DEERFIELD RIVER
WATERSHED ASSOCIATION

Water Quality Monitoring

2018 Program Report

Ryan ODonnell

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Introduction

The Deerfield River Watershed Association continued the newest iteration of its monitoring program for the second year in 2018. This program monitored sites throughout Deerfield watershed and on its tributaries in both Vermont and Massachusetts. It was conducted with the support of the Vermont Agency of Natural Resource's LaRosa Partnership Program, the Connecticut River Conservancy, the Green River Watershed Alliance, and DRWA volunteers.

Past and Other Monitoring Efforts

DRWA Past Volunteer Monitoring

DRWA monitored water quality in Deerfield River and several tributaries (primarily in Massachusetts) from 1990-2005. 1990-1998 focused on chemical data parameters including pH, alkalinity, and dissolved oxygen (DO). In 1998, DRWA reduced its chemical monitoring frequency and introduced testing for fecal coliform bacteria. After relying on outside labs for three years, DRWA established its own bacteria testing lab in Shelburne Falls in 2001. The program was discontinued after 2005. Generally, results from this period demonstrate that the watershed has low alkalinity and pH which can impact some aquatic species, and high dissolved oxygen which is good for supporting a coldwater fishery. Bacteria levels tended to be low during dry weather and become elevated at some sites after heavy rains.

DRWA Macroinvertebrate Monitoring

DRWA conducted macroinvertebrate sampling projects every year from 2005-2008 and in 2011. The projects focused on the Green River (2005), South River (2006), effects of regulated flows on macroinvertebrates (2006), North River (2007), Deerfield River Tributaries (2008), and Deerfield headwater streams (2011).

The Green River study conducted in 2005 sampled four mainstem Green River sites (one in Vermont and two in Massachusetts as well as eight sites (two in Vermont and six in Massachusetts) on lower reaches of Green River tributaries. Habitat conditions varied greatly with a general trend of becoming more degraded closer to Greenfield. Macroinvertebrates communities also reflected this trend of becoming more impacted the further down in the watershed and closer to Greenfield

The 2006 South River study sampled eight sites on the mainstem and five tributaries. Mainstem sites ranged from non-impacted to moderately impacted. Tributary sites ranged from non-impacted to slightly impacted.

Another 2006 study looked at the effects of regulated flows. Four sites in regulated reaches of Deerfield downstream of Fife Brook and three sites in unregulated reaches of tributaries were sampled twice, once in July and once in September. Water depth and velocity were recorded at each sampling and temperature loggers recorded 15-minute intervals from July-September. Results suggested that either hydrologic or thermal alterations affected macroinvertebrate community composition in comparison to non-regulated reaches. The effects of the dam appeared to be spatially limited as altered flow and temperature regimes were ameliorated downstream. This study has not been replicated and is inconclusive about the exact influences of regulated flows since dams have effects on flow, temperature, and nutrient availability. The report concluded that further study is necessary.

The 2007 North River study featured three sites on mainstem North, three sites on West Branch North, six sites on the East Branch North, and three sites in larger tributaries. North River watershed macroinvertebrate communities scored exclusively as not impaired.

The study conducted in 2008 looked at Deerfield River tributaries. Fifteen mid-watershed tributary sites were sampled for this project: Dunbar Brook (slightly impacted), Pelham Brook (not impacted), Mill Brook (Deerfield River tributary, not impacted), Bear River (not impacted), Cold River (three sites, not impacted), Tannery Brook (not impacted), Chickley River (three sites, not impacted), Mill Brook (Clesson Brook Tributary, slightly impacted), Clesson Brook (three sites, not impacted).

The 2011 headwater streams study sampled twenty headwater sites across six state forests in Massachusetts. Nineteen were headwater stream sites and one site was a spring/seep in a headwater reach. Macroinvertebrate community composition varied widely with great species richness. Some taxa identified in this study potentially may have not been previously observed in Massachusetts. Brook trout were also observed at nearly half of the sites. Riparian habitats were all in good condition and likely responsible for supporting such great macroinvertebrate communities.

Vermont DEC Monitoring

There has never been comprehensive water quality monitoring in most of the Vermont portion of the Deerfield watershed. The state of Vermont conducts biomonitoring assessments (including fish, macroinvertebrate, and habitat) on a five-year cycle. Biomonitoring results show generally very good to excellent conditions for supporting aquatic life within the watershed except directly below the Harriman and Sherman reservoirs and below the ski resort area of Mount Snow. There is also a bacteria total maximum daily load plan (TMDL) for a portion of the North Branch of the Deerfield River in Dover due to bacteria levels consistently exceeding safe recreation levels and state standards.

Massachusetts DEP Monitoring

Massachusetts's most recent assessment report of the Deerfield Watershed was released in 2004. Water quality assessment relied on the results from DRWA's volunteer monitoring of water chemistry and fecal coliform bacteria. By analyzing data from USGS streamflow gauges, the Green River near Colrain, the North River at Shattuckville, and the South River near Conway were identified as medium stressed while Deerfield River at Charlemont and Deerfield River near West Deerfield were identified as low stressed. A 2003 assessment survey quantified whether the designated uses of aquatic life, primary and secondary contact recreation, and aesthetics were supported or impaired. Most sites surveyed supported all uses with the exception of the Davis Mine Brook, impaired for recreation and not supportive of aquatic life or aesthetics, and the lower reach of the Green River, impaired for primary contact recreation. Davis Mine Brook is severely impacted by the Davis sulfur mine which collapsed in 1910 and leaches extremely acidic water directly into the brook.

Methods

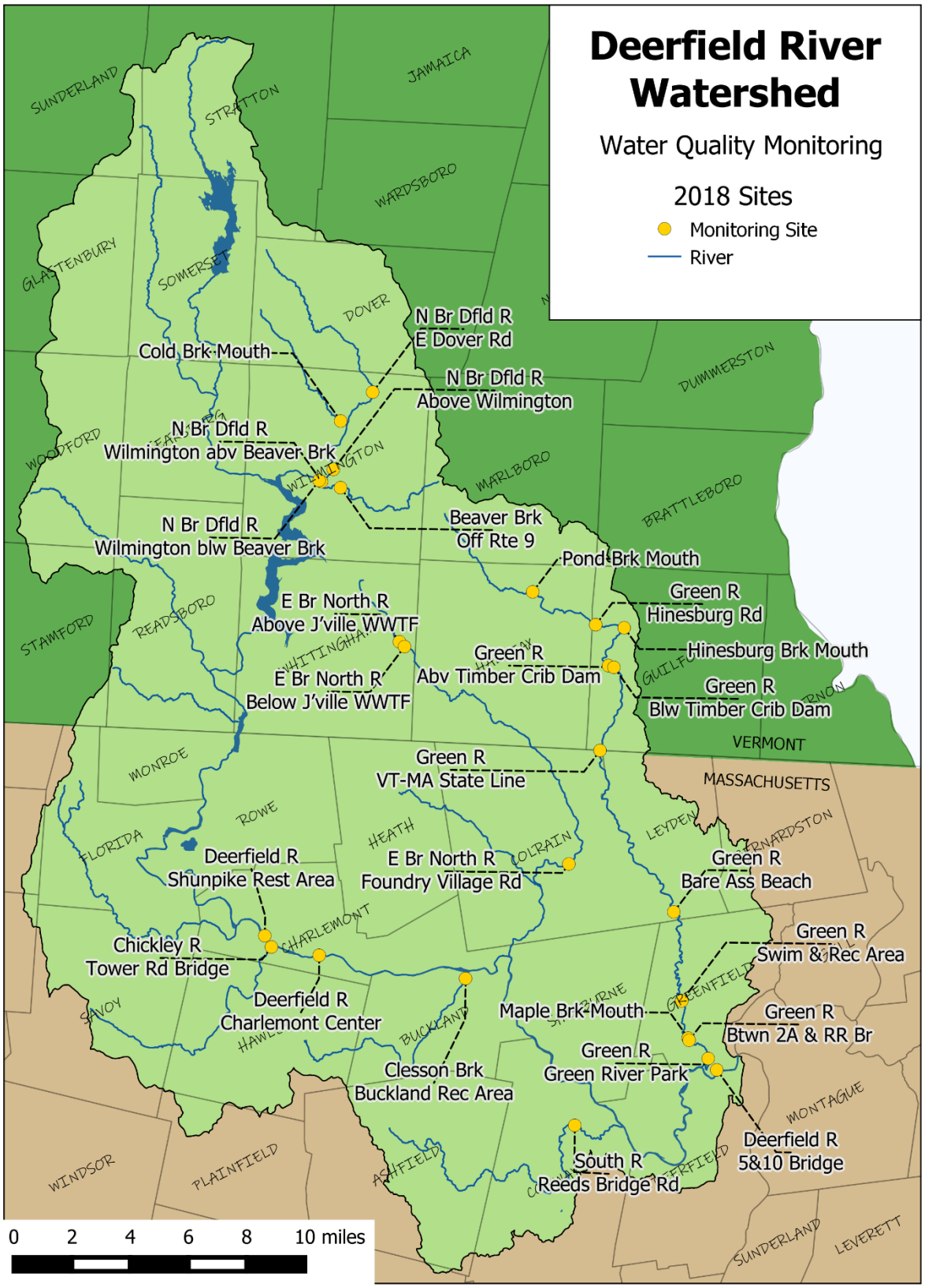
Sites Sampled

For the 2018 season, DRWA sampled 14 sites in Vermont and 11 sites in Massachusetts.

Table 1 - Sites Sampled

Site ID	Site Name	River	Town	Sampled in 2017?
VT-NBD_06.4	E Dover Rd	N. Br. Deerfield	Wilmington, VT	✓
VT-NBD_02.7	Above Wilmington Center	N. Br. Deerfield	Wilmington, VT	✓
VT-NBD_02.0	Wilmington Center, Above Beaver Brk	N. Br. Deerfield	Wilmington, VT	
VT-NBD_01.8	Wilmington Center, Below Beaver Brk	N. Br. Deerfield	Wilmington, VT	✓
MA-DFR_28.9	Shunpike Rest Area	Deerfield	Charlemont, MA	
MA-DFR_26.7	Charlemont Center	Deerfield	Charlemont, MA	
MA-DFR_01.1	5&10 Bridge	Deerfield	Greenfield, MA	✓
VT-EBN_15.0	Above Jacksonville WWTF	E. Br. North	Whitingham, VT	
VT-EBN_14.7	Below Jacksonville WWTF	E. Br. North	Whitingham, VT	✓
MA-EBN_02.4	Foundry Village Rd Ballfields	E. Br. North	Colrain, MA	✓
VT-PND_00.1	Pond Brook Mouth	Pond Brook	Halifax, VT	
VT-GRN_23.4	Hinesburg Rd	Green	Guilford, VT	✓
VT-HBG_00.1	Hinesburg Brk Mouth	Hinesburg Brook	Guilford, VT	
VT-GRN_20.5	Above Timber Crib Dam	Green	Guilford, VT	
VT-GRN_20.2	Below Timber Crib Dam	Green	Guilford, VT	✓
VT-GRN_16.8	VT-MA State Line	Green	Guilford, VT	
MA-GRN_09.8	Bare Ass Beach	Green	Colrain, MA	
MA-MPL_00.1	Maple Brook Mouth	Maple Brook	Greenfield, MA	
MA-GRN_02.0	Between MA-2A and RR Bridge	Green	Greenfield, MA	
MA-GRN_00.8	Green River Park (Greenfield)	Green	Greenfield, MA	✓
VT-COB_00.3	Cold Brook Mouth	Cold Brook	Wilmington, VT	✓
VT-BVR_01.1	Off Rte 9	Beaver Brook	Wilmington, VT	
MA-CHI_00.1	Tower Rd Bridge	Chickley	Charlemont, MA	✓
MA-CLS_00.3	Buckland Recreation Area	Clesson Brook	Buckland, MA	✓
MA-SOU_02.4	Reeds Bridge Rd	South	Conway, MA	✓
GRSA	Green River Swim & Rec Area (Sampled by Greenfield Health Dept)	Green	Greenfield, MA	✓

Figure 1 - 2017 Site map



Sampling Procedure

Before the start of the season, each volunteer was required to attend a training session with the program coordinator. Training sessions were held riverside so that each volunteer would have the opportunity to practice under the supervision of the coordinator before going out into the field.

Volunteers sampled sites on alternate Wednesday mornings from June 27th to September 5th before 10 am. In addition to collecting the suite of bottles to be tested for different parameters (see next section), volunteers recorded air and water temperature, flow conditions, and any other relevant notes about the site on the provided field sheet. They were also required to keep a chain of custody form for *E. coli* samples. On some days, volunteers collected additional quality control samples. We aided a University of Massachusetts water isotope study by collecting an additional bottle once a month. Samples and field sheets were delivered to the CRC Lab in Greenfield by 10 am where most bottles were sorted and sent to VAEL by courier. *E. coli* samples remained in Greenfield to be processed and tested immediately.

Parameters

Each site was tested for *E. coli*, total nitrogen, total phosphorus, turbidity, and conductivity. This is a change from 2017 where sites were tested for chloride instead of conductivity. This change was made at the request of the LaRosa partnership.

E. coli

Escheria coli (*E. coli*) is in the fecal coliform family of bacteria that is found in digestive tracts of all warm-blooded animals, including humans. Most *E. coli* will not make someone sick, but they do sometimes cause illnesses in people. The presence of *E. coli* in water indicates the presence of human or animal waste. It is relatively easy to test for in comparison to other more harmful waterborne pathogens, so it is used an indicator organism to determine the level of risk associated with primary recreation contact (swimming and wading), or secondary recreation contact (boating).

The US Environmental Protection Agency (EPA), Vermont, and Massachusetts standards for a single sample to be considered “safe to swim” is 235 *E. coli* organisms per 100 mL of water. The state standards for results over a period of time are that the geometric mean (a way of averaging living populations) should not exceed 126 E. coli/100 mL; Vermont also requires that no more than 10% samples exceed 235 E. coli/100 mL.

Total Nitrogen

Total nitrogen (TN) tests for nitrogen in all its forms, including nitrate (NO_3-), nitrite (NO_2-), ammonium (NH_4+), and as part of organic matter. Nitrogen is an essential nutrient for plants and can be found in the atmosphere as well as all living beings. It is also an important component of fertilizers. An overabundance of nitrogen in our waterways can contribute to eutrophication (over growth of algae) and anoxia (lack of oxygen) in saltwater systems, such as Long Island Sound.

There is no numerical state standard for nitrogen in Massachusetts and the standard in Vermont is a very lax 5.0 mg-N/L of water. No sites that we test come close to exceeding that standard. The EPA currently recommends a limit of 0.34 mg-N/L for waters entering Long Island Sound that support eelgrass based on literature values. We choose to compare our results to the EPA suggested standard.

Total Phosphorus

Total phosphorus (TP) tests for phosphorus in all its forms, including organic and inorganic phosphates (PO_4^{-3}). Organic phosphates are those that are bound to plant or animal tissue and formed primarily through biological processes, but they may occur from the breakdown of organic pesticides. Inorganic phosphates include orthophosphates, produced in natural processes and found in sewage, and polyphosphates, used in treating boiler waters and in detergents. An overabundance of phosphorus in our waterways can contribute to toxic algae blooms, eutrophication, and anoxia in freshwater systems, such as lakes and ponds.

There is no numerical state standard for phosphorus in Massachusetts and the standard in Vermont is based on gradient and temperature. The Green River sites are all high or medium gradient cold-water streams which have a standard of 9 µg-P/L for Class A(1) and B(1) waters and 15 µg-P/L for Class B(2) waters. Currently, the Green River and its tributaries in Vermont are classified as B(2), but results are compared to both standards.

Turbidity

Turbidity is a measure of how murky or cloudy water is. Clay, silt, finely divided inorganic and organic matter, algae, soluble colored organic compounds, and microscopic organisms all contribute to how turbid water is. Low and slow flows in streams tend to be less turbid while high flows after rain events are usually more turbid. Turbidity is a measured by the intensity of light scattered by particles suspended in a water sample. It is measured in nephometric turbidity units (NTU). Typically, low flowing, clear water has turbidity values of 10 NTU or lower.

