Focus watershed:
2016 and 2017

# Little Otter Creek – 2016 and 2017 Water Quality Summary

## Addison County River Watch Collaborative

| Site | Location | Town |
|---|---|---|
| LOC4.3 | Route 7 Bridge | Ferrisburgh |
| LOC7.8 | Middlebrook Rd (North) | Ferrisburgh |
| LOC10 | Monkton Road | Ferrisburgh |
| LOC14.4 | Plank Rd. | New Haven |
| LOC20.3 | Sawyer Road Bridge | New Haven |
| LOC21.5 | Kilbourn property | Bristol |
| MDC1.2 | Wing Rd./Middlebrook Rd. (South) | Ferrisburgh |
| LOCNB0.2 | Norton Brook | Bristol |

The Addison County River Watch Collaborative has been monitoring water quality in the Little Otter Creek since 1997. For the 2016 and 2017 seasons, the Little Otter Creek 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. Sentinel station LOC4.3 is located within a river segment that is listed as impaired (303D list, Part D) for contact recreation use due to *E.coli* from agricultural runoff (VTDEC, 2016). Sentinel station MDC1.2 is located on Mud Creek tributary within a segment that is considered stressed by *E.coli* from agricultural runoff that may be impacting contact recreation uses of these waters (VTDEC, 2016). Three new water quality monitoring stations were established in the watershed to complement two existing sentinel stations (LOC4.3 and MDC1.2) and three stations monitored during a previous focus effort in 2010 and 2011 (stations LOC7.8, LOC10, and LOC14.4). Station LOC20.3 was established at the Sawyer Road Bridge crossing of the upper Little Otter Creek. A one-mile segment of the river spanning this station is listed as impaired (303D List, Part A) for aquatic life support uses due to nutrients and sediment resulting from agricultural runoff, and for contact recreation uses due to pathogens (303D List, Part D; VTDEC, 2016). An additional station was established at LOC21.5, approximately one mile upstream of this station and west of Burpee Road. A third new station was set up at the Plank Road crossing of Norton Brook a tributary to Little Otter Creek draining The Watershed Center and adjacent agricultural lands in northwest Bristol.

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, with water levels either actively rising or declining from recent rainfall and runoff, based on streamflow gaging records from a USGS streamflow gaging station located on at the Route 7 crossing. 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 Little Otter Creek stations ranged from 41 to >2420 organisms/100 mL during 2017. Vermont Water Quality Criteria (October 2016) state that *E.coli* is not to exceed a geometric mean of 126 org/100mL obtained over a representative period of 60 days, and no more than 10% of samples should be above 235 org/100 mL. *E. coli* counts at six of the stations exceeded the state's health-based standard of 235 org/100 mL on at least one of the four summer sampling dates (Figure 1). The geometric mean of *E.coli* counts for all 2016 and 2017 sample dates exceeded the state's water quality standard of 126 org/ 100 mL at all stations except for the Route 7 Bridge (LOC4.3) and Plank Road crossing (LOC14.4). Geomean concentrations for baseflow versus freshet flow conditions are displayed in Figure 2.

