

Allen Brook Water Quality Monitoring 2017 Final Report

Background

The Williston Conservation Commission (WCC) is pleased to submit this Report to summarize the results of the 2017 sampling season under the LaRosa Partnership program. The principal objectives of projects under this program are to 1) provide a perspective on the range of water quality conditions across Vermont; 2) describe water quality conditions of individual waterbodies; 3) establish a data base for waterbodies for use in documenting future changes in water quality; and, 4) educate and involve local residents in waterbody protection.

The Allen Brook is a tributary of the Winooski River that is located entirely in the Town of Williston. Its watershed is approximately 14.5 square miles in size. The mainstem of Allen Brook is approximately 11 miles long from its headwaters in the Sunset Hill area of Williston to its confluence with Muddy Brook just before Muddy Brook empties into the Winooski River. Ten small tributaries to the brook are evident on aerial photographs of the watershed, most of which are ephemeral.ⁱ According to the State of Vermont, the Allen Brook is a Class B waterway, and should therefore be suitable for “aquatic habitat, boating, swimming and public water supply with filtration and disinfection.” Since 1992, portions of the Allen brook have been designated as “impaired” by stormwater and *E.coli* on the State’s 303(d) Impaired Waters List.ⁱⁱ The Allen Brook and its watershed have experienced many stressors in the recent and not-so-recent past, including historic impacts from floodplain encroachment (especially in developed areas), road crossings (15 total), historic straightening to protect agricultural resources and infrastructure, and natural influences like beaver activity. The Town of Williston has also experienced rapid growth over the past two decades, both in its residential population (78% increase) and as a center of employment (135% increase in working population).ⁱⁱⁱ Land use changes have been equally dramatic, and development has resulted in marked increases in impervious surface within the watershed. Though municipal stormwater and stream buffer regulations have been adopted to reduce future impacts from development, the Allen Brook flows directly through several areas where the Town intends to concentrate future growth (Industrial, Medium Density Residential, and Mixed Use Zoning Districts). Therefore it is important that the current *E.coli* and stormwater impairment of Allen Brook be accurately characterized and addressed before contamination worsens or becomes irreversible.

The Allen Brook monitoring program aims to characterize the spatial and temporal patterns of *E.coli* and nutrient contamination in Allen Brook. The information is used by the Williston Conservation Commission to identify potential sources of pollution, target remediation efforts, and direct public education and awareness surrounding watershed health, water quality, and stormwater contamination.

Sampling Methods and Quality Assurance

In 2017, the WCC sampled 8 locations along the Allen Brook (Figure 1, Table 1). The parameters sampled included Total Phosphorus (TP), *E. coli*, and Turbidity (NTU).

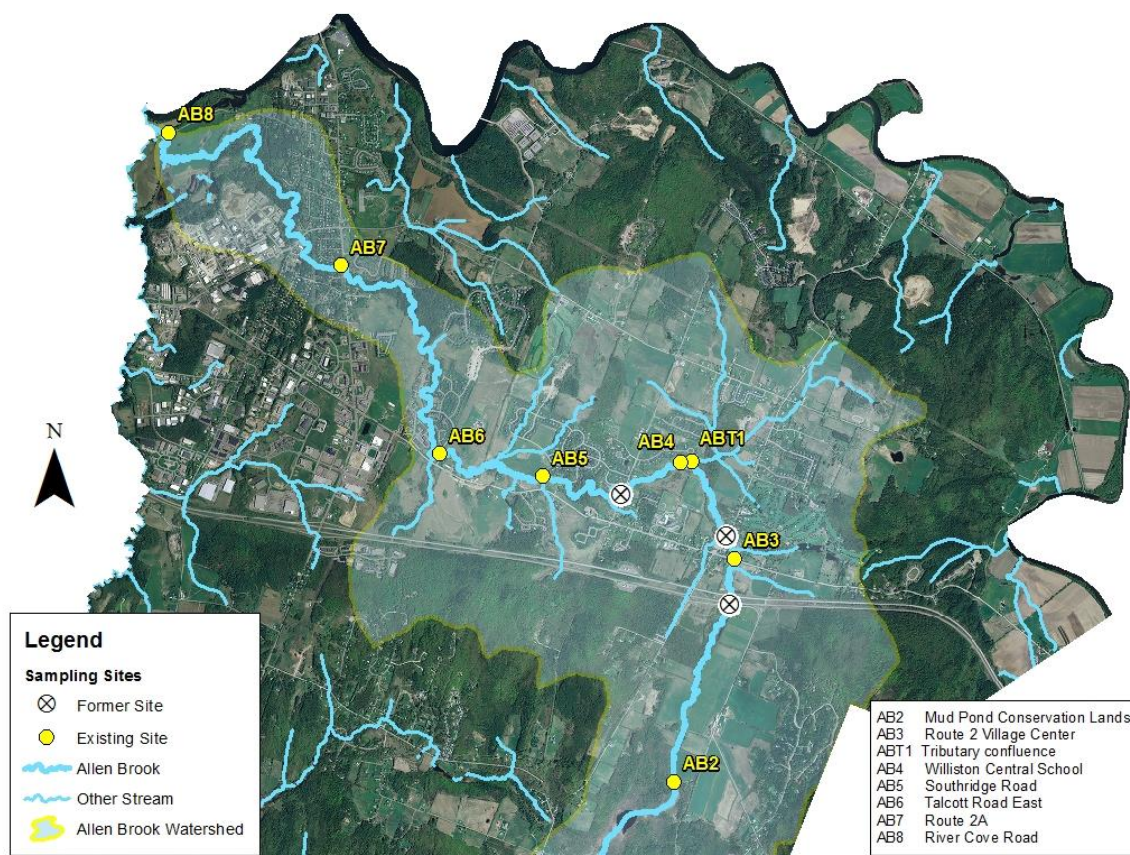


Figure 1: 2017 Allen Brook Sampling Sites

Table 1: 2017 Allen Brook Sampling Site Location Descriptions

Site	Description
AB2	Mud Pond Conservation Land, downstream of pond. Has been a sampling site for TN (2007-2013), TP (2007-Present), E.coli (2007-Present), Chloride (2010-2013), and Turbidity (2010-present)
AB3	Upstream of Route 2 crossing in Village Center. Has been a sampling site for TN (2007-2013), TP (2007-present), E.coli (2007- present), Turbidity (2010- present)
ABT1	Major tributary north of Central School ball fields, downstream of beaver lodge. Has been a sampling site for TN (2008,2010), TP (2008-present), E.coli (2010), Turbidity (2010-present)
AB4	Williston Central School- behind ball fields, south of 338 Southfield Drive (access through this yard). Has been a sampling site for TN (2007- 2010, 2013), TP (2007- present), E.coli (2007- present), Chloride (2010), Turbidity (2010- present)
AB5	Just upstream of Southridge Road crossing. Has been a sampling site for TN (2007-2010), TP (2007- present), E.coli (2007,2010), Chloride (2010), Turbidity (2007- present)

AB6	Just upstream of Talcott Road East crossing (access from Fire Station). Has been a sampling site for TN (2007-2013), TP (2007-present), <i>E. coli</i> (2007- present), Chloride (2010- 2013), Turbidity (2010- present)
AB7	Under Route 2A crossing (large culvert). Has been a sampling site for TN (2007- 2010), TP (2007- present), <i>E.coli</i> (2007- 2008), Chloride (2010), Turbidity (2007, present)
AB8	Just upstream of River Cove Road crossing. Has been a sampling site for TN (2007- 2013), TP (2007- present), <i>E.coli</i> (2007- 2010), Chloride (2010- 2013), Turbidity (2010- present)

Prior to the 2017 sampling season, the WCC developed a Quality Assurance Project Plan (QAPP)^{iv}, which was approved by the Vermont Department of Environmental Conservation (DEC). The QAPP specifies several objectives related to data precision, accuracy, completeness and representativeness during data collection, laboratory processing and data analysis. A detailed description of sampling methods is available in the Quality Assurance Project Plan.

The QAPP specifies that at least 80% of the anticipated number of samples will be collected, analyzed and determined to meet data quality objectives for the project to be considered successful. The Williston Conservation Commission met the objectives for the 2017 season (see Table 2). We sampled 15 out of 16 planned sampling dates. On September 6, we did not collect samples at AB5 because a stormwater pond access drive was under construction on that day. On September 20 we did not collect samples at AB4 and ABT1 because beaver traps had been set and it was not safe to access the site. Although we collected *E. coli* samples on September 20, they were not processed by the laboratory.

Table 2: Project Completeness

Parameter	Number of Samples Anticipated	Number of Valid Samples Collected & Analyzed	Percent Complete
Total Phosphorus	8 sites, 16 weeks = 128	5 sites, 15 weeks/3 sites, 14 weeks = 117	91%
Turbidity	8 sites, 16 weeks = 128	5 sites, 15 weeks/3 sites, 14 weeks = 117	91%
<i>E. coli</i>	4 sites, 8 weeks = 32	4 sites, 7 weeks = 28	88%
Temperature	8 sites, 16 weeks = 128	8 sites, 16 weeks = 128	100%

Sampling protocol requires at least one Field Duplicate and one Field Blank to be submitted for every ten samples collected. Field Duplicate serves as a check on water quality, sampling & analysis consistency. This is a replicated sample collected at the same point in time and space so as to be considered identical. A Field Duplicate is a second sample from a second sampling event, collected immediately after the first sampling. Otherwise put, these separate samples are said to represent the same population and are carried through all steps of the sampling and analytical procedures in an identical manner. They are used to assess precision of the total method, including sampling, analysis, and site heterogeneity.

The Field Blank checks for contamination (Accuracy/Bias) in the field by processing laboratory-supplied de-ionized through the sampling train. This checks for contamination introduced from the sample container(s) or from field contamination.

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We obtained the required number of Duplicates/Blanks for Phosphorus and Turbidity; however we came up short of the required number for *E. coli*. Although we submitted *E. coli* Duplicates/Blanks to the laboratory on 7/5, 8/2, and 8/17, they were not processed for reasons unknown to us.

The Field Duplicates and Field Blanks were subsequently analyzed for consistency and samples with values outside acceptable ranges (Table 3) were identified.

Table 3: Acceptable Range of Values for Field Duplicate and Field Blank

Parameter	Field Duplicate – Relative Percent Difference (RPD)	Field Blank
Total phosphorus	≤ 15%	≤ 5 ug/l
<i>E. coli</i>	≤ 50%	≤ 1 colony/100 ml
Turbidity	≤ 15%	≤ 0.2 NTU

The following samples returned high RPD values but were retained since they all fell within the normal range for the parameter and site.

<u>Site Number</u>	<u>Parameter</u>	<u>RPD</u>
170612-02	TP	28.57%
170831-04	<i>E. coli</i>	38.6%
171090-08	NTU	-16.62%
171163-01	TP	27.86%
171389-07	NTU	-19.43%

None of the blanks have unacceptably high values. Complete monitoring data are provided in Appendix A. Original field data sheets are attached as Appendix B.

Results

Relationship to Stream Discharge/Flow

Flow (discharge magnitude) can dramatically affect certain water quality parameters, thus it is important to record flow observations during data collection. Streamflow was documented during each sampling day using both qualitative (descriptive) and quantitative methods. A quantitative discharge measurement in a gaged stream is the most precise method. In the fall of 2016 a new gaging station was installed on Allen Brook at the Route 2A crossing, replacing the former USGS stream gage. Discharge was calculated from field measurements of the staff gage at the gaging station collected during sampling events (See Table 4) and a USGS rating table (see Appendix C).

