Amendment to the Monmouth and Ocean Counties Water Quality Management Plans

Fourteen Total Maximum Daily Loads for Total Coliform to Address Shellfish-Impaired Waters in Watershed Management Area 13 Atlantic Coastal Water Region

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EXECUTIVE SUMMARY

In accordance with Section 305(b) and 303(d) of the Federal Clean Water Act (CWA), the State of New Jersey, Department of Environmental Protection (NJDEP) developed the *2004 Integrated List of Waterbodies* addressing the overall water quality of the State's waters and, in Sublist 5, identifying impaired waterbodies for which Total Maximum Daily Loads (TMDLs) may be necessary. The *2004 Integrated List of Waterbodies* was adopted by the Department on October 4, 2004, (36 NJR 4543(a)) as an amendment to the Statewide Water Quality Management Plan, as part of the Department's continuing planning process pursuant to the Water Quality Planning Act at N.J.S.A. 58:11A-7 and the Statewide Water Quality Management Planning rules at N.J.A.C. 7:15-6.4(a). The *2004 Integrated List of Waterbodies* Sublist 5 identifies twenty-four waterbodies that are impaired with respect to total coliform in Watershed Management Area (WMA) 13. In that list, a waterbody was determined to be impaired if it does not fully support shellfish harvest in accordance with National Shellfish Sanitation Program (NSSP) criteria. Portions of some waterbodies that were initially listed as impaired on the *2004 Integrated List of Waterbodies* Sublist 5 were subsequently determined through this study to be ineligible for development of a TMDL for one of several reasons. For some, there was insufficient or no data to develop a TMDL for some waterbodies. Where data was insufficient to develop a TMDL, the waterbodies will remain on Sublist 5 until additional data is obtained to develop a TMDL. Where there was no data, the waterbody was incorrectly listed as impaired and it will be placed on Sublist 3 in the 2006 Integrated List. In addition, based on a spatial analysis of monitoring station locations and best available data, some of these waterbodies were found to be closed according to administrative requirements and not because of water quality data. Closures of waters as the result of administrative precautions will be removed from Sublist 5 and placed on the appropriate Sublist in the 2006 Integrated List of Waterbodies, as the impairment is due to pollution and not pollutants. TMDLs were developed for the shellfish impaired waterbodies that were impaired because of water quality, as listed in Table 1. During the TMDL assessment process, the sampling sites encompassed within each impaired waterbody spatial extent were reevaluated and data from all sites within the spatial extent were considered for TMDL development. The more inclusive sampling site information for the waterbodies is included under "Site IDs Addressed" in Table 1. Some of the waterbodies were divided into smaller sub-groups that reflect more consistent local water quality conditions, watershed characteristics, and local pollution sources for the purpose of establishing more localized load reduction targets.

Table 1. Waterbodies in WMA 13 identified on the *2004 Integrated List of Waterbodies* as impaired for shellfishing

2004 303(d) Listing	Listing Site ID #	Action
Barnegat Bay[(1)]	Barnegat Bay-1 thru 5, 7 thru 31,33 thru 41	TMDL Assessment - Reduction
Beaverdam Creek Estuary[(2)]	1401C, 1401D, 1600, 1600A, 1600B	TMDL Assessment - Reduction

Cedar Creek Estuary-13(3)	R12, Cedar Creek-1	TMDL Assessment - Reduction
Cedar Run-Tidal(4)	R17	TMDL Assessment - Reduction
Ceder Creek Estuary	1702	Unable to assess for TMDL
Coastal Tributaries to Barnegat Bay	1667, 1670, 1672, 1711E, 1918, 1377, 1378	TMDL Assessment – No Reduction in WMA 14 Grouped with Great Bay
Dinner Point Creek Estuary	1713, 1713A, 1713B	TMDL Assessment - No Reduction
Double Creek Estuary(5)	1672, 1672A, 1673, 1673A	TMDL Assessment – Reduction Grouped with Barnegat Bay
Forked River Estuary(6)	1661	TMDL Assessment – Reduction Grouped with Barnegat Bay
Jesse Creek/Thompson Creek Estuary	1807D	TMDL Assessment - No Reduction
Kettle Creek-Tidal(7)	R09, 1614	TMDL Assessment – Reduction Grouped with Barnegat Bay
Little Egg Harbor	Little Egg Harbor-2 thru 4	TMDL Assessment - No Reduction
Manahawkin Bay(8)	Manahawkin Bay-2 thru 10	TMDL Assessment - Reduction
Metedeconk River Estuary(9)	Upper Metedeconk River Estuary-1	TMDL Assessment - Reduction
Mill Creek-Tidal(10)	1706	TMDL Assessment - Reduction
Mystic Island Lagoons	1925, 1926, 1926A	Unable to assess for TMDL
Oyster Creek Estuary(11)	1663	TMDL Assessment – Reduction Grouped with Barnegat Bay
Parker Run Estuary	1801, 1801A, 1801C, 1801D, 1801F	TMDL Assessment - No Reduction
Plohemus Creek - Tidal	1614G	Unable to assess for TMDL
Point Pleasant Canal	1308C, 1601B	Unable to assess for TMDL
Toms River Estuary(12)	Toms River Estuary-1; Toms River/Barnegat Bay-2	TMDL Assessment - Reduction
Tuckerton Creek Estuary(13)	1928A, 1836A-H	TMDL Assessment - Reduction
Westecunk Creek Estuary(14)	1712, 1713C, 1714, 1714A	TMDL Assessment - Reduction
Willis Creek Estuary	1928, 1928B	TMDL Assessment - No Reduction

Footnote: (#) WMA 13 TMDL count.

Nonpoint and stormwater point sources are the primary sources of total coliform loads in these waterbodies. Source loads were estimated for land uses in each watershed and for local marinas that may be causing water quality impacts in these waterbodies. Traditional point sources, i.e., treatment facilities that have a sanitary waste component, were considered de minimus, due to the use of effective disinfection practices by these facilities. TMDLs were developed based on an analysis of the existing pathogen indicator data compared to National Shellfish Sanitation Program (NSSP) and NJDEP pathogen indicator criteria, and the loading capacity has been allocated among the point and nonpoint sources. This TMDL report includes implementation strategies that will bring the subject waterbodies into compliance with the NSSP criteria for unrestricted shellfish harvest.

This report adopts fourteen TMDLs as amendments to the appropriate area-wide water quality management plan in accordance with N.J.A.C. 7:15-3.4(g). This TMDL report was developed consistent with the United States Environmental Protection Agency's (USEPA's) May 20, 2002 guidance document entitled: "Guidelines for Reviewing TMDLs under Existing Regulations issued in 1992," (Sutfin, 2002) which describes the statutory and regulatory requirements for approvable TMDLs. These TMDLs have been adopted as amendments to the Monmouth and Ocean Counties Water Quality Management Plans in accordance with N.J.A.C. 7:15-3.4 (g).

1.0 INTRODUCTION

In accordance with Section 303(d) of the Federal Clean Water Act (CWA) (33 U.S.C. 1315(B)), the State of New Jersey is required biennially to prepare and submit to the USEPA a report that identifies waters that do not meet or are not expected to meet water quality standards after implementation of technology-based effluent limitations or other required controls. This report is commonly referred to as the 303(d) List. In accordance with Section 305(b) of the CWA, the State of New Jersey is also required biennially to prepare and submit to the USEPA a report addressing the overall water quality of the State's waters. This report is commonly referred to as the 305(b) Report or the Water Quality Inventory Report. The *Integrated List of Waterbodies* combines these two assessments and assigns waterbodies to one of five sublists. Sublists 1 through 4 include waterbodies that are generally unimpaired (Sublist 1 and 2), have limited assessment or data availability (Sublist 3), are impaired due to pollution rather than pollutants or have had a TMDL or other enforceable management measure approved by EPA (Sublist 4). Sublist 5 constitutes the traditional 303(d) list for waters impaired or threatened by one or more pollutants, for which a TMDL may be required. In WMA 13, the *2004 Integrated List of Waterbodies* currently identifies twenty-four waterbodies as impaired because they do not fully support shellfish use. In the course of developing TMDLs for the listed impairments, it was determined that portions of the waterbodies that were initially listed as impaired on the *2004 Integrated List of Waterbodies* Sublist 5 were subsequently determined to be ineligible for development of a TMDL for one of several reasons. For some, there was insufficient or no data to develop a TMDL for some waterbodies. Where data was insufficient to develop a TMDL, the waterbodies will remain on Sublist 5. Where there was no data, the waterbody will be placed on Sublist 3 in the 2006 Integrated List until additional data is obtained to develop a TMDL. In addition, based on a

spatial analysis of monitoring station locations and best available data, some of the site identifications were found to be closed as the result of considering administrative requirements and not because of water quality data. Proximity to potential sources such as marinas, development served by septic systems and concentrated stormwater outfall locations warrants precautionary closures of shellfish waters on a seasonal or full time basis. Closures of waters for shellfishing as the result of administrative precautions will be removed from Sublist 5 and placed on Sublist 4C in the 2006 Integrated List of Waterbodies because the impairment is due to pollution and not pollutants. TMDLs were developed for the shellfish impaired waterbodies that were impaired because of water quality.

A TMDL represents the assimilative or carrying capacity of a waterbody, taking into consideration point and nonpoint sources of pollutants of concern, natural background and surface water withdrawals. A TMDL quantifies the amount of a pollutant a waterbody can assimilate and still conform to applicable water quality standards and support designated uses. The TMDL or loading capacity is allocated to known point and nonpoint sources in the form of waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and a margin of safety (MOS).

Recent EPA guidance (Sutfin, 2002) describes the statutory and regulatory requirements for approvable TMDLs, as well as additional information generally needed for EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations. These TMDLs address the following required items in the May 20, 2002 guideline document:

1. Identification of waterbody(ies), pollutant of concern, pollutant sources and priority ranking.
2. Description of applicable water quality standards and numeric water quality target(s).
3. Loading capacity – linking water quality and pollutant sources.
4. Load allocations.
5. Wasteload allocations.
6. Margin of safety.
7. Seasonal variation.
8. Reasonable assurances.
9. Monitoring plan to track TMDL effectiveness.
10. Implementation (USEPA is not required to and does not approve TMDL implementation plans).
11. Public Participation.

This report adopts fourteen TMDLs for total coliform to address the impaired shellfish waters in WMA 13. All of the impaired waterbodies were assigned a High priority ranking in the *2004 Integrated List of Waterbodies* Sublist 5. These TMDLs include management approaches to reduce pathogen contributions from various sources in order to attain applicable surface water quality standards and fully support the designated shellfish use. These TMDLs cover more area then is actually listed as being impaired due to the fact that the implementation plans, as described in detail later in this document, cover entire watersheds, not just the impaired waterbodies. These waterbodies will be moved to Sublist 4

following approval of the TMDLs by USEPA. In addition to the shellfish impairments, Toms River Estuary was also listed as impaired for arsenic, copper, lead, nickel, and zinc on the 2004 *Integrated List*. This waterbody will remain on Sublist 5 for the remaining pollutants, which will be addressed in future TMDL efforts.

2.0 POLLUTANT OF CONCERN AND AREA OF INTEREST

The pollutant of concern for the adopted TMDLs is total coliform, which is measured as an indicator for the presence of pathogens. The National Shellfish Sanitation Program (NSSP) has established criteria for indicator organisms that are used to determine support of the shellfishing use. The NSSP sets forth other requirements for restricting shellfish harvest based on shoreline surveys. Where potential sources, such as wastewater or stormwater outfalls, septic systems or marinas, are present, precautionary restrictions are applied. These shellfish restrictions are referred to as administrative closures and are not appropriate for TMDL development. As discussed, where portions of listed impaired waterbodies were found to be administratively closed, they will be properly placed on Sublists 1, 3 or 4 on the 2006 Integrated List. TMDLs were developed for the waterbodies listed in Table 2 and shown in Figure 1. As an aid to analysis and to help focus implementation efforts, some waterbodies were divided into smaller sub-groups to reflect local water quality conditions, watershed characteristics, and local pollution sources. Sub-groups were delineated based on several criteria including the location of monitoring stations and data availability, the size and spatial extent of each waterbody, the location of possible pathogen sources, and other waterbody/watershed characteristics. A TMDL calculation was made for each waterbody sub-group or the entire waterbody if there were no sub-groups delineated. Waterbody sub-groups are listed in Table 2 and shown in Figure 1. The 2004 New Jersey 303(d) impairment listing for each waterbody (Sublist 5) is also provided in Table 2 for reference.

Table 2. Waterbodies listed for shellfish use impairment in WMA 13

Waterbody	2004 303(d) Listing Site IDs	TMDL Site ID	Sub-group	Percent reduction
Barnegat Bay	Barnegat Bay-1 thru 5, 7 thru 31,33 thru 41	Barnegat Bay-2, 3, 4, 11, 12, 13	A	0%
		Barnegat Bay-16, 21, 32b	B	0%
		Barnegat Bay-22, 26, 28, 31, 34 **Double Creek Estuary** 1672, 1672A, 1673, 1673A **Forked River Estuary** 1661 **Oyster Creek Estuary** 1663	C	50%
		Barnegat Bay-1,5	D	0%
		Barnegat Bay-7,10; **Kettle Creek-Tidal** R09, 1614	E	23%
		Barnegat Bay-14, 15, 17	F	0%
		Barnegat Bay-8,9	G	0%
		Barnegat Bay-40	H	0%
		Barnegat Bay-38	I	0%

Waterbody	2004 303(d) Listing Site IDs	TMDL Site ID	Sub-group	Percent reduction
		Barnegat Bay-36	J	0%
		Barnegat Bay-33, lower part of 23	K	0%
		Barnegat Bay-19, 20, 29, western portion of 23	L	0%
		Barnegat Bay-18, 30, eastern portion of 23	M	40%
Beaverdam Creek Estuary	1401C, 1401D, 1600, 1600A, 1600B	1401C, 1401D, 1600, 1600A	-	41%
Cedar Creek Estuary-13	R12, Cedar Creek-1	R12, Cedar Creek-1	-	48%
Cedar Run-Tidal	R17	R17, 1709		75%
Dinner Point Creek Estuary	1713, 1713A, 1713B	1713, 1713A, 1713B, 1713C; Manahawkin Bay-9	-	0%
Jesse Creek/Thompson Creek Estuary	1807D	1807D, 1807C	-	0%
Little Egg Harbor	Little Egg Harbor-2 thru 4	Little Egg Harbor-2, 3	A	0%
		Little Egg Harbor-4	B	0%
Manahawkin Bay	Manahawkin Bay-2 thru 10	Manahawkin Bay-2 (northern portion)	A	16%
		Manahawkin Bay-2 (southern portion)	B	0%
		Manahawkin Bay-3 through 6	C	0%
		Manahawkin Bay-8	D	0%
		Manahawkin Bay-9	(grouped with Dinner Point Creek)	0%
		Manahawkin Bay-10	F	0%
Metedeconk River Estuary	Upper Medeteconk River Estuary-1	Upper Metedeconk River Estuary-1	-	87%
Mill Creek-Tidal	1706	1706	-	16%
Parker Run Estuary	1801, 1801A, 1801C, 1801D, 1801F	1801, 1801A, 1801C, 1801D, 1801F, 1801E	-	0%
Toms River Estuary	Toms River Estuary-1; Toms River/Barnegat Bay-2	Toms River Estuary-1, Toms River/Barnegat Bay-2	-	74%
Tuckerton Creek Estuary	1928A, 1836A-H	1813A-H, 1928C	-	86%
Westecunk Creek Estuary	1712, 1713C, 1714, 1714A	1712, 1713C, 1714, 1714A	-	87%
Willis Creek Estuary	1928, 1928B	1928, 1928B, 1928A	-	0%

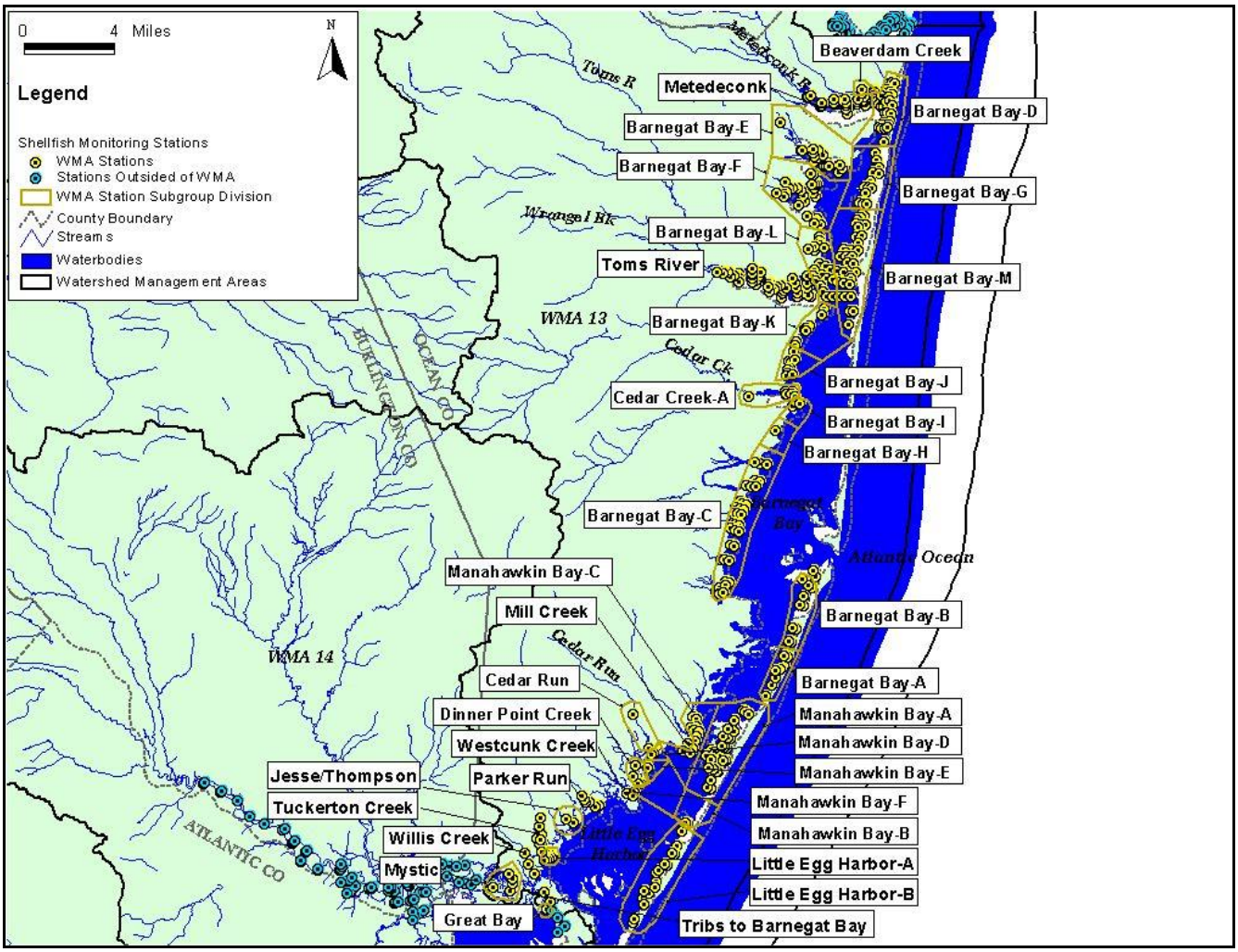

Figure 1. Shellfish impaired waterbodies in WMA 13

2.1 Applicable Water Quality Standards

New Jersey Surface Water Quality Standards (SWQS) include pathogen indicator criteria for the assessment of the recreational use (primary and secondary contact recreation) for all waterbodies (Table 3). New Jersey SWQS also specify that shellfish waters shall meet the guidelines of the National Shellfish Sanitation Program (NSSP). The NSSP guidelines include stringent criteria, expressed in terms of indicator organisms, to protect against the harvest of shellfish in waters where the sanitary quality could have health risks for consumers. Total coliform data are used to assess the shellfish designated use for the waterbodies in all waters according to the New Jersey 2004 Integrated Water Quality Monitoring and Assessment Report. With the exception of the ocean waters, total coliform and fecal coliform data were collected by NJDEP using Systematic Random Sampling (SRS) protocol. Ocean waters were collected using the Adverse Pollution Condition (APC) protocol. The analytical methods used were 3-tube dilution analysis for total coliform and 5-tube analysis for fecal coliform. These TMDLs were developed to meet the NSSP 90th percentile (330 cfu/100ml) and geometric mean (70 cfu/100ml) criteria for total coliform (in colony forming units, or cfu) because this is the basis for determining impairment in the subject waters.