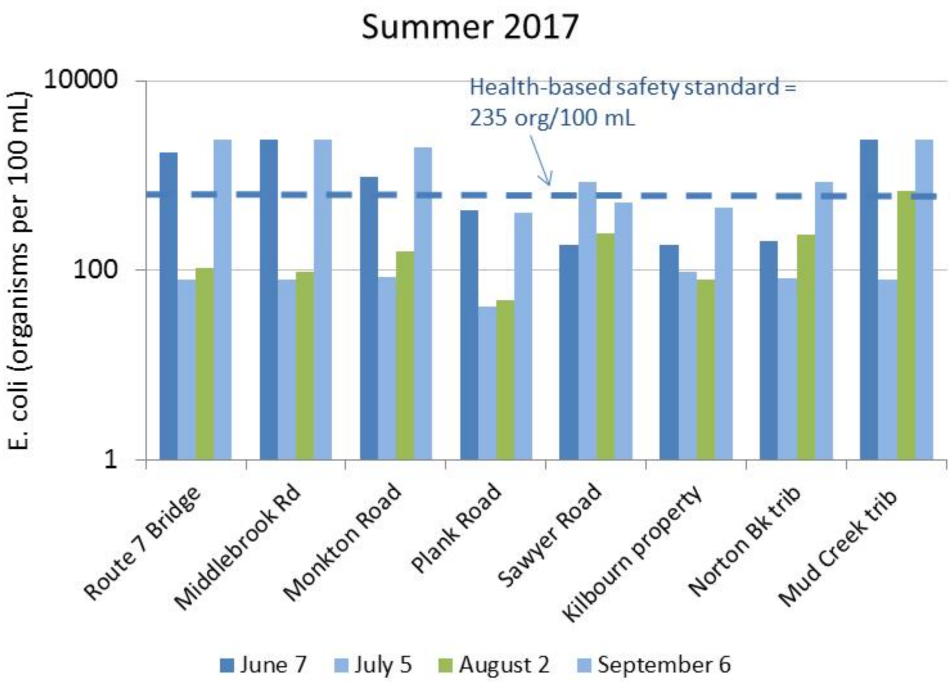


*Figure 1. E.coli measured at Little Otter Creek stations on four summer dates in 2017. Blue-shaded dates were freshet flows at high flow stage; green-shaded date was a base-flow event during low flow.*

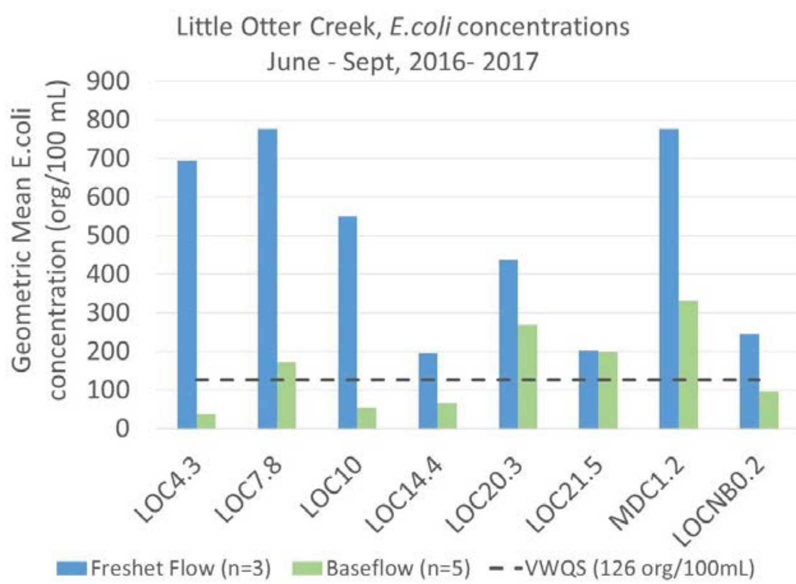


*Figure 2. Geometric mean of E.coli monitoring results for Little Otter Creek focus stations during wet-weather, freshet flow events (in blue) versus dry-weather, baseflow events (in green) during focus monitoring years 2016 and 2017.*

**Turbidity** levels reported for the Little Otter Creek stations ranged from 0.8 to 130 NTUs for the six sample dates in 2017. The distribution of Turbidity results for both focus years, 2016 and 2017, is displayed in the box-and-whisker plot below (Figure 3). The Vermont state standard of 10 NTUs (for Class B cold-water fisheries) is applicable during dry-weather, baseflow conditions which were relevant to six sample dates over the two years. The mean of baseflow Turbidity concentrations exceeded the water quality standard at all stations except LOC14.4, LOC20.3, and LOC21.5. Turbidity values tend to increase with distance downstream along the main stem, consistent with historic monitoring patterns. Turbidity can also become elevated at times of increased flow – during a Summer thunderstorm, or during Spring runoff conditions. These lower reaches of the Little Otter Creek drain regions underlain by fine-grained silt and clay soils derived from glacial lake deposits, which are easily eroded and transported by a range of flows.