The Massachusetts standard for turbidity is stated as “These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this Class.” Vermont water quality standards state that average annual turbidity should not exceed 10 NTU in cold water streams.

Conductivity

Specific conductivity (also known as specific conductance) is a measure of how well water conducts electricity. Conductivity is easy to test for and gives a broad look at potential water quality issues. It can be affected by the underlying geology and soil (ions dissolved out of rocks and soil), acid mine drainage (variety of metals and other contaminants), agricultural runoff (including nitrates and phosphates), and road runoff (automobile fluids and road salt). Sudden changes in conductivity could indicate a change in water quality.

Conductivity is not in itself regulated but large fluctuations in values over time or between sites may be an indicator of a water quality issue not identified in other parameters.

Results & Discussion

Deerfield River Mainstem & Branches

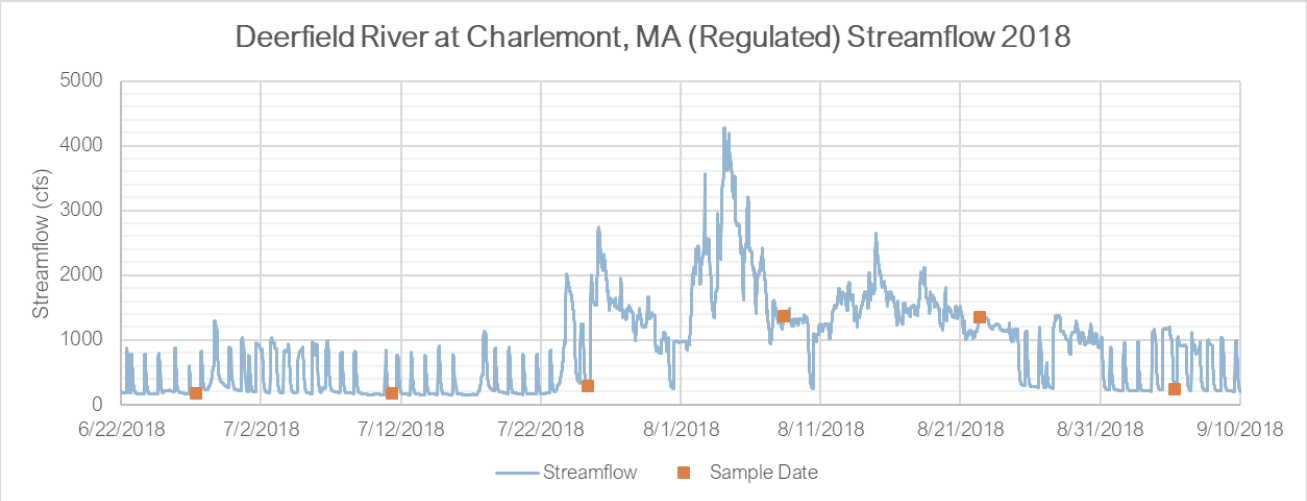
DRWA monitored four sites on the North Branch of the Deerfield River in Vermont and three sites on the mainstem of the Deerfield in Massachusetts. With the exception of the furthest downstream site in Massachusetts which is classified as warm water Class B, all of the sites are classified as cold water Class B. All of these sites were monitored for *E. coli*, total nitrogen, total phosphorus, and conductivity. They were not monitored for turbidity.

TABLE 2 - FLOW OBSERVED AT DEERFIELD SITES SAMPLED

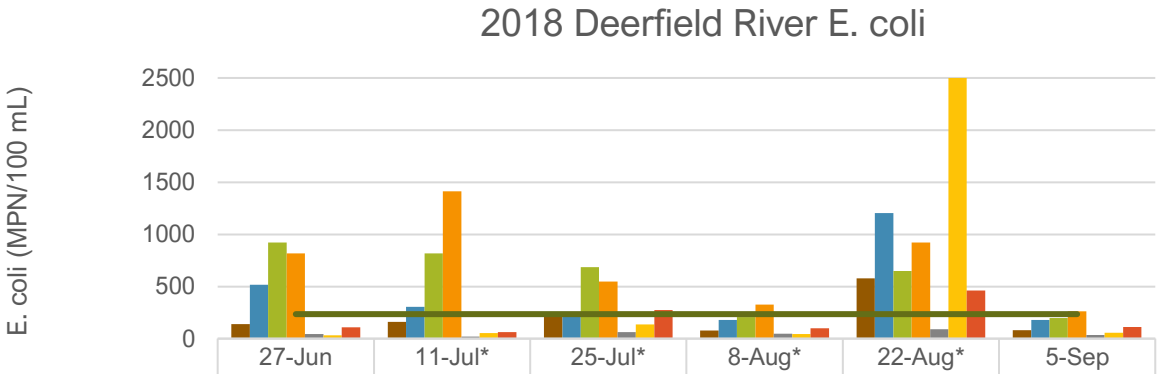
Site ID	6/27/2018		7/11/2018		7/25/2018		8/8/2018		8/22/2018		9/5/2018	
	Level	Type	Level	Type	Level	Type	Level	Type	Level	Type	Level	Type
VT-NBD_06.4	Low	Base	Low	Base	High	Fresh	High	Fresh	High	Fresh	Low	Base
VT-NBD_02.7	Low	Base	Low	Base	High	Fresh	High	Fresh	High	Fresh	Low	Base
VT-NBD_02.0	Low	Base	Low	Base	Mod	Fresh	Mod	Base	Mod	Base	Low	Base
VT-NBD_01.8	Low	Base	Low	Base	Mod	Fresh	Mod	Base	Mod	Base	Low	Base
MA-DFR_28.9	Low	Reg	Low	Base	Mod	Fresh	High	Fresh	High	Fresh	Low	Base
MA-DFR_26.7	Low	Reg	Low	Reg	Mod	Reg	Mod	Reg	Mod	Reg	Mod	Reg
MA-DFR_01.1	Low	Reg	Low	Reg	Mod	Fresh	High	Reg	High	Reg	Low	Base

Volunteers are required to note the level and type of flow at each site at the time of sampling, presented above. These observations are inherently subjective, based on individual observations at specific sites. They cannot be corroborated by any gages due to the highly regulated nature of the Deerfield River. There are no gauges on the North Branch Deerfield River. There are two USGS gages in the portion of the river that is subjected to daily hydropower and recreational releases. The streamflow recorded at the upstream gage (downstream of MA-DFR_26.7) and time sampled are depicted below. Samples tended to be collected during low flows in the mornings, but high flows this year resulted in the river not being drawn down daily during August.

FIGURE 2 - DEERFIELD RIVER STREAMFLOW SUMMER 2018



The results for all parameters are presented in the graphs below.

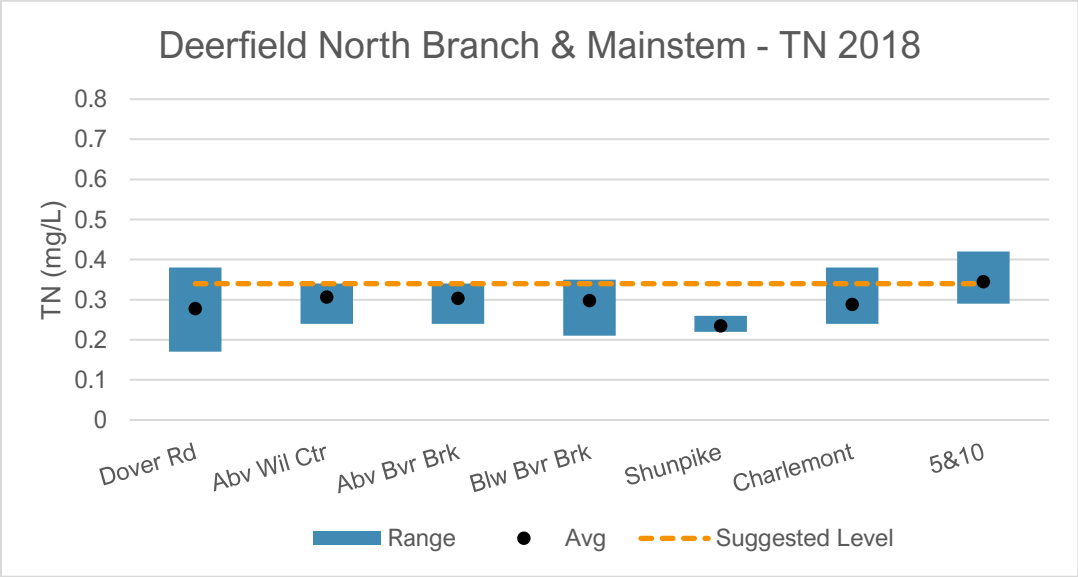


	27-Jun	11-Jul*	25-Jul*	8-Aug*	22-Aug*	5-Sep
Dover Rd	139.6	160.7	228.2	77.1	579.4	79.8
Abv Wil Ctr	517.2	305.7	228.2	178.5	1203.3	178.5
Abv Bvr Brk	920.8	816.4	686.7	206.4	648.8	198.9
Blw Bvr Brk	816.4	1413.6	547.5	325.5	920.8	261.3
Shunpike	44.1	18.3	62.7	45.9	90.6	34.5
Charlemont	33.1	52.1	135.4	43.5	2500	57.3
5&10 Bridge	110	63.1	275.5	99	461.1	111.2
Swim Stdrd	235	235	235	235	235	235

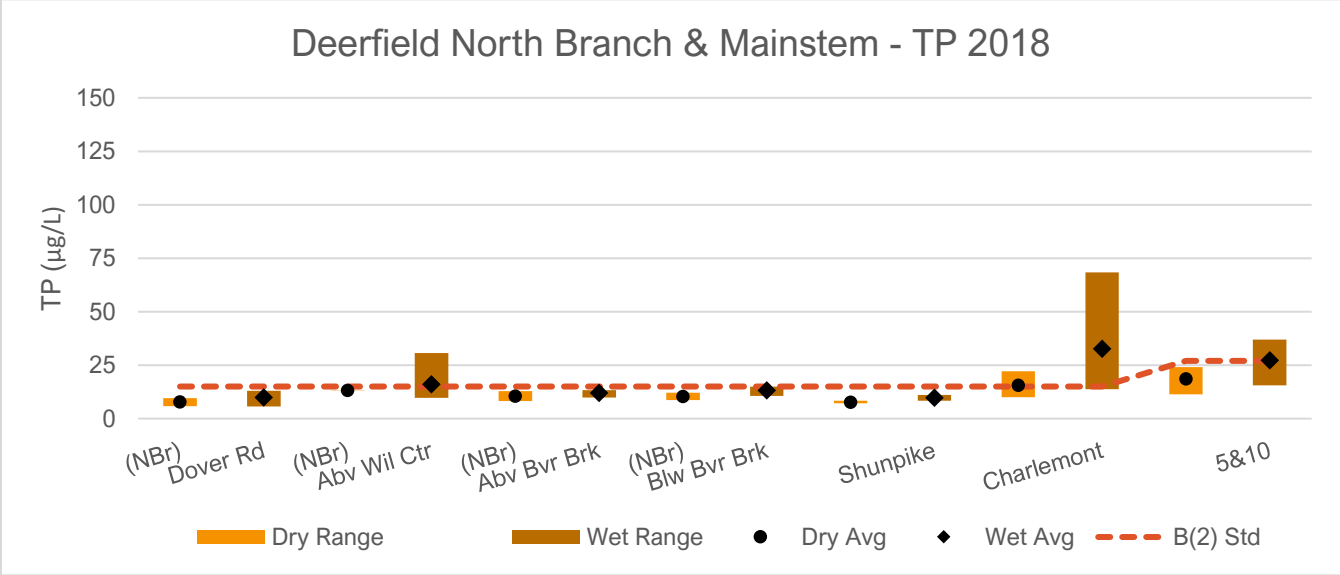
** Wet weather (>0.1" rain) in 24 hours prior to sampling*

The furthest upstream North Branch Deerfield site, Dover Rd, tended not to exceed the swimming standard except for in the wettest weather (Aug 22). The rest of the North Branch sites, Above Wilmington Center, Above Beaver Brook, and Below Beaver Brook had high levels in wet weather and sometimes during dry weather. It also appears that Beaver Brook usually contributed to increased *E. coli* levels in the North Branch in four out of six sampling events. Results from the Beaver Brook site can be found in the Other Tributaries section.

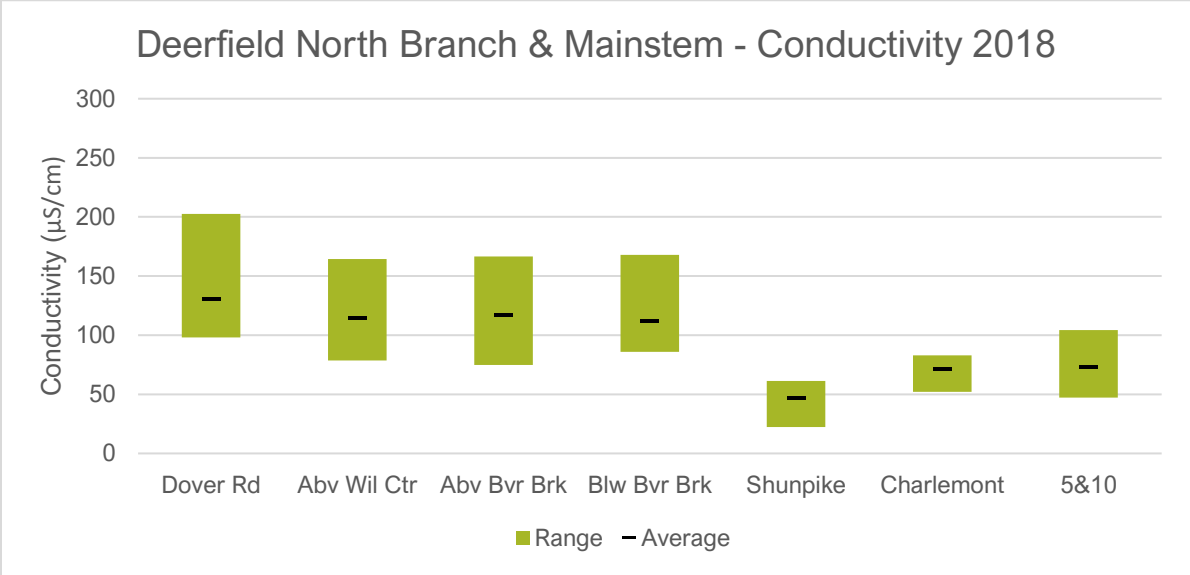
The mainstem sites, Shunpike Rest Area, Charlemont Center, and 5&10 Bridge, overall had much lower bacteria levels than the North Branch sites. Shunpike Rest Area always had very low readings even in extremely wet weather. Charlemont Center exceeded the swim standard only on the wettest day (Aug 22). The furthest downstream site at the 5&10 Bridge had the highest bacteria levels of the three mainstem sites but still only exceeded the swim standard twice during wet weather days.



The averages for all sites were well below the VT standard of 5.0 mg-N/L. Only the lowest mainstem site at the 5&10 Bridge in Greenfield exceeded the EPA's current suggested level of 0.34 mg-N/L. The North Branch Sites (Dover Rd, Above Wilmington Center, Above Beaver Brook, and Below Beaver Brook) are in a predominantly agricultural area that transitions into more urban land use.



All site averages met the VT standard for cold water streams of 15 µg-P/L (27 µg-P/L for the one warm water site) when sampled during dry weather. The North Branch site Above Wilimington Center and the mainstem sites at Charlemont Center and the 5&10 Bridge exceeded their standards when sampled during wet weather. Between the Shunpike Rest Area site and the Charlemont Center site are the confluences with the Chickley River (results below) and the Mill Brook (not sampled) and the discharge from the Charlemont wastewater treatment plant. DRWA is planning to sample the Mill Brook in 2019 to better understand where nutrient and bacteria contributions in Charlemont center are coming from during wet weather.