Table 3. Water quality criteria expressed as cfu/100 ml

Bacterial Indicator	NJ Surface Water Quality Standards (SWQS)		National Shellfish Sanitation Program (NSSP)
	Within 1500 ft. of shoreline	1500 ft. to 3 mi. from shoreline	
Total Coliform	N/A	N/A	• Geometric Mean (Geomean) shall not exceed 70 • No more than 10% of samples shall exceed 330 for APC monitoring • Estimated 90th percentile shall not exceed 330 for SRS monitoring
Fecal Coliform	• Geomean shall not exceed 50	• Geomean shall not exceed 200 • No more than 10% in any 30-day period to exceed 400	• Median or geomean shall not exceed 14 • No more than 10% shall exceed 49 for APC monitoring • Estimated 90th percentile shall not exceed 49 for SRS monitoring
Enterococcus	• Geomean shall not exceed 35 • Single sample shall not exceed 104	N/A	N/A

Source: NJDEP SWQS, 2005 and USFDA NSSP Guide for the Control of Molluscan Fish, 2003.
Notes:

- Samples shall be obtained at sufficient frequencies and at locations during periods which will permit valid interpretation of laboratory analyses. A minimum of five samples as equally spaced over a 30-day period, as feasible, should be collected; however, the number of samples, frequencies and locations will be determined by NJDEP or other appropriate agency in any particular case.
- NSSP standards shown are based on a 3-tube decimal dilution test. Additional standards for 5- and 12-tube decimal dilution tests apply.
- For NSSP sampling, sample collection requirements vary based on attributes of the waters where samples are collected (e.g., whether the area is affected by point sources, etc.).
- Standards shown are those that apply to waters approved for shellfish growing. Additional requirements and exceptions may apply and can be found in NJDEP's SWQS and NSSP's guidelines documents.
- APC = Adverse Pollution Conditions. APC sampling occurs in areas with known point sources, including around some marinas.
- SRS = Systematic Random Sampling. SRS sampling methods are used in the majority of shellfish waters and is based on a random statistical sampling approach.

Each year, the Department updates the classification of New Jersey's coastal waters for shellfish harvesting based on analysis of extensive sampling (over 15,000 samples per year) and pollution source surveys. The classifications indicate sanitary coastal water quality. New Jersey has had a long history of improving the sanitary quality of its coastal waters.

In accordance with the NSSP, the Department must also perform a sanitary survey and produce a Local Area Report (LAR) that collects and evaluates information concerning actual and potential pollution sources that may adversely affect the water quality in each growing area. Based on the sanitary survey information, the Department assigns the growing area to one of five classifications. These classifications are summarized below.

Classification	Description
Approved	No restrictions on licensed harvesters
Seasonal (November - April)	Water open for harvest seasonally from Nov - April
Seasonal (January - April)	Water open for harvest seasonally from January - April
Special Restricted	Harvest only by Special Permit. Shellfish harvested must be further purified by relay to Approved waters or processing in a depuration plant prior to being sold.
Prohibited	No harvest under any conditions.

The impaired waterbodies addressed in this document are classified as Saline Estuary 1 (SE1), except for small portions in the upper reaches of tidal streams that are classified as Fresh Water 2 (FW2).

In all SE1 waters the designated uses are:

1. Shellfish harvesting in accordance with N.J.A.C. 7:12;
2. Maintenance, migration and propagation of the natural and established biota;
3. Primary and secondary contact recreation; and
4. Any other reasonable uses.

In all FW2 waters, the designated uses are (from NJAC 7:9B-1.12):

1. Maintenance, migration and propagation of the natural and established aquatic biota;
2. Primary and secondary contact recreation;
3. Industrial and agricultural water supply;
4. Public potable water supply after conventional filtration treatment (a series of processes including filtration, flocculation, coagulation and sedimentation, resulting in substantial particulate removal but no consistent removal of chemical constituents) and disinfection; and
5. Any other reasonable uses.

2.2 Description of Land Use in the Watershed Management Area

WMA 13 includes watersheds draining the central Atlantic drainage of New Jersey. This area lies mostly in Ocean County and includes Barnegat Bay as well as the following subwatersheds: Metedeconk River, Toms River, Forked River, and Cedar Creek. The watershed is located in the Coastal Plain physiographic province, which is characterized by low-lying topography. WMA 13 is approximately 50% forested, with the remainder in residential developments, a military installation and agriculture. There has been a substantial amount of new residential and commercial development throughout the watershed in the past five years. Table 4 shows the land use distribution among the waterbody subgroup watersheds. Land use data for each watershed were derived from the 1995/1997 land use/land cover dataset developed for New Jersey.

Table 4. Land use area distribution in WMA 13 subgroup watersheds

Waterbody	Subgroup	Agriculture		Barren Land		Forest		Urban		Water		Wetlands		Total Area
		km²	%	km²	%	km²	%	km²	%	km²	%	km²	%	km²
Barnegat Bay	A	0.00	0.0%	0.00	0.0%	0.02	1.4%	0.96	86.6%	0.07	6.7%	0.06	5.3%	1.11
Barnegat Bay	B	0.00	0.0%	0.02	0.5%	0.06	1.2%	2.23	46.4%	0.60	12.4%	1.90	39.5%	4.81
Barnegat Bay	C	0.14	0.1%	1.48	1.1%	79.72	58.8%	20.12	14.9%	3.71	2.7%	30.29	22.4%	135.46
Barnegat Bay	D	8.54	3.6%	3.01	1.3%	62.95	26.3%	94.07	39.4%	8.36	3.5%	62.01	26.0%	238.94
Barnegat Bay	E	0.59	1.5%	0.87	2.2%	10.91	27.2%	20.34	50.8%	3.31	8.3%	4.05	10.1%	40.07
Barnegat Bay	F	0.07	0.3%	0.14	0.6%	3.64	14.6%	13.23	53.0%	0.62	2.5%	7.26	29.1%	24.97
Barnegat Bay	G	0.00	0.0%	0.00	0.2%	0.02	0.8%	1.96	79.1%	0.49	19.6%	0.01	0.4%	2.48
Barnegat Bay	H	0.33	2.9%	0.00	0.0%	1.51	13.5%	3.16	28.2%	0.97	8.7%	5.22	46.6%	11.19
Barnegat Bay	I	0.00	0.0%	0.00	0.0%	0.06	3.7%	1.09	72.3%	0.11	7.5%	0.25	16.5%	1.51
Barnegat Bay	J	0.02	0.2%	0.07	0.9%	2.28	27.9%	2.88	35.3%	0.16	2.0%	2.76	33.7%	8.17
Barnegat Bay	K	0.05	0.4%	0.06	0.5%	1.73	13.9%	4.09	32.8%	0.72	5.8%	5.80	46.6%	12.45
Barnegat Bay	L	11.96	2.4%	19.60	3.9%	235.19	46.6%	126.93	25.1%	14.27	2.8%	97.19	19.2%	505.14
Barnegat Bay	M	0.00	0.0%	0.12	2.2%	0.04	0.7%	4.79	89.4%	0.37	6.9%	0.03	0.6%	5.36
Beaverdam Creek Estuary	-	0.01	0.0%	0.23	1.1%	2.44	11.7%	14.28	68.1%	1.31	6.3%	2.68	12.8%	20.95
Cedar Creek Estuary-13	A	0.66	0.5%	4.61	3.2%	98.50	69.1%	9.20	6.5%	1.77	1.2%	27.77	19.5%	142.51
Cedar Run-Tidal	-	0.02	0.1%	0.45	2.1%	14.65	67.4%	1.39	6.4%	0.23	1.1%	5.00	23.0%	21.74
Dinner Point Creek Estuary	-	0.00	0.0%	0.09	0.7%	2.05	17.0%	0.43	3.5%	0.36	3.0%	9.12	75.7%	12.05
Great Bay	-	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.00	0.0%	0.85	21.3%	3.14	78.7%	3.99
Jesse/ Thompson	-	0.00	0.0%	0.01	0.3%	1.73	37.2%	0.62	13.4%	0.15	3.3%	2.13	45.8%	4.65
Little Egg Harbor	A	0.06	0.1%	0.70	1.7%	29.14	70.1%	5.92	14.2%	0.75	1.8%	5.02	12.1%	41.59
Little Egg Harbor	B	0.00	0.0%	0.01	0.3%	0.02	0.7%	2.20	84.0%	0.14	5.4%	0.25	9.6%	2.62
Manahawkin Bay	A	0.00	0.0%	0.00	0.0%	0.02	0.5%	3.04	97.8%	0.05	1.7%	0.00	0.0%	3.11
Manahawkin Bay	B	0.00	0.0%	0.00	0.0%	0.06	7.9%	0.61	83.9%	0.03	3.9%	0.03	4.3%	0.73
Manahawkin Bay	C	0.24	0.3%	1.78	2.2%	38.38	46.9%	16.61	20.3%	2.51	3.1%	22.35	27.3%	81.87
Manahawkin Bay	D	0.02	0.1%	0.47	1.9%	14.78	58.4%	1.58	6.2%	0.32	1.3%	8.14	32.2%	25.31
Manahawkin Bay	F	0.47	0.7%	0.52	0.8%	44.36	68.1%	3.14	4.8%	0.71	1.1%	15.91	24.4%	65.13
Metedeconk River Estuary	-	8.53	4.2%	2.75	1.4%	59.49	29.3%	71.66	35.3%	6.02	3.0%	54.36	26.8%	202.82
Mill Creek-Tidal	-	0.18	0.3%	1.70	2.7%	37.22	59.0%	13.97	22.1%	1.97	3.1%	8.05	12.8%	63.08

Waterbody	Subgroup	Agriculture		Barren Land		Forest		Urban		Water		Wetlands		Total Area
		km²	%	km²	%	km²	%	km²	%	km²	%	km²	%	km²
Parker Run-Estuary	-	0.00	0.0%	0.02	0.6%	1.39	35.2%	0.96	24.4%	0.12	3.1%	1.45	36.7%	3.95
Toms River Estuary	-	11.96	2.4%	19.60	3.9%	234.83	47.3%	121.42	24.4%	13.52	2.7%	95.52	19.2%	496.84
Tuckerton Creek Estuary	-	0.04	0.1%	0.45	1.2%	26.95	72.8%	4.78	12.9%	0.63	1.7%	4.18	11.3%	37.04
Westecunk Creek Estuary	-	0.47	0.7%	0.52	0.8%	44.36	68.1%	3.14	4.8%	0.71	1.1%	15.91	24.4%	65.13
Willis Creek Estuary	-	0.01	0.1%	0.28	3.4%	2.46	29.5%	1.47	17.7%	0.37	4.4%	3.75	44.9%	8.35

Notes: - The land area values for Barnegat Bay D include contributions from Metedeconk River Estuary and Beaverdam Creek Estuary.
- The land area values for Barnegat Bay L include contributions from Toms River Estuary.
- The land area values for Manahawkin Bay C include contributions from Mill Creek-Tidal.
- The land area values for Manahawkin Bay D include contributions from Cedar Run-Tidal.
- The land area values for Manahawkin Bay F include contributions from Westecunk Creek Estuary.
- The land area values for Little Egg Harbor A include contributions from Tuckerton Creek Estuary and Willis Creek Estuary.

3.0 SOURCE ASSESSMENT

A source assessment was conducted to identify and characterize potential pathogen sources that may be impacting water quality and shellfish growing areas in the listed waters. Point and nonpoint sources of total coliform were considered in TMDL development. Source assessment also included the determination of the relative contribution of the primary bacteria sources to facilitate proper management responses through TMDL implementation. A variety of information was used to characterize possible pathogen sources including shoreline surveys conducted by the Department, land use information gathered for each watershed, point source information, literature sources, and other available data.

3.1 Shoreline Surveys

Barnegat Bay is the primary waterbody in WMA 13 and is divided into four shoreline survey areas, as detailed below. Local Area Reports (LARs) were completed for each shoreline survey area by the Department to characterize shellfish growing areas, surrounding land uses, and potential pollution sources in the watershed. These reports satisfy the requirements of the NSSP program by providing information on local shellfish growing areas. This information is also used by the Department in the assessment process and for determining impairment status. The data contained in these reports was used to help identify and characterize the pathogen sources that may be impacting the shellfish harvest areas located within each TMDL waterbody sub-group. Note that recent data collected by

NJDEP regarding shellfish classifications (2004 GIS coverage) and pollution sources may not be reflected in these reports. Updated information on the point and nonpoint sources identified and the respective loading estimates are provided in the following source assessment sections.

The 2004 shellfish classification GIS coverage was used to cross-reference with TMDL waterbody sub-groups. A summary of the information presented in the most recent LAR for each shoreline survey area is presented below.

- BB-1: Barnegat Bay North (Bayhead to Bay Shore)
  This area includes Barnegat North, Metedeconk River, Kettle Creek, and Silver Bay.

- BB-2: Central Barnegat Bay (Bay Shore to Sunrise Beach)
  A reappraisal report for BB-2 was published in May 2005 and represents the data collection period: 1999-2002. This area encompasses the shellfish waters of the Toms River, Cedar Creek, and the central part of Barnegat Bay. The shellfish growing area is approximately 13,500 acres in size. Most of the shellfish waters in this area were classified as Approved, with Seasonal and Special Restricted areas acting as buffer zones along the developed sections of the shoreline. The inland waters of the Toms River are classified as Prohibited for shellfishing. The eastern portion of the Toms River is currently classified as Special Restricted, due to recent water quality improvements that warranted upgrading from the previous Prohibited status. Bacteria levels in the Toms River are primarily caused by nonpoint source discharges from overland flow and stormwater discharges. There are no known effluent discharges into this area. All sewage plant discharges are directed to the Atlantic Ocean via pipeline, however, a couple of small treatment systems remained. Sanitary wastewater generated in the Toms River-Barnegat Bay growing area is treated by the Ocean County Utilities Authority (OCUA) Central Facility. Numerous stormwater outfalls are located throughout the area and are responsible for elevated bacteria levels. In addition, there were 46 marinas identified in the Central Barnegat Bay area (180 marinas in Ocean County). Waters enclosed by marinas are classified as Prohibited, depending on the size of the marina and water quality. Buffers areas around marinas were classified as Prohibited, Special Restricted, or Seasonally Approved. Land use includes urban, forest, and wetland areas. Shoreline areas are highly developed and have large summer time populations. Seaside Park and surrounding areas are well known tourist areas on the Jersey Shore during the summer months. Major wetland areas are located within Island Beach State Park and Good Luck Point. Significant waterfowl populations also use this area. Septic failures and leaking sewer lines are also potential bacteria sources in the watershed.

- BB-3: Sunrise Beach to Westecunk Creek
  A partial sanitary survey was published for this area in March 2004 and represents the data collection period: 1997-2001. This area covers the shellfish waters from southern Barnegat Bay to northern Little Egg Harbor, including Barnegat Bay Inlet, Forked River, and Manahawkin Bay. The shellfish growing area is approximately 40,060 acres in size. The majority of the shellfish waters are classified as Approved, with several small sections of Seasonally Approved, Special Restricted, and Prohibited waters which act as buffers for

the developed shoreline areas. The Oyster Creek Nuclear Generating Station is the only discharge facility identified along the shellfish waters. This facility only contributes non-contact cooling water. Wetland and forested areas are the primary land use types with interspersed urban development. There are currently 51 marinas in the area. Waters enclosed by marinas are classified as Prohibited, depending on the size of the marina and water quality. Buffers areas around marinas were classified as Prohibited, Special Restricted, or Seasonally Approved. Water quality impacts from stormwater runoff and marina contributions, especially during the summer months are the primary sources. Waterfowl populations also contribute to water quality problems.

- BB-4: Westecunk Creek to Little Sheepshead Creek
  This area includes Little Egg Harbor South and Beach Haven Inlet.

3.2 Assessment of Point Sources

For TMDL development purposes, point sources include domestic and industrial wastewater treatment plants that discharge to surface waters, as well as surface water discharges of stormwater subject to regulation under the National Pollutant Discharge Elimination System (NPDES). This includes facilities with individual or general industrial stormwater permits, Tier A municipalities, and federal, interstate agency, state, and county facilities regulated under the New Jersey Pollutant Discharge Elimination System (NJPDES) municipal stormwater permitting program. Tier A municipalities are generally located within the more densely populated regions of the state or along the coast. These municipalities meet the population size requirements of EPA's Municipal Separate Storm Sewer System (MS4) program for regulating urban stormwater discharges. Stormwater point sources, like nonpoint sources, derive their pollutant loads from runoff from land surfaces and load reduction is accomplished through the use of best management practices (BMPs). The distinction is that stormwater point sources are regulated under the Clean Water Act (under the MS4 program). Stormwater point sources are or will be addressed through the management practices required through the discharge permits.

There are no treatment facilities in WMA 13 with the potential to contribute to the impaired waterbodies addressed in this TMDL report. Tier A municipalities that directly discharge to the shellfish waters in WMA 13 or tributaries that eventually flow into these waters are identified in Appendix C. Stormwater loads from Tier A MS4 systems are point sources that can be significant. These loads were estimated using the watershed loading methods described in the nonpoint source section, as they will be addressed through BMPs.

