Vermont Statewide
Total Maximum Daily Load (TMDL)

for Bacteria-Impaired Waters

VERMONT
ENVIRONMENTAL CONSERVATION

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State of Vermont
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1. Introduction

This *Statewide Total Maximum Daily Load (TMDL)* report provides a framework for addressing bacterial pollution in the streams and rivers of Vermont. Bacterial contamination of surface waters may result from a variety of sources including waste from humans, farm animals, pets, and wildlife, such as large congregations of birds and small mammals. Bacterial contamination can negatively affect public health and may ultimately result in closures of swimming areas, drinking water supplies, and shellfish areas (USEPA, 2001a).

This bacteria TMDL report establishes the allowable bacterial loadings (expressed as concentrations) for Vermont's surface waters, provides documentation of impairment, and outlines the reductions needed to meet water quality standards. One goal of this TMDL process is to promote, encourage, and inform local community action for water quality improvement and protection of public health by addressing sources of bacterial contamination. To this end, this report also provides information to help communities, watershed groups, and other stakeholders to implement the TMDL using a phased, community-based approach that will ultimately result in attainment of water quality standards.

1.1 Background

Section 303(d) of the Federal Clean Water Act (CWA) and Federal Water Quality Planning and Management Regulations (40 CFR Part 130) require states to place waterbodies that do not meet established water quality standards on a list of impaired waterbodies, commonly referred to as the ―303(d) List". In Vermont, the Department of Environmental Conservation (VTDEC) is responsible for the 303(d) listing process. The 303(d) List is updated and issued for public comment every two years, with the final list submitted to the United States Environmental Protection Agency (EPA) on April 1st of each even-numbered year.

Surface waters placed on the 303(d) List are impaired or threatened by one or more pollutant(s) and require development and implementation of a pollutant loading and reduction plan, called a Total Maximum Daily Load (TMDL), for the pollutant(s) causing the impairment (VTDEC, 2006). A TMDL establishes the allowable loadings for specific pollutants that a waterbody can receive without exceeding water quality standards (USEPA, 2001). Water quality standards include numeric and narrative criteria that must be met to protect the uses of the surface water such as swimming, boating, aquatic life habitat, and public water supply. The TMDL process maps a course for states and watershed stakeholders to follow that should lead to restoration of the impaired water and its uses. In Vermont, the components of the TMDL process typically include the following (VTDEC, 2005):

1. ***Problem Identification:*** The pollutant for which the TMDL is developed must be identified.
2. ***Identification of Target Values:*** This element establishes water quality goals for the TMDL. Target values may be stated explicitly in Vermont's water quality standards or they may need to be interpreted.
3. ***Source Assessment:*** Significant sources of the pollutant in question must be identified in the watershed.
4. ***Linkage between Targets and Sources:*** This element of the process establishes how much of a pollutant may be present while still meeting water quality standards. This step can vary in complexity from simple calculations to development of complex watershed models.
5. ***Allocations:*** Once the maximum pollutant loading is established, the needed reductions must be divided among the various sources. This is done for both point sources and nonpoint sources.
6. ***Public Participation:*** Stakeholder involvement is critical for the successful outcome of any TMDL. Draft TMDLs are released for public comment prior to their completion.
7. ***EPA Approval:*** EPA approval is needed for all TMDLs as required by the Federal Clean Water Act. The New England regional office of EPA, located in Boston, Massachusetts is responsible for TMDL approval.
8. ***Follow-up Monitoring:*** Additional monitoring may be needed to ensure the TMDL, once implemented, is effective in restoring the waters.

In Vermont, impaired waterbodies are included in the *"State of Vermont 2010 303(d) List of Waters: Part A – Impaired Surface Waters in Need of TMDL"* (VTDEC, 2010b). The methodology for assessing surface waters in Vermont is described in the State's Surface Water Assessment Methodology (VTDEC, 2005). Using the methodology, water quality data is compared to the State's surface water quality standards to determine which designated uses are supported, which are not, and which uses cannot be assessed due to insufficient data. Designated uses for Vermont surface waters include (VTDEC, 2005):

- Aquatic biota, wildlife and aquatic habitat;
- Aesthetics;
- Swimming and other primary contact recreation;
- Boating, fishing and other recreation uses;
- Public water supplies; and
- Irrigation of crops and other agricultural uses.

Relevant designated uses for bacteria are typically swimming, other primary contact recreation, boating and other recreation uses, and public water supplies because these uses involve direct human contact with potentially impacted waters.

To facilitate tracking and assessing surface water quality, all rivers, streams, lakes and ponds in Vermont have been designated into ―waterbodies" which serve as the cataloging units for statewide assessment. Waterbodies are typically entire lakes, subwatersheds of river drainages or segments of major rivers. For the 2010 TMDL cycle, Vermont assessed approximately 5,781 miles of rivers and streams and 55,561 inland lake and pond acres (VTDEC, 2010a). Vermont's water quality policy states that rivers, streams, lakes and ponds should be of high quality and supporting their designated uses (VTDEC, 2005).

1.2 Purpose of Report

This *Vermont Statewide TMDL Report* is designed to support bacteria pollution reduction and watershed restoration. Bacteria data for impaired waterbodies are presented in Appendices 1 through 19 on a watershed basis. Within each watershed, measured bacteria concentrations in each of the impaired waterbodies are used to estimate the percent reduction needed to attain water quality standards. This statewide report, organized on a watershed basis with site-specific data presented for each impaired waterbody, highlights pollutant sources and provides meaningful implementation actions to mitigate each type of pollutant source. The TMDL provides a framework for the implementation and restoration process a useful format for guiding both remediation and protection efforts in impaired watersheds. Using a watershed approach provides a coordinating framework for environmental management that supports efforts to systematically identify, evaluate and prioritize point and non-point sources of pollution using watershed or hydrologic boundaries to define the problem area.

A TMDL assessment typically calculates the amount of a pollutant that receiving waters can assimilate without exceeding water quality standards or compromising their designated use. The pollutant load is then allocated to specific sources. This statewide bacteria TMDL allocation sets a goal of meeting bacteria water quality criteria for all sources in order to meet water quality standards throughout the affected waterbodies.

The purpose of this report is to:

1. Provide documentation of impairment;
2. Determine the TMDLs that will achieve water quality standards;
3. Calculate the reductions necessary to achieve the TMDLs;
4. Provide tools to help communities, watershed groups, and other stakeholders to implement the TMDL in a phased approach that will ultimately result in attainment of water quality standards.

As future monitoring identifies additional bacteria-impaired waterbodies in Vermont, these bacteria TMDLs may be applied to those waters and made available for public comment through Vermont's publicly reviewed 303(d) listing process every two years. Once EPA approves the TMDL modification as part of the 303(d) List approval, the newly proposed waterbodies will be addressed by the bacteria TMDLs presented in this report. This process will require the same type of information on the additional impaired waterbodies and their TMDLs as is contained in the appendices to this report.

1.3. Report Format

This document contains the following sections:

- ***Water Quality Standards for Bacteria (Section 2)***: This section provides an overview of the potential pathogenic impacts of bacteria and the selection of indicator bacteria to assess pathogen impairment in waterbodies, as well as a summary of Vermont water quality standards and designated uses.
- ***Types of Bacteria Pollution Sources (Section 3):*** This section defines point and non-point sources of bacteria pollution and provides examples of bacteria sources that may affect Vermont's waterbodies.
- ***Bacteria Impaired Waters (Section 4):*** This section includes an overview of the 303(d) listing process, a summary of Vermont's data monitoring programs, and provides a brief introduction to bacteria impaired waters in Vermont.
- ***TMDL Development (Section 5):*** This section provides a description of the TMDL allocation process based on designated use and waterbody class.
- ***Implementation Plans (Section 6):*** This section provides a description of the implementation process, including coordination with local stakeholders and development of watershed management plans, and a menu of mitigative actions (organized by source) to reduce bacteria loading.
- ***Funding and Community Resources (Section 7)***: This section provides a description of funding sources available to address impaired waters in Vermont.
- ***Watershed-Specific Bacteria Summaries and Reductions (Section 8)***: This section summarizes Vermont's bacteria-impaired waterbodies and provides reductions necessary for each impaired segment. This section also introduces the report appendices, organized by Vermont planning basin (VPB), which contain a summary of available bacteria data and information, reduction needed for each impaired waterbody, and watershed maps.

2. Water Quality Standards for Bacteria

This section provides a description of potential impacts associated with bacteria in surface waters and the State of Vermont's water quality standards (WQS) for bacteria. Bacteria water quality standards are designed to protect surface waters and associated water users from the potentially adverse impacts of harmful bacteria.

2.1 Overview of Pathogens and Indicator Bacteria

Bacteria TMDLs are designed to support reduction of waterborne disease-causing organisms, known as pathogens, to reduce public health risk. Pathogens may be transported to surface waterbodies by storm water runoff or persistent sources, such as failing septic systems, untreated agricultural runoff, and illicit discharge pipes. Once in a waterbody, they can infect humans through skin contact, ingestion of water, or consumption of contaminated fish and shellfish. Of the designated uses listed in Section 303(d) of the Clean Water Act, protection from pathogenic contamination is most important for waters designated for recreation (primary and secondary contact); public water supplies; aquifer protection; and protection and propagation of fish, shellfish, and wildlife (USEPA, 2001).

Infections due to pathogen-contaminated recreational waters include gastrointestinal, respiratory, eye, ear, nose, throat, and skin diseases (USEPA, 1986). Filter-feeding shellfish, such as clams, oysters, and mussels, and other shellfish, concentrate microbial contaminants in their tissues and may be harmful to humans when consumed raw or undercooked.

Wastes from warm-blooded animals are a source for many types of bacteria found in waterbodies, including the coliform group and Streptococcus, Lactobacillus, Staphylococcus, and Clostridia. Each gram of human feces contains approximately 12 billion bacteria that may include pathogenic bacteria, such as Salmonella, associated with gastroenteritis. In addition, feces may contain pathogenic viruses, protozoa, and parasites (MADEP, 2007).

The numbers of pathogenic organisms present in waters are generally difficult to identify and isolate, and are often highly varied in their characteristic or type. Therefore, scientists and public health officials usually monitor nonpathogenic bacteria that are typically associated with harmful pathogens in fecal contamination and are most easily sampled and measured. These associated bacteria are called indicator organisms. Indicator bacteria are not themselves a health risk, but are used to indicate the presence of pathogenic organisms. High densities of indicator bacteria increase the likelihood of the presence of pathogenic organisms (USEPA, 2001).

Some commonly used indicators include coliform bacteria and fecal streptococci. The relationship of indicator organisms is illustrated in Figure 2-1, with the commonly used indicator in Vermont highlighted in yellow. Indicator criteria specific to Vermont are discussed in Section 2.2 of this report. Fecal coliform and *E.coli* (a subset of total coliform) are present in the intestinal tracts of warm-blooded animals. Presence of coliform bacteria in water indicates fecal contamination and the possible presence of pathogens.

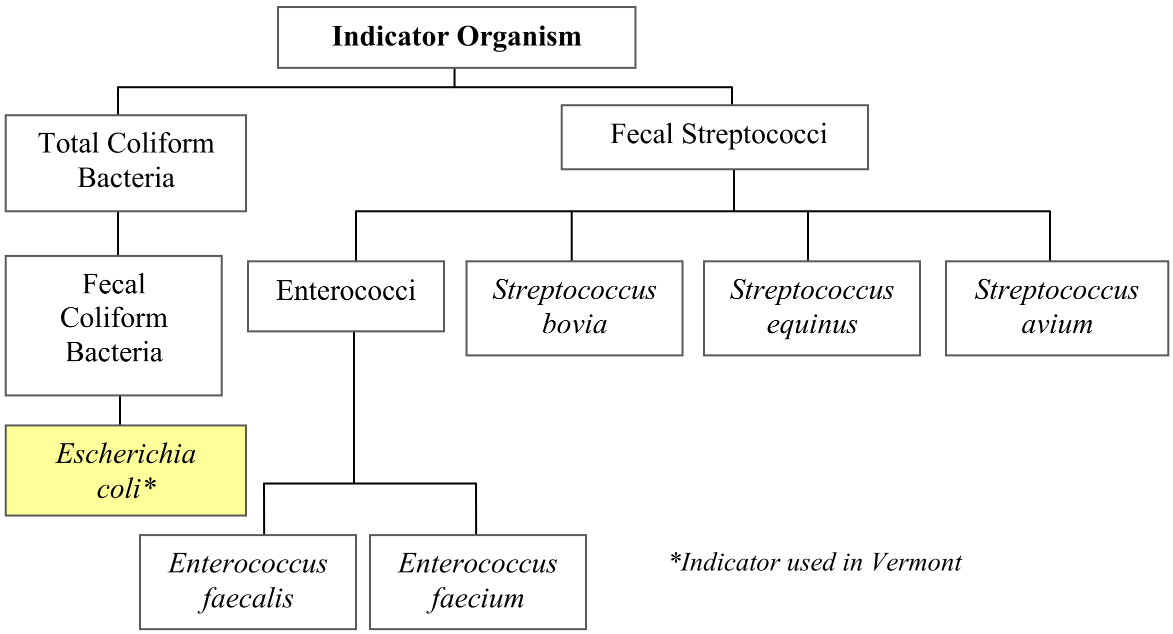


Figure 2-1: Relationship among Indicator Organisms (USEPA, 2001).

2.2 Water Quality Standards for Bacteria in Vermont Waters

Water quality standards determine the baseline water quality that all surface waters of a state must meet in order to protect their intended uses. They are the ―yardstick" for identifying where water quality violations exist and for determining the effectiveness of regulatory pollution control and prevention programs. The Vermont water quality standards are the foundation for the state's surface water pollution control and surface water quality management efforts. The WQS have been promulgated by the Water Resources Panel and provide the specific criteria and policies for the management and protection of Vermont's surface waters (VTDEC, 2008b). These standards are composed of three parts: classification and designated uses; criteria; and antidegradation regulations. Each of these parts is described below.

2.2.1 Classification and Designated Uses

All surface waters of the state are classified as either Class A or Class B according to the water use classifications of Section 3 of Vermont's WQS. Waters designated as Class A(1) are Ecological Waters, and are managed to maintain an essentially natural condition. Waters designated as Class A(2) are Public Water Supplies. There may be a change from natural conditions due to the fluctuations in reservoir water level and in the reduction in stream flow that result from water withdrawals for water supply purposes.

Most of Vermont's waters (97%) are Class B and are managed to achieve and maintain a level of quality that is compatible with their associated designated uses. The WQS contain a requirement that all Class B waters shall eventually be designated as Water Management Type B1, Type B2 or Type B3.

The classification of Vermont's surface waters as Class A(1), Class A(2), Class B or Class B with Water Management Type determines the management goals to be attained and maintained. The classification also specifies the designated water uses for each class. Designated uses, as established in Sections 3-02(A), 3-03(A) and 3-04(A) of the WQS, mean any value or use, whether presently occurring or not, that is specified in the management objectives for each class of water. Applicable designated uses by classification are listed in the table below (VTDEC, 2008b).

Table 2-1: Applicable Designated uses by Waterbody Class.

Designated Use	Class B *All Water Management Types*	Class A(1) *Ecological Waters*	Class A(2) *Public Water Supplies*
Aquatic Biota, Wildlife, and Aquatic Habitat	X	X	X
Aesthetics	X	X	X
Swimming and other Primary Contact Recreation	X	X	X
Boating, Fishing, and other Recreational Uses	X	X	X
Public Water Supplies	X		X
Irrigation of Crops and other Agricultural Uses	X		

2.2.2 Water Quality Criteria

Vermont's WQS establish narrative and numeric criteria to support designated and existing uses. The narrative criteria describe acceptable water quality conditions such that those uses provided in Table 2-1 can be supported. Numeric criteria are typically concentrations of pollutants representing maximum acceptable levels of pollutants. Concentrations of pollutants above the numeric criteria represent potentially harmful levels and violate the water quality standards.

*A **geometric mean** is a way to average a set of values, and is commonly used with bacterial water assessments which often show a great deal of variability. Unlike the arithmetic mean, a geometric mean reduces the effect of an occasional high or low value on the average.*

Ambient numeric criteria for bacteria for Vermont surface waters are presented in Table 2-2. *E.coli* is used as Vermont's primary bacteria indicator for assessing all waterbody classes. For Class A waters, bacteria criteria for *E.coli* are expressed as a **geometric mean** concentration and an instantaneous or single sample concentration (VTDEC, 2008b). For Class B waters, Vermont's bacteria criterion for *E.coli* is expressed as an instantaneous or single sample concentration only. Vermont's current criteria for bacteria in Table 2-2 are more conservative than those recommended by the USEPA in the National Recommended Water Quality Criteria for bacteria (1986) (see Section 8.3 discussion). These Vermont standards were originally envisioned to ensure a higher level of protection for swimmers and other forms of contact recreation use (VTDEC, 2011).

Table 2-2: Numeric Criteria for indicator Bacteria by Waterbody Class in Vermont.

Water Body Class	*E.coli* (organisms/100mL)	
	GMC	*SSMC*
Class B *All Water Management Types*	NA	77
Class A *Ecological Waters & Public Water Supply*	18	33

Notes: GMC denotes geometric mean concentration and is a statistically-based metric; SSMC denotes single sample maximum concentration; VTwater quality standards currently have no GMC for Class B waters. NA = not applicable.

The numeric bacteria standards for *E.coli* discussed above apply in ambient conditions in surface waters. Vermont WQS provide that if criteria are not met due to natural influences, the waterbody in question is considered to be in compliance.

2.2.3 Antidegradation Provisions

Antidegradation provisions are designed to preserve and protect the existing beneficial uses of the State's surface waters and to limit the degradation allowed in receiving waters. Vermont's Antidegradation Policy, Section 1-03 of Vermont's WQS, focuses on the maintenance, protection, and improvement of water quality of all waters through the following objectives (VTDEC, 2008b):

- The maintenance and protection of existing uses, regardless of the water's classification;
- The maintenance and protection of high quality waters. A limited reduction in the existing higher quality of such waters may be allowed in the following circumstances:
    - The adverse economic or social impacts of the people of the state specifically resulting from the maintenance of the high quality waters would be substantial and widespread;
    - These adverse impacts would exceed the environmental, economic, social, and other benefits of maintaining the higher water quality; and
    - There shall be achieved the highest statutory and regulatory requirements for all new or existing point sources and all cost-effective and reasonable accepted agricultural practices

and best management practices, as appropriate for non-point source control, consistent with State law.

3. Bacteria Pollution Sources

The Clean Water Act categorizes sources of indicator bacteria and associated pathogens into two major groups: *point source (PS)* pollution and *non-point source (NPS)* pollution. As will become evident in the sections that follow, a stormwater discharge can be categorized as either a point source or a non-point source, depending on whether or not the discharge is regulated under the CWA's National Pollutant Discharge Elimination System (NPDES) permit program. For this reason, stormwater is listed as a source of bacteria in both categories of pollution below.

This section describes bacteria pollution sources within the regulatory context. Types of bacteria sources are defined and the process of regulating bacteria pollution is described. Later in this document (Section 6), strategies for assessing bacteria pollution sources and taking mitigative action to reduce the adverse impacts of bacteria pollution are described.

3.1 Point Source Pollution

Point source pollution can be traced back to a specific source such as a discharge pipe from an industrial facility, municipal treatment plant, or a feedlot, making this type of pollution relatively easy to identify. According to the federal Clean Water Act (CWA) and Section 1-01(B) of the Vermont WQS, a point source is defined as follows (VTDEC, 2008):

> “Point source” means any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation or vessel, or floating craft, from which pollutants are or may be discharged.

Section 402 of the CWA requires all such point source discharges to be regulated under the NPDES permit program to control the type and quantity of pollutants discharged. NPDES is the national program for regulating point sources through issuance of permit limitations specifying monitoring, reporting, and other requirements under Sections 307, 318, 402, and 405 of the CWA.

Since 1974, the Vermont Agency of Natural Resources (ANR) has been the delegated authority to implement the NPDES program in Vermont (VTDEC, 2003). NPDES is a large part of the State's water pollution control strategy, which includes developing and enforcing permit limitations for municipal and industrial wastewater discharges, stormwater, sanitary sewer systems, and sewage pumpout facilities. Review of NPDES permits is conducted by VTDEC's Water Quality Division.

Bacteria point sources of pollution may be grouped as follows:

- NPDES Non-stormwater (i.e. WWTFs, CSOs, CAFOs)
- NPDES Stormwater (MS4, CGP, MSGP)

- Unauthorized Point Source Discharge of Untreated Wastewater (i.e. SSOs, Illicit Discharges, Boats)

Each of these point source categories is described below:

3.1.1 NPDES Non-Stormwater

This category includes all point sources permitted under the NPDES permit program other than those that convey only stormwater. NPDES non-stormwater discharges are typically wastewater treatment facilities (WWTFs), combined sewer overflows (CSOs), and concentrated animal feeding operations (CAFOs). Other discharges, such as those associated with non-contact cooling water for some industrial facilities are also included in this category, but typically do not have the discharge bacteria at levels comparable to WWTFs, CSOs, or CAFOs.

