

New Haven River – 2016 and 2017 Water Quality Summary
Addison County River Watch Collaborative

Site	Location	Town
NHR0.5	Former Dog Team Tavern	New Haven
NHR2	Muddy Branch confluence	New Haven
NHR5	New Haven Mills / Munger St Bridge	New Haven
NHR6	Route 116 Bridge, Sycamore Park	Bristol
NHR9	South St. Bridge	Bristol
NHR11.5	Bartlett's Falls Pool	Bristol
NHR13	York Hill Rd Bridge	Lincoln
NHR15	S. Lincoln Bridge (Gap Rd.)	Lincoln
NHM0.4	Just above confluence at Nash Farm	New Haven
NHM1.4	Halpin Covered Bridge Rd	New Haven
NHM3.6	Painter Road crossing	Middlebury
NHM5.2	Munger Road crossing	Middlebury
NHWB0.2	Cove Road crossing	Bristol
NHWB2.7	Rt 116 below Elephant Mtn Campground	Bristol

The Addison County River Watch Collaborative has been monitoring water quality in the New Haven River since 1993. For the 2016 and 2017 seasons, the New Haven River was the subject of a more intensive monitoring focus, where rotational as well as sentinel stations were monitored and additional parameters were tested to better define spatial variability in pathogen, sediment and nutrient concentrations. New Haven River is listed as a stressed water, with *E.coli* and sediment impacting contact recreation and aquatic habitat uses (VTDEC, 2016).

Monitoring was resumed at four historic water quality stations on the main stem to complement sentinel stations NHR2 and NHR9 and established swimming hole sites NHR6 and NHR11.5. In addition, six new bracket monitoring stations were established on two tributaries of the lower main stem to better define the degree and extent of water quality conditions on these waters. Four new stations were established at road crossings on the Muddy Branch which drains the northeastern third of the town of Middlebury and joins the New Haven River at the former Nash Bridge. Two new stations were set up on the West Brook tributary which drains north along VT Route 116 and joins the New Haven River nearly one mile downstream of Sycamore Park.

During 2017, sampling occurred on two spring dates (April 5 and May 3) and four summer dates (June 7, July 5, August 2, and September 6). The year was characterized by a wetter-than-normal spring and early summer, followed by a drier-than-normal fall. April through July and September sampling events took place during high flows, either actively rising or declining from recent rainfall and runoff, based on streamflow gaging records from a USGS streamflow gaging station located on the New Haven River at Brooksville. The August event occurred during low flows, representative of base-flow conditions (i.e., relatively stable flow stage, not significantly rising or falling in response to a rainfall event). Flow conditions in 2017 contrasted with the previous year, in which flows were dominated by low-flow, base-flow conditions during a drier-than-normal year.

Samples were tested for *E.coli*, phosphorus (total and dissolved), nitrogen, total suspended solids, and turbidity; *E. coli* was tested only on the summer dates.

E.coli counts at sites in the New Haven River watershed ranged from 9.7 to >2420 organisms/100 mL in 2017 (Figure 1). Vermont Department of Health guidance identifies a health-based standard for *E.coli* of 235 organisms/100 mL. *E. coli* counts at popular recreational sites (Figure 1) were below this health-based standard on all summer dates except for the September 6 sample from New Haven Mills, and the June 7 and September 6 dates at popular angling sites, Nash Bridge and Dog Team Tavern.