Table 4: Measured Height at Allen Brook USGS Stream Gage and Estimated Daily Mean Discharge

Date	Staff Gage Reading	Daily Mean Discharge
7-Jun	2.20	56.20
14-Jun	1.20	2.38
21-Jun	1.50	7.62
28-Jun	1.50	7.62
5-Jul	1.38	4.94
12-Jul	1.28	3.33
19-Jul	1.14	1.82

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26-Jul	1.22	2.60
2-Aug	1.02	1.02
9-Aug	1.14	1.82
17-Aug	1.08	1.37
23-Aug	1.50	7.62
6-Sep	1.74	16.53
13-Sep	1.18	2.18
20-Sep	0.96	0.74

Figure 2 below shows June – September 2017 daily precipitation plotted with Allen Brook observed discharge. Daily precipitation records were obtained from NOAA Online Weather Data.^v

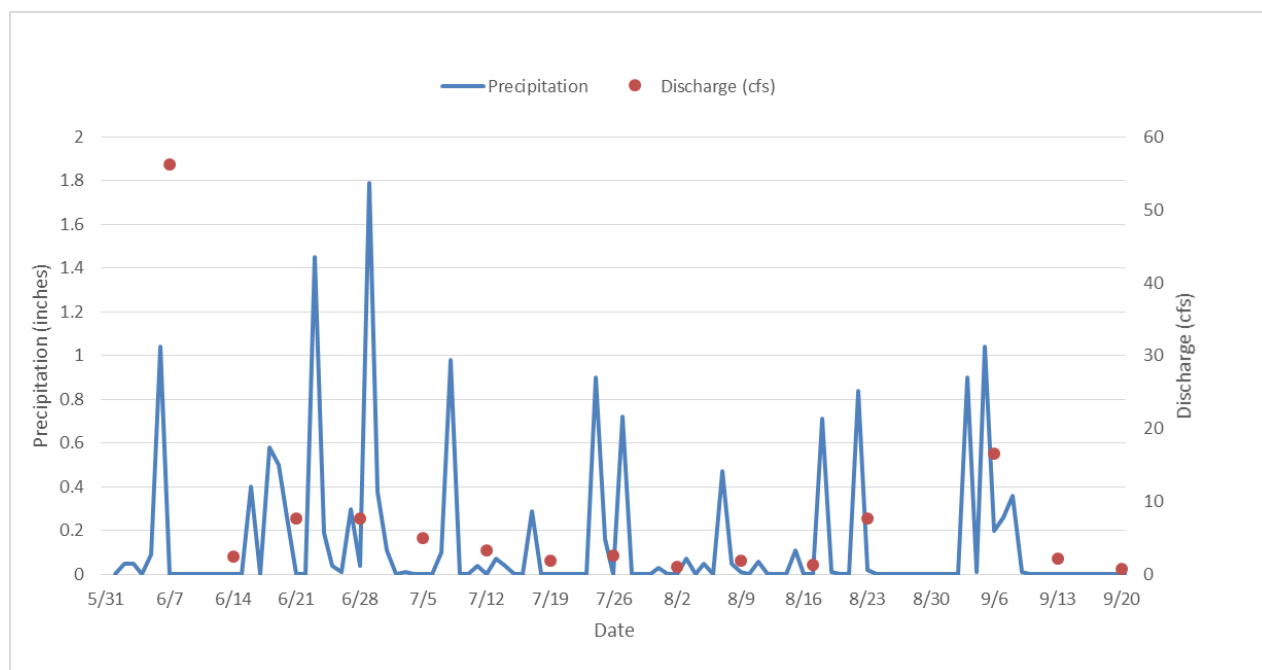


Figure 2: 2017 Daily Precipitation and Allen Brook Observed Discharge

During the 2017 field season, June was abnormally wet, while July had overall normal precipitation and August/September was slightly drier than normal. Baseflow conditions were prevalent on sampling dates despite frequent heavy rainstorms. This is characteristic of flashy streams, which exhibit very high flows immediately following heavy rain events, and then the stream flow quickly subsides. By far the highest flow (56 cfs) occurred on June 7, following a 1.04 inch rain event on June 6. By June 15, flow had receded to baseflow conditions. On June 16 and 18, there were two moderate rain events (~half-inch), which led to slightly elevated flows on June 21. On June 23, the area received 1.45 inches of rain. However, by the next sampling date on June 28, the stream was near baseflow. On June 29, we received 1.79 inches of rain. By July 5 the stream was again near baseflow. July saw three additional significant rain events on 7/8, 7/24 and 7/27. However, none of these were reflected in flows measured on 7/12, 7/26 and 8/2. Streamflow rose to 7.62 on 8/23, following a .84 inch rain event on 8/22. A dry spell prevailed from 8/23 to 9/2. Streamflow spiked once more on 9/6, following two ~1 inch rain events on 9/3 and 9/5. Dry weather prevailed until the end of the sampling season.

Figures 3-5 show the relationship of the water quality parameters collected to measured stream flow. *E. coli* levels did not appear to be correlated to flows. The bacteria counts were only slightly elevated at all sites during the first high flow on June 7. During the high flow of September 6, bacteria levels varied across sites. On that date the upstream sites AB2 and AB3 had relatively low *E. coli* levels and downstream sites AB4 and AB6 had high *E. coli* counts. During all other sampling dates, bacteria counts at all sites were low except for AB4 on August 2.

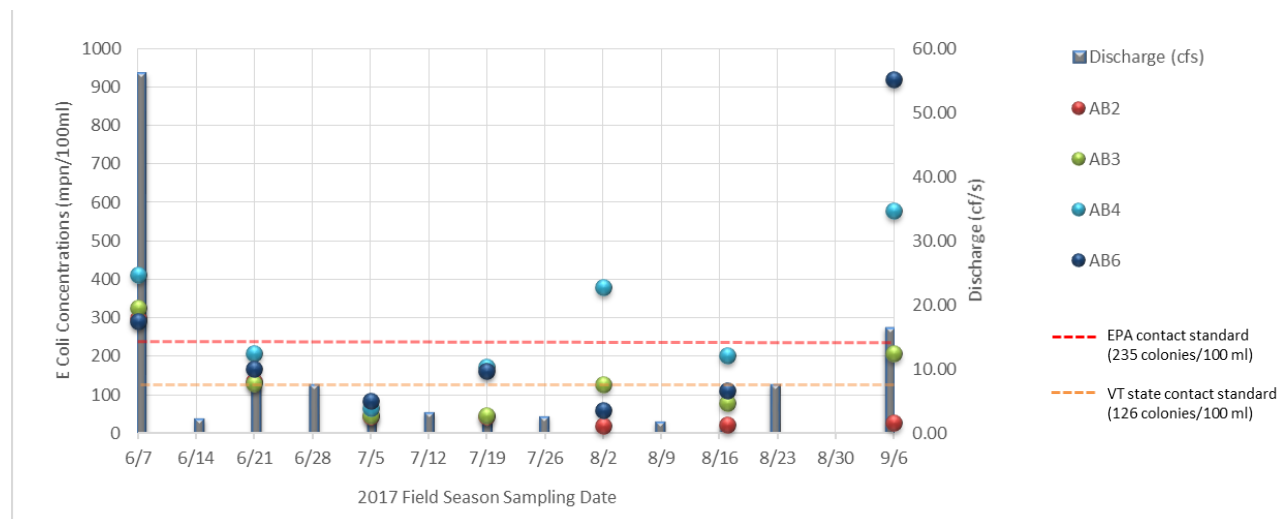


Figure 3: *E. coli* concentrations along the Allen Brook in relation to stream flow.

Phosphorus concentrations were the highest across all sites during the two high flow events (6/7 and 9/6). ABT1 and AB4 were heavily influenced by beaver activity all season long, and tended to have consistently high phosphorus concentrations, most likely due to the excess sedimentation at those sites. At base flows, all other sites had consistently low phosphorus concentrations.

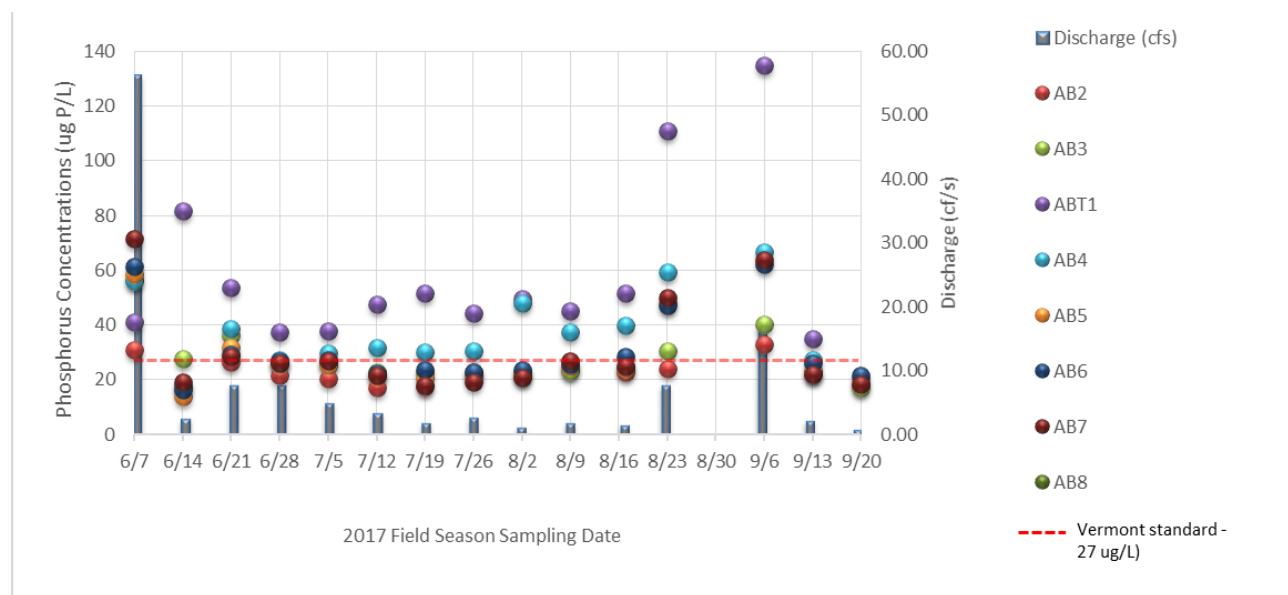


Figure 4: Phosphorus concentrations along the Allen Brook in relation to stream flow.

Turbidity concentrations were significantly elevated during the June 7 high flow event. On that sampling date turbidity concentrations increase predictably from upstream to downstream. However, during the 9/6 high flow event, turbidity concentrations at all sites were only elevated slightly. Turbidity was consistently high at sites AB8 and ABT1.

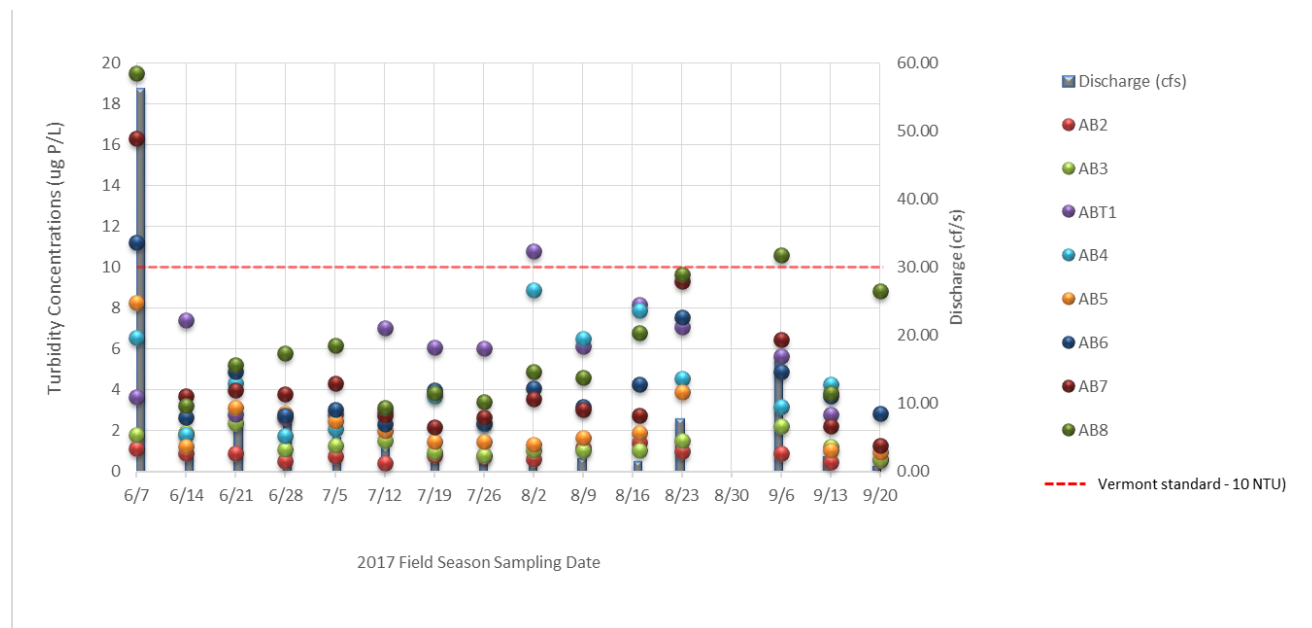


Figure 5: Turbidity levels along the Allen Brook in relation to stream flow.

