.72	12.38	107.4	6.34	45.2																	
6/13	28.1		8.54	12.47	107.7	6.34	45.0																	
6/13	29.0		8.37	12.56	108.0	6.34	45.1																	
6/13	30.1		8.23	12.54	107.5	6.32	45.0																	
6/13	31.1		7.95	12.64	107.6	6.33	45.2																	
6/13	32.1		7.78	12.63	107.1	6.30	45.1																	
6/13	33.1		7.55	12.60	106.3	6.31	45.2																	
6/13	34.1		7.45	12.61	106.1	6.30	45.4																	
6/13	35.1		7.14	12.60	105.2	6.30	45.3																	
6/13	36.1		7.04	12.50	104.0	6.28	45.4																	
6/13	37.0		7.03	12.45	103.6	6.25	45.4																	
6/13	38.0		7.01	12.46	103.7	6.23	45.3																	
6/13	39.1		7.02	12.43	103.4	6.21	45.4																	
6/13	40.1		7.01	12.37	102.9	6.19	45.5	202D	6/13/13	0.210	5.31	3.53												
6/13	41.0		6.99	12.32	102.4	6.18	45.3																	
7/10	0.5	9.4	25.37	8.21	101.7	6.33	44.5	202S	7/10/13	0.287	5.24	3.49	0	0	96		0	0	0.181	0	1760	0.022135		528.11
7/10	1.0		25.37	8.25	102.3	6.31	44.6																	
7/10	2.1		25.38	8.21	101.7	6.31	44.7																	
7/10	3.1		25.36	8.19	101.5	6.30	44.8																	
7/10	4.0		24.44	8.57	104.3	6.27	44.5																	
7/10	5.0		23.92	8.60	103.8	6.24	44.6																	
7/10	6.1		23.23	8.76	104.3	6.23	44.9	202M	7/10/13				1	0	63									
7/10	7.1		22.33	8.96	104.9	6.27	45.0																	
7/10	8.0		20.63	9.60	108.7	6.27	45.0																	
7/10	9.0		19.34	9.98	110.1	6.27	45.0																	
7/10	10.1		18.40	10.25	111.0	6.28	44.6																	
7/10	11.0		17.29	10.51	111.2	6.31	44.5																	
7/10	12.1		16.10	10.88	112.3	6.32	44.5	202M	7/10/13	0.372	5.12	3.45					0	0	0.217	0	1700	0.024395	2040	
7/10	13.1		14.86	11.23	112.9	6.34	45.0																	
7/10	14.1		13.78	11.62	114.1	6.37	45.2																	
7/10	15.1		12.86	11.80	113.5	6.36	45.1																	
7/10	16.0		12.15	11.88	112.5	6.35	45.1																	
7/10	17.0		11.71	11.97	112.1	6.33	45.1																	
7/10	18.1		11.38	11.88	110.5	6.28	45.1	202D	7/10/13				0	0	10									
7/10	19.0		11.00	11.89	109.6	6.24	45.0																	
7/10	20.1		10.75	11.82	108.3	6.21	45.2																	
7/10	21.0		10.55	11.83	107.8	6.19	45.2																	
7/10	22.0		10.23	11.84	107.1	6.14	45.3																	
7/10	23.1		10.05	11.83	106.7	6.13	45.4																	
7/10	24.0		9.92	11.83	106.3	6.09	45.1																	
7/10	25.1		9.75	11.83	105.9	6.07	45.2																	
7/10	26.1		9.45	11.93	106.0	6.06	45.3																	

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
7/10	27.1		9.22	11.93	105.5	6.05	45.3																	
7/10	28.0		8.98	11.96	105.1	6.03	45.3																	
7/10	29.0		8.70	11.84	103.4	6.00	45.3																	
7/10	30.1		8.49	11.88	103.2	5.95	45.4																	
7/10	31.1		8.29	11.95	103.3	5.94	45.5																	
7/10	32.1		8.06	11.78	101.3	5.92	45.6																	
7/10	33.1		7.85	11.86	101.4	5.90	45.6																	
7/10	34.1		7.77	11.86	101.2	5.90	45.5																	
7/10	35.1		7.63	11.81	100.4	5.89	45.7																	
7/10	36.1		7.58	11.73	99.6	5.88	45.7																	
7/10	37.1		7.50	11.56	98.0	5.83	45.6																	
7/10	38.2		7.47	11.50	97.4	5.82	45.6																	
7/10	39.0		7.47	11.46	97.0	5.81	45.8																	
7/10	40.1		7.47	11.42	96.7	5.79	45.6	202D	7/10/13	0.210	5.26	3.55					0.00958	0.0105	0.192	*0*	1910	0.019695		
7/10	41.1		7.45	11.40	96.5	5.80	45.7																	
7/10	42.1		7.43	11.27	95.4	5.79	45.9																	
8/14	0.5	12.1	23.39	8.26	98.5	6.84	45.1	202S	8/14/13	0.254	5.13	3.46	*0*	*0*	1850									527.11
8/14	1.3		23.39	8.22	98.0	6.75	45.2																	
8/14	2.0		23.39	8.21	97.8	6.65	45.2																	
8/14	3.0		23.39	8.16	97.3	6.62	45.3																	
8/14	4.0		23.39	8.14	97.0	6.59	45.1																	
8/14	5.1		23.39	8.11	96.7	6.60	45.3																	
8/14	6.1		23.39	8.12	96.8	6.58	45.3	202M	8/14/13				*0*	*0*	1190									
8/14	7.1		23.38	8.07	96.2	6.56	45.2																	
8/14	8.1		23.38	8.05	96.0	6.56	45.3																	
8/14	9.0		23.37	8.02	95.6	6.54	45.2																	
8/14	10.1		22.48	8.40	98.4	6.47	45.3																	
8/14	11.1		19.74	9.82	109.1	6.44	45.8																	
8/14	12.1		18.08	10.24	110.0	6.43	45.3	202M	8/14/13	0.317	5.32	3.59												
8/14	13.1		16.62	10.54	109.8	6.45	45.7																	
8/14	14.1		15.69	10.67	109.0	6.44	45.7																	
8/14	15.1		14.60	10.81	107.9	6.43	45.7																	
8/14	16.1		13.48	11.10	108.0	6.40	45.8																	
8/14	17.1		12.53	10.96	104.5	6.29	45.7																	
8/14	18.1		12.02	11.12	104.8	6.28	45.7	202D	8/14/13				*0*	*0*	538									
8/14	19.2		11.60	11.06	103.2	6.26	45.7																	
8/14	19.9		11.27	11.04	102.3	6.23	45.7																	
8/14	21.2		10.88	10.74	98.6	6.14	45.9																	
8/14	21.9		10.66	10.70	97.7	6.12	45.9																	
8/14	23.1		10.52	10.62	96.7	6.10	45.7																	
8/14	24.1		10.32	10.61	96.1	6.08	45.9																	
8/14	25.0		10.13	10.47	94.4	6.05	46.0																	
8/14	26.1		9.89	10.45	93.7	6.02	46.0																	
8/14	27.1		9.66	10.40	92.8	6.01	46.0																	
8/14	28.2		9.33	10.41	92.1	5.98	45.9																	
8/14	28.9		9.10	10.35	91.1	5.97	45.9																	
8/14	29.9		8.64	10.31	89.7	5.93	46.1																	
8/14	30.9		8.32	10.20	88.1	5.91	46.4																	
8/14	32.1		8.20	10.12	87.1	5.90	46.4																	
8/14	33.1		8.01	10.05	86.1	5.88	46.2																	
8/14	34.1		7.93	9.97	85.3	5.86	46.3																	
8/14	35.0		7.81	9.75	83.1	5.84	46.3																	
8/14	36.2		7.75	9.62	81.9	5.82	46.5																	
8/14	37.0		7.71	9.16	77.9	5.83	46.6																	
8/14	38.2		7.65	9.45	80.3	5.81	46.6																	
8/14	39.1		7.64	9.41	79.9	5.80	46.4																	
8/14	40.3		7.60	9.16	77.7	5.78	46.7	202D	8/14/13	0.264	5.38	3.71												
9/11	0.5	10.6	21.92	8.55	98.4	6.74	44.3	202S	9/11/13	0.284	5.26	3.50	*0*	*0*	1550									525.79
9/11	1.1		21.90	8.44	97.1	6.62	44.3																	
9/11	2.2		21.88	8.43	97.0	6.56	44.2																	
9/11	3.0		21.88	8.41	96.8	6.44	44.5																	
9/11	4.1		21.88	8.39	96.5	6.43	44.4																	
9/11	4.9		21.88	8.42	96.9	6.44	44.3																	

