Final Pathogen TMDL for the Buzzards Bay Watershed

March 2009

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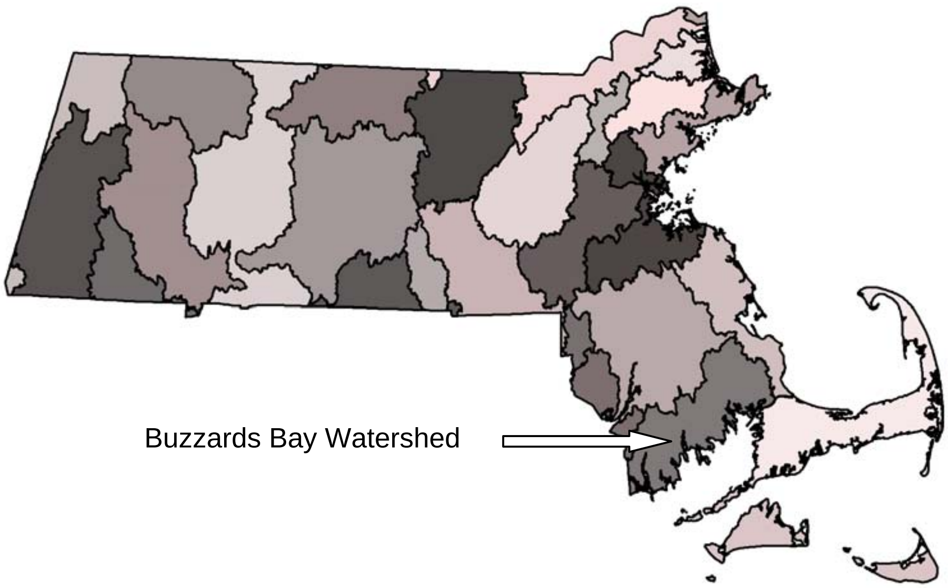

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References to trade names, commercial products, manufacturers, or distributors in this report constituted neither endorsement nor recommendations by the Division of Watershed Management for use.

Much of this document was prepared using text and general guidance from the previously approved Neponset River Basin and the Palmer River Basin Bacteria Total Maximum Daily Load documents.

ACKNOWLEDGEMENTS

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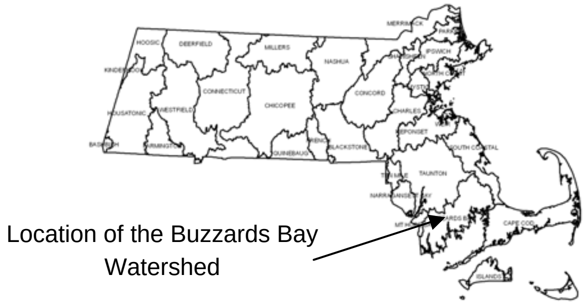
Thanks is also given to our colleagues at the Massachusetts Office of Coastal Zone Management (MCZM), the Division of Marine Fisheries (DMF), and to the City of New Bedford Shellfish Warden for providing important data and information needed to develop this report.

Finally, special recognition is given to Dr. Joseph Costa from the Buzzards Bay National Estuaries Program for allowing MassDEP to use important data and stormwater mapping previously published in the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed".* That document represents a premier effort to begin the work of identifying hotspot bacterial sources of pollution.

Total Maximum Daily Loads for Pathogens within the Buzzards Bay Watershed



Key Features: Pathogen TMDL for the Buzzards Bay Watershed
Location: EPA Region 1
Land Type: New England Coastal
303(d) Listings: Pathogens
Acushnet River (MA95-31, MA95-32, MA95-33); Agawam River (MA95-29); Apponagansett Bay (MA95-39); Aucoot Cove (MA95-09); Beaverdam Creek (MA95-53); Broad Marsh River (MA95-49); Buttermilk Bay (MA95-01); Buttonwood Brook (MA95-13); Cedar Island Creek (MA95-52); Clarks Cove (MA95-38); Crooked River (MA95-51); East Branch Westport River (MA95-40; MA95-41); Hammett Cove (MA95-56); Hiller Cove (MA95-10); Mattapoisett Harbor (MA95-35); New Bedford Inner Harbor (MA95-42); Onset Bay (MA95-02); Outer New Bedford Harbor (MA95-63); Sippican Harbor (MA95-08); Sippican River (MA95-07); Slocums River (MA95-34); Snell Creek (MA95-45); Wankinco River (MA95-50); Wareham River (MA95-03); West Branch Westport River (MA95-37); Westport River (MA95-54); Weweantic River (MA95-05); Snell Creek (MA95-44); Snell Creek (MA95-59); Mattapoisett River (MA95-60); Nasketucket Bay (MA95-65); Little Bay MA95-64); Bread and Cheese Brook (MA95-58); Buzzards Bay (MA95-62); Eel Pond (MA95-61); Cape Cod Canal (MA95-14); Eel Pond (MA95-48); Back River (MA95-47); Phinneys Harbor (MA95-15); Pocasset River (MA95-18); Pocasset Harbor (MA95-17); Red Brook Harbor (MA95-18); Herring Brook (MA95-21); Harbor Head (MA95-46); Wild Harbor (MA95-20); West Falmouth Harbor (MA95-22); Great Sippewisset Creek (MA95-23); Little Sippewisset Marsh (MA95-24); Quissett Harbor (MA95-25).

Data Sources: MassDEP "Buzzards Bay Watershed 2000 Water Quality Assessment Report"
- MA Division of Marine Fisheries Shellfish Data
- MA Department of Public Health Beaches Data
- MA Coastal Zone Management (CZM) "Atlas of Stormwater Discharges in the Buzzards Bay Watershed"

Data Mechanism: Massachusetts Surface Water Quality Standards for Fecal Coliform; The Federal BEACH Act; Massachusetts Department of Public Health Bathing Beaches; Massachusetts Division of Marine Fisheries Shellfish Sanitation and Management; Massachusetts Coastal Zone Management

Monitoring Plan: Massachusetts Watershed Five-Year Cycle; Division of Marine Fisheries Shellfish data; Department of Public Health Beaches data; Coastal Zone Management data.

Control Measures: Watershed Management; Storm Water Management (e.g., illicit discharge removals, public education/behavior modification); CSO & SSO Abatement; Agricultural and other BMPs; No Discharge Areas; By-laws; Ordinances; Septic System Maintenance/Upgrades

Executive Summary

Purpose and Intended Audience

This document provides a framework to address bacterial and other fecal-related pollution in surface waters of Massachusetts. Fecal contamination of our surface waters is most often a direct result of the improper management of human wastes, excrement from barnyard animals, pet feces and agricultural applications of manure. It can also result from large congregations of birds such as geese and gulls. Illicit discharges of boat waste are of particular concern in coastal areas. Inappropriate disposal of human and animal wastes can degrade aquatic ecosystems and negatively affect public health. Fecal contamination can also result in closures of shellfish beds, beaches, swimming holes and drinking water supplies. The closure of such important public resources can erode quality of life and diminish property values.

Who should read this document?

The following groups and individuals can benefit from the information in this report:

a) towns and municipalities, especially Phase I and Phase II storm water communities, that are required by law to address storm water discharges and/or combined sewage overflows (CSOs) and other sources of contamination (e.g., broken sewerage pipes and illicit connections) that contribute to a waterbody's failure to meet Massachusetts Water Quality Standards for pathogens;

b) MassHighway and other state and local highway agencies that are responsible for stormwater management and contributes stormwater to local surface waters..

c) watershed groups that wish to pursue funding to identify and/or mitigate sources of pathogens in their watersheds;

d) harbormasters, public health officials and/or municipalities that are responsible for monitoring, enforcing or otherwise mitigating fecal contamination that results in beach and/or shellfish closures or results in the failure of other surface waters to meet Massachusetts standards for pathogens;

e) citizens that wish to become more aware of pollution issues and may be interested in helping build local support for funding remediation measures.

f) government agencies that provide planning, technical assistance, and funding to groups for bacterial remediation.

Major Bacteria Sources and Prioritized Areas

During the last decade, municipalities have made significant investments and progress in controlling bacteria impacts to the various rivers, tributaries and estuary areas in The Buzzards Bay watershed. For example, the City of New Bedford has made substantial progress in addressing CSO's since 1989. There are currently 27 CSO outfalls (formerly 41 in 1989) discharging into Clark's Cove, Acushnet River, New Bedford Harbor, and Buzzards Bay (Shepherd 2007). Improvements have resulted in the reopening of two shellfish beds, which have been closed for 30 years. Work towards mitigating CSO impacts is ongoing and part of the City of New Bedford's long term CSO control plan. The City was awarded $ 22 million in FY '07 SRF funds for implementing these long- term controls and is on the 2009 state intended use plan for $19.3 million of SRF funds to reduce CSO by removing major grit blockages within the system.

The majority of segments (45 out of 52) covered in this document are currently on the State list of Impaired Waters (303d list) for pathogen impairment and are located within estuary areas that are either classified as SA or SB and designated for shell fishing with or without depuration. The vast majority are classified as SA waters which are designated for swimming and shellfish harvesting without additional treatment . In order for estuary areas to meet SA and SB standards, extraordinary work is necessary to detect specific bacteria sources, and remediate them. The goal of this work is to reopen closed shellfishing areas and protect existing shellfishing areas from degradation.

The primary sources of bacteria appear to be; (1) illicit connections, leaking sewer pipes, and sanitary sewer overflows in sewered areas; (2) failing septic systems around embayment's in non-sewered areas; and (3) stormwater runoff. Illicit connections, leaking sewer pipes, and sanitary sewer overflows must be detected (sources) and eliminated. The majority of these sources can be found through the implementation of an effective illicit detection and elimination program and by monitoring dry weather discharges in suspected areas. A comprehensive program needs to be conducted to find sources to bacteria hotspots in the stormwater systems of many communities. The Phase II Stormwater program, required in at least parts of all the communities, is an excellent conduit to do this work.

In regards to stormwater, the Buzzards Bay Watershed has many organizations, public and private, devoted to the sole goal of water quality improvement. These organizations include: The Buzzards Bay Action Committee, The Coalition of Buzzards Bay, Buzzards Bay Project National Estuaries Program, MassDEP, MACZM, DMF, EPA, and the municipalities themselves. The Buzzards Bay National Estuaries Program produced a document, *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed",* which represents a premier effort to begin the work of identifying hotspot bacterial sources of pollution. This detailed effort is often referenced throughout this report. Over 2,600 drainage pipe and road cut discharges are documented and, based on ranking of scores were prioritized into high, medium, or low for remediation activity, Additionally, 12,700 catch basins were also inventoried. In addition, over 37,000 fecal coliform data points were collected by the Division of Marine Fisheries (DMF) in estuarine areas from 1997-2001. The impetus of all these efforts is aimed at providing specific data to help prioritize efforts to improve the water quality in SA and SB waters, so that many of the shellfish areas now closed can reopen. The challenge now is to identify and devote the resources necessary to identify and remediate specific sources in high priority areas.

In addition to identifying the loads necessary to meet water quality standards this TMDL provides guidance for setting bacterial implementation priorities within the Buzzards Bay Watershed. Table ES- 1 below provides a prioritized list of pathogen-impaired segments that will require additional bacterial source tracking work and implementation of Best Management Practices (BMPs). Although ambient water quality data is available, limited source information and data are available in each impaired segment. As a result a simple scheme was used to prioritize segments based on ambient fecal coliform concentrations. High priority was assigned to those segments where either dry or wet weather concentrations (end of pipe or ambient) were equal to or greater than 10,000 cfu /100 ml. Medium priority was assigned to segments where concentrations ranged from 1,000 to 9,999 col/100mL. Low priority was assigned to segments where concentrations were observed less than 1,000 col/100 mL. MassDEP believes the higher concentrations are indicative of the potential presence or raw sewage and therefore they pose a greater risk to the public. It should be noted that in all cases, waters exceeding the water quality standards identified in Table ES- 1 are considered impaired.

Prioritization was adjusted upward based on the proximity of waters, within the segment, to sensitive areas such as Outstanding Resource Waters (ORW's), or where sensitive designated uses must be protected. Examples include, but are not limited to public water supply intakes, public swimming areas, or shellfish areas. Generally speaking, waters that were determined to be lower priority based on the numeric range identified above were elevated up one level of priority if that segment were adjacent to or immediately upstream of a sensitive area. An asterisk * in the priority column of the specific segment would indicate this situation.

Table ES-1. Bacteria Impaired Segment Priorities

Segment ID	Segment Name	Length (mi.) or size (sq.mi.)	Segment Description	Priority
MA95-40	East Branch Westport River	2.85 mi.	Outlet Lake Noquochoke, Westport to Old County Rd. bridge, Westport. (Class B)	Medium
MA95-45	Snell Creek	0.67 mi.	Drift Rd. to Marcus' Bridge in Westport. (Class B)	Medium
MA95-41	East Branch Westport River	2.65 sq.mi.	Old County Road bridge, Westport to the mouth at Westport Harbor, Westport (excluding Horseneck Channel). (Class SB, Shellfishing restricted,0.64/2.65sq.mi.)	High* Shellfishing
MA95-37	West Branch Westport River	1.28 sq.mi.	Outlet Grays Mill Pond, Adamsville, Rhode Island to mouth at Westport Harbor, Westport. (Class SA, Shellfishing	High* Shellfishing

Segment ID	Segment Name	Length (mi.) or size (sq.mi.)	Segment Description	Priority
			open, but impaired 0.78/2.65sq.mi.)	
MA95-54	Westport River	0.74 sq. mi.	From the confluence of the East and West Branches to Rhode Island Sound; Bounded by a line drawn from the southwestern point of Horseneck Point to the easternmost point near Westport Light. (Class SA, Shellfishing, open 0.5 sq.mi.,closed 0.78 sq.mi.)	Medium* Shellfishing
MA95-34	Slocums River	0.67 sq.mi.	Confluence with Paskamanset R., Dartmouth to mouth at Buzzards Bay. (Class SA, Shellfishing open 0.01 sq.mi.,closed 0.66sq.mi)	Medium* Shellfishing Swimming
MA95-44	Snell Creek	1.5 mi.	Headwaters west of Main Street, Westport, to Drift Road Westport	Medium
MA95-59	Snell Creek	0.01 sq.mi.	'Marcus Bridge', Westport to confluence with East Branch Westport River, Westport	Medium* Shellfishing
MA95-31	Acushnet River	2.7 mi	Outlet New Bedford Reservoir to Hamlin Rd. culvert, Acushnet. (Class B)	No Data
MA95-32	Acushnet River	1.10 mi.	Hamlin Rd. culvert to culvert at Main St., Acushnet. (Class B)	Medium
MA95-33	Acushnet River	0.31 sq.mi.	Main St. culvert to Coggeshall St. bridge, New Bedford/Fairhaven. (Class SB, Shellfishing Restricted, entirely)	High* Shellfishing CSOs
MA95-42	New Bedford Harbor	1.25sq.mi.	Coggeshall St. bridge to hurricane Barrier, New Bedford/Fairhaven . (Class SB, Shellfishing Restricted, entirely)	High* Shellfishing
MA95-63	Outer New Bedford Harbor	5.82sq.mi.	Hurricane Barrier to a line drawn from Wilbur Point, Fairhaven to Clarks Point, New Bedford . (Class SA, Shellfishing Open, but entirely restricted)	High* Shellfishing Swimming
MA95-38	Clark Cove	1.90sq.mi.	Semi-enclosed waterbody landward of a line drawn between Clarks Point, New Bedford and Ricketsons Point, Dartmouth (Class SA, Shellfishing Open, but entirely restricted)	High* Shellfishing Swimming
MA95-13	Buttonwood Brook	3.8 mi.	Headwaters at Oakdale St., New Bedford to mouth at Apponagansett Bay, Dartmouth. (Class B)	Low (no data)
MA95-39	Apponagansett Bay	0.95sq.mi.	From the mouth of Buttonwood Brook to a line drawn from Ricketsons Point, New	Medium* Shellfishing

Segment ID	Segment Name	Length (mi.) or size (sq.mi.)	Segment Description	Priority
			Bedford to Samoset St. near North Ave., Dartmouth. (Class SA, Shellfishing Open but restricted 0.68sq.mi.)	Swimming
MA95-35	Mattapoisett Harbor	1.10sq.mi.	From the mouth of the Mattapoisett R., Mattapoisett, to a line drawn from Ned Point to a point of land between Bayview Avenue and Grandview Ave., Mattapoisett. (Class SA, Shellfishing Open, but restricted 0.1/1.1sq.mi.)	Medium* Shellfishing Swimming
MA95-60	Mattapoisett River	0.05	From the River Road bridge, Mattapoisett to the mouth at Mattapoisett harbor, Mattapoisett	Medium* Shellfishing
MA95-65	Nasketucket Bay	3.7	From the confluence with Little bay, Fairhaven to Buzzards bay along Causeway Road, Fairhaven and along a line from the southern tip of Brant Island, Mattapoisett to the eastern tip of West Island, Fairhaven	Medium* Shellfishing
MA95-56	Hammett Cove	0.07sq.mi.	Hammett Cove, Marion to the confluence with Sippican Harbor along a line from the southwestern most point of Little Neck to the end of the seawall on the opposite point. (Class SA, Shellfishing impaired 0.02/0.07sq.mi.)	Medium* Shellfishing Swimming
MA95-08	Sippican Harbor	2.0sq. mi.	From the confluence with Hammett Cove to the mouth at Buzzards Bay (excluding Blakenship Cove and Planning Island Cove), Marion (Class SA, Shellfishing Open, but impaired 0.30 sq mi.)	Medium* Shellfishing Swimming
MA95-09	Aucoot Cove	0.50sq.mi.	From the confluence with Aucoot Creek, Marion to the mouth at Buzzards Bay at a line drawn between Converse Point and Joes Point, Mattapoisett. (Class SA, Shellfishing Open)	Medium* Shellfishing
MA95-10	Hiller Cove	0.04sq.mi.	Area landward of a line drawn between Joes Point, Mattapoisett and the second boat dock northeast of Hiller Cove Lane, Mattapoisett. (Class SA, Shellfishing impaired 0.01 sq.mi.)	Medium* Shellfishing Swimming
MA95-64	Little Bay	0.36 sq.mi.	From the confluence with the Nasketucket River, Fairhaven south to the confluence	Medium* Shellfishing

Segment ID	Segment Name	Length (mi.) or size (sq.mi.)	Segment Description	Priority
			with Nasketucket Bay at a line from the southernmost tip of Mirey Neck, Fairhaven to a point near Shore Drive.	
MA95-07	Sippican River	0.08sq.mi.	County Rd. to confluence with Weweantic R., Marion/Wareham. (Class SA, Shellfishing Open, all impaired)	Medium* Shellfishing
MA95-53	Beaverdam Creek	0.04sq.mi.	Outlet from cranberry bogs of Rte. 6, Wareham to confluence with Weweantic River, Wareham. (Class SA, shellfishing restricted). (Class SA, Shellfishing all impaired)	Medium* Shellfishing
MA95-58	Bread and Cheese Brook	4.9 mi.	Headwaters, north of Old Bedford Road, Westport to confluence with East Branch Westport River, Westport	Medium
MA95-05	Weweantic River	0.62sq.mi.	Outlet Horseshoe Pond, Wareham to mouth at Buzzards Bay, Marion/Wareham. (Class SA, Shellfishing Open, partially impaired,0.45sq.mi.)	Medium* Shellfishing
MA95-29	Agawam River	0.16 mi.	From the Wareham WWTP to confluence with Wankinco River at the Rte. 6 bridge, Wareham. . (Class SB, Restricted)	Medium* Shellfishing
MA95-50	Wankinco River	0.05sq.mi.	Elm St. bridge, Wareham to confluence with the Agawam R., at a line between a point south of Mayflower Ridge Drive and a point north of the railroad tracks near Sandwich Rd., Wareham. (Class SA, Shellfishing Restricted)	Medium* Shellfishing
MA95-49	Broad Marsh River	0.16sq.mi.	From its headwaters in a salt marsh south of Marion Rd. and Bourne Terrace, Wareham to the confluence with the Wareham R. (Class SA, Shellfishing Restricted)	Medium* Shellfishing Swimming
MA95-51	Crooked River	0.04sq.mi.	From the outlet of a cranberry bog, east of Indian Neck Rd., Wareham to confluence with the Wareham R., Wareham. (Class SA, Shellfishing Restricted)	Medium* Shellfishing
MA95-52	Cedar Island Creek	0.01sq.mi.	From the headwaters near intersection of Parker Dr. and Camardo Dr., Wareham to the mouth at Marks Cove, Wareham. (Class SA, Shellfishing Restricted)	Medium* (No Data) Shellfishing
MA95-03	Wareham River	1.18sq.mi.	Rte. 6 bridge to mouth at Buzzards Bay	Medium*

Segment ID	Segment Name	Length (mi.) or size (sq.mi.)	Segment Description	Priority
			(at an imaginary line from Cromset Point to curved point east, southeast of Long Beach point), Wareham. Includes Mark's Cove, Wareham. (Class SA, Shellfishing open, but partially restricted, 0.68/1.18sq.mi.)	Shellfishing
MA95-02	Onset Bay	0.78sq.mi.	Wareham. Class SA, Shellfishing open, but partially restricted, 0.15/0.78sq.mi.)	Medium* Shellfishing
MA95-01	Buttermilk Bay	0.77	Bourne/Wareham. Class SA, Shellfishing open, but partially restricted, 0.16/0.77sq.mi)	Medium* Shellfishing
MA95-62	Buzzards Bay	8.0	Open water area encompassed within a line drawn from Wilbur Point, Fairhaven to Clarks Point, New Bedford to Ricketson Point, Dartmouth to vicinity of Samoset St., Dartmouth down to Round Hill Point, Dartmouth, back to Wilbur Point, Fairhaven	Medium* Shellfishing
MA95-14	Cape Cod Canal	1.13	Connection between Buzzards Bay and Cape Cod Bay in Bourne and Sandwich.	Medium* Shellfishing
MA95-48	Eel Pond	0.03	Salt water pond that discharges to Back River, Bourne.	Medium* Shellfishing
MA95-61	Eel Pond	0.04	Coastal Pond at the head of Mattapoisett Harbor, Mattapoisett	Medium* Shellfishing
MA95-47	Back River	0.08	Outlet of small unnamed pond, downstream from Mill Pond, Bourne to confluence with Phinneys Harbor, Bourne (excluding Eel Pond).	Medium* Shellfishing
MA95-15	Phinneys Harbor	0.73	From the confluence with Back R. to its mouth at Buzzards Bay between Mashpee and Toby's Islands, Bourne.	Medium* Shellfishing Swimming
MA95-16	Pocasset River	0.05	From the outlet of Mill Pond, Bourne to the mouth at Buzzards Bay, Bourne.	Medium* Shellfishing Swimming
MA95-17	Pocasset Harbor	0.33	From the confluence with Red Brook Harbor near the northern portion of Bassett's Island and Patuisett to the mouth at Buzzards Bay between Bassett's	Medium* Shellfishing Swimming

Segment ID	Segment Name	Length (mi.) or size (sq.mi.)	Segment Description	Priority
			Island and Wings Neck, Bourne.	
MA95-18	Red Brook Harbor	0.91	From the confluence with Pocasset Harbor between the northern portion of Bassett's Island and Patuisett to its mouth at Buzzards Bay between Bassett's island and Scraggy Neck, Bourne (including Hen Cove).	Medium* Shellfishing Swimming
MA95-21	Herring Brook	0.01	From its headwaters, northeast of Dale Dr. and west of Rte. 28A, to its mouth at Buzzards Bay, Falmouth.	Medium Shellfishing
MA95-46	Harbor Head	0.02	The semi-enclosed body of water south of the confluence with West Falmouth Harbor at Chappaquoit Rd., Falmouth.	Medium, Shellfishing
MA95-20	Wild Harbor	0.15	Embayment extends from Point Road, Nyes Neck to Crow Point at the end of Bay Shore Road in North Falmouth	Medium*, Shellfishing
MA95-22	West Falmouth Harbor	0.29	From the confluence with Harbor Head at Chappaquoit Rd., Falmouth to the mouth at Buzzards Bay at a line connecting the ends of the seawalls from Little Island and Chappaquoit Point, Falmouth (including Snug Harbor).	Medium* Shellfishing Swimming
MA95-23	Great Sippewisset Creek	0.03	From the outlet of Beach Pond in Great Sippewissett marsh to the mouth at Buzzards Bay, Falmouth, including the unnamed tributary from the outlet of Fresh Pond, and Quahog Pond, Falmouth.	Medium* Shellfishing Swimming
MA95-24	Little Sippewisset Marsh	0.02	From the headwaters north of Sippewisset Rd., Falmouth to the mouth at Buzzards Bay near Saconesset Hills, Falmouth.	Medium* Shellfishing Swimming
MA95-25	Quissett Harbor	0.17	The semi-enclosed body of water landward of a line drawn between The Knob and Gansett Point, Falmouth.	Medium* Shellfishing

**It should be noted that in Table ES-1 above, the Mass DEP included the last fourteen segments (starting with MA 95-14 Cape Cod Canal and ending with MA 95-25 Quinsett Harbor), from the Cape Cod Watershed to the Buzzards Bay Watershed because the segments although located on Cape Cod actually discharge to Buzzards Bay.

TMDL Overview

The Massachusetts Department of Environmental Protection (MassDEP) is responsible for monitoring the waters of the Commonwealth, identifying those waters that are impaired, and developing a plan to bring them back into compliance with the Massachusetts Water Quality Standards (WQS). The list of impaired waters, better known as the "303d list", and now part of the Integrated List of Waters, identifies problem lakes, coastal waters and specific segments of rivers and streams and the reason for impairment.

Once a water body is identified as impaired, the MassDEP is required by the Federal Clean Water Act (CWA) to develop a "pollution budget" designed to restore the health of the impaired body of water. The process of developing this budget, generally referred to as a Total Maximum Daily Load (TMDL), includes identifying the source(s) of the pollutant from direct discharges (point sources) and indirect discharges (non-point sources), determining the maximum amount of the pollutant that can be discharged to a specific water body to meet water quality standards, and assigning pollutant load allocations to the sources. A plan to implement the necessary pollutant reductions is essential to the ultimate achievement of meeting the water quality standards.

Pathogen TMDL: This report represents a TMDL for pathogen indicators (e.g. fecal coliform, *E. coli*, and enterococcus bacteria) in the Buzzards Bay watershed. Certain bacteria, such as coliform, *E. coli*, and enterococcus bacteria, are indicators of contamination from sewage and/or the feces of warm-blooded wildlife (mammals and birds). Such contamination may pose a risk to human health. Therefore, in order to prevent further degradation in water quality and to ensure that waterbodies within the watershed meet state water quality standards, the TMDL establishes indicator bacteria limits and outlines corrective actions to achieve that goal.

Sources of indicator bacteria in the Buzzards Bay watershed were found to be many and varied. Most of the bacteria sources are believed to be storm water related. Table ES-2 provides a general compilation of likely bacteria sources in the Buzzards Bay watershed including failing septic systems, combined sewer overflows (CSO), sanitary sewer overflows (SSO), sewer pipes connected to storm drains, certain recreational activities, wildlife including birds along with domestic pets and animals and direct overland storm water runoff. Note that bacteria from wildlife would be considered a natural condition unless some form of human inducement, such as feeding, is causing congregation of wild birds or animals. A discussion of pathogen related control measures and best management practices are provided in the companion document: "*Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts*".

This TMDL applies to the 52 pathogen impaired segments of the Buzzards Bay watershed that are currently listed on the CWA § 303(d) list of impaired waters. MassDEP recommends however, that the information contained in this TMDL guide management activities for all other waters throughout the watershed to help maintain and protect existing water quality. For these non-impaired waters, Massachusetts is proposing "pollution prevention TMDLs" consistent with CWA § 303(d)(3).

The analyses conducted for the pathogen impaired segments in this TMDL would apply to the non-impaired segments, since the sources and their characteristics are equivalent. The waste load and/or load allocation for each source and designated use would be the same as specified herein. Therefore, the pollution prevention TMDLs would have identical waste load and load allocations based on the sources present and the designated use of the water body segment (see Table ES-2 and Table 7-1).

This Buzzards Bay watershed TMDL may, in appropriate circumstances, also apply to segments that are listed for pathogen impairment in subsequent Massachusetts CWA § 303(d) Integrated List of Waters. For such segments, this TMDL may apply if, after listing the waters for pathogen impairment and taking into account all relevant comments submitted on the CWA § 303(d) list, the Commonwealth determines with EPA approval of the CWA § 303(d) list that this TMDL should apply to future pathogen impaired segments.

Since accurate estimates of existing sources are generally widely variable and unavailable, it is difficult to estimate the pollutant reductions for specific sources. However, for illicit sources, the goal is complete elimination (100% reduction). Overall wet weather indicator bacteria load reductions can be estimated using typical storm water bacteria concentrations. These data indicate that in general two to three orders of magnitude reductions in storm water fecal coliform loading will be necessary, especially in developed areas.

TMDL goals for each type of bacteria source are provided in Table ES-2. Municipalities are the primary responsible parties for eliminating many of these sources. TMDL implementation to achieve these goals should be an iterative process by prioritizing areas based on available data and downstream resources affected, identification of specific sources and in particular the removal of illicit connections contributing to both dry and wet weather violations. Once illicit connections are removed then prioritization should be given to identifying and implementing best management practices to mitigate storm water runoff volume. Certain towns in the watershed are classified as Urban Areas by the United States Census Bureau and are subject to the Stormwater Phase II Final Rule that requires the development and implementation of an illicit discharge detection and elimination plan. Combined sewer overflows will be addressed through the on-going long-term control plans.

In most cases, authority to regulate non-point source pollution and thus successful implementation of this TMDL is limited to local government entities and will require cooperative support from local volunteers, watershed associations, and local officials in municipal government. Those activities can take the form of expanded education, obtaining and/or providing funding, and possibly local enforcement. In some cases, such as subsurface disposal of wastewater from homes, the Commonwealth provides the framework, but the administration occurs on the local level. Among federal and state funds to help implement this TMDL are, on a competitive basis, the Non-Point Source Control (CWA Section 319) Grants, Water Quality (CWA Section 604(b)) Grants, and the State Revolving (Loan) Fund Program (SRF). Most financial aid requires some local match as well. The programs mentioned are administered through the MassDEP. Additional funding and resources available to assist local officials and community groups can be referenced within the Massachusetts

Non-point Source Management Plan-Volume I Strategic Summary (2000) "Section VII Funding / Community Resources". This document is available on the MassDEP's website at: www.state.ma.us/dep/brp/wm/wmpubs.htm, or by contacting the MassDEP's Nonpoint Source Program at (508) 792-7470 to request a copy.

Table ES-2. Total Maximum Daily Load: Sources and Expectations for Limiting Bacterial Contamination in the Buzzards Bay Watershed.

Note: This table represents waste load and load reductions based on water quality standards prior to 2007 as well as revised WQS that were adopted by MassDEP in January of 2007

Surface Water Classification	Pathogen Source	Waste Load Allocation Indicator Bacteria (CFU/100 mL)[1]	Load Allocation Indicator Bacteria (CFU/100 mL)[1]
A, B, SA, SB	Illicit discharges to storm drains	0	Not Applicable
	Leaking sanitary sewer lines	0	Not Applicable
	Failing septic systems	Not Applicable	0
A (Water supply **Intakes** in <u>unfiltered</u> public water supplies)	Any regulated discharge [7,9]- including storm water runoff[4] subject to Phase I or II NPDES permits	Either; a) fecal coliform <=20 fecal coliform organisms per 100 ml[2] or **b)** total coliform <= 100 organisms per 100 ml[3;] where both are measured, only fecal must be met	Not Applicable
	Nonpoint source storm water runoff[4]	Not Applicable	Either; a) fecal coliform <=20 fecal coliform organisms per 100 ml[2], or b) total coliform <= 100 organisms per 100 ml[3;] where both are measured, only fecal must be met
A (Includes filtered water supply) & **B**	Any regulated discharge- including storm water runoff[4] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges [7,9], and combined sewer overflows[**6**].	Either; a) E. coli <=geometric mean[5] 126 colonies per 100 ml; single sample <=235 colonies per 100 ml; or b) Enterococci geometric mean[5] <= 33 colonies per 100 ml and single sample <= 61 colonies per 100 ml	Not Applicable

Surface Water Classification	Pathogen Source	Waste Load Allocation Indicator Bacteria (CFU/100 mL)[1]	Load Allocation Indicator Bacteria (CFU/100 mL)[1]
	Nonpoint source storm water runoff[4]	Not Applicable	Either a) E. coli <=geometric mean[5] 126 colonies per 100 ml; single sample <=235 colonies per 100 ml; or b) Enterococci geometric mean[5]<= 33 colonies per 100 ml and single sample <= 61 colonies per 100 ml
SA (Designated for shellfishing)	Any regulated discharge - including storm water runoff[4] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges[7,9], and combined sewer overflows[6].	Fecal Coliform <= geometric mean, MPN, of 14 organisms per 100 ml nor shall 10% of the samples be >=28 organisms per 100 ml	Not Applicable
	Nonpoint Source Storm water Runoff[4]	Not Applicable	Fecal Coliform <= geometric mean, MPN, of 14 organisms per 100 ml nor shall 10% of the samples be >=28 organisms per 100 ml
SA & SB (Beaches[8] and non-designated shellfish areas)	Any regulated discharge - including storm water runoff[4] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges[7,9], and combined sewer overflows[6].	Enterococci - geometric mean[5] <= 35 colonies per 100 ml and single sample <= 104 colonies per 100 ml	Not Applicable
	Nonpoint Source Storm water Runoff[4]	Not Applicable	Enterococci -geometric mean[5] <= 35 colonies per 100 ml and single sample <= 104 colonies per 100 ml
SB (Designated for shellfishing w/depuration)	Any regulated discharge - including storm water runoff[4] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges[7,9], and combined sewer overflows[6].	Fecal Coliform <= median or geometric mean, MPN, of 88 organisms per 100 ml nor shall 10% of the samples be >=260 organisms per 100 ml	Not Applicable
	Nonpoint Source Storm water Runoff[4]	Not Applicable	Fecal Coliform <= median or geometric mean, MPN, of 88 organisms per 100 ml nor shall 10% of the samples be >=260 organisms per 100 ml

[1] Waste Load Allocation (WLA) and Load Allocation (LA) refer to fecal coliform densities unless specified in table.
[2] In all samples taken during any 6 month period

[3] In 90% of the samples taken in any six month period;

[4] The expectation for WLAs and LAs for storm water discharges is that they will be achieved through the implementation of BMPs and other controls.

[5] Geometric mean of the 5 most recent samples is used at bathing beaches. For all other waters and during the non-bathing season the geometric mean of all samples taken within the most recent six months, typically based on a minimum of five samples.

[6] Or other applicable water quality standards for CSO's

[7] Or shall be consistent with the Waste Water Treatment Plant (WWTP) National Pollutant Discharge Elimination System (NPDES) permit.

[8] Massachusetts Department of Public Health regulations (105 CMR Section 445)

[9] Seasonal disinfection may be allowed by the Department on a case-by-case basis.

Note: this table represents waste load and load allocations based on water quality standards current as of the publication date of these TMDLs. If the pathogen criteria change in the future, MassDEP intends to revise the TMDL by addendum to reflect the revised criteria.

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1.0 Introduction

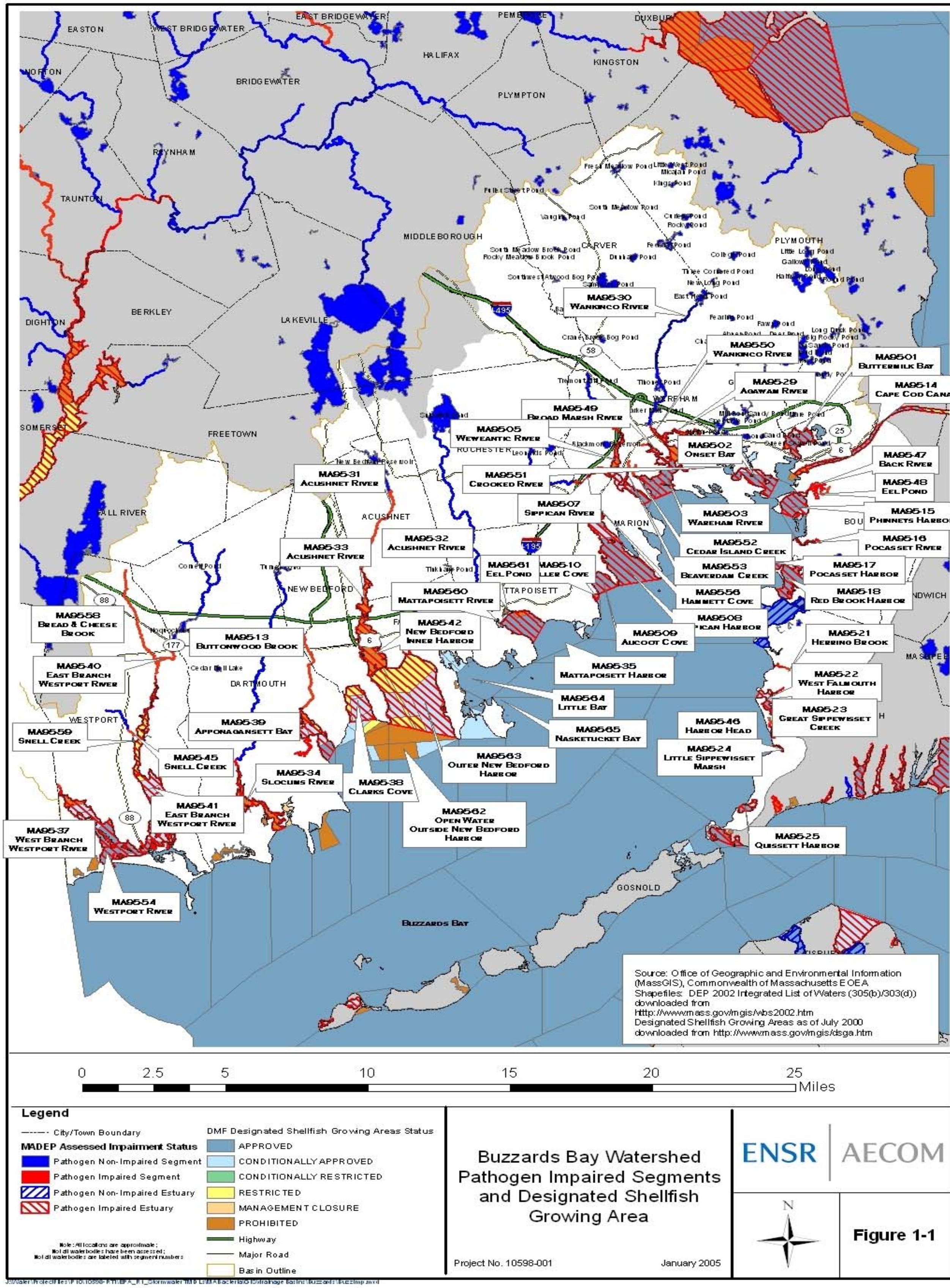
Section 303(d) of the Federal Clean Water Act (CWA) and Environmental Protection Agencies (EPA's) Water Quality Planning and Management Regulations (40 CFR Part 130) require states to place waterbodies that do not meet established water quality standards on a list of impaired waterbodies (commonly referred to as the "303d List") and to develop Total Maximum Daily Loads (TMDLs) for listed waters and the pollutant(s) contributing to the impairment. In Massachusetts, impaired waterbodies are included in Category 5 of the "*Massachusetts Year 2006 Integrated List of Water: Part 2- Final Listing of Individual Categories of Waters*" (*2006 List*; MassDEP 2006a). Figure 1-1 provides a map of the Buzzards Bay watershed with pathogen impaired segments indicated. As shown in Figure 1-1, much of the Buzzards Bay waterbodies are listed as a Category 5 "impaired or threatened for one or more uses and requiring a TMDL" due to excessive indicator bacteria concentrations.

TMDLs are to be developed for water bodies that are not meeting designated uses under technology-based controls only. TMDLs determine the amount of a pollutant that a waterbody can safely assimilate without violating water quality standards. The TMDL process establishes the maximum allowable loading of pollutants or other quantifiable parameters for a water body based on the relationship between pollutant sources and instream conditions. The TMDL process is designed to assist states and watershed stakeholders in the implementation of water quality-based controls specifically targeted to known sources of pollution in order to restore and maintain the quality of their water resources (USEPA 1999). TMDLs allow watershed stewards to establish measurable water quality goals based on the difference between site-specific instream conditions and state water quality standards.

A major goal of this TMDL is to achieve meaningful environmental results with regard to the designated uses of the Buzzards Bay waterbodies. These include water supply, shellfish harvesting, and fishing, boating, and swimming. This TMDL establishes the necessary pollutant load to achieve designated uses and water quality standard and the companion document entitled; "*Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts*" provides guidance for the implementation of this TMDL.

Historically, water and sediment quality studies have focused on the control of point sources of pollutants (i.e., discharges from pipes and other structural conveyances) that discharge directly into well-defined hydrologic resources, such as lakes, ponds, rivers, or estuarine segments. While this localized approach may be appropriate under certain situations, it typically fails to characterize the more subtle and chronic sources of pollutants that are widely scattered throughout a broad geographic region such as a watershed (e.g., roadway runoff, failing septic systems in high groundwater, areas of concentrated wildfowl use, fertilizers, pesticides, pet waste, and certain agricultural sources). These so called nonpoint sources of pollution often contribute significantly to the decline of water quality through their cumulative impacts. A watershed-level approach that uses the surface drainage area as the basic study unit enables managers to gain a more complete understanding of the potential pollutant sources impacting a waterbody and increases the precision of identifying local problem areas or "hot spots" which may detrimentally affect water and sediment quality. It is within this watershed-level framework that the MassDEP commissioned the development of watershed based TMDLs

Figure 1-1. Buzzards Bay Watershed and Pathogen Impaired Segments



1.1. Pathogens and Indicator Bacteria

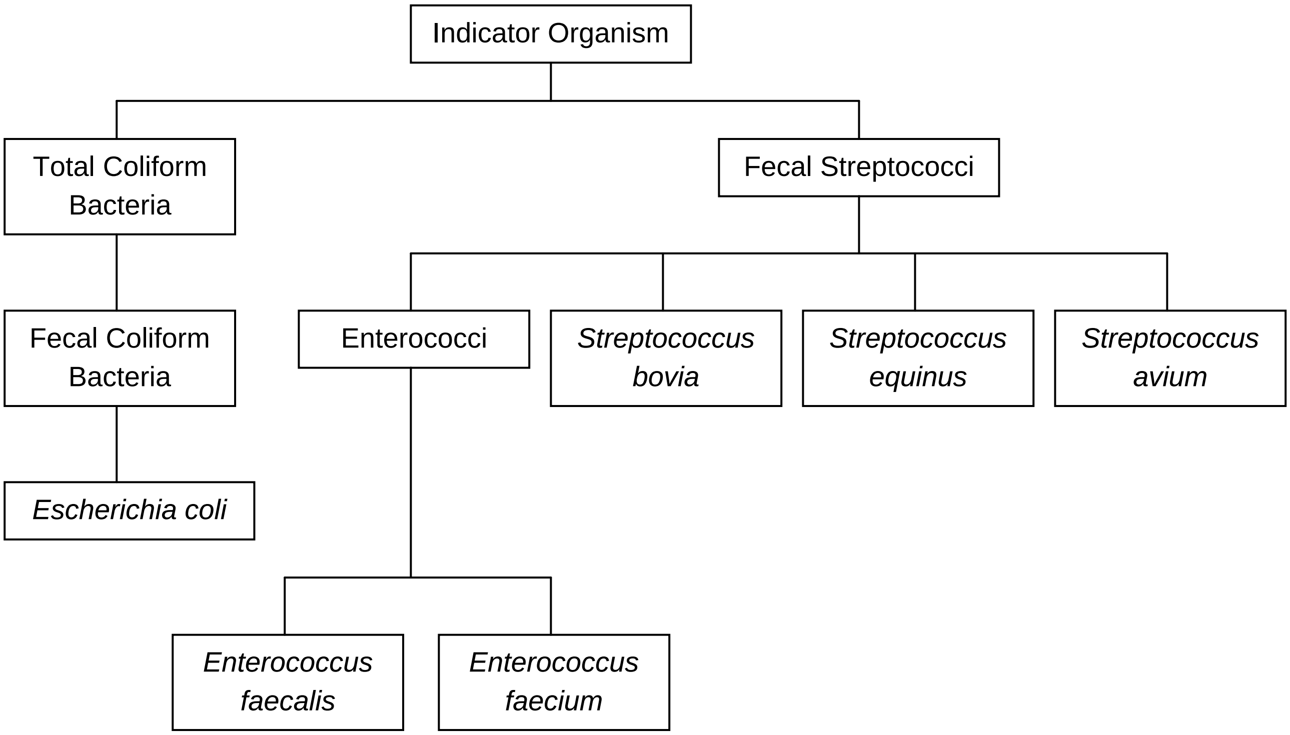
The Buzzards Bay pathogen TMDL is designed to support reduction of waterborne disease-causing organisms, known as pathogens, to reduce public health risk. Waterborne pathogens enter surface waters from a variety of sources including sewage and the feces of warm-blooded wildlife. These pathogens can pose a risk to human health due to gastrointestinal illness through exposure via ingestion and contact with recreational waters, ingestion of drinking water, and consumption of filter-feeding shellfish.

Waterborne pathogens include a broad range of bacteria and viruses that are difficult to identify and isolate. Thus, specific nonpathogenic bacteria have been identified that are typically associated with harmful pathogens in fecal contamination. These associated nonpathogenic bacteria are used as indicator bacteria as they are easier to identify and measure in the environment. High densities of indicator bacteria increase the likelihood of the presence of pathogenic organisms.

Selection of indicator bacteria is difficult as new technologies challenge current methods of detection and the strength of correlation of indicator bacteria and human illness. Currently, coliform and fecal streptococci bacteria are commonly used as indicators of potential pathogens (i.e., indicator bacteria). Coliform bacteria include total coliforms, fecal coliform and *Escherichia coli* (*E. coli*). Fecal coliform (a subset of total coliform) and *E. coli* (a subset of fecal coliform) bacteria are present in the intestinal tracts of warm blooded animals. Presence of coliform bacteria in water indicates fecal contamination and the possible presence of pathogens. Fecal streptococci bacteria are also used as indicator bacteria, specifically enterococci a subgroup of fecal streptococci. These bacteria also live in the intestinal tract of animals, but their presence is a better predictor of human gastrointestinal illness than fecal coliform since the die-off rate of enterococci is much lower (i.e., enterococci bacteria remain in the environment longer) (USEPA 2001). The relationship of indicator organisms is provided in Figure 1-2. The EPA, in the "*Ambient Water Quality Criteria for Bacteria – 1986*" document, recommends the use of *E. coli* or enterococci as potential pathogen indicators in fresh water and enterococci in marine waters (USEPA 1986).

Massachusetts now uses *E. coli* and enterococci as indicator organisms of potential harmful pathogens in fresh water. The Water Quality Standards (WQS) that apply for fresh water were revised in 2007 and *E. coli* has replaced fecal coliform as the indicator organism for pathogens (MassDEP, 2007). The Water Quality Standards can be viewed at: http://www.mass.gov/dep/service/regulations/314cmr04.pdf. Fecal coliform are still used in the Massachusetts Water Quality Standards for marine waters and are consistent with the Massachusetts Division of Marine Fisheries (DMF) in their classification of shellfish growing areas. In freshwater beach areas, Enterococci or *E. coli* are used as the indicator organism while Enterococci is used for marine beaches, as required by the Federal Beaches Environmental Assessment and Coastal Act of 2000 (Beach Act), an amendment to the CWA.

Figure 1-2. Relationships among Indicator Organisms (USEPA 2001).



The Buzzards Bay watershed pathogen TMDL has been developed using fecal coliform as an indicator bacterium for shellfish areas and enterococci for bathing in marine waters and generally E. *coli* for fresh waters (even though much of the recent ambient data is for fecal coliform). Any changes in the Massachusetts pathogen water quality standard will apply to this TMDL at the time of the standard change. Massachusetts believes that the magnitude of indicator bacteria loading reductions outlined in this TMDL will be both necessary and sufficient to attain present WQS and any future modifications to the WQS for pathogens.

1.2. Comprehensive Watershed-based Approach to TMDL Development

Consistent with Section 303(d) of the CWA, the MassDEP has chosen to complete pathogen TMDLs for all waterbodies in the Buzzards Bay watershed at this time, regardless of current impairment status (i.e., for all waterbody categories on the approved 2006 Integrated List of Waters). MassDEP believes a comprehensive management approach carried out by all watershed communities is needed to address the ubiquitous nature of pathogen sources present in the Buzzards Bay watershed. Watershed-wide implementation is needed to meet WQS and restore designated uses in impaired segments while providing protection of desirable water quality in waters that are not currently impaired or not assessed.

As discussed below, this TMDL applies to the 52 pathogen impaired segments of the Buzzards Bay watershed that are currently listed on the CWA § 303(d) list of impaired waters and determined to be pathogen impaired in the "*Buzzards Bay Watershed 2000 Water Quality Assessment Report*"

(MassDEP WQA; MassDEP 2003b) (see Figure 1-1, Table 4-3). MassDEP recommends however, that the information contained in this TMDL guide management activities for all other waters throughout the watershed to help maintain and protect existing water quality. For these non-impaired waters, Massachusetts is proposing “pollution prevention TMDLs” consistent with CWA § 303(d) (3).

The analyses conducted for the pathogen impaired segments in this TMDL would apply to the non-impaired segments, since the sources and their characteristics are equivalent. The waste load and/or load allocation for each source and designated use would be the same as specified herein. Therefore, the pollution prevention TMDLs would have identical waste load and load allocations based on the sources present and the designated use of the water body segment (see Table ES-2 and Table 7-1).

This Buzzards Bay watershed TMDL may, in appropriate circumstances, also apply to segments that are listed for pathogen impairment in subsequent Massachusetts CWA § 303(d) Integrated List of Waters. For such segments, this TMDL may apply if, after listing the waters for pathogen impairment and taking into account all relevant comments submitted on the CWA § 303(d) list, the Commonwealth determines with EPA approval of the CWA § 303(d) list that this TMDL should apply to future pathogen impaired segments.

There are 109 waterbody segments assessed by the MassDEP in the Buzzards Bay watershed (MassGIS 2005). These segments consist of 45 estuaries, all of which are pathogen impaired. Seven of the 14 river segments are pathogen impaired and only one of the 70 lake segments is pathogen impaired and appears as such on the official impaired waters list (303(d) List) (Figure 1-1). Pathogen impairment has been documented by the MassDEP in previous reports, including the MassDEP Water Quality Assessment Report (WQA), resulting in the impairment determination. In this TMDL document, an overview of pathogen impairment is provided to illustrate the nature and extent of the pathogen impairment problem. Additional data, not collected by the MassDEP or used to determine impairment status, are also provided in this TMDL to illustrate the pathogen problem. Since pathogen impairment has been previously established only a summary is provided herein.

The watershed based approach applied to complete the Buzzards Bay pathogen TMDL is straightforward. The approach is focused on identification of sources, source reduction, and implementation of appropriate management plans. Once identified, sources are required to meet applicable WQS for indicator bacteria or be eliminated. Do to limited available source data, this approach does not include water quality analysis or other approaches designed to link ambient concentrations with source loadings. For pathogens and indicator bacteria, water quality analyses are generally resource intensive and provide results with large degrees of uncertainty. Rather, this approach focuses on sources and required load reductions, proceeding efficiently toward water quality restoration activities.

The stepwise implementation strategy for reducing indicator bacteria is an iterative process where data are gathered on an ongoing basis, sources are identified and eliminated where possible, and control measures including Best Management Practices (BMPs) are implemented, assessed and modified as needed. Measures to abate probable sources of waterborne pathogens include everything from the identification and removal of illicit connections to stormwater systems, which should be given the highest priority, to public education, improved storm water management, and reducing the influence from inadequate and/or failing sanitary sewer infrastructure.

MassDEP believes that segments ranked as high priority in Table 6-1 are indicative of the potential presence of raw sewage and therefore they pose a greater risk to the public. Elevated dry weather bacteria concentrations could be the result of illicit sewer connections or failing septic systems. As a result, the first priority should be given to bacteria source tracking activities in those segments where sampling activities show elevated levels of bacteria during dry weather. Identification and remediation of dry weather bacteria sources is usually more straightforward and successful than tracking and eliminating wet weather sources. If illicit bacteria sources are found and eliminated it should result in a dramatic reduction of bacteria concentration in the segment in both dry and wet-weather. Segments that remain impaired during wet weather should be evaluated for stormwater BMP implementation opportunities starting with less costly non-structural practices first (such as street sweeping, and/or managerial approach using local regulatory controls with ongoing evaluation of the success of those programs. If it is determined that less costly approaches are not sufficient to address the issue then appropriate structural BMPs should be identified and implemented where necessary. Structural stormwater BMP implementation may require additional study to identify cost efficient and effective technology.

1.3. TMDL Report Format

This document contains the following sections:

- Watershed Description (Section 2) - provides watershed specific information
- Water Quality Standards (Section 3) – provides a summary of current Massachusetts WQS as they relate to indicator bacteria
- Problem Assessment (Section 4) – provides an overview of indicator bacteria measurements collected in the Buzzards Bay watershed
- Identification of Sources (Section 5) – identifies and discusses potential sources of waterborne pathogens within the Buzzards Bay watershed.
- Priority of Existing Sources (Section 6)
- TMDL Development (Section 7) – specifies required TMDL development components including:
    - Definitions and Equation
    - Loading Capacity
    - Load and Waste Load Allocations
    - Margin of Safety
    - Seasonal Variability
- Implementation Plan (Section 8) – describes specific implementation activities designed to remove pathogen impairment. This section and the companion "*Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts*" document should be used together to support implementing management actions.
- Monitoring Plan (Section 9) – describes recommended monitoring activities
- Reasonable Assurances (Section 10) – describes reasonable assurances the TMDL will be implemented

- Public Participation (Section 11) – describes the public participation process, and
- References (Section 12)

2.0 Watershed Description

Buzzards Bay watershed is bordered to the east by Cape Cod and to the northeast by southeastern Massachusetts. The bay is 28 miles long and 8 miles wide (MACZM 2003). The Buzzards Bay watershed drains 432 square miles and includes 17 cities and towns within Massachusetts and Rhode Island. Land use within the watershed is primarily undeveloped forest (Table 2-1, Figure 2-1). Development in the watershed is concentrated in a half mile area landward of the coastline. MassDEP estimated a population of 373,690 people living in the watershed in 2000 (MassDEP 2003b). Two-fifths of these people reside in the Greater New Bedford area. The 280 mile coastline includes 11 miles of public beaches (Figure 2-2). Information regarding swimming beaches can be obtained from the beach quality annual reports available for download at the Massachusetts Department of Public Health website (http://www.mass.gov/dph/beha/tox/reports/beach/beaches.htm).

The drainage basin includes several rivers, which flow into Buzzards Bay. The rivers tend to increase in velocity and width as they near the bay. In comparison to other rivers in the state, the rivers in the Buzzards Bay watershed tend to be shorter and have smaller drainage areas. Water also enters the Bay through groundwater seepage.

Significant natural and cultural resources exist in the Buzzards Bay Watershed that warrants special protection. The Back River and the Pocasset River have been established as Areas of Critical Environmental Concern (ACECs). Projects within ACECs are subject to state agency jurisdiction and are reviewed in greater detail to avoid deleterious impacts to these sensitive environments. The entire Buzzards Bay is considered a "No Discharge Area" (NDA). NDAs are waterbodies in which a state, with EPA approval, has determined to be important ecological or recreational areas worthy of special protection against the release of raw or treated sewage in navigable waters. Vessels are banned from discharging both raw and treated sewage in a NDA. NDAs in Massachusetts are provided in Figure 2-3 (USEPA 2004a).

The Buzzards Bay watershed waters are commonly used for primary and secondary contact recreation (swimming and boating), fishing, wildlife viewing, habitat for aquatic life, industrial cooling, shellfish harvesting, irrigation, agricultural uses, public water supply, and beachfront.

Table 2-1. Buzzards Bay Watershed Basin Land Use as of 1999.

Land Use Category	**% of Total Watershed Area**
Pasture	1.9
Urban Open	0.8
Open Land	3.2
Cropland	3.5
Woody Perennial	3.1
Forest	59.2
Wetland/Salt Wetland	3.8
Water Based Recreation	0.3
Water	0.3
General Undeveloped Land	76.1
Spectator Recreation	<0.1
Participation Recreation	1.3
> 1/2 acre lots Residential	7.3
1/4 - 1/2 acre lots Residential	6.0
< 1/4 acre lots Residential	2.8
Multi-family Residential	0.2
Mining	0.4
Commercial	1.8
Industrial	1.2
Transportation	1.4
Waste Disposal	1.5
General Developed Land	23.9

Figure 2-1 Buzzards Bay Watershed Land Use as of 1999.

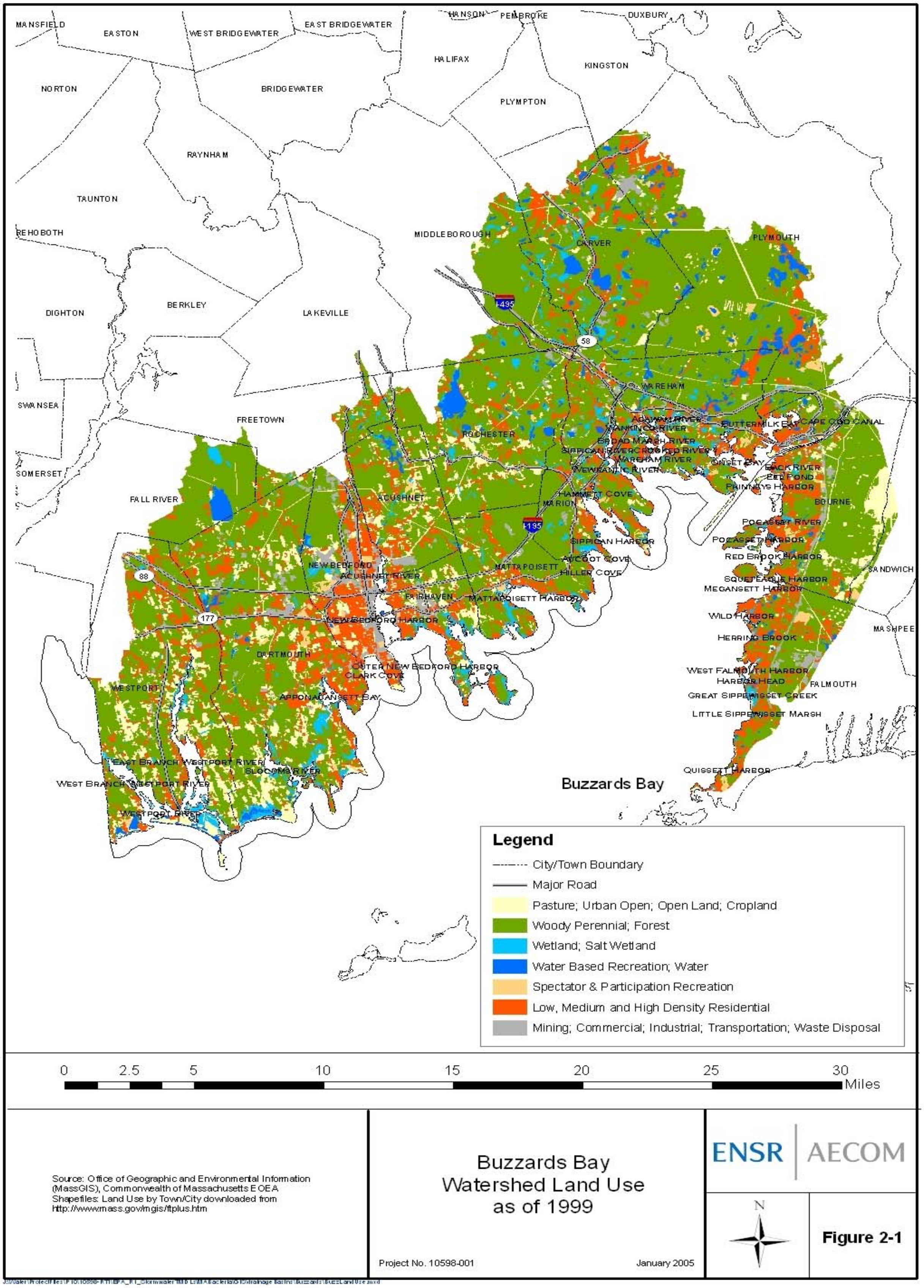


Figure 2-2. Buzzards Bay Marine Beach Locations and Pathogen Impaired Segments.

