Maine Statewide Bacteria TMDL
(Total Maximum Daily Loads)

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Maine Department of
Environmental Protection

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LIST OF ACRONYMS

AFO	Animal Feeding Operation
BMP	Best Management Practice
CDBG	Community Development Block Grant
CSO	Combined Sewer Overflow
CWA	Clean Water Act
CZM	Coastal Zone Management
DDT	Dichloro-Diphenyl-Trichloroethane
DECTA	Division of Engineering, Compliance and Technical Assistance (ME)
DLLR	Division of Land Resource Regulation (ME)
DMF	Department of Marine Fisheries (ME)
DMR	Division of Marine Resources (ME)
DWM	Division of Watershed Management (ME)
DWQM	Division of Water Quality Management (ME)
GIS	Geographic Information System
GMWQS	Geometric Mean Water Quality Standard
HUC	Hydrologic Unit Code
LA	Load Allocation
MEDEP	Maine Department of Environmental Protection
MEP	Maximum Extent Practicable
MHB	Maine Healthy Beaches
MEPDES	Maine Pollutant Discharge Elimination System
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer Systems
MSD	Marine Sanitation Device
NDA	No Discharge Area
NDZ	No Discharge Zone
NPDES	National Pollutant Discharge Elimination System
NPS	Non Point Source
NRCS	Natural Resource Conservation Service
NRPA	Natural Resource Protection Act
NSSP	National Shellfish Sanitation Program
OBD	Overboard Discharge
POTW	Publicly Owned Treatment Works
PCB	Polychlorinated Biphenyl
PS	Point Source
SCGP	Small Community Grant Program
SRF	State Revolving Fund
SSO	Sanitary Sewer Overflow
SSWQS	Single Sample Water Quality Standard
SWMP	Storm Water Management Plan
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFDA	United States Food and Drug Administration
VRMP	Volunteer River Monitoring Program (ME)
WLA	Waste Load Allocation
WLA_c	Waste Load Allocation from continuous sources
WQS	Water Quality Standards
WWTP	Wastewater Treatment Plant

1.0 INTRODUCTION

The Maine Statewide Bacteria TMDL (Total Maximum Daily Load) is designed to support action to reduce public health risk from waterborne disease-causing organisms. Specific types of non-pathogenic bacteria are used as indicator organisms, or surrogates, for these pathogens in water. Waterborne pathogens (bacteria, viruses, etc.) enter surface waters from a variety of sources, including human sewage and the feces of warm-blooded wildlife. These pathogens can pose a risk to human health due to gastrointestinal illness through different exposure routes, including contact with and ingestion of recreational waters, ingestion of drinking water, and consumption of filter-feeding shellfish (clams, mussels, etc.).

Maine's bacteria TMDL consist of two formats of targets for allowable levels of bacteria:

- Concentrations of bacteria (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 swimming and shellfishing, and to meet the associated criteria in Maine's water quality standards. These TMDLs set a goal of meeting bacteria water quality criteria at the point of discharge for all sources in order to meet water quality standards throughout the waterbody. Achievement of the goal will be assessed by ambient water quality monitoring.

These maximum bacteria levels for both point and nonpoint sources provide pollutant targets with which Clean Water Act actions (such as discharge permits) must be consistent. The concentration-based targets are most useful for guiding implementation of bacteria controls because the target is easy to understand, and achievement of that target is more readily assessed by groups with limited resources.

The Maine's bacteria TMDL protections for recreational uses apply state-wide on a seasonal basis from May 15 through September 30, as required by Maine statute [MRSA §465]. Maine's bacteria TMDLs for the protection of shellfish harvesting apply year-round, as required by Maine statute [MRSA § 6172]. The TMDLs apply specifically to 62 river segments, 143 estuarine & marine waters (including 13 affected by CSOs) that are impaired for bacteria and are listed on Maine's 2008 §303(d) list of impaired waters needing TMDL development (as required under §303(d) of the federal Clean Water Act)(MEDEP 2008). As future monitoring identifies additional bacteria-impaired segments of Maine waters, these bacteria TMDLs may be applied to those waters and made available for public comment through Maine's publicly reviewed §303(d) listing process every two years.

This bacteria TMDL report provides documentation of impairment and information on pollutant sources that are not only required for TMDL approval, but are also intended to provide a guide for future TMDL implementation by watershed stakeholders, as well as protection for waters that are not currently impaired or not assessed for bacteria. TMDL information applicable to all waters appears in the main body of the report, and more detailed waterbody-specific information is organized by watershed in the appendices. Although not required for TMDL approval, this report also provides a broad array of tools to get communities, watershed groups, and other stakeholders started implementing bacterial controls. This report is intended to promote, encourage, and inform local community action for water quality improvement and protection of public health by addressing sources of bacterial contamination.

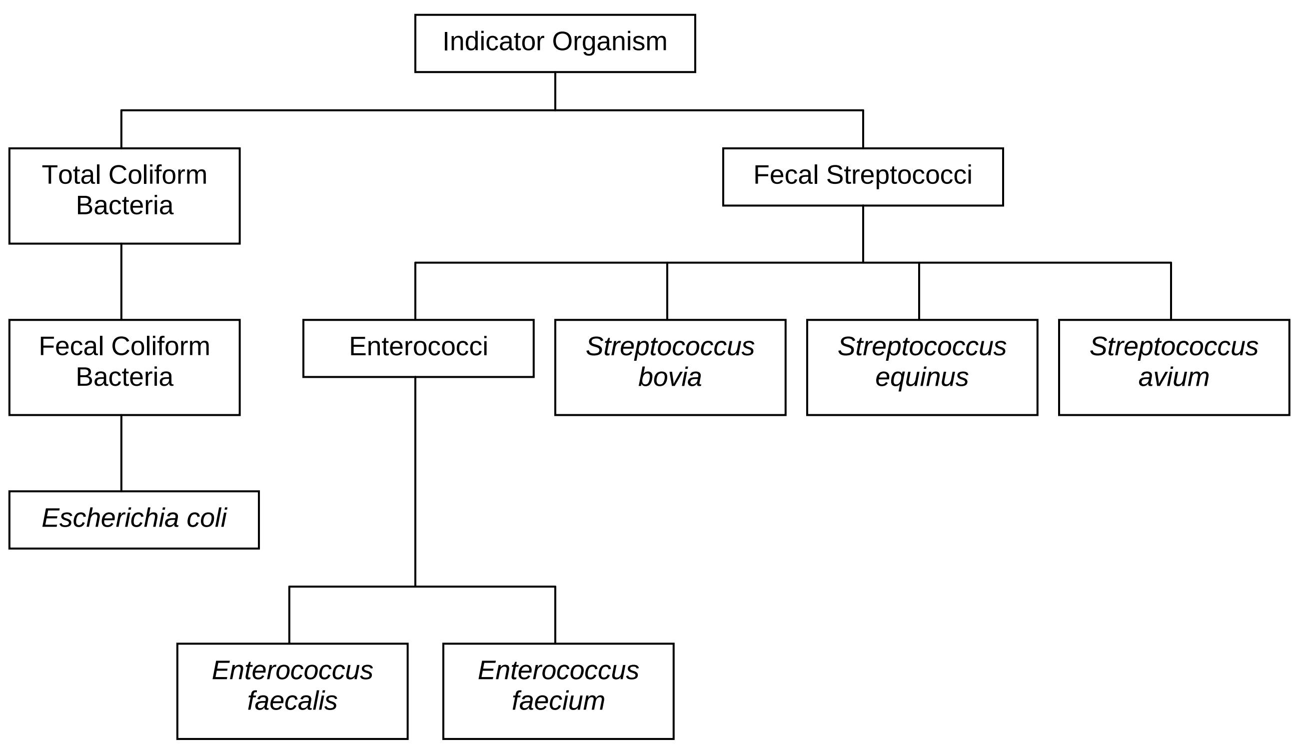
2.0 BACKGROUND

2.1 Bacteria

Bacteria are used as indicators of the presence of pathogens in water. Direct ingestion of pathogen-contaminated water or the consumption of filter-feeding shellfish from contaminated waters can cause gastrointestinal illness. Waterborne pathogens enter surface waters from a variety of sources including human sewage and the feces of other warm-blooded animals. These pathogens include a broad range of bacteria and viruses that are difficult to identify, isolate and quantify. Nonpathogenic bacteria have been identified that are typically associated with harmful pathogens, and are used as indicator bacteria or surrogates for assessing the presence of pathogens. High numbers of indicator bacteria increase the probability of pathogenic organisms also being present in the water.

Maine uses *E. coli* as indicator organisms of potential harmful pathogens in fresh waters and enterococci for estuarine or marine recreational waters (38 MRSA Ch. 3 §465). To determine risk in shellfish harvesting areas, total coliform or fecal coliform organisms are used (criteria recommended under the National Shellfish Sanitation Program; NSSP 2005). The relationship of indicator organisms is diagrammed in Figure 2-1, and Maine's indicators are highlighted. Specific indicator criteria are provided in the Water Quality Standards Section 3.0 of this report.

Figure 2-1. Relationships among Indicator Organisms (USEPA 2001) with Maine's indicator organisms highlighted.



2.2 Bacteria Sources

Sources of indicator bacteria and the pathogens they represent can generally be categorized into two major groups: point sources (PS) and non-point sources (NPS). A PS, as defined in the Clean Water Act §502(14), is much broader than the commonly recognized point source discharges from municipal wastewater or industrial treatment plants, and includes federally regulated stormwater:

> … means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural storm water discharges and return flows from irrigated agriculture.

2.2.1 Point Source Pollution

Point sources are subject to permitting requirements under the National Pollution Discharge Elimination System (NPDES) program (CWA §402). In Maine, the MEDEP is authorized to administer this permit program which regulates and ensures compliance with Maine's water quality standards. The Maine program is referred to as the MEPDES program. Permit limits issued for a discharge to an impaired waterbody must be consistent with any relevant TMDLs approved for that waterbody.
Bacteria Point Sources include;

Illicit Discharges

- Illicit discharges include any discharges to stormwater systems that are not entirely composed of stormwater. These include intentional or unknown illegal connections from commercial or residential buildings, failing septic systems, and improper disposal of sewage from campers and boats. These sources can contribute significantly to the load of bacteria in stormwater, particularly during periods of dry flow. Removal of illicit discharges to storm sewer systems, particularly of sanitary wastes, is an effective means of reducing bacteria loading to receiving waters

Wastewater Discharges & Treatment Facilities

- The Division of Water Resource Regulation (DWRR) is responsible for the licensing and re-licensing of all surface water discharges of pollutants (industrial, commercial, municipal and residential).

Overboard Discharges

- Overboard Discharge applies to small cluster developments where no municipal system is available and subsurface disposal is unsuitable. The OBD law allows for inspection, funds to eliminate discharges, and has opened over 17,000 acres of shellfish harvesting areas.

Accidental & Unspecified Discharges

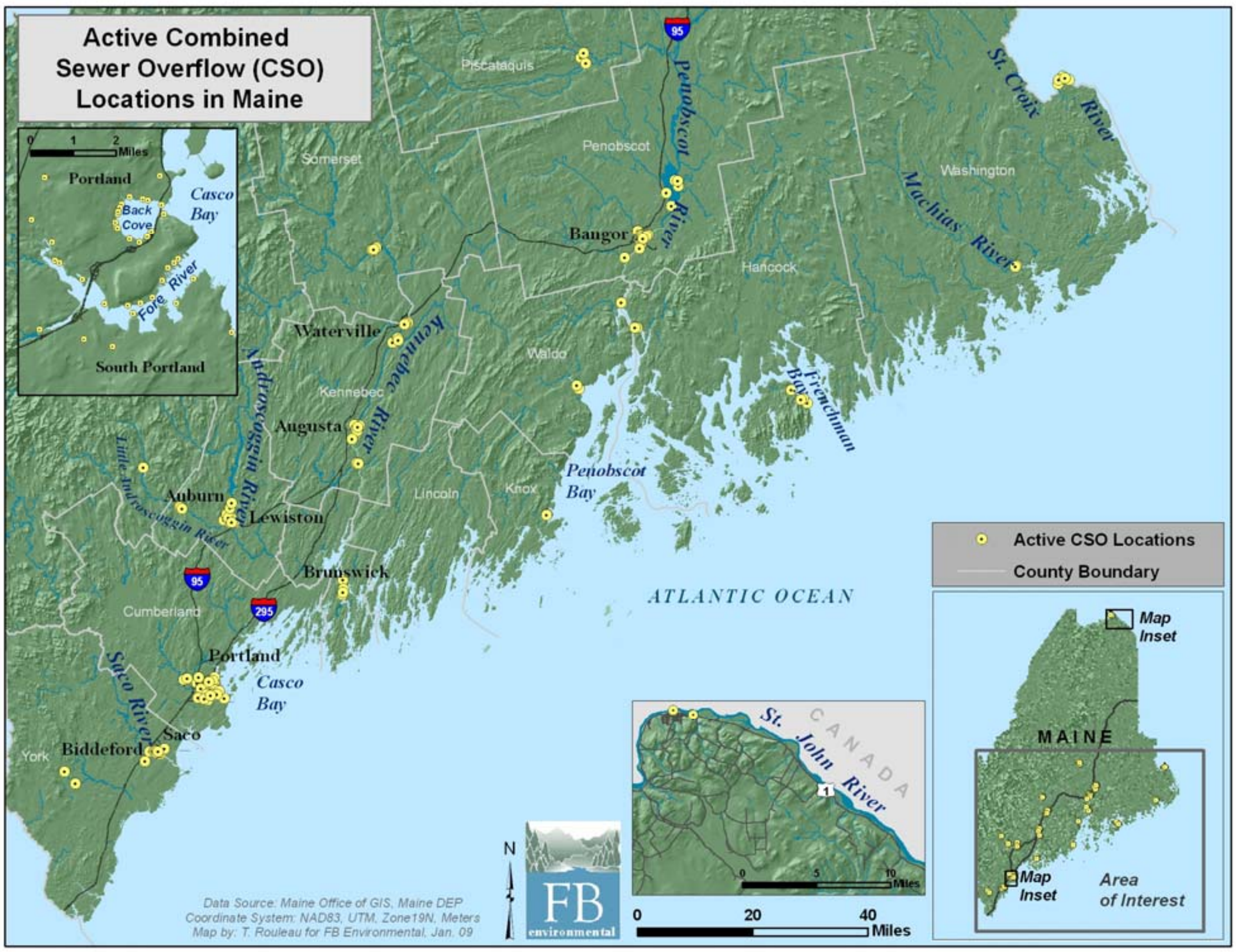
- The Division of Water Resource Regulation is responsible for all formal enforcement actions regarding complaints about wastewater discharges that are taken by MEDEP. Staff also conducts sanitary surveys and takes remedial actions needed to identify and remove sources that are contributing to the closure of shellfish harvesting areas or other water quality impairments.

Combined Sewer Overflows

- Combined Sewer Overflows (CSOs) discharge a combination of untreated sanitary sewer and stormwater to wastewater treatment facilities and can be a significant source of bacterial pollution during wet weather. Thirty-five Maine communities are now served by combined sewer systems, which convey a combination of sanitary and storm water flows to wastewater treatment facilities. During dry weather, all of the sewage in a combined system is conveyed to the treatment plant for adequate treatment. However, during rainstorms or snow-melt periods, stormwater mixes with the sanitary sewage, causing flows that exceed the capacity of the sewer system. This results in combined sewer overflows (CSOs), which vary extensively in pollutant types, concentrations and loads, as well as in volume of overflow and severity of impact to the receiving waterbodies. See Figure X for a state-wide map showing the location of CSOs in Maine.

Maine has established an aggressive program, coordinated with EPA's CSO program, to assist communities in evaluating the design, condition, activity, and effects of combined sewer systems and overflows. Since the program started in 1989, Maine has achieved significant reductions, including a 55-65% decrease in the number of overflow days, and a 60-70% reduction in the volume of CSO discharges. Abatement of CSOs is costly, with $304M reportedly spent by Maine CSO communities through 2007. Continued public support for this program is essential to future progress towards improving water quality. For more information, including an annual overflow status report, go to: [http://www.maine.gov/dep/blwq/doceng/csotech.htm].

Figure 2-2. Combined Sewer Overflows Locations in Maine.



Stormwater

- Stormwater runoff is a leading contributor towards impairment of our nation's waters and often contains high concentrations of bacteria from watershed sources. Urbanization and associated impervious surfaces have a significant impact on the hydrology within a watershed by increasing the amount of runoff to receiving surface waters. Runoff that enters municipal stormwater drainage systems and are discharged directly to surface waters are permitted under the NPDES Phase I and Phase II programs, but are not subject to numeric permit limits. Municipalities that operate separate storm sewer systems (MS4s) are subject to Phase I or II requirements and must develop and implement a stormwater management plan (SWMP) to address problems. In Maine, all construction sites disturbing one or more acres must apply for a Maine Construction General Permit (MCGP) in accordance with 38 MRSA Ch. 3 §420-D Storm Water Management, and 11 sectors of industries cannot discharge stormwater without a multisector general permit (MSGP)

- Regulated Municipal Separate Storm Sewer Systems (MS4s),
- Regulated Construction sites ,
- Regulated Industrial Sectors, and
- Concentrated Animal Feeding Operations (CAFOs)

2.2.2 Non-point Source Pollution

Nonpoint source discharges are diffuse and result from the transport of pollutants to receiving waters by rainfall or snow melt, either from groundwater leachate or overland runoff (e.g., agricultural runoff, or stormwater runoff in unregulated suburban and rural areas). NPS discharges can be difficult to manage, but, some of the same principles for mitigating point source impacts may be applicable.