QUABBIN LABORATORY RECORDS 2013
(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
9/11	6.2		21.88	8.32	95.7	6.41	44.2	202M	9/11/13				0	0	1330									
9/11	7.2		21.88	8.32	95.7	6.39	44.4																	
9/11	8.0		21.87	8.29	95.4	6.39	44.4																	
9/11	9.2		21.87	8.28	95.3	6.38	44.3																	
9/11	10.0		21.77	8.31	95.4	6.38	44.3																	
9/11	11.0		19.77	9.28	102.4	6.24	44.5																	
9/11	12.1		18.90	9.63	104.5	6.15	44.6																	
9/11	13.3		16.83	10.14	105.3	6.10	44.6																	
9/11	14.1		16.09	10.39	106.3	6.11	44.8	202M	9/11/13	0.330	5.44	3.78												
9/11	15.1		15.42	10.44	105.4	6.10	44.5																	
9/11	15.9		14.32	10.51	103.6	6.05	44.7																	
9/11	17.0		13.29	10.52	101.4	6.02	44.6																	
9/11	18.0		12.59	10.48	99.4	5.98	44.5	202D	9/11/13				0	0	1300									
9/11	19.1		12.15	10.22	95.9	5.99	44.8																	
9/11	19.9		11.77	10.35	96.3	5.95	44.6																	
9/11	21.2		11.19	10.31	94.7	5.91	44.5																	
9/11	22.2		10.99	10.24	93.6	5.87	44.6																	
9/11	23.0		10.73	10.18	92.5	5.86	44.8																	
9/11	24.2		10.50	10.22	92.3	5.84	44.6																	
9/11	25.1		10.33	10.09	90.8	5.83	44.8																	
9/11	26.1		10.07	9.81	87.7	5.80	44.9																	
9/11	27.1		9.79	9.89	87.9	5.79	44.7																	
9/11	28.0		9.45	9.80	86.4	5.78	45.0																	
9/11	29.1		9.18	9.69	84.9	5.76	45.1																	
9/11	29.9		9.02	9.58	83.6	5.73	44.9																	
9/11	31.0		8.81	9.49	82.4	5.72	45.1																	
9/11	32.0		8.63	9.54	82.5	5.71	45.1																	
9/11	33.1		8.49	9.46	81.5	5.71	45.0																	
9/11	34.1		8.25	9.32	79.9	5.70	45.3																	
9/11	35.0		8.06	9.30	79.3	5.68	45.3																	
9/11	36.0		7.91	8.86	75.3	5.65	45.3																	
9/11	37.2		7.85	8.73	74.0	5.63	45.6																	
9/11	38.0		7.81	8.09	68.5	5.63	45.4																	
9/11	39.1		7.78	8.41	71.2	5.61	45.6																	
9/11	40.1		7.76	8.31	70.3	5.60	45.5	202D	9/11/13	0.293	5.62	3.88												
9/11	40.9		7.73	8.16	69.0	5.59	45.7																	
10/2	0.5	11.8	19.33	8.73	96.1	6.72	45.6	202S	10/2/13	0.268	5.51	3.53	0	0	279		0	0	0.192	0.00538	1640	0.020850		525.13
10/2	1.1		19.34	8.70	95.8	6.78	45.5																	
10/2	1.9		19.33	8.68	95.5	6.67	45.5																	
10/2	2.9		19.33	8.68	95.5	6.64	45.4																	
10/2	3.9		19.33	8.65	95.2	6.63	45.5																	
10/2	4.9		19.33	8.65	95.1	6.63	45.6																	
10/2	6.1		19.31	8.52	93.7	6.61	45.5	202M	10/2/13				0	10	496									
10/2	7.0		19.30	8.64	95.0	6.63	45.3																	
10/2	8.2		19.29	8.61	94.6	6.62	45.4																	
10/2	8.9		19.28	8.61	94.6	6.62	45.6																	
10/2	10.1		19.26	8.58	94.3	6.60	45.3																	
10/2	11.1		19.23	8.61	94.5	6.61	45.4																	
10/2	12.3		19.14	8.50	93.2	6.57	45.6																	
10/2	13.2		18.94	8.51	92.9	6.56	45.4																	
10/2	14.1		18.26	8.60	92.6	6.46	45.4																	
10/2	15.0		16.11	9.26	95.3	6.17	46.1	202M	10/2/13	0.280	5.61	3.78					0	0	0.399	0	1540	0.021380	1940	
10/2	16.1		14.22	9.54	94.2	6.08	46.1																	
10/2	17.0		13.75	9.60	93.9	6.05	45.8																	
10/2	18.0		13.29	9.53	92.2	6.02	45.9	202D	10/2/13				0	0	1240									
10/2	19.1		12.46	9.72	92.4	6.02	45.6																	
10/2	20.0		11.98	9.77	91.8	6.00	45.7																	
10/2	21.2		11.69	9.55	89.2	5.97	45.9																	
10/2	22.1		11.50	9.53	88.7	5.95	45.6																	
10/2	23.2		11.28	9.58	88.7	5.95	45.8																	
10/2	24.0		11.07	9.51	87.5	5.93	45.8																	
10/2	25.1		10.91	9.38	86.1	5.92	45.9																	
10/2	25.9		10.60	9.44	85.9	5.92	45.8																	

