VERMONT
ENVIRONMENTAL CONSERVATION

Flower Brook

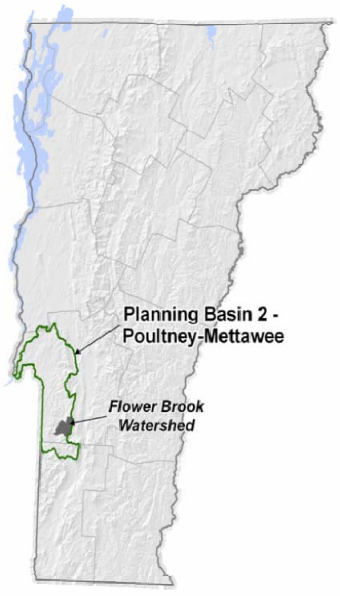
Watershed Description

This bacteria TMDL summary applies to Flower Brook (VT02-05), a 7-mile long stream located approximately twenty-five miles southwest of Rutland on Vermont's western boundary (Figure 1). Flower Brook begins on the southern slopes of Tinmouth Mountain in the Town of Tinmouth, and flows southerly into the Town of Danby. After passing between Mount Hoag and Dutch Hill, the brook flows southwesterly into the Town of Pawlet to its confluence with the Mettowee River (a.k.a. Mettawee River), approximately 9.5 miles from the mouth of the Mettowee (VTDEC, 2005). Flower Brook has one main tributary, Beaver Brook, which flows into Flower Brook from the north-west. The Flower Brook watershed covers 18.9 square miles, primarily in the towns of Pawlet, Danby and Tinmouth. The lands in the valleys of Flower Brook are used extensively for farming and dairying (Pawlet, 2010). Sheep and horse farms, and open spaces line the main river corridor of the Mettowee River and Flower Brook (VTDEC, 2011).

Overall, land use in the watershed is 74% forested, 22% agricultural, 1% developed, 1% wetland, and 1% other, as shown in Figure 2 (based on 2006 Land Cover Analysis by NOAA-CSC). A portion of Flower Brook is referred to as the Flower Brook Gorge in Pawlet Village. The gorge (and cascade) is an old mill site, with a dam at the upper end. The site is operated for hydroelectricity and a penstock bypasses the gorge (VTDEC, 2005). Elevations in the area range from over 2,000 feet at the highest elevation on the mountain tops, to around 400 feet in the stream valleys (Pawlet, 2010).

Waterbody Facts (VT02-05)

- **Watershed Towns:** Pawlet, Danby, Tinmouth
- **Impaired Segment Location:** from mouth upstream 0.5 miles
- **Impaired Segment Length:** 0.5 miles
- **Classification:** Class B
- **Watershed Area:** 18.9 square miles
- **Planning Basin:** 2-Poultney-Mettowee