There is no standard conductivity in either state. The North Branch sites all have higher conductivity levels than the mainstem sites. In 2017, the Dover Rd site also had the highest chloride levels which may be due to its proximity to the Mount Snow ski area and the increased use of road salt to accommodate winter recreation.

Turbidity was not collected for these sites in 2018.

North River

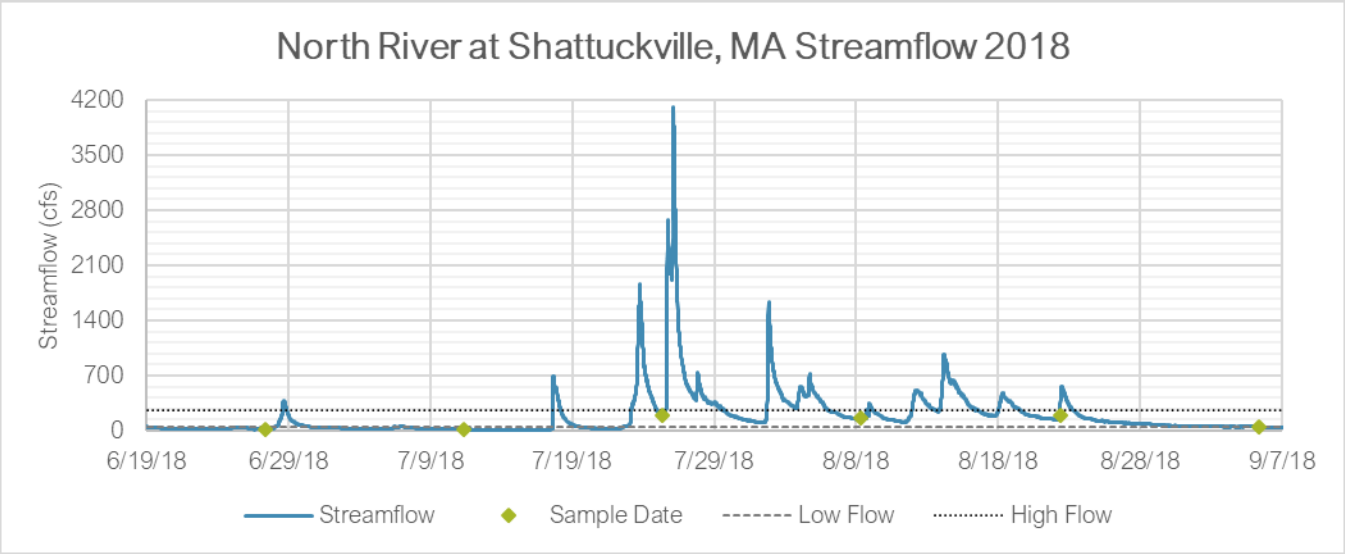
DRWA monitored three sites on the East Branch North River, two in Vermont and one in Massachusetts. DRWA was planning to monitor an additional site on the mainstem North River in Massachusetts, but the site sampled in 2017 became unsafe to sample and then weather and revoking of public access to the new sample site led to a lack of consistent sampling. The North River and its branches are considered class B cold water streams and are classified as high quality waters in Massachusetts. All sites were monitored for *e. coli* total nitrogen, total phosphorus, and conductivity. They were not monitored for turbidity.

Table 3 – Flow observed at North River sites sampled

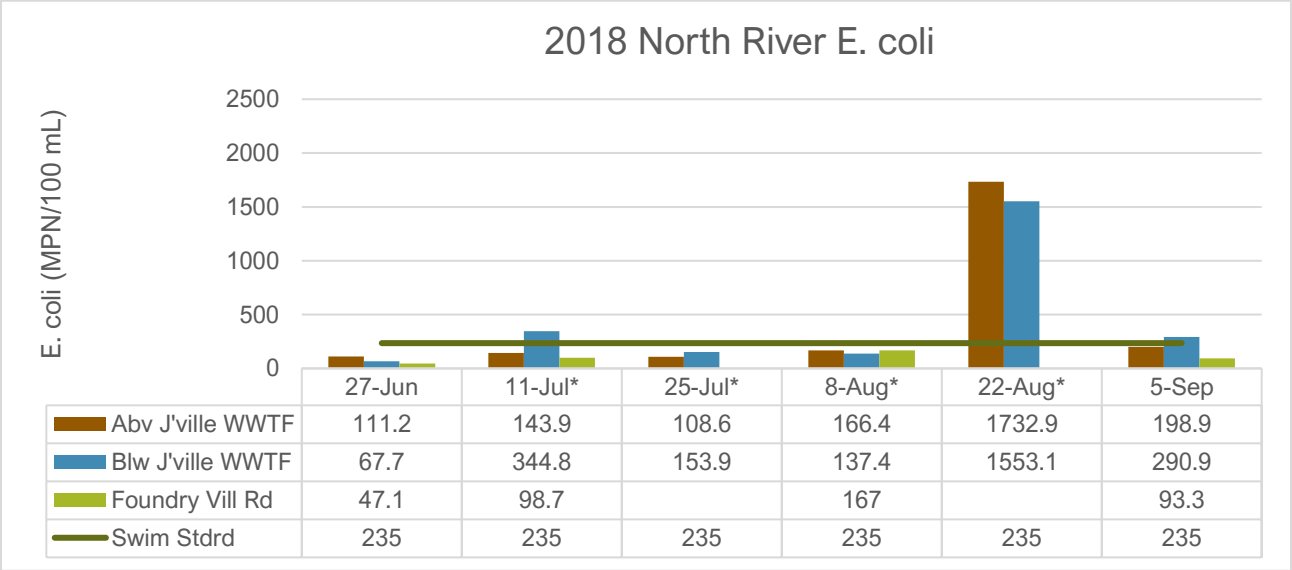
Site ID	6/27/2018		7/11/2018		7/25/2018		8/8/2018		8/22/2018		9/5/2018	
	Level	Type	Level	Type	Level	Type	Level	Type	Level	Type	Level	Type
VT-EBN_15.0	Low	Base	Mod	Base	NR	NR	NR	NR	NR	NR	NR	NR
VT-EBN_14.7	Low	Base	Mod	Base	NR	NR	NR	NR	NR	NR	NR	NR
MA-EBN_02.4	Mod	Base	Mod	Base	NT	NT	High	Fresh	NT	NT	Low	Base

Volunteers are required to note the level and type of flow at each site at the time of sampling, presented above. These observations are inherently subjective, based on individual observations at specific sites. There is a USGS gage located downstream of all the sites on the mainstem North River. Based on flows measured at the gage, 6/27, 7/11, and 9/5 had low flows and 7/25, 8/8, and 8/22 had moderate flows.

FIGURE 3 - NORTH RIVER STREAMFLOW SUMMER 2018



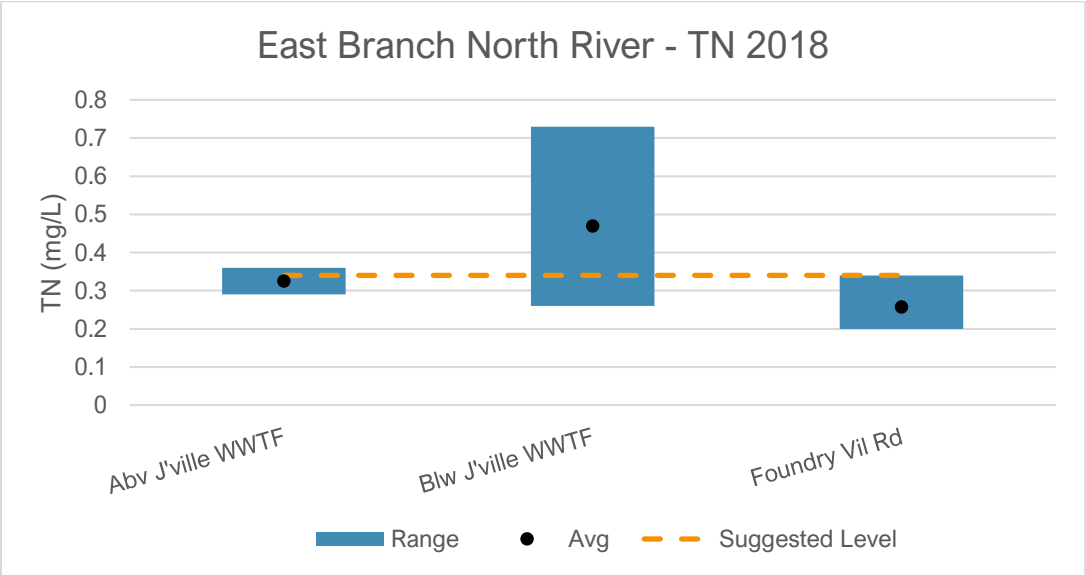
The results for all parameters are presented below.



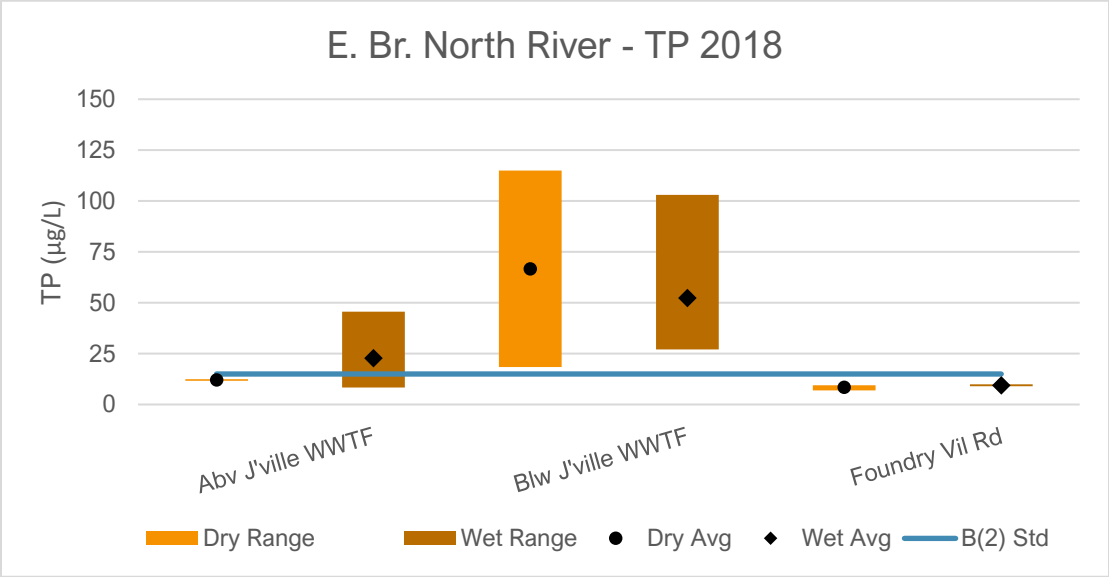
	27-Jun	11-Jul*	25-Jul*	8-Aug*	22-Aug*	5-Sep
Abv J'ville WWTF	111.2	143.9	108.6	166.4	1732.9	198.9
Blw J'ville WWTF	67.7	344.8	153.9	137.4	1553.1	290.9
Foundry Vill Rd	47.1	98.7		167		93.3
Swim Stdrd	235	235	235	235	235	235

** Wet weather (>0.1" rain) in 24 hours prior to sampling*

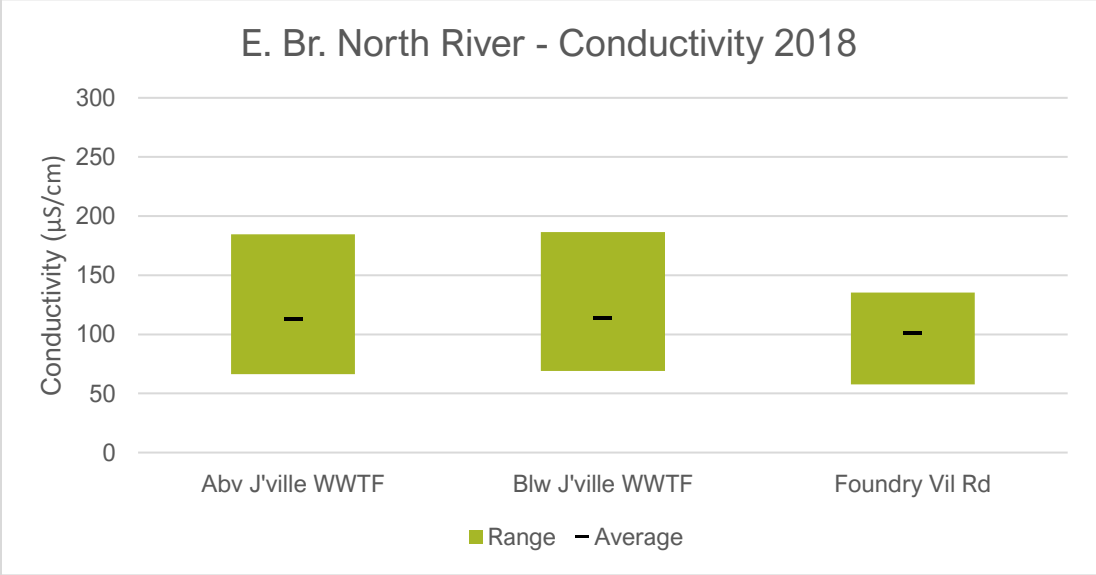
The site above the Jacksonville Wastewater Treatment Facility (WWTF) only exceeded the swim standard in the heaviest rain (August 22). The site below the Jacksonville WWTF sometimes exceeded the swim standard. The site off of Foundry Village Rd was not sampled during high water due to safety concerns, so it is unclear how that site would have tested after heavy rains but otherwise did not exceed the swim standard.



The averages for all sites were below the VT standard of 5.0 mg-N/L. The only site that exceeded the EPA suggested level of 0.34 mg-N/L was the site below the Jacksonville WWTF. The elevated nitrogen at the site below the Jacksonville WWTF is likely due to the facility discharge.



The site above the Jacksonville WWTF only exceeded the VT standard for cold water streams of 15 µg-P/L during wet weather. The site below the Jacksonville WWTF always exceeded the standard, which is likely from the wastewater treatment facility discharge. The site off Foundry Village Rd was not sampled during higher flows due to safety concerns, so it is difficult to understand if that site would have reacted during the two heavy rain days.



There is no standard conductivity in either state. The Foundry Village Road site had the lowest conductivity but was not sampled two days during higher flows due to safety concerns. No site stands out as concerning.

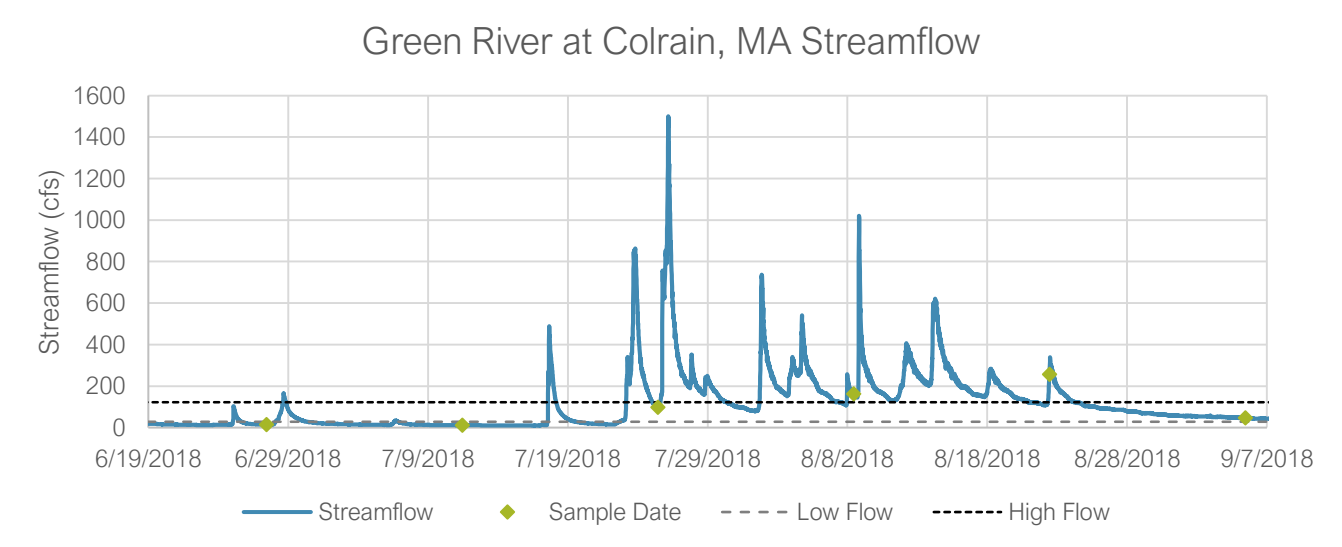
Turbidity was not collected for these sites in 2018.