Bacteria Non-Point Sources include:

<u>Stormwater</u>

- Non-point source (NPS) stormwater discharges are generally characterized as diffuse or sheet flow runoff and are not categorically regulated under the NPDES program. This is polluted stormwater runoff from areas outside of the federally designated MS4 urbanized areas (http://www.state.me.us/dep/blwq/docstand/stormwater/maps/index.htm).

<u>Septic Systems</u>

- Failing private septic systems can be a significant source of bacteria. When properly installed, operated, and maintained, septic systems effectively reduce bacteria concentrations in sewage. However, age, overloading, or poor maintenance can result in failure of septic systems and the release of bacteria and other pollutants (USEPA 2002). To reduce the release of bacteria, practices can be employed to maximize the life of existing systems, identify failed systems, and replace or remove failed systems. Alternatively, the installation of public sewers may be appropriate.

<u>Pet Waste</u>

- In residential areas, pet waste can be a significant contributor of bacteria in stormwater. Each dog is estimated to produce 200 grams of feces per day, and pet feces can contain up to 23,000,000 fecal coliform colonies per gram (Center for Watershed Protection 1999). If the waste is not properly disposed of, these bacteria can wash into storm drains or directly into water bodies and contribute to bacteria impairment. Encouraging pet owners to properly collect and dispose of pet waste is the primary means for reducing the impact of pet waste.

<u>Wildlife Waste</u>

- Fecal matter from wildlife is a significant source of bacteria in some watersheds. This is particularly true when human activities, including the feeding of wildlife and habitat modification, result in the congregation of wildlife. Concentrations of geese, gulls, and ducks are of particular concern because they often deposit their waste directly into surface waters. Therefore, they can be major sources of bacteria, particularly in lakes and ponds where large resident populations have become established near beaches (Center for Watershed Protection 1999).

<u>Agriculture</u>

- Agricultural land includes dairy farming, raising livestock and poultry, growing crops and keeping horses and other animals for pleasure or profit. Activities and facilities associated with agricultural land use can be sources of bacteria impairment to surface waters. Communities, farmers, horse owners and others who confine animals are largely responsible for mitigating bacteria pollution. Activities and facilities with the potential to contribute to bacteria impairment include:
    - Manure storage and application,
    - Livestock grazing,
    - Animal feeding operations and barnyards, and
    - Paddock and exercise areas for horses and other animals.

<u>Recreation</u>

- Recreational uses of waters can contribute to bacteria loads. Swimming beaches, marinas, and areas frequented by boats may be impacted by any of the bacteria sources discussed in the preceding sections of this document. In addition, there are a number of bacteria sources that are specific to these areas:
    - Bacteria from swimmers
    - Sewage & graywater from boats
    - Shore-based marina facilities

2.3 Monitoring Bacteria for Compliance with Water Quality Standards & Source Identification

The Maine Department of Environmental Protection (MEDEP) is responsible for assessing Maine's water quality and attainment of water quality standards. Every two years, this information is compiled into Maine's Integrated Water Quality Monitoring and Assessment Report. The impaired waters list (required under §303(d) of the federal Clean Water Act) is now combined with the broader "305b" water quality assessment report to fulfill reporting requirements of US EPA and the Maine State Legislature. [http://www.maine.gov/dep/blwq/docmonitoring/impairedwaters/index.htm]

Assessment of impairment due to bacteria is based on repeated measures collected and processed according to quality assurance protocols. Waters are listed as impaired in Category 5 of Maine's Integrated Report when the geometric mean exceeds the standards. Additionally, waters are listed and need a TMDL according to the following guidelines (MEDEP 2008):

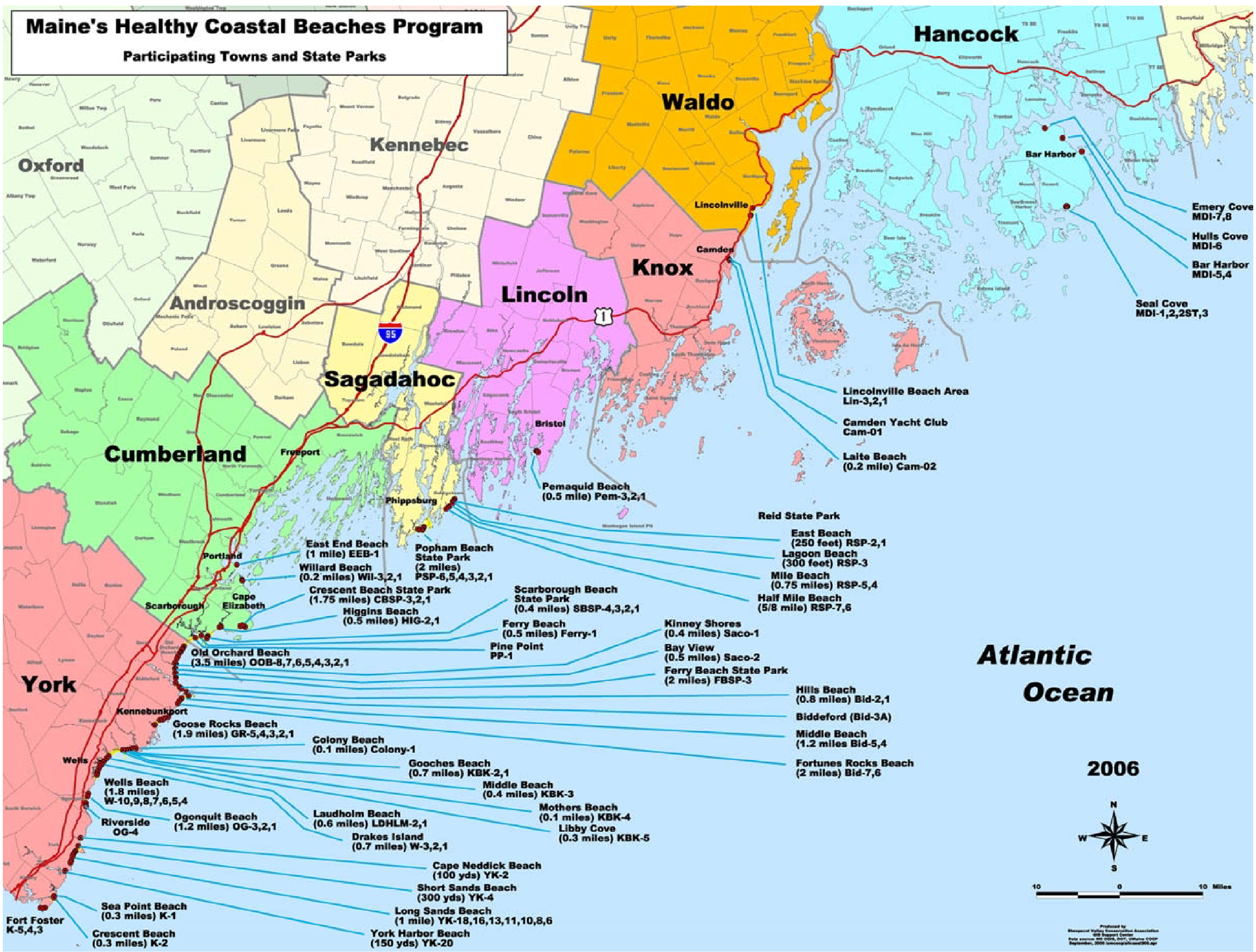
1. Current data (collected within five years) either indicates impaired use, or a trend toward expected impairment within the listing period, and where quantitative or qualitative data/information from professional sources indicates that the cause of impaired use is from a pollutant(s),
2. Water quality models predict impaired use under current loading for a standard, and where quantitative or qualitative data/information from professional sources indicates that the cause of impaired use is from a pollutant(s), or,
3. Those waters have been previously listed on the State's 303(d) list of impaired waters, based on current or old data that indicated the involvement of a pollutant(s), and where there has been no change in management or conditions that would indicate attainment of use.

For bacteria assessments, "there must be a plausible human or domestic animal source of bacteria for an impairment determination to be made (38 MRSA Section 465, 465-A, 465B)" (MEDEP 2008).

In general, monitoring bacteria indicator organisms for source identification involves sampling ambient water quality under both dry and wet conditions because many sources of bacteria are diffuse and intermittent (rather than flowing from an identifiable pipe on a regular basis). High levels of bacteria during dry conditions indicate the presence of direct wastewater discharges, or contamination from groundwater leachate (from agriculture, leaking sewer pipes, illicit connections to stormdrains), from recreational activities (swimmers and boaters), or from wildlife (including birds). High levels of bacteria during wet conditions (rainfall) indicate contamination from wildlife and domesticated animals (including pets), stormwater runoff (including municipal separate storm systems or MS4s), or discharges from combined sewer overflows (CSOs). Trying to monitor bacteria sources directly for accurate quantitative estimates of contributions from various sources is extremely difficult, time consuming, and expensive. A more reasonable monitoring approach is to use ambient data collected during both wet and dry conditions to estimate the bacteria levels from all contributing sources.

MEDEP relies heavily on volunteer monitoring of bacteria to protect recreational uses. MEDEP enforcement staff gathers data when investigating complaints and inspecting potential sources of contamination where problems are suspected. Additional potential sources for bacteria monitoring data include: watershed organizations, volunteer monitoring programs, other state, local, or federal agencies and Indian Tribes. Volunteer monitoring programs with MEDEP-approved monitoring plans (to assure quality data) include the Maine Volunteer Lakes Monitoring Program [http://www.mainevolunteerlakemonitors.org] and the Maine Healthy Beaches (MHB) Program [http://www.mainehealthybeaches.org].

Figure 2-3. Maine Healthy Coastal Beach Program Monitoring Locations (MHB 2006).



Public coastal swim beaches are monitored for indicator bacteria during the beach season, which is from Memorial Day to Labor Day, using EPA-approved quality control and quality assurance methods. Municipalities, state parks, and volunteer groups monitor water quality and provide public notification of unhealthy conditions. An online database provides beach managers, town and state park officials, and MHB program staff with immediate access to water monitoring data, allowing them to make decisions about posting advisories more efficiently. The public may view the status and data for each beach at [www.MaineHealthyBeaches.org] (MHB 2008).

Maine Department of Marine Resources (DMR) is the state shellfish control authority and is solely responsible for the classification (and maintenance of classification) of shellfish growing areas in accordance with guidelines defined in the Interstate Shellfish Sanitation Conferences (ISSC) National Shellfish Sanitation Program (NSSP) Model Ordinance (MO) which establishes the minimum requirements necessary to protect public health of shellfish consumers (MEDMR 2007).

There are generally two types of monitoring performed to protect shellfish growing areas. First, DMR conducts extensive water quality monitoring and evaluation of potential and actual pollution sources using sanitary and shoreline surveys in order to prevent illness from shellfish consumption. "All shoreline properties adjacent to growing areas are inspected for evidence of existing or potential sources of fecal matter, such as on-site septic systems, municipal sewage treatment facilities, agricultural/livestock operations, and wildlife. Shoreline surveys are conducted on a regular basis, and growing areas are classified accordingly." (MEDMR 2007). DMR also conducts regular water quality testing in shellfish growing areas for the presence of fecal coliform bacteria to ensure that shellfish harvest areas are classified correctly. Secondly, water quality sampling is conducted on classified shellfish areas to identify, investigate, and remediate pollution sources. The DMR has limited resources for this work and relies heavily on volunteer monitoring that are trained by DMR's volunteer coordinator and shellfish area water quality staff.

Protocols of the Shellfish Growing Area Classification Program were revised April 26, 2007 [http://www.maine.gov/dmr/rm/public_health/FinalGrowingAreaSOP4-26-2007.pdf] and uses sampling methods outlined in NSSP MO. Maine uses Systematic Random Sampling to monitor the classification of growing areas and Adverse Sampling to evaluate pollution source impact on shellfish growing areas (MEDMR 2007).

2.4 Waterbody Descriptions and Priority Ranking

There are 62 river and stream segments and 143 estuarine and marine segments listed on Maine's 2008 303(d) list (MEDEP 2008) as impaired due to bacteria[1.]. These 205 bacteria-impaired segments are located in 13 of the 21 major watersheds (8 digit hydrologic unit code basins) within the State of Maine and are shown in Figure 2-4 and Figure 3-1. Detailed descriptions, maps and calculations to support the TMDL for impaired waters are provided in Appendix I, Freshwaters and Appendix II, Marine & Estuarine Waters.

These 21 major basins (HUC 8) in the State of Maine (Figure 2-5) contain approximately 1 million acres of lakes, ponds and reservoirs, 3.2 million acres of wetlands, 45,000 miles of rivers and streams and 5,300 miles of coastline (MEDEP 2008). Maine supports a population of 1.3 million people, which is not very dense given the overall size of Maine (35,000 square miles; 37 people per square mile). Much of the population is concentrated along the coastline and in the southern portion of Maine. It is these populated areas that generally correspond with the bacteria-impaired waterbodies listed on Maine's CWA § 303(d) list.

[1.] ***Monitoring data identifying bacteria-impaired segments in the Meduxnekeag Watershed (see Appendix I, Section III) were inadvertently overlooked during Maine's 2008 §303(d) listing process. This Bacteria TMDL will be applied to those waters determined to be impaired and will be included in Maine's2010 publicly reviewed §303(d) listing process.***

Figure 2-4. Maine Bacteria Impaired Segments.

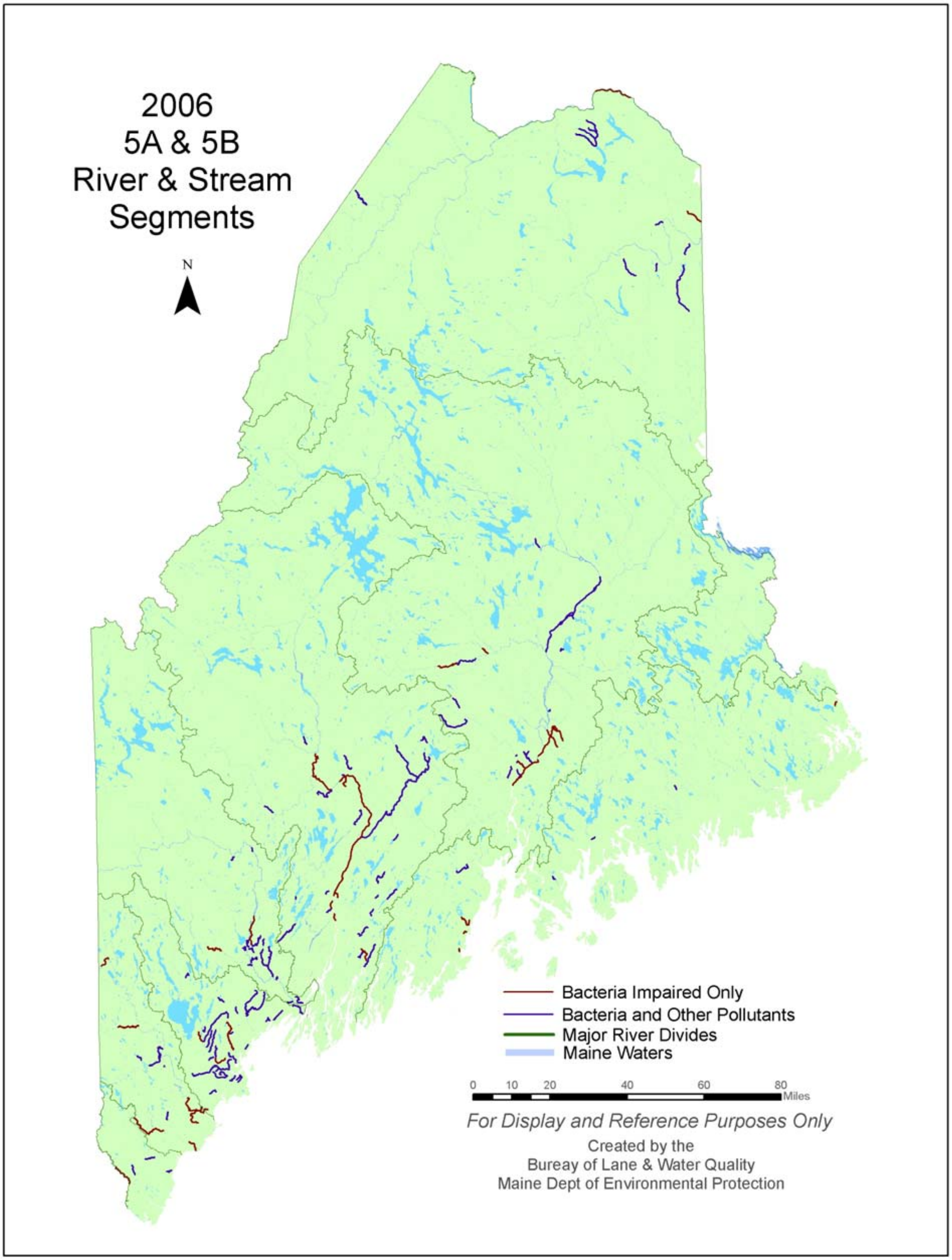
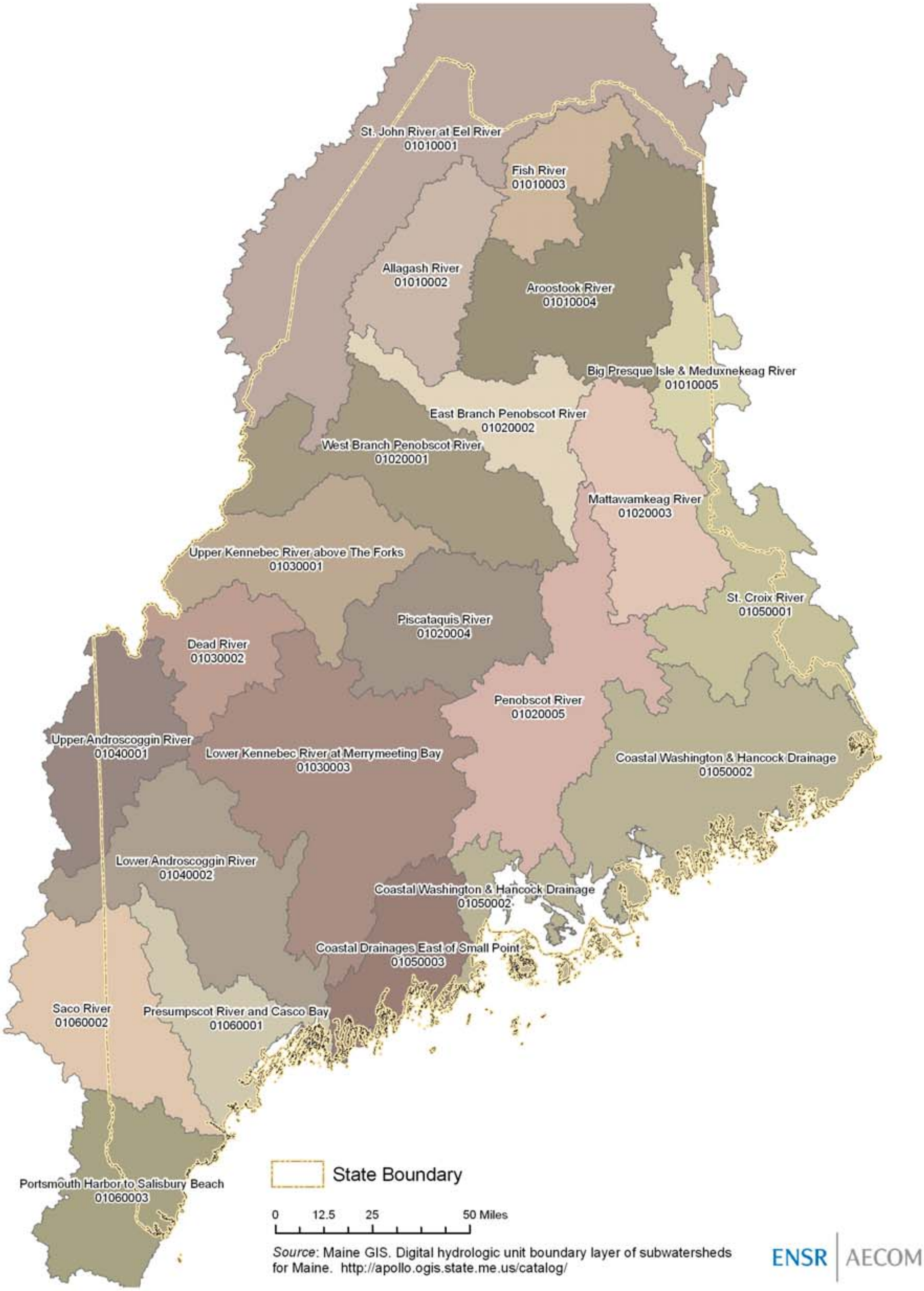