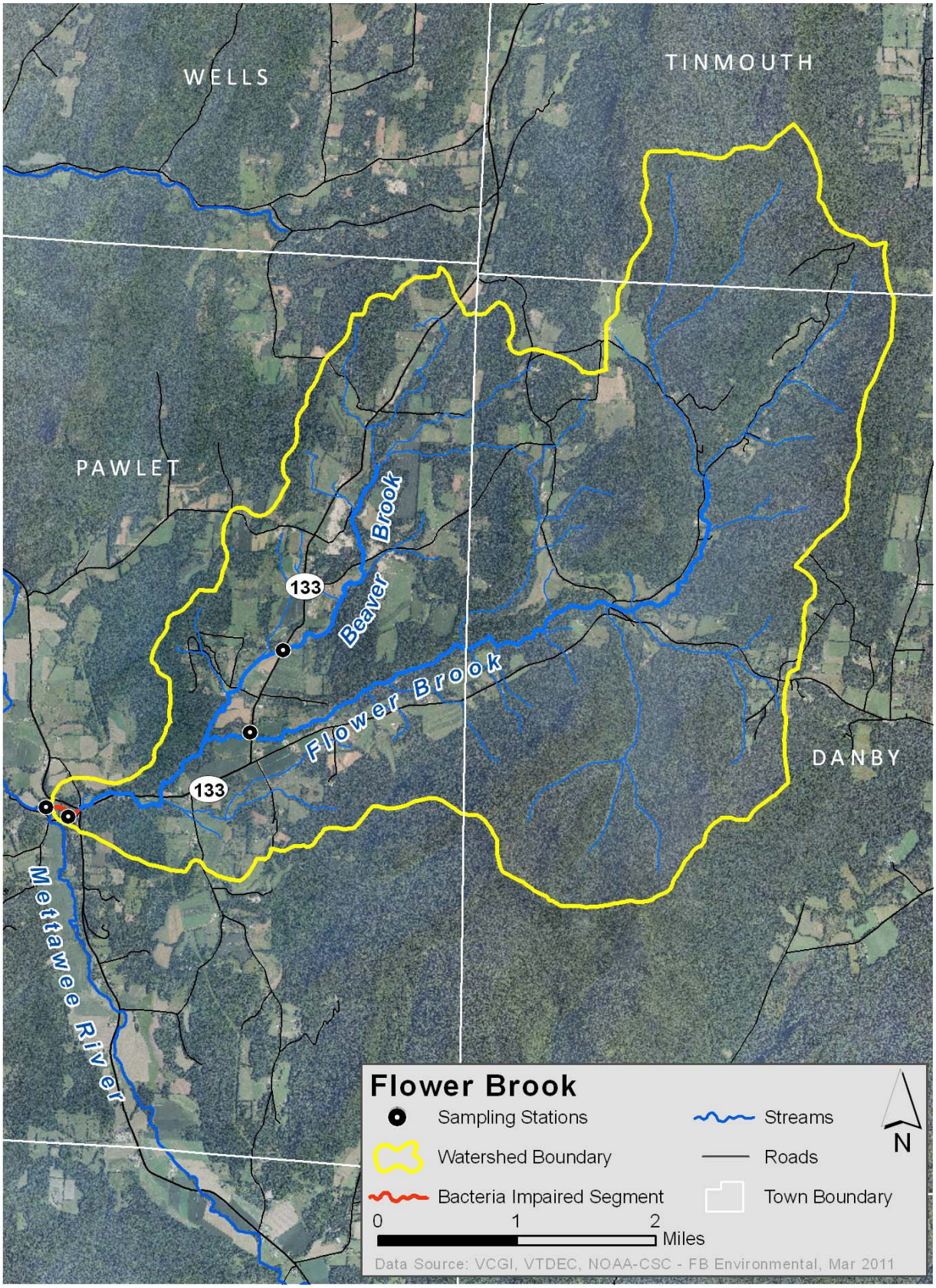


Figure 1: ***Map of the Flower Brook watershed with impaired segment and sampling stations indicated.***

