

Lewis Creek – 2018-2019 Water Quality Summary

Addison County River Watch Collaborative (ACRWC), Lewis Creek Association (LCA)
Prepared in conjunction with South Mountain Research and Consulting

Type	Stream	Site	Location	Town
R	Lewis Creek	LCR0.3	Boat Access upstream of Hawkins Bay	Ferrisburgh
S	Lewis Creek	LCR3.7	Old Route 7 Bridge	Ferrisburgh
R	Lewis Creek	LCR9.9	Upper Covered Bridge, Roscoe Rd.	Charlotte
R	Pond Brook	LCT3D.5	Silver Street culvert	Monkton
S	Lewis Creek	LCR14	Tyler Bridge	Monkton
O	Hollow Bk (Lewis Ck)	LCHLW1.0	Tyler Bridge Rd X'g of Hollow Bk	Hinesburg
O	Hollow Bk (Lewis Ck)	LCHLW0.1	Hollow Brook at Confl w/ Lewis	Monkton
O	Lewis Creek	LCR14.3	Just above confluence of Hollow Bk	Starksboro
O	Lewis Creek	LCR15	Just above Clifford stabilized crossing	Starksboro
O	Lewis Creek	LCR16	LaRue bridge crossing	Starksboro

The ACRWC and member LCA have been monitoring water quality in the Lewis Creek since 1992. In 2018-2019, Lewis Creek was the subject of a two-year, intensive monitoring focus, where rotational (R) sites as well as long-term, sentinel stations (S) were monitored, and additional parameters were tested to better define spatial variability in pathogen, sediment and nutrient concentrations.

Additionally, monitoring in vicinity of the Tyler Bridge Road crossing was continued from the previous two years as part of a special project (O = Other) to bracket known or suspected source regions of bacterial contamination, in support of a Total Maximum Daily Load for Bacteria-impaired waters.²

The two years brought quite different patterns of precipitation. In each year, sampling occurred on two spring dates (April 4 and May 2 in 2018 and April 10 and May 1 in 2019) and four summer dates (June 6, July 11, August 1, and September 5 in 2018 and June 5, July 10, August 7, and September 4 in 2019). While 2018 was characterized by near-normal precipitation, 2019 brought above-normal conditions. In both years, April and May sampling events took place during high flow conditions resulting from snowmelt and spring rains, based on records from the USGS streamflow gaging station near VT Route 7. In 2019, these conditions continued into June. June 2018 and July 2019 events occurred during moderate-flow, baseflow conditions where river stage was not changing appreciably, and groundwater levels were relatively high following spring rains. In 2019 these conditions, too, continued into August, and then a rainfall event coincided with the September 2019 sampling. Low-flow, baseflow conditions, at or below the Low Median Monthly (LMM) flow were met in July, August, and September of 2018. These conditions were never met during 2019 sampling events in Lewis Creek, and in fact the river only dipped below the LMM at all in 2019 for a few days in mid-September. Flooding occurred later in the fall, with the most severe conditions occurring in the headwaters, following a late October storm.

Samples from the Lewis Creek watershed were tested for *E.coli*, phosphorus (total and dissolved), total nitrogen, and turbidity; *E.coli* was tested only on the summer dates at recreational sites. Turbidity was originally scheduled for all sites on all twelve sampling dates, but due to a mid-season 2019 request by the LaRosa Volunteer Monitoring program to reduce expenditure, May 2019 samples were suspended at all sites, and only sites in the bracket monitoring study were sampled for turbidity that summer.

