2022 WINDHAM INVESTIGATIVE SAMPLING | MEMORANDUM

TO: Gretchen Anderson & Amanda Lessard, Town of Windham, ME
FROM: Margaret Mills, FB Environmental Associates (FBE)
SUBJECT: 2022 Windham Investigative Sampling
DATE: July 28, 2022
CC: Maggie Kelly & Forrest Bell, FB Environmental Associates

INTRODUCTION & SUMMARY OF RESULTS

FB Environmental Associates (FBE) has been working with the Town of Windham to investigate potential pollution sources of five impaired streams in Windham, ME, including Black Brook, Colley Wright Brook, Inkhorn Brook, Otter Brook, and the Pleasant River. The watersheds of Black Brook, Colley Wright Brook, and Otter Brook are entirely within the Town of Windham while the 48.9 sq.mi. Pleasant River watershed stretches into the Towns of Gray and Raymond and the Inkhorn Brook watershed has a small section in Westbrook. All five of these streams were included in the recent release of the *Maine Statewide TMDL for Nonpoint Source Pollution Addendum* in September 2021 as an addendum to the *Maine Statewide Total Maximum Daily Load for Nonpoint Source Pollution*. The cause of listing for all five was low dissolved oxygen. The *2009 Statewide Bacteria TMDL for Maine* includes bacteria impairments for Colley Wright Brook, Inkhorn Brook, Otter Brook, and the Pleasant River. Black Brook was not included in the *2009 Statewide Bacteria TMDL* but is not meeting bacteria standards and will be included as impaired in a future update.

The five impaired streams in Windham are important for the health of the local ecosystem and are also important to critical downstream waters such as the Presumpscot River and eventually, Casco Bay. The goal of this ongoing work is to outline actions that will help the Town identify causes and sources of current impairments to inform restoration. Investigative water quality monitoring allows the Town to differentiate fecal contamination sources that are manageable (e.g., septic systems) and those that are natural to the system (e.g., wildlife).

On June 9, 2022, FBE completed one round of targeted wet weather sampling at all five impaired streams for *Escherichia coli (E. coli)* and co-indicators including total phosphorus (TP), nitrate, ammonia, ortho-phosphate, total suspended solids (TSS) and optical brighteners. The State of Maine uses *E. coli* as the primary indicator bacteria for fecal source tracking, however, several other parameters have been successfully used as "co-indicators" that help to identify the source of contamination. The combination of these parameters can help determine whether the contamination source is likely from humans. It is important to note that the results discussed in this memo reflect only a static point in time. Continued follow-up investigative sampling will be necessary to hone in on the variables affecting fecal pollution. **Preliminary results from the June sampling for *E. coli* bacteria exceeded the state threshold across sites at all five streams, except for two locations on Black Brook (BL-010, BL-018). One location on Black Brook and two on Otter Brook had low dissolved oxygen (BL-018, OB-020, OB-010). The elevated levels of bacteria in all five streams under wet weather conditions suggest that there are likely multiple pollution sources, including fecal sources on the landscape via stormwater runoff that are negatively impacting the water quality. A review of land use confirms that agriculture is a likely source of pollution in many of these watersheds. Follow-up bracket sampling during wet and dry weather coupled with DNA source tracking using livestock markers is critical to identifying the contribution of agriculture. Specific recommendations can be found in the Results and Discussion section.**

METHODOLOGY

FBE collected water quality samples at six sites each on Black Brook and Pleasant River and two sites each on Colley Wright Brook, Inkhorn Brook, and Otter Brook on June 9, 2022, after 0.53 in of precipitation in the prior 24 hours. Sampling site locations were selected at established monitoring sites by the Presumpscot Regional Land Trust (PLRT) that have been the focus of baseline surface water data collection for the previous ten years. The investigative monitoring prioritized Black Brook and Pleasant River for restoration efforts to leverage existing efforts through ongoing watershed planning (Black Brook) and implementation projects (Pleasant River). Sample sites at Black Brook were located at the same sites as PRLT (BL010, BL015, BL018, BL020) as well as the addition of two stations at each of the tributary outlets by Meredith Drive and Twoey Drive (labeled BL-MER and BL-TWOEY, respectively). Sample sites at Pleasant River were also located at the same sites consistently monitored by PRLT that are within Windham's borders. Based on previous bacteria trends, sites PL010, PL020, PL030, PL040, PL043, and PL045 were prioritized. Sample

