

2023 Vermont Family Forest Monitoring Summary Report

Isham, Beaver Meadow, Cold and Norton Brooks

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For Addison County River Watch Collaborative

December 2023

Summary of 2023 Findings

- Site LOCNB0.2 (newly added in 2023) exceeded other monitored sites in concentration of all measured analytes and exceeded the water quality standards for TP, *E. coli* and turbidity at least once. The highest water quality temperatures of the year were recorded at LOCNB0.2.
- The *Escherichia coli* criterion for primary contact recreation in Class B(2) waters is not to exceed a geometric mean of 126 organisms/100 mL obtained over a representative period of 60 days, and no more than 10% of samples above 235 organisms/100 mL. That standard was exceeded at all sites on August 8 when stream flow was the highest of all sampling days. All samples on all days collected at LOCNB0.2 exceeded the *E. coli* standard.
- Both nitrate and chloride concentrations were well below the water quality standard on all measured dates at the one location where they were measured (LOCNB0.2).

Study Overview

Addison County River Watch (ACRWC) began monitoring in the upper New Haven River watershed in 2021 in the town of Lincoln with two sites: one on Isham Brook (NHIO.1) and one on Beaver Meadow Brook (NHBM0.1). Analytes measured in 2021 included *E. coli*, chloride, nitrate, total phosphorus (TP), turbidity and temperature. In 2022, ACRWC monitored the same two sites and added a third on Cold Brook (NHCBO.1), a tributary to Baldwin Creek in the town of Bristol, which drains to the New Haven River. Samples were analyzed for concentration of *E. coli*, chloride, nitrate, TP, and turbidity. Consistent with 2021 results, 2022 concentrations of nutrients, turbidity, and chloride were low at all sites. *E. coli* levels were highest at the Beaver Meadow Brook and Isham Brook monitoring sites (NHBM0.1 & NHIO.1) where the state standard was exceeded on one date during a rain event and lowest on Cold Brook (NHCBO.1) where no sample exceeded 1 organism/100 mL.

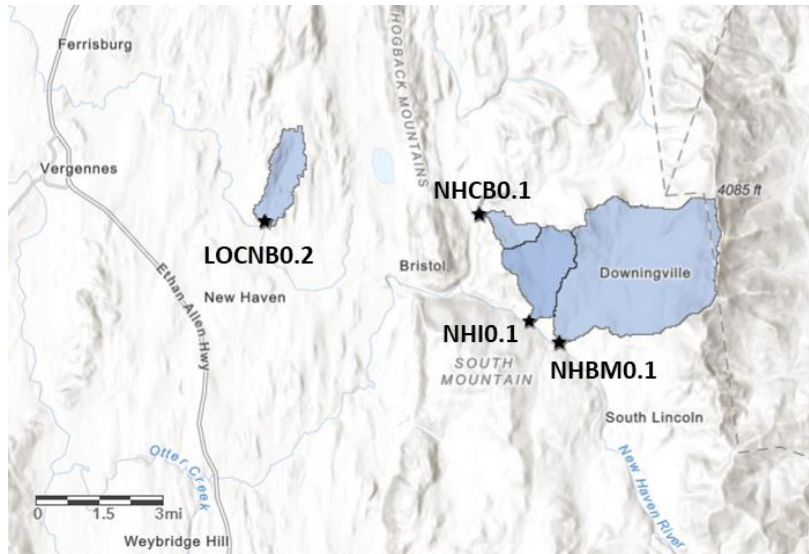


Figure 1. 2023 monitoring points and their associated watershed areas. LOCNB0.2 was newly added in 2023.

In 2023, a fourth monitoring point was added on Norton Brook which drains to Little Otter Creek in the town of Bristol. All sites were grab sampled for TP, *E. coli*, and turbidity. Site LOCNB0.2 was also sampled for chloride and nitrate.

Watershed sizes associated with each monitoring point are summarized in Table 1.

Table 1. 2023 Monitoring locations and associated watershed areas

Monitoring Site ID	Waterbody	Drains To	Watershed Area (acres)
NHI.0	Isham Brook	New Haven River	1,500
NHBM0.1	Beaver Meadow Brook		6,800
NHCBO.1	Cold Brook		435
LOCNB0.2	Norton Brook	Little Otter Creek	1,011

Methods

In 2023, Isham Brook, Beaver Meadow Brook, Cold Brook and Norton Brook were sampled at one location each on four dates: June 6, July 13, August 8, and September 5. Grab samples were collected and analyzed for TP, *E. coli*, and turbidity at all sites and the Norton Brook samples were additionally analyzed for chloride and nitrate-nitrogen. All samples were analyzed at Endyne Laboratories in Williston, Vermont.