3.3 Assessment of Nonpoint Sources

Nonpoint sources that may affect shellfish waters include stormwater discharges that are not subject to regulation under the Clean Water Act, including Tier B municipalities, direct stormwater runoff from land surfaces, as well as malfunctioning sewage conveyance systems, failing or inappropriately located septic systems, and direct contributions from wildlife, livestock and pets. Tier B municipalities are generally located in more rural, non-

coastal regions of the state. Tier B municipalities located in the affected drainage areas are identified in Appendix C.

Alternative methods were considered to determine the best approach for estimating land-based loads contributed by each watershed, including the Watershed Treatment Model (WTM) a study of nonpoint source loadings generated in a study of the Toms River watershed, and simpler bacteria load estimation equations. The WTM model was selected because it encompasses local rainfall data and stream length information to better tailor load estimates. In addition, it has been successfully applied in previous coastal TMDL studies (Oyster Bay-New York, U.S. Virgin Islands TMDLs). The goal of applying WTM is to characterize all the point and nonpoint sources, as available data allows, in the existing system and to determine their relative contributions to the waterbody of interest. The loading values thus derived, along with the loads contributed by marinas as discussed below, serve as the reference point from which reductions are made to meet TMDL targets.

The WTM model is a series of spreadsheets that quantifies the loading of pathogen indicators based on land use distribution, stream network length in the watershed, and annual rainfall. The model is designed as a planning level tool for watersheds that do not have sufficient data for complex modeling applications. Although the WTM model has several tiers of data specificity, loading estimates can be calculated with simple land use data, as they were for these shellfish TMDLs. Land use loads are calculated on an annual basis by using a series of coefficients for runoff volume and pathogen loading derived from scientific literature. General land use categories are assigned either a coefficient that is then multiplied by an annual runoff volume to calculate an annual load (e.g., urban land uses), or an annual unit area load that is applied as a function of land use (e.g., rural land uses). These coefficients, presented in Table 5, were chosen based upon the best available research and are summarized in WTM's user manual (Caraco, 2001).

Table 5. Default WTM land use categories and loading variables

WTM Land Use	Corresponding New Jersey Land Uses	Average % Impervious Cover	Fecal Coliform Conc. (MPN/100 ml) or Annual Load (billion/acre)
Low Density Residential	Low Density Residential, Rural Residential, Recreational Land, Athletic Fields	19	20,000
Medium Density Residential	Medium Density Residential, Mixed Residential, Mixed Urban or Built-Up, Other Urban or Built-Up, Military Reservations, No Longer Military	35	20,000
High Density Residential	High Density Residential	56	20,000
Commercial	Commercial Services	71	20,000
Roadway	Transportation/Communication/Utilities	39	20,000
Industrial	Industrial, Industrial/Commercial	78	20,000
Forest	Forest	0	Load: 12 billion/acre
Rural	Agriculture	0	Load: 39 billion/acre
Barren (replaced "Vacant Lots" category in WTM)	Barren	2	Load: 12 billion/acre (estimated)

The default fecal coliform loading rates in the WTM model were converted to total coliform values based on a regression equation developed to examine the relationship between fecal coliform and total coliform concentrations using New Jersey shellfish monitoring data collected from 1991 through 2004. Fecal coliform is a component of total coliform, therefore, the loading values were increased based on this equation.

The potential to accurately convert observed fecal coliform values to equivalent total coliform values is supported by a November 1996 study by Espy, Huston, and Associates, Inc. This study investigated public health issues related to recreational and commercial fisheries use of Corpus Christi Bay, Texas produced for the Corpus Christi Bay National Estuary Program (Jensen et al., 1996). A significant correlation (R^2=85.7%) was found between total and fecal coliform concentrations reported for water samples collected in shared sampling quadrants when plotted on a logarithmic scale. The regression equation derived from the Texas data, converted into an exponential expression ($TC=1.69*FC^{1.013}$) is very similar to the equation derived from water quality data analyzed as part of these TMDLs ($TC=1.22*FC^{1.061}$).

The watershed for each TMDL waterbody sub-group was delineated using the Hydrologic Unit Coverage (HUC-14 digit) developed by NJDEP, digital elevation model (DEM) data, and the National Hydrography Dataset (NHD) stream coverage for New Jersey. Land use data for each watershed was obtained from the 1995/1997 land use coverage developed for New Jersey's WMAs. Land use categories were consolidated into broader groups for use in estimating land-based loads using the WTM model and for presenting the loading results. The percent impervious information for each land use category was derived from the percent impervious information in the Department's GIS land use coverage, averaged across similar land uses. The bacterial loads for urban areas in each watershed were calculated based on the default fecal coliform concentration literature value for urban land uses, the average percent impervious cover, and the annual runoff volume calculated by the WTM model. Agricultural, forest, and barren land use loads were calculated based on the specific loading rate for each category. Wetland areas and waterways were not included in loading calculations based on WTM model assumptions.

In addition to land-based sources, pathogens can also be associated with direct discharges from boats at marinas. This potential source can be a primary cause of high bacteria concentrations in and around marinas. The bacteria load from inappropriate and illicit wastewater discharges in marinas and mooring locations was estimated based on the Department's marina GIS coverage. This dataset includes information on the number of boat slips and boat sizes typical of each marina. The marina formula presented in the Department's shoreline surveys (LARs) was used to calculate the bacteria load for each marina. Marina loads were calculated for the summer months (May – September). In addition, marina loads were multiplied by a factor of 0.25 to recognize a lower contribution during other months (October through April) based on best professional judgment. The marina formula was updated to calculate total coliform loads based on the total coliform-fecal coliform regression equation developed for this TMDL study, as described in the WTM model discussion above. Marinas associated with each waterbody (or sub-group) and the calculated total coliform/fecal coliform loads are presented in Appendix D.

The equation used to estimate fecal coliform loads from marina buffers is:

$$FC\,/\,day = 2x10^{9}(FC\,/\,person\,/\,day)x2(person\,/\,boat)x[(.25slips \geq 24') + (0.065 \times slips < 24')]$$

Explanation of terms in equation:

Fecal coliform per person per day:	2×10^{9}
Number of people per boat:	2
For slips able to accommodate boats > 24 feet (combination of factors yields multiplier of 0.25):	
Number of slips occupied:	50%
Number of boats occupied:	50%
For boats < 24':	6.5% discharge waste

Direct contributions from illicit discharges, livestock, pets, and wildlife (e.g. seagulls, geese, and other waterfowl in particular) were not estimated based on the lack of site-specific information needed to represent these sources. Note that waterfowl direct deposition in some shellfish areas was mentioned as a likely source according to several published shoreline survey reports for New Jersey. Population estimates, bacteria production rates, and other information would be needed to estimate these sources. Bacteria may also be present in the sediment in some areas, as a result of contamination from stormwater, failing septic systems, malfunctioning sewer systems, agricultural runoff, and other sources. For these TMDLs, the loads contributed by wildlife, sediment, and the other sources were assumed to be included in the land use loading coefficients.

Pathogen indicator source data used in TMDL development are shown in Figures 2 through 6. Land uses, NJPDES-permitted wastewater treatment facilities, marinas, stormwater outfalls, and water quality stations are shown in these maps.

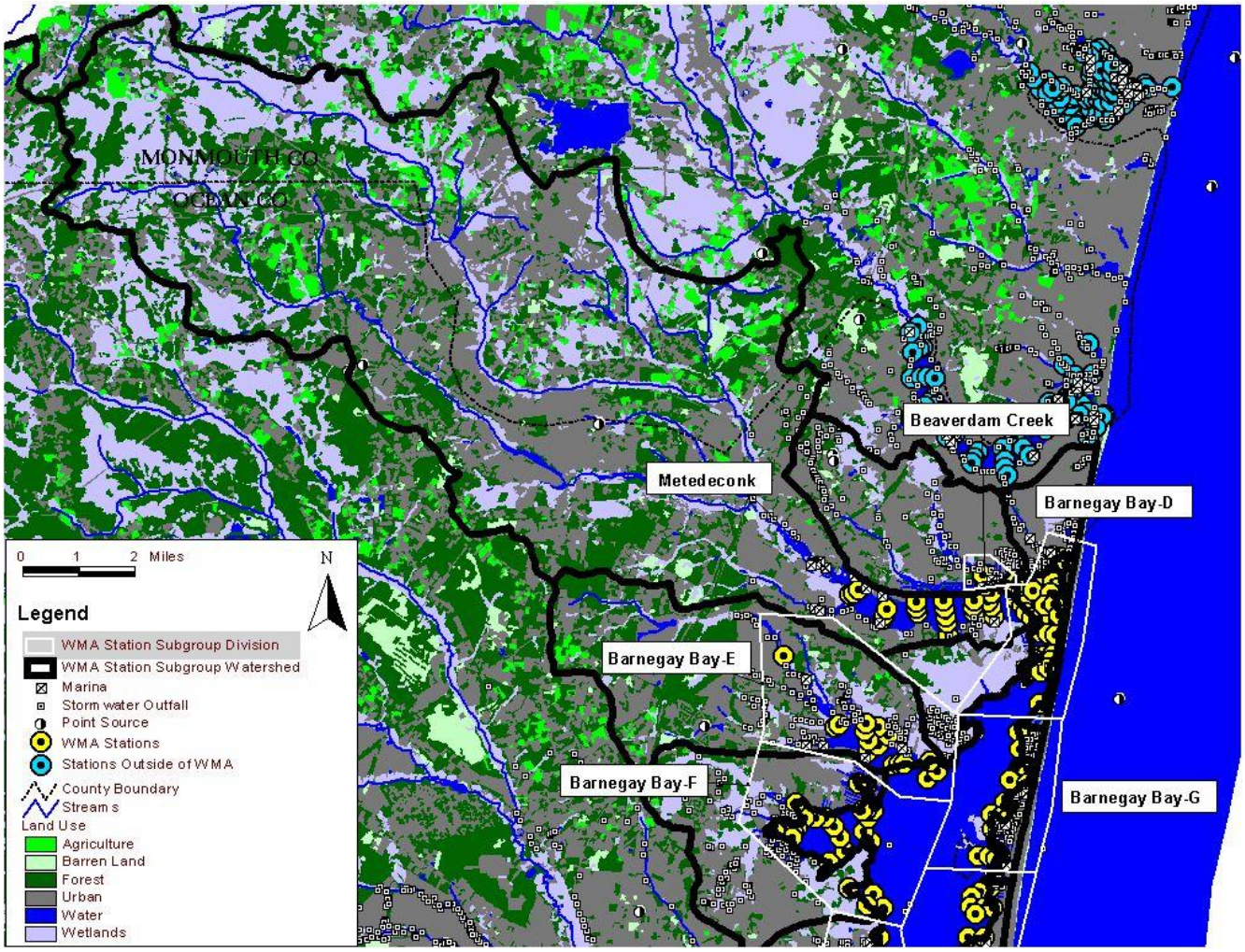

Figure 2. Primary pathogen indicator source data used in TMDL development for northern portions of WMA 13

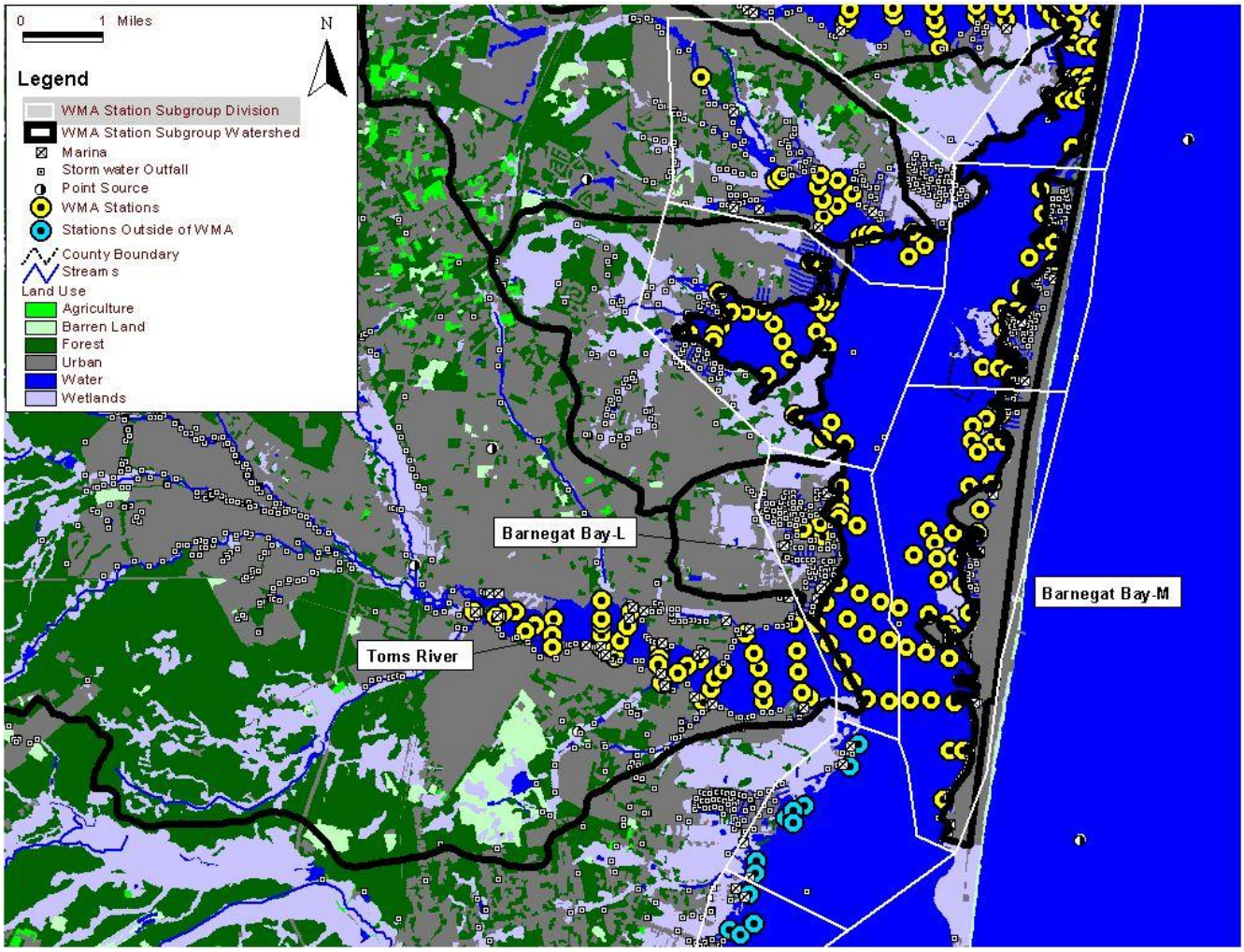

Figure 3. Primary pathogen indicator source data used in TMDL development for northern portions of WMA 13

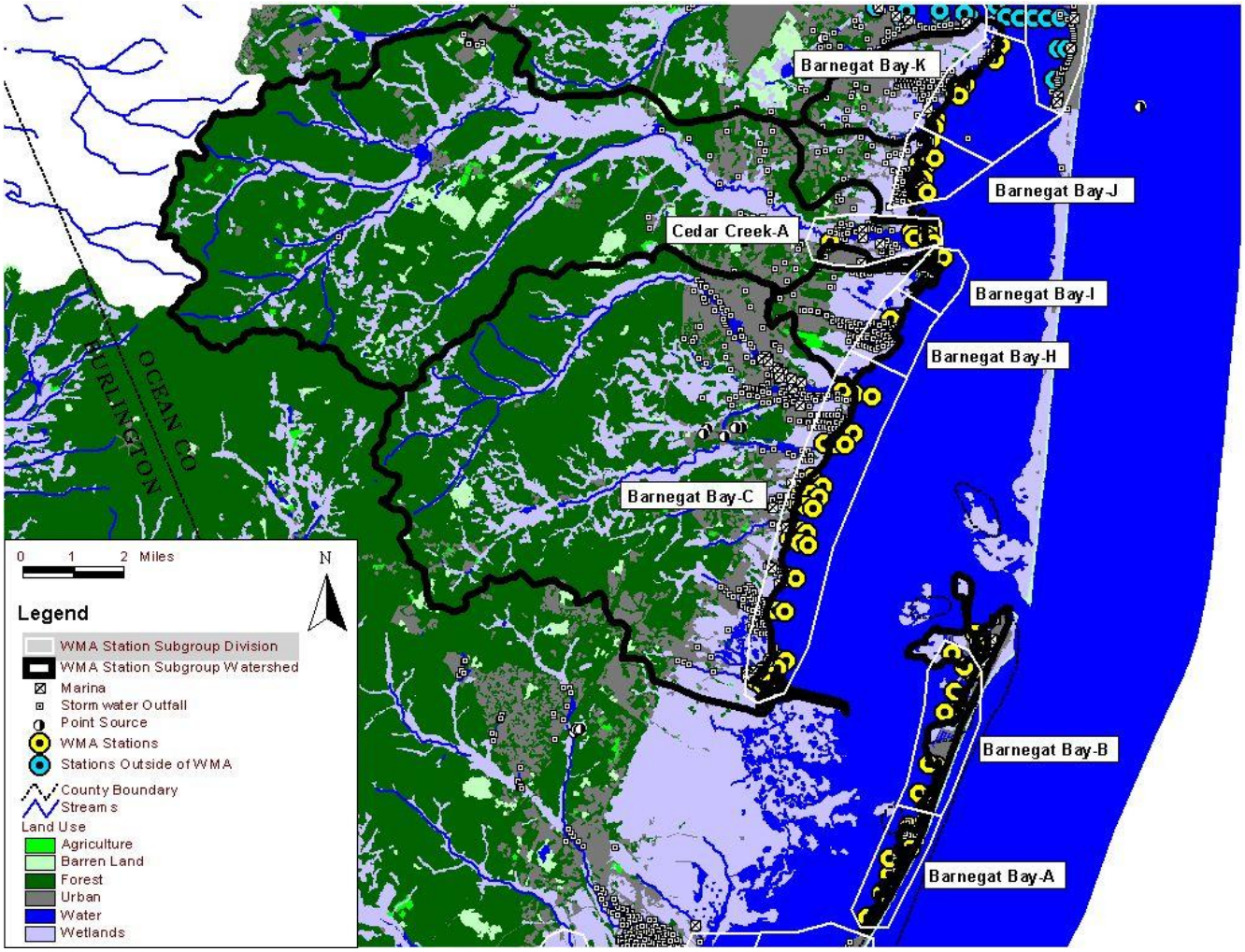

Figure 4. Primary pathogen indicator source data used in TMDL development for central portions of WMA 13