Gretchen Anderson, Town of Windham collecting a sample on the Pleasant River at Windham Center Road on 6/9/22 during wet weather conditions.

sites at both Colley Wright Brook and Otter Brook were located at the same sites as PRLT (CW-010, CW-020) and (OB-010, OB-020), respectively. The same site at Inkhorn Brook as PRLT was used as well as the additional site RIK-25 to understand upstream conditions.

Scientists from FBE sampled during wet weather conditions to understand the potential impact of runoff from the adjacent land uses. Wet weather often mobilizes fecal sources on the landscape and transports them via overland flow to nearby rivers and streams. Samples were analyzed for *E. coli* and additional parameters used as "co-indicators" to fecal indicator bacteria at Maine Environmental Laboratory in Yarmouth. Field parameters were also collected to serve as standard metrics of water quality to help with data interpretation, including dissolved oxygen, temperature, salinity, and specific conductance.

All samples were taken during a rain event to best capture the worst-case scenario of pollutants entering the streams from runoff and tributary drainages. Surface water samples were collected and analyzed as follows:

- Field parameters included dissolved oxygen, temperature, and specific conductance and were recorded using a YSI ProSolo field meter.
- *E.coli* bacteria, total phosphorus, nitrate, total suspended solids (TSS), and ortho-phosphate samples were analyzed at Maine Environmental Laboratory (MEL) in Yarmouth, Maine.
- Ammonia was determined in the field using HACH ammonia test strips.
- Optical brighteners were measured using a handheld Aquaflor fluorometer, based on methods described in SOP 3.4.1.4 Measuring Optic Brighteners in Ambient Water Samples Using a Fluorometer, by Erick Burres, dated March 2011.

Using E. Coli as a Fecal Indicator Bacteria

Fecal indicator bacteria (such as *Escherichia coli* or *E. coli*, Enterococci, and Fecal Coliform) are used to track a wide variety of potentially harmful pathogens such as viruses and bacteria found in fecal waste that would otherwise be too expensive to monitor comprehensively. High in-stream fecal indicator bacteria levels during wet weather events can point to fecal sources on the landscape via stormwater runoff. *E. coli* is the most appropriate indicator bacteria for fecal source tracking in freshwaters and is the Maine Department of Environmental Protection (Maine DEP) standard.

"Co-Indicators" to Fecal Indicator Bacteria

In addition to *E. coli*, several other parameters can be used as "co-indicators" to fecal indicator bacteria to help confirm humans are the likely source of contamination, such as nutrients (nitrate and phosphorus), dissolved oxygen, ammonia, and optical brighteners. Nutrients (nitrate and phosphorus) can indicate human sewage if in extremely high concentrations. Nutrient sampling (total phosphorus and nitrate) can also indicate runoff from agricultural lands which carry nutrients to the stream channel that fuel excess algae growth. Ammonia is used in illicit discharge detection screenings and high concentrations can indicate sewage contamination, however not all discharges have high concentrations, so it is best used in combination with other parameters. Optical brighteners are commonly used for wastewater detection. Optical brighteners are not naturally occurring and are typically added to laundry soaps, detergents, cleaning agents, and toilet papers to aid in the brightening of fabrics and/or surfaces. Testing positive for optical brighteners in groundwater strongly suggests greywater from leach fields is entering the groundwater without adequate filtration.

Fecal contamination is one of the most difficult pollutants to remediate. There are a few reasons for this:

(1) It is a nonpoint source pollutant, meaning that it can come from many different locations on the landscape.

