Amendment to the Monmouth County Water Quality Management Plan

Total Maximum Daily Loads for Fecal Coliform to Address 3 Streams in the Atlantic Water Region

Watershed Management Area 12
Shark River, Jumping Brook and Musquash Brook

Proposed:	April, 19 2004
Established:	August 25, 2004
Approved (by EPA Region 2):	September 29, 2004
Adopted:	

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1.0 Executive Summary

In accordance with Section 305(b) of the Federal Clean Water Act (CWA), the State of New Jersey developed the *2002 Integrated List of Waterbodies*, addressing the overall water quality of the State's waters and identifying impaired waterbodies for which Total Maximum Daily Loads (TMDLs) may be necessary. The *2002 Integrated List of Waterbodies* identified several waterbodies in the Atlantic Water Region as being impaired with respect to pathogens, as indicated by the presence of fecal coliform concentrations in excess of standards. This report, developed by the New Jersey Department of Environmental Protection (NJDEP), establishes three TMDLs addressing fecal coliform in the waterbodies identified in Table 1.

Table 1 Fecal coliform-impaired stream segments in the Atlantic Water Region, identified in Sublist 5 of the 2002 Integrated List of Waterbodies, for which fecal coliform TMDLs are being established.

TMDL Number	WMA	Station Name/Waterbody	Site ID	County(s)	River Miles
1	12	Musquash Brook	11	Monmouth	0.89
2	12	Shark River near Neptune City	01407705	Monmouth	8.5
3	12	Jumping Brook near Neptune City	01407760	Monmouth	2.4
Total River Miles:					**11. 79**

These three TMDLs will identify the sources of fecal coliform and establish fecal coliform load reductions needed in order to attain applicable surface water quality standards.

As stated in N.J.A.C. 7:9B-1.14(c) of the New Jersey Surface Water Quality Standards (SWQS), "Fecal coliform levels shall not exceed a geometric average of 200 CFU/100 ml nor should more than 10 percent of the total sample taken during any 30-day period exceed 400 CFU/100 ml in FW2 waters." Nonpoint and stormwater point sources are the primary contributors to fecal coliform loads in these streams and can include storm-driven loads transporting fecal coliform from sources such as geese, farms, and domestic pets to the receiving water. Nonpoint sources can also include steady-inputs from sources such as failing sewage conveyance systems and failing or inappropriately located septic systems. Because the total point source contribution from domestic wastewater treatment plants is an insignificant fraction of a percent of the total load, these fecal coliform TMDLs will not impose any change in existing effluent limits at the plants.

Using ambient water quality data monitoring conducted by USGS/NJDEP and the Monmouth County Health Department during water years 1985-2002, summer and all season geometric means were determined for each Category 5 listed segment. Given the two surface water quality criteria of 200 CFU/100 ml and 400 CFU/100 ml in FW2 waters, computations were necessary for both criteria and resulted in two values for percent reduction for each stream segment. The higher (more stringent) percent reduction value was selected as theTMDL and will be applied to nonpoint and stormwater point sources within the study area. The extent to which nonpoint and stormwater point sources have been identified or need to be identified or verified varies by segment based on data availability, watershed size and complexity, and pollutant sources. Implementation strategies to achieve SWQS are addressed in this report.

Each TMDL shall be proposed and adopted by the Department as an amendment to the appropriate area wide water quality management plan(s) in accordance with N.J.A.C. 7:15-3.4(g).

This TMDL Report is 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.

2.0 Introductio n

Sublist 5 (also known as the 303(d) List) of the State of New Jersey's 2002 Integrated List of Waterbodies (35 N.J.R. 470(a) January 21, 2003) identified several waterbodies in the Atlantic Water Region as being impaired by pathogens, as evidenced by the presence of fecal coliform concentrations in excess of the standards. These impairments were carried over tp the proposed 2004 Integrated List of Waterbodies (35 N.J.R. 1238(b), March 1, 2004). This report establishes three TMDLs, which address fecal coliform in the identified waterbodies. These TMDLs include management approaches to reduce loadings of fecal coliform from various sources in order to attain applicable surface water quality standards forfecal coliform. Jumping Brook and Shark River are listed on Sublist 5 due to impairment caused by other pollutants. Jumping Brook is listed at Sites 0147720 & 0147760 for pH and at Site AN0480 for Benthic Macroinvertbrates. Shark River is listed for biological impairments at Site AN0481 & AN482, phosphorus impairments at Sites 30 & 01407750, as well as total coliform and dissolved oxygen impairments in the estuary and Fish-PCB's and Dioxin's throughout. These TMDLs address only fecal coliform impairments. Separate TMDL evaluations will be developed to address the other pollutants of concern. The waterbodies will remain on Sublist 5 with respect to these pollutants until such time as TMDL evaluations for all pollutants have been completed and approved by USEPA. With respect to the fecal coliform impairment, the waterbodies will be moved to Sublist 4 following approval of the TMDLs by USEPA.

3.0 Background

In accordance with Section 305(b) of the Federal Clean Water Act (CWA) (33 U.S.C. 1315(B)), the State of New Jersey is required to prepare biennially 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.

In accordance with Section 303(d) of the CWA, the State is also required to prepare biennially and submit to USEPA a report that identifies waters that do not meet or are not expected to meet SWQS after implementation of technology-based effluent limitations or other required controls. This report is commonly referred to as the 303(d) List. In November 2001, USEPA issued guidance that encouraged states to integrate the 305(b) Report and the 303(d) List into one report. New Jersey's *2002 Integrated List of Waterbodies* uses this new format. This integrated report assigns waterbodies to one of five categories. In general, Sublists 1 through 4 include waterbodies that are unimpaired, have limited assessment or data availability, are impaired due to pollution rather than pollutants or have had a TMDL prepared. Sublist 5 constitutes the traditional 303(d) List for water quality limited segments, which are waters impaired or threatened by one or more pollutants. Water quality limited segments require TMDL evaluations.

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 water body can assimilate without violating a state's water quality standards and allocates that load capacity to known point and nonpoint sources in the form of wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and a margin of safety. A TMDL identifies all the contributors to surface water quality impacts and establishes load reductions for pollutants of concern as necessary to meet the SWQS.

Recent EPA guidance (Sutfin, 2002) describes the statutory and regulatory requirements for approvable TMDLs, as well as additional information generally needed for USEPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations. The Department believes that the TMDLs in this report address the following 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 does not require and does not approve TMDL implementation plans).
11. Public Participation.