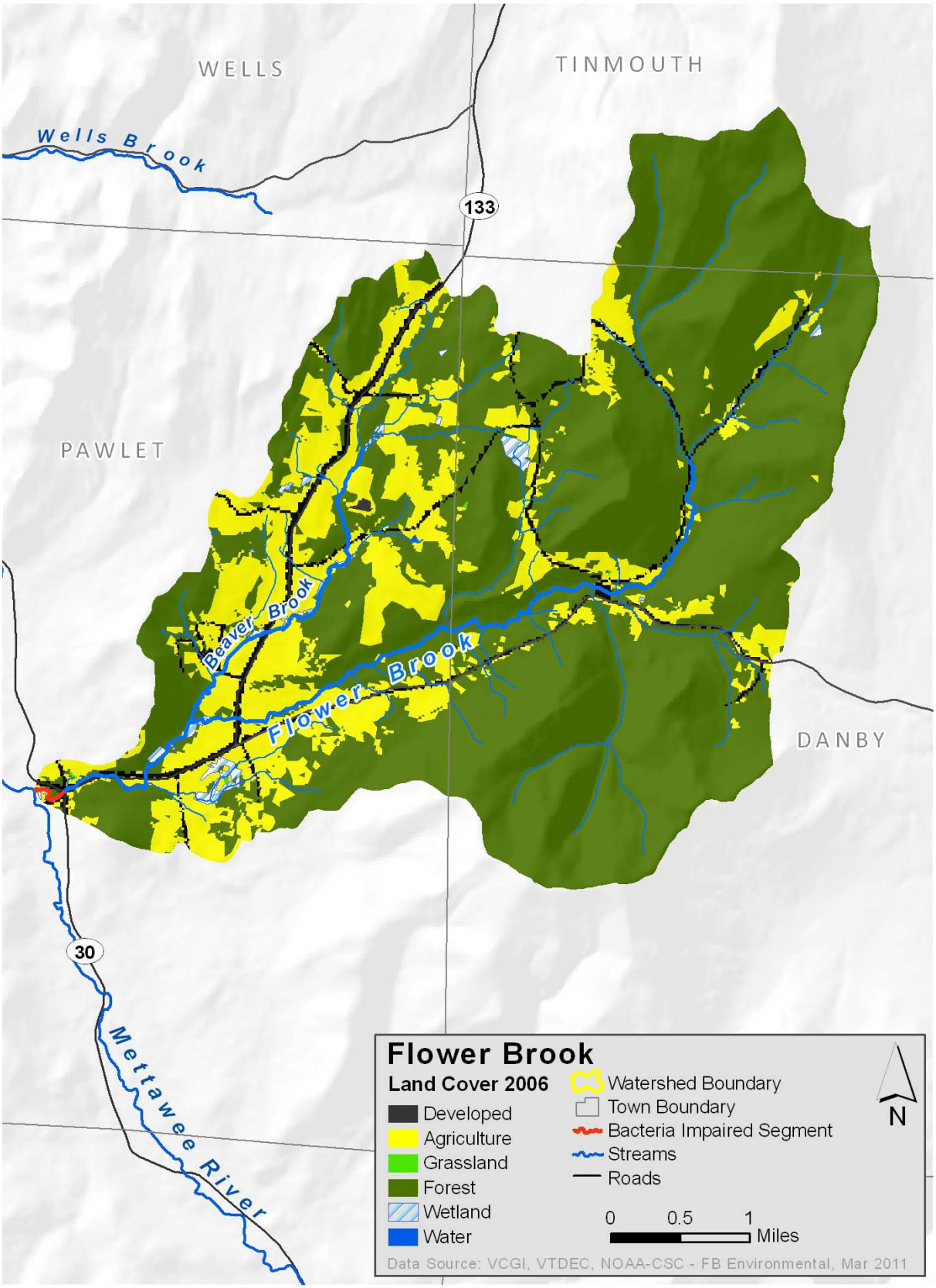


Figure 2: ***Map of the Flower Brook watershed with impaired segment and land cover indicated.***

There are several sampling locations in the Flower Brook watershed including one on Beaver Brook (Beaver01), one on the eastern branch of Flower Brook (Flower02), one within the impaired segment (Flower01) and one on the Mettowee just downstream of the confluence with Flower Brook (METT02.5). However, the impairment for Flower Brook is based only on the data collected at the sampling location within the impaired segment.

Flower01 sampling location as indicated by the red star. (Image: VTDEC)

A 2002 study of the Mettowee River found that water temperatures in Flower Brook were slightly warmer than temperatures in the adjacent river (VTDEC, 2002), and may be a potential source of thermal pollution contributing to the aquatic life impairment in the Metoweee. The primary reason for this thermal pollution is considered to be a loss of riparian vegetation (VTDEC, 2005). Management objectives for reducing water temperature in Flower Brook include conducting a field investigation to identify areas to make improvements, increasing linear riparian buffer plantings along the stream corridor, and monitoring temperature and fish populations.

The two greatest causes of impairments for rivers and streams in this region are nutrients and sediments from nonpoint source pollution. Temperature, as described above and pathogens also have an impact on the stream. The sources of these pollutants are varied and include agricultural activities, stream bank destabilization, riparian vegetation removal, and land development among other sources (VTDEC, 1999).