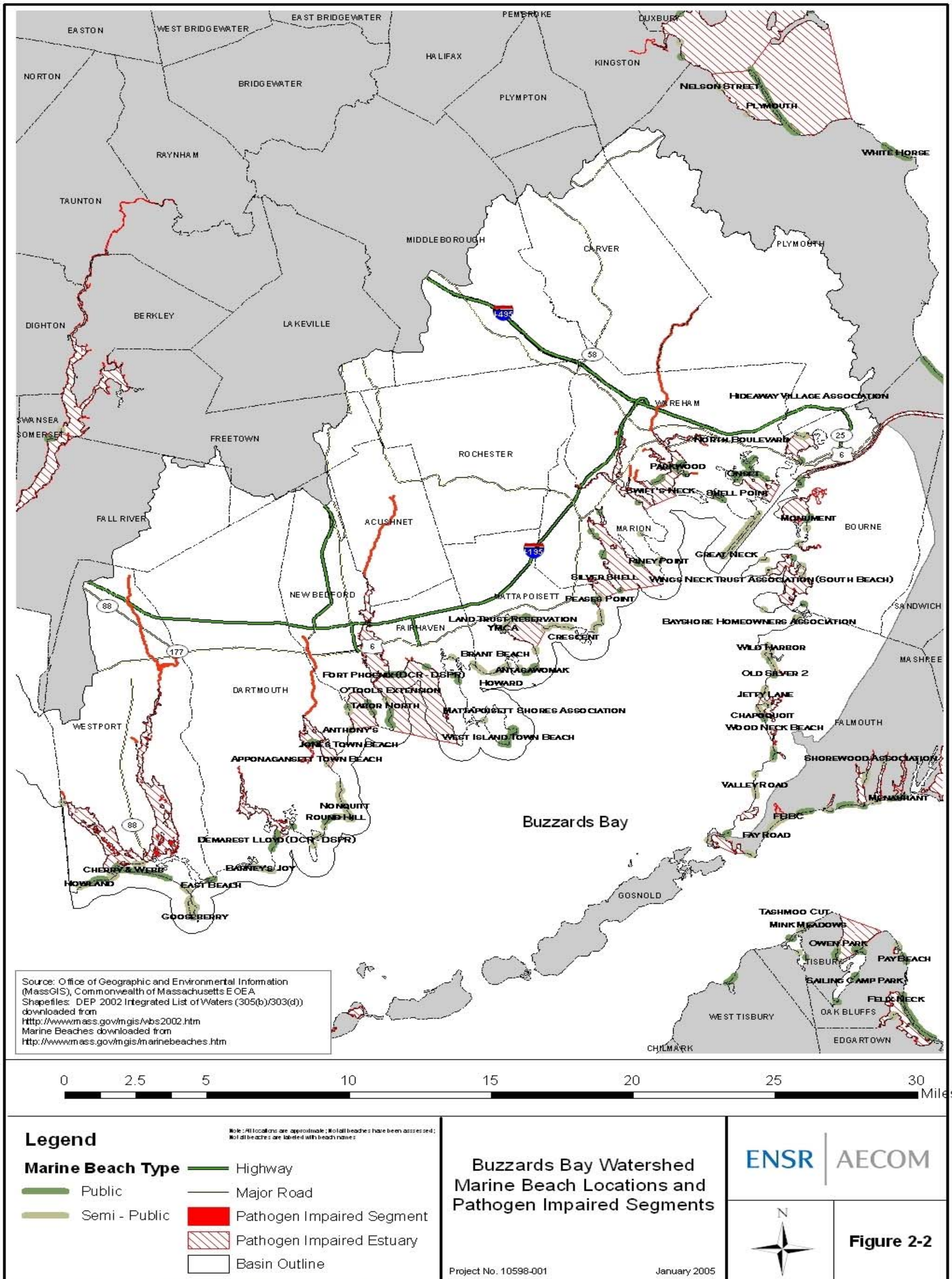


Figure 2-3. General Location of Massachusetts' No Discharge Areas (USEPA 2004a).

3.0 Water Quality Standards

The Surface Water Quality Standards (WQS) for the Commonwealth of Massachusetts establish chemical, physical, and biological standards for the restoration and maintenance of the most sensitive uses (MassDEP 2000a). The WQS limit the discharge of pollutants to surface waters for the protection of existing uses and attainment of designated uses in downstream and adjacent segments.

Fecal coliform, enterococci, and *E. coli* bacteria are found in the intestinal tract of warm-blooded animals, soil, water, and certain food and wood processing wastes. "Although they are generally not harmful themselves, they indicate the possible presence of pathogenic (disease-causing) bacteria, viruses, and protozoans that also live in human and animal digestive systems" (USEPA 2004b). These bacteria are often used as indicator bacteria since it is expensive and sometimes difficult to test for the presence of individual pathogenic organisms.

In 2007 Massachusetts revised its freshwater WQS by replacing fecal coliform with *E. coli* and enterococci as the regulated indicator bacteria in freshwater systems, as recommended by the EPA in the "*Ambient Water Quality Criteria for Bacteria – 1986*" document (USEPA 1986). The new WQS can be accessed at: http://www.mass.gov/dep/service/regulations/314cmr04.pdf. The state had previously done so for public beaches through regulations of the Massachusetts Department of Public Health as discussed below. Up until January of 2007 Massachusetts used fecal coliform as the indicator organism for all waters except for marine bathing beaches, where the Federal BEACH Act requires the use of enterococci. Massachusetts adopted *E. coli* and enterococci for all fresh waters and enterococci for all marine waters, including non-bathing marine beaches. Fecal coliform will remain the indicator organism for shellfishing areas, however.

Pathogens can significantly impact humans through ingestion of, and contact with recreational waters, ingestion of drinking water, and consumption of filter-feeding shellfish. In addition to contact recreation, excessive pathogen numbers impact potable water supplies. The amount of treatment (i.e., disinfection) required to produce potable water increases with increased pathogen contamination. Such treatment may cause the generation of disinfection by-products that are also harmful to humans. Further detail on pathogen impacts can be accessed at the following EPA websites:

- Water Quality Criteria: Microbial (Pathogen)
  http://www.epa.gov/ost/humanhealth/microbial/microbial.html
- Human Health Advisories:
  - Fish and Wildlife Consumption Advisories
    http://www.epa.gov/ebtpages/humaadvisofishandwildlifeconsumption.html
  - Swimming Advisories
    http://www.epa.gov/ebtpages/humaadvisoswimmingadvisories.html

The Buzzards Bay watershed contains waterbodies classified as Class A, Class B, Class SA, and Class SB.

Shellfish growing areas are classified by the Massachusetts Division of Marine Fisheries (DMF). The classification system is provided below (MassGIS 2005). Figure 1-1 provides designated shellfish growing areas status as of July 1, 2000. The August, 2003 *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"* reports that the growing area status remains virtually unchanged (MACZM, 2003). MACZM uses the following definitions to describe managed shellfish areas in Massachusetts.

> **Approved** – "Open for harvest of shellfish for direct human consumption subject to local rules and state regulations." (MassGIS 2005) "The area is shown to be free of bacterial contaminants under a variety of climatological and hydrographical situations (i.e. assumed adverse pollution conditions)." (MassDEP 2002a).
>
> **Conditionally Approved** - "During the time area is approved it is open for harvest of shellfish for direct human consumption subject to local rules and state regulations." (MassGIS 2005) "This classification category may be assigned for growing areas subject to intermittent and predictable microbiological contamination that may be present due to operation of a sewage treatment plant, rainfall, and/or season." (MassDEP 2002a)
>
> **Conditionally Restricted** – "During the time area is restricted it is only open for the harvest of shellfish with depuration subject to local rules and state regulations." (MassGIS 2005) "A classification used to identify a growing area that meets the criteria for the restricted classification except under certain conditions described in a management plan." (MassDEP 2002a)
>
> **Restricted** – "Open for harvest of shellfish with depuration subject to local rules and state regulations or for the relay of shellfish." (MassGIS 2005) "A classification used to identify where harvesting shall be by special license and the shellstock, following harvest, is subject to a suitable and effective treatment process through relaying or depuration. Restricted growing areas are mildly or moderately contaminated only with bacteria." (MassDEP 2002a)
>
> **Management Closure** – "Closed for the harvest of shellfish. Not enough testing has been done in the area to determine whether it is fit for shellfish harvest or not." (MassDEP 2002a)
>
> **Prohibited –** "Closed for harvest of shellfish." (MassGIS 2005) "A classification used to identify a growing area where the harvest of shellstock is not permitted. Growing area waters are so badly contaminated that no reasonable amount of treatment will make the shellfish safe for human consumption. Growing areas must also be classified as Prohibited if there is no or insufficient information available to make a classification decision." (MassDEP 2002a)

In general, shellfish harvesting use is supported (i.e., non-impaired) when shellfish harvested from approved open shellfish areas are suitable for consumption without depuration and shellfish harvested from restricted shellfish areas are suitable for consumption with depuration. For an expanded discussion on the relationship between the DMF shellfish growing areas classification and the MassDEP designated use support status, please see the "*Buzzards Bay Watershed 2000 Water Quality Assessment Report*" (MassDEP WQA; MassDEP 2003b).

In addition to the WQS, the Commonwealth of Massachusetts Department of Public Health (MADPH) has established minimum standards for bathing beaches (105 CMR 445.000) under the State Sanitary Code, Chapter VII (www.mass.gov/dph/dcs/bb4_01.pdf). These standards have been adopted by the

MassDEP as state surface WQS for fresh water and apply to this revised TMDL. The MADPH bathing beach standards are generally the same as those which were recommended in the "*Ambient Water Quality Criteria for Bacteria – 1986"* document published by the EPA (USEPA 1986). In the above referenced document, the EPA recommended the use of enterococci as the indicator bacterium for marine recreational waters and enterococci or *E. coli* for fresh waters. As such, the following MADPH standards have been established for bathing beaches in Massachusetts:

> Marine Waters - (1) No single enterococci sample shall exceed 104 colonies per 100 mL and the geometric mean of the most recent five enterococci levels within the same bathing season shall not exceed 35 colonies per 100 mL.
>
> Freshwaters - (1) No single *E. coli* sample shall exceed 235 colonies per 100 mL and the geometric mean of the most recent five *E. coli* samples within the same bathing season shall not exceed 126 colonies per 100 mL; or (2) No single enterococci sample shall exceed 61 colonies per 100 mL and the geometric mean of the most recent five enterococci samples within the same bathing season shall not exceed 33 colonies per 100 mL.

The Federal BEACH Act of 2000 established a Federal standard for marine beaches. These standards are essentially the same as the MADPH marine beach standard (i.e., single sample not to exceed 104 cfu/100mL and geometric mean of a statistically sufficient number of samples not to exceed 35 cfu/100mL). The Federal BEACH Act and MADPH standards can be accessed on the worldwide web at http://www.epa.gov/waterscience/beaches/act.html and www.mass.gov/dph/dcs/bb4_01.pdf, respectively.

Figure 2-2 provides the location of marine bathing beaches, where the MADPH Marine Waters and the Federal BEACH Act standards would apply. A map of freshwater beaches is not available at this time. However, a list of beaches (fresh and marine) by community with indicator bacteria data can be found in the annual reports on the testing of public and semi-public beaches provided by the MADPH. These reports are available for download from the MADPH website located at http://www.mass.gov/dph/beha/tox/reports/beach/beaches.htm.

4.0 Problem Assessment

Pathogen impairment has been documented at numerous locations throughout the Buzzards Bay watershed, as shown in Figure 1-1. The amount of indicator bacteria and potential pathogens entering waterbodies is dependent on several factors including watershed characteristics and meteorological conditions. Indicator bacteria levels generally increase with increasing development activities, including increased impervious cover, illicit sewer connections, and failed septic systems.

Indicator bacteria levels also tend to increase with wet weather conditions as storm sewer systems overflow and/or storm water runoff carries fecal matter that has accumulated to the receiving water via overland flow and storm water conduits. In some cases, dry weather bacteria concentrations can be higher when there is a constant source that becomes diluted during periods of precipitation, such as with illicit connections. The magnitude of these relationships is variable, however, and can be substantially different temporally and spatially throughout the United States or within each watershed.

Tables 4-1 and 4-2 provide typical ranges of fecal coliform concentrations in storm water associated with various land use types. Pristine areas are observed to have low indicator bacteria levels and residential areas are observed to have elevated indicator bacteria levels. Development activity generally leads to decreased water quality (e.g., pathogen impairment) in a watershed. Development-related watershed modification includes increased impervious surface area which can (USEPA 1997):

- Increase flow volume,
- Increase peak flow,
- Increase peak flow duration,
- Increase stream temperature,
- Decrease base flow, and
- Change sediment loading rates.

Many of the impacts associated with increased impervious surface area also result in changes in pathogen loading (e.g., increased sediment loading can result in increased pathogen loading). In addition to increased impervious surface impacts, increased human and pet densities in developed areas increase potential fecal contamination. Furthermore, storm water drainage systems and associated storm water culverts and outfall pipes often result in the channelization of streams which leads to less attenuation of pathogen pollution.

Table 4-1. Wachusett Reservoir Storm Water Sampling (as reported in MassDEP 2002b) original data provided in MDC Wachusett Storm Water Study (June 1997).

Land Use Category	Fecal Coliform Bacteria[1] Organisms / 100 mL
Agriculture, Storm 1	110 – 21,200
Agriculture, Storm 2	200 – 56,400
"Pristine" (not developed, forest), Storm 1	0 – 51
"Pristine" (not developed, forest), Storm 2	8 – 766
High Density Residential (not sewered, on septic systems), Storm 1	30 – 29,600
High Density Residential (not sewered, on septic systems), Storm 2	430 – 122,000

[1] Grab samples collected for four storms between September 15, 1999 and June 7, 2000

Table 4-2. Lower Charles River Basin Storm Water Event Mean Bacteria Concentrations (data summarized from USGS 2002)[1].

Land Use Category	Fecal Coliform (CFU/100 mL)	Enterococcus Bacteria (CFU/100 mL)	Number of Events
Single Family Residential	2,800 – 94,000	5,500 – 87,000	8
Multifamily Residential	2,200 – 31,000	3,200 – 49,000	8
Commercial	680 – 28,000	2,100 – 35,000	8

Pathogen impaired estuary segments represent 100% of the total estuary area assessed (25 square miles). Pathogen impaired river segments represent 21.3% of the total river miles assessed (10.2 miles of 47.9 total river miles). In total, 52 segments, each in need of a TMDL, contain indicator bacteria concentrations in excess of the Massachusetts WQS for Class A, SA, B, or SB waterbodies (314 CMR 4.05)[1], the MADPH standard for bathing beaches[2], and/or the BEACH Act[3]. The basis for impairment listings is provided in the 2006 Integrated List of Waters (MassDEP 2006a). Data presented in the Water Quality Assessment Report (WQA) and other data collected by the MassDEP were used to generate the Integrated List. For more information regarding the basis for listing particular segments for pathogen impairment, please see the Assessment Methodology section of the MassDEP WQA for this watershed.

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[1] An Event Mean Concentration (EMC) is the concentration of a flow proportioned sample throughout a storm event. These samples are commonly collected using an automated sampler which can proportion sample aliquots based on flow.

[2] See Table ES-2, or Table 7-1, or web address link:http://www.mass.gov/dep/service/regulations/314cmr04.pdf

A list of pathogen impaired segments requiring TMDLs is provided in Table 4-3. Segments are listed and discussed in hydrologic order (upstream to downstream) in the following sections. Additional details regarding each impaired segment including water withdrawals, discharges, use assessments and recommendations to meet use criteria are provided in the MassDEP WQA.

An overview of the Buzzards Bay watershed pathogen impairment is provided in this section to illustrate the nature and extent of the impairment. Since pathogen impairment has been previously established and documented on the Integrated List, it is not necessary to provide detailed documentation of pathogen impairment herein. Available data from the MassDEP WQA and other sources such as the Massachusetts Office of Coastal Zone Management (MACZM) were reviewed and are summarized by segment below for illustrative purposes. The intent is to provide the reader with background information and data for each segment currently listed as impaired on the state Integrated List of Waters.

Table 4-3. Buzzards Bay Pathogen Impaired Segments Requiring TMDLs (adapted from MassDEP 2003b and MassGIS 2005).

Segment ID	Segment Name	Segment Type	Segment Size[1]	Segment Description
MA95-40	East Branch Westport River	River	2.85 mi	Outlet Lake Noquochoke, Westport to Old County Rd. bridge, Westport
MA95-45	Snell Creek	River	0.67 mi	Drift Rd. to Marcus' Bridge in Westport
MA95-59	Snell Creek	Estuary	0.01 sq. mi.	'Marcus Bridge', Westport to confluence with East Branch Westport River, Westport
MA95-41	East Branch Westport River	Estuary	2.65 sq. mi.	Old County Road bridge, Westport to the mouth at Westport Harbor, Westport (excluding Horseneck Channel)
MA95-37	West Branch Westport River	Estuary	1.28 sq. mi.	Outlet Grays Mill Pond, Adamsville, Rhode Island to mouth at Westport Harbor, Westport
MA95-54	Westport River	Estuary	0.74 sq. mi.	From the confluence of the East and West Branches to Rhode Island Sound; Bounded by a line drawn from the southwestern point of Horseneck Point to the easternmost point near Westport Light
MA95-34	Slocums River	Estuary	0.67 sq. mi.	Confluence with Paskamanset R., Dartmouth to mouth at Buzzards Bay
MA95-44	Snell Creek	River	1.5 mi.	Headwaters west of Main Street, Westport, to Drift Road Westport
MA95-31	Acushnet River	River	2.7 mi.	Outlet New Bedford Reservoir to Hamlin Rd. culvert, Acushnet
MA95-32	Acushnet River	River	1.0 mi.	Hamlin Rd. culvert to culvert at Main St., Acushnet
MA95-33	Acushnet River	Estuary	0.32 sq. mi.	Main St. culvert to Coggeshall St. bridge, New Bedford/Fairhaven
MA95-42	New Bedford Harbor	Estuary	1.17 sq. mi.	Coggeshall St. bridge to hurricane Barrier, New Bedford/Fairhaven
MA95-63	Outer New Bedford Harbor	Estuary	5.82 sq. mi.	Hurricane Barrier to a line drawn from Wilbur Point, Fairhaven to Clarks Point, New Bedford

Segment ID	Segment Name	Segment Type	Segment Size[1]	Segment Description
MA95-38	Clark Cove	Estuary	1.15 sq. mi.	Semi-enclosed waterbody landward of a line drawn between Clarks Point, New Bedford and Ricketsons Point, Dartmouth
MA95-13	Buttonwood Brook	River	3.8 mi.	Headwaters at Oakdale St., New Bedford to mouth at Apponagansett Bay, Dartmouth
MA95-39	Apponagansett Bay	Estuary	0.95 sq. mi.	From the mouth of Buttonwood Brook to a line drawn from Ricketsons Point, New Bedford to Samoset St. near North Ave., Dartmouth
MA95-35	Mattapoisett Harbor	Estuary	1.1 sq. mi.	From the mouth of the Mattapoisett R., Mattapoisett, to a line drawn from Ned Point to a point of land between Bayview Avenue and Grandview Ave., Mattapoisett
MA95-60	Mattapoisett River	Estuary	0.05 sq. mi.	From the River Road bridge, Mattapoisett to the mouth at Mattapoisett harbor, Mattapoisett
MA95-65	Nasketucket Bay	Estuary	3.7 sq. mi.	From the confluence with Little bay, Fairhaven to Buzzards bay along Causeway Road, Fairhaven and along a line from the southern tip of Brant Island, Mattapoisett to the eastern tip of West Island, Fairhaven
MA95-56	Hammett Cove	Estuary	0.07 sq. mi.	Hammett Cove, Marion to the confluence with Sippican Harbor along a line from the southwestern most point of Little Neck to the end of the seawall on the opposite point
MA95-08	Sippican Harbor	Estuary	2.0 sq. mi.	From the confluence with Hammett Cove to the mouth at Buzzards Bay (excluding Blakenship Cove and Planning Island Cove), Marion
MA95-09	Aucoot Cove	Estuary	0.4 sq. mi. 7	From the confluence with Aucoot Creek, Marion to the mouth at Buzzards Bay at a line drawn between Converse Point and Joes Point, Mattapoisett
MA95-10	Hiller Cove	Estuary	0.04 sq. mi.	Area landward of a line drawn between Joes Point, Mattapoisett and the second boat dock northeast of Hiller Cove Lane, Mattapoisett
MA95-64	Little Bay	Estuary	0.36 sq. mi.	From the confluence with the Nasketucket River, Fairhaven south to the confluence with Nasketucket Bay at a line from the southernmost tip of Mirey Neck, Fairhaven to a point near Shore Drive.
MA95-07	Sippican River	Estuary	0.09 sq. mi.	County Rd. to confluence with Weweantic R., Marion/Wareham
MA95-53	Beaverdam Creek	Estuary	0.04 sq. mi.	Outlet from cranberry bogs of Rte. 6, Wareham to confluence with Weweantic River, Wareham
MA95-58	Bread and Cheese Brook	River	4.9 mi.	Headwaters, north of old Bedford Road, Westport to confluence with East Branch Westport River, Westport
MA95-05	Weweantic River	Estuary	0.62 sq. mi.	Outlet Horseshoe Pond, Wareham to mouth at Buzzards Bay, Marion/Wareham
MA95-29	Agawam River	Estuary	0.16 sq. mi.	From the Wareham WWTP to confluence with Wankinco River at the Rte. 6 bridge, Wareham
MA95-50	Wankinco River	Estuary	0.05 sq. mi.	Elm St. bridge, Wareham to confluence with the Agawam R., at a line between a point south of Mayflower Ridge Drive and a point north of the railroad tracks near Sandwich Rd., Wareham

Segment ID	Segment Name	Segment Type	Segment Size[1]	Segment Description
MA95-49	Broad Marsh River	Estuary	0.16 sq. mi.	From its headwaters in a salt marsh south of Marion Rd. and Bourne Terrace, Wareham to the confluence with the Wareham R.
MA95-51	Crooked River	Estuary	0.04 sq. mi.	From the outlet of a cranberry bog, east of Indian Neck Rd., Wareham to confluence with the Wareham R., Wareham
MA95-52	Cedar Island Creek	Estuary	0.01 sq. mi.	From the headwaters near intersection of Parker Dr. and Camardo Dr., Wareham to the mouth at Marks Cove, Wareham
MA95-03	Wareham River	Estuary	1.18 sq. mi.	Rte. 6 bridge to mouth at Buzzards Bay (at an imaginary line from Cromset Point to curved point east, southeast of Long Beach point), Wareham. Includes Mark's Cove, Wareham
MA95-02	Onset Bay	Estuary	0.79 sq. mi.	Wareham
MA95-01	Buttermilk Bay	Estuary	0.77 sq. mi.	Bourne/Wareham
MA95-62	Buzzards Bay	Estuary	8.0 sq. mi.	Open water area encompassed within a line drawn from Wilbur Point, Fairhaven to Clarks Point, New Bedford to Ricketson Point, Dartmouth to vicinity of Samoset St., Dartmouth down to Round Hill Point, Dartmouth, back to Wilbur Point, Fairhaven
MA95-14**	Cape Cod Canal-Estuary	Estuary	1.13 sq. mi.	Connection between Buzzards Bay and Cape Cod Bay in Bourne and Sandwich.
MA95-48	Eel Pond-Estuary	Estuary	0.03 sq. mi.	Salt water pond that discharges to Back River, Bourne.
MA95-61	Eel Pond-Estuary	Estuary	0.04 sq. mi.	Coastal pond at the head of Mattapoisett Harbor, Mattapoisett
MA95-47	Back River-Estuary	Estuary	0.08 sq. mi.	Outlet of small unnamed pond, downstream from Mill Pond, Bourne to confluence with Phinneys Harbor, Bourne (excluding Eel Pond).
MA95-15	Phinneys Harbor-Estuary	Estuary	0.73 sq. mi.	From the confluence with Back R. to its mouth at Buzzards Bay between Mashpee and Toby's Island, Bourne.
MA95-16	Pocasset River- Estuary	Estuary	0.05 sq. mi.	From the outlet of Mill Pond, Bourne to the mouth at Buzzards Bay, Bourne.
MA95-17	Pocasset Harbor-Estuary	Estuary	0.33 sq. mi.	From the confluence with Red Brook Harbor near the northern portion of Bassett's Island and Patuisett to the mouth at Buzzards Bay between Bassett's Island and Wings Neck, Bourne.
MA95-18	Red Brook Harbor-Estuary	Estuary	0.91 sq. mi.	From the confluence with Pocasset Harbor between the north Island and Patuisett to its mouth at Buzzards Bay between Bassetts island and Scraggy Neck, Bourne (including Hen Cove).
MA95-21	Herring Brook- Estuary	Estuary	0.01 sq. mi.	From its headwaters, northeast of Dale Dr. and west of Rte. 28A, to its mouth at Buzzards Bay, Falmouth.
MA95-46	Harbor Head- Estuary	Estuary	0.02 sq. mi.	The semi-enclosed body of water south of the confluence with West Falmouth Harbor at Chappaquoit Rd., Falmouth.
MA95-20	Wild Harbor- Estuary	Estuary	0.15 sq. mi.	Embayment extends from Point Road, Nyes Neck to Crow Point at the end of Bay Shore Road in North Falmouth

Segment ID	Segment Name	Segment Type	Segment Size[1]	Segment Description
MA95-22	West Falmouth Harbor- Estuary	Estuary	0.29 sq. mi.	From the confluence with Harbor Head at Chappaquoit Rd., Falmouth to the mouth at Buzzards Bay at a line connecting the ends of the seawalls from Little Island and Chappaquoit Point, Falmouth (including Snug Harbor).
MA95-23	Great Sippewisset Creek- Estuary	Estuary	0.03 sq. mi.	From the outlet of Beach Pond in Great Sippewissett marsh to the mouth at Buzzards Bay, Falmouth, including the unnamed tributary from the outlet of Fresh Pond, and Quahog Pond, Falmouth.
MA95-24	Little Sippewisset Marsh- Estuary	Estuary	0.02 sq. mi.	From the headwaters north of Sippewisset Rd., Falmouth to the mouth at Buzzards Bay near Saconesset Hills, Falmouth.
MA95-25	Quissett Harbor- Estuary	Estuary	0.17 sq. mi.	The semi-enclosed body of water landward of a line drawn between The Knob and Gansett Point, Falmouth.

[1] Units = Miles for river segments and square miles for estuaries

*It should be noted that in Table 4-3 above, the Mass DEP moved the last fourteen segments (starting with MA 95-14 Cape Cod Canal and ending with MA 95-25 Quinsett Harbor), from the Cape Cod Watershed to the Buzzards Bay Watershed because these segments actually discharge to Buzzards Bay even though they are on the Cape Cod.

This TMDL is based on the current WQS using fecal coliform for shellfish areas, and E. *coli* for fresh and enterococcus for either salt or fresh water bathing respectively, as the indicator organisms. Enterococci data are provided at the bottom of each table when data are available. The MassDEP has incorporated *E. coli* and enterococci as indicator organisms for all waters other than shellfishing and potable water intake areas. Not all data presented herein were used to determine impairment listing, due to a variety of reasons (including data quality assurance and quality control). The MassDEP used only a subset of the available data to generate the Integrated Lists

Data from the Massachusetts Division of Marine Fisheries (DMF) were used, in part, as the basis for pathogen impairment for many of the estuarine areas (Figure 1-1). Numerous samples have been collected throughout the Buzzards Bay watershed by the DMF. DMF has a well-established and effective shellfish monitoring program that provides quality assured data for each shellfish growing area. In addition, each growing area must have a complete sanitary survey every 12 years, a triennial evaluation every three years and an annual review in order to maintain a shellfishing harvesting classification with the exception of those areas already classified as Prohibited. The National Shellfish Sanitation Program establishes minimum requirements for sanitary surveys, triennial evaluations, annual reviews and annual fecal coliform water quality monitoring and includes identification of specific sources and assessment of effectiveness of controls and attainment of standards. “Each year water samples are collected by the DMF at 2,320 stations in 294 growing areas in Massachusetts's coastal waters at a minimum frequency of five times while open to harvesting” (DMF 2002). Due to the volume of data collected by the DMF, only a small sub-set of these data are provided herein. For the most recent indicator bacteria sampling data, please contact your local city or town shellfish constable or DMF's Shellfish Project.

Available bacteria data are summarized in the following section. The primary sources of data include, but are not limited to, DMF, CZM, MassDEP, and the Westport River Watershed Alliance (WRWA). Additional discussion can be found at:

- **MassDEP WQA 2003** – Buzzards Bay Watershed 2000 Water Quality Assessment Report available for download at http://www.mass.gov/dep/brp/wm/wqassess.htm.
- **MACZM 2003** – Atlas of Stormwater Discharges in the Buzzards Bay Watershed available for download at http://www.buzzardsbay.org/stormatlas.htm

The summary tables for each segment contain data sources and calendar years for which data were collected. The "Station" column displays the sampling location identifier issued by sampling organization and a short narrative description if available. The next three columns provide statistics relating to sampling conducted. These columns provide the number of samples collected as well as the number of those samples that were collected during the primary contact season. The next column provides the range of fecal coliform values for the samples collected at that station. The "geometric mean" column provides the geometric mean of all the samples collected for a particular station if sufficient data exists. The number and percentage of samples exceeding a threshold value is also reported in this column. The threshold values provided in this TMDL are those established by the MassDEP in the WQA and are: 100 cfu/100mL (Class A WQS- average shall not exceed 20 cfu/100mL, and 10% of the samples shall not exceed 100 cfu/100mL); (Class SA Shellfishing Approved- average shall not exceed 14cfu/ 100mL, and 10% of the samples shall not exceed 28 cfu/100 mL); (Class SB Shellfishing Approved (but not necessarily open)- average shall not exceed 88cfu/100 mL, and 10% of samples shall not exceed 260 cfu/100mL); (Class B WQS: geometric average (E coli) shall not exceed 126cfu/100mL, and a single sample shall not exceed 235 cfu/100mL (it should be noted that in January 2007, MA WQS for bacteria were revised to E *coli*). The percentage value indicates the percent of the samples exceeding the noted threshold. For example "7 samples > 126 (44%)" indicates that 7 samples contained fecal coliform densities greater than 126 cfu/100mL, equating to 44% of the samples analyzed. It should be noted that some of these percentages are calculated based on the number of samples analyzed during the primary contact season, while others may be calculated based on total number of samples. Note that while many of the data included here are for fecal coliform, which remain the indicator of sanitary quality for shellfish areas, E. *coli* and enterococcus in fresh water and enterococcus in salt water are now the standards for swimming. Nevertheless, fecal coliform remain a qualitative indicator of water quality.

The MADPH publishes annual reports on the testing of public and semi-public beaches for both marine and fresh waters. These documents provide water quality data for each bathing beach by community and note if there were exceedances of water quality criteria. There is also a list of communities that did not report testing results. These reports can be downloaded from http://www.mass.gov/dph/beha/tox/reports/beach/beaches.htm. Marine and freshwater beach status is highly variable and is therefore not provided in each segment description. Please see the MADPH annual beach report for specific details regarding swimming beaches.

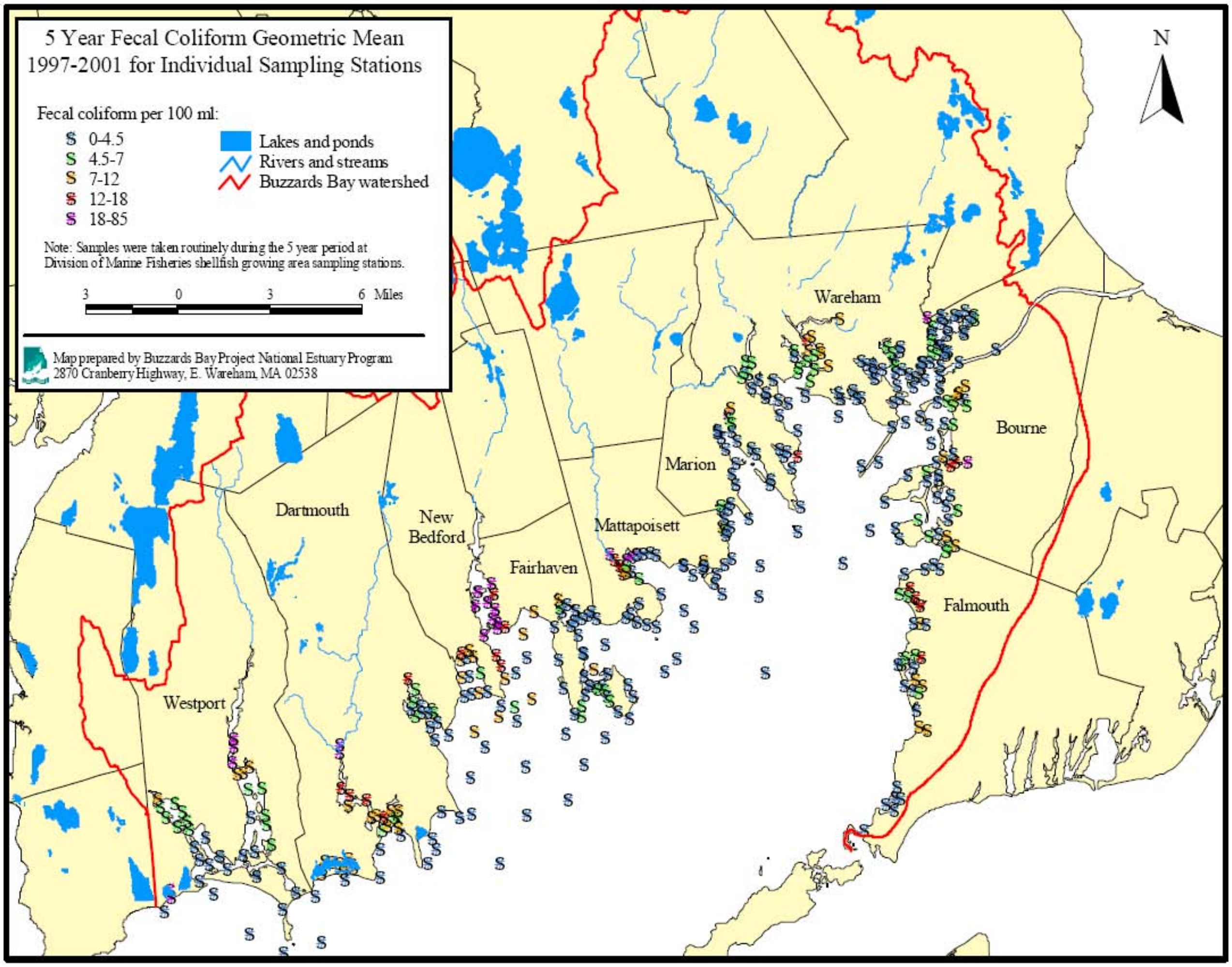
Individual maps showing catch basins and storm drain discharges are available in the "*Atlas of Stormwater Discharges in the Buzzards Bay Watershed*" (MACZM 2003), and are provided in appropriate parts of this section of the report. The Buzzards Bay Project National Estuary Program, through the Mass CZM office in East Wareham, has granted permission to include maps and other relevant information in this final TMDL report. These maps provide locations and prioritization of catch basins, storm drains and road cuts inventoried by the MACZM. This entire report is also available for download: http://www.buzzardsbay.org/stormatlas.htm.

The effort to prioritize storm water discharges (storm drains or road cuts) within the "*Atlas of Stormwater Discharges in the Buzzards Bay Watershed*" includes maps which are included in Appendix A in this report. Each discharge is assigned a "high", "medium", or "low" priority ranking for actual remediation based upon combined scores from a number of criteria, such as: (1) DMF estimate of quality of shellfish production potential from the particular area; (2) Actual present DMF management usage of the shellfish area adjacent to the discharge, e.g., closure of area = "0" points; (3) production potential from adjoining/.adjacent shellfish areas; (4) relative bacteria water quality levels of the particular area; (5) potential remediation project cost; (6) whether or not there is sewering in the adjoining land area; (7) number of discharges in the adjoining sub basin area; (8) number of discharges in the adjoining sub basin area (9) particular discharge problem as a percent of all discharges with problems in the area; (10) proximity to a public bathing area; etc., (see pages 19- 27 in the Atlas, http://www.mass.gov/dep/brp/wm/wqassess.htm for more details).

The following section of this report is intended to briefly summarize the impaired waterbody segments and available data in the Buzzards Bay watershed. For more information on any of these segments, see the "*Buzzards Bay Watershed 2000 Water Quality Assessment Report*" on the MassDEP website: http://www.mass.gov/dep/brp/wm/wqassess.htm.

Between 1997 and 2001, DMF collected over 37,000 fecal coliform samples from tributaries of Buzzards Bay. A summarization of the geometric means for shellfish growing areas over the same period is given in Figures 4-1and 4-2 below. Status of these growing areas as of July 1, 2000 is provided in Figure 1-1.

Figure 4-1. DMF Fecal Coliform Five Year Geometric Mean (1997-2001; MACZM 2003).



4.1 Segments With Data Available And Are Currently on the State List of Impaired Waters for Pathogens.

East Branch Westport River Segment MA95-40

This 2.85 mile long segment is a Class B warm water fishery in Westport. The segment begins at the outlet of Lake Noquochoke and extends to Old County Road bridge. The East Branch Westport River watershed contains 169.4 acres of cranberry bog open space. Mid City Scrap Iron & Salvage has a general storm water permit for this segment. The Town of Westport has submitted a Notice of Intent (NOI) requesting permit coverage under the NPDES program for their municipal separate storm sewer system (MS4). According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, within the two combined MA segments, East Branch Westport River, MA 95-40, and 95-41, there are 584 catch basins, of which 103 are treated, and there are a total of 332 pipe or road cut discharges, of which 126 are ranked medium or high priority for remediation, 17 of which have been remediated. A map showing stormwater discharge priorities (Priority Map #1) for this particular segment is provided in Section 6 herein. A separate map, outlining stormwater drainage systems with outfalls (Westport Map

#2) of this segment and surrounding areas is shown also in Appendix A. This is also available for download at http://www.buzzardsbay.org/stormatlas.htm.

A summary of fecal coliform data collected by the Westport River Watershed Alliance (WRWA), and Environmental Sciences Services, Inc. (ESS), in 2001and 2002 (MassDEP 2003b) is provided in Table 4-4. The Alliance conducted their monitoring program under an approved QAPP (Costa 2008). Samples were collected during both wet and dry weather. The majority of the high fecal coliform counts were collected during wet weather conditions.

Table 4-4. MA95-40 East Branch Westport River WRWA Fecal Coliform Data Summary.

Station	Total Number of Samples (Number of Samples during Primary Contact Season)	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean (cfu/100mL)
A-1: Westport River at Rte 177 (WRWA)	18 (16)	2 – 2,470	83 3 samples > 400 (19%) 1 sample > 2,000 (5%)
3: Head of Westport River at Old Colony Rd (WRWA)	18 (16)	25 – 84,000	375 7 samples > 400 (44%) 4 samples > 2,000 (22%)
Storm drain at Gifford Road between Route 177 and Old Colony Rd.(ESS)	2	580,000-2,100,000	Insufficient data

Enterococci counts, collected by WRWA, ranged from 2-201,000 cfu/100mL (35 samples); 74% > 61 cfu/100mL

<u>Snell Creek Segment (MA95-45)</u>

This segment 0.67 mile long Class B creek extends from Drift Road to Marcus' Bridge in Westport. The first *Concentrated Animal Feeding Operations* (CAFO) permit was issued to a farm bordering the waterbody on Drift Road, but this farm no longer operates. The town of Westport has submitted a NOI requesting permit coverage under the NPDES program for their MS4. Within the Town of Westport, The *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"* has identified a total of 173 pipe or road cut outfall discharges. Out of this total, 126 are ranked either high or medium priority for remediation, and 18 have already been remediated. A map showing stormwater discharge priorities (Priority Map #1) for this particular segment is provided in Section 6 herein. A separate map, outlining stormwater drainage systems with outfalls (Westport Map #3) of this segment and surrounding areas is shown also in Appendix A. This is also available for download at http://www.buzzardsbay.org/stormatlas.htm.

A summary of fecal coliform data collected by the WRWA between March and October of 2001 (MassDEP 2003b) is provided in Table 4-5. The WRWA program operated under an approved QAPP (Costa 2008). Samples were collected during both wet and dry weather. The majority of the high fecal coliform counts were collected during wet weather conditions.

Table 4-5. MA95-45 Snell Creek WRWA Fecal Coliform Data Summary.

Station	Total Number of Samples (Number of Samples during Primary Contact Season)	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean (cfu/100mL)
S-7: Snell Creek at Marcus' Bridge	17 (16)	17 – 6,000*	307* 7 samples > 400 (44%) 4 samples > 2,000 (24%)

* value reported as zero was not used in the number of samples analyzed, reported range or calculation.
Enterococci counts ranged from 12-94,000 cfu/100mL

Snell Creek Segment MA 95-59

This Class A shellfishing, impaired segment covers 0.01 square miles beginning at the 'Marcus Bridge', Westport, and running to the confluence with East Branch Westport River, Westport. As a result of elevated fecal coliform bacteria counts documented by WRWA at Marcus' Bridge and the known problems at the Pimental Farm (see segment MA95-45) both recreational uses (primary contact and shellfishing) are assessed as impaired.

DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Snell Creek Segment MA 95-59 are summarized in Table 4-6 as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-6. MA95-59 Snell Creek DMF Fecal Coliform Data

Total Number of Data Points 1985- 2005	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
202	**1-247**	**24**

East Branch Westport River Segment (MA95-41)

This Class SB Shellfishing (restricted) segment covers 2.65 square miles beginning at Old County Road bridge. In the East Branch Westport River subwatershed, cranberry bogs make up 169.4 acres of open space.. F L Tripp & Sons Inc. has a general storm water permit to discharge in this watershed. This river segment is adjacent to a farm on Drift Road, which was issued the CAFO permit as discussed under Snell Creek MA95-45. Town of Westport has submitted a NOI requesting permit coverage under the NPDES program for their MS4. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, within the two combined MA segments, East Branch Westport River, MA 95-40, and 95-41, there are 584 catch basins, of which 103 are treated, and there are a total of 332 pipe or road cut discharges, of which 126 are ranked medium or high priority for remediation, of which 17 have actually been remediated. A map showing stormwater discharge priorities (Priority Map #1) for this particular segment is provided in Section 6 herein. Separate maps, outlining stormwater drainage systems with outfalls (Westport Maps #2-4;6,7,9) of this segment and surrounding areas, is shown also in Appendix A. This is also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Shellfish harvesting is impaired because of elevated levels of fecal coliform in 0.64 square miles of this segment. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1.

WRWA, ESS, and DMF data (taken in both dry and wet weather periods) are summarized in Table 4-7. Also, DMF data are summarized in Figures 4-1 and 4-2 above.

Table 4-7. MA95-41 East Branch Westport River; WRWA; ESS; DMF Fecal Coliform Data.

Station	Total Number of Samples (Number of Samples during Primary Contact Season)	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean (cfu/100mL)
14 (WRWA)	23 (20)	2 - 2,900	31 3 samples > 400 (14%) 1 sample > 2,000 (4%)
15(WRWA)	20 (18)	1 - 9,200	31 4 samples > 400 (22%) 3 samples > 2,000 (15%)
17(WRWA)	15 (14)	6 - 25,000	90 4 samples > 400 (29%) 2 samples > 2,000 (13%)
18(WRWA)	15 (13)	6 - 30,600	322 4 samples > 2000 (27%)
19(WRWA)	15 (15)	10 - 29,900	292 4 samples > 2,000 (27%)
KB(WRWA)	11 (10)	56 - 31,800	423 2 samples > 2,000 (18%)
K4(WRWA)	20 (18)	14 - 2,500	87 2 samples > 400 (11%) 1 sample > 2,000 (5%)
WR1(ESS)	3	1-700	Insufficient data
WR2(ESS)	2	610-1,600	Insufficient data
WR5(ESS)	2	580,000- 2,100,000	Insufficient data
DMF stations	2127	1- 492	8.3

Enterococci counts (data collected by WRWA) ranged from 0-49,400 cfu/100mL (83 samples)

West Branch Westport River Segment MA95-37

This 1.28 square mile segment begins at the outlet of Gray's Mill Pond (also known as Adamsville Pond) in Adamsville, Rhode Island to the mouth at Westport Harbor in Westport. This segment is a Class SA, shellfishing (open) waterbody. The Gray's Mill Pond, which is created by a dam and is used by Gray's Grist Mill forms the headwaters of this segment. There are no permitted NPDES dischargers in this segment. Town of Westport has submitted a NOI requesting permit coverage under the NPDES program for their MS4. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, within this segment sub watershed there are 158 catch basins, of which 12 are treated, and there are a total of 43 pipe or road cut discharges, of which 13 are ranked medium or high priority for remediation. One of these has been remediated. A map showing stormwater discharge priorities (Priority Map #1) for this particular segment is provided in Section 6 herein. A separate map, outlining stormwater drainage systems with outfalls (Westport Map #5) of this segment and surrounding areas is shown also in Appendix A.

Shellfish harvesting is impaired in 0.78 square miles of this segment. The suspected source of fecal coliform is the MS4. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure

1-1. DMF and WRWA data (taken in both dry and wet weather periods) are summarized in Table 4-8, DMF data are also summarized in Figures 4-1 and 4-2 above.

Table 4-8. MA95-37 West Branch Westport River ; DMF/WRWA Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
2197 (DMF)	**1- 2400**	**5.2**
19 at 1 station (WRWA)	**0-2,500**	**8.6**

* zero value reported in the range was not used in the calculation
Enterococci counts ranged from 0-3,200 cfu/100mL

Westport River MA95-54

This 0.74 square mile segment is a Class SA waterbody. The segment extends from the confluences of the East and West Branches of the Westport River to Rhode Island Sound. The Town of Westport has submitted a NOI requesting permit coverage under the NPDES program for their MS4. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, within the town of Westport (which includes part of this segment) there are 29 low priority, 109 medium priority, and 17 high priority discharges (see Priority Map #1 in Section 6 herein). A total of 17 of these discharges have been remediated. Separate maps, outlining stormwater drainage systems with outfalls (Westport Maps #8,9) of this segment and surrounding areas are shown also in Appendix A. This is also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Shellfish harvesting is supported in 0.5 square miles of this segment and impaired in 0.78 square miles due to elevated fecal coliform concentrations. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. DMF 5 year (1997-2001) fecal coliform geometric mean data (taken in both dry and wet weather periods) for stations in this segment indicate relatively low levels for the SA Classification at most stations (0- 4.4cfu/100mL) Summaries of fecal coliform data are in figures 4-1 and 4-2 above and are available for download at http://www.buzzardsbay.org/stormatlas.htm.

A summary of fecal coliform data collected by WRWA between March and October 2001 (MassDEP 2003b) is provided in Table 4-9.

Table 4-9. MA95-54 Westport River; WRWA Fecal Coliform Data Summary.

Station	Total Number of Samples (Number of Samples during Primary Contact Season)	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean (cfu/100mL)
11A: Off of Westport Town Wharf	19 (17)	<1 – 1040	5.0 1 sample > 400 (6%)
7: Harbor entrance at Charlton Wharf	9* (9)	1 – 157	5.9

* value reported as zero was not used in the reported range or calculation
Enterococci counts for 11A ranged from 0-410 cfu/100mL (17 samples); counts at station 7 ranged from 0-240 (17 samples)

Slocums River Segment MA95-34

This 0.67 square mile segment is a Class SA, Shellfishing (open) waterbody. The segment begins at the confluence with Paskamanset River at Rock O'Dundee Road in Dartmouth and flows to its mouth at Buzzards Bay in Dartmouth. The Slocums River subwatershed contains 74.6 acres of cranberry bog open space. The discharges from general permittees into the Paskamansett River, an upstream segment, ultimately end up in this segment. Discharge permits on the Paskamansett River include nine general storm water permits and one permit to discharge emergency overflow from lagoons at the Chase Road Well D Water Treatment Plant. The Town of Dartmouth was awarded $2.33 million in FY'07 SRF Funds for_construction of new sewers. The Town of Dartmouth has also submitted a NOI requesting permit coverage under the NPDES program for their MS4. . According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, within this segment sub watershed there are 107 catch basins, of which none are treated, and there are a total of 136 pipe or road cut discharges, of which 16 are ranked medium or high priority for remediation, of which none have actually been remediated. A map showing stormwater discharge priorities (Priority Map #1) for this particular segment is provided in Section 6 herein. A separate map, outlining stormwater drainage systems with outfalls (Dartmouth Map #6) of this segment and surrounding areas is shown also in Appendix A. This information is also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Impairment status for this segment was based on DMF growing area status. Shellfish harvesting is supported in 0.01 square miles and impaired in 0.66 square miles of this segment. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. DMF data (taken in both dry and wet weather periods) are summarized in Table 4-10, as well as in Figures 4-1 and 4-2 above.

Table 4-10. MA95-34 Slocums River; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
336	**0- 4800**	**12**

Snell Creek Segment MA95-44

This 1.5 mile long Class B warm water fishery flows from the headwaters area west of Main Street, Westport, to Drift Road, Westport. WRWA collected fecal coliform and *Enterococci* bacteria samples at Station S-1, Snell Creek at Drift Road between March and October 2001. Samples were collected during both wet and dry weather. The majority of exceedances were recorded during wet weather conditions (Carvalho-Souza 2002).

Table 4-11. MA95-44 Snell Creek; WRWA Fecal Coliform Data Summary.

Station	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean
S-1 (n=20, 17 during primary contact season)	6 – 3,100	92 6 samples > 400 (35%) 2 samples > 2,000 (10%)

Enterococci counts ranged from 2 to 37,000 cfu/100mL.

Acushnet River Segments MA95-32 & MA95-33

Segment MA95-32 is a 1.10 mile long Class B warm water fishery flows from the Hamlin Road culvert to the culvert at Main Street, both in Acushnet. The Acushnet River subwatershed contains 429.6 acres of cranberry bog open space. The only NPDES permitted discharger along this segment is the Acushnet Company-Titleist Golf Division. The company discharges treated sanitary waste (via outfall 008) and treated process waste, NCCW, and boiler blow-down (via outfall 010). The outfall's secondary limit for fecal coliform bacteria is 200/100mL.

Segment MA 95-33 is a 0.31 square mile segment and is classified as Class SB, Shellfishing (Restricted), CSO river segment. The segment runs from the outlet Main Street culvert in Acushnet to the Coggeshall Street bridge in New Bedford/Fairhaven. This segment receives discharges from ten CSOs in the City of New Bedford. This segment also receives discharge from nine storm drains. Aerovox Inc. has a permit to discharge storm water into the Acushnet River/New Bedford Harbor. Additionally, Riverside Auto Service, Titleist and Foot Joy Ball Planting, and Acushnet Rubber Company have general storm water permits. . The Town of Acushnet has submitted a NOI requesting permit coverage under the NPDES program for their MS4. The Town of Acushnet was awarded $16.8 million in FY'07 SRF Funds for Phase II of a sewer collection system construction effort. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, within this segment sub watershed (including MA 95-31, 95-32, 95-33) there are 736 catch basins, of which none are treated, and there are a total of 66 pipe or road cut discharges which are within the "potential stormwater contribution zone" of the embayment. A map showing stormwater discharge priorities (Priority Map #3) for this particular segment is provided in Section 6 A herein. This is also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Impairment status for this segment was based on DMF growing area status. This segment is impaired for shellfish harvesting. The causes of impairment are elevated fecal coliform concentrations and PCBs. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for both Acushnet River Segments MA 95-32, and MA 95-33, and are summarized in Table 4-12, as well as in Figures 4-1 and 4-2

Table 4-12. MA95-32, MA95-33 Acushnet River; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
195	0- 494	62

During the winter of 2002 Umass Dartmouth School of Marine Science (SMAST) was given a grant of $30,000 to quantify nitrogen loading to the New Bedford Inner Harbor. Although the project was intended to address nitrogen additional bacterial data was collected by SMAST to determine the potential for the river to be a source of bacterial (fecal coliform, *E. coli*, *Enterococci*) contamination to the estuary. A stream gauge was maintained and nitrogen and bacterial samples were collected weekly for 12 months, with additional samples associated with rain events. Unfortunately, the bacterial data was not available to MassDEP for inclusion in this TMDL but will be evaluated once available to the Department to determine its associated impact on this TMDL.

New Bedford Inner Harbor Segment MA95-42

This 1.25 square mile segment is a Class SB Shellfishing (restricted), CSO area. The segment extends from Coggeshall Street Bridge to Hurricane Barrier in New Bedford/Fairhaven. In the 1960s the New Bedford-Fairhaven-Acushnet Hurricane Protection Project made three major alterations to the Harbor: a barrier across New Bedford and Fairhaven Harbor including an extension dike on the mainland, Clarks Cove Dike, and Fairhaven Dike.

Industrial waste water NPDES permittees include Revere Copper Products, Inc. (three cooling water outfalls going to the wastewater treatment plant), Glen Petroleum Company, and Trio Agarvio Inc. NPDES storm water dischargers include Revere Copper Products, Inc. (two outfalls), DN Kelley & Son Inc. and Global Companies LLC. The City of New Bedford (12 CSOs and 6 storm water outfalls) and the Town of Fairhaven have submitted NOIs for NPDES MS4 coverage. The City of New Bedford recently updated (2006) and is actively implementing a major long- term CSO control plan (see "Draft CSO Baseline Conditions Report', Sept. 2006). The City was awarded $ 22 million in FY '07 SRF funds for implementing these long- term controls and is on the 2009 state intended use plan for $19.3 million of SRF funds to reduce CSO by removing major grit blockages within the system.

According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, within this segment sub watershed, there are a total of 96 road cut and pipe discharges, of which 75 are medium or high priority for remediation, of which none have been remediated yet. A map showing stormwater discharge priorities (Priority Map #3) for this particular segment is provided in Section 6 herein. Separate maps, outlining stormwater drainage systems with outfalls (Fairhaven Map #1,3) of this segment and surrounding areas are shown in Appendix A. Sanitary waste NPDES dischargers include the Town of Fairhaven and the City of Bedford (12 CSO outfalls) into the Acushnet River.

Impairment status for this segment was based on DMFgrowing area status. Shellfish harvesting is impaired in this segment due to fecal coliform bacteria and PCBs. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for both New Bedford Inner and Outer Harbor Segments MA 95-42, and MA 95-63, and are summarized in Table 4-13, as well as in Figures 4-1 and 4-2 above. Also, the City of New Bedford, Shellfish Sanitation Program conducted sampling between August 1997 and August 2007 (Labelle, 2008). These data are also summarized in Table 4-13.

Table 4-13. MA95-42 New Bedford Inner Harbor ; DMF and City of New Bedford (NBSSP) Fecal Coliform Data

Total Number of Data Points 1985- 2007	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997- 2001 data base (cfu/100mL)
1084 (DMF)	0- 247	9.0
271 (8 stations up to 41 X) (NBSSB)	0->311	>28* 4- >311 146 readings >28 73 readings >100. Station #90 (@Fairhaven WWTP outfall had 18 out of 41 readings >311

most samples were reported at an upper limit rather than actually being determined. As such an exact geometric mean could not be determined.

This segment was also covered by the SMAST nitrogen and bacteria loading study indentified in the segment above.

Outer New Bedford Harbor Segment MA95-63

This 5.82 square mile segment is a Class SA, Shellfishing (open) segment. The outer harbor is defined by a straight line connecting Wilbur Point to Clarks Point and extends inwards to the Hurricane Barrier. Seven CSOs in the City of New Bedford, as well as the New Bedford WWTP (goes approximately 1.5 miles off- shore), discharge into the outer harbor. As noted above the City of New Bedford is actively implementing a major long- term CSO control plan and has received $ 22 million in FY ’07 SRF funds for implementing these long- term controls. The City is also permitted to discharge storm water into Clark’s Cove and Outer New Bedford Harbor. Cornell-Dubilier Electronics Corporation discharges storm water to Fort Phoenix Reach near the Acushnet River Estuary in the lower harbor. Allegheny Rodney also has a storm water permit to discharge in this segment. Fairhaven and New Bedford have submitted NOI’s requesting permit coverage under the NPDES program for their MS4. According to the *“Atlas of Stormwater Discharges in the Buzzards Bay Watershed”*, within this segment sub watershed, there are a total of 32 road cut and pipe discharges, of which all 32 are medium or high priority for remediation. A map showing stormwater discharge priorities (Priority Map #3) for this particular segment is provided in Section 6 herein. Separate maps, outlining stormwater drainage systems with outfalls (Fairhaven Map #3,4) of this segment and surrounding areas are shown in Appendix A. This is also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Impairment status for this segment was based on DMF growing area status. Shellfish harvesting in this segment is impaired due to fecal coliform bacteria. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for both New Bedford Inner and Outer Harbor Segments MA 95-42, and MA 95-63, and are summarized in Table 4-14, as well as in Figures 4-1 and 4-2 above. Also, the City of New Bedford, Shellfish Sanitation Program conducted sampling between August 1997 and August 2008 (Labelle, 2008). These data are also summarized in Table 4-14.

Table 4-14. MA95-63 Outer New Bedford Harbor ; DMF and City of New Bedford (NBSSP) Fecal Coliform Data

Total Number of Data Points	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean (cfu/100mL)
1084 (DMF)	0- 247	9.0
West Shore—584 (16 stations up to 75 X) (NBSSP)	<2- >311	Stations 65, 66: >28 All other stations <11 80 readings >28 20 readings >100 Stations #65, 66 near Hurricane Barrier have numerous readings >28 (at least 50%of time)
East Shore—367 (9 stations up to 43 X) (NBSSP)	<2- >311	Undetermined 18 readings >28.

* most samples were reported at an upper limit rather than actually being determined. As such an exact geometric mean could not be determined.

Clarks Cove Segment MA95-38

This segment is a 1.90 square mile marine segment and is classified under the Massachusetts Surface Water Quality Standards as Class SA Shellfishing (open). The cove extends from Clarks Point in New Bedford southeast to Ricketsons Point in Dartmouth. New Bedford discharges storm water into Clark's Cove. New Bedford also discharges via nine CSOs. Dartmouth and New Bedford submitted NOIs requesting permit coverage under the NPDES program for their MS4. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, within this segment sub watershed there are 173 catch basins, of which 47 are treated, and there are a total of 27 pipe or road cut discharges which are rated as medium or high in priority for remediation, of which 2 have been remediated. Maps showing stormwater discharge priorities (Priority Map #2,3) for this particular segment are provided in Section 6 herein. A separate map, outlining stormwater drainage systems with outfalls (Dartmouth Map #5) of this segment and surrounding areas, is shown in Appendix A. Theses are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Impairment status for this segment was based on DMF growing area status. Shellfish harvesting in this segment is impaired by fecal coliform. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Clarks Cove Segment MA 95-38 are summarized in Table 4-15, as well as in Figures 4-1 and 4-2 above. Also, the City of New Bedford, Shellfish Sanitation Program conducted sampling between August 1997 and August 2008 (Labelle, 2008). These data are also summarized in Table 4-16.