4.0 Pollutant of Concern and Area of Interest

The pollutant of concern for these TMDLs is pathogens, the presence of which is indicated by elevated concentrations of fecal coliform bacteria. Fecal coliform concentrations were found to exceed New Jersey's SWQS, published at N.J.A.C. 7-9B et seq., for the segments in the Atlantic Water Region identified in Table 2. As reported in the *2002 Integrated List of Waterbodies*, also identified in Table 2 are the river miles and management response associated with each listed segment

Table 2 Abridged Sublist 5 of the 2002 Integrated List of Waterbodies, listed for fecal coliform impairment in the Atlantic Water Region.

TMDL No.	WMA	Station Name/Waterbody	Site ID	River Miles	Management Response
1	12	Musquash Brook	11	0.89	Establish TMDL
2	12	Shark River near Neptune City	01407750	8.5	Establish TMDL
3	12	Jumping Brook near Neptune City	01407760	2.4	Establish TMDL

These three TMDLs will address 11.7 river miles. Based on the detailed county hydrography stream coverage, 50.8 stream miles are directly affected by the 3 TMDLs due to the fact that the implementation plans cover entire watersheds; not just impaired waterbody segments.

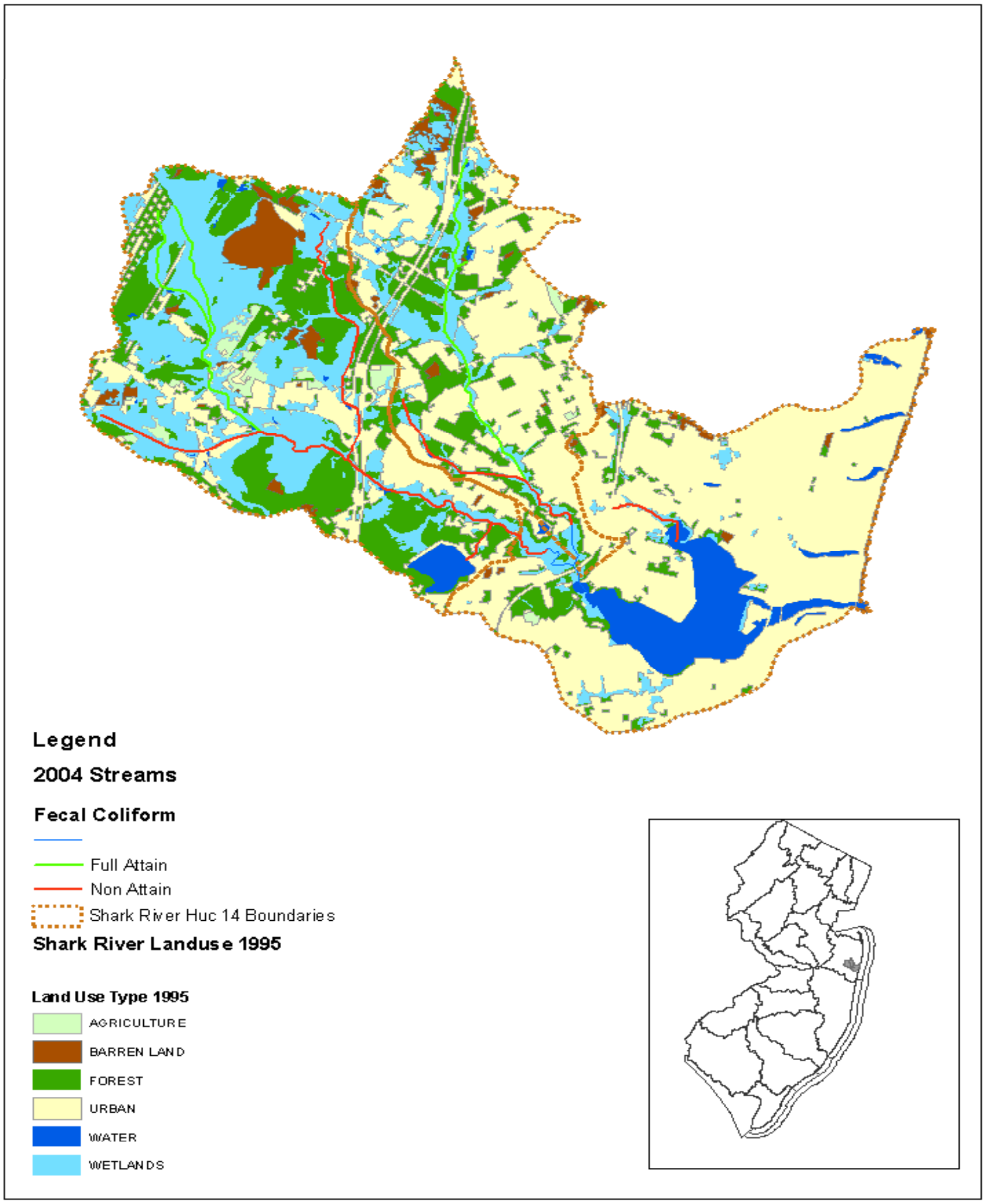
4.1. Description of the Watershed Management Area 12 and the Shark River Watershed

Watershed Management Area 12 includes watersheds that primarily drain the eastern portions of Middlesex, Monmouth and Ocean Counties and flow in one of two directions: northeast to Sandy Hook/Raritan Bay or southeast to the Atlantic Ocean. WMA 12 is 503 mi^2 in size and lies within the Coastal Plain physiographic province, which is characterized by a low–lying topography. All of the WMA 12 streams are tidally influenced, usually to the first dam or impoundment above the confluence. Sandy soils and coastal scrub/pine vegetation dominate WMA 12.

WMA 12 includes the following major watersheds: Raritan/Sandy Hook Bay Tributaries, Shark River, Navesink River, Manasquan River, Shrewsbury River, and Wreck Pond Brook. This TMDL deals with impaired segments within the Shark River Watershed.

The **Shark River** drains an area of 26 mi^2. A tributary to the river is Jumping Brook (7 miles long). The Shark River Watershed includes not only the Shark River but also a regional collection of nearby streams, most of which are impounded near their mouths to form coastal ponds before draining into the Atlantic Ocean. Surface waters in this watershed include: Hankins Brook, Hannabrand Brook, Hog Swamp Brook, Musquash Brook, Polly Pod Brook, Poplar Brook, Reevy Branch, Shark River, and Whale Pond Brook. Prominent lakes and coastal ponds in this watershed include: Lake Alberta, Como Lake, Fletcher Lake, Spring Lake, Takanassee Lake, and Wesley Lake.

