VERMONT
ENVIRONMENTAL CONSERVATION

Little Otter Creek: mouth to river mile 7.8

Watershed Description

This bacteria TMDL summary applies to a 7.8-mile reach of Little Otter Creek (VT03-07), a 25-mile long stream located southeast of Lake Champlain (Figure 1). Little Otter Creek begins in the town of Bristol and flows through New Haven, Monkton, and Ferrisburgh where it is joined by several smaller tributaries, including Mud Creek. The creek continues north west before flowing into Lake Champlain in the Town of Ferrisburgh (ACRWC, 2009). The watershed for Little Otter Creek (Figure 1) covers 69 square miles, primarily in the towns of Monkton, Bristol, New Haven, Waltham, and Ferrisburgh. Overall, land use in the watershed is 34% forested 60% agricultural, 3% developed, and 3% wetland, as shown in Figure 2 (based on a 2006 land cover analysis by NOAA-CSC).

Little Otter Creek is an important natural feature within Addison County. The soils along the creek's bank and within its floodplains are ideal for agriculture. Along its course the creek flows through the Champlain Valley lowlands. There are multiple conservation and wildlife management areas along the creek, including the Vermont Fish and Wildlife Department's Little Otter Creek Wildlife Management Area. The wildlife management area consists of 1,500 acres of pristine forest and wetland near the creek's confluence with Lake Champlain in Hawkins Bay. (VTF&W). The town of Ferrisburgh has some of the highest quality wetlands in New England. A large wetland complex along the shores of Little Otter Creek harbors many rare and endangered plants (Ferrisburgh, 2006). The impaired segment of Little Otter Creek begins at the creek's mouth on Lake Champlain and travels up to station LOC7.8 in Ferrisburgh, near the Monkton town line (Figure 3). Sampling stations use distances upstream of the mouth of the river, in their title. For example "LOC7.8" is situated 7.8 miles from the mouth of Little Otter Creek.

Waterbody Facts (VT03-07)

- **Watershed Towns:** Ferrisburgh, Monkton, New Haven, Bristol & Waltham
- **Impaired Segment Location:** Mouth of Creek to river mile 7.8
- **Impaired Segment Length:** 7.8 miles
- **Classification:** Class B
- **Watershed Area:** 69 square miles
- **Planning Basin:** 3-Little Otter Creek