² http://dec.vermont.gov/sites/dec/files/wsm/mapp/docs/mp_bacteriatmdl.pdf

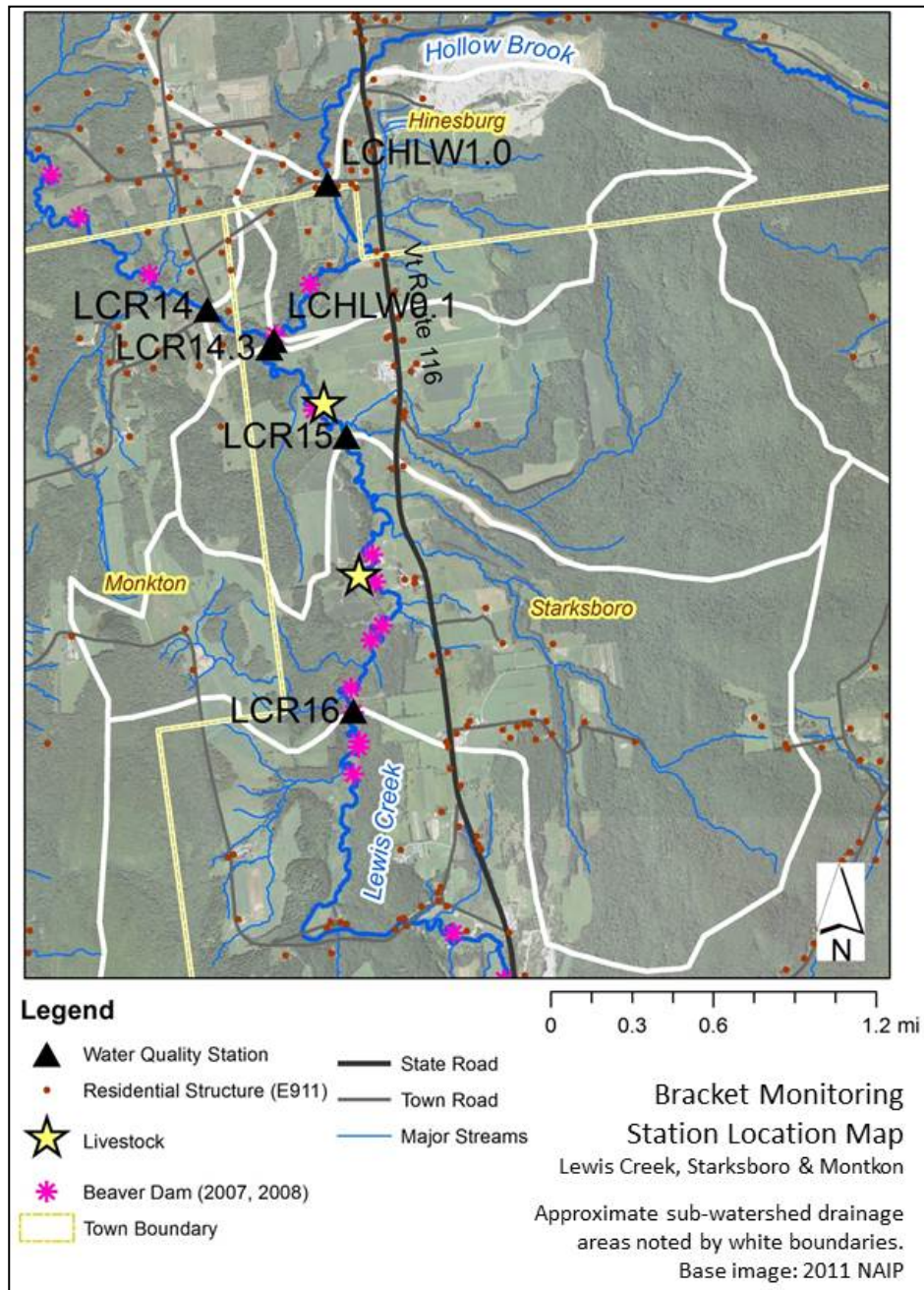


Figure 1. Location of *E. coli* Bracket Monitoring Sites

E. coli counts at the bracket stations (Figure 1) ranged from 18 to >2420 organisms/100 mL for the seven summer sampling dates in 2018-2019. While samples were additionally taken in September of 2019, they were not analyzed due to an error at the VAEL lab. Vermont Water Quality Standards (VWMD, 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 exceeded the state's health-based standard of 235 org/100 mL for a majority of the sample dates at bracket stations LCR16 through LCR14 (Figure 2). The geometric mean of results exceeded the state's geomean standard of 126 organisms/ 100 mL at these same stations during the dry-weather, base-flow conditions encountered in the summers of 2018-2019 (Figure 3).