Figure 2-5. Maine Major Watersheds (HUC8)



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In Maine's Integrated List of Waters, waters that are threatened or impaired due to non attainment of one or more designated uses and that require a TMDL are listed in Category 5. The following are four subcategories within Category 5 (MEDEP 2008), each representing different impairment sources and priority for TMDL development:

- 5-A: Impairment caused by pollutants (other than those listed in categories 5-B through 5-D).
- 5-B: Impairment is caused solely by bacteria contamination.
- 5-C: Impairment caused by atmospheric deposition of mercury and a regional scale.
- 5-D: Impairment caused by "legacy" pollutant.
  These freshwaters are impaired only by PCBs, dioxins, DDT, or other substances already banned from production or use. These coastal waters have a consumption advisory for the tomalley of lobsters due to the presence of persistent bioaccumulating toxics found in that organ.

Maine's bacteria TMDLs address subcategories 5-A and 5-B. Development of TMDLs for bacteria impaired waters in categories B has been moved up in priority partially in response to local interest in addressing this risk to human health, especially in coastal areas subject to development. Tables 2-1 through 2-6 provide a listing of waterbodies currently listed as impaired by bacteria in the State of Maine.

Water quality data used in the assessment process for each segment impaired by bacteria is provided in Appendix I, Freshwaters and Appendix II, Marine & Estuarine Waters. Appendix IV contains an expanded version of Tables 2-1 through 2-5 with additional information and TMDL endpoints.

Table 2-1. Rivers and Streams Impaired by Bacteria and Pollutants Other Than Those Listed in 5-B Through 5-D (TMDL Required) [Maine Listing Category 5-A] (MEDEP 2008).

Assessment Unit ID	Segment Name	Segment Size (Miles)	Segment Class
Category 5-A			
ME0101000105_103R01	Shields Branch of Big Black R mainstem	8.16	Class AA
ME0102000110_205R03	Millinocket Stream (Millinocket)	3.03	Class C
ME0102000506_222R01	Costigan Str (Costigan)	0.78	Class B
ME0103000306_320R03	Whitten Brook (Skowhegan)	1.12	Class B
ME0103000309_332R	Sebasticook River main stem, below confluence with E and W branches	30.83	Class C
ME0104000208_413R01	Jepson Brook (Lewiston)	2.43	Class B
ME0104000208_413R03	Stetson Brook (Lewiston)	6.82	Class B
ME0104000208_413R04	Logan Brook, Auburn	0.96	Class B
ME0104000208_413R07	Gully Brook (Lewiston)	1.91	Class B
ME0104000210_418R02	No Name Brook (Lewiston)	10.02	Class C
ME0104000210_419R02	Hart Brook (Lewiston) A.K.A Dill Brook and including Goff Bk	4.15	Class B
ME0105000213_514R_01	Card Brook (Ellsworth)	1.2	Class B
ME0105000305_528R03	Dyer River below Rt 215	9.35	Class B
ME0106000103_607R03	Colley Wright Brook (Windham)	8.16	Class B
ME0106000103_607R06	Hobbs Brook (Cumberland)	1.54	Class B
ME0106000103_607R07	Inkhorn Brook (Westbrook)	4.32	Class B
ME0106000103_607R08	Mosher Brook (Gorham)	2.03	Class B
ME0106000103_607R09	Otter Brook (Windham)	2.16	Class B
ME0106000103_607R12	Pleasant River (Windham) mainstem of Pleasant River from Thayer Brook to confluence with Presumpscot	8.8	Class B
ME0106000106_602R01	Frost Gully Brook	4.04	Class A
ME0106000211_616R05	Thatcher Bk (Biddeford)	5.67	Class B

Table 2-2. Rivers and Streams Impaired by Bacteria Contamination (TMDL Required) [Maine Listing Category 5-B] (MEDEP 2008)

Assessment Unit ID	Segment Name	Segment Size (Miles)	Segment Class
Category 5-B			
ME0101000121_117R	St. John River at Madawaska	0 *	Class C
ME0101000413_146R01	Webster Brook	12.1	Class B
ME0102000402_219R_02	Piscataquis River at Dover Foxcroft	0 *	Class B
ME0102000403_215R_02	Sebec River at Milo	0 *	Class B
ME0102000509_226R01	Otter Stream	6.27	Class B
ME0102000509_226R02	Boynton Brook	2.64	Class B
ME0102000509_233R_02	Penobscot River at Orono	0 *	Class B
ME0102000509_233R_03	Penobscot River at Old Town-Milford	0 *	Class B
ME0102000510_224R02	Kenduskeag Stream	1.5	Class B
ME0102000513_234R	Penobscot River	0 *	Class B
ME0103000306_320R02	Currier Brook	3.19	Class B
ME0103000306_338R_02	Kennebec River at Fairfield	0 *	Class C
ME0103000306_338R_03	Kennebec River at Skowhegan	0 *	Class B
ME0103000312_333R02	Whitney Brook (Augusta)	2.68	Class B
ME0103000312_339R_02	Kennebec River at Waterville	0 *	Class B
ME0103000312_340R_02	Kennebec River at Augusta, including Riggs Brook	0 *	Class B
ME0103000312_340R_03	Kennebec River at Hallowell	0 *	Class B
ME0103000312_340R_04	Kennebec River at Gardiner-Randolph	0 *	Class B
ME0104000209_417R_02	Little Androscoggin River at Mechanic Falls	0 *	Class C
ME0104000210_425R_02	Androscoggin River	0 *	Class C
ME0105000108_505R_02	St. Croix R, (Calais)	0*	
ME0105000203_508R02	Pottle Brook (Perry)	0.5	Class B
ME0105000220_522R01_01	Megunticook River (Camden)	3.56	Class B
ME0105000220_522R02_01	Unnamed Brook (Camden)	0.7	Class B
ME0105000220_522R03	Unnamed Brook (Rockport)	0.5	Class B
ME0105000220_522R04	Unnamed Brook (Rockland)	0.5	Class B
ME0105000305_528R01	Sheepscot River at Alna	4.01	Class AA
ME0106000103_607R04	Piscataqua River (Falmouth)	12.53	Class B
ME0106000103_607R11	Nason Brook (Gorham)	2.7	Class B
ME0106000103_609R_02	Presumpscot River at Westbrook	0 *	Class C
ME0106000106_612R01_02	Bear Brook, Saco	0 *	Class B
ME0106000106_616R04	Bear Bk	0.5	Class B
ME0106000204_618R01	Saco R	5	Class AA
ME0106000209_614R01	Ossippee R	5	Class B
ME0106000211_616R02	Tappan Bk	0.5	Class B
ME0106000211_616R03	Sawyer Bk	0.5	Class B
ME0106000211_616R06	Swan Pond Brook at South Street (Biddeford)	1	Class B
ME0106000211_619R01	Saco River at Biddeford-Saco	0 *	Class B
ME0106000301_622R01	Kennebunk River	3.07	Class B
ME0106000302_628R02	Mousam River at Sanford	0 *	Class C
ME0106000305_630R01	Salmon Falls R	7.43	Class B

* Estimate of affected river miles is not provided since it is highly variable depending on an overflow event

Table 2-3. Estuarine and Marine Waters Impaired only by Bacteria (TMDL Required) [Maine Listing Category 5-B] (MEDEP 2008).

Waterbody ID	DMR Area	Segment Description	Segment Size (Acres)	Segment Class
Category 5-B				
812-1	1	Piscataqua R. Estuary, Kittery, Eliot, So. Berwick	1144.2	SB/SC
826-1	1B	Jaffrey Point, N. H. to Brave Boat Harbor, York	1,211.90	SB
826-2	2	York River	276.1	SB
826-2	2A	York Harbor	41.2	SB
826-3	2B	Lobster Cove	57.4	SB
826-3	3	Cape Neddick	1425.7	SB
824-1	4	Ogunquit River	32.7	SB
824-3	5	Webhannet River	604.7	SB
824-3	5A	Little River	133.1	SB
824-4	7	Kennebunk River	498.3	SB
821-1	8	Cape Porpoise	126.6	SB
821-2	8-A	Cape Porpoise Harbor	130.7	SB
821-2A	8-AA	Goosefare Bay	7.8	SB
811-1	9	Saco River	1245.4	SB/SC
	10	Saco Bay	3404.4	SB
811-2	11	Scarborough River	201.7	SB/SA
811-4	13	Spurwink River	45.1	SB/SA
804-1	14	Portland - Falmouth Area	12827.6	SB/SC
804-2	14-A	Falmouth – Cumberland	11.5	SB
804-3	14-C	Long Island - Cliff Island, Portland	617.2	SB
802-25	16	Royal & Cousins R. Estuaries	108.8	SB
802-5	17-B	Maquoit Bay, Brunswick and Freeport	300.9	SB
	17-E	Basin, Ash and Stover Coves, Harpswell	280.1	SB
	17-F	Orrs and Bailey Island, Harpswell	200.4	SB
	17-G	Harpswell Sound, Harpswell	547.1	SB
802-7	18	Potts Harbor	675.3	SB
802-8	18-A	Gurnet Strait, Harpswell	154.5	SB
802-9	18-BB	New Meadows River, Brunswick, West Bath, Harpswell	12.6	SB
	18-B	New Meadows Lake, Brunswick, West Bath	22.5	SB
802-10	18-J	Middle Bay	76.9	SB
	18-CC	Merepoint, Brunsick	14.5	SB
802-11	18-D	Eastern Bailey - Orr's Island, Western Quahog Bay,	1,256.60	SB
802-12	18-F	Card Cove and Orrs Cove, Harpswell	52.1	SB
	18-G	Northern Quahog Bay	257.3	SB
802-19	18-X	Little Hen Island and Big Hen Island, Harpswell	70.7	SB
802-9	19-F	Long Cove, West Bath	7.7	SB
710-1	20	Upper Kennebec River and Tributaries	17,293.80	SB
	20-G	Middle Kennebec River	1,145.50	SB
710-2	20-H	Lower Kennebec, Phippsburg/Georgetown	1865.4	SB
730-1	20-B	Back River, Wiscasset and Westport	139.4	SB
730-6	22-E	Western Barters Island, Boothbay	225.9	SB
730-10	23-A	Ebencook Harbor, Southport	1226.9	SB

Table 2-3 (continued). Estuarine and Marine Waters Impaired only by Bacteria (TMDL Required) [Maine Listing Category 5-B] (MEDEP 2008).

Waterbody ID	DMR Area	Segment Description	Segment Size (Acres)	Segment Class
729-2	24-A	Lower Salt Bay	42.6	SB
729-2	25	Damariscotta River, Newcastle – Damariscotta	694.5	SB
726-10	26	Medomak River, Waldoboro and Friendship	155.6	SB
724-2	26-A	Monhegan Island	521.6	SB
724-4	26-D	Wiley Cove, Cushing	61.2	SB
	26-E	Dutch Neck and Back River	35.1	SB
724-8	26-N	Maple Juice Cove, Cushing	124	SB
724-11	27-B	Deep Cove - Otis Cove, St. George	318.2	SB
722-1	27-A	Eastern Wheeler Bay, St. George	35.1	SB
	27-E	Upper St. George and Mill River	317.6	SB
722-2	28	Tenants Harbor to Mosquito Head, St. George	621.4	SB
722-6	28-H	Marshall Point - Mosquito Head, St. George	193.8	SB
722-7	28-I	Weskeag River, So. Thomaston and Owls Head	41.9	SB
722-8	29	Rockland	2,459.90	SB/SC
722-11	30	Rockport	2,036.30	SB
722-13	30-D	Vinalhaven	1,255.20	SB
722-14	30-H	Kent Cove, North Haven	180.8	SB
722-16	30-J	Vinal Cove - Starboard Rock, Vinalhaven	90.4	SB
722-17	30-K	Southern Harbor, North Haven	36.4	SB
722-19	30-M	Roberts Harbor, Vinalhaven	175.4	SB
722-21	31-A	Rockport Harbor to Ducktrap Harbor, Lincolnville	2,139.60	SB
722-22	31-B	Great Spruce Head - Kelleys Cove, Northport	1,237.30	SB
722-23	32	Belfast Bay	4,172	SB
722-24	33	Searsport - Stockton Springs	2789	SB/SC
	34	Stockton Springs	460.6	SB/SC
722-25	35	Penobscot River	12,743.00	SB/SC
722-26A	36-A	Northern Bay, Penobscot	786.3	SB
722-26B	36-B	Upper Baggaduce River	7	SA
722-29A	37-D	Long Cove, Deer isle	22	SB
722-34	38	Stonington Harbor & NW Crocket Cove, Deer Isle & Stonington	222	SB
722-38	39-A	Center Harbor – Brooklin	32	SB
722-38	39-B	Eastern Flye Point, Brooklin	11	SB
722-39	39-F	Benjamin River, Sedgwick	23	SB
707-4	39-E	Salt Pond, Sedgwick – Brooklin	80	SB
	39-H	Northwest Herrick Bay, Brooklin	38	SB
	39-G	Northern Morgan Bay	114	SB
	39-I	Bragdon Brook, Blue Hill	25	SB
707-10	42-E	Mackerel Cove, Swans Island	4	SB
707-5	48-A	Goose Cove, Trenton	121	SB
707-11	48-B	Pretty Marsh Harbor, Mount Desert	180	SB
	48-C	Northwest Cove, Bar Harbor	87	SB
714-9	49-A	Jellison Cove, Hancock	9	SB
714-10	49-B	Carrying Place, Hancock	25	SB

Table 2-3 (continued). Estuarine and Marine Waters Impaired only by Bacteria (TMDL Required) [Maine Listing Category 5-B] (MEDEP 2008).