(2) Human health concerns are caused by potentially harmful pathogens such as viruses and bacteria, that are present within fecal matter. However, it would be too expensive to track and monitor each harmful virus and bacteria individually. Because of this, we use indicator organisms (such as *Escherichia coli* or *E. coli*, Enterococci, and Fecal Coliform). These indicator organisms are chosen based on similarities to pathogens in behavior and transport in the environment.

(3) Synchronicity in behavior between fecal indicator bacteria and the pathogens-of-concern for public health risk (e.g., salmonella, campylobacter, rotavirus, giardia, norovirus, hepatitis, etc.) may break down under certain environmental conditions. Therefore, caution must be used when interpreting fecal indicator bacteria data in the context of risk management decisions.

(4) Fecal contamination tracking is an evolving science, with new technologies consistently making their way to the market. We do our best to use the tools at our disposal while recognizing their limitations.

RESULTS

The sampling results found high levels of fecal indicator bacteria *(E. coli)* at all five freshwater tributaries. Results are displayed in Table 1 and Map 1. Bacteria levels were elevated above Maine's EPA-approved instantaneous (one sample) threshold of 236 MPN/100 mL at all sites except BL-010 and BL-018 and ten sites were above the maximum laboratory detection limit (>2,420 MPN). All sampling sites had elevated levels of total phosphorus above the threshold of 0.01 mg/L. Colley Wright Brook, Otter Brook, Pleasant River, and Inkhorn Brook had sites with nitrate levels exceeding the threshold of 0.10 mg/L while all the sites at Black Brook are meeting state nitrate recommendations. Results indicated that Black Brook, Otter Brook, Pleasant River, and Inkhorn Brook had at least one site with ortho-phosphate levels elevated above the threshold criteria of 0.012 mg/L. Optical brighteners were not present in any of the five impaired streams. Sites BL-015, BL-TWOEY, CW-020, and PL-043 had TSS values above the recommended threshold for freshwater.

Accompanying field parameters indicated that three sites had low dissolved oxygen (BL-018, OB-020, OB-010) and all sites had water temperatures under the recommended threshold of 24°C for cold water fish survival. There were no exceedances of the specific conductance or ammonia thresholds.

Sampling on 06/09/2022 at Inkhorn Brook along River Road. Photo credit: Amanda Lessard, Town of Windham.

Table 1. Field parameter and laboratory results for the five tributaries sampled for water quality conditions during wet weather. Bold, italicized ***red*** text indicates results failing to meet state criteria and natural background or suggested levels (as indicated by the grey highlighted values for freshwater sites). Sites are listed downstream to upstream for each tributary.