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Water quality samples were collected by ACRWC volunteers in accordance with quality assurance procedures outlined in the EPA-approved Generic Quality Assurance Project Plan prepared by VTDEC.

No duplicate samples were collected at any site. Duplicate field samples provide a quality assurance check of field protocols as two samples collected at the same time and place are expected to measure within a pre-determined range which indicates clean and consistent sampling procedures. Without field duplicates at these sites, no such cross check of results is possible.

USGS gages on the New Haven River at Brooksville (Station ID 04282525) and the Little Otter Creek at Ferrisburg (Station ID 04282650) were referenced to determine general flow conditions on each sampling date. Rainfall data was downloaded from the Northeast RCC CLIMOD 2 weather station in New Haven Vermont which is part of the CoCoRaHS (Community Collaborative Rain, Hail & Snow) network.

Applicable Water Quality Standards

Flow

Flow conditions are relevant for evaluating testing parameters in terms of Vermont Water Quality Standards. Total phosphorus (TP) standards are based on samples collected when flows are at or below the Low Median Monthly flow (LMM) while nitrate-nitrogen levels are evaluated when flows exceed the LMM. In 2023, one sampling day (June 6) corresponded with a flow lower than the LMM and all others corresponded with higher flows.

Temperature

The water quality standard for temperature in streams is based on consistency with ambient temperature of the water body at a control point. In warm water fish habitat, the total increase from ambient temperature due to all discharges and activities shall not exceed 1-5°F depending on the starting ambient temperature of the waterbody. Waterbodies with higher ambient temperatures (66°F) have less temperature increase allowance than those with lower temperatures (55°F). Without access to ambient temperature tracking, this monitoring uses temperature as a way to track changes due to best management practice implementation over time.

Total Phosphorus (TP)

Total phosphorus is a measurement of all of the types of phosphorus in a sample including those that are dissolved in the water as well as those bound to minerals or associated with plant tissue. The instream phosphorus criterion for warm-water medium gradient (WWMG) wadable stream ecotypes in Class B water at or below low median monthly (LMM) flow conditions from June through October is not to exceed 27 µg-P/L. June 6 was the only sampling day with flows below LMM in the New Haven.

E. coli

The Vermont Water Quality Criteria (2022) states that *E. coli* is not to exceed a geometric mean of 126 organisms (MPN)/100 mL obtained over a representative period of 60 days, and no more than 10% of samples should be above 235 organisms/100 mL. Sampling in 2023 does not qualify as a representative period of 60 days because only four total samples were collected at any site over a 90-day period but the standard provides a threshold to which the measured samples can be compared.

Turbidity

The turbidity standard for Class B streams is not to exceed 25 NTU in dry weather base-flow conditions. The only sampling date in 2023 that could be considered dry weather base-flow is June 6.

Chloride

The water quality criteria to protect aquatic biota allows an average concentration of not to exceed 230 mg/L as a rolling 4-day average and a maximum concentration not to exceed 860 mg/L as a 1-hour average. Determining chloride standard exceedances requires continuous monitoring which was not done at any site in 2023. However, as with other standards, the state’s threshold provides context for evaluating grab sample results.

Nitrate

The Class B cold water fishery VT Water Quality Standard for nitrogen as nitrate is 5 mg/L when flows exceed LMM flow. All sample days except June 6 occurred during flow conditions that exceeded the LMM.

Results

Precipitation and River Flow

2023 was a wetter than average summer. Between May 1 and September 30, more than 29 inches of rain fell in New Haven, VT (Figure). The August 8 sampling event took place during a storm event. All other sampling was between storms.