QUABBIN LABORATORY RECORDS 2013
(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
10/2	27.1		10.37	9.31	84.4	5.90	45.9																	
10/2	28.1		9.95	9.32	83.6	5.88	46.0																	
10/2	29.1		9.44	9.16	81.2	5.86	46.2																	
10/2	30.1		9.23	8.92	78.6	5.82	46.3																	
10/2	31.2		9.03	8.78	77.0	5.80	46.3																	
10/2	31.9		8.78	8.73	76.1	5.79	46.4																	
10/2	32.8		8.56	8.66	75.1	5.78	46.2																	
10/2	34.1		8.35	8.03	69.3	5.76	46.2																	
10/2	35.0		8.22	8.33	71.6	5.74	46.5																	
10/2	36.0		8.15	8.26	70.9	5.72	46.5																	
10/2	37.2		8.09	8.17	70.1	5.71	46.6																	
10/2	38.2		8.03	7.82	67.0	5.69	46.6																	
10/2	39.1		7.93	7.42	63.4	5.66	46.9	202D	10/2/13	0.191	5.44	3.53					0.0149	0.0259	0.233	0.00921	2080	0.019630		
10/2	39.9		7.87	7.09	60.5	5.64	47.0																	
10/2	41.0		7.82	6.65	56.7	5.62	47.1																	
11/6	0.5	10.5	13.02	9.88	93.4	6.42	45.3	202S	11/6/13	0.288	5.46	3.74	*0*	*0*	1240									524.00
11/6	1.1		13.02	9.88	93.4	6.38	45.2																	
11/6	2.0		13.02	9.77	92.4	6.29	45.4																	
11/6	3.1		13.02	9.93	94.0	6.27	45.2																	
11/6	4.1		13.03	9.67	91.5	6.25	45.5																	
11/6	5.0		13.03	9.73	92.1	6.24	45.5																	
11/6	6.0		13.03	9.67	91.5	6.22	45.4	202M	11/6/13				*0*	*0*	1290									
11/6	7.0		13.03	9.70	91.8	6.22	45.3																	
11/6	8.1		13.03	9.69	91.7	6.21	45.3																	
11/6	9.1		13.03	9.69	91.6	6.21	45.4																	
11/6	10.1		13.03	9.67	91.5	6.20	45.2																	
11/6	11.1		13.03	9.62	91.0	6.20	45.4																	
11/6	12.1		13.03	9.64	91.2	6.20	45.3																	
11/6	13.1		13.02	9.62	91.0	6.20	45.2																	
11/6	14.1		13.03	9.72	91.9	6.20	45.3																	
11/6	15.1		13.03	9.62	91.0	6.19	45.4																	
11/6	16.2		13.03	9.61	90.9	6.19	45.3																	
11/6	17.0		13.03	9.77	92.4	6.20	45.2																	
11/6	18.1		13.02	9.51	89.9	6.19	45.3	202D	11/6/13				*0*	10	1380									
11/6	19.1		13.02	9.52	90.1	6.19	45.4																	
11/6	20.1		13.03	9.74	92.1	6.20	45.2	202M	11/6/13	0.298	5.45	3.61												
11/6	21.0		13.01	9.52	90.0	6.19	45.4																	
11/6	22.0		12.97	9.61	90.8	6.18	45.2																	
11/6	23.0		12.85	9.56	90.0	6.17	45.3																	
11/6	24.1		12.31	9.00	83.7	6.07	45.4																	
11/6	25.1		11.69	8.93	81.9	5.99	45.5																	
11/6	26.0		11.00	8.32	75.2	5.85	45.7																	
11/6	27.1		10.79	8.27	74.3	5.78	45.8																	
11/6	28.1		10.74	8.11	72.8	5.73	45.7																	
11/6	29.0		10.66	8.10	72.5	5.69	46.0																	
11/6	30.0		10.56	7.95	71.1	5.67	45.7																	
11/6	31.1		10.51	7.93	70.8	5.65	46.0																	
11/6	32.1		10.25	8.07	71.6	5.65	45.8																	
11/6	33.0		9.98	8.09	71.3	5.64	46.1																	
11/6	34.0		9.76	7.97	70.0	5.63	45.9																	
11/6	35.0		9.48	8.01	69.8	5.63	46.2																	
11/6	36.0		9.31	7.93	68.9	5.62	46.1																	
11/6	37.1		9.11	7.77	67.1	5.60	46.3																	
11/6	38.1		8.92	7.64	65.7	5.59	46.1																	
11/6	39.0		8.71	7.34	62.8	5.57	46.3	202D	11/6/13	0.238	5.47	3.67												
11/6	40.0		8.59	6.92	59.1	5.54	46.5																	
12/4	0.5	12.5	8.29	11.27	97.4	6.71	45.2	202S	12/4/13	0.243	5.54	3.67	1	*0*	327		*0*	0.00982	0.185	*0*	1830	0.019570		523.54
12/4	3.1		8.29	11.09	95.9	6.41	45.2																	
12/4	6.0		8.30	11.06	95.6	6.33	45.4	202M	12/4/13				1	*0*	373									
12/4	9.1		8.30	11.02	95.3	6.26	45.3																	
12/4	10.0		8.30	11.03	95.4	6.29	45.4																	
12/4	12.0		8.30	10.98	94.9	6.24	45.3																	
12/4	15.0		8.30	11.00	95.1	6.21	45.3																	

QUABBIN LABORATORY RECORDS 2013
(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
12/4	18.1		8.30	10.97	94.8	6.18	45.3	202D	12/4/13				1	*0*	332									
12/4	21.1		8.30	11.00	95.1	6.17	45.3	202M	12/4/13	0.229	5.53	3.78					*0*	0.00849	0.142	*0*	1830	0.019470	2300	
12/4	24.1		8.29	11.05	95.5	6.16	45.2																	
12/4	27.0		8.29	11.06	95.6	6.16	45.2																	
12/4	30.0		8.29	11.09	95.9	6.17	45.3																	
12/4	33.1		8.29	11.04	95.4	6.14	45.4																	
12/4	36.2		8.29	11.09	95.8	6.14	45.1																	
12/4	37.1		8.30	11.05	95.5	6.14	45.2																	
12/4	38.0		8.29	11.03	95.4	6.13	45.4																	
12/4	39.1		8.29	11.06	95.6	6.13	45.4	202D	12/4/13	0.218	5.47	3.59					*0*	0.00878	0.17	*0*	1820	0.019210		
12/4	40.1		8.29	11.03	95.3	6.12	45.3																	
12/4	41.1		8.29	11.08	95.8	6.14	45.2																	
	AVG.	11.0	11.83	10.59	97.8	6.18	45.3			0.265	5.36	3.60	<1	1	553	N/A	<0.005	0.00680	0.196	<0.005	1800	0.020465	2120	
	MAX.	12.5	25.38	14.86	122.8	7.02	47.1			0.372	5.62	3.88	1	10	1850	N/A	0.0149	0.0259	0.399	0.00921	2080	0.024395	2300	
	MIN.	9.4	5.49	6.65	56.7	5.54	44.2			0.190	5.09	3.44	<1	<10	<10	N/A	<0.005	<0.005	0.142	<0.005	1540	0.019210	1940	
	MEDIAN	10.6	10.47	10.25	97.4	6.21	45.3			0.268	5.34	3.57	<1	<10	327	N/A	<0.005	0.00620	0.183	<0.005	1825	0.019705	2110	

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, for fecal and/or total coliform.
NH3: Ammonia MDL = 0.005 mg/L.
NO3-: Nitrate MDL = 0.005 mg/L.
TKN: Total Kjeldahl nitrogen MDL = 0.100 mg/L.
TPH: Total phosphorus MDL = 0.005 mg/L.
Ca++: Calcium MDL = 20 ug/L (0.020 mg/L).