Wastewater Treatment Facilities (WWTFs)

The Direct Discharge Permit Section of Vermont's Wastewater Management Division administers the NPDES program for discharges from individual, municipal, and industrial WWTFs to state surface waters (VTDEC, 2010d). Potentially harmful bacteria may enter surface waters via wastewater discharges, such as from sewage created by institutions, hospitals and commercial and industrial establishments, and from household waste liquid from toilets, baths, showers, kitchens, and sinks. This wastewater, which contains a variety of organic and inorganic pollutants, is treated by WWTFs in order to remove harmful waste products and to render it environmentally acceptable.

Combined Sewer Overflows (CSOs)

Combined sewers are pipes that collect both stormwater and municipal wastewater or sewage. Stormwater may enter the combined sewer system through catch basins installed in streets to alleviate flooding when it rains. Combined sewers are different from separated sewers, which are pipes that collect and convey only wastewater from businesses and residences.

During dry weather, combined sewers convey only wastewater to the municipal WWTF where it is treated before being discharged to a water body, such as a river or a stream. When it rains heavily, however, large amounts of stormwater may enter the combined sewer and rapidly fill the pipes. If the capacity of the combined sewer or the WWTF is exceeded, the combined sewer overflows. The resulting wet weather discharges of untreated wastewater and stormwater are called combined sewer overflows (CSO). CSOs are a potential source of water pollution as they discharge a combination of untreated domestic sewage, industrial wastewater, and stormwater. Because of this, they may pose a risk to public health, stress the aquatic environment and/or impact water uses such as swimming, fishing or shellfishing. Like WWTF discharges, CSO discharges are regulated under the NPDES permit program for point sources. For more information, see Section 6.

Concentrated Animal Feeding Operations (CAFOs)

Concentrated Animal Feeding Operations (CAFOs) are generally defined as farms with 700 or more head of livestock confined for more than 45 days. Under the CWA [Section 502(14)] these operations are considered point sources. To be considered a CAFO, a facility must first be defined as an Animal Feeding Operation (AFO). AFOs generally congregate and feed animals, manage their manure, and have production operations on a small land area. Feed is brought to the animals rather than the animals grazing or feeding in pastures.

3.1.2 NPDES Stormwater

Stormwater runoff is water that does not soak into the ground during a rain storm, but instead flows over the surface of the ground until it reaches a waterbody. As the runoff moves, it picks up and carries away natural and anthropogenic pollutants, such as soil and manure, and eventually deposits them into surface waters. Stormwater runoff is one of the leading sources of impairment of our nation's waters and often contains high concentrations of various pollutants including bacteria. Urbanization and associated impervious surfaces have a significant impact on the hydrology within a watershed by increasing stormwater runoff volume to receiving surface waters (VTDEC, 2010a). Stormwater discharges in urbanized municipalities that are federally designated under the Stormwater Phase I or II programs are considered point sources under the CWA and require NPDES permits.

There are three NPDES general permits required by federal law. NPDES permits administered by VTDEC include (VTDEC, 2003):

- Construction General Permit (CGP);
- Multi-sector General Permit (MSGP); and
- Municipal Separate Storm Sewer System General Permit (MS4GP)

A Construction General Permit is required when construction activities disturb more than one acre of land. The Multi-sector General Permit is required for stormwater discharge associated with industrial activities. A MSGP discharge must be considered a point source which discharges directly to a water body and/or a municipal separate storm sewer system (VTDEC, 2006a).

Once permitted, each CGP or MSGP permittee is responsible for preparing and implementing a Stormwater Pollution Prevention Plan (SWPPP). A SWPPP includes site descriptions, descriptions of appropriate control measures, copies of approved State or local requirements, maintenance procedures, inspection procedures, and identification of non-stormwater discharges (VTDEC, 2010c).

Municipal Separate Storm Sewer Systems (MS4s) are regulated under the Stormwater Phase I (medium and large MS4s) and Phase II (small MS4s) programs and are defined as a conveyance or a system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) that are owned or operated by a city or town, or the State, district association, or other public body. Regulated MS4s must develop, implement, and enforce a Stormwater Management Program designed to reduce the discharge of pollutants from the MS4 to the maximum extent practicable, to protect water quality requirements of the Clean Water Act. Narrative effluent limitations requiring implementation of best management practices are generally the most appropriate form of effluent limitations when designed to satisfy technology requirements (including reduction of pollutants to the maximum extent practicable) and to protect water quality (VTDEC, 2010e).

USEPA may also designate additional currently unregulated sources of stormwater for permit coverage if they are significant contributors of pollutants to surface waters or if their discharges cause or contribute to water quality impairments.

3.1.3 Unauthorized Point Sources of Untreated Wastewater

This category includes all point source discharges that are not authorized (i.e., cannot be permitted) under the NPDES permit program or by the State because they will not meet water quality standards. Examples include the discharge of untreated wastewater from sources such as sanitary sewer overflows (SSOs) and illicit discharges to storm drains. Untreated discharges of sewage (i.e., wastewater) to waters of the state are prohibited. Since such point discharges will not meet water quality standards, they must be eliminated (or treated) once discovered. As discussed below, this category also includes discharges of sewage from boats which is prohibited by state law.

Sanitary Sewer Overflows (SSOs)

Sanitary sewer overflows (SSOs) are discharges of untreated wastewater from municipal sewer systems. SSOs can be caused by blocked or cracked sewer pipes, excess infiltration and inflow, an undersized sewer system (piping and/or pumps), or equipment failure. Such untreated wastewater can find its way to surface waters and cause bacteria violations.

Illicit Discharges (to Stormwater Systems)

Illicit discharges include any discharges to stormwater systems that are not entirely composed of stormwater (NEIWPCC, 2003). These include intentional or unknown illegal connections from commercial or residential buildings, and improper disposal of sewage from campers and boats. Examples of illicit discharges commonly seen in urban communities in Vermont include sanitary wastewater piping that is directly connected from a home to a storm drainage pipe or a cross-connection between the municipal sewers to the storm sewer systems. As a result of these illicit connections, contaminated wastewater can enter into storm drains and be conveyed to surface waters. These sources can contribute significantly to the load of bacteria in stormwater, particularly during periods of dry flow (MEDEP, 2009).

Boat Discharges

Boats have the potential to discharge pathogens in sewage from installed toilets and graywater (includes drainage from sinks, showers, and laundry). Sewage and graywater discharged from boats can contain pathogens (including bacteria, viruses, and protozoans), nutrients, and chemical products which can lead to water quality violations. Section SL.7 of the Vermont State-Specific Boating Safety Requirements requires boats equipped with a marine toilet to have a wastewater holding system to prevent the discharge of waste products into surrounding waters.

―No Discharge Areas" are designated bodies of water that prohibit the discharge of treated and untreated boat sewage. All surface waters in Vermont have been classified as ―No Discharge Areas" for wastewater and graywater (USEPA, 2010).

3.2 Non-Point Source Pollution

Non-point source (NPS) pollution comes from many diffuse sources and is more difficult to identify and control than point sources. NPS pollution can result from overland runoff (e.g. agricultural runoff, or stormwater runoff in unregulated suburban and rural areas), groundwater flow or direct deposition of pollutants to receiving waters. NPS are diffuse and are often associated with land-use practices. These sources carry pollutants to waters of the State. Municipal stormwater discharges located outside of federally designated urban areas are considered non-point source discharges and typically are not regulated under the NPDES program (unless they are covered by a NPDES general permit).

Examples of NPS that can contribute bacteria to surface waters via stormwater runoff, groundwater, and direct deposition include malfunctioning septic systems, agricultural activities, pet waste, wildlife, and contact recreation (swimming or wading). Each of these is described below.

Stormwater Runoff

As discussed above, stormwater can be categorized as both point and non-point source pollution. In Vermont, some smaller construction projects will require a State Stormwater Discharge Permit in order to comply with 10 V.S.A. 1264. The State Stormwater Discharge Permit Program addresses runoff from impervious surfaces (rooftops, paved and non-paved parking/roads, etc.) and may be required based on thresholds of impervious surfaces in an area (VTDEC, 2006b).

Malfunctioning Septic Systems

Untreated discharges of sewage (i.e. wastewater) are prohibited regardless of point or non-point source origin. An example of a NPS discharge of untreated wastewater is bacteria from a malfunctioning septic system. When properly installed, operated, and maintained, septic systems effectively reduce bacteria concentrations in sewage. However, age, overloading, or poor maintenance can result in septic system failure and the release of bacteria and other pollutants into surface waters (USEPA, 2006). Bacteria from malfunctioning septic systems can enter surface waters through groundwater or stormwater runoff.

Agriculture

Agricultural activities include dairy farming, raising livestock and poultry, growing crops and keeping horses and other animals for pleasure or profit. Activities and facilities associated with agricultural land use can be sources of bacteria impairment to surface waters. Direct deposition of fecal matter from farm animals standing or swimming in surface waters and the runoff of farm animal waste from land surfaces is considered the primary mechanism for agricultural bacteria pollution in surface waters. Most agricultural discharges are considered to be NPS. However, certain agricultural activities are regulated under the NPDES permit program as point sources.

Agricultural activities and facilities with the potential to contribute to bacteria impairment include:

- Manure storage and application;
- Livestock grazing;
- Animal feeding operations and barnyards; and
- Paddock and exercise areas for horses and other animals.

Pets

In residential areas, fecal matter from pets can be a significant contributor of bacteria to surface waters. For example, each dog is estimated to produce 200 grams of feces per day and pet feces can contain up to 23,000,000 fecal coliform colonies per gram (CWP, 1999). If pet feces is not properly disposed, these bacteria can be washed off the land and transported to surface waters by stormwater runoff. Pet feces can also enter surface waters by direct deposition of fecal matter from pets standing or swimming in surface water.

Wildlife

Fecal matter from wildlife may be a significant source of bacteria in some watersheds. Several studies have documented the existence of bacteria in waterbodies in “pristine” environments, even under non-storm conditions. This is particularly true when human activities, including the feeding of wildlife and habitat modification, result in the congregation of wildlife (CWP, 1999). Concentrations of geese, gulls, and ducks are of particular concern because they often deposit their fecal matter directly into surface waters. Wildlife fecal matter deposited on land can also be washed off and transported to surface waters by stormwater runoff. Recent local studies indicate that under moderate rainfall, *E. coli* will be found in waters running off of completely undisturbed, forested watersheds at levels in excess of 77 *E. coli* /100ml, the current water quality criterion for Class B waters in Vermont (VTDEC).

Contact Recreation (Swimming or Wading)

Bacteria from people swimming or wading in surface waters can contribute to bacteria loads via direct deposition. When people enter the water, residual fecal matter may be washed from the body and contaminate the water with pathogens. In addition, small children with diapers may contribute to bacterial contamination of surface waters.

Stream Bottom Sediments

Studies have shown that stream bottom sediments can harbor large numbers of *E. coli.* During rainfall events, these bottom sediments are resuspended, resulting in high *E. coli* concentrations in the water. *E. coli* can survive much longer in underwater sediments than in the water column itself, and can overwinter in the sediment, particularly in fine sediment particles (Garzio-Hadzick, 2010; Perry, 2011).

4. Bacteria-Impaired Waters

This section provides a description of the 303(d) listing process, an outline of the data monitoring programs for bacteria in Vermont, and a discussion on the benefits of using a watershed-based approach to develop a TMDL. Information specific to Vermont's 2010 303(d) List is provided at the end of this section.

4.1 The 303 (d) Listing Process

In accordance with sections 305(b) and 303(d) of the Federal Clean Water Act (CWA), every two years Vermont must report to EPA on the quality of its water resources (Section 305(b)) and provide a list of waters which have designated uses that are "impaired" (Section 303(d)). In Vermont, development of the 303(d) List of Impaired Waters runs concurrently with the development of the Section 305(b) Integrated Report. Vermont's 303(d) List of Impaired Waters is finalized with EPA approval and made available separately from the 305(b) Report. VTDEC also makes available separately a List of Priority Waters that includes waters not on the 303(d) List. The 305(b) report, in combination with Vermont's 303(d) List and List of Priority Waters are considered Vermont's complete Integrated Water Quality Report. Vermont's 2010 Integrated Report can be found online at:
http://www.anr.state.vt.us/dec/waterq/mapp/docs/305b/mp_305b-2010.pdf.

The *“Vermont Surface Water Assessment Methodology”* (VTDEC, 2005) documents the decision-making process for assessing and reporting on the quality of the State's surface waters. The methodology document describes a dynamic process that reflects the evolving and ever-improving methods available for water quality monitoring and interpretation. The process provides the basis for a majority of water pollution abatement actions undertaken in Vermont (VTDEC, 2005).

4.1.1 Categorizing Vermont's Surface Waters

To facilitate tracking and assessing surface water quality, all rivers, streams, lakes and ponds in Vermont have been designated into “waterbodies” which serve as the cataloging units for statewide assessment. The Vermont WQS provide the basis used by VTDEC in determining the condition of surface waters including whether the water meets (attains) or does not meet (exceeds or violates) certain criteria. The assessment of a waterbody's condition within the context of the WQS requires consideration of the water's classification and management type, designated or existing uses, and numerical and narrative water quality criteria. The outcome of an assessment conducted by VTDEC is to categorize Vermont's surface waters as either “full support,” “stressed,” “altered,” or “impaired” (VTDEC, 2005). The altered category does not apply for bacteria, so there are three applicable use support categories and each is described below. The components and organization of Vermont's assessment and listing methodology is shown in Figure 4-1.

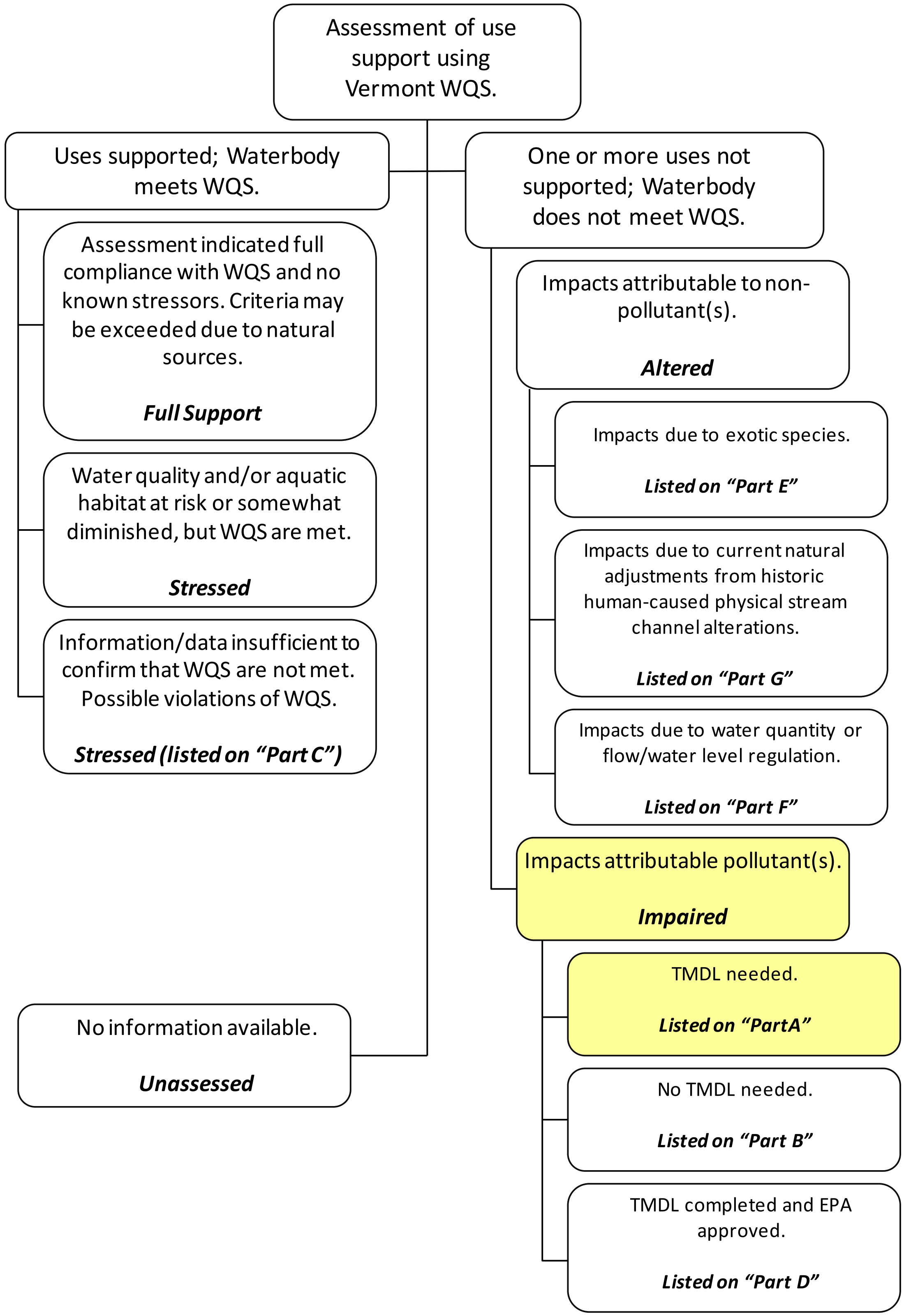


Figure 4-1: Chart Depicting Organization of Vermont's Water Quality Assessment and Listing Methodology (VTDEC, 2005a).

1. ***Full Support Waters:*** This assessment category includes waters of high quality that meet all use support standards for the water's classification and water management type.
2. ***Stressed Waters:*** These are waters that support the uses for the classification but the water quality and/or aquatic biota/ habitat have been disturbed to some degree by point or by nonpoint sources of human origin and the water may require some attention to maintain or restore its high quality; the water quality and/or aquatic habitat may be at risk of not supporting uses in the future; or the integrity of the aquatic community has been changed but not to the degree that the standards are not met or uses not supported. Data or other information that is available confirms water quality or habitat disturbance but not to the degree that any designated or existing uses have become altered or impaired (i.e. not supported). Some stressed waters have documented disturbances or impacts and the water needs further assessment.
3. ***Impaired Waters:*** These are surface waters where there are chemical, physical and/or biological data collected from quality assured and reliable monitoring efforts that reveal 1) an ongoing violation of one or more of the criteria in the WQS and 2) a pollutant of human origin is the most probable cause of the violation.

Waters for which DEC has no monitoring data and only limited information and knowledge is available are considered “unassessed”.

Following the assessment process, waters are categorized and placed onto one or more listings for tracking purposes. The listing of waters is undertaken for Section 303d of the Federal CWA. Outside the scope of the Act's requirements, VTDEC maintains several other lists for tracking and management purposes. The sum of listings maintained by VTDEC is collectively known as the Vermont Priority Waters List (VTDEC, 2005).

All waters determined to be impaired are placed on one of the following listings: Part A-303(d) List (impaired waters scheduled for TMDL development), Part B (impaired waters for which TMDLs are not required), and Part D (impaired waters for which TMDLs have been completed). All impaired waterbodies addressed in this report are included in Part A-303d List (VTDEC, 2005).

Waters determined to be altered are placed on one of following lists: Part E List (water altered by exotic species), Part F (waters altered by flow regulation), and Part G (waters altered due to physical channel changes). A subset of waters assessed as “stressed” are listed on the Part C List (waters in need of further assessment).

4.1.3 Priority Ranking and TMDL Schedules

Section 303(d) of the Clean Water Act requires that waters on the 303(d) list be ranked in order of TMDL development priority. A TMDL schedule date shown on the 303(d) list indicates when the TMDL is expected to be completed. In Vermont, priority ranking for TMDL development is done with consideration of many factors. These include but are not limited to: (1) health issues, (2) the nature, extent, and severity of the pollutant(s), (3) the use or uses that are impaired, (4) the availability of resources and methods to develop a TMDL, (5) the degree of public interest, and (6) the utility of TMDL development to the elimination of the impairment (VTDEC, 2005).

According to Vermont's 2010 303(d) list, development of TMDLs for bacteria-impaired waters has been given high priority. Given the number of bacteria-impaired waters scheduled for TMDL development, addressing TMDL development with a Statewide TMDL report is the most appropriate and efficient use of resources, makes the TMDL process more efficient, allows the implementation and restoration process to begin sooner.

4.2 Water Quality Monitoring Programs for Bacteria

Section 106(e)(1) of the CWA, requires States to develop a comprehensive monitoring and assessment strategy that provides a description of the sampling approach, a list of parameters to be tested, and a schedule for collecting data and information. VTDEC accomplished this by preparing the Vermont Water Quality Monitoring Program Strategy 2011-2020 (VTDEC, 2011). The monitoring framework reflects the partnerships and collaborations that occur among state, local and federal agencies, universities, other organizations and volunteers regarding monitoring activities. When fully implemented, the strategy will yield data to support a statewide assessment of water quality conditions, allow measurements of key environmental indicators and provide important information to support management decision-making at both the state and local level. Vermont's Monitoring, Assessment and Planning Program (MAPP) coordinates the State's water quality monitoring programs using the following approaches (VTDEC, 2005; VTDEC 2011):

- ***Vermont's 17 Basin Rotational Assessment Approach*** – The VTDEC Water Quality Division (WQD) has designed a rotational watershed assessment process such that lakes and rivers or all 17 major drainage basins in the state are evaluated once every five years. By focusing evaluations on selected watersheds each year, more systematic and intensive efforts can be made to evaluate status and trends.
- ***Fixed Station Monitoring*** – The VTDEC WQD coordinates a large number of fixed-station monitoring projects, incorporating river, stream and lake water quality projects. Projects considered ―fixed station" in Vermont are long-term, recurring projects which the VTDEC has operated (or intends to operate) for several years. There are over 2,000 established fixed stations in Vermont's streams and lakes.
- ***Special and TMDL Studies*** – VTDEC undertakes special and TMDL studies as needed, when additional information is necessary to make informed impairment decisions. These studies are scheduled as needed consistent with the timeline established in Vermont's impaired waters 303(d) List, and depending on available resources.