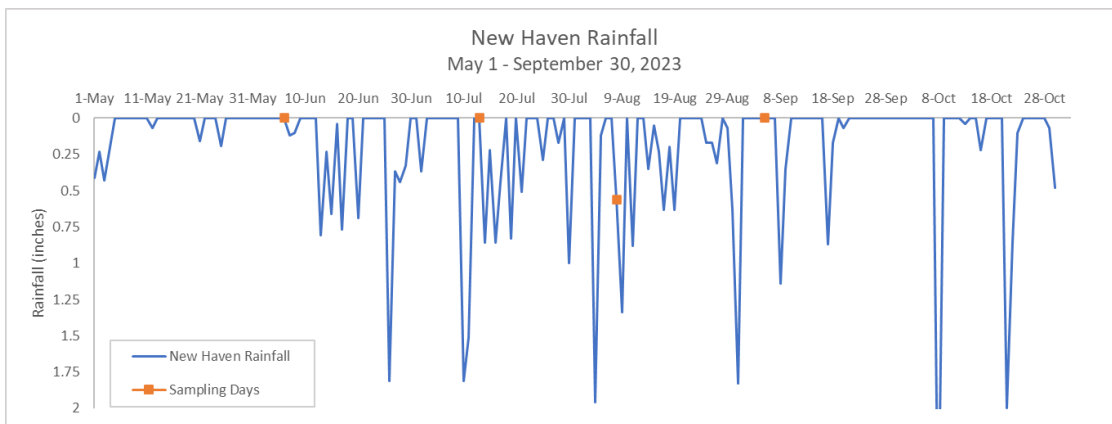


Figure 2. Rainfall record for the 2023 monitoring period in New Haven VT downloaded from the Northeast RCC CLIMOD 2 dataset managed by Cornell University.

In 2023, flow in the New Haven River exceeded the low median monthly flow (LMM) (65 cfs) during all but one sample day (June 6) The highest measured flow at the New Haven Brooksville gage in the spring/summer (April 1- September 1) exceeded 4,980 cfs (F). Flow status in the river during sampling dictates the pollutant level as it relates to a legal standard associated with concentrations during flows of a particular type. The nitrate-nitrogen standard is relevant when flow exceed LMM while the phosphorus standard is relevant at flows below LMM. As a result, three of the sample dates in 2023 can be compared to the standard threshold for nitrate and one can be compared to the phosphorus standard.

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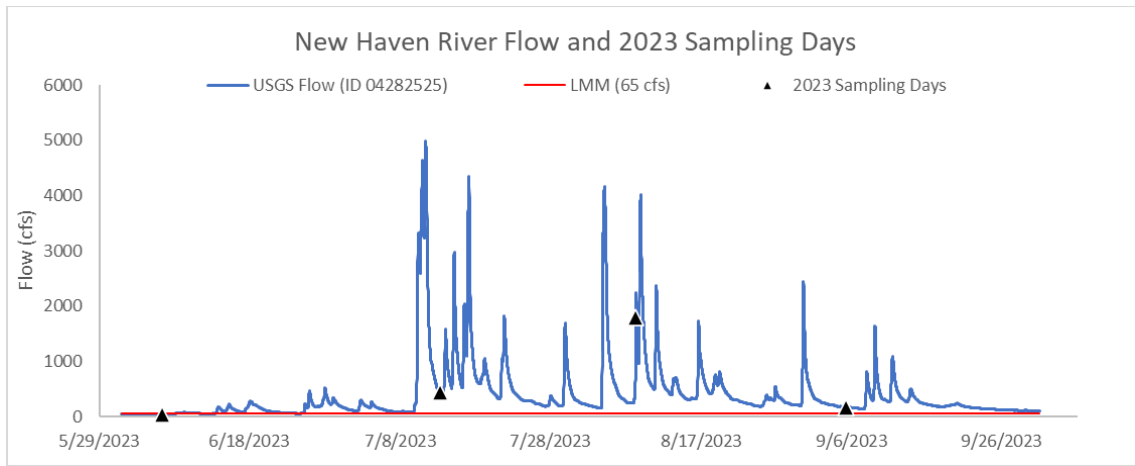


Figure 3. Flows in the New Haven River with 2023 sampling days noted as points. The low median monthly flow (LMM) for the New Haven is 65 cfs.

Water Quality

Raw water quality data for all sites are listed in Table 2.