QUABBIN LABORATORY RECORDS 2013
(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
4/24	0.5	10.9	6.46	14.16	114.3	6.66	45.2	206S	4/24/13	0.341	5.30	3.66	0	0	0									525.43
4/24	3.0		6.37	13.99	112.7	6.49	45.1																	
4/24	6.0		6.37	13.87	111.7	6.43	45.0	206M	4/24/13				0	0	0									
4/24	9.0		6.34	13.93	112.2	6.40	45.1																	
4/24	10.1		6.33	13.96	112.3	6.41	45.2																	
4/24	12.0		6.33	13.93	112.1	6.38	45.2																	
4/24	14.1		6.33	13.90	111.9	6.36	45.0	206M	4/24/13	0.278	5.33	3.67												
4/24	15.0		6.32	13.89	111.8	6.37	45.1																	
4/24	18.1		6.29	13.90	111.7	6.35	45.1																	
4/24	21.1		6.28	14.06	113.0	6.33	45.0																	
4/24	24.1		6.26	13.78	110.7	6.29	45.0	206D	4/24/13				1	0	10									
4/24	26.1		6.25	13.83	111.1	6.28	45.0	206D	4/24/13	0.288	5.21	3.58												
4/24	27.1		6.25	13.85	111.2	6.30	44.9																	
5/15	0.5	11.1	13.33	11.31	110.1	6.55	46.5	206S	5/15/13	0.260	5.33	3.57	0	0	0		0.00668	0	0.234	0	1740	0.022675		525.25
5/15	1.0		13.31	11.23	109.2	6.48	46.5																	
5/15	2.1		13.28	11.19	108.8	6.43	46.2																	
5/15	3.0		13.28	11.19	108.7	6.38	46.2																	
5/15	4.0		13.24	11.17	108.4	6.41	46.3																	
5/15	5.0		13.16	11.16	108.2	6.38	46.2																	
5/15	6.0		13.03	11.24	108.6	6.35	45.9	206M	5/15/13				0	0	10									
5/15	6.9		12.51	11.61	110.9	6.32	45.7																	
5/15	8.1		12.26	11.72	111.3	6.31	45.5																	
5/15	9.0		11.77	12.04	113.1	6.31	45.5																	
5/15	10.0		11.32	12.26	114.0	6.29	45.2																	
5/15	11.1		11.22	12.25	113.7	6.28	45.2																	
5/15	12.0		10.65	12.52	114.6	6.31	45.4																	
5/15	13.1		10.15	12.75	115.4	6.29	45.3																	
5/15	14.0		9.09	13.26	117.0	6.31	45.2	206M	5/15/13	0.238	5.35	3.59					0	0	0.270	0	1660	0.020190	2190	
5/15	15.0		7.82	13.40	114.7	6.33	45.4																	
5/15	16.0		7.77	13.37	114.3	6.30	45.3																	
5/15	17.1		7.56	13.34	113.4	6.28	45.1																	
5/15	18.0		7.51	13.22	112.3	6.28	45.4																	
5/15	19.0		7.35	13.20	111.6	6.24	45.4																	
5/15	20.0		7.32	13.21	111.6	6.26	45.5																	
5/15	21.0		7.26	13.25	111.8	6.25	45.3																	
5/15	22.0		7.17	13.17	110.8	6.23	45.2																	
5/15	23.0		7.14	13.19	110.9	6.21	45.3																	
5/15	24.0		7.09	13.19	110.8	6.21	45.4	206D	5/15/13				0	0	10									
5/15	25.0		7.08	13.11	110.1	6.19	45.4	206D	5/15/13	0.276	5.47	3.70					0	0	0.204	0	1670	0.019860		
5/15	26.0		6.88	13.16	110.0	6.21	45.4																	
5/15	27.0		6.83	12.87	107.4	6.14	45.4																	
6/13	0.5	9.9	17.20	9.54	100.1	6.44	45.3	206S	6/13/13	0.309	5.51	3.73	0	0	20									526.88
6/13	1.1		17.20	9.59	100.6	6.46	45.4																	
6/13	2.0		17.14	9.73	101.9	6.46	45.4																	
6/13	3.0		17.13	9.72	101.8	6.46	45.1																	
6/13	4.0		17.12	9.74	102.0	6.47	45.3																	
6/13	5.1		17.10	9.73	101.8	6.45	45.2																	
6/13	6.1		17.08	9.75	102.0	6.45	45.3	206M	6/13/13				0	0	20									
6/13	7.1		17.08	9.77	102.2	6.47	45.3																	
6/13	8.0		17.06	9.78	102.3	6.45	45.0																	
6/13	9.0		17.05	9.78	102.3	6.46	45.0																	
6/13	10.1		17.02	9.78	102.2	6.44	45.3																	
6/13	11.0		16.47	10.03	103.6	6.47	45.2																	
6/13	12.1		16.09	10.18	104.3	6.48	45.3																	
6/13	13.1		15.07	10.64	106.7	6.48	45.3																	
6/13	14.1		14.24	10.83	106.7	6.46	45.1	206M	6/13/13	0.415	5.40	3.63												
6/13	15.1		12.94	11.34	108.5	6.50	45.2																	
6/13	16.0		12.37	11.43	108.0	6.47	45.5																	
6/13	17.0		12.16	11.42	107.4	6.40	45.4																	
6/13	18.1		11.22	11.77	108.3	6.43	45.5																	
6/13	19.0		10.57	11.81	107.1	6.42	45.2																	
6/13	20.1		9.87	11.84	105.6	6.27	45.4																	
6/13	21.1		9.67	11.86	105.2	6.27	45.3																	
6/13	22.1		9.42	11.93	105.2	6.24	45.4																	