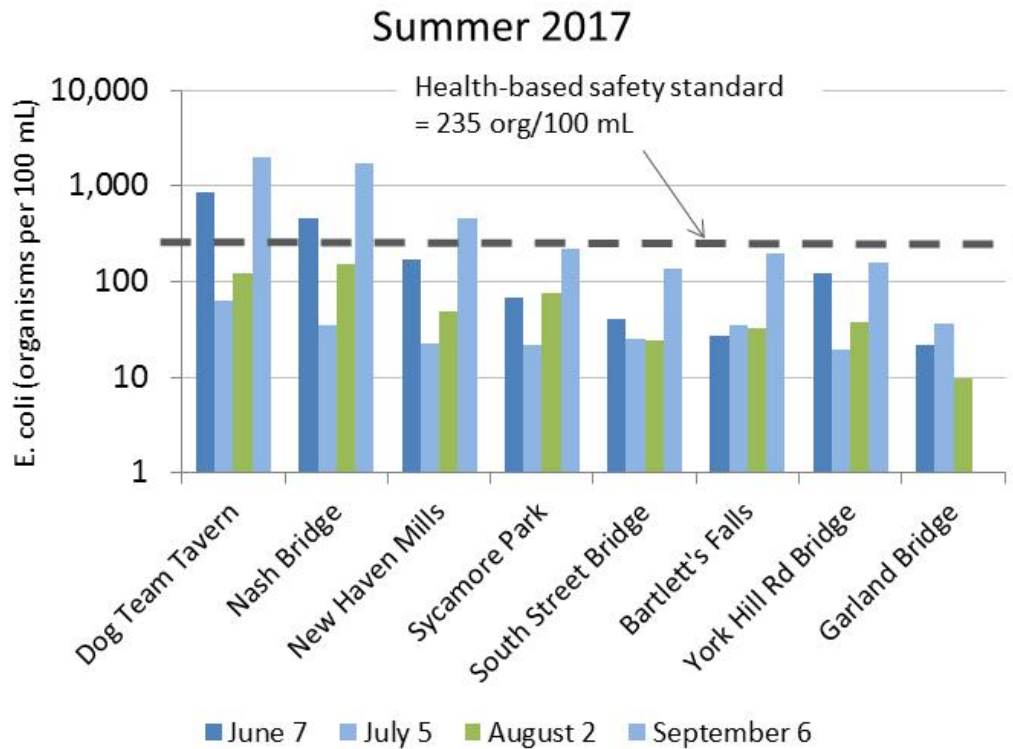


Figure 1. *E.coli* measured at recreation sites along the New Haven River main stem on four summer dates in 2017. Blue-shaded dates were freshet flows at high flow stage; the green-shaded date was a base-flow event during low flow.

The box-and-whisker chart in Figure 2 summarizes *E. coli* concentrations detected at all stations on summer sampling dates during both focus years. Vermont Water Quality Criteria (October 2016) state that *E.coli* is 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 should be above 235 organisms/100 mL. Consistent with historic results, an increasing trend in *E.coli* levels is evident with distance downstream along the main stem from station NHR11.5 (Bartlett’s Falls) to NHR2 (Nash Bridge). Developed and agricultural land uses are more prevalent in the lower New Haven River watershed. Newly-monitored West Brook joins the main stem nearly one mile downstream of Sycamore Park, between stations NHR6 and NHR5. Muddy Branch joins the main stem at the Nash Bridge just above station NHR2. *E.coli* counts in these tributary stations were elevated above the health-based standard on one or more summer sampling dates, except for the uppermost station on West Brook at the VT Route 116 crossing just downstream of Elephant Mountain campground. The geometric mean of concentrations for all four Muddy Branch stations and the downstream-most West Brook station were also elevated above the 126 org/100mL geomean standard. The incremental drainage areas of these tributary stations are dominated by agricultural (24 to 58%) and developed (1 to 13%) land uses, while the uppermost site on West Brook (NHWB2.7) has a drainage area that is 96% forested.