Site Name	DO (mg/L)	DO (%)	Temp (°C)	Specific Conductance (µS/cm)	Ammonia (PPM)	Optical Brighteners (pos. or neg.)	*E. coli* (MPN/100 mL)	Nitrate (mg/L)	Phosphorus (mg/L)	TSS (mg/L)	Ortho-Phosphate (mg/L)
Threshold	*< 7 mg/L*	*<75% saturation*	*<24°C**	*<854 µS/cm*	*> 0.3 ppm*	*positive*	*> 236 MPN/100 mL*	*> 0.10 mg/L*	*> 0.01 mg/L*	*<80 mg/L ***	*> 0.012 mg/L*
BL-010	9.35	93.1	15.2	286.4	0	negative	152	ND	***0.05***	10	0.008
BL-015	7.58	77.0	16.1	255.0	0	negative	***> 2,420***	ND	***0.26***	***220***	***0.050***
BL-018	***5.52***	***56.3***	16.4	325.8	0	negative	225	ND	***0.05***	3	0.009
BL-020	8.34	81.6	14.3	202.6	0	negative	***> 2,420***	ND	***0.15***	76	***0.027***
BL-MER	9.43	94.9	15.6	278.4	0	negative	***517***	ND	***0.17***	11	0.010
BL-TWOEY	9.35	93.9	15.6	279.8	0.1	negative	***276***	ND	***0.07***	***83***	0.009
CW-010	8.69	87.2	15.5	200.4	0	negative	***> 2,420***	***0.26 J***	***0.15***	75	0.006
CW-020	9.12	89.7	14.6	157.1	0	negative	***> 2,420***	***0.25 J***	***0.30***	***270***	0.010
OB-020	***4.87***	***48.8***	15.7	274.0	0	negative	***> 2,420***	***0.34***	***0.17***	69	***0.024***
OB-010	***5.54***	***55.4***	15.1	251.7	0	negative	***365***	***0.24***	***0.04***	3	***0.014***
PL-010	8.01	84.4	17.0	209.3	0	negative	***548***	***0.44***	***0.04***	4.3	***0.014***
PL-020	8.99	93.0	16.9	183.9	0	negative	***1,733***	***0.41***	***0.06***	15	***0.014***
PL-030	8.78	90.5	16.8	177.6	0	negative	***> 2,420***	***0.40***	***0.09***	53	***0.014***
PL-040	8.76	90.3	16.8	193.1	0	negative	***> 2,420***	***0.35***	***0.20***	20	***0.014***
PL-043	9.02	90.8	15.7	211.2	0	negative	***> 2,420***	***0.26 J***	***0.20***	***110***	***0.021***
PL-045	7.52	78.1	17.1	266.0	0	negative	***> 2,420***	ND	***0.05***	16	0.008
IN-010	7.23	***74.6***	16.9	153.7	0	negative	***1,414***	***0.12J***	***0.05***	16	***0.016***
RIK-25	8.98	88.0	14.4	138.7	0	negative	***> 2,420***	***0.12 J***	***0.12***	67	0.012

J = Data reported between the Limit of Quantitation and Limit of Detection is J-flagged as "estimated".
ND = Not detected below the Limit of Detection
** Recommended for cold water fish survival*
***Recommended for freshwater fish survival*

DISCUSSION & RECOMMENDATIONS

The elevated *E. coli* bacteria levels across all five tributaries during wet weather indicate that there are likely multiple pollution sources that are negatively impacting the water quality. The lack of presence of optical brighteners at all sites indicates there was no identified presence of wastewater during this specific sampling event; however, a negative result for optical brighteners does not eliminate the possibility of a malfunctioning septic system as a cause of fecal contamination. Furthermore, sampling during wet weather increases the proportion of the water volume that is from surface runoff and overland flow, diluting the groundwater signal in the samples, which would be the route of transfer for wastewater.

Results for each stream are discussed below with specific follow-up recommendations. Given elevated results across all streams for bacteria, we continue to recommend that follow-up work be prioritized for Black Brook and Pleasant Brook to leverage resources through the watershed planning projects. Longer term priority recommendations are discussed in the recently published Monitoring Plan.

Black Brook: Elevated bacteria at Black Brook was most severe at sites BL-015 (Webb Road) and BL-020 (Windham Center Road). The two samples on the Twoey and Meredith Drive tributaries did have elevated bacteria but relatively low co-indicator parameters and lower bacteria than the upstream sites 15 and 18. Human sewage indicators (ammonia, optical brighteners, and nitrate) were not present at any site, but elevated phosphorus and ortho-phosphate at sites BL-015 and BL-020 suggest a possible animal waste input (e.g., wildlife or agriculture). Aerial imagery suggests multiple agricultural operations in the vicinity of Black Brook upstream of Site BL-015 (in the greater Town Farm Road area) and north of BL-020 in the headwaters along Route 202. We recommend bracket sampling in this region under both dry and wet weather conditions with follow-up microbial source tracking with markers for any livestock species present at these operations. Dissolved oxygen at Black Brook was well above state standards for Class B streams except for site BL-018. The sample location at BL-018 was a slow-moving wetland off Swett Road, likely causing low dissolved oxygen.