Table 4-15. MA95-38 Clarks Cove ; DMF and City of New Bedford (NBSSP) Fecal Coliform Data

Total Number of Data Points 1985- 2007	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2007 data base (cfu/100mL)
1932 (DMF)	1- 3,200 (DMF)	6.9 (DMF)
398 (9 stations sampled up to 63 X) Inner Clarks Cove (NBSSP)	<2- 560- TNTC	28 readings>28MPN Insufficient data*
294 (7 stations sampled up to 56 X) Outer Clarks Cove (NBSSP)	<2- 240	11 readings >28 Insufficient data*
304 (6 stations sampled up to 75 X) Outside of Outer Clarks Cove (NBSSP)	<2- 240	7 readings >28 (6 of these @ station #37, near WWTP outfall) Insufficient data*

* most samples were reported at an upper limit rather than actually being determined. As such an exact geometric mean could not be determined.

Apponagansett Bay Segment MA95-39

This is a 0.95 square mile Class SA Shellfishing (open) waterbody. Apponagansett Bay begins at the mouth of Buttonwood Brook and stretches to Ricketsons Point in New Bedford and Samoset Street in Dartmouth. The Apponagansett Bay subwatershed contains 4. 5 acres of cranberry bog open space.

Davis and Tripp Inc. is permitted to discharge within this segment. The Town of Dartmouth was awarded $2.33 million in FY'07 SRF Funds for construction of new sewers. Dartmouth submitted an NOI requesting permit coverage under the NPDES program for their MS4. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, within the Town of Dartmouth, there are a total of 423 road cut and pipe discharges, of which all 121 are ranked medium or high priority for remediation, of which 13 have been remediated. A map showing stormwater discharge priorities (Priority Map #2) for this particular segment is provided in Section 6 herein. Separate maps, outlining stormwater drainage systems with outfalls (Dartmouth Maps #4,5,7) of this segment and surrounding areas are shown also in Appendix A. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Impairment status for this segment was based on DMF growing area status. Periodic high concentrations of fecal coliform have caused 0.68 square miles of the Bay to be impaired for shellfish harvesting. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Apponagansett Bay Segment MA 95-39 are summarized in Table 4-16, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-16. MA95-39 Apponagansett Bay DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
1178	1- 460	4.75

<u>Mattapoisett Harbor Segment MA95-35 & MA95-60</u>

Segment MA95-35 is a 1.10 square mile Class SA segment which is open to shellfishing. The segment begins at the mouth of the Mattapoisett River and extends to Ned Point and to a point of land between Bayview and Grandview Avenues in Mattapoisett. Coen Brook is a tributary to Mattapoisett Harbor. The Old Rochester Regional School District has a permit to discharge treated sewage effluent into Coen Brook. In 2002, the school district tied into the Mattapoisett sewer system, which, after going through the Fairhaven WWTF, discharges treated water into the New Bedford Inner Harbor.

Segment MA95-60 is a 0.05 square mile, Class SA Shellfishing estuary that extends from the River Road bridge, Mattapoisett to the mouth at Mattapoisett Harbor, Mattapoisett. The DMF Shellfishing Status Report of July 2000 indicates that shellfishing area BB26.1 is conditionally approved, and BB26.2 is restricted. Therefore the entire 0.05 square mile segment is assessed as impaired.

The Town of Mattapoisett received a FY'07 SRF Grant Award of $160,000 for development of a comprehensive wastewater management plan. Mattapoisett submitted an NOI requesting permit coverage under the NPDES program for their MS4. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, the Mattapoisett River (upstream of this segment) has a total of 814 catch basins, of which 19 are treated, and there are a total of 241 pipe or road cut discharges which are rated as medium or high in priority for remediation, of which 2 have been remediated. A map showing stormwater discharge priorities (Priority Map #3) for this particular segment is provided in

Section 6 herein. Separate maps, outlining stormwater drainage systems with outfalls (Mattapoisett Maps #3,4) of this segment and surrounding areas are shown also in Appendix A. These maps are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Impairment status for these segments was based on DMF growing area status. Shellfish harvesting in this segment is supported for 1.0 square miles and is impaired for 0.1 square miles due to periodic excessive fecal coliform concentrations. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Mattapoisett Harbor Segment MA 95-35, and Mattapoisett River Segment MA 95-60 are summarized in the following Table 4-17, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-17. MA95-35 Mattapoisett River and MA95-60 Mattapoisett Harbor; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
1614	1- 3,200	13

Nasketucket Bay Segment MA95-65

This is a 3.7 square mile, Class SA Shellfishing estuary that extends from the confluence with Little Bay, Fairhaven to Buzzards bay along Causeway Road, Fairhaven and along a line from the southern tip of Brant Island, Mattapoisett to the eastern tip of West Island, Fairhaven. Based on the DMF Shellfish Status Report of 2000, Shellfish Harvesting Use was assessed as support for 3.2 square miles, and impaired for 0.5 square miles.

DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for Nasketucket Bay (Segment MA 95-65 are summarized in Table 4-18 as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-18. MA95-65 Nasketucket Bay ;DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
1178	1- 460	4.8

Hammett Cove Segment MA95-56

This is a 0.07 square mile Class SA waterbody. Hammett Cove is located in Marion and runs south to the confluence with Sippican Harbor. A line connecting the southwest most point of Little Neck to the end of the seawall on the opposite point delineates the southern boundary of this segment. The Hammett Cove subwatershed contains 34.7 acres of cranberry bog open space. Marion submitted an NOI requesting permit coverage under the NPDES program for their MS4. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, the Town of Marion has a total of 280 catch basins tied into treatment systems, and the town has a total of 125 pipe or road cut discharges which are rated as medium or high in priority for remediation, of which 13 have been remediated. A map showing stormwater discharge priorities (Priority Map #4) for this particular segment is provided in Section 6 herein. A separate map, outlining stormwater drainage systems with outfalls (Marion Map #2) of this segment and surrounding areas is shown also in Appendix A. This is also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Impairment status for this segment was based on DMF growing area status. Shellfish harvesting is impaired in 0.02 square miles of this segment due to periodic elevated fecal coliform concentrations. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. Hammett Cove MA 95-56 is part of the larger Sippican Harbor Segment MA 95-08 (Table 4-22) immediately below. DMF data for both segments is summarized in Figure 4-19 below, and are provided in Figures 4-1 and 4-2 above, and are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Sippican Harbor Segment MA95-08

This is a 2.0 square mile Class SA Shellfishing (open) waterbody. Sippican Harbor extends from the confluence with Hammetts Cove to the mouth of Buzzards Bay (excluding Blankenship Cove and Planning Island Cove). The Sippican Harbor subwatershed contains 37.8 acres of cranberry bog open space. Barden's Boat Yard Inc and Edey & Duff Ltd. have general storm water permits. The Town of Marion submitted an NOI requesting permit coverage under the NPDES program for their MS4. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, the Town of Marion has a total of 280 catch basins tied into treatment systems, and the town has a total of 125 pipe or road cut discharges which are rated as medium or high in priority for remediation, of which 13 have been remediated. A map showing stormwater discharge priorities (Priority Map #4) for this particular segment is provided in Section 6 herein. Separate maps, outlining stormwater drainage systems with outfalls (Marion Maps #2,4,5) of this segment and surrounding areas are shown also in Appendix A, and is available for download at http://www.buzzardsbay.org/stormatlas.htm. Island Wharf has a vessel sewage pump out shoreside facility and porta-potty dump.

Impairment status for this segment was based on DMF growing area status. Shellfish harvesting is impaired in 0.30 square miles of this segment due to periodic fecal coliform concentrations. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Sippican Harbor Segment MA 95-08, and the connecting Hammett Cove Area MA 95-56 are summarized in Table 4-19, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-19. MA95-08 Sippican Harbor; MA 95-56 Hammett Cove DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
1,275	1- 350	4.1

Aucoot Cove Segment MA95-09

This is a 0.50 square mile segment which is classified as SA, Shellfishing (open) segment. Aucoot Cove extends from the confluence with Aucoot Creek to the mouth of Buzzards Bay. The area is bounded to the south by a line drawn from Converse Point to Joes Point. The Aucoot Cove subwatershed contains 52.7 acres of cranberry bog open space. Marion submitted an NOI requesting permit coverage under the NPDES program for their MS4. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, the Town of Marion has a total of 280 catch basins tied into treatment systems, and the town has a total of 125 pipe or road cut discharges which are rated as medium or high in priority for remediation, of which 13 have been remediated. A map showing stormwater discharge priorities (Priority Map #4) for this particular segment is provided in Section 6 herein. A separate map, outlining stormwater drainage systems with outfalls (Marion Map#4) of this segment and surrounding areas is shown also in Appendix A. This is also available for download at http://www.buzzardsbay.org/stormatlas.htm. The Town of Marion Waste Water Treatment Plant discharges treated waste water into an unnamed brook tributary to Aucoot Cove.

Impairment status for this segment was based on DMF growing area status .Shellfish harvesting is impaired in 0.04 square miles of this segment. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Aucoot Cove Segment MA 95-09 are summarized in Table 4-20 as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-20. MA95-09 Aucoot Cove ; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
502	1- 128	3.1

Hiller Cove Segment MA95-10

Hiller Cove is a 0.04 square mile Class SA segment. It is located landward of a line drawn between Jones Point and the second boat dock northeast of Hiller Cove Lane in Mattapoisett. Mattapoisett submitted an NOI requesting permit coverage under the NPDES program for their MS4. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, the Town of Mattapoisett has a total of 310 catch basins tied into treatment systems, and the town has a total of 195 pipe or road cut discharges which are rated as medium or high in priority for remediation, of which 2 have been remediated. A map showing stormwater discharge priorities (Priority Map #4) for this particular segment is provided in Section 6 herein. This is also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Impairment status for this segment was based on DMF growing area status. Shellfish harvesting is impaired in 0.01 square miles of Hiller Cove due to periodic excessive fecal coliform concentrations. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Hillier Cove Segment MA 95-10 are summarized in Table 4-21 as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-21. MA95-10 Hiller Cove; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
373	1- 240	5.9

Little Bay Segment MA95-64

Little Bay is a 0.36 square mile, Class SA segment . It runs from the confluence with the Nasketucket River, Fairhaven south to the confluence with Nasketucket Bay at a line from the southernmost tip of Mirey Neck, Fairhaven to a point near Shore Drive. The DMF Shellfish Status Report in July, 2000, indicates that growing areas BB22.0 and BB22.3 are conditionally approved and BB22.1 is prohibited. Therefore, the entire segment is classified as prohibited.

DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Little Bay Segment MA 95-64 are summarized in Table 4-22 as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-22. MA95-64 Little Bay; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
1009	1- 492	5.9

Sippican River Segment MA95-07

This 0.08 square mile segment is designated as a Class SA, Shellfishing (open) river segment. This segment flows from County Road to its confluence with Weweantic River in Marion/Wareham. The Sippican River subwatershed contains 2313.1 acres of cranberry bog open space. The Town of Marion submitted an NOI requesting permit coverage under the NPDES program for their MS4. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, the Sippican Harbor Area (including this segment) has a total of 426 catch basins, of which 48 are treated, and has a total of 55 pipe or road cut discharges which are rated as medium or high in priority for remediation, of which 6 have been remediated. A map showing stormwater discharge priorities (Priority Map #4) for this particular segment is provided in Appendix A herein. Separate maps, outlining stormwater drainage systems with outfalls (Marion Maps #2,3) of this segment and surrounding areas are shown in Appendix A, and is also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Impairment status for this segment was based on DMF growing area status. This entire river segment is impaired for shellfishing due to periodic high fecal coliform concentrations. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Sippican River Segment MA 95-07 are summarized in Table 4-23, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-23. MA95-07 Sippican River; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
1275	1- 350	4.1

Beaverdam Creek Segment MA95-53

Beaverdam Creek is a 0.04 square mile Class SA segment. It begins at the outlet from the cranberry bogs southeast of Route 6 and flows to its confluence with the Weweantic River. The Beaverdam Creek subwatershed contains 40.8 acres of cranberry bog open space. Wareham submitted an NOI requesting permit coverage under the NPDES program for their MS4. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, the Town of Wareham has a total of 710 pipe or road cut discharges of which 547 which are rated as medium or high in priority for remediation, of which 32 have been remediated. A map showing stormwater discharge priorities (Priority Map #4) for this particular segment is provided in Section 6 herein. A separate map, outlining stormwater drainage systems with outfalls (Marion Map #3) of this segment and surrounding areas is shown also in Appendix A. This is also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Impairment status for this segment was based on DMF growing area status. Periodic high fecal coliform values have caused shellfish harvesting impairment in this segment. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. DMF data (taken in both dry and wet weather periods) were taken over the years' 1985- 2001 for Beaverdam Creek (DMF shellfishing area BB-35-1), and are summarized in Table 4-24 as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-24. MA95-53 Beaverdam Creek; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
92	1- 460	3.8

Bread and Cheese Brook Segment MA95-58

This is a 4.9 mile long Class B river segment, running from the headwaters, north of Old Bedford Road, Westport to confluence with East Branch Westport River, Westport. WRWA collected bacteria samples from Bread and Cheese Brook at Rte 177 between March and October 2001 (Table 4-25 below). Two elevated counts were representative of wet weather conditions. ESS also collected fecal coliform bacteria samples from the three stations along Bread and Cheese Brook as part of a Nonpoint Source bacteriological assessment project (01-02/MWI). ESS noted that large impervious areas along Route 6 and Gifford Road convey storm water runoff directly into Bread and Cheese Brook. Livestock pastures were also noted within 200 feet of the brook.

Bread and Cheese Brook was previously listed for pathogen impairments. Data collected by the Westport River Watershed Alliance and ESS are provided in Table 4-25 and identify periodic exceedances of the State Water Quality Standards.

Table 4-25. MA95-58 Bread and Cheese Brook; WRWA Fecal Coliform Data Summary.

Station(s)	Total Number of Samples (Number of Samples during Primary Contact Season)	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean (cfu/100mL)
Route 177, Westport (WRWA)	17	0 – 1,190*	55.9 2 samples > 400 (13%), rep. of wet weather conditions.
WR-13, Bedford Rd; WR-12, Route 6; WR-10, Route 177 (ESS)	12	< 100	< 100

* Enterococci counts at Rte 177 ranged from 0 to 4940 cfu/100ml (n=16).

<u>Weweantic River Segment MA95-05</u>

This segment is designated as Class SA – Open to shellfishing. It is a 0.62 square mile segment that begins at the outlet to Horseshoe Pond in Wareham and continues to the mouth at Buzzards Bay in Marion/Wareham. Point Independence Yacht Club has a vessel sewage pump out sewage facility within this segment. The Weweantic River subwatershed contains 8969.4 acres of cranberry bog open space. The Towns of Wareham, Marion, and Rochester have all submitted NOIs requesting permit coverage under the NPDES program for their MS4. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, this segment has a total of 627 catch basins with potential stormwater contribution, of which 122 are treated, and has a total of 84 pipe or road cut discharges which are rated as medium or high in priority for remediation, of which 2 have been remediated. A map showing stormwater discharge priorities (Priority Map #4) for this particular segment is provided in Section 6 herein. Separate maps, outlining stormwater drainage systems with outfalls (Marion Maps #2,3; Wareham Maps 1,5) of this segment and surrounding areas are shown also in Appendix A. This is also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Impairment status for this segment was based on DMF growing area status. Periodic high levels of fecal coliform have caused shellfish harvesting impairment in 0.45 square miles of this segment. MassDEP suspects municipal separate storm sewer systems and failing septic systems to be the source of bacteria. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. DMF data (taken in both dry and wet weather periods) were taken for the Weweantic River Segment MA95-05 (DMF shellfishing area BB-35) over the years 1985- 2001, and are summarized in Table 4-26 as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-26. MA95-05 Weweantic River; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
1065	**1- 460**	**4.4**

Agawam River Segment MA95-29 & Wankinco River Segment MA95-50

Segment MA95-29 (Agawam River) is 0.16 miles long and is classified as a Class SB waterway which is restricted for shellfishing. The segment runs from the Wareham WWTP to the confluence with Wankinco River at the Route 6 bridge in Wareham. The Agawam River subwatershed contains 2792.0 acres of cranberry bog open space. The Town of Wareham has a permit to discharge treated sanitary wastewater into the Agawam River. The Town of Wareham submitted an NOI requesting permit coverage under the NPDES program for their MS4. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, this segment has a total of 437 catch basins with potential stormwater contribution, of which 24 are treated, and has a total of 96 pipe or road cut discharges which are rated as medium or high in priority for remediation, of which none have been remediated. A map showing stormwater discharge priorities (Priority Map #4) for this particular segment is provided in Section 6 herein. Separate maps, outlining stormwater drainage systems with outfalls (Wareham Maps 2,3) of this segment and surrounding areas are shown in Appendix A. This is also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Segment MA95-50 is 0.05 square mile Class SA waterbody extends from the Elm Street bridge in Wareham to the confluence with the Agawam River. The subwatershed of the upstream segment MA95-30 contains 1770.6 acres of cranberry bog open space. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, this segment has a total of 547 pipe or road cut discharges which are rated as medium or high in priority for remediation, of which 32 have been remediated. A map showing stormwater discharge priorities (Priority Map #4) for this particular segment is provided in Section 6 herein. A separate map, outlining stormwater drainage systems with outfalls (Wareham Map #2) of this segment and surrounding areas is shown also in Appendix A.

Impairment status for these segments was previously based on DMF growing area status. Shellfish harvesting along these segments is impaired due to periodic elevated fecal coliform levels. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Agawam River Segment MA 95-29, and the smaller connecting Wankinco River Segment MA 95-50, are summarized in Table 4-27, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-27. MA95-29 & MA95-50 Agawam and Wankinco Rivers; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
223	1- 2,228	10.8

Broad Marsh River Segment MA95-49

This 0.16 square mile Class SA waterbody flows from its headwaters in a salt marsh south of Marion Road to the confluence with the Wareham River. There is a public beach as well as several private beaches along the river. Wareham submitted an NOI requesting permit coverage under the NPDES program for their MS4. Fifteen storm drain pipes discharge directly into the river. The Broad Marsh Stormwater Remediation Project reduced fecal coliform concentrations in runoff by >99.99%, according to post-project monitoring (MassDEP 2003b). According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, the Town of Wareham has a total of 710 pipe or road cut discharges of which 547 which are rated as medium or high in priority for remediation, of which 32 have been remediated. A map showing stormwater discharge priorities (Priority Map #4) for this particular segment is provided in Section 6 herein. A separate map, outlining stormwater drainage systems with outfalls (Wareham Map #6) of this segment and surrounding areas is shown in Appendix A. This is also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Impairment status for this segment was previously based on DMF growing area status. Shellfish harvesting along this segment was deemed to be impaired due to periodic high fecal coliform values. This segment should be reassessed to determine if the Broad Marsh Remediation Project has eliminated the impairment. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. DMF data (taken in both dry and wet weather periods) were taken over the years 1985-2001 for the Broad Marsh River Segment MA 95-49 are summarized in Table 4-28, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-28. MA95-49 Broad Marsh River;DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
259	1- 130	5.5

Crooked River Segment MA95-51

The Crooked River is a 0.04 square mile Class SA waterbody extending from the outlet of a cranberry bog, east of Indian Neck Road, to the confluence with Wareham River. The Town of Wareham submitted an NOI requesting permit coverage under the NPDES program for their MS4. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, the Town of Wareham has a total of 710 pipe or road cut discharges of which 547 which are rated as medium or high in priority for remediation, of which 32 have been remediated. A map showing stormwater discharge priorities (Priority Map #4) for this particular segment is provided in Section 6 herein. Separate maps, outlining stormwater drainage systems with outfalls (Wareham Map #6,7) of this segment and surrounding areas are shown also in Appendix A. This also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Impairment status for this segment was previously based on DMF growing area status. Shellfish harvesting along this segment is impaired due to periodic high fecal coliform concentrations. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Crooked River Segment MA 95-51 are summarized in Table 4-29, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-29. MA95-51 Crooked River; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
30	1-240	15.3

Wareham River Segment MA95-03

This segment includes 1.18 square miles and extends from the Route 6 bridge to the mouth at Buzzards Bay. The segment is classified in the state Water Quality Standards as an SA water. Warr's Marine has a vessel pump-out facility and porta-potty dump located within this segment. The Wareham River subwatershed contains 2842.5 acres of cranberry bog open space. As previously noted the Town of Wareham has submitted an NOI requesting permit coverage under the NPDES program for their MS4. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, this segment has a total of 714 catch basins with potential stormwater contribution, and a total of 229 pipe or road cut discharges which are rated as medium or high in priority for remediation, of which 18 have been remediated. A map showing stormwater discharge priorities (Priority Map #4) for this particular segment is provided in Section 6 herein. A separate map, outlining stormwater drainage systems with outfalls (Wareham Map #6) of this segment and surrounding areas is shown in Appendix A, and is available for download at http://www.buzzardsbay.org/stormatlas.htm.

Impairment status for this segment was previously based on DMF growing area status. Shellfish harvesting was determined to be impaired in 0.25 square miles of this segment due to periodic high fecal coliform levels. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. http://www.buzzardsbay.org/stormatlas.htm. DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Wareham River Segment MA 95-03 are summarized in Table 4-30, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-30. MA95-03 Wareham River; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
1320	1-4800	8.5

Onset Bay Segment MA95-02

This 0.78 square mile Class SA segment is located in the Town of Wareham. Three vessel sewage pump out facilities are located on this segment. The Onset Bay subwatershed contains 162.8 acres of cranberry bog open space. The Town of Wareham submitted an NOI requesting permit coverage under the NPDES program for their MS4. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, this segment has a total of 471 catch basins with potential stormwater contribution, of which 76 are treated, and has a total of 94 pipe or road cut discharges which are rated as medium or high in priority for remediation, of which 9 have been remediated. Maps showing stormwater discharge priorities (Priority Map #4,5) for this particular segment are provided in Section 6 herein. Separate maps, outlining stormwater drainage systems with outfalls (Wareham maps 7, 8) are shown in Appendix A. This is also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Impairment status for this segment was previously based on DMF growing area status. Shellfish harvesting is impaired in 0.15 square miles of this segment due to periodic high fecal coliform concentrations. Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Onset Bay Segment MA 95-02 are summarized in Table 4-31, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-31. MA95-02 Onset Bay; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
3245	1-4800	3.3

Buttermilk Bay Segment MA95-01

Segment MA95-01 is a 0.67 square mile Class SA segment is located in Bourne/Wareham. There is one vessel sewage pump-out boat in this segment. The Buttermilk Bay subwatershed contains 515.0 acres of cranberry bog open space. Both Towns of Bourne and Wareham submitted NOIs requesting permit coverage under the NPDES program for their MS4. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, this segment has a total of 58 discharges with potential stormwater contribution, and has a total of 46 pipe or road cut discharges which are rated as medium or high in priority for remediation, of which 14 have been remediated. A map showing stormwater discharge priorities (Priority Map #5) for this particular segment are provided in Section 6 herein. Separate maps, outlining stormwater drainage systems with outfalls (Bourne maps 1,2) are shown in Appendix A. This is also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Impairment status for this segment was previously based on DMF growing area status. Shellfish harvesting was determined to be impaired in 0.16 square miles of this segment due to excessive periodic exceedances of the state fecal coliform criteria . Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1. DMF 5 year (1997-2001) fecal coliform geometric mean data (taken in both dry and wet weather periods) for stations in this segment indicate very high levels (>18cfu/100mL) in the northwest portion of the Bay on the border of Wareham and Bourne, and low to moderate levels (0-7cfu/100mL) throughout the other portions of the Bay. DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Buttermilk Bay Segment MA 95-01 are summarized in Table 4-32, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-32. MA95-01 Buttermilk Bay; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
1892	1-2,400	8.5

Buzzards Bay Segment MA 95-62

Segment 95-62 encompasses 8.0 square miles of open water estuary within a line drawn from Wilbur Point, Fairhaven to Clarks Point, New Bedford to Ricketson Point, Dartmouth to vicinity of Samoset St., Dartmouth down to Round Hill Point, Dartmouth, back to Wilbur Point, Fairhaven.

The 18,000-acre New Bedford Harbor is an urban tidal estuary with sediments that are highly contaminated with polychlorinated biphenyls (PCBs) and heavy metals.

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing area BB11.0 and BB14.0 are approved, BB11.3 and BB14.3 are conditionally approved, and BB11.2, BB11.30, BB14.2, and BB14.30 are prohibited (DFWELE 2000). DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Buzzards Bay Segment MA 95-62 are summarized in Table 4-33, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm. Also, the City of New Bedford, Shellfish Sanitation Program conducted sampling between August 1997 and August 2007 (Labelle, 2008). These data are also summarized in Table 4-33.

Also located in the segment are three public beaches - Noquitt Beach, Anthony Beach, and Town Beach. According to the Dartmouth Board of Health, there have been no closures (Dartmouth 2003 and MDPH 2002b).

Table 4-33. MA95-62 Buzzards Bay DMF and City of New Bedford (NBSSP) Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
845 (DMF)	1-128	2.3
142 (NBSSP) (4 stations sampled up to 38 X)	<2 to 18, with 95+% of readings <2.	<2

The following fourteen segments (starting with MA 95-14 Cape Cod Canal and ending with MA 95-25 Quinsett Harbor) were previously included in the Cape Cod Pathogen TMDL. They were moved to this document because although they are on the Cape Cod side of Buzzards Bay they discharge to Buzzards Bay

Cape Cod Canal Segment MA95-14

The Cape Cod Canal is designated as a class SB waterbody and is designated for shellfishing with depuration. The segment encompasses 1.13 mi^2 and connects Buzzards Bay and Cape Cod Bay. Two vessel sewage pump-out boats are located in Bourne and Sandwich. Mirant Canal, LLC has five NPDES discharge outfalls, which discharge condenser cooling water, intake screen and flume flushing water, floor and equipment drains, waste system blowdown and demineralizer and condensate polisher waste waters. Massachusetts Maritime Academy has a NPDES permit to discharge treated sanitary waste, untreated boiler water blowdown and treated swimming pool discharge via two outfalls. The Towns of Bourne and Sandwich applied for NPDES permits for their MS4s.

The DMF Designated Shellfish Growing Areas Status identified 0.49 mi^2 for approved shellfishing; and 0.33 mi^2 where shellfishing is presently prohibited (Figure 1-1).

DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Cape Cod Canal Segment MA 95-14 are summarized in Table 4-34, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-34. MA95-14 Cape Cod Canal ; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
395	1-9,800	3.2

One of the recent DMF sanitary surveys (data included in Table 4-37 above) conducted on January 31, 2006, (following a rain event), had elevated readings: 1) at Sagamore Bridge, 9,800 cfu/100mL; Bourne Rotary Bridge culvert, 560 cfu/100mL; Boat Basin ramp, 280 cfu/100mL.

The MA Department of Public Health (DPH) sampled for enterococcus levels at Gilder Road Beach, 12 times just adjacent to this segment during 2006. Results ranged between <2 and 82 cfu /100mL with no closures.

Eel Pond Segment MA95-48 & Back River Segment MA95-47

The Eel Pond segment encompasses 0.03 mi^2 and is classified as a Class SA waterbody under the state Water Quality Standards. The segment is designated for shellfishing and is a salt water pond that discharges into the Back River. There are no known dischargers in this segment other than MS4s. The Town of Bourne has applied for a NPDES permit for their MS4.

The Division of Marine Fisheries (DMF) has Conditionally Approved this area for shellfishing (Figure 1-1).

The Back River Segment is a 0.08 mi^2 segment and is designated as a Class SA waterbody and is designated for shellfishing. This segment flows from the outlet of a small unnamed pond (downstream of Mill Pond) to its confluence with Phinneys Harbor. The Lobster Trap Company has a permit to discharge treated wastewater.

The DMF has conditionally approved the use of shellfishing in much of this segment and prohibited use in a small portion (see BBWQA, DMF website for growing areas BB47.1, BB47.2, BB47.20 and BB47.3 for more specific information at http://www.mass.gov/dfwele/dmf/programsandprojects/dsga.htm#shelsani).

DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the combined segments Eel Pond MA 95-48 (in Bourne) and Back River MA 95-47 and are summarized in Table 4-35, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

These two segments were previously determined to be impaired based on DMF data and periodic exceedances of the state Water Quality Standards.

Table 4-35. MA95-48 Eel Pond & MA95-47 Back River ; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
523	1-2,400	6.7

Eel Pond Segment MA95-61

Segment MA95-61 is a 0.04 square mile coastal salt water pond at the head of Mattapoisett Harbor, Mattapoisett.

The DMF Shellfish Status Report of July 2000 indicates that shellfish growing areas BB27.0 is prohibited. DMF data (taken in both dry and wet weather periods) were taken over the years 1985-2001 for the Eel Pond Segment MA 95-61 (in Mattapoisett) are summarized in Table 4-36, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Based on the DMF shellfish growing area status this entire 0.04 mi^2 segment was previously assessed as being impaired due to periodically high coliform concentrations.

Table 4-36. MA95-61 Eel Pond (Mattapoisett) DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
134	1-492	67

Phinneys Harbor Segment MA95-15

Phinney's Harbor is a 0.73 mi^2 Class SA waterbody. Its designated uses include shellfish harvesting . The segment extends from the confluence with the Back River to its mouth at Buzzards Bay. A long dike to Hog and Mashnee Islands partially encloses the harbor. There are no known dischargers in this segment other than MS4s. The Town of Bourne has applied for a NPDES permit for their MS4.

DMF has approved 0.58 mi^2 for shellfish harvesting and conditionally approved 0.15 mi^2 (Figure 1-1).

DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Phinney's Harbor Segment MA 95-15 are summarized in Table 4-37, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-37. MA95-15 Phinney's Harbor; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
848	1-4,800	4.3

The MA Department of Public Health (DPH) also sampled for enterococcus levels at Monument Beach, 12 times, and at Monument Marina 11 times within this segment during 2006. Results ranged between <2 and 26 cfu /100mL with no closures.

<u>Pocasset River Segment MA95-16</u>

This segment encompasses 0.05 mi^2 . It is designated as a Class SA waterbody and designated for , shellfishing. This segment is also designated as an Outstanding Resource Water. The Town of Bourne has applied for a NPDES permit for their MS4.

The Division of marine Fisheries has listed this area as "Prohibited" for shellfishing which has resulted in it being designated as an impaired water by MassDEP. (Figure 1-1).

DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Pocasset River Segment MA 95-16 are summarized in the following Table 4-38, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-38. MA95-16 Pocasset River; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2001	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
173	1-4,800	11.0

The MA Department of Public Health (DPH) also sampled for enterococcus levels at Tahanto Associates, Inc., Beach, 13 times within this segment during 2006. Results ranged between <2 and 272 cfu /100mL with 2 failures.

<u>Pocasset Harbor Segment MA95-17</u>

Pocasset Harbor is 0.33 mi^2 and is a Class SA waterbody designated for shellfishing. The segment commences at the confluence with Red Brook Harbor to the mouth at Buzzards Bay. DMF has designated 0.20 mi^2 of the Harbor as "Approved" for shellfishing with another 0.13 mi^2 "Conditionally Approved" (Figure 1-1).

DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Pocasset Harbor Segment MA 95-17 are summarized in Table 4-39, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

This segment was previously listed by MassDEP as being impaired for pathogens based on the DMF designation including periodic exceedances of Water Quality Standards.

The MA Department of Public Health (DPH) also sampled for enterococcus levels at Barlow's Landing Beach, Pocasset Beach Imp. Association Beach, and at Wings Neck Trust South Beach 12 times within this segment during 2006. Results ranged between <2 and 84 cfu /100mL with no closures.

Table 4-39. MA95-17 Pocasset Harbor; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2005	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
631	1-3,200	4.0

Red Brook Harbor Segment MA95-18

Red Brook Harbor is a 0.91 mi^2 Class SA segment which commences at the confluence with Pocasset Harbor to its mouth at Buzzards Bay. The DMF has designated 0.80 mi^2 of the Harbor as "Approved" for shellfishing with another 0.11 mi^2 "Conditionally Approved" (Figure 1-1). Based on the DMF designation and the periodic exceedances of MA Water Quality Standards the MassDEP has listed this segment as impaired on the state list of impaired waters.

DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Red Brook Harbor (including Hen Cove) Segment MA 95-18 are summarized in the following Table 4-40, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-40. MA95-18 Red Brook Harbor; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2005	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
788	1-3,200	4.0

It should be noted that several sanitary surveys conducted since 2001 show indications of elevated fecal coliform levels > 50 cfu/100mL in the Hen Cove area.

Herring Brook Segment MA95-21

This segment encompasses 0.01 mi^2 and is designated as a Class SA waterbody according to MA Water Quality Standards. As such it a primary designated use is for shellfishing. The segment commences at its headwaters located northeast of Dale Drive and west of Route 28A to its mouth at Buzzards Bay. The Town of Falmouth has applied for a NPDES permit for its MS4. This entire segment has been designated as "Prohibited" for shellfishing by the Division of Marine Fisheries. Based on this designation the MassDEP has listed it as impaired on the state list of impaired waters.(Figure 1-1).

DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Herring Brook Segment MA 95-21 are summarized in the following Table 4-41, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-41. MA95-21 Herring Brook ;DMF Fecal Coliform Data

Total Number of Data Points 1985- 2005	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
84	1-350	5.7

It should noted that the DMF has done extensive sampling in the (non- connecting) Wild Harbor and Wild River area, an adjacent reach/ harbor approximately 1 mile to the north of Herring Brook. A major public beach, Old Silver Beach, lies between the two reaches. At least several of the stations (#4 to #7) are behind Old Silver Beach and the Seacrest Hotel property, in an apparent drainage pattern, suggesting a possible linkage with the Herring Brook sub- watershed. Fecal coliform readings in the Wild Harbor/ River reaches, in October- November 1988, ranged between 7.8- 1,600, with 3 readings > 200 cfu/100mL. Between August 2003 and April 2006, there were 10 stations sampled 16 times, and the ranges were between <2- >50 cfu/100mL, with 17 readings >50 cfu/100mL. These samplings included stations #4- #7, mentioned above.

The MA Department of Public Health (DPH) also sampled for enterococcus levels in 2006 at four locations on Old Silver Beach: two stations (residents beach) approximately 100- 200 yards to the north of where Herring Brook enters Buzzards Bay, and two stations (public beach) right at where Herring brook enters Buzzards Bay. All four stations were sampled 13 times during 2006. Results ranged between <2 and 124 cfu /100mL, with one closure.

Harbor Head Segment MA95-46

Harbor Head is a Class SA waterbody and as such is designated for shellfish use in the MA Water Quality Standards. This 0.02 mi^2 waterbody is located south of the confluence with West Falmouth Harbor at Chappaquoit Road. There are no known discharges in this segment other than MS4s. The Town of Falmouth has applied for a NPDES permit for its MS4.

The DMF has designated this area as “restricted” for shellfishing. (Figure 1-1). Based on this designation and the periodic exceedances of MA Water Quality Standards the MassDEP has listed this segment as impaired on the state list of impaired waters.

DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Harbor Head Segment MA 95-46 are summarized in the following Table 4-42, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-42. MA95-46 Harbor Head ; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2005	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
93	1-128	8

Wild Harbor Segment MA95-20

Wild Harbor is designated as a Class SA waterbody by MassDEP and as such must support shellfishing. This 0.15 mi^2 embayment extends from Point Road, Nyes Neck to Crow Point at the end of Bay Shore Road in North Falmouth. There are no known discharges in this segment other than MS4s. As previously mentioned the Town of Falmouth has applied for a NPDES permit for its MS4.

The DMF has designated this area as “restricted” for shellfishing. (Figure 1-1). Based on this designation and the periodic exceedances of MA Water Quality Standards the MassDEP has listed this segment as impaired on the state list of impaired waters.

DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Wild Harbor Segment MA 95-20 are summarized in Table 4.43, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-43. MA95-20 Wild Harbor ; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2005	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
566	1-3,200	7.3

Of particular note is that DMF has done extensive sampling in the (non-connecting) Wild Harbor and Wild River area, an adjacent reach/ harbor approximately 1 mile to the north of Herring Brook. A major public beach, Old Silver Beach, lies between the two reaches. At least several of the stations (#4 to #7) are behind Old Silver Beach and the Seacrest Hotel property, in an apparent drainage pattern, suggesting a possible linkage with the Herring Brook sub- watershed. Fecal coliform readings in the Wild Harbor/ River reaches, in October- November 1988, ranged between 7.8- 1,600, with 3 readings > 200 cfu/100mL. Between August 2003 and April 2006, there were 10 stations sampled 16 times, and the ranges were between <2- >50 cfu/100mL, with 17 readings >50 cfu/100mL. These samplings included stations #4- #7, mentioned above.

West Falmouth Harbor Segment MA95-22

The West Falmouth Harbor segment encompasses 0.29 mi^2 and extends from the confluence with Harbor Head to the mouth at Buzzards Bay. This segment has been designated as a Class SA waterbody capable of supporting shellfishing. The segment is in the Town of Falmouth which has applied for a NPDES permit for its MS4.

The DMF has designated 0.09 mi^2 of the Harbor as “Approved” for shellfishing with another 0.20 mi^2 “Conditionally Approved” (Figure 1-1).

DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the West Falmouth Harbor Segment MA 95-22 are summarized in Table 4-44, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-44. MA95-22 West Falmouth Harbor; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2005	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
525	**1-130**	**9.6**

The MA Department of Public Health (DPH) also sampled 13 times for enterococcus levels in 2006 at three other locations within this segment during 2006: 1) Little Island Beach Club Beach; 2) and 3) Chapaquoit Association, Front Beach, and Back Beach). Results ranged between <2 and 10 cfu /100mL, with no closures.

Great Sippewisset Creek Segment MA95-23

The Great Sippewisset Creek is designated as a Class SA waterbody. It encompasses 0.03 mi^2 extending from the outlet of Beach Pond to the mouth at Buzzards Bay. The DMF has designated this entire segment as "Prohibited" for shellfishing. As such MassDEP has included it on the state list of impaired waters. (Figure 1-1).

DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Great Sippewissett Creek Segment MA 95-23 are summarized in Table 4-45, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-45. MA95-23 Great Sippewissett Creek; DMF Fecal Coliform Data

Total Number of Data Points 1985- 2005	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
104	**1-128**	**2.8**

In addition, the MA Department of Public Health collected fecal coliform samples at Saconesset Hills Association Beach within this segment during 2006. A total of 14 samples were collected. Fecal coliform values ranged from <2 to >400 cfu/100mL, with 2 failures.

Little Sippewisset Marsh Segment MA95-24

Little Sippewisset Marsh is a 0.02 mi^2 , Class SA, waterbody. It extends from its headwaters north of Sippewisset Road to the mouth at Buzzards Bay. It is located within the Town of Falmouth. The Town has applied for an NPDES permit for its MS4.

The DMF has designated this entire segment as "Prohibited" for shellfishing. As such MassDEP has included it on the state list of impaired waters. (Figure 1-1).

DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2001 for the Wild Harbor Segment MA 95-24 are summarized in the following Table 4-46, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-46. MA95-24 Little Sippewisset Marsh ;DMF Fecal Coliform Data

Total Number of Data Points 1985- 2005	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
88	1-128	5.4

In addition, the MA Department of Public Health collected fecal coliform samples at Wood Neck River Beach within this segment during 2006. Fecal coliform values ranged from <2 to >400 (3 readings exceeded 135 cfu/100mL), with three failures.

Quissett Harbor Segment MA95-25

Quissett Harbor is designated as a Class SA waterbody in the MA Water Quality Standards. Its designated uses includes shellfishing. The segment is 0.17 mi^2 and includes landward of a line drawn between The Knob and Gansett Point in Falmouth . The Town of Falmouth has applied for a NPDES permit for its MS4.

The DMF has designated 0.1 mi^2 of the Harbor as “Approved” for shellfishing with another 0.05 mi^2 “Conditionally Approved” (Figure 1-1). The MassDEP has listed this segment as “impaired” on the list of impaired waters based primarily on the DMF designation and periodic exceedances of state Water Quality Standards.

Available DMF data (taken in both dry and wet weather periods) were taken over the years 1985- 2005 for the Quissett Harbor Segment MA 95-25 are summarized in Table 4-47, as well as in Figures 4-1 and 4-2 above. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 4-47. MA95-25 Quisett Harbor;DMF Fecal Coliform Data

Total Number of Data Points 1985- 2005	Fecal Coliform Bacteria Range (cfu/100mL)	Geometric Mean, 1997-2001 data base (cfu/100mL)
482	1-128	3

4.2 Summation of the Data from the 48 Segments Above

Clearly, the areas of greatest concern from the data above are: (A) East Branch of the Westport River MA95-41; (B) Acushnet River MA 95-33 to the New Bedford Inner and Outer Harbor (including Clark’s Cove) Area. The East Branch, Westport River area shows quite a few elevated data sets for fecal coliform in the tens of thousands, up to a maximum at one site of over 2,100,000 cfu/100mL. Some of the land uses suspected in these high bacteria counts include: animal feeding operations, dairy farms, grazing in riparian areas, MS4 sources, on-site septic systems, and highway/ road runoff.

The Lower Acushnet River to New Bedford Harbor and Clark’s Cove show historically elevated fecal coliform counts, particularly during/ following wet weather events. This appears due to CSO discharges (a total of 28 remaining in the whole area). DMF data (1985- 2001) indicate that the Acushnet River (segment MA 95-33) has a geometric mean of 62.3 cfu/ 100mL, the Inner- Outer

Harbor areas have a geometric mean of 9.0 cfu/100mL, and in Clark's Cove it is 6.9 cfu/100mL. The City of New Bedford is implementing corrective actions through its long-term CSO control plan which is likely to already result in decreasing levels to these segments. Clearly, continued implementation of the CSO discharges will greatly reduce bacteria loadings in this whole area.

4.2 Segments on the State List of Impaired Waters for Pathogens Where No Recent Data are Available

Acushnet River Segment MA95-31

This segment on the Achusnet River extends 2.7miles from the outlet of the New Bedford Reservoir to the Hamlin Road culvert in Acushnet. It is designated in the MA Water Quality Standards as a Class B, warm water fishery. The subwatershed contains 423.7 acres of cranberry bog open space. The Town of Acushnet submitted a NOI requesting permit coverage under the NPDES program for their MS4. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, within this segment sub watershed (including MA 95-31, 95-32, 95-33) there are 736 catch basins, of which none are treated, and there are a total of 66 pipe or road cut discharges which are within the "potential stormwater contribution zone" of the embayment. A map showing stormwater discharge priorities (Priority Map #3) for this particular segment is provided in Section 6 herein. This is also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Buttonwood Brook Segment MA95-13

Buttonwood Brook begins at its headwaters at Oakdale Street in New Bedford and flows 3.8 miles to its mouth at Apponagansett Bay in Dartmouth. This segment is also designated as a Class B, warm water fishery segment in the MA Water Quality Standards. Buttonwood Brook has been engineered for storm water management and is considered a "controlled stream." Buttonwood Brook is a major source of fecal coliform to Apponagansett Bay. The Town of Dartmouth and City of New Bedford have both submitted NOIs requesting permit coverage under the NPDES program for their MS4. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, within the Town of Dartmouth, there are a total of 423 road cut and pipe discharges, of which 121 are ranked medium or high priority for remediation, of which 13 have been remediated. A map showing stormwater discharge priorities (Priority Map #2) for this particular segment is provided in Section 6 herein. Separate maps, outlining stormwater drainage systems with outfalls (Dartmouth Map #3,4,5) of this segment and surrounding areas are shown also in Appendix A. These are also available for download at http://www.buzzardsbay.org/stormatlas.htm.

Cedar Island Creek Segment MA95-52

This segment encompasses 0.01 square miles extending from the headwaters near the intersection of Parker Drive and Camardo Drive to the mouth at Marks Cove. It is designated as a Class SA waterbody capable for supporting shellfish. The Town of Wareham submitted an NOI requesting permit coverage under the NPDES program for their MS4. According to the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, the Town of Wareham has a total of 710 pipe or road cut discharges of which 547 which are rated as medium or high in priority for remediation, of which 32 have been remediated. A map showing stormwater discharge priorities (Priority Map #4) for this particular segment is provided in Section 6 herein. A separate map, outlining stormwater drainage systems with outfalls (Wareham Map #6) of this segment and surrounding areas is shown also in Appendix A, and are available for download at http://www.buzzardsbay.org/stormatlas.htm.

Impairment status for this segment was based on former DMF growing area status. Shellfish harvesting along this segment is impaired due to periodic high fecal coliform concentrations . Designated shellfish growing areas status as of July 1, 2000 is provided in Figure 1-1.

5.0 Potential Bacteria Sources

The Buzzards Bay watershed has 52 segments, located throughout the watershed, that are listed as pathogen impaired requiring a TMDL. These segments represent 100% of the estuary area and 21.3% of the river miles that have been assessed. Sources of indicator bacteria in the Buzzards Bay watershed are many and varied. A number of organizations and local governments have conducted work over the last decade in an effort to identify and address local sources of bacteria. Even with these efforts much more needs to be done.

Largely through the efforts organizations such as the Westport River Watershed Association (WRWA), the Division of Marine Fisheries (DMF), the MA Office of Coastal Zone Management (MACZM), and MassDEP field staff, numerous point and non-point sources of pathogens have been identified. Table 5-1 summarizes a number of impaired segments and some of the suspected and known sources identified in the state Watershed Assessment Report (WAR) or by other organizations (e.g., MACZM, WRWA, etc.).

Suspected dry weather sources include:

- animal feeding operations,
- animal grazing in riparian zones,
- leaking sewer pipes,
- storm water drainage systems (illicit connections of sanitary sewers to storm drains),
- failing septic systems,
- recreational activities,
- wildlife, including birds, and
- illicit boat discharges.

Suspected and known wet weather sources include:

- wildlife and domesticated animals (including pets),
- storm water runoff including municipal separate storm sewer systems (MS4),
- combined sewer overflows (CSOs), and
- sanitary sewer overflows (SSOs).

It is difficult to provide accurate quantitative estimates of indicator bacteria contributions from the various sources in the Buzzards Bay watershed because many of the sources are diffuse and intermittent, and extremely difficult to monitor or accurately model. Many of the sources (failing septic systems, leaking sewer pipes, sanitary sewer overflows, and illicit sanitary sewer connections) are prohibited, because they could result in a potential health risk and, therefore, must be eliminated. Estimating the magnitude of overall indicator bacteria loading (the sum of all contributing sources) can perhaps be achieved for wet and dry conditions using ambient data available that define baseline conditions (see segment summary data information, Section 6 priority maps herein, Appendix A and other information in the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"*, and MassDEP 2003b).

Table 5-1. Potential Sources of Bacteria in Pathogen Impaired Segments in the Buzzards Bay Watershed.

Segment	Segment Name	Potential Sources
MA95-40	East Branch Westport River	MS4, highway/road runoff, animal feeding operations
MA95-45	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-59	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-41	East Branch Westport River	Animal feeding operation, dairy outside milk parlor area, grazing in riparian zone, MS4, on-site septic systems, highway/road runoff
MA95-37	West Branch Westport River	MS4
MA95-54	Westport River	MS4
MA95-34	Slocums River	On-site treatment systems (septic systems), urbanized high density area, MS4
MA95-44	Snell Creek	MS4, on-site septic systems, highway/road runoff
MA95-31	Acushnet River	Unknown
MA95-32	Acushnet River	Unknown
MA95-33	Acushnet River	CSO, urbanized high density area
MA95-42	New Bedford Inner Harbor	CSO, urbanized high density area, waterfowl
MA95-63	Outer New Bedford Harbor	MS4
MA95-38	Clarks Cove	CSO, urbanized high density area, MS4
MA95-13	Buttonwood Brook	Unknown
MA95-39	Apponagansett Bay	On-site treatment systems, urbanized high density area, MS4
MA95-35	Mattapoisett Harbor	MS4
MA95-39	Mattapoisett River	MS4
MA95-65	Nasketucket Bay	MS4
MA95-56	Hammett Cove	MS4
MA95-08	Sippican Harbor	MS4
MA95-09	Aucoot Cove	MS4
MA95-10	Hiller Cove	MS4
MA95-64	Little Bay	Unknown
MA95-07	Sippican River	MS4
MA95-53	Beaverdam Creek	MS4
MA95-58	Bread and Cheese Brook	MS4, Livestock
MA95-05	Weweantic River	MS4, on-site treatment systems (septic systems)
MA95-29	Agawam River	MS4, municipal point source discharge
MA95-50	Wankinco River	MS4
MA95-49	Broad Marsh River	MS4
MA95-51	Crooked River	MS4
MA95-52	Cedar Island Creek	MS4
MA95-03	Wareham River	MS4

Segment	Segment Name	Potential Sources
MA95-02	Onset Bay	MS4
MA95-01	Buttermilk Bay	MS4
MA95-62	Buzzards Bay	MS4
MA95-14	Cape Cod Canal	MS4, Boats
MA95-48	Eel Pond	MS4, on-site treatment systems (septic systems)
MA95-51	Eel Pond	MS4, on-site treatment systems (septic systems)
MA95-47	Back River	MS4, on-site treatment systems (septic systems)
MA95-15	Phinneys Harbor	On-site treatment systems (septic systems), highway/road runoff
MA95-16	Pocasset River	On-site treatment systems (septic systems), road runoff, MS4
MA95-17	Pocasset Harbor	On-site treatment systems (septic systems), highway/road MS4
MA95-18	Red Brook Harbor	On-site treatment systems (septic systems), highway/road MS4
MA95-21	Herring Brook	On-site treatment systems (septic systems)
MA95-46	Harbor Head	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-20	Wild Harbor Estuary	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-22	West Falmouth Harbor	On-site treatment systems (septic systems), highway/road runoff, MS4
MA95-23	Great Sippewisset Creek	On-site treatment systems (septic systems), highway/road runoff
MA95-24	Little Sippewisset Marsh	On-site treatment systems (septic systems), highway/road runoff
MA95-25	Quissett Harbor	On-site treatment systems (septic systems), road runoff

Specific sources for the remaining impaired segments are unknown
MS4 = Municipal Separate Storm Water Sewer System – community storm water drainage system
Most sources were identified in the MassDEP WQA, although some sources have been identified by other organizations such as WRWA and MACZM.

A brief overview of potential sources of bacteria and ways to mitigate them are provided below.

Agriculture – Animal Feeding Operations and Grazing
Land used primarily for agriculture is likely to be impacted by a number of activities that can contribute to indicator bacteria impairments of surface waters. Activities with the potential to contribute to high indicator bacteria concentrations include:

- Field application of manure,
- Runoff from grazing areas,
- Direct deposition from livestock in streams,
- Animal feeding operations,
- Leaking manure storage facilities, and

- Runoff from barnyards.

Elevated indicator bacteria concentrations are generally associated with sediment loading. Reducing sediment loading often results in a reduction of indicator bacteria loading as well. Brief summaries of some of these techniques are provided in the "*Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts*".

Sanitary Waste

Leaking sewer pipes, illicit sewer connections, sanitary sewer overflows (SSOs), combined sewer overflows (CSOs) and failing septic systems represent a direct threat to public health since they result in discharge of partially treated or untreated human wastes to the surrounding environment. Quantifying these sources is extremely speculative without direct monitoring of the source because the magnitude is directly proportional to the volume of the source and its proximity to the surface water. Typical values of fecal coliform in untreated domestic wastewater range from 10^4 to 10^6 MPN/100mL (Metcalf and Eddy 1991).

Illicit sewer connections into storm drains result in direct discharges of sewage via the storm drainage system outfalls. The existence of illicit sewer connections to storm drains is well documented in many urban drainage systems, particularly older systems that may have once been combined. The EPA, Massachusetts Water Resources Authority (MWRA), the Boston Water and Sewer Commission (BWSC), City of Worcester, City of New Bedford and many communities throughout the Commonwealth have been active in the identification and mitigation of these sources. It is probable that numerous other illicit sewer connections exist in storm drainage systems serving the older developed portions of the Buzzards Bay watershed.

Monitoring of storm drain outfalls during dry weather is needed to document the presence or absence of sewage in the drainage systems. Approximately 30 percent of the Buzzards Bay watershed is classified as Urban Areas by the United States Census Bureau and is therefore subject to the Stormwater Phase II Final Rule that requires the development and implementation of an illicit discharge detection and elimination plan. See Section 8.0 of this TMDL for information regarding illicit discharge detection guidance.

Septic systems designed, installed, operated and maintained in accordance with 310 CMR 15.000: Title 5, are not significant sources of fecal coliform bacteria. Studies demonstrate that wastewater located four feet below properly functioning septic systems contain on average less than one fecal coliform bacteria organism per 100 mL (Ayres Associates 1993). Failed or non-conforming septic systems, however, can be a major contributor of fecal coliform to the Buzzards Bay watershed, especially since most of Buzzards Bay's population relies on septic systems versus municipal sewer systems. Wastes from failing septic systems enter surface waters either as direct overland flow or via groundwater. Wet weather events typically increase the rate of transport of pollutant loadings from failing septic systems to surface waters because of the wash-off effect from runoff and the increased rate of groundwater recharge.

Recreational use of waterbodies is a source of pathogen contamination. Swimmers themselves may contribute to bacterial impairment at swimming areas. When swimmers enter the water, residual fecal matter may be washed from the body and contaminate the water with pathogens. In addition, small children in diapers may contribute to contamination of the recreational waters. These sources are likely to be particularly important when the number of swimmers is high and the flushing action of waves or tides is low.

Another potential source of pathogens is the discharge of sewage from vessels with onboard toilets. These vessels are required to have a marine sanitation device (MSD) to either store or treat sewage. When MSDs are operated or maintained incorrectly they have the potential to discharge untreated or inadequately treated sewage. For example, some MSDs are simply tanks designed to hold sewage until it can be pumped out at a shore-based pump-out facility or discharged into the water more than 3 miles from shore. Uneducated boaters may discharge untreated sewage from these devices into near-shore waters. In addition, when MSDs designed to treat sewage are improperly maintained or operated they may malfunction and discharge inadequately treated sewage. Finally, even properly operating MSDs may discharge sewage in concentrations higher than allowed in ambient water for fishing or shellfishing. Vessels are most likely to contribute to bacterial impairment in situations where large numbers of vessels congregate in enclosed environments with low tidal flushing. Many marinas and popular anchorages are located in such environments.

Wildlife and Pet Waste

Animals that are not pets can be a potential source of pathogens. Geese, gulls, and ducks are speculated to be a major pathogen source, particularly at lakes and storm water ponds where large resident populations have become established (Center for Watershed Protection 1999).

Household pets such as cats and dogs can be a substantial source of bacteria – as much as 23,000,000 colonies/gram, according to the Center for Watershed Protection (1999). A rule of thumb estimate for the number of dogs is ~1 dog per 10 people producing an estimated 0.5 pound of feces per dog per day. Using the MassDEP's population estimate in 2000, this translates to an estimated 37,369 dogs in the watershed producing 18,685 pounds of feces per day. Uncollected pet waste is then flushed from the parks, beaches and yards where pets are walked and transported into nearby waterways during wet-weather.

Storm Water

Storm water runoff is another significant contributor to pathogen pollution. As discussed above, during rain events fecal matter from domestic animals and wildlife are readily transported to surface waters via the storm water drainage systems and/or overland flow. The natural filtering capacity provided by vegetative cover and soils is dramatically reduced as urbanization occurs because of the increase in impervious areas (i.e., streets, parking lots, etc.) and stream channelization in the watershed.

Extensive storm water data have been collected and compiled both locally and nationally (e.g., Tables 4-1, 4-2, 5-2 and 5-3) in an attempt to characterize the quality of storm water. Bacteria are easily the most variable of storm water pollutants, with concentrations often varying by factors of 10 to 100 during a single storm. Considering this variability, storm water bacteria concentrations are difficult to accurately predict. Caution must be exercised when using values from single wet weather grab samples to estimate the magnitude of bacteria loading because it is often unknown whether the sample is representative of the "true" mean. To gain an understanding of the magnitude of bacterial loading from storm water and avoid overestimating or underestimating bacteria loading, event mean concentrations (EMC) are often used. An EMC is the concentration of a flow proportioned sample throughout a storm event. These samples are commonly collected using an automated sampler which can proportion sample aliquots based on flow. Typical storm water event mean densities for various indicator bacteria in Massachusetts watersheds and nationwide are provided in Tables 5-2 and 5-3. These EMCs illustrate that storm water indicator bacteria concentrations from certain land uses (i.e., residential) are typically at levels sufficient to cause water quality problems.

To obtain a better idea of segments most impacted by storm water and upland areas contributing to storm water, MACZM conducted a survey of the watershed to document storm water discharges (Appendix A). MACZM also noted road cuts in their survey. Impoundments often form upstream of road cuts, which reduce the flow of water. Water accumulates in these impounded areas and can contain elevated fecal coliform levels due to stagnation of the water. Larger impounded areas attract waterfowl thereby increasing the potential for increased bacteria numbers.

Discharge areas were prioritized for remediation in the "*Atlas of Stormwater Discharges in the Buzzards Bay Watershed*" (MACZM 2003), provided in various maps in Appendix A of this report. Prioritization of storm water discharge sites is based on several factors including water quality, shellfish resource area classifications, and cost estimates. A complete list and explanation of these criteria is available in this "Atlas", pages 19-27, and is available for download at http://www.buzzardsbay.org/stormatlas.htm.

Table 5-2. Lower Charles River Basin Storm Water Event Mean Bacteria Concentrations (data summarized from USGS 2002) and Necessary Reductions to Meet Class B WQS.

Land Use Category	Fecal Coliform EMC (CFU/100 mL)	Number of Events	Class B WQS[1]	Reduction to Meet WQS (%)
Single Family Residential	2,800 – 94,000	8	10% of the samples shall not exceed 400 organisms/ 100 mL	2,400 – 93,600 (85.7 – 99.6)
Multifamily Residential	2,200 – 31,000	8		1,800 – 30,600 (81.8 – 98.8)
Commercial	680 – 28,000	8		280 – 27,600 (41.2 - 98.6)

[1] Class B Standard: Shall not exceed a geometric mean of 200 organisms in any set of representative samples, nor shall 10% of the samples exceed 400 organisms. Used 400 to illustrate required reductions since a geometric mean of the samples were not provided.

Table 5-3. Storm Water Event Mean Fecal Coliform Concentrations (as reported in MassDEP 2002b; original data provided in Metcalf & Eddy, 1992) and Necessary Reductions to Meet Class B WQS.

Land Use Category	Fecal Coliform[1] Organisms / 100 mL	Class B WQS[2]	Reduction to Meet WQS (%)
Single Family Residential	37,000	10% of the samples shall not exceed 400 organisms/ 100 mL	36,600 (98.9)
Multifamily Residential	17,000		16,600 (97.6)
Commercial	16,000		15,600 (97.5)
Industrial	14,000		13,600 (97.1)

[1] Derived from NURP study event mean concentrations and nationwide pollutant buildup data (USEPA 1983).

[2] Class B Standard: Shall not exceed a geometric mean of 200 organisms in any set of representative samples, nor shall 10% of the samples exceed 400 organisms. Used 400 to illustrate required reductions since a geometric mean of the samples were not provided.

6.0 Prioritization and Known Sources

This section is intended to provide guidance for setting implementation priorities to identify and eliminate bacteria sources within the Buzzards Bay River Watershed and to briefly describe on-going efforts within the watershed. Guidance is provided by prioritizing both impaired segments as well as specific sources where known.