Beginning in 2008, Vermont DEC received grants from the EPA and the USGS to explore methods for identifying sources of bacterial contamination in various rivers and streams in Vermont. One study analyzed water samples for laundry detergents to identify possible sources of septic contamination at eight individual river sites. Beginning in 2009, feces samples were collected from targeted animal species as part of a bacterial marker study. In 2010, samples were collected on 3 dates at 2 stations on Flower Brook and at 4 stations on the Mettowee River. Preliminary results are not absolute for finding potential sources of fecal contamination from humans and ruminants. Human sources of fecal contamination were excluded at all stations as were ruminant sources at the upstream stations but not at the downstream-most stations. For the 2 sampled storms, humans were excluded as potential sources at most stations, though could not be excluded at 2 stations. Also for the 2 sampled storms, ruminants were excluded as potential sources at a few stations (at 1 station for the first storm and at 3 stations for the 2nd storm), and could not be excluded at the remaining stations. The ruminant marker could not distinguish between domestic (cows, sheep, goats) and wild ruminants such as moose and deer (VTDEC, 2011 final report pending).

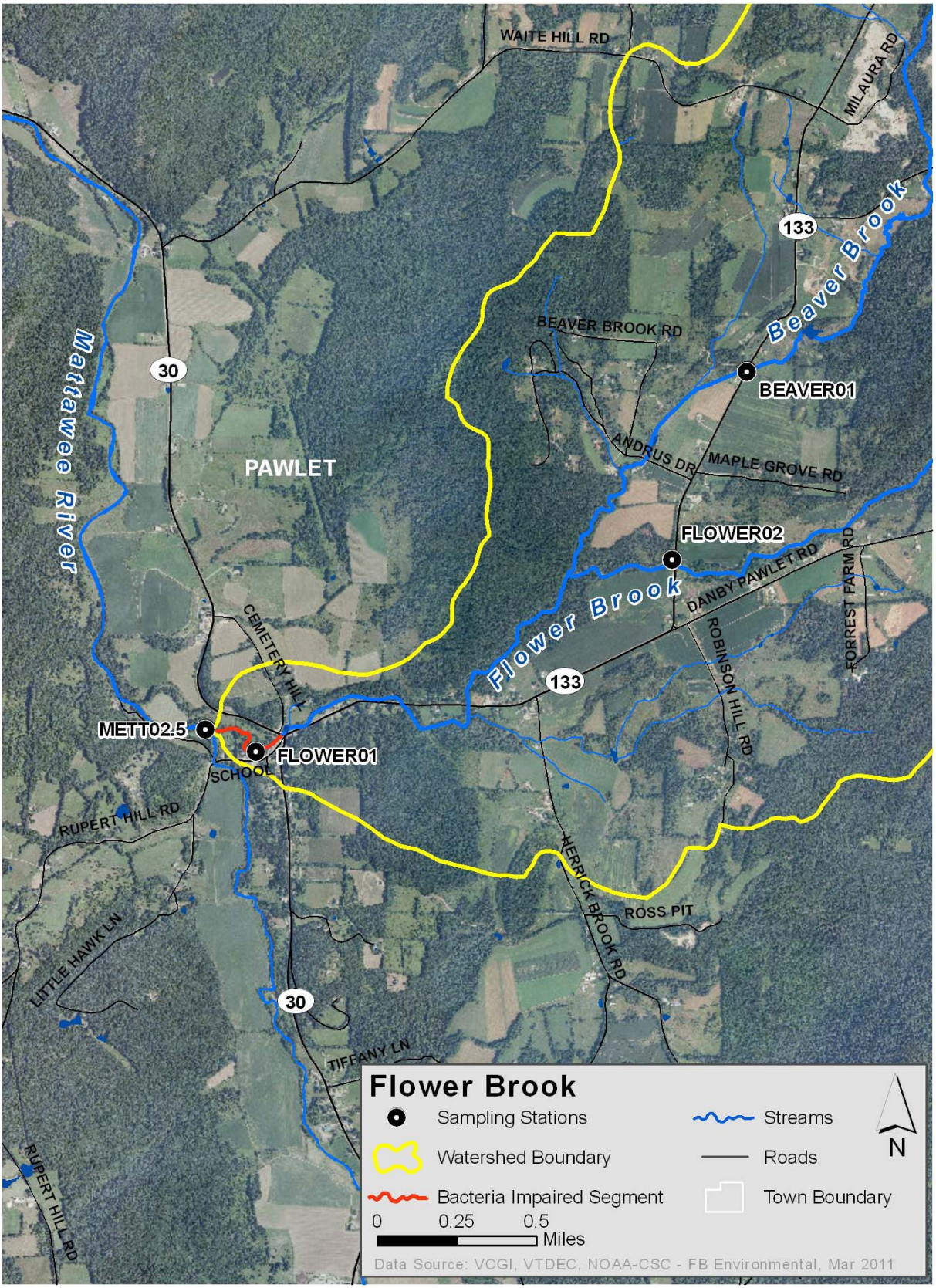


Figure 3: ***Map of downstream reaches of the Flower Brook with impaired segment and sampling locations indicated.***

Why is a TMDL needed?

Flower Brook in Pawlet Village. (Photo: VTDEC)

Flower Brook is a Class B, cold water fishery with designated uses including swimming, fishing and boating (VTDEC, 2008a). Bacteria data from the downstream sampling location FLOWER01 consistently exceeds Vermont's water quality criteria for *E.coli* bacteria. Table 1 (below) provides bacteria data collected at the downstream sampling location over the course of three years (2005, 2007, and 2008). 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. The water quality criteria are exceeded in all sampling events and the seasonal mean in 2005 and 2007. In 2008, water quality criteria were exceeded in all but 5 sampling events. In addition, sampling site METT02.5 on the Mettowee River, located downstream of the confluence with Flower Brook consistently exceeded Vermont's water quality criteria for *E.coli* bacteria in 2007 and 2008, suggesting that there may be a correlation between high bacteria levels in Flower Brook and water quality exceedances in the Mettowee River.