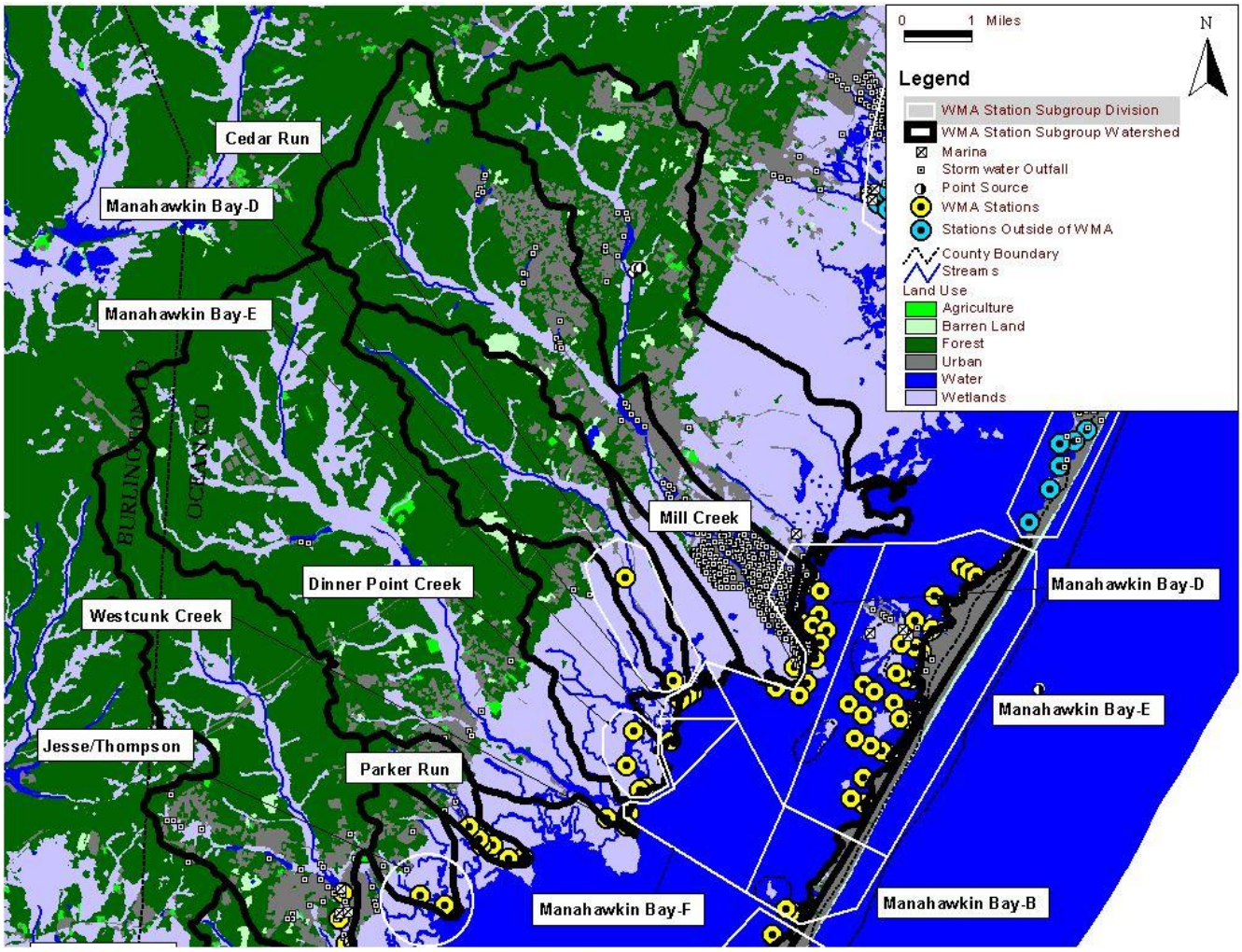

Figure 5. Primary pathogen indicator source data used in TMDL development for southern portions of WMA 13 (southern map 1)

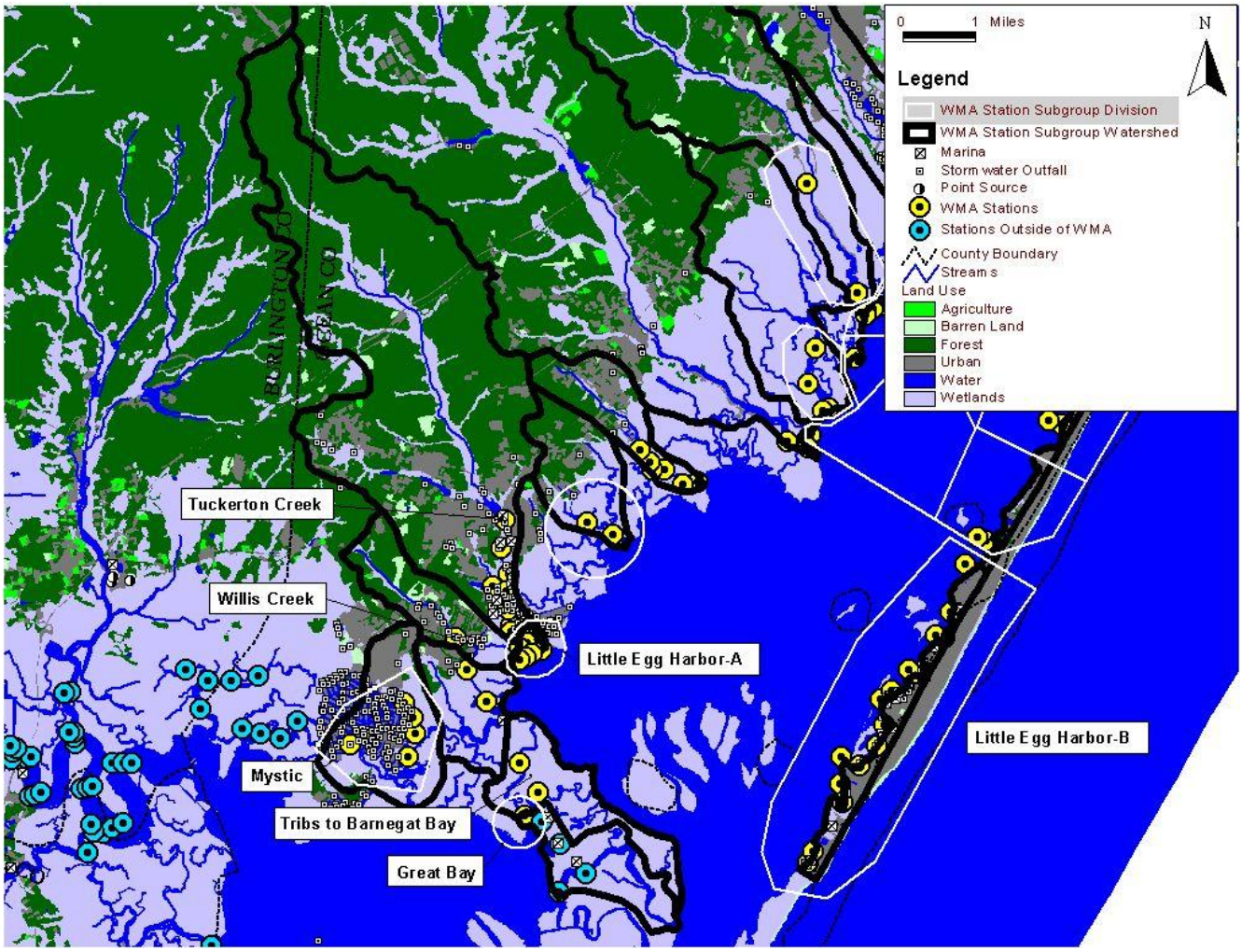

Figure 6. Primary pathogen indicator source data used in TMDL development for southern portions of WMA 13 (southern map 2)

4.0 WATER QUALITY ANALYSIS

Relating pathogen sources to concentrations of bacterial indicators in the impaired waters is distinguished from quantifying that relationship for other pollutants given the inherent variability in population size and dependence not only on physical factors such as temperature and soil characteristics, but also on less predictable factors such as re-growth media. Since bacteria loads and concentrations can vary many orders of magnitude over short distances and over time at a single location, dynamic water quality models can be very difficult to calibrate. Options available to control nonpoint sources of bacteria typically include measures such as sewage infrastructure improvements, goose management strategies, pet waste ordinances, agricultural conservation management plans, and septic system replacement and maintenance. The effectiveness of these control measures is not easily measured relative to observed ambient concentrations. Given these considerations, detailed water quality modeling was not selected for determining the load reductions needed to attain standards and support the designated shellfish use.

Shellfish monitoring data collected by the Department, in accordance with NSSP guidelines, were used as the basis for TMDL development for the listed shellfish waters. Total coliform data were used to assess the shellfish designated use for the listed waterbodies in WMA 17 according to the New Jersey 2004 *Integrated Water Quality Monitoring and Assessment Report*; therefore, total coliform data were used in TMDL development. As described in Section 3.0, each waterbody was divided into smaller sub-groups (as necessary) in order to better represent local water quality conditions, watershed characteristics, and local pollution sources and, thereby inform implementation efforts. The data collected for each waterbody sub-group (or the entire waterbody if not sub-divided) were compared to the NSSP criteria for total coliform. In order to account for the spatial distribution in pathogen sources, critical conditions, and other TMDL considerations, the "worst case" station within each waterbody (or sub-group) was identified and used in TMDL development. Monitoring data collected at stations located within marina buffer areas were not included in the analysis because these areas will remain restricted for shellfish harvest as a precautionary measure. Seasonal trends and other factors were evaluated to determine the critical condition period for TMDL development, as described in the next section. Critical condition analyses indicated that bacteria concentrations were typically higher during summer months, therefore, summer data (collected during May-September) were exclusively used in the analysis.

"Worst case" stations were identified based on the calculated 90th percentile (arithmetic), median, data period (emphasis on recent data), and sample size (priority given to stations with sample sizes >20). The "worst case" station identified for each waterbody (or sub-group) is shown in Table 6, along with summary data statistics. The data collected at each "worst case" station were then used to develop TMDLs for each respective waterbody (or sub-group). The percent reduction required was based on the difference between the calculated 90th percentile (using the FDA method specified in NSSP guidelines) and the NSSP 90th percentile criteria or the calculated geometric mean and the NSSP geometric mean criteria whichever was greater. Source loads were then reduced for each waterbody (or sub-group) to meet the overall percent reduction required.

As a result of this analysis, several waterbodies (or sub-groups) were found to meet the NSSP criteria. The listing of these waterbodies reflects application of the shoreline survey information in making water classifications. Critical to the shoreline survey is the identification of potential pollution sources that may intermittently impact water quality and not be detected by water samples collected 5-12 times a year. According to the NSSP *Guide for the Control of Molluscan Shellfish*, if in the judgment of the state authority, pollution sources present an actual or potential public health hazard, those waters cannot be classified as "Approved". Shellfish harvest restrictions that are imposed because of the shoreline surveys will remain restricted, regardless of water quality. Therefore, development of a TMDL for these areas is not generally appropriate. These areas will be reassigned on the 2006 Integrated List. In areas subject to administrative closure where water quality conforms to criteria, the areas will be placed on Sublist 1; where there is insufficient data to determine conformance with the criteria, the areas will be placed on Sublist 3; where the water quality does not conform to the criteria, but the areas would not be open even if water quality improved, the areas will be placed on Sublist 4, as the impairment is due to pollution, not

pollutants. In WMA 13, two waterbodies, Big Creek Estuary and Mystic will be moved to Sublist 3.

Table 6. Worst case stations in WMA 13

Waterbody	Subgroup	Worst Case Station	Parameter	Count*	Start Date	End Date	90th Percentile* (arithmetic)	Geometric Mean*	Median*
Barnegat Bay	A	1680B	Total Coliform	95	7/7/80	11/18/04	23	5	4
Barnegat Bay	B	1686	Total Coliform	39	6/26/80	11/18/04	284	13	9
Barnegat Bay	C	1673A	Total Coliform	54	7/7/80	3/25/04	1100	42	43
Barnegat Bay	D	1600D	Total Coliform	64	2/17/84	3/30/04	460	37	43
Barnegat Bay	E	1614	Total Coliform	28	10/17/88	3/2/04	460	53	43
Barnegat Bay	F	1618A	Total Coliform	96	6/5/84	11/19/04	240	20	23
Barnegat Bay	G	1617D	Total Coliform	91	6/7/84	10/29/04	240	21	15
Barnegat Bay	H	1652	Total Coliform	37	6/5/84	10/9/91	150	23	23
Barnegat Bay	I	1650B	Total Coliform	67	6/5/84	7/8/04	150	17	15
Barnegat Bay	J	1643	Total Coliform	66	6/5/84	11/10/04	460	22	19
Barnegat Bay	K	1635	Total Coliform	85	6/1/84	4/2/04	240	20	23
Barnegat Bay	L	1633	Total Coliform	88	6/1/84	3/1/04	460	34	23
Barnegat Bay	M	1631E	Total Coliform	86	6/1/84	7/21/04	780	37	33
Beaverdam Creek Estuary	-	1600	Total Coliform	11	2/17/84	2/24/04	240	42	43
Cedar Creek Estuary-13	-	1648B	Total Coliform	68	6/5/84	9/30/04	1100	63	59
Cedar Run-Tidal	-	1709	Total Coliform	71	1/21/80	12/10/04	1100	109	93
Dinner Point Creek Estuary	-	1713B	Total Coliform	65	6/8/81	3/2/04	460	27	23
Great Bay	-	1916A	Total Coliform	103	7/11/80	12/16/04	23	6	4
Jesse/ Thompson	-	1807C	Total Coliform	43	6/10/81	9/27/91	93	13	9
Little Egg Harbor	A	1815B	Total Coliform	95	2/21/80	4/22/04	240	21	15
Little Egg Harbor	B	1829	Total Coliform	86	6/2/81	10/13/04	460	27	23
Manahawkin Bay	A	1725	Total Coliform	41	6/5/81	2/20/04	460	33	23

Waterbody	Subgroup	Worst Case Station	Parameter	Count*	Start Date	End Date	90th Percentile* (arithmetic)	Geometric Mean*	Median*
Manahawkin Bay	B	1717A	Total Coliform	83	6/5/81	12/13/04	36	6	4
Manahawkin Bay	C	1704	Total Coliform	82	1/21/80	3/2/04	438	39	43
Manahawkin Bay	D	1710B	Total Coliform	68	1/21/80	3/2/04	460	54	43
Manahawkin Bay	F	1714	Total Coliform	65	6/8/81	12/10/04	1100	67	93
Metedeconk River Estuary	-	1403	Total Coliform	8	10/17/00	6/24/03	1490	138	240
Mill Creek-Tidal	-	1706	Total Coliform	75	1/21/80	10/26/04	460	37	29
Parker Run-Estuary	-	1801	Total Coliform	103	6/10/81	10/14/04	83	11	9
Toms River Estuary	-	1506	Total Coliform	35	5/14/90	10/1/04	1880	215	240
Tuckerton Creek Estuary	-	1813D	Total Coliform	54	2/21/80	9/16/03	2400	443	460
Westecunk Creek Estuary	-	1712	Total Coliform	60	6/8/81	1/6/04	2400	155	240
Willis Creek Estuary	-	1928	Total Coliform	25	2/21/80	4/22/04	43	8	7

* Concentration expressed in cfu/100 ml
Green highlighted, worst case stations meet NSSP standards.

4.1 Seasonal Variation/Critical Conditions

The technical approach used to develop these TMDLs includes conservative assumptions that take into account seasonal variability and critical conditions. Tidal waterbodies are difficult to assess given the dynamic flow regime, flushing characteristics, spatial and temporal variability in pathogen sources and contributions, watershed characteristics, and other factors. Seasonal trends were evaluated to determine the critical condition period for TMDL development. The results of this analysis indicated that bacteria concentrations were typically higher during summer months. The influx of summer vacationers and the resulting increase in septic and potential leaking sewer volumes, increased marina and boat use, and other factors contribute to this seasonal trend. Rainfall and flow impacts were also evaluated, but correlation results did not show a clear relationship between bacteria concentrations and these factors. As a result, TMDLs were developed based on summer data collected at the "worst case" station identified for each waterbody (or sub-group). Figure 7 shows the seasonal trend in shellfish monitoring data for "worst case" stations located in WMA 13.

This conservative approach takes into account seasonal variation and critical conditions because only the data collected during summer months were used to identify "worst case" stations and for determining the TMDL percent reduction required and load allocations. These assumptions are consistent with previous freshwater TMDLs developed in New Jersey and recent shellfish TMDLs developed in New York.

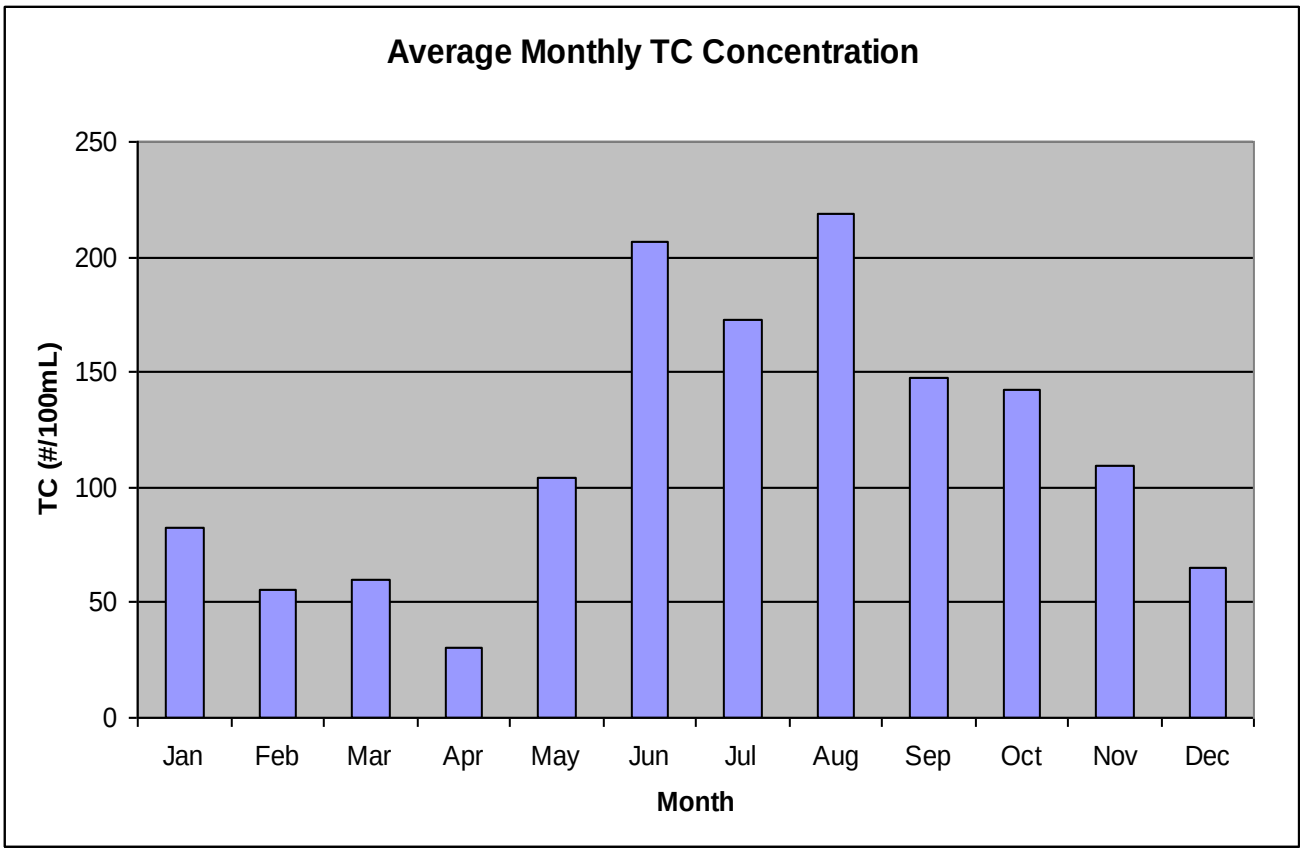

Figure 7. Seasonal trend in TC data for all worst case stations in WMA 13

4.2 Margin of Safety

A Margin of Safety (MOS) is provided to account for "lack of knowledge concerning the relationship between effluent limitations and water quality" (40 CFR 130.7(c)). For these TMDLs, both an implicit and explicit Margin of Safety (MOS) were incorporated. An implicit MOS was incorporated by using conservative assumptions, including the use of "worst case" stations to determine the percent reduction required, using data collected during the summer critical condition period to develop TMDLs, treating total coliform as a conservative substance (source loads were estimated without including die-off rates, soil incorporation, etc.), using conservative methods to estimate land-based loads, and other factors. In addition, a 5% explicit MOS was calculated for each TMDL eligible waterbody.