The Buzzards Bay National Estuaries Program has conducted a significant amount of investigation of potential bacteria sources to the Buzzards Bay System. The program produced a document, *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed",* which represents a premier effort to begin the work of identifying hotspot bacterial sources of pollution. This intensive effort investigated and documented over 2,600 drainage pipe and road cut discharges which have the potential to contribute bacteria pollution to nearby surface waters. That effort also prioritized each discharge into high, medium, or low for remediation, based on a ten category ranking of scores to help set priorities for remediation. (See Figures 6-1 to 6-6 below. Additionally, 12,700 catch basins were also inventoried. (See Appendix A). In addition, over 37,000 fecal coliform data points were collected by DMF in estuary areas between 1997-2001. The impetus of all these efforts is aimed at identifying potential outfall data locations/priorities as a beginning to improvement of water quality in SA and SB waters. The ultimate goal is to remove these sources and reopen many closed shellfish areas.

For the prioritization, drainage network characterizations were based on the total drainage basin characterized within the contributing area represented by the appropriate Designated Shellfish Growing Areas (DSGAs). The DMF determined DSGAs were used as the management unit for evaluating and scoring many of the parameters in this study. To evaluate stormwater remediation sites, the following ten categories were considered, with up to a maximum number of points determined for each category :

(1) DMF DSGA Recommended Ranking- High Shellfish Value Resource- 30 points; Medium Shellfish Value Resource- 15 points; Low Shellfish Value Resource- 0 pts.
(2) Existing DSGA Classification of Receiving Waters- Conditionally Approved- 15 points; Approved- 7 points; Conditionally Restricted, or Management Closure 5 points; Prohibited- 0 points.
(3) Existing Fecal Coliform Concentrations of Receiving Waters relative to Restoration Potential- Waters close to a change to a higher classification with appreciable restoration potential- 20 points; waters with moderate restoration potential- 10 points; waters with negligible restoration potential- down to 0 points.
(4) Projected Costs of Each Discharge- $ 9,000 or under- 10 points; $ 15,000- 50,000- 6 points; $50,000- 75,000- 4 points; 75,001-100,000- 2 points; >$100,000- 0 points.
(5) Sewering (if area is sewered, it figures it will be easier for remediation)- 5 points.
(6) Number of Discharges and Catch basins in the DSGA Drainage Area- the principal here is that the fewer discharge pipes and catch basins in a drainage area, the easier it will be to achieve water quality goals- up to 30 points.
(7) Percent of the problem- even a drainage area with large number of catch basins, if a single discharge pipe is connected to a large drainage system with many catch basins, it would represent a "large percent of the problem"- up to 30 points.

(8) Proximity (200 feet) to Public or Private Swimming Beaches- 10 points.
(9) The Discharge is Within a 303(d) Listed Pathogen Impaired Area- 10 points.
(10) The Discharge is from a Phase II MS4 Area- 10 points.

The ten category maximum scores add up to a total of 170 possible points. The total 2,600+ discharges were then placed into four priority classifications and were then located on 6 priority maps (Figures 6-1 to 6-6 below) : red dot- highest priority; yellow dot- medium priority; green dot- lowest priority; blue dot- site already remediated.

Finally, in an effort to provide further guidance for setting bacterial implementation priorities within the Buzzards Bay Watershed, a summary table is provided. Table 6-1 below provides a prioritized list of pathogen-impaired segments that will require additional bacterial source tracking work and implementation of structural and non-structural Best Management Practices (BMPs). It is based on a combination of the results of the Buzzards Bay Program effort adjusted by MassDEP based upon available data and the designated uses of the ambient water body in question. Since limited source information and data are available in each impaired segment a simple scheme was used to prioritize segments based on fecal coliform concentrations. High priority was assigned to those segments where either dry or wet weather concentrations (end of pipe or ambient) were equal to or greater than 10,000 cfu /100 ml. Medium priority was assigned to segments where concentrations ranged from 1,000 to 9,999 col/100ml. Low priority was assigned to segments where concentrations were observed less than 1,000 col/100 ml. MassDEP believes the higher concentrations are indicative of the potential presence or raw sewage and therefore they pose a greater risk to the public. It should be noted that in all cases, waters exceeding the water quality standards identified in Table ES- 2 are considered impaired.

Also, prioritization is adjusted upward based on proximity of waters, within the segment, to sensitive areas such as Outstanding Resource Waters (ORW's), or designated uses that require higher water quality standards than Class B, such as public water supply intakes, public swimming areas, or shellfish areas. Best professional judgment was used in determining this upward adjustment. Generally speaking, waters that were determined to be lower priority based on the numeric range identified above were elevated up one level of priority if that segment were adjacent to or immediately upstream of a sensitive use. An asterisk * in the priority column of the specific segment would indicate this situation.

Table 6-1. Bacteria Impaired Segment Priorities

Segment ID	Segment Name	Length (mi.) or size (sq.mi.)	Segment Description	Priority
MA95-40	East Branch Westport River	2.85 mi.	Outlet Lake Noquochoke, Westport to Old County Rd. bridge, Westport. (Class B)	Medium
MA95-45	Snell Creek	0.67 mi.	Drift Rd. to Marcus' Bridge in Westport. (Class B)	Medium
MA95-41	East Branch Westport River	2.65 sq.mi.	Old County Road bridge, Westport to the mouth at Westport Harbor, Westport (excluding Horseneck Channel). (Class SB, Shellfishing restricted,0.64/2.65sq.mi.)	High* Shellfishing
MA95-37	West Branch Westport River	1.28 sq.mi.	Outlet Grays Mill Pond, Adamsville, Rhode Island to mouth at Westport Harbor, Westport. (Class SA, Shellfishing open, but impaired 0.78/2.65sq.mi.)	High* Shellfishing
MA95-54	Westport River	0.74 sq. mi.	From the confluence of the East and West Branches to Rhode Island Sound; Bounded by a line drawn from the southwestern point of Horseneck Point to the easternmost point near Westport Light. (Class SA, Shellfishing, open 0.5 sq.mi.,closed 0.78 sq.mi.)	Medium* Shellfishing
MA95-34	Slocums River	0.67 sq.mi.	Confluence with Paskamanset R., Dartmouth to mouth at Buzzards Bay. (Class SA, Shellfishing open 0.01 sq.mi.,closed 0.66sq.mi)	Medium* Shellfishing Swimming
MA95-44	Snell Creek	1.5 mi.	Headwaters west of Main Street, Westport, to Drift Road Westport	Medium
MA95-59	Snell Creek	0.01 sq.mi.	'Marcus Bridge', Westport to confluence with East Branch Westport River, Westport	Medium* Shellfishing
MA95-31	Acushnet River	2.7 mi	Outlet New Bedford Reservoir to Hamlin Rd. culvert, Acushnet. (Class B)	No Data
MA95-32	Acushnet River	1.10 mi.	Hamlin Rd. culvert to culvert at Main St., Acushnet. (Class B)	Medium
MA95-33	Acushnet River	0.31 sq.mi.	Main St. culvert to Coggeshall St. bridge, New Bedford/Fairhaven. (Class	High* Shellfishing

Segment ID	Segment Name	Length (mi.) or size (sq.mi.)	Segment Description	Priority
			SB, Shellfishing Restricted, entirely)	CSOs
MA95-42	New Bedford Harbor	1.25sq.mi.	Coggeshall St. bridge to hurricane Barrier, New Bedford/Fairhaven . (Class SB, Shellfishing Restricted, entirely)	High* Shellfishing
MA95-63	Outer New Bedford Harbor	5.82sq.mi.	Hurricane Barrier to a line drawn from Wilbur Point, Fairhaven to Clarks Point, New Bedford . (Class SA, Shellfishing Open, but entirely restricted)	High* Shellfishing Swimming
MA95-38	Clark Cove	1.90sq.mi.	Semi-enclosed waterbody landward of a line drawn between Clarks Point, New Bedford and Ricketsons Point, Dartmouth (Class SA, Shellfishing Open, but entirely restricted)	High* Shellfishing Swimming
MA95-13	Buttonwood Brook	3.8 mi.	Headwaters at Oakdale St., New Bedford to mouth at Apponagansett Bay, Dartmouth. (Class B)	Low (no data)
MA95-39	Apponagansett Bay	0.95sq.mi.	From the mouth of Buttonwood Brook to a line drawn from Ricketsons Point, New Bedford to Samoset St. near North Ave., Dartmouth. (Class SA, Shellfishing Open but restricted 0.68sq.mi.)	Medium* Shellfishing Swimming
MA95-35	Mattapoisett Harbor	1.10sq.mi.	From the mouth of the Mattapoisett R., Mattapoisett, to a line drawn from Ned Point to a point of land between Bayview Avenue and Grandview Ave., Mattapoisett. (Class SA, Shellfishing Open, but restricted 0.1/1.1sq.mi.)	Medium* Shellfishing Swimming
MA95-60	Mattapoisett River	0.05	From the River Road bridge, Mattapoisett to the mouth at Mattapoisett harbor, Mattapoisett	Medium* Shellfishing
MA95-65	Nasketucket Bay	3.7	From the confluence with Little bay, Fairhaven to Buzzards bay along Causeway Road, Fairhaven and along a line from the southern tip of Brant Island, Mattapoisett to the eastern tip of West Island, Fairhaven	Medium* Shellfishing
MA95-56	Hammett Cove	0.07sq.mi.	Hammett Cove, Marion to the confluence with Sippican Harbor along a line from the southwestern most	Medium* Shellfishing Swimming

Segment ID	Segment Name	Length (mi.) or size (sq.mi.)	Segment Description	Priority
			point of Little Neck to the end of the seawall on the opposite point. (Class SA, Shellfishing impaired 0.02/0.07sq.mi.)	
MA95-08	Sippican Harbor	2.0sq. mi.	From the confluence with Hammett Cove to the mouth at Buzzards Bay (excluding Blakenship Cove and Planning Island Cove), Marion (Class SA, Shellfishing open, but impaired 0.30 sq mi.)	Medium* Shellfishing Swimming
MA95-09	Aucoot Cove	0.50sq.mi.	From the confluence with Aucoot Creek, Marion to the mouth at Buzzards Bay at a line drawn between Converse Point and Joes Point, Mattapoisett. (Class SA, Shellfishing Open)	Medium* Shellfishing
MA95-10	Hiller Cove	0.04sq.mi.	Area landward of a line drawn between Joes Point, Mattapoisett and the second boat dock northeast of Hiller Cove Lane, Mattapoisett. (Class SA, Shellfishing impaired 0.01 sq.mi.)	Medium* Shellfishing Swimming
MA95-64	Little Bay	0.36 sq.mi.	From the confluence with the Nasketucket River, Fairhaven south to the confluence with Nasketucket Bay at a line from the southernmost tip of Mirey Neck, Fairhaven to a point near Shore Drive.	Medium* Shellfishing
MA95-07	Sippican River	0.08sq.mi.	County Rd. to confluence with Weweantic R., Marion/Wareham. (Class SA, Shellfishing Open, all impaired)	Medium* Shellfishing
MA95-53	Beaverdam Creek	0.04sq.mi.	Outlet from cranberry bogs of Rte. 6, Wareham to confluence with Weweantic River, Wareham. (Class SA, shellfishing restricted). (Class SA, Shellfishing all impaired)	Medium* Shellfishing
MA95-58	Bread and Cheese Brook	4.9 mi.	Headwaters, north of Old Bedford Road, Westport to confluence with East Branch Westport River, Westport	Medium
MA95-05	Weweantic River	0.62sq.mi.	Outlet Horseshoe Pond, Wareham to mouth at Buzzards Bay, Marion/Wareham. (Class SA,	Medium* Shellfishing

Segment ID	Segment Name	Length (mi.) or size (sq.mi.)	Segment Description	Priority
			Shellfishing Open, partially impaired,0.45sq.mi.)	
MA95-29	Agawam River	0.16 mi.	From the Wareham WWTP to confluence with Wankinco River at the Rte. 6 bridge, Wareham. . (Class SB, Restricted)	Medium* Shellfishing
MA95-50	Wankinco River	0.05sq.mi.	Elm St. bridge, Wareham to confluence with the Agawam R., at a line between a point south of Mayflower Ridge Drive and a point north of the railroad tracks near Sandwich Rd., Wareham. (Class SA, Shellfishing Restricted)	Medium* Shellfishing
MA95-49	Broad Marsh River	0.16sq.mi.	From its headwaters in a salt marsh south of Marion Rd. and Bourne Terrace, Wareham to the confluence with the Wareham R. (Class SA, Shellfishing Restricted)	Medium* Shellfishing Swimming
MA95-51	Crooked River	0.04sq.mi.	From the outlet of a cranberry bog, east of Indian Neck Rd., Wareham to confluence with the Wareham R., Wareham. (Class SA, Shellfishing Restricted)	Medium* Shellfishing
MA95-52	Cedar Island Creek	0.01sq.mi.	From the headwaters near intersection of Parker Dr. and Camardo Dr., Wareham to the mouth at Marks Cove, Wareham. (Class SA, Shellfishing Restricted)	Medium* (No Data) Shellfishing
MA95-03	Wareham River	1.18sq.mi.	Rte. 6 bridge to mouth at Buzzards Bay (at an imaginary line from Cromset Point to curved point east, southeast of Long Beach point), Wareham. Includes Mark's Cove, Wareham. (Class SA, Shellfishing open, but partially restricted, 0.68/1.18sq.mi.)	Medium* Shellfishing
MA95-02	Onset Bay	0.78sq.mi.	Wareham. Class SA, Shellfishing open, but partially restricted, 0.15/0.78sq.mi.)	Medium* Shellfishing
MA95-01	Buttermilk Bay	0.77	Bourne/Wareham. Class SA, Shellfishing open, but partially restricted, 0.16/0.77sq.mi)	Medium* Shellfishing
MA95-62	Buzzards Bay	8.0	Open water area encompassed within	Medium*

Segment ID	Segment Name	Length (mi.) or size (sq.mi.)	Segment Description	Priority
			a line drawn from Wilbur Point, Fairhaven to Clarks Point, New Bedford to Ricketson Point, Dartmouth to vicinity of Samoset St., Dartmouth down to Round Hill Point, Dartmouth, back to Wilbur Point, Fairhaven	Shellfishing
MA95-14	Cape Cod Canal	1.13	Connection between Buzzards Bay and Cape Cod Bay in Bourne and Sandwich.	Medium* Shellfishing
MA95-48	Eel Pond	0.03	Salt water pond that discharges to Back River, Bourne.	Medium* Shellfishing
MA95-61	Eel Pond	0.04	Coastal Pond at the head of Mattapoisett Harbor, Mattapoisett	Medium* Shellfishing
MA95-47	Back River	0.08	Outlet of small unnamed pond, downstream from Mill Pond, Bourne to confluence with Phinneys Harbor, Bourne (excluding Eel Pond).	Medium* Shellfishing
MA95-15	Phinneys Harbor	0.73	From the confluence with Back R. to its mouth at Buzzards Bay between Mashpee and Toby's Island, Bourne.	Medium* Shellfishing Swimming
MA95-16	Pocasset River	0.05	From the outlet of Mill Pond, Bourne to the mouth at Buzzards Bay, Bourne.	Medium* Shellfishing Swimming
MA95-17	Pocasset Harbor	0.33	From the confluence with Red Brook Harbor near the northern portion of Bassett's Island and Patuisett to the mouth at Buzzards Bay between Bassett's Island and Wings Neck, Bourne.	Medium* Shellfishing Swimming
MA95-18	Red Brook Harbor	0.91	From the confluence with Pocasset Harbor between the northern portion of Bassett's Island and Patuisett to its mouth at Buzzards Bay between Bassett's island and Scraggy Neck, Bourne (including Hen Cove).	Medium* Shellfishing Swimming
MA95-21	Herring Brook	0.01	From its headwaters, northeast of Dale Dr. and west of Rte. 28A, to its mouth at Buzzards Bay, Falmouth.	Medium Shellfishing
MA95-46	Harbor Head	0.02	The semi-enclosed body of water	Medium,

Segment ID	Segment Name	Length (mi.) or size (sq.mi.)	Segment Description	Priority
			south of the confluence with West Falmouth Harbor at Chappaquoit Rd., Falmouth.	Shellfishing
MA95-20	Wild Harbor	0.15	Embayment extends from Point Road, Nyes Neck to Crow Point at the end of Bay Shore Road in North Falmouth	Medium*, Shellfishing
MA95-22	West Falmouth Harbor	0.29	From the confluence with Harbor Head at Chappaquoit Rd., Falmouth to the mouth at Buzzards Bay at a line connecting the ends of the seawalls from Little Island and Chappaquoit Point, Falmouth (including Snug Harbor).	Medium* Shellfishing Swimming
MA95-23	Great Sippewissett Creek	0.03	From the outlet of Beach Pond in Great Sippewissett marsh to the mouth at Buzzards Bay, Falmouth, including the unnamed tributary from the outlet of Fresh Pond, and Quahog Pond, Falmouth.	Medium* Shellfishing Swimming
MA95-24	Little Sippewisset Marsh	0.02	From the headwaters north of Sippewisset Rd., Falmouth to the mouth at Buzzards Bay near Saconesset Hills, Falmouth.	Medium* Shellfishing Swimming
MA95-25	Quissett Harbor	0.17	The semi-enclosed body of water landward of a line drawn between The Knob and Gansett Point, Falmouth.	Medium* Shellfishing

As previously noted MassDEP believes that segments ranked as high priority in Table 6-1 are indicative of the potential presence of raw sewage and therefore they pose a greater risk to the public. Elevated dry weather bacteria concentrations could be the result of illicit sewer connections or failing septic systems. As a result, the first priority should be given to bacteria source tracking activities in those segments where sampling activities show elevated levels of bacteria during dry weather. Identification and remediation of dry weather bacteria sources is usually more straightforward and successful than tracking and eliminating wet weather sources. If illicit bacteria sources are found and eliminated it should result in a dramatic reduction of bacteria concentration in the segment in both dry and wet-weather. Segments that remain impaired during wet weather should be evaluated for stormwater BMP implementation opportunities starting with less costly non-structural practices first (such as street sweeping, and/or managerial approaches using local regulatory controls with ongoing evaluation of the success of those programs. If it is determined that less costly approaches are not sufficient to address the issue then appropriate structural BMPs should be identified and implemented where necessary. Structural stormwater BMP implementation may require additional study to identify cost efficient and effective technology.

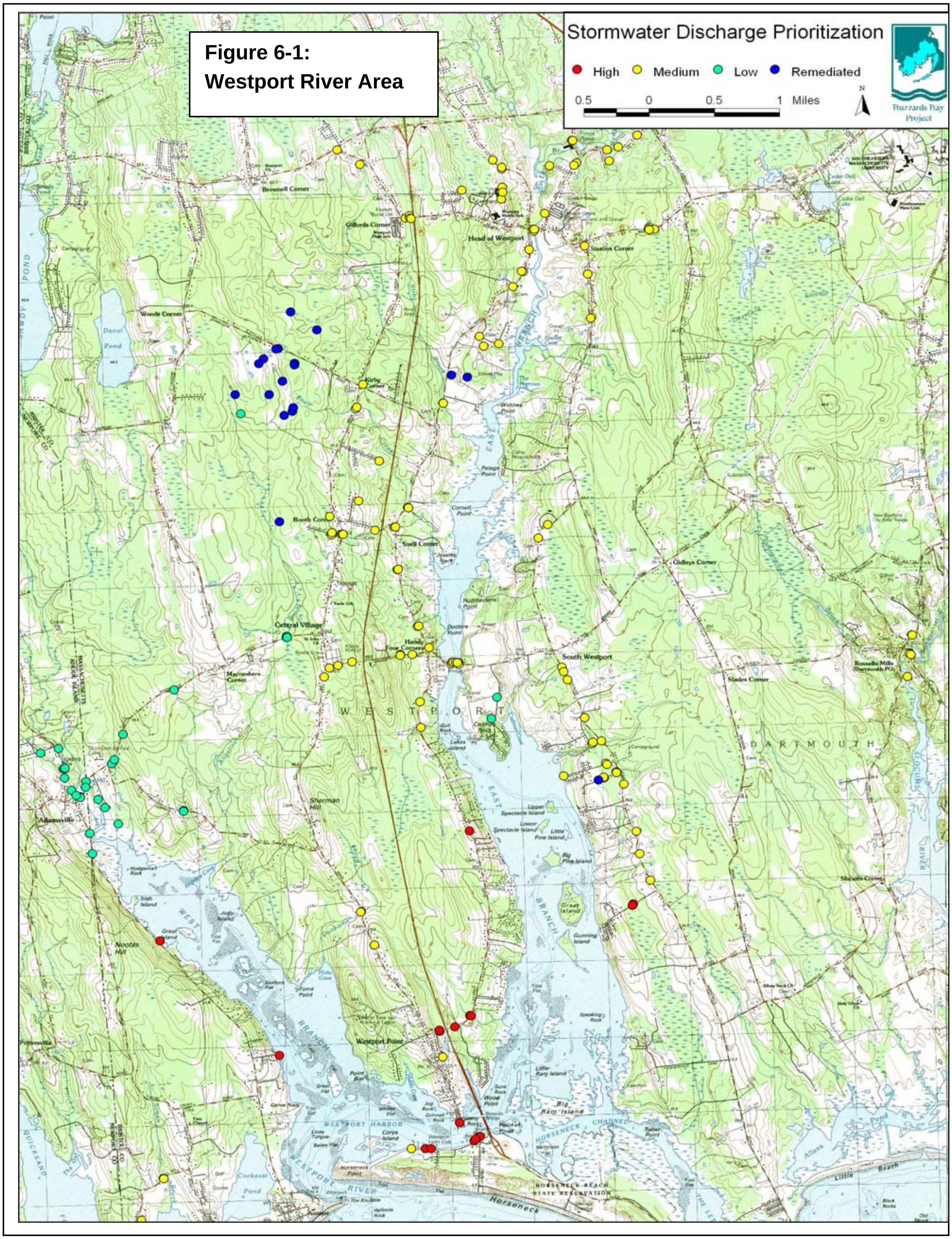


Figure 6-1:
Westport River Area
Stormwater Discharge Prioritization
High
Medium
Low
Remediated
0.5
0
0.5
1 Miles
N
Buzzards Bay Project

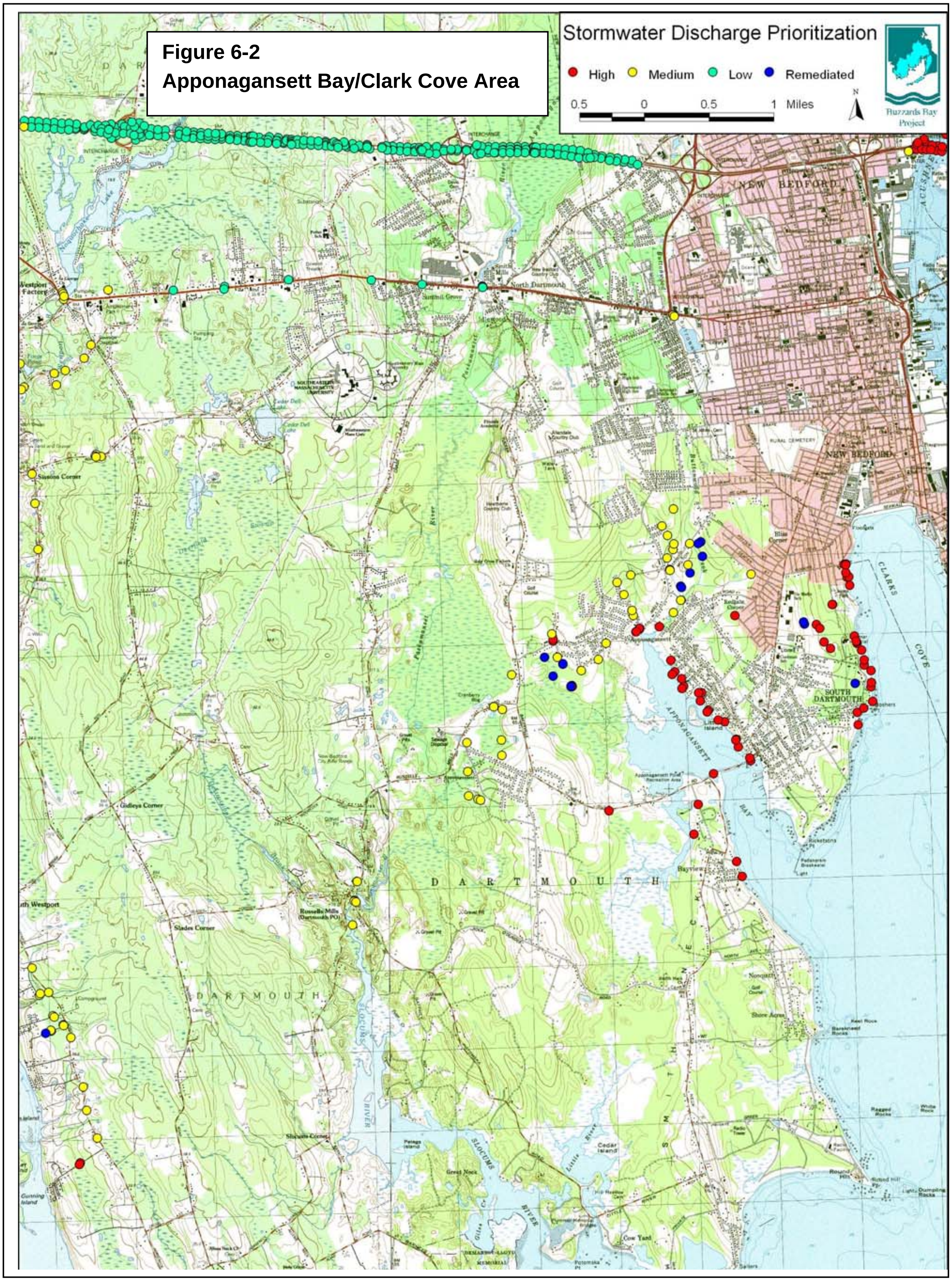


Figure 6-2
Apponagansett Bay/Clark Cove Area

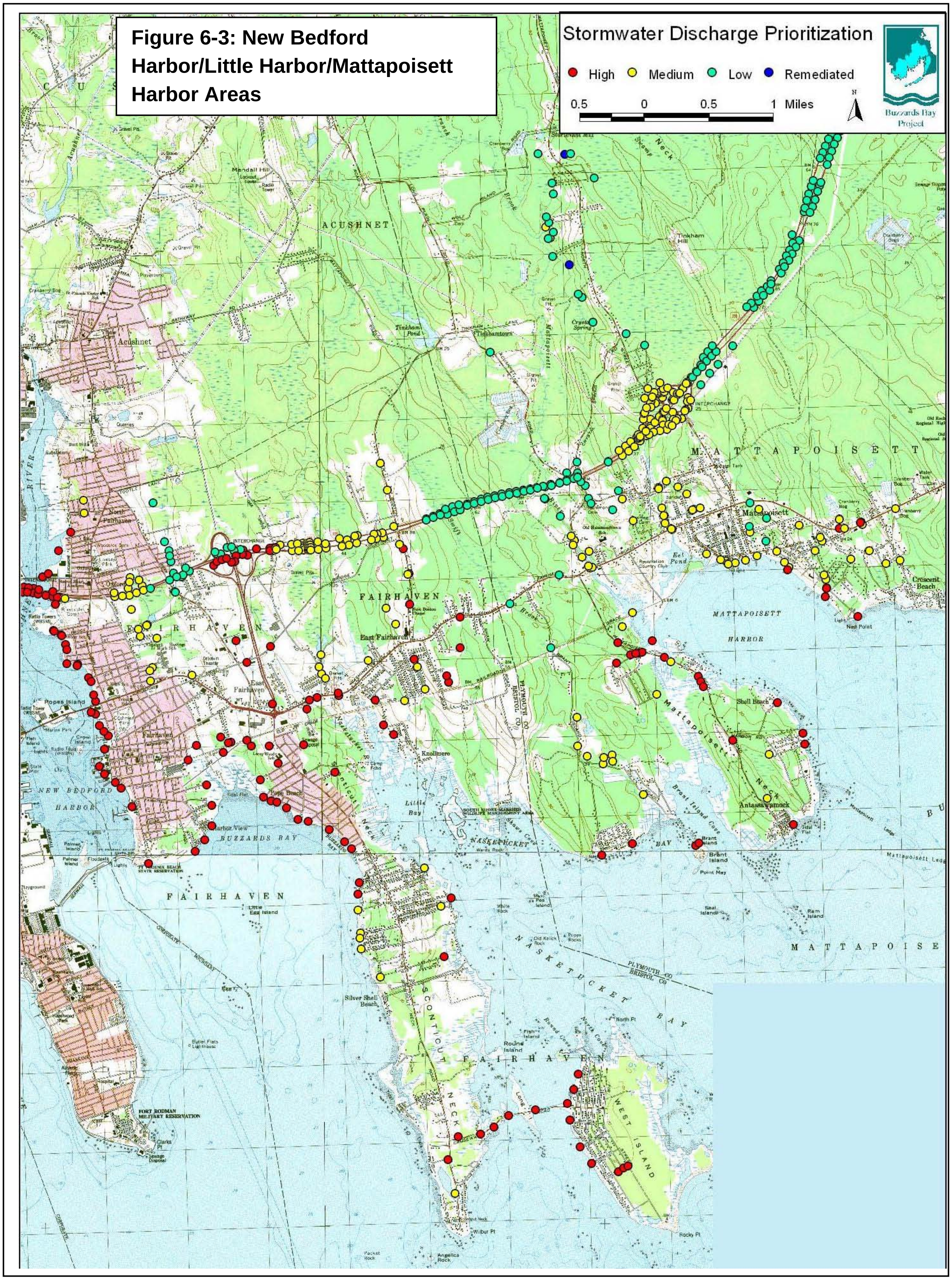


Figure 6-3: New Bedford Harbor/Little Harbor/Mattapoisett Harbor Areas
Stormwater Discharge Prioritization
High
Medium
Low
Remediated
0.5
0
0.5
1 Miles
Buzzards Bay Project
ACUSHNET
FAIRHAVEN
MATTAPOISETT
MATTAPOISETT HARBOR
NEW BEDFORD HARBOR
BUZZARDS BAY
NASKETUCKET BAY
WEST ISLAND

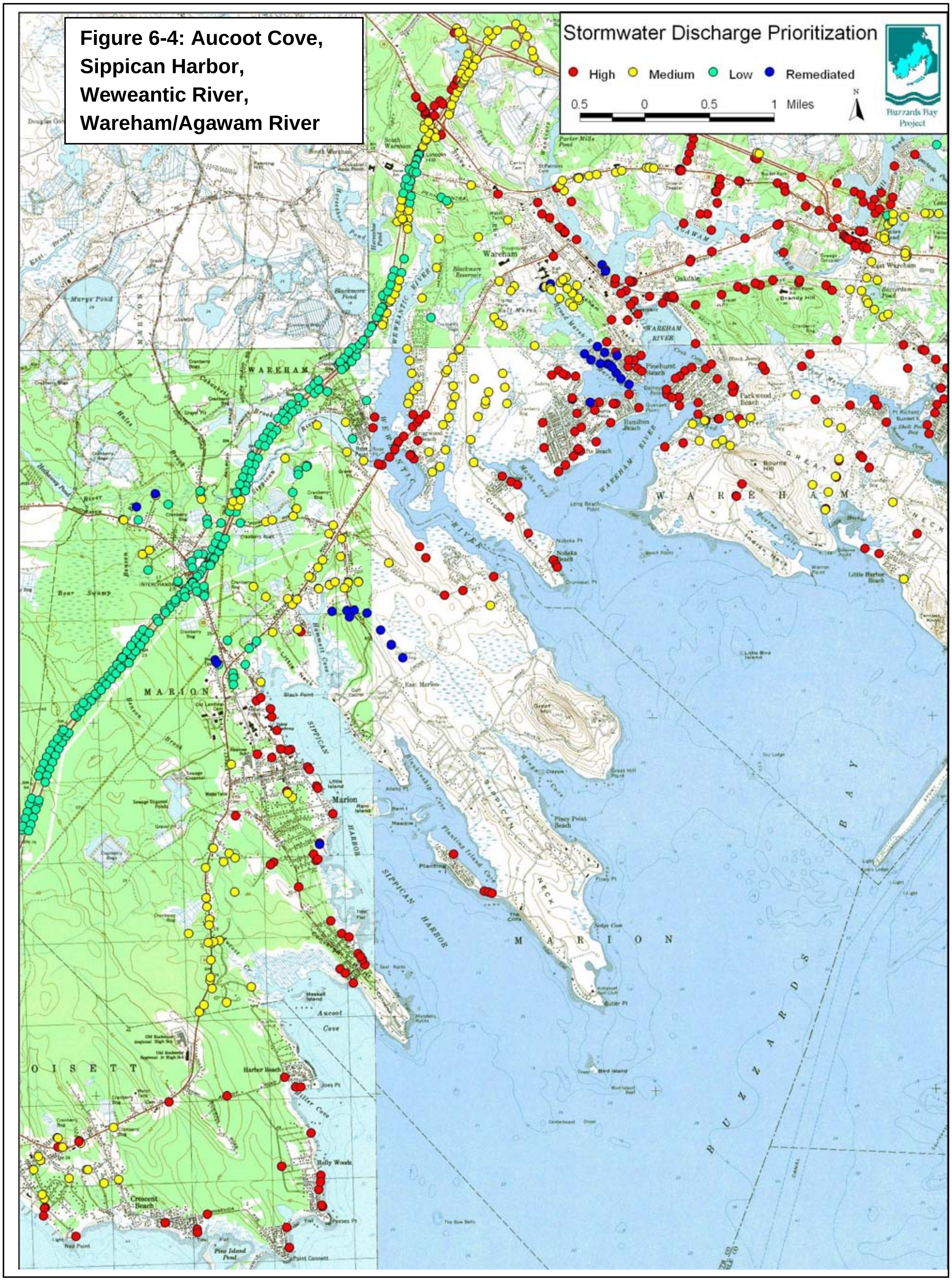


Figure 6-4: Aucoot Cove, Sippican Harbor, Weweantic River, Wareham/Agawam River
Stormwater Discharge Prioritization
High
Medium
Low
Remediated
0.5
0
0.5
1 Miles
N
Buzzards Bay Project

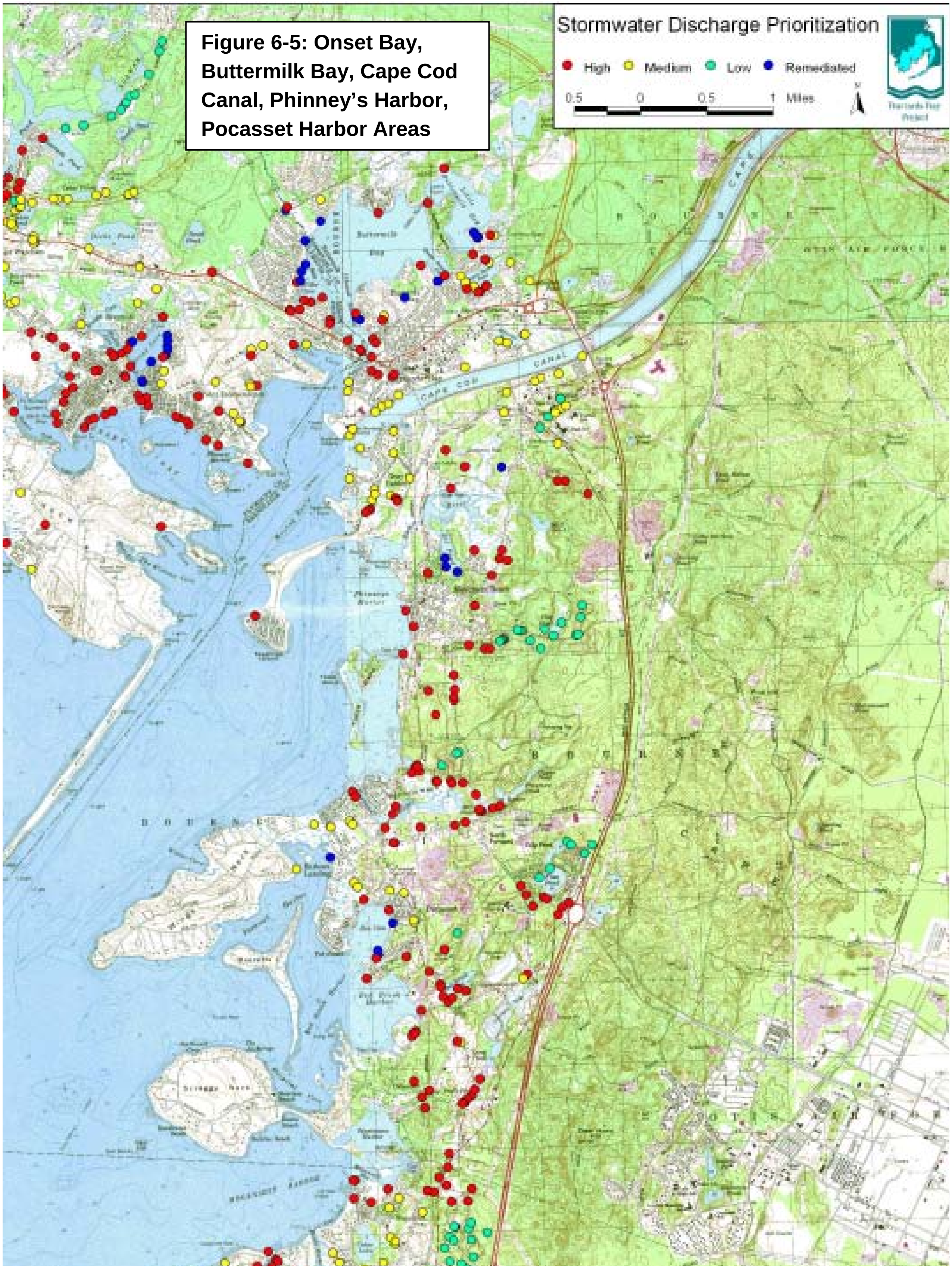
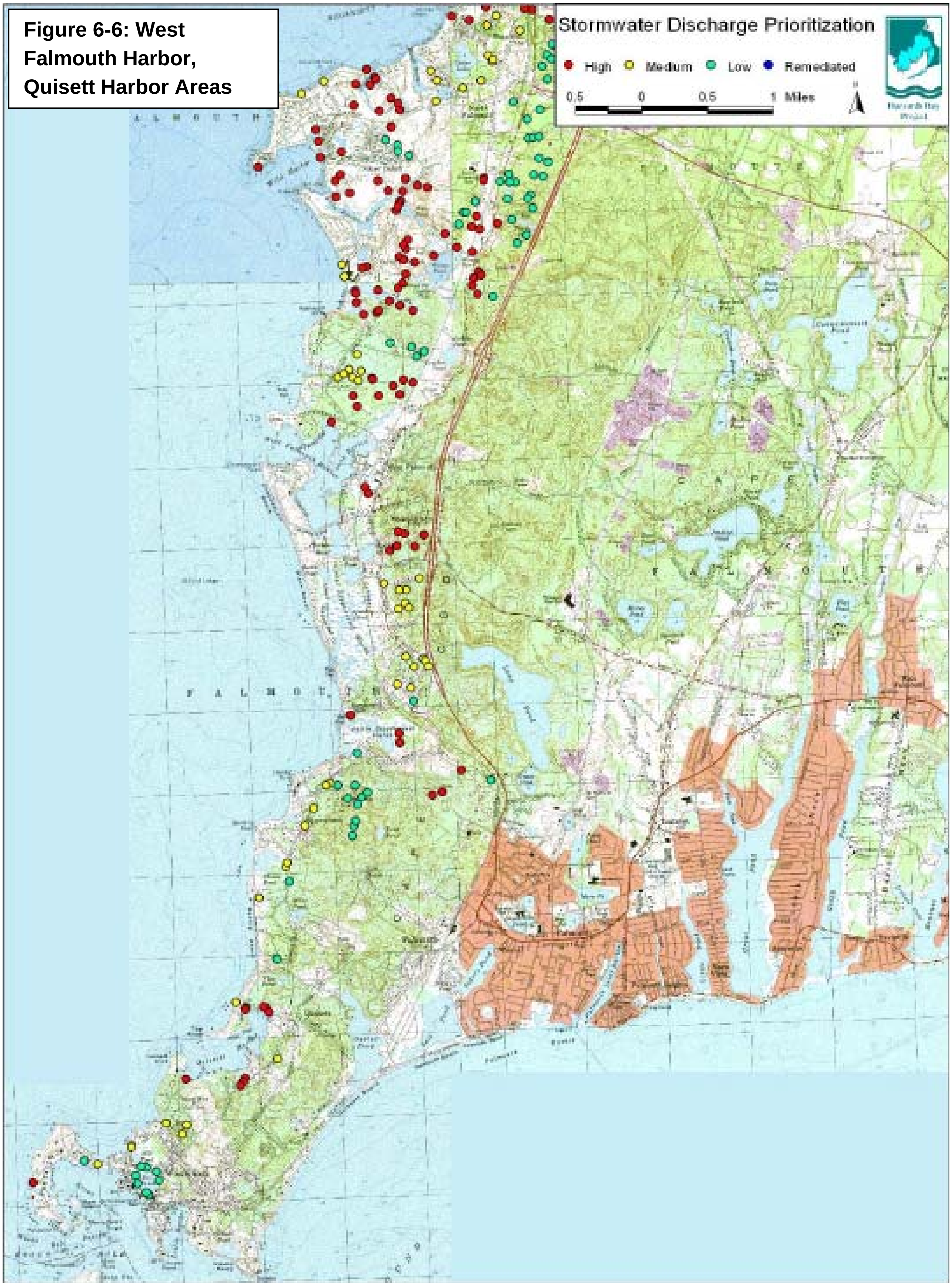


Figure 6-5: Onset Bay, Buttermilk Bay, Cape Cod Canal, Phinney's Harbor, Pocasset Harbor Areas
Stormwater Discharge Prioritization
High
Medium
Low
Remediated
0.5
0
0.5
1 Miles

Figure 6-6: West Falmouth Harbor, Falmouth Harbor, Quisett Harbor Areas



The challenge now is to devote the resources necessary to do bacteria source monitoring of the medium and high priority inland discharge pipes and road cut discharges to find hotspots, and then to remediate the pollution sources. In regards to stormwater, this watershed has several advantages that many others don't have: a plethora of organizations, both public and private, devoted to the sole goal of water quality improvement- Buzzards Bay Action Committee, the Coalition of Buzzards Bay, Buzzards Bay Project National Estuaries Program, MassDEP, MACZM, DMF, EPA, and the municipalities themselves. Help is needed from all these entities to utilize the Stormwater Atlas results in conducting monitoring activities with particularly the medium and high ranked outfalls identified in the Atlas report for remediation. Monitoring work is needed to confirm or deny the suspicion of high bacteria counts at particular outfalls, and to do source tracking in the drainage sub- basins of the confirmed high count outfalls to find the pollutant sources and remediate the sources.

Critical here would be activities conducted by the communities under the EPA Phase II Stormwater Program. Detection and elimination of illicit connections into stormwater conveyances, elimination of sanitary sewer overflows, and detection and elimination of other overland type bacterial sources (including failing septic systems and pet waste) would be tantamount in each community. Frequent referral to the information in the Stormwater Atlas is advised.

Section 8 of this report (Implementation Plan) provides a summary of existing activities within the Buzzards Bay watershed and a narrative overview of MassDEP nonpoint source (319) project activity in recent years that relate to the implementation of bacteria BMP's and other work to remediate sources. Section 8.3, Stormwater Runoff, provides an additional overview of each town's Stormwater Phase II plans. In general this information is intended to summarize progress to date, as well as future plans for finding and remediating bacteria sources of pollution. Communities should carefully refer to appropriate information parts of the Stormwater Atlas, particularly to the catch basin and priority discharge outfall maps within their community area included within Appendix A.

7.0 Pathogen TMDL Development

Section 303 (d) of the Federal Clean Water Act (CWA) requires states to place water bodies that do not meet the water quality standards on a list of impaired waterbodies. The most recent impairment list, 2006, identifies 52 segments within the Buzzards Bay watershed for use impairment caused by excessive indicator bacteria concentrations.

The CWA requires each state to establish Total Maximum Daily Loads (TMDLs) for listed waters and the pollutant contributing to the impairment(s). TMDLs determine the amount of a pollutant that a waterbody can safely assimilate without violating the water quality standards. Both point and non-point pollution sources are accounted for in a TMDL analysis. EPA regulations require that point sources of pollution (those discharges from discrete pipes or conveyances) subject to NPDES permits receive a waste load allocation (WLA) specifying the amount of pollutant each point source can release to the waterbody. Non-point sources of pollution (and point sources not subject to NPDES permits) receive load allocations (LA) specifying the amount of a pollutant that can be released to the waterbody. In the case of stormwater, it is often difficult to identify and distinguish between point source discharges that are subject to NPDES regulation and those that are not. Therefore, EPA has stated that it is permissible to include all point source stormwater discharges in the WLA portion of the TMDL. MassDEP has taken this approach. In accordance with the CWA, a TMDL must account for seasonal variations and a margin of safety, which accounts for any lack of knowledge concerning the relationship between effluent limitations and water quality. Thus:

$$\text{TMDL} = \text{WLAs} + \text{LAs} + \text{Margin of Safety}$$

Where:

WLA = Waste Load Allocation which is the portion of the receiving water's loading capacity that is allocated to each existing and future point source of pollution.

LA = Load Allocation which is the portion of the receiving water's loading capacity that is allocated to each existing and future non-point source of pollution (and point sources not subject to NPDES permits.

This TMDL was developed using an alternative standards-based approach, which is based on indicator bacteria concentrations, but considers the terms of the above equation. This approach is more in line with the way bacterial pollution is regulated (i.e., according to concentration standards) but the standard loading approach is provided as well.

7.1 – General Approach: Development of TMDL Targets

For this TMDL, the MassDEP developed two types of daily TMDL targets. First, MassDEP set daily concentration TMDL (WLA/LA) targets for each one of the discharge sources by category (i.e.,NPDES discharges, storm water, CSO, etc). MassDEP recommends that the concentration targets be used as the primary guide for implementation. Second, maximum daily loads were developed as a function of watershed size and runoff volume. For streams, since no USGS gages are located in this area the maximum loads were calculated as a function of the long-term average runoff observed at USGS gages in New England (which accounts for infiltration and evapotranspiration), the watershed size and water quality standard criteria for e-coli and enterococcus applicable to each segment. For embayment's, maximum daily loads were calculated as a function of the observed long-term precipitation on Cape Cod, the estimated average runoff associated within 200 feet from each embayment or entire contributing watershed area for each segment and the most stringent water quality criteria based on segment classification. Each methodology is described in greater detail in the following sections however both assure loading capacities are equal to or less than the Water Quality Standards.

MassDEP believes that expressing a loading capacity for bacteria in terms of concentrations set equal to the Commonwealth's adopted criteria, as provided in Table 7-1, provides the clearest and most understandable expression of water quality goals to the public and to groups that conduct water quality monitoring. MassDEP believes that expressing the loading capacity for bacteria in terms of loadings (e.g., numbers of organisms per day) although provided, is more difficult for the public to interpret and understand because the "allowable" loading number varies with flow and runoff over the course of the day and season and is very large (i.e. billions or trillions of organisms per day) and therefore is not as easily understood in the context of the State Water Quality Standards or public health criteria.

To ensure attainment with water quality standards throughout the waterbody, MassDEP emphasizes the simplest and most readily understood way of meeting the TMDL is to try to meet the bacteria standard at the point of discharge. However, for compliance purposes in-stream measurements must be used.

It is important to note that MassDEP realizes given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed that includes prioritization of outfalls and the application of BMPs should be used to achieve water quality standards. MassDEP believes this is approach is consistent with current EPA guidance and regulations as stated in a November 22, 2002 EPA memo from Robert Wayland (see attachment C) Further discussion on this issue is provided in Section 8.

7.1.1 Potential Sources of Bacterial Contamination

Some insight on potential sources of bacteria is gained using dry or wet weather bacteria concentrations as a benchmark for reductions. Where a segment is identified as having high dry weather concentrations, sources such as permitted discharges, failing septic tanks, illicit sanitary sewers connected to storm drains, and/or leaking sewers may be the primary contributors. Where elevated levels are observed during wet weather, potential sources may include flooded septic systems, surcharging sewers (combined sewer overflows or sanitary sewer overflows, and/or stormwater runoff. In urban areas, sources of elevated bacteria concentrations can include runoff in areas with high populations of domestic animals or pets. In agricultural areas, sources may include runoff from farms, poorly managed manure piles or areas where wild animals or birds congregate.

Other potential sources may include sanitary sewers connected to storm drains that result in flow that is retarded until the storm drain is flushed during wet weather. Sections 4, 5 and 6 of this document discuss in more detail the types of sources identified as well as their prioritization for implementation.

7.2 Waste Load Allocations (WLAs) and Load Allocations (LAs) As Daily Concentration (Colonies/100mL).

As previously noted there are many different potential sources of indicator bacteria in the Buzzards Bay Watershed. Most of the bacteria sources are believed to be storm water related. Table 7-1 presents the TMDL indicator bacteria WLAs and LAs for the various source categories as daily concentration targets for the Buzzards Bay Watershed. Point sources within the Buzzards Bay Watershed include several wastewater treatment plants (WWTPs) and other NPDES-permitted wastewater discharges. NPDES wastewater discharge WLAs are set at the water quality standards. All piped discharges are, by definition, point sources regardless of whether they are currently subject to the requirements of NPDES permits. Therefore a WLA set equal to the WQS criteria will be assigned to the portion of the stormwater that discharges to surface waters via storm drains. For any illicit sources including illicit discharges to stormwater systems and sewer system overflows (SSO's) the goal is complete elimination (100% reduction). The specific goal for controlling combined sewer overflows (CSO's) is meeting water quality standards through implementation of approved Long-term Control Plans. It is recommended that these concentration targets be used to guide implementation. The goal to attain WQS at the point of discharge is environmentally protective, and offers a practical means to identify and evaluate the effectiveness of control measures. In addition, this approach establishes clear objectives that can be easily understood by the public and others responsible for monitoring activities. Success of the control efforts and subsequent conformance with the TMDL will be determined by documenting that a sufficient number of bacteria samples from the receiving water meet the appropriate indicator criteria (WQS) for the water body.

Table 7-1: Waste Load Allocations (WLAs) and Load Allocations (LAs) as Daily Concentrations (Colonies/100mL)

Surface Water Classification	Pathogen Source	Waste Load Allocation Indicator Bacteria (CFU/100 mL)[1]	Load Allocation Indicator Bacteria (CFU/100 mL)[1]
A, B, SA, SB	Illicit discharges to storm drains	0	Not Applicable
	Leaking sanitary sewer lines	0	Not Applicable
	Failing septic systems	N/A	0
A (Water supply **Intakes** in unfiltered public water supplies)	Any regulated discharge [7,9]- including storm water runoff[4] subject to Phase I or II NPDES permits	Either; c) fecal coliform <=20 fecal coliform organisms per 100 ml[2] or **d)** total coliform <= 100 organisms per 100 ml[3;] where both are measured, only fecal must be met	Not Applicable

Surface Water Classification	Pathogen Source	Waste Load Allocation Indicator Bacteria (CFU/100 mL)[1]	Load Allocation Indicator Bacteria (CFU/100 mL)[1]
	Nonpoint source storm water runoff[4]	Not Applicable	Either; b) fecal coliform <=20 fecal coliform organisms per 100 ml[2], or b) total coliform <= 100 organisms per 100 ml[3;] where both are measured, only fecal must be met
A (Includes filtered water supply) & **B**	Any regulated discharge-including storm water runoff[4] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges [7,9], and combined sewer overflows[6].	Either; b) E. coli <=geometric mean[5] 126 colonies per 100 ml; single sample <=235 colonies per 100 ml; or b) Enterococci geometric mean[5] <= 33 colonies per 100 ml and single sample <= 61 colonies per 100 ml	Not Applicable
	Nonpoint source storm water runoff[4]	Not Applicable	Either c) E. coli <=geometric mean[5] 126 colonies per 100 ml; single sample <=235 colonies per 100 ml; or d) Enterococci geometric mean[5]<= 33 colonies per 100 ml and single sample <= 61 colonies per 100 ml
SA (Designated for shellfishing)	Any regulated discharge - including storm water runoff[4] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges[7,9], and combined sewer overflows[6].	Fecal Coliform <= geometric mean, MPN, of 14 organisms per 100 ml nor shall 10% of the samples be >=28 organisms per 100 ml	Not Applicable
	Nonpoint Source Storm water Runoff[4]	Not Applicable	Fecal Coliform <= geometric mean, MPN, of 14 organisms per 100 ml nor shall 10% of the samples be >=28 organisms per 100 ml
SA & SB (Beaches[8] and non-designated shellfish areas)	Any regulated discharge - including storm water runoff[4] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges[7,9], and combined sewer overflows[6].	Enterococci - geometric mean[5] <= 35 colonies per 100 ml and single sample <= 104 colonies per 100 ml	Not Applicable

Surface Water Classification	Pathogen Source	Waste Load Allocation Indicator Bacteria (CFU/100 mL)[1]	Load Allocation Indicator Bacteria (CFU/100 mL)[1]
	Nonpoint Source Storm water Runoff[4]	Not Applicable	Enterococci -geometric mean[5] <= 35 colonies per 100 ml and single sample <= 104 colonies per 100 ml
SB (Designated for shellfishing w/depuration)	Any regulated discharge - including storm water runoff[4] subject to Phase I or II NPDES permits, NPDES wastewater treatment plant discharges[7,9], and combined sewer overflows[6].	Fecal Coliform <= median or geometric mean, MPN, of 88 organisms per 100 ml nor shall 10% of the samples be >=260 organisms per 100 ml	Not Applicable
	Nonpoint Source Storm water Runoff[4]	Not Applicable	Fecal Coliform <= median or geometric mean, MPN, of 88 organisms per 100 ml nor shall 10% of the samples be >=260 organisms per 100 ml

[1] Waste Load Allocation (WLA) and Load Allocation (LA) refer to fecal coliform densities unless specified in the table.
[2] In all samples taken during any 6-month period
[3] In 90% of the samples taken in any six-month period;
[4] The expectation for WLAs and LAs for storm water discharges is that they will be achieved through the implementation of BMPs and other controls .
[5] Geometric mean of the 5 most recent samples is used at bathing beaches. For all other waters and during the non-bathing season the geometric mean of all samples taken within the most recent six months, typically based on a minimum of five samples.
[6] Or other applicable water quality standards for CSO's
[7] Or shall be consistent with the Waste Water Treatment Plant (WWTP) National Pollutant Discharge Elimination System (NPDES) permit.
[8] Massachusetts Department of Public Health regulations (105 CMR Section 445)
[9] Seasonal disinfection may be allowed by the Department on a case-by-case basis.

Note: this table represents waste load and load allocations based on water quality standards current as of the publication date of these TMDLs. If the pathogen criteria change in the future, MassDEP intends to revise the TMDL by addendum to reflect the revised criteria.

7.3 – TMDL Expressed as Daily Load (Colonies/Day)

7.3.1 Rivers

Background discussion: Flow in rivers and streams is highly variable. Nearly all are familiar with seeing the same river as a raging, flooding torrent and at another time as a tame and calm stream. In many areas, seasonal patterns are evident. A common pattern is high flow in the spring when winter snow melts and spring rains swell rivers. Summer time generally is a period of low flows except for the extreme events of heavy rainfall storms that can scale up to the high flows expected during hurricanes. Across the United States, the US Geological Survey and others maintain a network of stream gages that measure these flows on a continuous basis thus providing quantitative values to the qualitative scenarios described above. These flow measurements are reported in terms of a volume of water passing the gage in a given time period. Often the reported values are in cubic feet per second. A cubic foot of water is 7.48 gallons, and flows can range from less that a cubic foot per second to many thousands of cubic feet per second depending on the time of year and the size of the river or stream. The size of the river or stream and the amount of water that it usually carries is determined by the area of land it drains (known as a watershed), the type of land in the watershed, and the amount of precipitation that falls on the watershed. A common way the USGS reports flow is in cubic feet per second (cfs) averaged over a day since flow can vary even over the course of a day.

In addition to quantity, there is of course a quality aspect to water. Most chemical constituents are measured in terms of weight per volume, generally using the metric system with milligrams (mg) per liter (L) as the units. A milligram is one thousandth of a gram, 28 of which weighs one ounce. A liter is slightly more than a quart, so there are 3.76 L in a gallon. The total amount of material is called mass and is the quantity in a given volume of water. For instance, if a liter of water had 16 milligrams of salt and one evaporated all of the water, the 16 milligrams of salt would remain. A volume of two liters with the same 16 mg/L of salt would yield 32 milligrams of salt upon evaporation of the water. So, the total amount of material in a volume of water is the combination of the amount (volume) of water and the concentration of the substance being assessed. These two characteristics, in compatible units, are multiplied to determine the quantity of the material present. In the case of a river or stream, the total amount of material passing a gaging station in a day is the total volume multiplied by the concentration of the chemical being assessed. This quantity often is referred to as “load”, and if the time frame is a day, the quantity is called the “daily load.” If another time frame is used, such as a year, the term used is “yearly” or “annual” load.

Application to Bacteria: Bacteria also can be discussed in terms of concentrations and loads. However, the common way of expressing concentrations of bacteria is in terms of numbers rather than weight (although one could use weight). Bacteria standards for water are written in terms of concentrations, and while the method of determining the concentrations can be by direct count or estimated through the outcome of some reaction, it is the number of organisms that are determined to be in a given volume of water. Once again, the load is determined by the concentration multiplied by the volume of water. As can be seen, changes in concentration and/or changes in flow result in changes in the loads. Also, maximum loads can increase and if flow increases in proportion, the concentration will remain the same. For instance, if the total number of bacteria entering a section of stream doubles, but the flow also doubles, the concentration remains the same. This means that as flow increases, allowable load can increase so that concentration remains constant (or lower if dilution occurs) while continuing to meet the water quality criterion. In its simplest application, this is the concept of the flow duration curve approach. At each given flow, the maximum load that can enter and still meet the water quality concentration criterion is set. If the number of bacteria in a water body segment is higher than the allowable load as set by the water quality standard and flow, then a reduction is needed.

As a practical matter, determining the flow at each sampling point is resource intensive, expensive and generally is not done. This issue is magnified in the Buzzards Bay Watershed where long-term records of USGS gages are not available. Given this, however, some estimates can be made of the volume of runoff based on long-term records of USGS gages in New England. This is the approach used in the development of this TMDLS.

The pollutant loading that a waterbody can safely assimilate is expressed as either mass-per-time, toxicity or some other appropriate measure (40 CFR § 130.2). Typically, TMDLs are expressed as total maximum daily loads. However, as previously mentioned expressing pathogen TMDLs in terms of daily loads is difficult to interpret given the very high numbers of indicator bacteria and the magnitude of the allowable load is dependent on flow conditions and, therefore, will vary as flow rates change. For example, a very high load of indicator bacteria is allowable if the volume of water that transports indicator bacteria is also high. Conversely, a relatively low load of indicator bacteria may exceed the water quality standard if flow rates are low. Given the intermittent nature of storm water related discharges, MassDEP believes it is appropriate to express storm water-dominated indicator bacteria TMDLs proportional to flow for flows greater than 7Q10 (the lowest flow that is expected to occur for seven consecutive days over a ten day period). This approach is appropriate for storm water TMDLs because of the intermittent nature of storm water discharges. However, the WLAs for continuous discharges are not set based on the receiving water's proportional flow, but rather, are based on the criteria multiplied by the permitted effluent flow (applying the appropriate conversion factor). Because the water quality standard is also expressed in terms of the concentration of organisms per 100 mL, the acceptable in-stream daily load or TMDL is the product of the river flow at any given time and the water quality standard criterion.