Colley-Wright Brook: *E. coli*, nitrate, and phosphorus were elevated at both Colley-Wright Brook sampling sites. Coupled with low co-indicator parameters for human sewage, elevated bacteria and nutrients again suggests possible agricultural inputs to this stream. Twenty-four percent of the stream channel passes through agricultural land, especially in the southern portion of the stream near these sampling locations. Follow-up sampling at these sites coupled with one or two upstream sites would help to identify if the bacteria and nutrient source was limited to land use inputs in the southern part of the stream, or also derived from upstream sources. Samplers observed high turbidity at both sampling locations at Colley-Wright Brook, reinforced by high total suspended solids (TSS) results for both sites (especially CW-020 upstream). High turbidity and TSS suggests mobile sediments in the stream channel. Dissolved oxygen at both Colley-Wright Brook sites was well above state standards for Class B streams.

Otter Brook: Otter Brook experienced high bacteria and co-indicator parameters (nitrate, phosphorus, ortho-phosphate) at both sites. Additionally, it was the only tributary where both sampling locations had low dissolved oxygen. This reinforces our recommendation to perform microbial source tracking at these sites to identify if the bacteria are from wildlife in the wetland areas. If funds allow, a continuous DO logger at this site would help identify if the DO is a result of natural causes in the wetland.

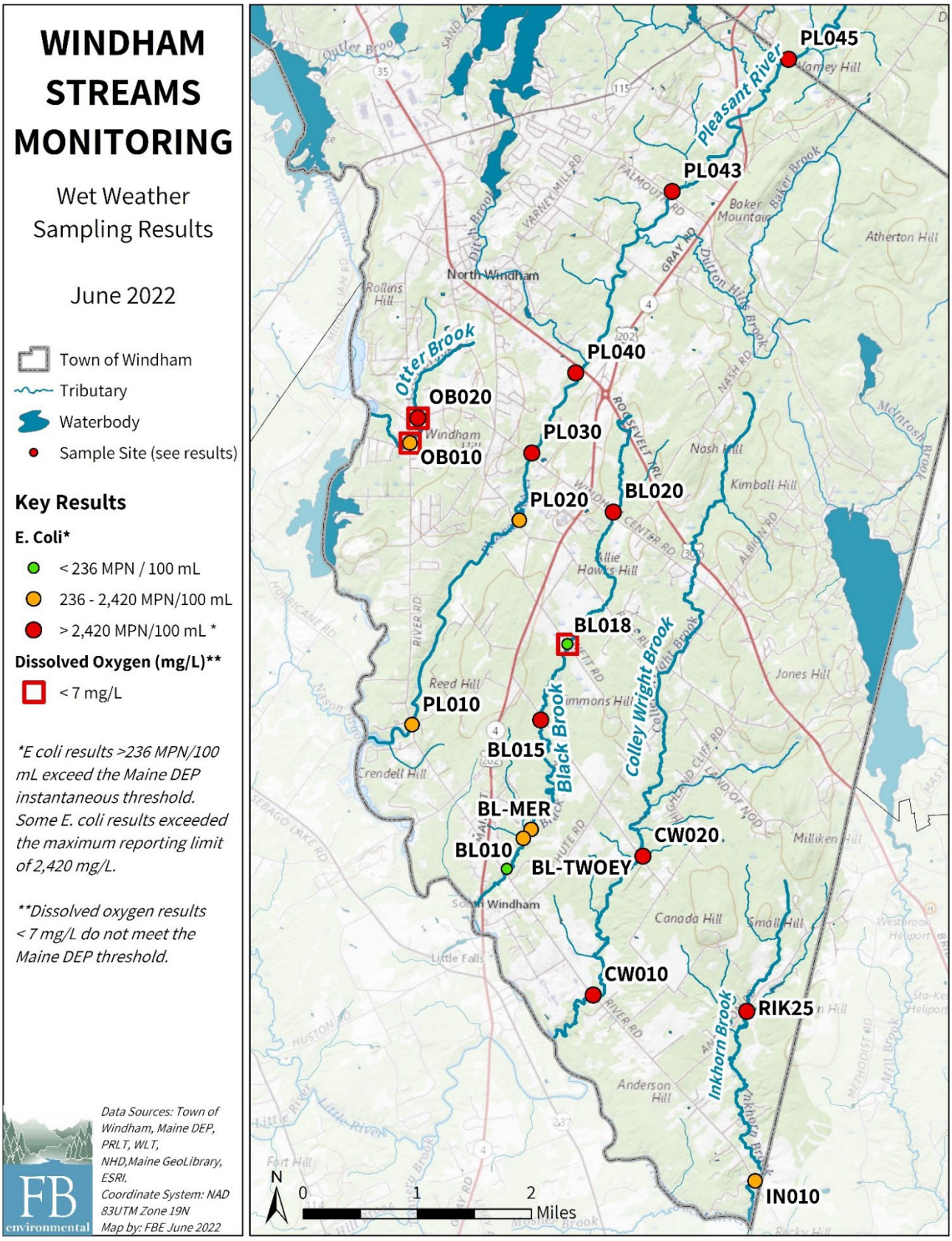
Pleasant River: *E. coli* results on the Pleasant River were above the state standards at all six sites sampled, however, results at the four sites upstream exceeded the maximum detection limit by the laboratory (2,420 MPN/100 mL). All but the most upstream of these sites (PL-045) also had high nutrient concentrations (nitrate, phosphorus, and ortho-phosphate) indicating land use activities and possible bacteria and nutrient inputs to the channel downstream of this site should be investigated. Aerial imagery suggests the presence of agriculture adjacent to the stream channel at multiple locations (near Wilson Road, off Hayfield Drive, and off Coyote Court) which is a possible source of both nutrients and bacteria. One discrete sampling event does not confirm these operations as pollution sources, but warrants future bracket sampling along these sections of the channel to further isolate sites with elevated nutrients. Because *E. coli* was also high at site PL-045, this suggests that there are additional source(s) of bacteria originating upstream and outside of the Town of Windham boundary. We suggest collaborating with the Town of Grey through Presumpscot Regional Land Trust to organize a collaborative sampling effort across the Town boundary. Dissolved oxygen was well above state standards for Class B streams at all sites along the Pleasant River.