Figure 1 **Land Use of Shark River Watershed HUC 0203010490040, 0203010490050 & 0203010490060**



Sublist 5 Waterbodies in WMA 12

The spatial extent of each impaired segment is identified in Figure 1 and described in Table 3. River miles, watershed sizes and land use/land cover by percent area associated with each segment are listed in Table 4.

Figure 2 **Spatial extent of Sublist 5 segments for which TMDLs are being developed in WMA 12**

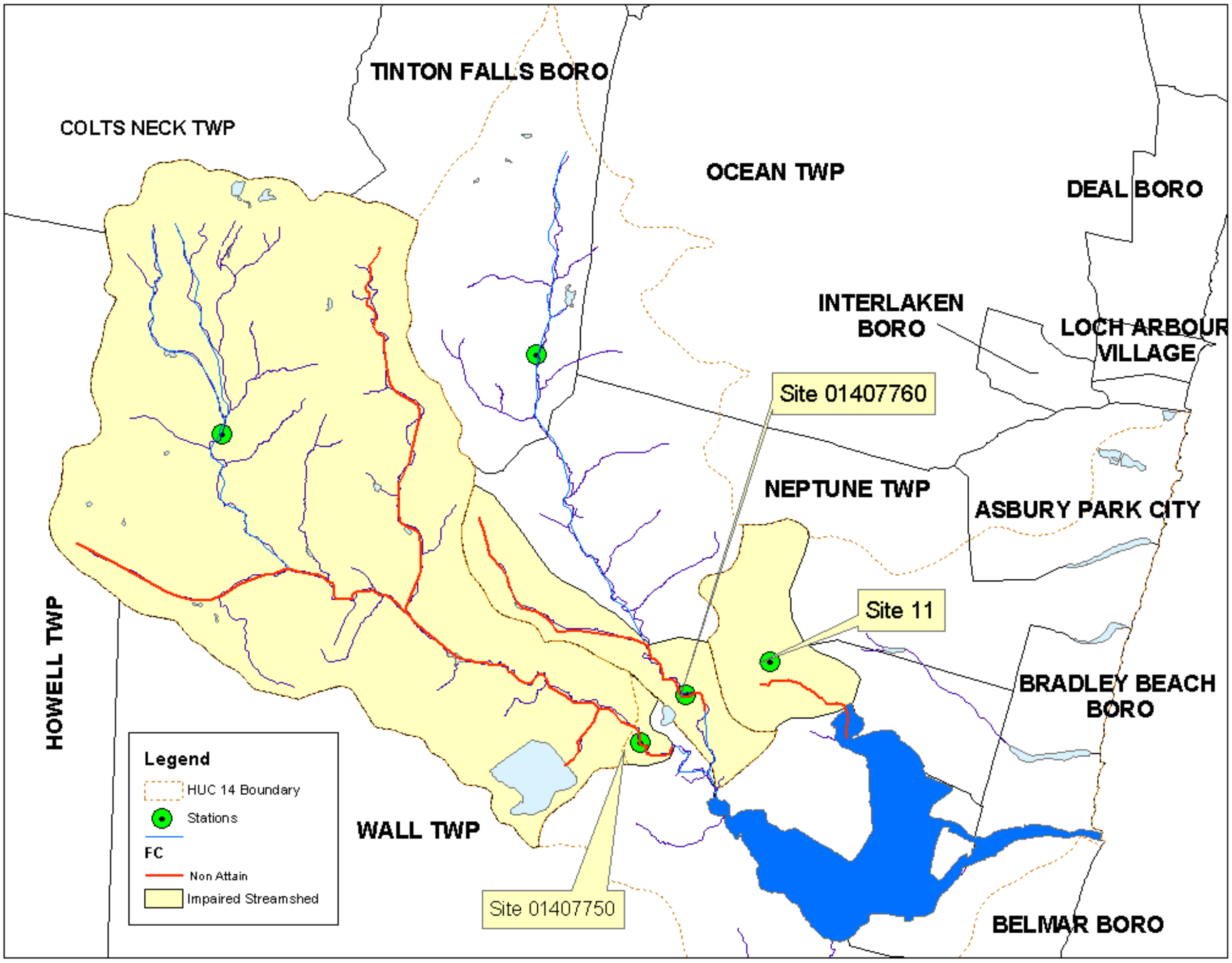
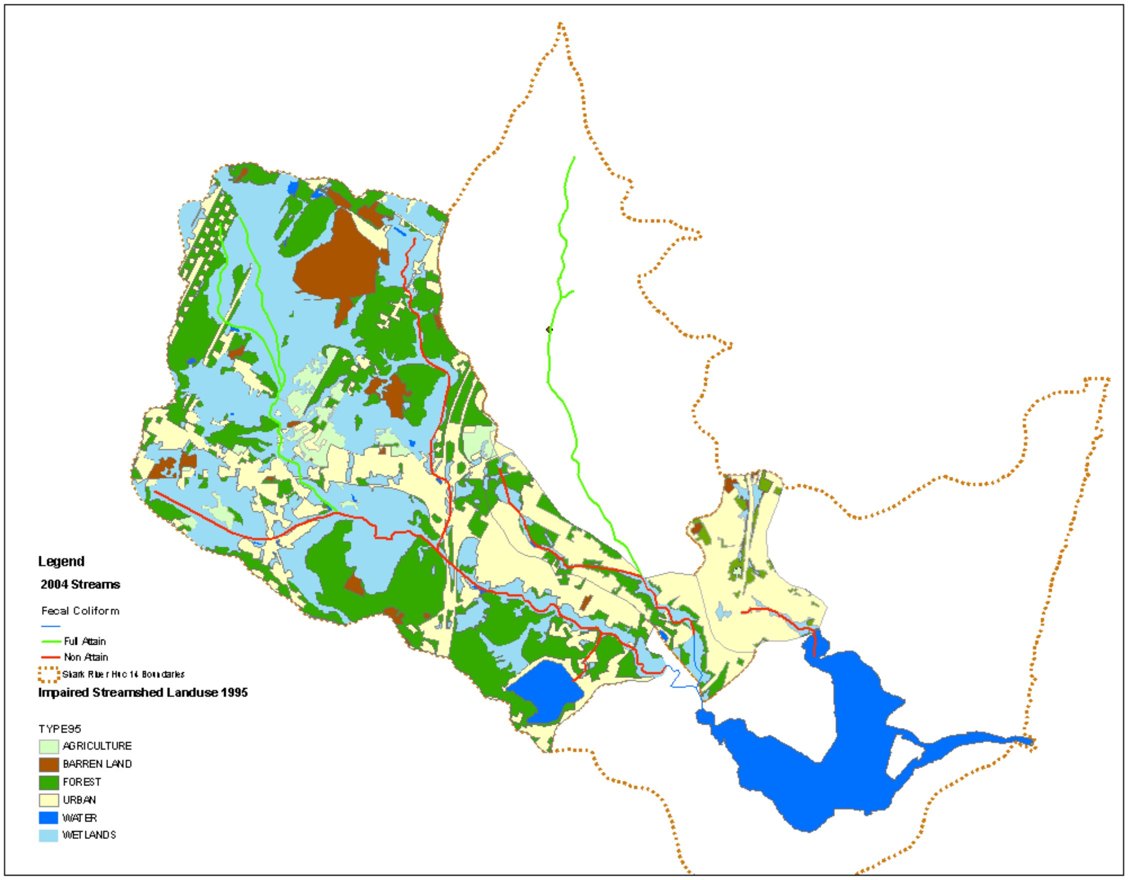