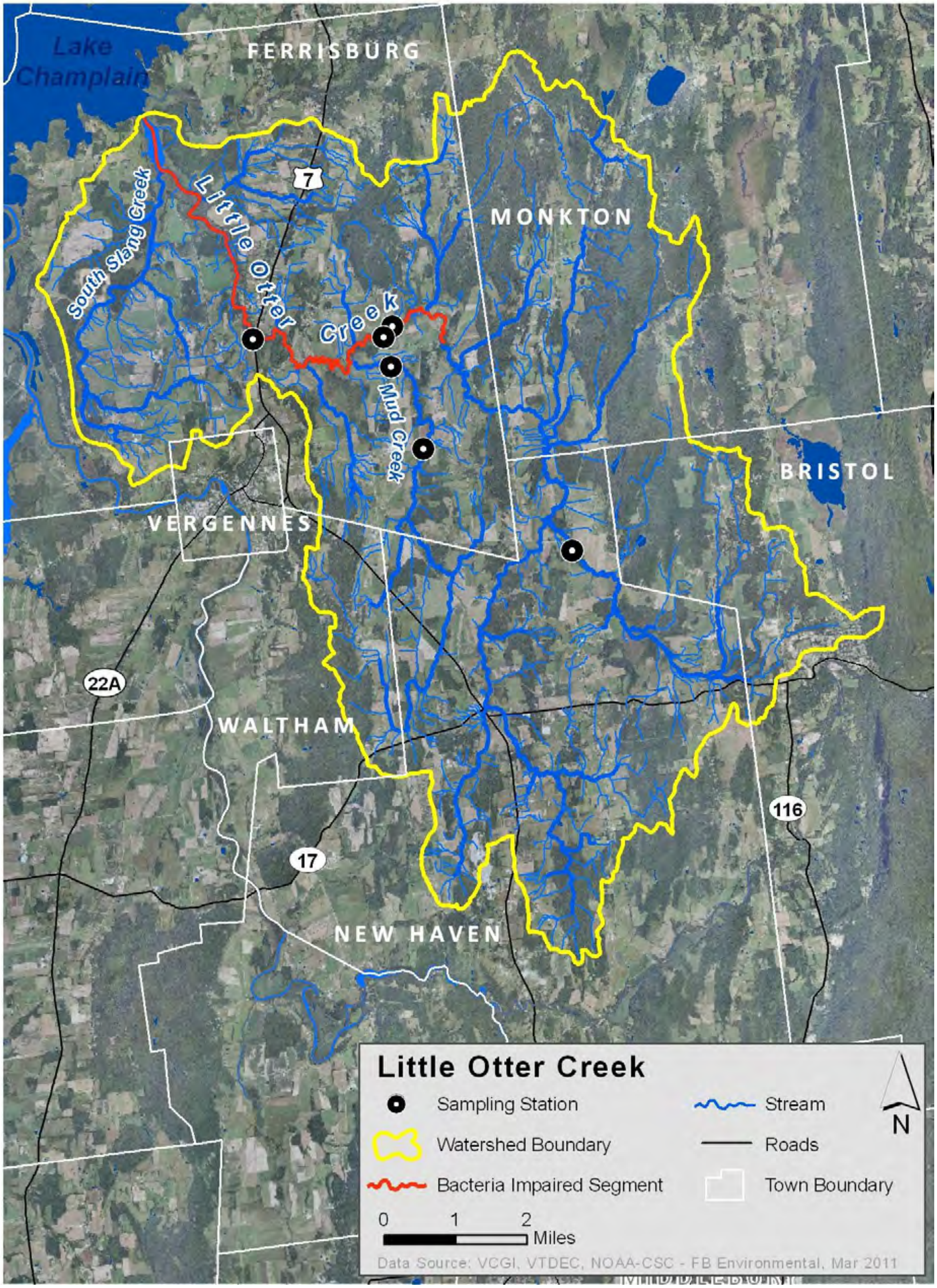

Figure 1: ***Map of Little Otter Creek watershed with impaired segment and sampling stations indicated.***