QUABBIN LABORATORY RECORDS 2013
(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
6/13	23.1		9.18	11.91	104.5	6.24	45.6																	
6/13	24.0		9.11	11.89	104.1	6.22	45.4	206D	6/13/13				0	0	0									
6/13	25.1		8.98	11.86	103.5	6.16	45.3																	
6/13	26.0		8.90	11.72	102.1	6.15	45.6																	
6/13	27.0		8.66	11.80	102.2	6.12	45.4	206D	6/13/13	0.390	5.36	3.60												
6/13	28.0		8.44	11.72	101.0	6.12	45.4																	
7/10	0.5	10.3	25.67	7.92	98.6	6.32	45.1	206S	7/10/13	0.227	5.17	3.50	0	0	31		0	0	0.166	0	1430	0.020730		528.11
7/10	1.0		25.67	8.00	99.7	6.31	45.0																	
7/10	2.0		25.67	8.02	99.9	6.31	45.0																	
7/10	3.1		25.64	8.04	100.1	6.26	45.1																	
7/10	4.1		25.60	8.03	99.9	6.31	45.0																	
7/10	5.1		25.52	8.05	100.0	6.23	45.0																	
7/10	6.0		24.19	8.52	103.3	6.26	45.3	206M	7/10/13				0	0	31									
7/10	7.1		22.91	8.85	104.7	6.27	45.0																	
7/10	8.0		21.35	9.52	109.3	6.32	45.2	206M	7/10/13	0.273	5.19	3.42					0	0	0.322	0	1430	0.022620	2050	
7/10	9.0		19.50	10.05	111.2	6.29	45.2																	
7/10	10.0		17.10	10.94	115.3	6.31	45.5																	
7/10	11.0		15.75	11.07	113.4	6.32	45.6																	
7/10	12.1		14.58	11.31	113.0	6.32	45.8																	
7/10	13.1		13.92	11.23	110.6	6.24	45.7																	
7/10	14.0		13.27	11.42	110.8	6.21	45.7																	
7/10	15.1		12.66	11.54	110.5	6.19	45.6																	
7/10	16.1		12.29	11.40	108.2	6.12	45.5																	
7/10	17.1		11.94	11.52	108.5	6.13	45.5																	
7/10	18.0		11.60	11.70	109.4	6.12	45.6																	
7/10	19.1		11.33	11.58	107.5	6.11	45.6																	
7/10	20.0		10.88	11.60	106.6	6.09	45.4																	
7/10	21.1		10.69	11.56	105.7	6.07	45.5																	
7/10	22.1		10.44	11.34	103.2	6.02	45.6																	
7/10	23.0		10.30	11.24	101.9	5.98	45.6																	
7/10	24.0		10.15	11.13	100.6	5.94	45.6	206D	7/10/13				0	0	20									
7/10	25.1		10.03	11.20	100.9	5.91	45.8																	
7/10	26.1		9.90	11.03	99.1	5.88	45.8																	
7/10	27.0		9.82	10.94	98.1	5.87	45.8																	
7/10	28.0		9.73	10.93	97.8	5.83	45.9	206D	7/10/13	0.271	5.35	3.55					0	0	0.229	0	1670	0.020635		
7/10	29.0		9.59	10.84	96.6	5.83	45.8																	
8/14	0.5	12.2	23.56	8.14	97.4	6.83	45.8	206S	8/14/13	0.254	5.32	3.57	0	0	1530									527.11
8/14	1.0		23.56	8.02	96.0	6.70	45.7																	
8/14	1.9		23.56	8.03	96.1	6.74	45.9																	
8/14	3.0		23.56	8.05	96.3	6.65	45.9																	
8/14	4.2		23.55	7.97	95.4	6.65	45.7																	
8/14	5.1		23.55	7.96	95.2	6.62	45.9																	
8/14	6.1		23.55	7.93	94.9	6.59	45.7	206M	8/14/13				0	0	1610									
8/14	7.1		23.54	7.93	94.8	6.61	45.8																	
8/14	8.2		23.52	7.93	94.8	6.59	45.9																	
8/14	9.1		23.51	7.91	94.5	6.59	45.7																	
8/14	10.3		23.45	7.92	94.5	6.58	45.8																	
8/14	11.1		20.15	9.64	108.0	6.41	46.7																	
8/14	12.1		17.44	9.94	105.4	6.29	46.4																	
8/14	13.2		16.30	10.05	104.0	6.23	46.5	206M	8/14/13	0.306	5.35	3.64												
8/14	14.1		14.77	10.02	100.4	6.16	46.3																	
8/14	15.2		13.92	9.78	96.2	6.07	46.7																	
8/14	16.3		13.39	9.97	96.9	6.05	46.4																	
8/14	17.0		12.71	9.91	94.9	6.07	46.1																	
8/14	18.1		12.29	9.93	94.1	6.02	46.4																	
8/14	19.0		11.93	9.84	92.5	5.99	46.2																	
8/14	20.3		11.65	9.73	90.9	5.96	46.3																	
8/14	21.1		11.41	9.62	89.4	5.95	46.2																	
8/14	21.9		11.08	9.81	90.4	5.94	46.3																	
8/14	23.2		10.71	9.56	87.4	5.90	46.3																	
8/14	23.9		10.27	9.13	82.6	5.84	46.4	206D	8/14/13				0	0	158									
8/14	24.9		10.20	8.98	81.1	5.81	46.7																	
8/14	26.0		10.15	8.57	77.3	5.80	46.7	206D	8/14/13	0.372	5.33	3.63												
8/14	27.1		10.09	8.85	79.7	5.79	46.7																	

QUABBIN LABORATORY RECORDS 2013
(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
9/11	0.5	8.4	22.04	8.50	98.1	6.72	44.7	206S	9/11/13	0.275	5.44	3.66	0	0	1480									525.79
9/11	1.0		22.03	8.28	95.5	6.61	44.9																	
9/11	1.9		21.97	8.36	96.4	6.55	44.9																	
9/11	2.9		21.93	8.31	95.7	6.52	44.8																	
9/11	4.0		21.92	8.21	94.6	6.52	44.7																	
9/11	5.0		21.90	8.24	94.8	6.48	44.8																	
9/11	6.1		21.88	8.24	94.8	6.48	44.9	206M	9/11/13				0	0	2140									
9/11	7.2		21.87	8.22	94.5	6.45	44.7																	
9/11	8.1		21.86	8.15	93.7	6.44	44.8																	
9/11	9.1		21.84	8.15	93.7	6.44	44.8																	
9/11	10.1		21.84	7.97	91.7	6.43	44.70																	
9/11	11.2		21.84	8.14	93.5	6.43	44.9																	
9/11	12.1		21.83	8.12	93.3	6.41	44.9																	
9/11	13.2		16.22	9.16	94.0	5.96	45.5	206M	9/11/13	0.307	5.35	3.56												
9/11	14.2		14.80	9.09	90.5	5.84	45.5																	
9/11	15.2		14.12	9.11	89.4	5.82	45.5																	
9/11	15.9		13.78	8.95	87.1	5.79	45.4																	
9/11	17.1		13.28	9.09	87.6	5.78	45.5																	
9/11	18.0		13.00	8.93	85.5	5.77	45.2																	
9/11	19.1		12.39	8.90	84.0	5.74	45.2																	
9/11	20.1		12.10	8.81	82.6	5.73	45.2																	
9/11	21.0		11.74	8.82	82.0	5.72	45.1																	
9/11	22.1		11.62	8.83	81.9	5.72	45.1																	
9/11	23.2		11.19	8.67	79.6	5.69	45.2																	
9/11	24.1		10.66	8.32	75.5	5.66	45.6	206D	9/11/13				0	0	175									
9/11	25.2		10.56	8.04	72.8	5.63	45.3																	
9/11	26.1		10.50	8.07	72.9	5.62	45.6	206D	9/11/13	0.326	5.39	3.68												
9/11	27.1		10.42	7.97	71.9	5.61	45.5																	
10/2	0.5	7.5	19.23	8.82	96.8	6.66	46.1	206S	10/2/13	0.293	5.57	3.65	0	0	134		0	0	0.270	0	1440	0.021070		525.13
10/2	1.0		19.23	8.78	96.4	6.64	46.0																	
10/2	2.1		19.22	8.75	96.0	6.59	45.9																	
10/2	3.1		19.20	8.76	96.1	6.54	46.0																	
10/2	4.0		19.20	8.69	95.3	6.54	45.8																	
10/2	5.1		19.18	8.68	95.2	6.53	46.0																	
10/2	5.9		19.18	8.64	94.8	6.52	45.9	206M	10/2/13				0	0	266									
10/2	7.0		19.18	8.63	94.6	6.52	46.0																	
10/2	8.1		19.16	8.62	94.5	6.51	45.8																	
10/2	9.0		19.16	8.62	94.5	6.51	45.9																	
10/2	10.1		19.15	8.60	94.3	6.51	45.8																	
10/2	11.0		19.15	8.36	91.7	6.52	45.9																	
10/2	12.1		19.12	8.39	92.0	6.50	45.8																	
10/2	12.9		19.11	8.56	93.8	6.50	45.9																	
10/2	14.0		18.99	8.54	93.3	6.47	45.9																	
10/2	15.2		18.83	8.50	92.6	6.44	46.0																	
10/2	15.9		15.14	8.30	83.6	6.04	46.7	206M	10/2/13	0.327	5.61	3.72					0	0	0.253	0.00555	1420	0.022125	1950	
10/2	17.0		13.72	8.53	83.4	5.91	46.5																	
10/2	18.0		13.14	8.33	80.4	5.80	46.3																	
10/2	19.2		12.66	8.26	78.9	5.78	46.3																	
10/2	20.1		12.37	8.12	77.1	5.77	46.3																	
10/2	21.2		12.17	8.12	76.7	5.76	46.4																	
10/2	22.1		11.99	8.10	76.2	5.75	46.3																	
10/2	23.0		11.43	7.86	73.0	5.72	46.6																	
10/2	24.2		10.95	7.59	69.7	5.69	46.7	206D	10/2/13				0	0	226									
10/2	25.0		10.80	7.44	68.1	5.68	46.7																	
10/2	26.1		10.70	7.60	69.4	5.67	46.9	206D	10/2/13	0.325	5.63	3.72					0.00643	0.0133	0.175	0.00647	1870	0.020370		
10/2	27.0		10.65	6.80	62.0	5.64	46.9																	
11/6	0.5	7.4	12.81	10.18	95.8	6.76	45.6	206S	11/6/13	0.430	5.67	3.82	0	0	119									524.00
11/6	1.1		12.82	10.17	95.7	6.63	45.8																	
11/6	2.1		12.82	10.05	94.6	6.51	45.6																	
11/6	3.0		12.82	10.05	94.6	6.47	45.6																	
11/6	4.1		12.82	9.98	94.0	6.43	45.8																	
11/6	5.0		12.82	9.94	93.6	6.39	45.6																	
11/6	6.0		12.82	9.95	93.6	6.36	45.5	206M	11/6/13				0	0	122									
11/6	7.1		12.82	9.92	93.4	6.34	45.7																	