The upper watershed site AB2 had consistently low concentrations for all parameters, regardless of flow conditions. This likely reflects the water storage and buffering capacity of the generally forested land cover in the upper watershed, as compared to the greater urbanization and impervious cover in the lower watershed.

Attainment of State Water Quality Standards

Allen Brook is classified as a Class B Cold Water Fish Habitat stream. The water quality criteria established by the State of Vermont Water Quality Rules^{vi} are as follows:

- Turbidity: Not to exceed 10 NTU (nephelometric turbidity units) as an annual average under dry weather base-flow conditions.
- *E. coli*: Not to exceed a geometric mean of 126 organisms /100ml obtained over a representative period of 60 days, and no more than 10% of samples above 235 organisms/100 ml.
- Total Phosphorus: Not to exceed 27 µg/L at low median monthly flow during June through October in a section of the stream representative of well-mixed flow.

E. coli

E. coli was sampled on seven days (approximately every other week) during the 2017 sampling season, at sites AB2, AB3, AB4 and AB6 (Table 5). At all sites, more than 10% of samples exceeded the Vermont water quality standard of 235 organisms/100 ml. Notably, site AB4 exceeded the standard on 3 out of 7

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sampling events. Splitting the sampling season into two 60-day periods, the geometric mean of sites AB4 and AB6 exceeded the water quality standard of 126 organisms/100ml during both June/July and July/August. Sites AB2 and AB3 were in attainment of the standard during this period.

Table 5: 2017 Allen Brook sites *E. coli* data (mpn/100ml)

Date	Sampling Site			
	AB2	AB3	AB4	AB6
6/7/2017	298.66	325.54	410.58	290.93
6/21/2017	135.4	129.63	206.35	166.95
7/5/2017	43.47	46.38	65.04	83.61
7/19/2017	43.47	46.22	172.33	161.62
8/2/2017	18.49	127.4	378.44	58.78
8/17/2017	22.55	79.76	201.42	110.61
9/6/2017	26.53	206.35	579.43	920.84
GEOMEAN (6/7 - 8/2)	67.61	102.88	204.70	131.00
GEOMEAN (7/5 - 9/6)	29.11	85.22	218.24	151.91

Geomean above 126 mpn/100ml

Above 235 mpn/100ml

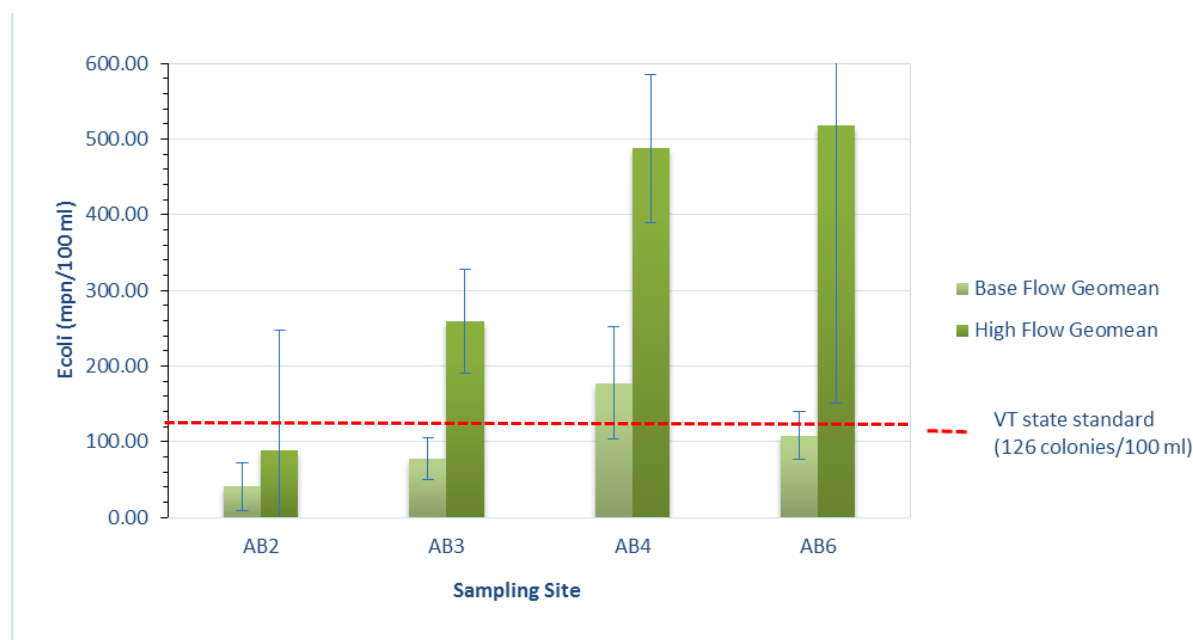


Figure 6: 2017 Allen Brook sampling sites *E. coli* concentrations (mpn/100ml) geometric mean and 90% confidence interval for base flow (n=5) and high flow (n=2).

The geometric mean for each site was calculated for sampling events during high (n=2) and base flow (n=5) conditions over the entire 2017 sampling season (Figure 6). Notably, AB2 and AB3 both had low *E. coli* counts during baseflow conditions. In contrast, AB4 and AB6 have especially high *E. coli* counts during high flow conditions.

Phosphorus

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Phosphorus was sampled at each site once per week from June 7 – September 20. The geometric mean for each site was calculated for sampling events during high (n=2) and base flow (n=15) conditions over the entire 4-month 2017 season (Figure 7).

Table 6: 2017 Allen Brook sites phosphorus data (ug/L) sampled at low median monthly flow. Two high flow events on 6/7 and 9/6 were excluded.

Date	Sampling Site							
	AB2	AB3	ABT1	AB4	AB5	AB6	AB7	AB8
6/14/2017	17.6	27.6	81.7	17.5	13.7	16.2	19.2	17.6
6/21/2017	26.4	36.1	53.5	38.5	31.8	29.2	28.6	28.7
6/28/2017	21.7	25.8	37.4	27.3	26.5	26.8	26.2	26.8
7/5/2017	20.4	26.1	38	29.6	25.3	27.4	26.9	28.2
7/12/2017	16.9	22.7	47.6	31.9	21.1	22.5	21.4	18.6
7/19/2017	17.4	22.3	51.8	30	20.2	23.6	18.1	16.1
7/26/2017	22.7	22	44.5	30.3	21.1	22.8	19.2	18.2
8/2/2017	22.9	22.5	49.5	48.1	21.3	23.4	20.9	18.3
8/9/2017	23.7	23.1	45.3	37.3	24.9	25.7	26.8	20.9
8/17/2017	22.8	24.7	51.5	39.7	23.8	28.6	24.9	23.5
8/23/2017	23.9	30.7	111	59.3	47.9	47.1	49.9	45.4
9/13/2017	21.8	22.7	35	27.1	23.2	26.1	21.8	32
9/20/2017	18.2	17			20.3	21.5	18.2	20.4
GEOMEAN	21.1	24.5	50.9	33.2	23.7	25.5	23.8	23.2

Above 27 ug/L

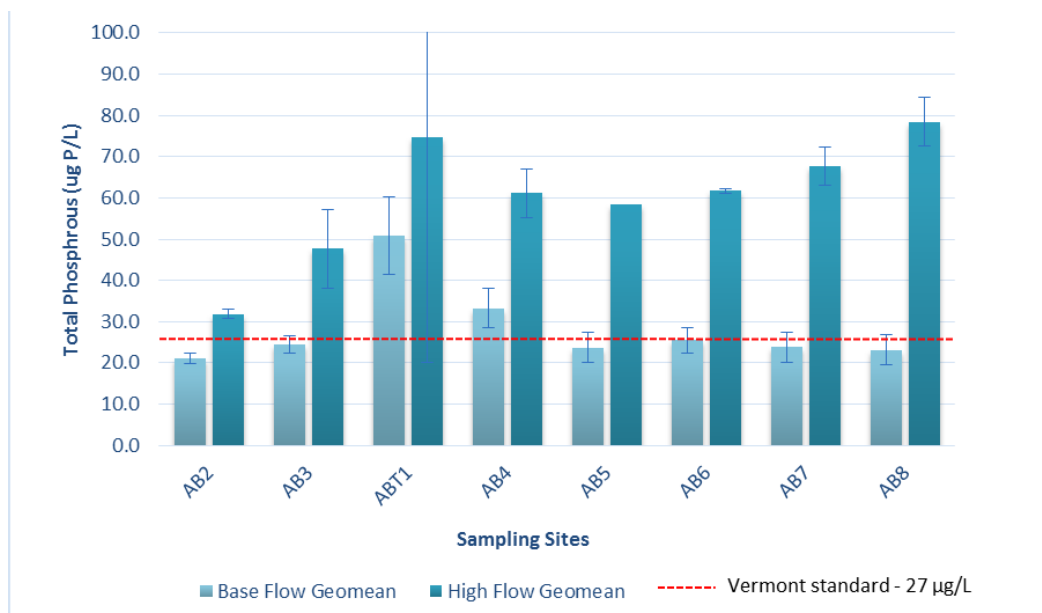


Figure 7: 2017 Allen Brook sampling sites phosphorus concentrations (ug/L) geometric mean and 90% confidence interval for base flow (n=15) and high flow (n=2) .

During the 4-month period, during base flows 64 out of 102 sampling events (63%) yielded phosphorus concentrations meeting Vermont water quality standards (< 27 ug/L) (Table 6). In 2017 the geometric mean of all sites except for AB4 and ABT1 were at or below the Vermont water quality standard of 27 ug/L at

base flow conditions. In contrast, during high flow conditions phosphorus concentrations were elevated at all sites, particularly ABT1 where phosphorus concentrations were also highly variable.

Turbidity

Turbidity was sampled at each site once per week from June 7 – September 20. The geometric mean for each site was calculated for sampling events during high (n=2) and base flow (n=15) conditions over the entire 4-month 2017 season (Figure 8). During the 4-month period, all sites met the Vermont water quality standards for 10 NTU at base flow conditions. The lower watershed sites of AB5, AB6, AB7 and AB8 had markedly higher mean turbidity at high flow conditions than at base flow conditions. Sites AB2 and AB3 consistently had the lowest NTU concentrations.