Table 2. Raw water quality data for 2023

Site ID	Date	Sample ID	Chloride (mg/L)	Nitrate-N (mg/L)	TP (ug/L)	E. coli (MPN/100ml)	Turbidity (NTU)	Water Temp F
NH10.1	6/6/2023	NH10.1			< 10	< 1	< 0.5	49
NH10.1	7/13/2023	NH10.1			12	31.3	0.85	63
NH10.1	8/8/2023	NH10.1			98	> 2419.6	40	61
NH10.1	9/5/2023	NH10.1			< 10	18.1	0.7	62
NHBM0.1	6/6/2023	NHBM0.1			< 10	2	< 0.5	49
NHBM0.1	7/13/2023	NHBM0.1			14	90.9	1.1	59
NHBM0.1	8/8/2023	NHBM0.1			52	> 2419.6	11	60
NHBM0.1	9/5/2023	NHBM0.1			< 10	29.8	0.65	60
NHCB0.1	6/6/2023	NHCB0.1			10	2	< 0.5	50
NHCB0.1	7/13/2023	NHCB0.1			12	10.9	0.95	59
NHCB0.1	8/8/2023	NHCB0.1			29	1203.3	2.6	61
NHCB0.1	9/5/2023	NHCB0.1			< 10	17.3	< 0.5	60
LOCNB0.2	6/6/2023	LOCNB0.2	0.87	0.043	37	524.7	5.7	58
LOCNB0.2	7/13/2023	LOCNB0.2	< 5	< 0.2	55	143.9	7.6	70
LOCNB0.2	8/8/2023	LOCNB0.2	< 1	< 0.04	< 70	1299.7	14	65
LOCNB0.2	9/5/2023	LOCNB0.2	< 1	0.062	75	601.5	38	

Temperature

Stream temperature was highest in Norton Brook (LOCNB0.2) and lowest in Beaver Meadow (NHBM0.1). Some of the highest temperatures of the monitoring period were measured on July 13 – following the large storm event and subsequent statewide flooding on July 10-11. Temperature was not measured at LOCNB0.2 on September 5 (Figure 4).

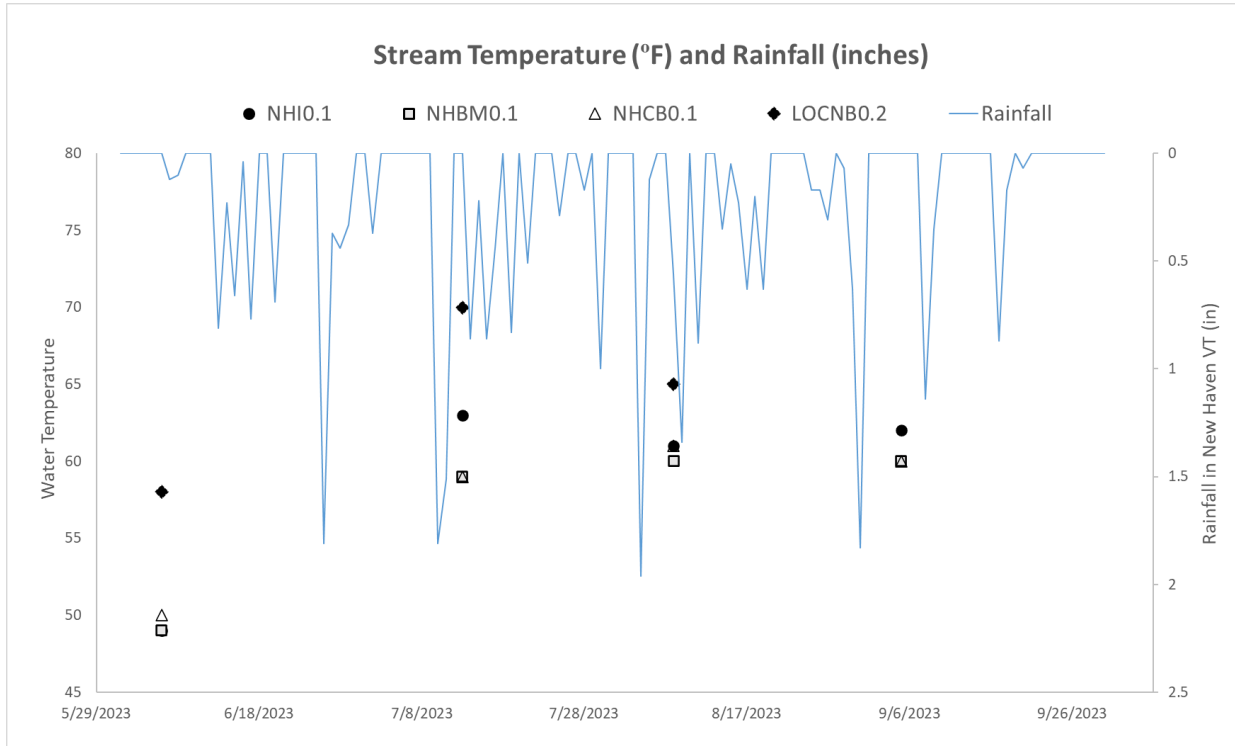


Figure 4. Water temperature at all monitoring locations in 2023 with concurrent rainfall in New Haven, Vermont.