In practice, most bacteria data collected in Vermont is obtained at swimming areas. These swimming areas are situated at formal beaches on lakes and ponds and at known swimming holes along rivers and streams throughout the state. Some of the programs include the collection of bacteria data from Vermont's surface waters are summarized below (VTDEC, 2011):

Agency Monitoring Partnerships

- ***US Army Corps of Engineers Reservoir Monitoring Program*** – The US Army Corps of Engineers (ACOE) manages several flood control reservoirs in Vermont. These reservoirs are monitored routinely for flow and stage, and periodically for a variety of physico-chemical constituents. ACOE reservoirs with designated swimming beaches are also monitored for *E. coli* regularly during the swimming season. ACOE reports on its monitoring activities annually, and shares these reports with VTDEC's WQD.

- ***US Geological Survey Monitoring Programs*** - The United States Geological Survey (USGS) operates a network of gauging stations on Vermont waters, which are supported by a cooperative agreement with VTDEC. This gauging network provides water flow data that are critical for numerous applications and programs, both within and outside of VTDEC. USGS also coordinates several water quality studies throughout Vermont and regionally in a variety of disciplines, and the results and data are commonly shared with VTDEC for numerous uses.

- ***Vermont Department of Forests, Parks, and Recreation Comprehensive Beach Monitoring Program*** - The Vermont Department of Forests, Parks, and Recreation operates a comprehensive beach monitoring program for all of its public use beaches on State Park lands. Twenty-nine beaches are monitored on a weekly basis following established protocols. Swim advisories are posted based on results of the testing, when *E. coli* sample values exceed the Vermont standard for Class B waters. These data are openly shared with VTDEC. They are used for assessments as well as for identifying beaches subject to chronic, controllable bacterial contamination.

- ***Vermont Department of Health Beach Sampling Program*** - The Vermont Department of Health (VTDOH) operates a program whereby appointed Town Health Officers are trained to collect water quality samples at designated beaches. This program is suitable for small municipalities with informally-used swim beaches. Data reported back to Town Health Officers from the VTDOH laboratory take the form ―safe for swimming," or ―violates Vermont's standard: unsafe for swimming.". Town Health Officers commonly use these data to post warnings at swim beaches. Owing to resource constraints, samples collected in conjunction with this program cannot follow the strict QA procedures required by VTDEC and the Department of Forests, Parks and Recreation in their *E. coli* monitoring projects. As such, this program provides useful and preliminary screening information to determine where swim beach water quality may need further assessment.

- ***Vermont Monitoring Cooperative Program*** - The Vermont Monitoring Cooperative (VMC) is a collaborative organization in which scientists collect and pool information and data for the purpose of improving our understanding, protection, and management of Vermont's forested ecosystems. Participating cooperators from government, academic and private sectors conduct research projects on a variety of topics including aquatic systems, forest health, air quality and meteorology, and wildlife. The VMC helps make the data and results from these projects available to other scientists, educators, resource managers and the general public. The VMC was initiated in 1990 as a state, university, and federal partnership, with a one-hundred year envisioned lifespan. The centerpiece of the VMC is the data library and card catalogue system that allow data to be shared, archived, and accessed by scientists and other interested parties via the VMC website. The data archive contains data and ancillary textual material from over 100 projects, and is geographically referenced. *Online*: http://sal.snr.uvm.edu/vmc/
- ***Town Monitoring Programs*** – The City of Burlington and Town of Colchester collectively monitor several heavily-used swimming beaches, by measuring *E. coli* on a regular basis. These data are made public in near real-time via the ―Burlington Eco-Info" website. *Online:* www.burlingtonecoinfo.net.

Volunteer Monitoring Programs

Watershed and lake associations are active on numerous rivers and lakes in Vermont. Citizen groups are becoming increasingly involved in monitoring, education, protection, and restoration projects in the State. The VTDEC provides assistance and training to volunteers through guides such as the ―Citizens Guide to Bacteria Monitoring in Freshwater" and the ―Vermont Volunteer Surface Water Monitoring Guide." These guides help to ensure standardization of sample collection procedures. VTDEC WQD keeps an updated list of watershed, river, and lake groups, many of whom contribute *E.coli* data to VTDEC (*Online*: http://www.anr.state.vt.us/cleanandclear/orgs/index.cfm). The majority of VTDECs bacteria monitoring data is provided by volunteer groups.

Volunteer groups in Vermont include the following:

Addison County Collaborative
Calais Conservation Commission
Essex Waterways Association
Franklin Watershed Association
Friends of the Mad River
Friends of the Winooski River
Great Hosmer Pond
Green Mountain College
Huntington Conservation Commission
Lake Groton Association
Lake Rescue Association
LaPlatte River Watershed Partnership
Memphremagog Watershed Association
Missisquoi River Basin Association
Northwoods Stewardship Center
Norwich Conservation Commission
Ompomanoosuc Watershed Council
Ottaqueechee Watershed Partnership
Poultney-Mettawee Partnership
Rock River – Friends of Mississquoi Bay

Seymour Lake Association
St. Albans Bay Association
Stevens River Watershed Council
Thorp Brook Association
Upper Otter Creek Watershed Association
UVM Sea Grant
West River Watershed Association
Westmore Association
White River Partnership
Williston Conservation Commission
Winooski Headwaters Association
Winooksi Mid-Watershed Association

In 2003, the WQD and the LaRosa Environmental Laboratory launched a new initiative to foster volunteer monitoring by providing laboratory analytical services at no cost to volunteer organizations under a competitive grant program. This program provides an opportunity to significantly enhance the monitoring of waters of joint importance to volunteer organizations and WQD. More information on this program is provided in Section 7 of this report (VTDEC, 2005).

Examples of Other Monitoring Efforts

- ***Lamoille Water Quality Monitoring and Exchange Program*** – Beginning in 2008, the Lamoille Water Quality Monitoring and Exchange Program has sampled for phosphorus, *E.coli*, and macroinvertebrates on tributaries in the Lamoille Watershed. This program involves collaboration with students from Johnson State College, St. Michael's, Sterling College, and University of Vermont and local middle and high schools. Schools participating in the project create Lamoille Watershed Resource Pages to describe their field work, follow up research, and results from their observations (VTDEC, 2010). Online at: http://www.lcnrcd.com/Watershed_MonitorAndExchangeProj.html.
- ***The Lake Champlain Agricultural Best Management Practices Monitoring Project*** – Completed in 2001, the Lake Champlain Agricultural Best Management Practices Monitoring Program was a seven-year special water quality monitoring project funded by USEPA. This comparative observational study used a three-way paired watershed experimental design using a single control and two treatment watersheds. The goal was to evaluate the efficacy of both low- and high-intensity whole-watershed BMP implementation strategies. Parameters measured included total phosphorus, total and Kjeldahl nitrogen, total suspended solids, and *E.coli*. Biological assessments of fish and macroinvertebrate communities were also performed on each of the three watersheds (VTDEC, 2011).

Data Quality Requirements

In order to be used for assessment purposes, submitted data must be of known quality and should be representative of the water's condition. All data generated by VTDEC in conjunction with WQD monitoring programs are subject to quality assurance planning using USEPA quality assurance guidance. Moreover, any and all data generated in part or whole using funding from USEPA must be subject to a USEPA-approved quality assurance project plan (QAPP). All data generated in conjunction with any active QAPP are considered readily available and reliable data and are considered in determining use support. Data can be rejected from consideration in the event that it does not meet data quality objectives established by individual QAPPs (VTDEC, 2011).

For data provided by organizations other than VTDEC such as universities and volunteer-based efforts, data quality must be assured prior to considering it in the determination of use support. The number of samples, the length of the sampling period, the weather conditions, degree of compliance or violation and other factors are all considered when evaluating data from other organizations. Where data of unknown or unquantifiable quality are at odds with companion data of quantified quality, the higher quality data will be accorded higher weight in determining use support. Where data of unknown or suspect quality are the only information available, the waterbody is scheduled for additional monitoring prior to determining use support (VTDEC, 2011).

4.4 Vermont's 2010 303(d) list

This *Statewide Bacteria Total Maximum Daily Load (TMDL)* report provides TMDL documentation for 22 bacteria-impaired waters on Vermont's 2010 303(d) List (Table 4-1). Figure 8-1 (Section 8) shows the Vermont bacteria impaired waterbody locations with the Vermont Planning Basins indicated. Note that the 2010 303(d) List and Figure 8-1 identify nine segments considered impaired due to CSOs or intermittent untreated discharges from WWTFs. These impairments are not covered by this TMDL and will continue to be managed, as they currently are, under the Vermont CSO Policy.

Appendices include summaries of available bacteria data and GIS-based maps showing sampling locations and surrounding watershed areas. These appendices also provide a summary of the impaired watershed and known pollutant sources, based on review of available literature. For three watersheds, the Huntington River, the West River, and the Ompompanooosuc River (Appendices, 13, 15 and 18, respectively), more detailed watershed reports are provided. The watershed summaries are intended to guide the process of further assessment and ultimate mitigation or elimination of bacteria sources in impaired river segments.

Table 4-1: List of Bacteria-Impaired Waterbodies Included in this Statewide TMDL Report.

Waterbody ID	Name	Pollutant	Impaired Use	Problem
VT02-05	FLOWER BROOK, MOUTH TO RM 0.5	*E. COLI*	CR	ELEVATED E. COLI MONITORING RESULTS
VT03-01	OTTER CREEK, MOUTH OF MIDDLEBURY RIVER TO PULP MILL BRIDGE (4.0 MI)	*E. COLI*	CR	AGRICULTURAL RUNOFF, POSSIBLE FAILED SEPTIC SYSTEMS
VT03-07	LITTLE OTTER CREEK, MOUTH TO RM 7.8	*E. COLI*	CR	ELEVATED E. COLI MONITORING RESULTS
VT03-07	LITTLE OTTER CREEK, RM 15.4 TO RM 16.4	*E. COLI,* UNDEFINED	ALS	AGRICULTURAL RUNOFF
VT03-08	LEWIS CREEK, FROM LOWER COV'D BRIDGE UPSTRM TO FOOTBRIDGE (12.3 MI)	*E. COLI*	CR	AGRICULTURAL RUNOFF
VT03-08	POND BROOK, FROM LEWIS CREEK CONFLUENCE UPSTREAM (1.5 MILES)	*E. COLI*	CR	AGRICULTURAL RUNOFF
VT03-12	MIDDLEBURY RIVER, FROM MOUTH UPSTREAM 2 MILES	*E. COLI*	CR	AGRICULTURAL RUNOFF, LIVESTOCK, POSSIBLE FAILED SEPTIC SYSTEMS
VT05-09	DIRECT SMALLER DRAINAGES TO INNER MALLETTS BAY	*E. COLI*	CR	URBAN RUNOFF, FAILED/FAILING SEPTIC SYSTEMS; INCLUDES SMITH HOLLOW BROOK & CROOKED CREEK
VT05-10	ENGLESBY BROOK	*E. COLI*	CR	ELEVATED E. COLI LEVELS
VT05-11	LAPLATTE RIVER FROM HINESBURG TO MOUTH (10.5 MILES)	*E. COLI*	CR	AGRICULTURAL RUNOFF
VT05-11	MUD HOLLOW BROOK, FROM MOUTH TO 3 MILES UPSTREAM	*E. COLI*	CR	AGRICULTURAL RUNOFF, STREAMBANK EROSION
VT05-11	POTASH BROOK	*E. COLI*	CR	ELEVATED E. COLI LEVELS
VT06-04	BERRY BK, MOUTH UP TO AND INCLUDING NO. TRIB (APPROX. 1 MI)	SEDIMENT, NUTRIENTS, *E. COLI*	ALS, CR	AGRICULTURAL RUNOFF, AQUATIC HABITAT IMPACTS
VT06-04	GODIN BROOK	SEDIMENT, NUTRIENTS, *E. COLI*	ALS, CR	AGRICULTURAL RUNOFF, AQUATIC HABITAT IMPACTS
VT06-04	SAMSONVILLE BROOK	SEDIMENT, NUTRIENTS, *E. COLI*	ALS, CR	AGRICULTURAL RUNOFF, AQUATIC HABITAT IMPACTS
VT08-02	ALLEN BROOK	*E. COLI*	CR	ELEVATED E. COLI LEVELS
VT08-10	HUNTINGTON RIVER, VICINITY OF BRIDGE STREET IN HUNTINGTON	*E. COLI*	CR	ELEVATED E. COLI LEVELS DETECTED AT SEVERAL SAMPLING STATIONS
VT08-18	MAD RIVER, MOUTH TO MORETOWN (6.2 MILES)	*E. COLI*	CR	POSIBLE FAILING SEPTIC SYSTEMS AND OTHER UNKNOWN SOURCES; ELEVATED E. COLI LEVELS
VT11-17	WEST RIVER, APPROX 1 MILE BELOW TO 0.5 MILE ABOVE SOUTH LONDONDERRY	*E. COLI*	CR	POSSIBLE SEPTIC SYSTEM DISCHARGES
VT12-05	NO. BRANCH, DEERFIELD RIVER, VICINITY OF WEST DOVER	*E. COLI*	CR	HIGH E.COLI LEVELS; CAUSE(S) & SOURCE(S) UNKNOWN; NEEDS ASSESSMENT
VT13-14	WHETSTONE BROOK - BRATTLEBORO	*E. COLI*	CR	SOURCES UNKNOWN, POTENTIALLY FAULTY SEWER LINE/SEPTIC SYSTEM
VT14-03	OMPOMPANOOSUC RIVER, USACOE BEACH AREA TO BRIMSTONE CORNER	*E. COLI*	CR	ELEVATED E. COLI LEVELS

Notes:
CR= Contact Recreation, ALS= Aquatic Life Support, AES= Aesthetics

5. TMDL Development

This section provides a description of a total maximum daily load (TMDL) allocation process and the components of the TMDL calculation. The method applied to determine TMDL allocations for bacteria in Vermont is described along with specific allocations for each type of waterbody in the state. Lastly, this section provides descriptions of required components of the TMDL allocation process, such as a margin of safety factor, seasonal considerations, and public participation.

5.1 Definition of a TMDL

A TMDL identifies the pollutant loading a waterbody can assimilate without violating water quality criteria or designated uses (40 CFR Part 130.2). A TMDL is the loading capacity of a waterbody including a margin of safety (MOS) to account for uncertainty in target-setting. The TMDL allocates pollutant loads among permitted point source discharges, under Section 402 of the Clean Water Act National Pollutant Discharge Elimination System (NPDES), and nonpoint source (NPS) discharges.

In equation form, a TMDL is expressed as follows:

$$\text{TMDL} = \text{WLA} + \text{LA} - \text{MOS}$$

where:

WLA	=	Waste Load Allocation (i.e. loadings from point sources)
LA	=	Load Allocation (i.e., loadings from non-point sources including natural background)
MOS	=	Margin of Safety

TMDLs can be expressed in terms of mass per time (i.e. daily load), concentration, or other appropriate measure (40 CFR Part 103.2 (i)). The MOS can be either implicit or explicit. If the MOS is implicit, a specific value is not assigned to the MOS. Use of an implicit MOS is appropriate when assumptions used to develop the TMDL are believed to be so conservative that they are sufficient to account for the MOS. If an explicit MOS is used, a portion of the total allowable loading is actually allocated to the MOS.

5.2 TMDL Allocations

Vermont bacteria TMDLs are expressed as concentrations, and the loading capacities and allocations are set equal to state's water quality criteria for bacteria. The Vermont water quality criteria are expressed as single sample maximum and statistical metrics, based on sets of bacteria concentration measurements. (Each of these statistical metrics is defined in Section 2.2.) This bacteria TMDL is expressed in terms of concentration for the purposes of implementation because:

- Expressing bacteria TMDL loading capacities in terms of concentration provides a direct link between existing water quality and numeric water quality criteria;
- Using concentration to set TMDL loading capacities is more relevant and consistent with water quality standards, which apply for a range of flow and environmental conditions;
- Expressing bacteria TMDL loading capacities as daily loads (e.g., as millions of organisms per day) can be more confusing to the public and can be difficult to interpret since they are dependent on flow conditions.

Concentration-based bacteria TMDLs set the WLA and LA equal to the ambient water quality criterion with no allowance for bacteria die-off. Consequently, the Vermont bacteria TMDLs represent very conservative TMDL target-setting, so there is a high level of confidence that the TMDLs established are consistent with water quality standards, and the entire loading capacity can be allocated among sources. Therefore, the MOS is implicit, and the explicit MOS shown in the general TMDL formula in Section 5.1 above is set equal to zero.

Table 5-1 below shows the specific WLAs and LAs for each of Vermont's two classes of surface waters and by potential bacteria source, based on current water quality standards for drinking water and primary/secondary contact recreation.

The numeric value of the WLA and LA depend on whether the source of bacteria is prohibited or allowable, and on the appropriate water quality criterion for the receiving water, as follows:

- If the source of the bacteria load is prohibited, then the WLA and LA are set to zero. For example, discharges of wastewater to Class A waters and discharges of untreated wastewater to any surface water from sources such as illicit discharges to stormwater systems, sanitary sewer overflows, boats, and failed septic systems are prohibited and would receive bacteria load allocations of zero.
- If the source of the bacteria load is allowable, the WLA or LA is set equal to the applicable water quality criterion for bacteria in the receiving water.

The underlying assumption in setting a concentration-based TMDL for bacteria is that if all sources are less than or equal to the water quality criterion, then the concentration of bacteria within the receiving water will attain water quality standards. This methodology implies a goal of meeting bacteria standards at the point of discharge for all sources. Although end-of-pipe bacteria measurements can identify and help prioritize sources that require attention, compliance with this TMDL will be based on ambient water quality and not water quality at the point of discharge.

The estimated percent reduction needed to achieve the TMDLs for each impaired segment is provided in Table 8-2 and the appendices. The estimated percent reduction needed is calculated based on the difference between measured bacteria data and the water quality criteria for bacteria. Section 8 provides additional information on the percent reduction calculations. The reductions necessary to achieve the TMDLs are based on estimates of current loadings. Future development activities and land use changes have the potential to increase levels of bacteria or stormwater runoff associated with bacterial pollutants. These future activities will need to meet the TMDLs and be addressed in applicable watershed management plans and by state or local requirements.

5.3 Margin of Safety

The MOS accounts for assumptions or lack of knowledge about linking loading allocations with water quality impairment and can be either explicit or implicit. Setting an explicit margin of safety for concentration-based TMDLs was not considered necessary because there is a sufficient margin of safety *implicit* in the methodology used to establish the TMDL. For example, setting all sources less than or

equal to the bacteria criteria is conservative because it does not account for mixing or dilution in the receiving water. In addition, the methodology assumes no losses of bacteria due to settling or die-off, which are known to take place in surface waters.

5.4 Seasonal Considerations

Vermont's bacteria water quality criteria are applicable at all times. Since the TMDLs are set equal to the bacteria criteria, they are also applicable at all times and are therefore protective of water quality under all conditions and seasons.

5.5 Public Participation

EPA regulations require that calculations to establish TMDLs be subject to public review (40 CFR 130.7 (c) (ii)). Following the presentation and publication of a draft of the Vermont Statewide TMDL for Bacteria Impaired Waters, the public will have a 30-day period for reviewing and submitting comments on this study and its findings.

A public comment period was established for the Draft Vermont Statewide Bacteria TMDL starting on May 31, 2011 and comments were received through June 24, 2011. In addition to newspaper notices, web postings and, direct notification of many water quality stakeholders across the state, informational meetings were also held. Three meetings occurred (Richmond, Thetford and South Londonderry) whereby the TMDL was presented and attendees were provided a chance to discuss aspects of the TMDL.

At of the close of the comment period on June 24, 2011, comments were received from eight parties. A response to comment summary has been developed under separate cover.

Table 5-1: WLAs and LAs for Vermont Surface Waters.

Class	Bacteria Source	Single Sample E.coli		Geometric Mean	
		WLA[1]	LA[1]	WLA[1]	LA[1]
B *All Water Management Zones*	NPDES Non-Stormwater[2]	77		NA	
	NPDES Stormwater[3]	77*		NA	
	Non-NPDES Stormwater and/or Groundwater[4]		77*		NA
	Discharges of Untreated Wastewater[5]	0	0	NA	NA
	Direct Deposition to Surface Waters[6]		77*		NA
A *Ecological Waters & Public Water supply*	NPDES Non-Stormwater[2]	0		0	
	NPDES Stormwater[3]	33*		18*	
	Non-NPDES Stormwater and/or Groundwater[4]		33*		18*
	Discharges of Untreated Wastewater[5]	0	0	0	0
	Direct Deposition to Surface Waters[6]		33*		18*

* or ―as naturally occurs" if only source is wildlife[7] NA = not applicable

[1]Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations.

[2]NPDES Non-Stormwater includes all point source discharges regulated under the NPDES permit program, such as municipal and wastewater treatment facilities (WWTFs). Point sources covered under the NPDES stormwater permit program are excluded. An example is municipal and industrial wastewater treatment facilities (WWTFs).

[3]NPDES Stormwater includes all stormwater regulated under the NPDES stormwater permit program, such as stormwater under the Municipal Separate Storm Sewer systems (MS$) General Permit, the Construction General Permit (CGP), and the Multi-Sector General Permit (MSGP).

