STATE OF CONNECTICUT

DEPARTMENT OF ENERGY AND ENVIRONMENTAL PROTECTION

A Statewide Total Maximum Daily Load Analysis for Bacteria Impaired Waters

December 2025

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Brian Thompson, Acting Bureau Chief | Date
Bureau of Water Protection and Land Reuse

Katie S. Dykes, Commissioner

Bureau of Water Protection and Land Reuse
79 Elm Street
Integrated Water Quality Report
Hartford, CT 06106-5127
(860) 424-3704

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LIST OF ACRONYMS

AFO	Animal Feeding Operation
BMP	Best Management Practice
CDBG	Community Development Block Grant
CFR	Code of Federal Regulations
CGS	Connecticut General Statutes
CNMP	Comprehensive Nutrient Management Plan
CSO	Combined Sewer Overflow
CT DEEP	Connecticut Department of Energy and Environmental Protection
CT DOT	Connecticut Department of Transportation
CT DPH	Connecticut Department of Public Health
CLEAR	Center for Land Use Education and Research
CWA	Clean Water Act
CWF	Clean Water Fund
EPA	United States Environmental Protection Agency
GM	Geometric Mean
GM WQS	Geometric Mean Water Quality Standard
IDDE	Illicit Discharge Detection and Elimination
LA	Load Allocation
LID	Low Impact Development
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer Systems
NA	Not Applicable
NDA	No Discharge Area
NOAA	National Oceanic & Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	Non-Point Source
NRCS	Natural Resource Conservation Service
NSSP	National Shellfish Sanitation Program
OBD	Overboard Discharge
SWPPP	Stormwater Pollution Prevention Plan
PS	Point Source
RCSA	Regulations of Connecticut State Agencies
SSDS	Subsurface Seage Treatment and Disposal System
SSO	Sanitary Sewer Overflow
SSWQS	Single Sample Water Quality Standard
SWMP	Stormwater Management Plan
TMDL	Total Maximum Daily Load
US DA	United States Department of Agriculture
US EPA	United States Environmental Protection Agency
US FDA	United States Food and Drug Administration
WBP	Watershed-Based Plan
WLA	Waste Load Allocation

WPCF	Water Pollution Control Facility
WQC	Water Quality Criteria
WQS	Water Quality Standards

SECTION 1. INTRODUCTION

1.1 Background

Since 1972, the Federal Clean Water Act (CWA) provides the regulatory framework and legal authority for the protection of lakes, rivers, streams, wetlands, and coastal areas within the United States. The CWA requires the United States Environmental Protection Agency (EPA) and authorized states and Tribes to institute and execute a planning and implementation process for the restoration and protection of all surface waters within their boundaries to meet state water quality standards (WQS) for applicable designated uses (Figure 1). The planning and implementation process includes: 1) adopting WQS; 2) monitoring the water quality of surface waters to evaluate consistency with WQS; 3) prioritizing surface waters for development of Water Quality Action Plans (WQAP), such as Total Maximum Daily Load (TMDL) analyses or other management plans to restore or protect water quality consistent with WQS; (4) developing TMDLs or other types of WQAP ; and (5) implementing those TMDLs or WQAP to achieve consistency with WQS.

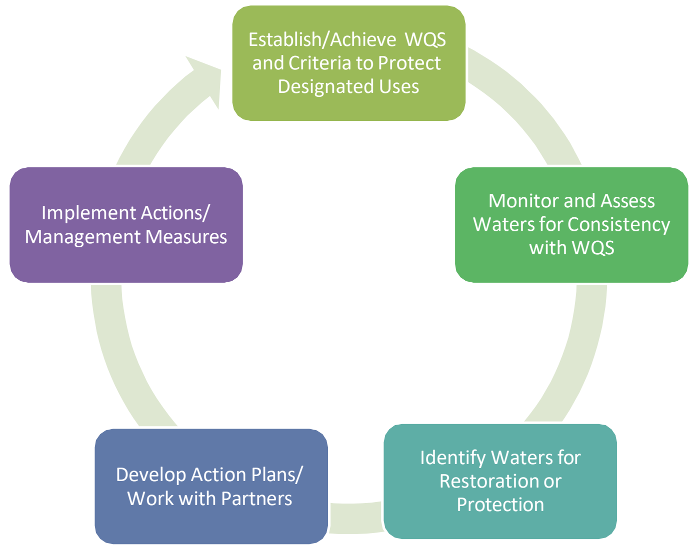


Figure 1. Conceptual diagram of the planning and implementation cycle.

*A **TMDL** defines the maximum amount of the pollutant that a waterbody can assimilate while continuing to meet WQS and allocates that maximum allowable pollutant load between point and nonpoint sources of the pollutant. A TMDL also provides a framework for EPA, states, and partner organizations to establish and implement pollution control and management plans, with the ultimate goal described in Section 101(a)(2) of the CWA: to achieve "water quality which provides for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water, wherever attainable."*

As an enhancement of the 303(d) program prioritization process, the Connecticut Department of Energy and Environmental Protection (CT DEEP) began employing an approach known as Integrated Water Resource Management, which is based on six key elements: prioritization, assessment, protection, alternatives, engagement, and integration. The approach allows CT DEEP to identify waterbodies for TMDLs or WQAP and Watershed-Based Plan (WBP) development based on state-specific concerns and provides CT DEEP sufficient time to develop WQAPs using flexible approaches under existing 303(d) program authority. Using this approach, managing and reducing excessive amounts of bacteria in surface waters was identified as a focus area for water quality restoration and protection activities in Connecticut.

1.2 Pathogens & Fecal Indicator Bacteria

Pathogens cause disease in humans and animals. Microbial pathogens include bacteria, protozoans, and viruses. The presence of waterborne pathogens in surface waters can pose a risk to human health, potentially causing gastrointestinal illness through different exposure routes, including contact with and ingestion of recreational waters, ingestion of contaminated drinking water, and consumption of filter-feeding shellfish (clams, mussels, etc.) harvested from contaminated waters. Many pathogenic bacteria are found in low levels and are difficult and expensive to detect directly. Virus detection requires specialized equipment and is also expensive (NNPSMP, 2013). Specific types of bacteria present in fecal matter are used as indicator organisms, or surrogates, for pathogens in water. These surrogates are used since their presence can indicate a potential for other organisms associated with infectious diseases in humans (CWA Section 502(23)). Connecticut uses fecal indicator bacteria such as Total Coliform, *Escherichia coli* (E. coli), fecal coliform bacteria, and Enterococcus as evidence of fecal contamination.

Pathogens may be transported to surface waterbodies by stormwater runoff or persistent sources, such as poorly treated effluent from sewage treatment facilities, failing septic systems, untreated agricultural runoff, and illicit discharge pipes. Once in a waterbody, the pathogen can infect humans through ingestion of water or consumption of contaminated fish and shellfish.

Waste from warm-blooded animals is a source for many types of bacteria found in waterbodies, such as, pathogenic E. coli, Salmonella, Campylobacter, Leptospira, Cryptosporidium and Giardia. In addition, feces may contain pathogenic viruses, protozoa, and parasites. For information on pathogens from nonhuman sources, see Review of Zoonotic Pathogens in Ambient Waters (US EPA, 2009).

Fecal indicator bacteria, (groups of nonpathogenic fecal bacteria) are used by public health and environmental agencies to detect the presence and magnitude of fecal material since the widespread monitoring of recreational waters directly for all disease-causing microorganisms is not feasible. The amount of fecal indicator bacteria is used to estimate the amount of feces, and therefore, the presence and quantity of fecal pathogens in the water. EPA conducted studies to evaluate human health impacts from exposure to pathogens at bathing beaches. These studies found Enterococci and *Escherichia coli* correlated with illness. EPA recommends E. coli as the indicator in fresh water and Enterococci as the indicator for both marine and fresh water (US EPA, 2012). E. coli is a single species within the fecal coliform group, and Enterococci is another group of bacteria found primarily in the intestinal tract of warm-blooded animals (US EPA, 2006).

Connecticut uses E. coli and Total coliform as indicator organisms of potential harmful pathogens in fresh waters and Enterococci and fecal coliform for estuarine or marine recreational waters. To determine risk in shellfish harvesting areas, fecal coliform organisms are used (based on criteria recommended under the National Shellfish Sanitation Program; NSSP). Specific indicator criteria are provided in the Water Quality Classifications and Standards Section (Section 2.0) of this report.

1.3 Purpose and Overview

The purpose of the Connecticut Statewide Bacteria TMDL is to use a watershed-based approach to set concentration-based bacteria targets in surface waters throughout Connecticut that, if achieved, will result in consistency with the State of Connecticut WQS. Water quality that is consistent with WQS is expected to support designated uses.

*A **watershed-based approach** that uses the surface drainage area as the basic study unit enables managers to gain a more complete understanding of the potential pollutant sources impacting a waterbody and increases the precision of identifying local problem areas or "hot spots" which may detrimentally affect water quality. Further, addressing many waterbodies across multiple watersheds through a statewide TMDL is more efficient than developing TMDLs for each impaired waterbody individually. This approach also provides a useful format for guiding both restoration and protection efforts at the municipal and regional level by providing a coordinating framework for environmental management that supports efforts to systematically identify, evaluate, and prioritize point and nonpoint sources of pollutants using natural hydrologic boundaries to define the problem areas.*

Starting in 2022, all waterbodies within each TMDL Study Area watershed are included in TMDLs developed under this watershed approach. This includes any waterbody segments that have been assessed, those segments for which an assessment is not currently available and waterbodies that have not yet been assigned a waterbody identification number (Waterbody ID). Prior to 2022, TMDLs focused only on waters listed as impaired on the Connecticut Integrated Water Quality Report. In all cases, this TMDL provides a mechanism to identify the water quality goals and criteria in the Connecticut Water Quality Standards that are applicable to these waters.

For waterbodies that are impaired due to elevated levels of bacteria, this TMDL provides a plan to restore water quality to support designated uses in the future. For those waterbodies that are assessed as supporting based on the level of bacteria in the surface waters, this TMDL provides a plan to continue to protect and maintain good water quality. For waterbodies that are not currently assessed or for those which have not yet been assigned a Waterbody ID, this TMDL provides a plan to support application of water quality criteria and goals already established for these waterbodies within the Connecticut Water Quality Standards.

The same analyses conducted for the segments impaired by elevated levels of bacteria would also apply to the nonimpaired segments and waterbodies within the study area. The sources potentially contributing bacteria to the waterbodies and their characteristics are equivalent. The waste load and/or load allocation for each source and designated use of the surface water would be the same with these TMDLs. Therefore, the TMDLs for the nonimpaired waters would have identical waste load and load allocations based on the sources present and the designated use of the water body segment. TMDLs for the nonimpaired segments and waterbodies are established consistent with Section 303(d)(3) of the Clean Water Act.

Waterbodies are identified for inclusion in TMDLs, and their assessment status indicated, based on the information available at the time the TMDL is written. In the future, the assessment status of these waterbodies may change, but the TMDL will remain in effect. This information will be conveyed through the most current CT DEEP Integrated Water Quality Report. If Waterbody IDs are established for segments within the study area of an established TMDL, those segments will be administratively added to that TMDL through the Integrated Water Quality Report process, which includes a public comment period. Including these waters in the TMDL does not represent a change in the water quality goals for these waters as the Waste Load Allocations and Load Allocations within the TMDL are based on attainment of the standards and criteria for bacteria established in the Connecticut Water Quality Standards which already apply to these waterbodies.

The main objectives of the Connecticut Statewide Bacteria TMDL include the following: describe existing conditions and applicable standards and guidelines; identify water quality targets for each waterbody; identify water quality targets for sources that may contribute bacteria to each waterbody; establish a margin of safety; account for seasonal variation; develop a monitoring plan; develop an implementation plan; provide reasonable assurances that the plans will be acted upon; and describe public participation in the TMDL process. Information common to bacteria related concerns for all waterbodies in Connecticut is contained in the main body of this report (a.k.a., Core Document), while information specific to each watershed is contained in the appendices.

With this 2024 revision to the Core Document, CT DEEP is incorporating a comprehensive approach to the water quality planning, restoration, and protection process to address bacteria in surface waters. CT DEEP has integrated portions of the required nine elements of a Watershed Based Plan (WBP) in the Core Document and TMDL appendices to the Connecticut Statewide Bacteria TMDL (Figure 2). CT DEEP recommends the development of a WBP for each TMDL to identify and implement approaches to address nonpoint source pollution sources that may be contributing bacteria to surface water bodies. These WBPs could be considered Addendums to the associated TMDL. By addressing some of the elements required for WBPs within the Core Document and TMDL appendices, CT DEEP is providing a platform to support a more efficient development of WBPs. WBPs developed after the updated Core and TMDL documents can build on the information provided in these documents and focus WBP development on the elements that either need further watershed-specific information and analyses, particularly as it pertains to identifying implementation activities to address nonpoint sources that may contribute bacteria to surface water bodies. Portions of the required nine elements for WBPs that are covered within the Core Document and TMDL appendices do not have to be repeated in the WBP but can be incorporated by reference. Combining these planning requirements helps to streamline environmental protection and restoration efforts because the Core Document, watershed-specific appendices, and watershed-specific WBP addendums can be approvable, collectively, as a WBP, which is needed to qualify for CWA Section 319 funding (see Section 6 for further discussion). These elements are incorporated generally in the Core Document and specifically (as available) in the watershed-specific appendices. WBP addendums provide more specific information not included in the TMDL appendices (such as schedules and implementation strategies based on field assessments and stakeholder engagement). More detail on the interconnections between this TMDL and WBPs is provided in Section 6.

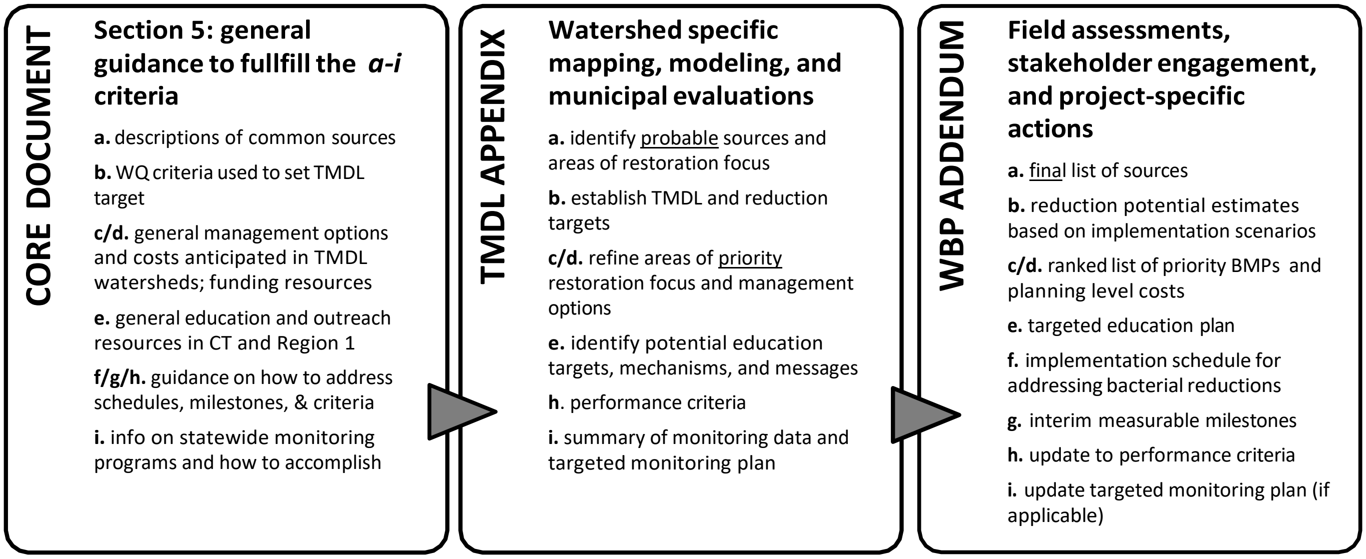


Figure 2. Conceptual diagram showing the integration of the required nine elements (a-i) of a WBP in the Core Document, TMDL appendices, and future WBP addendums to the Connecticut Statewide Bacteria TMDL.

SECTION 2. WATER QUALITY CLASSIFICATIONS AND STANDARDS FOR BACTERIA

WQS determine the baseline water quality that all waters of a state must meet to protect the intended uses for each waterbody. The Connecticut WQS are the foundation for the State's water pollution control and water quality management efforts and are applicable to both surface and groundwaters. Section 22a-426 of the Connecticut General Statutes requires that the Commissioner of the CT DEEP adopt WQS consistent with the CWA. The Connecticut WQS themselves are contained within the Regulations of Connecticut State Agencies (RCSA) 22a-426 Sections 1 through 9.

The Water Quality Standards establish a goal of restoring and maintaining the chemical, physical, and biological integrity of Connecticut surface waters and, wherever attainable, providing for the protection and propagation of fish, shellfish, and wildlife and for recreation in and on the water. While many aspects of the WQS are applicable to bacteria-related water quality, the following are particularly pertinent: surface water classifications, numeric criteria for bacteria, standards pertaining to managing bacteria sources associated with sewage, and the Antidegradation Policy and Implementation Strategy. More information on this topic is available from the CT DEEP WQS Webpage, including a multimedia story map on WQS and classifications.

The Connecticut WQS are formally composed of three parts: standards, criteria, and classification maps. The standards designate use goals and set overall policy for managing surface and ground waters (including antidegradation provisions). The criteria set the narrative and numerical targets for water quality which are necessary to protect the designated uses. The classification maps are a series of municipal level maps that indicate which classification, and thus which designated uses and criteria, applies to each waterbody in the State. For this TMDL, the applicable WQS are presented in the following order: surface water quality classification by designated uses; water quality criteria and Antidegradation Policy and Implementation Strategy. Each of these parts is described below, along with application of WQS to monitoring data for the

303(d) listing process and for setting the water quality-based Waste Load and Load Allocations for the TMDL.

2.1 Surface Water Classifications and Designated Uses

Designated uses for surface waters in Connecticut are Existing or Proposed Drinking Water Supply, Potential Drinking Water Supply, Habitat for Fish and Other Aquatic Life and Wildlife, Recreation, Navigation, Industrial Water Supply, Agricultural Water Supply, Shellfish Harvesting for direct human consumption, Commercial Shellfish Harvesting, and Fish Consumption. Surface waters are categorized according to the Water Quality Classifications of the Connecticut WQS which assigns all surface waters to one of three freshwater (Class AA, A, B), or one of two saltwater (Class SA, SB), classifications CT DEEP.

Freshwater

- ***Class AA:*** designated as a source of existing or proposed drinking water supply; habitat for fish and other aquatic life and wildlife; recreation; industrial and agricultural water supply; and shall have excellent aesthetic value.
- ***Class A:*** designated for potential drinking water supply; habitat for fish and other aquatic life and wildlife; recreation; navigation; industrial and agricultural water supply; and shall have excellent aesthetic value.
- ***Class B:*** designated as habitat for fish and other aquatic life and wildlife; recreation; navigation; industrial and agricultural water supply; and shall have good to excellent aesthetic value.

Saltwater

- ***Class SA*****:** designated for shellfish harvesting for direct human consumption; habitat for marine fish and other aquatic life and wildlife; recreation; navigation; industrial water supply; and shall have excellent aesthetic value.
- ***Class SB:*** designated for commercial shellfish harvesting; habitat for marine fish and other aquatic life and wildlife; recreation; navigation; industrial water supply; and shall have good to excellent aesthetic value.

Each classification is defined by the designated uses that are the most sensitive. The classification for each waterbody is indicated by a series of maps, one per municipality in Connecticut. Classification maps are available online through the Water Quality Classification Maps webpage, CT DEEP's GIS Data Repository, and Connecticut Environmental Conditions Online. Because the classifications pertain to uses, they do not reflect present conditions or environmental quality of the waterbody. Information on environmental quality is provided in the Connecticut Integrated Water Quality Report.

This Core Document was developed for all fresh and marine surface waters. As such, surface waters classified as AA, A, B, SA or SB may be included in the TMDL. The TMDL focuses on the impacts of bacteria on designated uses, primarily recreation and shellfishing uses, but drinking water use protection could also be considered, if needed.

The Department of Agriculture/Bureau of Aquaculture is responsible for regulating aquaculture operations and ensuring that Connecticut shellfish are safe for consumption. To learn more about the shellfish Sanitation Program, information on shellfish safety, sanitary surveys and shellfish growing areas please see the Shellfish Sanitation Program website. For information on shellfish beds and classifications, and sampling stations, please refer to the interactive Aquaculture Mapping Atlas online.

Table 1. Applicable Designated uses by Waterbody Class.

Designated Use*	Definition	Applicability
Recreation	Swimming, water skiing, surfing or other full body contact activities (primary contact), as well as boating, canoeing, kayaking, fishing, aesthetic appreciation or other activities that do not require full body contact (secondary contact)	All surface waters
Habitat for fish and other aquatic life and wildlife	Water suitable for the protection, maintenance and propagation of a viable community of aquatic life and associated wildlife.	All surface waters
Existing or proposed drinking water supplies	Waters presently used for public drinking water supply or officially proposed for future public water supply.	AA
Potential drinking water supplies	Waters that have not been identified, officially, but may be considered for public drinking water supply in the future.	A
Fish Consumption	Waters supporting fish populations that are free of contaminants at concentrations that would limit human consumption.	All surface waters
Commercial shellfish harvesting	Waters supporting commercial shellfish harvesting for transfer to a depuration plant or relay (transplant) to approved areas for purification prior to human consumption (may be conditionally approved); also support seed oyster harvesting.	SB
Shellfish harvesting for direct human consumption	Waters from which shellfish can be harvested both recreationally and commercially and consumed directly without depuration or relay. Waters may be conditionally approved.	SA
Navigation	Waters capable of being used for shipping, travel or other transportation by private, military or commercial vessels.	All surface waters
Water Supply for Industry	Waters suitable for industrial supply.	All surface waters
Water Supply for Agriculture	Waters suitable for general agricultural purposes.	AA, A, B

*Table Adapted from CT WQS

2.2 Water Quality Standards and Criteria

Connecticut'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 in Table 1 can be supported. Numeric criteria are typically concentrations representing acceptable levels of pollutants that allow for attainment of designated and existing uses. Concentrations of pollutants above the numeric criteria represent levels at which the uses for the waterbody may not be supported and, therefore, violate WQS. Water quality criteria for bacteria have been developed to protect several of the designated uses identified for waterbodies in Connecticut:

- Public Drinking Water Supply (Existing and Proposed and Potential);
- Recreation (Designated Swimming Areas, Non-Designated Swimming Areas, and other uses); and
- Shellfish Consumption (Direct and Indirect).

Current numeric criteria for bacteria for Connecticut surface waters are presented in Table 2 and Table 3. The State of Connecticut uses multiple fecal indicator bacteria to identify the potential for disease resulting from recreational activities in surface waters contaminated by fecal pollution. E. coli and Total coliform are indicator bacteria for fresh water and Enterococci and Fecal coliform are indicator bacteria for estuarine or marine water.

- ***Total coliform*** bacteria are used to determine risk for existing and proposed public drinking water supplies. Total coliform based criteria are expressed as an instantaneous or single sample concentration and as a monthly moving average;
- ***E.coli*** bacteria are used as Connecticut's primary bacteria indicator for assessing recreation uses in the State's fresh waterbodies. E.coli based criteria are expressed as a geometric mean concentration and an instantaneous or single sample concentration;
- ***Fecal coliform*** bacteria are used to determine risk for shellfish consumption. Fecal coliform based criteria are expressed as a geometric mean concentration and 90 % of samples less than; and
- ***Enterococci*** bacteria are used to assess recreation uses in the State's estuarine and marine waterbodies. Enterococci based criteria are expressed as a geometric mean concentration and an instantaneous or single sample concentration.

*A **geometric mean** is a way to determine the middle or average for 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.*

*The **90%of samples less than** is a measure that a dataset must have no more than 10% of included samples exceeding the appropriate criteria.*

*The **monthly moving average** is a way to average a set of values to reduce the effects of random variation by averaging consecutive values in a time series of a specified duration.*

Shellfish harvesting waters have two additional standards that have been adopted by the State from the National Shellfish Sanitation Program. These additional shellfish area standards are based on geometric means and the percent of samples meeting criteria using either a random sampling or adverse pollutant condition (e.g., wet weather, during effluent discharge, etc.). According to Connecticut Water Quality Standards Sec. 22a-426-4, Water Quality Criteria do not apply to environmental conditions brought about by natural causes or conditions. The criteria to protect shellfish uses apply through the full year and all recreation criteria apply during the disinfection season, specified in section 22a-426-4(a)(9)(E) of the CT WQS, or adjusted as needed to protect designated uses on a case-by-case basis as part of the permitting process.

Table 2. Current CT Water Quality Criteria for Bacteria in Freshwater

Table 2. Current CT Water Quality Criteria for Bacteria in Freshwater				
Designated Use: Freshwater Recreation	**Water Quality Class**	**Indicator Bacteria**	**Numeric Criteria (# colonies/100 ml)**	
Designated Swimming[1]	AA, A, B[3]	*Escherichia coli*	Geometric mean less than 126/100 ml	Single sample maximum less than or equal to 235/100 ml
Non-Designated Swimming[2]				Single sample maximum less than or equal to 410/100 ml
All Other Recreational Uses				Single sample maximum less than or equal to 576/100 ml
Designated Use: Drinking Water	**Water Quality Class**	**Indicator Bacteria**	**Numeric Criteria (# colonies/100 ml)**	
Drinking Water Supply[4]	AA	Total Coliform	Monthly moving average < 100/100 ml	Single Sample Maximum 500/100 ml

[1] Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in the *Guidelines for Monitoring Swimming Water and Closure Protocol* adopted jointly by CT DEEP and CT DPH, as updated. Available on the CT DEEP State Bathing Beach Monitoring Program webpage.

[2] Includes areas otherwise suitable for swimming but which have not been designated by State or Local authorities as bathing areas, waters which support tubing, water skiing, or other recreational activities where full body contact is likely. When a municipal or state designated swimming area is not identified along the waterbody route, Non-Designated Swimming is the default criteria applied to a fresh waterbody.

[3] Criteria for the protection of recreational uses in Class B waters do not apply when disinfection of WPCF effluents is not required, consistent with the WQS, as outlined in RCSA 22a-426-4(a)(9)(E).

[4]Criteria applies only at the drinking water supply intake structure.

Table 3. Current CT Water Quality Criteria for Bacteria in Saltwater

Table 3. Current CT Water Quality Criteria for Bacteria in Saltwater

Designated Use: Saltwater Recreation	Water Quality Class	Indicator Bacteria	Numeric Criteria (# colonies/100 ml)	
Designated Swimming[1]	SA, SB	Enterococci	Geometric mean less than 35/100 ml	Single sample maximum less than or equal to 104/100 ml
All Other Recreational Uses[2]				Single sample maximum less than or equal to 500/100 ml
Designated Use: Saltwater Shellfishing	**Water Quality Class**	**Indicator Bacteria**	**Numeric Criteria (# colonies/100 mL)**	
Direct Consumption[3]	SA	Fecal coliform	Geometric mean less than 14/100 ml	90% samples less than 31/100 ml
Indirect Consumption[3]	SB		Geometric mean less than 88/100 ml	90% samples less than 260/100 ml

[1] Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in the *Guidelines for Monitoring Swimming Water and Closure Protocol* adopted jointly by CT DEEP and CT DPH, as updated. Available on the CT DEEP State Bathing Beach Monitoring Program webpage.

[2] If a municipal or state designated swimming area is not identified along the segment route, CT applies the All Other Recreational Uses criteria.

[3] Shellfishing criteria are based on utilizing the mTec method as specified in the U.S. Food and Drug Administration National Shellfish Sanitation Program-Model Ordinance (NSSP-MO) document titled *Guide for the Control of Molluscan Shellfish*.

2.3 Potential Changes to Water Quality Criteria

At the time this TMDL is being established, CT DEEP is in the process of developing updates to the Connecticut WQS. One update that is currently under consideration is an update to the Water Quality Criteria (WQC) for Bacterial Indicators, for consistency with criteria recommendations provided by EPA under Section 304(a) of the Clean Water Act. The potential revisions to the Connecticut recreational WQC for bacteria will, if proposed, be subject to a public review and regulatory amendment process consistent with Connecticut state laws. An adopted revision to the WQC in the future would necessitate a revision to the Waste Load Allocations (WLAs) and Load Allocations (LAs) in this TMDL. For administrative efficiency, CT DEEP is providing information on the potential revisions to the CT WQC for bacteria and the associated changes to the WLAs and LAs for this TMDL. If the EPA criteria are adopted into the Connecticut WQS and subsequently approved by EPA, the WLAs and LAs in Appendix C will go into effect, replacing those identified in Tables 6 and 7 of this TMDL with those in Tables 8 and 9. This will be identified in the public notice for potential changes to the Water Quality Standards when issued.

Note: Changes to the CT WQC and to the WLAs and LAs in TMDLs do not affect the Guidelines for Monitoring Swimming Water and Closure Protocol, as updated, available on the State Bathing Beach Monitoring Program website.

Table 4. Potential Future CT Water Quality Criteria for Bacteria in Freshwater

Table 4. Potential Future CT Water Quality Criteria for Bacteria Freshwater				
Designated Use: Freshwater Recreation	**Water Quality Class**	**Indicator Bacteria**	**Numeric Criteria (# colonies/100 ml)**	
Freshwater Recreation Water Quality Criteria[1, 2]	AA, A, B[3]	*Escherichia coli*	Geometric mean less than or equal to 126/100 ml	90% samples less than or equal to 410/100 ml
[1] Potential criteria values are based on the 2012 US EPA national recommendations outlined in the *2012 Recreational Water Quality Criteria Document* (US EPA 820-F-12-058). These criteria are applicable to this TMDL only after they are proposed and adopted by CT DEEP through a public review and regulatory amendment process for the WQS consistent with CT state law and subsequent approval by US EPA.				
[2]Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in the *Guidelines for Monitoring Swimming Water and Closure Protocol* adopted jointly by CT DEEP and CT DPH, as updated. Available on the CT DEEP State Bathing Beach Monitoring Program webpage.				
[3]Criteria for the protection of recreational uses in Class B waters do not apply when disinfection of WPCF effluents is not required, consistent with the WQS, as outlined in RCSA 22a-426-4(a)(9)(E).				

Table 5. Potential Future CT Water Quality Criteria for Bacteria in Saltwater

Table 5. Potential Future CT Water Quality Criteria for Bacteria in Saltwater				
Designated Use: Saltwater Recreation	**Water Quality Class**	**Indicator Bacteria**	**Numeric Criteria (# colonies/100 ml)**	
Saltwater Recreation Water Quality Criteria[1,2]	SA, SB	Enterococci	Geometric mean less than or equal to 35/100 ml	90% samples less than or equal to 130/100 ml
Designated Use: Saltwater Shellfishing	**Water Quality Class**	**Indicator Bacteria**	**Numeric Criteria (# colonies/100 mL)**	
Direct Consumption[3]	SA	Fecal coliform	Geometric mean less than 14/100 ml	90% samples less than 31/100 ml
Indirect Consumption[3]	SB		Geometric mean less than 88/100 ml	90% samples less than 260/100 ml
[1] Potential criteria values are based on the 2012 US EPA national recommendations outlined in the *2012 Recreational Water Quality Criteria Document* (US EPA 820-F-12-058). These criteria are applicable to this TMDL only after they are proposed and adopted by CT DEEP through a public review and regulatory amendment process for the WQS consistent with CT state law and subsequent approval by US EPA.				
[2] Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in the *Guidelines for Monitoring Swimming Water and Closure Protocol* adopted jointly by CT DEEP and CT DPH, as updated. Available on the CT DEEP State Bathing Beach Monitoring Program webpage.				
[3] Shellfishing criteria are based on utilizing the mTec method as specified in the U.S. Food and Drug Administration National Shellfish Sanitation Program-Model Ordinance (NSSP-MO) document titled *Guide for the Control of Molluscan Shellfish*. No change to these criteria expected at this time.				

2.4 Antidegradation Standards & Implementation Policies

Antidegradation standards are designed to preserve and protect the designated uses of the State's surface waters and to limit the degradation of such waters (RCSA 22a-426-8(a)). The standards focus on the maintenance, protection, and improvement of water quality of all waters to support designated uses and provide additional protection for high quality and Outstanding National Resource Waters.

Antidegradation implementation policies for evaluation and implementation review contained in RCSA 22a-426-8(b) follow a tiered approach pursuant to federal regulations (Title 40 Code of Federal Regulations (CFR) 131.12). The purpose of antidegradation evaluation and implementation review for Tier 1 is to ensure that existing and designated uses of all surface waters and the water quality necessary for their protection are maintained and preserved. The purpose of Tier 2 evaluation and implementation review is to ensure high quality surface waters and wetlands with existing water quality better than the WQS are maintained at their existing high quality. The purpose of Tier 3 evaluation and implementation review is to ensure that water quality of Outstanding National Resource Waters is maintained and protected.

SECTION 3. ASSESSING AND LISTING WATERS BASED ON BACTERIA AND WATER QUALITY

Every two years, CT DEEP publishes an updated Integrated Water Quality Report (IWQR). This report provides information on water quality for surface waters in the state, identifying which waters are meeting the designated uses from the WQS and which ones are not. Waters that are not meeting their designated uses are referred to as impaired. Under Section 303(d) of the Federal Clean Water Act (CWA), States are required to develop TMDLs for waters impaired by pollutants and are encouraged to also develop TMDLs for all other waters. Please refer to the most recent IWQR for more information on water quality in waterbodies that have been assessed throughout the State.

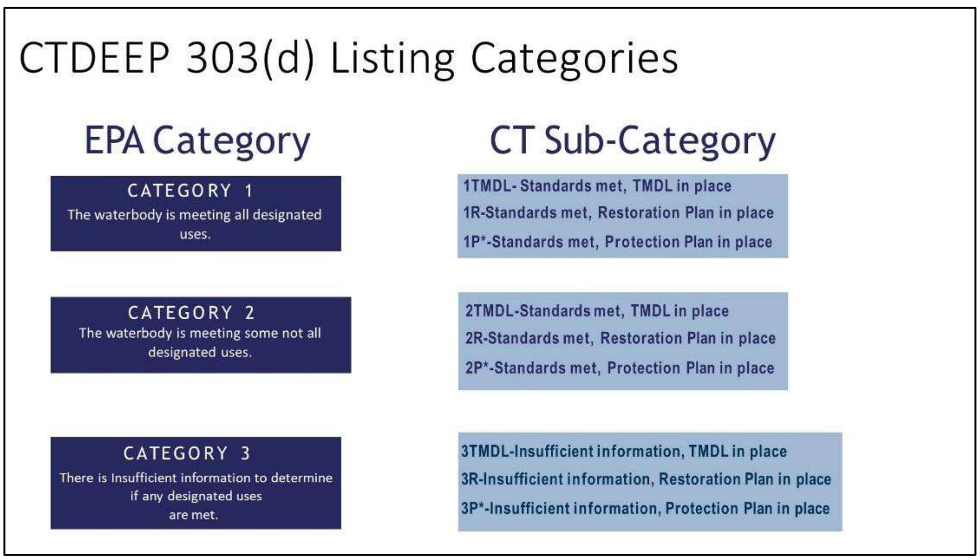
The methods used to assess waters for consistency with the WQS in Connecticut are provided in the Consolidated Assessment and Listing Methodology, which is Chapter 1 in the Integrated Water Quality Report. In making water quality assessments, each designated use of a waterbody is assigned a level of support (i.e., fully supporting, not supporting, insufficient information, not assessed), which characterizes whether the water is suitable for that use. The level of use support attainment is based upon available data and other reliable information. The Consolidated Assessment and Listing Methodology also establishes minimum standards for data acceptability to ensure that only credible data are used to perform the assessments.

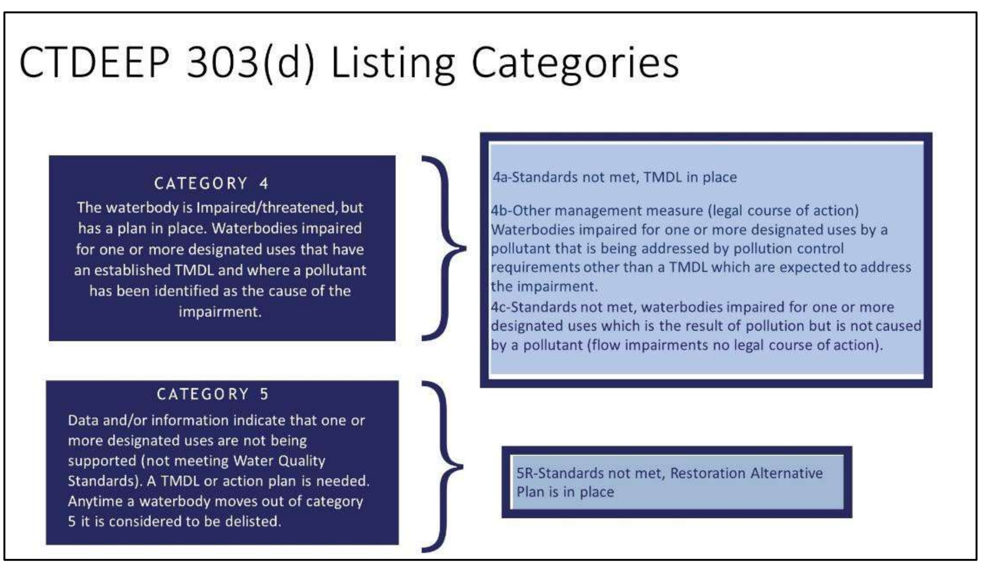
Although CT DEEP relies on data collected by the CT DEEP Ambient Monitoring and Assessment Program, data from other state and federal agencies, local governments, drinking water utilities, and volunteer organizations are also considered. Annual shellfish bed monitoring and sanitary surveys conducted by the CT Department of Agriculture, Bureau of Aquaculture provide assessment information for shellfish use support. Beach closure information (DPH Public Beaches) and data from volunteer organizations as well as known sources of pollution, are used to determine recreation use support. Not all waters are monitored for bacteria.

The CWA requires states to track attainment of water quality goals for each waterbody using a five-category approach (Categories 1,2,3,4, and 5) developed by EPA and amended by Connecticut. Categories 1, 2 and 3 are used for waters that are meeting some or all of the designated uses or for which insufficient information is available to allow for an assessment. These categories do not pertain to impaired waters but may include water bodies prioritized for WQAPs. Waterbodies that have been identified as impaired are assigned to Categories 4 and 5 under the reporting requirements of CWA Section 303(d).