Phosphorus

The TP water quality threshold (27 µg/L) was exceeded at site LOCNB0.2 on the only day with flows below LMM (June 6) with a concentration of 37 µg/L. All sites exceeded 27 µg/L on August 8 but the flow in the New Haven exceeded LMM so the standard is not applicable. Similarly, site LOCNB0.2 exceeded 27 µg/L on all sample days.

E. coli

The *E. coli* water quality standard for primary contact recreation was exceeded at all sites on August 8 (when New Haven River flows topped 1800 cfs). *E. coli* measured on that day exceeded 126 MPN/100 mL at all sites with NH10.1 and NHBM0.1 measuring the highest concentrations (>2419.6 MPN/100 mL). The only site to have grab samples that exceeded the water quality standard on any other day was LOCNB0.2, where *E. coli* concentrations exceeded the standard on every other day of sampling.

Turbidity

The turbidity standard was exceeded at LOCNB0.2 on September 5 (38 NTU). On August 8, NH10.1 exceeded 25 NTU (40 NTU) but that date corresponds with a high flow event so is not applicable to the water quality standard.

Chloride

Chloride was measured only at LOCNB0.2 and was far below the water quality standard on all sample days.

Nitrate-Nitrogen

Nitrate was measured only at LOCNB0.2 and was below the water quality standard on all sample days.

Conclusions

Water quality results in 2023 indicate standard exceedances primarily at the new monitoring location on Norton Brook (LOCNB0.2). Other monitoring locations measured high *E. coli* concentrations on August 8 but otherwise were within the applicable water quality standard thresholds.

The following points summarize the findings, implications, and suggested next steps based on the 2023 monitoring effort:

- Water temperatures were highest at LOCNB0.2 (Norton Brook). Determining temperature-based water quality exceedances requires an ambient temperature measurement in an unimpacted area of the stream. Therefore, simply observing high stream temperatures does not indicate standard exceedances. However, high stream temperatures can be abated through stormwater management and stream shading via the establishment of vegetated buffers. Both options may be explored as they might be relevant to reduce stream temperatures. The high values observed on July 13 were likely influenced by significant stormwater runoff entering the streams from a singular rainfall event and are not solar-radiation dependent.
- LOCNB0.2 was a newly added monitoring site in 2023. TP concentrations at that site exceeded all other monitored sites and exceeded the TP water quality criterion on June 6 when flow was below LMM. While the rest of the sampling coincided with flow conditions not appropriate for comparison to the water quality standard, the higher TP concentrations throughout the study period are worth further exploration to identify sources in that watershed and potential mitigation.
- The *E. coli* standard for primary contact recreation was exceeded at all sample locations on August 8 during a rain event in which the river flows were rising and high. While *E. coli* exceedances are common when flows are high, site LOCNB0.2 exceeded the standard on all sample days, irrespective of flow conditions. This indicates a source in the watershed that should be explored further.
- Turbidity was highest at LOCNB0.2 where a single exceedance of the water quality standard occurred on September 5. This indicates a source of particulate to the stream that is impacting water clarity. Some common sources of sediment to streams include uncontrolled stormwater runoff, agricultural runoff (such as bare soil field runoff), and stream bank erosion. Clay soils common in Addison County contribute to higher natural turbidity levels. Turbidity is often associated with phosphorus as the nutrient readily attaches to particulate. Addressing turbidity can simultaneously address phosphorus concentrations.
- Chloride and nitrate concentrations measured at LOCNB0.2 were well below applicable water quality standards and indicate that there is not a significant source of these pollutants in the watershed at this time.
- This project did not collect field duplicates. To provide a quality assurance check of field protocols, consideration should be made to include one duplicate sample at each location throughout the monitoring period in 2024.