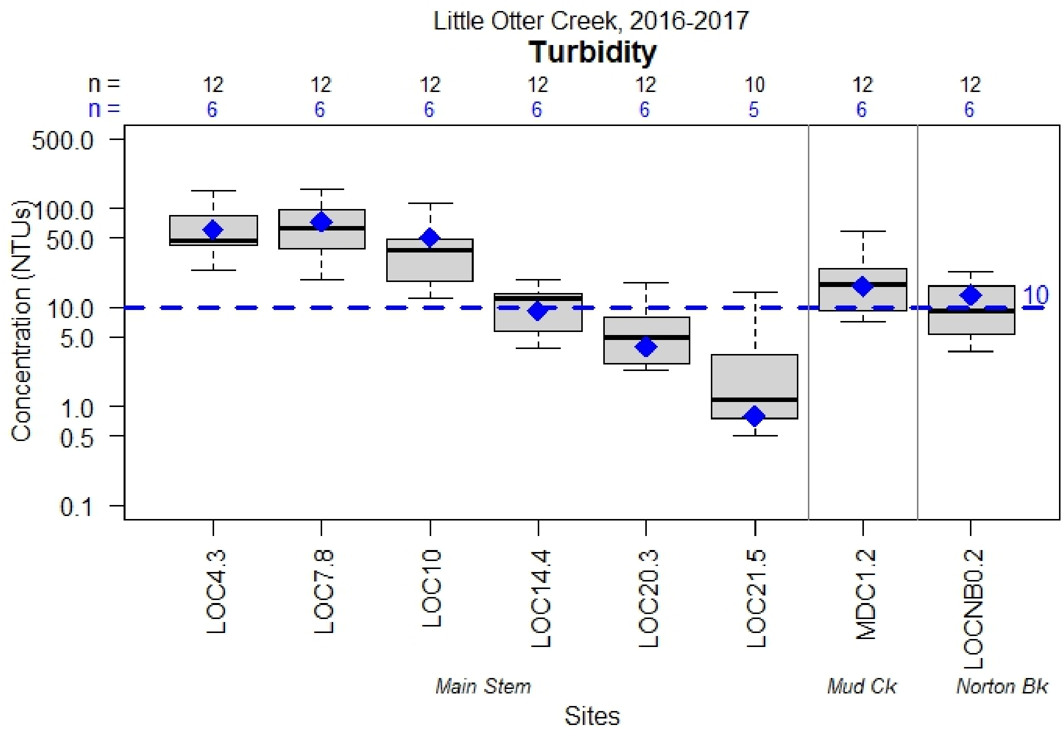


*Figure 3. Summary of Turbidity Results for Little Otter Creek, 2016 and 2017. The whiskers extend to the maximum and minimum values detected over twelve sampling events, while the gray-shaded box represents the middle 50% of values. The median value is marked by the dark horizontal line. The blue diamond marks the mean of that subset of samples collected during base-flow conditions, with the corresponding number of samples (n) indicated in blue along the top of the chart.*

**Nitrogen** levels were detected at low to moderate concentrations at most stations during the 2017 spring and summer sampling dates, ranging from 0.2 to 5.8 mg/L. Highest nitrogen concentrations were detected in the two headwaters stations, LOC20.3 and LOC21.5, which have incremental drainage areas characterized by 42% and 65% agricultural land use, respectively. According to Vermont Water Quality Standards, nitrogen as nitrate (NO3) is not to exceed 5.0 mg/L at flows exceeding the low median monthly discharge. In order to evaluate nitrogen levels in the Little Otter Creek with respect to this standard, a more specific lab test was scheduled for these stations in 2017 to detect nitrate and nitrite (NO2) forms of nitrogen, or NO3-NO2 Nitrogen (Figure 4). Based on the separate analysis for NO3-NO2-nitrogen, nitrates make up between 68 and 100% of the total nitrogen detected during these 6 events at these headwater stations. Nitrate-nitrogen detected at LOC21.5 exceeded the VT Water Quality Standard on August 2, during low-flow, base-flow conditions.