7.3.2 Embayment's

For embayment's, the allowable loading was estimated using two different methodologies. First, for most of those embayment's located on the eastern side of Buzzards Bay (Cape Cod side) where, for the most part, precipitation readily percolates into the groundwater rather than runoff, an assumption was made that only the runoff within a 200-foot buffer area of the perimeter of the embayment would likely runoff directly to the waterbody in question. Further, in this 200-foot buffer there are both pervious and impervious areas. To estimate this load, in the impervious areas it was assumed that all 45 inches (3.75 feet) of annual rainfall resulted in runoff directly to the embayment.

A review of existing USGS studies was conducted to estimate the amount of runoff anticipated from the pervious areas on Cape Cod. Walter and Whealan (2005; Fig 6)[4] report precipitation results at Hatchville (in Falmouth, MA from 1941-1995. That data indicate that an average of 45 in/yr typically falls on Cape Cod varying from a low of about 25 inches (1965) to a high of 73 in. (1972). Walter and Whealan also report and average ground water recharge rate (amount of precipitation that goes directly into the ground) of 27 in/yr for Cape Cod. Desimone[5] estimates that approximately 24 inches of

[4] Walter, D.A., and Whealan, A.T., 2005, Simulated Water Sources and Effects of Pumping on Surface and Ground Water, Sagamore and Monomoy Flow Lenses, Cape Cod, Massachusetts: U.S. Geological Survey Scientific Investigations Report 2004-5181, 85p.

[5] Desimone, Leslie, 2003, Simulation of Advective Flow under Steady-State and Transient Recharge Conditions, Camp Edwards,Massachusetts Military Reservation, Cape Cod, USGS Massachusetts Water-Resources Investigations Report 03-4053,U.S., Northborough, Massachusetts,

precipitation on Cape Cod is lost to evapotranspiration. Adding these two values together indicates that on an average over the years virtually all precipitation to the pervious areas on Cape Cod either recharges directly to the aquifer or evapotranspirates and thus none is expected to runoff from these areas. As a result it was assumed that no runoff occurs from the pervious areas and therefore no load allocation was provided. A buffer area of 200 feet was chosen as a reasonable estimate of the area which is likely to contribute stormwater discharges directly to each embayment. Within this area it is assumed that all 45 inches per year of precipitation runs directly off any impervious area within this buffer zone and zero inches per year runs off from non-impervious areas. Hence, the allowable total number of bacteria for a day is the water quality standard times the estimated daily runoff associated with impervious areas within the 200 foot buffer zone once conversions for the various units are applied. .

In a few cases, where the specific contributing watershed had already been developed for other reasons, the entire contributing watershed area was used to calculate the total load.
It was therefore conservatively assumed that all impervious runoff entered the estuary through a formal conveyance system and thus was included in the wasteload allocation portion of the TMDL.

In the embayment's on the western part of Buzzards Bay a different method was chosen because 1) most embayment's are fed by a surface water feature such as a river or stream, 2) even though the soil characteristics in many areas near Buzzards Bay Watershed are similar to those on Cape Cod the soils become less pervious in other areas of the watershed further from the shore, and 3) there are several urban areas like New Bedford that operate large sewer and stormwater systems and have vast amounts of impervious cover. As a result, the allowable loading was calculated using the concentration allowed by the Massachusetts Water Quality Standards and the estimated volume of runoff entering from each contributing watershed. Since there are no long-term USGS gage stations in the Buzzards Bay area it was conservatively assumed that all precipitation to impervious areas runs directly off into a local waterway (average runoff value of 45 inches per year or 3.75 feet). In pervious areas a conservative estimate of 23.8 inches per year (1.98 feet) was used which represents the 50 percentile of runoff values observed at USGS gages in New England (Hydrologic Unit 1) based on long-term records(1901-2002)
http://water.usgs.gov/waterwatch/index.php?map_type1=real&map_type2=&map_type3=&map_type4=&web_type=real%2Cmap&state=ma&xinfo=&map_type=roplt&group_idx=4&region_cd=ma&group_idx_changed=1&sel_nm=map_type4&sel_va=roplt.

Since the USGS records actual streamflow over the course of time the estimates already account for recharge and evapotranspiration and thus reflect a true runoff value.

These runoff values were multiplied by the contributing watershed acreage and the most stringent water quality standard for each segment to calculate the allowable total number of bacteria per year. The daily TMDL was then calculated by dividing the allowable annual load by the number of days, on average, that it rains. Since it rains once every three to four days the annual load was divided by 105 days per year with rainfall to calculate the daily load. Precipitation data were based on information interpreted from the National Oceanic and Atmospheric Administration (NOAA) at http://cdo.ncdc.noaa.gov/ancsum/ACS and www.ncdc.noaa.gov/oa/climate/online/ccd/prego1.txt.

The 105 days per year of rainfall represents an average of the total number of days of precipitation >0.01". It is assumed that precipitation less than 0.01 inches either adsorbs into the ground or evaporates and therefore does not runoff. Finally, the total daily load allocation was then split into wasteload and load allocations based on the ratio of impervious to pervious land within each watershed.

7.3.3 Water Quality Criteria

The water quality criteria used to develop the TMDL was based on the most stringent designated use identified in the Massachusetts Water Quality Standards. The criteria applied to each segment are identified in Tables 7.3a and 7.3b. The criteria are summarized as follows:

For Class A surface waters:

a. At intakes in unfiltered public water supplies fecal coliform shall not exceed 20 organisms per 100 mL in all samples taken in any six-month period; or total coliform shall not exceed 100 organisms per 100 mL in 90% of the samples taken in any six-month period.

b. At bathing beaches the geometric mean of the 5 most recent e-coli samples taken during the same bathing season shall not exceed 126 colonies per 100 ml and no single sample taken during the same bathing season shall exceed 235 colonies per 100 ml, or where enterococcus is used the geometric mean of the 5 most recent e-coli samples taken during the same bathing season shall not exceed 33 colonies per 100 ml and no single sample taken during the same bathing season shall exceed 61 colonies per 100 ml.

c. For all other class A waters and during the non-bathing season the geometric mean of all e-coli samples taken within the most recent 6 months shall not exceed 126 colonies per 100 ml typically based on a minimum of 5 samples and no single sample shall exceed 235 colonies per 100 ml, or where enterococcus is used the geometric mean of all samples taken within the most recent six months shall not exceed 33 colonies per 100 ml and no single sample taken during the same bathing season shall exceed 61 colonies per 100 ml.

For Class B surface waters:

Criteria b and c above apply for bathing beaches and for other waters and during non-bathing season.

For Coastal Waters designated as Class SA:

a. For waters designated for shellfishing: fecal coliform shall not exceed a geometric mean Most Probable Number (MPN) of 14 organisms per 100 ml nor shall more than 10 % of the samples exceed an MPN of 28 per 100 ml.

b. At bathing beaches no single enterococci sample taken during the bathing season shall not exceed 104 colonies per 100 ml, and the geometric mean of the five most recent samples taken within the same bathing season shall exceed 35 colonies per 100 ml.

c. In non-bathing beach waters and bathing beach waters during the non-bathing season, no single sample shall exceed 104 colonies per 100 ml, and the geometric mean of all samples taken within the most recent six months typically based on 5 samples shall exceed 35 colonies per 100 ml.

For Coastal Waters designated as Class SB:

a. Waters designated for shellfishing with depuration: fecal coliform shall not exceed a median or geometric mean Most Probable Number (MPN) of 88 organisms per 100 ml nor shall more than 10 % of the samples exceed an MPN of 260 per 100 ml.

b. at bathing beaches and in non-bathing beach waters and bathing beach waters during the non-bathing season the same criteria as Class SA apply.

MassDEP is basing the TMDL on the recently (1/07) revised Massachusetts Water Quality Standards for the indicator organisms (*E. coli* and enterococci). The full version of the revised standards can be found at: http://mass.gov/dep/water/laws/regulati.htm#wqual

7.3.4 Calculating the TMDL as Daily Loads (Colonies/Day)

MassDEP believes it is appropriate to express indicator bacteria TMDLs proportional to flow. Because the water quality standard is also expressed in terms of the concentration of organisms per 100 mL, the acceptable in-stream daily load or TMDL is the product of that flow and the water quality standard criterion, which is the same approach used for any pollutant with a numerical criterion. In the case of embayments, runoff is the flow that is being used to determine the maximum daily load.

The TMDL is calculated based on flow or volume and the concentration of the applicable Massachusetts water quality standard criterion for bacteria in the river. Once the flow or volume is estimated, the total maximum daily load of bacteria in numbers per day is derived by multiplying the estimated flow or runoff volume by the water quality standard criterion for the indicator bacteria. The actual allowable load of bacteria, in numbers of bacteria per day, varies with flow at or above 7Q10 in each segment as presented in Figures 7-1a and 7-1b. This approach sets a target for reducing the loads so that water quality criteria for indicator bacteria are met at all flows equal to or greater than 7Q10.

Example calculations for determining the TMDL are provided as follows:

For Rivers, the TMDL associated each 1.0 cubic foot per second of flow to meet a water quality standard of 126 colonies per 100 ml **(Class B)** is derived as follows:

TMDL= (0.02832 m^3/sec) x (86,400 sec/day) x (1000 liters/m^3) x (1000 ml/liter) x (126 col/100ml) = 3.08×10^9 col/day.

<u>For Embayment's</u>

For embayment's the size of the watershed contributing to the flow must be accounted for.
Therefore the TMDL associated with each acre of contributing watershed to meet a water quality standard for 14 colonies per 100 ml of fecal coliform (**Class SA for shellfishing**) is derived as follows:

On Eastern Side of Buzzards Bay (Cape Cod Side):

TMDL = (1 acre) x (43,560 ft^2/acre) x (3.75 ft (% impervious area in 200 ft buffer)/105 days) x (7.48 gallons/ft^3) x (3.78 liters/gallon) x (14 colonies/100 ml) x (1000 ml/l) = 6.19×10^6 col/day

The TMDL attributed to each acre of contributing watershed area to meet a water quality standard of 88 colonies/100 ml of fecal coliform (**Class SB for shellfishing**) is derived as follows:

TMDL = (1 acre) x (43,560 ft^2/acre) x (3.75 ft (% impervious area in 200 ft buffer)/105 days)) x (7.48 gallons/ft^3) x (3.78 liters/gallon) x (88 colonies/100 ml) x (1000 ml/l) = 3.87×10^7 col/day

The TMDL attributed to each acre of contributing watershed area to meet a water quality standard of 104 colonies/100 ml of enterococcus (**Class SA and SB for swimming**) is derived as follows:

TMDL = (1 acre) x (43,560 ft^2/acre) x (3.75 ft (% impervious area in 200 ft buffer)/105 days)) x (7.48 gallons/ft^3) x (3.78 liters/gallon) x (104 colonies/100 ml) x (1000 ml/l) = 4.57×10^7 col/day

On the Western Side of Buzzards Bay:

The TMDL associated with each acre of contributing watershed to meet a water quality standard for 14 colonies per 100 ml of fecal coliform (**Class SA for shellfishing**) is derived as follows:

TMDL = (1 acre) x (43,560 ft^2/acre) x ((1.98 ft (% pervious area) + 3.75 ft (% impervious area)/105 days)) x (7.48 gallons/ft^3) x (3.78 liters/gallon) x (14 colonies/100 ml) x (1000 ml/l)

The TMDL attributed to each acre of contributing watershed area to meet a water quality standard of 88 colonies/100 ml of fecal coliform (**Class SB for shellfishing**) is derived as follows:

TMDL = (1 acre) x (43,560 ft^2/acre) x ((1.98 ft (% pervious area) + 3.75 ft (% impervious area)/105 days)) x (7.48 gallons/ft^3) x (3.78 liters/gallon) x (88 colonies/100 ml) x (1000 ml/l)

The TMDL attributed to each acre of contributing watershed area to meet a water quality standard of 104 colonies/100 ml of enterococcus (**Class SA and SB for swimming**) is derived as follows:

TMDL = (1 acre) x (43,560 ft^2/acre) x ((1.98 ft (% pervious area) + 3.75 ft (% impervious area) /105 days)) x (7.48 gallons/ft^3) x (3.78 liters/gallon) x (104 colonies/100 ml) x (1000 ml/l)

The following plot (Figure 7.1a) depicts the number or amount of *E. coli* bacteria per day that can be in any Class B river segment at any given location in the Buzzards Bay Watershed depending on flow:

Figure 7-1a: TMDL: E. coli Rivers

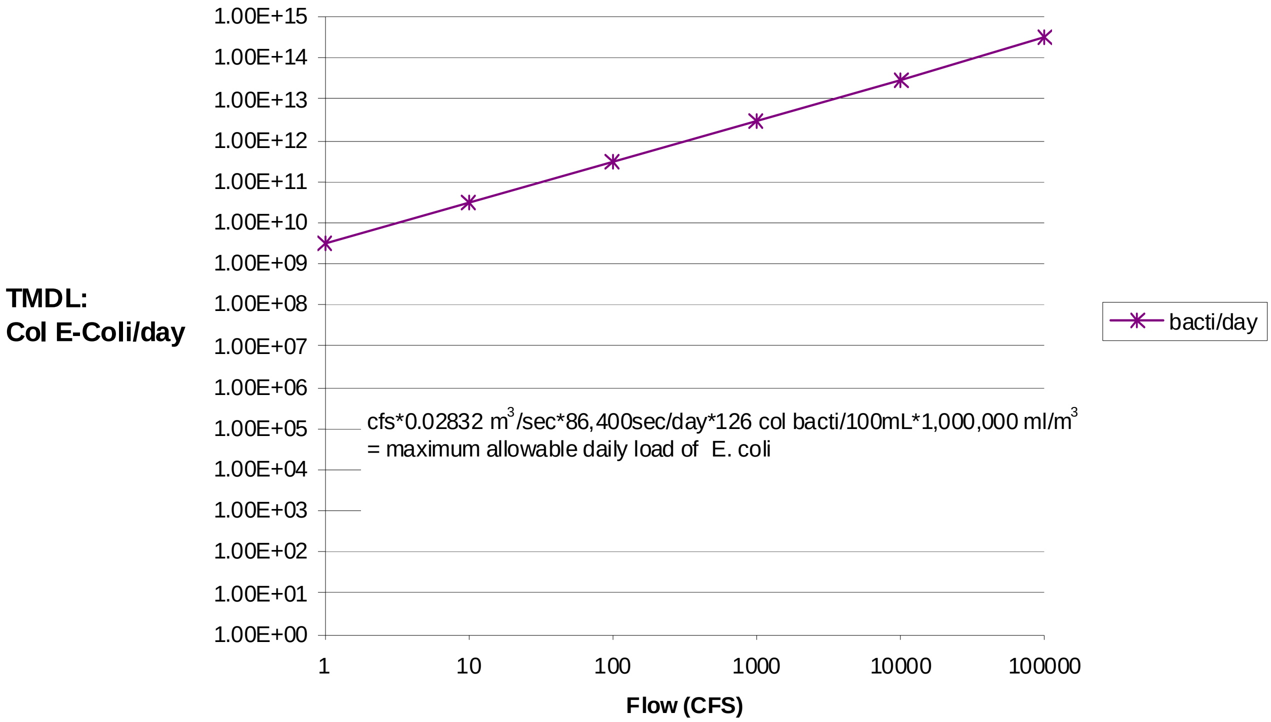
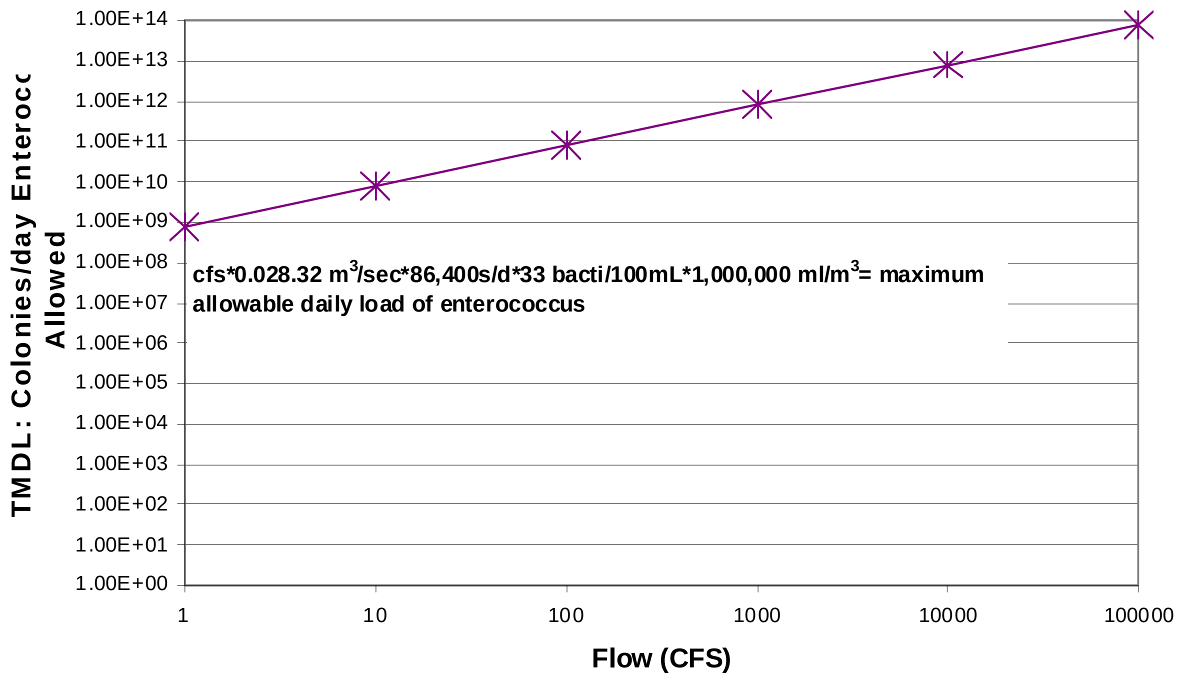


Figure 7.1b depicts the number or amount of *Enterococcus* bacteria per day that can be in any Class B river segment at any given location in the Buzzards Bay Watershed depending on flow:

Figure 7-1b:TMDL: Entercoccus Rivers



7.3.5 – Wasteload Allocations (WLAs) and Load Allocations (LAs)

There are several WWTPs and other NPDES-permitted wastewater discharges within the watershed. NPDES wastewater discharge WLAs are set at the WQS. In addition there are numerous storm water discharges from storm drainage systems throughout the watershed. All piped discharges are, by definition, point sources regardless of whether they are currently subject to the requirements of NPDES permits. Therefore, a WLA set equal to the WQS will be assigned to the portion of the storm water that discharges to surface waters via storm drains.

WLAs and LAs are identified for all known source categories including both dry and wet weather sources for Class SA, Class SB, B segments within the Buzzards Bay watershed. Establishing WLAs and LAs that only address dry weather indicator bacteria sources would not ensure attainment of standards because of the significant contribution of wet weather indicator bacteria sources to WQS exceedances. Illicit sewer connections and deteriorating sewers leaking to storm drainage systems represent the primary dry weather point sources of indicator bacteria, while failing septic systems and possibly leaking sewer lines represent the non-point sources. Wet weather point sources include discharges from storm water drainage systems (including MS4s) and sanitary sewer overflows (SSOs). Wet weather non-point sources primarily include diffuse storm water runoff.

7.3.6 Stormwater Contribution

Part of the stormwater contribution originates from point sources and is included in the waste load allocation, and part comes from non-point sources and is included in the load allocation of the TMDL. The fraction of the runoff load attributed to the waste load allocation is estimated from the fraction of the watershed that has impervious cover because storm water from impervious cover is more likely to be diverted, collected and conveyed to the receiving water by storm water collection systems than non-impervious areas. The fraction of the TMDL associated with the wasteload allocation was estimated, using MassGIS and the algorithm within it to estimate the extent of impervious surface. The wasteload allocation was then defined by multiplying the TMDL for each segment by the percent of imperviousness in each watershed. Likewise the load allocation was estimated using the percent pervious cover in each watershed. MassDEP believes this approach is conservative because it assumes that all runoff from impervious areas actually makes it to the waterbody segment in question, which may or may not always be the case.

For example, consider waterbody segment 95-31 of the Achusnet River from the Outlet of New Bedford Reservoir to the Hamlin Rd. culvert, Acushnet. This segment is designated as a Class B water in the Massachusetts Water Quality Standards and thus must meet the Water Quality Standard of 126 colonies/100 ml. The TMDL for 1 cubic feet per second of flow was calculated to be 3.08×10^9 colonies per day. According to the MassGIS data layer, the watershed above this point is 5.8% impervious and 94.2% pervious. Thus, the wasteload allocation was calculated to be $(3.08 \times 10^9) \times .058 = 1.79 \times 10^8$ colonies per day. Likewise the load allocation was calculated to be $(3.08 \times 10^9) \times .942 = 2.9 \times 10^9$ colonies per day.

Using this procedure the wasteload allocations and load allocations for each river segment were calculated for varying flow regimes and are provided in Table 7-2a below while the wasteload allocations and load allocations for each marine segment based on contributing acreage are provided in Table 7-2b.

Table 7- 2a: WLA and LA for River Segments - TMDL By Segment (Colonies/Day)							
		River Segments TMDL based on Flow (Colonies of E. *coli*/day) (from Figure 7-1a)					
River Segments /Size	**Description**	**Stormwater Contribution**	**1cfs**	**10cfs**	**100cfs**	**1000cfs**	**10000cfs**
MA95-31 3.1 miles	Achusnet River Class B (126 col/100ml)	WLA (5.8% impervious)	1.79E +08	1.79E +09	1.79E +10	1.79E +11	1.79E +12
		LA (94.2% pervious)	2.9E +09	2.9E +10	2.9E +11	2.9E +12	2.9E +13
MA95-32 1.1 miles	Achusnet River Class B (126 col/100ml)	WLA (8.0% impervious)	2.46E +08	2.46E +09	2.46E +10	2.46E +11	2.46E +12
		LA (92.0% pervious)	2.83E +09	2.83E +10	2.83E +11	2.83E +12	2.83E +13
MA95-58 4.9 miles	Bread and Cheese Brook Class B (126 col/100ml)	WLA (8.5% impervious)	2.62E +08	2.62E +09	2.62E +10	2.62E +11	2.62E +12
		LA (91.5% pervious)	2.82E +09	2.82E +10	2.82E +11	2.82E +12	2.82E +13
MA95-13 3.8 miles	Buttonwood Brook Class B (126 col/100ml)	WLA (18.9% impervious)	5.8E +08	5.8E +09	5.8E +10	5.8E +11	5.8E +12
		LA (81.1% pervious)	2.5E +09	2.5E +10	2.5E +11	2.5E +12	2.5E +13
MA95-40 2.9 miles	East Branch Westport River Class B (126 col/100ml)	WLA (6.1% impervious)	1.88E +08	1.88E +09	1.88E +10	1.88E +11	1.88E +12
		LA (93.9% pervious)	2.89E +09	2.89E +10	2.89E +11	2.89E +12	2.89E +13
MA-95-44 1.5 miles	Snell Creek Class B (126 col/100ml)	WLA (4.0% impervious)	1.23E +08	1.23E +09	1.23E +10	1.23E +11	1.23E +12
		LA (96.0% pervious)	2.96E +09	2.96E +10	2.96E +11	2.96E +12	2.96E +13
MA-95-45 0.36 miles	Snell Creek Class B (126 col/100ml)	WLA (5.7% impervious)	1.76E +08	1.76E +09	1.76E +10	1.76E +11	1.76E +12
		LA (94.3% pervious)	2.9E +09	2.9E +10	2.9E +11	2.9E +12	2.9E +13

Table 7- 2b: WLA and LA for Estuarine Waters - TMDL By Segment (Colonies/Day)							
Segment/Size	**Description**	**Watershed Size (Acres)**	**Stormwater Contribution**		**TMDL Col/Day**	**TMDL WLA Col/day**	**TMDL LA Col/day**
MA95-33 0.31 sq mi.	Achusnet River Class SB - based on 88/100 ml)	13895.1	WLA (11.7% impervious)	LA (88.3% pervious)	3.14E +11	6.29E +10	2.51E +11
MA95-29 0.17 sq. mi.	Agawam River Class SB - based on 88/100 ml)	13,423.4	WLA (4.8% impervious)	LA (95.2% pervious)	2.86E +11	2.49E +10	2.61E +11
MA95-39 1.1 sq. mi.	Apponagansett Bay Class SA	5,379.9	WLA (12.9% impervious)	LA (87.1% pervious)	1.95E +10	4.27E +09	1.52E +10
MA95-09 0.5 sq. mi.	Aucoot Cove Class SA	2,650.2	WLA (5.1% impervious)	LA (94.9% pervious)	9.01E +09	8.32E +08	8.18E +09
MA95-47 0.08 sq. mi.	Back River Class SA	5.41	WLA (9.2% impervious)	LA (90.8% pervious)	1.90E +07	3.06E +06	1.6E +07
MA95-53 0.04 sq. mi.	Beaverdam Creek Class SA	481.4	WLA (11.5% impervious)	LA (88.5% pervious)	1.73E +09	3.41E +08	1.39E +09
MA95-49 0.16 sq. mi.	Broad Marsh River Class SA	798.0	WLA (14.9% impervious)	LA (85.1% pervious)	2.94E +09	7.32E +08	2.21E +09
MA95-01 0.67 sq. mi.	Buttermilk Bay Class SA	10,082.6	WLA (8.2% impervious)	LA (91.8% pervious)	3.52E +10	5.1E +09	3.01E +10

Table 7- 2b: WLA and LA for Estuarine Waters - TMDL By Segment (Colonies/Day)							
Segment/Size	**Description**	**Watershed Size (Acres)**	**Stormwater Contribution**		**TMDL Col/Day**	**TMDL WLA Col/day**	**TMDL LA Col/day**
MA95-62 8.0 sq. mi.	Buzzards Bay (open water- see description) Class SA	27,111.6	WLA (16.5% Impervious)	LA (83.5% pervious)	1.01E +11	2.75E +10	7.34E +10
MA95-14 1.13 sq. mi.	Cape Cod Canal Class SB – based on 88/100 ml)	394.61	WLA (13.9% impervious)	LA (86.1% pervious)	9.07E +09	2.12E +09	6.95E +09
MA95-52 0.01 sq. mi.	Cedar Island Creek Class SA	251.4	WLA (7.6% impervious)	LA (92.4% pervious)	8.73E +08	1.18E +08	7.55E +08
MA95-38 1.9 sq. mi.	Clarks Cove Class SA	2,087.6	WLA (30.8% impervious)	LA (69.2% pervious)	8.66E +09	3.96E +09	4.7E +09
MA95-51 0.04 sq mi.	Crooked River Class SA	312.1	WLA (10.7% impervious)	LA (89.3% pervious)	1.11E +09	2.06E +08	9.04E +08
MA-95-41 2.6 sq. mi.	East Branch Westport River Class SB – based on 88/100 ml)	37,370.3	WLA (5.9% impervious)	LA (94.1% pervious)	8.04E +11	8.54E +10	7.19E +11
MA95-48 (96075) 0.03 sq. mi.	Eel Pond Class SA	4.51	WLA (7.7% impervious)	LA (92.3% pervious)	1.57E +07	2.13E +06	1.36E +07
MA95-61 (95049) 0.04 sq. mi.	Eel Pond (Mattapoisett) Class SA	616.8	WLA (5.7% impervious)	LA (94.3% pervious)	2.11E +09	2.16E +08	1.89E +09

Table 7- 2b: WLA and LA for Estuarine Waters - TMDL By Segment (Colonies/Day)							
Segment/Size	**Description**	**Watershed Size (Acres)**	**Stormwater Contribution**		**TMDL Col/Day**	**TMDL WLA Col/day**	**TMDL LA Col/day**
MA95-23 0.03 sq. mi.	Great Sippewissett Creek Class SA	55.61	WLA (2.4% impervious)	LA (97.6% pervious)	1.85E +08	8.22E +06	1.77E +08
MA95-56 0.07 sq. mi.	Hammett Cove Class SA	865.2	WLA (10.7% impervious)	LA (89.3% pervious)	3.08E +09	5.7E +08	2.51E +09
MA95-46 0.02 sq. mi.	Harbor Head Class SA	2.21	WLA (11.5% impervious)	LA (88.5% pervious)	7.92E +06	1.56E +06	6.35E +06
MA95-21 0.01 sq. mi.	Herring Brook Class SA	27.81	WLA (7.6% impervious)	LA (92.4% pervious)	9.68E +07	1.3E +07	8.38E +07
MA95-10 0.04 sq. mi.	Hiller Cove Class SA	262.5	WLA (6.1% impervious)	LA (93.9% pervious)	9.0E +08	9.86E +07	8.01E +08
MA95-42 1.3 sq. mi.	Inner New Bedford Harbor Class SB - based on 88/100 ml)	6,590.8	WLA (33.7% impervious)	LA (66.3% pervious)	1.75E +11	8.6E +10	8.9E +10
MA95-64 0.36 sq.mi.	Little Bay Class SA	2,561	WLA (13.6% impervious)	LA (86.4% pervious)	9.34E +09	2.14E +09	7.2E +09
MA95-24 0.02 sq. mi.	Little Sippewisset Marsh Class SA	30.61	WLA (3.2% impervious)	LA (96.8% pervious)	1.02E +08	6.03E +06	9.6E +07

Table 7- 2b: WLA and LA for Estuarine Waters - TMDL By Segment (Colonies/Day)							
Segment/Size	**Description**	**Watershed Size (Acres)**	**Stormwater Contribution**		**TMDL Col/Day**	**TMDL WLA Col/day**	**TMDL LA Col/day**
MA95-60 0.05 sq. mi.	Mattapoisett River Class SA	15,790.9	WLA (4.1% impervious)	LA (95.9% pervious)	5.32E +10	3.99E +09	4.92E +10
MA95-35 1.1 sq. mi.	Mattapoisett Harbor Class SA	18,168.2	WLA (5.2% impervious)	LA (94.8% pervious)	6.18E +10	5.82E +09	5.6E +10
MA95-65 3.7 sq. mi.	Nasketucket Bay Class SA	4,369.2	WLA (10.4% impervious)	LA (89.6% pervious)	1.55E +10	2.8E +09	1.27E +10
MA95-02 0.78 sq. mi.	Onset Bay Class SA	3,144.9	WLA (13.5% impervious)	LA (86.5% pervious)	1.15E +10	2.61E +09	8.9E +09
MA95-63 5.8 sq. mi.	Outer New Bedford Harbor Class SA	18,806.2	WLA (16.3% impervious)	LA (83.7% pervious)	7.36E +12	1.89E +10	7.34E +12
MA95-15 0.73 sq. mi.	Phinneys Harbor Class SA	5.41	WLA (10.2% impervious)	LA (89.8% pervious)	1.92E +07	3.4E +06	1.6E +07
MA95-17 0.33 sq. mi.	Pocasset Harbor Class SA	91.41	WLA (8.0% impervious)	LA (92.0% pervious)	3.18E +08	4.5E +07	2.73E +08
MA95-16 0.05 sq. mi.	Pocassett River Class SA	69.61	WLA (10.0% impervious)	LA (90.0% pervious)	2.5E +08	4.29E +07	2.07E +08

Table 7- 2b: WLA and LA for Estuarine Waters - TMDL By Segment (Colonies/Day)							
Segment/Size	**Description**	**Watershed Size (Acres)**	**Stormwater Contribution**		**TMDL Col/Day**	**TMDL WLA Col/day**	**TMDL LA Col/day**
MA95-25 0.17 sq. mi.	Quissett Harbor Class SA	329.82	WLA (9.1% impervious)	LA (90.9% pervious)	1.16E +09	1.85E +08	9.75E +08
MA95-18 0.92 sq. mi.	Red Brook Harbor Class SA	170.51	WLA (12.5% impervious)	LA (87.5% pervious)	6.2E +08	1.31E +08	4.9E +08
MA95-08 2.5 sq. mi.	Sippican Harbor Class SA	2,293.1	WLA (11.8% impervious)	LA (88.2% pervious)	8.24E +09	1.7E +09	6.57E +09
MA95-07 0.08 sq. mi.	Sippican River Class SA	20,232.6	WLA (5.0% impervious)	LA (95.0% pervious)	6.87E +10	6.23E +09	6.25E +10
MA95-34 0.67 sq. mi.	Slocums River Class SA	23,766.9	WLA (9.8% impervious)	LA (91.2% pervious)	8.48E +10	1.43E +10	7.04E +10
MA-95-59 0.01 sq. mi.	Snell Creek Class SA	1073.5	WLA (5.7% impervious)	LA (94.3% pervious)	3.7E +09	3.77E +08	3.3E +09
MA95-50 0.05 sq. mi.	Wankinco River Class SA	13,214.9	WLA (4.2% impervious)	LA (95.8% pervious)	4.46E +10	3.42E +09	4.12E +10
MA95-03 1.2 sq. mi.	Wareham River Class SA	28,686.4	WLA (5.1% impervious)	LA (94.9% pervious)	9.75E +10	9.0E +09	8.8E +10

Table 7- 2b: WLA and LA for Estuarine Waters - TMDL By Segment (Colonies/Day)							
Segment/Size	**Description**	**Watershed Size (Acres)**	**Stormwater Contribution**		**TMDL Col/Day**	**TMDL WLA Col/day**	**TMDL LA Col/day**
MA95-37 1.3 sq. Mi.	West Branch Westport River Class SA	5,842.1	WLA (3.7% impervious)	LA (96.3% pervious)	1.96E +10	1.33E +09	1.83E +10
MA95-22 0.29 sq. mi.	West Falmouth Harbor Class SA	6.21	WLA (13.9% impervious)	LA (86.1% pervious)	2.27E +07	5.31E +06	1.74E +07
MA95-54 0.74 sq. mi.	Westport River Class SA	45,894	WLA (5.6% impervious)	LA (94.4% pervious)	1.57E +11	1.58E +10	1.41E +11
MA95-05 0.62 sq. mi.	Weweantic River Class SA	58,286.4	WLA (5.8 impervious)	LA (94.2% pervious)	1.99E +11	2.1E +10	1.78E +11
MA95-20 0.15 sq. mi.	Wild Harbor Class SA	631.3	WLA (12.7% impervious)	LA (87.3% pervious)	2.29E +09	4.94E +08	1.8E +09

[1] Estimated Average annual runoff **in 200ft buffer area**
[2] Previously established watershed area.

7.3.7 Summary

This TMDL provides the allowable daily loads (TMDLs) needed to attain the goals of the TMDL. Since accurate estimates of existing sources are generally unavailable, it is difficult to estimate the pollutant reductions for specific sources. The TMDL for discharges from illicit sewer connections, sewer system overflows (SSO's), and discharges from failing septic systems are not allowed and therefore set to zero. Regulated discharges including wastewater treatment facilities and other NPDES-permitted wastewater discharges within the watershed are set at the WQS. The WLAs and LAs for stormwater are proportioned based on the amount of pervious and impervious area from the contributing watershed as defined in Tables 7-2a and 7-2b for each segment with the goal of meeting the most stringent water quality standard for each segment. Compliance with the TMDL, however, should be measured by an appropriate number of samples over a specific timeframe taken from the receiving water in each segment pursuant to the WQS. Achievement of WQS for stormwater is expected to be accomplished through an iterative process of finding and eliminating sources and through the implementation of best management practices (BMPs).

7.4 – Application of the TMDL To Unimpaired or Currently Unassessed Segments

This TMDL applies to the pathogen impaired segments of the Buzzards Bay watershed that are currently listed on the CWA § 303(d) list of impaired waters. MassDEP recommends however, that the information contained in this TMDL guide management activities for all other waters throughout the watershed to help maintain and protect existing water quality. For these non-impaired waters, Massachusetts is proposing "pollution prevention TMDLs" consistent with CWA § 303(d)(3).

The analyses conducted for the pathogen-impaired segments in this TMDL would apply to the non-impaired segments, since the sources and their characteristics are equivalent. The waste load and/or load allocation for each source and designated use would be the same as specified herein. Therefore, the pollution prevention TMDLs would have identical waste load and load allocations based on the sources present and the designated use of the water body segment (see Table ES-1 and Table 7-1).

This Buzzards Bay watershed TMDL may, in appropriate circumstances, also apply to segments that are listed for pathogen impairment in subsequent Massachusetts CWA § 303(d) Integrated List of Waters. For such segments, this TMDL may apply if, after listing the waters for pathogen impairment and taking into account all relevant comments submitted on the CWA § 303(d) list, the Commonwealth determines with EPA approval of the CWA § 303(d) list that this TMDL should apply to future pathogen impaired segments.

7.5 – Margin of Safety

This section addresses the incorporation of a Margin of Safety (MOS) in the TMDL analysis. 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 portion of the loadings). This TMDL uses an implicit MOS, through inclusion of several conservative assumptions. First, the TMDL does not account for mixing in the receiving waters and assumes that zero dilution is available. Realistically, influent water will mix with the receiving water and become diluted lowering instream bacteria concentrations, provided that the receiving water concentration does not exceed the TMDL concentration. Second, the goal of attaining standards at the point of discharge does not account for losses due to die-off and settling of indicator bacteria that are known to occur. Third, the TMDL assumes that all the runoff from impervious areas throughout the contributing watershed actually makes it to the impaired segment, which is generally not the case especially in large watersheds where impervious surfaces are not continually connected.

7.6 - Seasonal Variability

In addition to a Margin of Safety, TMDLs must also account for seasonal variability. Pathogen sources to Buzzards Bay 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. This TMDL has set WLAs and LAs for all known and suspected source categories equal to the Massachusetts WQS independent of seasonal and climatic conditions. This will ensure the attainment of water quality standards regardless of seasonal and climatic conditions. Controls that are necessary will be in place throughout the year, protecting water quality at all times. However, for discharges that do not affect shellfish beds, intakes for water supplies and when primary contact recreation is not taking place (i.e., during the winter months) seasonal disinfection is permitted for NPDES point source discharges if prior approval is granted by MassDEP.

8.0 Implementation Plan

Setting and achieving TMDLs should be an iterative process with realistic goals over a reasonable timeframe and adjusted as warranted based on ongoing monitoring. It is the Department's expectation that existing regulatory programs should be used to the maximum extent feasible to address identified sources. The concentrations set out in the TMDL represent reductions that will require substantial time and financial commitment to be attained. A comprehensive control strategy is needed to address the numerous and diverse sources of pathogens in the Buzzards Bay watershed.

Elevated dry weather bacteria concentrations could be the result of illicit sewer connections, leaking sewer pipes, sanitary sewer overflows, or failing septic systems. These sources are illegal and must be eliminated, so first priority overall should be given to bacteria source tracking activities to investigate potential illicit bacteria sources in segments impaired by bacteria during dry weather. Tracking and remediation of dry weather bacteria sources is usually more straightforward and successful than tracking and eliminating wet weather sources. If illicit bacteria sources are found and eliminated it should result in a dramatic reduction of bacteria concentration in the segment in both dry and wet weather. A comprehensive program is needed to ensure illicit sources are identified and that appropriate actions will be taken to eliminate them. Guidance can be found in the following references: A Center for Watershed Protection Manual entitled: Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments which can be downloaded at:: http://www.cwp.org/Resource_Library/Controlling_Runoff_and_Discharges/idde.htm
Practical guidance for municipalities is provided in a New England Interstate Water Pollution Control Commission publication entitled Illicit Discharge Detection and Elimination Manual, A Handbook for Municipalities available at: http://www.neiwpcc.org/iddemanual.asp.

Storm water runoff represents another major source of pathogens in the Buzzards Bay watershed, and the current level of control is inadequate for standards to be attained in many segments. Improving storm water runoff quality is essential for restoring water quality and recreational uses. It may not be cost effective or even possible to track and identify all wet weather sources of bacteria, therefore segments impaired during wet weather should be evaluated for stormwater BMP implementation opportunities starting with intensive application of less costly non-structural practices (such as street sweeping, and/or managerial strategies using local regulatory controls). Periodic monitoring to evaluate the success of these practices should be performed and, depending on the degree of success of the non-structural stormwater BMPs, structural controls may need to be identified and implemented to meet water quality standards. Structural stormwater BMP implementation may require additional study to identify cost efficient and effective technology. This adaptive management approach to controlling stormwater contamination is the most practical and cost effective strategy to reduce pathogen loadings as well as loadings of other storm water pollutants (e.g., nutrients and sediments) contributing to use impairment in the Buzzards Bay Watershed.

For all the above noted reasons, a basin-wide implementation strategy is recommended. The strategy includes a mandatory program for implementing storm water BMPs and eliminating illicit sources. The "*Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts*" was developed to support implementation of pathogen TMDLs. TMDL implementation-related tasks are shown in Table 8-1. Additionally the *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed"* should be utilized to find and confirm suspect stormwater conveyance discharge outfall sites that are ‘hotspots’. The MassDEP working with EPA and other team partners shall make every reasonable effort to assure implementation of this TMDL. These stakeholders can provide valuable assistance in defining hot spots and sources of pathogen contamination as well as the implementation of mitigation or preventative measures.

Table 8-1. Tasks

Task	Organization
Writing TMDL	MassDEP
TMDL public meeting	MassDEP
Response to public comment	MassDEP
Organization, contacts with volunteer groups	MassDEP/CBB/BBP
Development of comprehensive storm water management programs including identification and implementation of BMPs	Buzzards Bay Communities, MassHighway
Illicit discharge detection and elimination	Buzzards Bay Communities with CBB
Leaking sewer pipes and sanitary sewer overflows	Buzzards Bay Communities
CSO management	City of New Bedford
Inspection and upgrade of on-site sewage disposal systems as needed	Homeowners and Buzzards Bay Communities (Boards of Health)
Organize and implement; work with stakeholders and local officials to identify remedial measures and potential funding sources	MassDEP, BBP and Buzzards Bay Communities
Organize and implement education and outreach program	MassDEP, CBB and Buzzards Bay Communities
Write grant and loan funding proposals	CBB, Buzzards Bay Communities and Planning Agencies with guidance from MassDEP
Inclusion of TMDL recommendations in Executive Office of Environmental Affairs (EOEA) Watershed Action Plan	EOEEA
Surface Water Monitoring	MassDEP, CBB, BBP, CZM, DMF
Bacteria Source Tracking	MassDEP, Buzzards Bay Communities, MassHighway
Provide periodic status reports on implementation of remedial activities	Buzzards Bay Communities

8.1 Summary of Activities within the Buzzards Bay Watershed

There are two not-for-profit active stewards of the Buzzards Bay, the Coalition for Buzzards Bay (CBB) and the Buzzards Bay Action Committee (BBAC). The CBB is a citizens group primarily focused on education and outreach and the BBAC, consisting of municipal officials, focusing on regulation and legislation issues. These organizations, with assistance from the EPA and MACZM, have developed the Buzzards Bay Project National Estuary Program where their mission is "To protect and restore water quality and living resources in Buzzards Bay and its surrounding watershed through the implementation of the Buzzards Bay Comprehensive Conservation and Management Plan" (CCMP; available for download at http://www.buzzardsbay.org/ccmptoc.htm). The CCMP includes the following action plans:

- Managing Nitrogen-Sensitive Embayment's
- Protecting and Enhancing Shellfish Resources
- Controlling Stormwater Runoff
- Managing Sanitary Wastes from Boats
- Managing On-Site Systems
- Preventing Oil Pollution
- Protecting Wetlands and Coastal Habitat
- Planning for a Shifting Shoreline
- Managing Sewage Treatment Facilities
- Reducing Toxic Pollution
- Managing Dredging and Dredged Material Disposal

The first effort in controlling storm water runoff featured a storm water mapping task. This effort resulted in the publication of the "*Atlas of Stormwater Discharges in the Buzzards Bay Watershed*"(relevant maps are provided in Appendix A). Storm water mapping is continuing in areas not included in the original effort. Data collected during the mapping process is used to set remediation implementation priorities within the watershed. The BBAC works closely with municipalities in an effort to improve conditions within the Bay. A list of on-going and past projects is provided on the following web-site http://www.buzzardsbay.org/.

In addition, the DEP and EPA have sponsored various program (MWI, 319, 104(b)(3) grant projects related to controlling bacteria throughout the basin over the past decade. A brief summary of some of these projects follows and can be used as a guide for developing implementation approaches in the future.

Watershed Initiative Grants program: MWI Project 01-02, Westport River NPS Assessment Project"- a $49,500 project assessing land- use, mapping NPS sources of pollution (including bacteria), conducting a stormwater pollution assessment at Head of Westport area, and recommending BMP's for NPS pollution remediation;

319 Nonpoint Source Grant program: (1) Project 97-07- "Protecting Nitrogen Sensitive Coastal Embayment's Through Land Conservation"- a $72,500 project to develop tools for controlling nitrogen (and would relate to control of bacteria as well) inputs from increased development, by using BMP's on

fertilizer use, manure management, septic system maintenance, vegetative buffers in the Slocum's River and Onset Bay sub- watersheds; (2) Project 99-01, " Alternative Septic System Test Center Project Monitoring"- a $188,000 project to monitor pollutant removal by 21 different waste water treatment systems at the alternative septic system test center, Mass. Military Reservation, which will speed approval of effective technologies having advanced contamination removal (nitrogen and bacteria), and result in wide dissemination and use by the public; (3) Project 00-02, continue " Alternative Septic System Test Center Project Monitoring"- $190,500, to continue the work of 319 project 99-01 outlined above; (4) Project 00-03, "Development of a Rapid Field Test for Quality of Stone Aggregate in Onsite Septic Systems"- a $28,500 project to improve soil absorption portions of leaching systems of on-site septic systems; (5) Project 00-05, "Atlas of Stormwater Discharges in Buzzards Bay Watershed"- a $41,000 project, often quoted and referred to throughout this report; (6) Project 00-09, "Onset Bay, Wareham MA, Nonpoint Source Pollution Remediation Project"- a $218,000 project to upgrade seasonally closed shellfish areas in Onset Bay (northern portion particularly) by installing 4 subsurface infiltration "first flush" BMP's (with deep sumps, hoods, pipes to infiltration chambers) and conducting pre and post construction monitoring; (7) Project 01-07, "Wareham NPS Remediation Program: East River, Broad Cove, Muddy Cove"- a $455,000 project, to continue the work of Project 00-09 above, to install stormwater BMP's (deep sump catch basins, infiltration chambers, stormtreat systems, etc) at 7 outlets in (upstream) Onset Village, with pre and post construction monitoring; (8) Project 02-06, "Head of Westport Stormwater Project"- a $444,000 project to improve water quality in the East Branch of the Westport River by reducing NPS pollution at Head of River by construction of a sediment forebay for pretreatment of stormwater runoff before discharge into 2 detention basins, before discharge into a constructed wetlands, with an attendant O & M program.

104(b)(3) Water Quality Grant program: (1) Project 01/104, "Acushnet River TMDL Data Collection"- a $30,000 project to quantify Acushnet River Discharge nitrogen and bacteria loading from the upper watershed river discharge to New Bedford Inner Harbor Area, to provide data for water quality models to help EPA and DEP to develop appropriate TMDL management approaches for restoring water quality in the Acushnet River Estuary System.

The Massachusetts Office of Coastal Zone Management's (CZM) Buzzards Bay National Estuary Program (NEP) announced in mid- July, 2007, over $98,000 in grants to assist the 5 South Coast-Cape Cod communities in their efforts to protect and restore Buzzards Bay. The grants will help municipalities test, map and treat stormwater discharges; protect and restore wetlands and habitat; and safeguard open space. The communities with their projects include:

Rochester - $25,000 for the Church Family Property Land Preservation Project, which will permanently protect a 20.8-acre parcel of land on Marion Road (Route 105), a designated Scenic Highway. The town will partner with the non-profit Rochester Land Trust to acquire the property at the bargain price of $100,000. The land trust will hold title to the property, which will be open to the public. Located within the Sippican River watershed, the area includes dense mature pine and oak forests, wetlands, and significant wildlife habitat, and is close to other permanently protected properties.

Bourne - $16,000 for the Head of the Bay Stormwater Pollution Identification project, a collaborative effort between the towns of Bourne, Wareham, and Marion to conduct detailed water quality sampling of 20 high priority stormwater discharges. With a goal of reopening closed shellfish beds, data collected from this project will be used to prioritize these discharges, in order to target funds for future remediation. The three towns have partnered with The Coalition for Buzzards Bay, which will serve as the principal contractor, providing all project management, field sampling, analysis lab coordination, data compilation, and final presentation.

The town of Bourne will also receive $15,305 for the second phase of a Culvert Replacement Feasibility study for Conservation Pond along the shores of Hen Cove. This project is evaluating the feasibility of installing a larger culvert under Circuit Avenue at Conservation Pond. Phase one of the project was funded by the NEP through a $17,000 mini-grant in January. The tidal pond currently connects to Hen Cove via an 18-inch wide, 50-foot long corrugated steel culvert. The culvert's small size, elevation, and regular blockage severely restrict tidal flow to the pond.

New Bedford - The City of New Bedford Department of Public Works Waste Water Division has been addressing CSOs since 1989 (City of New Bedford 2005). There are currently 27 CSO outfalls (as opposed to formerly 41 in 1989) discharging into Clarks Cove, New Bedford Harbor and Buzzards Bay (Shepherd 2008). As a result of their efforts, two shellfish beds, which have been closed for 30 years, have been reopened (City of New Bedford 2005). Work toward mitigating CSO impacts is ongoing and part of the City of New Bedford's long term CSO control plan (New Bedford CSO Facilities Plan). The City was awarded $ 22 million in FY '07 SRF funds for implementing these long- term controls and is on the 2009 state intended use plan for $19.3 million of SRF funds to reduce CSO by removing major grit blockages within the system.

The City also received a $20,000 grant from CZM to continue mapping stormwater drainage networks as part of an update of the city's GIS data of stormwater and sewer systems. The NEP awarded New Bedford $10,000 in January to initiate this project, which involves field work and computer mapping performed by UMass/Dartmouth engineering interns.

Marion – Received $22,000 for the Washburn Park Wetland Restoration and Creation project. The municipality seeks to remove fill from a wetland and create additional wetlands on a property that is being purchased by the town for permanent conservation. The grant will also help fund two appraisals required by the state Division of Conservation Services' Self-Help Grant Program. The town intends to apply for Self-Help funds to assist in the acquisition and protection of the property. The non-profit Sippican Lands Trust has partnered with the town and will hold title to the property until the town completes the transfer.

Mattapoisett - has received in-kind support from the NEP to map stormwater drainage systems in some new subdivisions not mapped in previous stormwater system mapping efforts. Due to its limited nature, the NEP agreed to undertake the proposed work at no cost to the town.

MassDEP can also assist towns and local groups in identifying bacterial sources. In 2004 the MassDEP/DWM purchased an IDEXX system for in-house bacteria analyses and developed a protocol for conducting bacteria source tracking surveys. A pilot bacteria source tracking study in the Blackstone and Sudbury River watersheds was conducted by the DWM to test the protocol and develop "low-tech" methodologies to differentiate between human and non-human sources of bacteria.

A report on this study can be accessed at http://www.mass.gov/dep/water/priorities/bact2004.pdf. Bacteria source tracking surveys are now being conducted as part the duties of the regional DWM monitoring coordinators in the MassDEP southeast region. These surveys focus mostly on detecting dry weather bacteria inputs. When illicit sources are found, the MassDEP Southeast regional Office (SERO) notifies the community and/or responsible party and works with them to implement repairs.

In summary although work is underway much more needs to be done to obtain the goal of achieving designated uses in the Buzzards Bay Watershed. Data supporting this TMDL indicate that indicator bacteria enter the Buzzards Bay from a number of contributing sources, under a variety of conditions. Activities that are currently ongoing and/or planned to ensure that the TMDL can be implemented include and are summarized in the following subsections. The "*Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts*" provides additional details on the implementation of pathogen control measures summarized below as well as additional measures not provided herein, such as by-law, ordinances and public outreach and education.

8.2 Agricultural Runoff – Animal Feeding Operations and Grazing

Animal feeding operations and barnyards can produce significant volumes of manure with high fecal loads. To reduce the impacts of animal feeding operations, EPA recommends addressing the following eight issues (USEPA 2003).

1. *Divert clean water* - divert clean water (run-off from uplands, water from roofs) from contact with feedlots and holding pens, animal manure, or manure storage systems.
2. *Prevent seepage.*
3. *Provide adequate storage*.
4. *Apply manure in accordance with a nutrient management plan that meets the performance expectations of the nutrient management measure.*
5. *Address lands receiving wastes*. Areas receiving manure should be managed in accordance with the erosion and sediment control, irrigation, and grazing management measures as applicable.
6. *Recordkeeping.* Operators should keep records that indicate the quantity of manure produced and its utilization or disposal method, including land application.
7. *Mortality management*. Dead animals should be managed in a way that does not adversely affect ground or surface waters.
8. *Consider the full range of environmental constraints and requirements.* When siting a new or expanding facility, consideration should be given to the proximity of the facility to (a) surface waters; (b) areas of high leaching potential; (c) areas of shallow groundwater; and (d) sink holes or other sensitive areas.

Grazing best management practices can reduce erosion, the concentrations of bacteria in runoff from grazing areas, and the direct deposition of fecal matter into water bodies. The following grazing management practices may be implemented at agricultural sites as part of the overall implementation strategy to reduce pathogen discharges to receiving waters.

- Exclude livestock from surface water bodies, and sensitive shoreline and riparian zones,
- Provide bridges or culverts for stream crossings,
- Provide alternative drinking water locations,

- Locate salt, feeding areas, and additional shade away from sensitive areas, and
- Use improved grazing management to reduce erosion and overgrazing.

Additional details and a list of useful resources regarding animal feeding operations and grazing management is provided in the “*Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts*”.

8.3 Illicit Sewer Connections, Failing Infrastructure and CSOs

Elimination of illicit sewer connections, repairing failing infrastructure, and controlling impacts associated with CSOs are of extreme importance. As previously noted, The City of New Bedford Department of Public Works Waste Water Division has been addressing CSOs since 1989 (City of New Bedford 2005). In 1990, the New Bedford CSO Facilities Plan was completed, with a projected total cost of $191 million for full implementation. Work on the plan has ensued since that time. There are currently 27 CSO outfalls (as opposed to formerly 41 in 1989) discharging into Clarks Cove, New Bedford Harbor and Buzzards Bay (Shepherd 2008). As a result of their efforts, two shellfish beds, which have been closed for 30 years, have been reopened (City of New Bedford 2005). Work toward mitigating CSO impacts is ongoing and part of the City of New Bedford’s long term CSO control plan (New Bedford CSO Facilities Plan).

EPA’s Phase II rule specifies an MS4 community must develop, implement, and enforce a storm water management program that is designed to reduce the discharge of pollutants to the maximum extent practicable, protect water quality, and satisfy the applicable water quality requirements of the Clean Water Act. Illicit discharge detection and elimination (IDDE) is one of the six minimum control measures that must be included in the storm water management program. The other control measures are:

- Public education and outreach on storm water impacts
- Public involvement and participation
- Construction site storm water runoff control
- Post-construction storm water management in new development and redevelopment
- Pollution prevention and good housekeeping for municipal operations

As part of their applications for Phase II permit coverage, MS4 communities must identify the best management practices they will use to comply with each of these six minimum control measures and the measurable goals they have set for each measure.

In general, a comprehensive IDDE Program must contain the following four elements:

1) Develop (if not already completed) a storm sewer system map showing the location of all outfalls, and the names and location of all waters of the United States that receive discharges from those outfalls.

2) Develop and promulgate municipal regulations that require the municipality to comply with Phase II regulations including prohibition of illicit discharges and appropriate enforcement mechanisms.

3) Develop and implement a plan to detect and address illicit discharges, including illegal dumping, to the system. EPA recommends that the plan include the following four components: locating priority areas; tracing the source of an illicit discharge; removing the source of an illicit discharge; and program evaluation and assessment.

4) Inform public employees, businesses, and the general public of hazards associated with illegal discharges and improper disposal of waste. IDDE outreach can be integrated into the broader stormwater outreach program for the community. Fulfilling the outreach requirement for IDDE helps the MS4 community to comply with this mandatory element of the stormwater program.

Communities that are not covered under the Phase II rule (i.e., not designated as MS4 communities) are encouraged to implement a program for detecting and eliminating sewage discharges to storm sewer systems including illicit sewer connections. Implementation of the Phase II rule (USEPA 2000), whether voluntarily or mandated will help communities achieve bacteria TMDLs.

Guidance for implementing an illicit discharge detection and elimination program is available from several documents. EPA New England developed a specific plan for the Lower Charles River to identify and eliminate illicit discharges (both dry and wet weather) to their separate storm sewer systems (USEPA 2004b). Although originally prepared for the Charles River watershed it may be applicable to other watersheds throughout the Commonwealth, however it represents just one of the approved methodologies available. More generic guidance is provided in a document prepared for EPA by the Center for Watershed Protection and the University of Alabama entitled Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments which can be downloaded from:
http://www.cwp.org/Resource_Library/Controlling_Runoff_and_Discharges/idde.htm

In addition, practical guidance for municipalities is provided in a New England Interstate Water Pollution Control Commission publication entitled Illicit Discharge Detection and Elimination Manual, A Handbook for Municipalities available at: http://www.neiwpcc.org/iddemanual.asp. Implementation of the protocol outlined in these guidance documents satisfies the Illicit Discharge Detection and Elimination requirement of the NPDES program.

A list of the municipalities in Massachusetts regulated by the Phase II Rule, as well as the Notices of Intent for each municipality can be viewed at http://www.epa.gov/region01/npdes/stormwater/ma.html.

8.4 Storm Water Runoff

It is MassDEP's expectation that bacteria source identification and elimination will be conducted through existing regulatory programs such as EPA Phase I and Phase II stormwater programs and new regulatory programs that are currently being considered summarized in this section.

As previously noted MassDEP realizes given the vast potential number of bacteria sources and the difficulty of identifying and removing them from some sources such as stormwater require an iterative process and will take some time to accomplish. While the stated goal in the TMDL is to meet the water quality standard at the point of discharge it also attempts to be clear that MassDEP's expectation is that for stormwater an iterative approach is needed that includes prioritization of outfalls and the application of BMPs should be used to achieve water quality standards. MassDEP believes this is approach is consistent with current EPA guidance and regulations as stated in a November 22, 2002 EPA memo from Robert Wayland (see Attachment C)

In general, storm water runoff can be categorized in two forms; 1) point source discharges and 2) non-point source discharges (includes sheet flow or direct runoff). Many point source storm water discharges are regulated under the NPDES Phase I and Phase II permitting programs when discharged to a Waters of the United States. Municipalities that operate regulated municipal separate storm sewer systems (MS4s) must develop and implement a storm water management plan (SWMP), which must employ and set measurable goals for the following six minimum control measures:

1. public education and outreach particularly on the proper disposal of pet waste,
2. public participation/involvement,
3. illicit discharge detection and elimination,
4. construction site runoff control,
5. post construction runoff control, and
6. pollution prevention/good housekeeping.

Portions of towns in this watershed are classified as Urban Areas by the United States Census Bureau and are subject to the Stormwater Phase II Final Rule. This rule requires the development and implementation of an illicit discharge detection and elimination plan.

The BBAC created a web page to help municipalities with obtaining their Phase II permits. Partly due to their efforts, 95% of the municipalities submitted their permit applications within the required time limit (all municipalities have submitted their permit application at this point)

The NPDES permit does not, however, establish numeric effluent limitations for storm water discharges. Maximum extent practicable (MEP) is the statutory standard that establishes the level of pollutant reductions that regulated municipalities must achieve. The MEP standard is a narrative effluent limitation that is satisfied through implementation of SWMPs and achievement of measurable goals.

Non-point source discharges are generally characterized as sheet flow runoff and are not categorically regulated under the NPDES program and can be difficult to manage. However, some of the same principles for mitigating point source impacts may be applicable. Individual municipalities not regulated under the Phase I or II should implement the exact same six minimum control measures minimizing storm water contamination.