3.1 Subcategories for Connecticut Water Quality Management Plans

Waterbodies can move around the various categories as their water quality status changes. This happens when new water quality data become available indicating a change in water quality in the waterbody that changes the assessment for a designated use, or when a WQAP is developed (such as a TMDL) or if data becomes out of date or insufficient to determine if a waterbody is meeting WQS. However, as waters move through the EPA status categories, the WQAP remains in place. CT DEEP has created subcategories to reflect both the appropriate EPA category (categories 1-5) as well as the plan that has been developed for water quality restoration or protection that is associated with the waterbody. The addition of the sub-categories will allow for better tracking of the attainment status of those waterbodies that have a WQAP associated with it. The majority of CT TMDLs remain in category 4a with some that have attained water quality standards or have been moved to category 3 (insufficient information). If a segment with a protection plan becomes impaired that segment will require a TMDL and move back to category 5. For more detailed information on this process see the Listing Methodology also provided in Chapter 1 of the Integrated Water Quality Report.





SECTION 4. BACTERIA POLLUTION SOURCES

Sources of bacteria to surface waters include stormwater runoff, construction activities, fertilizers, illicit connections, failed or improperly functioning subsurface disposal systems, leaky sewer lines or discharge from sewage treatments plants that are not sufficiently disinfected, pet, livestock, wildlife waste and potentially other sources. The Federal Clean Water Act (CWA) categorizes pollution sources into two major groups: point source (PS) pollution and non-point source (NPS) pollution. A stormwater discharge can be categorized as either a PS or NPS, depending on whether or not the discharge is regulated under the CWA's National Pollutant Discharge Elimination System (NPDES) permit program. Stormwater runoff regulated under NPDES is considered a PS and non-regulated stormwater is NPS.

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 7), strategies for assessing bacteria pollution sources and taking mitigative action to reduce the adverse impacts of bacteria pollution are described.

4.1 Point Source Pollution

PS pollution can be traced back to a specific source such as a discharge pipe from an industrial facility, municipal treatment plant, permitted stormwater outfall or a regulated animal feeding operation, making this type of pollution relatively easy to identify. According to the CWA and RCSA 22a-426-1-51. A PS is defined as follows:

> "*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, landfill leachate collection system, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural stormwater discharges and return flows from irrigated agriculture.*"

Section 402 of the CWA requires all such PS 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 PS discharges through issuance of permit limitations specifying monitoring, reporting, and other requirements under Sections 307, 318, 402, and 405 of the CWA.

In Connecticut, CT DEEP has been delegated the authority to implement the NPDES program. Permit limits issued for a discharge to any waterbody must be consistent with WQS and any relevant TMDLs approved for that waterbody. The permitted PS discharges included in a TMDL are identified and described in more detail in each watershed-specific bacteria TMDL appendix.

4.1.1 Unauthorized Point Sources of Untreated Wastewater

Unauthorized wastewater may contain high levels of bacteria from human waste and other sources. This category includes all PS discharges that are not authorized under the NPDES permit program or by the State because they may not meet WQS or have not obtained necessary permits or authorization. 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 PS discharges will not meet WQS, 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 pollution due to elevated levels of bacteria in surface waters.

- **Illicit Discharges (to Stormwater Systems):** Illicit discharges include any discharges to stormwater systems that are not entirely composed of stormwater as defined in federal regulations (40 CFR 122.26(b)(2) as:

  "Illicit Discharge" means any discharge to a municipal separate storm sewer that is not composed entirely of storm water except discharges pursuant to a NPDES permit (other than the NPDES permit for discharges from a municipal separate storm sewer) and discharges resulting from firefighting activities.

Illicit discharges include intentional or unknown illegal connections from commercial or residential buildings, and improper disposal of sewage from campers and boats. This may 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 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.

- ***Boat Discharges:*** Boats have the potential to discharge pathogens in sewage from installed toilets and greywater (includes drainage from sinks, showers, and laundry). Sewage and greywater discharged from boats can contain pathogens (including bacteria, viruses, and protozoans), nutrients, and chemical products which can lead to water quality violations. The impact of dumping even a small amount of raw sewage into surface waters can significantly impact the local ecosystem, causing algal blooms and a degradation in water quality. The Connecticut WQS prohibit the discharge of sewage from any vessel to any water in Connecticut (RCSA 22a-426-4(a)(9)(D)). Additionally, Connecticut has designated No Discharge Areas in all of Connecticut's coastal waters from the Rhode Island State boundary in the Pawcatuck River to the New York State Boundary in the Byram River and extending from shore out to the New York State boundary (CT DEEP, 2019). In these waters the discharge of any sewage from any vessel is prohibited.

The State of Connecticut requires boats equipped with a marine sanitation device to have a wastewater holding system to prevent the discharge of waste products into surrounding waters. Marine sanitation devices should be emptied at one of the many free pump out facilities. For more information on pump out facility locations and properly maintaining these devices, go to CT DEEP's Clean Vessel Act Program website.

- ***Illegal disposal of pumped septage:*** In rare cases, septic pump trucks may illegally discharge their waste from on-site sewage disposal systems (septic systems). The Connecticut Department of Public Health (CT DPH) licenses contractors that pump sewage from septic systems, and CT DPH pursues enforcement actions against individuals that improperly dispose their septage.

4.1.2 Water Pollution Control Facilities (WPCFs)

The State of Connecticut's Permitting and Enforcement Division of the Bureau of Materials Management and Compliance Assurance and the Municipal Wastewater Section of the Bureau of Water Protection and Land Reuse administer the National Pollutant Discharge Elimination System (NPDES) program for discharges from individual, municipal, and industrial WPCFs. Wastewater treated by WPCFs remove or greatly reduce a variety of organic and inorganic pollutants so that post-treatment discharges are consistent with State WQS. Figure 3 shows the locations of the municipal WPCFs that treat sewage in Connecticut. Potentially harmful bacteria may enter surface waters via improperly treated wastewater discharges. This wastewater, which contains a variety of organic and inorganic pollutants, is treated by the WPCFs to remove harmful waste products so the discharge is environmentally acceptable and consistent with Connecticut WQS and Criteria.

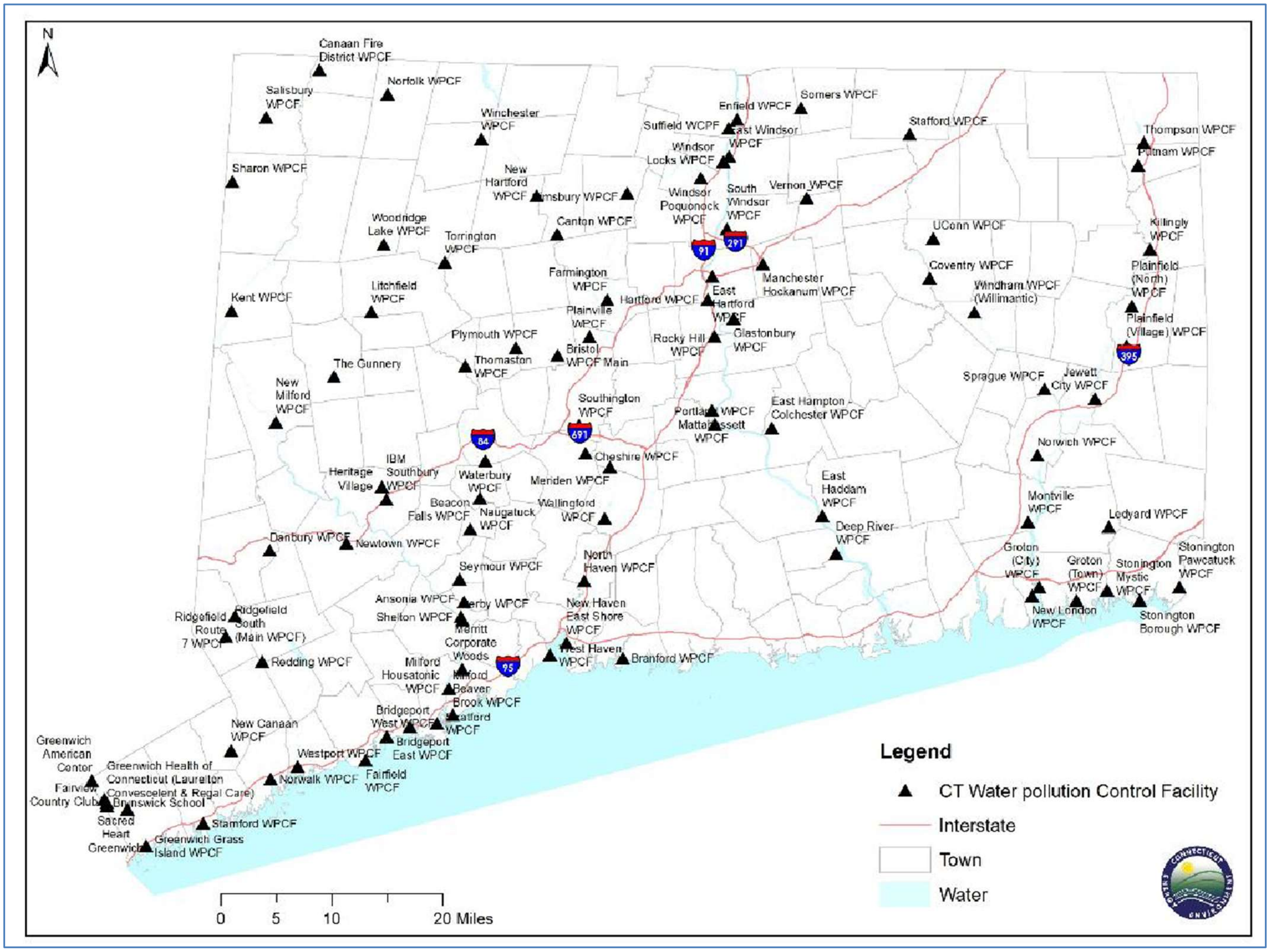


Figure 3. Map of WPCFs discharging in the State of Connecticut

4.1.3 Combined Sewer Overflows (CSOs)

Combined sewer systems collect sewage from buildings and stormwater runoff from street drains into one network of pipes leading to a WPCF. Treatment and transportation capacities of combined sewer systems are usually adequate for dry weather and small storm events, but capacity can be exceeded during large rainstorms or periods of snowmelt due to large amounts of inflow entering street drains. Combined Sewer Overflows (CSOs) were designed as release valves when system capacity was exceeded. A CSO by design dumps the excess flows of raw sewage mixed with stormwater runoff into the environment, often a river or estuary, to prevent sewage from backing up into buildings and to prevent pipes from bursting.

The pollutants released during CSO discharge events vary extensively in pollutant types, concentrations, and loads, as well as in volume of overflow and severity of impact to the receiving waterbodies. Due to the risk to human health and the environment represented by CSOs, major investments have been made to reduce and eliminate them in Connecticut and across the nation.

Connecticut established the Connecticut Clean Water Fund (CWF) program, coordinated with EPA's CSO program, to assist communities in evaluating the design, condition, activity, and effects of combined sewer systems and overflows (Figure 4). The CWF provides a combination of grants and loans to municipalities that undertake water pollution control projects administered by CT DEEP. CSO projects are given special consideration under the CWF due to their high cost and statewide significance for public health and water quality. There are six communities with CSOs in Connecticut: Bridgeport, Hartford, New Haven, Norwalk, Norwich, and Waterbury. For more information, including fact sheets on existing CSOs and a map of real-time discharges, see CT DEEP's CT Sewage Right-to-Know.

Connecticut has a sewage "right to know" law (CGS § 22a-424a), which requires CT DEEP to notify the public when there is a sewage overflow or bypass event that results in untreated or partially treated sewage discharging into waters, and to maintain a map of Open CSO and SSO Bypass by Location. The law also requires WPCF operators to report sewage spills promptly to CT DEEP. Additional information on the "Sewage Right to Know" Law is available online.

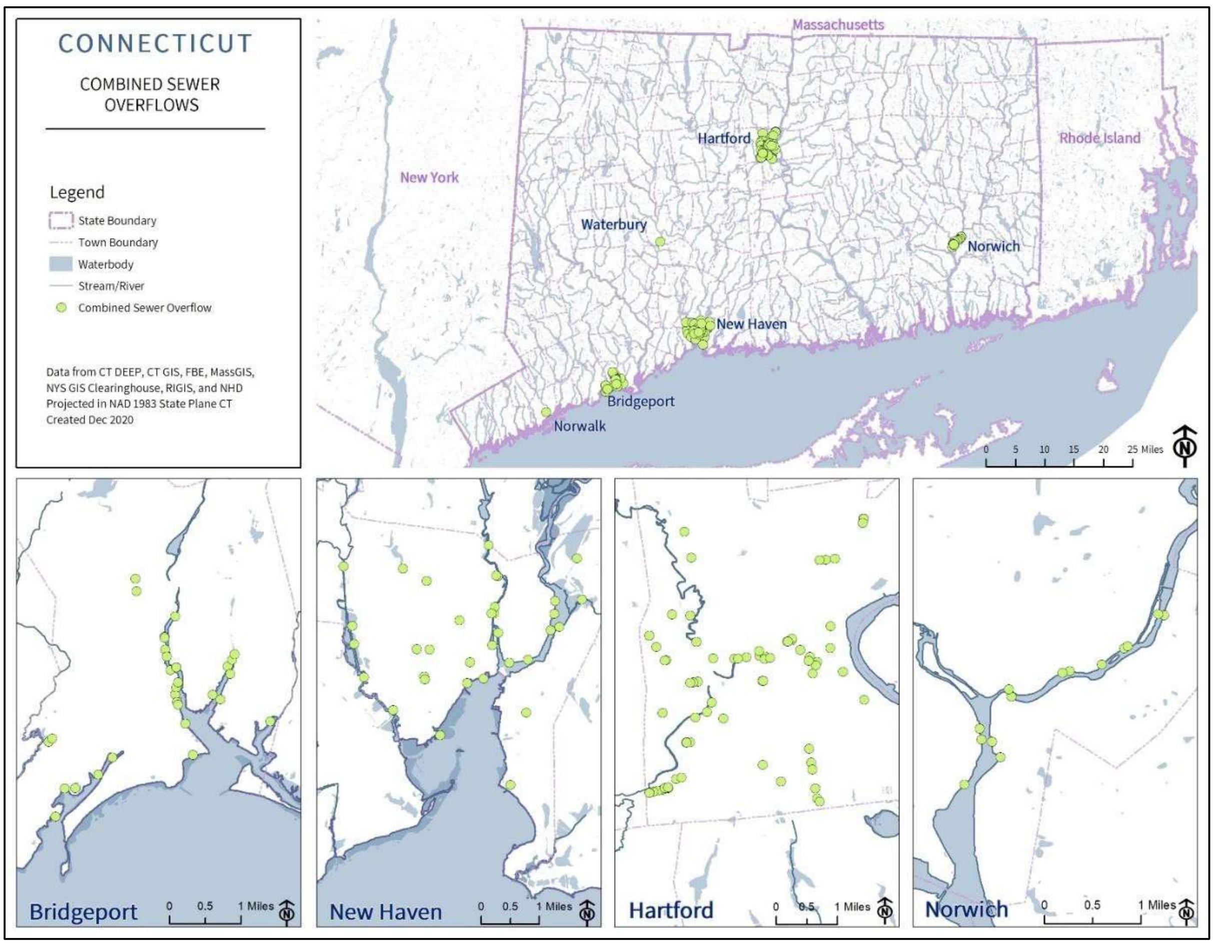


Figure 4. Map of combined sewer overflow (CSO) locations in the State of Connecticut.

4.1.4 Stormwater from Regulated Point Sources

Stormwater runoff is water that does not soak into the ground during a rainstorm, but instead flows over the surface of the ground until it reaches a waterbody or enters a drainage system and is transferred to a receiving waterbody. As the stormwater runoff moves, it picks up and carries away natural and anthropogenic pollutants, such as soil, manure, and many others, 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 rate and volume to receiving surface waters. The expansion of hard, impermeable surfaces like pavement, roofs, and highly compacted soil increase stormwater rate and volume to receiving surface waters. For more detailed information, see the CT DEEP Stormwater and Water Quality webpage, especially the Stormwater Pollution Management in Connecticut interactive map (figure 5) about stormwater pollution management plans in Connecticut.

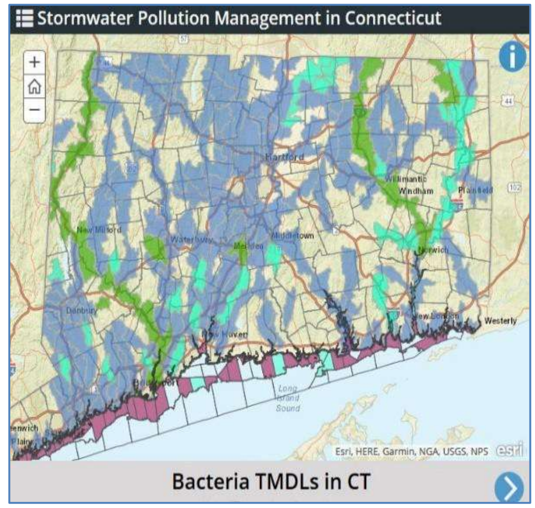


Figure 5. CT DEEP online interactive map showing stormwater and pollution management plans in Connecticut.

Stormwater discharges in urbanized municipalities that are federally designated under the Stormwater Phase I or II programs are considered PS discharges under the CWA and require NPDES permits along with certain stormwater discharges from other sources, identified in the list below.

The EPA has mandated a number of stormwater permit programs, administered by CT DEEP, to deal with stormwater pollution.

1. The **General Permit for the Discharge of Stormwater Associated with Industrial Activity** ("Industrial Stormwater General Permit") regulates industrial facilities with point source discharges that are engaged in specific industrial activities listed in the permit.

2. **The General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities** ("Construction Stormwater General Permit"), primarily address the control of sediment discharges from a site during construction. Although construction projects are not a significant source of bacteria, bacteria may be bound to sediment conveyed in stormwater runoff from these sites. Turbid waters can be associated with elevated levels of bacteria.

3. The **General Permit for the Discharge of Stormwater Associated with Commercial Activity** ("Commercial Stormwater General Permit") requires operators of large paved commercial sites such as malls, movie theaters, and supermarkets to undertake actions to minimize the amount of sediments and related pollutants that reach surface waters from commercial area runoff. The program was implemented through CT DEEP's own initiatives (rather than EPA mandate) in August 1995 to help track impacts to water quality from commercial development in Connecticut.

4. **The General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems** (MS4) ("MS4 General Permit") requires municipalities with urbanized areas to take steps to minimize stormwater pollutants from discharging to waterbodies from urbanized municipal drainage systems.

One important element of this permit is the public education requirement. To make residents aware that stormwater pollutants emanate from many of their everyday living activities, and to inform them of steps they can take to reduce pollutants in stormwater runoff.

To assist MS4 permit registrants, CT DEEP created a series of town fact sheets which provide water quality charts, maps, and MS4 pollutant control activities for every municipality in the State and CT DEEP developed an interactive on-line Water Quality Plans and Assessments map. CT DEEP also partnered with UConn's Center for Land Use Education and Research (CLEAR) to support and assist municipalities with MS4 permit compliance.

Non-MS4 Community Stormwater

Approximately one-quarter of the municipalities in Connecticut do not fall under the MS4 permit. These municipalities are not listed in Appendix A of the MS4 General Permit and are not regulated by the MS4 General Permit. However, these non-MS4 municipalities are encouraged to follow the Best Management Practices (BMPs) included in the MS4 permit and Section 7 of this TMDL to address sources of bacteria.

5. The **General Permit for the Discharge of Stormwater from the Department of Transportation** (DOT) Separate Storm Sewer Systems ("CTDOT MS4") requires CTDOT to take steps to minimize stormwater pollutants from discharging to waterbodies from CTDOT separate storm sewer systems. The applicability and requirements of this permit are similar to the MS4 general permit, detailed information on the CTDOT's Stormwater Quality Management Program can be found on their website. The DOT MS4 GP Factsheet provides helpful information regarding the CT DOT MS4 GP.

Each time the MS4 permit is renewed, additional municipalities are considered for inclusion based on current census data. For municipalities that are not currently regulated by the MS4 Permit, CT DEEP recommends that municipalities implement the six minimum measures specified in the MS4 permit to the extent possible. In particular, measures such as public education and outreach, public involvement and participation, construction site stormwater runoff control, post-construction stormwater management, and pollution prevention/good housekeeping can be implemented to achieve improved stormwater quality without significant cost.

4.2 Non-Point Source Pollution

Water pollution that is not concentrated within a drainage system, or discharged from a point, such as a pipe, is called nonpoint source pollution. Non-point source (NPS) pollution comes from many sources and is more difficult to identify and control than point source pollution. NPS pollution can result from overland runoff (e.g. agricultural runoff, or unregulated stormwater), groundwater flow or direct deposition of pollutants to receiving waters. Runoff occurring outside federally designated urban areas is considered a NPS discharge and typically is not regulated, unless it is covered by a stormwater general or individual permit. NPSs are diffuse and are often associated with land-use practices. Sec. 22a-426-1 of the Connecticut WQS defines "non-point source" as follows:

> *"Non-point source means any unconfined and diffuse source of pollution such as stormwater or snowmelt runoff, atmospheric deposition, or groundwater not conveyed to a surface water discharge point within a discrete conveyance*."

Examples of NPS pollution that can contribute bacteria to surface waters via runoff, groundwater, and direct deposition include malfunctioning septic systems, erosion from disturbed ground or along roads, excessive fertilizer application, unmitigated agricultural activities, pet waste, and wildlife waste. The Connecticut Nonpoint Source Management Program Plan lays out CT DEEP's 5-year approach to addressing NPS pollution for the protection and restoration of water resources in the State.

4.2.1 Polluted Runoff

As discussed above, stormwater runoff can be categorized as either PS or NPS pollution, depending on whether it occurs in a federally designated MS4 urbanized area. NPS runoff discharges are generally characterized as diffuse or sheet flow runoff that occur outside regulated urban areas and thus are not categorically regulated under the NPDES program. Resources such as the River Smart Program provide developed material and programs to help manage local polluted runoff.

4.2.2 Subsurface Sewage Treatment and Disposal Systems

Untreated discharges of sewage are prohibited regardless of source. An example of an NPS discharge of untreated wastewater is from insufficient or malfunctioning subsurface sewage treatment and disposal systems, commonly referred to as septic systems. When properly designed, installed, operated, and maintained, subsurface sewage treatment and disposal systems effectively treat sewage to reduce bacteria within a zone beyond the system. Age, overloading, or poor maintenance can result in system failure and the release of pollutants into groundwater or surface waters (USEPA 2002). Bacteria from insufficient subsurface sewage treatment and disposal systems can enter surface waters through surface overflow or breakout, stormwater runoff, or groundwater.

According to the CT DPH, approximately 40% of the population in Connecticut uses individual subsurface sewage treatment and disposal systems to treat wastewater and disperse it back into the environment. There are several specific types of systems that may be installed onsite. The following definitions highlight the major differences in function and type of systems that are available for consideration at sites across Connecticut (CT DEEP 2011).

A "**conventional subsurface sewage treatment and disposal system**" consists of a building sewer, a septic tank followed by a leaching system, any necessary pumps or siphons, and any groundwater control system on which the operation of the leaching system is dependent.

- The **building sewer** conveys the wastewater from the house plumbing to the septic tank.
- The **septic tank** is a watertight receptacle that serves as the primary physical treatment of the wastewater. Here, the heavier solids are settled out, and the floating scum and greases are kept from escaping into the leaching field. The standard septic tank has a 1,000-gallon minimum liquid capacity and may be made from concrete or plastic. Newer tanks are equipped with inlet and outlet baffles, an interior compartment wall, and an effluent filter, all which assist in retaining scum/solids inside the septic tank. A relatively stable biological system within the septic tank

helps promote the reduction of complex organic compounds to simpler soluble chemicals and gases.

- **Distribution piping** directs the flow of sewage effluent to the leaching system in a manner that assures full utilization of the system. Sewage effluent can flow through the distribution piping by means of gravity or with the assistance of a mechanical pump or siphon.
- The **leaching system** disperses the sewage effluent into the surrounding soil, which provides further biological treatment to the sewage. There are many types of leaching systems. The specific type utilized on a property is usually dependent on the soil conditions on that site. Most residential installations utilize stone-filled leaching trenches or hollow structures surrounded by stone. Septic system specifications are designed primarily to reduce pathogen loads to the environment. These specifications often provide adequate phosphorus removal, while nitrogen removal is not assured. Specifications include a minimum separating distance of at least 18 inches between the bottom of the leaching system and maximum groundwater level, as well as 4 feet between the bottom of the leaching system and ledge rock. These distances may be increased due to specific site conditions.

A "**community subsurface sewage treatment and disposal system**" currently consists of one subsurface sewage treatment and disposal system serving two or more residential buildings, regardless of system size. This definition may change with changing legislation.

An "**alternative treatment system**" consists of a sewage treatment system serving one or more buildings that utilizes a method of treatment other than a subsurface sewage treatment and disposal system (SSDS) and that involves a discharge to the groundwaters of the State.

Regulatory authority (design review, permitting, and enforcement) over subsurface sewage treatment and disposal systems varies, depending on the designed flow capacity and the type of treatment and disposal system present on the site. Currently in Connecticut, local Departments of Health issue approvals and permits (Approval to Construct, Permit to Discharge) for SSDSs up to 7,500 GPD. CT DPH is required to approve large (2,000 to 7,500 GPD) SSDS plans in accordance with RCSA Section 19-13-B103d (c). Regulatory jurisdiction for alternative treatment systems with design flows less than 7,500 gpd has also been delegated to CT DPH, but due to lack of available resources, a state-wide program for approving and permitting those systems does not yet exist. Use of alternative treatment systems with design flows less than 7,500 GPD is an option but recommended after a statewide permitting program is established. If used, proper permitting and regulatory oversight would need to be followed. Conventional and alternative treatment systems with design flows of greater than 7,500 gpd and all community treatment systems are regulated by the CT DEEP. This may change with changing legislation.

4.2.3 Erosion

Erosion can occur when ground is disturbed by digging, construction, plowing, foot or vehicle traffic, or wildlife. Soil which is normally stable can be mobilized by rain, wind, ice, and gravity when protective vegetation is removed, more fragile underlying soil layers are exposed, change in slopes or upstream soil compaction occurs, or other landscape altering activities (CTSWCS 2002). Rain and associated runoff are the primary pathways by which eroded soil reaches surface waters. Once in surface waters, bacteria may be released from the soil particles into the water column, causing elevated levels of bacteria in surface waters.

In areas with high development demand, construction activities can be a source of bacteria. Unpaved roads and trails used by motorized vehicles near surface waters are especially vulnerable to erosion. Stream bank erosion can also have a rapid and severe effect on water quality and can be triggered or worsened by upstream impervious surfaces like buildings, parking lots, and roads which send large amounts of high velocity runoff to surface waters. Maintaining natural vegetative buffers around waterbodies and employing strict erosion and sedimentation controls for construction can minimize these effects (CT DEP 1996). Where erosion is considered a point source, erosion control is a crucial function of several permit programs (Construction General Permit, Commercial General Permit, MS4 Permit, and others; see Section 4.1.4).

Additionally, evaluating culverts may help to identify issues that contribute to bacteria via transport of sediment. An example of a program designed to evaluate the impacts from stream crossings is available at the Housatonic Valley Association's Reconnect Rivers and Streams web page.

4.2.4 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 to surface waters. Direct deposition of fecal matter from farm animals standing in surface waters and the runoff of farm animal waste from land surfaces are considered the primary sources of 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:

- Plowing and earth moving;
- Manure storage and application;
- Livestock grazing;
- Animal feeding operations and barnyards and;
- Paddock and exercise areas for horses and other animals
- Leachate from haylage/silage storage bunkers.

Diffuse runoff of farm animal waste from land surfaces (whether from manure stockpiles or cropland where manure is spread), as well as direct deposition of fecal matter from farm animals standing in surface waters, are significant sources of agricultural pollution in surface waters (NERC 2019).

Excessive or ill-timed application of manure or poor storage which allows material to wash away with precipitation not only endangers the health of waterbodies, it also means those nutrients are not reaching the intended crop. The key to fertilizer application is to apply the right amount at the right time. When appropriately applied to soil, animal manure can fertilize crops and restore nutrients to the land. When improperly managed, pollutants in manure can enter surface waters through several pathways, including surface runoff and erosion, direct discharges to surface water, spills and other dry-weather discharges, and leaching into soil and groundwater.

4.2.5 Pets

In residential areas, pet waste 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. If pet feces are not properly disposed of, 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. CT DEEP has several online resources for managing pet waste including Pollution Prevention webpage for pets and the Give a Bark for Clean State Park program.

4.2.6 Wildlife

Fecal matter from wildlife such as geese, gulls, other birds, and beaver may be a significant source of bacteria in some watersheds. This is particularly true when human activities, including the direct and indirect feeding of wildlife and habitat modification, result in the congregation of wildlife (CWP 1999). Congregations of geese, gulls, and ducks are of concern because they often deposit their fecal matter next to or directly into surface waters. Examples include large mowed fields adjacent to waterbodies where geese and other waterfowl gather, as well as the underside of bridges with pipes or joists directly over the water that attract large numbers of pigeons or other birds.

SECTION 5. TOTAL MAXIMUM DAILY LOAD (TMDL)

5.1 TMDL Definition

TMDLs provide the framework for restoring impaired waters by establishing the maximum amount of a pollutant that a waterbody can receive without adverse impact to fish, wildlife, recreation, or other uses and can also be used to set a budget to protect waters with good quality. A TMDL establishes pollutant loading targets and allocates load reductions necessary for the source(s) of the pollutants, including a margin of safety (MOS) to account for uncertainty in target-setting. The TMDL allocates pollutant loads among PS discharges permitted under NPDES and all other NPS discharges and can be represented as:

$$\text{TMDL} = \text{Loading Capacity} = \Sigma\ \text{WLA} + \Sigma\ \text{LA} + \text{MOS}$$

Where:

Σ WLA = sum of the Waste Load Allocations (i.e., point sources including NPDES-regulated stormwater)

Σ LA = sum of the Load Allocations (i.e., natural background, nonpoint sources, and stormwater not regulated by NPDES)

MOS= Margin of Safety

The loading allocations can be expressed as a mass per unit time, concentration, or other appropriate measures (40 CFR Part 103.2(i)). The Waste Load Allocation (WLA) and Load Allocation (LA) both need to account for existing and future loads.

The Margin of Safety (MOS) accounts for any uncertainty or lack of knowledge concerning the relationship between pollutant loading and water quality. The MOS can either be implicit (i.e., incorporated into the TMDL analysis through conservative assumptions) or explicit (i.e., expressed in the TMDL as a reserved portion of the loadings), discussed in more detail below.

5.2 Loading Capacity, MOS, and Load Allocations

EPA allows for two types of TMDLs:

- Concentration TMDLs (expressed as bacteria counts/100mL of water)
- Loads of bacteria (expressed as numbers of bacteria/day)

Both formats express targets designed to attain the designated uses of recreation and shellfishing, and to meet the associated water quality standards (WQS). Here we will discuss concentration-based TMDLs, because this is the only type of TMDL for bacteria included in this document. The targets apply on any given day to assure achievement of bacteria water quality criteria whenever the WQS are in effect.

There are two types of load allocations: Waste Load allocations (WLAs) and Load Allocations (LAs).

The WLA refers to the portion of loading capacity allocated to PS discharges, such as piped stormwater, construction runoff, and pollution from other regulated activities. The LA refers to the portion of loading capacity allocated to NPS pollution and natural background, such as diffuse overland runoff, septic systems, groundwater seepage, internal loading, atmospheric deposition, and waterfowl. Both PS and NPS pollution sources are described in detail in Section 4.

In practice, ambient water quality data are usually not sufficiently detailed to allow a precise separation of PS and NPS pollution. For bacteria, in this TMDL, WLAs and LAs are concentration-based and set equal to the water quality criteria, as established in the WQS, or set equal to zero for non-authorized discharges.

These TMDLs set a goal of meeting bacteria water quality criteria within surface waters at the point of discharge for all sources in order to meet WQS throughout the waterbody. For Connecticut, concentration-based TMDLs for bacteria provides the most useful format for guiding both remediation and protection efforts in watersheds. A concentration target is more understandable and easier to implement. More detail on concentration-based TMDLs for bacteria is provided below. Additionally, Appendix A contains graphs, tables, and equations to provide more information on the relationship between a concentration-based TMDLs and TMDLs based on daily loads in terms of numbers of organisms/day.

5.2.1 Concentration TMDLs

Concentration of bacteria is expressed in terms of colony forming units (CFU/100mL) or bacteria counts per 100mL sample (#/100mL) for the indicator bacteria (e.g., E. coli, enterococcus, fecal coliform, or total coliform).

The TMDLs contain an implicit MOS by using the following conservative assumptions during the analysis: The TMDLs are set equal to the appropriate WQS for each waterbody segment and include the goal of meeting bacteria water quality criteria at the point of discharge for all sources. This means the TMDLs do not rely on dilution in the waterbody to meet WQS. In addition, the TMDLs do not rely on in-stream processes such as bacteria die-off and settling, which are known to reduce in-stream bacteria concentrations. Consequently, the Connecticut bacteria TMDLs represent very conservative TMDL target-setting, so there is a high level of confidence that the TMDLs established are consistent with WQS, and the entire loading capacity can be allocated among sources. For these reasons, the MOS is implicit, and the explicit MOS shown in the general TMDL formula above is set equal to zero. For concentration TMDLs which are independent of flow, the standard formula changes to:

TMDL = Loading Capacity = Water Quality Criterion

(The TMDL or water quality criterion is applied to the WLA for allowable regulated sources, and to the LA for allowable nonpoint sources.)

The TMDL allocates the load among sources, identifying WLAs for NPDES-regulated sources, and LAs for nonpoint sources and natural background. The numeric value of the TMDL, WLA, and LA depends on whether the source of bacteria is prohibited or allowable, and the appropriate water quality criterion for the receiving water, as follows:

- If the **source** of the bacteria load is **prohibited** (e.g., failing septic systems, or illicit discharges),the WLA or LA is set equal to 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 (depending on its classification).

The underlying assumption in setting a concentration TMDL for bacteria is that if all sources are below the WQS, then the concentration of bacteria within the receiving water will attain WQS. Using 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 in surface waters and not water quality at the point of discharge (i.e., end of pipe). All numeric values in the following tables (6 through 10) are listed as targets for discharge outfalls, unless otherwise specified by other regulatory programs or statutes. However, the WLA for non-stormwater NPDES discharges with disinfection treatment are expected to be used as regulatory limits on discharge quality at the end of pipe since disinfection treatment can significantly reduce the amount of bacteria in the treated effluent to be consistent with WQS. In all cases, these numeric WLA and LA values will not replace the use of ambient instream monitoring data for determining consistency with this TMDL.

Tables 6, 7 and 10 present the loading allocations for concentration-based bacteria TMDLs by waterbody classification and potential bacteria source. These are based on the water quality criteria in Tables 2 and 3 in Section 2.2 and represent WLAs and LAs based on WQS current as of the publication date of this document. If the bacteria criteria change in the future as discussed in Section 2.3, the WLA and LA for this TMDL will be administratively updated to those provided in Table 8 and 9 and also described in Appendix C of this document. Notice will be provided on the CT DEEP TMDL website, as part of the public notice for proposed changes to the Water Quality Standards and as part of the public notice for the Integrated Water Quality Report developed after such changes are made. This administrative update will not be applied to bacteria TMDLs established prior to this updated TMDL. Updates to prior TMDLs will be developed separately and will go through a public notice and review process. The percent reduction calculations in bacteria TMDLs are based on estimates of current loadings. The estimated percent reduction needed is calculated based on the difference between measured bacteria data and the water quality criteria for bacteria and are provided to estimate the potential level of effort needed to restore water quality. Future development activities and land use changes have the potential to increase or decrease 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 and/or local requirements.

Table 6. Current Bacteria WLAs and Las for Freshwater (Recreation)

Table 6 Current Bacteria WLAs and LAs for Freshwater (Recreation)									
		Single Sample Maximum Concentration less than or equal to: *E. coli* (#/100mL)						Geometric Mean less than: *E. coli* (#/100mL)	
Class	Bacteria Source	WLA[1]			LA[1]			WLA[1]	LA[1]
	Recreational Use	DS[2]	NDS[3]	O[4]	DS[2]	NDS[3]	O[4]	All	All
AA	Illicit sewer connection								
	Leaking sewer lines								
	Overboard Discharges[5]								
	Regulated Stormwater[6]	235	410	576				126	
	Non-regulated Stormwater[6]				235	410	576		126
	Subsurface Sewage Disposal System[7]	235	410	576	235	410	576	126	126
	Wildlife[6]				235	410	576		126
	Waste directly from people swimming or domestic animals[8]				235	410	576		126
A	Non-Stormwater NPDES								
	Combined Sewer Overflow								
	Sanitary Sewer Overflow								
	Illicit sewer connection								
	Leaking sewer lines								
	Overboard Discharges[5]								
	Regulated Stormwater[6]	235	410	576				126	
	Non-regulated Stormwater[6]				235	410	576		126
	Subsurface Sewage Disposal System[7]	235	410	576	235	410	576	126	126
	Wildlife[6]				235	410	576		126
	Waste directly from people swimming or domestic animals[8]				235	410	576		126
B[10]	Non-Stormwater NPDES[9]	235	410	576				126	
	Combined Sewer Overflow	235	410	576				126	
	Sanitary Sewer Overflow								
	Illicit sewer connection								
	Leaking sewer lines								

Table 6 Current Bacteria WLAs and LAs for Freshwater (Recreation)

		Single Sample Maximum Concentration less than or equal to: *E. coli* (#/100mL)						**Geometric Mean less than: *E. coli* (#/100mL)**	
Class	**Bacteria Source**	**WLA[1]**			**LA[1]**			**WLA[1]**	**LA[1]**
	Recreational Use	**DS[2]**	**NDS[3]**	**O[4]**	**DS[2]**	**NDS[3]**	**O[4]**	**All**	**All**
	Overboard Discharges[5]								
	Regulated Stormwater[6]	235	410	576				126	
	Non-regulated Stormwater[6]				235	410	576		126
	Subsurface Sewage Disposal System[7]	235	410	576	235	410	576	126	126
	Wildlife[6]				235	410	576		126
	Waste directly from people swimming or domestic animals[8]				235	410	576		126

WLA = Waste Load Allocation, LA = Load Allocation

If WLA or LA cells are blank, then the source is not authorized to contribute bacteria to surface waters.

(1) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations.

(2) **Designated Swimming.** Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in the *Guidelines for Monitoring Swimming Water and Closure Protocol* adopted jointly by CT DEEP and CT DPH, as updated. Available on the CT DEEP State Bathing Beach Monitoring Program webpage.