[4]Non-NPDES Stormwater and/or Groundwater includes all stormwater not regulated under the NPDES stormwater program and all groundwater discharges to surface waters.

[5]Discharges of untreated wastewater are prohibited. Examples of point source (WLA) discharges of untreated wastewater include sanitary sewer overflows, illicit connections to storm drains, and discharges of sewage from boats. An example of a non-point source discharge of untreated wastewater is bacteria from a failed septic system that is conveyed to surface water by groundwater or Non-NPDES stormwater.

[6]Direct deposition of bacteria into surface waters includes bacteria from humans contacting surface water by swimming or wading (i.e., bathing load) and from animals and birds located in or flying over the surface water.

[7] ―As naturally occurs" means all prevailing dynamic environmental conditions in a waterbody other than those human-made or human-induced.

5.6 Monitoring Plans

Pending the availability of resources, the long term monitoring plan for Vermont’s bacteria impaired waters includes several components:

1. Continue the monitoring of rivers and lakes through the Lake and River Assessment Programs using the Rotational Basin Approach.
2. Continue monitoring partnerships with the United States Army Corps of Engineers (USACE), the United States Geologic Survey (USGS), the Vermont Department of Forests, Parks, and Recreation, and Vermont municipalities.
3. Continue beach monitoring programs through the USACE and the Vermont Department of Health.
4. Continue to utilize data from volunteer monitoring organizations.
5. Continue to develop source tracking efforts through programs such as the Mettowee Water Quality Monitoring Program – Microbial Source Tracking (MST) Project to identify specific bacteria sources.
6. Continue to investigate complaints and inspect potential sources of bacteria;
7. Continue to support the implementation efforts of stakeholders at the local level, with the goal of meeting water quality standards; and
8. Continue to assess and develop strategies for planning and coordination among all organizations that collect water data in Vermont according to the Ambient Water Quality Monitoring Program Strategy 2005-2010 (VTDEC, 2005).

5.7 Reasonable Assurance

EPA guidance requires that in waters –impaired by both point and non-point sources, where a point source is given a less stringent wasteload allocation based on an assumption that non-point source load reductions will occur, reasonable assurance must be provided for the TMDL to be approvable” (USEPA, 2001). This TMDL does not include less stringent WLAs for point sources based on anticipation of LA reductions from non-point sources, and therefore, a reasonable assurance demonstration is not required.

Through its tactical basin planning process, VTDEC has a strategy to take the first concrete steps in identifying bacterial sources and developing remediation strategies in the impaired waterbodies. In some cases, successful reduction in non-point sources will be facilitated by motivated stakeholders, and the availability of federal, state, and local funds. Information regarding state and federal programs to address stormwater, septic systems, pet waste, and other sources of bacteria pollution are included in Section 6 - Implementation Plan below. Source of state and federal funding sources to assist with best management practice (BMP) implementation and other water quality protection projects are listed in Section 7.

6. Implementation Plans

The Vermont Bacteria TMDL allocations quantify the concentrations of bacteria required to achieve water quality standards, and provide general information on how the bacteria reductions might be achieved. Each bacteria contamination represents a unique problem that results from the interaction between watershed conditions and source activity. Substantial time, financial commitment and community drive will be required to attain the goals and load allocations in this TMDL.

This implementation plan section provides general guidance for developing more detailed, site-specific implementation plans to address water pollution caused by potentially harmful bacteria in Vermont's surface waters.

A watershed-based approach is recommended for mitigating bacteria impairment, and Vermont's Tactical Basin Planning Process, described below, in Section 6.1 is well-suited to provide local stakeholders with the technical guidance needed to improve water quality and restore uses of local waters. Development and implementation of detailed watershed-based plans for restoration may be eligible for federal funding under the **Section 319** grant program.

Implementation planning and subsequent watershed restoration activities may be conducted by municipalities, conservation districts, watershed groups, and private citizens responsible for, or interested in, mitigating bacterial pollution to surface waters. Municipal personnel include department of public works, water and sewer commission, conservation commissions, boards of health, and harbormasters. Stakeholder participation in site-specific plan development and follow-through is critical to the success of restoration efforts and attainment of water quality standards.

Section 6.1 provides a description of Vermont's plan to implement bacteria TMDLs through tactical basin planning that integrates targeted monitoring and assessment data with project identification, development and implementation. Section 6.2 provides examples of watershed management plans in New England and implementation resources.

Sections 6.3 through 6.10 contain information on implementation measures for various types of bacteria sources. These sources include developed area stormwater, septic systems, agricultural activities, illicit discharges, combined sewer overflows, pets, wildlife, boats, and marinas. Under each type of source, a brief description of applicable regulations, examples of implementation measures, and useful web links to information resources is provided.

6.1 The Implementation and Restoration Process & Vermont's Tactical Basin Planning Process

Using a watershed approach is an effective way to manage water resource quality within specified drainage areas or watersheds and offers a promising approach to protect and restore Vermont's water resources. The watershed approach includes stakeholder involvement through a series of cooperative, iterative steps to:

- Characterize existing conditions;
- Identify and prioritize problems;
- Define management objectives;
- Develop protection or remediation strategies; and
- Implement and adapt selected actions as necessary.

Appendices 13, 15 and 18 *of this report contain summaries of* ***watershed reconnaissance surveys*** *that were conducted for three bacteria-impaired waterbodies: the West River, the Huntington River, and the Ompompanooosuc River. These summaries are intended to demonstrate an initial step in the process of identifying and prioritizing sites for bacteria mitigation as part of an overall watershed restoration process.*

The outcomes of this process are normally documented in a type of implementation plan called a watershed management plan (WMP). A WMP serves as a guide to protect and improve water quality in a defined watershed and includes analyses, actions, participants, and resources related to developing and implementing the plan (USEPA, 2008).

It is particularly important to develop and implement WMPs for waters that are impaired in whole or in part by non-point sources of pollution. For these waterbodies, plans should incorporate on-the-ground mitigation measures and practices that will reduce pollutant loads and contribute in measurable ways to reducing impairments and to meeting water quality standards (USEPA, 2008). For Vermont's bacteria impaired waters, where TMDLs for the affected waters have already been developed, WMPs should be designed to achieve the load reductions called for in the TMDLs. Figure 6-1 (below) illustrates the potential relationship between TMDLs and WMPs designed to implement TMDLs.

Vermont's Tactical Basin Planning Process

To effectively translate watershed planning into on-the-ground actions, VTDEC has developed a coordinated statewide planning process and basin-specific planning approach designed to enhance the protection, maintenance, and restoration of surface waters. This approach is known as the Tactical Basin Planning Process.

VTDEC believes effective watershed management begins with effective planning, which must first have a solid, scientific foundation for decision-making. Science should be closely integrated into the underlying policies upon which plans are based, effectively driving the subsequent decision-making process. To accomplish this, sound scientific data, tools, and analytical techniques should be included in an iterative decision making process. The tactical planning process is predicated on a monitoring and assessment cycle that provides refreshed data and information to guide prioritized implementation efforts. The assessments will thus provide the foundation for geographically explicit strategies to promote the protection of waters that are in good or excellent condition, and management approaches for altered and/or impaired waters. Tactical plans, as appropriate, may reference stand-alone small-scale watershed-based plans that address specific impairments, such as waters affected by elevated levels of pathogenic bacteria.

Where problems affecting impaired waters are known and solutions are clear, the plan must contain specific remediation actions. For such waters, this would include a list of actions to be taken, who will take those actions, a timeline for completion of the actions, an estimate of the cost of the action and an indication of the most probable funding for the action. Where the problems are not fully known, or solutions are not clear, an adaptive management strategy will be adopted. Here, the plan must contain a strategy for reasonable actions that should improve the impaired waters, as well as a process to acquire the necessary information to further define the problem and develop new solutions as soon as reasonably possible. In this regard, ongoing monitoring and assessment programs will determine whether or not we are moving towards desired water quality improvement goal(s).

Each Tactical Basin Plan will include an Implementation Table that lays out specific objectives and then frames out geographically explicit actions to achieve the stated objectives. It is anticipated that the list of action items will first be expanded, based on input from agency staff and watershed partners, and later prioritized and refined based on the staff and financial resources available to implement specific actions. Action items will include both necessary data collection and assessment efforts, in addition to waterbody-specific implementation activities; action items should be able to be accomplished within the next two to five years. Action items will address known stressors in each basin and reflect the primary goals and objectives identified in the Vermont Surface Water Management Strategy as expressed in a geographically relevant manner.

Vermont's Tactical Basin Planning Process…

- Will compile existing physical, chemical, and biological monitoring and assessment data for the basin;
- Will evaluate collected data with a special emphasis of how physical, chemical and biological data may overlap (in the case of pathogens, data may also include Agricultural Environmental Management (AEM) surveys of farm operations and/or sanitary surveys);
- Will prioritize watershed top stressors (including strategies to address impaired waters);

- Will define future assessment and monitoring needs and timeline/schedule for the watershed (i.e. conducting ―bracketed monitoring" above and below suspected sources of pathogens);
- Will identify priority sub-watersheds to focus restoration and protection actions in this cycle of basin planning (and target areas where resource concerns have not been addressed);
- Will determine how future DEC/ANR permitting and grant funding will be prioritized/targeted/altered to reflect high priority actions in each Tactical Basin Plan;
- Will identify funding mechanisms to implement high priority actions in the watershed identified via the Tactical Planning Process;
- May invoke changes to state or federal permitting cycles within the basin.

Key Monitoring and Assessment Strategies to Address Pathogens

During the Tactical Basin Planning Process, the following monitoring and assessment strategies will be used by VTDEC to address pathogens in impaired waterbodies:

- Integrate existing stormwater mapping, water quality data, biomonitoring data, riparian corridor assessment (SGA-buffer gap analyses) and agricultural (NRCS) flow monitoring data in Agency GIS systems to enhance river corridor protection and basin planning capabilities. This strategy would engender the establishment of a map-based reporting program that could tailor outputs to assist the technical assistance, regulatory, and funding decisions of the ANR (e.g., within the Tactical Planning process) and other agencies.
- Increase pathogenic-bacteria monitoring at public swimming beaches at lakes and ponds by directing citizen groups supported through the LaRosa Partnership Program towards these areas.
- Identify public swimming beaches at lakes and ponds, especially where chronic exceedances of pathogens have been reported (either municipal swimming areas or state parks and other public lands). Work with communities, lake and pond associations, and others who are testing for indicators of pathogens and other health threats and implement reporting strategies.
- Consider development of an electronic reporting system that can enumerate *E. coli* levels at public swimming holes that are monitored. This monitoring/ reporting program is intended to be used as a reporting tool at swimming areas to post episodic increases in bacteria levels. Results from such a program could be used as public notification and information for decision-making for contact recreation activities. The use of VTDEC bacteria monitoring protocols will be imperative in this process.
- Continue to work with EPA to explore availability of federal funding mechanisms to support beach monitoring and reporting efforts.

- Develop water quality bacteria monitoring data to better guide the assessment of pathogenic stressor impacts and the alternatives analysis for BMPs and projects to protect and restore existing uses such as swimming and other forms of contact recreation.
- Through bracketed monitoring, investigate reaches or shoreline areas identified as chronic exceedances of pathogenic bacteria to determine the sources.
- Conduct sanitary surveys along reaches or shoreline areas where there's greater potential of septic system failure, due to depth to bedrock or where there's a greater concentration of antiquated systems.

Key Technical Assistance Strategies and Next Steps to Address Excessive Pathogens

During the Tactical Basin Planning Process, the following technical assistance strategies will be used by VTDEC to address pathogens in impaired waterbodies. As appropriate, WQD staff will also cooperate with AAFM and NRCD programs to target technical assistance to areas where monitoring and assessment data suggest it is most highly needed.

- The addition of new agricultural extension agents in 2011 will enhance technical assistance capabilities of the conservation districts with assistance from the Lake Champlain Basin Program and UVM Extension to provide assistance and treatment designs in agricultural areas.
- Stormwater mapping and Illicit Detection and Discharge Elimination (IDDE) efforts should be continued, but coordinated as appropriate within the tactical planning process to further target municipalities where infrastructure mapping has not yet been carried out. Staff from this program work in collaboration with municipalities to design remediation steps that address the deficiencies identified.
- Continue to address episodic overflows at wastewater treatment facilities where upgrades, expansion, and additional improvements are needed (such as under-sized pump stations)Encourage farmer participation in Nutrient Management Planning beyond the regulations governing Large and Medium Farm Operations.
- Buffer Outreach projects and federal cost-share programs should target sensitive riparian areas characterized by a lack of riparian vegetation that would benefit from the re-establishment of a vegetated riparian buffer. Encourage riparian landowners (and incentives, if possible) to maximize the width of buffer zones adjacent to the tributaries and the river itself.
- Assist farmers with manure storage and application practices. Help direct federal cost-share and other funding sources towards manure storage and handling improvement projects. Manure spreading close to tributaries and the river itself should be discouraged, especially in areas where the ground slopes into the water.

Technical Assistance Programs to Address Excessive Pathogens

Technical assistance to address pathogens is coordinated by VTDEC and partner organizations under the following:

Department of Environmental Conservation:

Facilities Engineering Division – Clean Water Revolving Fund

Wastewater Management Division - Design/Engineering Program

Wastewater Management Division – Operations and Management Program

Wastewater Management Division – Innovative and Alternative Systems

Water Quality Division – Stormwater section assistance to municipalities (MS4, MSGP)

Water Quality Division – Stormwater Mapping and Illicit Discharge Detection and Elimination Project

Agency of Agriculture, Food, and Markets:

Farm Agronomic Practices (FAP)

Large Farm Operations (LFO) Program

Medium Farm Operations (MFO) Program

Conservation District Technical Assistance Program

Accepted Agricultural Practices Assistance

Farm*A*Syst

Land Treatment Planners

Farm Agronomic Practices Program (FAP)

New England Interstate Water Pollution Control Commission:

Wastewater Operator Certification Program

Vermont Rural Water Association:

Training programs for wastewater and source water protection

6.2 Watershed Management Plan Examples and Resources

Below are examples of watershed plans developed for waterbodies in New England that are comprehensive and have strong technical foundations for setting resources goals and identifying restoration activities. Links to the full documents are provided and may be referred to when developing watershed plans in Vermont.

- ***Furnace Brook, New Ipswich, NH*** – Furnace Brook is a small stream situated in New Ipswich, New Hampshire and impaired due to excess bacteria. The aquatic habitat of Furnace Brook has been adversely impacted by physical modification and excessive loading of pollutants, and the brook has been found to contain elevated levels of potentially harmful bacteria. Violations of state water quality standards for *E. coli* bacteria have resulted in Furnace Brook being listed as an ―impaired" stream, meaning that it fails to comply with water quality standards and must be restored. Consequently, a set of analyses and restoration steps are required for Furnace Brook, as part of the TMDL process. A TMDL for Furnace Brook was completed in 2009, a watershed restoration plan was completed in 2010, and a Section 319 restoration implementation project has recently begun.

  The watershed-based restoration plan provides detailed information on the sources of bacteria in the Furnace Brook watershed and recommends actions to achieve the reductions called for in the TMDL. This plan may also serve as an example for other impaired streams, specified in the TMDL report, to follow as an important step toward restoration and water quality compliance.
  Online:
  http://des.nh.gov/organization/divisions/water/wmb/was/documents/furnace_brook_wbp.pdf

- ***Spruce Creek, Kittery, ME*** – In 2006, Spruce Creek was classified by the Maine Department of Environmental Protection as impaired, primarily due to bacterial contamination and risks imposed from development. This waterbody has also been identified as one of 17 Nonpoint Source Priority Coastal Watersheds in Maine due to bacterial contamination, low dissolved oxygen, toxic contamination, and a compromised ability to support commercial marine fisheries.

  In 2008, the Spruce Creek Association, working with the Towns of Kittery and Eliot, developed a watershed management plan for Spruce Creek. The WMP serves as a blueprint for restoring and protecting the waterbody. With crucial input from stakeholders, it identifies the most pressing problems and establishes goals, objectives, and actions for resolving them. The WMP also contains strategies for monitoring progress and financing implementation. The plan is a living document that will be reexamined and revised on a regular basis to ensure that the goals, objectives, and specific actions continue to address the most pressing problems in the watershed.
  Online: http://www.sprucecreekassociation.org/Spruce_Creek_WBMP_FINAL_08May08.pdf

- ***Cains Brook and Mill Creek, Seabrook, NH*** - The Cains Brook Watershed has experienced significant residential and commercial growth over the past 20 years. This growth and its impacts have led to a degradation of the quality and aquatic habitat of the waters within the brook and the Hampton-Seabrook Estuary.

  In 2006 the Seabrook Conservation Commission adopted the original Cains Brook/Mill Creek Watershed Management Plan in effort to better manage the activities and resources within the watershed. Since the adoption of the plan, the Commission has coordinated with the New Hampshire Department of Environmental Services to establish a watershed planning process consistent with EPA's 9 criteria for watershed planning. This plan update reflects the effort of the Commission to incorporate the EPA criteria into the plan as well as to update other activities affecting the watershed, such as NPDES Phase II stormwater management program.
  Online: http://des.nh.gov/organization/divisions/water/wmb/was/documents/wbp_cains_brook.pdf

Watershed Planning – Available Resources

Vermont Surface Water Management Strategy and Tactical Basin Planning - This guide to developing river basin water quality management plans is designed for use by the public, watershed coordinators, watershed organizations, watershed council members and other interested in understanding and being involved in Vermont's watershed planning process.
Online: Surface Water Management Strategy - http://www.vtwaterquality.org/swms.html
Tactical Planning - http://www.vtwaterquality.org/wqd_mgtplan/swms_ch4.htm

EPA Handbook for Developing Watershed Plans to Restore and Protect Our Waters - This handbook is designed for users who are just beginning to develop a WMP, are in the process of developing a plan, or updating an existing plan. EPA has also developed a web-based Watershed Plan Builder which guides planners through developing a customized outline that can be used to develop a WMP.
Online: WMP Handbook - http://www.epa.gov/owow/nps/watershed_handbook/
WMP Factsheet - http://www.epa.gov/owow/nps/watershed_handbook/factsheet.htm
WMP Builder - http://iaspub.epa.gov/watershedplan/watershedPlanning.do?pageid=48&navId=35

6.3 Developed Area Stormwater

> ***Best Management Practices (BMPs)*** *are effective, practical, structural, or non-structural methods which prevent or reduce the movement of pollutants from the land to surface or ground water. BMPs are designed to protect water quality and to prevent new pollution.*

Stormwater Management Practices (BMPs) to reduce pollutant loads, including potentially harmful bacteria, to Vermont's surface waters. BMPs are generally either structural or non-structural.

Structural BMPs are generally engineered, constructed systems that can be designed to provide water quality and/or water quantity control benefits. Structural BMPs are used to address both existing watershed impairments and the impacts of new development. Common structural BMPs include the following:

- ***Infiltration systems*****:** designed to capture stormwater runoff, retain it, and encourage infiltration into the ground;
- ***Detention systems*****:** designed to temporarily store runoff and release it at a gradual and controlled rate;
- ***Retention systems:*** designed to capture a volume of runoff and retain that volume until it is displaced in part or whole by the next runoff event;
- ***Constructed wetland systems:*** designed to provide both water quality and water quantity control;
- ***Filtration systems*****:** designed to remove particulate pollutants found in stormwater runoff through the use of media such as sand, gravel or peat.

Non-structural BMPs are a broad group of practices designed to prevent pollution through maintenance and management measures. They are typically related to improvement of operational techniques or the performance of necessary stewardship tasks that are of an ongoing nature. These include institutional and pollution-prevention practices designed to control pollutants at their source and to prevent pollutants from entering stormwater runoff. Non-structural measures can be very effective at controlling pollution generation at the source, thereby reducing the need for costly ―end-of-pipe" treatment by structural BMPs. Examples of non-structural BMPs include maintenance practices to help reduce pollutant contributions from various land uses and human operations, such as street sweeping, and road and ditch maintenance.

Structural and non-structural BMPs are often used together. Effective pollution management is best achieved from a management systems approach, as opposed to an approach that focuses on individual practices. Some individual practices may not be very effective alone, but in combination with others, may be more successful in preventing water pollution.

Effective BMP implementation should focus not only on reducing existing pollutant loads, but also on preventing new pollution. Once pollutants are present in a waterbody, it is much more difficult and expensive to restore to an unimpaired condition. Therefore, developing management systems that rely on preventing degradation of receiving waters is recommended

Stormwater - Best Management Practices Overview

BMPs are most effective when a combination of structural and non-structural practices is implemented. The key distinction between non-structural BMPs and structural BMPs is that the former are intended to prevent stormwater generation or contamination, while the focus of the latter is on mitigating unavoidable stormwater-related impacts.

In developed areas, large areas of natural landscape cover have been replaced with non-porous, or impervious, surfaces (e.g. homes, businesses, streets, and parking areas). Impervious surfaces change the character of runoff dramatically by causing water to remain on the land surface. Without slow percolation into the soil, water accumulates and runs off in larger quantities. This faster moving water washes soil from earth surfaces that are not securely held in place by structural means or healthy vegetation. Structural BMPs generally function by reducing and disconnecting these impervious surfaces, and minimizing the adverse impacts to receiving waters. Structural stormwater BMPs also collect and treat stormwater runoff before it is discharged.