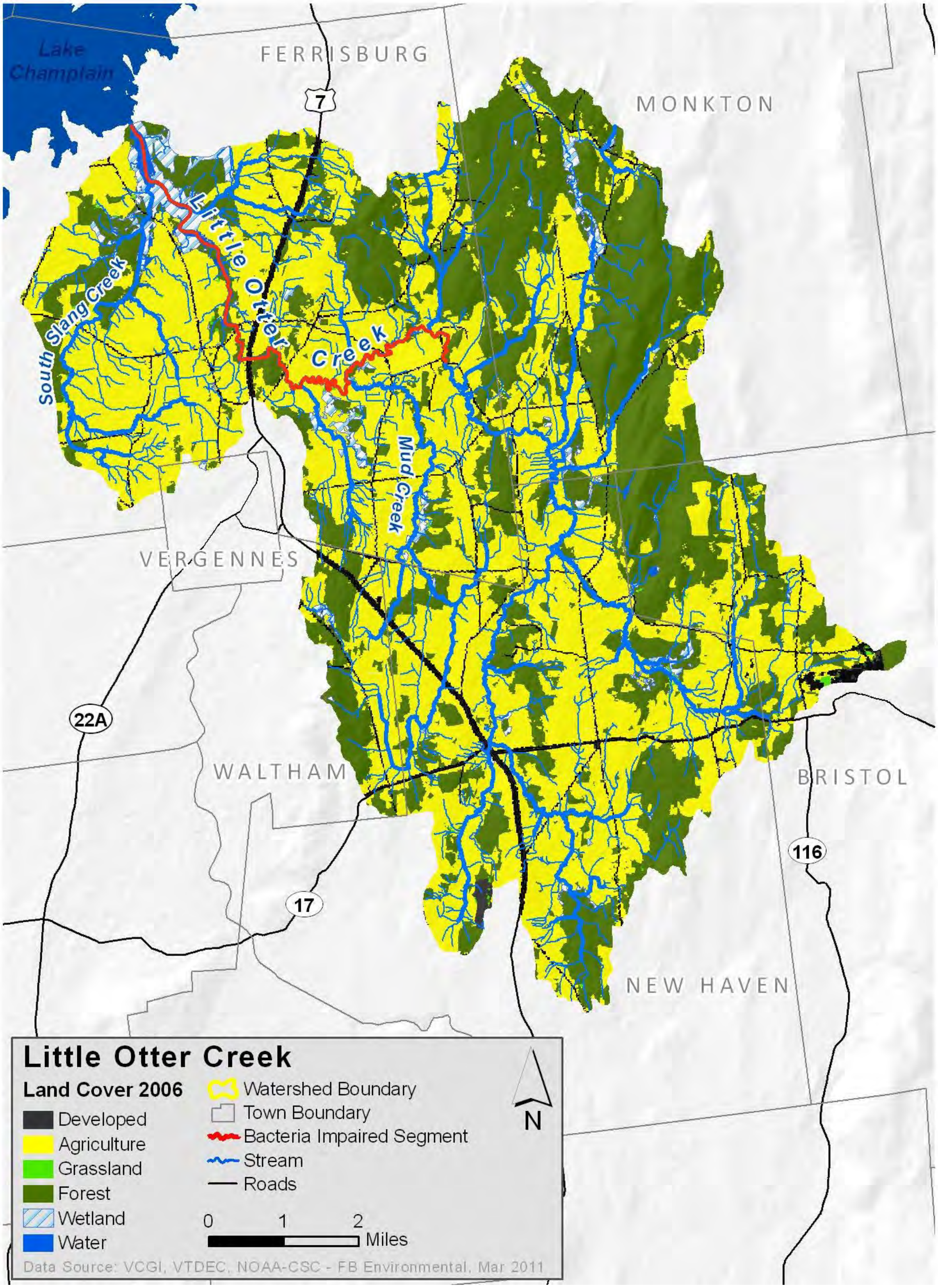

Figure 2: ***Map of Little Otter Creek watershed with impaired segment and land cover indicated.***