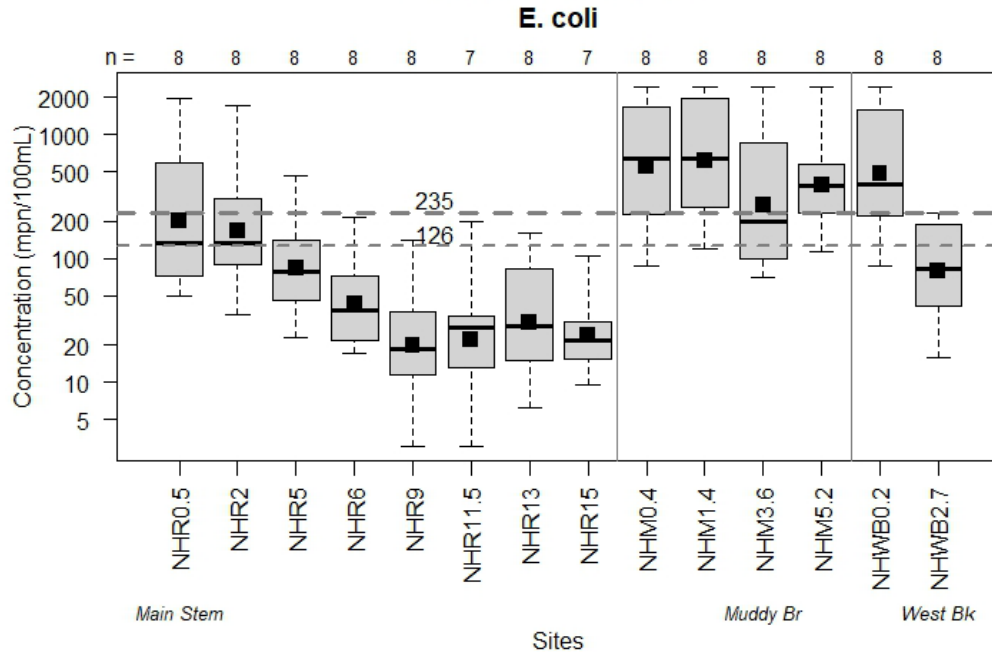


Figure 2. *E. coli* measured at New Haven River and tributary stations on five dry-weather, low-flow dates and three wet-weather, high-flow dates between June and September in 2016 and 2017. The number of samples (n) represented by each box-and-whisker is displayed across the top of the chart. The whiskers extend to the maximum and minimum values, while the gray-shaded box represents the middle 50% of values. The median value is marked by the dark horizontal line. The geometric mean of all available samples for each station is displayed as the black square symbol. The horizontal, gray dashed lines represent the health-based (235) and geomean (126) standards for *E. coli*.