(3) **Non-Designated Swimming.** Includes areas otherwise suitable for swimming but which have not been designated by State or Local authorities as bathing areas, waters which support tubing, water skiing, or other recreational activities where full body contact is likely.

(4) **All Other Recreational Uses.**

(5) All coastal and inland waters in Connecticut are designated as No Discharge Areas for Overboard Discharges (OBDs).

(6) Replace numeric value with "natural levels" if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP WQS RCSA 22a-426-1(47)).

(7) WLA and LA criteria both apply to SSDS, as some discharges from SSDS are point source/permitted and others are nonpoint source/not permitted based on characteristics of the system and the discharge.

(8) Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in the *Guidelines for Monitoring Swimming Water and Closure Protocol* adopted jointly by CT DEEP and CT DPH, as updated. Available on the CT DEEP State Bathing Beach Monitoring Program webpage.

(9) For discharges from water pollution control facilities (WPCFs) the WLA is applied as an end-of-pipe bacteria concentration, which at a minimum should be applicable during the disinfection period specified in the WQS (RCSA 22a-426-3(a)(9)(E)) unless a longer period for disinfection is specified in the facility permit

(10) Criteria for the protection of recreational uses in Class B waters do not apply when disinfection of WPCF effluents is not required, consistent with the WQS, as outlined in RCSA 22a-426-4(a)(9)(E).

Table 7. Current Bacteria WLAs and LAs for Saltwater (Recreation)

Table 7. Current Bacteria WLAs and LAs for Saltwater (Recreation)							
		Single Sample Maximum Concentration less than or equal to: Enterococci (#/100mL)				**Geometric Mean less than: Enterococci (#/100mL)**	
Class	**Bacteria Source**	**WLA[1]**		**LA[1]**		**WLA[1]**	**LA[1]**
	Recreational Use	**DS[2]**	**O[3]**	**DS[2]**	**O[3]**	**All**	**All**
SA	Illicit sewer connection						
SA	Leaking sewer lines						
SA	Overboard Discharges[4]						
SA	Regulated Stormwater[5]	104	500			35	
SA	Non-regulated Stormwater[5]			104	500		35
SA	Subsurface Sewage Disposal System[6]	104	500	104	500	35	35
SA	Wildlife[5]			104	500		35
SA	Waste directly from people swimming or domestic animals			104	500		35
SB	Non-Stormwater NPDES[7]	104	500			35	
SB	Combined Sewer Overflow	104	500			35	
SB	Sanitary Sewer Overflow						
SB	Overboard Discharges[4]						
SB	Illicit sewer connection						
SB	Leaking sewer lines						
SB	Regulated Stormwater[5]	104	500			35	
SB	Non-regulated Stormwater[5]			104	500		35
SB	Subsurface Sewage Disposal System[6]	104	104	104	500	35	35
SB	Wildlife[5]			104	500		35
SB	Waste directly from people swimming or domestic animals			104	500		35

WLA = Waste Load Allocation, LA = Load Allocation.

If WLA or LA cells are blank, then the source is not authorized to contribute bacteria to surface waters.

(1) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations.

(2) **Designated Swimming.** Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in the *Guidelines for Monitoring Swimming Water and Closure Protocol* adopted jointly by CT DEEP and CT DPH, as updated. Available on the CT DEEP State Bathing Beach Monitoring Program webpage.

(3) **All Other Recreational Uses.**

(4) All coastal and inland waters in Connecticut are designated as No Discharge Areas for Overboard Discharges (OBDs).

Table 7. Current Bacteria WLAs and LAs for Saltwater (Recreation)							
		Single Sample Maximum Concentration less than or equal to: Enterococci (#/100mL)				Geometric Mean less than: Enterococci (#/100mL)	
Class	**Bacteria Source**	**WLA[1]**		**LA[1]**		**WLA[1]**	**LA[1]**
	Recreational Use	**DS[2]**	**O[3]**	**DS[2]**	**O[3]**	**All**	**All**
(5) Replace numeric value with "natural levels" if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP WQS RCSA 22a-426-1(47)).							
(6) WLA and LA criteria both apply to SSDS, as some discharges from SSDS are regulated/permitted and others are nonregulated/not permitted based on the characteristics of the system and the discharge.							
(7) For discharges from water pollution control facilities (WPCFs) the WLA is applied as an end-of-pipe bacteria concentration, which at a minimum should be applicable during the disinfection period specified in the WQS (RCSA 22a-426-3(a)(9)(E)), which is year-round for salt waters unless otherwise specified in the facility permit.							

Table 8. Potential Future CT Bacteria WLAs and LAs for Freshwater (Recreation)

Table 8. Potential Future CT Bacteria WLAs and LAs for Freshwater (Recreation)

		90% Samples less than or equal to: *E. coli* (#/100mL)		Geometric Mean less than or equal to: *E. coli* (#/100mL)	
Class	**Bacteria Source**	**WLA[1]**	**LA[1]**	**WLA[1]**	**LA[1]**
AA	Illicit sewer connection				
	Leaking sewer lines				
	Overboard Discharges[2]				
	Regulated Stormwater[3]	410		126	
	Non-regulated Stormwater[3]		410		126
	Subsurface Sewage Disposal System[4]	410	410	126	126
	Wildlife[3]		410		126
	Waste directly from people swimming or domestic animals[5]		410		126
A	Non-Stormwater NPDES				
	Combined Sewer Overflow				
	Sanitary Sewer Overflow				
	Illicit sewer connection				
	Leaking sewer lines				
	Overboard Discharges[2]				
	Regulated Stormwater[3]	410		126	
	Non-regulated Stormwater[3]		410		126
	Subsurface Sewage Disposal System[4]	410	410	126	126
	Wildlife[3]		410		126
	Waste directly from people swimming or domestic animals[5]		410		126
B[7]	Non-Stormwater NPDES[6]	410		126	
	Combined Sewer Overflow	410		126	
	Sanitary Sewer Overflow				
	Illicit sewer connection				
	Leaking sewer lines				
	Overboard Discharges[2]				
	Regulated Stormwater[3]	410		126	
	Non-regulated Stormwater[3]		410		126
	Subsurface Sewage Disposal System[4]	410	410	126	126
	Wildlife[3]		410		126
	Waste directly from people swimming or domestic animals[5]		410		126

WLA = Waste Load Allocation, LA = Load Allocation

If WLA or LA cells are blank, then the source is not authorized to contribute bacteria to surface waters.

(1) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations.

(2) All coastal and inland waters in Connecticut are designated as No Discharge Areas for Overboard Discharges (OBDs).

(3) Replace numeric value with "natural levels" if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP WQS RCSA 22a-426-1(47)).

(4) WLA and LA criteria both apply to SSDS, as some discharges from SSDS are point source/permitted and others are nonpoint source/not permitted based on characteristics of the system and the discharge.

Table 8. Potential Future CT Bacteria WLAs and LAs for Freshwater (Recreation)					
		90% Samples less than or equal to: *E. coli* (#/100mL)		**Geometric Mean less than or equal to: *E. coli* (#/100mL)**	
Class	**Bacteria Source**	**WLA[1]**	**LA[1]**	**WLA[1]**	**LA[1]**
(5) Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in the *Guidelines for Monitoring Swimming Water and Closure Protocol* adopted jointly by CT DEEP and CT DPH, as updated. Available on the CT DEEP State Bathing Beach Monitoring Program webpage					
(6) For discharges from water pollution control facilities (WPCFs) the WLA is applied as an end-of-pipe bacteria concentration, which at a minimum should be applicable during the disinfection period specified in the WQS (RCSA 22a-426-3(a)(9)(E)) unless a longer period for disinfection is specified in the facility permit.					
(7) Criteria for the protection of recreational uses in Class B waters do not apply when disinfection of WPCF effluents is not required, consistent with the WQS, as outlined in RCSA 22a-426-4(a)(9)(E).					

Table 9. Potential Future Bacteria WLAs and LAs for Saltwater (Recreation)

Table 9. Potential Future Bacteria WLAs and LAs for Saltwater (Recreation)

		90% Samples less than or equal to: Enterococci (#/100mL)				Geometric Mean less than or equal to: Enterococci (#/100mL)	
Class	**Bacteria Source**	**WLA[1]**		**LA[1]**		**WLA[1]**	**LA[1]**
SA	Illicit sewer connection						
	Leaking sewer lines						
	Overboard Discharges[2]						
	Regulated Stormwater[3]	130	130			35	
	Non-regulated Stormwater[3]			130	130		35
	Subsurface Sewage Disposal System[4]	130	130	130	130	35	35
	Wildlife[3]			130	130		35
	Waste directly from people swimming or domestic animals[5]			130	130		35
SB	Non-Stormwater NPDES[6]	130	130			35	
	Combined Sewer Overflow	130	130			35	
	Sanitary Sewer Overflow						
	Overboard Discharges[2]						
	Illicit sewer connection						
	Leaking sewer lines						
	Regulated Stormwater[3]	130	130			35	
	Non-regulated Stormwater[3]			130	130		35
	Subsurface Sewage Disposal System[4]	130	130	130	130	35	35
	Wildlife[3]			130	130		35
	Waste directly from people swimming or domestic animals[5]			130	130		35

WLA = Waste Load Allocation, LA = Load Allocation.

If WLA or LA cells are blank, then the source is not authorized to contribute bacteria to surface waters.

(1) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations.

(2) All coastal and inland waters in Connecticut are designated as No Discharge Areas for Overboard Discharges (OBDs).

(3) Replace numeric value with “natural levels” if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP WQS RCSA 22a-426-1(47))

(4) WLA and LA criteria both apply to SSDS, as some discharges from SSDS are regulated/permitted and others are nonregulated/not permitted based on the characteristics of the system and the discharge.

(5) Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in the *Guidelines for Monitoring Swimming Water and Closure Protocol* adopted jointly by CT DEEP and CT DPH, as updated. Available on the CT DEEP State Bathing Beach Monitoring Program webpage.

(6) For discharges from water pollution control facilities (WPCFs) the WLA is applied as an end-of-pipe bacteria concentration, which at a minimum should be applicable during the disinfection period specified in the WQS (RCSA 22a-426-3(a)(9)(E)), which is year-round for salt waters unless otherwise specified in the facility permit.

Table 10. Bacteria TMDL WLAs and LAs for Saltwater (Shellfish Harvesting)

Table 10. Bacteria WLAs and LAs for Saltwater (Shellfish Harvesting)					
		Geometric Mean less than: Fecal Coliform (#/100mL)		90% Samples less than: Fecal Coliform (#/100mL)	
Class	**Bacteria Source**	**WLA[1]**	**LA[1]**	**WLA[1]**	**LA[1]**
SA Direct Consumption	Combined Sewer Overflow	14		31	
	Sanitary Sewer Overflow				
	Overboard Discharges[2]				
	Illicit sewer connection				
	Leaking sewer lines				
	Regulated Stormwater[3]	14		31	
	Non-regulated Stormwater[3]		14		31
	Subsurface Sewage Disposal System[4]	14	14	31	31
	Wildlife[3]		14		31
	Waste directly from people swimming or domestic animals		14		31
SB Indirect Consumption	Non-Stormwater NPDES[5]	88		260	
	Combined Sewer Overflow	88		260	
	Sanitary Sewer Overflow				
	Overboard Discharges[2]				
	Illicit sewer connection				
	Leaking sewer lines				
	Regulated Stormwater[3]	88		260	
	Non-regulated Stormwater[3]		88		260
	Subsurface Sewage Disposal System[4]	88	88	260	260
	Wildlife[3]		88		260
	Waste directly from people swimming or domestic animals		88		260
WLA = Waste Load Allocation, LA = Load Allocation.					
If WLA or LA cells are blank, then the source is not authorized to contribute bacteria to surface waters.					
(1) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations.					
(2) All coastal and inland waters in Connecticut are designated as No Discharge Areas for Overboard Discharges (OBDs).					
(3) Replace numeric value with "natural levels" if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP WQS RCSA 22a-426-1(47)).					
(4) WLA and LA criteria both apply to SSDS, as some discharges from SSDS are point source/permitted and others are nonpoint source/not permitted based on characteristics of the system and the discharge.					
(5) For discharges from water pollution control facilities (WPCFs) the WLA is applied as an end-of-pipe bacteria concentration, which at a minimum should be applicable during the disinfection period specified in the WQS (RCSA 22a-426-3(a)(9)(E)), which is year-round for salt waters unless otherwise specified in the facility permit.					

5.3 Seasonal Considerations

Bacteria sources to waters arise from a mixture of continuous and wet-weather driven sources, and there may be no single measure that is protective under all conditions. These bacteria TMDLs have set WLAs and LAs for all allowable known and suspected source categories equal to the water quality criteria or equal to loads which assure water quality criteria are achieved. In Connecticut, the season for contact recreation is limited to the warmer months. The TMDLs apply during these times to protect designated uses. Furthermore, any of the recommended measures that are implemented to meet the TMDL targets, will result in reductions of bacteria concentrations and daily loads to water quality criteria levels for all seasons for which WQS apply. Therefore, the TMDL adequately accounts for seasonal variability.

5.3.1 Impacts of Extreme Weather Conditions

Water resources in Connecticut are affected by extreme weather, including increasing temperatures, changing precipitation patterns, storms, floods, and drought, and rising sea levels. These events directly influence the factors that affect erosion potential, including rainfall intensity, rainfall frequency, rainfall duration, wind, and temperature. Use of a concentration-based approach to bacteria TMDL development allows for continued relevance of this TMDL under scenarios where extreme weather conditions may affect pollutant loadings since having concentration-based targets for attainment of water quality criteria can be applied even as loadings may change due to stormwater volume changes. More information on efforts to address extreme weather in Connecticut is discussed in Section 11 of this document.

5.4 Future TMDL Applicability

In the future, CT DEEP may submit additional TMDLs to EPA for waterbodies to be added as appendices to this Core Document for TMDL coverage without resubmitting the approved Core Document. The future submittals will provide detailed information on the additional segments and their TMDLs. Connecticut will provide public notice for review of the additional TMDLs. If modifications are made to the methods for evaluating pollutant loads or calculating loading targets for waterbodies covered by this Core Document, CT DEEP will propose changes to the Core Document at that time and provide a public notice process for review and comment on any changes to the Core Document.

5.5 Monitoring Plans

A comprehensive water quality monitoring program is necessary to guide TMDL implementation efforts and should be designed, at a minimum, to accomplish two major objectives: source detection and tracking water quality improvements. Monitoring is needed to identify specific sources of bacterial loading which will, in turn, direct BMP implementation efforts. As changes are made within the watershed and BMPs applied, additional monitoring is needed to quantify progress in achieving TMDL established goals.

Facilities, municipalities, and other NPDES permitted entities that discharge stormwater to areas covered by an approved TMDL are required to follow their permit which may include monitoring for the indicator pollutant. Details on monitoring required for compliance with permit requirements are contained in each permit. As part of a TMDL, CT DEEP may recommend additional monitoring.

Stormwater monitoring may be referred to as event monitoring because it is scheduled to coincide with a stormwater runoff event. Event monitoring can present numerous logistical difficulties for municipalities and may not be the most efficient way to measure progress in achieving water quality standards. This is particularly true for streams draining urbanized watersheds where many sources contribute to excursions above water quality criteria.

Source detection monitoring will include visual inspection of storm sewer outfalls under dry weather conditions, event sampling of individual storm sewer outfalls, and should be expanded to include monitoring of ambient in-stream conditions at closely spaced intervals to identify “hot spots” for more detailed investigations leading to specific sources of high bacteria loads. Such monitoring may be performed by municipal staff, citizen volunteers, or contracted to an environmental consulting firm. Additional information about testing methods used by volunteers can be found in the EPA Quality Assurance Handbook and Toolkit for Participatory Science Projects website.

Progress in achieving TMDL established goals through BMP implementation may be most effectively gauged through implementing a fixed station ambient monitoring program. CT DEEP strongly recommends that routine monitoring be performed at the same sites used to generate the data to perform the TMDL calculations. Samples should also be collected at other key locations within the watershed, such as above and below potential contributing sources or areas slated for BMP implementation. Since watershed borders and TMDLs do not follow town borders there is a possibility that samples were not previously collected within your town. If this is the case collecting a sample where the waterbody enters your town and another where the waterbody leaves your town maybe helpful to determine how stormwater from your town influences water quality. Sampling should be scheduled at regularly spaced intervals during the recreational season (April 1- November 1). In this way the data set at the end of each season will include ambient values for both “wet” and “dry” conditions in relative proportion to the number of “wet” and “dry” days that occurred during that period. As additional data is generated over time it will be possible to repeat the TMDL calculations and compare the percent reductions needed under “dry” and “wet” conditions to the percent reductions needed at the time of TMDL adoption.

All pollutant parameters must be analyzed using methods prescribed in RCSA 22a-430-3 and 4 as well as 40 CFR Part 136. Electronic submission of data collected from surface waters should be made through the EPA Water Quality Data exchange (WQX) WQX is a searchable database sponsored by the United States Geological Survey, the US EPA, and the National Water Quality Monitoring Council. It contains data collected by many state, federal, tribal, and local agencies. Monitoring data collected using State grant monies are required to have an approved Quality Assurance Project Plan (QAPP) and be submitted to WQX. Grant recipients experienced in database entry can choose to upload data directly to the portal by registering for a Water Quality Exchange (WQX) account. Data templates to facilitate data submission through WQX/WQP are available on CT DEEP’s Nonpoint Source Management webpage. Additionally, electronic submission to CT DEEP would be appreciated.

Results of monitoring that indicate unusually high levels of contamination or potentially unauthorized activities should be forwarded to the appropriate municipal or State agency for follow-up investigation and enforcement. Additional monitoring for detergents can assist with source tracking efforts. These parameters can be especially useful in determining a connection with impairments sourced to on-site sewage disposal systems.

CT DEEP will continue periodic monitoring of pollutants in impaired segments across the state. These monitoring efforts will primarily be a product of the beach monitoring, and to a lesser extent targeted sampling conducted by the CT DEEP Monitoring Program and shellfish bed monitoring conducted by the CT Department of Agriculture Bureau of Aquaculture.

Any non-governmental entities and watershed associations, as well as academic institutions are welcome to also collect monitoring data for inclusion in CT DEEP analysis of water quality. Bacteria monitoring should include source tracking efforts, targeted monitoring during all weather conditions, and ensuring the accessibility of data with documented data collection policies and metadata. CT DEEP is committed to providing technical assistance in monitoring program design and establishing procedures for electronic data submission see our Volunteer Water Monitoring Program (ct.gov) web page and the EPA Quality Assurance Handbook and Toolkit for Participatory Science Projects website.

Bacteria monitoring provides information essential to better locate, understand, and reduce pollution sources and evaluate progress towards meeting water quality goals over time. Through implementation of this TMDL, data may be collected over time through the monitoring of permitted discharges and development of WBPs, in association with implementation of BMPs within the watershed or for general evaluation of water quality conditions.

Monitoring Permitted Discharges

Monitoring of permitted discharges should be conducted per permit requirements and as recommended in Section 9. Monitoring results should be submitted to CT DEEP.

Other Implementation Monitoring

As BMPs and other practices are installed in the watershed, CT DEEP recommends that water quality monitoring occur pre- and post-construction and that erosion and sediment control inspections are performed, if possible, to ensure that BMPs are properly installed/maintained, particularly in areas adjacent to waterbodies. Information on the BMPs that were installed should also be provided to CT DEEP.

Monitoring Surface Waters

Sampling surface waters within the TMDL study area can help to evaluate the effectiveness of implementation activities within the watershed and to track trends in water quality restoration or protection. Access to ambient data can also help to identify if existing water quality is consistent with WQS targets and can aid in developing project-specific and waterbody-specific criteria as needed. For these reasons CT DEEP supports and encourages ambient monitoring of waterbodies as resources allow. CT DEEP may conduct additional ambient monitoring in the future to evaluate success of implementation and track trends in WQ attainment or protection.

CT DEEP recommends that a Quality Assurance Project Plan (QAPP) be developed to support efforts to monitor water quality in surface waters. Information on how to develop Quality Assurance Project Plans can be found in the EPA Quality Assurance Handbook and Toolkit for Participatory Science Projects website.

5.6 Reasonable Assurance

Reasonable assurances that both point and non-point allocations will be achieved include a combination of regulatory and non-regulatory program support in Connecticut, including regulatory enforcement, availability of financial incentives, and local, State, and federal programs for pollution control. Funding is a major factor in achieving TMDL targets. CSOs are regulated under an existing federal and State program. MS4 permitted communities and entities are required to address bacteria in stormwater systems through permit requirements. Actions to control non-point source sources of pollution include local implementation of Connecticut's Nonpoint Source Management Program. Progress is also contingent on the willingness and motivation of a strong local stakeholder group to lead each restoration effort. The CT DEEP Watershed Management Program encourages development of water quality based WBPs to support implementation of established TMDLs.

To accelerate water quality attainment, TMDLs are written to support nearly every element of a WBP that can be determined at the TMDL stage, thus supporting implementation. The integration of WBP elements into this TMDL is described in Section 1.3 of this document and Figure 2 and discussed in more detail in Section 6. Descriptions of existing watershed-specific management activities by municipalities, permit holders, and other responsible parties, as well as volunteer monitoring groups, homeowners associations, research organizations, and other engaged stakeholders, is provided in each watershed-specific TMDL appendix. Past and current management actions, plus Connecticut WQS which specifically mandate BMPs to protect water quality, provide reasonable assurance of future efforts toward meeting the TMDL targets. RCSA 22a-426-4(a)(10) specifically refers to controlling nonpoint sources of pollution through requiring the use of BMPs.

There are multiple categories of bacteria sources (see section 4) and many of the necessary remedial actions are well known. The resources identified in Section 6 and 7 of this report, Watershed Based Plans and Implementation and Best Management Practices, respectively, provide communities with information on effective mitigation of bacteria sources. Section 8 of this report identifies potential funding and community resources available for TMDL implementation.

In addition, CT DEEP continues to work with watershed stakeholders to draft WBPs under the CWA Section 319 NPS Grant program. As part of these WBPs, watershed stakeholders are required to investigate sources that contribute impairments and promote the implementation of nonpoint source pollution best management practices and stormwater management practices for non-regulated stormwater in the watershed. CT DEEP approves WPBs, including those that address management measures to reduce bacteria and source mitigation to support the TMDLs. WBPs include watershed-wide and place-based recommendations aimed at reducing nonpoint sources of pollution, including bacteria. These recommended WBP projects may be eligible for Section 319 funding, as long as such projects are not used for permit compliance.

5.7 Public Participation and Response to Public Comments

CT DEEP provides TMDL documents to the public for review and comment prior to establishing the TMDL and submitting it to the US EPA for review and approval. Under this effort, documents that are available for public review are noticed in appropriate newspapers and electronic notification is provided through the CT DEEP web page, various listservs, direct email notification and, in some cases, through social media. The intent is to provide substantial public outreach allowing for review and comment of available documents by interested and potentially affected stakeholders. A public meeting is held during the public comment period to provide details on the project that is available for comment and to answer any questions. Comments are to be submitted in writing through email during the public comment period in order to be considered by CT DEEP during finalization of the documents.

Written comments received on this document, will be reviewed and considered, a response to comment document developed and the documents revised as appropriate prior to finalizing the document. The response to comments documents are shared directly with those who provided comments and will be posted on the CT DEEP TMDL website.

SECTION 6. WATERSHED BASED PLANS AND IMPLEMENTATION

The Statewide Bacteria TMDL allocations quantify the reduction of bacteria required to achieve water quality standards (WQS) and provide general information on how the bacteria reductions might be achieved. Each bacterial contamination represents a unique problem that results from the interaction between watershed conditions and source activity. Substantial time, financial commitment and community dedication will be required to attain the goals and load allocations in this TMDL. This implementation planning section provides general guidance for developing more detailed, site-specific implementation plans to address water pollution caused by potentially harmful bacteria in Connecticut's surface waters from nonpoint pollution sources.

This TMDL provides a framework to set goals that are needed to address the numerous and diverse sources of bacteria in the State of Connecticut. A comprehensive control strategy to address bacterial pollution requires these basic steps:

- Commitment from community members to fix bacterial contamination;
- Identification of potential sources of contamination, through local information, including surveys and monitoring, as appropriate;
- Setting specific bacterial pollution targets goals consistent with the Load Allocations within the TMDL;
- Developing a plan to control nonpoint pollution sources using both BMPs and education; and
- Implementing the plan and continuing monitoring to determine effectiveness.

TMDL implementation should be an iterative process, with realistic goals over a reasonable timeframe and with ongoing adjustments based on monitoring results. A watershed-based approach is recommended for mitigating bacteria impairment; Section 6 describes the application of a watershed-based approach to managing nonpoint pollution sources and provides examples of watershed management plans and implementation resources.

Stakeholder participation in site-specific plan development and follow-through is critical to the success of restoration efforts and attainment of WQS. 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.

Section 7 contains information on implementation measures for various types of potential bacteria sources. These potential sources include developed areas, 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 are provided.

6.1 The Planning and Implementation Process

Developing a WBP is an important next planning step in restoring an impaired waterbody after a TMDL document is approved. WBPs provide the framework for coordinating restoration efforts to address nonpoint pollution sources and include analyses, actions, participants, and resources to achieve the NPS pollutant load reductions called for in the TMDLs. Please see the CT NPS Management Program Plan available on our website. WBPs are developed collaboratively among stakeholders, typically municipalities, conservation districts, watershed groups, and private citizens. Management measures recommended in WBPs are voluntary (unlike the required measures for communities or industries that fall under NPDES permits). WBPs set mechanisms for tracking progress over time because successful restoration is an iterative process, requiring realistic goals over a reasonable timeframe, as well as ongoing adjustments based on monitoring results. Each impairment is a unique problem with a its own set of stakeholders and resources to solve that problem. Substantial time, financial commitment, and community drive is required to attain the targets set by the TMDL and WBP.

WBPs developed to implement this TMDL may consider other impairments and threats in the watershed. TMDLs in Connecticut focus on the watershed, incorporating the pollutant- and site-specific TMDL into the larger context of the watershed, including additional water quality threats, pollutants, and sources. WBPs should also consider the watershed size to ensure that implementing the plan will address all the major nonpoint sources and causes of impairments to the waterbody of interest. Plans that bundle sub-watersheds with similar sets of problems or address a common stressor (e.g., bacteria) across multiple related watersheds can be particularly useful in terms of planning and implementation efficiency and the strategic use of administrative resources (US EPA 2008). Therefore, multiple impaired segments within the larger watershed may be covered under a single WBP.

Although many different components may be included in WBPs, EPA has identified nine key elements that are critical for achieving improvements in water quality. These nine elements must be included in all WBPs for planning and implementation projects to be eligible for funding through the CWA Section 319 NPS Grant Program administered by CT DEEP.

Nine Key Elements

a) Identify causes and sources of pollutants that need to be controlled.
b) Determine pollutant load reductions needed.
c) Develop management measures to reduce pollutants and achieve goals.
d) Identify technical and financial assistance needed to implement plan.
e) Develop information/education component.
f) Develop implementation schedule.
g) Develop interim milestones to track implementation of management measures.
h) Develop criteria to measure progress towards meeting goals.
i) Develop monitoring component

6.2 Nine Element Watershed-Based Plans

Many of the required nine elements in a WBP can be adopted directly from the TMDL. For example, TMDLs identify causes and sources of bacteria contamination (WBP Element a) and specify water quality targets such as bacteria WLAs/Las (WBP Element b) TMDLs also assist in other key elements of WBPs such as recommending management measures (WBP Element c) and monitoring components (WBP Element i). Since TMDLs and WBPs reinforce each other's goals, CT DEEP encourages that WBPs be put in place as a supplemental tool alongside TMDLs to improve water quality. It is important to note that a TMDL analyzes both PS and NPS while a WBP focuses on NPS. Additionally, the WBP process relies more heavily on local support for outreach and stakeholder involvement to develop and implement the plan. While the TMDL provides overall recommendations identifying NPS pollutant sources and necessary aggregate reductions in NPS pollutant loading, it is the WBP that provides the process for identifying specific sources of NPS pollution and the BMPs and timeline for addressing these sources. The following sections are intended to streamline the process of writing the WBP for each watershed in this TMDL by presenting the plan components in as much detail as possible. The next sections correspond to the nine elements of a WBP, with guidelines and materials for completing WBPs.

Identify Causes and Sources

This Core Document describes generally the potential sources of bacteria in a watershed as well as the WLAs and LAs associated with each pollutant source. Each bacteria TMDL also includes the WLAs and LAs, as well as a more detailed evaluation of potential sources of bacteria pollution. The TMDL includes a Potential Sources map that identifies sewer and non-sewer areas, permitted discharge sources, permitted waste sites, golf courses, migratory waterfowl hotspots, agricultural areas, and other relevant potential PS and NPS pollution sources in the watershed as available through CT DEEP spatial files and records.

WBPs developed to follow up on this TMDL should focus on identification of more specific pollutant sources based on input from local stakeholders and from technical personnel during field surveys of the watershed. Examples of pollutant sources could include:

- Street and parking lot drains which discharge to or near surface waters;
- Unmanaged runoff from urban and agricultural lands;
- Expansive pavement or lawns leading to the water's edge;
- Over-fertilized lawns, especially adjacent to impaired waters;
- Sites where dog waste is regularly found (i.e. a park);
- Suspected sewer and septic system leaks;
- Manure management needs; and
- Other NPS stormwater or pollutant hotspots.

Estimate Bacteria Load Reductions Expected from Management Measures

This Core Document describes generally the TMDL, and percent reduction calculation methods (refer to Section 5), to determine bacteria reductions to achieve WQS. General pollutant load reduction estimates are provided for some BMPs and other water quality restoration work in Section 7, Best Management Practices. See Section 7, for detailed information on the types of BMPs and the level of pollutant reduction possible. The watershed TMDLs include the bacteria data for impaired water segments and calculates the % reductions needed, based on that data, to achieve WLAs and LAs. The percent reductions are meant to describe the magnitude of difference between observed water quality and water quality goals. They do not represent targets for WBPs. Water quality targets are expressed as WLAs and LAs.

Accounting techniques should be employed to track BMP implementation and quantify expected load reductions as a result. Simple BMP tracking spreadsheets can be developed to document BMP type, location, drainage area, land use, pollutant removal performance, and estimated load reductions, etc. UConn CLEAR offers an Impervious Cover Disconnection Tracker for CT MS4 programs.

If a broader understanding of watershed load changes due to BMP implementation is of interest, Excel-based models independent from ArcGIS software can be used to estimate potential pollutant reductions. However, these tools generally do not include an evaluation of BMP effectiveness for bacteria. They generally include an evaluation of the removal efficiency of total suspended sediments. Since some amount of bacteria reduction may be gained from reducing total suspended sediments, these tools may be able to provide some helpful information. EPA Region 1 offers the Opti-Tool for evaluating the benefits and costs of stormwater BMP implementation. The Opti Tool includes a planning level analysis to evaluate opportunities across a given watershed and an implementation level analysis (links to the SUSTAIN model) to estimate BMP performance and identify cost-effective BMP sizing strategies. The Center for Watershed Protection's Watershed Treatment Model is another Excel-based model used to evaluate the impact of a variety of structural and non-structural practices (e.g., stormwater retrofits, wastewater upgrades, street sweeping, and inspection programs) on potential watershed load reduction. More sophisticated models recommended by EPA can be explored at Green Infrastructure Modeling Tools website.

Description of Management Measures

This Core Document generally outlines management measures that can reduce bacteria loading and restore water quality. WBP addendums further refine the recommended management measures through the development of an Implementation Strategy based on collaboration among local stakeholders. The first and most essential management measure is the establishment of a Watershed Management Team consisting of engaged stakeholders. Improving water quality is a major endeavor, requiring a cohesive effort from the whole community. Municipalities have resources and authority to address many sources of pollutants, but typically own and manage only a tiny fraction of the land in a watershed. The participation of community members, including private landowners, is essential to restoring the watershed for the community to use and enjoy. Examples of recommended members for a Watershed Management Team, plus an overview of the many activities and roles involved in developing an Implementation Strategy, are provided in Table 11. Generally, management measures include review and revision of municipal ordinances, including zoning, water quality monitoring and data analysis, design and installation of BMPs, and outreach and education. A list of possible management measures is provided in Table 12.

Table 11: Recommended Watershed Management Team members.

Adapted from the Amos Lake Watershed Based Plan (ECCD 2015).

Team Member	Roles / Responsibilities
Municipalities	Revise and enforce land use regulations, ordinances, review and permitting of site plans, BMPs on municipal properties, education and outreach; provide in-kind and/or funding support
Local Health Department	Conduct septic system permitting and inspection
Licensed SSDS Installer	Conduct inspection not associated with a permitted activity
Homeowners Association, Volunteer organizations	Conduct water quality monitoring; provide possible grant management
Local Businesses	Meet water quality focused regulations; maintain property to control pollutants; assist with outreach and education
Local Soil & Water Conservation District	Provide technical assistance; assist with implementation
Watershed Residents	Meet water quality focused regulations; install residential scale BMPs
Council of Government	Provide regional land use planning, grant assistance, and coordination among multiple member municipalities in the watershed

Team Member	Roles / Responsibilities
Regional Watershed / Conservation Nonprofits	Provide outreach and education and technical assistance
CT DEEP	Develop TMDLs; provide data review and archival and technical guidance; determine impairment or attainment status
CT DOT	Maintain stormwater systems on state roads

Estimate of Technical and Financial Assistance

The Core Document provides a list of technical (Section 7) and financial (Section 8) resources to assist with implementation of management measures. WBP addendums include specific costs, timeframes, and responsible parties for each management measure. Additional technical assistance may be sought from:

- State and federal agencies (e.g., US Army Corps of Engineers, EPA);
- Professional scientists, such as a limnologists, soil scientists, or aquatic ecologists;
- Engineers specialized in LID or stormwater management;
- Local health departments, especially related to septic systems;
- Municipal Public Works Departments, especially those responsible for MS4 management;
- Municipal Planning, Zoning, or Wetlands staff; and
- University programs.

Information, Education, and Outreach

The Core Document describes generally the types of education and outreach that would help achieve reductions in bacteria while the TMDL prioritize general education and outreach recommendations based on any existing local programs. Education and outreach are further refined with input from the Watershed Management Team. Example activities for education and outreach are included in Table 12.

Schedule for Addressing Bacteria Reductions

Scheduling is determined by the Watershed Management Team in the WBP addendum. Each management measure recommended in the WBP addendum is assigned a realistic date range for completion (typically in units of years). It is important to include an estimate for when the WQS will be achieved, even if that timeframe extends past the typical two- to three-year period of a funded project or the ten-year period of a WBP (EPA 2013).

Table 12 is a general list of possible management measures, by category with examples of associated responsibilities parties and measurable milestones. It is a starting point and is not comprehensive because there may be several site-specific management measures added by the Watershed Management Team as part of the WBP addendum. Realistically achievable numeric interim measurable milestones are set by the Watershed Management Team at the 2-, 5-, and 10-year benchmarks in the WBP addendums.

Table 12. List of possible Management Measures

Management Measure Example	Responsible Party Example	Measurable Milestone Example
Watershed & Shorefront BMPs		
Work with residents to implement at least one BMP on their land.	Municipality, homeowners association, conservation group	Number of small-scale BMPs installed on properties; linear feet of buffers installed; percentage of properties with at least one installed BMP.
Implement BMPs in the top areas identified during WBP field assessments.	Municipality, homeowners association, conservation group, DOT, private landowners	Number of BMPs implemented from field surveys.
Inventory existing structural BMPs, identify responsible landowners/managers, and assess maintenance status. Institute and execute a long-term maintenance program for structural BMPs.	Municipality, homeowners association. conservation group, DOT, private landowners	Number of existing structural BMPs identified; number of BMPs maintained.
Develop a method of tracking and monitoring BMP implementation progress, including load reduction estimates (e.g., NPS Site Tracker).	Municipality, homeowners association, conservation group	Setup of NPS Site Tracker; number of updates to NPS Site Tracker.
Work with the Natural Resource Conservation Service (NRCS) and farms to develop comprehensive nutrient management plans for livestock operations or fields with applied manure or other fertilizer.	NRCS, farm owners	Number of farmers with approved comprehensive nutrient management plans.
Summarize NPS sites identified on state-maintained roads and send to DOT for review and remediation.	Municipality, homeowners association, conservation group, DOT	Number of BMPs implemented from field surveys.
Review BMP road installation and maintenance practices currently used for each town and determine areas for improvement. Develop and/or update a written protocol for BMP road installation and maintenance practices.	Municipality, homeowners association, conservation group	Number of improved BMP road practices instituted.
Work with road agents and landowners to create and manage drainage easements on public and private properties. This will help ensure that culverts and other drainage structures that cross private property are being properly maintained to control stormwater runoff from roads.	Municipality, private landowner	Number (percentage) of mapped and properly managed drainage easements.
Municipal Planning & Land Conservation		
Collaborate with local conservation partners on land conservation initiatives within the watershed. Assign a liaison to communicate with conservation groups.	Municipality, homeowners association, conservation group	Number of participating conservation group members.
Create a priority list of watershed areas that need protection based on natural resource inventories and identify potential conservation buyers and property owners interested in easements within the watershed.	Municipality, homeowners association, conservation group	Number of parcels with new conservation easements; number of new parcels put into permanent conservation.
Incorporate WBP recommendations into town master plan.	Municipality	Incorporation of WBP recommendations into town master plan.