Although structural BMPs are generally more costly than non-structural BMPs, an effective maintenance program will extend the life of stormwater controls and BMPs and avert expensive repair costs. Examples of structural stormwater BMPs include buffers, constructed wetlands, sand filters, infiltration trenches, porous pavements, and rain gardens and other bioretention systems. Dense vegetative buffers facilitate bacteria removal through detention, filtration by vegetation, and infiltration into the soil. While the pollutant removal efficiency of BMPs will vary depending on local site characteristics and specific BMP design, construction, and maintenance considerations, the Center for Watershed Protection (CWP) has reported that bioretention, sand filters, and constructed wetlands all typically perform well with respect to bacteria removal (CWP, 2007). Although few studies have yet formally assessed the effectiveness of infiltration practices on bacteria removal, these practices are widely considered an effective option for bacterial because they are designed to reduce stormwater runoff volume and make use of the filtering capacity of the soil.

Stormwater Utilities - Communities across the nation are increasingly examining the option of stormwater utilities to fund stormwater management. A stormwater utility charges fees to property owners who use the local stormwater management system. The revenue can be used to maintain and upgrade existing storm drain systems, develop drainage plans, construct flood control measures, and cover administrative costs. Stormwater utilities are seen as a fair way of collecting funds for stormwater management. The properties that contribute stormwater runoff and pollutant loads and, therefore, create the need for stormwater management, pay for the program. Stormwater utilities provide a predictable and dependable amount of revenue that is dedicated to the implementation of stormwater management. Over

400 communities in the United States have created stormwater utilities. Act 109, passed by the Vermont Legislature in 2002, gave Vermont municipalities the authority to create stormwater utilities. The City of South Burlington has been the first municipality to create a stormwater utility in Vermont. More information about the South Burlington SWU can be found at http://www.sburlstormwater.com/ and in the *South Burlington, Potash Brook* case study in Section 6.12 of this report.

Stormwater – Available Resources

Vermont Stormwater Management Manual - The Vermont Stormwater Management Manual consists of two volumes, Volume I: Vermont Stormwater Treatment Standards; and Volume II: Vermont Stormwater Management Manual. Volume I contains the regulatory requirements for the management of stormwater, and Volume II consists primarily of technical guidance to assist in the design of stormwater treatment practices.

Online: Volume I: http://www.anr.state.vt.us/dec/waterq/stormwater/docs/sw_manual-vol1.pdf
Volume II: http://www.anr.state.vt.us/dec/waterq/stormwater/docs/sw_manual-vol2.pdf

VTDEC Stormwater Management Section - The Stormwater Section provides both technical assistance and regulatory oversight to ensure proper design and construction of stormwater treatment and control practices; and construction-related erosion prevention and sediment control practices necessary to minimize the potentially adverse impacts of stormwater runoff to receiving waters throughout Vermont. This website includes publications, videos, and slide shows available from the Stormwater Section.
Online: http://www.dem.ri.gov/programs/benviron/water/permits/ripdes/stwater/index.htm

National Menu of Stormwater BMPs – The National Menu of BMPs for Stormwater Phase II was first released in October 2000. An updated version of this original webpage, including the addition of new fact sheets and the revision of existing fact sheets, is available through the EPA website.
Online: http://cfpub1.epa.gov/npdes/stormwater/menuofbmps/index.cfm

University of New Hampshire Stormwater Center – The UNH Stormwater Center runs a facility that provides controlled testing of stormwater management designs and devices. The Center is a technical resource for stormwater practitioners and studies a range of issues for specific stormwater management strategies including design, water quality and quantity, cost, maintenance, and operations. The field research facility serves as a site for testing stormwater treatment processes, for technology demonstrations, and for conducting workshops. The testing results and technology demonstrations are meant to assist resource managers in planning, designing, and implementing effective stormwater management strategies. Detailed descriptions of multiple stormwater BMPs are available through their website and their annual reports. *Online:* http://www.unh.edu/erg/cstev/

6.4 Septic Systems

The conventional septic system consists of a septic tank followed by a drainfield, also called a leachfield or soil adsorption field. Wastewater flows out of the house into the septic tank through a sewer pipe. Once in the septic tank, most solids in the wastewater settle to the bottom of the tank to form a sludge layer. Other solids such as greases and fats float and form a scum layer on top of the wastewater. The primary function of the septic tank is to trap and store solids, most of which will be broken down by anaerobic bacteria. In a properly functioning tank, up to 80% of the solids will be broken down into gases and liquids. Despite primary treatment, the liquid leaving the septic tank still contains high concentrations of pollutants, such as nutrients and bacteria. These pollutants are treated as the liquid enters the leachfield and flows through the soil before it reaches ground or surface water (USEPA, 2003).

When used properly, septic systems function very well. However, age, overloading, or poor maintenance can result in failure or malfunction of septic systems and the release of potentially harmful bacteria and other pollutants creating conditions that may threaten human health and the environment. A failed septic system is unhealthy, expensive to replace, and may contaminate nearby surface and ground waters, including nearby wells. Regular maintenance of septic systems will reduce the likelihood of malfunction or failure, extend the life of existing systems, and identify failed systems (USEPA, 2003).

In Vermont, the Agency of Natural Resources is responsible for the permitting of septic systems. Owners of existing systems do not need a permit if there is nothing wrong with the septic system and no changes to the system are made. All new septic systems and replacement or modification of existing systems require permits. The most common reason for modification or replacement is the failure of an existing system (NeighborWorks, 2007).

The State gives municipalities the option to assume responsibility of issuing state permits and enforcing environmental protection standards for onsite wastewater and private drinking water systems and municipal water and sewer connections in their community. To take on this responsibility, a municipality must request delegation of the permitting and enforcement program from the State. To date, two municipalities, Colchester and Charlotte, have been delegated to administer the wastewater and potable water supply regulatory program.

Septic Systems – Best Management Practices Overview

The Vermont Onsite Wastewater Treatment System Rules define failure as a wastewater system that ―allows wastewater to be exposed to the open air, to pool on the surface of the ground, to discharge directly to surface water, or to back up into a building or structure" or that results in the failure of a potable water supply (VTANR, 2007).

Septic system failure can be prevented through routine maintenance of the system. The Vermont Onsite Wastewater Treatment System Rules define the following maintenance specifications for septic tanks (VTANR, 2007):

1. At least once a year, the depth of sludge and scum in the septic tank should be measured. The tank should be pumped if:
    a. the sludge is closer than twelve inches to the outlet baffle, or
    b. the scum layer is closer than three inches to the septic tank outlet baffle.
2. Following septic tank cleaning in units over 5,000 gallons, all interior surfaces of the tank should be inspected for leaks and cracks.
3. At least once a year, dosing tanks and distribution boxes should be opened and settled solids removed as necessary and the dosing tank or distribution box checked for levelness.
4. Toxic or hazardous substances should in general not be disposed of in septic systems. These substances may pass through the system in an unaltered state and contaminate groundwater or remain in the septage and subsequently contaminate the soil or crops at the site of ultimate disposal.

The following maintenance actions can help prolong the life of a septic system and minimize maintenance costs (URI, 2010; NHDES, 2010):

- Know the location of the septic tank and leach field,
- Inspect the scum and sludge depth in the septic tank every 1-3 years and clean the effluent filter as needed (if installed);
- Pump the tank as needed based on scum and sludge measurements. If inspections are not performed, then tanks should be pumped every 2-4 years depending on usage;
- Use a compost pile instead of using a kitchen garbage disposal unit;
- Do not put harmful materials (such as fats, solvents, oils, disinfectants, paints, chemicals, poisons, coffee grounds, paper towels) into the tank;
- Install an effluent filter at the outlet of the tank to enhance primary treatment and protect the leachfield from an overflow of solids;
- Install a simple high-water alarm to indicated clogging or the need for tank pumping;
- Install access risers above the inlet and outlet for easy access at the time of inspection and pumping.
- Keep deep-rooted trees and shrubs from growing on the leaching area.
- Keep heavy vehicles from driving or parking on the leaching area.

Septic Systems – Available Resources

Rules Establishing Minimum Standards Relating to the Location, Design, Construction, and Maintenance of Onsite Wastewater Treatment Systems - Vermont's onsite wastewater treatment system

rules are adopted in accordance with V.S.A. Title 10, Chapter 64 (Wastewater System and Potable Water Supply Rule) of the Vermont Statutes. The purpose of these rules is to protect public health and the environment by establishing a comprehensive program to regulate the design, construction, replacement, modification, operation, and maintenance of potable water supplies and wastewater systems in order to protect human health and the environment, including potable water supplies, surface water and groundwater.
Online: http://www.anr.state.vt.us/dec/ww/Rules/OS/2007/FinalWSPWSRuleEffective20070929.pdf

Homeowner's Guide to Septic Systems – This EPA guide describes how a septic system works and what homeowners can do to help their systems treat wastewater effectively
Online: http://www.epa.gov/owm/septic/pubs/homeowner_guide_long.pdf

EPA Septic Website – This site offers valuable information and resources to manage onsite wastewater systems in a manner that is protective of public health and the environment and allows communities to grow and prosper.
Online: http://cfpub.epa.gov/owm/septic/home.cfm

6.5 Agriculture

Agricultural activities such as dairy farming, the raising of livestock (including hogs, fowl, horses, llamas, alpacas, and other animals) and crop farming can contribute to bacterial impairment of surface waters. Agricultural land uses with the potential to contribute to bacteria pollution include manure storage and application, livestock grazing, and barnyards.

Regulation of agriculture and agricultural practices falls within the purview of the Vermont Agency of Agriculture, Food and Markets (AAF&M). AAF&M has promulgated rules known as Accepted Agricultural Practices (AAP) that concern all farms in Vermont regardless of size, type and location. The AAPs, considered as the base level of management for all farms throughout Vermont, are intended to minimize water pollution from agricultural activities. AAPs also dictate that construction of farm structures needs to comply with locally established building set backs. AAF&M has also promulgated rules and instituted individual permits affecting Large Farm Operations (LFO) and general permits affecting Medium Farm Operations (MFO). An LFO is an operation with 700 or more mature dairy animals and an MFO is an operation with 200 – 699 mature dairy animals (there are differing threshold values for other types and ages of livestock). In addition to set back requirements and backyard farming in areas not zoned for agriculture, municipalities have some [limited] authority over agriculture regarding nuisances and public health situations.

When appropriately applied to soil, animal manure can fertilize crops and restore nutrients to the land. However, when improperly managed, animal wastes can pose a threat to human health and the environment. Pollutants in animal waste and manure can enter surface waters through a number of pathways, including surface runoff and erosion, direct discharges to surface water, spills and other dry-weather discharges, and leaching into soil and groundwater. These discharges of manure pollutants can originate directly from animals accessing surface waters, or indirectly from manure stockpiles and cropland where manure is spread (USEPA, 2003).

Under Vermont's Agricultural Non-Point Sources Pollution Reduction Program, the state's Department of Agriculture, Food & Markets is designated with the authority to regulate and oversee programs designed to reduce agricultural NPS.

Agriculture - Best Management Practices Overview

Manure management BMPs and nutrient management planning are two of the primary tools for controlling bacterial runoff from agricultural areas. The Vermont Agriculture Nonpoint Source Pollution Reduction Program Law and Regulations, which contain the statute, V.S.A. Title 6 Chapter 215, outline the practices and BMPs required by Vermont farms. The regulations include:

Accepted Agricultural Practices (AAP) Law and Regulations - The AAPs are the base level of management required for all farms in Vermont. They are designed to be easy to implement, low-cost solutions for addressing water resource concerns. AAPs include such practices as erosion and sediment control, and management of animal waste, fertilizer and pesticides.
Online: http://www.vermontagriculture.com/ARMES/awq/AAPs.htm.

Best Management Practice (BMP) Law and Regulations - The implementation of Best Management Practices is subsequent to the implementation of Accepted Agricultural Practices. Best management practices are more restrictive than AAPs and typically require installation of structures, such as manure storage systems, to reduce agricultural nonpoint source pollution. According to the Vermont Water Quality Standards (Section 2-03.B), any agricultural activity that causes a nonpoint source discharge is presumed to be in compliance if it is conducted in accordance with the Accepted Agricultural Practices. However, that presumption is negated when a water quality analysis demonstrates that there is a continuing violation of the Water Quality Standards. In that instance, agricultural best management practices will be required to address the specific violation.
Online: http://www.vermontagriculture.com/ARMES/BMP.htm

Large Farm Operation (LFO) Law and Regulations - The LFO Program is an individual permitting process for farms with more than 700 mature dairy cows (whether milking or dry), 1,000 beef cattle or cow/calf pairs, 1,000 youngstock or heifers, 500 horses, 55,000 turkeys, or 82,000 laying hens (without a liquid manure handing system). The LFO law requires adequate and satisfactory waste storage, and requires the farm to land apply manure, compost, and other wastes according to a nutrient management plan. The LFO law and regulatory program prohibit the discharge of wastes from the production area to waters of the state.
Online: http://www.vermontagriculture.com/ARMES/awq/documents/LFORules.pdf

Medium Farm Operations (MFO) Program - The MFO program provides a cost-effective alternative to a potentially burdensome federal permitting program by allowing medium sized farms to seek coverage under a single Vermont state **General Permit.** The General Permit prohibits discharges of wastes from a farm's production area to waters of the state and requires manure, compost, and other wastes to be land applied according to a nutrient management plan. Unless otherwise given notice by the Agency, all medium farms in the state of Vermont are required to operate under the coverage of this General Permit.
Online: http://www.vermontagriculture.com/ARMES/awq/MFO_Rule_000.htm

A Comprehensive Nutrient Management Plan (CNMP) is a conservation system for livestock agricultural operations. CNMPs are designed to address, at a minimum, the soil erosion and water quality concerns of agricultural operations. The CNMP encompasses the storage and handling of the manure as well as the utilization and application of the manure nutrients on the land. Manure and nutrient management involves managing the source, rate, form, timing, and placement of nutrients. Writing a Comprehensive Nutrient Management Plan (CNMP) is an ongoing process because it is a working document that changes over time.

Agriculture - Available Resources

USDA Natural Resources Conservation Service (NRCS) - Agricultural operators can obtain assistance in developing CNMPs and BMPs from the NRCS in Vermont, which can be accessed through the local county conservation district.
Online: http://www.vt.nrcs.usda.gov/

EPA National Management Measures to Control Non-Point Source Pollution from Agriculture - *Online:* http://www.epa.gov/owow/nps/agmn/index.html

EPA Livestock Manure Storage – Software designed to assess the threat to ground and surface water from manure storage facilities. *Online:* http://www.epa.gov/seahome/manure.html

EPA Animal Waste Management Software – A tool for estimating waste production and storage requirements. *Online:* http://www.wcc.nrcs.usda.gov/awm/awm.html

6.6 Illicit Discharges

Illicit discharge refers to any discharge to a municipal separate storm sewer that is not composed entirely of stormwater, except discharges pursuant to a NPDES permit and discharges resulting from fire-fighting activities. Examples of illicit discharges commonly found in Vermont's urban communities include direct illicit discharges such as sanitary wastewater piping that is directly connected from a home to a storm sewer, and indirect illicit discharges such as an old and damaged sanitary sewer line that is leaking fluids into a cracked storm sewer line (NEIWPCC, 2003).

EPA's Stormwater Phase II Final Rule states that municipalities are required to develop illicit discharge detection and elimination (IDDE) plans as one of the following six minimum measures included in a stormwater management plan (NEIWPCC, 2003):

1. Public education and outreach;
2. Public involvement and participation;
3. **Illicit discharge detection and elimination;**
4. Construction site stormwater runoff control;
5. Post-construction stormwater management in new development and re-development; and
6. Pollution prevention and good housekeeping in municipal operations.

IDDE Case Studies:
Section 6.11 *includes two case studies describing successful IDDE projects in South Burlington and Barre, Vermont. These examples represent different stages of and approaches to the IDDE process.*

Stormwater management programs to address illicit discharges must incorporate the following four elements (NEIWPCC, 2003):

1. ***Developing a Storm Sewer Map****:* If not already completed, a storm sewer system map showing the location of all outfalls and the names and location of all waters that receive discharges from those outfalls must be developed.
2. ***Prohibiting Illicit Discharges****:* A municipal ordinance created to comply with Phase II regulations must include a prohibition of illicit discharges and an enforcement mechanism. It is also essential for the municipality to establish a legal authority to inspect properties suspected of releasing contaminated discharges into the storm sewer system.
3. ***Developing and Implementing a Plan to Detect and Address Illicit Discharges:*** Municipalities must develop and implement a plan to detect and address illicit discharges, including illegal dumping, to the system. It is recommended that the plan include locating priority areas, tracing and removing the source of an illicit discharge, and evaluating and assessing the program**.**
4. ***Outreach to Employees, Businesses, and the General Public****:* Municipalities must also inform public employees, businesses, and the general public of hazards associated with illegal discharges and improper disposal of waste.

<u>Illicit Discharges - Best Management Practices Overview</u>

A sample list of IDDE BMPs and measurable milestones is presented below. BMPs are listed in bold, followed by the measurable goals for each BMP. This list was excerpted from ―*Illicit Discharge Detection and Elimination Manual: a Handbook for Municipalities*" (NEIWPCC, 2003):

1. **Create a storm sewer map**
   - Map a certain percentage of outfalls (adding up to 100% by the end of the permit term) or of the area of the town.
2. **Pass an illicit discharge ordinance**
   - Draft an IDDE ordinance (or storm water ordinance with IDDE component) or an amendment to existing bylaws.
3. **Prepare an IDDE plan**
   - Complete a final plan and obtain the signature of the person overseeing the plan.
4. **Conduct dry weather field screening of outfalls**
   - Screen a certain percentage of outfalls (adding up to 100% by the end of the permit term).
5. **Trace the source of potential illicit discharges**
   - Trace the source of a certain percentage of continuous flows (adding up to 100% by the end of the permit term); and
   - Trace the source of a certain percentage of intermittent flows and illegal dumping reports.
6. **Eliminate illicit discharges**
   - Eliminate a certain number of discharges and/or a certain volume of flow, or a certain percentage of discharges whose source is identified (adding up to 100% by the end of the permit term).
7. **Implement and publicize a household hazardous waste collection program**
   - Hold a periodic (e.g., annual) hazardous waste collection day; and
   - Mail flyers about the hazardous waste collection program to all town residences.
8. **Create and distribute an informational flyer for homeowners about IDDE**
   - Mail the flyer to town residences; and
   - Print the flyer as a doorknob hanger and have water-meter readers distribute it.
9. **Create and distribute an informational flyer for businesses about IDDE**
   - Mail the flyer to targeted businesses.
10. **Work with community groups to stencil storm drains**
    - Stencil a certain percentage of drains.
11. **Create and publicize an illicit discharge reporting hotline**
    - Put the hotline in place;
    - Include an announcement of the hotline in sewer bills; and

- Follow up on all hotline reports within 48 hours.

Illicit Discharges – Available Resources

VTDEC Statewide Stormwater Mapping and Illicit Discharge Detection and Elimination Program – In 2000 the Vermont Legislature required VTDEC to implement a statewide program to promote detection and elimination of improper or illegal connections and discharges. (Sec. 3. 10 V.S.A. § 1264 (b)(9)). The intent was to expand IDDE efforts from the communities required to perform IDDE in compliance with EPA's Phase II Stormwater Rule to encompass all developed areas of the Vermont (VTANR, 2010).

Following the legislature's mandate, VTDEC has assisted municipalities not subject to the Phase II Stormwater Rule by mapping drainage systems and performing IDDE. This work, funded through state Ecosystem Restoration Program water quality grants and federal Section 319 and Lake Champlain Basin Program grants, has been completed for all major municipalities in the Missisquoi, Lamoille and Winooski River Basins, the three largest Connecticut River Basin towns and is ongoing in the Otter Creek River Basin (VTANR, 2010).
Online: http://www.anr.state.vt.us/cleanandclear/news/CONNECTICUT-RIVER-BASIN-FINAL.pdf

Illicit Discharge Detection and Elimination Manual - The New England Interstate Water Pollution Control Commission published a useful manual for communities titled Illicit Discharge Detection and Elimination Manual: A Handbook for Municipalities. *Online*: www.neiwpcc.org.

Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments - Center for Watershed Protection's comprehensive manual that outlines practical, low cost, and effective techniques for stormwater program managers and practitioners. The guidelines include details on creating and managing an IDDE program, timelines that estimate how long program implementation will take, information on estimating program costs in terms of capital and personnel expenses, and types of testing used to detect stormwater illicit discharges. This manual provides valuable guidance for communities and others seeking to establish IDDE program.
Online: http://cfpub.epa.gov/npdes/docs.cfm?program_id=6&view=allprog&sort=name#iddemanual

EPA Model Ordinances – The EPA maintains a list of model ordinances designed to protect local resources through the elimination and prevention of illicit discharges. The list includes language to address illicit discharges in general, as well as illicit connections from industrial sites.
Online: http://www.epa.gov/nps/ordinance/discharges.htm

EPA Illicit Discharge Detection and Elimination Program Development BMP Fact Sheet – Communities addressing IDDE minimum measure should begin with EPA's IDDE program development BMP fact sheet. The additional BMPs listed below can be used to help implement an IDDE program.
*Online:*http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=11

6.7 Combined Sewer Overflows (CSOs)

During heavy rains, stormwater can enter municipal combined sewer systems which can cause the system to surcharge and overflow; this is known as a Combined Sewer Overflow (CSO). When this happens, sewage and stormwater may be discharged to surface waters without being treated. CSOs can be a major source of pathogens.