In addition to the Phase I and II programs described above the Massachusetts Department of Environmental Protection's proposed new "Stormwater Management Regulations," that would establish a statewide general permit program aimed at controlling the discharge of stormwater runoff from certain privately-owned sites containing large impervious surfaces.

The proposed regulations would require private owners of land containing five or more acres of impervious surfaces to apply for and obtain coverage under a general permit; implement nonstructural best management practices (BMPs) for managing stormwater; install low impact development (LID) techniques and structural stormwater BMPs at sites undergoing development or redevelopment; and submit annual compliance certifications to the Department. Any new construction will have to comply with state stormwater standards and permits and with the antidegradation requirements of the state water quality standards.

A review of the various communities' SWMP's progress to date includes the following:

Westport- Has produced educational materials for distribution in the community to citizens. The Highway Department and the Board of Health have embarked on a program to identify and map all significant discharges and flows. The town will embark on changing by-laws on controlling illicit discharges, if necessary.

Dartmouth- The public education program consists of mainly involving the Middle School in a storm drain stenciling contest type project, with coordination through the Buzzards Bay Coalition. The town turned down funding to continue mapping storm drains and finding illicit connections. Rather, the solution of having high school students do this was proposed. Also, a partnership with the Lloyd Center for Environmental Studies and U Mass is being considered to find illicit detections, mainly through water quality testing and stream flow monitoring. Geese in Apponagansett Bay have been identified as a bacteria source, and discussions are underway on how to remove them. Streets and catch basins are cleaned annually. The town got a grant to purchase a vacuum truck/ Vortechnic unit for servicing storm drains.

New Bedford- Public education fact sheets have been prepared, and mailed out in several batches to citizens in their utility bills. Regular tours to the New Bedford P.O.T.W. are conducted for interested citizens. The high school vocational/ technical students have stenciled 1,000 catch basins. The City has mapped all known illicit connection locations, and major discharge outfall points. It has had CSO crews, pump station personnel, plus the shellfish warden investigating all significant dry weather flows with sampling and dye testing. They have identified a total of 250 illicit connections, and have corrected them. A city ordinance has been developed to disallow all illegal connections to the stormwater system.

Acushnet- An educational outreach flyer on stormwater controls has been developed and mailed out to citizens in their tax bills. Maps of the Town's stormwater infrastructure have been developed and posted in the Town hall meeting room. A Stormwater Planning Committee was formed and activated in 2004. Its emphasis was determined to be erosion/sediment controls and illicit connection detection/removal. An inventory (on maps and GIS) was completed on every discharge pipe from a stormwater conveyance, with the help of the Buzzards Bay Protection, and Buzzards Bay Action Committees. The Board of Health, through enforcement actions, discovered and fixed 14 illegal tie-ins.

Rochester- Educational flyers have been created, and are available at the Highway Department Offices. There is an active Stormwater Management Committee, which invites all interested residents to an annual meeting. Large format stormwater drainage and principal outfall maps are available (and are all on GPS) at the highway barn. A complaint log is maintained at the Board of Health offices. Priority stenciling of at least 10 storm drains per year occurs. Suspect illicit connections are also located on the stormwater drainage/ outfall maps. A number of illicit connections have been detected and fixed. The Town has developed adequate authority to properly regulate illicit discharges.

Marion- The current DPW Director has reorganized the Stormwater Management Committee of the Town, including the plan of holding quarterly action review meetings involving key personnel/citizens interested in stormwater related efforts. An annual meeting will be held to review all progress to date, and lay the foundation for the next year's planned activities. Significant funding was appropriated by the Town in late 2004 to fund a stormwater management program. Educational flyers were prepared on the subject, and mailed out to all addresses in June, 2005. The harbor master is responsible for an extensive storm drain stenciling project throughout Town. Storm drain and conveyance mapping has been conducted (maps are on display in town hall), and a number of illicit connections found and fixed. During the winter of 2005-6, the Board of Health will be conducting training for all relevant town personnel on stormwater management issues.

Mattapoisett- Comprehensive public education program began in 2003, particularly after the large off-shore oil spill from a tanker occurred. Informational water cycle and water quality posters were created and distributed. Maps have been created of all stormwater outfalls within the urbanized areas, and suspected illicit connections have been located on the maps. Failing septic systems are defined by the Town as part of this problem. Records of pump outs and problems are now kept at the Board of Health office. Sewer lines are being installed in problem (septic system) areas of the Town.

Plymouth- The Town appears to have an active SWP program. Public education includes flyers for distribution, programs on the local cable channel, and storm water drain stenciling. The Town has an active conservation officer in the SWPP, and has an active citizen stormwater committee, as well as an active volunteer monitoring group for ponds/lakes. The Town engineer, Board of Health, Planning Board, Conservation Officer have developed an illicit detection and elimination program, and they have developed draft and final by- laws, to be finalized by the Town by June '06. The Town has annual street sweeping/ catch basin cleaning, and has an annual day of training for all DPW personnel on SWPP concepts each year.

Wareham- The Town has made substantial investments of millions of dollars to sewer much of the Onset and Independence Point areas. Additionally, progress has been made with fixing, or eliminating failing septic systems throughout Town. Also, remediation of stormwater discharge problems has occurred, including eliminating illicit connections in several parts of Town.

Bourne: With public education, the town has established a stormwater task force advisory committee. This committee meets monthly to provide outreach, work on developing a Phase II by-law, developing a management plan, producing an annual stormwater newsletter that goes out to all residences, and producing programs for the local cable TV station. The Board of Health produces a video program in all 3^{rd} grade classes each year. The task force meets with the Superintendent of the DPW twice yearly on stormwater control progress. It also meets regularly with the Cape Cod Planning Commission, as part of an inter- group of Cape Cod communities working on stormwater ('Project Storm'), and on low impact development applications in town. It also works with the Coalition for Buzzards Bay. The task force has set up a hotline for residents to file complaints. The town was part of the Buzzards Bay Stormwater Outfall Mapping Project in the northern estuary area, and is using that data to identify potential problems. The local Board of Health regularly samples the beaches. With IDDE, The Buzzards Bay Outfall Mapping Project has been utilized in the Northern part of town, and AmeriCorps

Inc. has funded storm drain mapping in areas not covered by this project. Two CPR grants have been received to alleviate problems in Squeteague Harbor (Buzzards Bay) and Conservation Pond/ Hen's Cove areas. The DPW has begun a program to inventory dry weather flowing outfalls, and sample them for problems. It has displayed stormwater control posters all over town. With housekeeping, the DPW cleaned 479 catch basins in 2005, removing 900 tons of debris. Street sweeping has been performed annually on all roads.

Falmouth: The entire stormwater control effort has been hampered because of a personnel shortages and funding difficulties in town. The public education and outreach efforts have not yet commenced. Maps of the stormwater infrastructure drainage systems have progressed with GPS, and are on GIS. The '06 report says that illicit connection detection has commenced, but no details of corrections are evident. Housekeeping (street sweeping and catch basin cleaning) are undefined in the report.

It should be emphasized that in the process of reviewing various communities SWMP's and SWMP Annual Plans (summarized above), there is no mention of The *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed".* This document is referenced throughout this report because of its potential significance in controlling pathogen related sources of pollution. Many parts of the coastal- estuary areas have been mapped, locating stormwater conveyances, catch basins, and discharge outfalls going directly into estuaries/ embayment's, or tributaries that directly flow into these areas. Outfalls have been ranked low, medium, high in priority for remediation. Communities, in concert with various concerned organizations need to conduct a full- scale bacteria monitoring program to assess hotspot problems, and then find/ remediate the sources. This would be an important part of carrying out the required activities, by affected Towns, under the Phase II Stormwater Program, plus it would open the door for the possibility of re-opening more of the currently closed or restricted shellfish areas.

In addition to the above, the Massachusetts Department of Environmental Protection's proposed new "Stormwater Management Regulations," that would establish a statewide general permit program aimed at controlling the discharge of stormwater runoff from certain privately-owned sites containing large impervious surfaces.

The proposed regulations would require private owners of land containing five or more acres of impervious surfaces to apply for and obtain coverage under a general permit; implement nonstructural best management practices (BMPs) for managing stormwater; install low impact development (LID) techniques and structural stormwater BMPs at sites undergoing development or redevelopment; and submit annual compliance certifications to the Department.

8.5 Failing Septic Systems

There is only a relatively small portion of the Buzzards Bay basin serviced by municipal sanitary sewer systems, with a concentration in eastern Dartmouth, all of New Bedford, the extreme eastern and southern Fairhaven, Mattapoisett Harbor, Wareham River and immediate surroundings, Marion Harbor and a very small portion of Onset Bay. The rest of the area of the Buzzards Bay basin (80%, or more) relies on on-site waste water systems such as septic systems. Septic system bacteria contributions to the Buzzards Bay watershed may be reduced in the future through septic system maintenance and/or replacement. Additionally, the implementation of Title 5, which requires inspection of private sewage disposal systems before property ownership may be transferred, building expansions, or changes in use of properties, will aid in the discovery of poorly operating or failing systems. Because systems which fail must be repaired or upgraded, it is expected that the bacteria load from septic systems will be significantly reduced in the future. Regulatory and educational materials for septic system installation, maintenance and alternative technologies are provided by the MassDEP on the worldwide web at http://www.mass.gov/dep/brp/wwm/t5pubs.htm.

8.6 Wastewater Treatment Plants

WWTP discharges are regulated under the NPDES program when the effluent is released to surface waters. Each WWTP has an effluent limit included in its NPDES or groundwater permit. Some NPDES permits are listed on the following website: www.epa.gov/region1/npdes/permits_listing_ma.html. Groundwater permits are available at http://www.mass.gov/dep/brp/gw/gwhome.htm.

8.7 Recreational Waters Use Management

Recreational waters receive pathogen inputs from swimmers and boats. To reduce swimmers' contribution to pathogen impairment, shower facilities can be made available, and bathers should be encouraged to shower prior to swimming. In addition, parents should check and change young children's diapers when they are dirty. Options for controlling pathogen contamination from boats include:

- petitioning the State for the designation of a No Discharge Area (NDA),
- supporting installation of pump-out facilities for boat sewage,
- educating boat owners on the proper operation and maintenance of marine sanitation devices (MSDs), and
- encouraging marina owners to provide clean and safe onshore restrooms and pump-out facilities.

The entire Buzzards Bay has already been established as a no discharge area (NDA). This area was designated by the Commonwealth of Massachusetts and approved by the EPA to provide protection by Federal Law prohibiting the release of raw or treated sewage from vessels into navigable waters of the U.S. The law is enforced by the Massachusetts Environmental Police. The MACZM and Massachusetts Environmental Law Enforcement are actively pursuing an amendment to State regulations allowing for the institution of fines up to $2000 for violations within a NDA (USEPA 2004a).

8.8 Funding/Community Resources

A complete list of funding sources for implementation of non-point source pollution is provided in Section VII of the Massachusetts Nonpoint Source Management Plan Volume I (MassDEP 2000b) available on line at http://www.mass.gov/dep/brp/wm/nonpoint.htm. This list includes specific programs available for non-point source management and resources available for communities to manage local growth and development. The State Revolving Fund (SRF) provides low interest loans to communities for certain capital costs associated with building or improving wastewater treatment facilities. In addition, many communities in Massachusetts sponsor low cost loans through the SRF for homeowners to repair or upgrade failing septic systems. State monies are also available through the

Massachusetts Office of coastal Management's Coastal Pollutant Remediation, Coastal Nonpoint Source Pollution Control and Coastal Monitoring grant programs.

8.9 Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts

For a more complete discussion on ways to mitigate pathogen water pollution, see the "*Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts*" accompanying this document.

9.0 Monitoring Plan

The long term monitoring plan for the Buzzards Bay watershed includes several components:

1. continue with the current monitoring of the Buzzards Bay watershed (CBB, DMF and other stakeholders),
2. Communities and other entities that discharge stormwater should use The *"Atlas of Stormwater Discharges in the Buzzards Bay Watershed",* to identify medium and high priority stormwater discharge outfalls and use this information for formulating a bacteria sampling and prioritization plan to help guide remediation efforts.,
3. continue with MassDEP watershed five-year cycle monitoring,
4. monitor areas within the watershed where data are lacking or absent to determine if the waterbody meets the use criteria,
5. monitor areas where BMPs and other control strategies have been implemented, or discharges have been removed, to assess the effectiveness of the modification or elimination,
6. assemble data collected by each monitoring entity to formulate a concise report where the basin is assessed as a whole and an evaluation of BMPs can be made, and
7. add/remove/modify BMPs as needed based on monitoring results.

The monitoring plan is an ever changing approach that requires flexibility to add, change or delete sampling locations, sampling frequency, methods and analysis. At the minimum, all monitoring should be conducted with a focus on:

- capturing water quality conditions under varied weather conditions,
- establishing sampling locations in an effort to pin-point sources,
- researching new and proven technologies for separating human from animal bacteria sources, and
- assessing efficacy of BMPs.

10.0 Reasonable Assurances

Reasonable assurances that the TMDL will be implemented include both application and enforcement of current regulations, availability of financial incentives including low or no-interest loans to communities for wastewater treatment facilities through the State Revolving Fund (SRF), and the various local, state and federal programs for pollution control. Storm water NPDES permit coverage is designed to address discharges from municipal owned storm water drainage systems. Enforcement of regulations controlling non-point discharges includes local enforcement of the state Wetlands Protection Act and Rivers Protection Act; Title 5 regulations for septic systems and various local regulations including zoning regulations. Financial incentives include Federal monies available under the CWA Section 319 NPS program and the CWA Section 604 and 104b programs, which are provided as part of the Performance Partnership Agreement between MassDEP and the EPA. Additional financial incentives include state income tax credits for Title 5 upgrades, and low interest loans for Title 5 septic system upgrades through municipalities participating in this portion of the state revolving fund program.

A brief summary of many of DEP's tools and regulatory programs to address common bacterial sources is presented below.

10.1 Overarching Tools:

Massachusetts Clean Water Act: The MA Clean Water Act (M.G.L. Chapter 21, sections 26-53) provides MassDEP with specific and broad authority to develop regulations to address both point and non-point sources of pollution. There are numerous regulatory and financial programs, including those identified in the preceding paragraph, that have been established to directly and indirectly address pathogen impairments throughout the state. Several of them are briefly described below. The MA Clean Water Act can be found at the following URL. http://www.mass.gov/legis/laws/mgl/gl-21-toc.htm

Surface Water Quality Standards (314 CMR 4.0): The MA Water Quality Standards (WQS) assign designated uses and establish water quality criteria to meet those uses. Water body classifications (Class A, B, and C, for freshwater and SA, SB, and SC for marine waters) are established to protect each class of designated uses. In addition, bacteria criteria are established for each individual classification. The MA Surface Water Quality Standards can be found at http://www.mass.gov/dep/brp/wm/wqstds.htm

Ground Water Quality Standards (314 CMR 6.0): These standards consist of groundwater classifications, which designate and assign the uses for various groundwaters of the Commonwealth that must be maintained and protected. Like the surface water quality standards the groundwater standards provide specific ground water quality criteria necessary to sustain the designated uses and/or maintain existing groundwater quality. The MA Ground Water Quality Standards can be found at http://www.mass.gov/dep/brp/gw/gwregs.htm

River Protection Act: In 1996 MA passed the Rivers Protection Act. The purposes of the Act were to protect the private or public water supply; to protect the ground water; to provide flood control; to prevent storm damage; to prevent pollution; to protect land containing shellfish; to protect wildlife habitat; and to protect the fisheries. The provisions of the Act are implemented through the Wetlands Protection Regulations, which establish up to a 200-foot setback from rivers in the Commonwealth to control construction activity and protect the items listed above. Although this Act does not directly reduce pathogen discharges it indirectly controls many sources of pathogens close to water bodies. More information on the Rivers Protection Act can be found on DEPs web site at http://www.mass.gov/dep/brp/ww/files/riveract.htm.

10.2 Additional Tools to Address Combined Sewer Overflows (CSO's)

CSO Program/Policy: Massachusetts, in concert with EPA Region 1, have established a detailed CSO abatement program and policy. CSO discharges are regulated by the Commonwealth in several ways. Like any discharge of pollutants, CSOs must have an NPDES/MA Surface Water

Discharge Permit under federal and state regulations. Municipalities and districts seeking funding for wastewater treatment, including CSO abatement, must comply with the facilities planning process at 310 CMR 41.00. Entities obtaining funding or exceeding specific thresholds must also comply with the Massachusetts Environmental Policy Act (MEPA) regulations at 301 CMR 11.00. Each of these regulations contain substantive and procedural requirements. Because both MEPA and facilities planning require the evaluation of alternatives, these processes are routinely coordinated.

All permits for a CSO discharge must comply with Massachusetts Surface Water Quality Standards at 314 CMR 4.00. The water quality standards establish goals for waters of the Commonwealth, and provide the basis for water quality-based effluent limitations in NPDES permits. Any discharge, including CSO discharges, is allowed only if it meets the criteria and the antidegradation standard for the receiving segment. EPA's 1994 CSO Control Policy revised some features of its 1989 version to provide greater flexibility by allowing a minimal number of overflows, which are compatible with the water quality goals of the Clean Water Act. DEP's 1995 regulatory revisions correspondingly decreased reliance on partial use designation as the sole regulatory vehicle to support CSO abatement plans[1].

In all cases, NPDES/MA permits require the nine minimum controls necessary to meet technology-based limitations as specified in the 1994 EPA Policy. The nine controls may be summarized as; operate and maintain properly; maximize storage, minimize overflows, maximize flows to Publicly Owned Treatment Works (POTW), prohibit dry weather CSO's, control solids and floatables, institute pollution prevention programs, notify the public of impacts, and observe monitoring and reporting requirements. The nine minimum controls may be supplemented with additional treatment requirements, such as screening and disinfection, on a case-by-case basis. The Department's goal is to eliminate adverse CSO impacts and attain the highest water quality achievable. Separation or relocation of CSOs is required wherever it can be achieved based on an economic and technical evaluation.

As untreated CSOs cause violations of water quality standards, and thus are in violation of NPDES permits, all of the state’s CSO permittees are under enforcement orders to either eliminate the CSO or plan, design, and construct CSO abatement facilities. Each long-term control plan must identify and achieve the highest feasible level of control. The process also requires the permittee to comply with any approved TMDL.

Presently, there are 27 active CSO’s in Buzzards Bay Watershed (down from 41 in 1989), all of them concentrated in the City of New Bedford In the Lower Acushnet River and the Inner New

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[1] DEP's 1990 CSO Policy was based on EPA's 1989 CSO Control Policy and established the goal of eliminating adverse impacts from CSOs, using partial use designation where removal or relocation was not feasible. The three month design storm was identified as the minimum technology-based effluent limitation, which would result in untreated overflows an average of four times a year. Abatement measures to meet these minimum standards were necessary for a CSO discharge to be eligible for partial use designation. Presumably, all CSOs exceeding this standard required downgrading to Class C or SC status. No partial use designations or downgrades to Class C were actually made, but the process was perceived as administratively cumbersome.

Bedford Harbor area. The City of New Bedford completed long-term CSO control plans in 1990, and has been actively working since that time to carry out those plans.

10.3 Additional Tools to Address Failed Septic Systems:

Septic System Regulations (Title 5): The MassDEP has regulations in place that require minimum standards for the design of individual septic systems. Those regulations ensure, in part, protection for nearby surface and groundwaters from bacterial contamination. The regulations also provide minimum standards for replacing failed and inadequate systems. The Department has established a mandatory requirement that all septic systems must be inspected and upgraded to meet Title 5 requirements at the time of sale or transfer of the each property.

10.4 Additional Tools to Address Stormwater:

Stormwater is regulated through both federal and state programs. Those programs include, but are not limited to, the federal and state Phase I and Phase II NPDES stormwater program, and, at the state level, the Wetlands Protection Act MGL Chapter 130, Section 40, the state water quality standards, and the various permitting programs previously identified.

Federal Phase 1 & 2 Stormwater Regulations: Existing stormwater discharges are regulated under the federal and state Phase 1 and Phase II stormwater program. In MA there are two Phase 1 communities, Boston and Worcester. Both communities have been issued individual permits to address storm water discharges. In addition, 237 communities in MA are covered by Phase II. Phase II is intended to further reduce adverse impacts to water quality and aquatic habitat by instituting use controls on the unregulated sources of stormwater discharges that have the greatest likelihood of causing continued environmental degradation including those from municipal separate storm sewer systems (MS4s) and discharges from construction activity.

The Phase II Final Rule, published in the Federal Register on December 8, 1999, requires permittees to determine whether or not stormwater discharges from any part of the MS4 contribute, either directly or indirectly, to a 303(d) listed waterbody. Operators of regulated MS4s are required to design stormwater management programs to 1) reduce the discharge of pollutants to the “maximum extent practicable” (MEP), 2) protect water quality, and 3) satisfy the appropriate water quality requirements of the Clean Water Act. Implementation of the MEP standard typically requires the development and implementation of BMPs and the achievement of measureable goals to satisfy each of the six minimum control measures. Those measures include 1) public outreach and education, 2) public participation, 3) illicit discharge detection and elimination, 4) construction site runoff control, 5) post-construction runoff control, and 6) pollution prevention/good housekeeping. In addition, each permittee must determine if a TMDL has been developed and approved for any water body into which an MS4 discharges. If a TMDL has been approved then the permittee must comply with the TMDL including the application of BMPs or other performance requirements. The permittee’s must report annually on all control measures currently being implemented or planned to be implemented to control pollutants of concern identified in TMDLs. Finally, the Department has the authority to issue an individual permit to achieve water quality objectives. Links to the MA Phase II permit and other stormwater control guidance can be found at http://www.mass.gov/dep/brp/stormwtr/phiihelp.htm

A full list of Phase II communities in MA can be found at http://www.mass.gov/dep/brp/stormwtr/stormlis.htm

In addition to the Phase I and II programs described above the Massachusetts Department of Environmental Protection's proposed new "Stormwater Management Regulations," that would establish a statewide general permit program aimed at controlling the discharge of stormwater runoff from certain privately-owned sites containing large impervious surfaces.

The proposed regulations would require private owners of land containing five or more acres of impervious surfaces to apply for and obtain coverage under a general permit; implement nonstructural best management practices (BMPs) for managing stormwater; install low impact development (LID) techniques and structural stormwater BMPs at sites undergoing development or redevelopment; and submit annual compliance certifications to the Department. Any new construction will have to comply with state stormwater standards and permits and with the antidegradation requirements of the state water quality standards.

Where the Department has determined that stormwater runoff is causing or contributing to violations of the Massachusetts Surface Water Quality Standards, the proposed regulations would allow MassDEP to impose the same requirements on certain private owners of land with less than five acres of impervious surfaces and require the owners of such land to design and implement the LID techniques and stormwater BMPs needed to address these violations.

The DEP Wetlands regulations (310 CMR 10.0) direct issuing authorities to enforce the DEP Stormwater Management Policy, place conditions on the quantity and quality of point source discharges, and to control erosion and sedimentation. The Stormwater Management Policy was issued under the authority of the 310 CMR 10.0. The policy and its accompanying Stormwater Performance Standards apply to new and redevelopment projects where there may be an alteration to a wetland resource area or within 100 feet of a wetland resource (buffer zone). The policy requires the application of structural and/or non-structural BMPs to control suspended solids, which have associated co-benefits for bacteria removal. A stormwater handbook was developed to promote consistent interpretation of the Stormwater Management Policy and Performance Standards: Volume 1: Stormwater Policy Handbook and Volume 2: Stormwater Technical Handbook can be found along with the Stormwater Policy at http://www.mass.gov/dep/water/wastewater/stormwat.htm

In addition to the above, the Massachusetts Department of Environmental Protection's proposed new "Stormwater Management Regulations," that would establish a statewide general permit program aimed at controlling the discharge of stormwater runoff from certain privately-owned sites containing large impervious surfaces.

The proposed regulations would require private owners of land containing five or more acres of impervious surfaces to apply for and obtain coverage under a general permit; implement nonstructural best management practices (BMPs) for managing stormwater; install low impact development (LID) techniques and structural stormwater BMPs at sites undergoing development or redevelopment; and submit annual compliance certifications to the Department.

10.5 Financial Tools

Nonpoint Source Control Program: DEP has established a non-point source program and grant program to address non-point source pollution sources statewide. The Department has developed a Nonpoint Source Management Plan that sets forth an integrated strategy and identifies important programs to prevent, control, and reduce pollution from nonpoint sources and more importantly to protect and restore the quality of waters in the Commonwealth. The Clean Water Act, Section 319, specifies the contents of the management plan. The plan is an implementation strategy for BMPs with attention given to funding sources and schedules. Statewide implementation of the Management Plan is being accomplished through a wide variety of federal, state, local, and non-profit programs and partnerships. It includes partnering with the Massachusetts Coastal Zone Management on the implementation of Section 6217 program. That program outlines both short and long term strategies to address urban areas and stormwater, marinas and recreational boating, agriculture, forestry, hydromodification, and wetland restoration and assessment. The CZM 6217 program also addresses TMDLs and nitrogen sensitive embayment's and is crafted to reduce water quality impairments and restore segments not meeting state standards.

In addition, the state is partnering with the Natural Resource Conservation Service (NRCS) to provide implementation incentives through the national Farm Bill. As a result of this effort, NRCS now prioritizes its Environmental Quality Incentive Program (EQIP) funds based on DEP's list of impaired waters. The program also provides high priority points to those projects designed to address TMDL recommendations. Over the last several years EQIP funds have been used throughout the Commonwealth to address water quality goals through the application of structural and non-structural BMPs.

MA, in conjunction with EPA, also provides a grant program to implement nonpoint source BMPs that address water quality goals. The section 319 funding provided by EPA is used to apply needed implementation measures and provide high priority points for projects that are designed to address 303d listed waters and to implement TMDLs. MassDEP has funded numerous projects through 319 that were designed to address stormwater and bacteria related impairments. On an average about 75% of all projects funded since 2002 were designed to address bacteria related impairments.

The 319 program also provides additional assistance in the form of guidance. The Department is in the process of updating the Massachusetts' Nonpoint Source Management Manual that will provide detailed guidance in the form of BMPs by landuse to address various water quality impairments and associated pollutants.

Finally, it should be noted that the approach and process outlined for implementing this TMDL has been previously demonstrated with documented success. A previous TMDL, which utilized this approach was developed and approved by EPA for the Neponset River Watershed. The recommendations outlined in that TMDL were similar to the current proposal. Since the time of approval, MADEP worked closely with a local watershed group (Neponset River Watershed Association) to develop a 319 project to implement the recommendations of the TMDL. The total project cost was approximately $472,000 of which $283,000 was provided through federal 319 funds and the additional 40% provided by the watershed association and two local communities.

Other examples include the Little Harbor in Cohasset and the Shawsheen River. Similar TMDLs were developed in these areas. In Little Harbor, the TMDL was used as the primary tool to obtain local approval and funding to design and install sewers around Little Harbor and other additional areas of Town impacted by sewerage contamination. Presently, the Town is seeking additional state funding to construct the sewers. In the Shawsheen Watershed the TMDL was used to obtain a state grant to identify and prioritize specific stormwater discharges for remediation. In addition, MassDEP has received a grant to a conduct additional sampling and refine field and laboratory techniques that will allow us to differentiate between human and non-human sources that will be useful statewide. MassDEP and EPA Region 1 are also working on an compliance & enforcement strategy to address the worst sources.

Additional information related to the non-point source program, including the Management Plan can be found at http://www.mass.gov/dep/brp/wm/nonpoint.htm

State Revolving Fund: The State Revolving Fund (SRF) Program provides low interest loans to eligible applicants for the abatement of water pollution problems across the Commonwealth. Since July 2002 the MassDEP has issued millions of dollars in loans for the planning and construction of CSO facilities and to address stormwater pollution. Loans have also been distributed to municipal governments statewide to upgrade and replace failed Title 5 systems. These programs all demonstrate the State's commitment to assist local governments in implementing the TMDL recommendations. Additional information about the SRF Program can be found at http://www.mass.gov/dep/water/wastewater/wastewat.htm

Bacteria Source Tracking Program: Over the last several years MassDEP has hired new regional staff and provided analytical capabilities in three regions (Northeast, Southeast, and West) to work with communities to track, identify, and eliminate bacteria sources that contribute to water quality impairments.

In summary, MassDEP's approach and existing programs set out a wide variety of tools both MassDEP and communities can use to address pathogens, based on land use and the commonality of pathogen sources (e.g., combined sewer overflows (CSOs), failing septic systems, storm water and illicit connections, pet waste, etc.) Since there are only a few categories of sources of pathogens, the necessary remedial actions to address these sources are well established. DEP's authority combined with the programs identified above provide sufficient reasonable assurance that implementation of remedial actions will take place.

11.0 Public Participation

Two public meetings were held at 3 p.m. and 7pm. at the DEP-SERO, Lakeville on 8/10/2005 to present the Bacteria TMDL and to collect public comments. The attendance list, public comments, and the MassDEP responses are attached as Appendix B.

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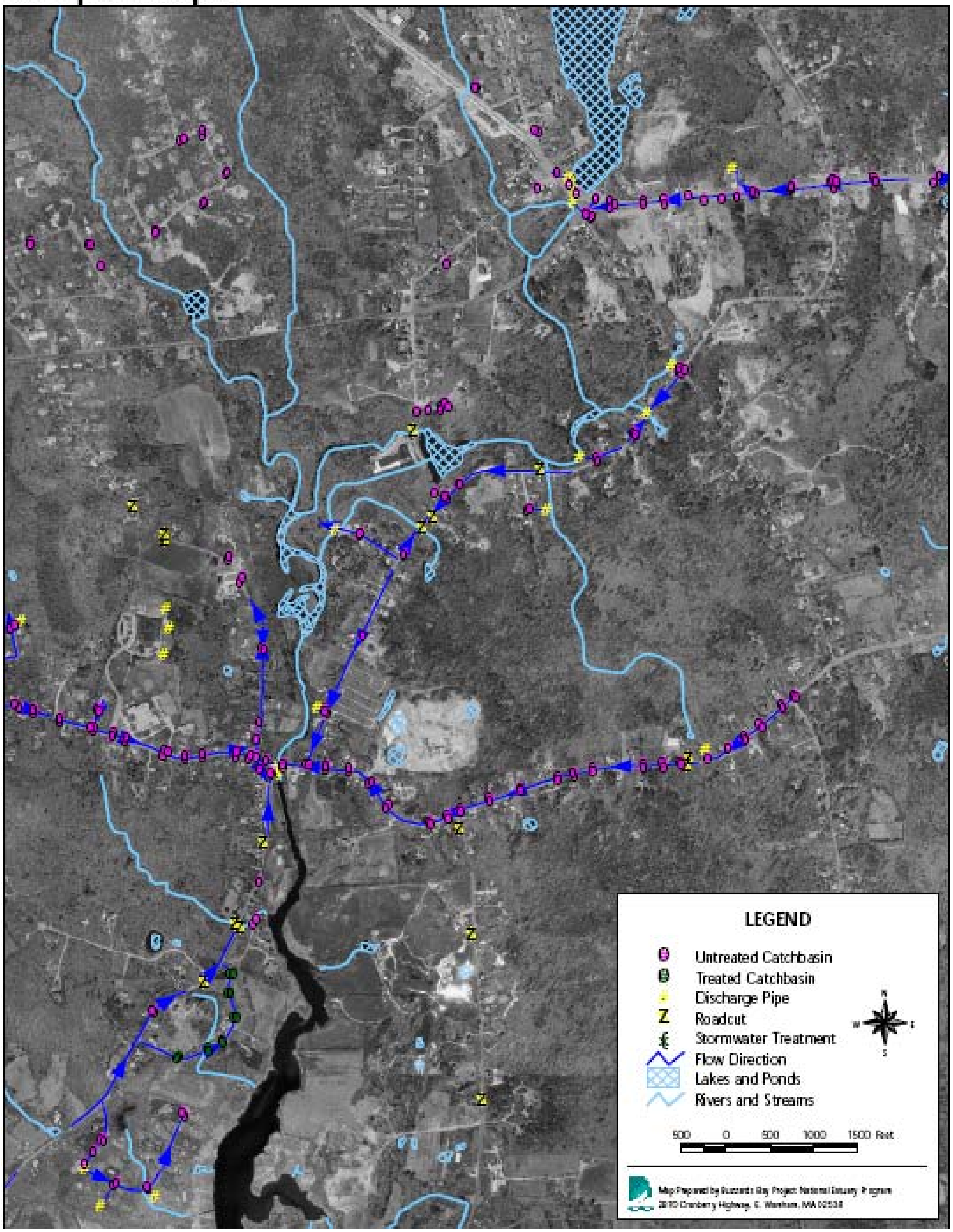
Appendix A

Atlas of Stormwater Discharges in the Buzzards Bay Watershed (MACZM 2003).

Highlight Maps Specifically Related to Bacteria Impaired Segments in This TMDL.

Also available for download at http://www.buzzardsbay.org/stormatlas.htm

Westport: Map 2



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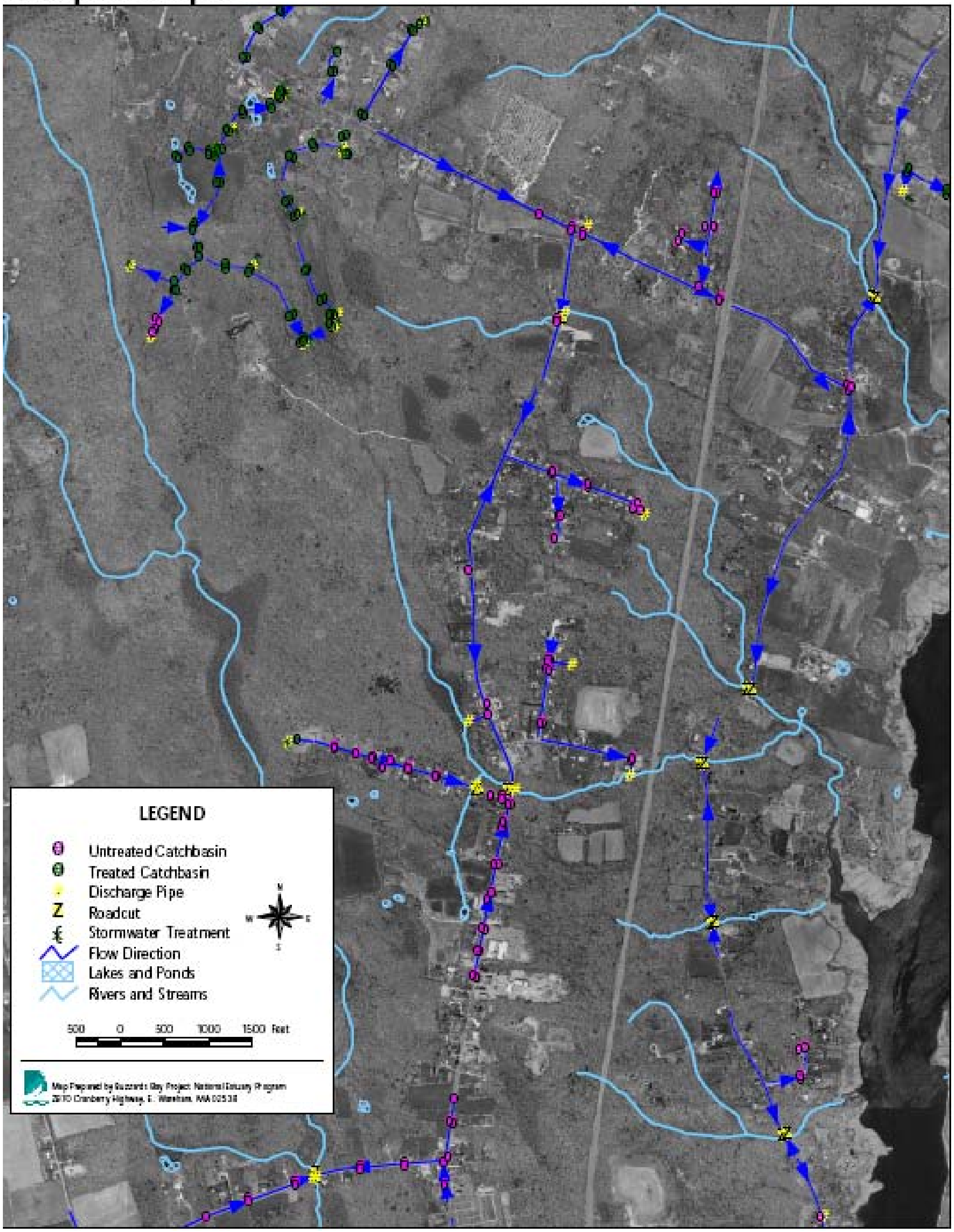

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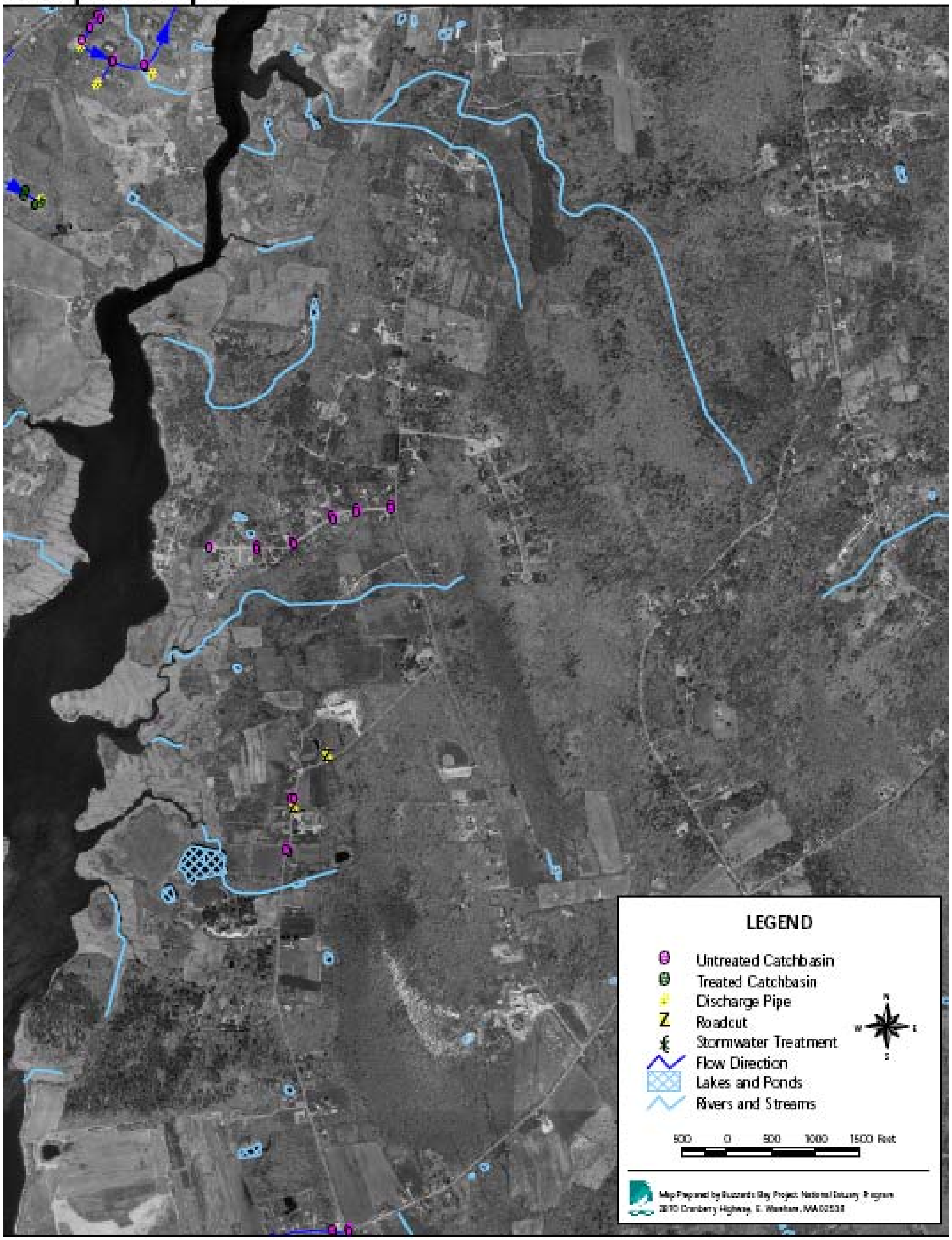

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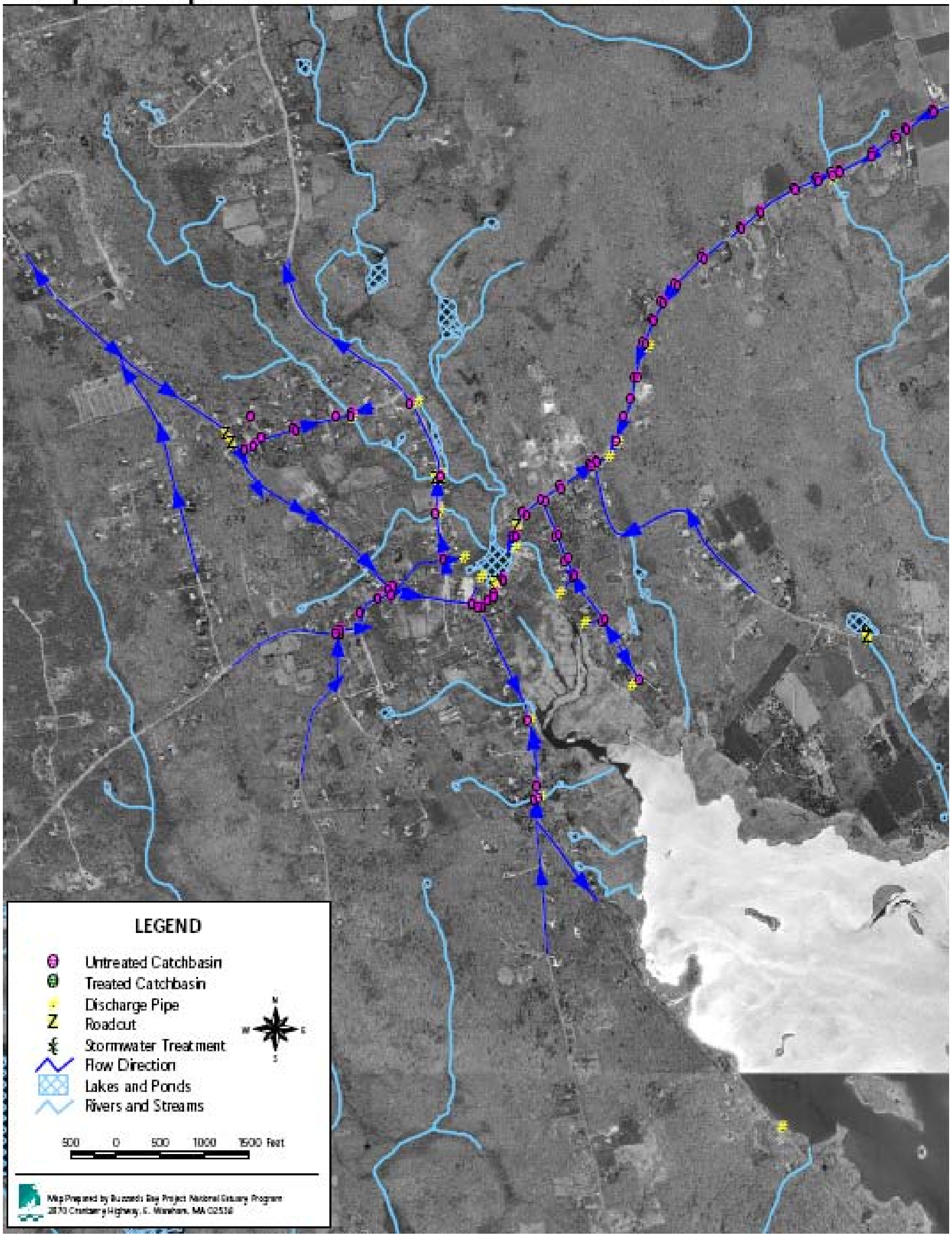

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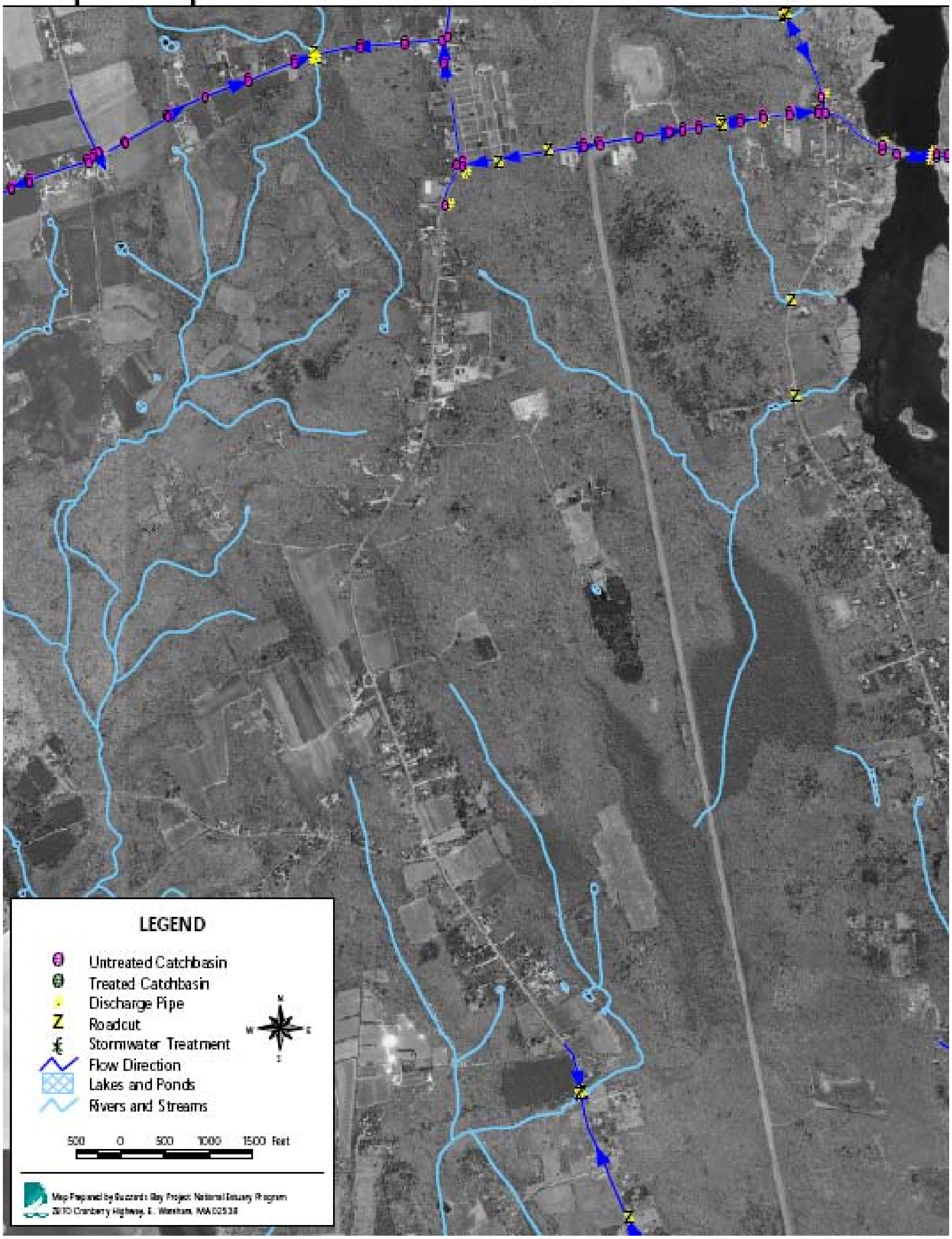

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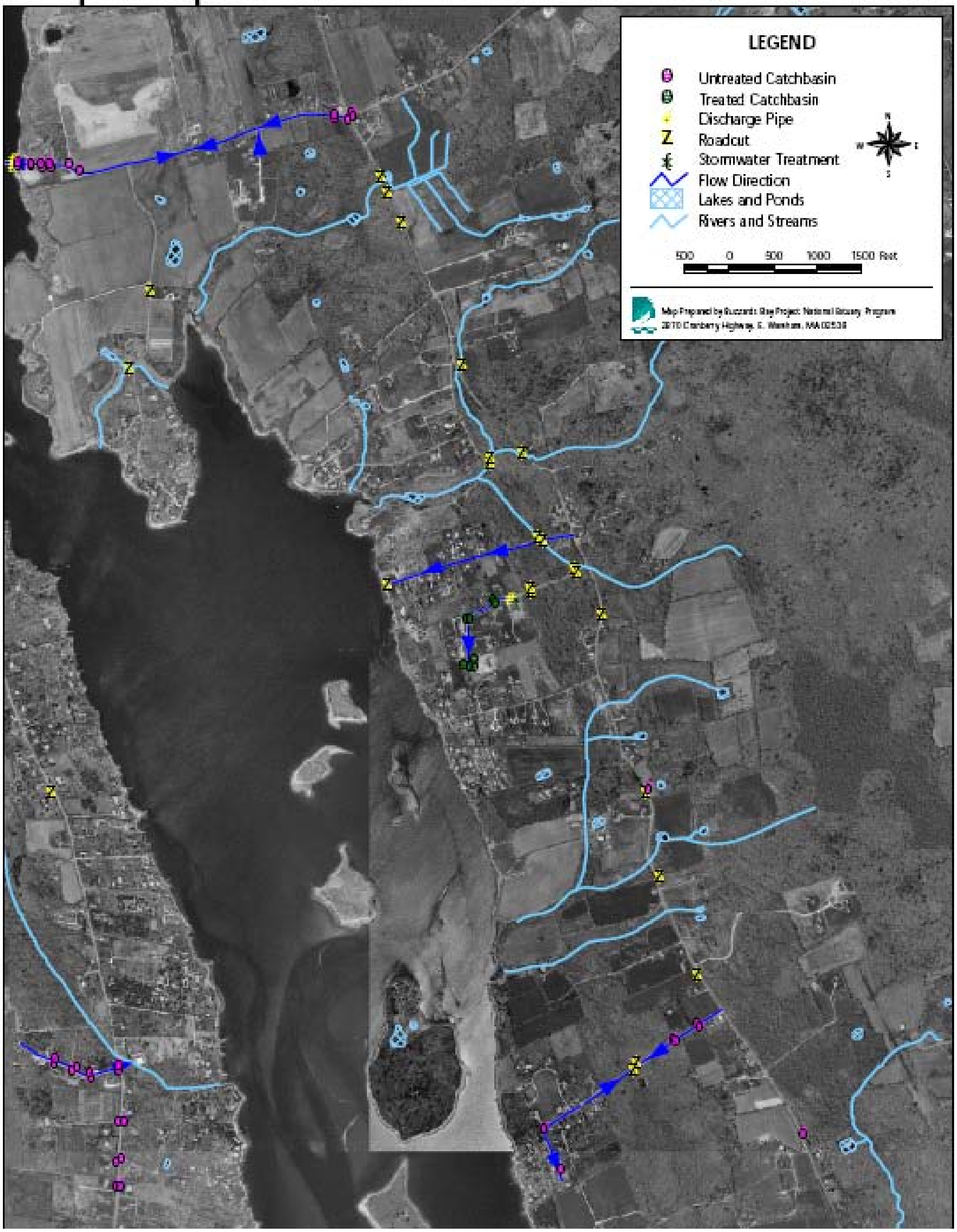

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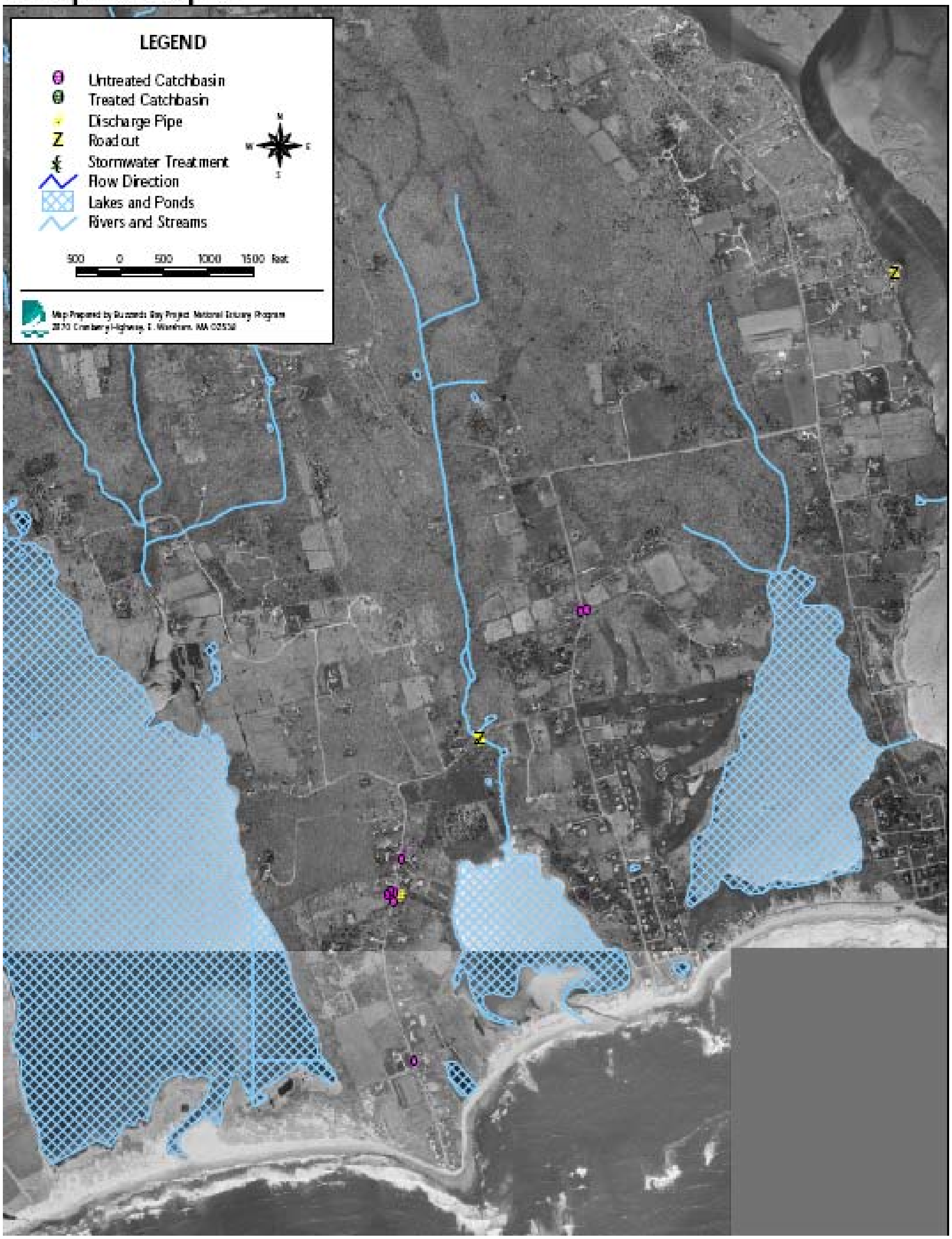

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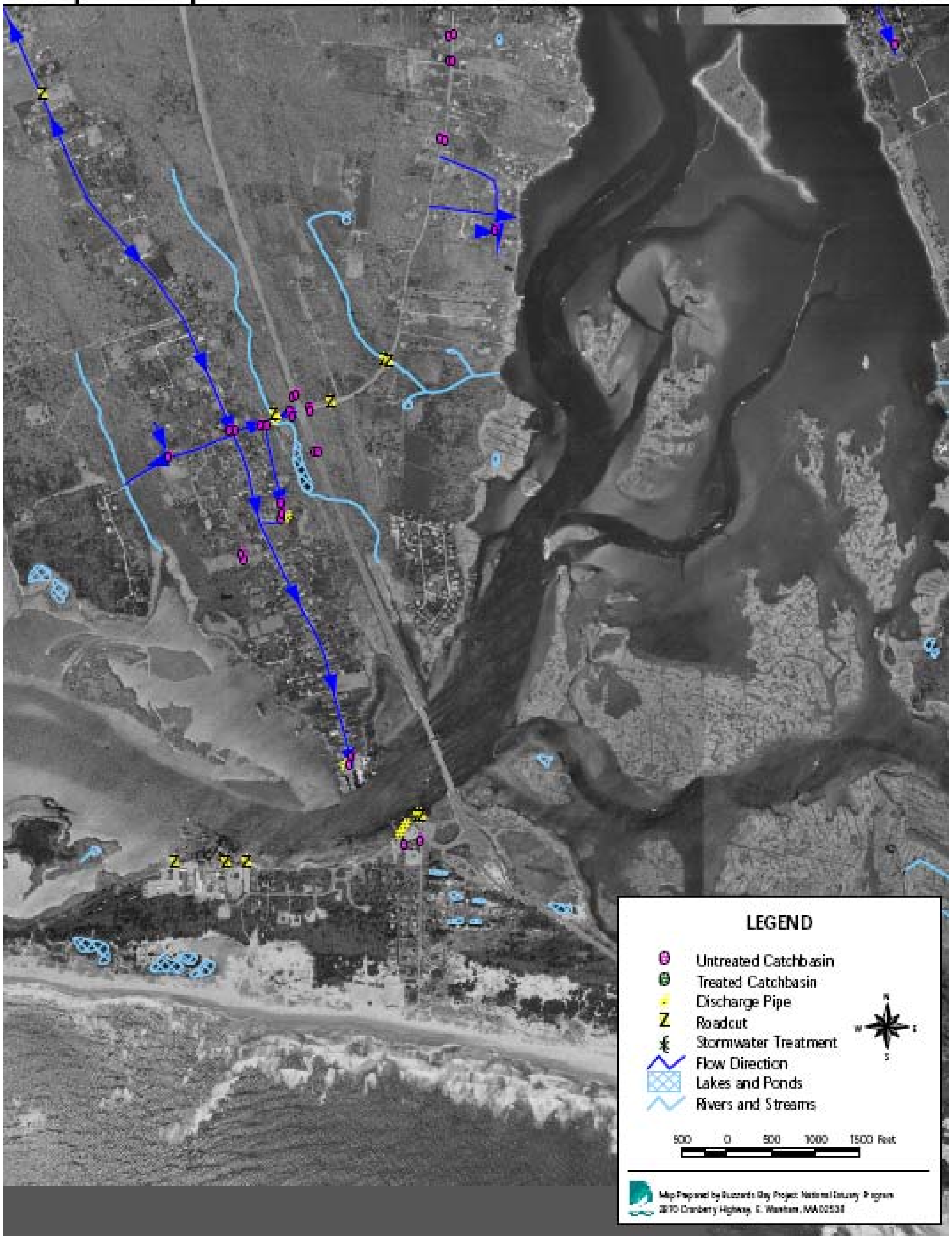
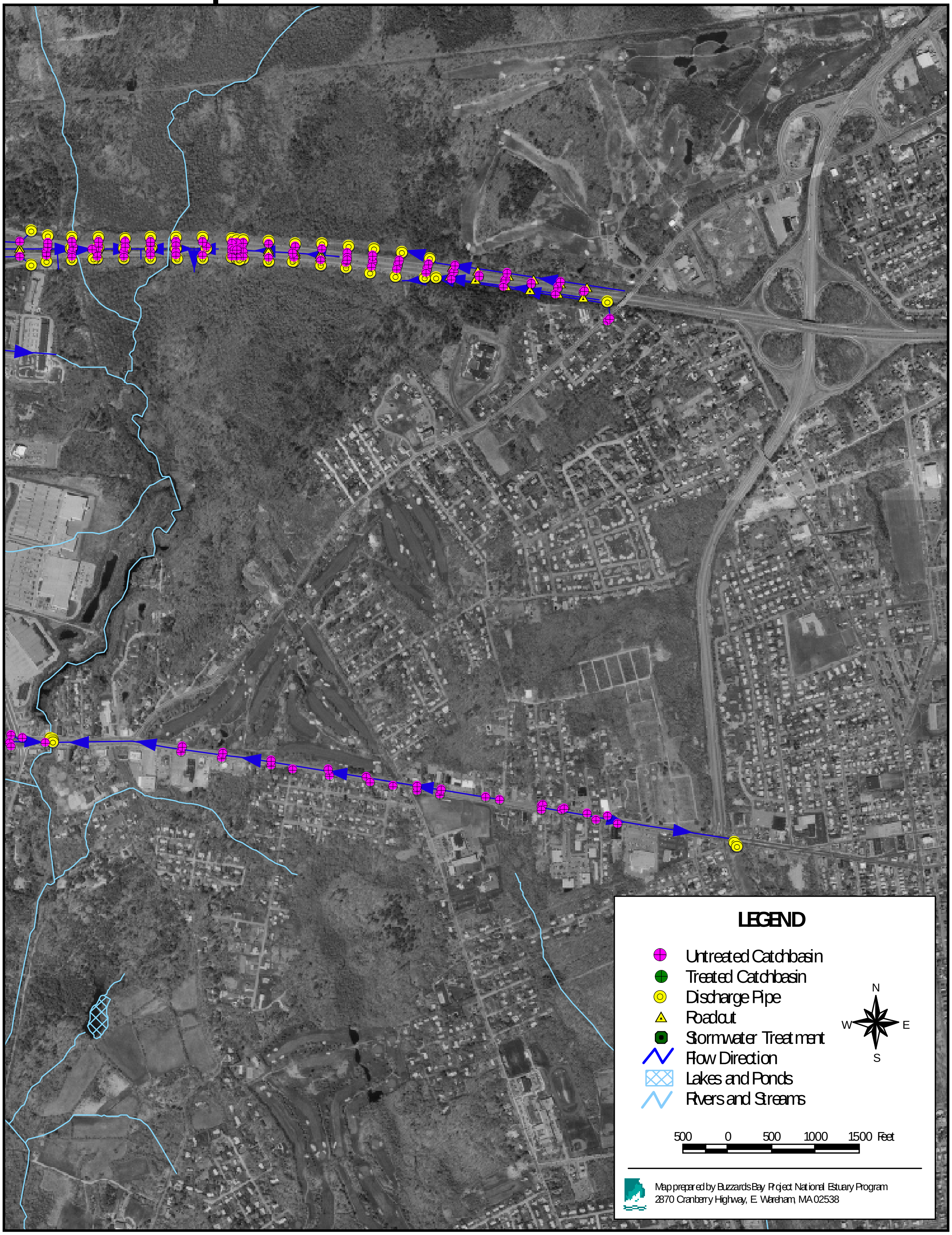