Management Measure Example	Responsible Party Example	Measurable Milestone Example
Create list of BMP and Low Impact Development (LID) descriptions for Town Selectman, Zoning Board of Appeals, Planning Boards, and landowners.	Municipality	Completed list of BMP/LID descriptions
Improve or develop ordinances addressing setbacks (how much), buffers, lot coverage, LID, steep slopes, stormwater regulations, and open space (also consider fertilizer/pesticide use and pet waste). Complete a full-scale ordinance review that includes working with the planning board to recommend changes, such as site plan review regulations, road and right of way standards, minimum lot sizes, minimum shore frontage per lot, and others.	Municipality	Number of updated or new ordinances that target water quality protection.
a) Lot Coverage: adopt requirements on Stormwater Management Plans for subdivisions, commercial, and multi-family development, and redevelopment disturbing 20,000 sq. feet or more.		
b) Setbacks (Shoreland Zoning): increase the setback distance to 100 feet within the shoreland zone. Develop and expand the coverage of a Shoreland Protection Overlay District to lakes and ponds, streams and rivers, and surface waters of local significance, as defined by a natural resource inventory.		
c) Wetland Buffers: increase the setback distance from all wetlands (not just prime wetlands) to 100 feet. Develop and approve a Wetland Conservation Overlay District that encompasses all wetlands and establishes higher levels of protection for wetlands of local significance, wetlands contiguous to lakes or ponds, and vernal pools.		
d) Steep Slopes: require design and implementation of BMPs on all development on slopes >15%.		
e) Conservation/Cluster Subdivisions: encourage conservation subdivisions and increase the amount of land set aside in conservation subdivisions to min. 50% of the development area.		
f) LID: Amend Stormwater Management ordinances to state that the use of LID techniques is preferred and shall be implemented to the maximum extent possible.		
Review and optimize MS4 compliance for all towns (regardless of MS4 designation), including infrastructure mapping, erosion and sediment controls, illicit discharge programs, and good housekeeping practices.	Municipality	Number (percentage) of MS4 minimum control measures implemented.
Subsurface Sewage Disposal Systems		

Management Measure Example	Responsible Party Example	Measurable Milestone Example
Require inspection of all home conversions from seasonal to permanent residences, sold properties, and property transfers for proper septic system size and design.	Municipality	Number of septic system inspections (seasonal conversion and property transfer); number of upgrades.
Consider septic system ordinances that require regular pump-outs and inspections to ensure proper functioning.	Municipality, state agency	Establishment and enforcement of a septic system ordinance.
Develop and maintain a septic system database for the watershed. Code Enforcement Office for towns to maintain database.	Municipality, state agency	Development of a septic system database; number of database updates.
Complete in-person, mail-in, or online survey of septic systems to fill in missing information in the database.	Municipality, homeowners association, conservation group	Number (percentage) of survey responses.
Conduct voluntary dye testing of any suspected septic systems. Goal: 5 systems.	Municipality, homeowners association, conservation group, private homeowner	Number of septic system dye tests; number of upgrades.
Funding		
Support State legislation that increases funds for aquatic invasive plant (e.g., milfoil) eradication.	homeowners association, conservation group	Amount of state or local funds increased for aquatic invasive plant eradication.
Obtain funding from sources such as municipal contributions, grants, lake associations, targeted fundraising, and other grants.	Municipality, homeowners association, conservation group	Amount of funding secured from municipal/private work, fundraisers, donations, and grants.
Create a subcommittee that develops a fundraising strategy and determines how funding is spent.	Municipality, homeowners association, conservation group	Establishment of a subcommittee; number of meetings; amount of funding secured.
Establish a capital reserve fund or include as a budget line item for towns to spend on BMP installation and maintenance or other water quality protection initiatives.	Municipality	Amount of funds secured through municipal capital reserve fund for general water quality protection initiatives.
Develop a "Friends of the Watershed" program for donations from local businesses. A business can receive a sticker or plaque recognizing their support for protecting local water resources.	Municipality, homeowners association, conservation group, businesses	Amount of funds secured through business donations.
Investigate grants and low-interest loans (e.g., Clean Water State Revolving Fund) to provide cost-share opportunities for septic system upgrades.	Municipality, conservation group	Number of grants identified; amount of funds secured.
Coordinate group septic system pumping discounts.	Municipality, homeowners association, conservation group, homeowner's association	Number of coordinated group septic system pump-outs.
Encourage towns, conservation commissions, or local conservation partners to reserve a portion of conservation dollars for the watershed that can be used for septic system upgrades.	Municipality	Amount of funds secured through reserve fund for septic system upgrades.

Management Measure Example	Responsible Party Example	Measurable Milestone Example
Consider stormwater utility, cooperative, or other stable coordinating and financing structure.	Municipality	Number of hearing or working group meetings; creation of a stormwater utility.
Education and Outreach		
Contact local representatives and attend selectman meetings to voice concerns and stay informed about water quality issues.	Private landowner, business owner, concerned citizen, homeowners association, conservation group	NA
Contribute interesting articles about water quality and watershed protection efforts to various media sources.	Municipality, Homeowners Association, conservation group, conservation group	Number of water quality related articles; number of media sources used; amount of traffic to articles on digital media sources.
Create educational annual "report cards" about water quality, presented in a format that is approachable to lay persons.	Municipality, Homeowners Association, conservation group	Number of report cards issued; number of copies published and distributed; amount of traffic to report cards on digital media sources.
Create flyers/brochures for shorefront homes regarding BMPs, fertilizers, and septic systems. Consider creating a "new homeowner" packet that covers water quality related issues and ordinances in the watershed. Utilize online points of contact to provide information on ordinances, LID, and BMPs for landowners (e.g., fact sheets). Reach out to residents converting properties to year-round single-family homes to educate on watershed issues, LID, and BMPs.	Municipality, Homeowners Association, conservation group	Number of copies of watershed-based educational materials distributed.
Hold informational workshops on proper road management, winter maintenance, and provide educational material for homeowners about winter maintenance and sand/salt application for driveways and walkways.	Municipality, Homeowners Association, conservation group	Number of informational workshops and/or trainings for landowners, town staff, and/or developers/landscapers on local ordinances, watershed goals, and/or best practices; number of volunteers participating in educational campaigns; number of workshop attendees.
Hold informational workshops for new landowners, towns, and developers on relevant town ordinances, conservation easements, and watershed goals. Educate municipal officers, planning staff, code enforcement staff, and planning / zoning board members on lake impairment (including the TMDL and WBP), LID, and other planning-level BMPs. Goal: Host 1-2 workshops.	Municipality, Homeowners Association, conservation group	
Hold workshops or field trips to residential or commercial BMP demonstration sites.	Municipality, Homeowners Association, conservation group	
Consider/host workshops on proper fertilizer application.	Municipality, , homeowners association, conservation group, professional landscaper and grounds keeper	
Establish WBP website or webpage on existing site (e.g., municipal) and place an informative slideshow in the public access TV rotation	Municipality, homeowners association, conservation group	Creation of WBP webpage; amount of traffic to webpage.

Management Measure Example	Responsible Party Example	Measurable Milestone Example
Present the WBP to the board of select/planning board of watershed towns.	Municipality, homeowners association, conservation group	Number of presentations given; percentage of watershed towns presented to.
Distribute educational pamphlets on septic system function and maintenance in tax bills, and have the materials available in the library or other public venue (to include recommended pumping schedules, proper leach field maintenance, etc.).	Municipality, homeowners association,, conservation group	Number of educational materials published and sent to residents.
Create and distribute a list of septic service providers (designers v. pumpers) (create magnets, etc.).	Municipality, lake association, homeowners association, conservation group	Number of lists/magnets published and distributed.
Host multiple "septic socials" to address link between septic system maintenance and water quality. Target educational campaign in areas with minimally maintained or aging septic systems near surface waters.	Municipality, lake association, conservation group	Number of "septic socials" hosted; number of attendees.
Require training for road agents on proper road BMPs for salt, sand, and equipment use. Use only treated salt and not sand on paved surfaces, reduce application rate by 40-50%, and sweep the roadways in the spring. Review locations of snow pile areas to avoid nearby surface waters.	Municipality	Numbers of trainings held; number of attendees; number of improvements instituted.
Conduct training with Public Works Department staff on structural and non-structural BMP options to protect water quality, including the importance of catch basin cleaning, street sweeping, and preventing erosion.	Municipality	
Conduct training with municipal Parks and Recreation staff on landscaping and property management BMPs to prevent polluted runoff from recreational lands (including discouraging large congregations of waterfowl).	Municipality	
Conduct LID/BMP training and investigate certification opportunities for public works, road agents, code enforcement officers, and Zoning Board of Appeals in watershed towns, where applicable. Target seasonal residents and renters as well.	Municipality	
Incorporate pollution, aquatic ecology, water quality monitoring, and aquatic restoration efforts into school curricula.	School	Number of water quality related updates to school curricula.
Promote an environmental science club or similar that conducts regular water quality monitoring and reporting to municipal officials. Explore possibility of LID demonstration projects created with student involvement.	School, homeowners association, s scouts, conservation group	Number of student members; number of environmental projects and collaborations.
Create pet waste collection signage and bag stations at popular dog-walking areas. Pet owners to utilize bag stations and properly dispose of pet waste.	Municipality, homeowners association,, conservation group, pet owner	Number of signage and bag stations installed; number of bag station refills.

Management Measure Example	Responsible Party Example	Measurable Milestone Example
Place informational material on proper pet waste disposal at local veterinarian offices and at municipal dog registration offices.	Municipality, lake association, conservation group, pet owner	Number of materials posted; number of venues posted at; number of material refills.
Conduct outreach on establishing riparian buffer zones around areas that potentially contribute bacteria to receiving streams, such as pastures, plowed and/or fertilized row crops, barnyards, and manure storage areas;	NRCS, farm owner, private landowner, business owner, conservation group	Number of landowners contacted; percentage of positive responses; linear feet of riparian buffer restored.

Description of Interim Measurable Milestones

To guide progress toward the long-term restoration target set by the TMDL, the Core Document includes general interim measurable milestones, while the WBP addendums further refine the interim measurable milestones through input received by the Watershed Management Team. These milestones are shorter-term steppingstones which can help focus and maintain momentum toward the long-term goal of restoration. The measurable milestones identified in the WBP addendum are specific to the watershed and stakeholders involved and closely follow the proposed management measures. An overview of commonly adopted milestones for each management measure is included in Table 12.

Performance Criteria

WBPs must cite the criteria to be used for determining whether pollutant load reductions are being achieved over time and whether recommended actions need to be revisited. The performance criteria used in bacteria TMDLs are the WQS, see tables 2 and 3. Ultimately, performance is measured based on bacteria concentrations in surface waters.

The TMDL targets, especially for NPS pollution, may be long-term goals; therefore, additional short-term goals can be valuable. These shorter-term goals may focus on water quality in specific geographic areas. For example, downstream water quality after installation of BMPs must be better than before the BMP was installed to determine whether the BMP is functioning as intended. Short-term goals for areas where no BMPs have been planned, such as rural areas with little development, may include that water quality does not worsen over time.

Monitoring Component

There are at least four main components to any monitoring program that evaluates the effectiveness of implementation efforts over time:

- Methods and documentation for quality assurance / quality control;
- Personnel trained to conduct the monitoring;
- A monitoring plan, with parameters, locations, and timing; and
- Data management, including analysis, interpretation, reporting, and archival.

Monitoring conducted by CT DEEP Water Monitoring Program (CT DEEP, 2015), trained volunteers, supervised university students, or other groups; are checked for quality and accepted by CT DEEP for assessment purposes; data are analyzed sufficiently for impairment decision and required pollutant load reductions; and data are archived by CT DEEP and possibly other organizations. Ultimately, the CT DEEP Water Monitoring Program determines whether WQS are being met.

Proposed future monitoring should be completed by trained personnel following a Quality Assurance Project Plan (QAPP) or similar document that details the monitoring plan, parameters, locations, and sampling frequency, as well as how data will be quality-checked, analyzed, and maintained. CT DEEP works under a water quality monitoring QAPP that meets the minimum standards for data acceptability set by the *Consolidated Assessment and Listing Methodology* (CALM). If work is conducted by an individual or group other than CT DEEP, then the individual or group should complete a sampling and analysis plan (SAP), which is an abbreviated, site-specific document that references a larger QAPP. The SAP should include all the parameters necessary to monitor the progress of criteria set in Measurable Milestones (table 12) and Water Quality Standards (Section 2). If a monitoring program already exists, maintain the existing program so as not to interrupt valuable long-term data collection, while adding additional parameters or timing as appropriate. EPA provides additional guidance for Quality Assurance associated with Citizen Science projects on their EPA Quality Assurance Handbook and Toolkit for Participatory Science Projects website.

6.3 Watershed Management Plans and Resources

CT DEEP Watershed Management Program - The Watershed Management Program addresses water resource issues across Connecticut's five major watersheds from an integrated watershed perspective. The Watershed Management Program supports the development of comprehensive watershed management plans. These plans are designed to protect and restore water quality, and conserve and manage water resources, by guiding local land use decision making, and enhancing pollution prevention programs. The Program also oversees CT DEEP's Nonpoint Source Management Program, which includes administering the Federal Clean Water Section Act 319 Nonpoint Source Grant Program. CT DEEP provides grant awards for both implementation and planning projects to address nonpoint source pollution, including for the development of nine element Watershed Based Plans (WBPs). Projects described within an approved WBP are considered a priority for section 319 grant awards.
Online: NPS Pollution Management Program.

CT DEEP Clean Water Act Grant Guidance Watershed Based Plan Checklist - CT DEEP developed a Checklist for a Watershed Based Plan with US EPA's 9-Elements that is required to be submitted alongside an eligible plan by the applicant in order to become a DEEP-approved 9 Element WBP.
Online: Watershed Based Plans and Watershed Management Plans

CT DEEP WBPs - CT DEEP maintains a list of approved WBPs. As additional WBPs are developed the web site will be updated and so this location should be relied on as the most current and comprehensive listing of WBPs in Connecticut.
Online: DEEP Watershed Management Plans and Documents

EPA WBP Development Resources - EPA WBP resources include the Handbook for Developing Watershed Plans to Restore and Protect our Waters, (2008) and A Quick Guide to Developing Watershed Plans to Restore and Protect Our Waters (2013). These resources provide guidance on developing an EPA-approved WBP with the required nine elements for users who are just beginning to develop a WBP, are in the process of developing a WBP, or updating an existing WBP.
Online: Resources for Watershed Planning

SECTION 7. BEST MANAGEMENT PRACTICES

BMPs refer to a wide range of possible options that help prevent or reduce the movement of pollutants from the landscape to surface or ground waters. The term has a specific meaning in the context of Connecticut WQS, defined by RCSA 22a-426-1(7):

> *"Best Management Practices' means those practices which reduce pollution and which have been determined by the Commissioner to be acceptable based on, but not limited to, technical, economic and institutional feasibility."*

As mentioned previously, RCSA 22a-426-4(a)(10) requires the use of BMPs for the for the control of NPS pollution on a case-by-case basis. Thus, BMPs are an essential and mandatory component of restoring surface water quality in Connecticut and maintaining good water quality where it already exists.

7.1 Stormwater BMPs

Stormwater BMPs are often described as structural and non-structural. **Structural BMPs** are engineered systems that provide for recharge, water quality treatment, erosion prevention, and flood control. The selection and design of stormwater practices has evolved from storage facilities designed for flood control and channel protection to a preference for green stormwater infrastructure design for volume reduction onsite (via recharge, evapotranspiration, and reuse) and water quality treatment. Examples of green stormwater infrastructure practices include bioretention facilities, underground infiltration chambers, constructed wetlands, etc. **Non-structural BMPs** refer to a broad range of behavioral practices, activities, and operational measures that contribute to pollutant prevention and reduction, such as street sweeping, spill prevention measures, and pet waste management. In addition to structural and non-structural stormwater practices, there are also a suite of techniques for removing or disconnecting impervious cover and ecosystem restoration that can also provide pollutant removal. These practices are typically awarded credits within stormwater management context and are, briefly discussed below.

The selection of stormwater BMPs will be site specific and dependent on several factors, such as: land use, pollutant source, soils, depth to groundwater, slope, and other site constraints including costs and long-term maintenance considerations.

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.

7.1.1 Structural Stormwater BMPs

In developed areas, structural BMPs are engineered infrastructure designed to intercept stormwater runoff, often allowing it to soak into the ground, be taken up by plants, harvested for reuse, or released slowly over time to minimize flooding and downstream erosion. These BMPs often incorporate some mechanism for pollutant removal, such as sediment forebays, oil separators, filtration, or microbial breakdown. They can also consist of removing or disconnecting impervious surfaces, which in turn reduces the volume of polluted runoff generated, minimizing adverse impacts to receiving waters.

When selecting the appropriate BMPs for a given site, it is important to consider the potential for groundwater contamination, especially if groundwater in an aquifer protection area. Maps and information on aquifer protection areas are available through the CT DEEP Aquifer Protection Area Program. While direct infiltration through drywells or leaching trenches may be acceptable for clean roof runoff, infiltration without pretreatment may not be appropriate for parking lot or road runoff where road salt, petroleum byproducts, brake-pad dust and brake fluid, antifreeze, and other soluble compounds could pollute drinking water. In fact, infiltration at known sites of high pollutant loads or contaminated soils may be prohibited. New information is emerging on certain contaminants that may lead to changes in what type of runoff can be infiltrated without pretreatment.

Typically, structural BMPs are small, distributed installations focused on treating stormwater runoff in localized areas. Examples of smaller structural BMPs include bioretention, soil infiltration (via trenches or basins), porous pavement, constructed gravel wetlands, vegetative buffers, rain gardens, etc. Structural BMPs tend to have a higher initial cost than non-structural BMPs, though an effective maintenance program will extend their service life, avert expensive repair costs, and maximize overall cost efficiency. An operations and maintenance program with a source of ongoing funding and a responsible party are necessary for structural BMPs to function over time.

In most watersheds there are many sources of bacteria. As a result, appropriate management practices must be selected, designed, and implemented at numerous locations to mitigate pollutants and prevent or reduce water quality impairment. The most appropriate suite of management practices will vary depending on land use, bacteria source, removal targets, implementation feasibility, and cost. 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.

Given the variability in BMP performance, it is critical to select structural BMPs based on scientific and engineering data and a site-specific analysis. The Connecticut Stormwater Quality Manual provides design guidance and qualitative pollutant removal, cost, and maintenance levels for different BMPs.

Table 13: Bacteria Removal Efficiencies for Structural Stormwater BMPs
Adapted from the Connecticut Stormwater Quality Manual

Best Management Practice (BMP)	BMP Type	Bacteria Removal Efficiency	Capital Cost	Maintenance Burden	Land Requirement
Infiltration Trench	Infiltration BMPs	High	Low	Low	Medium
Infiltration Basin	Infiltration BMPs	High	Low	Low	Medium
Dry Well & Infiltrating Catch Basin	Infiltration BMPs	High	Medium	Medium	Low
Bioretention	Filtering BMPs	High	Medium	Medium	Varies
Sand Filter	Filtering BMPs	High	Medium	High	Medium
Underground Infiltration System	Infiltration BMPs	High	High	Medium	Medium
Permeable Pavement	Infiltration BMPs	High	High	High	Low
Stormwater Pond	Stormwater Pond & Wetland BMPs	Moderate	Medium	Medium	High
Stormwater Wetland	Stormwater Pond & Wetland BMPs	Moderate	Medium	Medium	High
Dry Water Quality Swale	Water Quality Conveyance BMPs	Moderate	Medium	Medium	Medium
Green Roof	Other BMPs & BMP Accessories	Moderate	Medium	Medium	Varies
Tree Filter	Filtering BMPs	Moderate	High	Medium	Low
Rain Barrel and Cistern	Stormwater Reuse BMPs	Low	Varies	Low	Low
Pretreatment Swale	Pretreatment BMPs	Low	Low	Low to Moderate	Moderate
Deep Sump Hooded Catch Basin	Pretreatment BMPs	Low	Low	Moderate to High	Low
Sediment Forebay	Pretreatment BMPs	Low	Low to Moderate	Moderate	Moderate to High

Best Management Practice (BMP)	BMP Type	Bacteria Removal Efficiency	Capital Cost	Maintenance Burden	Land Requirement
Pretreatment Vegetated Filter Strip	Pretreatment BMPs	Low	Low to Moderate	Low to Moderate	High
Wet Water Quality Swale	Water Quality Conveyance BMPs	Low	Medium	Medium	Medium
Dry Extended Detention Basin	Other BMPs & BMP Accessories	Low	Medium	Medium	High
Oil Grit Separator	Pretreatment BMPs	Low	Moderate	Moderate to High	Low to Moderate
Proprietary Pretreatment Device	Pretreatment BMPs	Low	Moderate to High	Moderate to High	Low
Underground Detention	Other BMPs & BMP Accessories	Low	High	High	Low

7.1.2 Non-Structural Stormwater BMPs, Impervious Disconnection, and Ecological Restoration

Reduction of bacteria can also be accomplished through non-structural BMPs, removal or disconnection of impervious cover, and restoration of natural green infrastructure or ecological restoration. Non-structural BMPs include a wide variety of activities that contribute to the protection of water quality. Examples include the following (some of which are already required by the MS4 program):

- Mapping and inspection of storm drain network;
- Municipal maintenance (BMP inspection and maintenance tracking, catch basin cleaning, street sweeping, road and ditch maintenance);
- Source control and pollution prevention;
- Outreach and education for watershed residents, municipal officials, and stormwater operators;
- Enactment and enforcement of ordinances and bylaws to protect water quality;
- Land use planning to protect water quality (minimize impervious cover, protect and restore buffers, require use LID techniques and green infrastructure);
- Agricultural practices that protect water quality;
- Illegal dumping controls;
- Spill prevention; and
- Illicit discharge detection and elimination programs.

CT DEEP has guidance for municipalities on street sweeping and catch basin cleanout (CT DEP 2007) and CT MS4 permits have targets for impervious cover disconnection. Impervious cover removal or disconnection results in the reduction in the volume of stormwater runoff that is generated or ultimately discharged from a site. Either by conversion of pavement to pervious area or by redirecting runoff from an area of pavement to an on-site BMP can result in an overall reduction in pollutant loads.

In the following sections, mitigation measures are organized by the source of pathogens they address. For each source type, relevant BMPs are briefly described and sources for more detailed information (including websites and documents) are provided.

7.1.3 Developed Area Stormwater Runoff

In developed areas, large portions of natural landscape have been replaced with non-porous, or impervious surfaces. Impervious cover refers to surfaces such as roads, driveways, parking lots, and rooftops that change the natural dynamics of the hydrologic cycle. Impervious surfaces don't allow the stormwater to slowly infiltrate into the ground. Without slow percolation into the soil, water flows quickly off these impervious surfaces, carrying soil, bacteria, nutrients, and other pollutants to nearby waterbodies. This faster moving water also washes soil away that isn't securely held in place by structural means or healthy vegetation.

Researchers directly correlated the amount of fecal coliform present to the percent of impervious cover in a watershed (Mallin *et al.,* 2000). A study by CT DEEP identified that 12% or more IC was associated with a decline in water quality in the state for aquatic life use support as measured by the health of the benthic community (Bellucci, 2007). This information was developed into the *Connecticut Watershed Response Plan for Impervious Cover* document, which set a target of 11% impervious cover or less to be applied in Connecticut based on the observed water quality impairments for aquatic life use support at 12% IC and an application of a 1% margin of safety (CT DEEP, 2015b). Municipalities and other stakeholders should therefore aim to mitigate stormwater impacts in areas with IC greater than 11% to reduce the amount of stormwater pollution reaching surface waters, to improve water quality. For more information on impervious cover and its effects on water quality, please refer to CT DEEP's Stormwater Planning Tool for Impervious Cover website.

Structural BMPs generally function by reducing and disconnecting these impervious surfaces, and minimizing adverse impacts to receiving waters. Structural stormwater BMPs also collect and treat stormwater runoff before it is discharged. Non-structural BMPs include public education, land use planning, vehicle use reduction, illegal dumping controls, spill prevention, illicit discharge detection programs, and street and storm drain maintenance (NCDEQ, 2020).

7.1.4. Stormwater - Best Management Practices Overview

Structural BMPs to control stormwater 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. Bioretention BMPs have the largest concentration reductions and achieves the lowest effluent concentration as compared to any other BMP. (Clary et al, 2020). For more information see the International Stormwater BMP Database. Several studies examining the bacteria removal performance of stormwater BMPs suggest that flow reduction is the most effective approach to pathogen attenuation in stormwater. BMPs which achieve flow reduction are rain gardens, bioretention cells, and compost amended soils that allow stormwater to infiltrate into the ground. The practices are discussed in more detail below (Low Impact Development Strategies).

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) and the North Carolina Department of Environmental Quality (NCDEQ) have reported that sand filters, constructed wetlands, and bioretention areas typically perform well with respect to bacteria removal (CWP, 2007a; NCDEQ, 2020). Dense vegetative buffers also facilitate bacteria removal through infiltration into the soil, detention, and filtration by vegetation (Sullivan et al., 2007). Studies have shown variability in pathogen removal by wet (detention) ponds and overall poor performance (57-70% bacteria removal) due to an inability to remove fine clay particles that bacteria tend to adsorb to (Mallin et al., 2000; CWP, 2007b). Stormwater wetlands reduce bacteria loading by 78% (CWP, 2007b), 76% (Birch et al., 2004), 79% (Davies and Bavor, 2000), and 70-99% (Hathaway et al., 2008).

Non-structural BMPs such as preventing overspray onto impervious areas (e.g., sprinklers, hoses, car washes, etc., which send water into driveways and streets), and regular vacuum street sweeping may also help to reduce bacteria loading (Skinner et al., 2010). CT DEEP has guidance for Municipal Management Practices for Street Sweepings & Catch Basin Cleanings.

In general, the majority of conventional stormwater BMPs (such as retention ponds, deep sump catch basins, and filter berm swales) do not appear to be effective at reducing fecal indicator bacteria concentrations to primary contact stream standards, which is the ultimate target of TMDLs. Therefore, working to address pathogen impairments in waterbodies should focus first and foremost on source controls. This requires clear identification of the primary sources of indicator bacteria relative to site-specific conditions. Focusing on controllable sources of bacteria, particularly those of human origin, is believed to be the most important first step in protecting human health (Clary et al, 2020). The efficiency of various structural BMPs for the removal of bacteria is presented in Table 13. Additional information on these and other stormwater management practices can be found in the Connecticut Stormwater Quality Manual.

7.1.5 Other Municipal Tools

Three types of stormwater runoff management activities which use an integrated BMP approach are Low Impact Development (LID) requirements, stormwater utilities, and the MS4 permit program and are described as follows (and in subsequent sections):

- **LID** occurs at the planning and development stage, when new construction is designed and built to use the natural landscape to the maximum extent possible to protect water quality, and when redevelopment or retrofits improve stormwater management over existing conditions.
- A **stormwater utility** is a legal and financial vehicle for coordinating stormwater management activities at a watershed scale, optimizing overall water quality protection by focusing investments to the most effective technologies and geographic areas and to ongoing inspection, maintenance, and repairs.
- The **MS4 permit program** defines and mandates stormwater pollutant reduction efforts by municipalities in urbanized areas, involving a mix of structural and non-structural BMPs and ensuring good record-keeping through reporting requirements.

Low Impact Development (LID)

As mentioned earlier, one of the primary impacts of urbanization is an increase in impervious surface area within the watershed. As a result, stormwater runoff volume and velocity increase and lead to the flushing of contaminants, including bacteria, into adjacent surface waters. Therefore, one of the most significant ways to reduce stormwater runoff contribution to pollution is to reduce the volume and rate of runoff from a given area, which can be achieved with the use of LID or environmentally sensitive site design.

Low Impact Development (LID) is a site design and stormwater management strategy that maintains, mimics, or replicates pre-development hydrology through the use of numerous site design principles and small-scale structural stormwater practices distributed throughout a site to manage runoff volume and water quality at the source. The overall goal of LID is to design and build, utilizing the natural landscape and unique features of a site to avoid unnecessary water pollution, environmental degradation, and flooding. Techniques include controlling stormwater runoff close to the point of generation, reducing impervious surfaces, and infiltrating more rainwater into the soil where it falls. Possible LID elements include building narrower and shorter roads, setting maximum parking space standards (rather than minimums), and leaving as much of the natural landscape and vegetation as is feasible. This approach avoids or greatly reduces expensive pipe-and-drain collection systems and associated end-of-pipe treatment infrastructure and can reduce paving costs (Fuss & O'Neill 2011). The treatment infrastructure that is applied is generally smaller and more evenly distributed throughout the development. Although LID is often intended primarily for new development, many of these practices can be applied as retrofits to existing sites with similar benefits.

LID strategies should be targeted for use in areas known to contribute bacteria to surface water (e.g., areas with high use by domestic animals or wildlife or highly urban areas with significant impervious cover) but should also consider potential impacts to surface and groundwater. Any LID projects should consider existing or future subsurface sewage treatment and disposal system applications and avoid altering of site hydraulics and negative impacts on existing systems. Protection of existing or potential future uses for groundwater should drive infiltration options and locations.

LID Resources

- **CT DEEP Connecticut Stormwater Quality Manual**. The manual provides guidance on protecting the waters of Connecticut from the impacts of post-construction stormwater runoff and is a design tool for site planning source control and stormwater treatment practices.
- **LID Appendix to the Connecticut Stormwater Quality Manual.** CT DEEP conducted a study evaluating possible incorporation of LID principles into the Stormwater General Permits program. This document is one of the resulting deliverables of the study and is meant to supplement the Connecticut Stormwater Quality Manual. It provides detailed information on LID, including integrated management approaches, design standards useful at the municipal and state planning level, and site-specific stormwater BMPs (Fuss & O'Neill 2011).
- **CT DEEP LID Resources.** This document provides links to many additional LID resources useful to municipalities).
- **Watershed Municipal Outreach and LID.** CT DEEP has compiled LID project examples in Connecticut and has developed a series of brochures for municipalities and homeowners who wish to learn more about implementing innovative stormwater controls.
- **Forging the Link: Linking the Economic Benefits of LID and Community Decisions.** The University of New Hampshire Stormwater Center published a study that discusses the benefits of integrating LID and traditional stormwater management for towns and commercial developers. Through a series of case studies, this project documents the advantages of LID in economic terms in relation to how municipal land use decisions are commonly made.
- **New England Environmental Finance Center.** Additional LID examples are available from the New England Environmental Finance Center New England Environmental Finance Center (neefc.org).

Links to additional LID resources and information provided at the end of this section should provide the most updated information regarding percent BMP pathogen reductions. The biannual report issued in 2009 by the University of New Hampshire Stormwater Center (UNHSC) evaluated 22 stormwater treatment systems for flow reduction and pollutant removal efficiencies, and examples of common LID strategies are listed below (MA DEP, 2005; UNHSC, 2009). The North Carolina Department of Environmental Quality (NE DEQ) Stormwater Design Manual also evaluated multiple Stormwater BMPs. It is important to note that no single system will address all pollutant issues at a given site, and therefore, close examination of the source problem will reveal the most appropriate system or combination of systems.

Source control is the first step to addressing bacteria impairments in receiving water. This requires a clear identification of the primary sources of fecal indicator bacteria relative to site-specific conditions. Source control alone may not be sufficient to meet ambient water quality standards, implementation of BMPs may be necessary to further reduce the overall bacteria loads to receiving waters. Most BMP types are not able to consistently reduce bacteria concentrations to primary contact recreation receiving water standards. However, some BMP types show the ability to significantly reduce currently recommended fecal indicator bacteria concentrations, including bioretention, wetland basins, retention ponds, media filters and dry extended detention basins (Clary et al, 2020).

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 considered 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.

In 2007, Connecticut Public Act 7-154, also known as the Municipal Stormwater Authority Pilot Program, was signed into law. This law allows for grants for up to four communities interested in examining stormwater utility districts. It also allows for the formation of such districts by participating communities if stormwater utility districts were desired upon completion of the grant studies (Fuss & O'Neill 2010). Effective July 2021, Public Act 21-115, updated CGS Section 22a-498 and authorizes all municipalities, rather than just certain ones, to establish a municipal stormwater authority (CT legislation: 2021HB-06497-R00-HB.PDF (ct.gov)).

Three Connecticut communities opted to participate in this program—New Haven, Norwalk, and New London. Each community has considered a utility district to assist with implementation of Phase II Stormwater and other stormwater management issues such as flooding and upgrade of aging infrastructure. New Haven is proceeding with additional analysis and stakeholder meetings to identify the best organizational structure and user fee implementation program to address the City's anticipated stormwater management program needs (Fuss & O'Neill 2010). New London instituted the first stormwater utility in Connecticut in 2019. For more information on implementing a Stormwater Utility in your community see the UCONN Stormwater Utility Webinar Series website and this factsheet and US EPA Funding Stormwater Programs.

MS4 Stormwater Management

An MS4 is defined by EPA as:

> "*a conveyance or system of conveyances that is owned by a state, city, town, village, or other public entity that discharges to waters of the U.S., designed or used to collect or convey stormwater (e.g., storm drains, pipes, ditches), not a combined sewer, and not part of a sewage treatment plant, or publicly owned treatment works (POTW).*"

These storm drain networks collect polluted stormwater and often direct it to lakes and streams, and thus are a critical part of surface water impairments. How these systems are managed, maintained, and gradually evolve will have a major effect on water quality in Connecticut lakes and streams.

Since MS4 systems involve rainwater collection pipes, they are considered point source pollution by EPA (see the definition in Section 3.1) and are thus subject to NPDES regulation. The EPA began to address the polluted stormwater by MS4s under the NPDES program in 1990, with Phase I of the EPA Stormwater Rule addressing runoff from medium and large MS4s with populations greater than 100,000. Phase II of the Stormwater Rule was issued in 1999 and focused on small MS4s serving less than 100,000. Connecticut began regulating small MS4 municipalities in 2004 under a General Permit for the Discharge of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4 General Permit).

The MS4 General Permit approach means that a single permit is written for the state, approved by EPA, then individual municipalities register under the permit and meet its requirements. The MS4 General Permit requires municipalities to conduct a standard set of stormwater management activities, most of which are non-structural BMPs. Key requirements are described below.

The SWMP is the cornerstone requirement under the MS4 General Permit. This plan is developed by the municipality and documents the relevant infrastructure and BMPs to reduce water quality pollutants to the "Maximum Extent Practicable" (Clean Water Act 402(p)(3)).

These six minimum control measures are identified in the MS4 General Permit:

- **Public Education and Outreach** requires the municipality to educate the public about water quality and pet waste, application of fertilizers, herbicides, and pesticides, and impacts of illicit discharges and improper disposal of waste. Educational materials may be developed by the municipality itself or adapted from universities, watershed organizations, or other sources.
- **Public Participation** involves making the SWMP and Annual Reports publicly available, with a 45-day public comment period on the Annual Report. In addition, municipalities are encouraged to work with local organizations to help carry out the plan.
- **Illicit Discharge Detection and Elimination** requires the municipality to inspect drainage infrastructure and the watershed for sewer cross-connections, illegal dumping, industrial and commercial wastes, floor drains, animal wastes, and lawn management chemicals and wastes. It includes detailed guidelines for conducting mapping, fieldwork, and reporting and is mandated in priority areas only.
- **Construction Site Stormwater Runoff Control** focuses on using local authority to implement the *Connecticut Stormwater Quality Manual* and the *Connecticut Guidelines for Soil Erosion and Sediment Control*. This element contains detailed guidance on review and inspection, as well as notification requirements to CT DEEP regarding construction, maintenance of stormwater treatment ponds, and how municipal departments and boards with varying jurisdictions shall coordinate their functions.
- **Post-Construction Stormwater Management** involves updating land use regulations to include LID measures, post-construction stormwater retention, and inspection and long-term maintenance of existing stormwater facilities operated by the municipality and those in new developments, as well as a requirement to map DCIA.
- **Pollution Prevention and Good Housekeeping** requires water quality focused maintenance and management of municipal parks and open space, employee training, pet waste and waterfowl, buildings and facilities, vehicles and equipment, parking lots, snow management, street sweeping, leaf collection, and catch basin cleaning. It also contains a requirement to reduce DCIA through retrofits or stormwater retention in redevelopment projects.

Monitoring is required by the MS4 General Permit, although it is not considered one of the six essential elements. The permit requires monitoring outfalls discharging to impaired waters, such as those covered by this TMDL. Monitoring outfalls discharging to impaired waters requires additional parameter analyses for Pollutants of Concern. Outfalls with results over a specified threshold require follow up investigation and improvements to BMPs in the portion of the drainage network upstream of the outfall.

MS4 Stormwater Management Resources

- ***CT DEEP Overview of the MS4 Program in Connecticut***: There are reporting requirements under the MS4 General Permit, and these reports provide valuable documentation and insight to water quality protection and restoration activities. Much of this information previously reported to CT DEEP is summarized in individual town Water Quality Fact Sheets, available online through CT DEEP Municipal Stormwater.
- ***EPA Overview of the National MS4 program***: Additional MS4 program information is available online through EPA's NPDES program, Stormwater Discharges from Municipal Sources.
- ***University of Connecticut NEMO Program:*** UConn's CLEAR established the NEMO program in 1991 to address the lack of education and assistance to community land use decision makers. NEMO offers a LID Inventory as an online resource to geo-referenced examples of stormwater management practices in Connecticut. NEMO offers site planning concepts for stormwater runoff in conjunction with principles laid out in the State's *Stormwater Quality Manual*. In addition, UConn's CLEAR was contracted to work with the CT DEEP Stormwater Program to help provide support, training, and tools to MS4 communities.
- ***National Menu of Stormwater BMPs***. The National Menu of BMPs for Stormwater (based on the MS4 Phase II rules) was first released in October 2000. An updated version of this original webpage includes the addition of new fact sheets and the revision of existing fact sheets.
- ***University of New Hampshire (UNH) 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 annual reports.

7.2 Combined Sewer Overflows (CSOs)

In 1994, under the NPDES program, EPA developed a CSO Control Policy, which acts as a national framework for the control of CSOs. The policy provides guidance to municipalities and state and federal permitting authorities on how to cost-effectively meet the CWA's pollutant control goals (US EPA 1994). The policy contains four fundamental principles to ensure that CSO controls are cost-effective and meet local environmental objectives (US EPA 1994):

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 WQS during the development of CSO control plans to reflect the site-specific wet weather impacts of CSOs.

CT DEEP and EPA 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 CWA, including attainment of WQS.

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 sources of pollution to stormwater will reduce their concentrations in CSO discharges.

As of 1995, all CSO communities are responsible for implementing EPA's nine minimum technology-based controls (unrelated to the nine elements for a WBP). The nine minimum controls are measures that can reduce the prevalence and impacts of CSOs without significant engineering or construction (US EPA 1995). These controls include:

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. Pollutant prevention;
8. Public notification; and
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 stormwater flows. This approach is usually a major infrastructure investment. In a separate system, stormwater is conveyed to a stormwater outfall for discharge directly into the receiving water. Based on a comprehensive review of a community's sewer system, separating part or all 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 (US EPA 1995).

CSO Resources

- ***Guidance: Coordinating CSO Long-Term Planning with WQS Reviews***. Addresses impediments to implementing the water quality-based provisions in the CSO Policy and provides recommended actions that State and Interstate Water Pollution Control directors and CSO communities can take to overcome these impediments (US EPA 2001a).
- ***CSO 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 (US EPA 1995).
- ***CSO Management Fact Sheet: Sewer Separation***. Describes the basic information regarding the separation of CSOs for combined sewer systems (US EPA 1999).
- ***Other NPDES CSO guidance documents are available online.***

7.3 Illicit Discharges

Illicit discharge refers to any release into an MS4 that is not composed entirely of stormwater, except discharges pursuant to a NPDES permit and discharges resulting from fire-fighting activities. Refer to Section 4.1.1, Unauthorized Point Sources of Untreated Wastewater. Examples include direct discharges such as sanitary wastewater piping that is directly connected from a home to a storm sewer, and indirect discharges such as an old and damaged sanitary sewer line that is leaking 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. IDDE can also help in areas without such MS4 requirements. Removing these illicit discharges is a high priority for CT DEEP and EPA because it is an effective approach to eliminating water quality impairments. The MS4 General Permit has gradually adopted more prescriptive requirements related to the IDDE program to ensure efforts are effective.