Waterbody ID	DMR Area	Segment Description	Segment Size (Acres)	Segment Class
714-11	49-C	Kilkenny Cove, Hancock	43	SB
	49-D	Eagle Point, Sullivan	7	SB
714-13	50-A	US Rt. 1 Bridge, West Sullivan and Long Cove, Sullivan	30	SB
714-14	50-B	Springer Brook, Mill Brook and West Brook, W. Franklin	93	SB
714-15	50-C	Johnny's Brook and Card Mill Stream, Franklin	2	SB
	50-D	Evergreen Point, Sullivan	34	SB
714-16	50-E	Egypt Bay, Hancock and Franklin	106	SB
	51-C	Bunker Cove, South Gouldsboro	12	SB
706-3	52-B	Mill Pond Stream, Gouldsboro	8	SB
706-6	52-E	Dyer Harbor - Pinkham Bay, Steuben	73	SB
706-7	52-F	Birch Harbor, Gouldsboro	19	SB
	52-G	Joy Bay, Gouldsboro and Steuben	1024	SB
706-8	52-J	Dyer Harbor, Steuben	162	SB
705-3	52-K	Mitchell Point, Milbridge	32	SB
705-1	53	Narraguagus River, Milbridge	821	SB
704-2	53-D	Curtis Creek, Flat Bay, Harrington	31	SB
704-3	53-E	Upper Harrington River	483	SB
705-3	53-G	Smith Cove, Narraguagus Bay, Milbridge	3	SB
703-2	54	Jonesport and West Jonesport	459	SB
703-3	54-A	North End of Beals Island	95	SB
703-4	54-B	Indian River, Addison – Jonesport	68	SB
703-5	54-K	Southeastern Alley Bay & Pig Island Gut, Beals	24	SB
703-6	54-M	Lamesen Brook in West River, Addison	52	SB
713-1	54-D	East & West Branches, Little Kennebec Bay, Machias and Machiasport	68	SB
713-2	54-G	White Creek, Masons Bay, Jonesport – Jonesboro	47	SB
713-3	54-H	Chandler River, Jonesboro	119	SB
709-5	55-I	Indian Head, Machiasport	17	SB
708-1	55-A	Little River - Cutler Harbor	37	SB
708-3	55-G	Money Cove, Cutler	32	SB
708-4	56-C	Haycock Harbor, Trescott	16	SA/SB
708-6	58	Lubec and South Lubec	70	SB
701-1	56	Denny's River and Northwest Denny's Bay, Edmunds – Pembroke	88	SA/SB
701-2	56-A	Pennamaquan Bay, Pembroke	80	SB
708-4	56-B	East Stream, Trescott	15	SA/SB
	56-D	Crane Mill Brook, Edmunds	94	SA
	56-H	Ox Cove, Pembroke	653	SA
701-7	57-B	Deep Cove, Eastport	154	SC
	59	Hal Moon Cove, Eastport	46	SB
701-8	58	Lubec and South Lubec	487	SB
701-10	58-F	The Haul-Up, South Bay, West Lubec	40	SB
702-4	62	St. Croix River – Passamaquoddy Bay	7,933.00	SB/SC

Table 2-4. Estuarine and Marine Waters Impaired by Pollutants Other Than Those Listed in 5-B Through 5-D (TMDL Required) [Maine Listing Category 5-A] (MEDEP 2008).

Waterbody ID	Segment Description	Segment Size (Acres)	Segment Class
Category 5-A			
811-9	Mousam R. Estuary (DMR Area 6)	192	SB
811-8	Saco R. Estuary	576	SC
804-7	Fore R. Estuary	768	SC
802-25	Royal R. Estuary	173.5	SB

Table 2-5. Estuarine and Marine Waters Impaired by Bacteria from Combined Sewer Overflows [Maine Listing Category 5-B-2] (MEDEP 2008).

Waterbody ID	Location	Permitted Facility Name
811-6	Biddeford	Biddeford WWTF
811-7	Saco	Saco WWTP
804-7	Cape Elizabeth	Portland Water District - Portland WWTF
804-6	South Portland	South Portland WPCF
804-5	Portland	Portland Water District - Portland WWTF
710-03	Bath	Bath WPCF
722-40	Rockland	Rockland WWTF
722-41	Belfast	Belfast WWTF
722-42	Bucksport	Bucksport WWTP
722-43	Winterport	Winterport Sewerage District
722-44	Hampden	Hampden, Town of
714-21	Bar Harbor	Bar Harbor, Town of
709-6	Machias	Machias WWTF

3.0 WATER QUALITY STANDARDS

3.1 Applicable Water Quality Standards

The State of Maine has four tiers of water quality classifications for rivers and streams (AA, A, B, C), one for lakes (GPA), and three tiers for estuarine and marine waters (SA, SB, SC), each with varying designated uses and water quality criteria providing different levels of protection. Classifications range from the highest quality (AA and SA, "free flowing and natural"; A and GPA, "natural") to classifications allowing some discharges as long as the water quality remains "unimpaired" (B and SB) to classifications allowing discharges with some impact as long as aquatic life habitat is maintained (C and SC). The highest quality classes have the most stringent water quality criteria.

The designated uses in Maine Statute applicable to bacteria-impaired waters include:

- Recreation in and on the water (e.g., swimming and boating) and
- Propagation and harvesting of shellfish [MRSA 38 Chapter 3, §465].

Maine's bacteria criteria for the protection of primary contact recreation for Class B, C, SB, and SC waters include bacteria of human and domestic animal origin. Maine's water quality standards include criteria for both instantaneous bacteria counts and geometric means of bacteria data.

Maine's bacteria criteria for the protection of shellfish harvesting follow the standards for fecal coliform developed under the National Shellfish Sanitation Program (NSSP) by the United States Food and Drug Administration. The statistical evaluation of water quality data for classifying shellfish areas must meet the following two criteria: a geometric average standard, and a variability standard. (MEDMR 2007). See Table 3-1 for the various bacteria water quality standards applied to Maine's waters. The shellfish harvesting area classifications listed in Table 3-1 are summarized as follows and impaired areas are presented in Figure 3-1:

Approved – These areas are approved when sanitary and biotoxins surveys indicate that the area is free of measured pollutants described in the NSSP. Harvesting is allowed.

Conditionally Approved and **Conditional Restricted** – These areas are approved for harvesting under a designated set of environmental conditions. These areas generally have some intermittent microbiological pollution. For conditionally approved locations, harvesting is allowed except during specified conditions. For conditionally restricted locations, depuration harvesting is allowed except during specified conditions.

Restricted – These areas are subject to a limited degree of pollution where additional treatment can result in shellstock safe for consumption. Depuration harvesting only.

Prohibited – These areas are prohibited from shellfish harvesting due to excessive concentration of pollutants. No harvesting allowed.

In addition, Maine water quality standards have an antidegradation provision designed to protect and maintain all water uses and water quality whether or not stated in the waterbody's classification as of November 28, 1975 [38 MRSA Ch. 3 §464]. Uses include aquatic life, wildlife that use the waterbody, habitat, recreation, water supply, commercial activity, and ecological, historical or social significance. The antidegradation provision ensures that waste discharge licenses, or a water quality certification are issued only when there will be no significant impact on the existing use or result in failure of the waterbody to meet standards of classification.

3.2 Numeric Water Quality Target

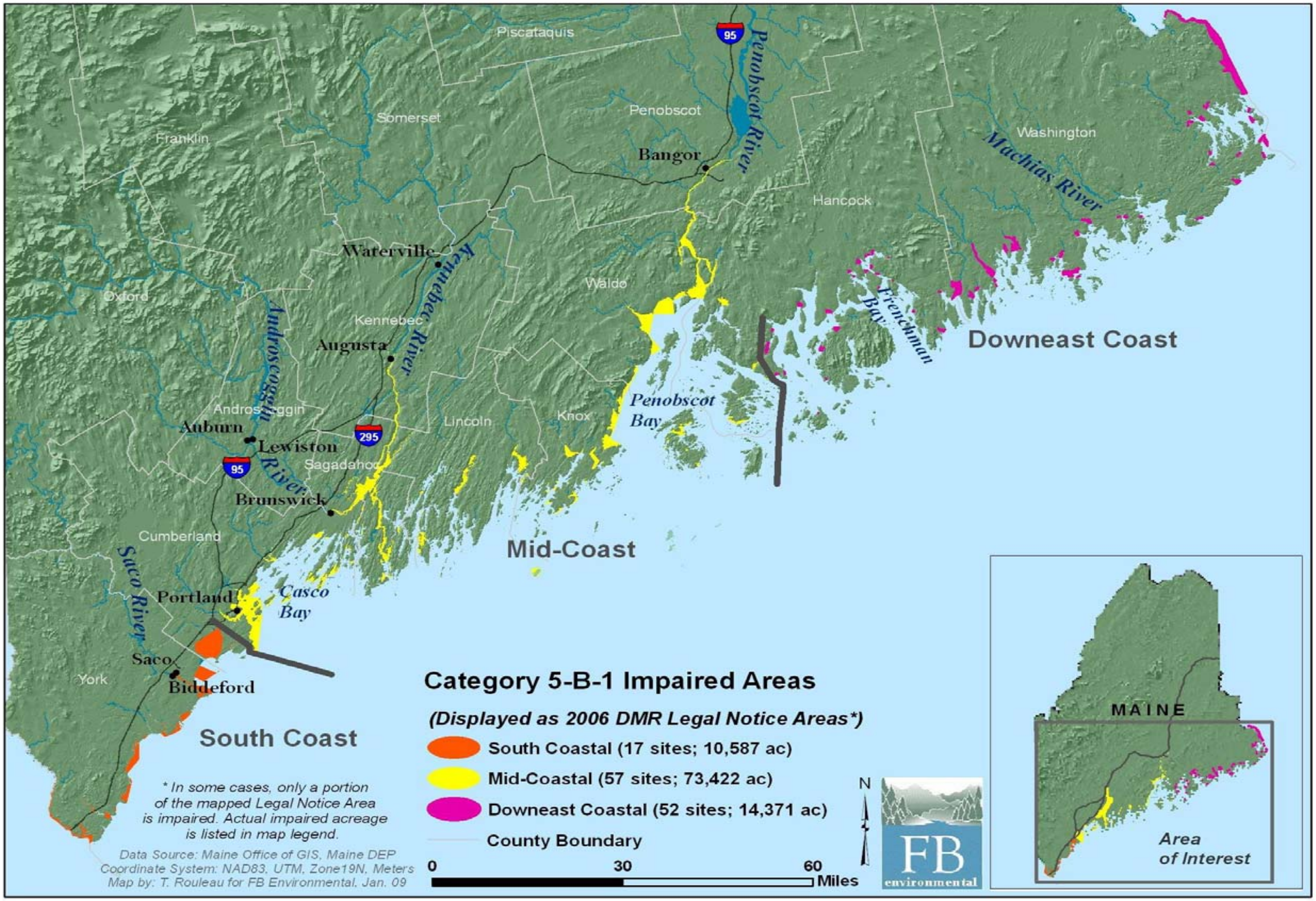
The Maine water quality criteria for bacteria are used as the numeric water quality targets for the bacteria TMDLs as shown in Table 3-1. Numeric bacteria targets vary depending on a specific waterbody's use classification (e.g., recreational, or shellfish harvesting), level of protection (e.g., A, B, or C), and upon the applicable indicator organism (*E. coli* for freshwater, Enterococci for estuaries and marine recreational waters, and fecal coliform for shellfish harvesting areas. The TMDLs for recreational use apply from May 15 – September 30 because that is the period when Maine's water quality standards for bacteria are in effect [38 MRSA Ch.3 §464 & 465]. The TMDLs for shellfish harvesting areas apply year round [National Shellfish Sanitation Program Manual of Operations, Part I, Sanitation of Shellfish Growing Areas, USFDA].

Table 3-1. Bacteria Water Quality Standards Applicable to Maine Waters

Waterbody Class	Bacteria Criteria
Fresh water	
Class AA	As naturally occurs[1]
Class A	As naturally occurs[1]
Class B	Between May 15th and Sept. 30th *E. coli* of human and domestic animal origin shall not to exceed a geometric mean of 64/100mL or an instantaneous level of 236/100mL
Class C	May 15th – Sept. 30th *E. coli* of human and domestic animal origin shall not to exceed a geometric mean of 126/100mL or an instantaneous level of 236/100mL
Class GPA	Between May 15th and Sept. 30th *E. coli* of human origin shall not to exceed a geometric mean of 29/100mL or an instantaneous level of 194/100mL
Estuarine and Marine Waters	
Class SA	As naturally occurs
Class SB	Between May 15th and Sept. 30th Enterococcus of human and domestic animal origin shall not to exceed a geometric mean of 8/100mL or an instantaneous level of 54/100mL.
Class SC	Between May 15th and Sept. 30th Enterococcus of human and domestic animal origin shall not to exceed a geometric mean of 14/100mL or an instantaneous level of 94/100mL.
Coastal Beaches	Between May 15th and Sept. 30th Failure results from single sample enterococcus level exceeding 104/100mL or a geometric mean of 35/100mL for five samples within a 30-day period
Shellfish Growing Area[2]	
Area	**Fecal Coliform**
Approved (Growing Areas affected by Point Sources)	<u>Fecal Coliform:</u> Geometric mean shall not exceed 14/100mL and estimated 90th percentile shall not exceed 31/100mL
Conditionally Approved (Growing Areas affected by Nonpoint Sources)	<u>Systematic Random Sampling</u>: Geometric mean shall not exceed 14/100mL and estimated 90th percentile shall not exceed 31/100mL (for open status)
Restricted (Growing Areas affected by Point Sources and Used as a Source for Shellstock Depuration)	Geometric mean shall not exceed 88/100mL and estimated 90th percentile shall not exceed 163/100mL
Conditionally Restricted (Growing Areas affected by Nonpoint Sources and Used as a Source for Shellstock Depuration)	<u>Systematic Random Sampling</u>: Geometric mean shall not exceed 88/100mL and estimated 90th percentile shall not exceed 163/100mL (for classification)
Prohibited	<u>Geometric mean exceeding 88/100mL and estimated 90th percentile exceeding 163/100mL</u>

[1] Defined in 38 MRSA §466(2): "As naturally occurs" means conditions with essentially the same physical, chemical and biological characteristics as found in situations with similar habitats free of measurable effects of human activity." In practice, the Class GPA standard for *E. coli* may be used as a surrogate target if a freshwater's "natural" bacteria levels are unknown.
*Remote areas is defined where "A sanitary survey determines that the area has no human habitation, and is not impacted by any actual or potential pollution sources"
[2] Standards from *Standard Operating Procedures for the Division of Public Health Shellfish Growing Area Classification Program*, Effective date: April 26, 2007. (Maine DMR 2007)

Figure 3-1. Maine Shellfish Growing Areas Classification



4.0 TMDL

4.1 TMDL Definition

A TMDL identifies the amount of a pollutant the receiving water can assimilate without violating water quality criteria or impairing the designated use. It is the loading capacity of a waterbody including a margin or safety (MOS) to account for uncertainty in target-setting. The TMDL allocates pollutant loads among permitted point source (PS) discharges, under Section 402 of the CWA National Pollutant Discharge Elimination System (NPDES), and nonpoint source (NPS) discharges. A TMDL can be represented as:

$$TMDL = Loading\ Capacity = \sum WLA + \sum LA + MOS$$

Where:

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

$\sum LA$ = 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, toxicity or other appropriate measures (40 C.F.R. §130.2(i)). The WLA and LA both need to account for existing and future loads.

The 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.

4.2 Loading Capacity, MOS, and Allocations

Maine's bacteria TMDLs consist of two formats of targets for allowable levels of bacteria:

- Concentrations of bacteria (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 (e.g., swimming and boating) and shellfishing, and to meet the associated criteria in Maine's water quality standards. Both formats of the TMDLs are considered by DEP to be daily targets. The targets apply on any given day to assure achievement of bacteria water quality criteria whenever the water quality standards are in effect.

These TMDLs set a goal of meeting bacteria water quality criteria at the point of discharge for all sources in order to meet water quality standards throughout the waterbody. Of the two TMDL formats presented, Maine DEP believes that the concentration-based TMDL is most useful format for guiding both remediation and protection efforts in watersheds. A concentration target is more readily understandable to the public, and allows interested citizens and/or watershed groups to determine easily whether any particular source is exceeding its allocation. Appendix III, TMDL Calculations & Graphs covers calculation loads and relationships between constituents.

As mentioned above, the MOS, which accounts for assumptions or lack of knowledge about linking loading allocations with water quality impairment, can be explicit or implicit. The two types or forms of the bacteria TMDL targets described in more detail below have different types of MOS due to the different calculations used for TMDL development.

4.2.1 Concentration TMDLs

The concentration bacteria TMDLs are expressed in terms of colony forming units or bacteria counts per 100mL sample (counts/100mL) for the indicator bacterium of concern (e.g., *E coli*, Enterococcus, Fecal Coliform, or Total Coliform), and are equal to the loading capacity.

The concentration bacteria 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 do not rely on in-stream processes, such as bacteria die-off, dilution and settling (which are known to reduce in-stream bacteria concentrations). The Maine bacteria TMDLs represent very conservative TMDL target-setting, so there is a high level of confidence that the TMDLs established are consistent with water quality standards, and the entire loading capacity can be allocated among sources. 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 concentration bacteria TMDL allocates the load among sources, identifying wasteload allocations (WLA) for NPDES-regulated sources, and load allocations (LA) 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 at or below the WQS, then the concentration of bacteria within the receiving water will attain WQS. Table 3-1 in Section 3.2 provides a summary of the WQS applicable to Maine waters. There are two types of criteria for fresh and marine waters (non-shellfish harvesting areas) in the State: instantaneous sample and geometric mean. 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 or a statistical percentile under either a random sampling or adverse pollutant condition (e.g., wet weather, during effluent discharge, etc).

Tables 4-1 through 4-3 presenting the loading allocations concentration bacteria TMDLs by waterbody class and potential bacteria source are provided below. These tables represent WLAs and LAs based on water quality standards current as of the publication date of these TMDLs. If the bacteria criteria change in the future, MEDEP intends to revise the TMDL to reflect the revised criteria, with opportunity for public review and comment.

Table 4-1. TMDLs, WLAs, and LAs for Fresh Water Bacteria (May 15 – September 30).