Table 3 **River miles, Watershed size, and Anderson Land Use classification for three Sublist 5 segments, listed for fecal coliform, in WMA 12.**

	Segment ID		
	11	**01407750**	**01407760**
Sublist 5 impaired river miles (miles)	0.89	8.5	2.4
Total river miles within watershed and included in the implementation plan (miles)	12.37	25.05	13.38
Watershed size (acres)	599.55	6439.27	686.87
Landuse/Landcover			
Agriculture	0.48%	3.32%	0.17%
Barren Land	2.00%	5.71%	0.0 %
Forest	10.83%	30.62%	28.46%
Urban	78.93%	20.83%	54.69%
Water	0.03%	2.16%	0.52%

	Segment ID		
	11	**01407750**	**01407760**
Wetlands	7.72%	37.36%	16.16%

Figure 3 Landuse for the 3 Sublist 5 Segments listed for Fecal Colifrom in WMA 12



4.2. Data Sources

The Department's Geographic Information System (GIS) was used extensively to describe the Atlantic watershed characteristics. In concert with USEPA's November 2001 listing guidance, the Department is using Reach File 3 (RF3) in the 2002 Integrated Report to represent rivers and streams. The following is general information regarding the data used to describe the watershed management area:

- Land use/Land cover information was taken from the 1995/1997 Land Use/Land cover Updated for New Jersey DEP, published 12/01/2000 by Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA), delineated by watershed management area.

- 2004 Assessed Rivers coverage, NJDEP, Watershed Assessment Group, unpublished coverage.

- County Boundaries: Published 11/01/1998 by the NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA), "NJDEP County Boundaries for the State of New Jersey." Online at: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/stco.zip

- Detailed stream coverage (RF3) by County: Published 11/01/1998 by the NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA). "Hydrography of Monmouth County, New Jersey (1:24000)." Online at: http://www.state.nj.us/dep/gis/digidownload/zips/strm/

- NJDEP 14 Digit Hydrologic Unit Code delineations (DEPHUC14), published 4/5/2000 by Department of Environmental Protection (NJDEP), New Jersey Geological Survey (NJGS) Online at: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/dephuc14.zip

- NJDEP 10-meter Digital Elevation Grid of the Lower Delaware Watershed Management Area (WMA 12), published 12/23/2002 by NJ Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA) http://www.state.nj.us/dep/gis/digidownload/zips/wmalattice/wma12lat.zip

- NJPDES Surface Water Discharges in New Jersey, (1:12,000), published 02/02/2002 by Division of Water Quality (DWQ), Bureau of Point Source Permitting - Region 1 (PSP-R1).

- NJDEP Existing Water Quality Stations in New Jersey, published 5/12/2003, NJDEP, Division of Land Use Management (LUM), Water Monitoring & Standards, Bureau of Freshwater Biological Monitoring (BFBM) http://www.state.nj.us/dep/gis/digidownload/zips/statewide/ewqpoi.zip

- NJDEP Ambient Stream Quality Monitoring Sites, published 5/30/2001, NJDEP , Bureau of Freshwater Biological Monitoring (BFBM), http://www.state.nj.us/dep/gis/digidownload/zips/statewide/swpts01.zip

5.0 Applicable Water Quality Standards

5.1. New Jersey Surface Water Quality Standards for Fecal Coliform

As stated in N.J.A.C. 7:9B-1.14(c) of the New Jersey SWQS, the following are the criteria for freshwater fecal coliform:

"Fecal coliform levels shall not exceed a geometric average of 200 CFU/100 ml nor should more than 10 percent of the total samples taken during any 30-day period exceed 400 CFU/100 ml in FW2 waters".

All of the waterbodies covered under these TMDLs have a FW2 classification (NJAC 7:9B-1.12). The designated uses, i.e. surface water uses, both existing and potential, that have been established by the Department for waters of the State, for all of the waterbodies in the Atlantic Water Region is as stated below:

In all FW2 waters, the designated uses are:

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.

5.2. Pathogen Indicators in New Jersey's Surface Water Quality Standards (SWQS)

A subset of total coliform, fecal coliform originates from the intestines of warm-blooded animals. Therefore, because they do not include organisms found naturally in soils, fecal coliform is preferred over total coliform as a pathogen indicator. In 1986, USEPA published a document entitled *"Implementation Guidance for Ambient Water Quality Criteria for Bacteria – 1986"* that contained their recommendations for water quality criteria for bacteria to protect bathers from gastrointestinal illness in recreational waters. The water quality criteria established levels of indicator bacteria *Escherichia coli* (*E. coli*) for fresh recreational water and enterococci for fresh and marine recreational waters in lieu of fecal coliforms. Historically, New Jersey has listed water bodies for exceedances of the fecal coliform criteria. Therefore, the Department is obligated to develop TMDLs for Sublist 5 water bodies based upon fecal coliform, until New Jersey makes the transition to *E. coli* and enterococci in its SWQS and sufficient data have been collected to assess impairment in accordance with the revised indicators.

6.0 Source Assessment

In order to evaluate and characterize fecal coliform loadings in the waterbodies of interest in these TMDLs, and thus propose proper management responses, source assessments are warranted. Source assessments include identifying the types of sources and their relative contributions to fecal coliform loadings, in both time and space variables.