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):

- **Create a storm sewer map:** Map a certain percentage of outfalls or areas of town (adding up to 100% by the end of the permit term).
- **Pass an illicit discharge ordinance:** Draft an IDDE ordinance (or stormwater ordinance with IDDE component) or an amendment to existing bylaws.
- **Prepare an IDDE plan:** Complete a final plan and obtain the signature of the person overseeing the plan.
- **Conduct dry weather field screening of outfalls:** Screen a certain percentage of outfalls (adding up to 100% by the end of the permit term).
- **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 (adding up to 100% by the end of the permit term).
- **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).
- **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.
- **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.
- **Create and distribute an informational flyer for businesses about IDDE:** Mail the flyer to targeted businesses.
- **Work with community groups to stencil storm drains:** Stencil a certain percentage of drains (adding up to 100% by the end of the permit term).
- **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 Resources

- ***Connecticut IDDE Program***. Connecticut municipalities subject to the MS4 permit are required to develop, implement, and enforce plans to detect and eliminate existing illicit discharges and connections. Information is available on the CT DEEP Municipal Stormwater webpage and also through the UCONN NEMO Program.
- ***NEIWPCC IDDE Manual.*** The New England Interstate Water Pollution Control Commission (NEIWPCC) published a useful manual for communities titled *Illicit Discharge Detection and Elimination Manual: A Handbook for Municipalities* (NEIWPCC 2003).
- ***CWP IDDE Manual.*** This manual provides practical, low cost, and effective techniques for Phase II NPDES MS4 communities and others to develop an effective IDDE program (Brown et al. 2004). Guidance is provided on IDDE testing techniques, estimating program costs that include capital and personnel expenses, and estimating program implementation.
- ***EPA Model Ordinances.*** The EPA maintains a list of Model Ordinances for Illicit Discharges 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.

7.4 Subsurface Sewage Treatment and Disposal Systems

When properly designed, installed, operated, and maintained, subsurface sewage treatment and disposal systems or septic systems can renovate wastewater just as well as most conventional WPCFs. However, if a system is going to experience failure, it is most likely to occur in late winter or early spring when groundwater levels are at their highest elevations. It is important to evaluate site conditions during this time to account for potential worst-case scenarios. The following is an additional list of key components for consideration when installing and operating a subsurface sewage disposal system:

- Proper **design** includes adequate evaluation of soil conditions, seasonal high groundwater or impermeable materials, proximity of sensitive resources (e.g., drinking water wells, surface waters, wetlands, etc.);
- Proper siting and **installation** means that the system is installed in conformance with the approved design and siting requirements (e.g., setbacks from waterways);
- Proper **operation** includes how the property owner uses the system. While most systems excel at treating normal domestic sewage, disposing of some materials, such as toxic chemicals, paints, personal hygiene products, oils and grease in large volumes, and garbage, can adversely affect the function and design life of the system, resulting in treatment failure and potential health threats; proper operation also includes how the property owner protects the system; allowing vegetation with extensive roots to grow above the system will clog the system; driving large vehicles over the system may crush or compact piping or leaching structures;
- Proper **maintenance** means having the septic tank pumped at regular intervals to eliminate accumulations of solids and grease in the tank; it may also mean regular cleaning of effluent filters, if installed.
- Proper **replacement** of failed systems, which may include programs or regulations to encourage upgrades of conventional systems to more innovative alternative technologies, provided a statewide permitting program has been established.

The life and effectiveness of a properly designed and installed subsurface sewage treatment and disposal system can be optimized through proper operation and maintenance of the system, including:

- Knowing the location of the building sewer, septic tank, distribution piping, and leaching system;
- Keeping deep-rooted trees and shrubs from growing above the leaching system;
- Maintaining proper vegetation between your system and adjacent water resources;
- Keeping heavy vehicles from driving on or parking above any component of the subsurface sewage treatment and disposal system;
- Installing risers above the inlet and outlet of the septic tank to allow for easy access during inspections and pumping;
- Installing an effluent filter at the outlet of the septic tank to enhance its performance and protect the leaching system from clogging;
- Pumping the tank on a regular basis (typically 3-5 years) to optimize primary treatment and to minimize the potential for solids carry-over into the leaching system (which would result in premature failure of the system);
- Composting kitchen wastes instead of using a garbage disposal;
- Avoiding the dumping of materials down the drain which are likely to inhibit the proper operation of the system, including toxic chemicals, paints, solvents, personal hygiene products, oils and grease in large volumes, and garbage;
- Avoiding the disposal of water softener or other water treatments into the septic system;
- No pet wastes including cat litter should be placed into the septic system;
- No water softener treatment backwash or regeneration brine should be allowed into the septic system; and
- Checking all plumbing for leaks on a regular basis; a continually running faucet or toilet could add hundreds of gallons of water a day to the system, possibly resulting in a hydraulic overload and failure of the system.

Subsurface Sewage Treatment and Disposal System Resources

- ***CT DPH.*** The CT DPH has published a *Design Manual for Subsurface Sewage Disposal Systems for Households and Small Commercial Buildings* in two parts. Part I identifies general design principles, while Part II discusses specific design considerations. There are also links to *Home Buyers Guide to Septic Systems,, Septic Systems 101: Operation and Maintenance of a Subsurface Sewage Disposal System, and Sewage Backup Fact Sheet*. Links to these documents, and other resources are available on their Environmental Engineering - Subsurface webpage. Also see the CT DPH On-Site Sewage Disposal Regulations and Technical Standards for Subsurface Disposal Systems.
- ***CT General Statutes.*** Connecticut's subsurface sewage treatment and disposal system rules are adopted in accordance with Connecticut General Statutes, Chapter 368a and Chapter 446k. 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 subsurface sewage treatment and disposal systems.
- ***SepticSmart Homeowner's Program***. EPA's SepticSmart initiative is a nation-wide public education effort with resources for homeowners, local organizations, and government leaders.
- **EPA.** Septic Systems Reports, Regulations, Guidance, and Manuals offers valuable information and resources to manage subsurface sewage treatment and disposal systems in a manner that is protective

of public health and the environment and allows communities to grow and prosper. Specific resources include:

- ***Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems.*** Guide that helps states and local communities establish comprehensive management programs to ensure that subsurface sewage treatment and disposal systems function properly (US EPA 2003). Proper management of decentralized systems involves implementation of approximately one dozen management components such as public education and participation, planning, operation and maintenance, and financial assistance and funding.
- ***Handbook for Managing Onsite and Clustered (Decentralized) Wastewater Treatment Systems***. A "how-to guide" for implementing EPA's Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems (US EPA 2005). The guide describes a step-by-step approach for the development of a community management program for decentralized wastewater systems. It includes specific community examples, gives an overview of the elements essential for sound management of these systems and provides links to resources.
- ***Onsite Wastewater Treatment Systems Manual.*** This manual was developed to provide supplemental and new information for wastewater treatment professionals in the public and private sectors (US EPA 2002). This manual goes into more detail about subsurface sewage treatment and disposal systems than the previous manual.

7.5 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.

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 (US EPA, 2003 and NERC 2019).

According to National Association of State Departments of Agriculture (NASDA) and the Connecticut Department of Agriculture, over 50% of Connecticut's agricultural production is greenhouse and nursery products. Maple syrup production, apples, hay, dairy products, shellfish (including clams and oysters) and tobacco are also important crops in Connecticut. Connecticut DEEP is the lead agency for nonpoint source management, responsible for administering the annual Section 319 NPS grant awards. Connecticut is able to offer technical and financial support to farm businesses in their farm waste efforts through the "Partnership for Assistance on Agricultural Waste Management Systems". This partnership includes the following agencies: USDA Natural Resources Conservation Service (NRCS), USDA Farm Service Agency, University of Connecticut Cooperative Extension System, Connecticut Conservation Districts, the Connecticut Department of Energy and Environmental Protection and the Connecticut Department of Agriculture. Through this partnership, a farm may obtain waste management planning, structure design and qualify for financial assistance as well as help in procuring required permits. More technical information on agricultural wastewater is available on our Agricultural Wastewater website.

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, particularly horse farms in Connecticut. Agriculture management measures addressed by Connecticut's NPS pollution control program and Agricultural Permitting Program pertain to nutrient management and confined animal facilities (CAFs). A CAF is a non-agriculturally productive lot or facility where non-aquatic animals are held and fed for at least 45 days per year. The key measures recommended include:

1. Confined Animal Facilities

- Limit discharges by storing wastewater and runoff caused by storms;
- Manage stored runoff and solids through proper use of waste and disposal methods that minimize impacts to surface water and/or groundwater; and
- Collect solids and reduce contaminant concentrations, and reduce runoff to minimize the discharge of contaminants in both facility wastewater and runoff caused by all storms up to and including 25-year, 24-hour frequency storms.

2. Nutrient Management

- Develop and implement Comprehensive Nutrient Management Plan (CNMPs), including:
  - Nutrient budgets for crops;
  - Identification of the types and amount of nutrients necessary to produce a crop based on realistic crop yield expectations; and
  - Identification of the environmental hazards of the site.
- Conduct soil tests and other tests to determine crop nutrient needs and proper calibration of nutrient application equipment.

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 on the land as fertilizer. Manure management involves managing the source, rate, form, timing, and placement of manure. Writing a CNMP is an ongoing process because it is a working document that changes over time.

The State of Connecticut has the second highest horse density in the nation, which makes proper horse farm management a priority for farm operations in the State. The Horse Environmental Awareness Program (HEAP) developed the "*Good Horse Keeping: Best Practices Manual for Protecting the Environment 2011*," which identified the following BMPs for sustainable horse management and environmental protection:

1. Construct adequate manure (permanent or temporary) storage facilities based on the number of horses and divert runoff away from manure piles using roof, gutters, curbs, walls, or land grading.

   a. Earthen channels or diversion should be constructed where clean water may mix with wastewater from paddocks or manure storage areas and diverted to a stable outlet such as a vegetated channel or storm drain.

2. If not using a roll-off dumpster for manure removal, construct an onsite compost pile away from water sources for farm spreading operations.
3. Select an appropriate bedding material (such as pine shavings, pine sawdust, straw, wood pellets, straw pellets, peat moss, etc.) that is absorbent and cost effective at mitigating wastewater runoff to surface and ground waters.
4. Develop a nutrient management plan based on field soil tests to determine the amount, type, and timing of nutrient amendments. Ensure adequate buffers are planted around water sources to reduce erosion and excess nutrient loading.
5. Designate stream crossings to minimize impacts to stream banks using bridges, culverts, and stabilized gravel pads.
6. Rotate pastures to ensure overgrazing does not compact soil and cause erosion.
7. Use alternative water systems (automatic or manual) and proper fencing to restrict horse access to streams.

CT DEEP has a ***General Permit for Concentrated Animal Feeding Operations (CAFOs)*** with the purpose of controlling discharges of agricultural wastewater and stormwater from areas of animal confinement, feeding and maintenance at CAFOs, CT DEEP has issued the General Permit for Concentrated Animal Feeding Operations (CAFO GP) which authorizes new and existing discharges from Large and Medium CAFOs and facilities designated as CAFOs. Agricultural wastewater generated from a variety of farm activities, including animal feeding operations and the processing of agricultural products, can pollute surface and ground water if not properly managed. Examples of agricultural wastewater include but are not limited to manure, milking center wash water, barnyard and feedlot runoff, egg washing and processing, slaughterhouse wastewaters, horse washing waters and runoff associated with composting. Additionally, runoff from croplands can contribute sediment, fertilizers and pesticides into surface waters.

Examples of successful agricultural management projects can be found in the Lake Waramaug Watershed Agricultural Waste Management System and the Blackberry River watershed, Managing Surplus Manure Laurel Brook Farm & Freund's Farm. More information on agricultural wastewater and the CAFO General Permit is available on the CT DEEP Agricultural Wastewater website.

Agriculture - Available Resources

Manual of Best Management Practices for Agriculture: Guidelines for Protecting Connecticut's Water Resources. This manual describes a wide range of BMPs designed to reduce the impact of agriculture on ground and surface water quality (CT DEEP, NRCS & CT CSWC 1996).
Online:portal.ct.gov/-/media/DEEP/aquifer_protection/BMPsagriculturepdf.pdf

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

CT Department of Agriculture. Agricultural operators can obtain assistance from the Department of Agriculture in Connecticut. Many of the State grants and loans are in collaboration with such agencies as NRCS.
Online: Programs and Services (ct.gov)

EPA National Management Measures to Control Non-Point Source Pollution from Agriculture
*Online:*www.epa.gov/nps/national-management-measures-control-nonpoint-source-pollution-agriculture

Horse Environmental Awareness Program – Good Horse Keeping: Best Practices Manual for Protecting the Environment 2011 - a guide that assists equine owners with managing horses and protecting the environment through sustainable BMP practices (HEAP 2011).
Online: ctrcd.org/wp-content/uploads/2017/10/GOODHORSEKEEPINGBMP_WEB.pdf

CT DEEP Coastal Nonpoint Source Pollution Control Program Agriculture
Online: Agriculture Management Measures

7.6 Pets

Pet waste as a pollutant source control involves a combination of educational outreach and enforcement to encourage residents to clean up after their pets. It is recommended that residents do not put dog and cat feces in a compost pile because it may contain parasites, bacteria, pathogens, and viruses that are harmful to humans that may not be destroyed by composting. Collect dog and cat feces and dispose of it in the trash.

Education and Outreach Campaigns: Public education programs can be used to reduce pet waste. These programs are often incorporated to a larger message of reducing NPS 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 (US EPA 2001b). Pet owners should walk pets in grassy areas such as parks or undeveloped areas and pet waste should be kept out of street gutters and storm drains.

Designated dog parks are becoming more common and can be used to educate pet owners 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 to the design of the park, such as "Doggy Loos," which are pet waste disposal units placed in the ground and operated by foot-activated lids, "Pooch Patches," which consist of a pole surrounded by sand where dogs are encouraged to defecate, and "Long Grass Areas," which are areas where grass is left un-mowed to allow pet waste to disintegrate naturally. Long grass areas should be located away from overland flow, stream channels lakes, stormwater structures and drinking water sources. 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 to soils (US EPA 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 in dumpsters or other refuse containers, 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.

Pet Waste Resources

The following resources discuss the heath and water quality risks associated with pet waste:

- ***Give a Bark for a Clean State Park*** *(CT DEP 2008).* portal.ct.gov/-/media/DEEP/p2/newsletter/p2viewfall08pdf.pdf

- ***Do Your "Doody" for Clean Water*** newlondonct.org/filestorage/7495/7518/7924/18412/24480/Pet_Waste_Flyer.pdf
- ***EPA Source Water Protection Practices Bulletin***. Managing Pet and Wildlife Waste to Prevent Contamination of Drinking Water (US EPA 2001a).

7.7 Nuisance Wildlife

Human development has altered the natural habitat of many wildlife species, restricting wildlife access to surface waters in some areas and promoting access in others. Minimizing the impact of wildlife on water quality generally requires either reducing the concentration of wildlife in an area or reducing their proximity to a waterbody. In areas where wildlife has congregated due to human development and are observed to be causing a water quality problem, 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 an at-risk area. Providing closed trash cans near waterbodies, as well as discouraging wildlife from entering surface waters by installing fences, pruning trees, or making other changes to landscaping, can reduce impacts to water quality.

Canada geese are an increasing urban nuisance in office parks, recreation areas, residential areas, and golf courses. Studies have correlated the amount of developed land to the number of geese, particularly land use defined as turf grass or lawns at open fields and parks. The goal of goose management is to reduce goose populations and protect property, water quality, and aesthetics. The CT DEEP Wildlife Division identifies two primary methods of goose management that municipalities can adopt and include non-lethal and lethal forms of control. More information on handling nuisance Canada Geese can be found on the CT DEEP's CT DEEP Problems with Canada Geese web page and Dealing with Nuisance Canada Geese factsheet.

Wildlife Resources

- CT DEEP Wildlife Division. The Wildlife Division offers links to wildlife publications related to hunting, trapping and wildlife habitat.
- *EPA Source Water Protection Practices Bulletin*. Managing Pet and Wildlife Waste to Prevent Contamination of Drinking Water (US EPA 2001a).

7.8 Boats and Marinas

Recreational water uses can contribute to bacteria loads. 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), and chemical products which can lead to water quality violations. Marinas and other areas frequented by boats may be impacted by potentially harmful bacteria from illegally discharged sewage.

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 Connecticut, the Clean Vessel Act is administered by CT DEEP. Even dumping 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 prohibited from discharging sewage into Connecticut's coastal waters from the Rhode Island State boundary in the Pawcatuck River to the New York State Boundary in the Byram River and extending from shore out to the New York State boundary (CT DEEP, 2019). These waters are considered "No Discharge Areas".

Many communities along Connecticut's shoreline have marinas with a pump-out facilities for recreational boaters. It is important for marinas to offer pump-out services; 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. Connecticut CVA Pump-Out Directory is available online.

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

A sample list of BMPs for boats and marinas is presented below.

- Target outreach to marina owners, boat dealers, and their consumers regarding State and EPA requirements; and
- Encourage marina owners to provide clean and safe onshore restrooms and pump-out facilities;
- Provide an appropriate location for boat washing;
- 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 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 waterbodies without treatment. Contact the municipal public works department before stenciling any drain.

Boats and Marinas Resources

- ***Connecticut's Clean Vessel Act Program***. The Connecticut Clean Vessel Act Program works to secure a healthy aquatic environment by preventing improper sewage disposal by recreational boats.
- ***Connecticut's Pump-out Services Directory.*** Pump-out facilities or pump-out boats are offered in many Connecticut boating. Pump-out services are free to utilize by boat owners.

- ***A Guidebook for Marina Owners and Operators for the Installation and Operation of Sewage Pump-out and Dumping Stations***. The purpose of this guidebook is to provide marina owners and operators with general information on the design, construction, operation, and maintenance of marine sewage pump-out facilities and dump stations.

SECTION 8. FUNDING AND COMMUNITY RESOURCE

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 Connecticut. 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, additional information can be found on the website Nonpoint Source Management.

8.1 Water Quality Improvement Grants

Long Island Sound Research Grant Program

The Long Island Sound Research Grant offers support for scientific pursuit that will increase understanding of ecological processes of Long Island Sound. The information obtained through funded research must be directly applicable to managing Long Island Sound natural resources.

Eligible applicants: In-State academic institutions

Contact: Harry Yamalis, Land and Water Resources Division, Bureau of Water Protection and Land Reuse, CT DEEP, 79 Elm Street, Hartford, CT 06106, (860) 424-3034 or Harry.Yamalis@ct.gov

Section 319 NPS Grants

Congress enacted Section 319 of the CWA in 1987 establishing a national program to abate NPS pollution. These grants, known as Section 319 Grants, are made possible by the federal funds provided to CT DEEP by the EPA, and may be available to assist in the implementation of projects to promote restoration of water quality by reducing and managing NPS pollution in Connecticut waters.

Eligible applicants: Municipalities, other governmental agencies and non-profit organizations, schools, and universities

Contact: Erik Bedan Watershed Section, Bureau of Water Protection and Land Reuse, CT DEEP, 79 Elm Street, Hartford, CT 06106, or erik.bedan@ct.gov

CT DEEP Coastal Habitat Restoration Program

The CT DEEP Coastal Habitat Restoration Program funds restoration projects around tidal wetlands, coves and embayments, riverine migratory corridors, and coastal barrier beaches. The riverine corridors category includes re-vegetation, erosion, and sedimentation controls for inland waters that are useful to protecting lakes from further cultural eutrophication.

Eligible applicants: any individual, agency, or private organization

Contact: Land and Water Resources Division, Bureau of Water Protection and Land Reuse, CT DEEP, 79 Elm Street, Hartford, CT 06106, (860) 424-3019

NFWF Long Island Sound Futures Fund

The Long Island Sound Futures Fund (LISFF) supports projects that restore and protect the health and living resources of Long Island Sound and its coastal watersheds. Projects focus on habitat restoration, water quality improvement, watershed management plan development and public awareness of water resource issues. Funding is provided by EPA, U.S. Fish and Wildlife Service, and the National Fish and Wildlife Foundation (NFWF).

Eligible applicants: State and local governments, non-profit organizations, for-profit entities, educational institutions, and interstate entities or regional water pollution control agencies

Contact: Lynn Dwyer, NFWF, Eastern Partnership Office, 1133 Fifteenth St., N.W., Ste 1100, Washington, D.C., 20005, (631) 627-3488. Lynn.dwyer@nfwf.org

NRCS Wildlife Habitat Incentive Program (WHIP)

Natural Resources Conservation Service WHIP offers funding for development and improvement of fish and wildlife habitat on private land. NRCS provides technical assistance and up to 75% of the cost-share assistance.

Eligible Applicants: private landowners

Contact: Nancy Ferlow, State Resource Conservationist, 860-871-4049 nancy.ferlow@usda.gov

CT DEEP Recreation and Natural Heritage Trust Program

This is the CT DEEP's primary program for acquiring land to expand the State's system of parks, forests, wildlife, and other natural open spaces. The program focuses on land in CT that represents the ecological and cultural diversity of the State, including rivers, mountains, rare natural communities, scenic qualities, historic significance, connections to other protected land, and access to water.

Online: The Recreation and Natural Heritage Trust Program

Eligible Applicants: landowners willing to sell their land now or for a future sale or donation of the property

Contact: Matt Starr, CT DEEP Division of Land Acquisitions and Management, 79 Elm Street, Hartford, CT 06106, (860) 424-3080

CT DEEP Section 6217 Coastal Nonpoint Pollution

Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 requires the State of Connecticut to control NPS pollution in coastal waters. There are six major nonpoint pollution categories covered: agriculture, forestry, urban sources, marinas and recreational boating, hydromodifications, and wetlands and riparian areas. The Coastal Nonpoint Program Management Areas associated with this program extend well inland, with a map and list of municipalities.

Eligible Applicants: Connecticut municipalities in coastal nonpoint program management areas

Contact: CT DEEP, 79 Elm Street, Hartford, CT 06106, (860) 424-3000

CT DEEP Open Space and Watershed Land Acquisition Grant Program

This program offers funding to towns or organizations for the purchase of land that is valuable for recreation, forestry, fishing, and conservation of wildlife and natural resources.

Online: Open Space - Grants and Financial Assistance

Eligible applicants: municipalities, non-profit land conservation organizations, and water companies

Contact: Allyson Clarke, Office of Constituent Affairs and Land Management, 79 Elm Street, Hartford, CT 06106, (860) 424-3016

STEAP - Small Town Economic Assistance Program (CGS Section 4-66g)

STEAP provides grants for environmental protection, economic development, community conservation, and quality-of-life capital projects for localities that are ineligible to receive Urban Action (CGS Section 4-66c) bonds.

Eligible applicants: certain smaller municipalities

Contact: Martin Heft at (860) 418-6355, CT Office of Policy and Management 450 Capitol Avenue, Hartford, CT 06106

Connecticut Society for Women Environmental Professionals

The Grant Program provided by the Connecticut Society for Women Environmental Professionals provides funding for projects benefiting the environment.

Eligible applicants: not specified

Contact: Ruth Kennedy Ruth.Kennedy@gza.com

Environmental Professionals Organization of Connecticut (EPOC)

The EPOC Grant Program offers funds for local projects that benefit the environment. Projects may include the improvement of the environment through "property and watershed clean-ups, reforestation efforts, biodiversity projects, streamside buffer restoration projects, and hazardous waste collection efforts." Proposals with environmental education and/or environmental monitoring of watersheds or ecosystems are also welcomed.

Eligible applicants: non-profit and not-for-profit environmental advocacy groups, community-based groups, and environmental education organizations

Contact: Seth Molofsky, Executive Director, epoc@epoc.org, P.O. Box 176, Amston, CT 06231-0176

8.2 Infrastructure Improvement Grants and Loans

National Recreational Trails Program

The National Recreational Trails Program is administered by the CT DEEP for the U.S. Department of Transportation's Federal Highway Administration. This fund supports construction of new trails, maintenance and restoration of existing trails, disability access to trails, purchase of trail construction equipment, and purchase of land for trails. Trail maintenance can prevent erosion and sedimentation, a major source of pollution to lakes and tributary streams. Availability of grants is dependent on funding of the program.

Eligibility: non-profit organizations, municipalities, State departments

Contact: Kimberly Bradley, CT DEEP Trails and Greenways Coordinator at kimberly.bradley@ct.gov or 860-424-3938

CT DEEP Clean Water Fund

The Clean Water Fund (CWF) provides funding and loans to municipalities along Long Island Sound for projects aimed at water pollution control, construction and upgrades to WPCFs, nutrient removal projects, non-point source pollution control, river restoration and drinking water treatment plant upgrades.

Eligible applicants: Municipalities

Online: DEEP/Municipal-Wastewater/Financial-Assistance-for-Municipal-Wastewater-Projects

Contact: DEEP.CWF@ct.gov

CT OPM Small Town Economic Assistance Program (STEAP)

The Small Town Economic Assistance Program (STEAP) funds economic development, community conservation, and quality of life projects for localities that are ineligible to receive Urban Action (CGS Section 4-66c) bonds. This program covers development projects involving economic and community development, transportation, environmental protection, public safety, children and families, and social service programs.

Eligible applicants: municipalities that are not designated as a distressed municipality or public investment community, and the State Plan of Conservation Development does not show them as having a regional center

Contact: Martin Heft Martin.Heft@ct.gov or 860.418.6355

Connecticut Community Development Block Grants

The Connecticut Community Development Block Grant (CDBG) Program, also known as the Small Cities Program, is funded through the Department of Housing and Urban Development as part of the federal Community Development Block Grant program. It provides grants for a wide range of assistance projects for low- and moderate-income communities with populations of less than 50,000. These projects include improvements to water, sewer, and roads serving economic development and housing.

Eligible applicants: Any Connecticut town, city, or incorporated village chartered to function as a general purpose unit of local government. Most projects are a coordinated effort between the municipalities, community groups, and local or State non-profit organizations.

Contact: Miguel Rivera, Director 860-270-8012 Rivera.Miguel@ct.gov.

USDA Rural Development Water and Waste Disposal Loans and Grants

The USDA Rural Utilities Service Water and Environmental Programs (WEP) 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.

Contact: See local area contact on the USDA Rural Development website.

8.3 Agricultural Grants

Connecticut Conservation Stewardship Program

NRCS in Connecticut provides funding for landowners with agricultural land and forest land to address natural resource conservation and management activities on their properties through the Connecticut Conservation Stewardship Program.

Eligible applicants: private landowners of agricultural land and non-industrial private forest land

Contact: Nancy Ferlow, State Resource Conservationist, 860-871-4049 nancy.ferlow@usda.gov or your local NRCS field office

Farms, Forest and Open Space Property Tax Benefits

Under Connecticut Public Act 490, all farm, forest, and open space land can apply for a use value assessment that may lower property taxes for the landowner.

Eligible applicants: landowners with farm, forest, or open space land must apply at their local tax assessor's office. Landowners with designated forest land must have an area totaling 25 acres or more in parcels no smaller than 10 acres.

Contact: local tax assessor's office

US Department of Agriculture NRCS 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% of the costs of installing certain conservation practices.

Online: Environmental Quality Incentives Program | Natural Resources Conservation Service

Eligible applicants: Any person engaged in livestock, agricultural production, aquaculture, or forestry on eligible land.

Contact: Nancy Ferlow, State Resource Conservationist, 860-871-4049 nancy.ferlow@usda.gov or your local NRCS field office

8.4 Boating Grants

Clean Vessel Act Grants

The Federal Clean Vessel Act was established in 1992 to protect waters and associated recreational opportunities from damaging vessel sewage discharges. Projects proposed for the construction, renovation, operation, or maintenance of pump-out stations, pump-out 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 treatment plants, such as holding tanks, piping, or hauling and disposal fees. Approved projects are given funding for up to 75% of the total cost of the project.

Online: CVA Grant Program Information

Eligible applicants: Any public/private marina, boatyard, shipyard, or State/county/municipal organization wishing to install or significantly upgrade their pump-out station and make it available to all boaters is eligible for grant funding.

Contact: Kate Hughes Brown, Office of Long Island Sound Program, 79 Elm Street, Hartford, CT 06106, (860) 424-3652. Submit applications to Bureau of Outdoor Recreation, CT DEEP, 79 Elm Street, 6th floor, Hartford, CT 06106, Attn: Sara Ganzer.

8.5 Additional Resources

U.S. Environmental Protection Agency (US EPA)

The EPA recognizes that committed watershed organizations and State and local governments need adequate resources to achieve the goals of the CWA and improve our nation's water quality. To this end,

the EPA has created the website below to provide tools, databases, and information about sources of funding to practitioners and funders that serve to protect watersheds:
Online: EPA Grants | US EPA

U.S. Department of Agriculture (USDA)
The USDA offers several potential sources of funding for the protection, restoration, and stewardship of our water resources, including the USFS Landscape Scale Restoration Grants, the Watershed and Flood Prevention Operations Program, and the Water Resources Program.

National Oceanic and Atmospheric Administration (NOAA)
NOAA's Office of Ocean and Coastal Resource Management offers several options in protecting coastal resources.
Online: Office of Coastal Management Funding Opportunities (noaa.gov)

SECTION 9. RECOMMENDED NEXT STEPS

Future actions may be necessary to ensure long-term protection and restoration of the waterbodies in the TMDL study area. Recommended actions to respond to this TMDL are outlined below.

9.1 General Recommendations
The following recommendations are generally applicable throughout the watersheds included in TMDLs. Municipalities, businesses, industries, environmental groups, civic groups and residents should review the following recommendations to identify any which can potentially be implemented at your locations and/or throughout your projects.

Implement Land Use practices to address stormwater runoff from impervious cover

It is recommended that community stakeholders, such as property owners and local development commissions/boards, take action to prevent, reduce, and mitigate NPS bacteria that enters waterbodies from stormwater runoff. To address this issue, the following recommendations apply:

- Incorporate LID strategies into project planning, development, and re-developments to reduce runoff rate/volume and increase groundwater recharge. LID techniques include controlling stormwater runoff near the point of generation, reducing impervious surfaces, allowing rainwater to infiltrate to soil where it falls, building narrower and shorter roads, setting maximum parking space standards (rather than minimums), and leaving as much of the natural landscape and vegetation as is feasible. For a list of LID BMPs and resources please refer to Section 7.
- Decreasing DCIA, or "disconnecting" directly connected impervious areas, is one of the most effective LID strategies. Areas with clusters of IC could be targeted so that runoff from impervious surfaces is allowed to flow over vegetated surfaces before entering a drainage collection system or waterbody; this would direct some or all runoff to be intercepted and percolated into the ground, eliminating the direct loading of bacteria to waterbodies during small storm events. Ways to disconnect DCIA include removing curbs along roads and parking lots and disconnecting roof drains.
- Towns are encouraged to establish and/or amend local ordinances to promote LID BMPs to land use activities which can mitigate the effects of IC and disconnect impervious area, consistent with the points above.

Implement/expand BMPs and good housekeeping measures to control stormwater runoff

Implementing BMPs can help reduce bacteria loading to receiving waterbodies. CT DEEP recommends that, where practicable, structural and non-structural BMPs be identified and implemented within the TMDL study area as a means to restore and protect water quality. More detailed information regarding BMP recommendations can be found in the CT DEEP Stormwater Quality Manual. Additional information is available at:

- CT Guidelines for Soil Erosion and Sediment Control
- CT NEMO (Nonpoint Education for Municipal Officials)
- University of New Hampshire Stormwater Center
- EPA Stormwater Tools in New England

Develop and implement a Watershed-based Plan (WBP)
WBPs are tools that can support TMDL implementation by facilitating water quality restoration or protection focused on NPS contributions. Development of new WBPs (or updating existing WBPs) to address the Load Allocation recommendations in the TMDL is recommended. A TMDL can facilitate the development or revision of WBPs.

Facilitate public education and involvement
Towns, local businesses, environmental groups and civic groups are encouraged to continue ongoing efforts to educate and engage the community and to look for additional opportunities to expand efforts that support water quality. Community education and outreach should include efforts to address bacteria-related impacts on water quality. It is recommended that, where possible, educational materials and opportunities be developed and provided throughout the community to spread awareness about sources of bacteria and the impacts of bacteria on water quality.
DEEP encourages public involvement in the TMDL and WQS development process. If you would like to receive water quality program updates by e-mail, please subscribe to the CT DEEP Water Quality Planning Listserv.

Establish a Stormwater Utility
Stormwater utilities can be established at the municipal or regional level and can serve MS4 and non-MS4 communities. If a stormwater utility is not already in place within the TMDL study area, CT DEEP recommends establishing one to help fund stormwater management and infrastructure costs. For more information related to stormwater utilities, see Section 7.1.5.

Addressing PS of Bacteria
For permitted PS discharges, following the recommendations below will help to manage stormwater and wastewater in a way that limits bacteria loading to waterbodies and supports water quality restoration and protection.

Recommendations for MS4 Permittees/stormwater discharges authorized under the MS4 GP (Municipal, CT DOT, and other State & Federal Facilities as applicable)

- Update the Stormwater Management Plan and MS4 Annual Reports to include the waters covered by this TMDL. The timeframes and prioritization of such updates as prescribed in the MS4 GP effective at the time this TMDL is final, and as required by future changes in the MS4 GP, as amended (MS4 GP).
- Per permit requirements for the MS4 GP's 6 minimum control measures, ensure any additional requirements related to bacteria are implemented. The implementation of such measures shall be as prescribed in the current MS4 GP, and as amended.
- Evaluate outfalls to the waters in this TMDL for the presence of discharges during dry conditions and implement the appropriate MS4 GP requirements to address these discharges.
- Monitoring of outfalls during wet weather conditions is recommended. Such outfall monitoring is to be conducted and prioritized in accordance with the MS4 GP requirements.
- Additional monitoring (and/or modeling, as allowed per MS4 GP) of outfalls and receiving waters upstream and downstream of any outfall subject to installation of BMPs or other measures, is recommended before and after installation of such measures, for evaluation of the effectiveness of such measures and to mitigate the impact of stormwater on water quality.
- BMPs and other implementation measures should be established for outfalls to the waters included in this TMDL, to achieve consistency with the WLAs for bacteria (Tables 6 and 7). Consistency with the WLAs shall be achieved over time and pursuant to the requirements in the MS4 GP and based on a prioritization criteria outlined in the MS4 GP.
- For communities that rely on a centralized sanitary sewer collection system for management of domestic sewage, it's recommended that the municipality or sewer utility operating such system engage in efforts to prevent and minimize SSOs and sanitary sewer failures/sewage releases that may enter the MS4 system. Such efforts may include: a) developing and/or expanding programs to evaluate the sewer system to prevent/reduce leaks and overflows; b) conducting periodic inspections of the public sewer line and associated facilities; and c) licensing, inspecting, and maintaining septage vehicles in good order to prevent the discharge of septage leachate to town roads and the MS4 system. Furthermore, such communities should also work to address any illicit discharges of domestic sewage from the MS4 system pursuant to the requirements of the MS4 GP.

Recommendations for stormwater discharges authorized under the Industrial Stormwater GP and Commercial Stormwater GP

- For permittees covered by the Industrial Stormwater GP, update the Stormwater Pollution Prevention Plan (SWPPP) to include all waters covered by this TMDL. The timeframes and prioritization of such updates as prescribed in the Industrial GP effective at the time this TMDL is final, and as required by future changes in the Industrial GP, as amended.
- For permittees covered by the Commercial Stormwater GP, update the Plan to include all waters covered by this TMDL. The timeframes and prioritization of such updates as prescribed in the Commercial GP effective at the time this TMDL is final, and as required by future changes in the Commercial GP, as amended.
- Update the Plan to include an evaluation of potential sources of bacteria pollution in stormwater runoff from the facility. If the facility is connected to municipal sanitary sewer, ensure the on-site system is functioning properly to prevent/reduce potential leaks and/or releases. The implementation of such measures shall be as prescribed in the current Industrial/Commercial Stormwater GP, and as amended.
- Monitor stormwater discharges for indicator bacteria under wet weather conditions at the monitoring frequency specified in the Industrial/Commercial Stormwater GP.

- Visually inspect stormwater outfalls quarterly during wet weather conditions.
- If either wet or dry weather monitoring results are greater than the applicable WLA in this TMDL, evaluate potential sources of bacteria and implement a plan to reduce the amount of bacteria in the discharges. Consistency with the WLAs shall be achieved over time and pursuant to the requirements in the Industrial/Commercial Stormwater GP and based on a prioritization criteria outlined in the General Permits.
- Report all sample results to the CT DEEP Stormwater Permitting Program.

Recommendations for stormwater discharges authorized under the Construction Stormwater GP

- Update the Stormwater Pollution Control Plan (SWPCP) to include all waters covered by this TMDL. The timeframes and prioritization of such updates as prescribed in the Construction GP effective at the time this TMDL is final, and as required by future changes in the Construction GP, as amended.
- Update the SWPCP to include an evaluation of potential sources of bacteria pollution in stormwater runoff from the construction project. The implementation of such measures shall be as prescribed in the current Construction GP, and as amended.
- Visually inspect stormwater discharges during wet weather conditions periodically to identify and address erosion issues as they occur, per permit requirements.

Recommendations for discharges from WPCFs and municipal sewer infrastructure

- Monitor discharges to surface water for indicator bacteria in accordance with the frequency specified in the permit(s).
- Ensure that disinfection systems are maintained and operated appropriately to allow for attainment of the WLAs for the facility consistent with Section 22a-426-4(a)(9) of the WQS and applicable permit requirements. For effluent disinfection, ultraviolet light systems are preferred over chlorine-based systems. If chlorine-based systems are approved, dechlorination may be required.
- Towns with municipal sanitary sewer service should develop a Capacity, Management, Operations and Maintenance program to evaluate their sewer system and reduce leaks and overflows, especially in areas near waterbodies. This program should at a minimum include periodic inspections of municipal sewer lines and pumping stations, implement infiltration and inflow removal plans, implement programs to eliminate the discharge of fats, oils and grease from food preparation establishments that may lead to sewage backups, and identify sewer maintenance priorities in municipal capital improvement plans.

Recommendations for surface water discharges from municipal sewer infrastructure

Towns with municipal sanitary sewer service should develop a Capacity, Management, Operations and Maintenance program to evaluate their sewer system and reduce leaks and overflows, especially in areas near waterbodies. This program should at a minimum include periodic inspections of municipal sewer lines and pumping stations, implement infiltration and inflow removal plans, implement programs to eliminate the discharge of fats, oils and grease from food preparation establishments that may lead to sewage backups, and identify sewer maintenance priorities in municipal capital improvement plans.