Dartmouth: Map 3



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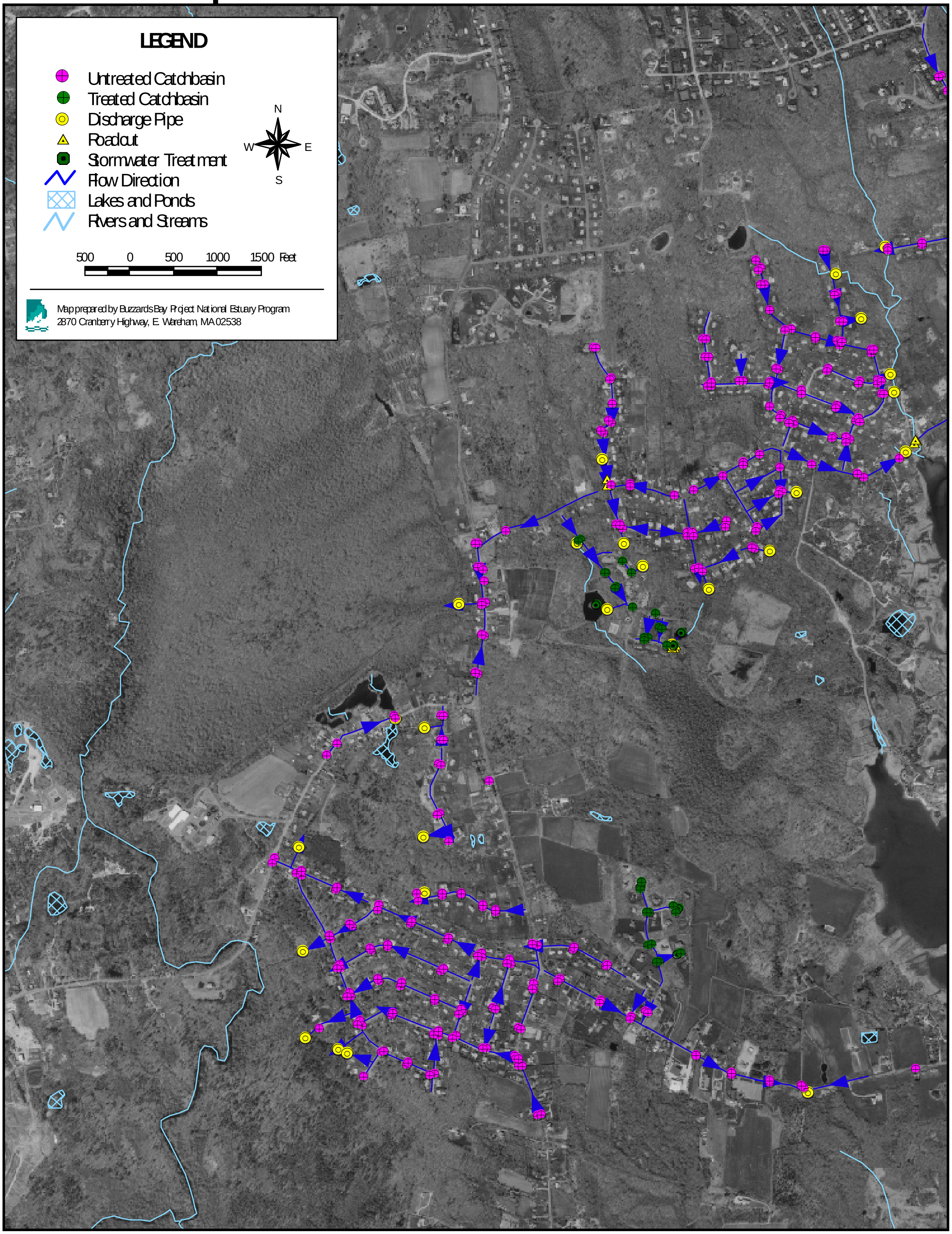

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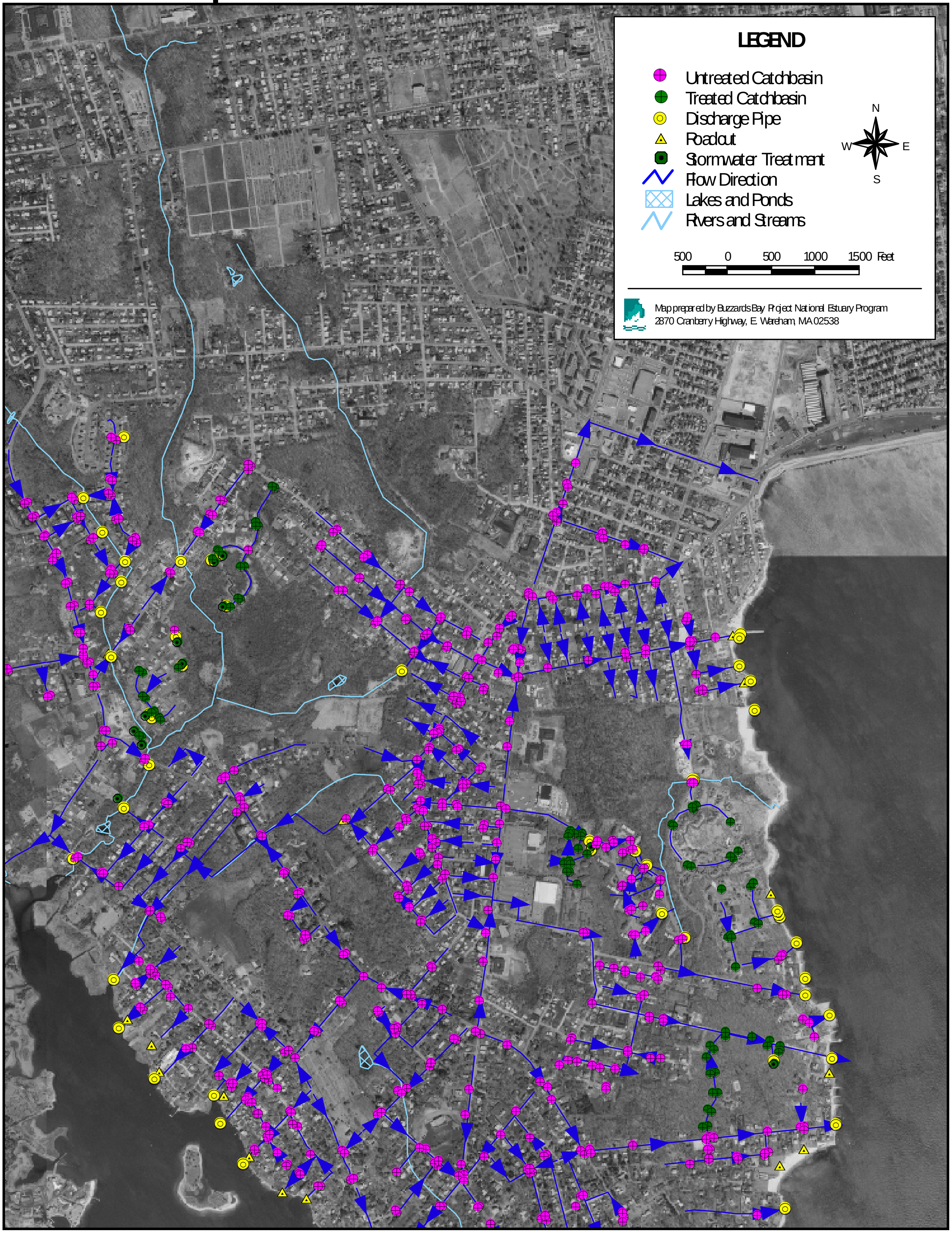

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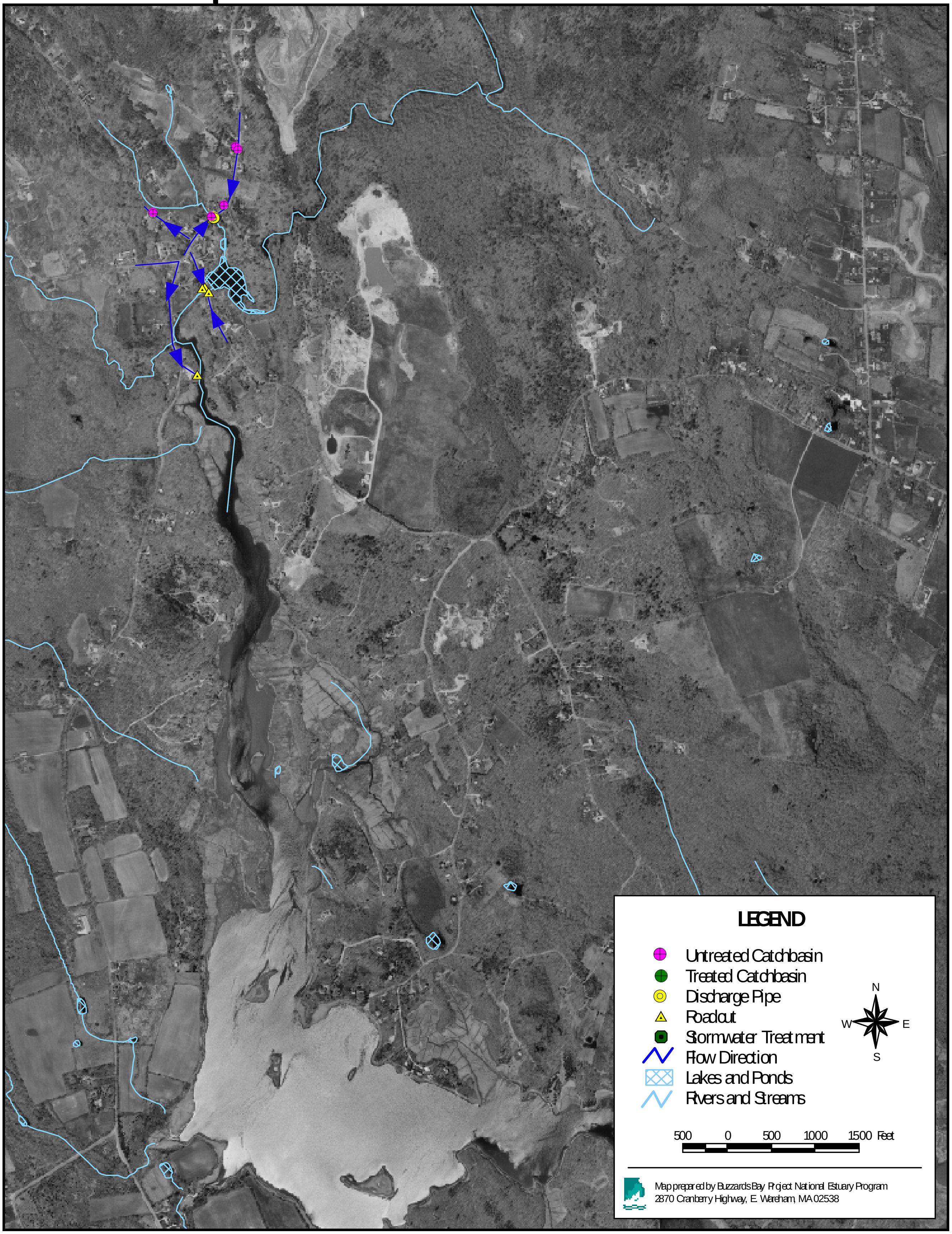

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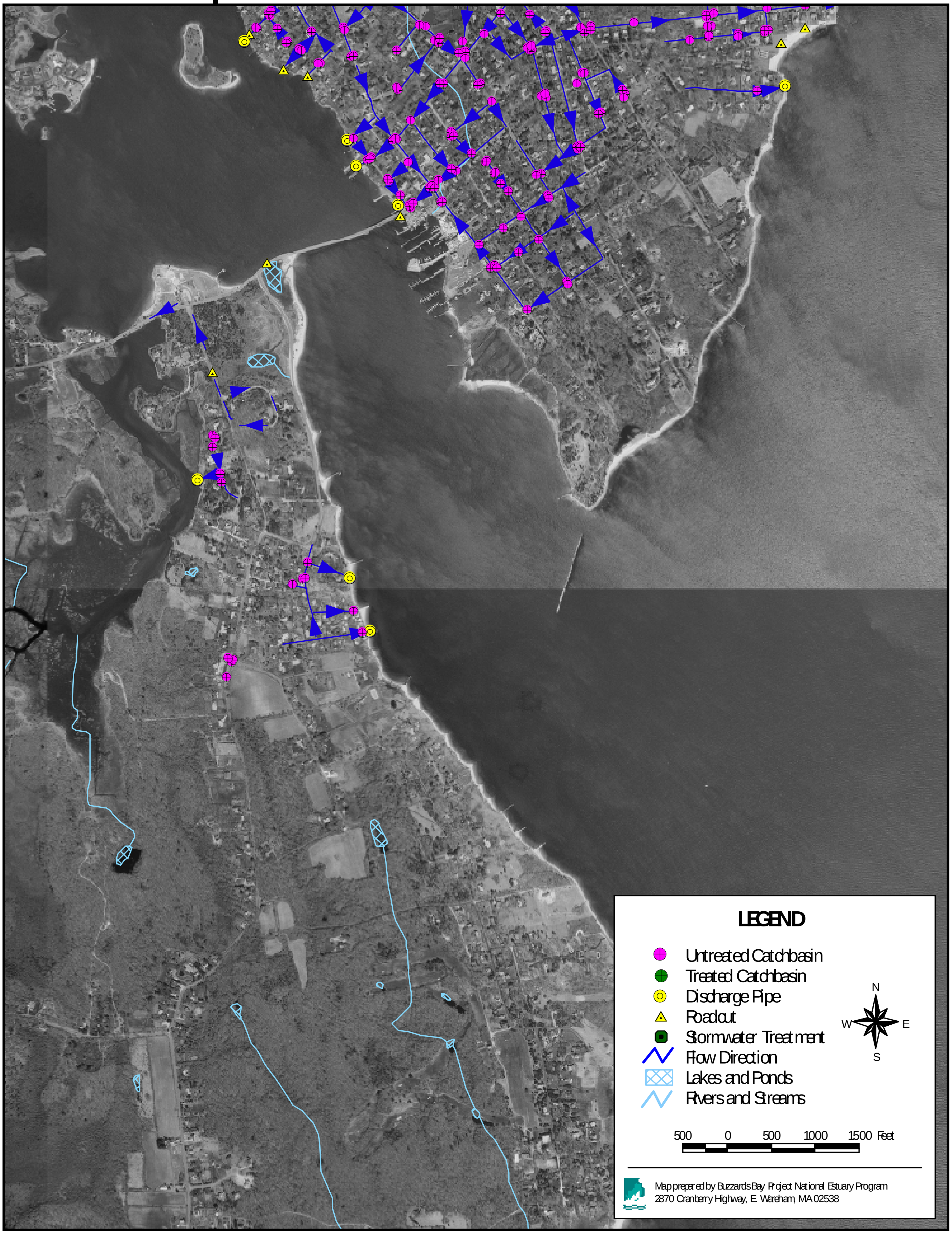
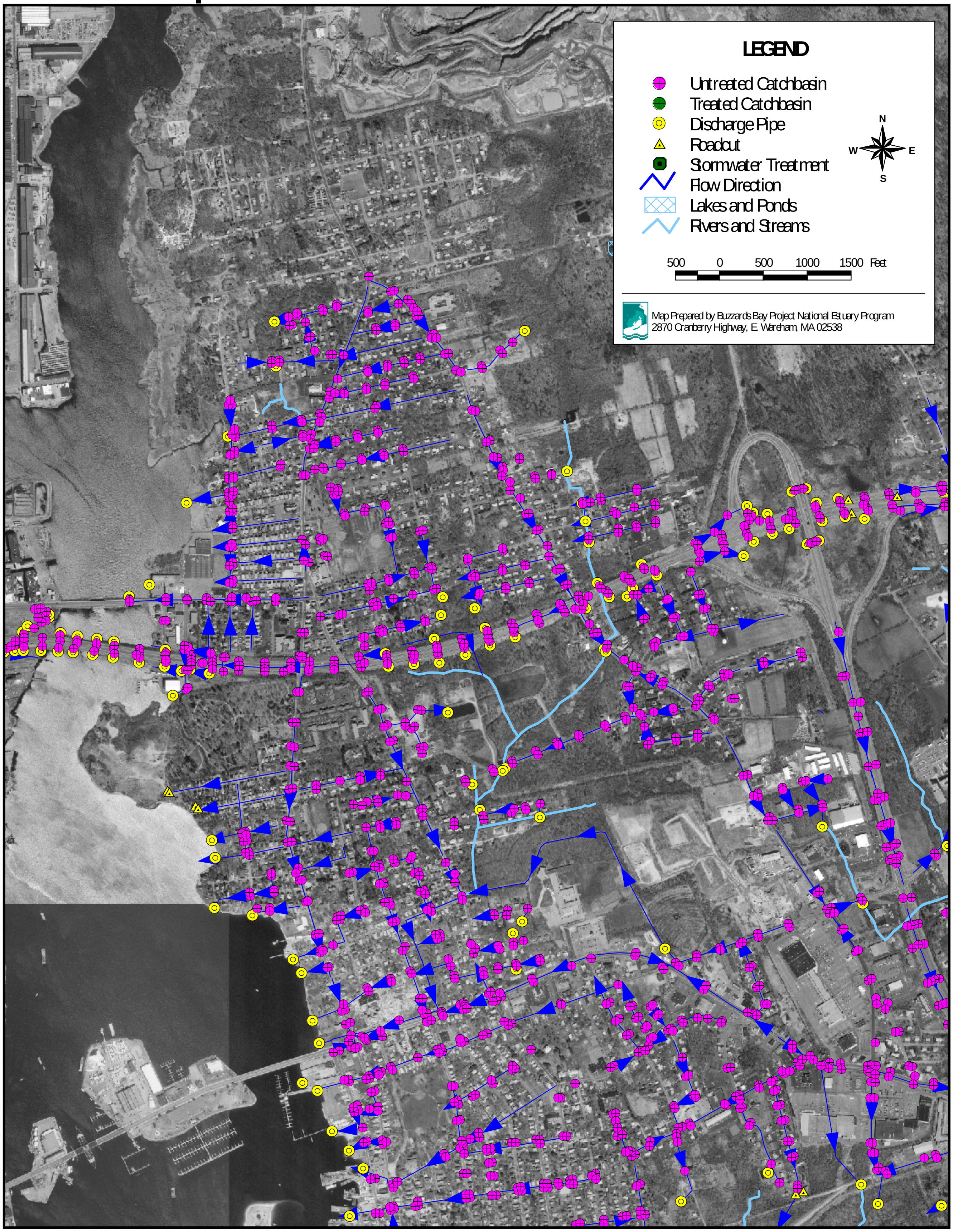


Fairhaven: Map 1



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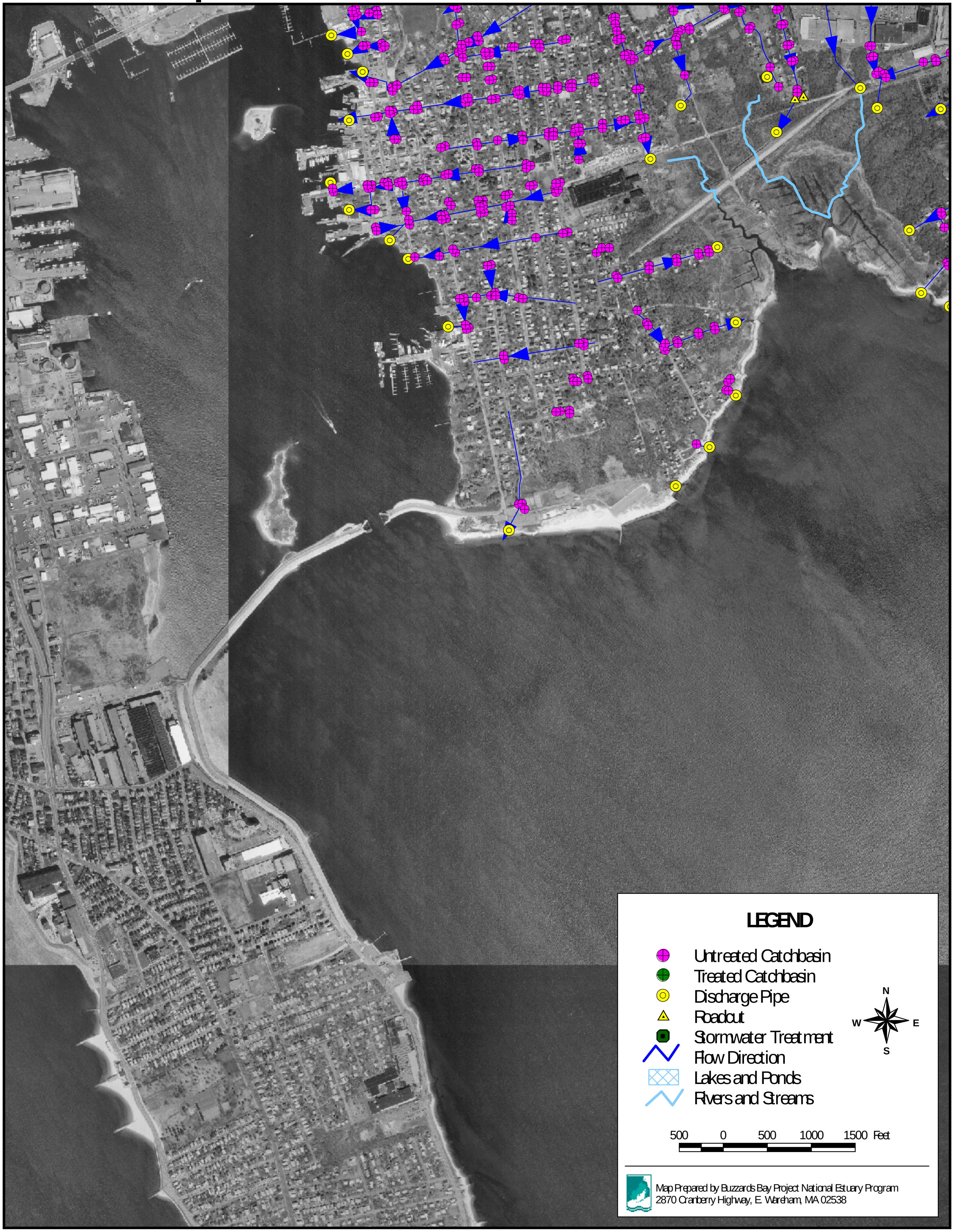
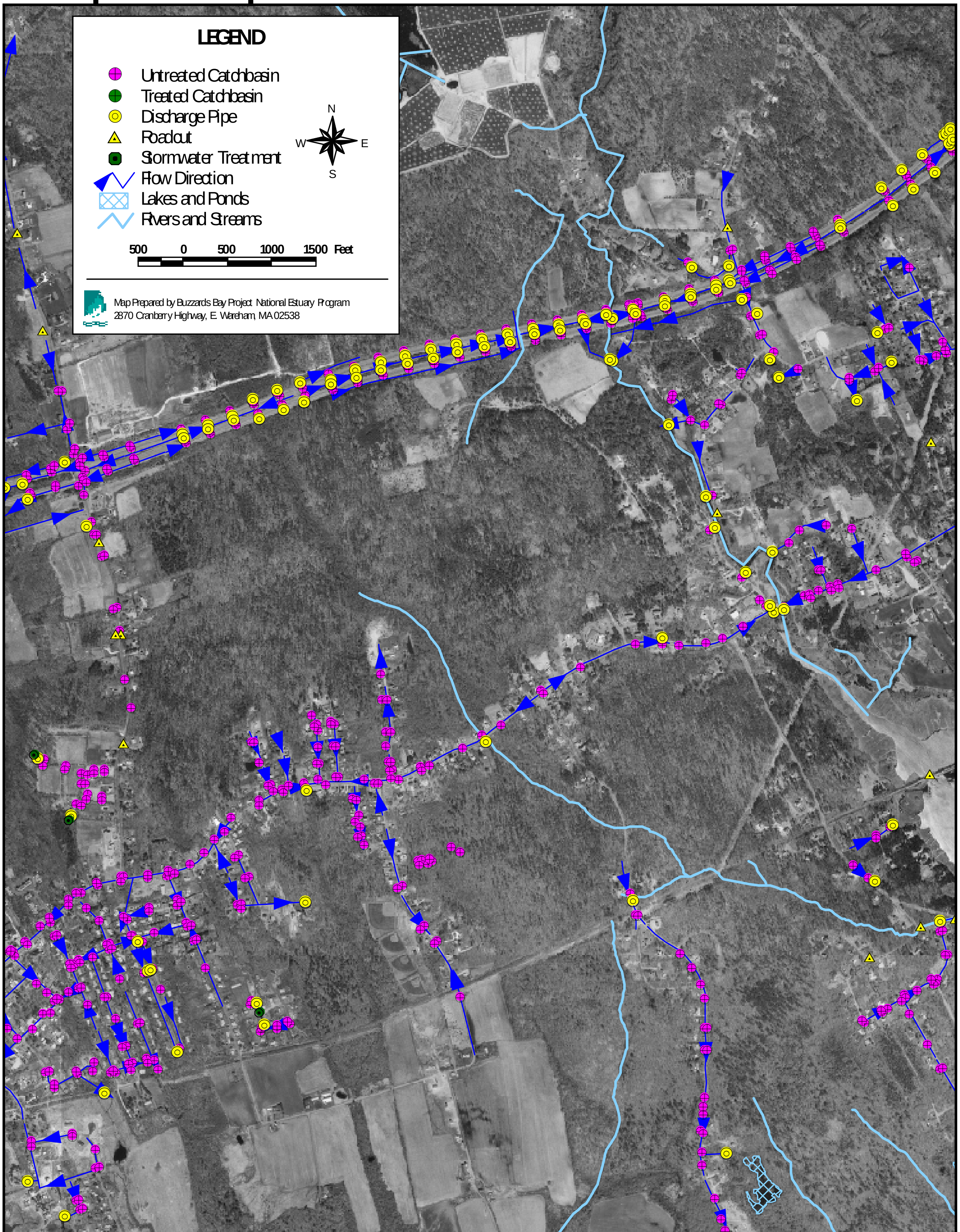


Mattapoisett: Map 3



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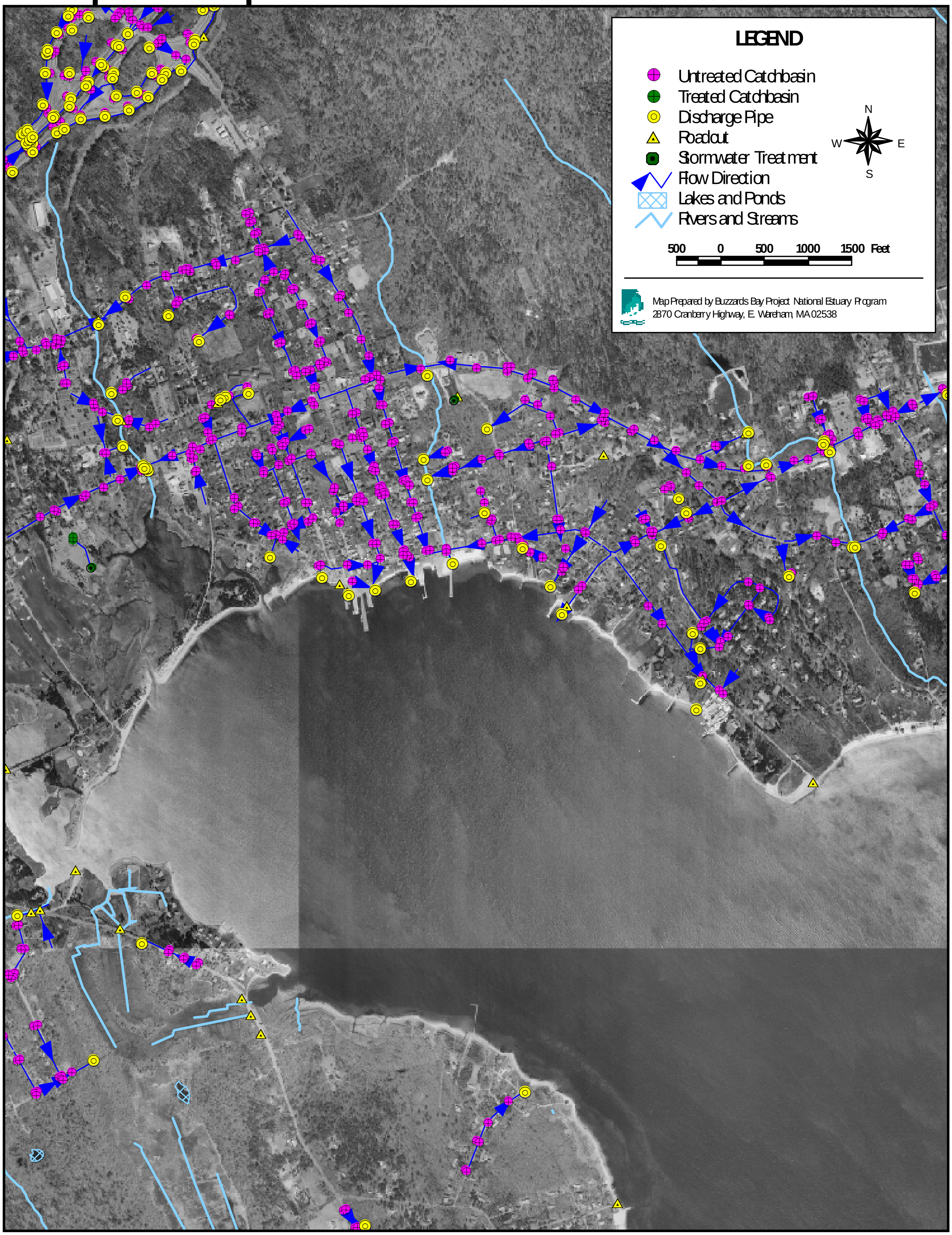
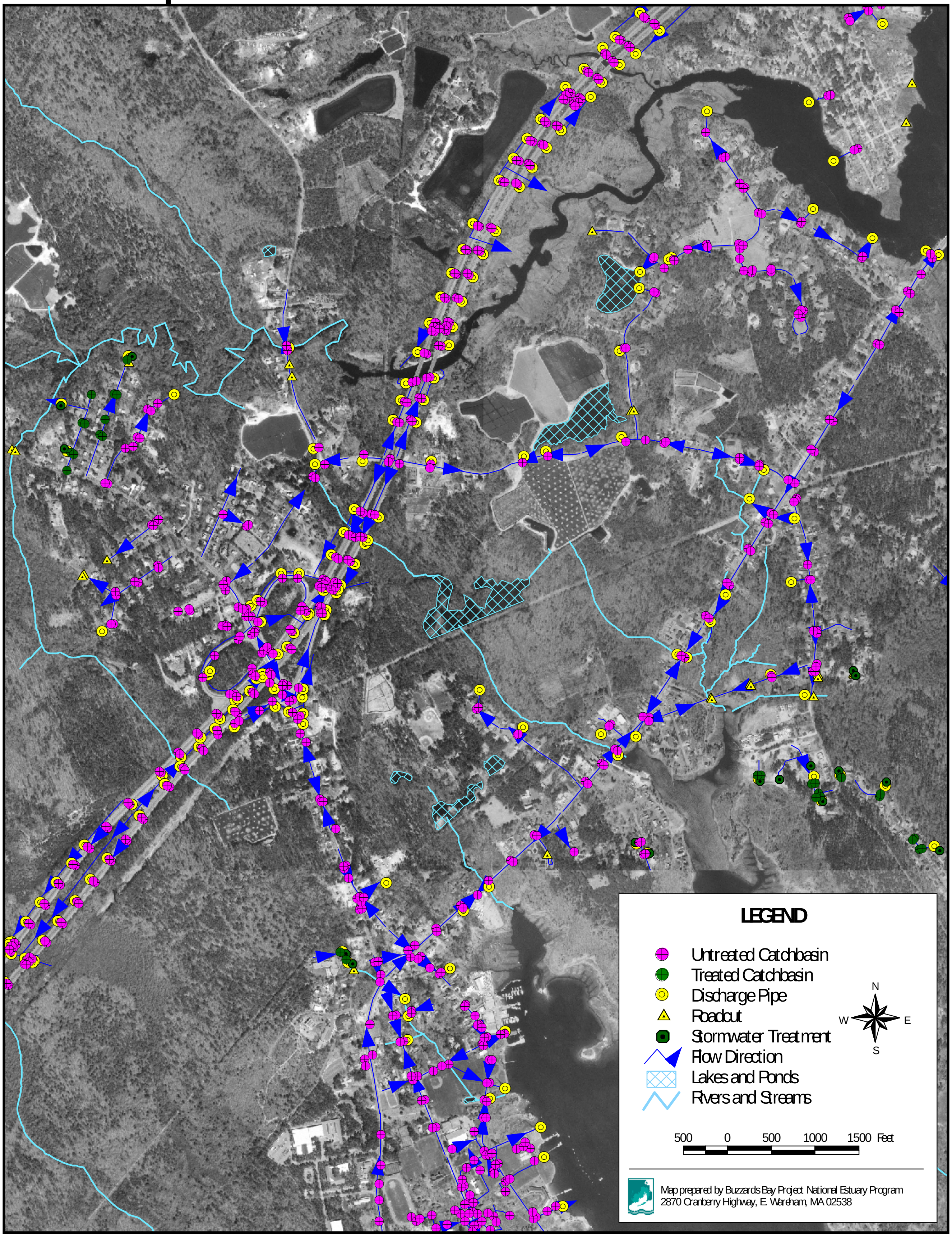


Marion: Map 2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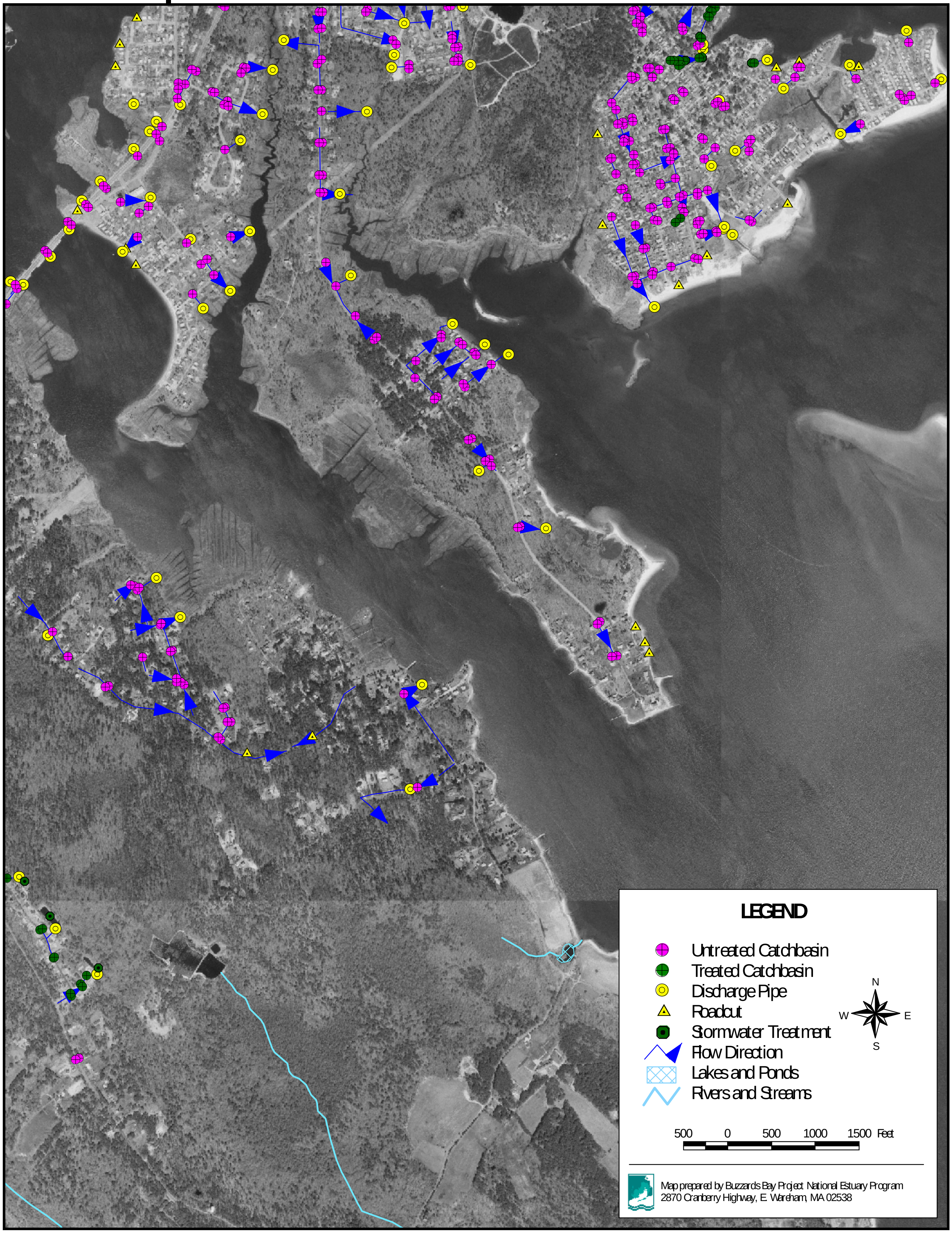

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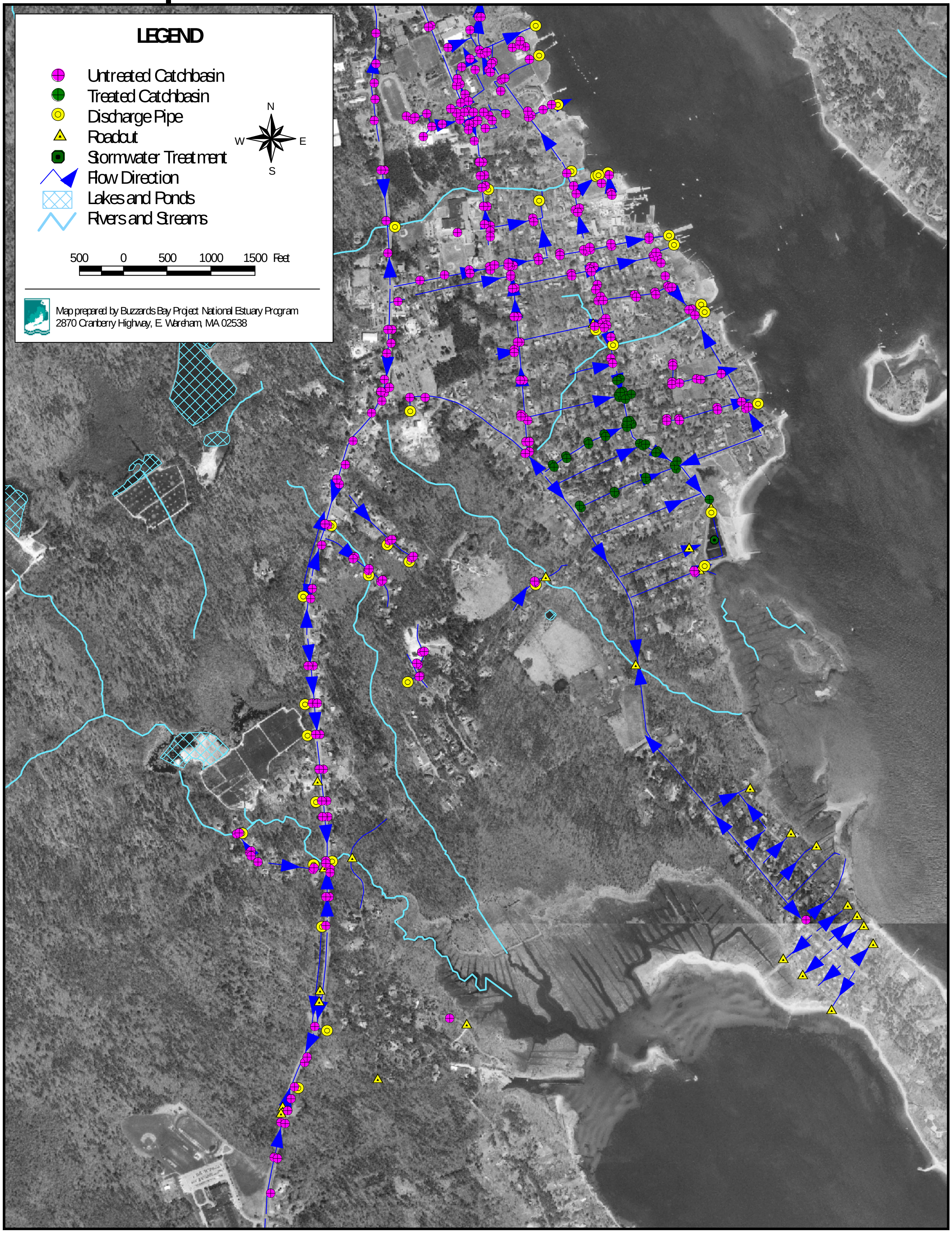

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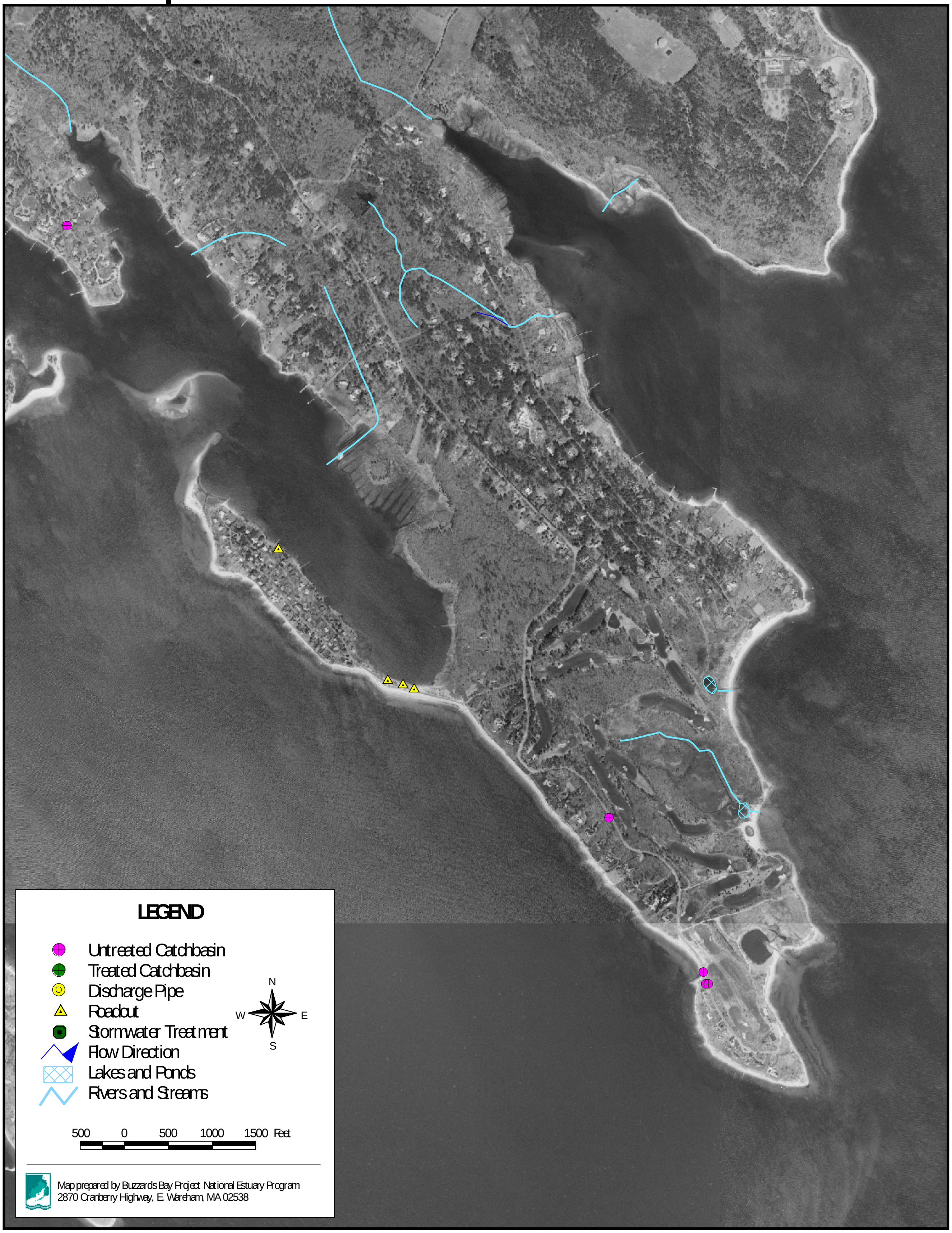
Marion: Map 5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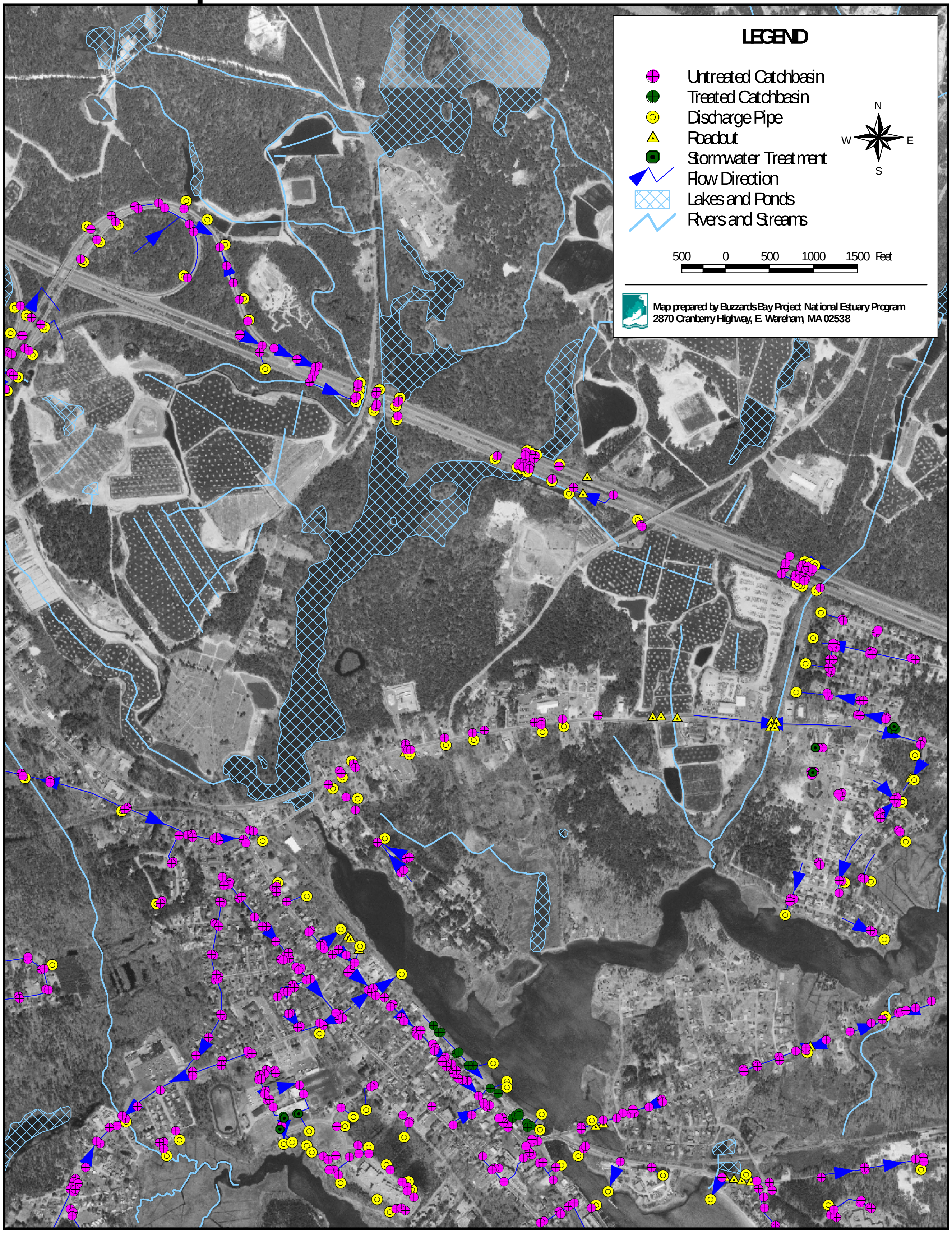
Wareham: Map 2



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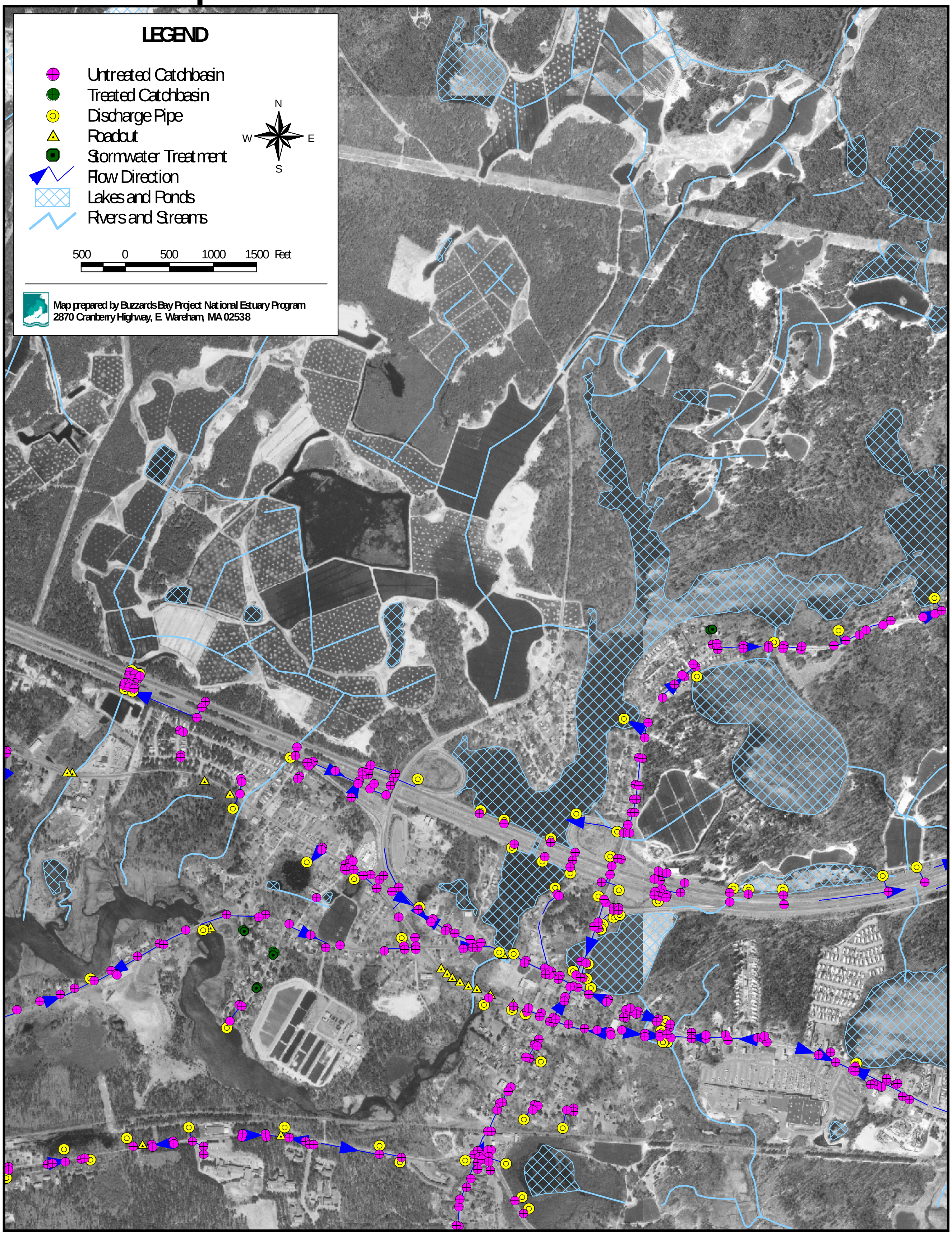

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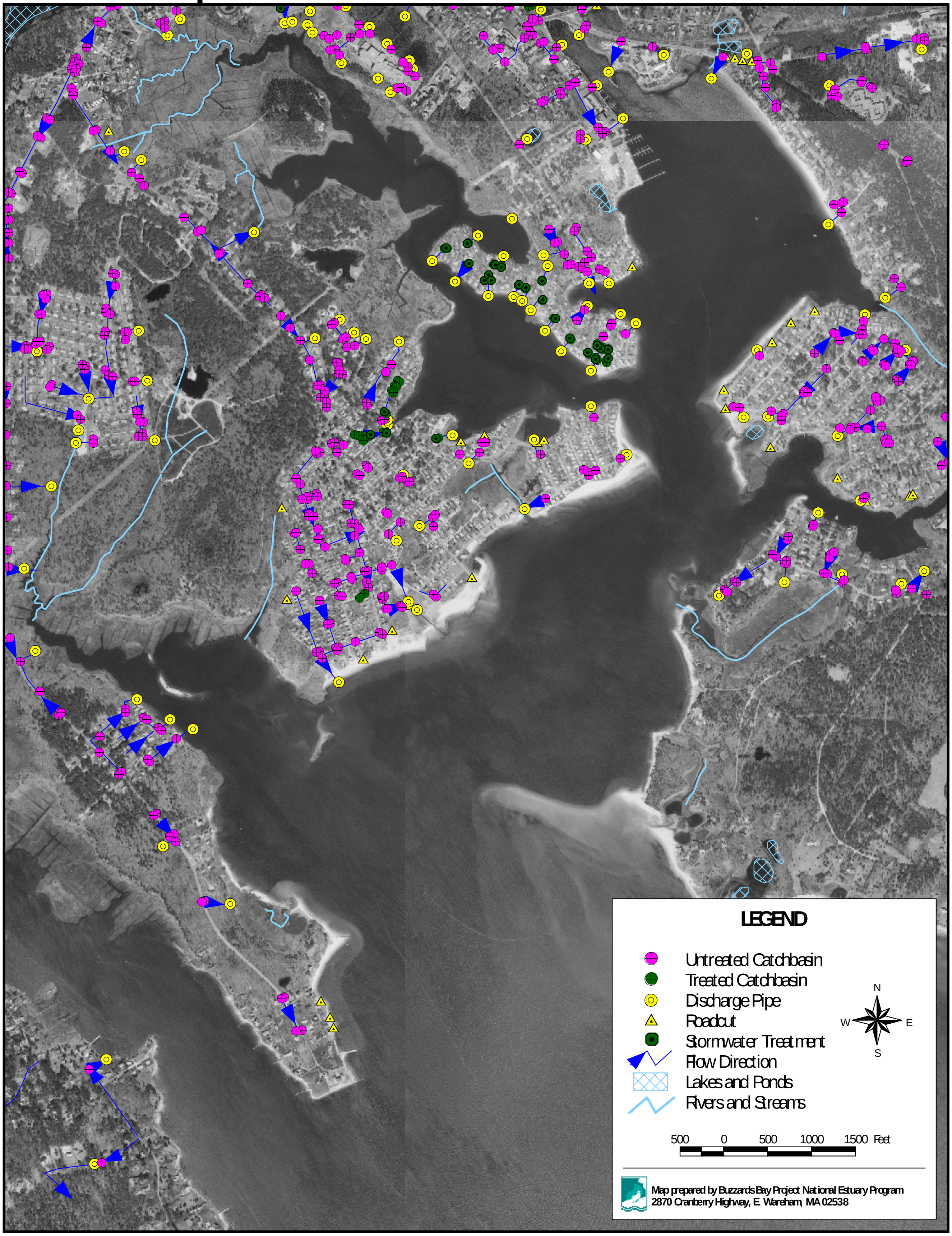