6.1. Assessment of Point Sources other than Stormwater

Sewage treatment plants that receive human waste, whether municipal or industrial, are required to disinfect effluent prior to discharge and to meet surface water quality criteria for fecal coliform in their effluent. In addition, New Jersey's Surface Water Quality Standards at N.J.A.C. 7:9B-1.5(c)4 reads "No mixing zones shall be permitted for indicators of bacterial quality including, but not limited to, fecal coliforms and enterococci". This mixing zone policy is applicable to both municipal and industrial sewage treatment plants.

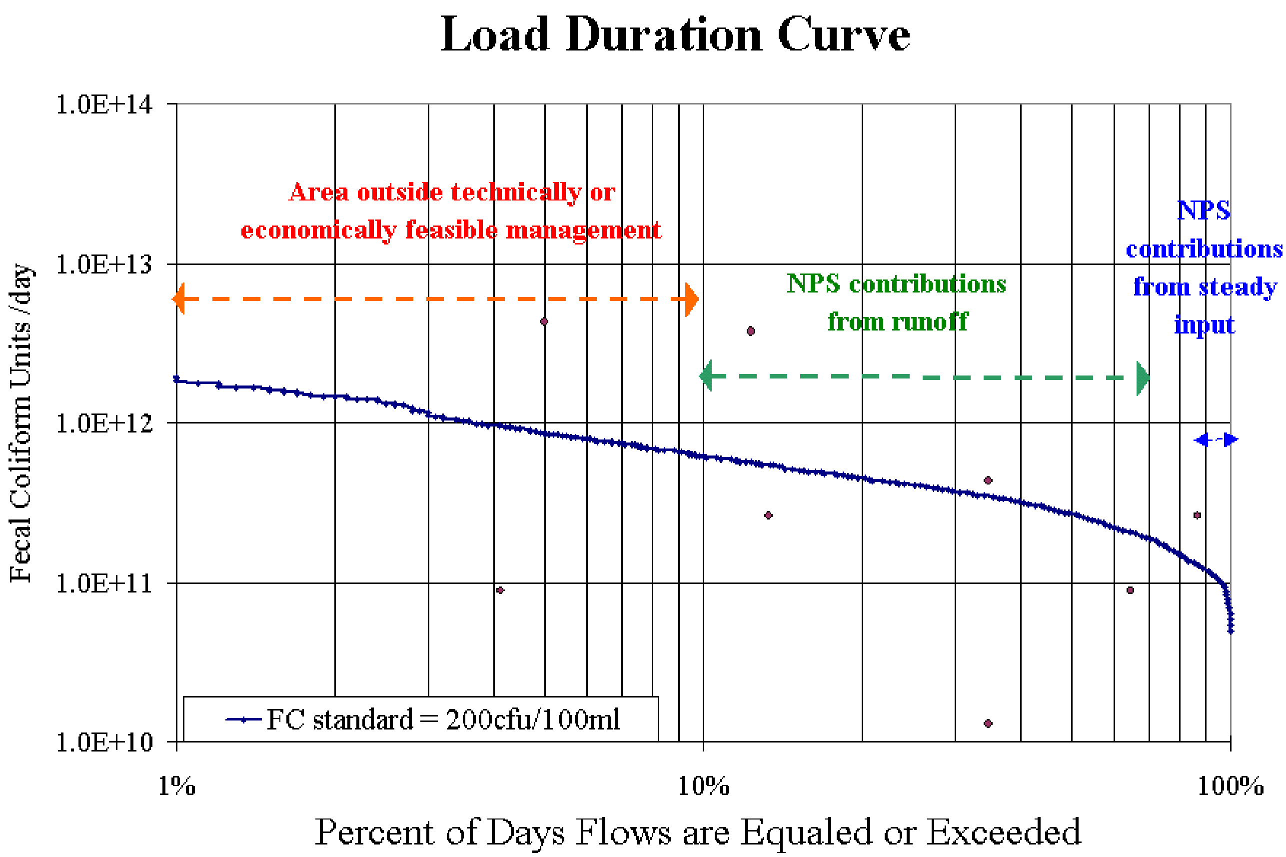
Since sewage treatment plants routinely achieve essentially complete disinfection (less than 20 CFU/100ml), the requirement to disinfect results in fecal coliform concentrations well below the criteria and permit limit. The percent of the total point source contribution is an insignificant fraction of the total load. Furthurmore there are no point sources of fecal coliform, namely sewage treatment discharges, within the watershed of the impaired segments for these TMDLs. Consequently, these fecal coliform TMDLs will not impose any change in existing effluent limits for domestic and industrial treatment plants.

6.2. Assessment of Nonpoint and Stormwater Point Sources

Nonpoint and stormwater point sources include storm-driven loads such as runoff from various land uses that transport fecal coliform from sources, such as geese, farms, and domestic pets, to the receiving water. Domestic pet waste, geese waste, as well as loading from storm water detention basins will be addressed by the Phase II MS4 program. Nonpoint sources also include steady inputs from "illicit" sources such as failing sewage conveyance systems, sanitary sewer overflows (SSOs), and failing or inappropriately located septic systems. When "illicit" sources are identified, either through the Phase II MS4 requirements or trackdown studies conducted by the Department, appropriate enforcement measures will be taken to eliminate them.

When streamflow gage information is available, a load duration curve (LDC) is useful in identifying and differentiating between storm-driven and steady-input sources. As an example, Figure 4 represents a LDC using the 200 CFU/100 ml criterion.

Figure 4 Example Load Duration Curve (LDC)



The load duration curve method is based on comparison of the frequency of a given flow event with its associated water quality load. A LDC can be developed using the following steps:

1. Plot the Flow Duration Curve, Flow vs. % of days flow exceeded.
2. Translate the flow-duration curve into a LDC by multiplying the water quality standard, the flow and a conversion factor; the result of this multiplication is the maximum allowable load associated with each flow.
3. Graph the LDC, maximum allowable load vs. percent of time flow is equaled or exceeded.
4. Water quality samples are converted to loads (sample water quality data multiplied by daily flow on the date of sample).
5. Plot the measured loads on the LDC.

Values that plot below the LDC represent samples below the concentration threshold whereas values that plot above represent samples that exceed the concentration threshold. Loads that plot above the curve and in the region between 85 and 100 percent of days in which flow is exceeded indicate a steady-input source contribution. Loads that plot in the region between 10 and 70 percent suggest the presence of storm-driven source contributions. A combination of both storm-driven and steady-input sources occurs in the transition zone between 70 and 85 percent. Loads that plot above 99 percent or below 10 percent represent values occurring during either extreme low or high flows conditions and are thus considered to be outside the region of technically and economically feasible management. In this report, LDCs are used only for TMDL implementation and not in calculating TMDLs.