Recommendations to address CSO discharges

Connecticut has been actively working to phase out CSOs by encouraging alternative systems and/or retrofitting current systems. The six municipalities in the State that still allow CSOs through their collection systems are working to reduce and eliminate overflows. Strategies being used to prevent overflows include: disconnecting and/or separating combined sewer infrastructure, constructing new sewer and/or wastewater storage tanks, updating and/or expanding WPCFs and/or sewer lines, etc. These municipalities should abide by requirements within approved Long Term Control Plans. For more information on CSO control and elimination in Connecticut, refer to CT DEEP's Combined Sewer Overflows (CSOs) webpage.

Recommendations to address unpermitted and/or unregulated PS discharges

Permittees should follow permit requirements to prevent, identify and eliminate illicit discharges to stormwater, including any such discharges or releases that may contribute bacteria to surface waters. Currently the MS4 municipal and DOT GPs and the Industrial Stormwater GP contain specific requirements to address illicit discharges. The MS4 GP's IDDE requirement to track SSOs and septic discharges is an example of how illicit discharges can be managed, prevented, and addressed. Permittees under the Commercial Stormwater GP are also recommended to implement procedures to prevent illicit discharges and identify and eliminate any such discharges to their storm water system.

9.2 Addressing NPS of Bacteria

For NPS, the recommendations below will help to manage sources in a way that limits bacteria loading to waterbodies and supports water quality restoration and protection.

Addressing stormwater not covered under a permit

Approximately 25% of the municipalities in Connecticut are not regulated under the MS4 GP, and not all facilities are covered under the industrial, construction, or commercial stormwater permits. While stormwater discharges from these municipalities and facilities are not regulated, it is recommended that non-regulated entities follow the BMPs included in the MS4 GP and in Section 4 of this TMDL to address sources of bacteria. Any actions that can be taken such as equipment inspections, street sweeping, public education/IDDE programs, buffer enhancement projects, etc. may benefit water quality.

Integrate water quality into municipal planning and Town/City Ordinances

Municipalities should conduct a review of ordinances and/or bylaws to ensure that existing regulations encourage the use of LID and green infrastructure strategies on new and redevelopment projects. Municipal regulations should encourage and/or require the use of innovative approaches to stormwater management such as the use of bioretention, vegetated swales, and permeable paving, as well as the protection and maintenance of natural green infrastructure such as forests, riparian buffers, floodplains, and wetlands. Improved ordinance language may include requirements surrounding site plan review regulations, LID and green infrastructure projects, road and right-of-way standards, minimum lot sizes, minimum shore frontage per lot, setbacks, buffers, lot coverage, steep slopes, stormwater management, open space, fertilizer/pesticide use, and domesticated animal waste.

Recommendations to address subsurface water discharges from SSDS

To address NPS discharges stemming from SSDS such as groundwater leachate due to septage leaks and/or system failures, it is recommended that municipalities and applicable Local Health Departments (LHDs) take the following steps:

- Ensure that these subsurface discharges are treated or controlled to the maximum extent practicable in accordance with the requirements of 22a-426-4(e) of the WQS.
- Establish programs to ensure that existing SSDS are properly operated and maintained, if these programs are not already in place. For example, communities can create an inventory of existing SSDS through mandatory inspections. Inspections help encourage proper maintenance and identify failed or sub-standard systems.
- Institute minimum pump-out intervals (for example once per 3 or 5 years), with pump-out firms submitting monthly or quarterly reports to the municipality of systems served.
- Adopt policies that govern the eventual replacement of the sub-standard systems within a reasonable timeframe.
- Develop programs to assist citizens with the replacement and repair of older and failing systems.
- Actively engage with LHDs and evaluate SSDS ordinances in other municipalities to address SSDS issues.
- Ensure SSDS are properly designed and installed in conformance with the approved design and siting requirements (e.g., setbacks from waterways).
- Ensure SSDS are properly operated by the owner, to prevent disposal of some materials (such as toxic chemicals, paints, personal hygiene products, pet waste/kitty litter, water softeners, oils and grease in large volumes, and garbage) that may adversely affect the function and life of the system.
- Ensure the property owner protects the system, such as preventing trees and shrubs with extensive roots from growing above the system/clogging the system and avoiding driving large vehicles over the system which may crush or compact piping or leaching structures.
- Install an effluent filter at the outlet of the septic tank to enhance its performance and protect the leaching system from clogging, and regularly cleaning installed filters.
- Properly replace components of failed systems, which may include programs or regulations to encourage upgrades of conventional systems to more innovative alternative technologies, provided a statewide permitting program has been established.
- Maintain proper vegetative buffers between your system(s) and adjacent water resources.
- Check all system plumbing for leaks on a regular basis, and avoid continually running water, which could possibly result in a hydraulic overload and failure of the system.

Evaluate riparian buffer areas and work to preserve existing and enhance future riparian areas

Establishing, protecting, and maintaining vegetated riparian buffer corridors adjacent to waterbodies provides an important filtration function for runoff and pollutants. Municipalities and landowners are encouraged to assess the status of riparian buffers on their property(ies) and then implement programs and engage in projects that protect existing vegetated riparian areas as well as enhance and increase vegetation in riparian areas, where practicable. As riparian buffers can help filter agricultural runoff, it is recommended that agricultural operations work to install and/or maintain vegetated buffers between agricultural areas and waterbodies.

Discourage discharges from agricultural runoff

Farmers are encouraged to assess current conditions and identify issues which may affect water quality, then work to develop solutions and implement conservation practices which protect and restore water quality. Conservation plans should focus on water quality enhancement measures such as ensuring that sufficient riparian buffers are in place to mitigate runoff, fencing is in place to restrict livestock access to streams and wetlands, and that animal waste handling/disposal and other appropriate BMPs are in place. Examples of other agricultural BMPs that impact water quality include planting cover crops to prevent soil erosion during storm events, applying green manure, and properly managing fertilizers to discourage pollutant loading to waterbodies.

Connecticut has programs that provide assistance and offer technical and financial support to farm operations. Farmers should reach out to these programs and consult BMP guidance documents, to help mitigate farm runoff and waste management issues that may negatively impact water quality. Agricultural producers are advised to work with the CT Department of Agriculture and the U.S. Department of Agriculture Natural Resources Conservation Service (USDA NRCS) to develop conservation plans for their farming activities.

Recommended resources pertaining to the use of agricultural BMPs include:

- The *Manual of Best Management Practices for Agriculture: Guidelines for Protecting Connecticut's Water Resources* describes BMPs designed to reduce the impact of agriculture on water quality.
- UConn's Agriculture and Food Extension Program offers many tools and contact information for people who can assist in managing farm and farm waste issues.
- UConn's Agriculture and Food Publications website offers published guidance documents for a wide variety of farm topics from dairy, goat/sheep guides to horsemanship, honeybees, and tree horticulture.
- USDA NRCS Conservation Practice Standards website provides BMP documents by topic and factsheets.
- US EPA's A-Z Agriculture Index provides links to programs and BMPs, by topic, to assist farmers.
- A listing of State and Federal agricultural organizations that can provide assistance Associated Agencies and Organizations.

Discourage livestock, pet, and wildlife waste from entering waterbodies

Animal wastes should be disposed of away from any waterbodies or storm drain systems. Continued education and outreach materials should highlight the importance of minimizing animal waste impact on waterbodies. Educational materials should emphasize that feeding wildlife such as ducks, geese, and swans may contribute to water quality impairments and can harm human health and the environment. Waterfowl (especially grazers like geese) prefer easy access to water, and towns are encouraged to take measures to minimize waterfowl-related bacteria impacts. Allowing tall, coarse vegetation to grow in riparian buffer areas to deter waterfowl and maintaining an uncut vegetated buffer along the shore helps make the habitat less desirable to geese and encourages natural migration.

Managing waste from domesticated animals such as horses, dogs, and other pets should also be emphasized. BMPs effective at reducing the impact of animal waste on water quality include installing signage, providing pet waste receptacles in high-use areas, enacting ordinances requiring the clean-up of pet waste, and targeting educational and outreach programs in problem areas. For more information regarding BMPs to manage horse manure/waste, please refer to the document entitled Good Horse Keeping: Best Practices Manual for Protecting the Environment 2011 (HEAP, 2011).

Addressing bacteria sourced from recreational use of waterbodies

To help prevent and/or mitigate recreational sources of bacteria such as humans and boats at beaches and/or marinas, the following recommendations apply:

- At beach locations, post signage and provide trash receptacles to help discourage waste (such as diapers) from being left behind by beach visitors.
- Provide onshore restrooms and shower facilities to encourage visitors to shower and dispose of waste before entering waterways.
- At boat launches/wash stations, prevent waste/wash waters from draining directly to waterbodies by taking the following actions: a) configure site drainage to direct stormwater away from surface waterbodies, b) install vegetated buffers between upland areas and surface waters to support infiltration, c) protect storm drains with filters and/or oil-grit separators, and d) stencil words such as "Drains to the River" on storm drains to alert visitors that drains lead directly to waterbodies.
- Beach/park personnel can conduct daily inspections of shoreline bathing areas for evidence of waste and contamination. Officials can utilize sanitary surveys along shorelines as a tool to determine sanitary quality and aid decision-making regarding contamination that may warrant beach closure(s).
- Boat owners should ensure waste is being properly contained, managed and disposed of. Connecticut provides free pump-out facilities for boaters, and requires boats equipped with a marine sanitation device to have a wastewater holding system to prevent discharge of waste into waters. More information about boat sewage disposal, pump out facility locations, and proper maintenance for marine sanitation devices is provided on CT DEEP's Clean Vessel Act Program website.
- Marina owners should not allow pump-out station wastes to drain directly into receiving waters.
- Marina owners and operators should refer to the *Guidebook for Marina Owners and Operators for the Installation and Operation of Sewage Pump-out and Dumping Stations* for information on the design, construction, operation, and maintenance of sewage pump-out facilities and dump stations.

SECTION 10. ENVIRONMENTAL HEALTH FOR ALL COMMUNITIES

Environmental health for all communities means that all people should be treated fairly under environmental laws. Recent and renewed focus on environmental health issues has emerged in response to a growing body of evidence nationally and statewide indicating that communities within low income census blocks may be exposed to higher-than-average amounts of environmental pollution. Exposures from industrial air pollution, lead paint, pesticides and contaminated fish or seafood or closer proximity to waste disposal facilities are just a few examples.

Environmental health for all communities includes Distressed Municipalities, as defined by the CT Department of Economic and Community Development, as well as Low Income Area census block groups (that are not in distressed municipalities) in which 30% or more of the population lives below 200% of the Federal Poverty Level. Census block groups were determined using poverty data from the 2019 American Community Survey 5-year Estimates. According to Section 32- 9p of the CGS, a distressed municipality should be based on "high unemployment and poverty, aging housing stock and low *or* declining rates of growth in job creation, population, and per capita income." CT DEEP recommends that project managers consider targeting these areas for TMDL implementation efforts as well as tribal lands associated with indigenous tribes recognized by State statute Sec. 47-59a and areas affecting federally recognized tribes. For more information regarding Environmental health for all communities please refer to CT DEEP's webpage and the map viewer.

SECTION 11. IMPACTS OF EXTREME WEATHER CONDITIONS

Water resources in Connecticut are affected by weather stressors, including increasing temperatures, changing precipitation patterns, extreme events (storms, floods, and drought), and rising sea levels. These changing conditions have implications for stormwater management as local and state decision makers look to implement appropriate maintenance plans, improve existing infrastructure, and build new stormwater systems that are more resilient to changes in the quantity and quality of stormwater runoff.

It is important for municipalities and other land owners to be flexible and continually assess and adapt to the threat of extreme weather conditions. Multiple municipal departments and infrastructure may be impacted, including drinking water, wastewater, and stormwater.

In 2013, CT DEEP partnered with the University of Connecticut and launched CIRCA. CIRCA, located at the University's Avery Point campus in Groton, is a multi-disciplinary, regional center of excellence, bringing together experts in the natural sciences, engineering, economics, political science, finance, and law to provide practical solutions to extreme weather conditions. The GC3 and research and precipitation projections developed by CIRCA, indicate that ongoing and future projected changes will continue to impact stormwater management in Connecticut, as well as related environmental, infrastructure, and community resources, in the following ways:

- More frequent and intense storms can increase stormwater runoff, which can cause more frequent and extreme flooding events and can exacerbate existing, or introduce new, pollution problems. Overwhelmed stormwater management systems can lead to backups that cause localized flooding or lead to greater runoff of contaminants such as trash, nutrients, sediment, and bacteria into local waterways.

- More frequent and intense downpours can also challenge cities with combined stormwater and wastewater drainage systems. These systems can be overwhelmed by large amounts of rainfall or snowmelt and lead to more combined sewer overflows (CSOs) into waterways. An increase in CSOs can reduce water quality and make meeting water quality standards more difficult.
- Increased stormwater runoff and transport of pollutant loads to waterbodies can diminish water quality and threaten drinking water sources. Projected increases in the number of days of precipitation over 1 inch, as well as the total amount of precipitation falling in the heaviest 1% of rainfall events are important factors in determining future pollutant loads to waterbodies.
- Warming air and water temperatures combined with increased precipitation and stormwater pollutant loads will increase the potential for harmful algal blooms, loss of high-quality headwater streams and cold-water habitat, further degradation of impaired waters, and negative impacts on recreational use of waters.
- More frequent, intense, and longer-lasting periods of drought, combined with new land development, can exacerbate loss of groundwater recharge, reducing streamflow and affecting water quality, stream ecology, recreational use of waters, and drinking water supplies.
- Sea level rise and increased frequency and intensity of coastal storms has implications for stormwater management systems along the Connecticut coast and tidally influenced areas. According to projections by CIRCA, sea level rise is expected to increase water levels in Long Island Sound by up to 20 inches by 2050 and to continue increasing after that. Continued rising sea levels will result in more regular coastal flooding, increased water depths will result in greater potential for wave and storm surge propagation further inland during storms, and groundwater elevations will rise in areas that are directly influenced by coastal waters. Stormwater management systems in these areas are vulnerable to rising sea levels and, backwatering and submerging of outfalls, rising groundwater and reduced infiltration, storm surge inundation of facilities, and additional wind, sand, and salt exposure.

Considering Extreme Weather Conditions when Implementing TMDLs

Implementation of TMDLs focused on bacteria rely on properly treating discharges that contain bacteria and on controlling regulated and unregulated stormwater. For stormwater management, understanding the impacts extreme weather is particularly important as implementation is planned and enacted in response to bacteria TMDLs for watersheds and coastal areas across Connecticut. Considering these issues when selecting and implementing management measures to restore or protect water quality will support a more effective and longer-term approach managing bacteria levels in surface waters in Connecticut.

Reducing impervious cover using site planning and design techniques can significantly reduce the volume of stormwater runoff to local waterbodies. To better preserve pre-development hydrology (runoff duration, rate, volume, and temperature and groundwater recharge) and protect stream quality, a common approach is to prevent a stormwater discharge from occurring from a site during 90% of the storms. The volume of rainfall associated with 90% of the storms is referred to as the water quality volume (WQV). On average 90 percent of the storms in a year are less than this amount. The WQV will change overtime. Previously, the WQV for Connecticut was estimated to be 1-inch of rainfall. However, using over 40 years of rainfall data, (1980-2021), the Stormwater Quality Manual replaces the 1- inch rainfall amount with an updated WQV rainfall amount of 1.3 inches. Following this recommendation to manage the water quality volume on-site (infiltrate or capture and treat or a combination of both) the amount of runoff that occurs from a storm event that produces 1.3 inches of rain should be adequate to protect water quality in the receiving stream. It will be necessary to reevaluate the water quality volume as time passes, to ensure continued protection of stream water quality.

There is a Water Quality benefit to getting the runoff into the ground:

- Increase baseline flow
- Maintain hydrology
- Groundwater recharge

Infiltration of stormwater is not recommended under the following site conditions:

- Land Uses or Activities with Potential for Higher Pollutant Loads can contaminate public and private groundwater supplies.
- Subsurface Contamination: Infiltration of stormwater in areas with soil or groundwater contamination such as brownfield sites and urban redevelopment areas can mobilize contaminants.
- Groundwater Supply Areas: Infiltration of stormwater can potentially contaminate groundwater drinking water supplies in public drinking water aquifer recharge areas and wellhead protection areas

It is important that we continue to evaluate rainfall amounts to detect potential future changes in observed precipitation and make informed decisions about infrastructure, LID and BMPs to ensure that the runoff from most storms is infiltrated, and if infiltration is not an option, then runoff is captured and treated.

Resiliency and Adaptation Resources for extreme weather

Extreme weather can lead to more powerful storms, rising sea levels, and increased risks of flooding. Learn more about what your community can do to adapt to the challenges of extreme weather.

CIRCA: The mission of the CIRCA is to increase the resilience and sustainability of vulnerable communities along Connecticut's coast and inland waterways.

CAA: This partnership with Connecticut Sea Grant, UConn CLEAR and others provides municipalities with information and tools to help them adapt to extreme weather conditions.

Long Island Sound Partnership: This web page provides municipalities with examples and ideas on the actions they can take to address extreme weather in their portion of the Long Island Sound watershed.
CT DEEP webpage

CIRCA Grant Products

Municipal Resilience Grant Program: Learn about new funding available and previously funded municipal projects designed to move our state from planning to implementation.

Matching Funds Grant Program: Learn more about the 9 matching funds grants awarded to Connecticut organizations, municipalities and researchers to leverage external funding programs to advance resilience in the state.

Research Grants: Learn more about all of CIRCA's Research projects and products.

SECTION 12. REFERENCES

Bellucci, C. (2007). *Stormwater and Aquatic Life: Making the Connection Between Impervious Cover and Aquatic Life Impairments for TMDL Development in Connecticut Streams*. Copyright Water Environment Federation. CT Department of Environmental Protection, Bureau of Water Protection and Land Reuse, 79 Elm Street, Hartford, Connecticut 06106. URL: https://portal.ct.gov/-/media/DEEP/water/water_quality_management/monitoringpubs/Bellucci_2007_WEF.pdf

Birch, G.F., Matthai, C., Fazeli, M.S., Suh, J. (2004). Efficiency of a constructed wetland in removing contaminants from stormwater. *Wetlands*. 24(2), (June 1, 2004) 459-466. https://www.researchgate.net/publication/225680231_Efficiency_of_a_constructed_wetland_in_removing_contaminants_from_stormwater#:~:text=During%20four%20high%2Dflow%20events,98%25%20and%E2%80%9467%25).

Brown, E., Caraco, D., Pitt, R. (2004). Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments. Center for Watershed Protection, Ellicott City, MD & University of Alabama, Tuscaloosa, AL. URL: owl.cwp.org/mdocs-posts/idde-guidance-manual/

Cervione, M.A., R.L.Melvin, K.A.Cyr. (1982). A *Method for Estimating the 7-Day, 10-Year Low Flow of Streams in Connecticut. Connecticut Water Resources Bulletin No. 34.* URL: https://portal.ct.gov/-/media/DEEP/site_clean_up/remediation_regulations/7Q10EstimationMethodofStreamsinCTpdf.pdf

Clary, J., J. Jones, M. Leisenring, P. Hobson, and E. Strecker. (2020). *International Stormwater BMP Database 2020 Summary Statistics*. Prepared by Wright Water Engineers, Geosyntec Consultants and Terraphase Engineering for The Water Research Foundation URL: www.waterrf.org/system/files/resource/2020-11/DRPT-4968_0.pdf

CWP (1999). *Watershed Protection Techniques*. Center for Watershed Protection, Vol. 3, No. 1.

CWP (2007a). National Pollutant Removal Performance Database: Version 3. Ellicott City, MD. URL: www.stormwaterok.net/CWP%20Documents/CWP-07%20Natl%20Pollutant%20Removal%20Perform%20Database.pdf

CWP (2007b). *Urban Stormwater Retrofit Practices*. Center for Watershed Protection. owl.cwp.org/mdocs-posts/urban-subwatershed-restoration-manual-series-manual-3/

CT DEP (1996). Caring for Our Lakes: Watershed and In-Lake Management for Connecticut Lakes. portal.ct.gov/-/media/DEEP/water/lakes/CaringforOurLakespdf.pdf

CT DEP (August 2007). *Guideline for Municipal Management Practices for Street Sweepings & Catch Basin Cleanings*. Connecticut Department of Environmental Protection. URL: portal.ct.gov/-/media/DEEP/waste_management_and_disposal/solid_waste/streetsweepingspdf.pdf

CT DEP (Fall 2008). *Pollution Prevent View: Give a Bark for Clean State Park*. A Newsletter from the Connecticut Department of Environmental Protection. Fall 2008. P2 View, 8 (4). URL:portal.ct.gov/-/media/DEEP/p2/newsletter/p2viewfall08pdf.pdf

CT DEP, Natural Resources Conservation Service (NRCS) and Connecticut Council on Soil and Water Conservation (CT CSWC). 1996 revision (original 1993). *Manual of Best Management Practices for Agriculture: Guidelines for Protecting Connecticut's Water Resources*. URL: https://portal.ct.gov/-/media/DEEP/aquifer_protection/BMPsagriculturepdf.pdf

CT DEEP. *Connecticut Water Quality Standards*. Regulations of Connecticut State Agencies (RCSA) Title 22a, 22a-426-1 through 22a-426-9. Bureau of Water Planning and Land Reuse, Water Planning and Management Division, Hartford, CT. URL: portal.ct.gov/-/media/DEEP/water/water_quality_standards/wqsfinaladopted22511pdf.pdf

CT DEEP (2011). Connecticut Department. of Energy & Environmental Protection. Subsurface Sewage Treatment and Disposal Systems (Septic Systems). URL: https://portal.ct.gov/DEEP/Water-Regulating-and-Discharges/Subsurface-Disposal/Subsurface-Sewage-Treatment-and-Disposal-Systems---Septic-Systems

CT DEEP (2015). *Ambient Water Quality Monitoring Program Strategy 2015-2024*. Connecticut Department of Energy & Environmental Protection. URL: https://portal.ct.gov/-/media/DEEP/water/water_quality_management/monitoringpubs/monstrategy20152024finalpdf.pdf

CT DEEP (2019). Connecticut Department. of Energy & Environmental Protection. Connecticut's No Discharge Area Program. URL: https://portal.ct.gov/DEEP/Boating/No-Discharge-Area/Connecticuts-No-Discharge-Area-Program-Home

CT DPH and CT DEEP (2016). *Guidelines for Monitoring Bathing Water and Closure Protocol:* revised 2016. CT Department of Public Health, Connecticut Department of Energy & Environmental Protection, Hartford, CT. URL: portal.ct.gov/-/media/Departments-and-Agencies/DPH/dph/environmental_health/BEACH/Guidelines-for-Monitoring-Swimming-Water- and-Closure-Protocol-March-2016.pdf.

Davies, C. and H. Bavor. (2000). The fate of stormwater-associated bacteria in constructed wetland and water pollution control pond systems. *Journal of Applied Microbiology.* 89: 349-360. URL: https://www.researchgate.net/publication/12349880_The_Fate_of_Stormwater-Associated_Bacteria_in_Constructed_Wetland_and_Water_Pollution_Control_Pond_Systems

ECCD (2015). *2015 Amos Lake Abbreviated Watershed-Based Plan*. Eastern Connecticut Conservation District. URL: portal.ct.gov/-/media/DEEP/water/watershed_management/wm_plans/amoslakewbpeccdpdf.pdf

Fuss and O'Neill (2010). *Technical Memorandum 2 Evaluating the Role of Stormwater Utility Districts in the Implementation of Low Impact Development*. Partners for the Connecticut Low Impact Development and Stormwater General Permit Evaluation, Connecticut. August 2010. URL: https://portal.ct.gov/-/media/DEEP/water/nps/swgp/tm2roleswupdf.pdf

Fuss & O'Neill (2011). *Low Impact Development Appendix to the Connecticut Stormwater Quality Manual*. Partners for the Connecticut Low Impact Development and Stormwater General Permit Evaluation, Connecticut. June 2011. portal.ct.gov/-/media/DEEP/water/nps/swgp/lidapdxctstormwatermanualpdf.pdf

Hathaway, J.M., W.F. Hunt, J.D. Wright, and S.J. Jadlocki. (2008). *Pathogen removal performance of best management practices in Charlotte and Wilmington, North Carolina*. World Environmental and Water Resources Congress. URL: https://www.researchgate.net/publication/271420965_An_Evaluation_of_Pathogen_Removal_in_Stormwater_Best_Management_Practices_in_Charlotte_and_Wilmington_North_Carolina

Horse Environmental Awareness Program HEAP (2011). *Good Horse Keeping: Best Practices Manual for Protecting the Environment*. Horse Environmental Awareness Program. URL: ctrcd.org/wp-content/uploads/2017/10/GOODHORSEKEEPINGBMP_WEB.pdf

Mallin, M.A., K.E. Williams, E.C. Escham, R.P. Lowe. (August 2000). Effect of Human Development on Bacteriological Water Quality in Coastal Watersheds. *Ecological Applications* 10(4): 1047-1056. URL: www.researchgate.net/publication/253372408_Effect_of_Human_Development_on_Bacterial_Water_Quality_in_Coastal_Watersheds

MA DEP (2005). *Mitigation Measures to Address Pathogen Pollution in Surface Waters: A TMDL Implementation Guidance Manual for Massachusetts*. Massachusetts Department of Environmental Protection. URL: www.mass.gov/doc/implementation-guidance-manual-for-watershed-specific-pathogen-tmdl-reports-0/download

NCDEQ (November 2020) *Stormwater Design Manual*. North Carolina Department of Environmental Quality. URL: deq.nc.gov/about/divisions/energy-mineral-and-land-resources/stormwater/stormwater-program/stormwater-design

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

NERC (May 2019). *Manure Management for Small and Hobby Farms*. Northeast Recycling Council. URL: https://irp.cdn-website.com/bd31aa5e/files/uploaded/manure_management_handbook.pdf

NNPSMP (2013) *TechNOTES 9 Monitoring for Microbial Pathogens and Indicators*. September 2013. National Nonpoint Source Monitoring Program. URL: http://www.epa.gov/sites/default/files/2016-05/documents/tech_notes_9_dec2013_pathogens.pdf

Skinner, J.F., J. Kappeler, and J. Guzman (July 2010) *Regrowth of Enterococci & Fecal Coliform in Biofilm* from www.stormwater.com/bmps/article/13005530/regrowth-of-enterococci-fecal-coliform-in-biofilm

Sullivan, T.J., J.A. Moore, D.R. Thomas, E. Mallery, K.U. Snyder, M. Wustenberg, J. Wustenberg, S.D. Mackey, D.L. Moore (2007). *Efficacy of Vegetated Buffers in Preventing Transport of Fecal Coliform Bacteria from Pasturelands*. Environmental Management. 40:958–965. URL: https://link.springer.com/article/10.1007/s00267-007-9012-3

UNHSC (2009). 2009 Biannual Report. University of New Hampshire Stormwater Center. URL: https://scholars.unh.edu/cgi/viewcontent.cgi?article=1076&context=stormwater

US EPA (1994). *National Pollutant Discharge Elimination System (NPDES) Combined Sewer Overflows Control Policy*. United States Environmental Protection Agency. 59 Fed. Reg. 18688. URL: www.epa.gov/sites/production/files/2015-10/documents/owm0111.pdf.

US EPA (May1995). *Combined Sewer Overflows: Guidance for Nine Minimum Controls*. United States Environmental Protection Agency. EPA/832/B-95/003. URL: www.epa.gov/sites/production/files/2015-10/documents/owm0030_2.pdf

US EPA (September 1999). *Combined Sewer Overflow Management Fact Sheet: Sewer Separation*. United States Environmental Protection Agency. EPA 832-F-99-041. URL: www3.epa.gov/npdes/pubs/sepa.pdf

US EPA (2001a). *Guidance: Coordinating CSO Long-Term Planning with Water Quality Standards Review*. July 2001. United States Environmental Protection Agency. EPA/833/R-01/002. URL: https://nepis.epa.gov/Exe/ZyNET.exe/P1002YXM.TXT?ZyActionD=ZyDocument&Client=EPA&Index=1995+Thru+1999&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C95thru99%5CTxt%5C00000023%5CP1002YXM.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL

US EPA (2001b). *Managing Pet and Wildlife Waste to Prevent Contamination of Drinking Water*. Source Water Protection Practices Bulletin. July 2001. United State Environmental Protection Agency. EPA 916-F-01-027. Available online at: https://nepis.epa.gov/Exe/ZyPDF.cgi/901V1N00.PDF?Dockey=901V1N00.PDF

US EPA (2002). *Onsite Wastewater Treatment Systems Manual*, February 2002. EPA/625/R-00/008. URL:www.epa.gov/sites/production/files/2015-06/documents/2004_07_07_septics_septic_2002_osdm_all.pdf

US EPA (2003). *Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems*. United States Environmental Protection Agency. March 2003. EPA 832-B-03-001. URL: nepis.epa.gov/Exe/ZyPDF.cgi/20009NAM.PDF?Dockey=20009NAM.PDF

US EPA (2005). *Handbook for Managing Onsite and Clustered (Decentralized Wastewater Treatment Systems: An Introduction to Management Tools and Information for Implementing EPA's Management Guidelines*. United States Environmental Protection Agency. December 2005. EPA 832-B-05-001. URL: nepis.epa.gov/Exe/ZyPDF.cgi/20017K2G.PDF?Dockey=20017K2G.PDF

US EPA (2006). *Volunteer Estuary Monitoring Manual, A Methods Manual, Second Edition*. United States Environmental Protection Agency. March 2016 EPA-842-B-06-003. URL: www.epa.gov/sites/default/files/2015-09/documents/2009_03_13_estuaries_monitor_chap17.pdf.

US EPA (2008). *Handbook for Developing Watershed Plans to Restore and Protect Our Waters*. March 2008. United States Environmental Protection Agency. EPA 841-B-08-002. URL: https://www.epa.gov/sites/default/files/2015-09/documents/2008_04_18_nps_watershed_handbook_handbook-2.pdf

US EPA (2009). *Review of Zoonotic Pathogens in Ambient Waters*. EPA 822-R-09-002. URL: www.epa.gov/sites/default/files/2019-03/documents/review-zoonotic-pathogens-waters.pdf

US EPA (2012). *Recreational Water Quality Criteria*. United States Environmental Protection Agency Office of Water. EPA 820-F-12-058. URL https://www.epa.gov/sites/default/files/2015-10/documents/rwqc2012.pdf

US EPA (2013). *A Quick Guide to Developing Watershed Plans to Restore and Protect Our Waters*. May 2013. United States Environmental Protection Agency. EPA 841-R-13-003. URL: www.epa.gov/sites/production/files/2015-12/documents/watershed_mgmnt_quick_guide.pdf

APPENDIX A: TMDLS EXPRESSED AS DAILY LOAD:

As explained in Section 5.2, Connecticut expresses bacteria TMDLs as concentrations (counts of bacteria/100mL). However, in accordance with federal guidance, bacteria TMDLs are also expressed as daily loads in terms of mass per unit time (i.e., number of bacteria per day as a function of flow for rivers and streams; and daily replacement volume of water for lakes, ponds and coastal embayments.) Graphs and tables are provided below for *E. coli,* Enterococci and Fecal coliform geometric means.

Using a concentration-based approach to establishing bacteria TMDLs, CT DEEP used on implicit margin of safety (MOS) since not allocating dilution within the receiving water setting the WLAs and LAs equal to the applicable water quality criteria is a conservative approach. For TMDLs expressed as a daily load, the margin of safety (MOS) in mass per unit time TMDLs can be either explicit or implicit. For the examples provided in this Appendix, the daily load calculations will be developed using a discrete MOS. An implicit MOS is used since the daily loads are calculated based on low flow conditions. This is a conservative assumption since, since except for treated sewage, most discharges that convey bacteria to receiving waters occur during storm events that also cause increased streamflow above low flow conditions. For discharges of treated sewage, conservatism is maintained as these discharges are required to disinfect the effluent which effectively eliminates bacteria in the treated effluent to levels at or below the water quality criteria.

Mass per unit time TMDLs for rivers are calculated by multiplying river or stream flow under 7Q10 conditions by the allowable bacteria concentration. 7Q10 stream flows should be obtained from USGS stream gage data. If gaged stream-flow data are not available, the 7Q10 flow can be estimated using information on the drainage area for the TMDL watershed and amount of till and stratified drift. This information is available from the Connecticut StreamStats webpage. This information is then used to calculate 7Q10 streamflows using the following equation (Cervione et al., 1982):

$Q_{7,10} = 0.67\ A_{sd} + 0.01\ A_{till}$

Where

$Q_{7,10}$: 7-day, 10-year low flow (cubic feet per second)

A_{sd} : the drainage area underlain by coarse-grained stratified drift (square miles)

A_{till} : the drainage area underlain by till-mantled bedrock (square miles)

An update to the Connecticut StreamStats platform is expected in the future to provide updated 7Q10 flow estimates directly accessed from the web platform. Once that update is published, the 7Q10 estimates provided directly from Connecticut StreamStats should be used in place of the values calculated using the equation above.

To calculate the TMDL as a daily load, the 7Q10 flow is multiplied by the water quality standard (geometric mean) to obtain the loading capacity or TMDL for the stream segment or watershed. For lakes and ponds or estuarine and marine segments, the daily replacement volume of the waterbody is multiplied by the WQS concentration. This volume estimate is the flushing rate for the waterbody based on 7Q10 conditions within lakes and ponds and under low tide condition for estuarine or marine segments. This volume is then multiplied by the volume of the waterbody under 7Q10 or low tide conditions, as applicable. Formulas to calculate mass per unit time can be found on the following pages.

The following figures contain TMDL calculations for bacteria-impaired rivers and streams, lakes and ponds, and coastal embayments. These figures are intended to provide the necessary formulas, tables, and graphs required for calculating bacteria TMDLs based on daily loads for any waterbody, and for appropriate low flow and/or volume.

Freshwater River & Stream Recreational Waters

Daily loads (mass per unit time) for recreational uses in freshwater rivers and streams are shown in Figures A1 – A4 and Tables A1- A4 based on the geometric mean and single sample maximum criteria for recreation. This is a flow-based, daily load calculation for freshwater rivers and streams using the equation below. If the Water Quality Criteria are changed as discussed in Section 2 of this document, the WLAs and LAs will change as discussed in Section 5. In that case, the applicable daily load calculations are those shown in Figures A1 and A5 and Tables A1 and A5.

Formula:

TMDL (10^9 organisms / day) = Water Quality Standard (count / 100 mL) x Flow (m^3 / sec) x 86,400 (sec / day) x 10 (100 mL / L) x 1000 (L / m^3) x $1/10^9$

Where: WQS = applicable Water Quality Criteria

Daily Replacement volume = (7Q10 flushing rate/# days during disinfection season) x Waterbody Volume (m^3)

7Q10 Flushing Rate = number of times per year the waterbody's volume is exchanged under 7Q10 conditions

Disinfection Season is the period of the year specified in the Water Quality Standards (22a 426 4(a)(9)(E)) during which disinfection of treated sewage discharges is required.

Abbreviations:

GM WQS = Geometric Mean Water Quality Standard; TMDL = Total Maximum Daily Load

WLA = Waste Load Allocations; LA = Load Allocation.