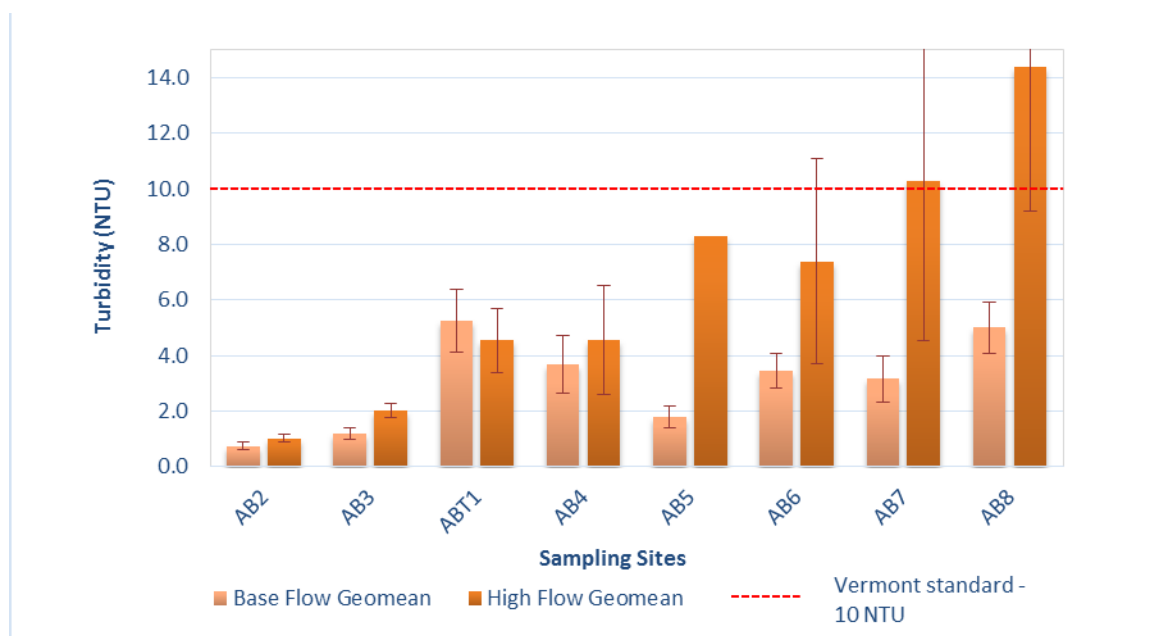


Figure 8: 2017 Allen Brook sampling sites turbidity concentrations (NTU) geometric mean and 90% confidence interval for base flow (n=15) and high flow (n=2).

Data Trends over Time

To characterize and compare the sampling data gathered from 2007-2017 (no samples were taken in 2009), the median concentration of each parameter was calculated for each monitoring site for each year. Below is a summary of the findings for each parameter.

E. coli

Concentrations of *E. coli* are quite variable across sites and over time (Figure 9). Site AB2 is the furthest upstream site, located within a protected wetland area. Sites AB4 and AB6 are both located downstream of residential development. Site AB 3 is located downstream from agricultural uses. Site AB2 was the only sampling location to consistently remain under 126 mpn/100ml (VT state contact standard), except for 2012. This trend makes sense as AB2 is situated in a conservation area where the only inputs would be wildlife related. Over the 10 year sampling period, site AB4, located behind the Allen Brook elementary school, averaged the highest *E. coli* concentrations. The high *E. coli* concentrations could be due to pet waste, as the site is near a popular dog-walking route; it could also be due to upstream beaver activity, which is common.

The high *E. coli* concentrations in 2011 are likely reflective of the high flow events associated with Tropical Storm Irene in August of that year and other significant runoff events that occurred in June. Notably, in 2016 site AB3 had unusually high *E. coli* concentrations, the reason for which is unclear and needs further exploration. It may be due to a change in agricultural practices at the dairy farm just upstream of the site.

Source sampling (DNA testing) at sites AB3, AB4 and AB6 could be valuable for determining the origin (human, bovine, etc.) of these *E. coli* concentrations, and the Conservation Commission is looking into sources of funding for this effort. If the *E. coli* at AB3 was determined to be bovine in origin, the farmland bordering the Allen Brook between sites AB2 and AB3 should be checked to ensure that there is an appropriate sized buffer between the fields and the stream. Also, it might be worthwhile to try and raise awareness amongst the farmers to try and not spread manure during or before significant rain events. This phenomenon will undoubtedly improve with the new Required Agricultural Practices that prohibit manure spreading when field conditions are conducive to runoff or if runoff events are anticipated.

Phosphorus: Over the ten year sampling span, 77% of the samples are above the Vermont Standard (27 ug-P/L).^{vii} From 2012 to 2014, phosphorus concentrations appear to decrease across all sites, followed by a sharp rise in 2015. Since 2015, there has been a downward trend at most sites, with ABT1 being the exception. Since 2011, site AB2 has had consistently low total phosphorus concentrations. The decrease in phosphorus concentrations at this site may be related to the implementation of agricultural BMPs, which reduce the amount of sediment and phosphorus entering the Allen Brook.

From 2011 to 2014, the Town implemented several riparian buffer plantings in the lower watershed near sites AB3, AB4, ABT1, AB5 and AB6. In addition, 22 developments (mostly residential) will be implementing substantial improvements to their stormwater treatment systems in order to comply with current State standards

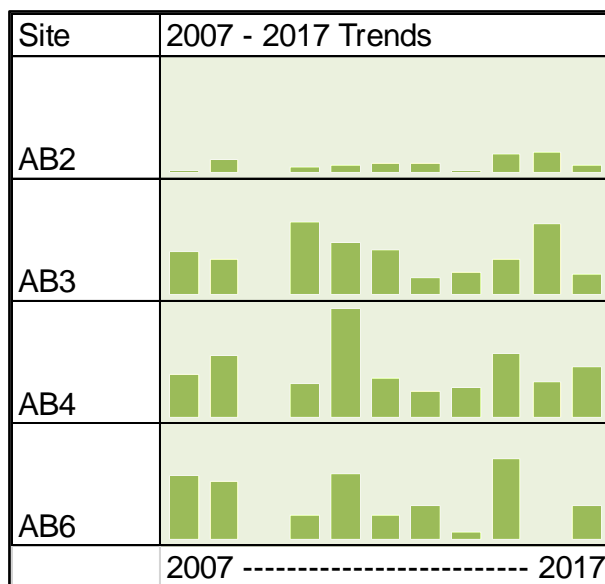


Figure 9: 2007 to 2017 Median *E. coli* Concentrations (mpn/100ml). No sampling occurred in 2009.

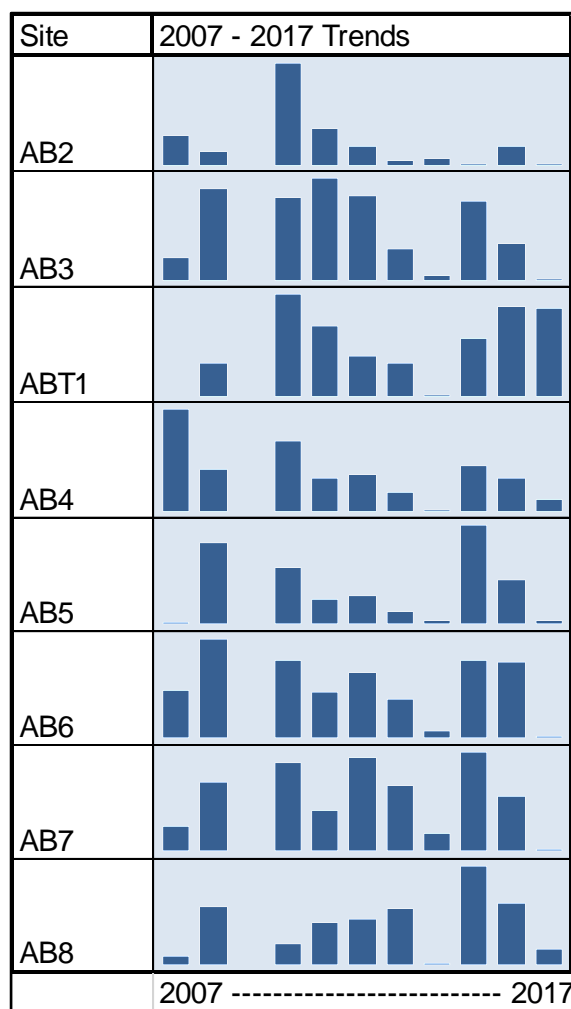


Figure 11: 2007 to 2017 Median Total Phosphorus Concentrations (ug/L). No sampling occurred in 2009.

over the next few years. We anticipate future decreases in phosphorus concentrations over time, although it might be several years before these management practices yield improvements.

Turbidity: Turbidity was consistently below the State water quality threshold of 10 NTU for a cold water stream. Looking at the median values for every site over the 8 year period shows that only site AB8 has a median over 10 NTU. Over the nine year sampling span, only 11% of the samples exceeded the Vermont cold water fish habitat standard of 10 NTU.

Sites AB2, AB3, AB5 and AB7 had the lowest turbidity, while sites AB8 and ABT1 had the highest turbidity. Notably, AB8 is downstream from an area of industrial development which may be responsible for some illicit discharge or stream buffer encroachment. Also, the Allen Brook travels through an area of severely eroded farmland along River Cove Road immediately upstream from site AB8. This site, the Griswold Farm, was the site of a 4 acre streambank restoration project in 2012-2013 which is being managed by Friends of the Winooski River. From 2012 - 2014 stream buffer restoration projects were implemented along other stretches of the Allen Brook in the vicinity of sampling points AB3, AB4, AB5 and AB6 with the intention of reducing stream bank erosion. It may take additional time for stabilization to occur along this corridor and to be reflected in the sampling results.

Conclusion/Lessons Learned

Ten years of data collection and analysis are revealing some trends, while other parameters remain variable across sites and over time. Nutrient and *E. coli* concentrations appear to have weak correlations to stream discharge, with higher pollutant concentrations following peak stream flows. However, these correlations are not consistent. Pollutant concentrations at downstream sites are highly sensitive to changes in stream flow, which is likely due to the increased development density in the downstream portion of the Allen brook watershed. The newly established flow monitoring station at AB7 will help to ensure continuous accurate flow measurements on the Allen Brook, including base flow.

Since 2007 annual median phosphorous concentrations have trended upward and downward. It is unclear what is causing these changes in trends; however, we would expect to begin to see a steady downward trend as water quality issues are addressed at both the local and state level. Changes in agricultural practices can have marked effects on water quality and may be influencing the water quality trends at site AB3. The riparian buffer restoration projects completed from 2008-2014 likely had at least an initial positive impact

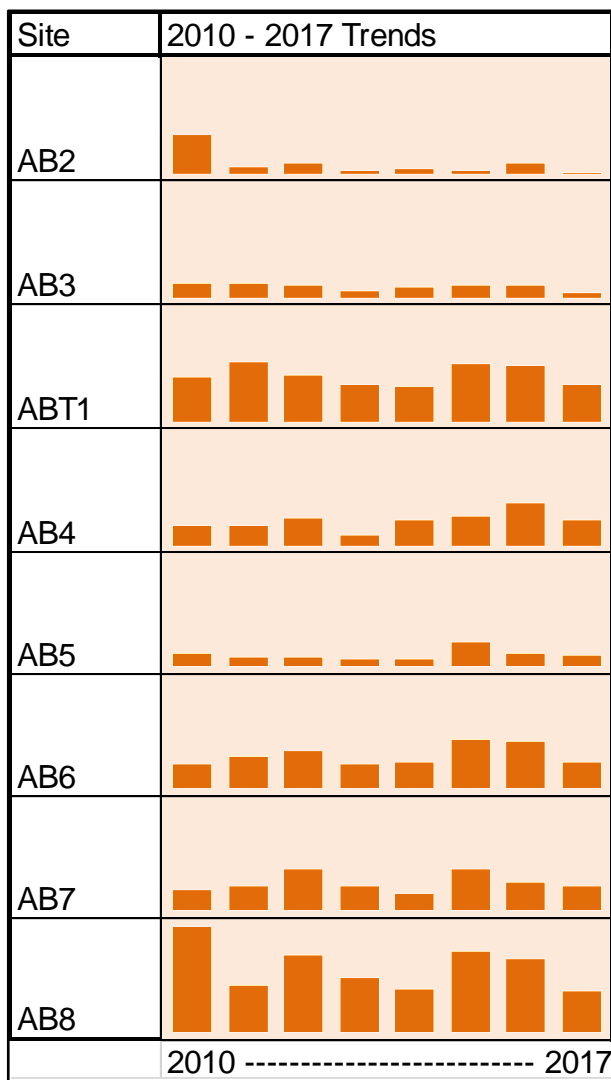


Figure 10: 2010 to 2017 Median Turbidity Concentrations (NTU)

on water quality; however, the increasing density of residential development near AB4, ABT1, AB5 and AB6 is a confounding factor. On the positive side, 22 residential subdivisions are substantially upgrading their stormwater infrastructure over the next several years, which is expected to result in water quality improvements. Continuing to track phosphorus over time along a gradient of land uses will help determine the effectiveness of these management practices.