QUABBIN LABORATORY RECORDS 2013
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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
11/6	8.1		12.82	9.90	93.3	6.33	45.8																	
11/6	9.0		12.81	9.87	93.0	6.30	45.8																	
11/6	10.1		12.81	9.82	92.4	6.30	45.6																	
11/6	11.2		12.80	9.80	92.3	6.28	45.8																	
11/6	12.1		12.80	9.79	92.1	6.27	45.8																	
11/6	13.1		12.81	9.75	91.8	6.26	45.5	206M	11/6/13	0.343	5.46	3.63												
11/6	14.2		12.81	9.64	90.7	6.25	45.5																	
11/6	15.0		12.80	9.78	92.0	6.25	45.8																	
11/6	16.1		12.80	9.75	91.8	6.24	45.5																	
11/6	17.1		12.80	9.76	91.8	6.23	45.7																	
11/6	18.2		12.80	9.64	90.7	6.24	45.8																	
11/6	19.0		12.80	9.76	91.9	6.22	45.8																	
11/6	20.2		12.80	9.76	91.8	6.22	45.7																	
11/6	21.1		12.79	9.76	91.9	6.22	45.7																	
11/6	22.0		12.80	9.75	91.7	6.21	45.8																	
11/6	23.1		12.80	9.75	91.8	6.21	45.5																	
11/6	24.1		12.80	9.73	91.6	6.21	45.7	206D	11/6/13	0.300	5.54	3.67	*0*	*0*	110									
11/6	25.0		12.78	9.75	91.7	6.21	45.7																	
11/6	26.1		12.77	9.76	91.8	6.21	45.7																	
12/4	0.5	11.6	7.05	12.17	102.0	6.53	45.3	206S	12/4/13	0.250	5.59	3.70	*0*	*0*	31		*0*	*0*	0.174	*0*	1730	0.019460		523.54
12/4	3.0		7.05	11.99	100.5	6.36	45.3																	
12/4	6.1		7.04	11.76	98.5	6.24	45.4	206M	12/4/13				*0*	*0*	40									
12/4	9.0		7.03	11.82	99.0	6.21	45.3																	
12/4	10.1		7.01	11.76	98.5	6.22	45.3																	
12/4	12.0		7.00	11.63	97.3	6.21	45.5																	
12/4	14.1		6.99	11.67	97.6	6.26	45.4	206M	12/4/13	0.245	5.64	3.80					*0*	*0*	0.291	*0*	1710	0.019855	2340	
12/4	15.1		6.98	11.71	98.0	6.18	45.4																	
12/4	18.1		6.94	11.71	97.9	6.20	45.5																	
12/4	21.1		6.88	11.70	97.6	6.19	45.5																	
12/4	24.1		6.81	11.70	97.5	6.19	45.4	206D	12/4/13				*0*	*0*	31									
12/4	25.0		6.80	11.72	97.6	6.19	45.4																	
12/4	26.1		6.78	11.62	96.7	6.21	45.3	206D	12/4/13	0.247	5.73	3.84					*0*	*0*	0.259	*0*	1720	0.019335		
12/4	27.0		6.76	11.71	97.4	6.21	45.4																	
12/4	28.1		6.75	11.74	97.7	6.21	45.4																	
	AVG.	9.9	13.62	10.25	98.3	6.25	45.6			0.302	5.43	3.65	<1	<10	308	N/A	<0.005	<0.005	0.237	<0.005	1620	0.020744	2130	
	MAX.	12.2	25.67	14.16	117.0	6.83	46.9			0.430	5.73	3.84	1	<10	2140	N/A	0.00668	0.0133	0.322	0.00647	1870	0.022675	2340	
	MIN.	7.4	6.25	6.80	62.0	5.61	44.7			0.227	5.17	3.42	<1	<10	<10	N/A	<0.005	<0.005	0.166	<0.005	1420	0.019335	1950	
	MEDIAN	10.3	12.80	9.82	97.6	6.28	45.5			0.293	5.39	3.65	<1	<10	31	N/A	<0.005	<0.005	0.244	<0.005	1670	0.020503	2120	

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, for fecal and/or total coliform.

NH3: Ammonia MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

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

TPH: Total phosphorus MDL = 0.005 mg/L.