Inkhorn Brook: *E. coli* results at the two Inkhorn Brook sites (IN-010 and RIK-25) were both above the state standards. Both sites also experienced high nitrate and phosphorus, with high ortho-phosphate at site IN-010. Site RIK-25 was selected to bracket stream conditions above the influence of Milliken Brook. Results for *E. coli*, phosphorus, and TSS were higher at this upstream site which suggests that there are pollution sources along the upstream reach of the main stem. Follow-up sampling at Inkhorn Brook should

include bracketing of Milliken Brook directly (site RIKMK01) as well as an additional site upstream along the main channel if accessible (possibly off Craig Road or Canada Hill Road). Dissolved oxygen was above state standards except for percent DO at IN-010 which was just under at 74.6%.

Sampling at site BB-010 on Black Brook during wet weather on 06/09/2022. Photo credit: Maggie Kelly, FBE.

Map 1. Results from the investigative sampling of five impaired streams in Windham in June 2022.



CITATIONS

USEPA. 2001. Ambient Water Quality Criteria Recommendations: Information Supporting the Development of State and Tribal Nutrient Criteria: Rivers and Streams in Nutrient Ecoregion VIII. United States Environmental Protection Agency, Office of Water 4304, EPA 822-B-01-015. Retrieved online from http://www2.epa.gov/sites/production/files/documents/rivers8.pdf.

Weather History for KMEWINDH25. 2022. https://www.wunderground.com/dashboard/pws/KMEWINDH25/table/2022-06-8/2022-06-8/daily