Green River

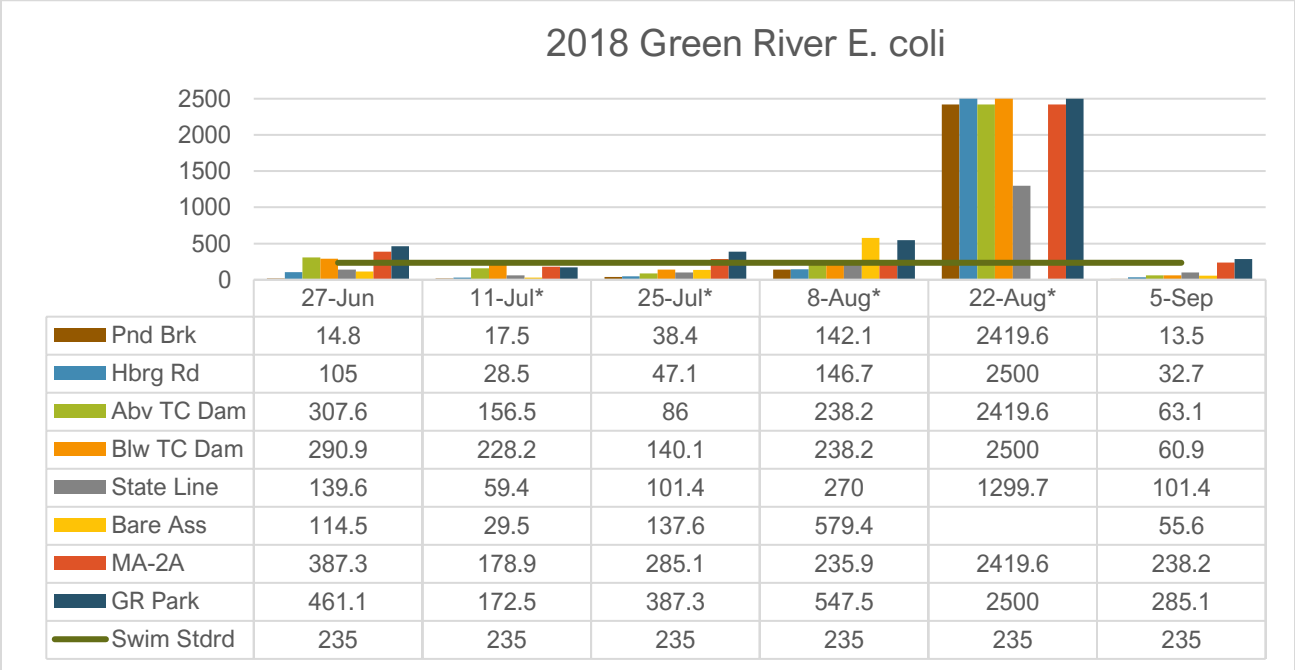
DRWA greatly expanded monitoring in the Green River watershed in both Vermont and one in Massachusetts with support from the Green River Watershed Alliance. DRWA monitored four mainstem sites and two tributaries in Vermont and three mainstem sites and one tributary in Massachusetts. The Green River and its tributaries in Vermont are all Class B cold water; at the Massachusetts border, the Green River is classified as Class A until the drinking water reservoir just downstream of MA-GRN_09.8 (Bare Ass Beach) where it switches to Class B cold water. All sites were monitored for *E. coli*, total nitrogen, total phosphorus, and turbidity. Note that most of the Green River tributary charts have a different scale in order to see the Maple Brook numbers. Please see the Green River 2018 report for more specific discussions about these results and comparisons with 2017 numbers.

Site ID	6/27/2018		7/11/2018		7/25/2018		8/8/2018		8/22/2018		9/5/2018	
	Level	Type	Level	Type	Level	Type	Level	Type	Level	Type	Level	Type
VT-PND_00.1	Low	Base	Low	Base	High	Fresh	High	Fresh	High	Fresh	Low	Base
VT-GRN_23.4	Low	Base	Low	Base	Mod	Fresh	Mod	Fresh	High	Fresh	Low	Base
VT-HBG_00.1	Low	Base	Low	Base	Mod	Fresh	Mod	Base	High	Fresh	Mod	Base
VT-GRN_20.5	Mod	Base	Low	Base	Mod	Fresh	Mod	Fresh	Mod	Fresh	Low	Base
VT-GRN_20.2	Mod	Base	Mod	Base	High	Fresh	High	Reg	High	Reg	Mod	Base
VT-GRN_16.8	Low	Base	Low	Base	High	Fresh	High	Fresh	High	Fresh	Mod	Base
MA-GRN_09.8	Mod	Base	Mod	Base	Mod	Fresh	Mod	Fresh	NT	NT	Mod	Base
MA-MPL_00.1	Low	Base	NR	NR	High	Fresh	High	Fresh	High	Fresh	Low	Base
MA-GRN_02.0	Mod	Base	Low	Base	High	Fresh	High	Fresh	High	Fresh	Low	Base
MA-GRN_00.8	Mod	Base	Low	Base	High	Fresh	Mod	Fresh	Mod	NR	Low	Base

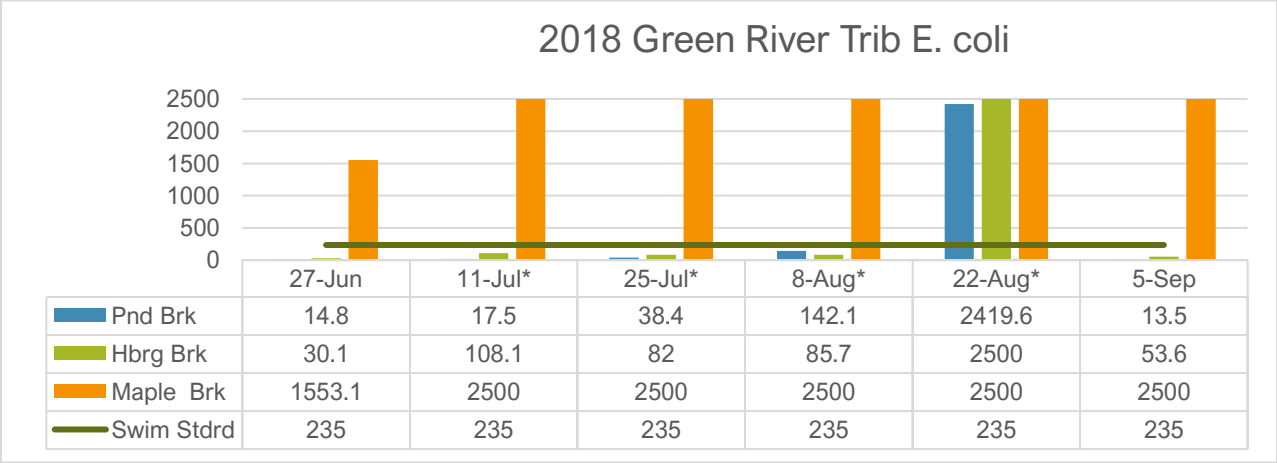
Volunteers are required to note the level and type of flow at each site at the time of sampling, presented above. These observations are inherently subjective, based on individual observations at specific sites. There is a USGS gage located between the Vermont and Massachusetts sites. Based on flows measured at the gage, 6/27 and 7/11 had low flows; 7/25 and 9/5 had moderate flows; and 8/8 and 8/22 had high flows.



Results from all parameters are presented below.



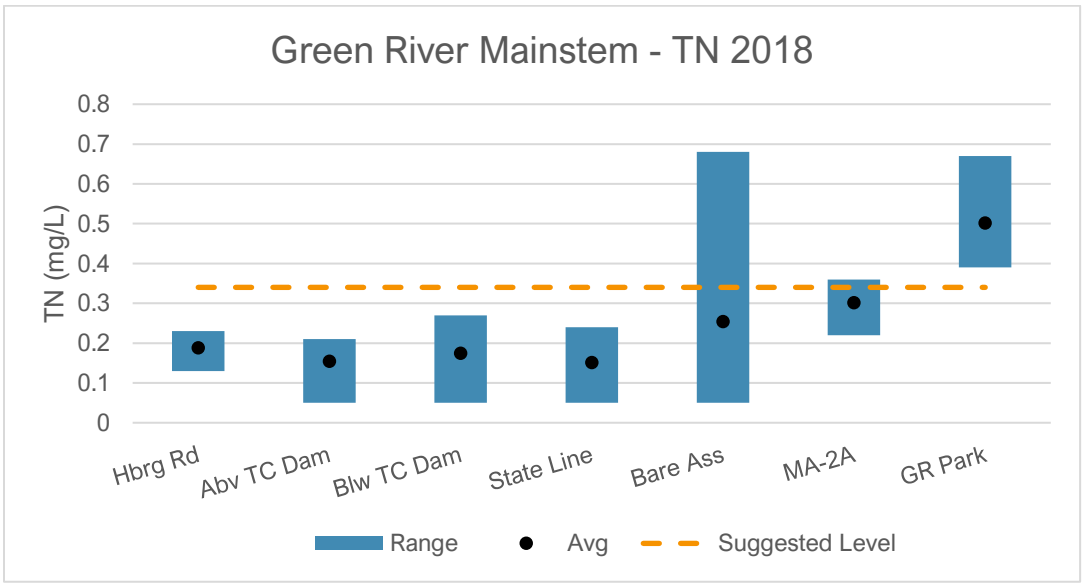
	27-Jun	11-Jul*	25-Jul*	8-Aug*	22-Aug*	5-Sep
Pnd Brk	14.8	17.5	38.4	142.1	2419.6	13.5
Hbrg Rd	105	28.5	47.1	146.7	2500	32.7
Abv TC Dam	307.6	156.5	86	238.2	2419.6	63.1
Blw TC Dam	290.9	228.2	140.1	238.2	2500	60.9
State Line	139.6	59.4	101.4	270	1299.7	101.4
Bare Ass	114.5	29.5	137.6	579.4		55.6
MA-2A	387.3	178.9	285.1	235.9	2419.6	238.2
GR Park	461.1	172.5	387.3	547.5	2500	285.1
Swim Stdrd	235	235	235	235	235	235

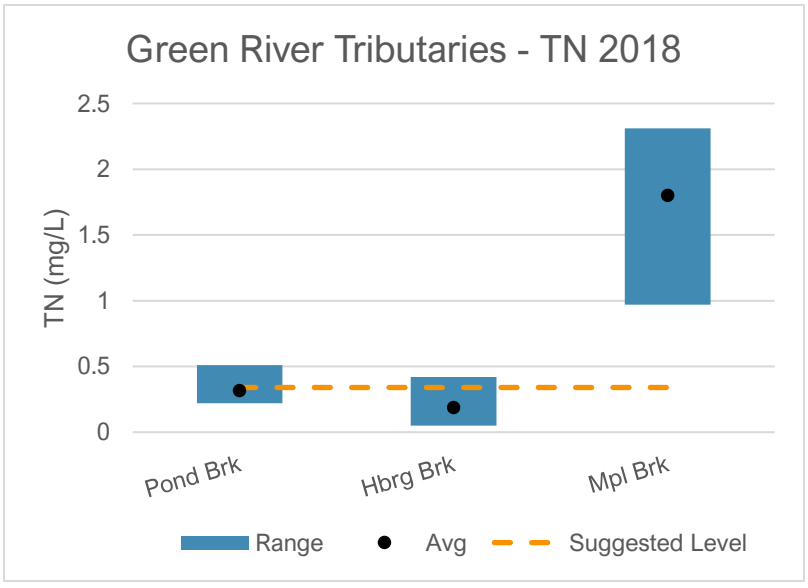


	27-Jun	11-Jul*	25-Jul*	8-Aug*	22-Aug*	5-Sep
Pnd Brk	14.8	17.5	38.4	142.1	2419.6	13.5
Hbrg Brk	30.1	108.1	82	85.7	2500	53.6
Maple Brk	1553.1	2500	2500	2500	2500	2500
Swim Stdrd	235	235	235	235	235	235

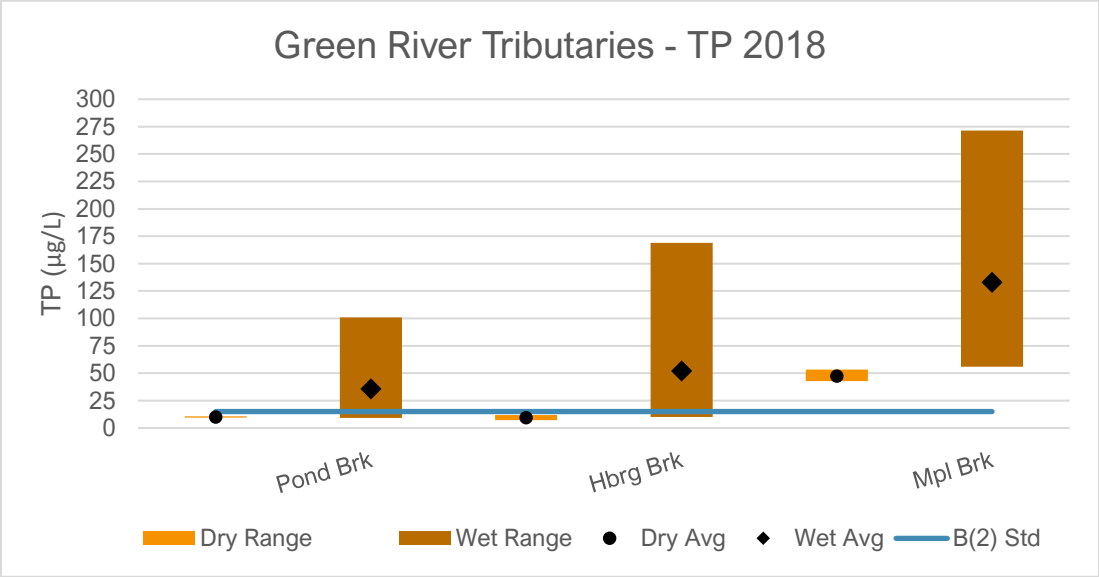
** Wet weather (>0.1" rain) in 24 hours prior to sampling*

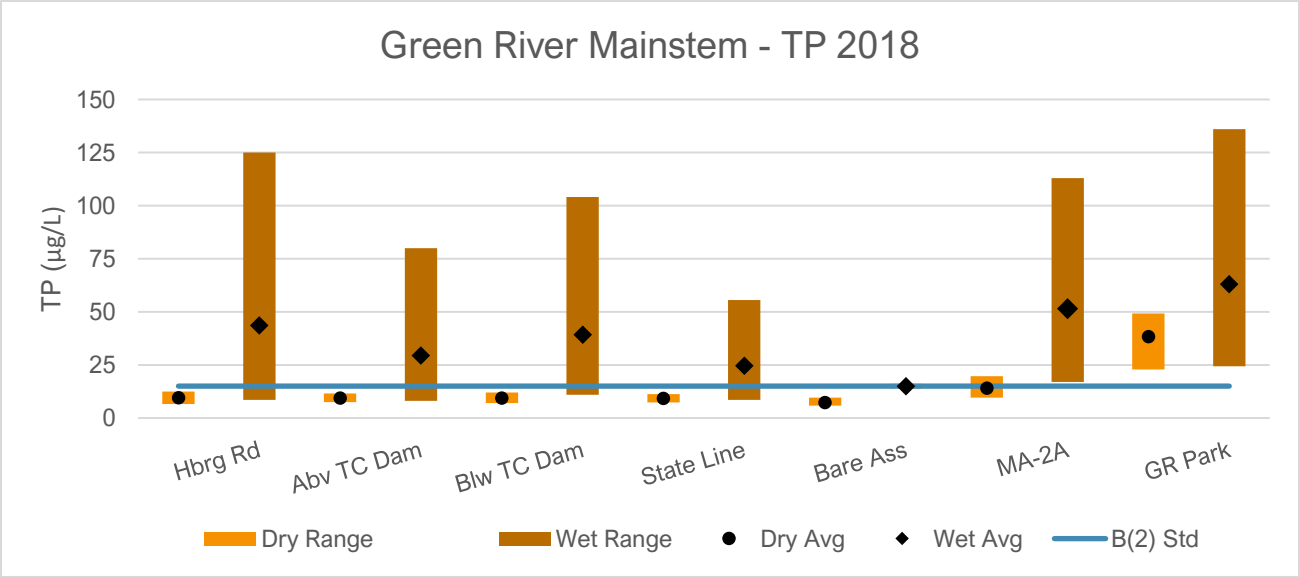
The mainstem Green River sites upstream of Greenfield proper (Bare Ass Beach and up) as well as the headwater tributaries (Pond Brook and Hinesburg Brook) tended to be below the swim standard in dry weather and mostly in wet weather as well. The notable exception is August 22 when the Green River valley received a significant amount of rain resulting in extremely high flows and *E. coli* levels to match. Greenfield sites (MA-2A, Green River Park, and Maple Brook) tended to always be in exceedance of the recreation standard. Maple Brook is buried under Greenfield and is directly connected to much of the town's stormwater infrastructure before emptying into the Green River.