		Instantaneous *E. coli* (#/100mL)		Geometric Mean *E. coli* (#/100mL)	
Class	**Bacteria Source**	**WLA**	**LA**	**WLA**	**LA**
AA	Non-Stormwater NPDES	0		0	
	Illicit sewer connection	0		0	
	Leaking sewer lines	0		0	
	Stormwater (NPDES)	As naturally occurs[1]		As naturally occurs[1]	
	Stormwater (non- NPDES)		As naturally occurs[1]		As naturally occurs[1]
	Wildlife direct discharge		As naturally occurs[1]		As naturally occurs[1]
	Human or domestic animal direct discharge		0		0
A	Non-Stormwater NPDES	0		0	
	CSOs	0		0	
	SSOs	prohibited		prohibited	
	Illicit sewer connection	0		0	
	Leaking sewer lines	0		0	
	Stormwater (NPDES)	As naturally occurs[1]		As naturally occurs[1]	
	Stormwater (non- NPDES)		As naturally occurs[1]		As naturally occurs[1]
	Wildlife direct discharge		As naturally occurs[1]		As naturally occurs[1]
	Human or domestic animal direct discharge		0		0
B[2]	Non-Stormwater NPDES	236		64	
	CSOs	236		64	
	SSOs	0		0	
	Illicit sewer connection	0		0	
	Leaking sewer lines	0		0	
	Stormwater (NPDES)	236		64	
	Stormwater (non- NPDES)		236		64
	Wildlife direct discharge		As naturally occurs[1]		As naturally occurs[1]
	Human or domestic animal direct discharge		236		64
C[2]	Non-Stormwater NPDES	236		126	
	CSOs	236		126	
	SSOs	0		0	
	Illicit sewer connection	0		0	
	Leaking sewer lines	0		0	
	Stormwater (NPDES)	236		126	
	Stormwater (non- NPDES)		236		126
	Wildlife direct discharge		As naturally occurs[1]		As naturally occurs[1]
	Human or domestic animal direct discharge		236		126
GPA[3]	Non-Stormwater NPDES	0		0	
	CSOs	0		0	
	SSOs	0		0	
	Illicit sewer connection	0		0	
	Leaking sewer lines	0		0	
	Stormwater (NPDES)	194		29	
	Stormwater (non- NPDES)		194		29
	Wildlife direct discharge		As naturally occurs[1]		As naturally occurs[1]
	Human or domestic animal direct discharge		194		29

Human direct discharge = swimmers

[1] Defined in 38 MRSA §466(2): "As naturally occurs" means conditions with essentially the same physical, chemical and biological characteristics as found in situations with similar habitats free of measurable effects of human activity." In practice, the Class GPA standard for *E. coli* may be used as a surrogate target if a freshwater's "natural" bacteria levels are unknown.

[2] WLA and LA refer to *E. coli* of human and domestic animal origin.

[3] WLA and LA refer to *E. coli* of human origin; No new direct discharge of pollutants allowed [38 MRSA §465-A(1)(C)].

Table 4-2. TMDLs, WLAs, and LAs for Estuarine and Marine Waters (non-shellfish harvesting areas) Bacteria (May 15 – September 30).

		Instantaneous Enterococcus (#/100mL)		Geometric Mean Enterococcus (#/100mL)	
Class	**Bacteria Source**	**WLA**	**LA**	**WLA**	**LA**
SA[1]	Illicit sewer connection	0		0	
	Leaking sewer lines	0		0	
	Stormwater (MS4s)	As naturally occurs[2]		As naturally occurs[2]	
	Stormwater (non-MS4)		As naturally occurs[2]		As naturally occurs[2]
	Wildlife direct discharge		As naturally occurs[2]		As naturally occurs[2]
	Human or domestic animal direct discharge		0		0
SB[1]	Non-Stormwater NPDES	54		8	
	CSOs	54		8	
	SSOs	0		0	
	OBDs	54		8	
	Illicit sewer connection	0		0	
	Leaking sewer lines	0		0	
	Stormwater (MS4s)	54		8	
	Stormwater (non-MS4)		54		8
	Wildlife direct discharge		As naturally occurs[2]		As naturally occurs[2]
	Human or domestic animal direct discharge		54		8
SC[1]	Non-Stormwater NPDES	94		14	
	CSOs	94		14	
	SSOs	0		0	
	OBDs	94		14	
	Illicit sewer connection	0		0	
	Leaking sewer lines	0		0	
	Stormwater (MS4s)	94		14	
	Stormwater (non-MS4)		94		14
	Wildlife direct discharge		As naturally occurs[2]		As naturally occurs[2]
	Human or domestic animal direct discharge		94		14

[1] WLA and LA refer to Enterococcus of human and domestic animal origin
[2] Defined in 38 MRSA §466(2): "As naturally occurs" means conditions with essentially the same physical, chemical and biological characteristics as found in situations with similar habitats free of measurable effects of human activity."

Table 4-3. Bacteria (Fecal Coliform) TMDLs WLAs, and LAs for Shellfish Harvesting Areas (applicable year round).

		Geometric Mean Fecal Coliform (#/100mL)		90th Percentile Statistical Measure Fecal Coliform (#/100mL)	
Class[1]	**Bacteria Source**	**WLA**	**LA**	**WLA**	**LA**
Approved and Conditionally Approved Areas (affected by Point or Nonpoint[2] Sources) & Restricted and Conditionally Restricted Areas (affected by Point or Nonpoint Sources[2] & used as a source for shellstock depuration)	Non-Stormwater NPDES	14		31	
	CSOs	14		31	
	SSOs	0		0	
	OBDs	14		31	
	Illicit sewer connection	0		0	
	Leaking sewer lines	0		0	
	Stormwater (MS4s)	14		31	
	Stormwater (non-MS4)		14		31
	Wildlife direct discharge		As naturally occurs3		As naturally occurs
	Human or domestic animal direct discharge		14		31

[1] Classes defined by Maine DMR (2007)
[2] Adverse Condition Allocations apply to areas affected by Point Sources
Adverse Condition or Random Sampling Allocations apply to areas affected by Nonpoint Sources
Adverse condition is defined as "… a state or situation caused by meteorological, hydrological or seasonal events or point source discharges that has historically resulted in elevated [bacteria] levels in a particular growing area. " USFDA 2005
[3]Defined in 38 MRSA §466(2): "As naturally occurs" means conditions with essentially the same physical, chemical and biological characteristics as found in situations with similar habitats free of measurable effects of human activity."

4.3 Seasonal Considerations

Bacteria sources to waters arise from a mixture of continuous and wet-weather driven sources, and there may be no single critical condition that is protective for all other conditions. These bacteria TMDLs have set WLAs and LAs for all allowable known and suspected source categories equal to the WQ criteria or equal to loads which assure WQ criteria are achieved. The bacteria TMDLs apply over the entire seasons that the bacteria criteria apply. Furthermore, the measures implemented to meet the TMDL targets will reduce bacteria concentrations and daily loads to water quality criteria levels for all seasons for which the water quality standards apply. Therefore, the TMDL adequately accounts for seasonal variability.

4.4 Future TMDL Applicability

These bacteria TMDLs may apply to waters found to be impaired in the future, provided that DEP's intent to modify the TMDL is made clear, the public has an opportunity to comment, and EPA approves the proposed TMDL modification. In appropriate circumstances in the future, DEP will submit a TMDL modification to EPA for specific waterbodies to be added for bacteria TMDL coverage, and will use the public notice process associated with the biannual Integrated Report review for public comment. Within the Integrated Report and in its public notice requesting review and comment, Maine will clearly state its intent to relist the newly assessed waterbodies as impaired and to apply the appropriate bacteria TMDLs. This means that future newly assessed bacteria-impaired waters may be proposed for re-listing in Maine's Integrated List directly to Category 4A (impaired, TMDL completed) instead of in Category 5 (§303(d) portion; TMDL needed) . Once EPA approves the TMDL modification as part of the 303(d) list approval, the newly proposed waterbodies will be addressed by the bacteria TMDLs presented in this report.

5.0 MONITORING PLAN

MEDEP relies heavily on bacteria data from quality assured volunteer monitoring programs (Maine's Volunteer River Monitoring Program, VRMP) to indicate problems and to evaluate progress towards attainment of Maine's water quality standards. MEDEP will continue to investigate complaints and inspect potential sources of bacteria. Maine Healthy Beaches routinely collects bacterial samples on recreational beaches to determine safe swimming conditions and this information is widely disseminated through the MHB website. DMR will continue to conduct extensive year-round monitoring evaluations associated with assuring proper classification of shellfish harvest areas. DMR will also continue to rely on fecal coliform data from volunteers in order to identify, investigate, and remediate pollution sources. Adaptive implementation of the remedial measures listed in the Implementation section of this report should be pursued by stakeholders at the local level until water quality standards are met.

6.0 IMPLEMENTATION PLAN

The goal of this TMDL is to restore public confidence and facilitate the recreational enjoyment of local waters, while achieving compliance with Maine's Water Quality Standards. Each bacteria contamination represents a unique problem that results from the interaction between watershed conditions and source activity. Substantial time, financial commitment and community drive will be required to attain the goals and load allocations in this TMDL. This section provides guidance on implementing bacteria TMDLs by identifying existing informational resources on Best Management Practices (BMPs) and through Maine case studies. The case studies are creative examples for communities to use as they search for cost effective solutions. Watershed specific information and monitoring results can be found in Appendix I, Freshwaters and Appendix II, Marine & Estuarine Waters.

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

- Community members make a commitment to fix bacterial contamination
- Identify potential sources of contamination, through surveys and monitoring
- Set specific bacterial pollution targets goals
- Develop a plan to control sources using both BMPs and education
- Implement the plan and continue to monitoring to determine effectiveness

In addition, TMDL implementation should be an iterative process, with realistic goals over a reasonable timeframe and with ongoing adjustments based on monitoring results.

6.1 Best Management Practices & Educational Resources

Most of the bacterial sources identified in this TMDL are associated with stormwater, so in general, BMPs that are designed to address stormwater sources can be adapted to control bacteria laden runoff. Mitigation measures for stormwater are generally not designed to reduce bacteria concentrations. Instead, BMPs are typically designed to remove sediment and other pollutants, but perhaps the most effective means of reducing stormwater contributions to bacteria impairment is to reduce the volume of runoff. Therefore, treatment systems and BMPs that remove sediment may also provide reductions in bacteria concentrations.

This document provides a starting point for education regarding bacterial assessment methods and implementation ideas. Communities throughout the United States are confronting the problems associated with waters contaminated with *E. Coli* and fecal coliform and states are developing TMDLs to address these problems. Stormwater and bacterial remediation is an actively developing and new approaches are continually emerging, therefore practical implementation planning will require a review of the latest BMPs (Clary, et al 2008).

There are a variety of governmental and non-governmental agencies that have developed guidance on BMPs to assist municipalities, homeowners, watershed organizations and volunteer groups with mitigation approaches for bacteria sources. These resources all exist on the internet and are readily obtained by typing ‘Maine stormwater bacteria’ or ‘reduce bacteria bmps’ into an internet search engine, like Google. No comprehensive Maine specific guidance document exists to assist with mitigating bacterial sources, though much information is available at Maine’s Stormwater website (www.thinkbluemaine.org/) and Maine Healthy Beaches (http://www.mainehealthybeaches.org/). A major recommendation of this TMDL is to develop a Maine specific guidance manual on mitigating sources of bacteria.

Here is a list of resources to review while considering options to address bacterial sources:

<u>General Resources – for Stormwater Mitigation</u>

- MEDEP Stormwater Management Law: http://www.state.me.us/dep/blwq/docstand/stormwater/index.htm
- University of New Hampshire Stormwater Center: Effective stormwater management: http://www.unh.edu/erg/cstev/index.htm#
- Maine NEMO: Nonpoint Education for Municipal Officials: http://www.mainenemo.org
- Mitigation Measures to Address Pathogen Pollution in Surface Waters: A TMDL Implementation Guidance Manual for Massachusetts (MADEP 2005): http://www.mass.gov/dep/water/resources/impguide.pdf
- Center for Watershed Protection: http://www.cwp.org/
- EPA’s Stormwater BMPs: http://www.epa.gov/guide/stormwater/

- International Stormwater Best Management Practices (BMP) Database http://www.bmpdatabase.org/

Illicit Discharges

- Illicit Discharge Fact Sheets, Ordinances, Detection & Elimination Methodology: http://www.thinkbluemaine.org/municipal.stm
- Illicit Discharge Detection and Elimination Manual - A Handbook for Municipalities. 2003. New England Interstate Water Pollution Control Commission: http://www.neiwpcc.org/PDF_Docs/iddmanual.pdf

Combined Sewer Overflows

- MEDEP Technical Assistance and Guidance on CSOs. Available at: http://www.maine.gov/dep/blwq/doceng/csotech.htm

Septic Systems

- Septic Systems, How They Work: http://maine.gov/dep/blwq//docgw/septic_systems.pdf.
- Maine Department of Health, Engineering: http://www.maine.gov/dhhs/eng/plumb/index.htm

Pet Waste

- Pet Waster & Water Quality Brochure: www.mainehealthybeaches.org/assets/pdfs/Pet_Waste_Brochure.pdf
- Clean Up Pet and Other Domestic Animal Waste http://www.thinkbluemaine.org/homeown.stm

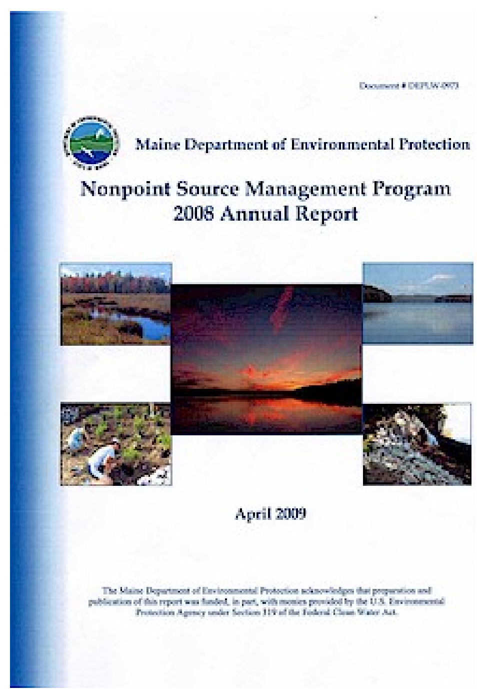
Agriculture -Manure & Grazing

- Manual of Best Management Practices (BMP) For Maine Agriculture http://www.maine.gov/agriculture/narr/documents/index.html

Recreation- Swimming & Boating

- Boater Education & Brochure: http://www.mainehealthybeaches.org/HealthyBoating.pdf
- Boat Pump Out Program: http://www.maine.gov/dep/blwq/docgrant/pumpout.htm
- Healthy Beach Habits : http://www.mainehealthybeaches.org/resources.html

6.1.1 Maine NPS Watershed Management



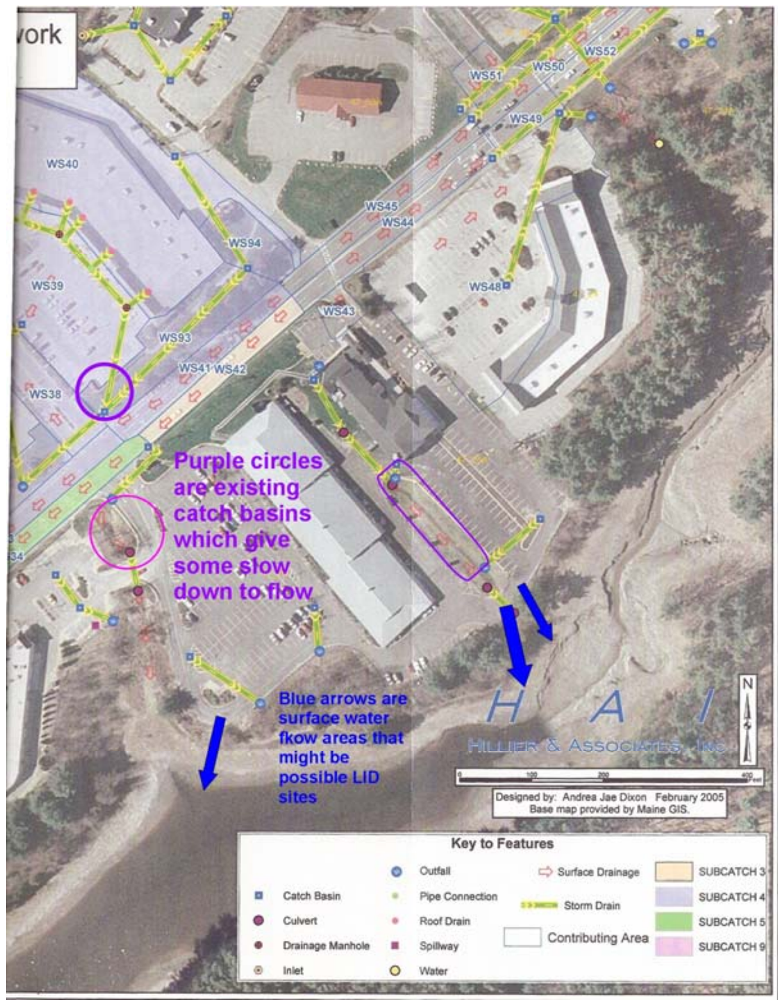
Maine's Nonpoint Source (NPS) Water Pollution Management Program (38 M.R.S.A. §410-I) helps restore and protect water resources from NPS pollution. MEDEP receives federal funds under Section 319 of the Clean Water Act from EPA and uses the funds to identify, prevent or reduce NPS pollution and promote the use of "best management practices" (BMPs) to address pollution. Maine's BMP guidance manuals are available at: www.maine.gov/dep/blwq/training/index.htm. Staff provides technical assistance to local watershed groups and run outreach programs for a variety of target audiences - developers, building contractors, municipal officials, landowners, teachers and the general public. Funds are also used to develop Total Maximum Daily Load (TMDL) assessment reports for waters impaired primarily by NPS pollution, including bacterial pollution.