Due to the elevated bacteria measurements presented in Table 1, Flower Brook, from the mouth upstream for 0.5 miles did not meet Vermont's water quality standards, and was identified as impaired and placed on the 303(d) list (VTDEC, 2008b). The 303(d) listing states that use of Flower Brook 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 to comply with state water quality standards.

Potential Bacteria Sources

Flower Brook has been the site of documented sewer problems over the past 15 years. In 1996, the Vermont Agency of Natural Resources (VTANR) followed up with a complaint regarding discharge of raw sewage into Flower Brook. The investigation included a dye test that confirmed the release of raw sewage into the brook (VTANR, 1999).

The Town of Pawlet reports that sewage throughout most of the town is disposed of on the lots of the individual or multifamily housing units using septic tanks and drywells or leach fields for treatment and disposal. According to the Wastewater Disposal Systems Analysis prepared for the Town of Pawlet, there are areas in Pawlet Village where storm drainage and raw sewage may be combined in the same system, with outfall directly into Flower Brook or the Mettowee River. Although the report is not conclusive, it should be noted that there may be potential for contamination of these streams (Pawlet, 2010). The Vermont DEC Microbial Source Tracking Study (VTDEC, 2011) also confirmed the presence of bacteria of human origin in downstream reaches near Pawlet.

Agricultural activities including manure management and manure spreading adjacent to Flower Brook likely result in fecal bacteria contributions. The Poultney Mettowee Natural Resource Conservation District (NRCD) and the Poultney-Mettowee Watershed Partnership have spent the last several years reaching out to agricultural landowners to improve riparian practices, and manure management. The NRCD has also been collecting water quality data in Beaver Brook, the sole tributary to Flower Brook. It appears likely, however, that agricultural runoff of fecal bacteria continues to be a problem and that more work is needed to improve riparian buffers not only to mitigate for agricultural activities, but also to mitigate for temperature.