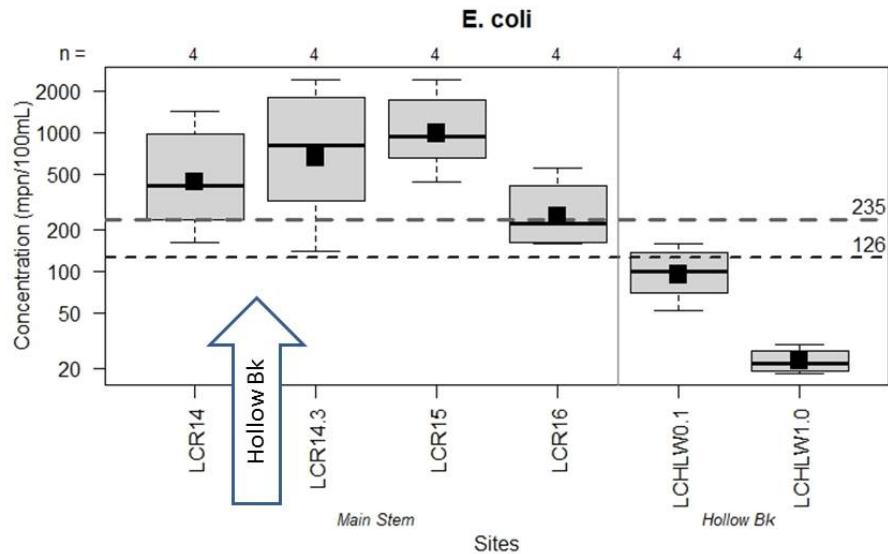


Figure 2. *E. coli* measured at Lewis Creek and Hollow Brook bracket monitoring stations on four dry-weather, base-flow events between June and September in 2018. The whiskers extend to the maximum and minimum values, while the gray-shaded box represents the middle 50% of values. The median value is 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*.

In 2017 and 2018, a marked increase in mean *E. coli* counts was apparent between upstream “control” station LCR16 and station LCR15, followed by a decline in *E. coli* counts at stations LCR14.3, under both dry-weather and wet-weather conditions (Figure 3). These results indicate a contributing source(s) of bacteria within the incremental drainage area for LCR15. Continuing downstream, mean *E. coli* counts decline at station LCR14, likely due in large part to dilutionary effects of inputs from the Hollow Brook. The geometric mean at each of these two Hollow Brook stations was below the mean recorded for each of the main stem stations.

Sources of fecal matter in surface waters can be variable, and include humans, ruminants (e.g., deer and cows), wildlife, and waterfowl (USEPA, 2011). The upstream drainage area to Tyler Bridge Road is sparsely populated by residential structures serviced by onsite septic systems (Figure 1). Failing septic systems can be a source of *E. coli* to groundwater and to the Creek, particularly for those structures located within the riparian corridor. Station LCR14 is located one mile downstream of a pasture (Farm B) where for several decades dairy cows have had direct access to the stream along a mile of pasture (small, conventional dairy). A second conventional dairy farm (Farm A), located 0.3 mile upstream of LCR14, has excluded cows along 3,600 feet the Lewis Creek with fencing since 2007, and has reduced access to a single stabilized crossing. Several management practices have also been implemented at this farm in recent years, resulting in expansion of vegetated riparian buffers, increased setbacks of crop fields and pasture areas, and cedar revetments and willow waddle treatments to enhance streambank stability (SMRC, 2010, 2017). In October 2018, livestock were removed from the upper site (Farm B), as part of a farm transition and sale of the property. We also learned that the lower site (Farm A) is no longer planning to pasture cows, also beginning in the fall of 2018.