The program also issues 319 matching (40%) grants to local project sponsors to achieve restoration or improvement goals in watersheds are impaired or considered threatened: http://www.maine.gov/dep/blwq/docgrant/319.htm. In 2006 - 2007, more than 60 active projects were funded under this program and more information is available at: http://www.maine.gov/dep/blwq/docgrant/319_files/reports/index.htm

6.2 Case Studies for Real People

These case studies are taken out of Appendix I and Appendix II to highlight activities and approaches available to assess, investigate and reduce the impact of bacterial impairments.

6.2.1 Spruce Creek, Low Impact Development Retrofit Study



Waterbody:

Spruce Creek Watershed is a 9.6 square mile coastal southern Maine watershed located 90% within the Town of Kittery with the remaining 10% of the headwaters located in the Town of Eliot. The watershed empties into the Piscataqua River 1.5 miles northerly from where the Piscataqua meets the Gulf of Maine. The Spruce Creek watershed is primarily fed by 6 freshwater streams. It contains approximately 3 square miles of tidal area that consists of high salt marsh, ledge, and mud flats.

Location:

Towns of Kittery & Eliot, York County, Maine

Facilitator:

Town of Kittery and Spruce Creek Association

Timeframe:

Spring 2005 to winter 2010

Funding Provided by:

Maine Department of Transportation Surface Water Quality Protection Program and Maine Department of Environmental Protection Nonpoint Source Water Pollution Control Grant ("Section 319")

Problem

Excessive levels of fecal coliform bacteria have led to the closing of shellfish beds and the listing of Spruce Creek on the State of Maine's 303d list. The project partners have completed several assessments to track bacteria sources and several more are planned for this TMDL waterbody. One source of high fecal coliform bacteria is through untreated stormwater from developed areas in the watershed.

The retail outlets corridor stretching along US Route 1 in Kittery contains a large percentage of impervious surfaces and poses large stormwater treatment challenges and impacts directly on Spruce Creek. The Town and the Spruce Creek Association have teamed on several projects and with several funding sources to implement innovative stormwater retrofit and Low Impact Development (LID) projects in this area, both to help to reduce stormwater impacts, as well as to serve as demonstration sites to further educate other businesses, developers and homeowners.

Project Description

In the fall of 2004, the Maine State Planning Office (SPO), the Town of Kittery and the Maine DOT identified 21 possible stormwater retrofit sites within the commercial district of Route 1 in the lower Spruce Creek watershed. The study served as background to apply for the MDOT SWQPP funds (part of the Federal Transportation Enhancement Act for the 21st Century or TEA-21).

In the fall of 2005, the Town and the Spruce Creek Association successfully nominated three rain garden sites to the MDOT SWQPP program and a long process of securing legal rights-of-way and agreements between MDOT and the retail outlet owners was commenced.

In the intervening time, the Town of Kittery and the Spruce Creek Association secured funding from the Maine DEP 319 program and in summer 2008 began a two-year initiative to reduce bacteria, nutrients, toxic chemicals, sediments and habitat alterations aimed at improving the health of the Spruce Creek watershed. The Spruce Creek Watershed Improvement Project (Phase 1) with Section 319 funding is, in part, enabling project partners to determine locations for stormwater retrofit implementation based on current efforts with the Kittery Outlets future capital improvement efforts on private property, roadway maintenance activities and/or municipal planning efforts. The secondary purpose is to continue to raise community awareness in this watershed, with the long-term goal of improving and protecting the water quality of Spruce Creek and the Piscataqua River Estuary.

Under the SCWIP project, stormwater and LID specialist(s) will develop the best stormwater Best Management Practice (BMP) technologies to utilize in the selected retrofit locations. Project partners will implement two stormwater retrofit demonstration areas that will provide significant treatment of stormwater quantity and quality. Site selection is planned to be completed in year one of the project and installation will be complete within two years.

The exception to this timeline is the planned rain garden for the Kittery Premium Outlets and Super Shoes Outlet. These two sites have been designed, the legal issues straightened out, and the contracts secured with the Town of Kittery Public Works to conduct the site work. Therefore, this project is going to continue under the funding from MDOT SWQPP program with a minor addition of funding from the MDEP 319 grant to provide professional landscape design services from a local landscaper. Construction of the first LID site, the rain gardens, is set to begin in November and December 2008.

What We Did

- Were gracious recipients of Maine SPO’s assessment of stormwater retrofit opportunities in this commercial zone
- Worked together to nominate the proposed site to the MDOT SWQPP program
- Waited very patiently while lawyers and engineers developed the project design
- Facilitated discussions with stakeholders (Towns, State departments, businesses)
- Coordinated efforts with the Town’s SCWIP (319-funded) project to ensure success of the project
- Worked with professionals and volunteers to identify other LID sites for the SCWIP project

What We Found

- Kittery outlet owners are quite willing to assist and participate – great partners
- There are dozens, possibly hundreds of potential LID retrofit opportunities

Future Steps

- Demonstration efforts will include one press release and one tour to include commercial, municipal, agency, and citizen attendees.
- Fund installation of future LID sites – use Kittery as a "model LID community"
- Re-open the shellfish beds based on lower bacteria levels

Spruce Creek Volunteer and Stormwater Engineer, Jeff Clifford of Altus Engineering evaluates a LID site before implementation.

6.2.2 Spruce Creek, Neighborhood Septic Social

Water Body:

The Spruce Creek Watershed is described in section 6.2.1.

Location:

Towns of Kittery & Eliot, York County, Maine

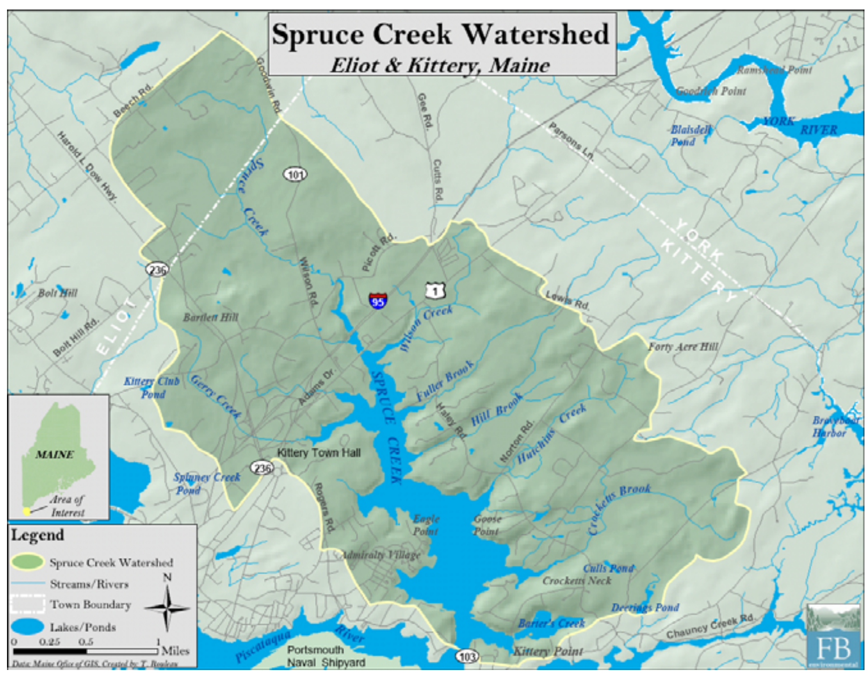
Facilitator:

Town of Kittery and Spruce Creek Association

Timeframe: Summer 2008 – winter 2010

Funding Provided by:

Maine Department of Environmental Protection Nonpoint Source Water Pollution Control Grant ("319"), through the US EPA.



Problem

The towns of Kittery and Eliot have launched a two-year initiative to reduce bacteria, nutrients, toxic chemicals, sediments and habitat alterations aimed at improving the health of the Spruce Creek watershed. These pollutants are the primary sources of impairments identified by federal, state and local assessments and pose the greatest threat human and ecological health. The Spruce Creek Watershed Improvement Project (Phase 1) with Section 319 funding is, in part, enabling project partners to identify and repair failing systems. The secondary purpose is to continue to raise community awareness in this watershed, with the long-term goal of improving and protecting the water quality of the bacteria-impaired (TMDL required) Spruce Creek and the Piscataqua River Estuary.

Project Description

The towns of Kittery and Eliot employed a public outreach approach modeled on the successful Washington Sea Grant Septic Social Program. The grant team has held the first of three planned septic socials in three separate neighborhoods that have evidence of failing septic systems. The social included a presentation by Joe Anderson (of York County Soil & Water Conservation District), then a question and answer session with a local septic designer and a local septic servicing company representative. A septic system factsheet was developed and distributed at the social.

Joe Anderson, of York County Soil & Water Conservation District, presenting a septic social.

What We Did

- Identified a social host and invited neighborhood residents
- Designed and printed social invitations
- Designed and printed septic system informational flyers
- Designed and printed optical brightener fact sheet
- Procured trial samples of organic laundry detergent as "party favors"
- Hosted a septic social with 12 neighbors in attendance (plus 7 team members)

What We Found

- Residents were very attentive during the presentation and quite willing to ask questions of guest speakers
- Attendees noted that while they felt they were fairly knowledgeable about septic systems and their maintenance, they still felt they had learned during the evening's event
- In order to ensure attendance, a combination of mailed invitation and follow-up phone call is best

Future Steps

- Solicit feedback from attendees and speakers to modify presentation and hand-out materials (including those provided by guest speakers)
- Create a press release publicizing the social and inviting others to host
- Adapt YCS&WCD presentation for more coastal (not lake) information
- Identify two additional neighborhoods to conduct additional socials
- Conduct interviews with attendees to solicit feedback and further refine outreach materials and approach

6.2.3 Casco Bay, Shoreline Surveys

One of the goals of the Casco Bay Plan (CBEP 1996, 2006) is to open and protect shellfish areas adversely impacted by poor water quality. While much progress has been made since 1994 (when 37% of the shellfish flats in the Bay were closed), thousands of acres are still impacted or threatened by bacterial pollution. Identification and remediation of the sources of bacteria is necessary to improve water quality and open valuable beds. Shoreline Survey Training augments the capacity of the state to address bacterial pollution by enabling municipal employees to assist Maine Department of Marine Resources (DMR) and Maine Department of Environmental Protection (DEP) with pollution source identification and remediation in the near-shore zone. Training is provided through DMR and DEP with assistance from the U.S. Food and Drug Administration.

Project Description

In order to implement a two-day training session for interested Casco Bay watershed coastal communities, the Casco Bay Estuary Partnership (CBEP) agreed to provide logistical support (assistance with registration, securing space, food, supplies and AV equipment) at a cost of $1,232. The training was advertised through the web and via e-mail. The training course provided basic knowledge of pollution source identification and the steps needed to document actual and potential pollution sources. Both classroom and field instruction in shoreline survey techniques were provided.

Laura Livingstone, Maine DMR, collects a water sample during a 2005 shoreline survey.

Project Outcomes

Over 30 individuals from 12 Casco Bay communities took the training course. They included shellfish wardens, code enforcement officers, public works employees and representatives of shellfish businesses.

Information gathered by the municipal employees trained through this program is being used by the DMR and DEP to assist in their efforts to recognize and address actual and potential problems impacting shellfish areas. Several examples follow.

The Town of Brunswick and the DMR conducted shoreline surveys in areas which were slated to be closed due to expired shoreline survey, preventing the need for the closure. Several problems were identified during the shoreline survey at seasonal properties that would have necessitated the placement of prohibited areas until the issues were resolved. The town was able to ameliorate the problems before the 'season' started which eliminated the need for prohibited areas.

The Town of Yarmouth and the Royal River Conservation Trust had several members trained at the CBEP sponsored course and they have formed the Shoreline Watchers Action Team (SWAT) of Amanda Devine, Tom Connolly, and Bill Longley. The group meets regularly and helps DMR perform shoreline survey work and they do work independently in the upper reaches of their fresh water streams. They have also engaged in discussions with other industrial dischargers to get additional information on the type and quantity of discharges to marine waters.

Finally, David Cheney and Jen Casad from the John's River area in South Bristol/Bristol were in an area impacted by widespread closures due to expired shoreline survey. They worked closely with DEP and DMR to conduct shoreline surveys in teams and quickly returned areas to open status.

Next Steps

The state would be happy to have other groups sponsor the shoreline survey training sessions. Due to the DMR/DEP/FDA/DHHS time commitment for teaching and preparing the course materials, it is preferred that at least 30 people be in attendance. The costs involved would be similar for notebooks, etc. and would also include refreshments at breaks and lunches which are oftentimes provided. Contact Amy Fitzpatrick at Maine DMR for more information.

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6.2.4 Casco Bay, Overboard Discharge Project

Problem

Harvesting shellfish is an important tradition in all of Maine, including Casco Bay. In 2002, nearly 20% of the state licenses were held by commercial harvesters in Casco Bay. Harvesting poses a significant economic benefit to the region, last estimated in 1994 at more than $4 million, with a broader economic value of the fishery (including all of those associated with the industry) between $13 and $14 million (Heinig et al. 1995). As substantial as this value may be, when this study began in 1999, bacterial contamination had caused nearly half of the harvestable areas within the Bay to be closed to harvesting. Because of the obvious potential socioeconomic benefit from opening clam flats, one of the goals of the Casco Bay Plan (CBEP 1996, 2006) is to open and protect shellfish areas adversely impacted by poor water quality.

Project Description

The Casco Bay Estuary Partnership (CBEP) secured a Sustainable Development Challenge grant from the U.S. Environmental Protection Agency (US EPA) with two goals: remediate pollution sources keeping clam flats closed to harvest, and investigate options for sustaining that harvest. In Phase I of this project, with the assistance of many stakeholders, clam resources in 57 closed clam flats in nine municipalities (800 acres) were reviewed and the pollution sources contributing to their closure were identified. Working closely with the municipalities, 21 flats (430 acres) were selected for remediation, based on high clam resource value, ease of remediation, and community support. This process and results for this phase of the project are described in the report Expanding and Sustaining the Shellfisheries of Casco Bay: Phase I. Ranking Clam Flats for Potential Remediation. 1999. In Phase II of this project, (described in the report Expanding and Sustaining the Shellfisheries of Casco Bay: Phases II and III, 2003) again with the assistance of other stakeholders, 3 goals were undertaken:

- ***Remediation*** – Opening clam flats to harvest by partnering with other stakeholders and
- removing pollution sources,
- ***Assessment*** – Understanding nonpoint sources of pollution that affect clam flats and
- ***Management*** –Testing management strategies for increasing and sustaining harvest.

This case study focuses on the Remediation part of the project.

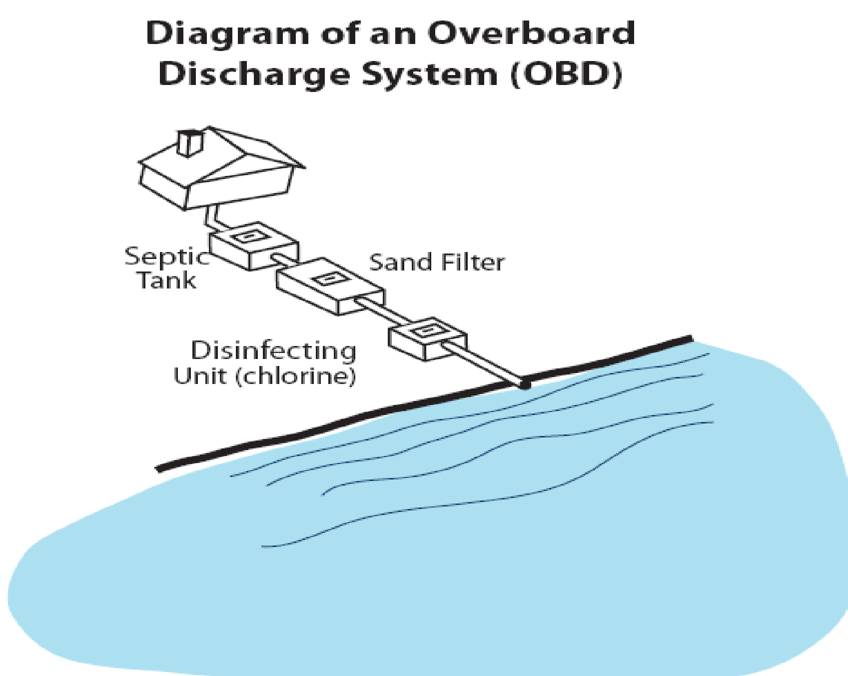
Outcomes: REMEDIATION

Phase I results indicated that in 1999, nearly 430 acres of high value clam habitat in Casco Bay with good water quality were closed to harvest. Nearly half were closed simply due to the presence of a septic design called an overboard discharge (OBD); therefore, this project focused a significant amount of effort on removing these systems. An overboard discharge (OBD) system differs from a conventional subsurface wastewater disposal system because a sand filter or commercial mechanical treatment plant is used for secondary treatment rather than a leach field. As a result, OBDs require chlorination of the wastewater required prior to discharge into a body of water. NSSP regulations prohibit shellfish harvesting near OBDs because of the potential for contamination from system malfunction. In Maine, the discharge of untreated wastes was prohibited in 1973 and lots with unsuitable soils for subsurface disposal received overboard discharge licenses or installed a holding tank. The Overboard Discharge Law (38 M.R.S.A § 411-A) phases out existing non-municipal, overboard discharge systems, and, through a grant program, shares the cost of replacement. Four areas were targeted for OBD removal: Gurnet/Buttermilk Cove in Brunswick/Harpswell and Fosters Point, Birch Point, and Sabino in West Bath. In addition, several sites on the New Meadows River in West Bath were added to the list at the request of the West Bath shellfish committee. These areas contained a total of 31 Overboard Discharge (OBD) systems (8 in Brunswick, 2 in Harpswell, and 21 in West Bath).