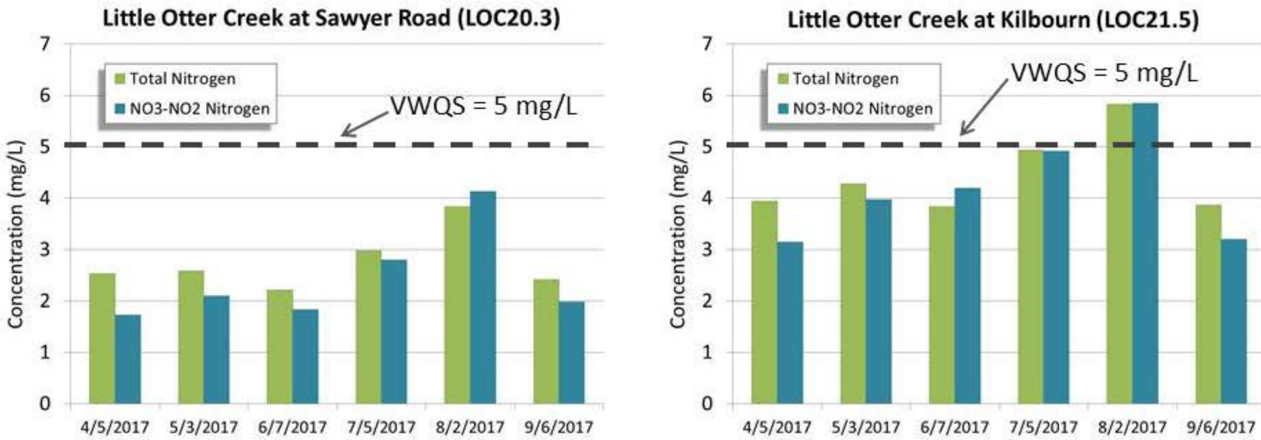


*Figure 4. Total Nitrogen and nitrate-Nitrogen Results for stations LOC20.3 and LOC21.5 in 2017.*

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 Little Otter Creek during the spring and summer sampling dates in 2016 and 2017. Concentrations ranged from 16 to 440 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 Little Otter Creek at Route 7, flows were slightly above the low median monthly flow on the July, August, and September sample dates in 2016. The mean of the phosphorus results available for these three summer sampling dates exceeded the instream nutrient standard of 27 µg/L at all sampled stations (Figure 5a). Exceedances of the instream phosphorus standard will be considered by VTDEC alongside other indicators, including biomonitoring data, to refine impairment status of these waters.

During high-flow, freshet-flow conditions (Figure 5b), 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 37 to 90% during high-flow conditions and from 20 to 100% during baseflow conditions.

These regions with high concentrations of phosphorus and nitrogen are areas where restoration and mitigation actions should be focused, including nutrient management to reduce phosphorus and nitrogen inputs. Given the prevalence of agricultural uses in those sub-watersheds of the Little Otter Creek which demonstrated elevated concentrations of nitrate-N, and the Bristol village contributions to the uppermost subwatershed, nutrient management planning and other best management practices to reduce N runoff should be prioritized in these headwater areas of the watershed, as well as Mud Creek. Finer-scale bracket-monitoring is warranted in the Mud Creek tributary watershed in future years to identify sources of nutrient runoff. Monitoring of the Slang areas of the watershed downstream of Route 7 is also warranted. These areas have traditionally not been monitored due to backwater effects from Lake Champlain. Nevertheless, there is a potential for nutrient and sediment loading to the lake from agricultural and developed uses which are densely concentrated in this region.