LDCs for listed segments in the Atlantic region are located in Appendix D. In each case, thirty (30) years of USGS gage flow data (water years 1970-2000), from the listed station, were used in generating the curve. When a recent 30-year period was not available at the listed station, an adjacent station was selected based on station correlation information in US Geological Survey Open File Report 81-1110 (USGS, 1982). When an adjacent station was used in the manner, flows were adjusted to the station of interest based on a ratio of watershed size. LDCs were not developed for stations in which a satisfactory correlation could not be found.

7.0 Water Quality Analysis

Relating pathogen sources to in-stream concentrations 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 fecal coliform 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 fecal coliform typically include measures such as 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 in-stream concentrations. Given these considerations, detailed water quality modeling was not selected for determining the load reductions needed to attain standards.

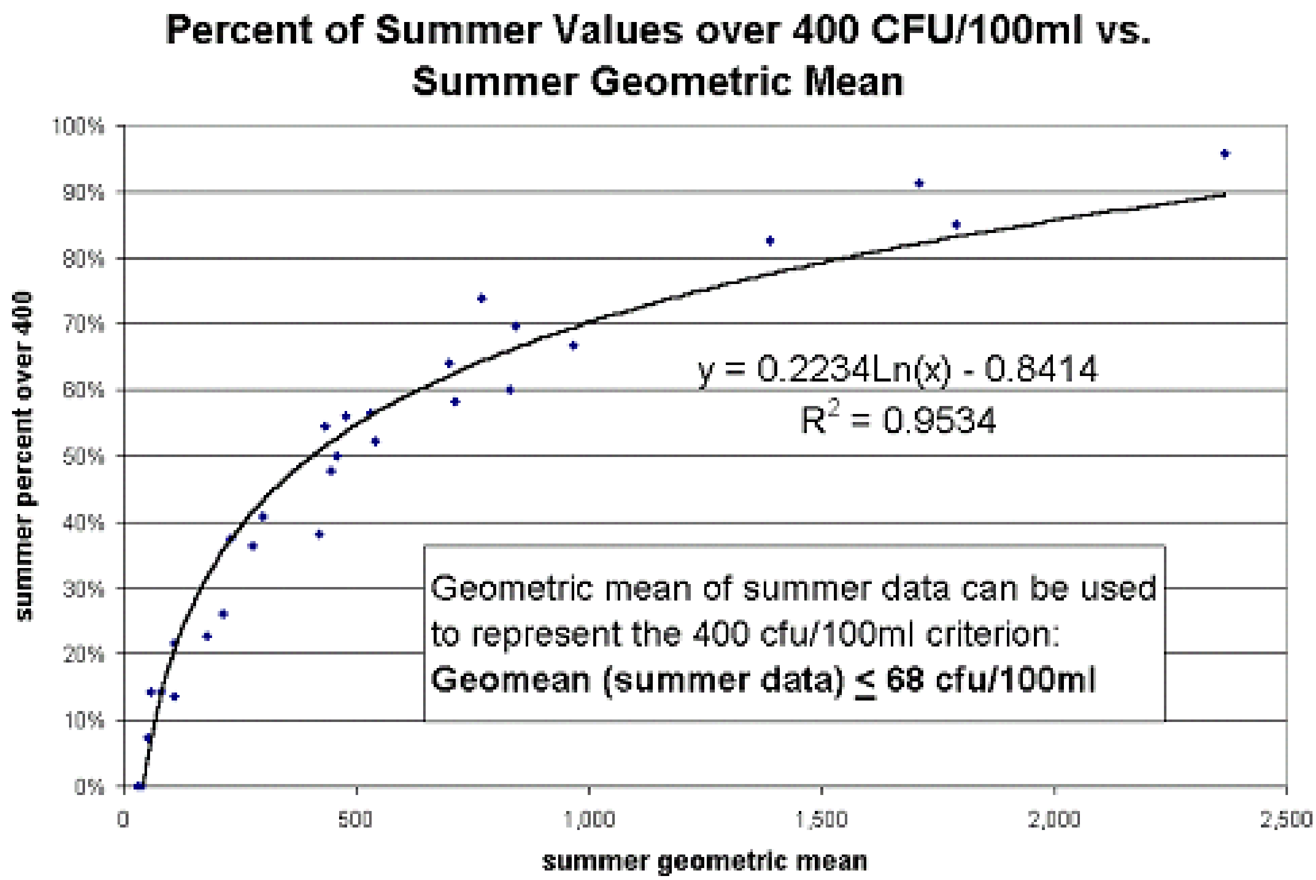
As described in EPA guidance, a TMDL identifies the loading capacity of a waterbody for a particular pollutant. EPA regulations define loading capacity as the greatest amount of loading that a waterbody can receive without violating water quality standards (40 C.F.R. 130.2). The loadings are required to be expressed as either mass-per-time, toxicity, or other appropriate measures (40 C.F.R. 130.2(i)). For these TMDLs, the load capacity is expressed as a concentration set to meet the state water quality standard. For bacteria, it is appropriate and justifiable to express the components of a TMDL as percent reduction based on concentration. The rationale for this approach is that:

- expressing a bacteria TMDL in terms of concentration provides a direct link between existing water quality and the numeric target;
- using concentration in a bacteria TMDL is more relevant and consistent with the water quality standards, which apply for a range of flow and environmental conditions; and
- follow-up monitoring will compare concentrations to water quality standards.

Given the two criteria of 200 CFU/100 ml and 400 CFU/100 ml in FW2 waters, computations were necessary for both criteria and resulted in two percent reduction values. The higher percent reduction value was applied in the TMDL so that both the 200 CFU/100 ml and 400 CFU/100 ml criteria were satisfied.