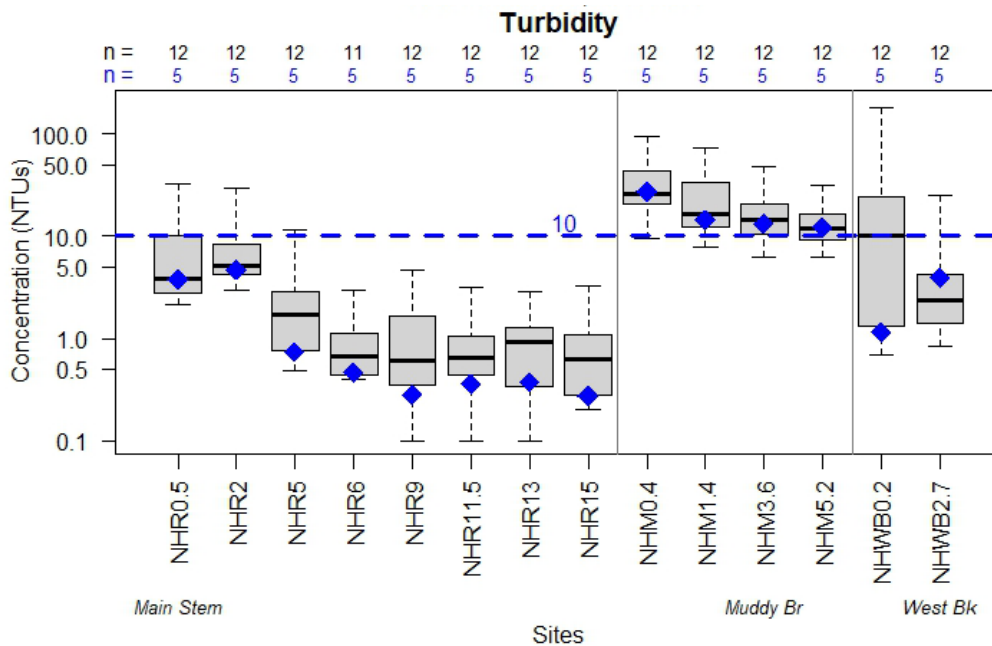


Figure 3. Summary of Turbidity results measured at New Haven River and tributary stations on five dry-weather, low-flow dates and seven medium-to-high-flow dates in 2016 and 2017. The arithmetic mean of the five low-flow/baseflow samples for each station is displayed as the blue diamond symbol. The horizontal, blue dashed line represents the Turbidity standard for Class B cold-water streams.

Turbidity levels at the New Haven River watershed sites ranged from <0.2 to 178 NTUs for the twelve sample dates in 2016 and 2017. The Vermont state standard of 10 NTUs (for Class B cold-water fisheries) is applicable during dry-weather, baseflow conditions which were relevant to five of the sample dates over the 2016-2017 seasons. The blue diamond for each box and whisker in Figure 3 marks the mean of that subset of samples collected during baseflow conditions, with the corresponding number of samples (n) indicated in blue along the top of the chart. Mean Turbidity concentrations were below the standard at all main stem sites in 2016-2017, and the mean of results was below this standard for each of the new stations on West Brook. On the other hand, the Turbidity standard was exceeded by the mean of low-flow sample results for all four of the Muddy Branch stations. Based on past years' monitoring results, turbidity can become elevated at times of increased flow – during a summer thunderstorm, or during spring runoff conditions – especially in the lower reaches of the river below the Bristol Flats. A slight increasing trend in turbidity with distance downstream is generally observed during all flow conditions. These lower reaches of the watershed are dominated by fine-grained soils derived from a glacial lake that previously filled the Champlain Valley. Also, developed and agricultural uses are more prevalent in this lower portion of the watershed. A separate study recently completed by ACRWC found a strong, and statistically-significant, positive correlation between mean Turbidity concentrations and both the percentage of these fine-grained glacial lake soils and the percentage of agricultural land use in the catchments draining to water quality stations in the New Haven River and Little Otter Creek watersheds (ACRWC & SMRC, 2016).

Nitrogen was tested in samples collected only from the new stations established in West Brook and Muddy Branch, and was detected at low to moderate concentrations at these stations during the twelve spring and summer sampling dates in 2016 and 2017, ranging from 0.2 to 5.9 mg/L. Highest nitrogen concentrations were detected at the downstream station on West Brook, which has an incremental drainage area characterized by 58% agricultural land use. According to Vermont Water Quality Standards, nitrogen as nitrate (NO₃) should not exceed 5.0 mg/L at flows exceeding the low median monthly discharge. In order to evaluate nitrogen levels in the New Haven River with respect to this standard, a more specific lab test was scheduled for these six tributary stations in 2017 to detect nitrate and nitrite (NO₂) forms of nitrogen, or NO₃-NO₂ Nitrogen. Based on the separate analysis for NO₃-NO₂-nitrogen, nitrates make up on average 56% of the total nitrogen (TN) detected during these six events in the West Brook station at Route 116, and 85% of the TN detected during these 6 events in the West Brook station at Cove Road (Figure 4). Nitrogen as nitrate exceeded the water quality standard on the July 5 event at Cove Road.