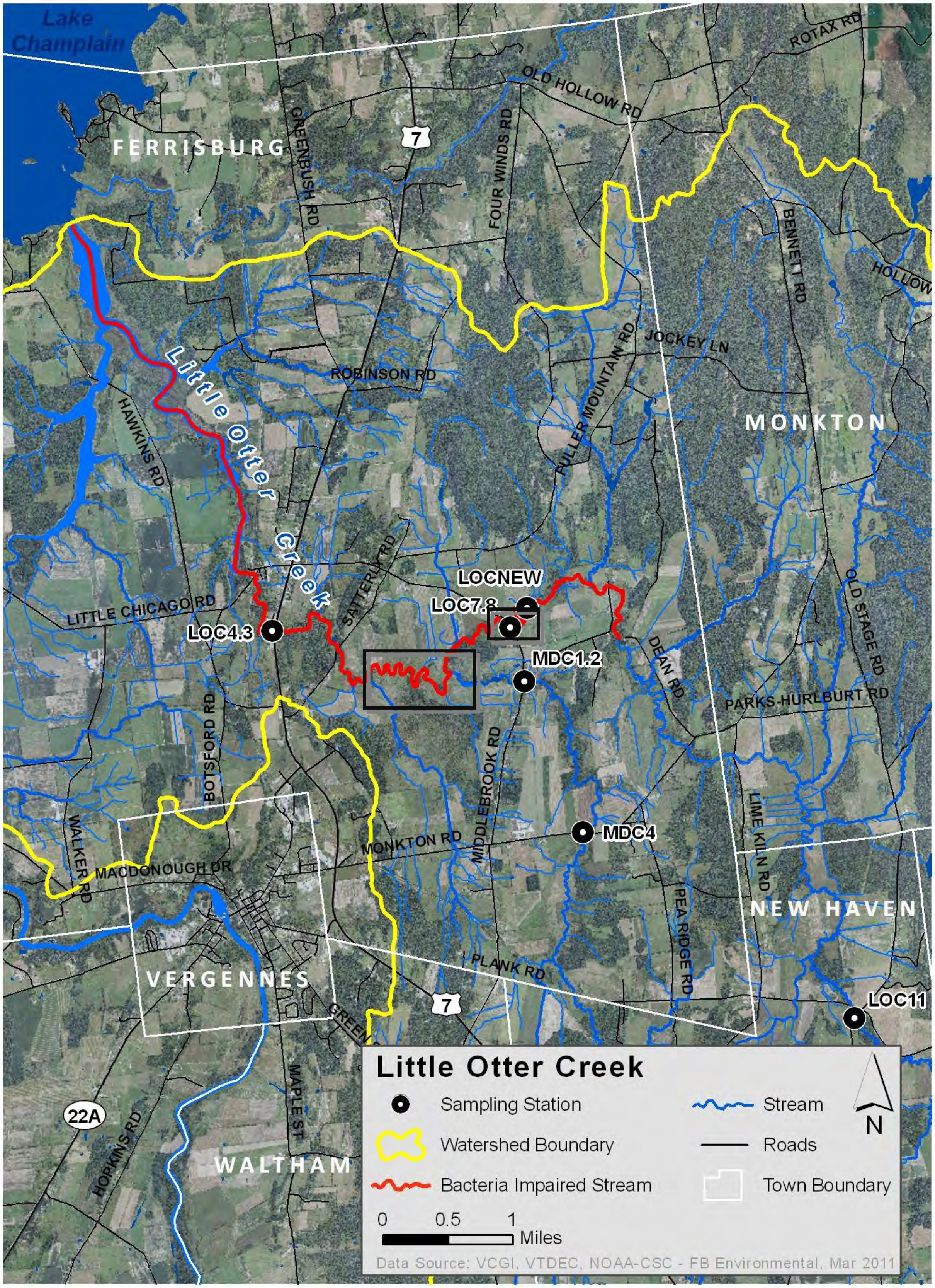

Figure 3: ***Map of downstream reaches of Little Otter Creek with impaired segment and sampling locations indicated. Inset areas correspond to Figures 4 and 5 below.***

Figure 4: ***Aerial view of Little Otter Creek from approximately river mile 5.5 to river mile 6.5. Also shown in this view is Mud Creek flowing into Little Otter Creek (center right)(Source: Google Maps).***

Figure 4 shows the reach from approximately river mile 5.5 to river mile 6.5 in Ferrisburgh. As seen in this aerial image, there are large tracts of agricultural land along the creek's banks. Agriculture remains an important cultural and economic resource in Addison County (ACRPC, 2008). Furthermore, this impaired segment of Little Otter Creek is completely within the town of Ferrisburgh, where agriculture is critical to the town's economy (Ferrisburgh, 2006). Including the areas outside of Ferrisburgh, Little Otter Creek's watershed is heavily farmed, with many dairy operations and cornfields (LOC, 2009). Given the large percentage of its watershed dedicated to agricultural land uses, Little Otter Creek is considered an agricultural stream (Medalie, 2007). Much of the agricultural land surrounding the impaired segment and in the creek's course through Addison County in general, was once wetland. Up to one-third of Addison County's farmland may have once been wetland (ACRPC, 1994).

From the beginning of the impaired segment at station LOC7.8 on Middlebrook Road, until the segments terminus in Lake Champlain, Little Otter Creek flows through the Champlain Valley flatlands. This reach is in large-scale agricultural land use and typically has narrow riparian buffers. The long term health of Little Otter Creek is closely linked to the use of best management practices (BMPs) on agricultural lands, aimed at reducing pollutant loads. However, bacteria are not the only pollutant of concern for Little Otter Creek. Large loads of nutrients (including phosphorus and nitrogen) and suspended sediment enters the creek from both agricultural land and developed areas (Medalie, 2007). Much like nutrients, which are known to bind to sediment, bacteria are known to settle out in sediment. Therefore, sediment that enters the stream via erosion from stormwater runoff can transport bacteria into the water column. Therefore, it is important to carefully consider the numerous pollutants that are adversely impacting Little Otter Creek including not only bacteria, but also nitrogen, phosphorus and sediment. Figure 5 provides an aerial view of Little Otter Creek (upstream and downstream of river mile 7) showing a long stretch of inadequate riparian buffers within agricultural land along a majority of this reach.

Figure 5: ***Aerial view of Little Otter Creek upstream and downstream of sampling location LOC7.8 on Middlebrook Road in Ferrisburgh. The location of the sampling station is indicated in red (Source: Google Maps).***

Why is a TMDL needed?

Little Otter Creek is a Class B, cold water fishery with designated uses including swimming, fishing and boating (VTDEC, 2008). The Addison County River Water Collaborative (ACRWC) has been collecting samples from Little Otter Creek for analysis of *E.coli* since 1997 (ACRWC, 2009). Each summer, samples are collected from the sampling stations shown in Figure 3. Over the course of ACRWC's sampling history, bacteria samples from Little Otter Creek and its tributaries have exceeded the state standard on most sample dates at station LOC 7.8 (LOC, 2009). Table 1 (below) provides bacteria data collected in the downstream sampling locations LOC4.3, LOC7.8 and LOCNEW from 2000 to 2007. Table 1 provides the water quality criteria for *E.coli* bacteria along with the individual sampling event bacteria results and geometric mean concentration statistics for each sampling season. Vermont's current water quality criterion is exceeded for almost every sample at station LOC7.8 and the geometric mean concentration is exceeded for every seasonally calculated geometric mean since 2000 at that station. During the 2010 sampling season *E.coli* concentrations at Little Otter Creek station LOC7.8 were well above the Vermont standard on all four sampling dates, and stations LOC4.3 and LOCNEW were well above the standard on three of the four sampling dates (ACRWC, 2011).