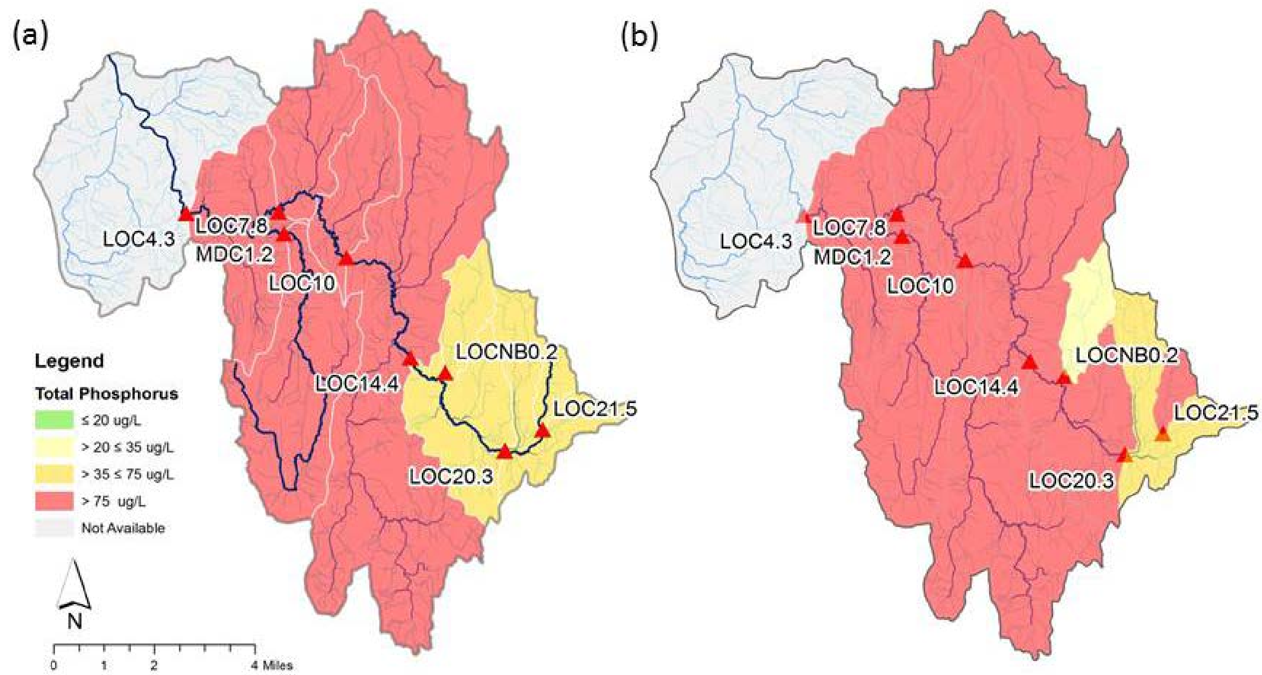


*Figure 5. Total Phosphorus monitoring results for Little Otter Creek focus stations during 2016 and 2017, presented as the mean of results for (a) three low-flow baseflow sample dates at or below the Low Median Monthly flow and (b) five high-flow, freshet-flow sample dates.*

**2018**: Beginning in 2018, Little Otter Creek watershed will rotate out of focused monitoring, and sampling will be conducted for a reduced number of parameters at two sentinel stations, LOC4.3 and MDC1.2.