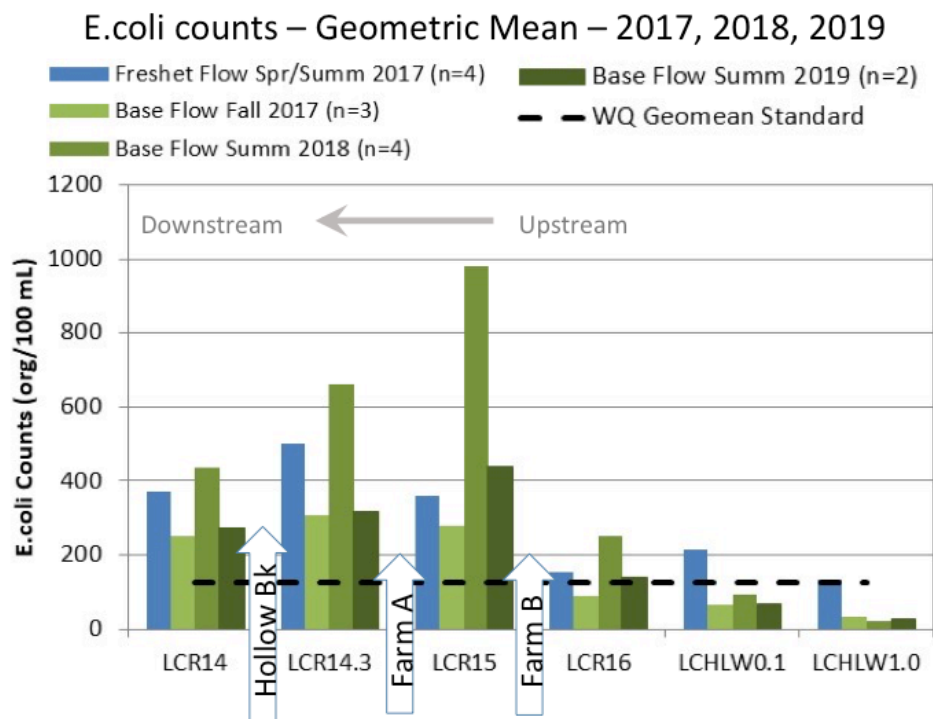


Figure 3. Geometric mean of *E.coli* monitoring results for Lewis Creek and Hollow Brook bracket monitoring stations during wet-weather, freshet flow events (in blue) versus dry-weather, baseflow events (in green) during 2017 - 2019.

Results of only two post-treatment sampling events in 2019 are promising, showing a reduction in baseflow counts of *E.coli* at station LCR15 located downstream of Farm B. Additional post-treatment sampling will be conducted in 2020 to target a full range of dry-weather and wet-weather conditions during 6 scheduled monthly events, as well as up to 4 additional events to target storms.

Turbidity levels at the Lewis Creek stations ranged from <0.2 to 55 NTUs for the eleven 2018-2019 sample dates. The Vermont state standard of 10 NTUs (for cold-water fisheries) is applicable during dry-weather, baseflow conditions, which were relevant to the four summer events of 2018 and the July and August 2019 events. The mean concentrations were below the standard at all sites between LCR9.9 and LCT3D.5 (Figure 4), then rose to above standard levels in the lowest portion of the watershed. Similar to past years, there is a generally increasing trend in turbidity with distance downstream along the main stem. A marked increase in Turbidity is evident between stations LCR16 and LCR15, during both dry-weather and wet-weather conditions. This is consistent with the pattern demonstrated with total phosphorus. Given the late 2018 removal of cows from the pasture in the incremental watershed between these two stations, and as the streambank and riparian soils begin to revegetate, we anticipate that Turbidity levels will decrease at stations LCR15. Also, elevated levels of Turbidity in Pond Brook contribute to a notable increase in turbidity between LCR14 (Tyler Bridge Rd) and LCR9.9 (Roscoe Rd – Upper covered bridge). The watershed soils transition toward more clay and silt-rich sediments of glaciolacustrine origin in this lower part of the watershed. During dry-weather, baseflow conditions (low to moderate flow levels), the mean turbidity level is below the VWQS of 10 NTUs for this cold-water river – at least in the middle and upper watershed.