To satisfy the 200 CFU/100ml criteria, the geometric mean of all available data between water years 1994-2002 was compared to an adjusted target concentration. The adjusted target accounts for an explicit margin of safety and is equal to 200 minus the margin of safety. A calculation incorporating all available data is generally conservative since most samples are taken during the summer when fecal coliform is generally higher. A geometric mean of summer data was used to develop a percent reduction to satisfy the 400 CFU/100 ml criteria. A summer geometric mean can be used to represent the 400 criteria by regressing the percent over 400 CFU/100 ml against the geometric mean (Figure 7). Thus, each datapoint on Figure 7 represents all the data from one individual monitoring station. Sites with 20 or more summer data points were used to develop this regression, in order to make use of more significant values for percent exceedance. A statewide regression was used rather than regional regressions because the regression shape was not region-specific and the strength of the correlation was highest when all statewide data were included. The resulting regression has an r-squared value of 0.9534. Solving for X when Y is equal to 10% yields a geometric mean threshold of 68 CFU/100ml. This means that, using summer data, a geometric mean of 68 can be used to represent the 400 CFU/100ml criterion. Since the geometric mean is a more reliable statistic than percentile when limited data are available, 68 CFU/100ml was used to represent the 400 CFU/100ml criterion for all sites. The inclusion of all data from summer months (May through September) to compare with the 30-day criterion is justified because summer represents the critical period when primary and secondary contact with water bodies is most prevalent. A more detailed justification for using summer data can be found in Section 7.1, "Seasonal Variation and Critical Conditions."

Figure 5 Percent of summer values over 400 CFU/100ml as a function of summer geometric mean values



$$y = 0.2234\text{Ln}(x) - 0.8414 \qquad \text{Equation 1}$$

$R^2 = 0.9534$

Geometric mean, and summer geometric mean, and percent reductions were determined at each location for both criteria using Equations 2 through 4. To satisfy the 200 CFU/100ml criteria, equations 2 and 3 were applied. Equations 2 and 4 were used in satisfying the 400 CFU/100ml criteria.

$$Geometric\ Mean\ for\ 200CFU\ criteria = \sqrt[n]{y_1 y_2 y_3 y_4 \ldots . y_n} \qquad \text{Equation 2}$$

where:
y = sample measurement
n = total number of samples

$$200\ CFU\ criteria\ Percent\ \text{Re}duction = \frac{(Geometric\ mean - (200 - e))}{Geometric\ mean} \times 100\ \% \qquad \text{Equation 3}$$

$$400\ CFU\ criteria\ Percent\ \text{Re}duction = \frac{(SummerGeometric\ mean - (68 - e))}{SummerGeometric\ mean} \times 100\ \% \qquad \text{Equation 4}$$

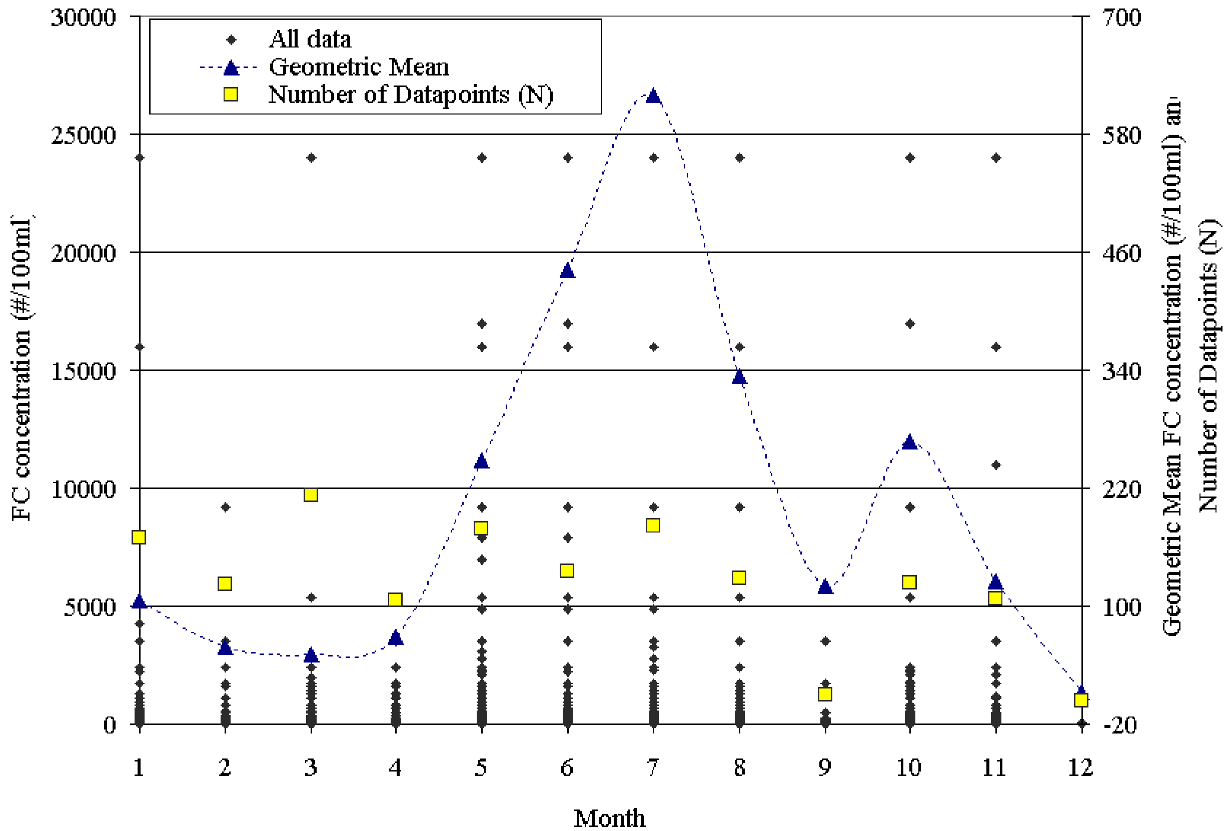
where:
e = (margin of safety)

This percent reduction can be applied to nonpoint and stormwater point sources as a whole or be apportioned to categories of nonpoint and stormwater point sources within the study area. The extent to which nonpoint and stormwater point sources have been identified or need to be identified varies by study area based on data availability, watershed size and complexity, and pollutant sources.

7.1. Seasonal Variation/Critical Conditions

These TMDLs will attain applicable surface water quality standards year round. The approach outlined in this paper is conservative given that in most cases fecal coliform data were collected during the summer months, a time when in-stream concentrations are typically the highest. This relationship is evidenced when calculating, on a monthly basis, the geometric mean of fecal coliform data collected statewide. Statewide fecal coliform geometric means during water years 1994-1997 were compared on a monthly basis and are shown in Figure 8. The 1994-1997 period was chosen for this analysis so that the significance of the number of individual datapoints for any given month was minimized. During the 1994-1997 period year-round sampling for fecal coliform was conducted by sampling four times throughout the year. Following 1997, the fecal coliform sampling protocol was changed to five samples during a 30-day period in the summer months. As evident in Figure 8, higher monthly geometric means are observed between May and September with the highest values occurring during mid-summer. This relationship is also evident when using the entire 1994-2002 dataset or datasets from individual water years. Given this relationship, summer is considered the critical period for violating fecal coliform SWQS and, as such, sampling during this period is considered adequate to provide year round protection and to support designated uses.