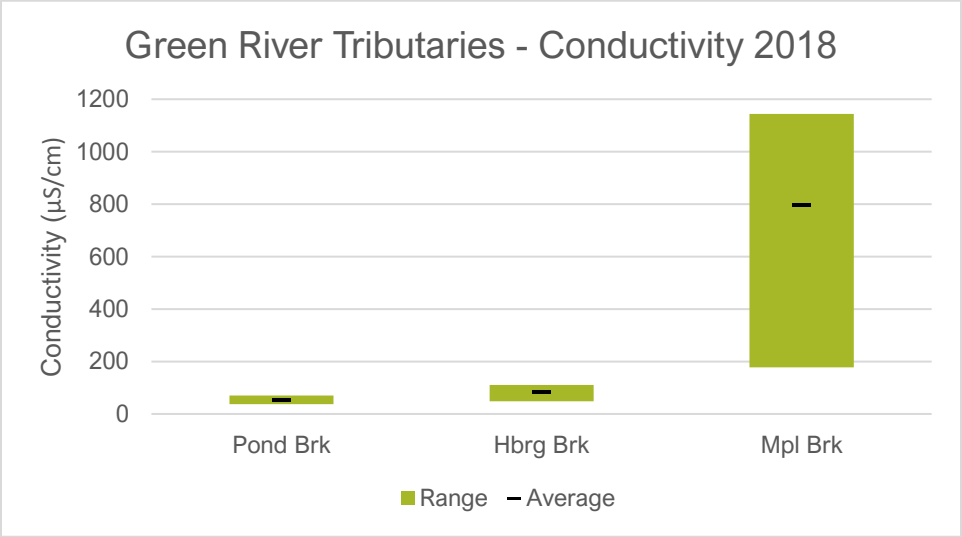


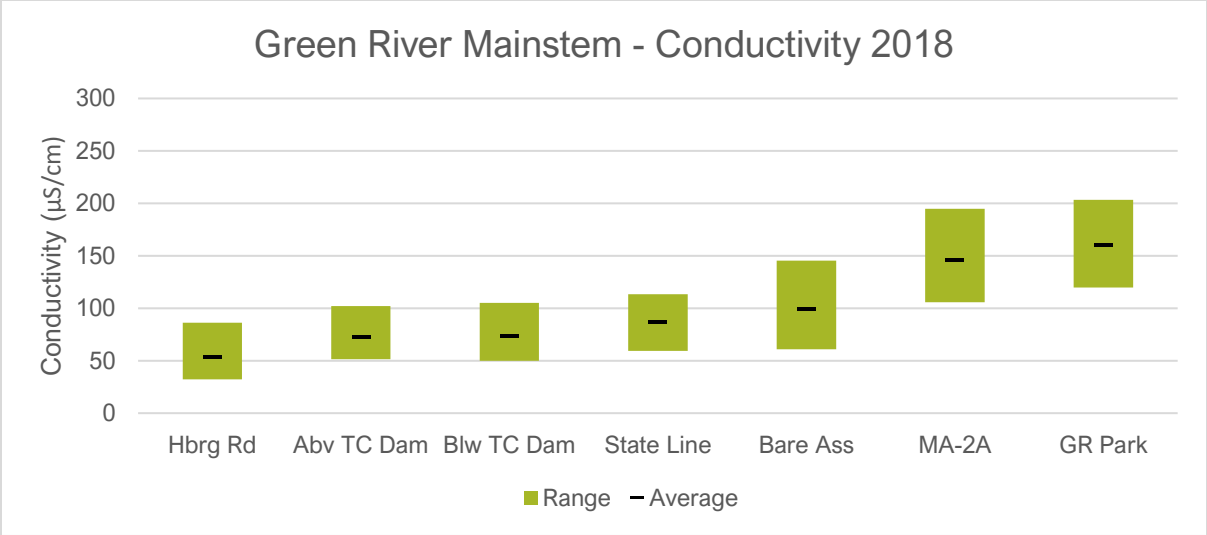
The averages for all sites were well below the VT standard of 5.0 mg-N/L. Maple Brook and the Green River Park were the only sites with averages above the EPA suggested level of 0.34 mg-N/L and no recorded values below that suggested.



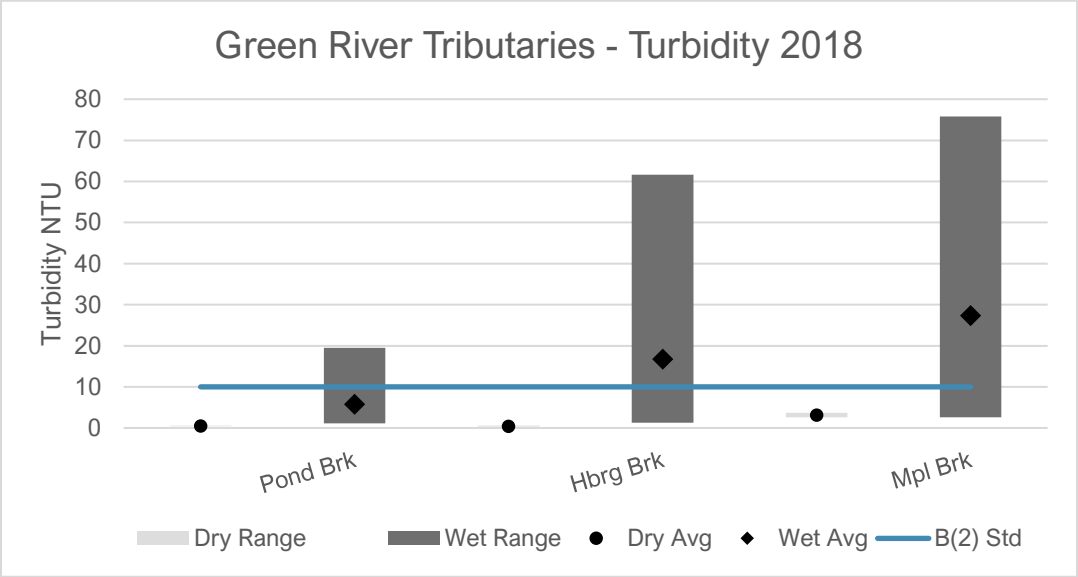


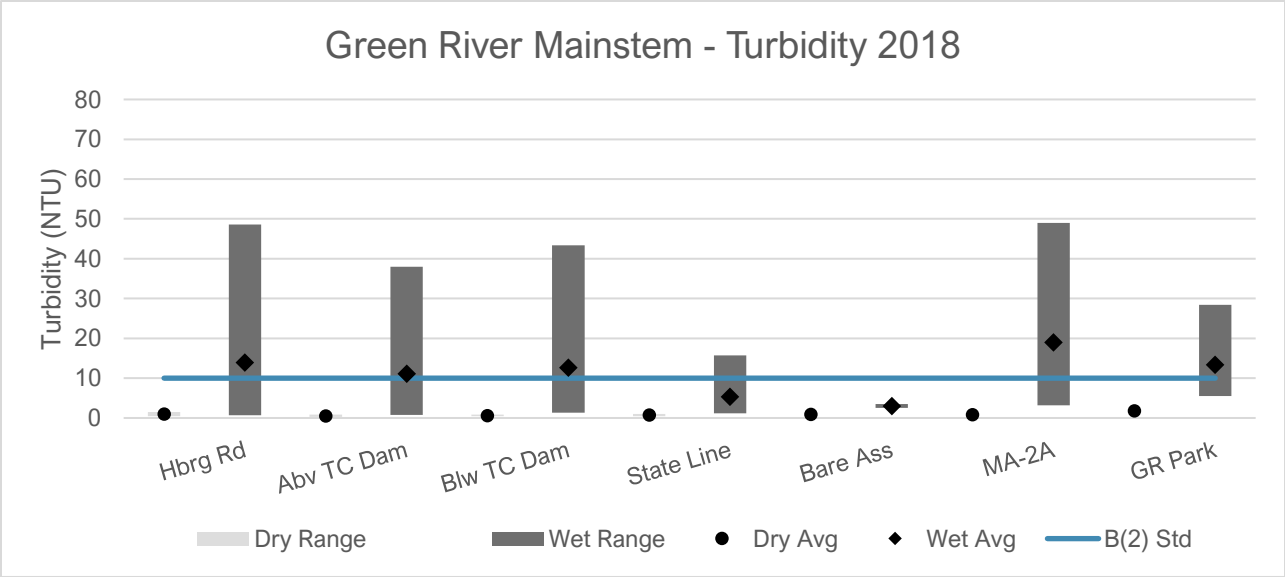
All sites exceeded the VT standard for cold water streams of 15 µg-P/L during wet weather; the Maple Brook and Green River Park sites always exceeded this standard. There are serious erosion issues during wet weather throughout the headwaters of the Green River watershed which is the likely cause of the high phosphorus levels upstream of Greenfield.





There is no standard conductivity in either state. Ideal conductivity for freshwater streams to support aquatic life is below 1500 µS/cm, which Maple Brook is still below despite being 5-6 times higher than other sites throughout the Deerfield River watershed.





The Green River watershed sites were the only sites consistently monitored for turbidity in 2018. Similar to the total phosphorus results, turbidity was above the Vermont state standard (10 NTU) during wet weather. Unlike other parameters, the turbidity standard is for the year-round average and not just low flow conditions, so it is possible that the Green River and its tributaries is not meeting this standard due to erosion.

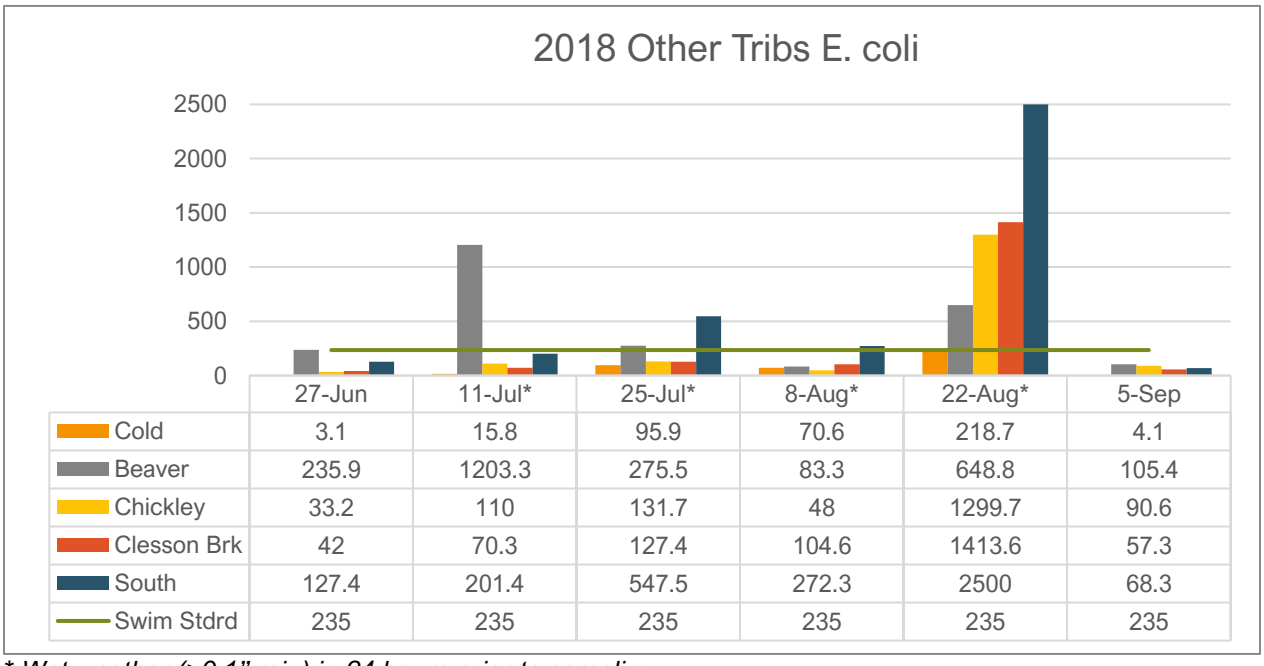
Other Tributaries

DRWA monitored single sites on several other tributaries within the Deerfield Watershed. Cold Brook and Beaver Brook (tributaries to the North Branch Deerfield in Vermont) and the Chickley River, Clesson Brook, and South River (tributaries to the Deerfield River in Massachusetts) were all monitored for *E. coli*, total nitrogen, total phosphorus, and conductivity. All these tributaries are considered Class B cold water streams.

Site ID	6/27/2018		7/11/2018		7/25/2018		8/8/2018		8/22/2018		9/5/2018	
	Level	Type	Level	Type	Level	Type	Level	Type	Level	Type	Level	Type
VT-COB_00.3	Low	Base	Low	Base	Mod	Fresh	Mod	Fresh	Mod	Fresh	Low	Base
VT-BVR_01.1	Low	Base	Mod	Base	NR	NR	NR	NR	NR	NR	NR	NR
MA-CHI_00.1	Mod	Base	Mod	Base	Mod	Fresh	Mod	Fresh	High	Fresh	Mod	Base
MA-CLS_00.3	Mod	Base	Low	Base	Mod	Fresh	Mod	Fresh	High	Fresh	NR	NR
MA-SOU_02.4	Low	Base	Low	Base	Mod	Fresh	Mod	Fresh	NR	Fresh	Mod	Base

Volunteers are required to note the level and type of flow at each site at the time of sampling, presented above. These observations are inherently subjective, based on individual observations at specific sites. There is a USGS gage located above the site on the South River, but all of the other tributaries are ungagged. Based on flow levels recorded at the South River gage, other gaged rivers in the watershed, and the flows recorded on the unregulated tributaries discussed above, 6/27 and 7/11 were low flows, 8/8 and 9/5 were moderate flows, and 7/25 and 8/22 were high flows.