Concentrations of *E. coli* are quite variable across sites and over time. Site AB2, the furthest upstream site and located within a protected wetland area, was the only sampling location to consistently remain below 126 mpn/100ml (VT state contact standard). The evidence to date suggests that overland stormwater runoff is a major factor in Allen Brook's bacteria and nutrient impairment, although other contributory sources may also exist. Sites where *E. coli* concentrations were most elevated are located along a section of Allen Brook that flows through medium density suburban developments. The biological source (human vs. other animal) of *E. coli* contamination should be identified so that remediation efforts can be planned for and implemented.

With the exception of AB8, median values for turbidity at all other monitoring sites are well below the Vermont cold water fish habitat standard of 10 NTU. Over the eight year sampling span, only 11% of the samples exceeded this standard. The industrial complex in the vicinity of AB8 should be checked to ensure that there is no illicit discharge contributing to turbidity concentrations at AB8. Continuing to test turbidity levels will help determine if BMP implementation projects designed to reduce peak flows and stream bank erosion positively impact the stream. However, in successive field seasons it should be sufficient to sample turbidity less often, perhaps only for one base flow and one high flow event.

It is a primary objective of the WCC to ensure that the Allen Brook provides high-quality habitat for aquatic and riparian organisms, as well as opportunities for safe public recreation, including swimming, wading, and fishing. Meeting these objectives will involve addressing the *E. coli* and nutrient problems which have placed the brook on the State's 303(d) list of impaired waters. Continued water quality monitoring is an important step in this process and will complement the State's efforts to implement a TMDL for Allen Brook.

As a clearer picture of bacteria and nutrient contamination in Allen Brook emerges, the Town and WCC are developing strategies for improvement of water quality. Watershed-wide strategies include stringent and thorough review of development projects to ensure they meet current State stormwater standards, working with property owners to bring old stormwater infrastructure up to current standards, maintaining the Town's existing riparian buffer restoration projects, supporting efforts to implement additional buffer planting projects, and working to conserve and protect floodplains and upland forests.

References

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- ^v NOAA Online Weather Data, accessed at <http://w2.weather.gov/climate/xmacis.php?wfo=btv>
- ^{vi} State of Vermont Agency of Natural Resources Department of Environmental Conservation, 2016. *Vermont Water Quality Standards Environmental Protection Rule Chapter 29(a)*. Accessed February 16, 2018 at http://dec.vermont.gov/sites/dec/files/documents/wsmd_water_quality_standards_2016.pdf.
- ^{vii} State of Vermont Agency of Natural Resources Department of Environmental Conservation, 2016. *Vermont Water Quality Standards Environmental Protection Rule Chapter 29(a)*. Accessed February 16, 2018 at http://dec.vermont.gov/sites/dec/files/documents/wsmd_water_quality_standards_2016.pdf.

Appendix A: 2017 Allen Brook Water Quality Monitoring Data

Sample Number	Location	Date	Water Temp	E. Coli (mpn/100 ml)	RPD Ecoli Dupe (%)	TP (ug P/L)	RPD TP Dupe (%)	Turbidity (NTU)	RPD Turbidity Dupe (%)
170611-01	AB2	6/7/2017	55	298.66	0.00%	31	-2.61%	1.14	13.88%
170611-10	AB2 D	6/7/2017		298.66		30.2		1.31	
170611-09	AB2 B	6/7/2017		< 1		< 5		< 0.2	
170611-02	AB3	6/7/2017	54.60	325.54		56.6		1.8	
170611-03	ABT1	6/7/2017	56.60			41.2		3.65	
170611-04	AB4	6/7/2017	55.50	410.58		56.2		6.55	
170611-05	AB5	6/7/2017	56.20			58.4		8.29	
170611-06	AB6	6/7/2017	56.20	290.93		61.3		11.2	
170611-07	AB7	6/7/2017	56.20			71.7		16.3	
170611-08	AB8	6/7/2017	56.30			83.6		19.5	
170612-01	AB2	6/14/2017	63.00			17.6		0.9	
170612-02	AB3	6/14/2017	61.5			27.6	28.57%	1.91	4.83%
170612-10	AB3 D	6/14/2017				20.7		1.82	
170612-09	AB3 B	6/14/2017				< 5		< 0.2	
170612-03	ABT1	6/14/2017	66.50			81.7		7.41	
170612-04	AB4	6/14/2017	63.30			17.5		1.82	
170612-05	AB5	6/14/2017	61.30			13.7		1.21	
170612-06	AB6	6/14/2017	64.50			16.2		2.64	
170612-07	AB7	6/14/2017	63.30			19.2		3.72	
170612-08	AB8	6/14/2017	66.50			17.6		3.23	
170831-01	AB2	6/21/2017	69.30	135.4		26.4		0.89	
170831-02	AB3	6/21/2017	67.50	129.63		36.1		2.37	
170831-03	ABT1	6/21/2017	68.40			53.5		2.81	
170831-04	AB4	6/21/2017	68.5	206.35	38.60%	38.5	-6.05%	4.33	-1.60%
170831-10	AB4 D	6/21/2017		139.58		40.9		4.4	
170831-09	AB4 B	6/21/2017		< 1		< 5		< 0.2	
170831-05	AB5	6/21/2017	68.00			31.8		3.13	
170831-06	AB6	6/21/2017	68.30	166.95		29.2		4.88	
170831-07	AB7	6/21/2017	67.30			28.6		3.99	
170831-08	AB8	6/21/2017	69.40			28.7		5.2	
170832-01	AB2	6/28/2017	62.30			21.7		0.53	
170832-02	AB3	6/28/2017	60.30			25.8		1.1	
170832-03	ABT1	6/28/2017	62.3			37.4	5.49%	2.65	-10.71%
170832-10	ABT1 D	6/28/2017				35.4		2.95	
170832-09	ABT1 B	6/28/2017				< 5		< 0.2	
170832-04	AB4	6/28/2017	62.30			27.3		1.74	
170832-05	AB5	6/28/2017	61.30			26.5		2.85	
170832-06	AB6	6/28/2017	63.70			26.8		2.73	
170832-07	AB7	6/28/2017	62.30			26.2		3.81	
170832-08	AB8	6/28/2017	66.00			26.8		5.81	
170934-01	AB2	7/5/2017	62.50	43.47		20.4		0.74	
170934-02	AB3	7/5/2017	63.40	46.38		26.1		1.29	
170934-03	ABT1	7/5/2017	68.10			38		2.8	
170934-04	AB4	7/5/2017	65.40	65.04		29.6		2.06	
170934-05	AB5	7/5/2017	69.50			25.3		2.46	

Sample Number	Location	Date	Water Temp	E. Coli (mpn/100 ml)	RPD Ecoli Dupe (%)	TP (ug P/L)	RPD TP Dupe (%)	Turbidity (NTU)	RPD Turbidity Dupe (%)
170934-06	AB6	7/5/2017	65.5	83.61		27.4	2.21%	3.04	0.99%
170934-10	AB6 D	7/5/2017			None	26.8		3.01	
170934-09	AB6 B	7/5/2017			None	< 5		< 0.2	
170934-07	AB7	7/5/2017	67.50			26.9		4.3	
170934-08	AB8	7/5/2017	70.30			28.2		6.16	
170987-01	AB2	7/12/2017	70.40			16.9		0.4	
170987-02	AB3	7/12/2017	69.30			22.7		1.49	
170987-03	ABT1	7/12/2017	72.50			47.6		7.03	
170987-04	AB4	7/12/2017	70.30			31.9		2.93	
170987-05	AB5	7/12/2017	69.5			21.1	0.00%	1.97	-14.15%
170987-10	AB5 D	7/12/2017				21.1		2.27	
170987-09	AB5 B	7/12/2017				< 5		< 0.2	
170987-06	AB6	7/12/2017	71.30			22.5		2.34	
170987-07	AB7	7/12/2017	71.50			21.4		2.74	
170987-08	AB8	7/12/2017	73.20			18.6		3.12	
171040-01	AB2	7/19/2017	70.30	43.47		17.4		0.78	
171040-02	AB3	7/19/2017	68.30	46.22		22.3		0.95	
171040-03	ABT1	7/19/2017	70.30			51.8		6.1	
171040-04	AB4	7/19/2017	70.10	172.33		30		3.69	
171040-05	AB5	7/19/2017	70.00			20.2		1.46	
171040-06	AB6	7/19/2017	72.30	161.62		23.6		3.97	
171040-07	AB7	7/19/2017	71.7			18.1	-0.55%	2.19	2.78%
171040-10	AB7 D	7/19/2017				18.2		2.13	
171040-09	AB7 B	7/19/2017				< 5		< 0.2	
171040-08	AB8	7/19/2017	73.00			16.1		3.86	
171090-01	AB2	7/26/2017	65.50			22.7		0.77	
171090-02	AB3	7/26/2017	62.70			22		0.8	
171090-03	ABT1	7/26/2017	64.30			44.5		6.01	
171090-04	AB4	7/26/2017	63.50			30.3		2.32	
171090-05	AB5	7/26/2017	64.00			21.1		1.47	
171090-06	AB6	7/26/2017	66.00			22.8		2.38	
171090-07	AB7	7/26/2017	64.40			19.2		2.65	
171090-08	AB8	7/26/2017	67.4			18.2	-3.24%	3.42	-16.62%
171090-10	AB8 D	7/26/2017				18.8		4.04	
171090-09	AB8 B	7/26/2017				< 5		< 0.2	
171163-01	AB2	8/2/2017	69.5	18.49		22.9	27.86%	0.6	-1.65%
171163-10	AB2 D	8/2/2017		None		17.3		0.61	
171163-09	AB2 B	8/2/2017		None		< 5		< 0.2	
171163-02	AB3	8/2/2017	67.10	127.4		22.5		1.02	
171163-03	ABT1	8/2/2017	71.30			49.5		10.8	
171163-04	AB4	8/2/2017	71.10	378.44		48.1		8.9	
171163-05	AB5	8/2/2017	60.20			21.3		1.34	
171163-06	AB6	8/2/2017	72.30	58.78		23.4		4.09	
171163-07	AB7	8/2/2017	71.20			20.9		3.56	
171163-08	AB8	8/2/2017	72.30			18.3		4.87	
171213-01	AB2	8/9/2017	65.30			23.7		1.16	