Recommended Next Steps

The Vermont DEC is working closely with several groups including the US Geological Survey (USGS) on the microbial source tracking (MST) project, and with the Poultney Mettowee NRCD to monitor water quality in both Flower Brook and Beaver Brook, and to work with agricultural landowners to establish and improve riparian buffers.

Additional bacteria data collection will be beneficial to support identification of sources of potentially harmful bacteria in the Flower Brook watershed, and to determine if improved management practices, or changes in ownership changes of contributing farmland has improved conditions in the stream. Sampling upstream and downstream of potential on-site sewage and agricultural sources (a practice known as "bracket sampling") may be beneficial for identifying and quantifying sources. Ongoing sampling focused on capturing bacteria data under different weather conditions (e.g., wet and dry) may also be beneficial in support of source identification. Field reconnaissance surveys focused on stream buffers, stormwater runoff, or other source identification may also be beneficial.

Previous investigations (VTDEC 1999; VTDEC 2002; VTANR 2005; VTDEC, 2010; Pawlet, 2010) have recommended the following actions to support water quality goals in Flower Brook:

- Riparian Corridor – Continue riparian corridor projects that enhance buffers, stabilize stream banks and reduce water temperature in the stream through a combination of buffer plantings, land conservation, and improved agricultural practices.
- Agricultural - Work with agricultural operators to improve riparian practices and manure management.
- On-Site Sewage System Management – Conduct a sanitary survey of domestic sewage, work with Vermont environmental enforcement officers and local health officials to identify and replace failing systems. Conduct a review and potentially modify existing sewage ordinances.
- Monitoring – Monitor water temperature and fish populations in both Flower Brook and the Mettowee River as management actions are implemented in Flower Brook. Investigate high bacteria levels in Beaver Brook as a source to Flower Brook. Review, and build-upon Microbial

Source Tracking results to prioritize areas needing additional monitoring, or areas requiring immediate remediation.

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 Flower Brook.

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.

Flower Brook, from mouth upstream 0.5 miles

***WB ID*:** VT02-05

Characteristics: Class B

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

Current Water Quality Criteria for E. coli:

Single sample: 77 organisms/100 mL

NRWQC for E. coli:

Single sample: 235 organisms/100 mL

Geometric mean: 126 organisms/100 mL

Percent Reduction to meet TMDL (Current):

Single Sample: **93%**

Percent Reduction to meet NRWQC:

Single sample: **79%**

Geometric mean: **80%**

Data: Poultney Mettowee Conservation District, VTDEC

Table 1: *E.coli* (organisms/100 mL) Data for Flower Brook (2005-2008) and Geometric Mean (organisms/100mL) for Station FLOWER01 based on Calendar Year.

Station Name	Date	Result	Geometric Mean**
FLOWER01	8/27/2008	62	113
FLOWER01	8/13/2008	147	
FLOWER01	7/30/2008	261	
FLOWER01	7/16/2008	291	
FLOWER01	7/2/2008	172	
FLOWER01	6/18/2008	326	
FLOWER01	6/4/2008	219	
FLOWER01	5/7/2008	250	
FLOWER01	4/30/2008	70	
FLOWER01	4/23/2008	54	
FLOWER01	4/9/2008	18	
FLOWER01	3/26/2008	29	
FLOWER01	8/29/2007	687	638
FLOWER01	8/14/2007	517	
FLOWER01	8/1/2007	1050	
FLOWER01	7/18/2007	727	
FLOWER01	7/5/2007	687	
FLOWER01	6/20/2007	1120	
FLOWER01	6/6/2007	206	
FLOWER01	8/24/2005	236	261
FLOWER01	8/10/2005	461	
FLOWER01	7/27/2005	308	
FLOWER01	7/13/2005	122	
FLOWER01	6/29/2005	167	
FLOWER01	6/15/2005	488	
FLOWER01	6/1/2005	248	

*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

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VTDEC (2011). Vermont Department of Environmental Conservation. Pending, 2011. Microbial Source Tracking Study.