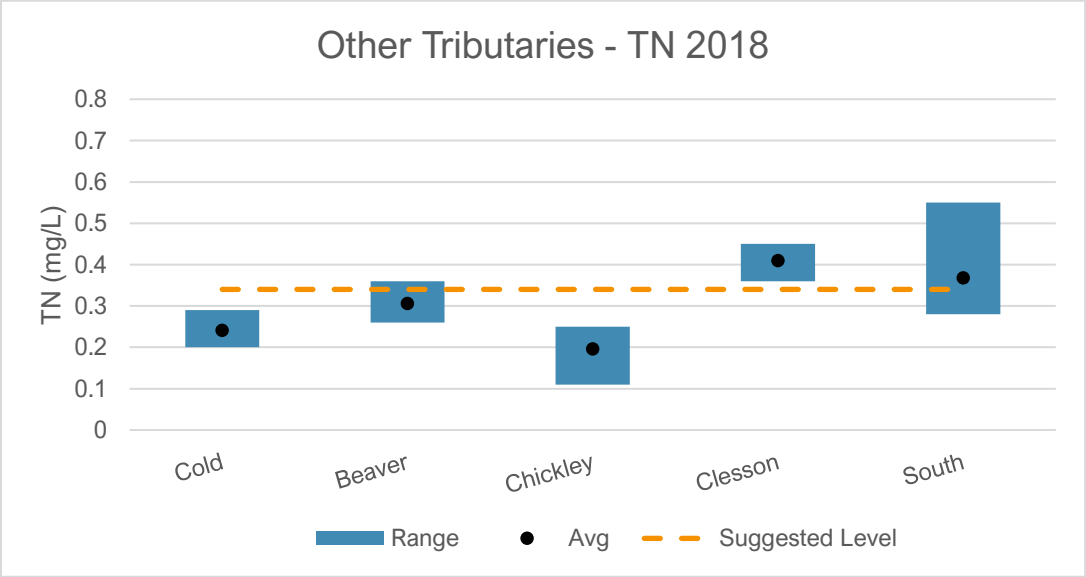
Results from all parameters are presented below.



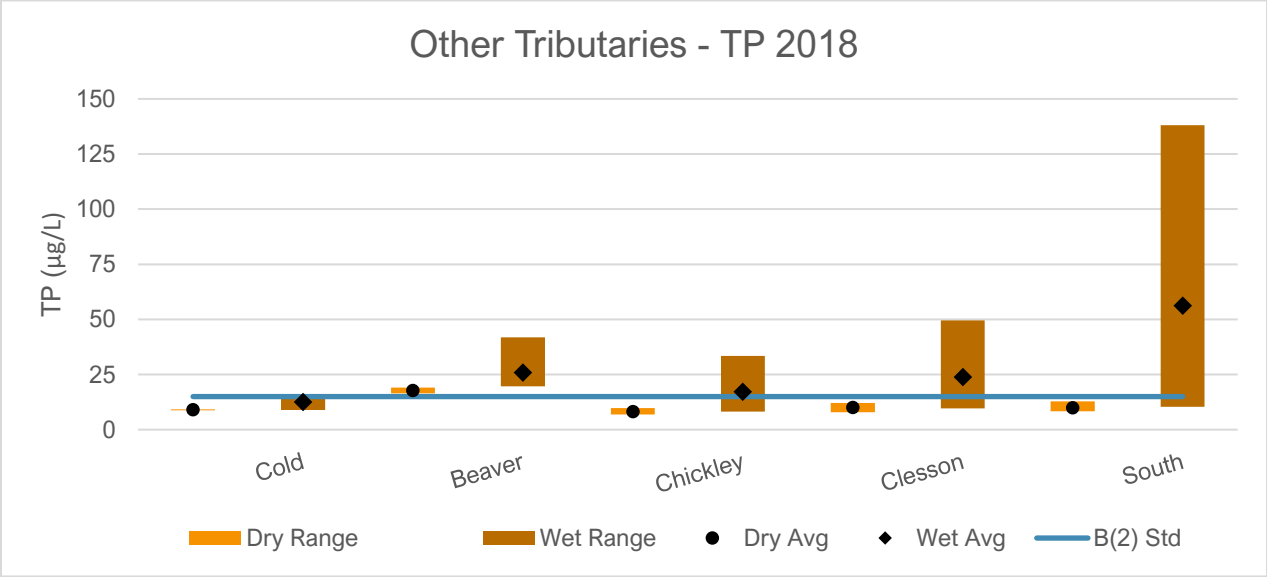
	27-Jun	11-Jul*	25-Jul*	8-Aug*	22-Aug*	5-Sep
Cold	3.1	15.8	95.9	70.6	218.7	4.1
Beaver	235.9	1203.3	275.5	83.3	648.8	105.4
Chickley	33.2	110	131.7	48	1299.7	90.6
Clesson Brk	42	70.3	127.4	104.6	1413.6	57.3
South	127.4	201.4	547.5	272.3	2500	68.3
Swim Stdrd	235	235	235	235	235	235

** Wet weather (>0.1" rain) in 24 hours prior to sampling*

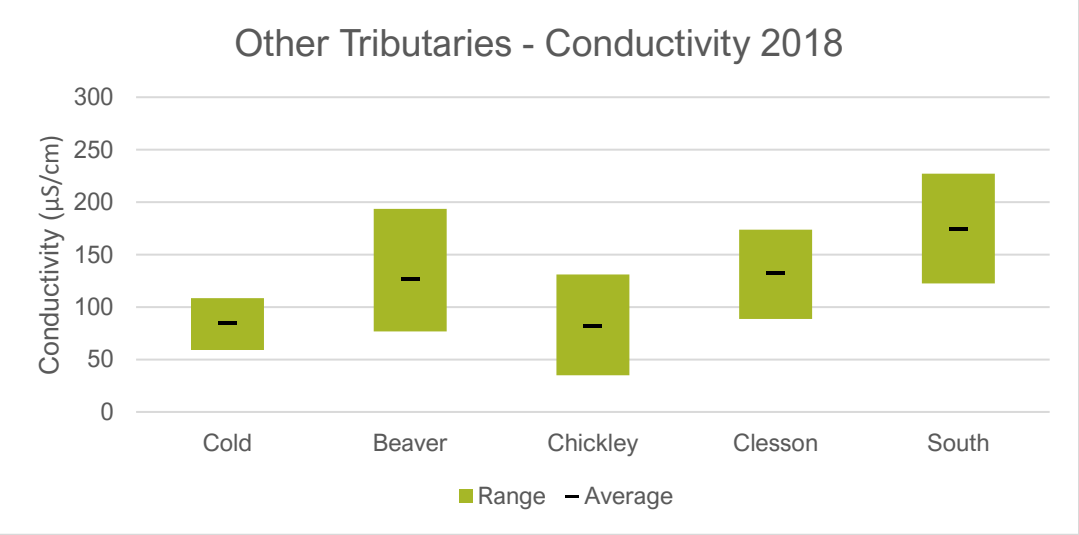
Like most the watershed, each of these tributaries tended to be below the swim standard in dry weather and were more likely to exceed the standard in wet weather.



The averages for all these tributary sites were below the VT standard of 5.0 mg-N/L. Both Clesson Brook and the South River sites exceeded the EPA's current suggested standard of 0.34 mg-N/L; those watersheds both encompass significant agricultural areas.



Cold Brook was always below the VT standard for cold water streams of 15 µg-P/L, the Chickley River, Clesson Brook, and South River were below the standard in dry weather but above in wet weather, and the Beaver Brook was always above the standard.



There is no standard for conductivity in either state. No site stands out as particularly impacted.

The only tributary monitored for turbidity was Cold Brook however all values were too low to show visually in a graph, which is a great problem to have.

Quality Assurance/Quality Control

As part of participation with the LaRosa Partnership program, DRWA is required to prepare and follow an approved Quality Assurance Project Plan (QAPP) to ensure that the data we collect are scientifically valid. The following charts illustrate our commitment to quality assurance and quality control within our program. The full QAPP is available from DRWA by request.

QAPP Part 7b – Quality Control Samples

Anomalies (highlighted in bold) from the following two tables will be discussed in the next section.

TABLE 4 - FIELD DUPLICATE RELATIVE PERCENT DIFFERENCE (RPD) RESULTS

Site ID	QC ID	Date	CRC	VAEL			DRWA
			E. coli	TN	TP	Turb	Cond
VT-PND_00.1	GR-QCA	6/27	6%	3%	22%	N/A	11%
MA-DFR_28.9	MA-QCA	6/27	1%	0%	4%	N/A	**100%**
VT-NBD_06.4	VT-QCA	6/27	3%	0%	8%	N/A	71%
MA-MPL_00.1	GR-QCA	7/11	0%	1%	1%	N/A	0%
MA-CLS_00.3	MA-QCA	7/11	6%	3%	2%	N/A	**73%**
VT-EBN_14.7	VT-QCA	7/11	13%	0%	9%	N/A	0%
VT-HBG_00.1	GR-QCA	7/25	3%	6%	5%	N/A	0%
MA-CHI_00.1	MA-QCA	7/25	7%	5%	2%	N/A	**32%**
VT-NBD_02.0	VT-QCA	7/25	8%	3%	1%	31%	22%
MA-GRN_00.8	GR-QCA	8/8	12%	**58%**	13%	N/A	3%
MA-DFR_01.1	MA-QCA	8/8	6%	0%	1%	N/A	8%
VT-EBN_14.7	VT-QCA	8/8	0%	**27%**	7%	N/A	16%
VT-GRN_20.2	GR-QCA	8/22	0%	4%	7%	3%	1%
VT-COB_00.3	VT-QCA	8/22	2%	0%	4%	2%	2%
VT-GRN_16.8	GR-QCA	9/5	5%	0%	15%	N/A	25%
MA-EBN_02.4	MA-QCA	9/5	5%	**67%**	**40%**	N/A	1%
VT-EBN_15.0	VT-QCA	9/5	4%	7%	8%	N/A	7%
MA-DFR_28.9	MA-QCB	9/5	30%	4%	9%	N/A	3%
Mean RPD			**6%**	**10%**	**9%**	**12%**	**21%**
RPD Goal			≤30% log10 trans. results	≤20%	≤30%	≤15% ≤50% (< 2 NTU)	≤30%

RPD formula used: $RPD_{field\ duplicate\ pair} = \frac{|sample_1 - sample_2|}{Average(sample_1, sample_2)}$

TABLE 5 - FIELD BLANK RESULTS

Site ID	Sample ID	Date	CRC	VAEL			DRWA
			E. coli	TN	TP	Turb	Cond
VT-QCB	VT-EBN_15.0	6/27	< 1	< 0.1	< 5	NT	6
GR-QCB	MA-GRN_02.0	6/27	< 1	< 0.1	< 5	NT	8.2
MA-QCB	MA-CHI_00.1	6/27	< 1	< 0.1	< 5	NT	5.5
VT-QCB	VT-EBN_02.7	7/11	< 1	< 0.1	< 5	NT	14
GR-QCB	VT-GRN_23.4	7/11	< 1	< 0.1	< 5	NT	4.1
MA-QCB	MA-SOU_02.4	7/11	< 1	< 0.1	< 5	NT	5.2
VT-QCB	VT-EBN_14.7	7/25	< 1	< 0.1	< 5	NT	8.8
GR-QCB	MA-GRN_09.8	7/25	< 1	< 0.1	< 5	NT	9.4
MA-QCB	MA-DFR_26.7	7/25	< 1	< 0.1	< 5	NT	3.8
VT-QCB	VT-NBD_06.4	8/8	< 1	< 0.1	< 5	NT	8.2
GR-QCB	VT-GRN_20.5	8/8	< 1	< 0.1	< 5	NT	2.6
MA-QCB	MA-CHI_00.1	8/8	< 1	< 0.1	**6.65**	NT	4.5
VT-QCB	VT-EBN_14.7	8/22	< 1	**0.22**	**505**	**0.57**	**225.6**
GR-QCB	VT-PND_00.1	8/22	< 1	**0.25**	**525**	**0.83**	**206.7**
MA-QCB	MA-EBN_02.4	8/22	< 1	NT	**515**	**0.91**	**219.8**
VT-QCB	VT-BVR_01.1	9/5	< 1	< 0.1	< 5	NT	9.5
GR-QCB	MA-GRN_09.8	9/5	< 1	< 0.1	< 5	NT	6.5
Reporting Limit:			**1**	**0.1**	**5**	**0.2**	**0**

TABLE 6 - QAPP PART 7C – PROJECT COMPLETENESS

Parameter	Number of Samples Anticipated	Number of Valid Samples Collected & Analyzed	Percent Complete
E. coli	186	184	99%
Total nitrogen	186	183	98%
Total Phosphorus	186	184	99%
Turbidity	186	95	51%
Conductivity	186	184	99%

DRWA collected nearly all samples this season. We were asked by the LaRosa program after submitting our QAPP to reduce the number of turbidity samples submitted so we only submitted samples from the Green River watershed and that reduced our completeness for that parameter.

TABLE 7 - QUALITY CONTROL COMPLETENESS

	Parameter				
	E. Coli	TN	TP	Turb	Cond
Total Number of Samples	184	183	184	95	184
Total Number of Field Duplicates	18	18	18	3	18
% of Field Dups (Goal is ≥ 10%)	10%	10%	10%	3%	10%
Total Number of Field Blanks	17	16	17	3	17
% of Field Blanks (Goal is ≥ 10%)	9%	9%	9%	3%	9%

We are satisfied with submitting 10% or close to 10% of QC samples since we are regularly asked to round down the number of samples, we submit to reduce costs. Since we were asked to submit a reduced number of turbidity samples, we chose not to submit most QC samples for that parameter.

QA Discussion

In 2018, DRWA collected samples to test for *E. coli*, total nitrogen (TN), total phosphorous (TP), turbidity, and conductivity; volunteers also recorded air and water temperature measurements at each site using and alcohol thermometer and observed flow level and type while collecting their samples. *E. coli* samples were analyzed by the CRC lab in Greenfield, MA; TN, TP, and turbidity samples were analyzed by the Vermont Environmental and Agricultural Laboratory (VAEL); conductivity samples were analyzed by DRWA personnel using a handheld meter in Greenfield, MA.

Field Duplicates: Most field duplicates (conductivity excluded) were within acceptable RPD goals (see Table 4) and all RPD goals for the season were met. Some individual results did not meet exceeded the goals but were either from a bucket sample or a site that is known to be highly variable. DRWA revised its bucket sampling protocols for the 2019 season to reduce the possibility of sample contamination.

With regards to conductivity, DRWA borrowed a DO/conductivity meter from CRC to analyze samples for conductivity and followed the Southeastern Vermont Watershed Alliance's protocol but their meter was inoperable this season. SeVWA has been following their protocol for years with no QA errors; however, it became clear in looking at the results that the CRC combined DO/conductivity meter's probe is incompatible with the sample bottles used to get accurate results. Since conductivity is not reported and there are no standards for conductivity, we are keeping the results with the knowledge that they are not as accurate as they could be, and a different meter will be used in 2019.

Field Blanks: Most field blanks were at or below the detection limit for all parameters. The exception is that all blanks from August 22nd were done with DI water that had been contaminated prior to DRWA receiving it and this problem was not unique to the DRWA program.

Temperature: All thermometers used for air and water temperatures were calibrated with a NIST thermometer at the CRC laboratory before the 2018 monitoring season began.

Next Steps

After a successful second year of monitoring, Deerfield River Watershed Alliance is planning on another year for 2019. We will continue our partnership with the Green River Watershed Alliance, a collaboration with Windham Regional Commission, Vermont River Conservancy, Connecticut River Conservancy,, the towns of Guilford, Marlboro, and Halifax (Vermont), local schools and an increasing number of local partners, supported by a grant from the High Meadows Fund. As part of that collaboration, we will

continue increased in the Green River watershed . One goal of the group is to have the Green River reclassified as Class A and maybe even pursue Wild and Scenic status. The DRWA board is mostly based out of Greenfield, MA, where the Green River is in much worse shape. The board has also expressed interest in increasing monitoring in the Massachusetts portion of the Green River watershed with a particular focus on Maple Brook, a tributary in the heart of Greenfield. We will continue to work to monitor above and below the Jacksonville Wasterwater Treatment Facility and to identify the source(s) of bacteria in downtown Wilmington.