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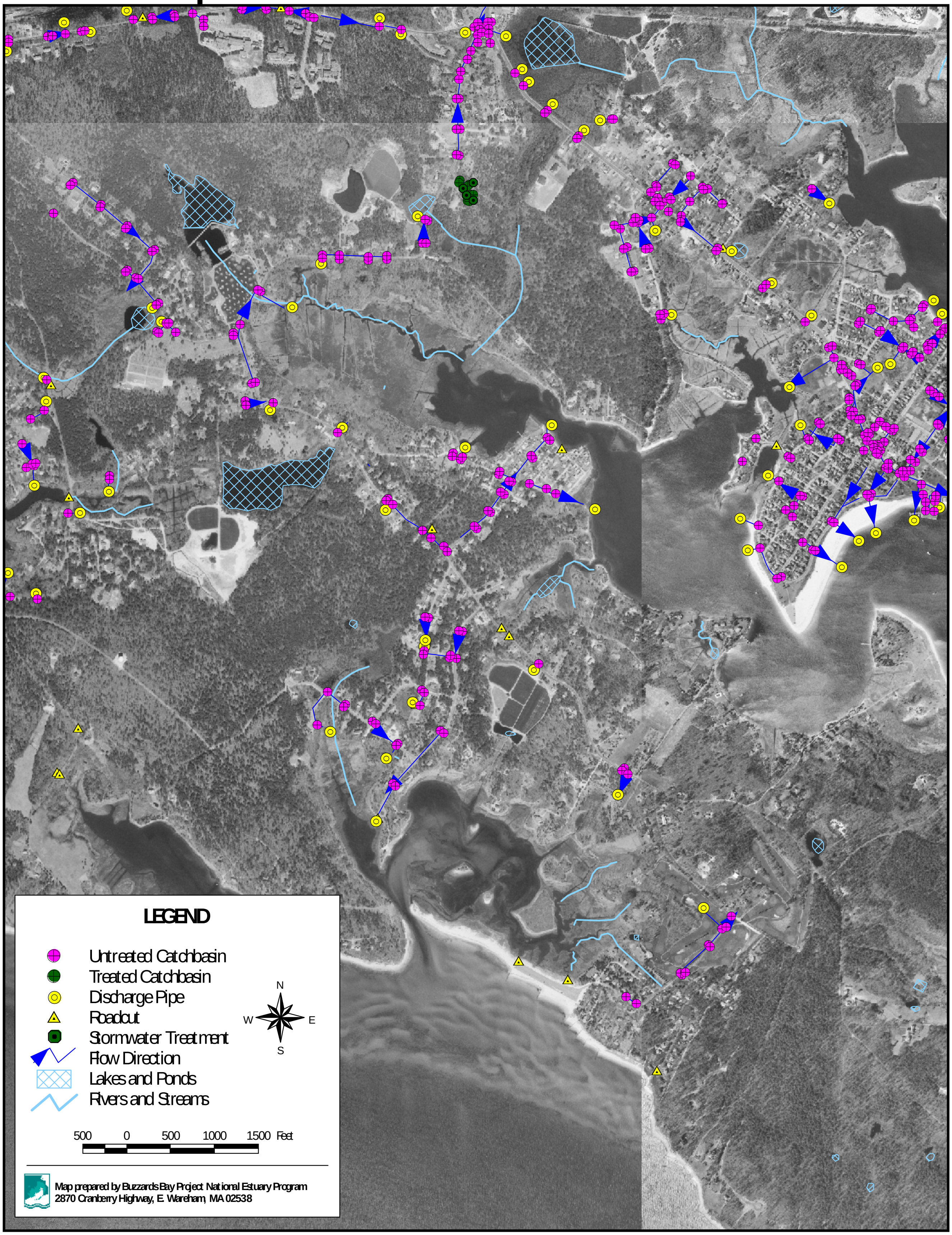
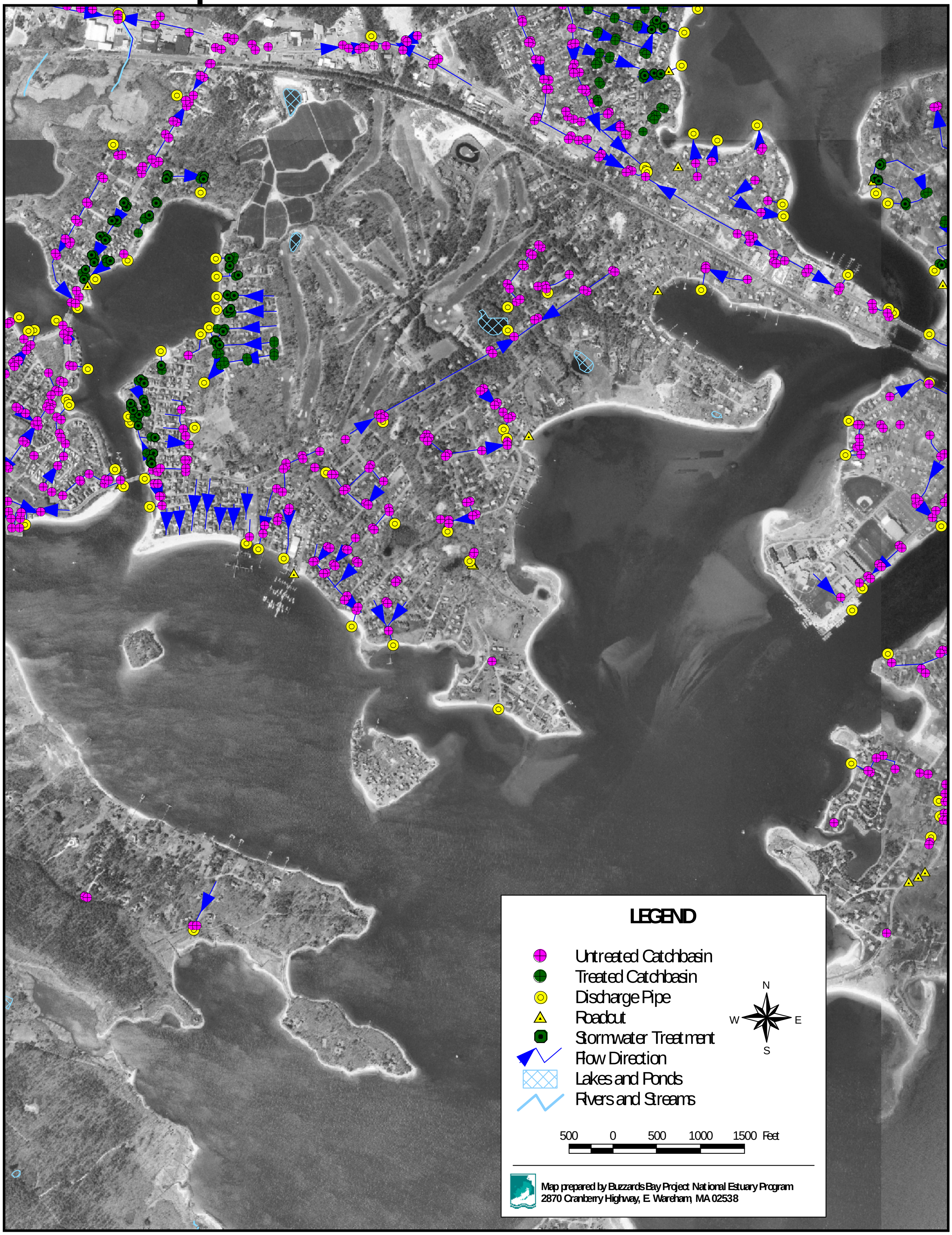
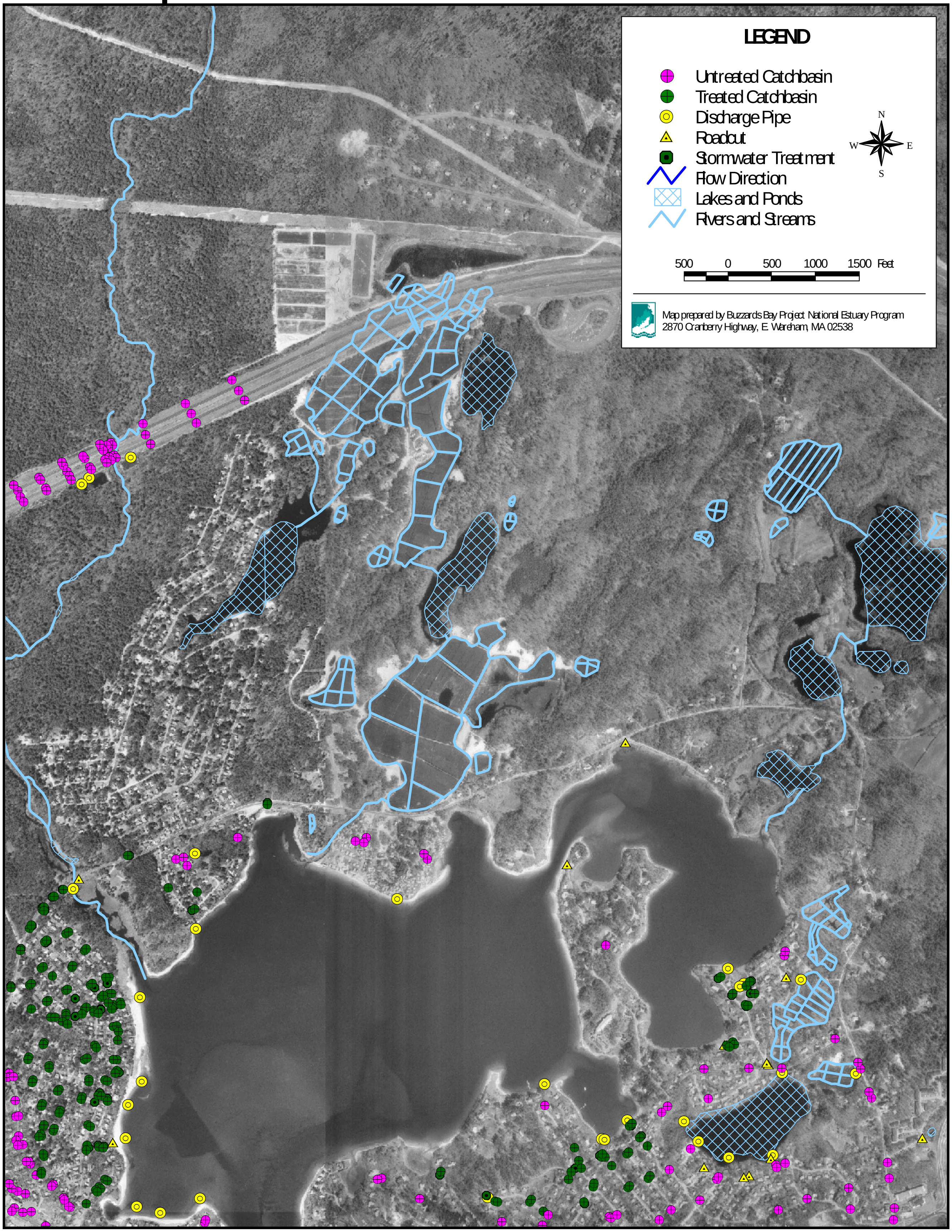


Wareham: Map 8



Bourne: Map 1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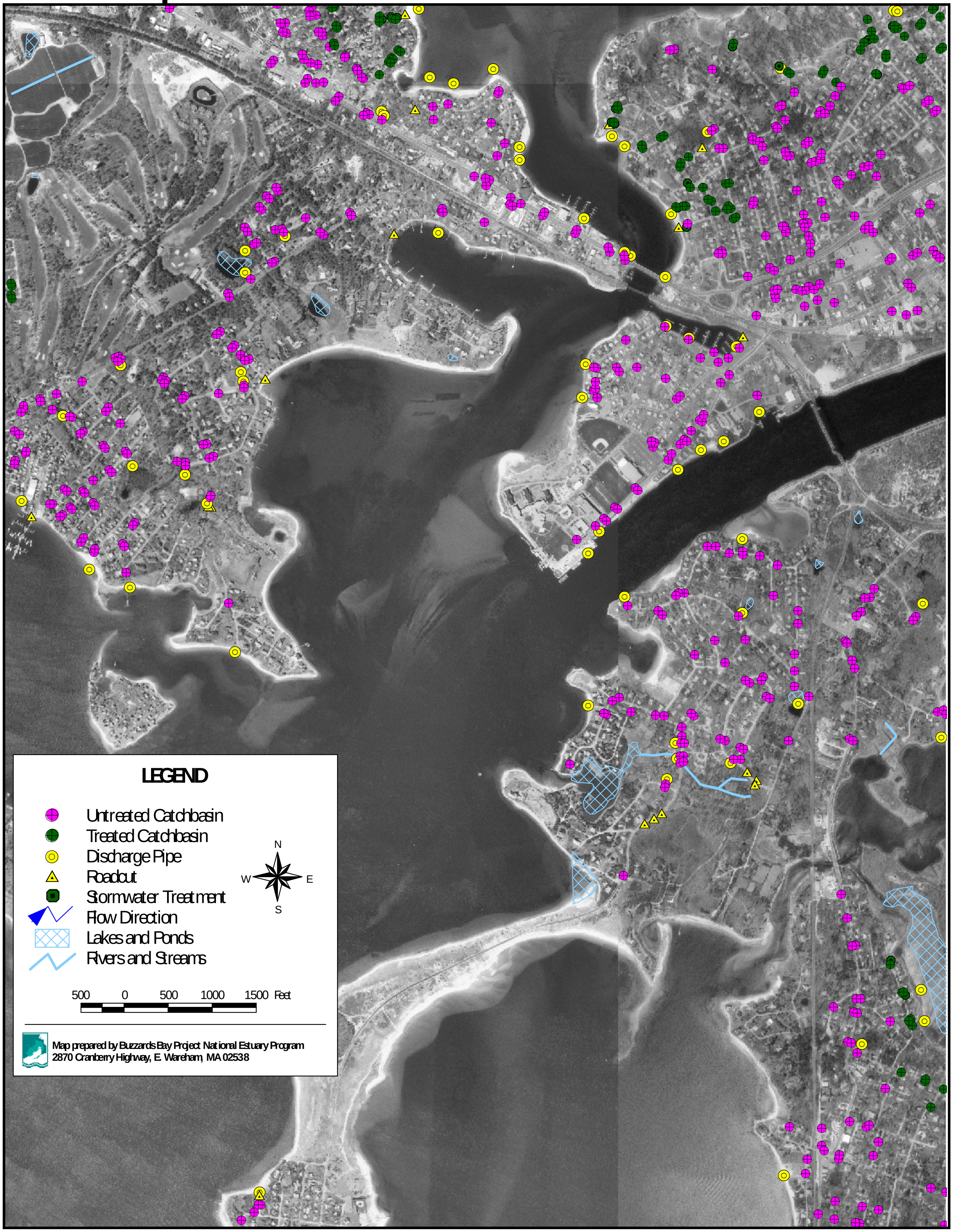
Bourne: Map 2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Appendix B
Public Participation

RESPONSE TO COMMENTS ON THE DRAFT PATHOGEN TMDL FOR THE BUZZARDS BAY WATERSHED

Public Meeting Announcement Published in the Monitor	7/23/2005
Date of Public Meeting	8/10/2005
Location of Public Meeting	DEP-SERO, Lakeville
Times of Public Meeting	3 P.M. and 7 P.M.

BUZZARDS BAY WATERSHED DRAFT PATHOGEN TMDL PUBLIC MEETING ATTENDEES

Date 8/10/2005 Time 3 PM

Name	Organization
1. Ben Bryant	Coalition for Buzzards Bay
2. A. Antoniello	DPW Scituate
3. Jason Burtner	CZM
4. Mike Hill	EPA
5. Bill Fitzgerald	DPW Franklin/Citizen Taunton
6. Cathal O'Brien	DPW Water Taunton
7. Lawrence Perry	Lakeville Health Agent
8. Newton Newman	Lloyd Center Dartmouth

Date 8/10/2005 Time 7 P.M

Name	Organization
1. Sara Grady	NSRWA/Mass Bays
2. Steve Silva	EPA

This appendix provides detailed responses to comments received during the public comment process. MassDEP received many comments/questions that were of a general nature (i.e. related to terminology, statewide programs, the TMDL development process and regulations, etc.) while others were watershed specific. Responses to both are presented in the following sections.

General Comments:

1. Question: On the slide titled "components of a TMDL" what does "WLA" and "LA" stand for.

Response: Waste load allocation (WLA) refers to pollutants discharged from pipes and channels that require a discharge permit (point sources). Load allocation refers to pollutants entering waterbodies through overland runoff (non point sources). A major difference between the two categories is the greater legal and regulatory control generally available to address point sources while voluntary cooperation added by incentives in some cases is the main vehicle for addressing non-point sources.

2. Question: What is the Septic System Program?

Response: Cities and Towns can establish a small revolving fund to help finance repairs and necessary upgrades to septic systems. The initial funding is from the Commonwealth's State, Revolving Fund Program (SRF). These programs generally offer reduced interest rate loans to homeowners to conduct such improvements. Many communities have taken advantage of this effort and on Cape Cod Barnstable County has proposed its own version of this aid. A discussion of the septic system programs may be seen in the TMDL companion document "A TMDL Implementation Guidance Manual for Massachusetts" under Section 3.2.

3. Question: What is the WQS for non-contact recreation in terms of bacteria?

Response: EPA does not have specific guidance for a bacteria criterion for secondary contact. The agency recommended states use 5 times the swimming standard in the case of fecal coliform. Based on EPA's recommendation Massachusetts adopted a class "C" standard of 1000 organisms per 100 ml. Class C waters are designated as a habitat for fish, other aquatic life and wildlife, and for secondary contact recreation such as fishing and boating. In 2007 the State of Massachusetts revised its standards for certain waters from fecal coliform to e-coli or enterococcus

4. Question: On the topic of DNA testing for bacterial source tracking what is MassDEP doing or planning to do?

Response: DNA testing is a promising but as yet not fully reliable tool in distinguishing between human and other sources of fecal bacteria. When perfected, this tool will be extremely valuable in helping target sources of pathogens and remedial actions. At the same time, one needs to recognize that even if the source of the bacteria is identified as non-human, any concentrations exceeding the criteria still impair the use, such as swimming or shellfishing, associated with those criteria. MassDEP is already working with our Wall Experiment Station to help develop reliable techniques to address this issue. Once developed MassDEP will include those techniques into our sampling programs however we hope local monitoring programs will also benefit from them.

5. Question: What is the current thought on e coli / entero bacteria survival and reproduction in the environment, especially in wetlands ?

Response: There are reports that indicator bacteria can survive in sediment longer than they can in water. This may be a result of being protected from predators. Also, there is some indication that reproduction may occur in wetlands, but until wildlife sources can be ruled out through, for example, a reliable DNA testing, this possibility needs to be treated with caution. Also, die off of indicator bacteria tends to be more rapid in warm water than in cold.

6.**Question:** For the implementation phase of TMDLs who will do the regular progress reporting and who will pay for it?

Response: In most cases, MassDEP is relying on existing programs for TMDL implementation. Reporting will also depend on the action being taken. Phase I and Phase II municipalities already do regular reporting and provide annual status reports on their efforts. Any additional information can be coupled with existing reporting requirements and monitoring results to determine the success and failure of implementation measures. For non-Phase II municipalities it gets more difficult and MassDEP may have to work directly with each community or possibly add communities with known impairments to the phase II list. The TMDL does not require volunteer groups, watershed organizations or towns to submit periodic reports - it is not mandatory. The MassDEP is relying on self interest and a sense of duty for communities to move ahead with the needed controls facilitated by some state aid. The MassDEP feels that the cooperative approach is the most desirable and effective but also believes that we possess broad regulatory authority to require action if and when it is deemed appropriate. .

7. Question: How does the Phase II program and TMDL program coordinate with each other?

Response: The NPDES Stormwater Phase II General Permit Program became effective in Massachusetts in March 2003. The permit requires the regulated entities to develop, implement and enforce a stormwater management program (SWMP) that effectively reduces or prevents the discharge of pollutants into receiving waters to the Maximum Extent Practicable (MEP). Stormwater discharges must also comply with meeting state water quality standards. The Phase II permit uses a best management practice framework and measurable goals to meet MEP and water quality standards. A requirement of the permit is that if a TMDL has been approved for any water body into which the small municipal separate storm sewer system (MS4) discharges, the permittee must determine whether the approved TMDL is for a pollutant likely to be found in stormwater discharges from the MS4. If the TMDL includes a pollutant waste load allocation, best management practices (BMPs) or other performance standards for stormwater discharges, the permittee must incorporate into their SWMP the recommendations in the TMDL for limiting the pollutant contamination. The permittee must assess whether the pollutant reduction required by the TMDL is being met by existing stormwater management control measures in their SWMP or if additional control measures are necessary. As TMDLs are developed and approved, permittees' stormwater management programs and annual reports must include a description of the BMPs that will be used to control the pollutant(s) of concern, to the maximum extent practicable. Annual reports filed by the permittee should highlight the status or progress of control measures currently being implemented or plans for implementation in the future. Records should be kept concerning assessments or inspections of the appropriate control measures and how the pollutant reductions will be met.

8. Question: Will communities be liable for meeting water quality standards for bacteria at the point of discharge?

Response: No. While this is the goal stated in the TMDL, compliance with the water quality standards is judged by in-stream measurements. For instance, in an extreme case, it could be possible for a community to meet this criterion in their storm drains and yet still be responsible for reducing the impacts of overland runoff if the in-stream concentrations of bacteria exceeded the water quality standard. So no matter how the TMDL is expressed, compliance is measured by the concentrations in the ambient water.

This approach is also consistent with current EPA guidance and regulations. As stated in the 2002 Wayland/Hanlon memorandum, "WQBELs for NPDES-regulated storm water discharges that implement WLAs in TMDLs may be expressed in the form of best management practices (BMPs) under specified circumstances. See 33 U.S.C. 1342(p)(3)(B)(iii); 40 C.F.R. 122.44(k)(2)&(3)" (Wayland/Hanlon memo, page 2; See Attachment A. This memorandum goes on to state:
"...because storm water discharges are due to storm events that are highly variable in frequency and duration and are not easily characterized, only in rare cases will it be feasible or appropriate to establish numeric limits for municipal and small construction storm water discharges. The variability in the system and minimal data generally available make it difficult to determine with precision or certainty actual or projected loadings for individual dischargers or groups of dischargers. Therefore, EPA believes that in these situations, permit limits typically can be expressed as BMPs, and that numeric limits will be used only in rare instances" (Wayland, Hanlon memorandum, November 22, 2002, page 4).

The TMDL attempts to be clear on the expectation that an adaptive management approach utilizing BMPs will be used to achieve WQS as stated in the Wayland/Hanlon memorandum: "If it is determined that a BMP approach (including an iterative BMP approach) is appropriate to meet the storm water component of the TMDL, EPA recommends that the TMDL reflect this." (Wayland, Hanlon memorandum, page 5). Consistent with this, the Massachusetts' pathogen TMDLs state that an iterative approach using an illicit connection detection and elimination program and utilization of non-structural BMPs be used initially to meet WQS followed by structural BMPs where necessary. The actual WLA and LA for storm water will still be expressed as both a concentration-based/WQS limit and daily load which will be used to guide BMP implementation. The attainment of WQS, however, will be assessed through ambient monitoring.

In storm water TMDLs, the issue of whether WQSs will be met is an ongoing issue and can never be answered with 100% assurance. MassDEP believes that the BMP-based, iterative approach for addressing pathogens is appropriate for storm water. Indeed, "the policy outlined in [the Wayland/Hanlon] memorandum affirms the appropriateness of an iterative, adaptive management BMP approach, whereby permits include effluent limits (e.g., a combination of structural and non-structural BMPs) that address storm water discharges, implement mechanisms to evaluate the performance of such controls, and make adjustments (i.e., more stringent controls or specific BMPs) as necessary to protect water quality" (Wayland, Hanlon memorandum, page 5).

A more detailed discussion / explanation of this response can be found in Attachment C, a memorandum titled "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs" by Robert H. Wayland and James A. Hanlon of EPA (11/22/02) which is appended to this Response To Comments Document.

9. Question: What are the regulatory hooks for this TMDL in regards to non-point sources?

Response: In general, the MassDEP is pursuing a cooperative approach in addressing non-point sources of contamination by bacteria. A total of 237 cities and towns in Massachusetts do have legal requirements to implement best management practices under their general NPDES storm-water permits. In addition, failing septic systems are required to be corrected once the local Board of Health becomes aware of them and at the time of property transfer should required inspections reveal a problem. Other activities, such as farming involving livestock, are the subject of cooperative control efforts through such organizations as the Natural Resources Conservation Service (NRCS) which has a long history of providing both technical advice and matching funds for instituting best management practices on farms. While MassDEP has broad legal authority to address non-point source pollution and enforcement tools available for use for cases of egregious neglect, it intends to fully pursue cooperative efforts which it feels offer the most promise for improving water quality.

In addition to the above, the Massachusetts Department of Environmental Protection's proposed new "Stormwater Management Regulations," that would establish a statewide general permit program aimed at controlling the discharge of stormwater runoff from certain privately-owned sites containing large impervious surfaces.

The proposed regulations would require private owners of land containing five or more acres of impervious surfaces to apply for and obtain coverage under a general permit; implement nonstructural best management practices (BMPs) for managing stormwater; install low impact development (LID) techniques and structural stormwater BMPs at sites undergoing development or redevelopment; and submit annual compliance certifications to the Department.

10. Question: Why is there little mention in the draft TMDL reports on incorporation of LID (Low Impact Development) principles as a way through implementation to control Bacteria pollution?

Response: Part of the Statewide TMDL project was to produce an accompanying TMDL implementation guidance document for all the TMDL reports, " Mitigation Measures to Address Pathogen Pollution in Surface Waters: A TMDL Implementation Guidance Document for MA". There is an entire section in that document (Section D.4) that discusses LID principles and TMDL implementation in detail.

11. Question: What about flow issues and TMDL requirements?

Response: TMDLs must be developed for each "pollutant" causing water quality impairments. Although "flow" can impact pollutant concentrations and loadings, flow is not a "pollutant" as defined in federal regulations and is therefore not subject to TMDL development.

12. Question: Is there a way that the TMDL can be integrated with grants, and can the grants be targeted at TMDL implementation?

Response: The 319 Grant program is a major funding program providing up to $2 million per year in grants in MA. TMDL implementation is a high priority in that program. In fact, projects designed to address TMDL requirements are given higher priority points during project evaluation.

The 319 grant program RFP Includes this language: “Category 4a Waters: TMDL and draft TMDL implementation projects – The 319 program prioritizes funding for projects that will implement Massachusetts’ Total Maximum Daily Load (TMDL) analyses. Many rivers, streams and water bodies in the Commonwealth are impaired and thus do not meet Massachusetts’ Surface Water Quality Standards. The goal of the TMDL Program is to determine the likely cause(s) of those impairments and develop an analysis (the TMDL) that lists those cause(s).”

Several comments were also directed towards the complications associated with applying for and reporting that are required elements state grant programs. The MassDEP is sympathetic to the paper work requirements of State and Federal grant programs. The MassDEP periodically reviews the body of requirements to assess what streamlining may be possible. At the same time, the MassDEP underscores that accountability for spending public funds continues to be an important and required component of any grant program.

13. Question: How will implementation of the TMDL address the major problem of post- construction run-off?

Response: It is anticipated that proper design and implementation of stormwater systems during construction will address both pre and post-construction runoff issues and thus eliminate future problems. Post-construction runoff is also one of the six minimum control measures that Phase II communities are required to include in their stormwater management program in order to meet the conditions of their National Pollutant Discharge Elimination System (NPDES) permit. In short, Phase II communities are required to :

a. Develop and implement strategies which include structural and/or nonstructural best management practices (BMPs);

b. Have an ordinance or other regulatory mechanism requiring the implementation of post-construction runoff controls to the extent allowable under State or local law;

c. Ensure adequate long-term operation and maintenance controls;

d. Determine the appropriate best management practices (BMPs) and measurable goals for their minimum control measure.

The general permit implementing the phase 2 requirements also contains requirements for permittees that discharge into receiving waters with an approved TMDL. In summary, municipalities covered under phase II are required to incorporate and implement measures and controls into their plans that are consistent with an established TMDL and any conditions necessary for consistency with the assumptions and requirements of the TMDL.

14. Question: How does a pollution prevention TMDL work?

Response: MassDEP recommends that the information contained in the pathogen TMDLs guide management activities for all other waters throughout the watershed to help maintain and protect existing water quality. For non-impaired waters, Massachusetts is proposing “pollution prevention TMDLs” which are also known as “preventative TMDLs” consistent with CWA s. 303(d)(3). Pollution prevention TMDLs encourage the Commonwealth, communities and citizens to maintain and protect existing water quality. Moreover it is easier and less costly in the long term to prevent impairments rather than retrofit controls and best management practices to clean up pollution problems. The goal of this approach is take a more proactive role to water quality management.

The analyses conducted for the pathogen impaired segments in this TMDL would apply to the non-impaired segments, since the sources and their characteristics are equivalent. The waste load and/or load allocation for each source and designated use would be the same as specified in the TMDL documents. Therefore, the pollution prevention TMDLs would have identical waste load and load allocations based on the sources present and the designated use of the waterbody segment.

The TMDLs may, in appropriate circumstances, also apply to segments that are listed for pathogen impairment in subsequent Massachusetts CWA s. 303(d) Integrated List of Waters. For such segments, this TMDL may apply if, after listing the waters for pathogen impairment and taking into account all relevant comments submitted on the CWA s. 303(d) list, the Commonwealth determines with EPA approval of the CWA s. 303(d) list that this TMDL should apply to future pathogen impaired segments.

Pollution prevention best management practices form the backbone of stormwater management strategies. Operation and maintenance should be an integral component of all stormwater management programs. This applies equally well with the Phase II Program as well as TMDLs. A detailed discussion of this subject and the BMPs involved can be found in the TMDL companion document "Measures to Address Pathogen Pollution in Surface Waters: A TMDL Implementation Guidance Document for Massachusetts" in Section 3.

15. Comment: The TMDL methodology uses concentrations based on water quality standards to establish TMDL loads, not traditional "loads".

Response: Concentration-based limits are consistent with EPA regulations. Clean Water Act Section 130.2(i) states that "TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure". The TMDL in this case is set at the water quality standard. Pathogen water quality standards (which are expressed as concentrations) are based on human health, which is different from many of the other pollutants. It is important to know immediately when monitoring is conducted if the waterbody is safe for human use, without calculating a "load" by multiplying the concentration by the flow – a complex function involving variable storm flow, dilution, proximity to source, etc.

The goal to attain water quality standards at the point of discharge is conservative and thus protective, and offers a practical means to identify and evaluate the effectiveness of control measures. In addition, this approach establishes clear objectives that can be easily understood by the public and individuals responsible for monitoring activities.

MassDEP believes that it is difficult to provide accurate quantitative loading estimates of indicator bacteria contributions from the various sources because many of the sources are diffuse and intermittent, and flow is highly variable. Thus, it is extremely difficult to monitor and accurately model. bacteria are less accurate than a concentration-based approach and do not provide a way to quickly verify if you are achieving the TMDL. Regardless, MassDEP has included a daily load for each segment in this TMDL in addition to the concentration-based approach.

16. **Comment**: There is concern with the “cookie-cutter” nature of the draft TMDL. Particularly the lack of any determination about the causes and contributions to pathogen impairment for specific river and stream segments.

Response: The draft TMDL, although generic in nature, provides a framework and foundation for actions to address bacteria pollution statewide. The MassDEP feels the pathogen TMDL approach is justified because of the commonality of sources affecting the impaired segments and the commonality of best management practices used to abate and control those sources.

Many existing programs such as the Federally mandated stormwater program and combined sewer overflow (CSO) Long-term Control Plans, once implemented, will dramatically reduce or eliminate many sources of bacteria and serve as an important first step in an adaptive management approach to eliminate sources. At the same time however MassDEP agrees that it will be important for not only the state, but more importantly local monitoring programs to develop and incorporate source identification and tracking programs to achieve long-term water quality goals.

It should also be noted that based on public input MassDEP has conducted additional research to try to identify sources where information was available. This includes the addition of information developed by the Buzzards Bay Project National Estuary Program (BBP) as presented in the ““Atlas of Stormwater Discharges in the Buzzards Bay Watershed”. Based on this additional information MassDEP added additional tables and maps to help identify and prioritize important segments and sources. Also, MassDEP revised Section 7 of this TMDL to include segment-by-segment daily load allocations necessary to meet water quality standards. All of the above noted actions were intended to provide additional guidance on potential sources and areas of concern and to help target future remediation activities.

17. Comment: While Table 7-1 of each TMDL lists the Tasks that the agencies (MassDEP/EPA) believe need to be achieved, it isn’t clear exactly how these tasks line up with and address the eight sources of impairment listed in Table 6-1. CZM recommends that the final TMDL be more specific and couple the Implementation Plan tasks with the known or expected sources of contamination. This would make the document more useful to a community

Response: All of the sources of impairments listed in Table 6-1 are addressed in either Table 7-1, the text of Section 7, or both. Because Table 6-1 and 7-1 serve slightly different purposes it was not intended that the tasks needed to align with and exactly address the eight sources of impairment.

18. Comment: While the text in sections 7.1-7.7 of each TMDL describe some actions that can address the sources in Table 6-1, the issue of failing infrastructure is only mentioned in a sub-section title and in the text, but not addressed in any detail.

Response: Failing infrastructure is a very broad term, and is addressed, in part in such discussions as those on leaking sewer pipes, sanitary sewer overflows, and failed septic systems. It is outside of the scope of the TMDL documents to detail every possible type of infrastructure failure. Nonetheless, additional information is provided in the TMDL companion document titled: “Measures to Address Pathogen Pollution in Surface Waters: A TMDL Implementation Guidance Document for Massachusetts.”

19. Comment: There is a need for more specific information about what individual communities are currently doing and how much more effort is required (e.g., how many more miles of pipe need to be inspected for illegal connections in a specific community).

Response: MassDEP and the EPA recognize that the municipalities have done, and are continuing to do, a tremendous amount of work to control bacterial contamination of surface waters. The TMDL provides some examples of that overall effort. The TMDL however is not designed nor intended to include an exhaustive listing of all the work required by each municipality to finalize this effort and provide a status of that work. However, some of the programs, such as Phase II Storm water, require such status reports, and those will be very valuable in assessing priorities and future work. Phase II reports for each community are available through each City or Town and can be viewed at MassDEP.

20. Comment: There are no milestones to which individual communities should aim (e.g., all stormwater lines upstream of known contamination inspected for illegal connections in five years). As another example, Section 7.0 of each TMDL states that “The strategy includes a mandatory program for implementing storm water BMPs and eliminating illicit sources” but it is not clear over what timeframe a community should be acting.

Response: The timeframe for implementing corrective measures depends highly on the extent and source of the problem within each community, as such, it would be impossible to identify individual timelines within the TMDL. With that said however many timelines are established through the implementation of existing programs. For instance, the Phase II stormwater program required all communities to submit an application and plan in 2003. That plan must address the six minimum control measures and establish regulatory mechanisms to implement those measures by 2008. Status reports are developed annually to report their progress on achieving that goal. Actual implementation however will likely take many years. A second example would be the control of combined sewer overflows (CSO’s). Most municipalities are already under enforcement orders by EPA and/or MassDEP to develop and implement initial measures (commonly referred to as the Nine Minimum Controls (NMCs) and long-term control plans to address the issue. Since CSO discharges are defined as a point source under the Clean Water Act an NPDES permit must be jointly issued by EPA and MassDEP for those discharges. The permit sets forth the requirements for implementation and assessment of the EPA mandated NMCs and the requirement for developing a long-term CSO control strategy. Either the permit or an enforcement order will typically contain the schedules for completing that work.

MassDEP recognizes that the addition of timelines in the TMDLs would appear to strengthen the documents, however, the complexity of each source coupled with the many types of sources which vary by municipality simply does not lend itself to the TMDL framework and therefore must be achieved through other programmatic measures.

21. Comment: Under “Control Measures” does “Watershed Management” include NPDES permitting?

Response: “Watershed Management” is a general term used to assess and address water quality impacts associated with both point and nonpoint sources throughout an entire watershed. NPDES permitting is a primary tool used to address point source pollution such as permitted discharges from municipal wastewater treatment and industrial discharges. Stormwater is considered a point source if it comes from a pipe or other discrete conveyance system. Sheet flow of stormwater however is considered a nonpoint source. Additional tools used to address nonpoint sources include, but are not limited to, local education, and the use of best management practices like those outlined in this report. The Department also operates varies grant and loan programs to address both point and nonpoint sources of pollution. Application of these tools is considered part of the watershed management approach.

22. Comment: Absent from each report under “Who should read this document ?” are the government agencies that provide planning, technical assistance, and funding to groups to remediate bacterial problems.

Response: The introduction was edited to include these groups in a general sense. It is beyond the scope of the TMDL to provide an exhaustive list of agencies that provide funding and support. Chapter 8.0 however provides a link to this information, which is provided in the Massachusetts Nonpoint Source Strategy.

23. Comment: For coastal watersheds the section that describes funding sources should include grant programs available through the Massachusetts Office of Coastal Zone Management.

Response: Please refer to comment #22 above

24. Comment: Table ES-1 and the similar tables throughout the report do not list B (CSO) or as a surface water classification – this classification and its associated loadings allocations are missing. Although the footnote to the table refers to Long term CSO Control Plans, the relationship between the TMDL, LTCP, and the B(CSO) water classification are unclear.

Response: The 1995 revisions to the MA Water Quality Standards created a B (CSO) water quality category by establishing regulatory significance for the notation “CSO” shown in the “Other Restriction” column at 314 CMR 4.06 for impacted segments. The B (CSO) designation was given, after public review and comment, to those waters where total elimination of CSO’s was not economically feasible and could lead to substantial and widespread economic and social impact and the impacts from remaining CSO discharges were minor. Although a high level of control must be achieved, Class B standards may not be met during infrequent, large storm events.

The goal of the TMDL and the long-term control plan is to minimize impacts to the maximum extent feasible, attain the highest water quality achievable, and to protect critical uses. Given this, the TMDL establishes in Table ES-1 (as well as other tables) the goal of meeting class B standards in CSO impacted waters but recognizes that this criteria cannot be met at all times and therefore defers to the EPA and MassDEP approved long-term control CSO plan to define the infrequent occasions when the criteria may not be met.

25. Comment: The implementation of new bacteria water quality criteria into NPDES permits should be determined during the permit writing process rather than by the TMDL process – and that should be made clear in the TMDL document.

Response: MassDEP agrees that implementation of new bacteria water quality criteria should be incorporated into the permitting process as well as the state Water Quality Standards. This is already the case. The criteria are also being included in the TMDL because it is a required element of the TMDL process. Readers / users of the bacteria TMDL reports should be aware that new water quality standards were recently developed in 2007 and are included in this final TMDL.

26. Comment: Coastal resources are significantly impacted from the storm water run-off from Mass Highway roads. This goes beyond the control of municipalities to upgrade and is often beyond the capability of local groups to monitor. MHD (Massachusetts Highway Department (Mass Highway)) continues to evade storm water standards and it is thus our opinion that MHD deserves special recognition, complete with implementation strategy to upgrade the drainage systems along its web of asphalt.

Response: Mass Highway is included in the Storm water Phase II Program, and as such will be responsible for completing the six minimum controls mandated by that program, i.e., public education and outreach, public involvement and participation, illicit discharge detection and elimination, construction site storm water runoff control, post construction storm water management, and good housekeeping in operations.

27. Comment: The current 303d list of impaired waters – is it the 2002 or the 2004 list ?

Response: Since the draft of this report was produced, the final 2006 list was approved and MassDEP is awaiting final EPA approval of the 2008 list. All of the pathogen TMDLs apply to the current 2006 303d list and all future EPA approved 303d lists.

28. Comment: Does the NPDES nondelegated state status of Massachusetts affect the TMDLs in any way ?

Response: No. The MassDEP and EPA work closely together and the nondelegated status will not affect the TMDLs. The EPA has not written any of the pathogen TMDLs but has helped fund them.

29. Comment: The TMDL report does not tell the watershed associations anything they didn't already know.

Response: True. The MassDEP is taking a cooperative approach and by working together as a team (federal, state, local, watershed groups) we can make progress in addressing bacterial problems – especially storm water related bacterial problems. Establishment of the TMDL however provides higher priority points in MassDEP funding programs to issue grants and loans for qualified projects to address priority areas.

30. Comment: What will the MassDEP do now for communities that they have not already been doing ?

Response: Grants that can be used for implementation (such as the 319 grants) will be targeted toward TMDL implementation. Also, the more TMDLs a state completes and gets approved by EPA the more funding it will receive from EPA and thus the more TMDL implementation it can initiate.

31. Comment: The State Revolving Fund (SRF) should support municipalities with TMDLs and Phase II status a lot more.

Response: As with any grant/loan program, there are some very competitive projects looking for funds from the SRF. A lot of these are the traditional sewage treatment plants and sewering projects which are very expensive. The SRF currently does allocate funds to storm water related projects as well and additional priority points are awarded in the SRF program where a project addresses waters identified on the state 303d list as well as where TMDLs have been established by either MassDEP or EPA..

32. Comment: Who will be doing the TMDL implementation ?

Response: Each pathogen TMDL report has a section on implementation which includes a table that lists the various tasks and the responsible entity. Most of the implementation tasks will fall on the authority of the municipalities. Probably two of the larger tasks in urban areas include implementing storm water BMPs and eliminating illicit sources. The document "Mitigation Measures to Address Pathogen Pollution in Surface Water: A TMDL Implementation Guidance Manual for Massachusetts" was developed to support implementation of pathogen TMDLs. The MassDEP working with EPA and other team partners shall make every reasonable effort to assure implementation of the TMDLs.
Watershed Specific Comments / Responses

33. Comment: Several watershed groups believe that active and effective implementation and enforcement is essential to carry out the objectives in the pathogen TMDLs. They define effective implementation as the MassDEP partnering with them and municipalities to identify funding opportunities to develop stormwater management plans, implement Title 5 upgrades, and repair failing sewer infrastructure. The groups define effective enforcement as active MassDEP application of Title 5 regulations and implementation of Stormwater Phase II permitting requirements for Phase II municipalities.

Response: The MassDEP has every intention of assisting watershed groups and municipalities with implementing the high priority aspects of the pathogen TMDLs, including identification of possible funding sources. With respect to Title 5 regulations and the Phase II program requirements, the MassDEP will continue to emphasize and assist entities with activities that lead to compliance with those program requirements.

34. Comment: The MassDEP Division of Watershed Management (DWM) should network implementation planning efforts in the coastal watersheds with the Coastal Zone Management's (CZM) Coastal Remediation Grant Program and the EPA Coastal Nonpoint Source Grant Program. Also, the

DWM should make the pathogen TMDL presentation to the Mass Bays Group, and network with them in regards to coordinating implementation tasks.

Response: The MassDEP DWM has every intent to coordinate efforts wherever possible including those identified by the commenter.

35. Comment: Why are specific segments or tributaries of watersheds addressed in the Draft TMDL but not all of the segments ?

Response: In accordance with the EPA regulations governing TMDL requirements, only segments that are included on the state's 303(d) list of impaired waterbodies (category 5 of the state Integrated List of Waters) need to be included in any TMDL. It should be noted, however, that addressing other segments which presently are not listed is appropriate as well.

36. Comment: When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source reductions will occur, EPA's 1991 TMDL Guidance states that the TMDL should provide reasonable assurances that nonpoint source control measures can achieve expected load reductions in order for the TMDL to be approvable.

Response: Section 9.0, Reasonable Assurances, provides these assurances. This section has been drastically expanded in the Final version of the Draft Pathogen TMDL reports. The revised section 9.0 describes all of the appropriate state programs and their enabling statutes and relevant regulations which actively address nonpoint source pollution impacting waters of the Commonwealth. Many of these programs involve municipalities as a first line of defense mechanism such as the Wetlands Protection Act (which includes the Rivers Protection Act).This expanded section also covers grant programs available to municipalities to control and abate nonpoint source pollution such as 319 grants, 604b grants, 104b(3) funds, 6217 coastal nonpoint source grants, low interest loans for septic system upgrades, state revolving fund grants, and many others.

37. Comment: The Draft TMDLs indicate that for non-impaired waters the TMDL proposes "pollution prevention BMPs". The term is not defined in any state regulation and the origin of the term is unclear.

Response: An explanation of pollution prevention BMPs can be found in the pathogen TMDL companion document "Mitigation Measures to Address Pathogen Pollution in Surface Waters: A TMDL Implementation Guidance Manual for Massachusetts". Section 3.1 of that manual describes pollution prevention as one of the six control measures for minimizing stormwater contamination under the EPA Phase I or II Stormwater Control Program. Control Measure #6, "Pollution Prevention / Good Housekeeping" involves a number of activities such as maintenance of structural and nonstructural stormwater controls, controls for reducing pollutants from roads, municipal yards and lots, street sweeping and catch basin cleaning, and control of pet waste. Also the term "pollution prevention" can include a far wider range of pollution control activities to prevent bacterial pollution at the source. For instance, under Phase I and II, minimum control measures #4 and #5, construction site and post construction site runoff controls, would encompass many pollution prevention type BMP measures. Proper septic system maintenance and numerous agricultural land use measures can also be considered pollution prevention activities. Further information may be found in Sections 3.0, 4.0, and 5.0 in the Guidance Manual.

38. Comment: EPA regulations require that a TMDL include Load Allocations (LAs) which identify the portion of the loading capacity attributed to existing and future nonpoint sources and to natural background. Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R. s.130.2(g)). Where possible, load allocations should be described separately for natural background and nonpoint sources. The Draft TMDL makes no such allocation. Also, EPA regulations require that a TMDL include Waste Load Allocations (WLAs) which identify the portion of the loading capacity allocated to individual existing and future point sources. The Draft TMDL makes no such allocation . Because it makes no estimate of the TMDL, it makes no WLA for point sources.

Response: This comment (and several others which addressed the same topic) relates to the establishment and allocation of an acceptable pollutant load so that water quality standards can be met and maintained. As touched upon elsewhere in this document, TMDLs can be expressed in a variety of ways so long as they are rational. Section 7 has been expanded to include load allocations in addition to the concentration based approach, however. MassDEP has chosen to use concentration as the primary metric for bacteria TMDLs for several reasons. First, there is a numeric standard that can be used. Second, and more important, bacteria, unlike some other pollutants, can increase with flow rather than decrease. As such, the bacteria load applicable at low flow (7Q10) would be very stringent if applied to higher flows. It is also constantly changing due to tidal action. In essence, this TMDL recognizes that higher loads are likely at higher flows and therefore the emphasis is on meeting the in-stream or embayment water quality rather than on meeting a load established for low flows as is done for most other constituents. Hence the TMDL is based on concentration rather than loads of bacteria expressed either as pounds or as daily loads. Again, in contrast to many other pollutants, higher flows may not mean more dilution in the case of bacteria. This approach for bacteria still accepts that site specific information can result in site specific control strategies that modify the general TMDL framework presented provided that water quality standards for bacteria are achieved. Nonetheless, MassDEP has included load allocations in the final TMDL based on the annual average precipitation anticipated in the Buzzards Bay/Cape Cod area and an estimate of the average daily runoff based on long-term precipitation records (see revised Section 7).

Watershed Specific Comments / Responses

1. **Question**: Why are there no lakes in the Buzzards Bay Watershed on the 303d list in light of the fact that there have been several beach closings due to bacteria ?

Response: The MassDEP relies on information from local Boards of Health and the Commonwealth's Department of Public Health for information on beach closures. This information is becoming more timely and readily available with the institution of a state wide reporting system required and facilitated by the passage of the National Beaches Act. This will permit much more recent information to be used in the listing of impaired waters in the future. It should be noted that beaches subject to chronic closures normally would be listed as impaired, but those reporting occasional closures in which bather density is suspected as a possible cause may not be listed.

2. CZM Comment
p. 51, Table 7-1, CZM was surprised to see that this table does not recognize the important role of the Buzzards Bay Project National Estuary Program (BBP). The BBP is a technical assistance unit of CZM whose mission is to implement the Buzzards Bay Comprehensive Conservation Management Plan. We recommend the following changes to Table 7-1. Next to the task "Organize and implement; work with stakeholders and local officials to identify remedial measures and potential funding sources" the BBP and not the Coalition for Buzzards Bay (CBB) should be listed. The CBB is a citizens group primarily focused on education and outreach. Likewise, next to the task "Write grant and loan funding proposals," the BBP should be listed and not CBB. Furthermore, the tasks "Organization, contacts with volunteer groups" and "Surface Water Monitoring" should include the BBP as a participating organization.

Response: The draft TMDL incorrectly cited the Coalition for Buzzards Bay rather than the Buzzards Bay Project. The changes have been made to Table 7-1 and text has been added to Section 7-1 to correct this error.

3. Comment- It is noted that there are quite a few segments on the Western end of the Cape in Falmouth and Bourne that are included in this report. Could you explain that?

Response- The MassDEP, beginning with the 2004 Integrated List of Impaired Waters, determined that 14 segments on the Western end of the Cape in Falmouth and Bourne most appropriately fit within the Buzzards Bay Watershed, as drainage from these segments discharges into Buzzards Bay. These segments include: MA95-14, Cape Cod Canal; MA95-48 Eel Pond; MA95-47 Back River; MA95-15 Phinneys Harbor; MA95-16 Pocasset River; MA95-18; Pocasset Harbor MA95-17; Red Brook Harbor; MA95-21 Herring Brook; MA95-46 Harbor Head; MA95-20 Wild Harbor; MA95-22 West Falmouth Harbor; MA95-23 Great Sippewisset Creek; MA95-24 Little Sippewisset Marsh; MA95-25 Quissett Harbor. These segments are now covered in the Buzzards Bay Bacteria TMDL Report rather than the Cape Cod TMDL report

Appendix C
EPA: Wayland Guidance

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

NOV 22 2002

OFFICE OF WATER

MEMORANDUM

SUBJECT: Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs

FROM: Robert H. Wayland, III, Director
Office of Wetlands, Oceans and Watersheds

James A. Hanlon, Director
Office of Wastewater Management

TO: Water Division Directors
Regions 1 - 10

This memorandum clarifies existing EPA regulatory requirements for, and provides guidance on, establishing wasteload allocations (WLAs) for storm water discharges in total maximum daily loads (TMDLs) approved or established by EPA. It also addresses the establishment of water quality-based effluent limits (WQBELs) and conditions in National Pollutant Discharge Elimination System (NPDES) permits based on the WLAs for storm water discharges in TMDLs. The key points presented in this memorandum are as follows:

NPDES-regulated storm water discharges must be addressed by the wasteload allocation component of a TMDL. See 40 C.F.R. § 130.2(h).

NPDES-regulated storm water discharges may not be addressed by the load allocation (LA) component of a TMDL. See 40 C.F.R. § 130.2 (g) & (h).

Storm water discharges from sources that are not currently subject to NPDES regulation may be addressed by the load allocation component of a TMDL. See 40 C.F.R. § 130.2(g).

It may be reasonable to express allocations for NPDES-regulated storm water discharges from multiple point sources as a single categorical wasteload allocation when data and information are insufficient to assign each source or outfall individual WLAs. See 40 C.F.R. § 130.2(i). In cases where wasteload allocations are developed for categories of discharges, these categories should be defined as narrowly as available information allows.

The WLAs and LAs are to be expressed in numeric form in the TMDL. See 40 C.F.R. § 130.2(h) & (i). EPA expects TMDL authorities to make separate allocations to NPDES- regulated storm water discharges (in the form of WLAs) and unregulated storm water (in the form of LAs). EPA recognizes that these allocations might be fairly rudimentary because of data limitations and variability in the system.

NPDES permit conditions must be consistent with the assumptions and requirements of available WLAs. See 40 C.F.R. § 122.44(d)(1)(vii)(B).

WQBELs for NPDES-regulated storm water discharges that implement WLAs in TMDLs may be expressed in the form of best management practices (BMPs) under specified circumstances. See 33 U.S.C. §1342(p)(3)(B)(iii); 40 C.F.R. §122.44(k)(2)&(3). If BMPs alone adequately implement the WLAs, then additional controls are not necessary.

EPA expects that most WQBELs for NPDES-regulated municipal and small construction storm water discharges will be in the form of BMPs, and that numeric limits will be used only in rare instances.

When a non-numeric water quality-based effluent limit is imposed, the permit's administrative record, including the fact sheet when one is required, needs to support that the BMPs are expected to be sufficient to implement the WLA in the TMDL. See 40 C.F.R. §§ 124.8, 124.9 & 124.18.

The NPDES permit must also specify the monitoring necessary to determine compliance with effluent limitations. See 40 C.F.R. § 122.44(i). Where effluent limits are specified as BMPs, the permit should also specify the monitoring necessary to assess if the expected load reductions attributed to BMP implementation are achieved (e.g., BMP performance data).

The permit should also provide a mechanism to make adjustments to the required BMPs as necessary to ensure their adequate performance.

This memorandum is organized as follows:

(I). Regulatory basis for including NPDES-regulated storm water discharges in WLAs in TMDLs;

(II). Options for addressing storm water in TMDLs; and

(III). Determining effluent limits in NPDES permits for storm water discharges consistent with the WLA

(I). Regulatory Basis for Including NPDES-regulated Storm Water Discharges in WLAs in TMDLs

As part of the 1987 amendments to the CWA, Congress added Section 402(p) to the Act to cover discharges composed entirely of storm water. Section 402(p)(2) of the Act requires permit coverage for discharges associated with industrial activity and discharges from large and medium municipal separate storm sewer systems (MS4), i.e., systems serving a population over 250,000 or systems serving a population between 100,000 and 250,000, respectively. These discharges are referred to as Phase I MS4 discharges.

In addition, the Administrator was directed to study and issue regulations that designate additional storm water discharges, other than those regulated under Phase I, to be regulated in order to protect water quality. EPA issued regulations on December 8, 1999 (64 FR 68722), expanding the NPDES storm water program to include discharges from smaller MS4s (including all systems within "urbanized areas" and other systems serving populations less than 100,000) and storm water discharges from construction sites that disturb one to five acres, with opportunities for area-specific exclusions. This program expansion is referred to as Phase II.

Section 402(p) also specifies the levels of control to be incorporated into NPDES storm water permits depending on the source (industrial versus municipal storm water). Permits for storm water discharges associated with industrial activity are to require compliance with all applicable provisions of Sections 301 and 402 of the CWA, i.e., all technology-based and water quality-based requirements. See 33 U.S.C. §1342(p)(3)(A). Permits for discharges from MS4s, however, "shall require controls to reduce the discharge of pollutants to the maximum extent practicable ... and such other provisions as the Administrator or the State determines appropriate for the control of such pollutants." See 33 U.S.C. §1342(p)(3)(B)(iii).

Storm water discharges that are regulated under Phase I or Phase II of the NPDES storm water program are point sources that must be included in the WLA portion of a TMDL. See 40 C.F.R. § 130.2(h). Storm water discharges that are not currently subject to Phase I or Phase II of the NPDES storm water program are not required to obtain NPDES permits. 33 U.S.C. §1342(p)(1) & (p)(6). Therefore, for regulatory purposes, they are analogous to nonpoint sources and may be included in the LA portion of a TMDL. See 40 C.F.R. § 130.2(g).

(II). Options for Addressing Storm Water in TMDLs

Decisions about allocations of pollutant loads within a TMDL are driven by the quantity and quality of existing and readily available water quality data. The amount of storm water data available for a TMDL varies from location to location. Nevertheless, EPA expects TMDL authorities will make separate aggregate allocations to NPDES-regulated storm water discharges (in the form of WLAs) and unregulated storm water (in the form of LAs). It may be reasonable to quantify the allocations through estimates or extrapolations, based either on knowledge of land use patterns and associated literature values for pollutant loadings or on actual, albeit limited, loading information. EPA recognizes that these allocations might be fairly rudimentary because of data limitations.

EPA also recognizes that the available data and information usually are not detailed enough to determine waste load allocations for NPDES-regulated storm water discharges on an outfall-specific basis. In this situation, EPA recommends expressing the wasteload allocation in the TMDL as either a single number for all NPDES-regulated storm water discharges, or when information allows, as different WLAs for different identifiable categories, e.g., municipal storm water as distinguished from storm water discharges from construction sites or municipal storm water discharges from City A as distinguished from City B. These categories should be defined as narrowly as available information allows (e.g., for municipalities, separate WLAs for each municipality and for industrial sources, separate WLAs for different types of industrial storm water sources or dischargers).

(III). Determining Effluent Limits in NPDES Permits for Storm Water Discharges Consistent with the WLA

Where a TMDL has been approved, NPDES permits must contain effluent limits and conditions consistent with the requirements and assumptions of the wasteload allocations in the TMDL. See 40 CFR § 122.44(d)(1)(vii)(B). Effluent limitations to control the discharge of pollutants generally are expressed in numerical form. However, in light of 33 U.S.C. §1342(p)(3)(B)(iii), EPA recommends that for NPDES-regulated municipal and small construction storm water discharges effluent limits should be expressed as best management practices (BMPs) or other similar requirements, rather than as numeric effluent limits. See *Interim Permitting Approach for Water Quality-Based Effluent Limitations in Storm Water Permits*, 61 FR 43761 (Aug. 26, 1996). The Interim Permitting Approach Policy recognizes the need for an iterative approach to control pollutants in storm water discharges. Specifically, the policy anticipates that a suite of BMPs will be used in the initial rounds of permits and that these BMPs will be tailored in subsequent rounds.

EPA's policy recognizes that because storm water discharges are due to storm events that are highly variable in frequency and duration and are not easily characterized, only in rare cases will it be feasible or appropriate to establish numeric limits for municipal and small construction storm water discharges. The variability in the system and minimal data generally available make it difficult to determine with precision or certainty actual and projected loadings for individual dischargers or groups of dischargers. Therefore, EPA believes that in these situations, permit limits typically can be expressed as BMPs, and that numeric limits will be used only in rare instances.

Under certain circumstances, BMPs are an appropriate form of effluent limits to control pollutants in storm water. See 40 CFR § 122.44(k)(2) & (3). If it is determined that a BMP approach (including an iterative BMP approach) is appropriate to meet the storm water component of the TMDL, EPA recommends that the TMDL reflect this.

EPA expects that the NPDES permitting authority will review the information provided by the TMDL, see 40 C.F.R. § 122.44(d)(1)(vii)(B), and determine whether the effluent limit is appropriately expressed using a BMP approach (including an iterative BMP approach) or a numeric limit. Where BMPs are used, EPA recommends that the permit provide a mechanism to require use of expanded or better-tailored BMPs when monitoring demonstrates they are necessary to implement the WLA and protect water quality.

Where the NPDES permitting authority allows for a choice of BMPs, a discussion of the BMP selection and assumptions needs to be included in the permit's administrative record, including the fact sheet when one is required. 40 C.F.R.§§ 124.8, 124.9 & 124.18. For general permits, this may be included in the storm water pollution prevention plan required by the permit. See 40 C.F.R. § 122.28. Permitting authorities may require the permittee to provide supporting information, such as how the permittee designed its management plan to address the WLA(s). See 40 C.F.R. § 122.28. The NPDES permit must require the monitoring necessary to assure compliance with permit limitations, although the permitting authority has the discretion under EPA's regulations to decide the frequency of such monitoring. See 40 CFR § 122.44(i). EPA recommends that such permits require collecting data on the actual performance of the BMPs. These additional data may provide a basis for revised management measures. The monitoring data are likely to have other uses as well. For example, the monitoring data might indicate if it is necessary to adjust the BMPs. Any monitoring for storm water required as part of the permit should be consistent with the state's overall assessment and monitoring strategy.

The policy outlined in this memorandum affirms the appropriateness of an iterative, adaptive management BMP approach, whereby permits include effluent limits (e.g., a combination of structural and non-structural BMPs) that address storm water discharges, implement mechanisms to evaluate the performance of such controls, and make adjustments (i.e., more stringent controls or specific BMPs) as necessary to protect water quality. This approach is further supported by the recent report from the National Research Council (NRC), *Assessing the TMDL Approach to Water Quality Management* (National Academy Press, 2001). The NRC report recommends an approach that includes "adaptive implementation," i.e., "a cyclical process in which TMDL plans are periodically assessed for their achievement of water quality standards" . . . and adjustments made as necessary. *NRC Report* at ES-5.

This memorandum discusses existing requirements of the Clean Water Act (CWA) and codified in the TMDL and NPDES implementing regulations. Those CWA provisions and regulations contain legally binding requirements. This document describes these requirements; it does not substitute for those provisions or regulations. The recommendations in this memorandum are not binding; indeed, there may be other approaches that would be appropriate in particular situations. When EPA makes a TMDL or permitting decision, it will make each decision on a case-by-case basis and will be guided by the applicable requirements of the CWA and implementing regulations, taking into account comments and information presented at that time by interested persons regarding the appropriateness of applying these recommendations to the particular situation. EPA may change this guidance in the future.

If you have any questions please feel free to contact us or Linda Boornazian, Director of the Water Permits Division or Charles Sutfin, Director of the Assessment and Watershed Protection Division.

cc:
Water Quality Branch Chiefs
Regions 1 - 10

Permit Branch Chiefs
Regions 1 - 10