Due to the elevated bacteria measurements presented in Table 1, Little Otter Creek from its confluence with Lake Champlain for 7.8 miles upstream, did not meet Vermont's water quality standards, and was identified as impaired and was placed on the 303(d) list (VTDEC, 2008). The 303(d) listing states that use of Little Otter Creek for contact recreation (i.e., swimming) is impaired. The Clean Water Act requires that all 303(d) listed waters undergo a TMDL assessment that describes the impairments and identifies the measures needed to restore water quality. The goal is for all waterbodies is to comply with state water quality standards.

Potential Bacteria Sources

Agricultural runoff, washing manure and other wastes into the creek is most likely the primary source of bacteria to Little Otter Creek (Ferrisburgh, 2006). Long term on-site improvement and restoration projects are currently being undertaken to help reduce agriculture runoff and educate municipalities about the issues with agricultural runoff to the creek (VTDEC, 2010). The Natural Resources Conservation Service (NRCS), United States Geological Society (USGS), and other agencies provided technical assistance and partial funding to support these projects (USGS, 2007). Since ACRWC began monitoring for *E.coli* on Little Otter Creek in 1997 there has been no evidence of improvement in the sanitary quality of the water in the creek (LOC, 2009). These data suggest that there is still much to be done in the watershed to reduce the threat of bacterial contamination in the stream. Given the high proportion of agriculture uses within the watershed, the proximity of these activities to the creek, and the general lack of riparian buffers along the creek, agricultural activities are likely the major source of bacterial contamination to Little Otter Creek.

Another potential source of bacteria to Little Otter Creek is malfunctioning or failing septic (on-site) waste disposal systems. Most of the residents within the creek's watershed, as well as in Addison County, are not serviced by wastewater treatment facilities and therefore rely on septic systems to treat waste. Only 22% of residents within Addison County are serviced by wastewater treatment facilities (ACRPC, 2008). Much of the watershed, especially in the town of Ferrisburgh, consists of heavy clay soils that make septic disposal difficult. More than half of the soil within Ferrisburgh is unsuitable for conventional on-site septic systems and much of the rest of the town has soils only marginally suited to handling septic waste (Ferrisburgh, 2006). The combination of relatively old septic systems and a relatively high water table with clay soils increases the probability of septic systems failing (ACRPC, 2008). When these systems malfunction or fail, they can release untreated human waste into surface waters, including Little Otter Creek.

Recommended Next Steps

The Addison County River Watch Collaborative (ACRWC) is working with the VT DEC to develop and implement an education and outreach program for several rivers including Little Otter Creek. ACRWC is also developing a comprehensive assessment of Little Otter Creek with funds from a Clean and Clear Watershed Planning Assistance grant (VTDEC, 2010). ACRWC, municipalities within the impaired segment, and other community and watershed based groups are being encouraged to continue implementation of education and outreach programs, restoration programs, and the identification of land use activities that might be influencing high *E. coli* levels in the creek (ACRWC, 2005).

The sampling data displayed in Table 1 indicates that *E.coli* readings tend to be highest at station LOC7.8. Less than a mile upstream, station LOCNEW exhibits *E.coli* readings that are significantly lower than station LOC7.8. This suggests that bacteria are entering the creek in large enough loads to result in higher readings at the downstream station, LOC7.8. Field surveys, as well as education and outreach efforts should focus on properties upstream of station 7.8 to determine what factors may be influencing these high *E.coli* levels. An aerial analysis of the land use upstream from station 7.8 shows large agricultural fields adjacent to the creek. There are no houses near the creek along this reach, implying that the contributing sources most likely do not include failing septic systems. The land use adjacent to the creek in this area suggests that bacteria are entering the creek from agricultural areas. Landowners should be notified or reminded that organizations such as NRCS, USGS, the VT Department of Agriculture, and the Otter Creek Conservation District which provide assistance with the installation of BMPs helping to reduce bacteria, nutrients, and suspended sediment loads to Little Otter Creeks, and education to landowners about ways to reduce the impact of those practices that may increase bacteria loading to the creek.