In 1994, under the National Pollutant Discharge Elimination System (NPDES) permitting program, EPA developed a Combined Sewer Overflow Control Policy which acts as a national framework for control of CSOs. The policy provides guidance to municipalities and State and Federal permitting authorities on how to cost-effectively meet the Clean Water Act's pollution control goals (USEPA, 1999a).

The policy contains four fundamental principles to ensure that CSO controls are cost-effective and meet local environmental objectives (USEPA, 1999a):

1. Establish clear levels of control to meet health and environmental objectives;
2. Provide flexibility to consider the site-specific nature of CSOs and find the most cost-effective way to control them;
3. Use phased implementation of CSO controls to accommodate a community's financial capability; and
4. Review and revise water quality standards during the development of CSO control plans to reflect the site-specific wet weather impacts of CSOs.

VTDEC and EPA Region 1 work with permittees to incorporate these principles into NPDES permits. Communities with combined sewer systems are expected to develop long-term CSO control plans that will ultimately provide for full compliance with the Clean Water Act, including attainment of water quality standards.

In 1990, the VTANR adopted a Combined Sewer Overflow Control Policy to assure that all CSOs within Vermont are identified. If the wastewater collection system has a 50 percent probability of overflow in a one year period, the respective municipality must take corrective action. The state published a timetable to bring municipalities into compliance with the Vermont WQS and the Federal CWA. The policy also describes the state funding mechanism which incorporates a procedure for prioritizing correction of CSOs (VTANR, 1990).

The Vermont Municipal Pollution Control Priority System is the system used to rank all municipal pollution abatement projects, including CSOs, for the purposes of awarding financial assistance (VTANR, 1990). Funding consists of 25% state grants and interest free loans in the amount of 50% of the total project costs to municipalities undertaking CSO correction. Project priority lists are prepared annually through a process of public participation, and may be amended during the year to reflect any changing circumstances in the ability of projects to proceed to construction. On February 5, 2010, VTANR notified municipalities and other interested parties of the availability of the Draft Municipal Pollution Control Projects Priority List for state Fiscal Year 2011, and a public hearing was held on March 23, 2010. The final list indicates those projects anticipated to receive state and/or federal funding in 2011 and includes a Planning List which shows projects anticipated to be funded in 2012 through 2015 [2011 Vermont Pollution Control Projects Priority List].

CSO - Best Management Practices Overview

Mitigation measures to address CSOs include:

CSO Prevention Practices - CSO prevention practices are aimed at both minimizing the volume of pollutants entering a combined sewer system and reducing the frequency of CSOs. Stormwater management measures that reduce the volume and rates of runoff can also reduce the frequency of CSO events. Additionally, management measures that reduce pathogen sources to stormwater will reduce the pathogen concentrations in CSO discharges (MADEP, 2005).

As of 1997, all CSO communities are responsible for implementing EPA's 9 minimum technology-based controls. The nine minimum controls are measures that can reduce the prevalence and impacts of CSOs without significant engineering or construction (USEPA, 1999a). These controls include (MADEP, 2005):

1. Proper operation and maintenance of the collection system
2. Maximum use of the collection system for storage
3. Review of pretreatment programs to minimize CSO-related impacts
4. Maximum flow to the treatment plant
5. Prohibit dry-weather overflows
6. Control of solid and floatable materials
7. Pollution prevention
8. Public notification
9. Monitoring to characterize CSO improvements and remaining CSO impacts

Combined Sewer Separation - Sewer separation is the practice of separating the combined, single pipe system into separate sewers for sanitary and storm water flows. In a separate system, storm water is conveyed to a storm water outfall for discharge directly into the receiving water. Based on a comprehensive review of a community's sewer system, separating part or all of its combined systems into distinct storm and sanitary sewer systems may be feasible. Communities that elect for partial separation typically use other CSO controls in the areas that are not separated (USEPA, 1999b).

CSO – Available Resources

Guidance: Coordinating Combined Sewer Overflow (CSO) Long-Term Planning with Water Quality Standards Reviews - Addresses impediments to implementing the water quality-based provisions in the CSO Policy, and actions that State and Interstate Water Pollution Control Directors and CSO communities should take to overcome these impediments.
Online: http://www.epa.gov/npdes/pubs/cover-cso.pdf

Combined Sewer Overflows Guidance for Nine Minimum Control Measures -
Provides information on nine minimum technology-based controls that communities are expected to use to address CSO problems, without extensive engineering studies or significant construction costs, before long-term measures are taken.
Online: http://www.epa.gov/npdes/pubs/owm0272.pdf

Combined Sewer Overflow Management Fact Sheet: Sewer Separation – Describes the basic information regarding the separation of CSOs for combined sewer systems.
Online: http://www.epa.gov/OWM//mtb/sepa.pdf

6.8 Pets

In residential and urban areas, pet fecal matter can be a significant contributor of pathogens in stormwater. Each dog is estimated to produce 200 grams of feces per day, and pet feces can contain up to 23,000,000 fecal coliform colonies per gram (CWP, 1999). If the waste is not disposed of properly, these bacteria can wash into storm drains or directly into waterbodies and contribute to bacteria impairment.

Pets- Best Management Practices Overview

Animal waste collection as a pollution source control involves using a combination of educational outreach and enforcement to encourage residents to clean up after their pets. Vermont encourages pet waste reduction through the use of delegated dog parks, such as those in the municipalities of Burlington, Essex, Hartford, Manchester, South Burlington and St, Johnsbury, among others and through educational outreach campaigns informing local residents about the water quality impacts of pet waste, and the development of local ―pooper-scooper" ordinances such as those in Barre and Burlington.

Education and Outreach Campaigns - Public education programs can be used to reduce pet waste. These programs are often incorporated into a larger message of reducing non-point source pollution to improve water quality. Signs, posters, brochures, and newsletters describing the proper techniques to dispose of pet waste can also be used to educate the public about this problem and to create a cause-and-effect link between pet waste and water quality (USEPA, 2001b).

Designated dog parks are becoming more common and can be used as a technique to reduce pet waste near surface waters. These parks often include signs about the importance of removing pet waste as well as bags and trashcans in which to dispose of the waste. Other techniques can be incorporated into the design of the park. ―Doggy Loos," pet waste disposal units placed in the ground and operated by footactivated lids, ―Pooch Patches," a pole surrounded by sand that dogs are encouraged to go to defecate, and ―Long Grass Areas," an area where grass is left un-mowed to allow pet waste to disintegrate naturally have been used in existing dog parks. Other practices, such as creating a vegetated buffer around the park would reduce impacts of this type of developed area runoff to nearby surface waters by encouraging infiltration into soils (USEPA, 2001b).

Individual pet owners can also take steps to reduce their pet's impact on water quality. Adopting simple habits such as carrying a plastic bag on walks and properly disposing of pet waste can make a difference.

Town Ordinances and Enforcement - ―Pooper-scooper" ordinances are often used to regulate pet waste disposal. These ordinances generally require the removal of pet waste from public areas, other people's properties, and occasionally from personal property, before leaving the area. Fines are typically the enforcement method used to encourage compliance with these ordinances.

Pets– Available Resources

EPA Source Water Protection Practices Bulletin – Managing Pet and Wildlife Waste to Prevent Contamination of Drinking Water.
Online: http://www.epa.gov/safewater/sourcewater/pubs/fs_swpp_petwaste.pdf

6.9 Wildlife

Wildlife such as deer, rodents, beaver, geese, and other birds are commonly associated with bacterial contamination of water bodies. While important, these sources are diffuse and difficult to measure. Large numbers of geese, gulls, and ducks, however, are of particular concern because they often deposit their waste directly into surface waters, contributing bacteria directly to lakes and ponds (CWP, 1999).

Wildlife - Best Management Practices Overview

Reducing the impact of wildlife on bacteria concentrations in water bodies generally requires either reducing the concentration of wildlife in an area or reducing their proximity to the water body. In areas where wildlife is observed to be a large source of bacterial contamination, a program of repelling wildlife from surface waters (also called harassment programs) may be implemented. These programs often involve the use of scarecrows, kites, a daily human presence, or modification of habitat to reduce attractiveness of a particularly at-risk area. Generally, VTDEC is only interested in wildlife control in instances of excessive nuisance densities such as geese at state park beaches.

Human development has altered the natural habitat of many wildlife species, which may lead to greater access to surface waters by wildlife. Restricting the availability of food sources to wildlife from humans will discourage wildlife from frequenting these sensitive surface waters. Providing closed trash cans near water bodies, as well as discouraging wildlife from entering sensitive surface waters by installing fences, pruning trees, or making other changes to landscaping may reduce impacts to water quality. However, it should be reiterated that the VTWQS do not consider impacts from natural sources (e.g. wildlife) as contributing to noncompliance and therefore remediation measures may not be required or necessary.

6.10 Boats and Marinas

Recreational water uses can contribute to bacteria loads. Marinas and areas frequented by boats may be impacted by sources of potentially harmful bacteria specific to these areas including sewage from boats and marinas.

Boats have the potential to discharge bacteria in sewage from installed toilets and gray water (including drainage from sinks, showers, and laundry). Sewage and gray water discharged from boats can contain pathogens (including harmful bacteria, viruses, and protozoans), nutrients, and chemical products which can lead to water quality violations.

Under the federal Clean Water Act, it is illegal to discharge untreated (raw) sewage from a vessel within three miles of shore of the United States, Great Lakes, and navigable rivers. The Clean Vessel Act was established in 1992 by the Federal Government and was signed into law to protect our waters and associated recreational opportunities from damaging vessel sewage discharges. In Vermont, the Clean Vessel Act is administered by Vermont's Fish & Wildlife Department. The impact of dumping even a small amount of raw sewage into open waters can significantly impact the local ecosystem, causing algal blooms and a degradation in water quality. Boaters are now prohibited from discharging sewage into Lake Champlain or any other body of water in Vermont. All waters in Vermont are considered ―No Discharge Areas".

Approximately 80 percent of marinas in Vermont have a pumpout station for recreational boaters. It is important for marinas to offer pumpout services for two reasons; to provide a convenient service to boaters and to maintain a clean aquatic marina environment. This additional service results in a more attractive marina to prospective boaters.

In addition to discharges from boats, there are a number of other potential bacteria sources in marinas. Bacteria from shore side restrooms, uncontrolled pet waste, and fecal matter from wildlife attracted to fish cleaning waste can contaminate waters near marinas. Shore side sanitary facilities should be functioning properly to protect public health and the environment. Waste from pets, especially dogs, is a major source of complaints from barefoot boaters and has the potential to substantially affect bacteria levels at nearby beaches.

Boats and Marinas - Best Management Practices Overview

Boats

- Target outreach to marina owners, boat dealers, and their consumers regarding the State and EPA requirements for No Discharge Areas; and
- Encourage marina owners to provide clean and safe onshore restrooms and pumpout facilities.

Marinas

- Provide an appropriate location for boat washing;
- Provide an appropriate pump out station that is accessible to staff and customers;
- Do not allow waste from the pump out stations to drain directly into receiving waters;
- Consider alternatives to asphalt for parking lots and vessel storage areas such as dirt, gravel, or permeable pavement;
- Install infiltration trenches at the leading edge of a boat ramp to catch pollutants in an oil absorbent barrier or crushed stone before discharge;
- Install vegetated buffers between surface waters and upland areas; and
- Protect storm drains with filters or oil-grit separators. Stencil words (such as ―Drains to the River") on storm drains to alert customers and visitors that storm drains lead directly to water bodies without treatment. Contact the municipal public works department before stenciling any drain.

Boats and Marinas – Available Resources

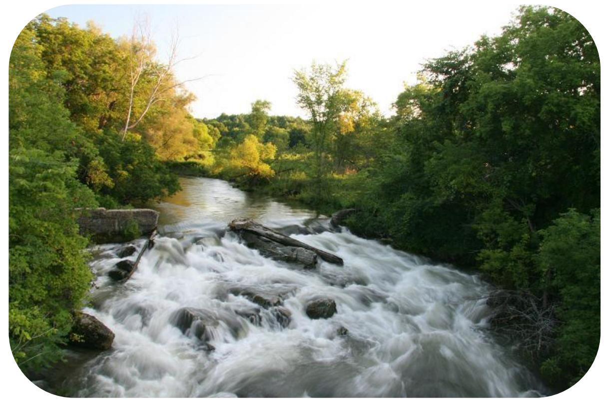
Vermont's Clean Vessel Act Program **-** The VT Clean Vessel Act Program works to secure a healthy aquatic environment by preventing improper sewage disposal by recreational boats. Many recreational activities are sustained by our water resources and improper sewage disposal could threaten this use.
Online: http://www.vtfishandwildlife.com/boating_grants.cfm#cva

6.11 Implementation and Monitoring Case Studies

The following pages contain a set of case studies of successful bacteria-related implementation and monitoring efforts in different areas of Vermont. Each of these summaries represents a different stage in the process of implementation.

Case Study: the Poultney River

Bacteria Source Identification Success Story



The Poultney River in Poultney, VT.
(Source: http://www.vtfalls.com/poultneyriverfalls.htm)

The Poultney River originates in the town of Tinmouth in the valley between Tinmouth and Spoon Mountains and meanders 40 miles through west-central Vermont and New York. The Poultney defines a portion of the border between these two states before it drains into the Lake Champlain's South Bay. The Poultney River drains 236 square miles in Vermont.

Background:

Since 2003, the Poultney Mettowee Natural Resource Conservation District (PMNRCD) has monitored water quality in the Poultney River (and other waterbodies) for pathogenic bacteria (Escherichia coli or E. coli), total phosphorus and turbidity. E. coli measurements have been high, according to State and Federal Water Quality Standards, in all of the streams that PMNRCD monitors, especially the Poultney River. Sampling has shown that E. coli measurements in the watershed are particularly high after rain events. The PMNRCD is working to implement projects such as tree plantings (to act as buffers) and agricultural practice changes that they hope will decrease E. coli runoff to the water, and is continuing to assess streams for potential E. coli sources. Many of their partners are working directly with towns and agricultural producers to decrease E. coli in streams through projects that upgrade septic systems and exclude livestock from streams.

Actions Taken & Outcomes:

In 2004 and 2005, PMNRCD observed chronically high levels of E. coli downstream of a farm along the Poultney River. The District then began ―bracketed monitoring", taking samples both upstream and downstream of this farm and observed a noticeable difference between these two sites and deduced that livestock to this reach of river may have been a contributing cause. With data in hand, the District approached this agricultural operator and was able to present these findings in hopes of influencing the operator's practices. This effort had the intended effect, and the farmer subsequently enrolled in the Conservation Reserve Enhancement Program (CREP) to fence their livestock out of the Poultney River and allow a riparian buffer to become established along pasture land. Since then, E. coli levels through this reach of the Poultney have steadily declined, as have nutrients and sedimentation. This approach of identifying the sources of E. coli and other pollutants and then determining an appropriate solution has proved successful in several instances to date.

Case Study: City of Barre, Vermont

IDDE Success Story

The City of Barre, Vermont is located in the Winooski River Watershed. The watershed drains approximately 1,080 square miles in central Vermont, encompassing all of Washington County, half of Chittenden County, and portions of Lamoille and Orange Counties (FWR, 2010). Barre is located southeast of Montpelier, Vermont and includes the following streams: Stevens Branch, Jail Branch, Edgewood Brook, Gunners Brook, Aldrich Brook, and Unnamed Tributaries (FWR, 2007). A portion of Gunners Brook is on the Vermont 2010 303(d) List of Impaired Waters for sediments, nutrients and metals and is Class B water designated as cold water fish habitat.

The Winooksi River in nearby Montpelier, VT.

Background:

The Friends of Winooski River (FWR), a non-profit organization dedicated to the restoration and protection of the Winooski River and its tributaries, is a hands-on organization helping to coordinate restoration projects such as tree plantings to stabilize stream banks, water quality monitoring, storm water outfall monitoring, and streambank geomorphic assessment. In 2003 and 2006, FWR worked with the City of Barre, Vermont to locate, map, and sample many of its outfalls to identify illicit discharges to streams.

Actions Taken:

In 2003, FWR and the City of Barre completed a visual assessment of 112 outfall pipes in the City of Barre, Vermont. Outfalls suspected of having contaminated flows were flagged for future investigation. In 2006, the 78 flagged outfalls were sampled for basic water quality parameters, chlorine, potassium, *E.coli*, and **optical brighteners (OB).**

> ***Optical Brighteners (OB)*** *is fluorescent white dyes that are added to many laundry detergents to make clothes appear brighter. Because they are a component of laundry effluent, the presence of OBs in surface waters may indicate illegal dumping, a direct illicit connection, a leaking sewer, or a failing septic system.*

Outcomes:

The 2003 and 2006 outfall surveys and water quality testing resulted in the following outcomes:

- Of the 78 outfalls sampled in 2006, 60 outfalls had dry weather flow.
- At 21 of the 60 flowing outfalls, illicit discharges were confirmed, based on water quality results, particularly *E.coli* and OB.
- Many outfalls were identified as being in disrepair.
- A detailed map of outfall locations, potential illicit discharges, and ―hotspots" of potential contamination was created.

Visual Assessment of Outfalls (FWR, 2007)

These studies also confirmed the strong positive correlation between OB and *E.coli* data found in earlier surveys by FWR in the Winooski Watershed, supporting the use of OB monitoring as an alternative for wastewater screening. This lower-cost method for detecting illicit discharges may make larger scale outfall sampling more accessible for municipalities. These studies by the FWR in the Winooski Watershed are now referred to in the New England Interstate Water Pollution Control Commission's 2003 Illicit Discharge Detection and Elimination Manual: A Handbook for Municipalities as case studies supporting the use of OB in detecting illicit discharges (NEWIPCC, 2003).

A problem outfall (FWR, 2007)

Future Steps:

The City of Barre, Vermont will continue to investigate problem outfalls. The city will partner with the Environmental Studies class at Spaulding High School to retest many of these outfalls.

References:

Friends of Winooski (FWR), 2010. Winooski Watershed.
Online: http://www.winooskiriver.org/.

Friends of Winooski (FWR), 2007. Implementing Illicit Discharge Detection and Elimination (IDDE) in Barre City: Lessons Learned. Chittenden County MS-4 Regional Stormwater Education Program. August 15, 2007.

New England Interstate Water Pollution Control Commission (NEWIPCC), 2003. Illicit Discharge Detection and Elimination Manual: A Handbook for Municipalities.
Online: *www.neiwpcc.org/neiwpcc_docs/iddmanual.pdf.*

Case Study: South Burlington, Potash Brook

Stormwater Utility & IDDE Success Story

The drainage area of the Potash Brook Watershed is approximately 7.5 square miles and is heavily urbanized. Land use within the watershed is 53% developed, 30% agricultural, and 17% forested, open water, or wetlands. The watershed is estimated to be 22% impervious (VTDEC, 2006). The main stem of Potash Brook originates in the town of Williston, Vermont and then flows northwest through the cities of Burlington and South Burlington, eventually discharging into Lake Champlain at Shelburne Bay. Potash Brook is on the Vermont 2010 303(d) List of Impaired Waters for *E.coli* and is Class B water designated as cold water fish habitat. Potash Brook also has a completed TMDL for stormwater that was approved in 2006 and is currently being implemented.

Potash Brook Watershed (VTDEC, 2006)

Background:

In 2005, the City of South Burlington, Vermont created the first and only **Stormwater Utility (SWU)** in Vermont. The SWU was formed by an ordinance of the city council and is planned by an advisory committee comprising of local professionals, residents, and city officials. The SWU provides an efficient avenue for upgrading and implementing new and effective stormwater treatment measures designed to improve water quality. The SWU also provides a stable and adequate source of revenue to complete required maintenance and manage stormwater-related activities. The City of South Burlington shares the costs and receives services from the SWU including maintenance and improvement of roads, culverts, and parking lots (South Burlington Stormwater Services, 2010).

*A **Stormwater Utility (SWU)** is a special entity set up to provide funding that is used specifically for stormwater management. It is a dedicated service unit within the City government which provides revenues through fees for service (or user fees), similar to how water*

South Burlington has been running an active Illicit Discharge Detection and Elimination (IDDE) program since the creation of the SWU in 2005. The IDDE program consists of four different components (South Burlington Stormwater Utility, 2008):

- Ordinance defining and prohibiting/identifying illicit discharges;

- Stormwater infrastructure mapping;
- Outfall inspections; and
- Stormwater sampling.

Problem:

In August 2006, City Highway Department staff smelled a foul odor coming from one of the storm drains while repairing storm drains on Mill Pond Lane in South Burlington, Vermont. SWU staff were called to investigate and discovered that the sanitary wastewater line from one of the homes had been incorrectly connected to the stormwater line instead of the wastewater line. It was estimated that wastewater had been flowing through the stormwater piping system directly to Potash Brook for approximately 12 years (South Burlington Stormwater Utility, 2008).

Actions Taken:

The initial illicit connection was discovered using a robotic camera purchased by the town. With the use of this camera, a second sanitary connection to the stormwater piping system under Mill Pond Lane was discovered. Both connections were immediately dug up and properly connected to the sanitary system. As two improper connections were discovered in this neighborhood, both of which were installed by the same contractor, the City of South Burlington contacted all homeowners whose homes were built by this contractor, and conducted dye tests to ensure that sanitary sewer lines were properly connected to the sanitary system. No additional cross-connections were found. The total costs for this project were approximately $12,000 (South Burlington Stormwater Utility, 2009).