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

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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
4/24	0.5	6.1	9.19	12.16	105.0	6.30	54.5	DENS	4/24/13	0.404	5.57	3.92	0	0	41									525.43
4/24	3.0		8.98	12.14	104.2	6.30	54.7																	
4/24	6.0		8.96	12.10	103.9	6.25	54.9	DENM	4/24/13				0	0	41									
4/24	9.0		8.96	12.01	103.1	6.22	54.9	DENM	4/24/13	0.431	5.63	3.79												
4/24	12.0		8.92	12.04	103.2	6.22	54.7																	
4/24	13.0		8.82	11.98	102.5	6.22	55.0	DEND	4/24/13				0	0	10									
4/24	15.0		8.54	12.12	103.0	6.18	55.1																	
4/24	17.1		8.06	12.09	101.6	6.16	54.6	DEND	4/24/13	0.404	5.49	3.83												
4/24	18.0		7.23	11.93	98.2	6.11	54.9																	
5/15	0.5	6.4	14.73	10.41	104.5	6.51	51.3	DENS	5/15/13	0.305	5.57	3.81	0	0	20		0	0	0.249	0.0101	2430	0.045120		525.25
5/15	1.0		14.73	10.42	104.6	6.43	51.4																	
5/15	2.0		14.71	10.40	104.3	6.34	51.3																	
5/15	3.0		14.71	10.32	103.5	6.32	51.4																	
5/15	4.1		14.52	10.36	103.5	6.31	51.5																	
5/15	5.0		14.43	10.41	103.7	6.29	51.8																	
5/15	6.1		14.37	10.34	103.0	6.28	51.2	DENM	5/15/13				0	0	20									
5/15	7.0		14.33	10.35	103.0	6.24	51.5																	
5/15	7.9		10.48	12.22	111.4	6.22	52.9	DENM	5/15/13	0.337	5.46	3.71					0.00585	0	0.205	0.00519	2500	0.047220	2440	
5/15	9.0		9.65	12.02	107.4	6.13	53.0																	
5/15	10.0		9.26	11.81	104.6	6.01	52.5																	
5/15	11.0		9.08	11.80	104.1	6.00	52.3																	
5/15	12.0		8.83	11.60	101.7	5.93	52.6																	
5/15	13.1		8.62	11.45	99.9	5.88	52.6	DEND	5/15/13				0	0	0									
5/15	14.0		8.53	11.40	99.2	5.86	53.6																	
5/15	15.0		8.42	11.12	96.5	5.83	53.1																	
5/15	16.1		8.38	11.03	95.6	5.81	53.2	DEND	5/15/13	0.317	5.54	3.71					0.0150	0.0197	0.196	0.00623	2910	0.052745		
5/15	17.0		8.33	10.95	94.9	5.77	53.9																	
6/13	0.5	6.8	19.18	8.70	95.0	6.23	49.1	DENS	6/13/13	0.480	5.67	3.94	0	0	41									526.88
6/13	1.0		19.18	8.87	96.9	6.27	48.9																	
6/13	2.0		19.14	8.88	96.9	6.27	49.1																	
6/13	3.1		19.02	8.94	97.3	6.30	49.2																	
6/13	4.0		19.01	8.95	97.4	6.28	49.1																	
6/13	5.1		18.98	9.01	98.0	6.29	49.2																	
6/13	6.0		18.86	8.91	96.7	6.26	49.2	DENM	6/13/13				0	0	75									
6/13	7.0		16.30	9.98	102.7	6.27	48.1																	
6/13	8.2		15.05	9.99	100.1	6.24	48.9																	
6/13	9.1		14.09	10.18	99.9	6.23	49.1	DENM	6/13/13	0.492	5.76	3.92												
6/13	10.1		13.43	10.13	98.0	6.22	49.1																	
6/13	11.1		12.90	9.98	95.4	6.15	49.1																	
6/13	12.1		12.48	9.99	94.6	6.09	49.1																	
6/13	13.1		11.80	9.95	92.8	6.03	49.6	DEND	6/13/13				0	0	0									
6/13	14.0		11.19	9.78	90.0	5.99	50.7																	
6/13	15.1		11.04	9.63	88.2	5.92	51.0																	
6/13	16.1		9.97	9.70	86.7	5.91	52.4																	
6/13	17.1		9.42	9.50	83.8	5.85	53.1	DEND	6/13/13	0.383	5.54	3.71												
6/13	18.1		8.96	9.30	81.1	5.82	53.8																	
7/10	0.5	6.7	26.93	7.86	100.2	6.28	47.8	DENS	7/10/13	0.379	5.52	3.71	0	0	146		0	0	0.457	0.00506	1920	0.068935		528.11
7/10	1.1		26.85	7.76	98.8	6.28	47.7																	
7/10	2.1		26.75	7.85	99.7	6.26	47.6																	
7/10	3.0		26.72	7.85	99.6	6.24	47.7																	
7/10	4.0		25.21	8.45	104.4	6.32	46.8																	
7/10	5.1		24.13	8.47	102.5	6.21	46.8																	
7/10	5.9		23.37	8.40	100.2	6.09	47.8	DENM	7/10/13				0	0	74									
7/10	7.1		22.35	8.45	98.9	5.97	47.8																	
7/10	8.0		20.95	8.80	100.3	5.92	47.8	DENM	7/10/13	0.443	5.62	3.84					0	0	0.299	0	1700	0.060205	2200	
7/10	9.0		19.56	9.00	99.8	5.94	48.2																	
7/10	10.0		18.03	7.55	81.1	5.72	49.3																	
7/10	11.0		16.90	7.58	79.5	5.64	49.0																	
7/10	12.0		15.44	8.22	83.7	5.67	49.1																	
7/10	13.1		13.89	8.50	83.7	5.65	49.9	DEND	7/10/13				0	0	52									
7/10	14.0		12.51	8.69	82.9	5.64	50.1																	
7/10	14.0		12.45	8.59	81.8	5.62	50.1																	
7/10	15.0		11.83	8.55	80.4	5.63	50.9																	
7/10	16.1		10.88	8.43	77.5	5.61	51.7	DEND	7/10/13	0.326	5.43	3.69					0.0161	0.0221	0.323	0	2370	0.039855		