MOS = Margin of Safety, implicit

mL = milliliter; L = Liter, m^3 = cubic meter

Table A 1: E. coli Freshwater Rivers & Streams Daily Loads

Flow (m^3 / sec)	Geometric Mean WQS (count / 100 mL)	TMDL (10^9 count / day)	MOS (10^9 count / day)	LA and WLA (10^9 count / day)
0.005	126	0.544	implicit	0.5
0.01	126	1.089	implicit	1.1
0.025	126	2.722	implicit	2.7
0.05	126	5.443	implicit	5.4
0.075	126	8.165	implicit	8.2
0.1	126	10.886	implicit	10.9
0.25	126	27.216	implicit	27.2
0.5	126	54.432	implicit	54.4
0.75	126	81.648	implicit	81.6
1	126	108.864	implicit	108.9
5	126	544.320	implicit	544.3

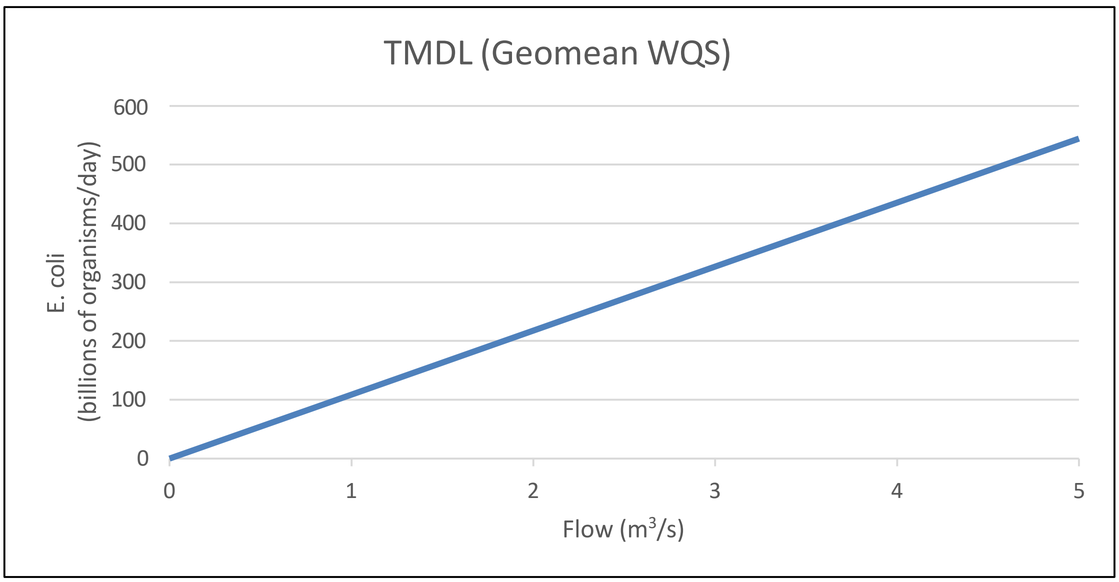


Figure A 1: E. coli Freshwater Rivers & Streams Daily Loads

Table A 2: E. coli Freshwater Rivers & Streams Daily Loads

Flow (m^3 / sec)	Single Sample Maximum WQS (count / 100 mL)	TMDL (10^9 count / day)	MOS (10^9 count / day)	LA and WLA (10^9 count / day)
0.005	235	1.015	implicit	1.0
0.01	235	2.030	implicit	2.0
0.025	235	5.076	implicit	5.1
0.05	235	10.152	implicit	10.2
0.075	235	15.228	implicit	15.2
0.1	235	20.304	implicit	20.3
0.25	235	50.760	implicit	50.8
0.5	235	101.520	implicit	101.5
0.75	235	152.280	implicit	152.3
1	235	203.040	implicit	203.0
5	235	1,015.200	implicit	1,015.2

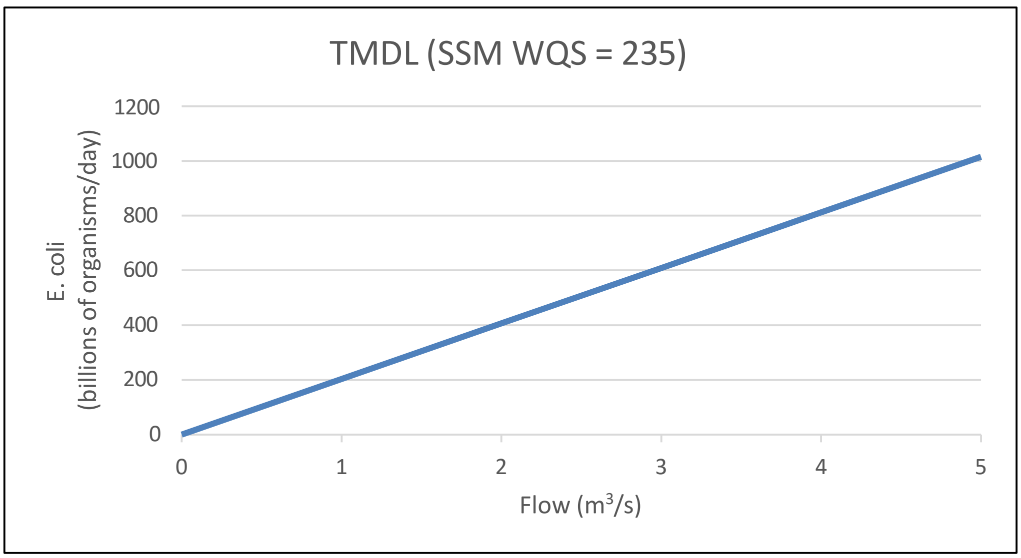


Figure A 2: E. coli Freshwater Rivers & Streams Daily Loads

Table A 3: E. coli Freshwater Rivers & Streams Daily Loads

Flow (m³ / sec)	Single Sample Maximum WQS (count / 100 mL)	TMDL (10^9 count / day)	MOS (10^9 count / day)	LA and WLA (10^9 count / day)
0.005	410	1.771	implicit	1.8
0.01	410	3.542	implicit	3.5
0.025	410	8.856	implicit	8.9
0.05	410	17.712	implicit	17.7
0.075	410	26.568	implicit	26.6
0.1	410	35.424	implicit	35.4
0.25	410	88.560	implicit	88.6
0.5	410	177.120	implicit	177.1
0.75	410	265.680	implicit	265.7
1	410	354.240	implicit	354.2
5	410	1,771.200	implicit	1,771.2

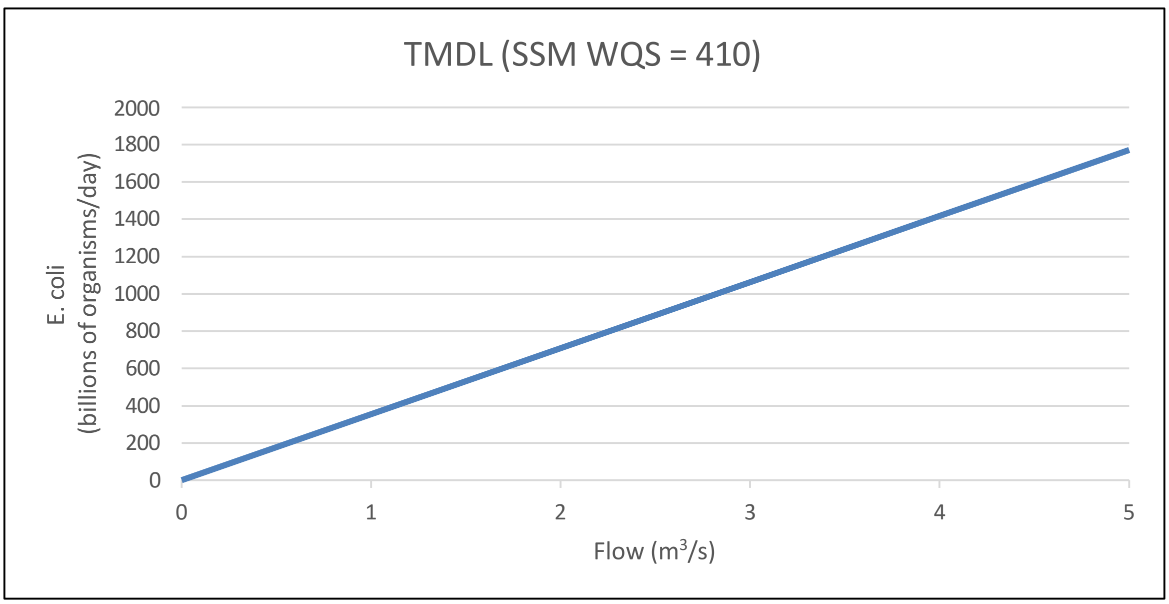


Figure A 3: E. coli Freshwater Rivers & Streams Daily Loads

Table A 4: E. coli Freshwater Rivers & Streams Daily Loads

Flow (m^3 / sec)	Single Sample Maximum WQS (count / 100 mL)	TMDL (10^9 count / day)	MOS (10^9 count / day)	LA and WLA (10^9 count / day)
0.005	576	2.488	implicit	2.5
0.01	576	4.977	implicit	5.0
0.025	576	12.442	implicit	12.4
0.05	576	24.883	implicit	24.9
0.075	576	37.325	implicit	37.3
0.1	576	49.766	implicit	49.8
0.25	576	124.416	implicit	124.4
0.5	576	248.832	implicit	248.8
0.75	576	373.248	implicit	373.2
1	576	497.664	implicit	497.7
5	576	2,488.320	implicit	2,488.3

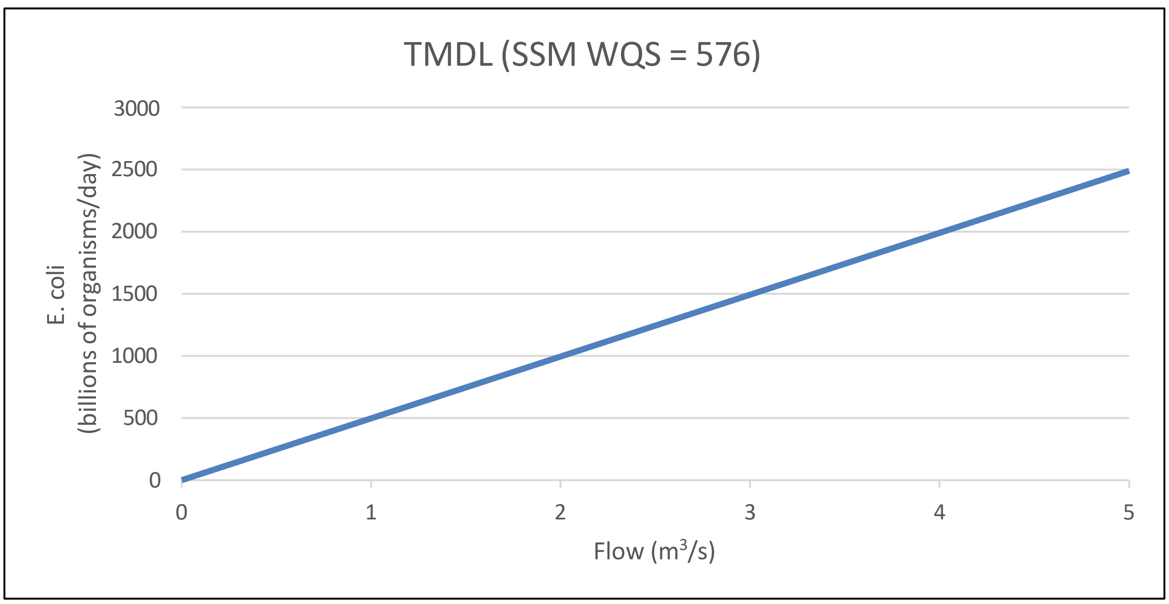


Figure A 4: E. coli Freshwater Rivers & Streams Daily Loads

Table A 5: E. coli Freshwater Rivers & Streams Daily Loads

Flow (m³ / sec)	90% Values < WQS (count / 100 mL)	TMDL (10^9 count / day)	MOS (10^9 count / day)	LA and WLA (10^9 count / day)
0.005	410	1.771	implicit	1.8
0.01	410	3.542	implicit	3.5
0.025	410	8.856	implicit	8.9
0.05	410	17.712	implicit	17.7
0.075	410	26.568	implicit	26.6
0.1	410	35.424	implicit	35.4
0.25	410	88.560	implicit	88.6
0.5	410	177.120	implicit	177.1
0.75	410	265.680	implicit	265.7
1	410	354.240	implicit	354.2
5	410	1,771.200	implicit	1,771.2

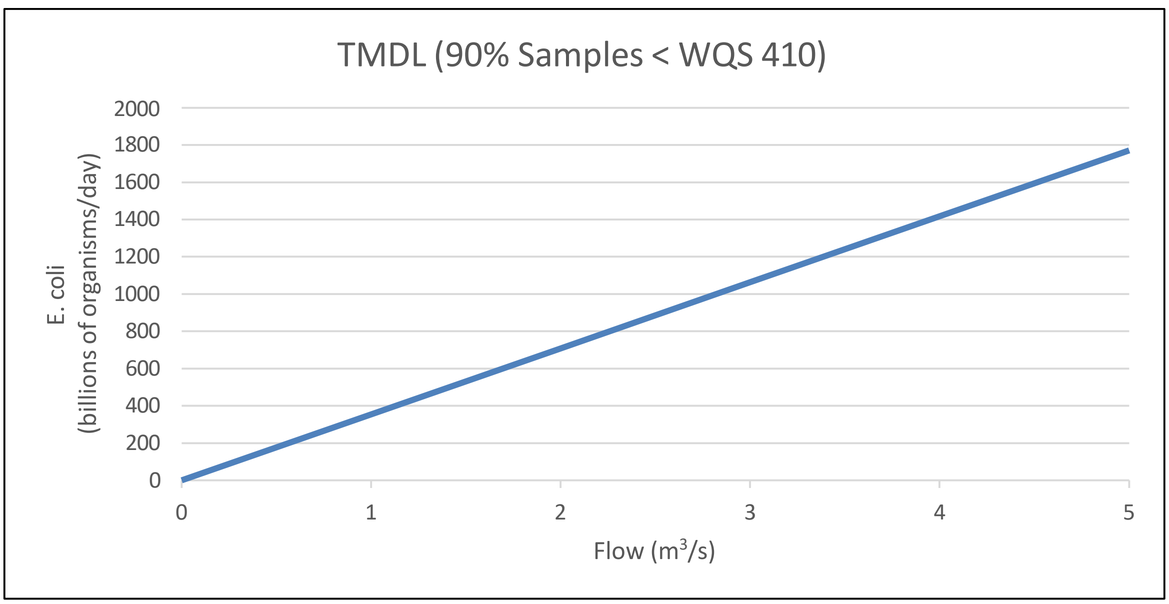


Figure A 5: E. coli Freshwater Rivers & Streams Daily Loads

Freshwater Lake & Pond Recreational Waters

Daily loads (mass per unit time) for recreational uses in freshwater lakes and ponds are shown in Figures A6 – A9 and Tables A6- A9 based on the geometric mean and single sample maximum criteria for recreation. These daily load calculations for freshwater lakes and ponds are based the daily replacement volume, which is the volume of the waterbody that is exchanged each day under low flow conditions and is calculated using the equation below. If the Water Quality Criteria are changed as discussed in Section 2 of this document, the WLAs and LAs will change as discussed in Section 5. In that case, the applicable daily load calculations are those shown in Figures A6 and A10 and Tables A6 and A10.

Formula:

TMDL (10^9 organisms / day) = WQS (count / 100 mL) x Daily Replacement Volume (m^3 / d) x 10 (100 mL / L) x 1000 (L / m^3) x $1/10^9$

Where: WQS = applicable Water Quality Criteria

Daily Replacement volume = (7Q10 flushing rate/# days during disinfection season) x Waterbody Volume (m^3)

7Q10 Flushing Rate = number of times per year the waterbody's volume is exchanged under 7Q10 conditions

Disinfection Season is the period of the year specified in the Water Quality Standards (22a 426 4(a)(9)(E)) during which disinfection of treated sewage discharges is required.

Abbreviations:

TMDL = Total Maximum Daily Load

mL = milliliter; L = Liter, m^3 = cubic meter

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Table A 6: E. coli freshwater lakes and ponds daily loads

Daily Replacement Volume (m^3 / d)	Geometric Mean WQS (count / 100 mL)	TMDL (10^9 count / day)	MOS (10^9 count / day)	LA and WLA (10^9 count / day)
1,000	126	1.3	implicit	1.3
5,000	126	6.3	implicit	6.3
10,000	126	12.6	implicit	12.6
50,000	126	63.0	implicit	63.0
100,000	126	126.0	implicit	126.0
500,000	126	630.0	implicit	630.0
1,000,000	126	1,260.0	implicit	1,260.0

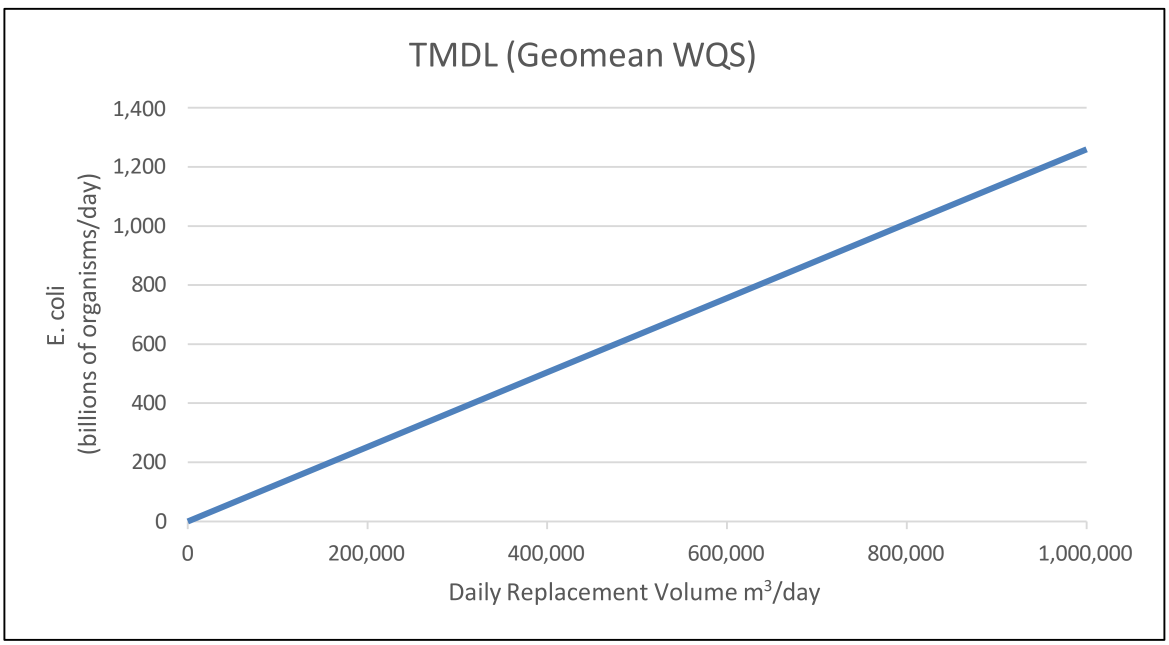

Figure A 6: E. coli freshwater lakes and ponds daily loads

Table A 7: E. coli freshwater lakes and ponds daily loads

Daily Replacement Volume	Single Sample Maximum WQS	TMDL	MOS	LA and WLA
(m^3 / d)	(count / 100 mL)	(10^9 count / day)	(10^9 count / day)	(10^9 count / day)
1,000	235	2.4	implicit	2.4
5,000	235	11.8	implicit	11.8
10,000	235	23.5	implicit	23.5
50,000	235	117.5	implicit	117.5
100,000	235	235.0	implicit	235.0
500,000	235	1,175.0	implicit	1,175.0
1,000,000	235	2,350.0	implicit	2,350.0

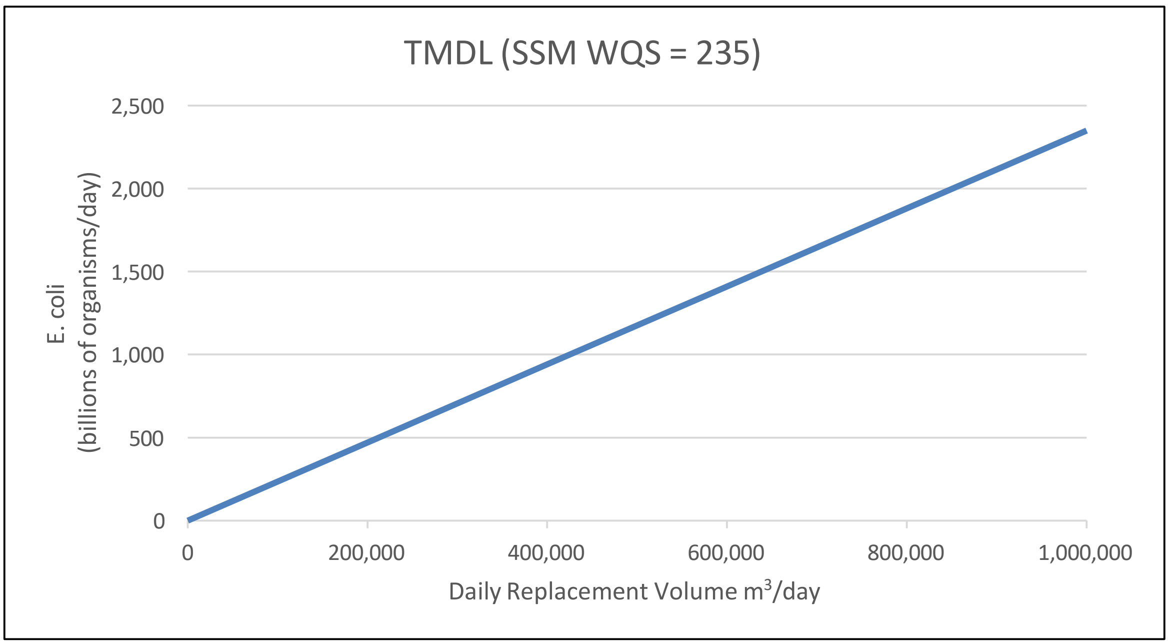

Figure A 7: E. coli freshwater lakes and ponds daily loads

Table A 8: E. coli freshwater lakes and ponds daily loads

Daily Replacement Volume	Single Sample Maximum WQS	TMDL	MOS	LA and WLA
(m^3 / d)	(count / 100 mL)	(10^9 count / day)	(10^9 count / day)	(10^9 count / day)
1,000	410	4.1	implicit	4.1
5,000	410	20.5	implicit	20.5
10,000	410	41.0	implicit	41.0
50,000	410	205.0	implicit	205.0
100,000	410	410.0	implicit	410.0
500,000	410	2,050.0	implicit	2,050.0
1,000,000	410	4,100.0	implicit	4,100.0

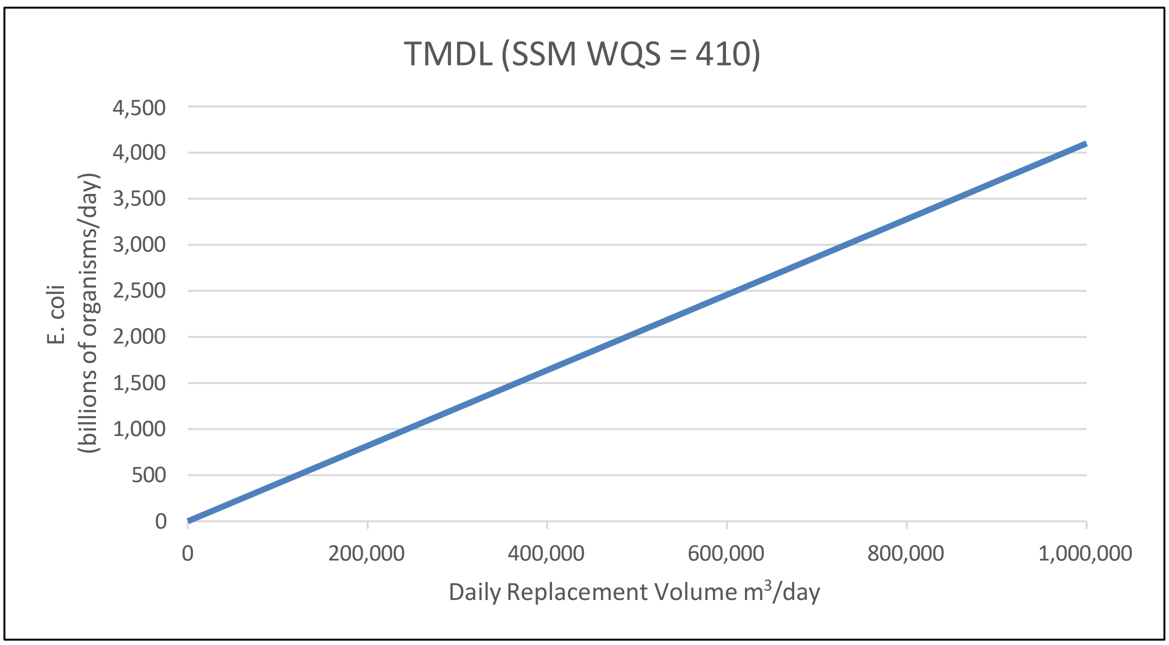

Figure A 8: E. coli freshwater lakes and ponds daily loads

Table A 9: E. coli freshwater lakes and ponds daily loads

Daily Replacement Volume (m^3 / d)	Single Sample Maximum WQS (count / 100 mL)	TMDL (10^9 count / day)	MOS (10^9 count / day)	LA and WLA (10^9 count / day)
1,000	576	5.8	implicit	5.8
5,000	576	28.8	implicit	28.8
10,000	576	57.6	implicit	57.6
50,000	576	288.0	implicit	288.0
100,000	576	576.0	implicit	576.0
500,000	576	2,880.0	implicit	2,880.0
1,000,000	576	5,760.0	implicit	5,760.0

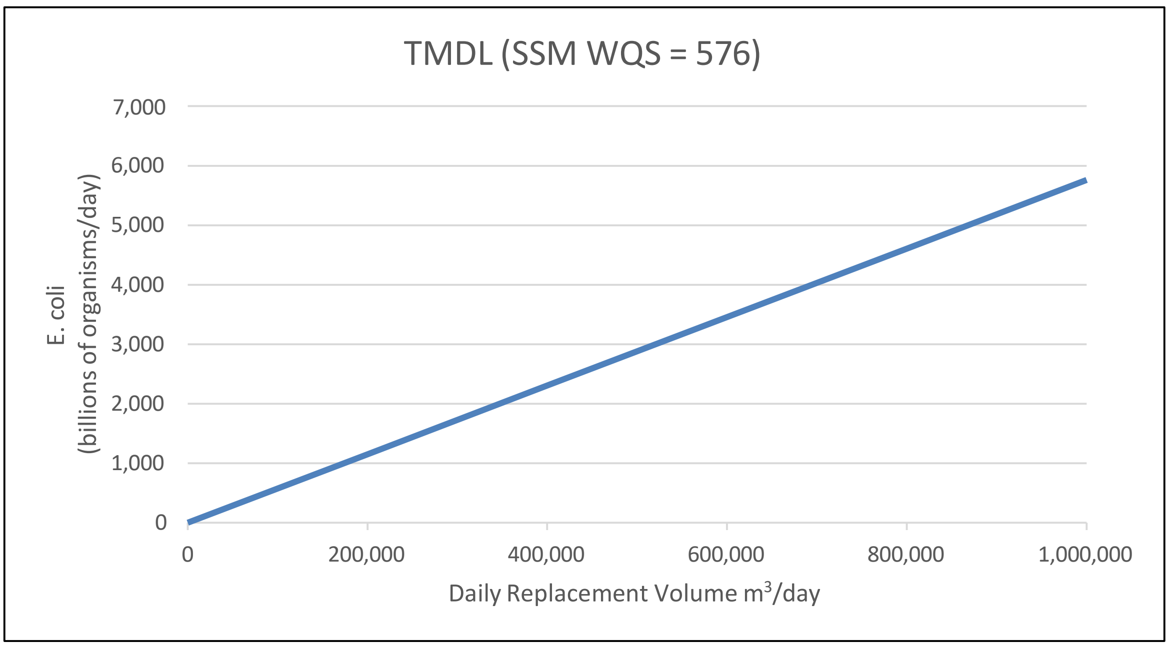

Figure A 9: E. coli freshwater lakes and ponds daily loads

Table A 10: E. coli freshwater lakes and ponds daily loads

Daily Replacement Volume (m^3 / d)	90% Values < WQS (count / 100 mL)	TMDL (10^9 count / day)	MOS (10^9 count / day)	LA and WLA (10^9 count / day)
1,000	410	4.1	implicit	4.1
5,000	410	20.5	implicit	20.5
10,000	410	41.0	implicit	41.0
50,000	410	205.0	implicit	205.0
100,000	410	410.0	implicit	410.0
500,000	410	2,050.0	implicit	2,050.0
1,000,000	410	4,100.0	implicit	4,100.0

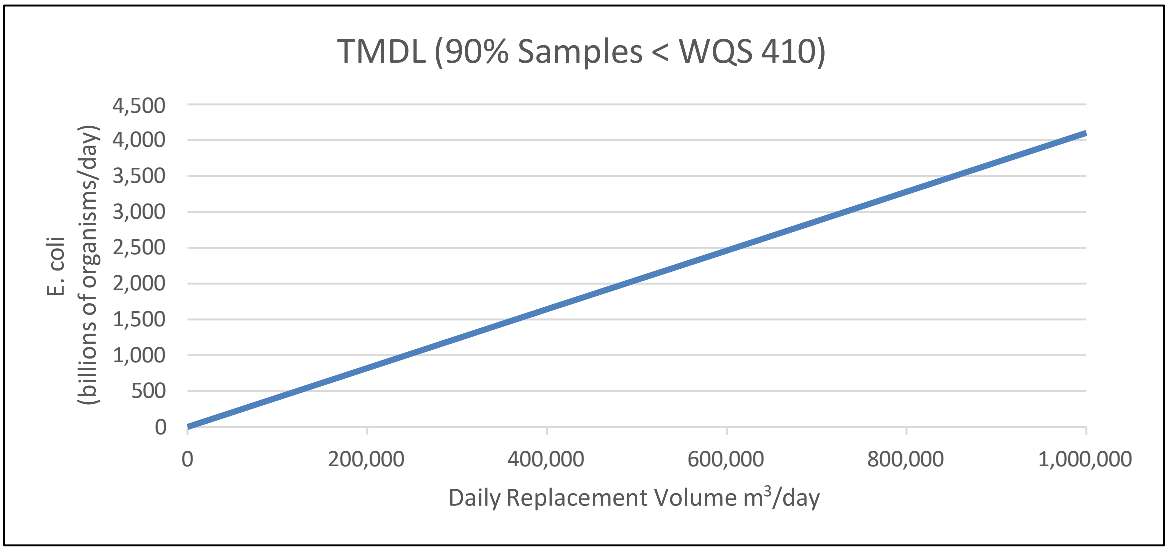

Figure A 10: E. coli freshwater lakes and ponds daily loads

Estuarine and Marine Recreational Waters

Daily loads (mass per unit time) for recreational uses in estuarine and marine waters are shown in Figures A11 – A13 and Tables A11- A13 based on the geometric mean and single sample maximum criteria for recreation. These daily load calculations for estuarine and marine recreational waters are based the daily replacement volume, which is the volume of the waterbody that is exchanged each day under low tide conditions and is calculated using the equation below. If the Water Quality Criteria are changed as discussed in Section 2 of this document, the WLAs and LAs will change as discussed in Section 5. In that case, the applicable daily load calculations are those shown in Figures A11 and A14 and Tables A11 and A14.

Formula:

TMDL (10^9 organisms / day) = WQS (count / 100 mL) x Daily Replacement Volume (m^3 / d) x 10 (100 mL / L) x 1000 (L / m^3) x $1/10^9$

Where: WQS = applicable Water Quality Criteria

Daily Replacement volume = (low tide flushing rate/# days during disinfection season) x Waterbody Volume (m^3)

Low Tide Flushing Rate = number of times per year the waterbody's volume is exchanged under Low Tide conditions

Disinfection Season is the period of the year specified in the Water Quality Standards (22a 426 4(a)(9)(E)) during which disinfection of treated sewage discharges is required.

Abbreviations:

TMDL = Total Maximum Daily Load

mL = milliliter; L = Liter, m^3 = cubic meter

Table A 11: Enterococci estuarine and marine daily loads for recreational waters

Flow (m^3 / sec)	Geometric Mean WQS (count / 100 mL)	TMDL (10^9 count / day)	MOS (10^9 count / day)	LA and WLA (10^9 count / day)
1,000	35	0.4	implicit	0.4
5,000	35	1.8	implicit	1.8
10,000	35	3.5	implicit	3.5
50,000	35	17.5	implicit	17.5
100,000	35	35.0	implicit	35.0
500,000	35	175.0	implicit	175.0
1,000,000	35	350.0	implicit	350.0

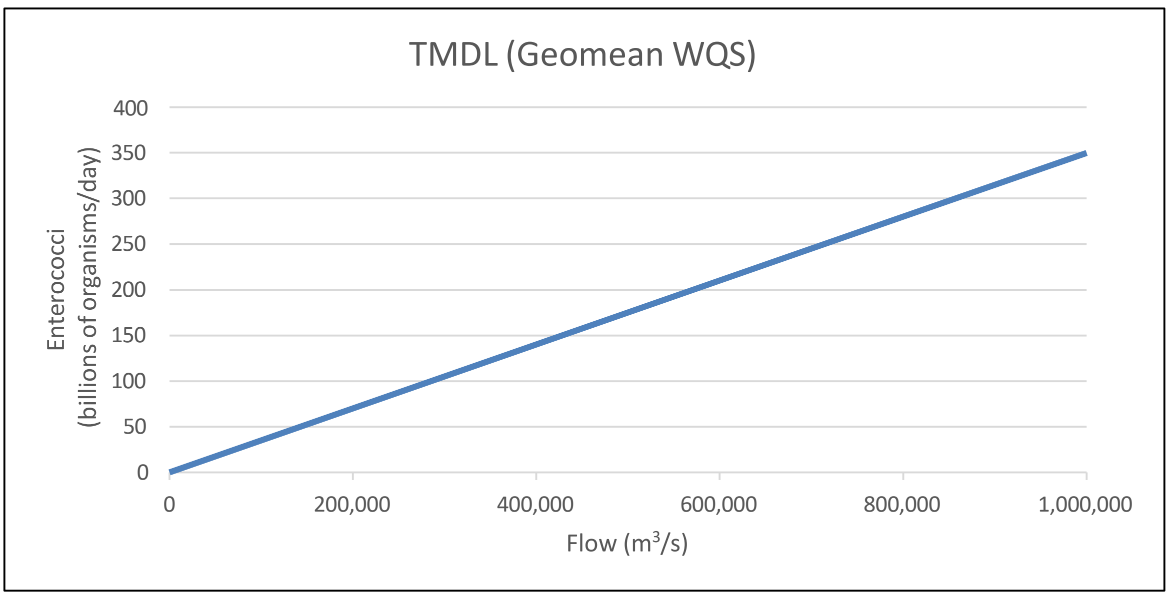

Figure A 11 Enterococci estuarine and marine daily loads for recreational water

Table A 12 Enterococci estuarine and marine daily loads for recreational waters

Flow	SSM WQS	TMDL	MOS	LA and WLA
(m^3 / sec)	(count / 100 mL)	(10^9 count / day)	(10^9 count / day)	(10^9 count / day)
1,000	104	1.0	implicit	1.0
5,000	104	5.2	implicit	5.2
10,000	104	10.4	implicit	10.4
50,000	104	52.0	implicit	52.0
100,000	104	104.0	implicit	104.0
500,000	104	520.0	implicit	520.0
1,000,000	104	1,040.0	implicit	1,040.0

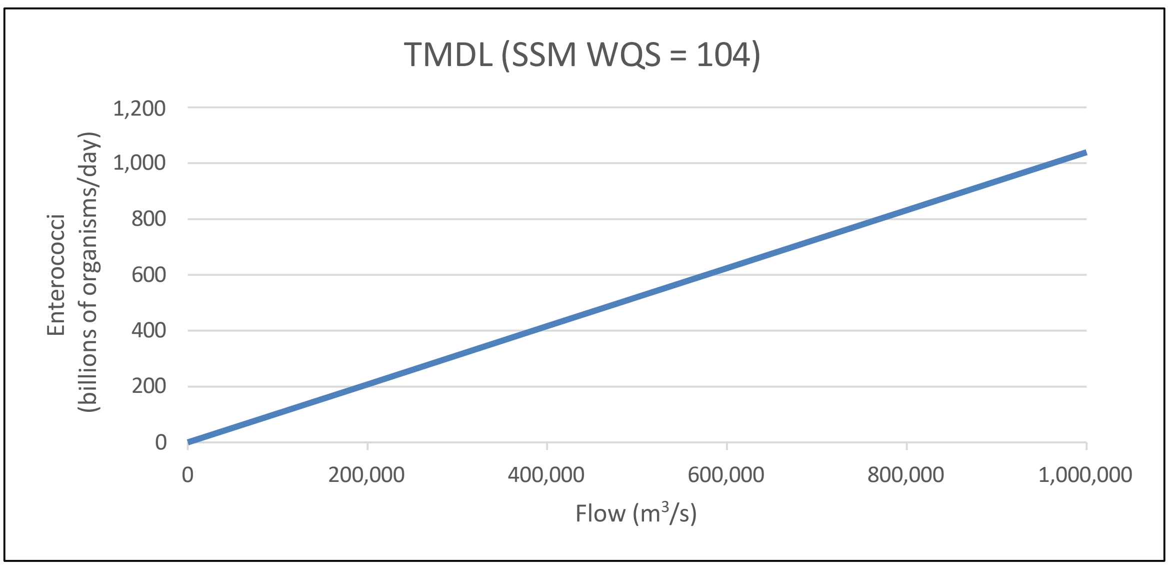

Figure A 12 Enterococci estuarine and marine daily loads for recreational waters

Table A 13 Enterococci estuarine and marine daily loads for recreational waters

Flow	SSM WQS	TMDL	MOS	LA and WLA
(m^3 / sec)	(count / 100 mL)	(10^9 count / day)	(10^9 count / day)	(10^9 count / day)
1,000	500	5.0	implicit	5.0
5,000	500	25.0	implicit	25.0
10,000	500	50.0	implicit	50.0
50,000	500	250.0	implicit	250.0
100,000	500	500.0	implicit	500.0
500,000	500	2,500.0	implicit	2,500.0
1,000,000	500	5,000.0	implicit	5,000.0

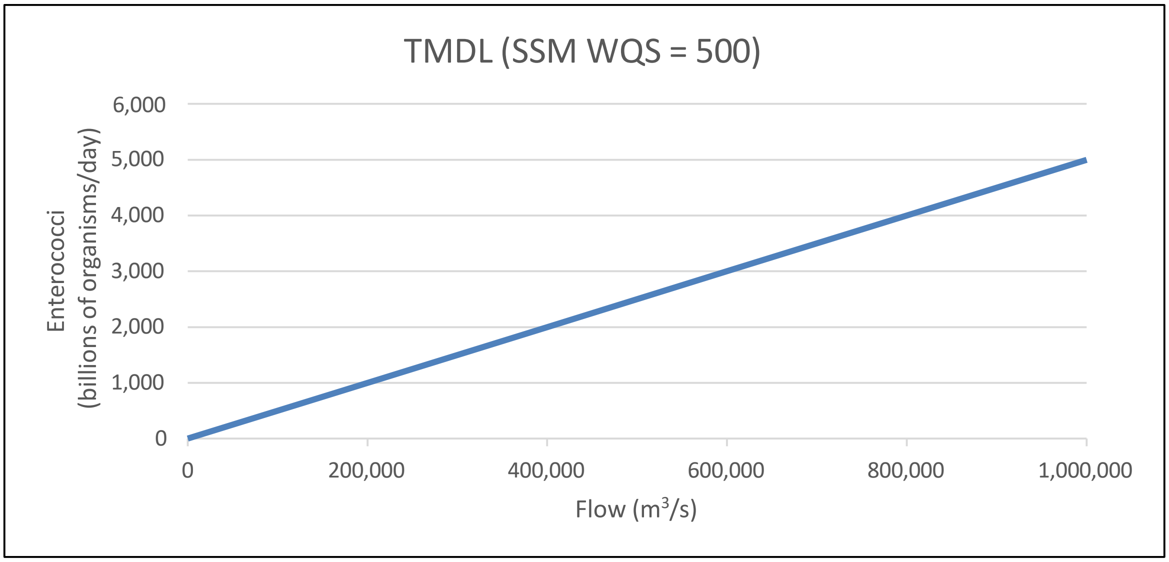

Figure A 13: Enterococci estuarine and marine daily loads for recreational waters

Table A 14: Enterococci estuarine and marine daily loads for recreational waters

Flow	90% < WQS	TMDL	MOS	LA and WLA
(m^3 / sec)	(count / 100 mL)	(10^9 count / day)	(10^9 count / day)	(10^9 count / day)
1,000	130	1.3	implicit	1.3
5,000	130	6.5	implicit	6.5
10,000	130	13.0	implicit	13.0
50,000	130	65.0	implicit	65.0
100,000	130	130.0	implicit	130.0
500,000	130	650.0	implicit	650.0
1,000,000	130	1,300.0	implicit	1,300.0

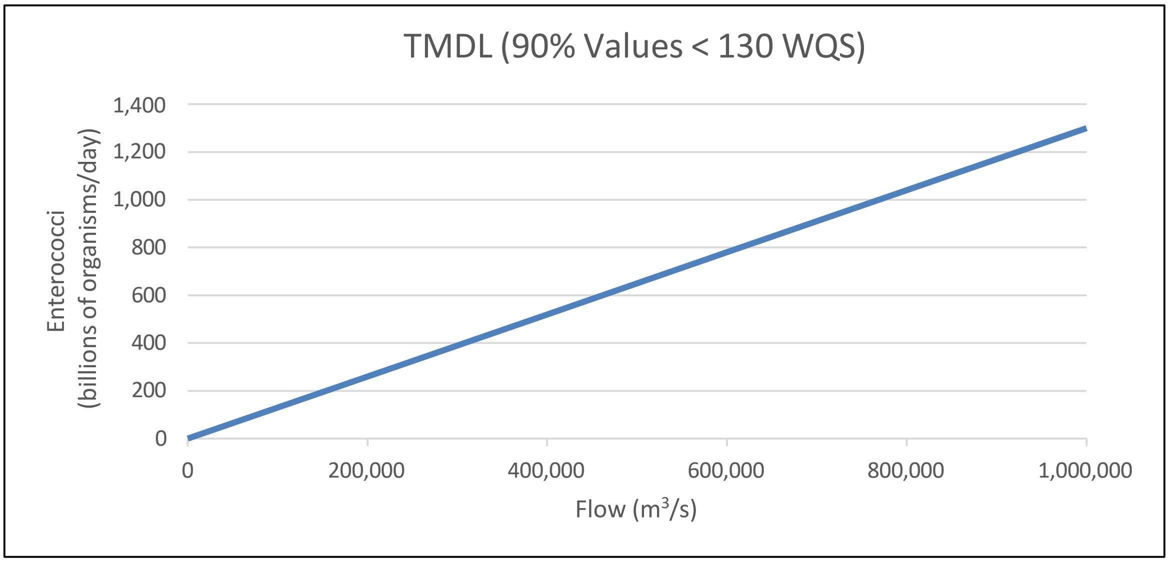

Figure A 14: Enterococci estuarine and marine daily loads for recreational waters

Estuarine and Marine Shellfishing Waters

Daily loads (mass per unit time) for shellfishing uses in estuarine and marine waters are shown in Figures A15 – A18 and Tables A15- A18 based on the geometric mean and 90% values criteria for shellfishing. These daily load calculations for estuarine and marine recreational waters are based the daily replacement volume, which is the volume of the waterbody that is exchanged each day under low tide conditions and is calculated using the equation below.