Due to staff constraints at the DEP, CBEP agreed to provide project management services to remove licensed OBDs in the targeted areas. CBEP contracted with Normandeau Associates, in association with Albert Frick Associates, to facilitate the OBD removal program, which required the close coordination of several stakeholders:

- The landowner, who was heavily invested in the success of outcome, and in some cases abutters, if easements were required;
- The septic system designer;
- The construction company, who installed the new systems;
- Maine DEP, responsible for licensing (and revoking the license for) OBDs, administering the OBD removal grant program, approving (sometimes with Department of Health and Human Services) replacement systems and variances, when necessary; and
- The municipality, responsible for disbursement of funds, contract for system installation, system approval, variance granting, and negotiation with unhappy landowners.

As of the completion of the Phase II project report in 2003, the OBD removal project resulted in the elimination of 26 of the 31 targeted OBD systems. While over 243 acres of flat were opened during the course of this project, only 25 acres were the direct result of OBD removal. However, increased communication and prioritization of flats as a result of this project played an important role in the opening of the 243 acres.



Maine Department of Environmental Protection and Maine Department of Community and Economic Development, 1993, *Treat it Right: Alternative Wastewater Systems that Protect Water Quality*

Follow-up Steps

As of 2005, the project had helped to open over 300 acres (State of the Bay, 2005). The issues that remained following the project are the most difficult to resolve and require the continued efforts of DEP, DMR and the municipalities. The majority of the openings were facilitated by collaboration with DMR staff who were already working in these areas. Once staff knew where the priorities were, they were able to focus their efforts on the most important areas. The project enhanced collaboration with other stakeholders such as DEP, municipalities, and harvesters, and has continued with groups such as the New Meadows Watershed Committee.

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Normandeau Associates, MER Assessment Corporation, and Albert Frick Associates. Expanding and Sustaining the Shellfisheries of Casco Bay: Phases II and III. 2003. Casco Bay Estuary Partnership

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6.2.5 Seal Harbor Beach, Watershed Survey

Water Body: Seal Harbor on Mount Desert Island is located in the center of this 1.9 square mile watershed over which water flows to popular Seal Harbor Beach.

Location: Hancock County, Maine

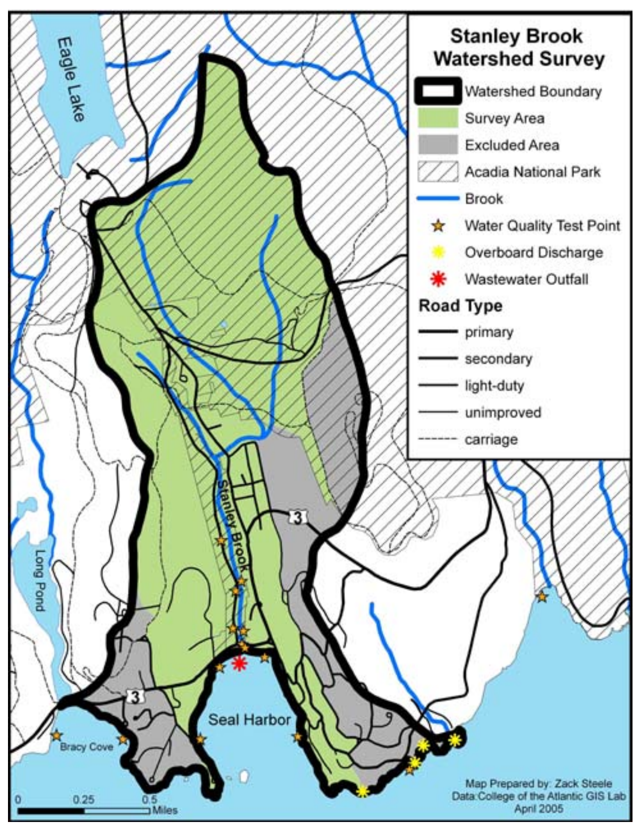
Facilitator: Mount Desert Island Water Quality Coalition

Timeframe: June-October 2005

Funding Provided by:
Maine Healthy Coastal Beaches Program**,**
Mount Desert Island Biological Laboratory**,**
Mount Desert Island Water Quality Coalition**,**
New England Grassroots Environmental Fund and
Seal Harbor Residents

Problem

Town officials were concerned about the potential for outbreaks of swimming illness because of historical high levels of bacteria at the Seal Harbor Beach. People were also upset whenever the beach was closed due to high bacterial counts. On initial investigation it was found that bacterial counts would rise and fall in Stanley Brook but were consistently high at the Route 3 Bridge from Mid-July to the end of August. The Maine Healthy Beaches Program brought together town officials and the MDI Water Quality Coalition to address pollution issues at Seal Harbor Beach.



Project Description

The goals of the watershed survey included identifying pollution sources impacting habitat integrity in Stanley Brook and locating pollution sources contributing to bacteria levels at Seal Harbor Beach. The survey combined the best features of a sanitary shoreline survey, used most often to detect pollution sources impacting shellfish growing areas, and a watershed survey, used most often to identify the types of pollutants that are running off the land into a particular body of water. By combining these approaches we identified sources of pollution and defined the types of pollutants that are impacting water quality in the Stanley Brook Watershed.

Stanley Brook flows through Seal Cove Beach, on Mount Desert Island, ME (above).

What We Did

- Recruited and trained volunteers to identify pollution sources and pollution types (bacteria, nutrients, sediments, toxics, thermal).
- Visited 210 properties in the Stanley Brook watershed, recorded data, and photographed problems.
- Talked with residents and property owners, provided informational pamphlet.
- Conducted additional water quality tests.
- Published a report which can be found at www.mdiwqc.org.

What We Found

- 52 properties had pollution sources including drains, ditches, broken sewer lines, eroding and/or chemically treated lawns, compost piles or yard waste situated close to the brook.
- 71 pollution sources were identified on these 52 properties; 17 of these were considered to be "Major" pollution problems.
- Most of the pollution types (40%) were scored as nutrient and sediment. These pollution types can severely impact the health of a brook, leading to algal blooms, oxygen problems, ruined spawning grounds, and loss of fish and other aquatic species.
- Above ground broken sewer lines and dog waste accounted for most of the bacterial pollution noted in the watershed.

Results of Survey

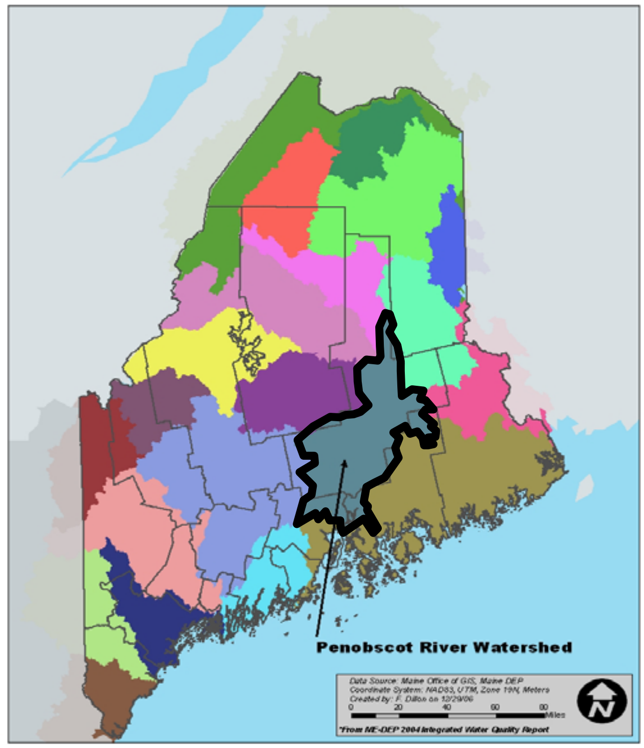
Due to the findings of the watershed survey, a new ordinance in Mt. Desert was passed at town meeting on March 6th 2007. The current ordinance dictates that all above ground private sanitary sewers must be inspected on or before June 1st of each year. It requires conformance with local, state, and federal regulations and addresses sewer pipe materials and installation (HDPE, PVC, Ductile Iron Pipe). It also prohibits construction on town property.

Future Steps

- Form a Watershed Action Plan Steering Committee made up of members of the Stanley Brook Watershed Survey advisory committee, volunteer surveyors, residents, and other interested parties to make short term decisions and begin long term planning for the future of the Stanley Brook Watershed
- Develop a work plan with Hancock County Soil and Water Conservation District to prioritize problems, seek funding sources, and plan improvements.

- Initiate a storm event monitoring project to identify which pollution sources are most severely impacting the stream and beach.
- Expand the Stanley Brook macroinvertebrate study to pin point the most impacted sites on the brook.
- Develop a plan for inspections of all waste treatment systems and sewer lines before the start of each summer season.
- Adopt responsible practices throughout the watershed; everyone can do something; individual property owners, neighborhood groups, the town of Mt. Desert, local contractors and developers, and Acadia National Park. These practices include re-directing runoff, preventing erosion, moving compost piles, limiting fertilizer and pesticide use, repairing private sewer lines, installing and maintaining silt fences at construction sites, and implementing Best Management Practices throughout the Stanley Brook Watershed.

6.2.6 Kenduskeag Stream (Bangor)



Kenduskeag Stream (Segment ID 224R02) is located in the town of Bangor in the Penobscot River Watershed. The listed segment length for Kenduskeag Stream is 3 miles and its total listed watershed area is 39.5 square miles. Potential sources of bacteria impairment are listed as unknown.

Bacteria Data Summary & Percent Reduction Calculations

Bacteria data for the Lower Penobscot River Watershed were collected by FB Environmental staff in spring and summer of 2007 and are presented in Table 14. Three stream segments: Boynton Brook, Kenduskeag Stream, and Otter Stream were listed for "bacteria-only" impairment in the Lower Penobscot River Watershed as specified in Maine's 2004 305(b) report. The instantaneous bacteria standard for Kenduskeag Stream, which is a Class B stream, is 236 MPN/100mL of sample while the geometric mean standard is 64 MPN/100mL of sample.

Bacteria concentrations in Kenduskeag Stream were observed to exceed the instantaneous standard in 3 of 15 surveys conducted throughout the 2007 sampling period, with bacteria concentrations of 1553 MPN/100mL on June 5th, 579 MPN/100mL on June 6th, and 395 MPN/100mL on September 10th. Bacteria concentrations in Kenduskeag Stream met the geometric mean standard for the entire sampling period. Bacteria data were also evaluated on the basis of storm flow and dry weather sampling events. From this perspective, the geometric mean standard was exceeded during the storm events with 174 MPN/100mL and met during the dry weather sampling events.

Bacteria loading reductions required to meet water quality standards were determined for all data throughout the entire sampling period as well as separately for storm flow and dry weather sampling events. These determinations were made for both maximum instantaneous sample results and geometric mean values. (Since it is unlikely that a stream would be listed for impairment based on a single maximum instantaneous sample, % reduction calculations for instantaneous results are presented for illustrative purposes only).

The geometric mean for the overall results was below (i.e., in compliance with) the water quality standard; therefore the % reduction calculation for this criterion does not apply. For storm samples, the % reduction required to comply with the geometric mean standards is 63.3% (Table 14). Bacteria concentration reductions needed to attain the instantaneous water quality standard were 84.8% for both the overall and storm event results. The instantaneous result and geometric mean for dry weather conditions complied with standards and, therefore, do not require % reduction calculations.

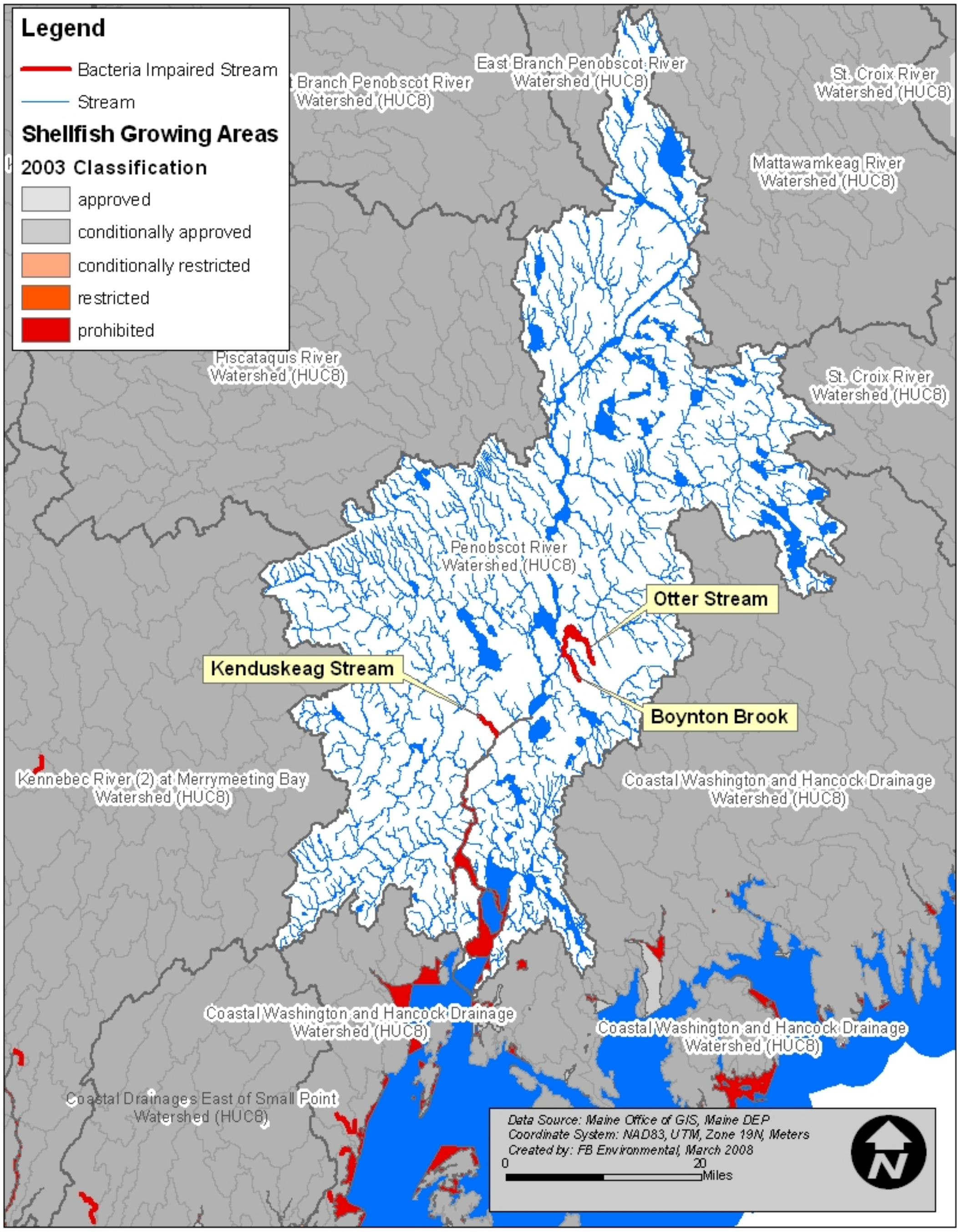
Bacteria data summary for Kenduskeag River, with wet and dry weather assessment.

Kenduskeag - Bangor	Sampler	Sample Time	Current Weather	Precip* on sampling day	Precip 1 day prior	Precip 2 days prior	Precip 3 days prior	Precip 4 days prior	Storm Sample?	Water temp	*E. coli* (MPN)**	% Reduction to Meet WQS	Comments***
Storm Samples				*Precip data for Harmony, ME (Source: NOAA / NWS)*									
16-May-07	TR	12:00	Rain	0.55	0.05	0.00	0.00	0.13	y	13	126		Avg of 2 samples: 122 and 129
5-Jun-07	TR	13:00	Clear	0.94	0.13	0.17	0.00	0.01	y	19	**1553**		
6-Jun-07	TR	13:30	Clear	0.02	0.94	0.13	0.17	0.00	y	20	**579**		
5-Jul-07	TR	14:15	Overcast	0.18	0.02	0.00	0.00	0.00	y?	22	115		Storm sample
7-Aug-07	MW	9:10	-	0.90	0.00	0.00	0.77	0.00	y?	-	112		Base flow sample
10-Sep-07	MW	9:00	-	0.49	0.00	0.00	0.00	0.00	y?	-	**395**		Very low base flow
17-Sep-07	MW	13:30	-	0.00	0.18	0.05	0.00	0.00	y?	19	9		Lowest level MW has seen on the Kenduskeag.
								Storm Results:		Max:	**1553**	84.8%	% reduction for instantaneous WQS (236 col/100 mL)
										Geomean:	**174**	63.3%	% reduction for geomean WQS (64 col/100 mL)
Dry Weather Samples													
9-May-07	TR	12:30	Ptly cldy	0.00	0.00	0.00	0.00	0.00	n	15	7		Fyke net upstream
23-May-07	TR	11:50	Clear	0.00	0.00	0.09	0.04	0.68	n	15	20		Fyke net removed
21-Jun-07	TR	9:50	Clear	0.04	0.00	0.00	0.00	0.00	n	24	50		Average of two samples: 56 and 44
21-Jun-07	TR	9:50	Clear	0.04	0.00	0.00	0.00	0.00	n	24	44		Lab split
18-Jul-07	MW	14:00	Overcast	0.00	0.00	0.04	0.00	0.22	n	-	35		Base flow sample
1-Aug-07	MW	10:10	Clear	0.00	0.00	0.00	0.00	0.05	n	-	20		Base flow sample
2-Aug-07	MW	-	Clear	0.00	0.00	0.00	0.00	0.00	n	25	14		Average of two samples: 10.7 and 17.3. Water level very low.
21-Aug-07	MW	-	-	0.00	0.00	0.02	0.30	0.28	n	-	12		Low base flow
								Dry Results:		Max:	50	na	% reduction calculation results in negative number
										Geomean:	21	na	% reduction calculation results in negative number.
								Overall Results:		Max:	**1553**	84.8%	% reduction for all samples using instant WQS (236 col/100 mL)
										Geomean:	56	na	% reduction calculation results in negative number.