QUABBIN LABORATORY RECORDS 2013
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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
7/10	17.0		10.13	8.04	72.6	5.60	53.0																	
7/10	18.0		9.94	7.68	69.1	5.58	53.0																	
8/14	0.5	6.5	23.98	7.78	93.8	6.73	47.5	DENS	8/14/13	0.404	5.62	3.96	0	0	650									527.11
8/14	1.2		23.99	7.86	94.8	6.66	47.5																	
8/14	2.0		23.99	7.59	91.5	6.59	47.3																	
8/14	3.1		23.99	7.73	93.2	6.50	47.5																	
8/14	4.2		23.99	7.65	92.3	6.48	47.2																	
8/14	5.1		23.99	7.68	92.6	6.49	47.4																	
8/14	6.1		23.99	7.71	93.0	6.47	47.5	DENM	8/14/13				0	0	464									
8/14	7.1		23.97	7.62	91.8	6.43	47.3																	
8/14	8.0		23.94	7.58	91.3	6.41	47.5																	
8/14	9.0		23.38	6.83	81.5	6.12	48.6																	
8/14	9.9		22.73	6.45	75.9	5.93	48.7																	
8/14	10.9		19.30	6.26	68.9	5.76	49.5																	
8/14	12.1		16.75	5.21	54.5	5.64	50.4																	
8/14	13.3		15.06	5.44	54.8	5.65	50.5	DENM,DEND	8/14/13	0.395	5.80	4.09	0	0	120									
8/14	14.2		13.86	5.74	56.3	5.66	50.7																	
8/14	15.1		12.54	6.02	57.4	5.66	51.5																	
8/14	16.0		11.06	4.44	40.9	5.58	52.9																	
8/14	17.0		10.47	4.51	41.0	5.54	53.2																	
8/14	17.9		10.19	4.73	42.7	5.53	53.4	DEND	8/14/13	0.552	5.71	3.97												
8/14	19.0		9.83	4.02	36.0	5.50	53.8																	
9/11	0.5	7.0	22.52	8.32	97.0	6.43	46.1	DENS	9/11/13	0.395	5.82	4.05	0	0	203									525.79
9/11	1.2		22.44	8.00	93.1	6.37	46.3																	
9/11	1.9		22.32	7.97	92.5	6.35	46.4																	
9/11	3.1		22.11	7.95	91.9	6.33	46.2																	
9/11	4.0		22.08	7.91	91.3	6.32	46.2																	
9/11	5.0		22.06	7.87	90.9	6.30	46.1																	
9/11	6.2		22.03	7.83	90.4	6.29	46.1	DENM	9/11/13				0	0	397									
9/11	6.9		22.02	7.80	90.0	6.29	46.1																	
9/11	8.0		22.00	7.85	90.5	6.29	46.1																	
9/11	9.0		21.98	7.77	89.6	6.27	46.0																	
9/11	10.0		21.75	7.62	87.5	6.18	46.1																	
9/11	11.0		21.44	7.29	83.2	6.04	46.4																	
9/11	12.1		19.49	5.46	60.0	5.64	47.7																	
9/11	13.1		16.29	4.31	44.3	5.51	49.2	DENM,DEND	9/11/13	0.536	6.12	4.33	0	0	109									
9/11	14.1		14.55	4.26	42.2	5.50	49.6																	
9/11	15.2		12.68	3.75	35.6	5.42	50.8																	
9/11	16.1		11.28	2.74	25.2	5.39	52.1																	
9/11	17.0		10.76	2.22	20.2	5.37	52.6	DEND	9/11/13	0.791	5.91	4.14												
9/11	18.1		10.22	2.41	21.6	5.35	52.6																	
10/2	0.5	8.0	19.50	8.64	95.4	6.62	47.3	DENS	10/2/13	0.387	5.88	3.95	0	0	52		0	0	0.177	0.00571	1490	0.037900		525.13
10/2	1.1		19.46	8.63	95.2	6.61	47.4																	
10/2	2.1		19.41	8.56	94.3	6.56	47.4																	
10/2	3.0		19.26	8.55	94.0	6.53	47.2																	
10/2	3.9		19.15	8.51	93.3	6.51	47.4																	
10/2	4.9		19.09	8.47	92.7	6.49	47.3																	
10/2	6.1		19.05	8.46	92.6	6.49	47.4	DENM	10/2/13				0	0	20									
10/2	6.9		19.03	8.44	92.3	6.47	47.3																	
10/2	7.9		19.01	8.27	90.4	6.48	47.3																	
10/2	9.0		18.97	8.35	91.2	6.47	47.2																	
10/2	10.0		18.92	8.32	90.7	6.44	47.2																	
10/2	10.8		18.77	8.14	88.6	6.39	47.1																	
10/2	11.8		18.69	8.03	87.2	6.33	47.2																	
10/2	12.9		18.57	7.89	85.5	6.28	47.1	DEND	10/2/13				0	0	63									
10/2	14.2		17.20	6.26	65.9	5.95	48.4	DENM	10/2/13	0.442	5.80	3.87					0	0	0.164	0.00626	1620	0.036695	2080	
10/2	14.9		13.68	2.79	27.2	5.60	52.3																	
10/2	15.9		11.68	2.25	21.0	5.53	53.4																	
10/2	17.2		10.98	1.66	15.3	5.50	53.7	DEND	10/2/13	0.600	6.22	4.18					0.00725	0.0195	0.165	0.00704	2000	0.037660		
10/2	18.0		10.65	1.27	11.6	5.52	54.5																	
11/6	0.5	5.1	12.00	10.05	92.9	6.79	47.8	DENS	11/6/13	0.581	6.12	4.34	0	0	10									524.00
11/6	1.1		12.00	10.03	92.7	6.71	47.8																	
11/6	2.2		11.96	9.95	91.9	6.56	47.7																	
11/6	3.1		11.94	9.89	91.3	6.49	47.8																	

QUABBIN LABORATORY RECORDS 2013
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
11/6	4.1		11.94	9.90	91.4	6.48	47.8																	
11/6	5.1		11.90	9.81	90.5	6.43	47.7																	
11/6	6.0		11.90	9.77	90.1	6.41	47.7	DENM	11/6/13				*0*	*0*	31									
11/6	7.1		11.87	9.81	90.4	6.38	47.7																	
11/6	8.0		11.86	9.80	90.3	6.37	47.5																	
11/6	9.0		11.85	9.77	90.0	6.35	47.6	DENM	11/6/13	0.547	6.19	4.46												
11/6	10.1		11.80	9.72	89.5	6.33	47.5																	
11/6	11.1		11.79	9.75	89.7	6.30	47.7																	
11/6	12.1		11.78	9.71	89.3	6.29	47.7																	
11/6	13.0		11.77	9.75	89.6	6.29	47.7	DEND	11/6/13				*0*	*0*	31									
11/6	14.1		11.76	9.75	89.6	6.28	47.5																	
11/6	15.1		11.70	9.77	89.7	6.28	47.6																	
11/6	16.1		11.62	9.75	89.4	6.28	47.6																	
11/6	17.1		11.40	9.88	90.1	6.28	47.8	DEND	11/6/13	0.519	6.15	4.33												
11/6	18.1		11.20	9.98	90.6	6.28	48.1																	
12/4	0.5	8.6	5.25	12.41	99.4	6.42	47.4	DENS	12/4/13	0.384	6.40	4.39	*0*	*0*	10		0.00902	0.0119	0.181	*0*	1840	0.037710		
12/4	3.1		5.23	12.29	98.4	6.30	47.5																	
12/4	6.1		5.17	12.24	97.8	6.25	47.6	DENM	12/4/13				*0*	*0*	*0*									
12/4	9.1		5.16	12.22	97.7	6.23	47.5	DENM	12/4/13	0.378	6.14	4.24					0.00857	0.0115	0.170	*0*	1900	0.038000	2440	
12/4	12.0		5.12	12.26	97.8	6.21	47.5																	
12/4	13.0		5.12	12.26	97.8	6.21	47.5	DEND	12/4/13				1	*0*	31									
12/4	14.1		5.10	12.28	98.0	6.22	47.7																	
12/4	15.1		5.06	12.26	97.7	6.23	47.7																	
12/4	16.1		4.82	12.41	98.3	6.23	47.9																	
12/4	17.0		4.73	12.42	98.1	6.25	48.3	DEND	12/4/13	0.399	6.15	4.19					0.00771	0.0124	0.288	*0*	1900	0.040635		
12/4	18.0		4.72	12.43	98.2	6.23	48.2																	
	AVG.	6.8	14.87	8.79	86.8	6.13	49.5			0.445	5.81	4.00	<1	<10	100	N/A	0.00579	0.00809	0.240	<0.005	2050	0.045223	2290	
	MAX.	8.6	26.93	12.43	111.4	6.79	55.1			0.791	6.40	4.46	1	<10	650	N/A	0.0161	0.0221	0.457	0.0101	2910	0.068935	2440	
	MIN.	5.1	4.72	1.27	11.6	5.35	46.0			0.305	5.43	3.69	<1	<10	<10	N/A	<0.005	<0.005	0.164	<0.005	1490	0.036695	2080	
	MEDIAN	6.7	13.77	8.75	92.6	6.25	48.4			0.404	5.76	3.95	<1	<10	41	N/A	0.00655	0.00575	0.201	0.00513	1910	0.040245	2320	

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, for fecal and/or total coliform.

NH3: Ammonia MDL = 0.005 mg/L.

NO3-: Nitrate MDL = 0.005 mg/L.

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

TPH: Total phosphorus MDL = 0.005 mg/L.

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