Additional bacteria data collection may be beneficial to support identification of sources of potentially harmful bacteria elsewhere in the Little Otter Creek watershed. The data in Table 1 indicates that there are areas below LOC7.8 where bacteria are entering the creek. While the area directly upstream of LOC7.8 should be considered first, there are clearly other areas where expanded sampling would help to locate bacteria sources. For example, sampling upstream and downstream of potential on-site septic and agricultural sources (a practice known as "bracket sampling") may be beneficial for identifying and quantifying sources. It would be beneficial to undertake "bracket sampling" along the reach of the creek between LOC7.8 and LOCNEW. Sampling activities focused on capturing bacteria data under different weather conditions (e.g., wet and dry) may also be beneficial in support of source identification.

Previous investigations (LOC, 2009; ACRPC, 1994; Ferrisburgh, 2006) have recommended the following actions to support water quality goals in Little Otter Creek:

- <u>On-Site Septic System Management</u> – Conduct a sanitary survey of domestic wastewater, maintain accurate records of approved septic systems, and encourage upgrading of old or inadequate septic systems paying special attention to areas near surface water.

- Agricultural - Work with the USDA, NRCS, USGS and other agencies to improve nutrient management planning, reduce livestock access to surface water, and increase riparian buffer width. Evaluate riparian buffers and identify opportunities to remove areas near the river from production.

- Land Use Protection - Preserve undeveloped portions of the watershed and institute controls on development near Little Otter Creek. Encourage communities to develop plans and regulations that afford greater protection of wetlands.

- Riparian Corridor – Encourage communities to install regulations addressing setbacks, buffers, and other tools that protect shoreline and/or riparian areas. Seek to enhance buffers through a combination of buffer plantings, land conservation, and improved agricultural practices.

Several of the steps outlined above are ongoing and should be continued and enhanced to focus on the goals of bacteria TMDL implementation. If implemented, these actions will provide a strong basis toward the goal of mitigating bacteria sources and meeting water quality standards in Little Otter Creek.

Bacteria Data

Vermont's current criteria for bacteria are more conservative than those recommended by EPA. For Class B waters, VTDEC currently utilizes an E. coli single sample criterion of 77 organisms/100ml. Although, Vermont is in the process of revising their bacteria WQS to better align with the National Recommended Water Quality Criteria (NRWQC) of a geometric mean of 126 organisms/100ml, and a single sample of 235 organisms/100ml. Therefore, in Table 1 below, bacteria data were compared to both the current VTWQS and the NRWQC for informational purposes.

Little Otter Creek, mouth to river mile 7.8

***WB ID*:** VT03-07

Characteristics: Class B

Impairment: *E. coli* (organisms/100mL)

Current Water Quality Criteria for E. coli:

Single sample: 77 organisms/100 mL

Percent Reduction to meet TMDL (Current):

Single Sample: **97%**

NRWQC for E. coli::

Single sample: 235 organisms/100 mL

Geometric mean: 126 organisms/100 mL

Percent Reduction to meet NRWQC

Single sample: **90%**

Geometric mean: **76%**

Data: 2000 – 2007, Addison County River Watch Collaborative

Table 1: *E.coli* (organisms/100 mL) Data for Little Otter Creek (2000-2007) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year.

Station Name	Station Location	Date	Result	Geometric Mean**
LOC4.3	Route 7 Bridge	8/22/2007	20	19
LOC4.3	Route 7 Bridge	8/8/2007	27	
LOC4.3	Route 7 Bridge	7/25/2007	2	
LOC4.3	Route 7 Bridge	7/11/2007	141	
LOC4.3	Route 7 Bridge	6/27/2007	16	
LOC4.3	Route 7 Bridge	8/23/2006	111	89
LOC4.3	Route 7 Bridge	8/2/2006	140	
LOC4.3	Route 7 Bridge	7/19/2006	131	
LOC4.3	Route 7 Bridge	7/5/2006	72	
LOC4.3	Route 7 Bridge	6/21/2006	39	
LOC4.3	Route 7 Bridge	8/17/2005	18	90
LOC4.3	Route 7 Bridge	8/3/2005	272	
LOC4.3	Route 7 Bridge	7/20/2005	45	
LOC4.3	Route 7 Bridge	7/6/2005	104	
LOC4.3	Route 7 Bridge	6/22/2005	261	

*Shaded cells indicate single sample and geometric mean used to calculate percent reduction.
**Only geometric mean values calculated with 5 data points or more are used to determine percent reduction.