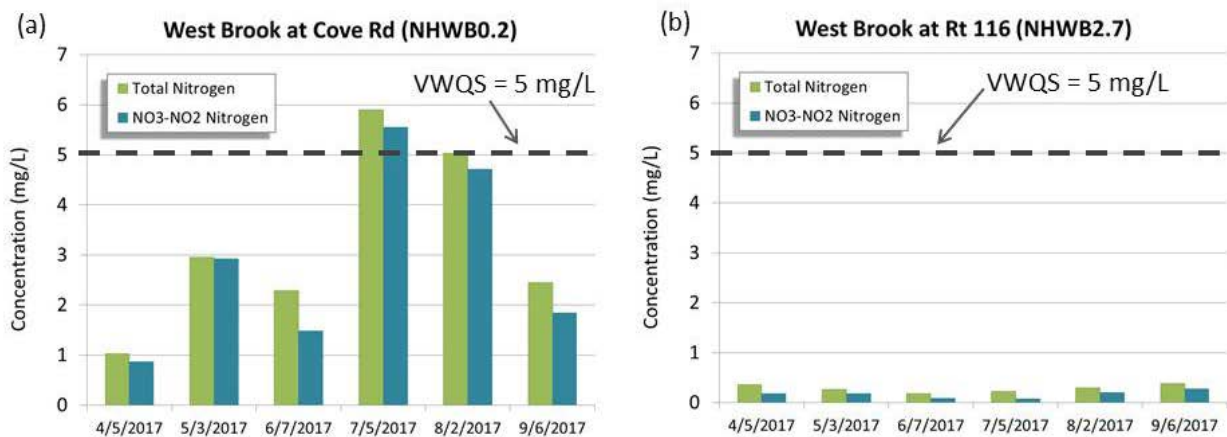


Figure 4. Nitrogen monitoring results for West Brook tributary of the New Haven River focus stations during 2017 including TN and NO₃-NO₂ by sample date for: (a) station NHWB0.2 and (b) NHWB2.7, relative to the Vermont Water Quality Standard of 5 mg/L for nitrogen as nitrate.

In the Muddy Branch, TN concentrations were much lower, ranging from 0.4 to 1.3 mg/L in 2017. NO₃-NO₂ forms represented between 28 to 38% of the TN, on average, for each Muddy Branch station. It should be noted that the NO₃-NO₂-nitrogen analysis tests for both nitrite and nitrate forms of nitrogen. However, nitrite is relatively rare in waters draining sparsely developed landscapes. Results of this test are therefore interpreted by VT Agricultural & Environmental Lab to represent nitrogen in the form of nitrates (personal communication, Jim Kellogg, VTWMD, 3/17/17).

Phosphorus was detected at low to high concentrations on the New Haven River during the spring and summer sampling dates in 2016 and 2017. Concentrations ranged from < 5 to 448 µg/L. Mean TP concentrations are illustrated below for low-flow conditions (Figure 5a) and high-flow conditions (Figure 5b) by color-coding the incremental sub-watershed draining to each station. The instream phosphorus criterion of 27 µg/L for warm-water medium gradient (WWMG) Wadeable Stream Ecotypes in Class B waters is applicable at low median monthly flow during June through October. Based on gaging records from the New Haven River at Brooksville, flows were below the low median monthly flow on the July, August, and September sample dates in 2016. The mean of the results available for these three summer sampling dates exceeded the standard at all four stations on the Muddy Branch (Figure 5a). Exceedances of the instream phosphorus standard will be considered by VTDEC alongside other indicators, including biomonitoring data, to determine if these waters should be listed as impaired.