Sample Number	Location	Date	Water Temp	E. Coli (mpn/ 100 ml)	RPD Ecoli Dupe (%)	TP (ug P/L)	RPD TP Dupe (%)	Turbidity (NTU)	RPD Turbidity Dupe (%)
171213-02	AB3	8/9/2017	64.10			23.1		1.04	
171213-03	ABT1	8/9/2017	66.4			45.3	-10.86%	6.14	-1.13%
171213-10	ABT1 D	8/9/2017				50.5		6.21	
171213-09	ABT1 B	8/9/2017				< 5		< 0.2	
171213-04	AB4	8/9/2017	65.30			37.3		6.5	
171213-05	AB5	8/9/2017	65.40			24.9		1.67	
171213-06	AB6	8/9/2017	66.30			25.7		3.2	
171213-07	AB7	8/9/2017	66.30			26.8		3.05	
171213-08	AB8	8/9/2017	67.00			20.9		4.62	
171250-01	AB2	8/17/2017	62.50	22.55		22.8		1.44	
171250-02	AB3	8/17/2017	61	79.76		24.7	8.00%	1.06	6.83%
171250-10	AB3 D	8/17/2017		None		22.8		0.99	
171250-09	AB3 B	8/17/2017		None		< 5		0.2	
171250-03	ABT1	8/17/2017	65.20			51.5		8.17	
171250-04	AB4	8/17/2017	65.10	201.42		39.7		7.9	
171250-05	AB5	8/17/2017	63.50			23.8		1.9	
171250-06	AB6	8/17/2017	65.30	110.61		28.6		4.26	
171250-07	AB7	8/17/2017	64.30			24.9		2.77	
171250-08	AB8	8/17/2017	66.30			23.5		6.79	
171298-01	AB2	8/23/2017	66.30			23.9		0.99	
171298-02	AB3	8/23/2017	67.10			30.7		1.5	
171298-03	ABT1	8/23/2017	68.50			111		7.06	
171298-04	AB4	8/23/2017	68.50			59.3		4.57	
171298-05	AB5	8/23/2017	69.5			47.9	-2.07%	3.87	-7.22%
171298-10	AB5 D	8/23/2017				48.9		4.16	
171298-09	AB5 B	8/23/2017				< 5		< 0.2	
171298-06	AB6	8/23/2017	68.70			47.1		7.53	
171298-07	AB7	8/23/2017	68.30			49.9		9.29	
171298-08	AB8	8/23/2017	69.30			45.4		9.65	
171336-01	AB2	9/6/2017	61.30	26.53		32.8		0.91	
171336-02	AB3	9/6/2017	61.10	206.35		40.2		2.23	
171336-03	ABT1	9/6/2017	62.10			135		5.65	
171336-04	AB4	9/6/2017	60.1	579.43	0.00%	66.5	3.83%	3.19	7.14%
171336-10	AB4 D	9/6/2017		579.43		64		2.97	
171336-09	AB4 B	9/6/2017		< 1		5.85		< 0.2	
No sample	AB5	9/6/2017							
171336-06	AB6	9/6/2017	61.70	920.84		62.2		4.87	
171336-07	AB7	9/6/2017	60.30			63.9		6.45	
171336-08	AB8	9/6/2017	61.30			73.5		10.6	
171389-01	AB2	9/13/2017	61.00			21.8		0.48	
171389-02	AB3	9/13/2017	58.30			22.7		1.22	
171389-03	ABT1	9/13/2017	62.50			35		2.8	
171389-04	AB4	9/13/2017	60.30			27.1		4.26	
171389-05	AB5	9/13/2017	59.50			23.2		1.04	
171389-06	AB6	9/13/2017	61.00			26.1		3.68	
171389-07	AB7	9/13/2017	60.3			21.8	3.74%	2.23	-19.43%

Sample Number	Location	Date	Water Temp	E. Coli (mpn/100 ml)	RPD Ecoli Dupe (%)	TP (ug P/L)	RPD TP Dupe (%)	Turbidity (NTU)	RPD Turbidity Dupe (%)
171389-10	AB7 D	9/13/2017				21		2.71	
171389-09	AB7 B	9/13/2017				< 5		< 0.2	
171389-08	AB8	9/13/2017	63.10			32		3.86	
171390-01	AB2	9/20/2017	65.70			18.2		0.57	
171390-02	AB3	9/20/2017	62.30			17		0.62	
No sample	AB4	9/20/2017							
No sample	ABT1	9/20/2017							
171390-05	AB5	9/20/2017	63.30			20.3		0.93	
171390-06	AB6	9/20/2017	67.7			21.5	-8.89%	2.83	-11.65%
171390-10	AB6 D	9/20/2017				23.5		3.18	
171390-09	AB6 B	9/20/2017				< 5		< 0.2	
171390-07	AB7	9/20/2017	66.30			18.2		1.27	
171390-08	AB8	9/20/2017	65.30			20.4		8.82	

**Average
RPD**

12.87%

3.03%

-3.18%

Appendix B: 2017 Field Data Sheets

Allen Brook Water Quality Sampling Field Data Sheet

Waterbody Name: Allen Brook

Collector Name(s): Melinda Scott

Date: 06/07/2017

General Weather: Clear/Sunny

Cloud cover (circle one): no clouds partly cloudy cloudy/overcast

Wind (circle one): calm breezy windy

Precipitation (circle one): none misty/foggy drizzle/light rain rain

Date of Last Rain: 06/06/2017

Last Rain Event (circle one): mild moderate severe

*Flow *Category: Base or Freshet Rising / Receding or Hydro Rising / Receding

*Level: H - M - L - Flood Discharge (cfs) _____

SAMPLES COLLECTED

(write TIME sample is collected in each blank; if no sample collected, write 'N/A')

SITE NAME	DESCRIPTION	TIME SAMPLED	D/L/FB	H2O TEMP
AB2	MP Road	9:35 am	D/L/FB	55°
AB3	Route 2	9:58 am	D/L/FB	54.6°
ABT1	Trib confluence	10:22 am	D/L/FB	56.6°
AB4	WSC	10:24 am	D/L/FB	55.6°
AB5	Southridge Rd.	10:50 am		55.5
AB6	Talcott Rd. East	11:06 am		56.2
AB7	Route 2A	11:22		56.2
AB8	River Cove Rd.	11:40		56.3

Garrett collected ↓

Notes/Comments: Please refer to each sample in the following manner: Site Name-Parameter-type of sample. If you make a comment about a lab duplicate Total Phosphorus sample at site AB7, the sample would be: AB7-TP-L.

- AB3 was more middle flow
 - AB5 was not quite as high
 - ABCO " " "

Allen Brook Staff Gauge	
Reading Time:	<u>11:20</u>
USGS Height (on gauge)	<u>2.20</u> (ft)
Height above USGS	(ft)
Height down from screw	(ft)

The USGS height should be collected every visit. If the water level is above the top of the USGS gauge, please measure from the top of the gauge using a ruler/yardstick that has decimal feet units (not inches). If you are collecting samples when the water is very high, you can measure down from the top of the head on the stainless steel lag screw that is near the FEA staff gauge. Please include any notes about obstructions in the channel that may be influencing water levels at the staff gauge.

Allen Brook Water Quality Sampling Field Data Sheet

Waterbody Name: Allen Brook

Collector Name(s): Garrett Chisholm

Date: 06/14/2017

General Weather: Sunny

Cloud cover (circle one): no clouds partly cloudy cloudy/overcast

Wind (circle one): calm breezy windy

Precipitation (circle one): none misty/foggy drizzle/light rain rain

Date of Last Rain: 06/13/2017

Last Rain Event (circle one): mild moderate severe

*Flow *Category: Base or Freshet- Rising / Receding or Hydro Rising / Receding

*Level: H - M - L - Flood Discharge (cfs) _____

SAMPLES COLLECTED

(write TIME sample is collected in each blank; if no sample collected, write 'N/A')

SITE NAME	DESCRIPTION	TIME SAMPLED	D/L/FB	H2O TEMP
AB2	MP Road	8:47		63.0°
AB3	Route 2	9:06	D/L/FB	61.5°
ABT1	Trib confluence	9:28		66.5°
AB4	WSC	9:35		63.3°
AB5	Southridge Rd.	9:53		61.3°
AB6	Talcott Rd. East	10:12		64.5°
AB7	Route 2A	10:29		63.3
AB8	River Cove Rd.	10:41		66.5

Notes/Comments: Please refer to each sample in the following manner: Site Name-Parameter-type of sample. If you make a comment about a lab duplicate Total Phosphorus sample at site AB7, the sample would be: AB7-TP-L.

Allen Brook Staff Gauge	
Reading Time:	<u>10:29</u>
USGS Height (on gauge)	<u>1.20</u> (ft)
Height above USGS	(ft)
Height down from screw	(ft)

The USGS height should be collected every visit. If the water level is above the top of the USGS gauge, please measure from the top of the gauge using a ruler/yardstick that has decimal feet units (not inches). If you are collecting samples when the water is very high, you can measure down from the top of the head on the stainless steel lag screw that is near the FEA staff gauge. Please include any notes about obstructions in the channel that may be influencing water levels at the staff gauge.

Allen Brook Water Quality Sampling Field Data Sheet

Waterbody Name: Allen Brook

Collector Name(s): Garrett Chisholm

Date: 6/21/17

General Weather: cloudy with a some sun

Cloud cover (circle one): no clouds partly cloudy cloudy/overcast

Wind (circle one): calm breezy windy

Precipitation (circle one): none misty/foggy drizzle/light rain rain

Date of Last Rain: 6/20/17

Last Rain Event (circle one): mild moderate severe

*Flow *Category: Base or Freshet- Rising / Receding or Hydro Rising / Receding

*Level: H - M - L - Flood Discharge (cfs) _____

SAMPLES COLLECTED

(write TIME sample is collected in each blank; if no sample collected, write 'N/A')

SITE NAME	DESCRIPTION	TIME SAMPLED	D/L/FB	H2O TEMP
AB2	MP Road	10:00am		69.3°
AB3	Route 2	10:14am		67.5°
ABT1	Trib confluence	10:45am		68.4°
AB4	WSC	10:50am	D/L/FB	68.5°
AB5	Southridge Rd.	11:10am		68.5°
AB6	Talcott Rd. East	11:30am		68.3°
AB7	Route 2A	11:50am		67.3°
AB8	River Cove Rd.	12:20am		69.4°

Notes/Comments: Please refer to each sample in the following manner: Site Name-Parameter-type of sample. If you make a comment about a lab duplicate Total Phosphorus sample at site AB7, the sample would be: AB7-TP-L.

Allen Brook Staff Gauge	
Reading Time:	<u>12:30</u>
USGS Height (on gauge)	<u>1.50</u> (ft)
Height above USGS	(ft)
Height down from screw	(ft)

The USGS height should be collected every visit. If the water level is above the top of the USGS gauge, please measure from the top of the gauge using a ruler/yardstick that has decimal feet units (not inches). If you are collecting samples when the water is very high, you can measure down from the top of the head on the stainless steel lag screw that is near the FEA staff gauge. Please include any notes about obstructions in the channel that may be influencing water levels at the staff gauge.

Allen Brook Water Quality Sampling Field Data Sheet

Waterbody Name: Allen Brook

Collector Name(s): Garrett Chisholm

Date: 6/28/17

General Weather: Sunny

Cloud cover (circle one): no clouds partly cloudy cloudy/overcast

Wind (circle one): calm breezy windy

Precipitation (circle one): none misty/foggy drizzle/light rain rain

Date of Last Rain: 6/27/17

Last Rain Event (circle one): mild moderate severe

*Flow *Category: Base or Freshet- Rising / Receding or Hydro Rising / Receding

*Level: H - M - L - Flood Discharge (cfs) _____

SAMPLES COLLECTED

(write TIME sample is collected in each blank; if no sample collected, write 'N/A')

SITE NAME	DESCRIPTION	TIME SAMPLED	D/L/FB	H2O TEMP
AB2	MP Road	8:59am		62.3
AB3	Route 2	9:13am		60.3
ABT1	Trib confluence	9:29am	D/L/FB	62.3
AB4	WSC	9:34am		62.3
AB5	Southridge Rd.	10:06am	D/L/FB	61.3
AB6	Talcott Rd. East	10:35am	L	63.7
AB7	Route 2A	10:58am		62.3
AB8	River Cove Rd.	11:17am		66.0

Notes/Comments: Please refer to each sample in the following manner: Site Name-Parameter-type of sample. If you make a comment about a lab duplicate Total Phosphorus sample at site AB7, the sample would be: AB7-TP-L.

Allen Brook Staff Gauge	
Reading Time:	<u>10:50</u>
USGS Height (on gauge)	<u>1.50</u> (ft)
Height above USGS	(ft)
Height down from screw	(ft)

The USGS height should be collected every visit. If the water level is above the top of the USGS gauge, please measure from the top of the gauge using a ruler/yardstick that has decimal feet units (not inches). If you are collecting samples when the water is very high, you can measure down from the top of the head on the stainless steel lag screw that is near the FEA staff gauge. Please include any notes about obstructions in the channel that may be influencing water levels at the staff gauge.