Table 1: *E.coli* (organisms/100 mL) Data for Little Otter Creek (2000-2007) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year (continued).

Station Name	Station Location	Date	Result	Geometric Mean**
LOC4.3	Route 7 Bridge	8/18/2004	178	176
LOC4.3	Route 7 Bridge	8/4/2004	435	
LOC4.3	Route 7 Bridge	7/21/2004	51	
LOC4.3	Route 7 Bridge	7/7/2004	365	
LOC4.3	Route 7 Bridge	6/23/2004	116	
LOC4.3	Route 7 Bridge	8/6/2003	69	86
LOC4.3	Route 7 Bridge	7/23/2003	454	
LOC4.3	Route 7 Bridge	7/9/2003	23	
LOC4.3	Route 7 Bridge	6/25/2003	76	
LOC4.3	Route 7 Bridge	8/7/2002	124	215
LOC4.3	Route 7 Bridge	7/27/2002	81	
LOC4.3	Route 7 Bridge	7/10/2002	411	
LOC4.3	Route 7 Bridge	6/29/2002	517	
LOC4.3	Route 7 Bridge	8/11/2001	38	133
LOC4.3	Route 7 Bridge	7/25/2001	46	
LOC4.3	Route 7 Bridge	7/14/2001	649	
LOC4.3	Route 7 Bridge	6/27/2001	276	
LOC4.3	Route 7 Bridge	8/12/2000	2420	261
LOC4.3	Route 7 Bridge	7/26/2000	201	
LOC4.3	Route 7 Bridge	7/15/2000	145	
LOC4.3	Route 7 Bridge	6/28/2000	66	
LOC7.8	Middlebrook Rd. (North)	8/22/2007	345	395
LOC7.8	Middlebrook Rd. (North)	8/8/2007	488	
LOC7.8	Middlebrook Rd. (North)	7/25/2007	179	
LOC7.8	Middlebrook Rd. (North)	7/11/2007	579	
LOC7.8	Middlebrook Rd. (North)	6/27/2007	548	
LOC7.8	Middlebrook Rd. (North)	8/23/2006	196	306
LOC7.8	Middlebrook Rd. (North)	8/2/2006	866	
LOC7.8	Middlebrook Rd. (North)	7/19/2006	649	
LOC7.8	Middlebrook Rd. (North)	7/5/2006	214	
LOC7.8	Middlebrook Rd. (North)	6/21/2006	114	
LOC7.8	Middlebrook Rd. (North)	8/17/2005	980	520
LOC7.8	Middlebrook Rd. (North)	8/3/2005	435	
LOC7.8	Middlebrook Rd. (North)	7/20/2005	344	
LOC7.8	Middlebrook Rd. (North)	7/6/2005	1300	
LOC7.8	Middlebrook Rd. (North)	6/22/2005	199	

*Shaded cells indicate single sample and geometric mean used to calculate percent reduction.

**Only geometric mean values calculated with 5 data points or more are used to determine percent reduction.

Table 1: *E.coli* (organisms/100 mL) Data for Little Otter Creek (2000-2007) and Geometric Mean (organisms/100mL) for each Station based on Calendar Year (continued).