5.0 TMDL CALCULATIONS

TMDLs were developed based on the percent reduction calculated by comparing the data collected at each "worst case" station to the NSSP 90th percentile criteria for total coliform. The overall percent reduction (including a minimum explicit 5% MOS) was calculated and load reductions for point and nonpoint sources were estimated. The percent reduction specified for each waterbody (or sub-group) was applied equally to pathogen sources in each watershed for which source reductions measures can reasonably be applied. The loads

contributed by forest lands and barren lands were not reduced in the TMDL allocation because these loads represent natural background levels (e.g. wildlife contributions) and/or sources that cannot be reasonably reduced. As a result, existing loads from these sources are equal to the future loads. Therefore, the load reduction from land uses and marinas for which reduction measures can reasonably be applied must be increased proportionally, as presented in Table 9. There is an exception to this, as described below in Cedar Run, Westecunk Creek Estuary, and Tuckerton Creek Estuary.

The TMDL was allocated among point and nonpoint sources. There are no treatment plan discharges in the impaired waterbodies. The only point sources are stormwater discharges from Tier A municipalities, as represented by urban land uses, and these were assigned a WLA, while Tier B municipalities, non-urban land uses and marinas were assigned LAs.

In the TMDL analysis, some of the waterbodies were divided into smaller subgroups. In several situations, one subgroup was determined to flow/contribute loads to another subgroup. This is referred to as a "nested" watershed situation. Because the load reductions were calculated on progressively larger, overlapping drainage areas, this led to some waterbodies initially receiving more than one load reduction percentage. To eliminate multiple reductions, a revision was made in how the TMDLs are presented. Load contributions from impaired up-stream drainage areas were adjusted to TMDL (reduced) quantities; then added to downstream loads and the percent reductions recalculated. The revised values are presented in Table 1, Table 2, Table 8, and Table 9 for the affected subgroups. This exercise resulted in Barnegat Bay D, Barnegat Bay L, Manahawkin Bay D, and Manahawkin Bay F subgroups no longer requiring a load reduction. By meeting the up-stream, TMDL reduction for Metedeconk River Estuary (87%) and Beaverdam Creek Estuary (41%), Barnegat Bay D would require no further reduction to support designated uses. By meeting the up-stream, TMDL reduction for Toms River Estuary (74%), Barnegat Bay L would require no further reduction to support designated uses. By meeting the up-stream, TMDL reduction for Cedar Run (75%), Manahawkin Bay D would require no further reduction to support designated uses. By meeting the up-stream, TMDL reduction for Westecunk Creek (87%), Manahawkin Bay F would require no further reduction. There were no changes in the number of 2004 303(d) Listings receiving TMDLs.

5.1 Wasteload Allocations and Load Allocations

WLAs were established for point source discharges within each watershed and for NJPDES-regulated municipal stormwater discharges subject to regulation under the CWA. LAs were established for all stormwater sources that are not subject to regulation under the CWA and for all other nonpoint sources. Stormwater point sources that received a WLA were distinguished from stormwater sources receiving a LA on the basis of land use type and municipal tier designation (Tier A/Tier B).

This distribution of loading capacity between WLAs and LAs is consistent with recent EPA guidance that clarifies existing regulatory requirements for establishing WLAs for stormwater discharges (Wayland, November 2002). Stormwater discharges are captured within the runoff sources quantified according to land use, as described previously.

Distinguishing between regulated and unregulated stormwater is necessary in order to express WLAs and LAs numerically; however, "EPA recognizes that these allocations might be fairly rudimentary because of data limitations and variability within the system" (Wayland, November 2002, p.1). Therefore, allocations are established according to source categories as shown in Table 7. This demarcation between WLAs and LAs based on land use source categories is not perfect, but it represents the best estimate defined as narrowly as data allow. The Department acknowledges that there may be stormwater sources in the residential, commercial, industrial and mixed urban runoff source categories that are not NJPDES-regulated. Nothing in these TMDLs shall be construed to require the Department to regulate a stormwater source under NJPDES that would not already be regulated as such, nor shall anything in these TMDLs be construed to prevent the Department from regulating a stormwater source under NJPDES.

Table 7. Assignment of WLAs and LAs for stormwater point sources and nonpoint sources

Land Use Source Category	Municipal Tier	TMDL Allocation Type
High density residential	A	WLA
Medium density residential (incl. mixed residential, mixed urban, other urban, military reservations, and no longer military)	A	WLA
Low density residential (incl. rural residential, recreational land, and athletic fields)	A	WLA
Commercial	A	WLA
Industrial	A	WLA
Roadways	A	WLA
High density residential	B	LA
Medium density residential (incl. mixed residential, mixed urban, other urban, military reservations, and no longer military)	B	LA
Low density residential (incl. rural residential, recreational land, and athletic fields)	B	LA
Commercial	B	LA
Industrial	B	LA
Roadways	B	LA
Agricultural	N/A	LA
Forest	N/A	LA
Barren land	N/A	LA

Note: Wetland areas were not included in load estimates based on model assumptions.

A summary of the WLAs, LAs and MOS is provided for each subject waterbody (or sub-group) in Table 8 and source loads and allocations are presented in Table 9. The loads contributed by forest lands and barren lands were generally not reduced in the TMDL allocation table, as described above. The load reduction for controllable sources (i.e. urban lands, agricultural lands, and marinas) was increased proportionally to meet the overall percent reduction required for each waterbody (or subgroup). However, in the highlighted waterbody drainages (below), calculations yielded LA TMDLs in excess of 100% (unattainable). The load reduction in these waterbody drainages were redistributed evenly across all sources, and implementation in these areas will affect barren and forested land. In these watersheds, efforts to control wildlife sources, specifically resident geese populations, will need to include forest and barren land uses.

Table 8. TMDL calculations for shellfishing impaired waters in WMA 13

Waterbody	Sub-group	WLA			LA			MOS		TMDL (cfu/yr)	TMDL (cfu/day)
		Load (cfu/yr)	Load (cfu/day)	% of TMDL	Load (cfu/yr)	Load (cfu/day)	% of TMDL	Load (cfu/yr)	Load (cfu/day)		
Barnegat Bay	C	1.59E+15	4.36E+12	52%	1.29E+15	3.53E+12	43%	1.51E+14	4.14E+11	3.02E+15	8.27E+12
Barnegat Bay	E	3.17E+15	8.68E+12	90%	1.85E+14	5.07E+11	5%	1.77E+14	4.85E+11	3.54E+15	9.70E+12
Barnegat Bay	M	6.95E+14	1.90E+12	59%	4.23E+14	1.16E+12	36%	5.89E+13	1.61E+11	1.18E+15	3.23E+12
Beaverdam Creek Estuary	-	1.68E+15	4.60E+12	85%	2.07E+14	5.67E+11	10%	9.94E+13	2.72E+11	1.99E+15	5.45E+12
Cedar Creek Estuary-13	A	5.11E+14	1.40E+12	37%	7.98E+14	2.19E+12	58%	6.89E+13	1.89E+11	1.38E+15	3.78E+12
Cedar Run-Tidal	-	5.35E+13	1.47E+11	65%	2.48E+13	6.79E+10	30%	4.12E+12	1.13E+10	8.24E+13	2.26E+11
Manahawkin Bay	A	5.23E+14	1.43E+12	58%	3.33E+14	9.12E+11	37%	4.50E+13	1.23E+11	9.01E+14	2.47E+12
Metedeconk River Estuary	-	1.38E+15	3.78E+12	67%	5.85E+14	1.60E+12	28%	1.04E+14	2.85E+11	2.07E+15	5.67E+12
Mill Creek-Tidal	-	2.28E+15	6.25E+12	85%	2.61E+14	7.15E+11	10%	1.33E+14	3.64E+11	2.67E+15	7.32E+12
Toms River Estuary	-	4.62E+15	1.27E+13	66%	2.07E+15	5.67E+12	29%	3.52E+14	9.64E+11	7.04E+15	1.93E+13
Tuckerton Creek Estuary	-	9.40E+13	2.58E+11	59%	5.80E+13	1.59E+11	36%	8.00E+12	2.19E+10	1.60E+14	4.38E+11
Westecunk Creek Estuary	-	5.67E+13	1.55E+11	56%	3.94E+13	1.08E+11	39%	5.06E+12	1.39E+10	1.01E+14	2.77E+11

Footnote: Daily TMDLs were calculated by dividing the annual load values by 365 days/year. The daily loads are based on the TMDL not exceeding the calculated annual load. MOS is 5% of the TMDL.

Table 9. WMA 13 land-based load allocations

Waterbody	Subgroup	Overall % Reduction	Agriculture			Barren Land			Forest			Urban Total (WLA)			Urban Total (LA)			Marinas (LA)			MOS (cfu/yr)	TMDL (cfu/yr)
			Existing Load (colonies/yr)	Percent Reduction	Allocated Load (colonies/yr)	Existing Load (colonies/yr)	Percent Reduction	Allocated Load (colonies/yr)	Existing Load (colonies/yr)	Percent Reduction	Allocated Load (colonies/yr)	Existing Load (colonies/yr)	Percent Reduction	Allocated Load (colonies/yr)	Existing Load (colonies/yr)	Percent Reduction	Allocated Load (colonies/yr)	Existing Load (colonies/yr)	Percent Reduction	Allocated Load (colonies/yr)		
Barnegat Bay	C	50%	3.02E+12	55%	1.36E+12	9.82E+12	0%	9.82E+12	5.27E+14	0%	5.27E+14	3.52E+15	55%	1.59E+15	0.00E+00	55%	0.00E+00	1.66E+15	55%	7.49E+14	1.51E+14	3.02E+15
Barnegat Bay	E	23%	1.28E+13	23%	9.78E+12	5.76E+12	0%	5.76E+12	7.22E+13	0%	7.22E+13	4.14E+15	23%	3.17E+15	0.00E+00	23%	0.00E+00	1.27E+14	23%	9.71E+13	1.77E+14	3.54E+15
Barnegat Bay	M	40%	0.00E+00	40%	0.00E+00	8.41E+11	0%	8.41E+11	2.24E+11	0%	2.24E+11	1.15E+15	40%	6.95E+14	0.00E+00	40%	0.00E+00	6.99E+14	40%	4.22E+14	5.89E+13	1.18E+15
Beaverdam Creek Estuary	-	41%	2.21E+11	41%	1.30E+11	1.51E+12	0%	1.51E+12	1.62E+13	0%	1.62E+13	2.87E+15	41%	1.68E+15	0.00E+00	41%	0.00E+00	3.23E+14	41%	1.89E+14	9.94E+13	1.99E+15
Cedar Creek Estuary-13	A	48%	1.42E+13	66%	4.88E+12	3.05E+13	0%	3.05E+13	6.52E+14	0%	6.52E+14	1.48E+15	66%	5.11E+14	0.00E+00	66%	0.00E+00	3.23E+14	66%	1.11E+14	6.89E+13	1.38E+15
Cedar Run-Tidal	-	75%	3.92E+11	75%	9.70E+10	2.98E+12	75%	7.39E+11	9.69E+13	75%	2.40E+13	2.16E+14	75%	5.35E+13	0.00E+00	75%	0.00E+00	0.00E+00	75%	0.00E+00	4.12E+12	8.24E+13
Manahawkin Bay	A	16%	0.00E+00	16%	0.00E+00	0.00E+00	0%	0.00E+00	1.03E+11	0%	1.03E+11	6.20E+14	16%	5.23E+14	0.00E+00	16%	0.00E+00	3.95E+14	16%	3.33E+14	4.50E+13	9.01E+14
Metedeconk River Estuary	-	87%	1.83E+14	89%	1.99E+13	1.82E+13	0%	1.82E+13	3.94E+14	0%	3.94E+14	1.27E+16	89%	1.38E+15	0.00E+00	89%	0.00E+00	1.41E+15	89%	1.53E+14	1.04E+14	2.07E+15
Mill Creek-Tidal	-	16%	3.83E+12	17%	3.16E+12	1.12E+13	0%	1.12E+13	2.46E+14	0%	2.46E+14	2.76E+15	17%	2.28E+15	0.00E+00	17%	0.00E+00	0.00E+00	17%	0.00E+00	1.33E+14	2.67E+15
Toms River Estuary	-	74%	2.57E+14	79%	5.40E+13	1.30E+14	0%	1.30E+14	1.55E+15	0%	1.55E+15	2.20E+16	79%	4.62E+15	2.76E+14	79%	5.79E+13	1.31E+15	79%	2.75E+14	3.52E+14	7.04E+15
Tuckerton Creek Estuary	-	86%	9.43E+11	86%	1.29E+11	2.97E+12	86%	4.05E+11	1.78E+14	86%	2.43E+13	6.89E+14	86%	9.40E+13	3.86E+12	86%	5.27E+11	2.39E+14	86%	3.26E+13	8.00E+12	1.60E+14
Westecunk Creek Estuary	-	87%	1.01E+13	87%	1.29E+12	3.46E+12	87%	4.41E+11	2.94E+14	87%	3.74E+13	4.45E+14	87%	5.67E+13	1.83E+12	87%	2.33E+11	0.00E+00	87%	0.00E+00	5.06E+12	1.01E+14

Footnote: Daily TMDLs can be calculated by dividing the load values by 365 days/year.

5.2 Reserve Capacity

Reserve capacity is an optional means of reserving a portion of the loading capacity to allow for future growth. Reserve capacities are not included for the subject waters. Wastewater treatment facilities will continue to be required to achieve disinfection. Nonpoint source reduction strategies applied to land uses will be equally effective with respect to existing and future use of the land.

6.0 FOLLOW - UP MONITORING

The Department maintains a large network of monitoring stations throughout the State's coastal region. The Department's Bureau of Marine Water Monitoring collects water quality data to determine compliance with the National Shellfish Sanitation Program, for the evaluation of the ecological health of coastal waters, and to monitor, identify and track pollution sources impacting the State's coastal waters. Shellfish monitoring data collected the Bureau and information on pollution sources within each watershed and waterbody were used to identify the shellfish-impaired waters that are the subject of these TMDLs. Pathogen indicator data will continue to be collected by the Bureau on a routine basis to assess changes in water quality over time and to determine compliance with the NSSP criteria for shellfish growing areas.

7.0 IMPLEMENTATION

Management measures are "economically achievable measures for the control of the addition of pollutants from existing and new categories and classes of nonpoint and stormwater sources of pollution, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint and stormwater source pollution control practices, technologies, processes, citing criteria, operating methods, or other alternatives" (USEPA, 1993).

Development of effective management measures depends on accurate source assessment. Coliform bacteria are contributed to the environment from a number of categories of sources including human, domestic or captive animals, agricultural practices, and wildlife. Coliform bacteria from these sources can reach waterbodies directly, through overland runoff, or through sewage or stormwater conveyance facilities. Each potential source will respond to one or more management strategies designed to eliminate or reduce that source of coliform bacteria. Each management strategy has one or more entities that can take lead responsibility to effect the strategy. Various funding sources are available to assist in accomplishing the management strategies. The Department will address the sources of impairment through systematic source trackdown, matching strategies with sources, selecting responsible entities and aligning available resources to effect implementation.

For example, the stormwater discharged to the impaired waterbodies through "municipal separate storm sewer systems" (MS4s) are regulated under the Department's Municipal

Stormwater Regulation Program. Under these rules and associated general permits, many municipalities (and various county, State, and other agencies) will be required to implement various control measures that should substantially reduce bacteria loadings, including measures to eliminate "illicit connections" of domestic sewage and other waste to the MS4s, adopt and enforce a pet waste ordinance, prohibit feeding of unconfined wildlife on public property, clean catch basins, perform good housekeeping at maintenance yards, and provide related public education and employee training. These measures are to be phased in over a timeframe specified in the Department's Municipal Stormwater permitting program. The Department will use its Water Quality Management Planning program to expedite implementation of these measures where amendments to areawide Water Quality Management Plans are proposed. The Department has provided State funds as well as a portion of its Clean Water Act 319(h) pass through grant funds to assist municipalities in meeting these requirements.

Sewage conveyance facilities are potential sources of fecal coliform in that equipment failure or operational problems may result in the release of untreated sewage. These sources, once identified, can be eliminated through appropriate corrective measures that can be effected through the Department's enforcement authority. Inadequate on-site sewage disposal can also be a source of fecal coliform. Systems that were improperly designed, located or maintained may result in surfacing of effluent; illicit remedies such as connections to storm sewers or streams add human waste directly to waterbodies. Once these problems have been identified through local health departments, sanitary surveys or other means, alternatives to address the problems can be evaluated and the best solution implemented. The New Jersey Environmental Infrastructure Financing Program, which includes New Jersey's State Revolving Fund, provides low interest loans to assist in correction of water quality problems related to stormwater and wastewater management.

Geese are migratory birds that are protected by the Migratory Bird Treaty Act of 1918 and other Federal and State Laws. Resident Canada geese do not migrate, but are nevertheless protected by this and other legislation. The United States Department of Agriculture (USDA), Animal and Plant Health Inspection Service (APHIS)-Wildlife Services program reports that the 1999 estimated population of non-migratory geese in New Jersey was 83,000. Geese may produce up to 1½ pounds of fecal matter a day and when the congregate in large numbers they can represent a locally significant source of coliform bacteria. This may warrant taking steps to reduce populations in these areas.