2018 - 2019

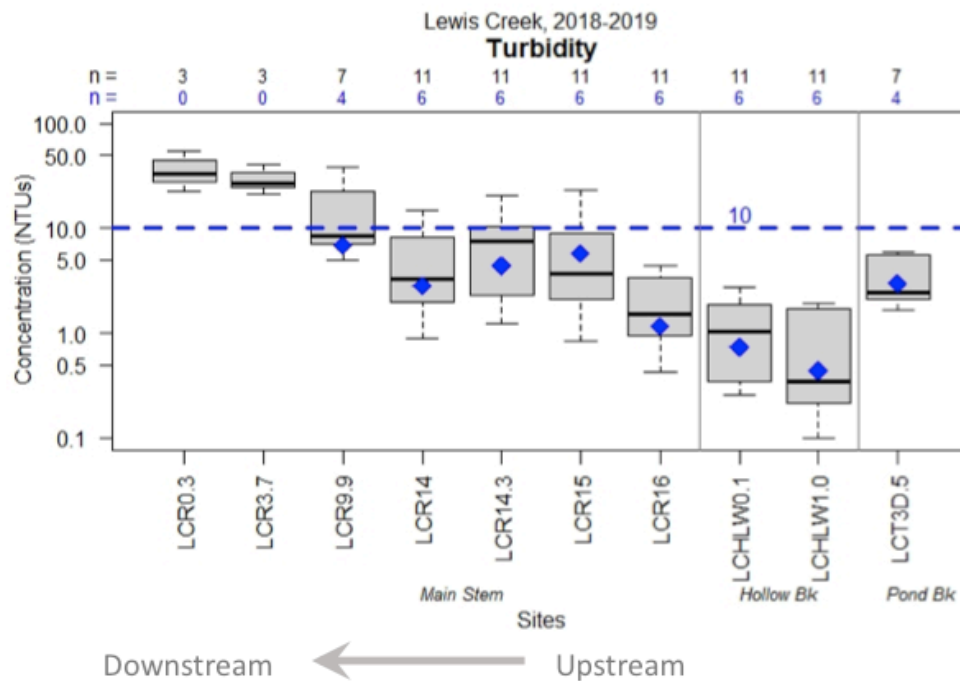


Figure 4. Summary of Turbidity results for Lewis Creek, 2018-2019. The whiskers extend to the maximum and minimum values detected over twelve sampling events, while the gray-shaded box represents the middle 50% of values. The median value is marked by the dark horizontal line. The blue diamond marks 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.

Phosphorus was detected at low to high concentrations during the 12 Spring and Summer sampling dates, ranging from <5 to 176 $\mu\text{g/L}$. The instream phosphorus criterion of 27 $\mu\text{g/L}$ for warm-water medium gradient (WWMG) Wadeable Stream Ecotypes in Class B waters is applicable at low median monthly flow, a condition which was captured during the 2018 July, August, and September sample dates but not at all in 2019. Detected concentrations of phosphorus on these 2018 dates exceeded the instream nutrient standard of 27 $\mu\text{g/L}$ at main stem stations, LCR15 and LCR0.3, as well as Pond Brook station LCT3D.5 (Figure 5). These results are relatively consistent with historic results, which have shown an increasing trend in phosphorus concentration with distance downstream, as well as a tendency for elevated phosphorus concentrations during high flows. Notably, there was a marked increase in TP concentration at base flow between stations LCR16 and LCR15. The incremental drainage area between these two stations includes now fallow pasture where until October of 2018, cows had unrestrained access to the Lewis Creek. We anticipate a decrease in nutrient and sediment concentrations due to the removal of cows from the brook; unfortunately, we were not able to measure that impact at low-flow baseflow conditions in 2019.

2018 - 2019

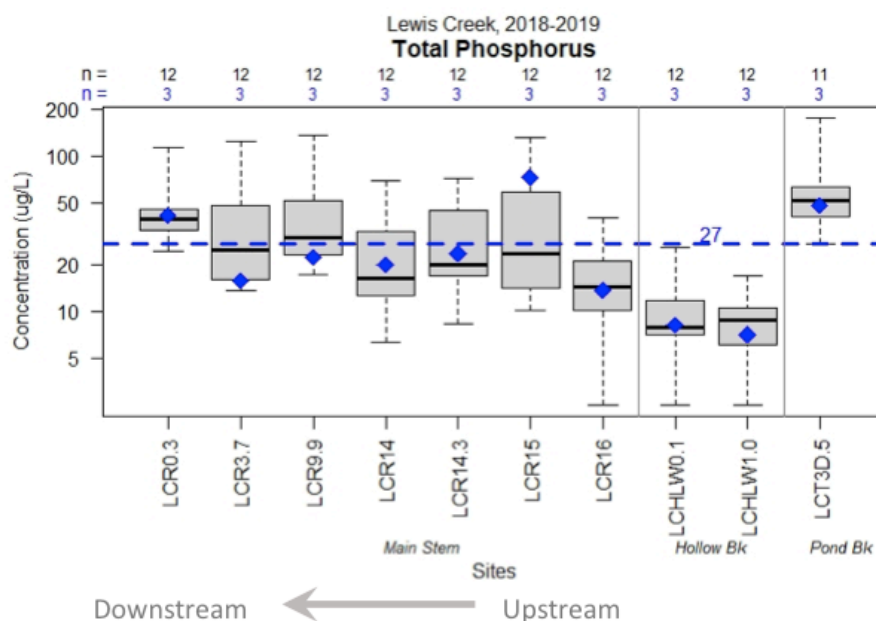


Figure 5. Summary of Total Phosphorus results for Lewis Creek, 2018-2019. 2019 was a wet year, and we were not able to capture a Low-Flow Baseflow event during our 6 scheduled sample dates. Thus, the mean of the TP detected during low-flow, baseflow conditions (shown by the blue diamond symbols) was calculated from the three events in the previous year (2018) that did happen to capture these conditions. The whiskers extend to the maximum and minimum values detected, 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 (n=3) collected during base-flow conditions at or below the Low Median Monthly Flow.