Station Name	Station Location	Date	Result	Geometric Mean**
LOC7.8	Middlebrook Rd. (North)	8/18/2004	135	448
LOC7.8	Middlebrook Rd. (North)	8/4/2004	488	
LOC7.8	Middlebrook Rd. (North)	7/21/2004	387	
LOC7.8	Middlebrook Rd. (North)	7/7/2004	866	
LOC7.8	Middlebrook Rd. (North)	6/23/2004	816	
LOC7.8	Middlebrook Rd. (North)	8/6/2003	866	1074
LOC7.8	Middlebrook Rd. (North)	7/23/2003	2420	
LOC7.8	Middlebrook Rd. (North)	7/9/2003	1300	
LOC7.8	Middlebrook Rd. (North)	6/25/2003	488	
LOC7.8	Middlebrook Rd. (North)	8/7/2002	2420	1494
LOC7.8	Middlebrook Rd. (North)	7/27/2002	2420	
LOC7.8	Middlebrook Rd. (North)	7/10/2002	1553	
LOC7.8	Middlebrook Rd. (North)	6/29/2002	548	
LOC7.8	Middlebrook Rd. (North)	8/11/2001	2420	1451
LOC7.8	Middlebrook Rd. (North)	7/25/2001	2420	
LOC7.8	Middlebrook Rd. (North)	7/14/2001	313	
LOC7.8	Middlebrook Rd. (North)	6/27/2001	2420	
LOC7.8	Middlebrook Rd. (North)	8/12/2000	2420	750
LOC7.8	Middlebrook Rd. (North)	7/26/2000	1300	
LOC7.8	Middlebrook Rd. (North)	7/15/2000	501	
LOC7.8	Middlebrook Rd. (North)	6/28/2000	201	
LOCNEW	Upstream of LOC7.8	8/17/2005	9	64
LOCNEW	Upstream of LOC7.8	8/3/2005	308	
LOCNEW	Upstream of LOC7.8	7/20/2005	25	
LOCNEW	Upstream of LOC7.8	7/6/2005	108	
LOCNEW	Upstream of LOC7.8	6/22/2005	138	
LOCNEW	Upstream of LOC7.8	8/18/2004	70	76
LOCNEW	Upstream of LOC7.8	8/4/2004	196	
LOCNEW	Upstream of LOC7.8	7/21/2004	25	
LOCNEW	Upstream of LOC7.8	7/7/2004	49	
LOCNEW	Upstream of LOC7.8	6/23/2004	154	
LOCNEW	Upstream of LOC7.8	8/6/2003	18	95
LOCNEW	Upstream of LOC7.8	7/23/2003	2420	
LOCNEW	Upstream of LOC7.8	7/9/2003	50	
LOCNEW	Upstream of LOC7.8	6/25/2003	37	

*Shaded cells indicate single sample and geometric mean used to calculate percent reduction.

**Only geometric mean values calculated with 5 data points or more are used to determine percent reduction.

References

ACRPC (1994). Addison County Regional Planning Commission, Addison County Regional Plan: Section 4: Natural Resources. Last updated April 13, 1994 (website) www.acrpc.org/pages/publications/Reg_Plan/NR_TOC.htm, accessed online on February 10, 2011.

ACRPC (2008). Addison County Regional Planning Commission, Addison County Regional Plan. Last updated May 14, 2008.

ACRWC (2005). Addison County River Watch Collaborative. 2005 Stream-Monitoring Report. Little Otter Creek and Mud Creek.

ACRWC (2009). 2009 Watershed Outreach Brochure: Little Otter Creek. Addison County River Watch Collaborative.

ACRWC (2011). Summary Report: 2010 Sampling Results, Addison County River Watch Collaborative, February 25, 2011. Prepared for: Jim Kellogg, VTDEC Water Quality Division. Prepared by: Kristen Underwood, South Mountain Research & Consulting and ACRWC.

Ferrisburgh (2006). Ferrisburgh Town Plan. Prepared for the Town of Ferrisburgh. Prepared by: Place Sense. Adopted 2006. Available online at: www.placesense.com/component/docman/cat_view/23-Ferrisburghhplan?orderby=dmdate_published&ascdesc=DESC, accessed online on: February 18, 2011.

LOC (2009). Little Otter Creek Water Quality Report (Interpretations and Conclusions based on Results: 1997-2008), Addison County River Watch Collaborative, April, 2009.

Medalie (2007). Medalie, Laura. Concentrations and loads of nutrients and suspended sediments in Englesby Brook and Little Otter Creek, Lake Champlain Basin, Vermont, 2000-2005: US. Geological Survey Scientific Investigations Report 2007-5074, 50p. Available online at: http://pubs.usgs.gov/sir/2007/5074/, accessed online on February 16, 2011.

USGS (2007). United States Geological Survey, Lake Champlain Basin BMP: Agriculture Environment, Little Otter Creek (website) Available online at: http://nh.water.usgs.gov/projects/champlain_bmp/ag.htm, accessed online on February 16, 2011.

VTDEC (2010). Progress Report on River Basin Water Quality Management Planning During 2009. A Report for: House and Senate Committees on Agricultural and Natural Resources and Energy. Prepared by: Vermont Agency of Natural Resources, Department of Environmental Conservation, Water Quality Division, Waterbury, VT. January, 2010.

VTDEC (2008). State of Vermont, 2008, 303(d) List of Waters, Part A – Impaired Surface Waters in Need of TMDL, October 2008 (Approved by USEPA September 24, 2008). Prepared by: Vermont Department of Environmental Conservation, Water Quality Division, Waterbury, VT.

VTF&W (undated). Little Otter Creek Wildlife Management Area. Vermont Fish & Wildlife Department.