Because geese are free to move about and commonly graze and rest on large grassy areas associated with schools, parks, golf courses, corporate lawns and cemeteries, measures to reduce populations, where necessary, are best developed and conducted at the community level through a community-based goose damage management program. USDA's Wildlife Services program recommends that a community prepare a written Canada Goose Damage Management Plan that may include the following actions:

- Initiate a fact-finding and communication plan
- Enact and enforce a "no feeding" ordinance
- Conduct goose damage control activities such as habitat modification

- Review and update land use policies
- Reduce or eliminate goose reproduction (permit required)
- Hunt geese to reinforce nonlethal actions (permit required)

Procedures such as handling nests and eggs, capturing and relocating birds, and the hunting of birds require a depredation permit from either the USDA APHIS Wildlife Services or U.S. Fish and Wildlife Services. Procedures requiring permits should be a last resort after a community has exhausted the other listed measures. The Department's draft guide *Management of Canada Geese in Suburban Areas, March 2001,* which may be found at www.state.nj.us/dep/watershedmgt under publications, provides extensive guidance on how to modify habitat to serve as a deterrent to geese as well as other prevention techniques such as education through signage and ordinances.

In coastal areas, other waterfowl are naturally present in significant numbers and vary seasonally with migratory patterns. Other wildlife contributions may include deer populations, which have been identified as a potential fecal coliform source in the impaired watersheds. The forested and low-density residential areas that provide deer habitat can be found in close proximity to the impaired stream segments. Deer have been evaluated in fecal coliform TMDLs by other States (e.g. Alabama and South Carolina) and could be a fecal coliform source in New Jersey. Management measures to reduce coliform bacteria contributed by wildlife are not generally practicable.

Agricultural activities are another example of potential sources of coliform bacteria. Possible contributors are direct contributions from livestock permitted to traverse streams and stream corridors, manure management from feeding operations, or use of manure as a soil fertilizer/amendment. Implementation of conservation management plans and best management practices are the best means of controlling agricultural sources of coliform bacteria. Several programs are available to assist farmers in the development and implementation of conservation management plans and best management practices. The Natural Resource Conservation Service is the primary source of assistance for landowners in the development of resource management pertaining to soil conservation, water quality improvement, wildlife habitat enhancement, and irrigation water management. The USDA Farm Services Agency performs most of the funding assistance. All agricultural technical assistance is coordinated through the locally led Soil Conservation Districts. The funding programs include:

- **The Environmental Quality Incentive Program (EQIP)** is designed to provide technical, financial, and educational assistance to farmers/producers for conservation practices that address natural resource concerns, such as water quality. Practices under this program include integrated crop management, grazing land management, well sealing, erosion control systems, agri-chemical handling facilities, vegetative filter strips/riparian buffers, animal waste management facilities and irrigation systems.

- **The Conservation Reserve Program (CRP)** is designed to provide technical and financial assistance to farmers/producers to address the agricultural impacts on water

quality and to maintain and improve wildlife habitat. CRP practices include the establishment of filter strips, riparian buffers and permanent wildlife habitats. This program provides the basis for the Conservation Reserve Enhancement Program (CREP).

- **The Conservation Reserve Enhancement Program** The New Jersey Departments of Environmental Protection and Agriculture, in partnership with the Farm Service Agency and Natural Resources Conservation Service, established a $100 million dollar CREP agreement. The program matches $23 million of State money with $77 million from the Comodity Credit Corporation within USDA. Through CREP, financial incentives are offered for agricultural landowners to voluntarily implement conservation practices on agricultural lands. NJ CREP will be part of the USDA's Conservation Reserve Program (CRP). There will be a ten-year enrollment period, with CREP leases ranging between 10-15 years. The State intends to augment this program thereby making these leases permanent easements. The enrollment of farmland into CREP in New Jersey is expected to improve stream health through the installation of water quality conservation practices on New Jersey farmland.

Uses of the marine environment as a recreational area and receiving water have the potential to contribute pathogen loads. As part of the Governor's Coast 2005 initiative, the Department has taken many steps toward stronger protection for water quality and habitat, including:

- The Department has worked to strengthen standards for ocean dischargers to avoid impacts to water quality. The Department requires implementation of measures that will prevent catastrophic sewage spills though the maintenance and upgrading of aging infrastructure.
- The Department targets $30 million in grants to accelerate projects that improve coastal water quality.
- The Department partners with other state agencies, non-profit groups, trade organizations, and marina owners to activate the "New Jersey Clean Marina" program.
- New Jersey will work with anglers, environmentalists, and the New Jersey congressional delegation to establish a "Clean Ocean Zone" to protect water quality in the NY/NJ Bight by eliminating and preventing pollution.

In March 2005, the New Jersey Clean Marina Program was established. It is a voluntary education program that provides information, guidance, and technical assistance to marina operators, local government, and recreational boaters regarding the most effective practices to protect water quality and coastal resources. Marina and boat operational and maintenance activities can contribute to nonpoint source pollution by discharging substances such as oil, grease, paint and cleaning chemicals, and fish waste. This Program gives marina managers the information they need to reduce these incidental effects of their activities. Facilities that meet the requirements of the Program are recognized as "Clean Marinas." By adopting pollution prevention measures, marina owners and managers can engage in environmentally

responsible operations and management of their facility. The New Jersey Clean Marina Program is a partnership among state and federal government agencies, trade associations, marine businesses and other interested parties. The Department website (www.njcleanmarina.org) contains more information and a complete list of participating agencies and organizations.

Another program designed for coastal water quality improvement is New Jersey's Clean Vessel Act (CVA) Committee. Passed by the Congress in 1992, the CVA helps reduce pollution from vessel sewage discharges. Federal grants are available to states on a competitive basis for the construction and/or renovation, operation and maintenance of pumpout and portable toilet dump stations. Currently, states submit grant proposals, by May 1st of each year, to one of seven Fish and Wildlife Service regional offices for review. The service's Division of Federal Aid then convenes a panel including representatives from the Service's Washington Office of the Division of Federal Aid, the National Oceanic and Atmospheric Administration (NOAA), the USEPA, and the U.S. Coast Guard. The panel reviews, ranks and makes funding recommendations to the Director of the Fish and Wildlife Service. The Director gives priority consideration to grant proposals which provide installation and/or operation of pumpout and dump stations under federally approved state plans.

All recreational vessels must have access to pumpouts funded under the Clean Vessel Act. NOAA will mark pumpout and dump station locations on its nautical charts. Halfway through the program, grants have been awarded to install 1,200 pumpout stations and 630 dump stations. A maximum fee of $5.00 may be charged for the use of pumpout facilities constructed or maintained with grant funds.

As part of this program, four CVA funded pumpout boats are in service in New Jersey. They are operated by the Borough of Seaside Park, by Monmouth County, and by Ocean County. Pumpout boats can pull up along side a recreational boat and pump out its sewage holding device with a suction hose. Once a pumpout boat is full of waste, it discharges the waste into a sewage treatment facility for proper disposal.

No Discharge Areas

The Manasquan River and the Shark River were given some help on May 28, 1998, as they were designated as New Jersey's first "no discharge zone" for boat sewage. Later the Navesink River, Shrewsbury River and Barnegat Bay/Manahawkin Bay/Little Egg Harbor Region were also designated "no discharge zones" by the Department and the USEPA. A "no discharge zone" means that the discharge of any boat sewage, treated or untreated, is forbidden in these areas. These waterways have sufficient boat sewage pumpout facilities to accommodate all boaters using the areas. Current law for the Manasquan, Shark, Navesink, and Shrewsbury Rivers now makes it illegal to dump boat sewage within 3 miles of the shorelines of these areas. Fines for illegal dumping may reach $2,000 or more. In order for a body of water to become designated as a no discharge zone, there should be one pumpout station per 200 to 300 slips. Once this number is established and the pumpout station is

operational, the body of water may be designated a "no discharge zone" by the EPA and the NJDEP.

The Department has approved the Hudson River for "no discharge zone" designation. The State of New York has also approved the Hudson River for such a designation. If approval of the body of water is given by the USEPA, the waterway will also become "no discharge zones". The information above is located on the Department's website (http://www.njfishandwildlife.com/cvahome.htm).

Management strategies are summarized below in Table 10.

Table 10. Implementation management strategies

Source Category	Responses	Potential Responsible Entity	Funding options
Human Sources			
Inadequate (per design, operation, maintenance, location, density) on-site disposal systems	Sanitary surveys, septic management programs/ordinances	Municipality	CWA 604(b) for confirmation of inadequate condition; Environmental Infrastructure Financing Program for construction of selected option
Inadequate or improperly maintained stormwater facilities; illicit connections	Measures required under Municipal Stormwater permitting program including any additional measures determined in the future to be needed through TMDL process	Municipality, State and County regulated entities, stormwater utilities	CWA 319(h); Environmental Infrastructure Financing Program for construction of selected option
Malfunctioning sewage conveyance facilities	Identify through source trackdown and repair	Owner of malfunctioning facility--compliance issue	User fees
Marinas	Clean Marina Program; No Discharge Zones; Marina BMPs including: Marine pump-out facilities; Marina flushing design; Fish waste management including fish-cleaning restrictions, public education, and fish waste disposal; Proper sewage handling including: installing a sanitary pump-out system, providing on-shore restrooms, provide accommodations for emptying potable Marine Sanitation Devices (MSDs),	Marina property owner; Municipalities for ordinance adoption and compliance	State sources and CWA 319(h)

Source Category	Responses	Potential Responsible Entity	Funding options
	safeguarding and maintaining septic systems, providing live aboard facilities, offering MSD inspections, encouraging compliance, and educating boaters.		
Domestic/captive animal sources			
Pets	Pet waste ordinances	Municipalities for ordinance adoption and compliance	State source and CWA 319(h) assistance to municipalities to implement municipal stormwater regulations
Horses, livestock, zoos	Confirm through source trackdown: SCD/NRCS develop conservation management plans	Property owner	EQIP, CRP, CREP
Agricultural practices	Confirm through source trackdown; SCD/NRCS develop conservation management plans, exercise CAFO/AFO authority if applicable	Property owner	EQIP, CRP, CREP
Wildlife			
Locally excessive populations of resident Canada geese or other waterfowl	Feeding ordinances; Goose Management BMPs	Municipality for ordinance; local community groups for BMPs	State source; CWA 319(h)
Indigenous wildlife	Confirm through trackdown; riparian buffer restoration; consider revising designated uses	State	State source

7.1 Source Trackdown

Sewage Infrastructure Improvement Act (SIIA)

N.J.A.C. 7:22A was originally adopted by the Department on December 29, 1989 (see 22 N.J.R. 368(a)) to implement the Sewage Infrastructure Improvement Act (SIIA), N.J.S.A. 58:25-23 et seq. The SIIA has two main components: (1) to address discharges from combined sanitary and stormwater sewer systems (CSO) throughout the State (planning and design grants for CSOs) and (2) to map and investigate stormwater sewer systems in Atlantic, Cape May, Monmouth and Ocean counties (stormwater mapping grants). The SIIA,

which became effective on August 3, 1988, was designed to address nonpoint and point sources of pollution from stormwater sewer systems and combined sewer overflow points. The New Jersey Legislature has declared that these sources of pollution contribute greatly to the biological and chemical degradation of coastal and surface waters of the state. The SIIA recognized that nonpoint sources of pollution create public health dangers and mandate beach and shellfish bed closings by contributing high levels of bacteria to surface waters through stormwater sewer systems. The SIIA also recognized that overflows of raw sewage from combined sewer systems are another major source of water pollution and established various requirements for municipalities and public entities to address these pollution problems.

The SIIA required all municipalities with stormwater sewer systems discharging into the salt waters of Monmouth, Ocean, Atlantic or Cape May counties to prepare and submit a map of their sanitary and stormwater sewer systems and to conduct periodic stormwater monitoring of outfalls discharging to saltwater. Grant funding was provided for mapping, sampling and identification of cross connections and interconnections between the stormwater and sanitary sewers. This work is essentially complete and will inform implementation efforts.

While there are no CSOs in the waterbodies addressed in this TMDL report, it should be noted that significant source reduction strategies have been and continue to be put in place to address this source of pathogens in other waterbodies, such as the New York/New Jersey Harbor, which will be addressed in future TMDL efforts.

Pathogen Indicators and Microbial Source Tracking:

Advances in microbiology and molecular biology have produced several methodologies that discriminate among sources of fecal coliform and thus more accurately identify pathogen sources. The numbers of pathogenic microbes present in polluted waters are few and not readily isolated nor enumerated. Therefore, analyses related to the control of these pathogens must rely upon indicator microorganisms. The commonly used pathogen indicator organisms are the coliform groups of bacteria, which are characterized as gram-negative, rod-shaped bacteria. Coliform bacteria are suitable indicator organism because they are generally not found in unpolluted water, are easily identified and quantified, and are generally more numerous and more resistant than pathogenic bacteria (Thomann and Mueller, 1987).

Tests for fecal organisms are conducted at an elevated temperature (44.5°C), where the growth of bacteria of non-fecal origin is suppressed. While correlation between indicator organisms and diseases can vary greatly, as seen in several studies performed by the EPA and others, two indicator organisms *Esherichia coli* (*E. coli*) and enterococci species showed stronger correlation with incidence of disease in bathers than fecal coliform (USEPA, 2001). Similar epidemiological studies for shellfish consumption have not been performed for *E. coli* or enterococci. Recent advances have allowed for more accurate identification of pathogen sources. A few of these methods, including, molecular, biochemical, and chemical are briefly described in the following paragraph.

Molecular (genotype) methods are based on the unique genetic makeup of different strains, or subspecies, of fecal bacteria (Bowman et al, 2000). An example of this method includes "DNA fingerprinting" (i.e., a ribotype analysis which involves analyzing genomic DNA from fecal *E. coli* to distinguish human and non-human specific strains of *E. coli*.). Biochemical (phenotype) methods include those based on the effect of an organism's genes actively producing a biochemical substance (Graves et al., 2002; Goya et al 1987). An example of this method is multiple antibiotic resistance (MAR) testing of fecal *E. coli.* In MAR testing, *E. coli* are isolated from fecal samples and exposed to 10-23 different antibiotics. In theory, *E. coli* originating from wild animals should show resistance to a smaller number of antibiotics than *E. coli* originating from humans or pets. Given this general trend, MAR patterns or '"signatures" can be defined for each class of *E. coli* species. Chemical methods are based on finding chemical compounds associated with human wastewater, and useful in determining if the sources are human or non-human. Such methods measure the presence of optical brighteners, which are contained in all laundry detergents, and soap surfactants in the water column. Unlike the optical brightener method, the measurement of surfactants may allow for some quantification of the source.

MST methods have already been successfully employed at the Department in the past decade. Since 1988, the Department has worked cooperatively with the University of North Carolina in developing and determining the application of RNA coliphage as a pathogen indicator. This research was funded through USEPA and Hudson River Foundation grants. These studies showed that the RNA coliphages are useful as an indicator of fecal contamination; particularly in chlorinated effluents and that they can be serotyped to distinguish human and animal fecal contamination. Through these studies, the Department has developed an extensive database of the presence of coliphages in defined contaminated areas (point human, non-point human, point animal, and non-point animal).

More recently, the Department has established a MST methodology that utilizes both genotype (genotyping of F+RNA coliphages) and phenotype (MAR testing) tests. The results of these tests are collectively evaluated to best determine sources of fecal contamination. The Department's methodology includes evaluation of long-term microbial results as well as data (GIS Land use coverage, aerial photographs, and visual assessments) of actual and potential sources, stormwater monitoring to delineate the location of major sources and the use of MAR and F+ coliphage in conjunction with conventional microbial indicators. This methodology has been successfully applied in several areas including; Seaside Park, Long Swamp, Atlantic City, and Parvin State Park. This methodology may be utilized for select TMDL waterbodies.

7.2 Segment Specific Strategies

In addition to generic strategies described previously, a number of projects have been undertaken which are expected to aid in achieving the load reductions assigned to the impaired waterbodies. Ongoing activities to develop and implement watershed restoration plans are expected to result in additional specific projects to reduce pollutant loads.

Table 11. WMA 13 Outreach and Restoration Projects

WMA	FY	Funding Source	Recipient	Project Title	Grant Amount
13	1996	319	Borough of Pine Beach	Barnegat Bay Watershed Demonstration Project Storm Drain Maintenance & Education Programs	$75,000.00
13	1996	319	Ocean County Soil Conservation District	Barnegat Bay Watershed Demonstration Project – Nutrient and Sediment Control Systems for Urban Runoff	$90,000.00
13	1997	319	Ocean County Soil Conservation District	Implementation of Management Techniques which promote the Stewardship of Soil Health and Water Quality in the Watershed off Barnegat Bay	$155,800.00
13	2000	319	Seaside Heights	Watershed Action oriented NPs	$75,000.00
13	2000	319	Ocean County SCD	Barnegat Bay Watershed-Specific Activity Guide	$60,000.00
13	2000	319	USGS	Toms River NPS Data Analysis	$45,000.00
13	2001	319	Dover Township	To develop a multi-phase development & implementation plan designed to coordinate NPS strategies throughout the Long Swamp Creek watershed.	$190,000.00
13	2001	319	Marine Trades Association of New Jersey	Proposes to increase awareness & encourage implementation of innovative pollution control measures by NJ Marinas.	$65,601.00
13	2001	319	Fairleigh Dickinson University	Proposes to plant eelgrass & widgeon grass as a technique for increasing water quality & reducing nonpoint source pollution in Barnegat Bay; to perform additional monitoring.	$156,249.00
13	2002	319	Fairleigh Dickinson University (w/RP01-089)	Mapping of SAV in Barnegat Bay	$155,000.00
13	2002	319	Lakewood Township	Lake Carasaljo Diagnostic/Feasibility Study	$100,000.00
13	2002	319	Tuckerton Boro	Lake Pohatcong Restoration	$145,000.00
	1998	319	Rutgers Department of Environmental Services	BMPs for the use of Non-traditional Organic Wastes in Agriculture	$79,000.00
	1998	319	Alliance for a Living Ocean	Barnegat Bay Watch Monitoring Program	$5,000.00

8.0 REASONABLE ASSURANCE

With the implementation of follow-up monitoring, source identification and source reduction as described in general and for each segment, the Department has reasonable assurance that a significant increase in the shellfish designated use will be attained. The results of trackdown and follow up ambient monitoring will be evaluated to determine effectiveness of the identified measures and if additional measures are needed.

9.0 PUBLIC PARTICIPATION

The Water Quality Management Planning Rules N.J.A.C. 7:15-7.2 requires the Department to initiate a public process prior to the development of each TMDL and to allow public input to the Department on policy issues affecting the development of the TMDL. Further, the Department proposed each TMDL as an amendment to the appropriate areawide water quality management plan in accordance with procedures at N.J.A.C. 7:15-3.4(g). As part of the public participation process for the development and implementation of the subject TMDLs, the Department worked collaboratively with a series of stakeholder groups as part of the Department's ongoing watershed management efforts.

The Department conducted three outreach sessions: November 17, 2005 for WMAs 12 and 13 with the Barnegat Bay Advisory Committee at Ocean County College; December 15, 2005 for WMAs 14, 15, and 16 at the Galloway Township Library in Galloway, New Jersey; and January 3, 2006 for WMAs 16 and 17 at the Commercial Township Municipal Building in Port Norris. During the sessions, presentations of the Department TMDL process, the locations of impaired shellfish waterbodies, and potential methods to achieve bacteria source reductions were shared. GIS maps aided in soliciting information regarding potential sources within each watershed.