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Appendix – Full Monitoring Results

Date	Site	Time	CRC Sample #	Final E. Coli. (mpn/ 100ml)	Wet? (Y/N)	VAEL Sample #	TN (mg-N/l)	TP (µg P/L)	Turbidity (NTU)	Spec. Cond. (µS/cm)	Air Temp. °C	Water Temp °C	Water Level	Flow Type	Sample or QA Notes:
6/27/2018	VT-NBD_06.4	7:00	9-1-18	139.6	N	181176-01	0.38	9.6	NT	98	12	12	low	base	
6/27/2018	VT-NBD_02.7	7:50	9-2-18	517.2	N	181176-02	0.34	13	NT	78.6	13.5	15	low	base	
6/27/2018	VT-NBD_02.0	8:00	9-3-18	920.8	N	181176-03	0.34	12.8	NT	82.5	15.5	15.5	low	base	
6/27/2018	VT-NBD_01.8	7:30	9-4-18	816.4	N	181176-04	0.31	12.1	NT	85.8	16	15.5	low	base	
6/27/2018	VT-COB_00.3	7:30	9-5-18	3.1	N	181176-23	0.24	9.26	0.67	96.1	13	14.5	low	base	
6/27/2018	VT-BVR_01.1	8:10	9-6-18	235.9	N	181176-24	0.31	19.1	NT	193.5	18.5	15	low	base	
6/27/2018	VT-EBN_15.0	9:15	9-7-18	111.2	N	181176-08	0.34	11.7	NT	155	16.5	14.5	low	base	
6/27/2018	VT-EBN_14.7	9:01	9-8-18	67.7	N	181176-09	0.73	115	NT	158.3	16	14.5	low	base	
6/27/2018	VT-QCA	7:05	9-9-18	120.1	N	181176-28	0.38	8.89	NT	206.3	NR	NR	NR	NR	VT-NBD_06.4
6/27/2018	VT-QCB	9:21	9-10-18	< 1	N	181176-31	< 0.1	< 5	NT	6	NR	NR	NR	NR	VT-EBN_15.0
6/27/2018	VT-PND_00.1	7:25	9-11-18	14.8	N	181176-12	0.33	10.5	0.43	61.2	13	11	low	base	
6/27/2018	VT-GRN_23.4	8:00	9-12-18	105	N	181176-13	0.23	12.5	1.47	43.5	15	14	low	base	
6/27/2018	VT-HBG_00.1	7:30	9-13-18	30.1	N	181176-15	0.18	11.9	0.58	105.7	14	12	low	base	
6/27/2018	VT-GRN_20.5	8:17	9-14-18	307.6	N	181176-16	0.21	11.5	0.82	53.3	16.5	14	moderate	base	
6/27/2018	VT-GRN_20.2	9:15	9-15-18	290.9	N	181176-17	0.2	12	0.85	61.4	18	14.5	moderate	base	
6/27/2018	VT-GRN_16.8	8:00	9-16-18	139.6	N	181176-18	0.17	11.2	1.04	102.8	14	14.5	low	base	
6/27/2018	GR-QCA	7:25	9-17-18	17.3	N	181176-29	0.34	13.1	NT	68.5	NR	NR	NR	NR	VT-PND_00.1
6/27/2018	GR-QCB	9:15	9-18-18	< 1	N	181176-32	< 0.1	< 5	NT	8.2	NR	NR	NR	NR	MA-GRN_02.0
6/27/2018	MA-DFR_28.9	8:40	9-19-18	44.1	N	181176-05	0.22	8.42	NT	22.3	16	15	low	regulated	
6/27/2018	MA-DFR_26.7	7:55	9-21-18	33.1	N	181176-06	0.33	22.1	NT	81.6	14	14	low	regulated	
6/27/2018	MA-DFR_01.1	9:38	9-22-18	110	N	181176-07	0.42	24.1	NT	47.1	18.5	20	low	regulated	
6/27/2018	MA-EBN_02.4	8:35	9-23-18	47.1	N	181176-10	0.34	9.53	NT	57.6	15	15.5	moderate	base	
6/27/2018	MA-NOR_04.4	8:20	9-24-18	93.4	N	181176-11	0.54	37.4	NT	64	14	15	moderate	base	
6/27/2018	MA-GRN_09.8	9:00	9-25-18	114.5	N	181176-19	0.16	9.55	NT	60.8	17	15.5	moderate	base	

Date	Site	Time	CRC Sample #	Final E. Coli. (mpn/ 100ml)	Wet? (Y/N)	VAEL Sample #	TN (mg-N/l)	TP (µg P/L)	Turbidity (NTU)	Spec. Cond. (µS/cm)	Air Temp. °C	Water Temp °C	Water Level	Flow Type	Sample or QA Notes:
6/27/2018	MA-GRN_02.0	7:10	9-26-18	387.3	N	181176-21	0.33	19.7	NT	194.8	16	18	moderate	base	
6/27/2018	MA-GRN_00.8	9:20	9-27-18	461.1	N	181176-22	0.64	49.2	NT	203.3	NR	NR	moderate	base	
6/27/2018	MA-MPL_00.1	7:20	9-28-18	1553.1	N	181176-20	1.67	53.3	NT	1018	15	14.5	low	base	
6/27/2018	MA-CHI_00.1	7:35	9-29-18	33.2	N	181176-25	0.22	9.77	NT	35.1	14	13	moderate	base	
6/27/2018	MA-CLS_00.3	8:25	9-30-18	42	N	181176-26	0.42	12.1	NT	88.5	NR	NR	moderate	base	
6/27/2018	MA-SOU_02.4	8:30	9-31-18	127.4	N	181176-27	0.37	12.9	NT	227.2	17	15.5	low	base	
6/27/2018	MA-QCA	8:40	9-32-18	42	N	181176-30	0.22	8.74	NT	66.5	NR	NR	NR	NR	MA-DFR_28.9
6/27/2018	MA-QCB	7:40	9-33-18	< 1	N	181176-33	< 0.1	< 5	NT	5.5	NR	NR	NR	NR	MA-CHI_00.1+B1:Q185
7/11/2018	VT-QCA	9:14	13-10-18	172.3	Y	181293-28	0.58	94.3	NT	187	NR	NR	NR	NR	VT-EBN_14.7
7/11/2018	VT-QCB	7:00	13-11-18	< 1	Y	181293-31	< 0.1	< 5	NT	14	NR	NR	NR	NR	VT-EBN_02.7
7/11/2018	VT-NBD_06.4	7:00	13-1-18	160.7	Y	181293-01	0.33	5.68	NT	112	17	17	low	base	
7/11/2018	VT-PND_00.1	7:45	13-12-18	17.5	Y	181293-12	0.37	9.12	1.32	70.5	18	15	low	base	
7/11/2018	VT-GRN_23.4	7:55	13-13-18	28.5	Y	181293-13	0.22	8.58	0.67	86.1	16.5	17.5	low	base	
7/11/2018	VT-HBG_00.1	6:30	13-14-18	108.1	Y	181293-15	0.19	9.94	1.31	48.5	17	15.5	low	base	
7/11/2018	VT-GRN_20.5	8:10	13-15-18	156.5	Y	181293-16	0.14	8.13	0.77	102.2	20.5	18.5	low	base	
7/11/2018	VT-GRN_20.2	8:22	13-16-18	228.2	Y	181293-17	0.17	11	1.36	105	21.5	18.5	moderate	base	
7/11/2018	VT-GRN_16.8	8:02	13-17-18	59.4	Y	181293-18	0.11	8.59	1.21	113.4	20	19	low	base	
7/11/2018	GR-QCA	8:45	13-18-18	> 2419.6	Y	181293-29	1.77	45.5	NT	1147	NR	NR	NR	NR	MA-MPL_00.1
7/11/2018	GR-QCB	8:05	13-19-18	< 1	Y	181293-32	< 0.1	< 5	NT	4.1	NR	NR	NR	NR	VT-GRN_23.4
7/11/2018	MA-DFR_28.9	8:50	13-20-18	18.3	N	181293-05	0.22	7.21	NT	61.3	21	17.5	low	base	
7/11/2018	MA-DFR_26.7	7:55	13-21-18	52.1	N	181293-06	0.29	14.5	NT	83	17	17	low	regulated	
7/11/2018	VT-NBD_02.7	7:48	13-2-18	305.7	Y	181293-02	0.34	10.3	NT	156	18	15.5	low	base	
7/11/2018	MA-DFR_01.1	8:00	13-22-18	63.1	N	181425-31	0.42	20.1	NT	104.4	21	23	low	regulated	
7/11/2018	MA-EBN_02.4	8:10	13-23-18	98.7	N	181293-10	0.2	8.82	NT	135.2	22	20	moderate	base	
7/11/2018	MA-NOR_04.4	8:30	13-24-18	248.3	N	181293-11	1.2	95.2	NT	209.6	24	21	moderate	base	
7/11/2018	MA-GRN_09.8	9:15	13-25-18	29.5	N	181293-19	< 0.1	6.6	NT	145.5	23	20.5	moderate	base	
7/11/2018	MA-GRN_02.0	8:58	13-26-18	178.9	N	181293-21	0.31	13	NT	116.3	25	21	low	base	

Date	Site	Time	CRC Sample #	Final E. Coli. (mpn/ 100ml)	Wet? (Y/N)	VAEL Sample #	TN (mg-N/l)	TP (µg P/L)	Turbidity (NTU)	Spec. Cond. (µS/cm)	Air Temp. °C	Water Temp °C	Water Level	Flow Type	Sample or QA Notes:
7/11/2018	MA-GRN_00.8	8:30	13-27-18	172.5	N	181293-22	0.67	43.1	NT	123.9	22	23.5	low	base	
7/11/2018	MA-MPL_00.1	8:49	13-28-18	> 2419.6	N	181293-20	1.75	45.8	3.71	1144	25	17	NR	NR	
7/11/2018	MA-CHI_00.1	7:35	13-29-18	110	N	181293-25	0.19	7.93	NT	74.4	17	18	moderate	base	
7/11/2018	MA-CLS_00.3	8:22	13-30-18	70.3	N	181293-26	0.38	10.2	1.49	100.1	27	19	low	base	
7/11/2018	MA-SOU_02.4	8:30	13-31-18	201.4	N	181293-27	0.31	8.34	NT	122.5	21.5	20	low	base	
7/11/2018	VT-NBD_02.0	8:10	13-3-18	816.4	Y	181293-03	0.34	12	NT	166.7	20	20	low	base	
7/11/2018	MA-QCA	8:29	13-32-18	90.8	N	181293-30	0.39	9.98	NT	216.2	NR	NR	NR	NR	MA-CLs_00.3
7/11/2018	MA-QCB	8:00	13-33-18	< 1	N	181293-33	< 0.1	< 5	NT	5.2	NR	NR	NR	NR	MA-SOU_02.4
7/11/2018	VT-NBD_01.8	8:00	13-4-18	1413.6	Y	181293-04	0.35	15	NT	117.9	21	20	low	base	
7/11/2018	VT-COB_00.3	7:20	13-5-18	15.8	Y	181293-23	0.29	8.97	1.33	108.5	16	19	low	base	
7/11/2018	VT-BVR_01.1	8:05	13-6-18	1203.3	Y	181293-24	0.36	21.8	3.57	188.8	19	18.5	moderate	base	
7/11/2018	VT-EBN_15.0	9:00	13-7-18	143.9	Y	181293-08	0.32	8.4	0.58	184.6	21	18.5	moderate	base	
7/11/2018	VT-EBN_14.7	9:14	13-8-18	344.8	Y	181293-09	0.58	103	NT	186.4	NR	NR	moderate	base	
7/25/2018	VT-QCB	10:30	17-10-18	< 1	Y	181425-10	< 0.1	< 5	NT	8.8	NR	NR	NR	NR	VT-EBN_14.7
7/25/2018	VT-PND_00.1	7:50	17-11-18	38.4	Y	181425-11	0.22	10.8	1.15	40.3	20	17	high	freshet	
7/25/2018	VT-NBD_06.4	7:35	17-1-18	228.2	Y	181425-01	0.28	13	2.12	121.8	20.5	18.5	high	freshet	
7/25/2018	VT-GRN_23.4	8:00	17-12-18	47.1	Y	181425-12	0.16	15.7	4.55	43.6	20.5	10.7	moderate	freshet	
7/25/2018	VT-HBG_00.1	7:00	17-13-18	82	Y	181425-13	0.16	11.4	1.54	70.7	20.5	17.5	moderate	freshet	
7/25/2018	VT-GRN_20.5	7:45	17-14-18	86	Y	181425-14	0.21	12.5	2.6	55.9	23	20	moderate	freshet	
7/25/2018	VT-GRN_20.2	8:30	17-15-18	140.1	Y	181425-15	0.19	14.6	4.02	55.6	21	19	high	freshet	
7/25/2018	VT-GRN_16.8	8:10	17-16-18	101.4	Y	181425-16	0.17	13.1	1.98	61.5	22	19	high	freshet	
7/25/2018	GR-QCA	7:05	17-17-18	95.9	Y	181425-17	0.17	12	NT	70.4	NR	NR	NR	NR	VT-HBG_00.1
7/25/2018	GR-QCB	9:02	17-18-18	< 1	Y	181425-18	< 0.1	< 5	NT	9.4	NR	NR	NR	NR	MA-GRN_09.8
7/25/2018	MA-DFR_28.9	8:50	17-19-18	62.7	Y	181425-19	0.22	8.38	0.7	57.4	22.5	19	moderate	freshet	
7/25/2018	MA-DFR_26.7	8:20	17-20-18	135.4	Y	181425-20	0.25	15.8	1.07	74.4	21	17	moderate	regulated	
7/25/2018	MA-DFR_01.1	7:53	17-21-18	275.5	Y	181425-21	0.32	29.2	3.15	49	25	21.5	moderate	freshet	
7/25/2018	VT-NBD_02.7	8:15	17-2-18	228.2	Y	181425-02	0.27	13.2	1.57	91	20	18.5	high	freshet	

Date	Site	Time	CRC Sample #	Final E. Coli. (mpn/ 100ml)	Wet? (Y/N)	VAEL Sample #	TN (mg-N/l)	TP (µg P/L)	Turbidity (NTU)	Spec. Cond. (µS/cm)	Air Temp. °C	Water Temp °C	Water Level	Flow Type	Sample or QA Notes:
7/25/2018	MA-GRN_09.8	9:02	17-22-18	137.6	Y	181425-22	0.18	13.9	2.57	74.1	NR	NR	moderate	freshet	
7/25/2018	MA-GRN_02.0	7:05	17-23-18	285.1	Y	181425-23	0.26	24.3	4.9	105.9	25	20	high	freshet	
7/25/2018	MA-GRN_00.8	9:40	17-24-18	387.3	Y	181425-24	0.4	24.4	6.27	119.7	26	21.5	high	freshet	
7/25/2018	MA-MPL_00.1	7:20	17-25-18	> 2419.6	Y	181425-25	1.96	71.8	2.63	760	24	20	high	freshet	
7/25/2018	MA-CHI_00.1	8:00	17-26-18	131.7	Y	181425-26	0.2	9.86	1.29	91.9	21	19	moderate	freshet	
7/25/2018	MA-CLS_00.3	8:26	17-27-18	127.4	Y	181425-27	0.42	12.4	0.78	162.8	NR	NR	moderate	freshet	
7/25/2018	MA-SOU_02.4	8:35	17-28-18	547.5	Y	181425-28	0.39	20.1	4.2	171.8	23	20	moderate	freshet	
7/25/2018	MA-QCA	8:05	17-29-18	96	Y	181425-29	0.21	10.1	NT	66.3	NR	NR	NR	NR	MA-CHI_00.1
7/25/2018	MA-QCB	8:25	17-30-18	< 1	Y	181425-30	< 0.1	< 5	NT	3.8	NR	NR	NR	NR	MA-DFR_26.7
7/25/2018	VT-NBD_02.0	7:55	17-3-18	686.7	Y	181425-03	0.29	13.3	2.85	74.7	20	19	moderate	freshet	
7/25/2018	VT-NBD_01.8	7:45	17-4-18	547.5	Y	181425-04	0.31	14.4	2.82	88.1	20	19	moderate	freshet	
7/25/2018	VT-COB_00.3	7:50	17-5-18	95.9	Y	181425-05	0.27	10.7	1.11	59.1	20	18	moderate	freshet	
7/25/2018	VT-BVR_01.1	7:49	17-6-18	275.5	Y	181425-06	0.32	19.6	1.27	79.5	NR	NR	NR	NR	
7/25/2018	VT-EBN_15.0	9:01	17-7-18	108.6	Y	181425-07	0.36	20	1.68	66.4	NR	NR	NR	NR	
7/25/2018	VT-EBN_14.7	9:12	17-8-18	153.9	Y	181425-08	0.39	27.1	1.6	69	NR	NR	NR	NR	
7/25/2018	VT-QCA	8:05	17-9-18	410.6	Y	181425-09	0.3	13.5	2.08	93.6	NR	NR	NR	NR	VT-NBD_02.0
8/8/2018	VT-QCA	9:04	21-10-18	137.6	Y	181560-09	0.38	31.5	NT	81.2	NR	NR	NR	NR	VT-EBN_14.7
8/8/2018	VT-QCB	8:25	21-11-18	< 1	Y	181560-10	< 0.1	< 5	NT	8.2	NR	NR	NR	NR	VT-NBD_06.4
8/8/2018	VT-NBD_06.4	7:20	21-1-18	77.1	Y	181560-01	0.25	9.16	NT	119.6	18	18.5	high	freshet	
8/8/2018	VT-PND_00.1	7:55	21-12-18	142.1	Y	181560-11	0.22	21.7	1.31	37.6	19	18	high	freshet	
8/8/2018	VT-GRN_23.4	7:50	21-13-18	146.7	Y	181560-12	0.18	25.3	2.02	32.1	19.5	18	moderate	freshet	
8/8/2018	VT-HBG_00.1	7:05	21-14-18	85.7	Y	181560-13	0.13	17.6	2.7	68.4	20	17.5	moderate	base	
8/8/2018	VT-GRN_20.5	8:10	21-15-18	238.2	Y	181560-14	0.17	17.5	3.14	51.4	24	19	moderate	freshet	
8/8/2018	VT-GRN_20.2	8:13	21-16-18	238.2	Y	181560-15	0.17	27.5	2	49.9	20	18.5	high	regulated	
8/8/2018	VT-GRN_16.8	7:50	21-17-18	270	Y	181560-16	0.17	21.3	2.35	59.5	20	18	high	freshet	
8/8/2018	GR-QCA	9:20	21-18-18	275.5	Y	181560-17	0.71	32.9	NT	139.7	NR	NR	NR	NR	MA-GRN_00.8
8/8/2018	GR-QCB	8:10	21-19-18	< 1	Y	181560-18	< 0.1	< 5	NT	2.6	NR	NR	NR	NR	VT-GRN_20.5