Installation of New Piping

Outcomes:

- Successful discovery of two illicit connections in the Mill Pond Lane neighborhood.
  Repair of these improper connections.
- Assurance that no other similar illicit connections exist in this neighborhood.
- Improved community awareness of water quality and stormwater issues.

Future Steps:

The City of South Burlington and the SWU continue to implement measures to reduce the impacts of stormwater to Potash Brook through efforts such as illicit discharge detection and remediation.

References:

South Burlington Stormwater Services, 2010. About Our Utility.

Online: http://www.sburlstormwater.com/about_us/about_us.shtml.

South Burlington Stormwater Utility, 2008. Illicit Discharge Detection and Elimination Program. Online: www.sburlstormwater.com/downloads/reports/2007_IDDE.pdf.

South Burlington Stormwater Utility, 2009. 2008 Annual Stormwater Report.

Online: www.sburlstormwater.com/downloads/reports/2008_Annual_Report.pdf.

VTDEC, 2006. Total Maximum Daily Load to Address Biological Impairment in Potash Brook, Chittenden County, Vermont. October 2006.

Online: http://www.anr.state.vt.us/dec//waterq/stormwater/htm/sw_TMDLs.htm.

Case Study: Tributary to Shelburne Beach

Septic System Improvement Success Story

Shelburne Beach is a town swimming beach on a central portion of Lake Champlain in the town of Shelburne, Vermont. The state has classified the beach and the unnamed tributary to the beach as Class B waters—a designation defined as "suitable for bathing and recreation, irrigation and agricultural uses; good fish habitat; good aesthetic value; acceptable for public water supply with filtration and disinfection.

Coordinated efforts by area residents to control bacteria levels permit the continual enjoyment of Shelburne Beach.

Problem:

The town monitors *E. coli* levels at the beach, including at a station at the mouth of a tributary, about 20 times a year during the swimming season to check for compliance with Vermont's *E. coli* water quality criterion. The criterion is 77 colony-forming units (cfu) per 100 milliliters for Class B waters. Among other purposes, the *E. coli* standard is designed to protect human health by preventing exposure to harmful levels of pathogens. Monitoring results for a number of years in the mid- to late-1990s indicated occasional exceedances of the E. coli standard at the monitoring station at the tributary mouth triggering occasional closures of the beach. The high *E. coli* counts resulted in the state adding the unnamed tributary to the 303(d) list in 1998.

Project Highlights:

In 1997 the town commissioned a study to find the source of the bacteria in the tributary, and the study identified six residential septic systems along the stream as the most likely sources. Based on the findings of the study, the town encouraged the owners of these septic systems to correct the deficiencies. Between 1998 and 2001, all six homeowners rebuilt their systems by installing new tanks and leach fields.

Results:

The data summarized in Table 1 show that the *E. coli* standard was exceeded occasionally during the years 1996 to 1999. Although data are not available for 2000 and 2001, the data for 2002 and 2003 (following septic system improvements) show that the Vermont water quality standards for *E. coli* were met 100% of the time during those years. Accordingly, the state removed the tributary from the 303(d) list in 2004.

Summary of E. coli data at the mouth of the southern tributary to Shelburne Beach.

Year	Number of samples taken throughout the season	Number of samples that exceeded Vermont's *E. coli* criterion of 77 CFU/100 mL	Average *E. coli* count for samples that exceeded criterion(CFU/100 mL)	Number of days beach was closed to swimming
1996	31	1	240	1
1997	28	3	197	1
1998	26	3	3,033	4
1999	16	1	130	0
2002	21	0	--	0
2003	21	0	--	0

Partners and Funding:

The restoration work in this case was funded by the Shelburne homeowners, who together spent approximately $90,000 to rebuild their on-site septic systems. The Town of Shelburne supported this work by providing seasonal bacteria monitoring and by funding the study that identified the bacteria source. Vermont Department of Environmental Conservation staff were funded by the Section 319 program and provided technical assistance to the town during the source-tracking phase.

References:

US Environmental Protection Agency, 2011. Nonpoint Source Success Stories – Vermont: Shelburne Beach. Online: http://water.epa.gov/polwaste/nps/success319/vt_shel.cfm.

Mettowee and Huntington Rivers

Microbial Source Tracking (MST) Study

VTDEC and the USGS are conducting a cooperative research project aimed at developing methods for addressing the problem of fecal contamination in Vermont waters. In 2007, VTDEC received an $80,000 grant from the USEPA to conduct a study to enhance TMDL capacity for bacteria impaired waters, including exploring the use of **microbial source tracking (MST)** to identify specific sources of bacterial contamination.

The Huntington River in Huntington, VT.

Background:

In 2009, the project focused on the Poultney-Mettowee Rivers and the Huntington River, as these rivers have been shown to have recurring high levels of *E. coli* bacteria. Stream samples collected during high-flow and base-flow conditions were analyzed for concentrations of *E. coli* and genetic markers to exclude or identify humans, ruminants, and canids as potential sources of fecal contamination. Fecal-reference samples from each of the potential source groups, as well as from common species of wildlife, were collected in the same time and space as water samples in order to assess marker cross reaction and to relate marker results to *E. coli*, the regulated water-quality parameter (Matthews et al., 2011).

Microbial Source Tracking (MST)
Analyzes the genetic fingerprint of E. coli to identify the organism that produced the fecal material containing the E. coli.

Outcomes:

Preliminary results from samples from the Huntington River collected under different flow conditions on three dates indicated that humans were unlikely to be a major source of fecal contamination, except for a single positive result at one station that indicated the potential for human sources. Ruminants were potential sources of fecal contamination at all stations on the Huntington River during one high-flow event and at all but two stations during the other high-flow event. Canids were potential sources of fecal contamination at some stations during two high-flow events, with genetic-marker concentrations in samples from two of the six stations showing positive results for both storm dates. A base-flow sample showed no evidence of major fecal contamination in the Huntington River from humans, ruminants, or canid (Matthews et al., 2011).

In the Mettawee River watershed during the high-flow events, humans were excluded as major sources of fecal contamination at four sampling stations, humans were potential major sources at two stations, ruminants were excluded as major sources at one station, and ruminants were potential major sources at five stations. Samples collected during baseflow show that humans were excluded as major sources at all stations, ruminants were excluded as major sources at three stations, and ruminants were potential major sources at three stations (Matthews et al., 2011).

The MST method used in this study was particularly useful for ruling out human contamination. According to the preliminary study results, pet waste management in the Huntington watershed and manure management in both the Huntington and Mettawee watersheds are the management tools most likely to yield reductions in fecal contamination in these rivers (Matthews et al., 2011). Final results from the study are still pending.

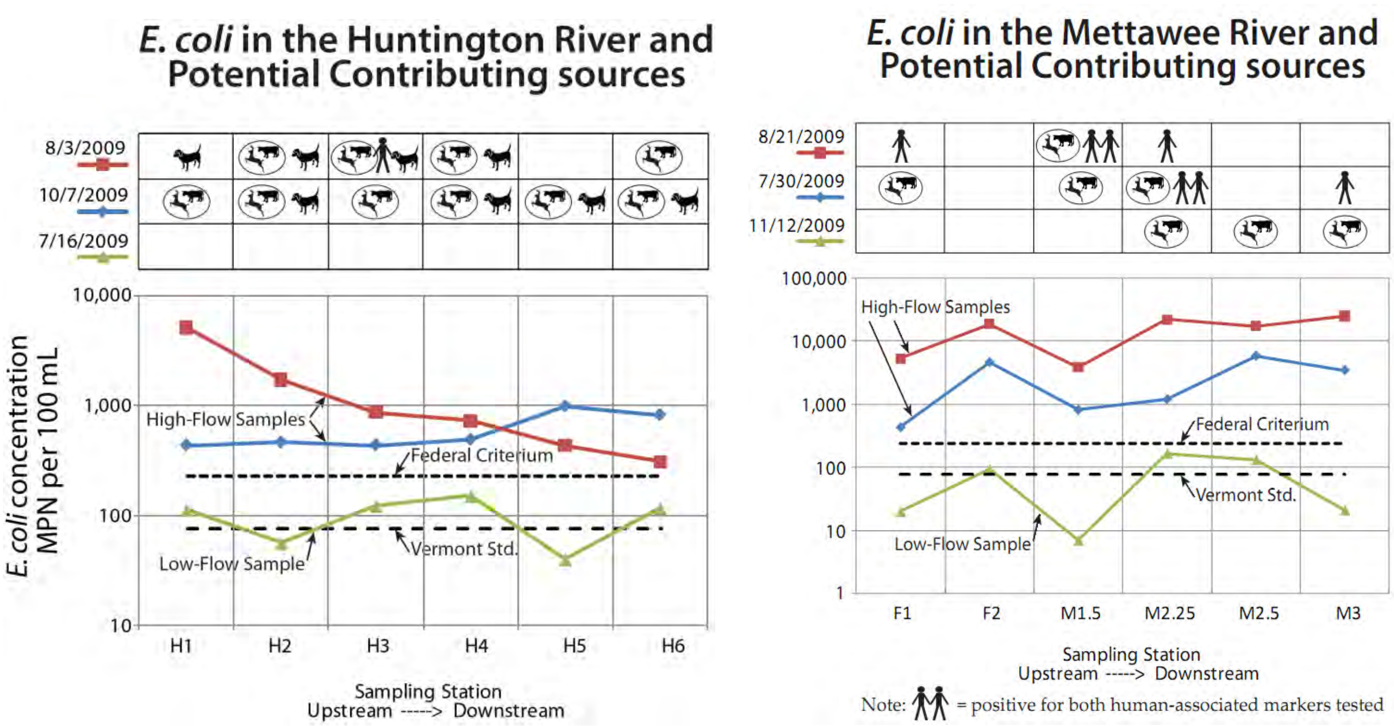


Figure 6: ***Preliminary MST study results on the Huntington and Mettawee Rivers (Matthews et al., 2011)***

References:

Matthews, Leslie, Laura Medalie and Erin A. Stelzer. 2011. Using host-associated genetic markers to investigate sources of fecal pollution in two Vermont streams. Vermont Department of Environmental Conservation, U.S. Geological Survey NH/VT Water Science Center, U.S. Geological Survey Ohio Water Science Center. Presented at the New England Association of Environmental Biologists Conference in Sturbridge, MA. March 16-18, 2011.

7. Funding and Community Resources

Funding assistance for bacteria mitigation and other watershed management projects is available from various governmental and private sources. This section provides an overview and contact information for financial assistance programs offered by the State of Vermont. Information here is subject to change, so please contact the appropriate agency to learn more about the programs. Grant funding information for water quality, infrastructure, and agricultural improvements is provided below.

Water Quality Improvement Grants

Section 319 Non-Point Source Management Grants

Congress enacted Section 319 of the Clean Water Act in 1987 establishing a national program to abate non-point sources of water pollution. These grants, known as Section 319 Grants, are made possible by the federal funds provided to VTDEC by the USEPA, and are available to assist in the implementation of projects to promote restoration of water quality by reducing and managing non-point source pollution in Vermont waters.

Eligible applicants: Municipalities, other governmental agencies and non-profit organizations, schools, and universities.
Online: http://www.anr.state.vt.us/dec//waterq/grants.htm
Contact: Rick Hopkins, Water Quality Division, VTDEC, 103 South Main St., Waterbury, VT 05671, (802) 241-3769.

604(b) Water Quality Planning Grants to Regional Planning Commissions

VTDEC is required to pass 40% of its annual federal Clean Water Act Section 604(b) allocation to ―regional comprehensive planning organizations" to conduct a variety of water-related planning activities.

Eligible applicants: Vermont's 11 Regional Planning Commissions
Online: http://www.vtwaterquality.org/wqdhome.htm
Contact: Rick Hopkins, Water Quality Division, VTDEC, 103 South Main St., Waterbury, VT 05671, (802) 241-3769.

Vermont Watershed (Conservation License Plate) Grants

The Vermont Watershed Grants Program provides funding to water-related projects throughout the state. Half of the proceeds from the sale of the Vermont Conservation License Plates fund this program. Projects include the protection and restoration of water quality, fish and wildlife habitat, the education of people about watershed resources, and the monitoring of water quality.

Eligible applicants: Municipalities, local or regional governmental agencies, nonprofits and citizen organizations.
Online: http://www.anr.state.vt.us/dec//waterq/lakes/htm/lp_watershedgrants.htm

Contact: Rick Hopkins, Water Quality Division, VTDEC, 103 South Main St., Waterbury, VT 05671, (802) 241-3769.

Laboratory Services Water Quality Grants

The VTDEC Water Quality Division (WQD) collaborates with the R.A LaRosa Environmental Laboratory on a program to assist citizen monitoring groups statewide. Beginning in 2003, the WQD and the laboratory initiated analytical services partnerships with volunteer organizations, based on a competitive proposal process. No funds are awarded, as grants are in the form of free analytical services to support water quality monitoring performed by local volunteer groups. The project has been extremely successful since its inception, when eleven projects were supported. These projects ranged in scope from small, single-lake studies to large, multi-year and multi-parameter watershed assessment initiatives. In its first year, the program produced in excess of 1,800 viable, quality-assured data records across Vermont. In 2004, over 4,400 monitoring data points were collected by 12 projects.

Eligible applicants: River, lake or watershed associations; municipal conservation commissions or water quality committees; and secondary-level education classes. Post-secondary-level institutions or statewide groups are eligible under certain circumstances.
Online: http://www.anr.state.vt.us/dec/grants.htm.
Contact: Jim Kellogg, Environmental Scientist, Monitoring, Assessment and Planning Program. VTDEC. 103 South Main St., Waterbury, VT 05671 (802) 241-1366.

Lake Champlain Basin Program Grants

Since 1992, the Lake Champlain Basin Program has awarded more than $3.83 million to over 700 projects in New York and Vermont through several competitive grants programs, known collectively as Local Implementation Grants. These grants fund for local watershed projects related to the implementation of the Opportunities for Action Management Plan for the Lake Champlain Basin. Funded projects have included efforts to reduce phosphorus inputs to the lake, to prevent the spread of nuisance species, and to increase public education and outreach about general water quality issues.

Eligible applicants: Municipalities, non-profit organizations, and schools located in the Lake Champlain watershed.
Online: http://www.lcbp.org/
Contact: Lake Champlain Basin Program, 54 West Shore Road, Grand Isle, VT 05458
(800) 468-5227.

Ecosystem Restoration Grants

The Clean and Clear Program through Vermont's Agency of Natural Resources offers Ecosystem Restoration Grants for projects specifically designed to improve water quality. Though projects primarily focus on phosphorus and sediment, bacteria issues may be addressed secondarily through projects such as improving shoreline stability through the installation of BMPs and mitigating the effects of stormwater runoff.

Eligible applicants: Vermont municipalities, local or regional governmental agencies, non-profit organizations, and citizen groups.
Online: http://www.anr.state.vt.us/cleanandclear/
Contact: Eric Smeltzer, Water Quality Division, Vermont Agency of Natural Resources, 103 South Main St., Waterbury, VT 05671, (802) 241-3792.

Infrastructure Improvement Grants and Loans

Municipal Pollution Control Grants and Loans

VTDEC's Facilities Engineering Division administers grant and loan programs for municipal pollution control and water supply construction projects. Eligible projects include those focused on phosphorus removal; pollution abatement; combined sewer overflow abatement; and certain sludge and septage projects at Wastewater Treatment Facilities (WWTFs). Funding is provided by the State and the Federal Clean Water State Revolving Loan (CWSRP) Program.

Eligible applicants: Municipalities.
Online: http://www.anr.state.vt.us/dec/fed/grants.htm
Contact: Larry Fitch, Facilities Engineering Division VTDEC, 103 South Main St., Waterbury, VT 05671. (802) 241-3742.

Public Water System Construction Loans

This loan program, funded by the USEPA, provides funds to municipalities and certain privately-owned water systems for construction, repair or improvement of a public water system to comply with state and federal standards and protect public health.

Eligible applicants: Public community water systems and non-profit non-community water systems.
Online: http://www.vermontdrinkingwater.org/capacity.htm
Contact: Eric Blatt, Engineering and Financial Services Chief, Water Supply Division, VTDEC, 103 South Main St., Old Pantry Bldg., Waterbury, VT 05671. (802) 241-3245.

Drinking Water State Revolving Loan Fund

This loan program provides funds to repair or improve existing privately-owned drinking water systems. Vermont's Agency of Natural Resource's Economic Development Authority approves loans to obtain requisite permits, design, plan, construct, repair, or improved eligible water systems to comply with federal and state standards.

Eligible applicants: Privately-owned community water systems and privately – owned non-profit, non-community public water systems.
Online: http://www.veda.org/interior.php/pid/1/sid/45
Contact: Bryan Redmond, VTDEC Water Supply Division, 103 South Main St., Waterbury, VT 05671. (802) 241-3284.

Water Source Protection Loans

This loan program, funded by the USEPA, provides funds for municipalities for purchasing land or conservation easements in order to protect the health of public water sources.

Eligible applicants: Municipalities.
Online: http://www.vermontdrinkingwater.org/capacity.htm
Contact: Eric Blatt, Engineering and Financial Services Chief, Water Supply Division, VTDEC, 103 South Main St., Old Pantry Bldg., Waterbury, VT 05671. (802) 241-3245.

Vermont Community Development Program (VCDP) Grants

The Vermont Community Development Program (VCDP), funded through the Department of Housing and Community Affairs as part of the federal Community Development Block Grant program, provides grants for a wide range of assistance projects for low and moderate income communities. These projects include improvements to water, sewer, and roads serving economic development and housing.

Eligible applicants: Any Vermont town, city (except Burlington), or incorporated village chartered to function as a general purpose unit of local government. The majority of projects are a coordinated effort between the municipalities, community groups, and local or state non-profit organizations.
Online: http://www.dhca.state.vt.us/VCDP/index.htm
Contact: Joshua Hanford, Department of Housing and Community Affairs, National Life Office Building, Drawer 20, Montpelier, VT 05620, (802) 828-5201.

NeighborWorks Alliance of Vermont Septic Repair Loans

The NeighborWorks Alliance of Vermont offers Septic Repair and Replacement Loans as part of their Home Improvement Loan program. At no charge, NeighborWorks Alliance will write job specifications, approve insured contractors, help coordinate and evaluate bids for the work, inspect the work, and manage payments to contractors. Loan eligibility is determined by income. Money for this program is provided by the Department of Housing and Community Affairs.

Eligible applicants: Vermont homeowners.
Online: http://www.vthomeownership.org/home_improvement.html
Contact: There are five regional centers throughout Vermont. Refer to the following website to determine the center that serves your area: http://www.vthomeownership.org/centers.html.

USDA Rural Development Water and Waste Disposal Loans and Grants

The USDA Rural Development Water and Waste Disposal Loans and Grants program supports community development projects in communities of less than 10,000 people. Eligible projects include water improvements (source, storage, distribution, treatment), sanitary sewer (collection, treatment, combine sewer separation, storm sewers), solid waste disposal (transfer station, incinerator), new systems, renovations, expansions, purchase of an existing system, or –buy-in" fees to existing systems.

Eligible applicants: An eligible applicant can be a public body (town, village, special purpose district) or a non-profit association serving a community with a population of less than 10,000 people. Applicants must also show that they are unable to afford commercial credit.
Online: http://www.rurdev.usda.gov/Home.html
Contact: Mark Koprowski, Vermont office of USDA Rural Development Water and Waste Disposal Loans and Grants Program, (802) 748-8746.

Vermont Better Backroads Grants
The Vermont Better Backroads program has been working with towns, planning commissions, non-profits, and lake and water groups to correct road-related erosion problems to save towns money on road maintenance and improve water quality since 1997. This program, funded by the Natural Resources Conservation Service (NRCS), is a collaborative effort that promotes erosion control techniques and practices through technical and financial assistance. To date, over 300 grants have been awarded to 154 towns and organizations.

Eligible applicants: Vermont municipalities, planning commissions, non-profit organizations, and citizen groups.
Online: http://www.vt.nrcs.usda.gov/rc&d/bbcoverpage.html
Contact: Linda Boudette, Better Backroads Technician, Northern Vermont RC & D, 617 Cornstock Road, Suite 2, Berlin, VT 05602, (802) 793-7816.

Agricultural Grants

Department of Agriculture Natural Resources Conservation Service Environmental Quality Incentives Program (EQIP)
This program is a voluntary conservation grant program designed to promote and stimulate innovative approaches to environmental enhancement and protection, while improving agricultural production. Through EQIP, farmers and forestland managers may receive financial and technical help to install or implement structural and management conservation practices on eligible agricultural and forest land. EQIP provides for additional funding specifically to promote ground and surface water conservation activities to improve irrigation systems; to convert to the production of less water intensive agricultural commodities; to improve water storage through measures such as water banking and groundwater recharge; or to institute other measures that improve groundwater and surface water conservation. EQIP payment rates may cover up to 75 percent of the costs of installing certain conservation practices.

Eligible applicants: Any person engaged in livestock, agricultural production, aquaculture, or forestry on eligible land.
Online: http://www.vt.nrcs.usda.gov/programs/eqip/index.html
Contact: USDA NRCS – VT office 356 Mountain View Drive, Suite 105, Colchester, VT 05446, (802) 951-6796 ext 223.