10.0 AMENDMENT PROCESS

Notice proposing these TMDLs was published February 21, 2006 in the New Jersey Register and in newspapers of general circulation in order to provide the public an opportunity to review the TMDL document and submit formal comments. In addition, a public hearing was held on March 23, 2006 at the Ocean County Community College – Toms River Campus in the Technology Building Lecture Hall. There was an informal presentation from 7:00 p.m. to 7:30 p.m., which was followed by the public hearing from 7:30 p.m. until the end of testimony. Notice of the proposal and hearing was provided to affected municipalities in the watershed.

All comments received during the public notice period and at the public hearing has become part of the record for this TMDL and is considered in the Department's decision to establish this TMDL through submittal to EPA Region 2. This TMDL has been adopted as an amendment to the Monmouth and Ocean Counties Water Quality Management Plans in accordance with New Jersey's Water Quality Management Planning Rules at N.J.A.C. 7:15-3.4 (g). The outcome of the public participation process is described in Appendix F.

APPENDIX A: REFERENCES

Bacteria Load Estimation methods used to estimate land-based bacteria load contributions: (1) Toms River studies – USGS (May 2005); (2) Loading Coefficient Analysis and Selection Tool (LCAST). Developed by NJDEP and Tetra Tech, December 2001.; (3) Watershed Treatment Model (WTM). Developed by the Center for Watershed Protection in July 2001; (4) Simple Method for calculating bacteria loads (Schueler, T. 1987).

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"NJDEP County Boundaries for the State of New Jersey", published 01/23/2003 by NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA), Online at: http://www.nj.gov/dep/gis/stateshp.html#NJCO

"NJDEP Municipality Boundaries for the State of New Jersey", published 01/23/2003 by NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS). Online at: http://www.nj.gov/dep/gis/stateshp.html#NJMUN

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U.S. Food and Drug Administration (FDA). 2003. National Shellfish Sanitation Program Guide for the Control of Molluscan Fish. FDA, Washington, D.C.

Wayland, R.H. III. November 22, 2002. Memo: Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs. Office of Wetlands, Oceans and Watersheds, U.S.E.P.A.

APPENDIX B: NJPDES WASTEWATER TREATMENT FACILITIES

There are no NJPDES Wastewater Treatment Facilities in WMA 13 that contribute to the impaired waterbodies addressed through this TMDL report.

APPENDIX C: MUNICIPALITIES

WMA13 Tier A and Tier B Municipalities

Tier	Waterbody	Subgroup	Municipality	NJPDES Number
A	Barnegat Bay	A	HARVEY CEDARS BORO	NJG0149349
			LONG BEACH TWP	NJG0149471
		B	BARNEGAT LIGHT BORO	NJG0149357
			HARVEY CEDARS BORO	NJG0149349
			LONG BEACH TWP	NJG0149471
			OCEAN TWP	NJG0150860
		C	BARNEGAT TWP	NJG0152111
			LACEY TWP	NJG0148491
			OCEAN TWP	NJG0150860
		D	BAY HEAD BORO	NJG0149381
			BRICK TWP	NJG0151394
			MANTOLOKING BORO	NJG0153281
			POINT PLEASANT BEACH BORO	NJG0150657
			POINT PLEASANT BORO	NJG0154555
		E	BRICK TWP	NJG0151394
			DOVER TWP	NJG0154164
			LAKEWOOD TWP	NJG0148067
		F	DOVER TWP	NJG0154164
		G	BRICK TWP	NJG0151394
			DOVER TWP	NJG0154164
		H	LACEY TWP	NJG0148491
		I	LACEY TWP	NJG0148491
		J	BERKELEY TWP	NJG0151432
		K	BERKELEY TWP	NJG0151432
			OCEAN GATE BORO	NJG0151416
		L	DOVER TWP	NJG0154164
			ISLAND HEIGHTS BORO	NJG0152650
		M	BERKELEY TWP	NJG0151432
			DOVER TWP	NJG0154164
			LAVALLETTE BORO	NJG0151629
			SEASIDE HEIGHTS BORO	NJG0150827
			SEASIDE PARK BORO	NJG0151149
	Beaverdam Creek Estuary	-	BRICK TWP	NJG0151394
			POINT PLEASANT BORO	NJG0154555
	Cedar Creek Estuary-13	-	BERKELEY TWP	NJG0151432
			LACEY TWP	NJG0148491
			MANCHESTER TWP	NJG0152951
			OCEAN TWP	NJG0150860
	Cedar Run-Tidal	-	EAGLESWOOD TWP	NJG0151548
			STAFFORD TWP	NJG0149080
	Dinner Point Creek Estuary	-	EAGLESWOOD TWP	NJG0151548
			STAFFORD TWP	NJG0149080
	Jesse Creek/Thompson Creek Estuary	-	LITTLE EGG HARBOR TWP	NJG0151831
			TUCKERTON BORO	NJG0152579
	Little Egg Harbor	A	LITTLE EGG HARBOR TWP	NJG0151831
			TUCKERTON BORO	NJG0152579

		B	BEACH HAVEN BORO	NJG0149322
			LONG BEACH TWP	NJG0149471
	Manahawkin Bay	A	LONG BEACH TWP	NJG0149471
			SHIP BOTTOM BORO	NJG0149331
			SURF CITY BORO	NJG0149195
		B	LONG BEACH TWP	NJG0149471
		C	BARNEGAT TWP	NJG0152111
			OCEAN TWP	NJG0150860
			STAFFORD TWP	NJG0149080
		D	EAGLESWOOD TWP	NJG0151548
			STAFFORD TWP	NJG0149080
		E	EAGLESWOOD TWP	NJG0149080
		F	EAGLESWOOD TWP	NJG0151548
	Metedeconk River Estuary	-	BRICK TWP	NJG0151394
			FREEHOLD TWP	NJG0150797
			HOWELL TWP	NJG0153940
			JACKSON TWP	NJG0150665
			LAKEWOOD TWP	NJG0148067
			MILLSTONE TWP	NJG0153532
			WALL TWP	NJG0153214
	Mill Creek-Tidal	-	BARNEGAT TWP	NJG0152111
			STAFFORD TWP	NJG0149080
	Parker Run Estuary	-	EAGLESWOOD TWP	NJG0151548
			LITTLE EGG HARBOR TWP	NJG0151831
	Toms River Estuary	-	BEACHWOOD BORO	NJG0148075
			BERKELEY TWP	NJG0151432
			DOVER TWP	NJG0154164
			FREEHOLD TWP	NJG0150797
			ISLAND HEIGHTS BORO	NJG0152650
			JACKSON TWP	NJG0150665
			LACEY TWP	NJG0148491
			LAKEHURST BORO	NJG0147761
			LAKEWOOD TWP	NJG0148067
			MANCHESTER TWP	NJG0152951
			MILLSTONE TWP	NJG0153532
			OCEAN GATE BORO	NJG0151416
			PINE BEACH BORO	NJG0152609
			SOUTH TOMS RIVER BORO	NJG0150398
	Coastal Tributaries to Barnegat Bay	-	LITTLE EGG HARBOR TWP	NJG0151831
	Tuckerton Creek Estuary	-	LITTLE EGG HARBOR TWP	NJG0151831
			TUCKERTON BORO	NJG0152579
	Westecunk Creek Estuary	-	EAGLESWOOD TWP	NJG0151548
			LITTLE EGG HARBOR TWP	NJG0151831
			STAFFORD TWP	NJG0149080
	Willis Creek Estuary	-	LITTLE EGG HARBOR TWP	NJG0151831
			TUCKERTON BORO	NJG0152579
B	Barnegat Bay	L	PLUMSTED TWP	NJG0154351
	Toms River Estuary	-	PLUMSTED TWP	NJG0154351
	Tuckerton Creek Estuary	-	BASS RIVER TWP	NJG0149527
	Westecunk Creek Estuary	-	BASS RIVER TWP	NJG0149527

APPENDIX D: MARINA LOADING ESTIMATES

WMA 13 Marina Loading Estimates

Waterbody	Subgroup	Marina Name	Load (cfu/year)
Barnegat Bay	B	BARNEGAT LIGHT YACHT	5.027E+13
		BAYVIEW M	4.189E+13
		ED'S BOAT RENTALS	5.399E+13
		HENRY'S BOAT RENTAL	1.117E+13
		HIGH BAR M	1.396E+14
		INLET MARINE SALES	3.537E+13
		LIGHTHOUSE M	7.447E+13
		LOVELADIES M	4.654E+13
		THE BOAT YARD	1.676E+13
		VIKINGOVILLAGEALS	2.793E+13
	C	BARAA M	1.396E+13
		BARNEGAT BOAT BASIN	1.210E+13
		BOB'S DOCKAGE	8.378E+12
		Cape Island	1.929E+14
		CAPTAIN'S INN	2.793E+13
		DIRB BOATS	1.862E+13
		EAST BAY M	2.699E+13
		FORKED RIVER STATE M	1.095E+14
		FORKED RIVER TOWN DO	1.024E+13
		GRANT BOAT WORKS	4.654E+13
		HOLIDAY HARBOR M	1.862E+14
		Lacey Elks 2518	4.654E+13
		LEAMING'S M	3.975E+13
		LONG KEY M	5.902E+13
		MAC'S DOCKK	7.447E+12
		MARINER'S M	1.322E+14
		MYSTIC SAILING PORT	7.447E+12
		RICK'S M	7.540E+13
		RIVER LIGHTS, INC	3.630E+13
		Rivers Edge Marina	2.448E+13
		SANBORN MARINE CENTE	1.025E+14
		SHERER'S BOAT BASIN	5.585E+13
		SILVER CLOUD HARBOR	5.027E+13
		SOUTHWIND M	1.350E+14
		TALL OAKS M	9.681E+13
		TED & SONS M	4.038E+13
		Tides End Marina	2.886E+13
		TOWNSEND'S M	5.520E+13
		WILBERT'S M	1.582E+13
	D	Canal Point Marina	1.719E+14
		Johnson Boat Marina	6.503E+13
		PT. PLEASANT YACHT &	2.793E+13
	E	DRUMPOINT M	3.258E+13
		Holiday on the Bay C	9.309E+12
		KETTLE CREEK MARINA	4.654E+13
		Sailors Quay	2.521E+13
		Tower Power	1.303E+13

	G	CHADWICK ISLAND M	1.311E+14
		Harbor Yacht Club	1.024E+14
		OCEAN BEACH MARINA I	2.276E+14
		Ocean Beach Shores	8.955E+12
	I	LAUREL HARBOR M	1.648E+14
	J	WHITEY'S LANDING	9.048E+12
	K	BECKER'S BOAT BASIN	6.777E+12
		Dicks Landing	5.771E+13
		GOOD LUCK POINT M	5.120E+13
		RINDERER'S M	1.050E+13
	L	ANCHOR REEF M	6.702E+13
		EAST DOVER M	4.896E+13
		HOBBY LOBBY M	5.380E+13
		PIER ONE M	6.051E+13
		TIDE'S IN M	4.189E+13
	M	Bay Villa Yacht Club	9.309E+13
		Cranbury Inlet	4.654E+13
		Docksider Marina and	1.396E+14
		L&R Marine	3.258E+13
		Lavellette Yacht Clu	4.654E+13
		RED TOP BOATS M	1.396E+14
		Seaside Boats	4.840E+12
		Seaside Park Municip	1.750E+14
		WHEEL HOUSE M	2.081E+13
Beaverdam Creek Estuary	-	ARNOLD'S YACHT BASIN	1.517E+14
		COMSTOCK BOATTWORKSS	6.888E+13
		COMSTOCK YACHT SALES	3.258E+13
		FORSBERG'S BOAT WORK	4.654E+13
		SHERMAN'SBBOATWBASIN	1.977E+13
		STARK'S LANDING	3.630E+12
Cedar Creek Estuary-13	A	CEDAR CREEK M	4.654E+13
		LANOKA HARBOR MARINE	1.862E+14
		OCEAN BEACH M SOUTH	2.323E+13
		UP THE CREEK M	6.702E+13
		CEDAR CREEK M	4.654E+13
		LANOKA HARBOR MARINE	1.862E+14
		OCEAN BEACH M SOUTH	2.323E+13
		UP THE CREEK M	6.702E+13
Great Bay	-	Cape Horns	4.485E+13
		Capt Mikes	3.911E+13
		Rands Boats	2.074E+13
Little Egg Harbor	A	Bills Marina - CLOSE	0.000E+00
		Capt Specks	1.210E+12
	B	Beach Haven Marlin &	4.692E+12
		Beach Haven Yacht Cl	3.787E+13
		Black Whale Dock	6.553E+12
		Eastern Marine	1.467E+13
		Escape Harbor Marina	4.353E+13
		Harborview Club & Ma	7.186E+12
		Lindy's Trailer Park	2.035E+13
		Little Egg Harbor Ya	1.659E+13
		Morrison's Rest. & M	1.018E+14

		Penna's Marina	8.350E+13
		Shelter Harbor Marin	1.323E+14
		Southgate Marina	1.342E+13
		Southwicks Marina	5.278E+13
		Sportsmans Marina	2.521E+13
		Spray Beach Yacht Cl	8.657E+13
		Woehr's Marine Dock	2.199E+13
Manahawkin Bay	A	CAUSEWAY RENTALS	1.415E+14
		DUCK INN & M	4.654E+13
		DUKE'S BOAT RENTALS	8.378E+12
		HOCHSTRASSER'S M	6.516E+13
		Merit Marine	2.087E+13
		Sunset Marina	4.654E+13
		SURF CITY M	6.609E+13
	B	Haven Beach Club	2.932E+13
	C	HANCE & SMYTHE INC	1.862E+13
		MARGO'S INN	3.723E+13
Metedeconk River Estuary	-	Blue Water Marina	0.000E+00
		Brennan Boat Company	6.268E+13
		CASSIDAY'SOBRETON WO	1.676E+14
		Forge Landing Marina	1.621E+14
		GEAR AND GADGETS	1.396E+13
		GREEN COVE M	1.859E+14
		JOHNSON BOAT BASIN	1.629E+14
		LAURELTON YACHT CLUB	1.489E+14
		Lightening Jacks	2.681E+14
		Metedeconk Yacht Clu	5.585E+13
		SAILS AWEIGH INC	3.180E+13
		SHERMAN'SBBOATWBASIN	1.977E+13
		STARK'S LANDING	3.630E+12
		VFW	3.131E+13
		WEHRLEN BROS. M	1.173E+14
Toms River Estuary	-	BARNEGAT BAY Boat SA	9.141E+13
		Breton Harbor Marina	8.955E+12
		CEDAR COVE M	3.258E+13
		closed marina	0.000E+00
		COZY COVE M	4.468E+13
		Dillons Creek Marina	1.445E+14
		Gilford Park Yacht C	7.912E+13
		Island Beach Civic A	1.210E+13
		Island Heights Yacht	1.378E+13
		JACK BAKERS Lobster	9.309E+12
		LIGHTHOUSE POINT M	1.983E+14
		NELSON MARINE BASIN	4.831E+13
		OCEAN GATE YACHT BAS	1.564E+14
		Ocean Gate Yacht Clu	2.327E+13
		Pine Beach Yacht Clu	8.285E+12
		RIVER BANK M	1.667E+14
		Riverfront Landing	4.654E+13
		SANTO MARINE CORP	7.912E+13
		STUMP CREEK SLIPWAYS	2.327E+13
		TOMS RIVER BOAT WORK	2.327E+13

		TOMS RIVER MUN BOAT	1.396E+13
		Toms River Yacht Clu	8.378E+13
Tuckerton Creek Estuary	-	Cedar Cove	2.327E+13
		GEB Marine	1.972E+13
		Marina 470	9.495E+12
		Schimpf's Marina	3.210E+13
		Shelter Cove	4.263E+13
		Skinners Marina	3.984E+13
		Stewarts Basin	7.075E+12
		Total Marine	4.589E+13
		Tuckerton Marine Ser	1.882E+13
Willis Creek Estuary	-	First Bridge Marina	2.793E+13

APPENDIX E: RESPONSE TO PUBLIC COMMENTS

This constitutes the New Jersey Department of Environmental Protection's (Department) response to comments raised during the comment period for the document entitled "Fourteen Total Maximum Daily Loads for Total Coliform to Address Shellfish-Impaired Waters in Watershed Management Area 13 Atlantic Coastal Water Region", which was proposed on February 21, 2006. These TMDLs were proposed as an amendment to the Monmouth County and Ocean County Water Quality Management Plans and include management approaches to reduce loadings of total coliform from various sources in order to support the shellfish harvesting use.

The notice proposing the TMDLs was published on February 21, 2006 in the New Jersey Register and in newspapers of general circulation in order to provide the public an opportunity to review the TMDL document and submit formal comments. The TMDL documents were made available at the Department, upon request by mail, and on the Department's website. The Department conducted a non-adversarial public hearing on March 23, 2006 at the Ocean County Community College - Toms River Campus in the Technology Building Lecture Hall. The public comment period ended on April 7, 2006.

No comments were received during the public hearing. However, four comment letters were received on the proposed TMDLs during the open public comment period. The letters were received from:

1. Mid-Atlantic Environmental Law Center, c/o Widener University School of Law, 4601Concord Pike, PO Box 7474, Wilmington, Delaware 19803

2. Clean Ocean Action, 18 Hartshorne Drive, PO Box 505, Sandy Hook, Highlands, NJ 07732-0505

3. American Littoral Society, Building 18, Sandy Hook, Highlands, NJ 07732

4. Monmouth County Health Department, 3435 US Route 9, Freehold, NJ 07728

Department initiated changes to the document include the following:
1. In several TMDLs, situations arose where one impaired subgroup flows into another impaired subgroup. This was referred to as a "nested" watershed situation. To compensate for the overlapping waterbodies' drainage contribution areas, the proposed TMDL document was revised. Load contributions from impaired up-stream drainages were adjusted to TMDL (reduced) quantities; then added to downstream loads. The result in WMA 13 was that several watershed subgroups no longer required a load reduction. By meeting the up-stream reductions, Barnegat Bay D, Barnegat Bay L, Manahawkin Bay D, and Manahawkin Bay F would require no further reduction to support designated uses. Values were revised in Table 1, Table 2, Table 8, and Table 9 for the affected nested watersheds.
2. Table 8 was revised to present Daily TMDLs. The daily loads were calculated by dividing the annual load values by 365 days/year, and are based on the TMDL not exceeding the calculated annual load.
3. Several references in Appendix A have been added or revised.

4. The barren land and forested land use load reductions were revised in Section 5.1 and Table 9 of the document. In the highlighted drainage areas, the forested and barren land uses make up such a large proportion of the land use that without a reduction in the loads contributed by these land uses, the loads contributed by the remaining land uses would need to be reduced by more than 100% to compensate for no reduction in the forested/barren land use loads. Thus, in these areas, greater attention to measures such as resident goose management and riparian buffer restoration will be required in order to achieve reductions in land uses normally deemed unreduceable.
5. Appendix B, C, and D were revised to eliminate duplicate facility, municipality, and/or marina listings.