** Precip data for Harmony, ME (Source: NOAA / NWS)*

* **Bold red values** indicate exceedance of instantaneous of Maine Class B WQS (236 col/100 mL sample) or geometric mean WQS (64 col/100 mL sample).

** Storm event defined as 0.1" in previous 24 hr of sample collection; 0.25" in previous 48 hours; or 2" in previous 96 hours.



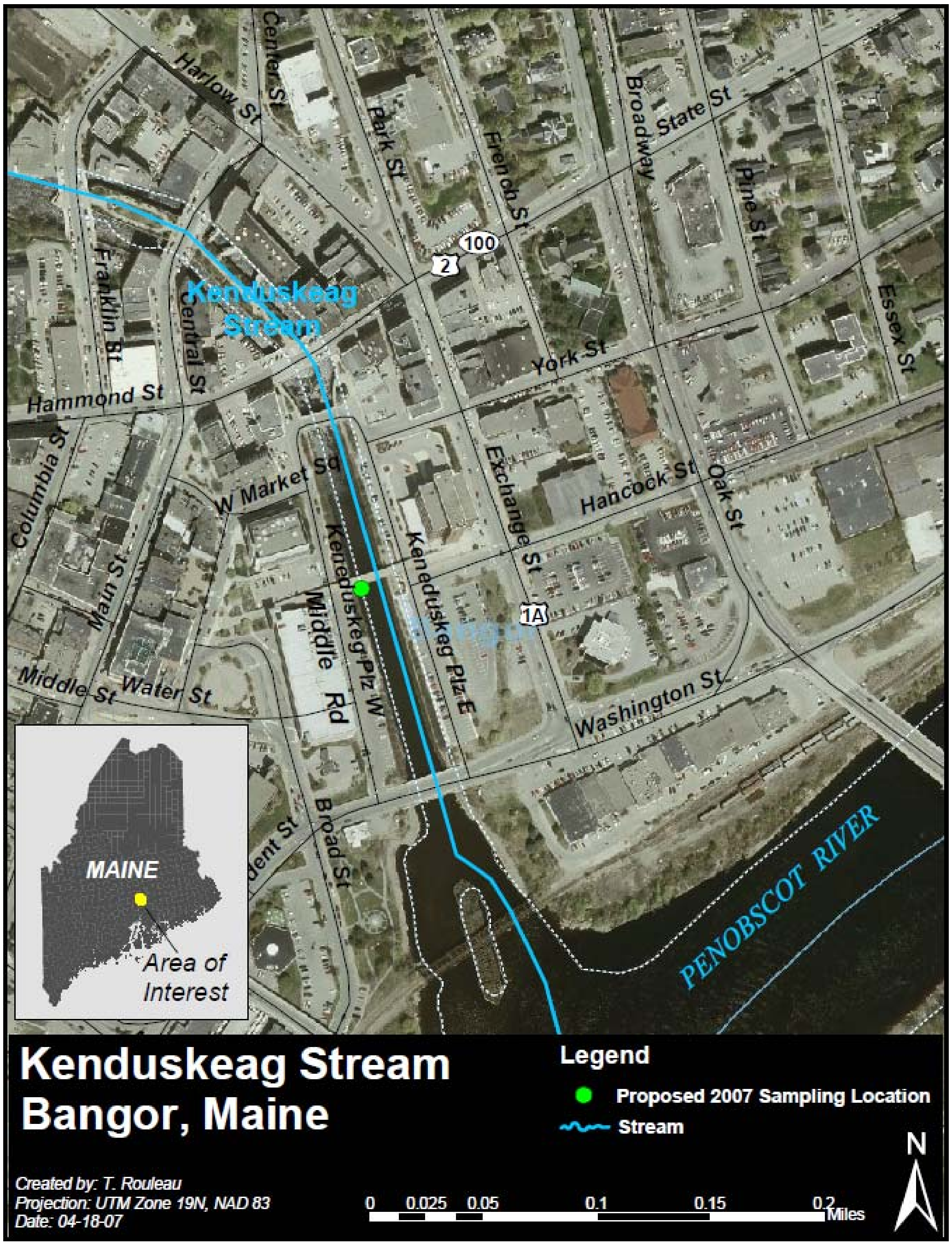
***Penobscot River Watershed with the impaired waterways indicated*.**

Watershed Characterization

The aerial photo (figure 52) shows Kenduskeag Stream as it passes through Bangor. The Kenduskeag Stream watershed was delineated for the area directly draining to the impaired segment to indicate the surrounding land cover types potentially affecting bacteria concentrations in this vicinity (Figure 53). A view of the larger watershed is shown in the land cover map and statistics on the following page. The watershed area as delineated is approximately 43.34 square miles, and impervious surfaces are estimated to total 12% of this area. Stream gradient is low with a slope over the segment length of about 0.38%.

Forest constitutes a majority of the land use area at 57.3%. Developed uses are significant at 22%. Agricultural land uses, some of which are directly adjacent to the stream, are calculated as 11.9% of watershed area. Wetlands and open water add 7.3% of watershed area, and grass / scrub makes up the smallest of these aggregated categories at 1.5% of the watershed.

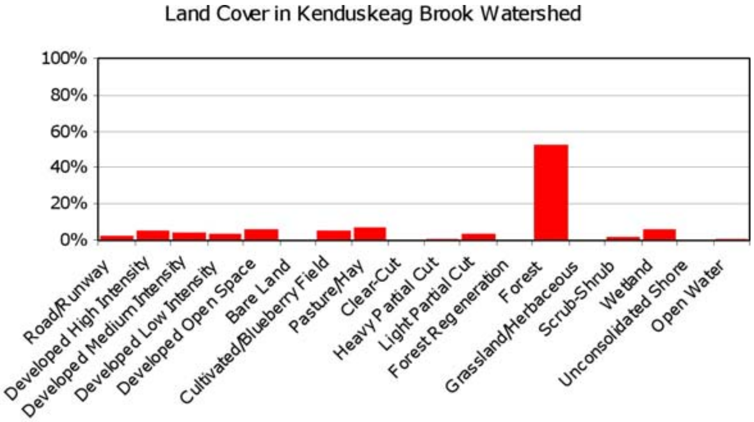
Development dominates the lowest reaches of the stream, suggesting sources such as aging septic or sewer infrastructure and pet waste may also be present. Agriculture could be source through the spreading of manure or the presence of livestock directly.

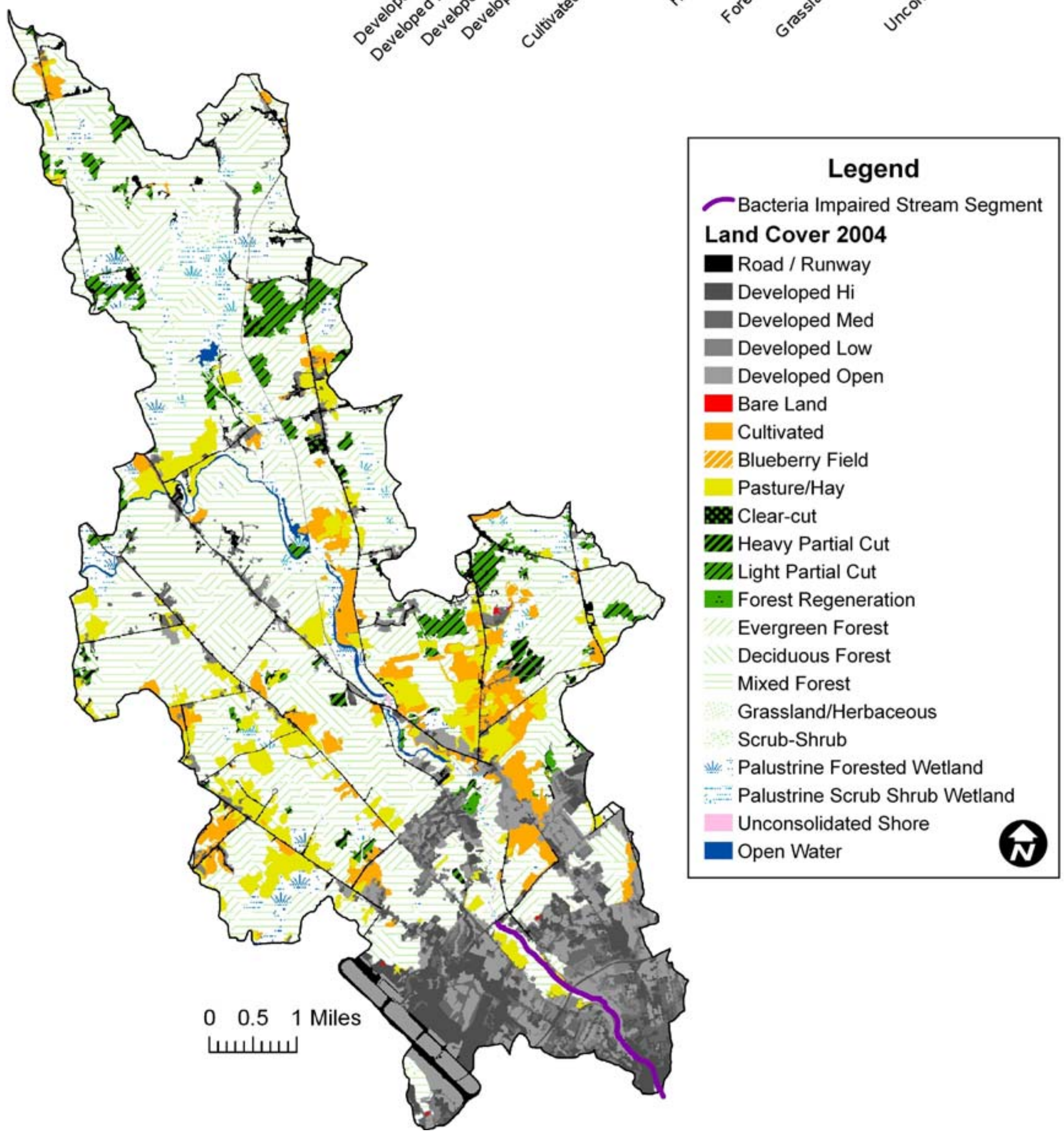


Aerial photograph of Kenduskeag Stream and surrounding area.

Watershed Statistics

watershed area (sq mi)	43.34
impervious surface	12.0%
length (miles)	2.96
highest elevation (ft)	60
lowest elevation (ft)	0
drop (ft)	60
slope	-0.38%





Kenduskeag Stream watershed land cover map and statistics.

Recommended Mitigation Strategies

Developed areas (22%) and impervious surfaces (12%) are substantial in the Kenduskeag Stream watershed. The nature and location of the development crowds the lower reaches of the river, although there are notable reaches with forested riparian buffer. It is possible that a few wastewater systems serving structures the area may be malfunctioning. This pollution may be exacerbated by rain, which can essentially wash wastewater out of containment systems and into streams. Alternately, a constant volume of wastewater discharge from a structure into a stream may result in more severe impairments during dry conditions, when there is less stream water to dilute the incoming pollution. Another possible source of pollution from the developed areas is improperly managed pet waste, which tends to lead to elevated bacterial concentrations after rain. Since Kenduskeag Brook watershed contains significant amounts of forests (approximately 57% of area), wildlife inhabiting these areas also could conceivably contribute fecal contamination to the river.

There are several approaches to mitigation. First, a sampling plan can be designed to better pinpoint the location and weather conditions of impairment. For example, collecting samples both upstream and downstream of the developed area could reveal where impairment is greatest, which can also help suggest which sources (urban or agricultural/wildlife) are more likely. Several sampling events would be needed in order to provide a representative view of conditions and overcome the natural variability of bacterial concentrations in streams.

Fecal contamination from wastewater system malfunction can require considerable effort to locate and correct. Record-keeping before the mid-1970’s is spotty, after which Maine’s wastewater permitting system began to become progressively more stringent. Both the municipality and the state keep records of septic system permits, although they are not necessarily digitized or entered into a database. Once a malfunctioning systems is located, enforcement of repair may require extensive follow-up by the municipality. The expense of wastewater system repair or replacement can sometime stall efforts at enforcement if a municipality is reluctant to make a special assessment against the property and supplemental financing is not available.

Areas served by sewer are generally easier to assess for potential malfunctions, and repair is more generally prompt when a problem is found. A complicating factor may be property owners who have been granted waivers from connecting to the public sewer, and research of municipal records may be needed to identify these gaps in service. A comprehensive analysis of wastewater systems, both private and public, conducted in close collaboration with the sewer district and municipal officials is the best approach to locating and fixing infrastructure problems which are contributing to stream impairment, because it is comprehensive and builds awareness of the impairment among a variety of stakeholders.

Pet waste is another likely source of bacteria in developed areas. Reduction of this impairment can be achieved by conducting detailed sanitary survey along the stream corridor to document pet waste management problems. Parks can be equipped with sanitary bags to assist pet owners in cleaning up after their pets, and a variety of educational outreach activities, from mailing brochures or postcards to publishing a slideshow on local access cable TV can result in greater public awareness and eventually help change habits. It is also possible for a single individual to contribute greatly to an impairment (for example, dumping cat litter or other pet waste next to a stream).

7.0 REASONABLE ASSURANCE

The TMDL targets for point sources in this TMDL are not less stringent based on any assumed nonpoint source reductions; therefore, documentation of reasonable assurance in the TMDL is not a requirement. Nevertheless, reasonable assurances that both point and non-point allocations will be achieved include a combination of regulatory and non-regulatory program support in Maine, including: regulatory enforcement, availability of financial incentives, and local, state, and federal programs for pollution control. CSOs are regulated under an existing federal and state program. Communities subject to stormwater NPDES permit Phase I and II coverage will address discharges from municipally-owned stormwater drainage systems. Enforcement of regulations controlling non-point source discharges include local implementation of Maine's Natural Resources Protection Act and Site Location Development Law (38 MSRA, Chapter 3, §§ 480-490).

There are only a few categories of sources of bacteria and many of the necessary remedial actions to address these sources are well known. The 'Maine Stormwater Best Management Practices Manual' (MEDEP 2006) and the resources identified in the Implementation section provide communities with information on effective mitigation of bacteria sources. Financial incentives include federal and state funds available under §319 and 104(b) programs of the Clean Water Act, as well as the State Revolving Loan Program. Other potential funds and assistance are available through Maine's Department of Agriculture program, and the U.S. Department of Agriculture's Natural Resources Conservation Services.

8.0 PUBLIC PARTICIPATION

Public participation the Maine Statewide Bacteria TMDL development was ensured through several avenues to enable DEP to receive feedback and comments. A preliminary draft TMDL was reviewed by Bureau of Land and Water Quality staff (D. Courtemanch, D. Witherill, B. Welch, N. Marcotte, B. Mower, J. Stahlnecker) and the document was further reviewd at a DEP staff meeting. Prior to the formal public review the document was also distributed to DMR and the MHB program for comment. A presentation of an early draft was also given to the Presumpscot River Watershed Coalition and Casco Bay Estuary Project for feedback.

This draft was made available for a 30 day public review period beginning on May 29, 2009. A notice with a link to the public review draft has been distributed, via email, to the following interested parties and watershed stakeholder organizations:

- Sheepscot Valley Conservation Association
- Sheepscot Watershed Council
- Casco Bay Estuary Project, Portland
- Friends of Casco Bay, South Portland
- Cumberland County Soil and Water Conservation District
- Kennebec County Soil and Water Conservation District
- Department of Marine Resources
- Maine Healthy Beaches Program
- Presumpscot River Watershed Coalition
- Spruce Creek Watershed Association
- Conservation Law Foundation, Maine Office
- Penjajawoc Watershed Council
- City of Portland
- Town of Freeport
- MS4 Area Stormwater Groups

The email also requests that the notification be further distributed to organization members or any other interested persons. Almost all comments DEP has received on TMDL's posted for review for the last few years have come from this type of direct email notification.

Paper and electronic forms of the *Maine Statewide Bacteria TMDL* were made available for public review by posting DEP Comment Web site (http://www.maine.gov/dep/blwq/comment.htm) and a notice was placed in the 'legal' advertising of a local newspaper. Any requests for hard copies due to difficulties with downloads are immediately sent out. The following ad was printed in the Sunday editions of the Portland Press Herald and the Bangor Daily during the public review period. The U.S. Environmental Protection Agency (Region I) and the interested public were initially provided a 30 day period (from May 29 to June 30, 2009), to respond with comments.

PUBLIC NOTICE FOR MAINE STATEWIDE BACTERIA TMDL -In accordance with Section 303(d) of the Clean Water Act, and implementation regulations in 40 CFR Part 130, the Maine Department of Environmental Protection has prepared a Total Maximum Daily Load (TMDL) report for all waters in the State of Maine with excessive levels of bacterial contamination. This TMDL report describes: bacterial impairments in fresh, estuarine, & marine waters of Maine, potential sources of contamination, the targets for healthy levels of bacteria, and approaches needed to restore these waters. This report is posted at the DEP website: http://www.maine.gov/dep/blwq/comment.htm or to receive copies please contact Melissa Evers at 287-3901 or *melissa.evers@maine.gov*.

SEND ALL WRITTEN COMMENTS BY JUNE 30, 2009 TO MELISSA EVERS, MAINE DEP, STATE HOUSE STATION #17, AUGUSTA, ME 04333, OR EMAIL:. MELISSA.EVERS@MAINE.GOV.

Some stakeholders requested more time was to review the document and the deadline was extended to July 15, 2009. All written comments received and the associated DEP response are provided in Appendix V.

9.0 REFERENCES

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