For more information, contact the Little Otter Creek sampling coordinator:
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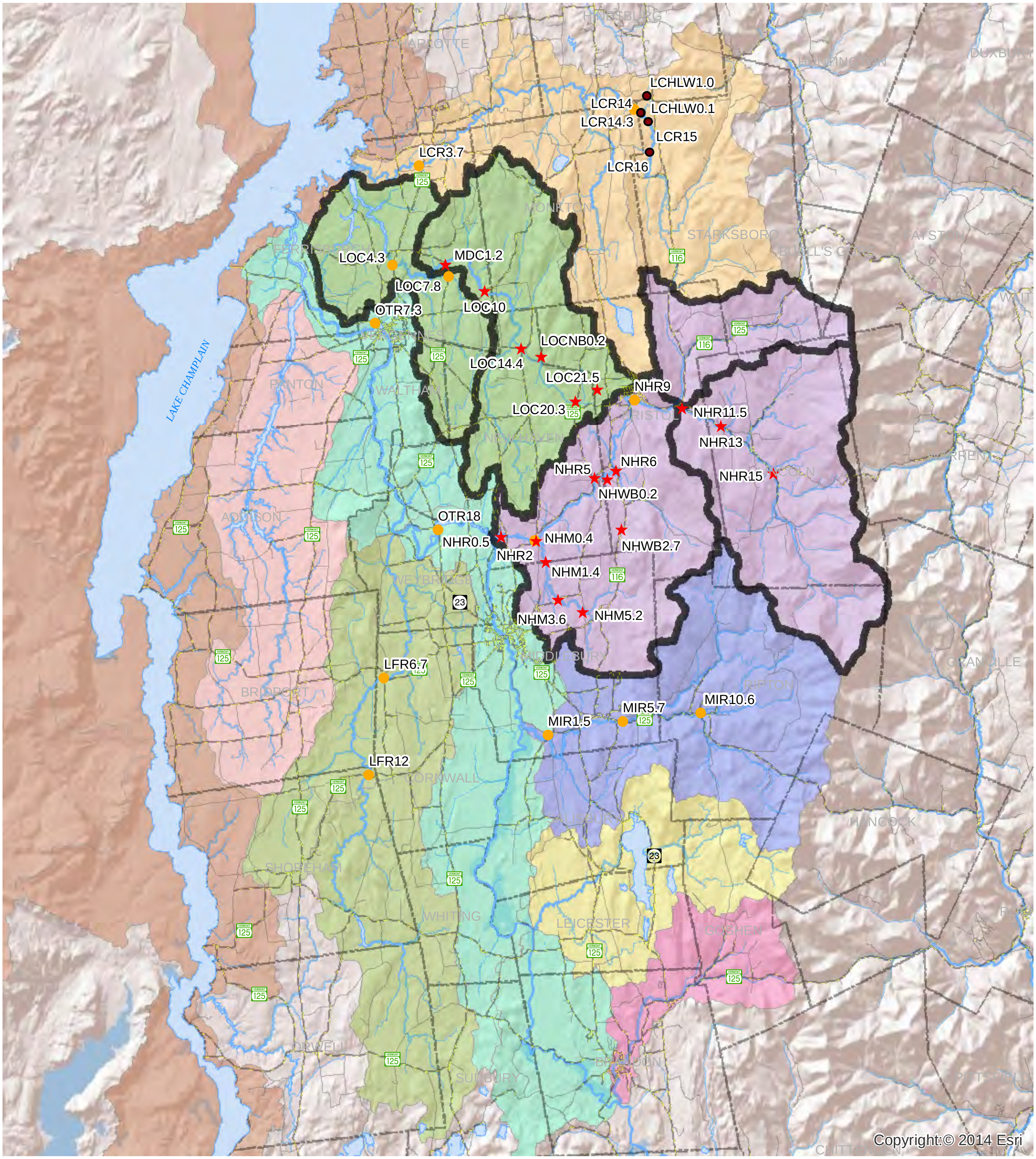
Matt Witten, 434-3236, mwitten@gmavt.net
or visit our web page at: www.acrpc.org/acrwc

# *Addison County River Watch Collaborative*

## Water Quality Monitoring Sites by Watershed, 2017




★ 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

Miles: 0 2 4 6

N

Addison County Regional Planning Commission

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.

ACRPC 3/2016