Allen Brook Water Quality Sampling Field Data Sheet

Waterbody Name: Allen Brook

Collector Name(s): Garrett Chisholm

Date: 7/6/17

General Weather: Sunny

Cloud cover (circle one): no clouds partly cloudy cloudy/overcast

Wind (circle one): calm breezy windy

Precipitation (circle one): none misty/foggy drizzle/light rain rain

Date of Last Rain: 7/4

Last Rain Event (circle one): mild moderate severe

*Flow *Category: Base or Freshet- Rising / Receding or Hydro Rising / Receding

*Level: H - M - L - Flood Discharge (cfs) _____

SAMPLES COLLECTED

(write TIME sample is collected in each blank; if no sample collected, write 'N/A')

SITE NAME	DESCRIPTION	TIME SAMPLED	D/L/FB	H2O TEMP
AB2	MP Road	9:01		62.5°
AB3	Route 2	9:13		63.4°
ABT1	Trib confluence	9:32		68.1°
AB4	WSC	9:40		65.4°
AB5	Southridge Rd.	10:10		69.3°
AB6	Talcott Rd. East	10:21	D/L/FB	65.5°
AB7	Route 2A	10:45		67.5°
AB8	River Cove Rd.	11:02		70.3°

Notes/Comments: Please refer to each sample in the following manner: Site Name-Parameter-type of sample. If you make a comment about a lab duplicate Total Phosphorus sample at site AB7, the sample would be: AB7-TP-L.

Allen Brook Staff Gauge	
Reading Time:	<u>10:42</u>
USGS Height (on gauge)	<u>1.38</u> (ft)
Height above USGS	(ft)
Height down from screw	(ft)

The USGS height should be collected every visit. If the water level is above the top of the USGS gauge, please measure from the top of the gauge using a ruler/yardstick that has decimal feet units (not inches). If you are collecting samples when the water is very high, you can measure down from the top of the head on the stainless steel lag screw that is near the FEA staff gauge. Please include any notes about obstructions in the channel that may be influencing water levels at the staff gauge.

Allen Brook Water Quality Sampling Field Data Sheet

Waterbody Name: Allen Brook

Collector Name(s): Garrett Chisholm

Date: 7/12/17

General Weather: Sunny

Cloud cover (circle one): no clouds partly cloudy cloudy/overcast

Wind (circle one): calm breezy windy

Precipitation (circle one): none misty/foggy drizzle/light rain rain

Date of Last Rain: 7/11/17

Last Rain Event (circle one): mild moderate severe

*Flow *Category: Base or Freshet- Rising / Receding or Hydro Rising / Receding

*Level: H - M - L - Flood Discharge (cfs) _____

SAMPLES COLLECTED

(write TIME sample is collected in each blank; if no sample collected, write 'N/A')

SITE NAME	DESCRIPTION	TIME SAMPLED	D/L/FB	H2O TEMP
AB2	MP Road	8:57		70.4
AB3	Route 2	9:10		69.3
ABT1	Trib confluence	9:31		72.5
AB4	WSC	9:34		78.3
AB5	Southridge Rd.	10:04	D/L/FB	69.3
AB6	Talcott Rd. East	10:20		71.3
AB7	Route 2A	10:34		71.5
AB8	River Cove Rd.	10:50		73.2

Notes/Comments: Please refer to each sample in the following manner: Site Name-Parameter-type of sample. If you make a comment about a lab duplicate Total Phosphorus sample at site AB7, the sample would be: AB7-TP-L.

Allen Brook Staff Gauge	
Reading Time:	<u>10:30</u>
USGS Height (on gauge)	<u>1.28</u> (ft)
Height above USGS	(ft)
Height down from screw	(ft)

The USGS height should be collected every visit. If the water level is above the top of the USGS gauge, please measure from the top of the gauge using a ruler/yardstick that has decimal feet units (not inches). If you are collecting samples when the water is very high, you can measure down from the top of the head on the stainless steel lag screw that is near the FEA staff gauge. Please include any notes about obstructions in the channel that may be influencing water levels at the staff gauge.

Allen Brook Water Quality Sampling Field Data Sheet

Waterbody Name: Allen Brook

Collector Name(s): Garrett Chisholm

Date: 7/19/17

General Weather: Sunny

Cloud cover (circle one): no clouds partly cloudy cloudy/overcast

Wind (circle one): calm breezy windy

Precipitation (circle one): none misty/foggy drizzle/light rain rain

Date of Last Rain: 7/17/17

Last Rain Event (circle one): mild moderate severe

*Flow *Category: Base or Freshet- Rising / Receding or Hydro Rising / Receding

*Level: H - M - L - Flood Discharge (cfs) _____

SAMPLES COLLECTED

(write TIME sample is collected in each blank; if no sample collected, write 'N/A')

SITE NAME	DESCRIPTION	TIME SAMPLED	D/L/FB	H2O TEMP
AB2	MP Road	9:35		70.3
AB3	Route 2	9:51		68.3
ABT1	Trib confluence	10:10		70.3
AB4	WSC	10:15		70.1
AB5	Southridge Rd.	10:42		70.0
AB6	Talcott Rd. East	10:58		72.3
AB7	Route 2A	11:17	<u>D/L/FB</u>	74.1
AB8	River Cove Rd.	11:29		73.0

Notes/Comments: Please refer to each sample in the following manner: Site Name-Parameter-type of sample. If you make a comment about a lab duplicate Total Phosphorus sample at site AB7, the sample would be: AB7-TP-L

AB4 + ABT1 were flood b/c of beaver

This may need to be checked when data is downloaded

Allen Brook Staff Gauge		
Reading Time:	<u>11:15</u>	
USGS Height (on gauge)	<u>1.14</u>	(ft)
Height above USGS		(ft)
Height down from screw		(ft)

The USGS height should be collected every visit. If the water level is above the top of the USGS gauge, please measure from the top of the gauge using a ruler/yardstick that has decimal feet units (not inches). If you are collecting samples when the water is very high, you can measure down from the top of the head on the stainless steel lag screw that is near the FEA staff gauge. Please include any notes about obstructions in the channel that may be influencing water levels at the staff gauge.

Allen Brook Water Quality Sampling Field Data Sheet

Waterbody Name: Allen Brook

Collector Name(s): Garrett Chisholm

Date: 7/29/17

General Weather: sunny

Cloud cover (circle one): no clouds partly cloudy cloudy/overcast

Wind (circle one): calm breezy windy

Precipitation (circle one): none misty/foggy drizzle/light rain rain

Date of Last Rain: 7/24/17

Last Rain Event (circle one): mild moderate severe

*Flow *Category: Base or Freshet- Rising / Receding or Hydro Rising / Receding

*Level: H - M - L - Flood Discharge (cfs)

SAMPLES COLLECTED

(write TIME sample is collected in each blank; if no sample collected, write 'N/A')

SITE NAME	DESCRIPTION	TIME SAMPLED	D/L/FB	H2O TEMP
AB2	MP Road	9:31		65.5
AB3	Route 2	9:59		62.7
ABT1	Trib confluence	10:18		64.3
AB4	WSC	10:30		63.5
AB5	Southridge Rd.	10:47		64.0
AB6	Talcott Rd. East	11:07		66.0
AB7	Route 2A	11:20		64.4
AB8	River Cove Rd.	11:38	✓	67.4

Notes/Comments: Please refer to each sample in the following manner: Site Name-Parameter-type of sample. If you make a comment about a lab duplicate Total Phosphorus sample at site AB7, the sample would be: AB7-TP-L.

ABT1 / AB4 are floodet / higher than last week

Allen Brook Staff Gauge	
Reading Time:	11:17
USGS Height (on gauge)	1.22 (ft)
Height above USGS	(ft)
Height down from screw	(ft)

The USGS height should be collected every visit. If the water level is above the top of the USGS gauge, please measure from the top of the gauge using a ruler/yardstick that has decimal feet units (not inches). If you are collecting samples when the water is very high, you can measure down from the top of the head on the stainless steel lag screw that is near the FEA staff gauge. Please include any notes about obstructions in the channel that may be influencing water levels at the staff gauge.

Allen Brook Water Quality Sampling Field Data Sheet

Waterbody Name: Allen Brook

Collector Name(s): Garrett Chisholm

Date: 8/2/2017

General Weather: Sunny

Cloud cover (circle one): no clouds partly cloudy cloudy/overcast

Wind (circle one): calm breezy windy

Precipitation (circle one): none misty/foggy drizzle/light rain rain

Date of Last Rain: 7/31/17

Last Rain Event (circle one): mild moderate severe

*Flow *Category: Base or Freshet- Rising / Receding or Hydro Rising / Receding

*Level: H - M - L - Flood Discharge (cfs) _____

Take duplicate/FB
at AB 2
change labels
on these to AB 2

SAMPLES COLLECTED

(write TIME sample is collected in each blank; if no sample collected, write 'N/A')

SITE NAME	DESCRIPTION	TIME SAMPLED	D/L/FB	H2O TEMP
AB2	MP Road	10:17	D/L/FB	69.5
AB3	Route 2	10:33		67.1
ABT1	Trib confluence	10:51		71.5
AB4	WSC	11:00		71.1
AB5	Southridge Rd.	11:06		69.2
AB6	Talcott Rd. East	11:38		72.3
AB7	Route 2A	11:52		71.2
AB8	River Cove Rd.	12:10		72.5

Notes/Comments: Please refer to each sample in the following manner: Site Name-Parameter-type of sample. If you make a comment about a lab duplicate Total Phosphorus sample at site AB7, the sample would be: AB7-TP-L.

ABT1/AB4 flooded higher because of beaver

Allen Brook Staff Gauge	
Reading Time:	<u>11:45</u>
USGS Height (on gauge)	<u>1.02</u> (ft)
Height above USGS	(ft)
Height down from screw	(ft)

The USGS height should be collected every visit. If the water level is above the top of the USGS gauge, please measure from the top of the gauge using a ruler/yardstick that has decimal feet units (not inches). If you are collecting samples when the water is very high, you can measure down from the top of the head on the stainless steel lag screw that is near the FEA staff gauge. Please include any notes about obstructions in the channel that may be influencing water levels at the staff gauge.

Allen Brook Water Quality Sampling Field Data Sheet

Waterbody Name: Allen Brook

Collector Name(s): Garrett Chisholm

Date: 8/9/17

General Weather: Sunny with clouds

Cloud cover (circle one): no clouds partly cloudy cloudy/overcast

Wind (circle one): calm breezy windy

Precipitation (circle one): none misty/foggy drizzle/light rain rain

Date of Last Rain: 8/7/17

Last Rain Event (circle one): mild moderate severe

*Flow *Category: Base or Freshet- Rising / Receding or Hydro Rising / Receding

*Level: H - M - L - Flood Discharge (cfs) _____

SAMPLES COLLECTED

(write TIME sample is collected in each blank; if no sample collected, write 'N/A')

SITE NAME	DESCRIPTION	TIME SAMPLED	D/L/FB	H2O TEMP
AB2	MP Road	9:45		65.7
AB3	Route 2	9:54		64.4
ABT1	Trib confluence	10:22	D/L/FB	66.4
AB4	WSC	10:28		65.3
AB5	Southridge Rd.	10:48		65.4
AB6	Talcott Rd. East	11:32		66.3
AB7	Route 2A	11:19		66.3
AB8	River Cove Rd.	11:30		67.0

Notes/Comments: Please refer to each sample in the following manner: Site Name-Parameter-type of sample. If you make a comment about a lab duplicate Total Phosphorus sample at site AB7, the sample would be: AB7-TP-L.

ABT1/AB4 flooded more

Allen Brook Staff Gauge	
Reading Time:	<u>11:16</u>
USGS Height (on gauge)	<u>1.14</u> (ft)
Height above USGS	(ft)
Height down from screw	(ft)

The USGS height should be collected every visit. If the water level is above the top of the USGS gauge, please measure from the top of the gauge using a ruler/yardstick that has decimal feet units (not inches). If you are collecting samples when the water is very high, you can measure down from the top of the head on the stainless steel lag screw that is near the FEA staff gauge. Please include any notes about obstructions in the channel that may be influencing water levels at the staff gauge.