2020: While Lewis Creek will no longer be a focus watershed for Addison County Riverwatch in 2020, the Collaborative will continue with bracket monitoring at stations in the vicinity of the Tyler Bridge Road crossing with funding from a LaRosa Organizational Support grant. In addition to the six regularly-scheduled monthly events, this will include the sampling of targeted storm events to gain a better understanding of water quality patterns following livestock removal from Lewis Creek as part of a farm transition that occurred in October 2018. Monitoring of total phosphorus at the two Lewis Creek Sentinel stations (LCR3.7 and LCR14) will also continue.

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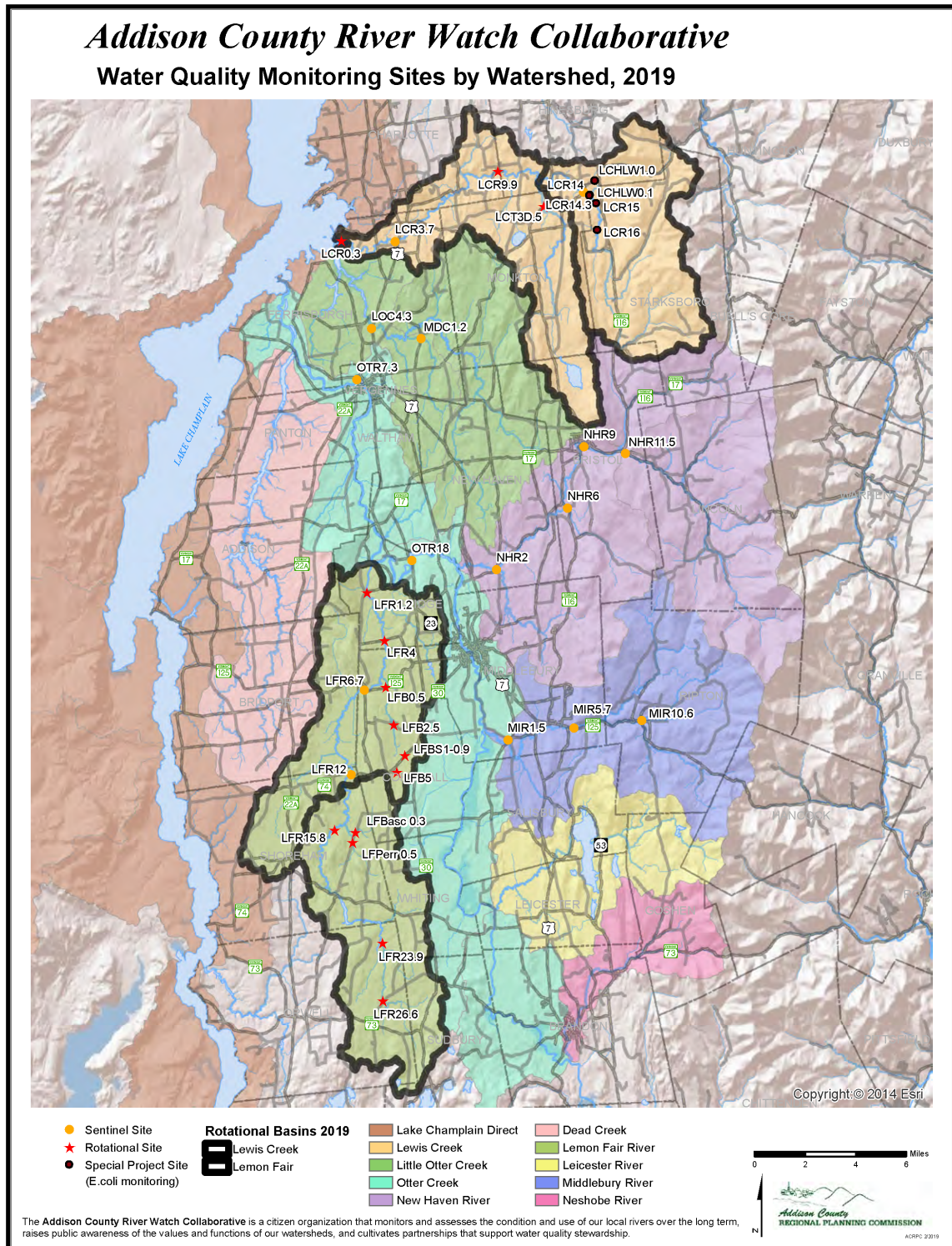


Figure 1. Location of ACRWC monitoring stations for 2018 and 2019.