A summary of comments to the proposal and the Department's responses to those comments follow. The number(s) in brackets at the end of each comment corresponds to the commenter(s) listed above.

Comment 1.
The Department has a duty to develop TMDLs for impaired waters in all shellfish harvest restriction areas, including those restricted based on shoreline surveys or where insufficient data or no data for a waterbody exists. The Department cannot move a waterbody from one Sublist to another without the approval of the USEPA.

Response 1.
The Department acknowledges that EPA must approve any change in status of a waterbody with respect to Sublist 5 of the Integrated List. The EPA has been involved in the development of these TMDLs and concurs with the approach for each segment. In the course of developing the TMDLs, all available data was gathered and analyzed and the spatial extent of each listing was assessed. For some segments it was determined that, while there was sufficient data to declare the waterbody as impaired, there was insufficient data to calculate a TMDL. These waterbodies will remain on Sublist 5 until enough data is gathered to permit calculation of a TMDL. In some cases it was determined that a waterbody was listed as impaired in the absence of water quality data applicable to the waterbody. For example, the spatial extent used for initial assessment may have been revised as the result of more detailed assessment during TMDL development. In these cases, the resultant waterbody with no water quality data will be moved to Sublist 3 until a determination as to impairment status based on data can be made. Where there was sufficient data, TMDLs were calculated for each waterbody that was impaired based on the water quality data, provided an improvement in water quality would result in lifting the harvesting restriction. However, beyond requiring compliance with the numeric water quality standards, the NSSP requires the State authority to impose precautionary restrictions based on the presence of sources that could deliver loads of pathogens unexpectedly, for example as the result of a malfunction of a sewer or septic system, or behaviors that are difficult to regulate, such as the handling of waste generated on watercraft. In order to protect human health, precautionary harvesting restrictions are required, even if ambient monitoring data conform to the standards, because ambient monitoring may not capture random, unpredictable excursions due to such sources. Waterbodies that are restricted based on such administrative precautions were not considered for TMDLs because no improvement in water quality would result in full support of the designated use. As these waterbodies are closed due to the potential for contamination, regardless of actual water quality data, closures of waters for shellfishing as the result of administrative precautions will be

removed from Sublist 5 and placed on Sublist 4C in the 2006 Integrated List of Waterbodies because the impairment is due to pollution, not pollutants.

Comment 2.
The Department does not indicate that it developed the TMDLs with the USEPA's guidance document, "Protocol for Developing Pathogen TMDLs", First Edition, January 2001, USEPA Document Number EPA 841-R-00-002, ("Pathogen Protocol"). The Pathogen Protocol is the more specific guidance document, and should have been utilized in the development of the TMDL. (1)

Response 2.
The USEPA guidance document "Protocol for Developing Pathogen TMDLs" establishes an organizational framework for states to utilize in the development of pathogen TMDLs. These TMDLs have been developed consistent with the protocol, even though this was not specifically stated in the document.

Comment 3.
There is a blank page in the document, yet there is no explanation for whether this was intentional. (1)

Response 3.
The Department has removed the unintentional, blank page from the document.

Comment 4.
MAELC appreciates the effort put into the source assessment. (1)

Response 4.
The Department appreciates MAELC support.

Comment 5.
The Department does not state when the waterbodies included in the LAR were first listed as impaired yet in some cases it relies on data from 1992. If the water bodies were not impaired when this data was gathered then it would not reflect the impairment for which this TMDL is to address. To ensure that accurate data is being used to develop this TMDL, the Department must use recent data. (1)

Response 5.
Local Area Report summaries were included to provide background information on water quality conditions, pollution sources, and watershed characteristics. Recent shellfish monitoring data collected by the Department (data period: 1980-2004) and updated source information (marina locations, land use data, and other geographic information) were used to develop these TMDLs. These TMDLs, therefore, reflect the most current data available.

Comment 6.
Although the Department, in Table 8, provides the sum of the WLAs for each waterbody, it has failed to list the WLA for each individual point source, including NJPDES permit holders and Tier A municipality point sources, as required by the Regulations. (1)

Response 6.
As stated in the document, wastewater discharges in the affected waterbodies (listed individually in Appendix B) are considered de minimus sources and have each been assigned a WLA of zero, with no change in the effluent limit of 200 cfu/ml. Tier A municipalities (identified individually in Appendix C) have each been assigned the percent reduction assigned to all reduceable sources. This method of assigning WLAs to MS4 sources is accepted by EPA, as described in the document. The distinction is that the point sources receive the reduction as a WLA, while nonpoint sources receive the reduction as a LA.

Comment 7.
MAELC assumes that by "malfunctioning sewage conveyance systems the Department is referring to combined sewer overflows, which should be a point source, not a nonpoint source. (1)

Response 7.
The term refers to broken pipes and pumping facilities, which are episodic, unplanned events that are immediately corrected and do not figure into either load or wasteload allocations.

Comment 8.
The Department fails to state where the runoff volume figures were derived. (1)

Response 8.
The WTM model calculates the annual runoff volume for each watershed based on annual average (or median) rainfall data (inches/year). Annual median rainfall estimates were derived from the rainfall data collected at NOAA weather stations (for the period of record) within or proximate to these watersheds.

Comment 9.
After examination of the WTM's User Manual, MAELC was unable to reconcile the figures and land uses listed in Table 5. (1)

Response 9.
The bacteria loading coefficients presented in Table 5 are the default values used in the WTM model. The online WTM user's manual references the WTM model spreadsheet in the introductory statement and also provides a download link to the spreadsheet. A loading coefficient for barren lands was not included in the WTM model; therefore, an estimated value was used for this land use category.

Comment 10.
The Department does not state what the load capacity is or how such a figure was calculated. There is no way to verify the accuracy of the TMDLs. (1)

Response 10.
The TMDL that was calculated for each waterbody defines the loading capacity, which is the amount of pollutant loading that a waterbody can receive without violating water quality standards. TMDLs were developed based on comparing current bacteria levels to National

Shellfish Sanitation Program (NSSP) criteria for total coliform. Source load reductions necessary to meet these TMDLs (i.e. loading capacity) were calculated and are presented in Table 8 and Table 9 of these reports.

Comment 11.
The Department does not offer a timeframe for implementing the proposed implementation management strategies, including a timeframe for when the control measures are to be phased in under the Municipal Stormwater permitting program. The Department should fast-track the MS4 program for these waterbodies to implement the reductions through MS4 permits. (1)

Comment 12.
Clean Ocean Action commends NJDEP for setting over 48 TMDLs in 6 watershed management areas, but achievement of the needed reductions is not ensured because of the lack of detailed information on monitoring, implementation, and enforcement strategies. Because several different "potentially responsible entities" will need to implement management strategies to meet the TMDL for each waterbody, it is imperative that NJDEP elaborate as to the specific actions in TMDL implementation to be taken for success, including the Division of the NJDEP that will be taking on these responsibilities. It is also essential that this program be adequately funded with a dedicated staff person. (2)

Comment 13.
It appears that the TMDLs will be implemented primarily through the Municipal Stormwater Regulation Program. The rules for this program provide for "additional measures" which can be required by, among other things, a TMDL approved or established by EPA. The TMDLs must be included in each municipal permit as an additional measure and must, therefore, include BMPs that are required to be implemented with measurable goals for each BMP, and a specific timeframe in which to complete the implementation of the BMPs. (2)

Comment 14.
There are neither timelines on when required reductions must be achieved, nor any enforcement provisions when a waterbody fails to achieve the required reduction. These deficiencies make it impossible to for the NJDEP to effectively manage the responsible entities and enforce these mandated fecal coliform concentration reductions. If the NJDEP finds that enforcement is not appropriate, they must identify specific follow-up action that will be required to successfully achieve the imposed TMDLs. (2)

Response to Comments 11 through 14.
New Jersey has a long history of improvement for coastal waters. Between 1978 and 2003, the area of New Jersey's harvestable shellfish waters have increased 16%, or from 74% to 90%. The rate of improvement over the past 10 years has been, roughly, a 0.4%per year increase in "Approved" waters. The commenter is correct that, going forward, the primary means to implement the TMDLs is through the municipal stormwater regulation program. As described in 7.0 Implementation section of the TMDL, the Statewide Basic Requirements implement various control measures that should substantially reduce bacteria loadings, including measures to eliminate "illicit connections" of domestic sewage and other waste to the MS4s, adopt and enforce a pet waste ordinance, prohibit feeding of unconfined wildlife on public property, clean catch

basins, perform good housekeeping at maintenance yards, and provide related public education and employee training. Upon implementation, these requirements are expected to be highly effective in controlling inputs of total coliform load into the waterbodies. The implementation schedule for the municipal stormwater regulation program has already been set forth in rules and can be found at www.njstormwater.org. The Department believes that this schedule is sufficiently aggressive and would note that the Statewide basic requirements are currently operative. "Additional measures" as provided for in the rules are those that are identified to be needed, beyond the basic requirements, to address water quality problems. No "additional measures" have been identified at this time, therefore, the statement that BMPs with associated goals and timeframes must be identified is incorrect. Through the effectiveness monitoring, it may be determined that the objective of the TMDLs has not been met. Adaptive management would then call for consideration of additional measures at that time.

The remaining elements of the plan for attaining the designated use will proceed over time and may be adjusted, as needed, through adaptive management, to respond to results of the shellfish waters classification monitoring program. Data is collected and assessed continually throughout the year, and will inform further development and/or refinement of management measures to implement the TMDLs. The Department is continually working through its watershed management initiative to implement nonpoint source reduction strategies within the 20 watershed management areas, consistent with established TMDLs, using available resources. The TMDL documents provide the basis upon which regulatory action can be taken to implement management strategies and to prioritize funding for water quality improvement. The Department has been and continues to target available resources, like the 319(h) grant program, Corporate Business Tax (CBT) revenues, and allied grant programs for agricultural areas (EQIP, CRP and CREP) to address sources in the impaired areas for which TMDLs were completed. Follow up monitoring will determine where efforts need to be stepped up or redirected to attain the designated use. Finally, the TMDL process and adoption of the TMDLs as amendments to the applicable areawide Water Quality Management Plans (WQMPs) is significant because it assures that plan amendments and permitting throughout the Department are consistent with the TMDLs. For example, implementation of septic management districts may be required through wastewater management plan updates where septic system sources are identified.

The overall implementation plan, while relying on monitoring, permitting and enforcement programs as well as funding sources available within and outside of the Department, is coordinated through the Division of Watershed Management, which has dedicated resources to this purpose.

Comment 15.
The proposed amendments fail to incorporate management strategies to systematically monitor and improve TMDL compliance. Adequate and continual assessment of the implemented TMDLs must happen to ensure that loadings are reduced. Sections 6.0 and 7.0, addressing follow-up monitoring and implementation, do not explicitly require regular monitoring in all listed waterbodies or a schedule to assess the effectiveness of the TMDLs through monitoring. It is strongly urged that DEP include in the proposed amendments the requirement to perform regular monitoring on all listed waterbodies and a timeline for using these data in trend analyses to assess the effectiveness of the TMDL implementation. (2)

Response 15.
The Department's Bureau of Marine Water Monitoring conducts extensive sampling in the shellfishing waterbodies addressed in this TMDL report. Trend analysis of water quality for shellfish classification is performed throughout the year and will also be used to assess effectiveness of TMDL implementation.

Comment 16.
In general we strongly support the Department's efforts to document declining water quality throughout the coastal zone, estuaries, and shellfish areas. Providing scientific evidence of water quality degradation and developing management and implementation strategies to improve the situation are needed for estuarine recovery. The data show that over time, resources like harvestable shellfish waters can recover and we applaud the Department for this proposal which could, if forcefully implemented, lead to continued estuarine recovery. We support numerical thresholds for resolving impairments and believe integration of these standards into the WQM plan and Stormwater Management programs is the right step toward implementation. However, the TMDLs lack specific requirements for coordinated regulatory, regional and municipal implementation, without which land use decisions will continue to undermine plans for water quality improvement.

Studies show development and increasing impervious cover is directly linked to diminishing water quality in our bays and estuaries. Natural resource capacity is currently not reflected in permitting and planning in the coastal zone, including in establishing Coastal Centers and in the cross-acceptance/endorsed plan process. The Department must require that these TMDLs are integrated into the policies and permitting decisions made by other agencies and by all sections of the Department as scientifically verified and appropriate limits on how much growth is sustainable and where growth should go. In particular, the Land Use Regulation Program (LURP), the Division of Watershed Management, the Office of Policy and Planning and the Coastal Management Program must work collaboratively to ensure that decisions affecting coastal watersheds are consistent with capacity limits that will achieve water quality objectives. No permits should be issued for land uses that threaten shellfish waters and there should be no further extension of sewer service area to support center-based development in sensitive coastal watersheds.

Also needed is a fully funded watershed area management plan in which State-sponsored stakeholders in every coastal county are charged with integrating TMDLs into regional and local stormwater management plans and local ordinances. Additional funding for stormwater plans is needed as well. Monitoring and implementation of TMDLs at the local level could assist the Department to increase the frequency of monitoring for those waterbodies. In this way, problems could be more quickly identified, and Sublist 5 could be more quickly updated and the risks to the public health could be reduced. Regulatory requirements in both the Stormwater Management and Surface Water Quality Protection programs must also be strengthened so that counties and municipalities can be held accountable for land use decisions that undermine the specific TMDL standards and/or the intent and purpose of this proposed shellfish water quality recovery program. Recognizing 2006 budget constraints, alternatively, funding benefits in other programs should be linked to completion of updated Plans and in so doing direct that municipalities take

steps in both land use planning and stormwater management to implement these proposed TMDLs. (3)

Response 16.
In general, TMDLs have certain regulatory authority that is applied to advance implementation strategies. For example, NJPDES permits may have requirements added as specified in a TMDL to achieve load reductions. In addition, once adopted as an amendment to the applicable Water Quality Management Plan, State permits must be consistent with the findings of a TMDL. These TMDLs do not establish any capacity limitations, as it is expected that the measures identified will control new sources as well as existing sources. The suggestion that there be no further sewer service provided in coastal areas may be counter productive, as some closure areas are so designated because of high density development served by septic systems. If these systems are failing, sewer installation may be an appropriate solution to address the problem and should not be discounted out of hand. Other implementation measures require voluntary participation, encouraged and assisted by the Department's watershed management program and funding programs managed by the Department (CBT, 319(h), 604(b) and the Environmental Infrastructure Financing Program) and other agencies (Farm Bill programs). As stated by the commenter, the 2006 budget does not allow for funding beyond that which has already been provided to assist municipalities to implement the stormwater regulation requirements. The watershed management program has resources dedicated to coordinating the Department's and other agencies activities aimed at implementing the TMDLs. The Department welcomes assistance provided by watershed partners, such as monitoring, and uses quality data provided by partners in assessing water quality throughout the State. As previously stated, if the implementation of identified measures is found to be inadequate to achieve support of designated uses, additional measures, which would become enforceable requirements of stormwater permits, will be considered.

Comment 17.
To enhance implementation, TMDL segments should be designated as C1 waters, thereby receiving larger buffer protection and more aggressive anti-degradation thresholds. C1 thresholds should be revised to include Cedar Creek (portions of which are already FW1 and SE1), the Mullica River (portions of which are already C1 and SE1), and the Cohansey River (portions of which are already SE1). C1 designation would allow greater control over uplands and feeder streams, development of which harms downstream and estuarine water quality. (3)

Response 17.
The Department concurs that riparian buffers are important for water quality protection/restoration and riparian restoration is identified as one of the measures needed to implement the TMDLs. None of the above listed waters were officially petitioned for upgrade to C1. The Department periodically evaluates waters and designates C1antidegradation designation for those that qualify through a rulemaking process. Waters designated as C1 and the mapped tributaries within the CI subwatershed have 300-foot Special Water Resource Protection Areas within which future development is regulated. However, designation as C1 will not effect restoration of currently developed/disturbed buffers. This will be accomplished through voluntary projects undertaken with State and other resources. Furthermore, antidegradation policies apply to C2 waters as well. A lowering of water quality is only allowed if alternatives that avoid a lowering are infeasible and a socio-economic justification warrants a lowering, but not

below the Surface Water Quality Criteria. In any case, the Surface Water Quality Standards rules provide for changing a stream designation at N.J.A.C. 7:9B, which includes a petition option that the commenter may choose to exercise.

Comment 18.
Regarding marina sources, we urge the Department to not just encourage but require more marinas to engage in the Clean Marina Program. This strategy requires no additional funding by using more aggressive, perhaps mandatory, participation or compliance requirements. (3)

Response 18.
The Department will explore options to increase funding to further encourage participation in the Clean Marina Program. Requiring individual marina enrollment could be used, on a case by case basis, when impairment is directly linked to marina operation. The cost of comprehensive state-wide marina enrollment is likely to be prohibitively high for marina owners.

Comment 19.
Several studies have shown that bacteria can survive and reproduce in sediment, under the right conditions, as discussed in the comment submitted by Monmouth County. (4)

Response 19.
These TMDLs were developed based on recent shellfish monitoring data collected by NJDEP. These data reflect the ambient bacteria levels and contributing sources in each waterbody, therefore, these TMDLs take into account all sources of bacteria that may be present. Enteric bacteria in the environment originate from humans and other warm-blooded animals. Bacteria levels in sediment are the result of contamination from stormwater, failing septic systems, malfunctioning sewer systems, agricultural runoff, and other contributing sources. Bacteria loads from these sources were quantified using best available data to help facilitate implementation activities designed to reduce bacteria levels and shellfish contamination. Sediment re-suspension and other potential sources, such as waterfowl direct deposition, could not be quantified due to lack of available data. Nevertheless, language has been added stating that sediment may be a source of bacteria in shellfish waters to section "3.3 Assessment of Nonpoint Sources" of the document.

Comment 20.
Because public participation plays a key role in TMDL development, MAELC suggests TMDLs be geared towards laypeople by providing a more user friendly approach in regard to data analysis and explanations. (1)

Response 20.
The Department endeavors to make each TMDL report understandable and also provides multiple opportunities through presentations of methodology and results to aid public understanding and to obtain feedback. The Department would welcome any specific recommendations that would enhance understanding of the TMDL information.

Comment 21.

MAELC is disappointed that multiple water body segments are addressed in a single TMDL and that the language within all of February's proposed TMDLs is verbatim. (1)

Response 21.
The Department aims to maximize efficiency in conveying the outcomes of TMDL studies. Where information and methodologies are the same it is logical to consolidate those aspects, rather than generate a large number of repetitious written materials. Wherever information is unique, it is conveyed, such as by providing separate maps, calculations, local area report information, on-going projects tailored to the applicable area. The documents proposed are clearly not "verbatim" except where the information to be conveyed is the same, such as the introductory remarks and the process description.