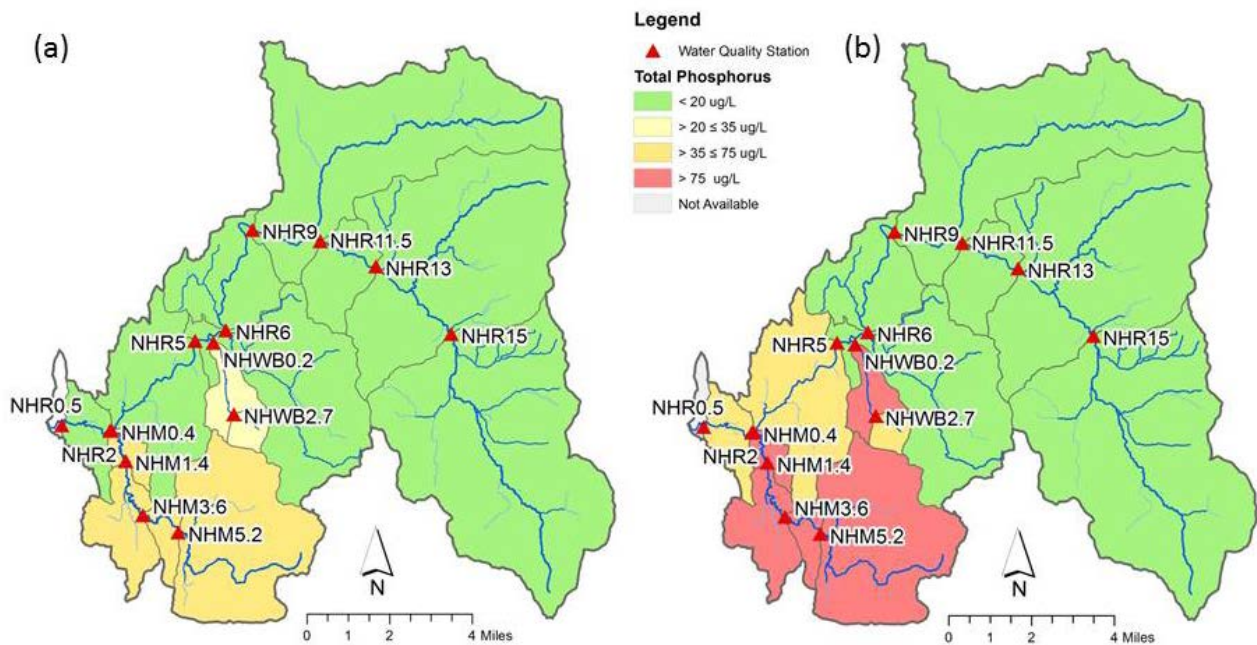


Figure 5. Total Phosphorus monitoring results for New Haven River focus stations during 2016 and 2017, presented as the mean of results for (a) three low-flow baseflow sample dates at or below the Low Median Monthly flow and (b) five high-flow, freshet-flow sample dates.

During high-flow, freshet-flow conditions these same regions of the watershed yielded higher concentrations of phosphorus, consistent with historic results. Dissolved phosphorus (DP) was also tested at each of the six new sites in 2016 and 2017. As a percentage of Total Phosphorus, DP ranged from 5 to 77% during high-flow conditions and from 31 to 100% during baseflow conditions. Under both low- and high-flow conditions, the Muddy Branch (NHM sites) and West Brook (NHWB sites) tributaries are disproportionate loaders of TP to the New Haven River. Agricultural and developed land uses are more concentrated in this southwestern part of the watershed, as compared to the headwaters. Each of these tributaries is also underlain by fine-grained silt and clay soils derived from glacial lake deposits, which have

an affinity for phosphorus and which are easily eroded and transported by a range of flows. These are areas where restoration and mitigation actions should be focused, including nutrient management to reduce phosphorus and nitrogen inputs.

2018: Beginning in 2018, New Haven River watershed will rotate out of focused monitoring, and sampling will be conducted for a reduced number of parameters at two sentinel stations, NHR2 and NHR9, and two swimming hole sites, NHR11.5 and NHR6.

For more information, contact the New Haven River sampling coordinator:

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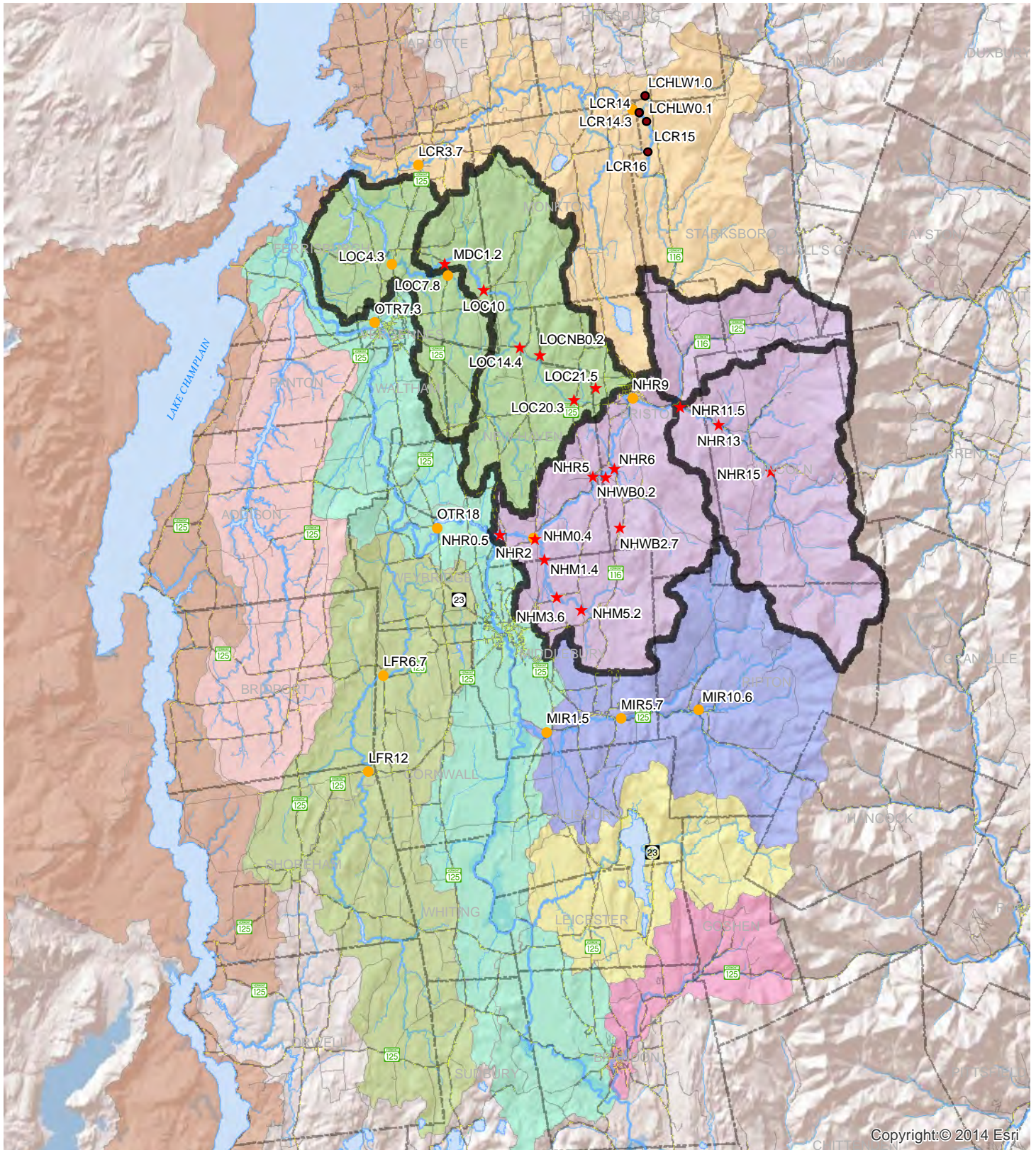
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or visit our web page at: www.acrpc.org/acrwc

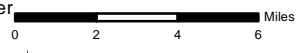
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Water Quality Monitoring Sites by Watershed, 2017



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- ★ Rotational Site
 - Sentinel Site
 - Special Project Site (E.coli monitoring)
- Rotational Basins 2017**
- Little Otter Creek
 - New Haven River
- Roads**
- Pavement
 - Gravel
- Lake Champlain Direct
 - Lewis Creek
 - Little Otter Creek
 - Otter Creek
 - New Haven River
 - Dead Creek
 - Lemon Fair River
 - Leicester River
 - Middlebury River
 - Neshobe River



The Addison County River Watch Collaborative is a citizen organization that monitors and assesses the condition and use of our local rivers over the long term, raises public awareness of the values and functions of our watersheds, and cultivates partnerships that support water quality stewardship.