Boating Grants

Clean Vessel Act Grants - The Clean Vessel Act was established in 1992 by the Federal Government and was signed into law to protect our waters and associated recreational opportunities from damaging vessel sewage discharges. Projects proposed for the construction, renovation, operation, or maintenance of pumpout stations, pumpout boats, and dump stations used by boaters are all eligible to receive federal funding. This money can also be used to pay for projects that hold and transport boater sewage to sewage treatment plants, such as holding tanks, piping, or hauling and disposal fees. Approved projects are given funding for up to 75 percent of the total cost of the project.

Eligible applicants: Any public/private marina, boatyard, shipyard, or state/county/municipal organization wishing to install OR significantly upgrade their pumpout station and make it available to all boaters is eligible for grant funding.
Online: ttp://www.vtfishandwildlife.com/boating_grants.cfm
Contact: Mike Wichrowski, Vermont Fish and Wildlife Department, (802) 241-3700 or mike.wichrowski@state.vt.us.

Additional Resources

The USEPA recognizes that committed watershed organizations and state and local governments need adequate resources to achieve the goals of the Clean Water Act and improve our nation's water quality. To this end, the USEPA has created the following website to provide tools, databases, and information about sources of funding to practitioners and funders that serve to protect watersheds:

Online: http://www.epa.gov/owow/funding.html

8. Watershed-Specific Data Summaries and Reduction Estimates

This section provides an overview of Vermont's Planning Basins (VPBs) and its bacteria impaired segments. The method of calculating the TMDL reduction required to meet water quality standards is described and the specific reductions required for each of the 22 impaired segments are presented for informational purposes only. An introduction to the watershed-specific bacteria data and information summaries in Appendices 1 through 19 is also provided.

8.1 Vermont's Planning Basins and Bacteria Impaired Segments

This statewide TMDL for bacteria impaired waters includes 22 impaired segments from Vermont's 2010 303(d) List. This document serves as a framework for addressing bacteria impaired waters in Vermont. As such, additional waterbodies may be added over time. Figure 8-1 provides a map of Vermont with the 17 planning basins indicated by number and outlined with green boundaries. The figure also illustrates the locations of bacteria impaired segments, shown as blue and red lines. As shown in Table 8-1, the impaired segments from Vermont's 2010 303(d) List are spread among 9 of the 17 VPBs in Vermont, with most of the bacteria impaired segments situated in two VPBs.

Table 8-1: Vermont Planning Basins with Number of Bacteria-Impaired Segments Indicated.

VPB ID	VPB Name	# of Impaired Segments
1	Battenkill, Walloomsuc, Hoosic	0
2	Poultney, Mettawee	1
3	Otter Creek, Little Otter Creek, Lewis Creek	6
4	Lower Lake Champlain	0
5	Upper Lake Champlain, LaPlatte, Malletts Bay, St. Albans Bay, Rock, Pike	5
6	Missisquoi	3
7	Lamoille	0
8	Winooski	3
9	White	0
10	Ottauquechee, Black	0
11	West, Williams, Saxtons	1
12	Deerfield	1
13	Lower Connecticut, Mill Brook	1
14	Stevens, Wells, Waits, Ompompanoosuc	1
15	Passumpsic	0
16	Upper Connecticut, Nulhegan, Willard Stream, Paul Stream	0
17	Lake Memphremagog (Barton, Black, Clyde), Coaticook, Tomifobia	0
	Total	**22**

The two VPBs with the most impaired segments are Basin 5 - Upper Lake Champlain, LaPlatte, Malletts Bay, St. Albans Bay, Rock, Pike (5 impaired segments), and Basin 3 - Otter Creek, Little Otter Creek, Lewis Creek (6 impaired segments).

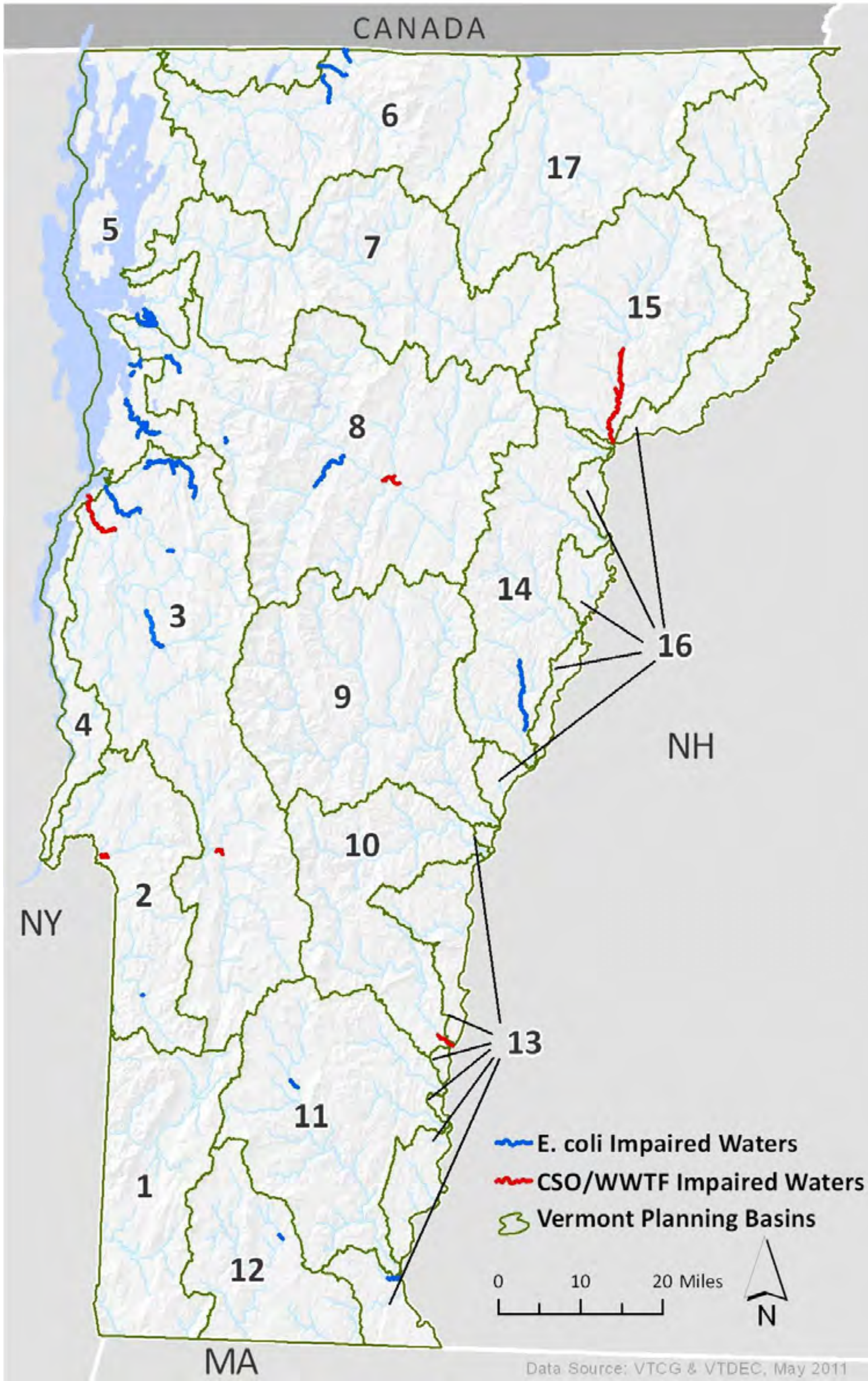


Figure 8-1: Bacteria-Impaired Waters in Vermont, by Vermont Planning Basins.

A complete list of the 22 bacteria impaired segments included in this statewide TMDL is provided at the end of this section in Table 8-2. The table provides the waterbody name, ID, town(s), and specific indicator bacteria for each impaired segment. Information related to the estimated percent reduction needed to meet the TMDL is described in Section 8.3 below, for informational purposes only. All of the impaired segments are river segments and *E.coli* was the indicator bacteria used to establish impairment status.

8.2 Segment-Specific Bacteria Data Summaries

Appendix 1: Flower Brook, mouth to RM 0.5

Appendix 2: Otter Creek, mouth of Middlebury River to Pulp Mill Bridge (4.0 miles)

Appendix 3: Little Otter Creek, mouth to RM 7.8

Appendix 4: Little Otter Creek, RM 15.4 to RM 16.4

Appendix 5: Lewis Creek, from Lower Cov'd Bridge upstream to footbridge (12.3 miles); Pond Brook, from Lewis Creek confluence upstream (1.5 miles)

Appendix 6: Middlebury River, from mouth upstream 2 miles

Appendix 7: Direct Smaller Drainages to Inner Malletts Bay

Appendix 8: Englesby Brook

Appendix 9: LaPlatte River from Hinesburg to mouth (10.5 miles); Mud Hollow Brook, from mouth to 3 miles upstream

Appendix 10: Potash Brook

Appendix 11: Berry Brook, mouth up to and including No. trib (approx. 1 mile); Godin Brook; Samsonville Brook

Appendix 12: Allen Brook

Appendix 13: Huntington River, vicinity of Bridge Street in Huntington

Appendix 14: Mad River, mouth to Moretown (6.2 miles)

Appendix 15: West River, approx 1 mile below to 0.5 miles above South Londonderry

Appendix 16: No. Branch, Deerfield River, vicinity of West Dover

Appendix 17: Whetstone Brook – Brattleboro

Appendix 18: Ompompanoosuc River, USACOE Beach Area to Brimstone Corner (9.8 miles)

Appendix 19: Summary of waters with impairments caused by wastewater treatment facilities or combined sewer overflows

Each segment-specific summary provides the following information:

- A description of the watershed for each impaired segment (size, location, and major features) and an overview of available information related to bacteria.
- A watershed map showing the locations of impaired segments and the land area draining to the impaired segment (i.e., the watershed);
- A land cover map showing land cover types within the watershed.
- Data tables with recent (within 10 years) bacteria data for each impaired segment, with single sample and geometric mean and estimated percent reductions needed to meet the TMDL targets, which are set equal to Vermont's current water quality standards.

Methods applied to characterize the bacteria data and to calculate the estimated reductions in bacteria are described below.

8.3 Estimated Load Reduction Calculation Methodologies

As mentioned in Section 2, this TMDL is based on the current Vermont WQS , and Vermont's current criteria for bacteria are more conservative than those recommended by USEPA. For Class B waters, VTDEC currently uses a single sample criterion of 77 organisms/100ml; for Class A waters, VTDEC currently uses an *E.coli* single sample criterion of 33 organisms/100ml and a geometric mean concentration of 18 organisms/100ml. Since Vermont is in the process of revising their bacteria WQS to better align withthe National Recommended Water Quality Criteria (NRWQC), a comparison is provided here for informational purposes. For Class B waters, EPA has recommended that the most conservative *E.coli*-based criterion be a geometric mean of 126 organisms/100ml, and a single sample of 235 organisms/100ml, and Table 8.2 below shows a visual comparison to Vermont's current bacteria criteria:

Table 8-2: Comparison of Numeric Criteria for Indicator Bacteria.

Water Body Class	E.coli (organisms/100 ml)	
	SSMC	GMC
VT Class A	33	18
VT Class B	77	NA
NRWQC	126	235

Notes: SSMC denotes single sample maximum concentration; GMC denotes geometric mean concentration and is a statistically-based metric; NA denotes not applicable because Vermont currently has no GMC for Class B waters; NRWQC denotes National Recommended Water Quality Criteria (bacteria, 1986).

EPA expects SSM values be used for making beach notification and closure decisions. Other than in this beach management context, the geometric mean is the more relevant value for ensuring that appropriate actions are taken to protect and improve water quality. The GMC is more relevant because it is usually a more reliable measure of long term water quality, being less subject to random variation, and more directly linked to the underlying studies upon which the 1986 bacteria criteria were based (EPA August 2006).

In order to provide a rough estimation of pollution abatement actions needed, Vermont bacteria data statistics were calculated when sufficient data were available, and the estimated percent bacteria reductions needed to meet water quality standards were provided both in Table 8-3 and in the site-specific appendices, for informational purposes only. For comparative purposes, estimated percent reductions in bacteria for each waterbody were compared to both Vermont's current single sample maximum *E.coli* concentration for Class B waters, and to EPA's National Recommended Water Quality Criteria for *E.coli* (both single sample, and geometric mean) in Table 8-3 below. In each impaired segment, the sampling station with the highest single sample bacteria data value was compared first to Vermont's current single sample standard of 77 organisms/100ml to calculate each segment's estimated percent reduction for bacteria. In the next column to the right in Table 8.3, the highest single sample bacteria data value was then compared to National Recommended Water Quality Criteron (NRWQC) for a the single sample of *Ecoli* (235 organisms/100ml).

For the final column in Table 8-3 comparing Vermont data to the NRWQC, geometric means of bacteria data sets were calculated for all sampling stations with four or more data points within a given sampling season. However, only geometric mean values calculated with five or more data points within a given season were used to determine percent reduction. In each impaired segment, the sampling station with the highest geometric mean bacteria data value was compared to the EPA recommended geometric mean standard of 126 organisms/100ml to determine each segment’s percent reduction for bacteria. The estimate of percent reduction needed is calculated based on the difference between measured ambient bacteria data and the water quality criteria for bacteria. For example, if the highest single sample from a specific Class B segment impaired for *E.coli* is 200 organisms/100mL and the single sample water quality standard is 77 organisms/100ml, the percent reduction needed to meet the criteria is calculated as follows:

Percent reduction = [(200 – 77)/200] x 100 = 62% reduction

The results of the analysis for each sampling station and each impaired segment are provided in the appendices. The sampling stations with the highest geometric mean values and the associated required reductions are provided in Table 8-3 by impaired waterbody.

Vermont’s WQS are based on “organisms/100ml”, which is a direct measure of colonies of bacteria. However, most of the available *E. coli* data in Vermont is reported as “MPN (or, Most Probable Number)/100ml”, which is a statistical representation of what level of *E.coli* is likely present in a sample. For the purposes of reporting, these terms have been used interchangeably; VTDEC considers both results equally with regard to assessing waters against the WQS.

Table 8-3: Summary of Estimated Percent Reductions for Bacteria-Impaired Waterbodies (continued).

Waterbody Name	Waterbody ID	Towns	Impairment	% Reduction to meet TMDL		
				Current Single Sample	NRWQC* Single Sample	NRWQC* Geometric Mean
Basin 2: Poultney-Mettawee						
Flower Brook, mouth to RM 0.5	VT02-05	Pawlet	*E.coli*	93%	79%	80%
Basin 3: Otter Creek, Little Otter Creek, and Lewis Creek						
Otter Creek, mouth of Middlebury River to Pulp Mill Bridge (4.0 mi)	VT03-01	Middlebury, Salisbury, Cornwall	*E.coli*	97%	90%	47%
Little Otter Creek, mouth to RM 7.8	VT03-07	Ferrisburg	*E.coli*	97%	90%	76%
Little Otter Creek, RM 15.4 to RM 16.4	VT03-07	New Haven	*E.coli*	97%	90%	59%
Lewis Creek, from lower cov'd bidge upstream to footbridge	VT03-08	Charlotte, Hinesburg, Starksboro, Monkton	*E.coli*	97%	90%	87%
Pond Brook, from Lewis Creek confluence upstream (1.5 mi)	VT03-08	Hinesburg, Monkton	*E.coli*	97%	90%	49%
Middlebury River, from mouth upstream 2 miles	VT03-12	Middlebury	*E.coli*	97%	90%	68%
Basin 5: Upper Lake Champlain, LaPlatte, Malletts Bay, St. Albans Bay, Rock, Pike						
Direct Smaller Drainages to Inner Malletts Bay	VT05-09	Colchester	*E.coli*	97%	90%	83%
Englesby Brook	VT05-10	Burlington	*E.coli*	97%	90%	53%
LaPlatte River from Hinesburg to mouth (10.5 miles)	VT05-11	Hinesburg, Charlotte, Shelburne	*E.coli*	97%	90%	36%
Mud Hollow Brook, from mouth to 3 miles upstream	VT05-11	Charlotte	*E.coli*	97%	90%	52%
Potash Brook	VT05-11	South Burlington	*E.coli*	97%	90%	NA
Basin 6: Missisquoi						
Berry Bk, mouth up to and including No. Trib (approx. 1 mi)	VT06-04	Richford	*E.coli*	99%+	99%+	69%
Godin Brook	VT06-04	Berkshire	*E.coli*	99%+	99%	66%
Samsonville Brook	VT06-04	Berkshire, Enosburg	*E.coli*	99%	98%	Complies
Basin 8: Winooski						

Waterbody Name	Waterbody ID	Towns	Impairment	% Reduction to meet TMDL		
				Current Single Sample	NRWQC* Single Sample	NRWQC* Geometric Mean
Allen Brook	VT08-02	Williston	*E.coli*	97%	90%	59%
Huntington River, vicinity of Bridge Street in Huntington	VT08-10	Huntington	*E.coli*	97%	90%	74%
Mad River, mouth to Moretown (6.2 miles)	VT08-18	Moretown	*E.coli*	97%	90	55%
Basin 11: West River, Saxtons						
West River, approx 1 mile below to 0.5 miles above South Londonderry	VT11-17	Londonderry	*E.coli*	97%	90%	69%
Basin 12: Deerfield						
No. Branch, Deerfield River, vicinity of West Dover	VT12-05	Wilmington, Dover	*E.coli*	82%	46%	Complies
Basin 13: Lower Connecticut, Mill Brook						
Whetstone Brook - Brattleboro	VT13-14	Brattleboro	*E.coli*	86%	57%	NA
Basin 14: Stevens, Wells, Waits, Ompompanoosuc						
Ompompanoosuc River, USACOE Beach Area to Brimstone Corner	VT14-03	Thetford, West Fairlee	*E.coli*	97%	90%	42%

* NRWQC = National Recommended Water Quality Criteria – used for informational purposes in the percent reduction calculations, as described in Section 8.3.

8.4 CSO/WWTF-related Bacteria-Impaired Waterbodies

The nine waterbodies listed in Table 8-4 (below), and shown in red in Figure 8-1, are impaired for *E.coli* due to the influence of wastewater treatment facilities (WWTFs) and combined sewer overflows (CSOs). These waters are not covered under this TMDL but specifics regarding their location and management status is included in this document for informational purposes only. The sources of the impairment are well known, and VTDEC is addressing them using the policies outlined the state's Combined Sewer Overflow Control Policy (1990). This policy specifies that "all combined sewer overflows are identified and issued compliance schedules which lead to compliance with Vermont WQS and the Federal Clean Water Act". Communities with combined sewer systems are expected to develop long-term CSO control plans that will eventually provide for full compliance with the Clean Water Act, including attainment of water quality standards. The ultimate goal is CSO elimination.

The USEPA's CSO Control Policy provides information on nine minimum technology-based controls that communities are expected to use to address CSO problems, prior to the implementation of long-term control measures (EPA, 1995). The nine minimum controls are considered a set of good housekeeping practices aimed at minimizing the frequency of CSO discharges at a minimal cost. These controls are measures that can be implemented to reduce the effect of CSOs without large engineering studies or major construction. The nine minimum controls are summarized below, and additional information is provided in EPA's *Guidance for Nine Minimum Controls* [http://www.epa.gov/npdes/pubs/owm0030.pdf].

1. Proper operation and regular maintenance programs for the sewer system and CSOs;
2. Maximum use of collection system for storage;
3. Review and modification of pretreatment requirements to ensure CSO impacts are minimized;
4. Maximization of flow to publicly owned treatment works for treatment;
5. Prohibition of CSOs during dry weather;
6. Control of solid and floatable materials in CSOs;
7. Pollution prevention programs to reduce contaminants in CSOs;
8. Public notification program to ensure that public receives adequate notice of CSO events and impacts; and
9. Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls.

It is anticipated that these segments will remain on the 303(d) (Vermont's Part A) list of impaired waters until water quality standards are met. Appendix 19 of this report provides information on the status of the schedule of compliance, and progress toward CSO elimination for the following waters with impairments caused by WWTFs or CSOs:

Table 8-4: Summary of CSO/WWTF-related Bacteria-Impaired Segments.

Waterbody Name	Waterbody ID	Towns	Impairment
Basin 2: Poultney-Mettawee			
Castleton River, Fair Haven	VT02-03	Fairhaven	*E.coli*
Basin 3: Otter Creek, Little Otter Creek, and Lewis Creek			
Lower Otter Creek, Below Vergennes WWTF (approx 7 miles)	VT03-01	Vergennes, Panton, Ferrisburg	*E.coli*
Otter Creek below Rutland City WWTF	VT03-05	Rutland City	*E.coli*
East Creek, mouth to 0.2 mi (below CS) drainage pts #2 and #9)	VT03-14	Rutland City	*E.coli*
Basin 8: Winooski			
Winooski River above Montpelier WWTF discharge	VT08-05	Montpelier	*E.coli*
Lower North Branch, Winooski River (approx 1 mile)	VT08-13	Montpelier	*E.coli*
Basin 10: Ottauquechee, Black			
Black River, from mouth to 2.5 miles upstream (Springfield)	VT10-11	Springfield	*E.coli*
Basin 15: Passumpsic			
Passumpsic River from Pierce Mills Dam to 5 miles below Passumpsic Dam	VT15-01	St. Johnsbury, Waterford, Barnet	*E.coli*
Lower Sleepers River in St. Johnsbury	VT15-04	St. Johnsbury	*E.coli*

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