Formula:

TMDL (10^9 organisms / day) = WQS (count / 100 mL) x Daily Replacement Volume (m^3 / d) x 10 (100 mL / L) x 1000 (L / m^3) x $1/10^9$

Where: WQS = applicable Water Quality Criteria

Daily Replacement volume = (Low Tide flushing rate/# days during disinfection season) x Waterbody Volume (m^3)

Low Tide Flushing Rate = number of times per year the waterbody's volume is exchanged under 7Q10 conditions

Disinfection Season is the period of the year specified in the Water Quality Standards (22a 426 4(a)(9)(E)) during which disinfection of treated sewage discharges is required.

Abbreviations: TMDL = Total Maximum Daily Load

mL = milliliter; L = Liter, m^3 = cubic meter

Table A 15: Fecal coliform estuarine and marine daily loads for shellfishing waters

Daily Replacement Volume (m^3 / d)	Geometric Mean WQS for Class SA Waters (count / 100 mL)	TMDL (10^9 count / day)	MOS (10^9 count / day)	LA and WLA (10^9 count / day)
1,000	14	0.1	implicit	0.1
5,000	14	0.7	implicit	0.7
10,000	14	1.4	implicit	1.4
50,000	14	7.0	implicit	7.0
100,000	14	14.0	implicit	14.0
500,000	14	70.0	implicit	70.0
1,000,000	14	140.0	implicit	140.0

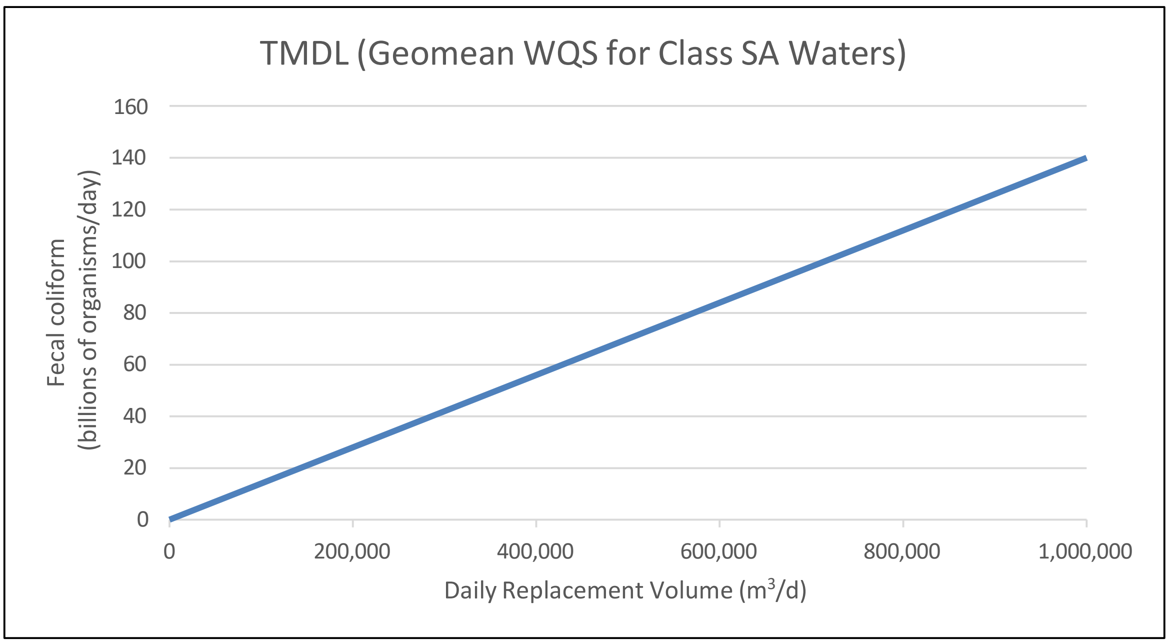

Figure A 15: Fecal coliform estuarine and marine daily loads for shellfishing waters

Table A 16: Fecal coliform estuarine and marine daily loads for shellfishing waters

Daily Replacement Volume (m^3 / d)	90% WQS for Class SA Waters (count / 100 mL)	TMDL (10^9 count / day)	MOS (10^9 count / day)	LA and WLA (10^9 count / day)
1,000	31	0.3	implicit	0.3
5,000	31	1.6	implicit	1.6
10,000	31	3.1	implicit	3.1
50,000	31	15.5	implicit	15.5
100,000	31	31.0	implicit	31.0
500,000	31	155.0	implicit	155.0
1,000,000	31	310.0	implicit	310.0

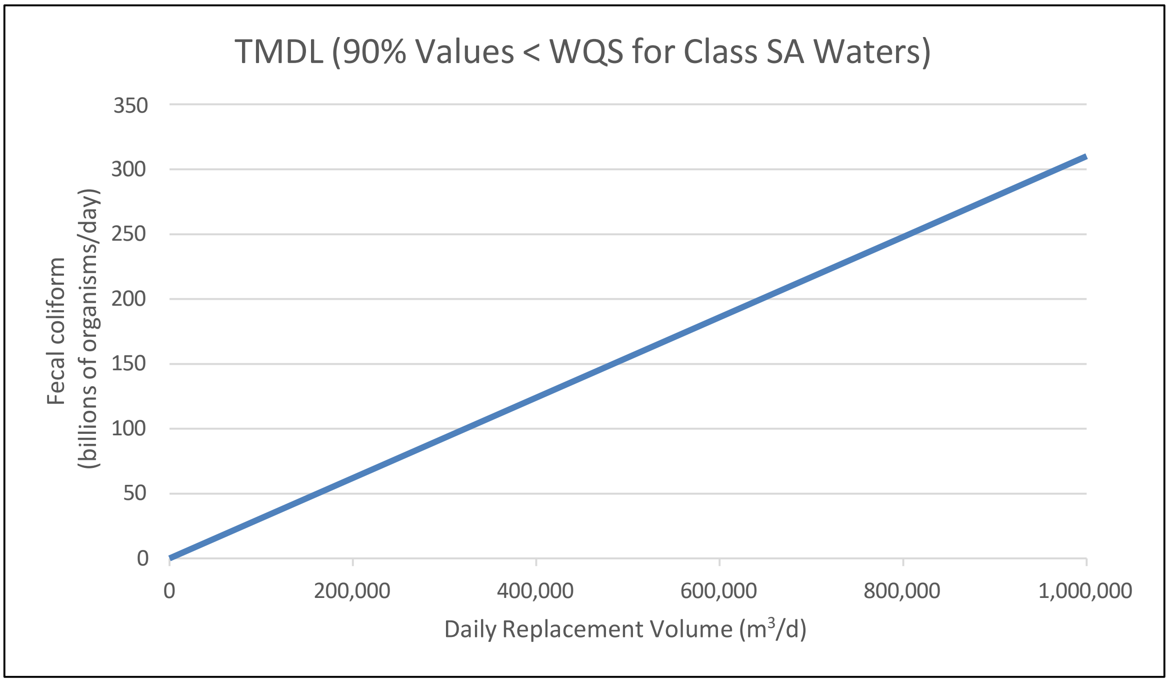

Figure A 16: Fecal coliform estuarine and marine daily loads for shellfishing waters

Table A 17: Fecal coliform estuarine and marine daily loads for shellfishing waters

Daily Replacement Volume (m^3 / d)	Geometric Mean WQS for Class SB Waters (count / 100 mL)	TMDL (10^9 count / day)	MOS (10^9 count / day)	LA and WLA (10^9 count / day)
1,000	88	0.9	implicit	0.9
5,000	88	4.4	implicit	4.4
10,000	88	8.8	implicit	8.8
50,000	88	44.0	implicit	44.0
100,000	88	88.0	implicit	88.0
500,000	88	440.0	implicit	440.0
1,000,000	88	880.0	implicit	880.0

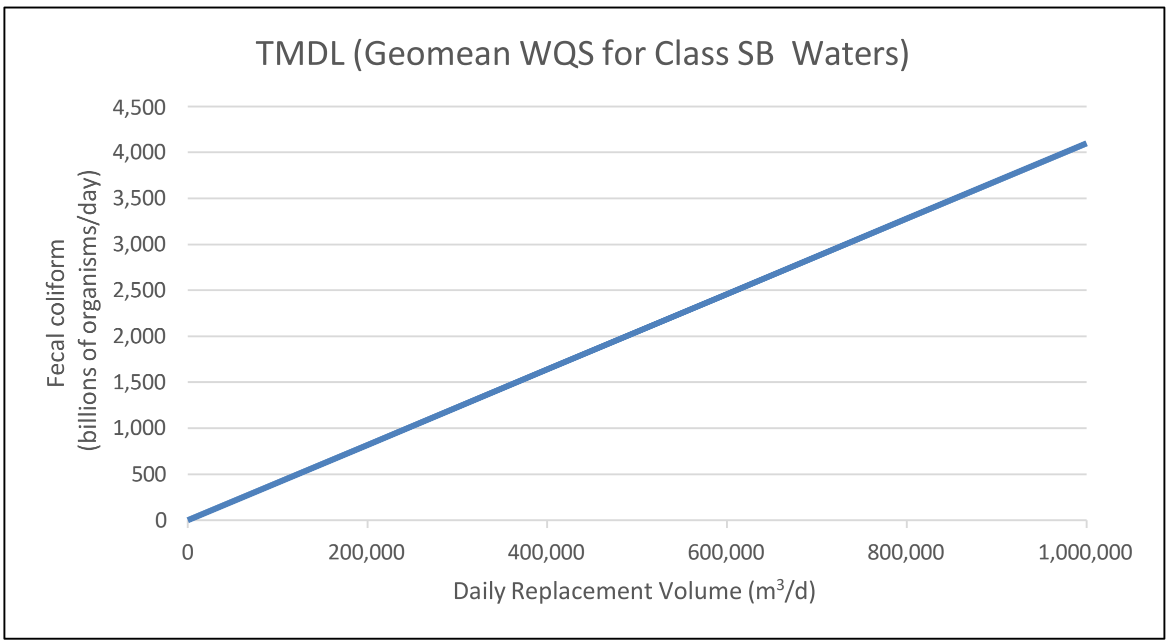

Figure A 17: Fecal coliform estuarine and marine daily loads for shellfishing waters

Table A 18: Fecal coliform estuarine and marine daily loads for shellfishing waters

Daily Replacement Volume (m^3 / d)	90% WQS for Class SB Waters (count / 100 mL)	TMDL (10^9 count / day)	MOS (10^9 count / day)	LA and WLA (10^9 count / day)
1,000	260	2.6	implicit	2.6
5,000	260	13.0	implicit	13.0
10,000	260	26.0	implicit	26.0
50,000	260	130.0	implicit	130.0
100,000	260	260.0	implicit	260.0
500,000	260	1,300.0	implicit	1,300.0
1,000,000	260	2,600.0	implicit	2,600.0

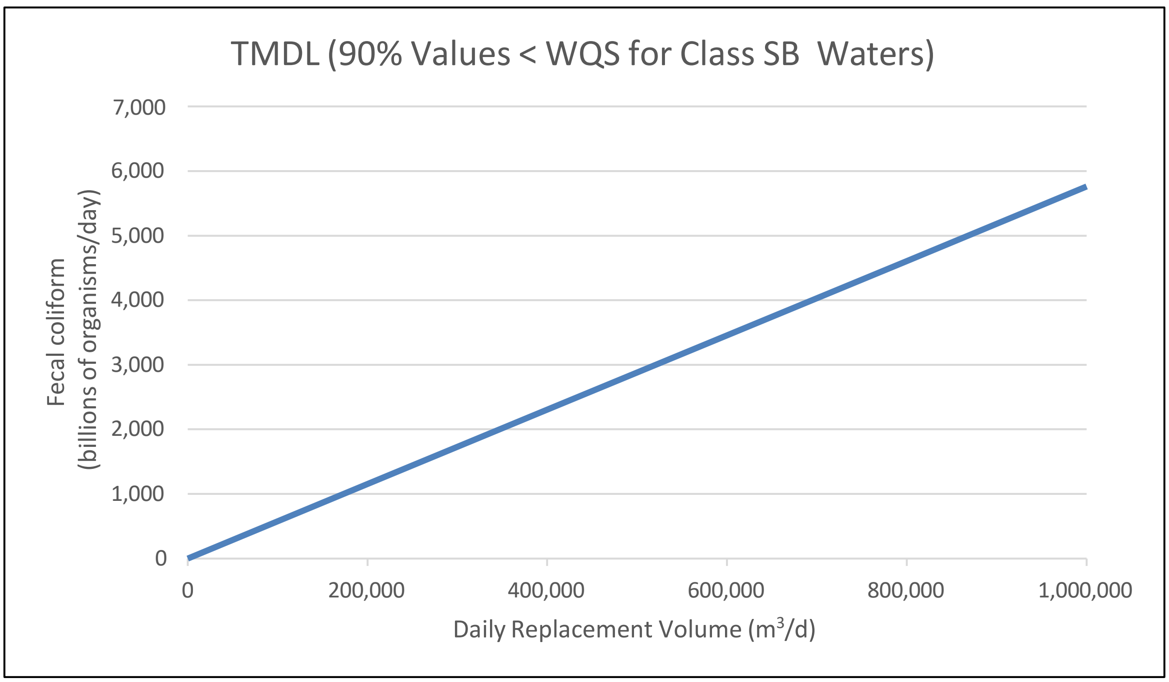

Figure A 18: Fecal coliform estuarine and marine daily loads for shellfishing waters

APPENDIX B: TMDL CALCULATIONS

Wet/Dry Weather Analysis Methodology

Determining if a sample was collected during wet or dry weather conditions is integral to identifying potential sources of bacteria. If bacteria amounts are above WQC only during wet weather sample events, that indicates that stormwater is contributing bacteria to the watershed. If bacteria amounts are over WQC during both wet and dry conditions, then there are other sources, not just stormwater. Using the analytical method below, each sample date was determined to be either wet or dry.

Analytical Procedure – Wet and Dry Weather Events:

We chose multiple geographically diverse weather stations throughout Connecticut, choosing stations that had the most complete data sets available online. If the data is not available at the rainfall station for a particular day, the rainfall data from the Bradley Airport station is used to fill in the gaps. The daily rainfall amounts are added together, and the cumulative amount is compared against these wet/dry guidelines listed below. A determination is made for each date to see if the day is considered a "wet" or "dry" day. A wet day is one where cumulatively, there is greater than:

- 0.1 inches precipitation in 24 hours or
- 0.25 inches precipitation in 48 hours, or
- 2.0 inches precipitation in 96 hours.

If any one of these conditions above are met, we considered that day to be a "wet" day. This wet/dry determination was done for all dates at each location for all samples data included the TMDLs.

For all watersheds, an analysis of ambient concentrations of bacteria was done for each sampling location for each year that sampling was conducted to identify the highest single sample results under collected under wet or dry conditions. Additionally, the geometric mean of values for that sampling location was calculated for all wet samples, all dry samples and all samples (wet or dry) combined.

Estimated Bacteria Reduction Calculation Methodologies

Estimated reduction goals to meet the TMDL targets for indicator bacteria were calculated using ambient monitoring data when data were available. These methods are consistent with CT DEEP water quality standards and EPA guidelines for statistical analysis of bacteria data. As described in Section 2.2, and Appendix B, Connecticut uses the geometric mean, single sample maximum concentrations and the 90th percentile values to assess against applicable water quality criteria.

Geometric means of bacteria data sets were calculated for all sampling stations in all impaired segments. Geometric means are often used to evaluate data spanning several orders of magnitude to remove the influence of any one particularly high or low data point. By definition, the geometric mean is the average of the logarithmic values, converted back to a base 10 number. In our TMDLs, the geometric mean values were calculated using the GEOMEAN function in Microsoft Excel.

The 90 percent values were calculated for each sampling station by sampling year. A 90% of samples less than concentration indicates that 90 percent of sample results in the dataset are less than the appropriate criteria from the WQS. The 90% less than values were calculated by determining how many sample values

(n) were in a given dataset and dividing that value into 100%. This gave the (P)% of each data value. Then tthis (P)% was multiplied by the total number of values that exceeded criteria (E) which results in % of samples exceeding (S). S was then reduced by 10 and the difference was included as the reduction goal (RG) needed for the dataset.

100/n = P%
(P%) *E = S
S – 10 = (RG)

For segments impaired for fecal coliform, the 90^{th} percentile was calculated annually at each sample location using the PERCENTRANK.INC function in Microsoft Excel.

In each impaired segment, the sampling station with the highest annual geometric mean and/or 90th percentile value and/or single sample maximum was then used to calculate a percent reduction for bacteria for each segment. These reductions provide a rough estimation of the pollution abatement action needed for each segment to meet water quality standards. The percent reduction is calculated based on the difference between measured ambient bacteria data and the applicable water quality criteria for bacteria, which are also the TMDL target concentrations.

APPENDIX C: REVISIONS TO TMDL WLAS/LAS BASED ON WQS UPDATES

At the time this TMDL is being established, CT DEEP is in the process of developing updates to the Connecticut WQS. One update that is currently under consideration is an update to the WQC for Bacterial Indicators, for consistency with criteria recommendations provided by the US EPA under Section 304(a) of the Clean Water Act. The potential revisions to the Connecticut recreational WQC for bacteria will, if proposed, be subject to a public review and regulatory amendment process consistent with Connecticut state laws. An adopted revision to the WQC in the future would necessitate a revision to the WLAs and LAs in this TMDL. For administrative efficiency, CT DEEP is providing information on the potential revisions to the CT WQC for bacteria and the associated changes to the WLAs and LAs for this TMDL. If the US EPA criteria are adopted into the Connecticut WQS and subsequently approved by US EPA, the WLAs and LAs in this Appendix will go into effect, replacing those identified in Tables 6 and 7 of this TMDL with those in Tables 8 and 9.

Note: Changes to the CT WQC and to the WLAs and LAs in TMDLs do not affect the *Guidelines for Monitoring Swimming Water and Closure Protocol*, as updated, available on the State Bathing Beach Monitoring Program website.

Potential Changes to Water Quality Criteria

The most current US EPA criteria recommendation for recreational water quality criteria was issued in 2012 and is available on the US EPA's Recreational Water Quality Criteria website. These recommended criteria are very similar to the currently adopted Connecticut water quality criteria. Bacteria criteria are defined by two values which characterize an acceptable distribution of measured bacteria concentrations in surface waters. A central tendency value is provided as a criterion based on the geometric mean of the observed concentrations. Another value is provided to define the upper range of an acceptable distribution in ambient waters. The currently adopted Connecticut geometric mean bacteria criteria for recreational exposures is the same as the 2012 recommended US EPA criteria based on an illness rate of 36 illnesses per 1,000 people with primary contact recreational exposures. There is a difference in how the criteria are applied. For the current criteria, the geometric mean concentration of bacteria in surface waters should be less than the geometric mean criteria. Using the 2012 recommended criteria from US EPA, the geometric mean concentration of bacteria in surface waters should be less than or equal to the geometric mean criteria.

The Connecticut and US EPA criteria also differ, for the criteria based on the upper range of allowable bacteria concentrations. Connecticut currently has criteria based on a single sample maximum value that represents a "not to be exceeded" concentration, with different values provided based on the level of recreational uses for surface waters. In the 2012 criteria recommendation, Currently, the concentration of bacteria in surface waters should be less than or equal to the single sample maximum criteria. US EPA recommends the use of a 90^{th} percentile value of the water quality distribution data, which is intended to be a value that should not be exceeded by more than 10 percent of the samples taken. This value is called the Statistical Threshold Value and is recommended to be adopted for any waters for which primary contact recreation is identified as a Designated Use for the water. Using this criterion, the concentration of bacteria in 90% of the samples collected from surface waters should be less than or equal to the Statistical Threshold Value-based criteria. Since recreational uses apply to all waters in Connecticut, so the Statistic Threshold Value would be applied statewide under US EPA guidance.

Tables C1 andC2 below show a comparison of the current Connecticut Recreational WQC for fresh and marine waters to the proposed future WQC. Proposed WQC are indicated with yellow shading in the tables, and a line is placed through the text of the criteria that would be replaced/superseded. Note that there are no potential updates to the Connecticut bacteria WQC for shellfishing in marine waters at this time.

Table C1. Water Quality Criteria for Bacterial Indicators of Sanitary Quality (Freshwater): Comparison of Current and Potential Future Criteria

Table C1. Water Quality Criteria for Bacterial Indicators of Sanitary Quality (Freshwater) – Comparison of Current and Potential Future CT WQC per EPA Recommendation				
Designated Use: Freshwater Recreation[1]	**Water Quality Class**	**Indicator Bacteria**	**Numeric Criteria (# colonies/100 ml)**	
~~CT Designated Swimming[2]~~	AA, A, B	*Escherichia coli*	Geometric mean less than 126/100 ml	~~Single sample maximum less than or equal to 235/100 ml~~
~~CT Non-Designated Swimming[3]~~				~~Single sample maximum less than or equal to 410/100 ml~~
~~CT All Other Recreational Uses~~				~~Single sample maximum less than or equal to 576/100 ml~~
All Waters[1,2,3]	AA, A, B	*Escherichia coli*	Geometric mean less than or equal to 126/100 ml	90% samples less than or equal to 410/100 ml
[1] Criteria for the protection of recreational uses in Class B waters do not apply when disinfection of WPCF effluents is not required, consistent with the WQS, as outlined in RCSA 22a-426-4(a)(9)(E).				
[2] ~~**Designated Swimming.**~~ Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in the *Guidelines for Monitoring Swimming Water and Closure Protocol* adopted jointly by CT DEEP and CT DPH, as updated. Available on the CT DEEP State Bathing Beach Monitoring Program webpage.				
[3] ~~Includes areas otherwise suitable for swimming but which have not been designated by State or Local authorities as bathing areas, waters which support tubing, water skiing, or other recreational activities where full body contact is likely. When a municipal or state designated swimming area is not identified along the waterbody route, Non-Designated Swimming is the default criteria applied to a fresh waterbody.~~				
[3] US EPA criteria source: *2012 Recreational Water Quality Criteria Document* (EPA 820-F-12-058).				

Table C2. Water Quality Criteria for Bacterial Indicators of Sanitary Quality (Saltwater): Comparison of Current and Potential Future Criteria

Table C2. Water Quality Criteria for Bacterial Indicators of Sanitary Quality (Saltwater) Comparison of Current and Potential Future CT WQC per EPA Recommendation				
Designated Use: Saltwater Recreation	**Water Quality Class**	**Indicator Bacteria**	**Numeric Criteria (# colonies/100 ml)**	
~~CT Designated Swimming[1]~~	SA, SB	Enterococci	Geometric mean less than 35/100 ml	~~Single sample maximum less than or equal to 104/100 ml~~
~~CT All Other Recreational Uses~~				~~Single sample maximum less than or equal to 500/100 ml~~
All Waters[1,2]	SA, SB	Enterococci	Geometric mean less than or equal to 35/100 ml	90% samples less than or equal to 130/100 ml
Designated Use: Saltwater Shellfishing[3]	**Water Quality Class**	**Indicator Bacteria**	**Numeric Criteria (# colonies/100 mL)**	
CT Direct Consumption	SA	Fecal coliform	Geometric mean less than 14/100 ml	90% samples less than 31/100 ml
CT Indirect Consumption	SB		Geometric mean less than 88/100 ml	90% samples less than 260/100 ml
[1] Procedures for monitoring and closure of bathing areas by State and Local health authorities are specified in the Guidelines for Monitoring Bathing Waters and Closure Protocol, adopted jointly by the Department of Environmental Protection and Department of Public Health, May 1989, revised April 2003, updated December 2016. If a municipal or state designated swimming area is not identified along the segment route, CT applies the All Other Recreational Uses criteria.				
[2] US EPA criteria source: *2012 Recreational Water Quality Criteria Document* (EPA 820-F-12-058).				
[3] Criteria are based on utilizing the mTec method as specified in the U.S. Food and Drug Administration's National Shellfish Sanitation Program-Model Ordinance (NSSP-MO) document entitled *Guide for the Control of Molluscan Shellfish* (2007, revised 2019).				

Potential Changes to Waste Load and Load Allocations

If the potential changes to the Connecticut recreational WQC are formally adopted into the Connecticut WQS regulations and approved by US EPA, revisions to the WLAs and LAs identified within Tables 8 and9 of Section 5 of this TMDL will automatically be updated. This revision will be identified for informational purposes within the Integrated Water Quality Report issued after the change takes place.

A comparison of the current and proposed bacteria WLAs and LAs are provided in Tables C3 and C4 below, with Table C3 indicating freshwater and C4 indicating saltwater values. Current values that are proposed to be updated are identified using a line through the current values, and new proposed values are provided in parentheses. Note that there are no potential updates to the Connecticut bacteria WLAs or LAs (Table C5) for shellfishing in marine waters at this time.

Table C3. Bacteria (*E. coli*) TMDL Waste Load and Load Allocations for Freshwater Recreation: Comparison Based on Current and Potential Future Criteria

Table C3. Bacteria WLAs and LAs for Recreational Uses in Freshwater: Comparison Based on Current and Potential Future Criteria

		~~Single Sample Maximum Concentration~~ (90% Samples) less than or equal to: *E. coli* (#/100mL)						Geometric Mean less than (or equal to): *E. coli* (#/100mL)	
Class	**Bacteria Source**	**WLA[1]**			**LA[1]**			**WL**	**LA[1]**
	~~Recreational Use~~	~~DS~~[2]	~~NDS~~[3]	~~O~~[4]	~~DS~~[2]	~~NDS~~[3]	~~O~~[4]	~~All~~	~~All~~
AA	Illicit sewer connection								
	Leaking sewer lines								
	Overboard Discharges[5]								
	Regulated Stormwater[6]	~~235~~ (410)	410	~~576~~ (410)				126	
	Non-regulated Stormwater[6]				~~235~~ (410)	410	~~576~~ (410)		126
	Subsurface Sewage Disposal System[7]	~~235~~ (410)	410	~~576~~ (410)	~~235~~ (410)	410	~~576~~ (410)	126	126
	Wildlife[6]				~~235~~ (410)	410	~~576~~ (410)		126
	Waste directly from people swimming or domestic animals[8]				~~235~~ (410)	410	~~576~~ (410)		126
A	Non-Stormwater NPDES								
	Combined Sewer Overflow								
	Sanitary Sewer Overflow								
	Illicit sewer connection								
	Leaking sewer lines								
	Overboard Discharges[5]								
	Regulated Stormwater[6]	~~235~~ (410)	410	~~576~~ (410)				126	
	Non-regulated Stormwater[6]				~~235~~ (410)	410	~~576~~ (410)		126
	Subsurface Sewage Disposal System[7]	~~235~~ (410)	410	~~576~~ (410)	~~235~~ (410)	410	~~576~~ (410)	126	126
	Wildlife[6]				~~235~~ (410)	410	~~576~~ (410)		126

Table C3. Bacteria WLAs and LAs for Recreational Uses in Freshwater: Comparison Based on Current and Potential Future Criteria									
		~~Single Sample Maximum Concentration~~ (90% Samples) less than or equal to: *E. coli* (#/100mL)						Geometric Mean less than (or equal to): *E. coli* (#/100mL)	
	Waste directly from people swimming or domestic animals[8]				~~235~~ (410)	410	~~576~~ (410)		126
B[10]	Non-Stormwater NPDES[9]	~~235~~ (410)	410	~~576~~ (410)				126	
	Combined Sewer Overflow	~~235~~ (410)	410	~~576~~ (410)				126	
	Sanitary Sewer Overflow								
	Illicit sewer connection								
	Leaking sewer lines								
	Overboard Discharges[5]								
	Regulated Stormwater[6]	~~235~~ (410)	410	~~576~~ (410)				126	
	Non-regulated Stormwater[6]				~~235~~ (410)	410	~~576~~ (410)		126
	Subsurface Sewage Disposal System[7]	~~235~~ (410)	410	~~576~~ (410)	~~235~~ (410)	410	~~576~~ (410)	126	126
	Wildlife[6]				~~235~~ (410)	410	~~576~~ (410)		126
	Waste directly from people swimming or domestic animals[8]				~~235~~ (410)	410	~~576~~ (410)		126

WLA = Waste Load Allocation, LA = Load Allocation

If WLA or LA cells are blank, then the source is not authorized to contribute bacteria to surface waters.

(1) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations.

(2) **Designated Swimming.** Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in the *Guidelines for Monitoring Swimming Water and Closure Protocol* adopted jointly by CT DEEP and CT DPH, as updated. Available on the CT DEEP State Bathing Beach Monitoring Program webpage.

(3) **Non-Designated Swimming.** Includes areas otherwise suitable for swimming but which have not been designated by State or Local authorities as bathing areas, waters which support tubing, water skiing, or other recreational activities where full body contact is likely.

(4) **All Other Recreational Uses.**

(5) All coastal and inland waters in Connecticut are designated as No Discharge Areas for Overboard Discharges (OBDs).

(6) Replace numeric value with "natural levels" if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP WQS RCSA 22a-426-1(47)).

(7) WLA and LA criteria both apply to SSDS, as some discharges from SSDS are point source/permitted and others are nonpoint source/not permitted based on characteristics of the system and the discharge.

Table C3. Bacteria WLAs and LAs for Recreational Uses in Freshwater: Comparison Based on Current and Potential Future Criteria		
	~~Single Sample Maximum Concentration~~ (90% Samples) less than or equal to: *E. coli* (#/100mL)	Geometric Mean less than (or equal to): *E. coli* (#/100mL)
(8) Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in the *Guidelines for Monitoring Swimming Water and Closure Protocol* adopted jointly by CT DEEP and CT DPH, as updated. Available on the CT DEEP State Bathing Beach Monitoring Program webpage.		
(9) For discharges from water pollution control facilities (WPCFs) the WLA is applied as an end-of-pipe bacteria concentration, which at a minimum should be applicable during the disinfection period specified in the WQS (RCSA 22a-426-3(a)(9)(E)) unless a longer period for disinfection is specified in the facility permit		
(10) Criteria for the protection of recreational uses in Class B waters do not apply when disinfection of WPCF effluents is not required, consistent with the WQS, as outlined in RCSA 22a-426-4(a)(9)(E).		

Table C4. Bacteria Waste Load and Load Allocations for Recreational Uses in Saltwater: Comparison Based on Current and Potential Future Criteria

Table C4. Bacteria WLAs and LAs for Recreational Uses in Saltwater: Comparison Based on Current and Potential Future Criteria							
		~~Single Sample Maximum Concentration~~ (90% Samples) less than or equal to: Enterococci (#/100mL)				Geometric Mean less than (or equal to): Enterococci (#/100mL)	
Class	**Bacteria Source**	**WLA[1]**		**LA[1]**		**WLA[1]**	**LA[1]**
	~~**Recreational Use**~~	~~**DS[2]**~~	~~**O[3]**~~	~~**DS[2]**~~	~~**O[3]**~~	~~**All**~~	~~**All**~~
SA	Illicit sewer connection						
SA	Leaking sewer lines						
SA	Overboard Discharges[4]						
SA	Regulated Stormwater[5]	~~104~~ (130)	~~500~~ (130)			35	
SA	Non-regulated Stormwater[5]			~~104~~ (130)	~~500~~ (130)		35
SA	Subsurface Sewage Disposal System[6]	~~104~~ (130)	~~500~~ (130)	~~104~~ (130)	~~500~~ (130)	35	35
SA	Wildlife[5]			~~104~~ (130)	~~500~~ (130)		35
SA	Waste directly from people swimming or domestic animals			~~104~~ (130)	~~500~~ (130)		35
SB	Non-Stormwater NPDES[7]	~~104~~ (130)	~~500~~ (130)			35	
SB	Combined Sewer Overflow	~~104~~ (130)	~~500~~ (130)			35	
SB	Sanitary Sewer Overflow						
SB	Overboard Discharges[4]						
SB	Illicit sewer connection						
SB	Leaking sewer lines						
SB	Regulated Stormwater[5]	~~104~~ (130)	~~500~~ (130)			35	
SB	Non-regulated Stormwater[5]			~~104~~ (130)	~~500~~ (130)		35
SB	Subsurface Sewage Disposal System[6]	~~104~~ (130)	~~104~~ (130)	~~104~~ (130)	~~500~~ (130)	35	35
SB	Wildlife[5]			~~104~~ (130)	~~500~~ (130)		35

Table C4. Bacteria WLAs and LAs for Recreational Uses in Saltwater: Comparison Based on Current and Potential Future Criteria							
		~~Single Sample Maximum Concentration~~ (90% Samples) less than or equal to: Enterococci (#/100mL)				Geometric Mean less than (or equal to): Enterococci (#/100mL)	
Class	**Bacteria Source**	**WLA[1]**		**LA[1]**		**WLA[1]**	**LA[1]**
	Waste directly from people swimming or domestic animals			~~104~~ (130)	~~500~~ (130)		35

WLA = Waste Load Allocation, LA = Load Allocation.

If WLA or LA cells are blank, then the source is not authorized to contribute bacteria to surface waters.

(1) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations.

(2) **Designated Swimming.** Procedures for monitoring and closure of bathing areas by State and Local Health Authorities are specified in the *Guidelines for Monitoring Swimming Water and Closure Protocol* adopted jointly by CT DEEP and CT DPH, as updated. Available on the CT DEEP State Bathing Beach Monitoring Program webpage.

(3) **All Other Recreational Uses.**

(4) All coastal and inland waters in Connecticut are designated as No Discharge Areas for Overboard Discharges (OBDs).

(5) Replace numeric value with "natural levels" if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP WQS RCSA 22a-426-1(47)).

(6) WLA and LA criteria both apply to SSDS, as some discharges from SSDS are regulated/permitted and others are nonregulated/not permitted based on the characteristics of the system and the discharge.

(7) For discharges from water pollution control facilities (WPCFs) the WLA is applied as an end-of-pipe bacteria concentration, which at a minimum should be applicable during the disinfection period specified in the WQS (RCSA 22a-426-3(a)(9)(E)), which is year-round for salt waters unless otherwise specified in the facility permit.

Table C5. Bacteria TMDL Waste Load and Load Allocations for Saltwater Shellfish Harvesting (No WLA or LA Changes Proposed)

Table C5. Bacteria WLAs and LAs for Saltwater Shellfish Harvesting (No WLA or LA Changes Proposed)					
		Geometric Mean less than: Fecal Coliform (#/100mL)		90% Samples less than: Fecal Coliform (#/100mL)	
Class	**Bacteria Source**	**WLA[1]**	**LA[1]**	**WLA[1]**	**LA[1]**
SA Direct Consumption	Combined Sewer Overflow	14		31	
	Sanitary Sewer Overflow				
	Overboard Discharges[2]				
	Illicit sewer connection				
	Leaking sewer lines				
	Regulated Stormwater[3]	14		31	
	Non-regulated Stormwater[3]		14		31

Table C5. Bacteria WLAs and LAs for Saltwater Shellfish Harvesting (No WLA or LA Changes Proposed)					
		Geometric Mean less than: Fecal Coliform (#/100mL)		90% Samples less than: Fecal Coliform (#/100mL)	
Class	**Bacteria Source**	**WLA[1]**	**LA[1]**	**WLA[1]**	**LA[1]**
	Subsurface Sewage Disposal System[4]	14	14	31	31
	Wildlife[3]		14		31
	Waste directly from people swimming or domestic animals		14		31
SB Indirect Consumption	Non-Stormwater NPDES[5]	88		260	
	Combined Sewer Overflow	88		260	
	Sanitary Sewer Overflow				
	Overboard Discharges[2]				
	Illicit sewer connection				
	Leaking sewer lines				
	Regulated Stormwater[3]	88		260	
	Non-regulated Stormwater[3]		88		260
	Subsurface Sewage Disposal System[4]	88	88	260	260
	Wildlife[3]		88		260
	Waste directly from people swimming or domestic animals		88		260

WLA = Waste Load Allocation, LA = Load Allocation.

If WLA or LA cells are blank, then the source is not authorized to contribute bacteria to surface waters.

(1) Unless otherwise required by statute or regulation, compliance with this TMDL will be based on ambient concentrations and not end-of-pipe bacteria concentrations.

(2) All coastal and inland waters in Connecticut are designated as No Discharge Areas for Overboard Discharges (OBDs).

(3) Replace numeric value with "natural levels" if only source is naturally occurring wildlife. Natural is defined as the biological, chemical and physical conditions and communities that occur within the environment which are unaffected or minimally affected by human influences (CT DEEP WQS RCSA 22a-426-1(47)).

(4) WLA and LA criteria both apply to SSDS, as some discharges from SSDS are point source/permitted and others are nonpoint source/not permitted based on characteristics of the system and the discharge.

(5) For discharges from water pollution control facilities (WPCFs) the WLA is applied as an end-of-pipe bacteria concentration, which at a minimum should be applicable during the disinfection period specified in the WQS (RCSA 22a-426-3(a)(9)(E)), which is year-round for salt waters unless otherwise specified in the facility permit.