Allen Brook Water Quality Sampling Field Data Sheet

Waterbody Name: Allen Brook

Collector Name(s): garrett chisholm

Date: 8/17/17

General Weather: sunny

Cloud cover (circle one): no clouds partly cloudy cloudy/overcast

Wind (circle one): calm breezy windy

Precipitation (circle one): none misty/foggy drizzle/light rain rain

Date of Last Rain: 8/16/17

Last Rain Event (circle one): mild moderate severe

*Flow *Category: Base or Freshet- Rising / Receding or Hydro Rising / Receding

*Level: H - M - L - Flood Discharge (cfs) _____

SAMPLES COLLECTED

(write TIME sample is collected in each blank; if no sample collected, write 'N/A')

SITE NAME	DESCRIPTION	TIME SAMPLED	D/L/FB	H2O TEMP
AB2	MP Road	8:32		62.5
AB3	Route 2	9:52	11/4/17	61.0
ABT1	Trib confluence	10:08		65.2
AB4	WSC	10:12		65.1
AB5	Southridge Rd.	10:45		63.5
AB6	Talcott Rd. East	10:54		65.3
AB7	Route 2A	11:22		64.3
AB8	River Cove Rd.	11:37		66.3

Notes/Comments: Please refer to each sample in the following manner: Site Name-Parameter-type of sample. If you make a comment about a lab duplicate Total Phosphorus sample at site AB7, the sample would be: AB7-TP-L.

ABT1 / AB4 flow not higher because of beaver

Allen Brook Staff Gauge	
Reading Time:	<u>11:20</u>
USGS Height (on gauge)	<u>1.08</u> (ft)
Height above USGS	(ft)
Height down from screw	(ft)

The USGS height should be collected every visit. If the water level is above the top of the USGS gauge, please measure from the top of the gauge using a ruler/yardstick that has decimal feet units (not inches). If you are collecting samples when the water is very high, you can measure down from the top of the head on the stainless steel lag screw that is near the FEA staff gauge. Please include any notes about obstructions in the channel that may be influencing water levels at the staff gauge.

Allen Brook Water Quality Sampling Field Data Sheet

Waterbody Name: Allen Brook

Collector Name(s): Garrett + Chisholm
Date: 08/23/2017

General Weather: Sunny

Cloud cover (circle one): no clouds partly cloudy cloudy/overcast

Wind (circle one): calm breezy windy

Precipitation (circle one): none misty/foggy drizzle/light rain rain

Date of Last Rain: 08/22/2017

Last Rain Event (circle one): mild moderate severe

*Flow *Category: Base or Freshet- Rising / Receding or Hydro Rising / Receding

*Level: H - M - L - Flood Discharge (cfs) _____

SAMPLES COLLECTED

(write TIME sample is collected in each blank; if no sample collected, write 'N/A')

SITE NAME	DESCRIPTION	TIME SAMPLED	D/L/FB	H2O TEMP
AB2	MP Road	9:07		66.5
AB3	Route 2	9:23		67.1
ABT1	Trib confluence	9:38		68.15
AB4	WSC	9:40		68.15
AB5	Southridge Rd.	10:08	D/L/FB	67.5
AB6	Talcott Rd. East	10:22		68.17
AB7	Route 2A	10:25		68.13
AB8	River Cove Rd.	10:54		69.7

Notes/Comments: Please refer to each sample in the following manner: Site Name-Parameter-type of sample. If you make a comment about a lab duplicate Total Phosphorus sample at site AB7, the sample would be: AB7-TP-L.

ABT1/AB4 flooded because of beaver
AB7 water level higher than usual

Allen Brook Staff Gauge	
Reading Time:	10:33
USGS Height (on gauge)	1.60 (ft)
Height above USGS	(ft)
Height down from screw	(ft)

The USGS height should be collected every visit. If the water level is above the top of the USGS gauge, please measure from the top of the gauge using a ruler/yardstick that has decimal feet units (not inches). If you are collecting samples when the water is very high, you can measure down from the top of the head on the stainless steel lag screw that is near the FEA staff gauge. Please include any notes about obstructions in the channel that may be influencing water levels at the staff gauge.

Allen Brook Water Quality Sampling Field Data Sheet

Waterbody Name: Allen Brook

Collector Name(s): Melinda Scott
Date: 9/6/2012

General Weather: rain

Cloud cover (circle one): no clouds partly cloudy cloudy/overcast

Wind (circle one): calm breezy windy

Precipitation (circle one): none misty/foggy drizzle/light rain rain

Date of Last Rain: 9/5/2012

Last Rain Event (circle one): mild moderate severe

*Flow *Category: Base or Freshet-Rising / Receding or Hydro Rising / Receding

*Level: (H) M - L - Flood Discharge (cfs) _____

SAMPLES COLLECTED

(write TIME sample is collected in each blank; if no sample collected, write 'N/A')

SITE NAME	DESCRIPTION	TIME SAMPLED	D/L/FB	H2O TEMP
AB2	MP Road	<u>10:50</u>	<u>L</u>	<u>61.3</u>
AB3	Route 2	<u>11:00</u>		<u>61.1</u>
ABT1	Trib confluence	<u>11:30</u>		<u>62.1</u>
AB4	WSC	<u>11:35</u>	<u>ABTD</u>	<u>60.1</u>
AB5	Southridge Rd.			<u>61.7</u>
AB6	Talcott Rd. East	<u>11:55</u>		<u>61.7</u>
AB7	Route 2A	<u>12:00</u>		<u>61.3</u>
AB8	River Cove Rd.	<u>12:20</u>		<u>61.3</u>

Notes/Comments: Please refer to each sample in the following manner: Site Name-Parameter-type of sample. If you make a comment about a lab duplicate Total Phosphorus sample at site AB7, the sample would be: AB7-TP-L.

Flooded at ABT1, AB4 - beavers

Did not sample AB5 as trees were being felled along side stream

Allen Brook Staff Gauge	
Reading Time:	<u>12 Noon</u>
USGS Height (on gauge)	<u>1.74</u> (ft)
Height above USGS	(ft)
Height down from screw	(ft)

The USGS height should be collected every visit. If the water level is above the top of the USGS gauge, please measure from the top of the gauge using a ruler/yardstick that has decimal feet units (not inches). If you are collecting samples when the water is very high, you can measure down from the top of the head on the stainless steel lag screw that is near the FEA staff gauge. Please include any notes about obstructions in the channel that may be influencing water levels at the staff gauge.

Allen Brook Water Quality Sampling Field Data Sheet

Waterbody Name: Allen Brook

Collector Name(s): M Scott

Date: 9/13/2017

General Weather: fair

Cloud cover (circle one): no clouds partly cloudy cloudy/overcast

Wind (circle one): calm breezy windy

Precipitation (circle one): none misty/foggy drizzle/light rain rain

Date of Last Rain: _____

Last Rain Event (circle one): mild moderate severe

*Flow *Category: Base or Freshet-Rising / Receding or Hydro Rising / Receding

*Level: H - M - L - Flood Discharge (cfs) _____

SAMPLES COLLECTED

(write TIME sample is collected in each blank; if no sample collected, write 'N/A')

SITE NAME	DESCRIPTION	TIME SAMPLED	D/L/FB	H2O TEMP
AB2	MP Road	10:20	L	61.0
AB3	Route 2	10:34		58.3
ABT1	Trib confluence	10:50		62.5
AB4	WSC	10:56		60.3
AB5	Southridge Rd.	11:04		59.5
AB6	Talcott Rd. East	11:20		61.0
AB7	Route 2A	11:35	D/FB	62.3
AB8	River Cove Rd.	11:51		63.1

Notes/Comments: Please refer to each sample in the following manner: Site Name-Parameter-type of sample. If you make a comment about a lab duplicate Total Phosphorus sample at site AB7, the sample would be: AB7/TP-L.

ABT1 and AB4 flooded - beaver pond downstream

AB5 - Work has started on the SW ponds - limits of construction are ~ 20' away from stream

Allen Brook Staff Gauge	
Reading Time:	11:35
USGS Height (on gauge)	1.18 (ft)
Height above USGS	(ft)
Height down from screw	(ft)

The USGS height should be collected every visit. If the water level is above the top of the USGS gauge, please measure from the top of the gauge using a ruler/yardstick that has decimal feet units (not inches). If you are collecting samples when the water is very high, you can measure down from the top of the head on the stainless steel lag screw that is near the FEA staff gauge. Please include any notes about obstructions in the channel that may be influencing water levels at the staff gauge.

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Allen Brook Water Quality Sampling Field Data Sheet

Waterbody Name: Allen Brook

Collector Name(s): M. Scott

Date: 9/20/17

General Weather: fair

Cloud cover (circle one): no clouds partly cloudy cloudy/overcast

Wind (circle one): calm breezy windy

Precipitation (circle one): none misty/foggy drizzle/light rain rain

Date of Last Rain: _____

Last Rain Event (circle one): mild moderate severe

*Flow *Category: Base or Freshet- Rising / Receding or Hydro Rising / Receding

*Level: H - M - L - Flood Discharge (cfs) _____

SAMPLES COLLECTED

(write TIME sample is collected in each blank; if no sample collected, write 'N/A')

SITE NAME	DESCRIPTION	TIME SAMPLED	D/L/FB	H2O TEMP
AB2	MP Road	10:25	L	65.7
AB3	Route 2	10:40		62.3
ABT1	Trib confluence			
AB4	WSC			
AB5	Southridge Rd.	11:05		62.3
AB6	Talcott Rd. East	11:15		67.1
AB7	Route 2A	11:30		66.3
AB8	River Cove Rd.	11:45		65.3

Did not sample -
entire site flooded

Beaver dam being built
just downstream of bridge (upstream of site)

Notes/Comments: Please refer to each sample in the following manner: Site Name-Parameter-type of sample. If you make a comment about a lab duplicate Total Phosphorus sample at site AB7, the sample would be: AB7-TP-L.

Allen Brook Staff Gauge	
Reading Time:	<u>11:30 AM</u>
USGS Height (on gauge)	<u>9.6</u> (ft)
Height above USGS	(ft)
Height down from screw	(ft)

The USGS height should be collected every visit. If the water level is above the top of the USGS gauge, please measure from the top of the gauge using a ruler/yardstick that has decimal feet units (not inches). If you are collecting samples when the water is very high, you can measure down from the top of the head on the stainless steel lag screw that is near the FEA staff gauge. Please include any notes about obstructions in the channel that may be influencing water levels at the staff gauge.

Appendix C: USGS rating table

USGS Stage Height (ft)	USGS Discharge (cf/s)	USGS Stage Height (ft)	USGS Discharge (cf/s)
0.90	0.53	1.54	8.75
0.92	0.60	1.56	9.36
0.94	0.67	1.58	10.00
0.96	0.74	1.60	10.68
0.98	0.83	1.62	11.39
1.00	0.92	1.64	12.14
1.02	1.02	1.66	12.94
1.04	1.13	1.68	13.77
1.06	1.25	1.70	14.65
1.08	1.37	1.72	15.57
1.10	1.51	1.74	16.53
1.12	1.66	1.76	17.55
1.14	1.82	1.78	18.62
1.16	2.00	1.80	19.73
1.18	2.18	1.82	20.90
1.20	2.38	1.84	22.13
1.22	2.60	1.86	23.41
1.24	2.83	1.90	26.16
1.26	3.07	1.92	27.63
1.28	3.33	1.94	29.16
1.30	3.61	1.96	30.77
1.32	3.91	1.98	32.44
1.34	4.23	2.00	34.18
1.36	4.57	2.02	36.01
1.38	4.94	2.04	37.90
1.40	5.32	2.06	39.88
1.42	5.73	2.08	41.94
1.44	6.16	2.10	44.09
1.46	6.62	2.12	46.32
1.48	7.11	2.14	48.65
1.50	7.62	2.16	51.07
1.52	8.17	2.18	53.58
		2.20	56.20