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8/8/2018	MA-DFR_28.9	9:10	21-20-18	45.9	Y	181560-19	0.25	11	NT	42.9	21.5	15	high	freshet	
8/8/2018	MA-DFR_26.7	8:30	21-21-18	43.5	Y	181560-20	0.24	13.7	NT	52	22	14.5	moderate	regulated	
8/8/2018	VT-NBD_02.7	8:10	21-2-18	178.5	Y	181560-02	0.32	9.78	NT	102.2	21	18	high	freshet	
8/8/2018	MA-DFR_01.1	7:50	21-22-18	99	Y	181560-21	0.29	15.6	NT	74.3	22.5	19	high	regulated	
8/8/2018	MA-EBN_02.4	9:09	21-23-18	167	Y	181560-22	0.24	9.49	1.58	92.6	22	19	high	freshet	
8/8/2018	MA-GRN_09.8	9:05	21-24-18	579.4	Y	181560-24	0.2	16.1	3.49	80.9	NR	NR	moderate	freshet	
8/8/2018	MA-GRN_02.0	8:35	21-25-18	235.9	Y	181560-25	0.22	17	3.15	118.5	23	20	high	freshet	
8/8/2018	MA-GRN_00.8	9:15	21-26-18	547.5	Y	181560-26	0.39	28.8	5.52	135	NR	NR	moderate	freshet	
8/8/2018	MA-MPL_00.1	8:25	21-27-18	> 2419.6	Y	181560-27	2.31	55.8	3.66	794	23	20	high	freshet	
8/8/2018	MA-CHI_00.1	8:00	21-28-18	48	Y	181560-28	0.21	8.21	NT	104	22	18	moderate	freshet	
8/8/2018	MA-CLS_00.3	8:30	21-29-18	104.6	Y	181560-29	0.45	9.57	NT	158.6	NR	NR	moderate	freshet	
8/8/2018	MA-SOU_02.4	8:30	21-30-18	272.3	Y	181560-30	0.31	10.4	NT	192	21	20	moderate	freshet	
8/8/2018	MA-QCA	8:00	21-31-18	131.4	Y	181560-31	0.29	15.4	NT	80.6	NR	NR	NR	NR	MA-DFR_01.1
8/8/2018	VT-NBD_02.0	8:10	21-3-18	206.4	Y	181560-03	0.3	9.82	NT	106.9	21	18	moderate	base	
8/8/2018	MA-QCB	8:05	21-32-18	< 1	Y	181560-32	< 0.1	6.65	NT	4.5	NR	NR	NR	NR	MA-CHI_00.1
8/8/2018	VT-NBD_01.8	7:55	21-4-18	325.5	Y	181560-04	0.3	10.6	NT	108.3	21	18	moderate	base	
8/8/2018	VT-COB_00.3	7:40	21-5-18	70.6	Y	181560-05	0.23	16.1	1.13	69.3	19	18	moderate	freshet	
8/8/2018	VT-BVR_01.1	7:54	21-6-18	83.3	Y	181560-06	0.26	20.6	NT	76.9	NR	NR	NR	NR	
8/8/2018	VT-EBN_15.0	9:16	21-8-18	166.4	Y	181560-07	0.29	17.5	0.97	68.1	NR	NR	NR	NR	
8/8/2018	VT-EBN_14.7	9:04	21-9-18	137.4	Y	181560-08	0.5	29.3	1.39	69.2	NR	NR	NR	NR	
8/22/2018	VT-QCB	10:30	25-10-18	< 1	Y	181672-10	0.22	505	0.57	225.6	NR	NR	NR	NR	VT-EBN_14.7
8/22/2018	VT-PND_00.1	7:50	25-11-18	2419.6	Y	181672-11	0.51	101	19.5	47.2	19	15	high	freshet	
8/22/2018	VT-NBD_06.4	7:25	25-1-18	579.4	Y	181672-01	0.17	11.5	2.32	130.8	18.5	16	high	freshet	
8/22/2018	VT-GRN_23.4	8:00	25-12-18	> 2419.6	Y	181672-12	0.21	125	48.6	48.3	17	15.5	high	freshet	
8/22/2018	VT-HBG_00.1	7:20	25-13-18	> 2419.6	Y	181672-13	0.42	169	61.6	91	17	16	high	freshet	
8/22/2018	VT-GRN_20.5	8:25	25-14-18	2419.6	Y	181672-14	0.15	79.9	38	78.8	18.5	17	moderate	freshet	
8/22/2018	VT-GRN_20.2	8:25	25-15-18	> 2419.6	Y	181672-15	0.27	104	43.4	76.1	18	16	high	regulated	

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8/22/2018	VT-GRN_16.8	7:59	25-16-18	1299.7	Y	181672-16	0.24	55.5	15.7	80	20	16.8	high	freshet	
8/22/2018	GR-QCA	8:30	25-17-18	> 2419.6	Y	181672-17	0.26	96.6	44.8	75.6	NR	NR	NR	NR	VT-GRN_20.2
8/22/2018	GR-QCB	7:50	25-18-18	< 1	Y	181672-18	0.25	525	0.83	206.7	NR	NR	NR	NR	VT-PND_00.1
8/22/2018	MA-DFR_28.9	9:15	25-19-18	90.6	Y	181672-19	0.26	9.61	1.16	46.9	20.5	16.5	high	freshet	
8/22/2018	MA-DFR_26.7	8:30	25-20-18	> 2419.6	Y	181672-20	0.38	68.3	15.2	61.2	19	15	moderate	regulated	
8/22/2018	MA-DFR_01.1	8:35	25-21-18	461.1	Y	181672-21	0.3	36.9	6.8	83.2	18.5	18.5	high	regulated	
8/22/2018	VT-NBD_02.7	8:10	25-2-18	1203.3	Y	181672-02	0.24	30.7	3.38	97.1	17.5	17	high	freshet	
8/22/2018	MA-GRN_02.0	9:00	25-22-18	2419.6	Y	181672-25	0.36	113	49	148.4	18.5	18.5	high	freshet	
8/22/2018	MA-GRN_00.8	8:50	25-23-18	> 2419.6	Y	181672-26	0.45	136	28.4	179.9	18.5	NR	moderate	NR	
8/22/2018	MA-MPL_00.1	9:28	25-24-18	> 2419.6	Y	181672-27	0.97	271.5	75.8	177.8	20.5	19.5	high	freshet	
8/22/2018	MA-CHI_00.1	8:45	25-26-18	1299.7	Y	181672-28	0.25	33.4	5.53	57.7	19	16	high	freshet	
8/22/2018	MA-CLS_00.3	8:35	25-27-18	1413.6	Y	181672-29	0.36	49.5	6.91	112.9	17	18	high	freshet	
8/22/2018	MA-SOU_02.4	8:45	25-28-18	> 2419.6	Y	181672-30	0.55	138	37.9	132.7	19	16.5	NR	freshet	
8/22/2018	MA-QCB	10:30	25-29-18	< 1	Y	181672-32	NT	515	0.91	219.8	NR	NR	NR	NR	MA-EBN_02.4 - TN Sample lost
8/22/2018	VT-NBD_02.0	8:10	25-3-18	648.8	Y	181672-03	0.24	12.9	1.06	106	18	18	moderate	base	
8/22/2018	VT-NBD_01.8	8:20	25-4-18	920.8	Y	181672-04	0.21	12.5	2.14	106.5	18	18	moderate	base	
8/22/2018	VT-COB_00.3	7:40	25-5-18	218.7	Y	181672-05	0.2	14.5	1.94	76	16.5	16	moderate	freshet	
8/22/2018	VT-BVR_01.1	8:04	25-6-18	648.8	Y	181672-06	0.28	41.8	6.55	78.1	NR	NR	NR	NR	
8/22/2018	VT-EBN_15.0	9:10	25-7-18	1732.9	Y	181672-07	0.35	45.6	8.68	87.2	NR	NR	NR	NR	
8/22/2018	VT-EBN_14.7	9:21	25-8-18	1553.1	Y	181672-08	0.36	49.9	7.52	89.3	NR	NR	NR	NR	
8/22/2018	VT-QCA	7:45	25-9-18	238.2	Y	181672-09	0.2	13.9	1.91	77.5	NR	NR	NR	NR	VT-COB_00.3
9/5/2018	VT-QCB	10:30	29-10-18	< 1	N	181823-10	< 0.1	< 5	NT	9.5	NR	NR	NR	NR	VT-BVR_01.1
9/5/2018	VT-PND_00.1	7:20	29-11-18	13.5	N	181823-11	0.26	9.33	0.6	58.8	NR	NR	low	base	
9/5/2018	VT-NBD_06.4	7:20	29-1-18	79.8	N	181823-01	0.26	5.83	NT	202.6	19	16	low	base	
9/5/2018	VT-GRN_23.4	7:50	29-12-18	32.7	N	181823-12	0.13	6.53	0.47	70.1	17.5	16.5	low	base	
9/5/2018	VT-HBG_00.1	7:00	29-13-18	53.6	N	181823-13	< 0.1	7.23	0.31	110.8	18	15.5	moderate	base	
9/5/2018	VT-GRN_20.5	8:20	29-14-18	63.1	N	181823-14	< 0.1	7.46	0.28	93.4	20	17	low	base	

Date	Site	Time	CRC Sample #	Final E. Coli. (mpn/ 100ml)	Wet? (Y/N)	VAEL Sample #	TN (mg-N/l)	TP (µg P/L)	Turbidity (NTU)	Spec. Cond. (µS/cm)	Air Temp. °C	Water Temp °C	Water Level	Flow Type	Sample or QA Notes:
9/5/2018	VT-GRN_20.2	8:30	29-15-18	60.9	N	181823-15	< 0.1	6.97	0.42	93.3	19	17	moderate	base	
9/5/2018	VT-GRN_16.8	8:55	29-16-18	101.4	N	181823-16	< 0.1	7.39	0.43	103.1	18	17.5	moderate	base	
9/5/2018	GR-QCA	8:15	29-17-18	129.1	N	181823-17	< 0.1	6.34	NT	132	NR	NR	NR	NR	VT-GRN_16.8
9/5/2018	GR-QCB	8:55	29-18-18	< 1	N	181823-18	< 0.1	< 5	NT	6.5	NR	NR	NR	NR	MA-GRN_09.8
9/5/2018	MA-DFR_28.9	8:30	29-19-18	34.5	N	181823-19	0.24	7.23	NT	51.4	18.5	17.5	low	base	
9/5/2018	MA-DFR_26.7	8:50	29-20-18	57.3	N	181823-20	0.24	9.96	NT	75.3	2NR	17	moderate	regulated	
9/5/2018	MA-DFR_01.1	8:50	29-21-18	111.2	N	181823-21	0.32	11.4	NT	80.7	22	22	low	base	
9/5/2018	VT-NBD_02.7	7:55	29-2-18	178.5	N	181823-02	0.33	13.2	NT	164.4	18	17	low	base	
9/5/2018	MA-EBN_02.4	8:40	29-22-18	93.3	N	181823-22	0.25	7.01	NT	118.4	22	18	low	base	
9/5/2018	MA-GRN_09.8	8:15	29-23-18	55.6	N	181823-24	0.68	5.8	0.92	133.2	NR	NR	moderate	base	
9/5/2018	MA-GRN_02.0	9:30	29-24-18	238.2	N	181823-25	0.33	9.61	0.82	191.8	24	20	low	base	
9/5/2018	MA-GRN_00.8	9:15	29-25-18	285.1	N	181823-26	0.46	22.8	1.78	199.8	25	NR	low	base	
9/5/2018	MA-MPL_00.1	9:41	29-26-18	> 2419.6	N	181823-27	2.15	42.8	2.57	896	24	18	low	base	
9/5/2018	MA-CHI_00.1	8:30	29-27-18	90.6	N	181823-28	0.11	6.84	NT	130.9	20	19	moderate	base	
9/5/2018	MA-CLS_00.3	8:00	29-28-18	57.3	N	181823-29	0.43	7.87	NT	173.8	18	17.5	NR	NR	
9/5/2018	MA-SOU_02.4	10:48	29-29-18	68.3	N	181823-30	0.28	8.58	NT	200	27	20	moderate	base	
9/5/2018	MA-QCA	8:34	29-30-18	75.4	N	181823-31	0.5	10.5	NT	117	NR	NR	NR	NR	MA-EBN_02.4
9/5/2018	MA-QCB	8:30	29-31-18	118.2	N	181823-32	0.25	7.88	NT	49.8	NR	NR	NR	NR	MA-DFR_28.9
9/5/2018	VT-NBD_02.0	8:15	29-3-18	198.9	N	181823-03	0.31	8.27	NT	166.7	18	18	low	base	
9/5/2018	VT-NBD_01.8	8:05	29-4-18	261.3	N	181823-04	0.31	8.65	NT	167.9	17	18	low	base	
9/5/2018	VT-COB_00.3	7:30	29-5-18	4.1	N	181823-05	0.22	8.75	1.67	99.5	18	18	low	base	
9/5/2018	VT-BVR_01.1	8:02	29-6-18	105.4	N	181823-06	0.31	16.5	NT	143.7	NR	NR	NR	NR	
9/5/2018	VT-EBN_15.0	8:48	29-7-28	198.9	N	181823-07	0.29	12.4	NT	115.6	NR	NR	NR	NR	
9/5/2018	VT-EBN_14.7	9:00	29-8-18	290.9	N	181823-08	0.26	18.4	NT	111.8	NR	NR	NR	NR	
9/5/2018	VT-QCA	8:48	29-9-18	248.9	N	181823-09	0.27	13.4	NT	107.6	NR	NR	NR	NR	VT-EBN_15.0