Figure 6 **Statewide monthly fecal coliform geometric means during water years 1994-1997 using USGS/NJDEP data.**



7.2. 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 calculations, both an implicit and explicit Margin of Safety (MOS) are incorporated. An implicit MOS is inherent in the estimates of current pollutant loadings, the targeted water quality goals (New Jersey's SWQS) and the allocations of loading. This was accomplished by taking conservative assumptions throughout the TMDL evaluation and development. Examples of some of the conservative assumptions include treating fecal coliform as a conservative substance, applying the fecal coliform criteria to stormwater point sources, and applying the fecal coliform criteria to the stream during all weather conditions. Fecal coliforms decay in the environment (i.e. outside the fecal tract) relatively rapidly, yet this analysis assumes a linear relationship between fecal load and in-stream concentration. Furthermore, it is generally recognized that fecal contamination from stormwater poses much less risk of illness than fecal contamination from sewage or septic system effluent (Cabelli, 1989). Finally, much of the fecal coliform is flushed into the system during rainfall events and passes through the system in a short time. Primary and secondary recreation generally occur during dry periods.

An explicit MOS is provided by incorporating a confidence level multiplier associated with log-normal distributions in the calculation of the load reduction for both the 200 and 400 standards. Using this method, the 200 and 400 targets are reduced based on the number of data points and the variability within each data set. For these TMDLs, a confidence level of 90% was used in calculating the MOS. As a result, and as identified in Appendix C, the target value will be different for each stream segment or grouped segments. The explicit margin of safety is calculated using the following steps:

1- FC data (x) will transformed to Log form data (y),
2- the mean of the Log- transformed data (y) is determined, $\bar{y}$
3- Determine the standard deviation of the Log-transformed data, S_y using the following equation:

$$S_y = \sqrt{\frac{\sum_i (y_i - \bar{y})^2}{N-1}}$$

4- Determine the Geometric mean of the FC data (GM)
5- Determine the standard deviation of the mean (standard error of the mean), $s_{\bar{y}}$, using the following equation:

$$s_{\bar{y}} = \frac{s_y}{\sqrt{N}}$$

6- For the 200 standard ($x_{standard}$), $y_{standard}$ = Log(200)= 2.301, thus for a confidence level of 90%, the target value will be the lower confidence limit (n= -1.64), $y_{target} = y_{std} - n \cdot s_{\bar{y}}$, for example, the 200 criteria: y_{target} = 2.301- n* $s_{\bar{y}}$
7- The target value for x, $x_{target} = 10^{y_{target}}$
8- The margin of safety (e) therefore will be e = $x_{standard}$ - x_{target}
9- Finally, the load reduction = $\frac{GM - x_{target}}{GM} \cdot 100\%$, for example the 200 criteria will be defined as: $\frac{(GM - (200 - e))}{GM} \cdot 100\%$

   The 400 criteria would be defined as: $\frac{(GM - (68 - e))}{GM} \cdot 100\%$

8.0 TMDL Calculations

Because these TMDLs are calculated based on ambient water quality data, the allocations are provided in terms of percent reductions. In the same way, the loading capacity of each stream is expressed as a function of the current load:

$LC = (1 - PR) \times L_o$, where

LC = loading capacity for a particular stream;
PR = percent reduction as specified in Table 5

L_o = current load.

8.1. Wasteload Allocations and Load Allocations

For the reasons discussed previously, these TMDLs do not include WLAs for traditional point sources (domestic and industrial wastewater treatment facilities). WLAs are hereby established for regulated point sources, including NJPDES-regulated stormwater, while LAs are established for all stormwater sources that are not subject to NJPDES regulation, and for all other nonpoint sources. Both WLAs and LAs are expressed as percentage reductions for particular stream segments.

Table 5 identifies the required percent reduction necessary for each stream segment or group of segments to meet the fecal coliform SWQS. The reductions reported in this table include a margin of safety factor and represent the higher percent reduction (more stringent) required of the two criteria. Reductions that are required under each criteria are located in Appendix C. In all cases, the 400 CFU/100ml criteria was the more stringent of the two criteria, thus values reported in Table 5 were equal to the percent required to meet the 400 CFU/100ml criteria.

Table 4 TMDLs for fecal coliform-impaired stream segments in the Atlantic Water Region as identified in Sublist 5 of the 2002 Integrated List of Waterbodies. The reductions reported in this table represent the higher, or more stringent, percent reduction required of the two fecal colifom criteria.

TMDL Number	WMA	303(d) Category 5 Segments	Water Quality Stations	Station Names	Load Allocation (LA) and Margin of Safety (MOS)					Wasteload Allocation (WLA)
					Summer N	Summer geometric mean CFU/100ml	MOS as a percent of the target concentration	Percent reduction without MOS	Percent reduction with MOS	
1	12	11	11	Musquash Brook	5	52	48%	-31%	32%	32%
2	12	01407750	01407750	Shark River near Neptune City	19	348	37%	80%	88%	88%
3	12	01407760	01407760	Jumping Brook Near Neptune City	9	401	38%	83%	89%	89%

[1] MOS as a percent of target is equal to: $\frac{e}{200\ CFU/100ml}$ or $\frac{e}{68\ CFU/100ml}$ where "e" is defined as the MOS in Section 7.2

8.2. 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 at this time. The loading capacity of each stream is expressed as a function of the current load (Section 8.0), and both WLAs and LAs are expressed as percentage reductions for particular stream segments (Section 8.1). Therefore, the percent reductions from current levels must be attained in consideration of any new sources that may accompany future development. Strategies for source reduction will apply equally well to new development as to existing development.

9.0 Follow - up Monitoring

In association with the Water Resources Division of the U.S. Geological Survey, the NJDEP has cooperatively operated the Ambient Stream Monitoring Network (ASMN) in New Jersey since the 1970s. The ASMN currently includes approximately 115 stations that are routinely monitored on a quarterly basis. Bacteria monitoring, as part of the ASMN network, are conducted five times during a consecutive 30-day summer period each year. The data from this network has been used to assess the quality of freshwater streams and percent load reductions. The ASMN will remain a principal source of fecal coliform monitoring. In addition beginning in the summer of 2004 the Department will commence a Bacterial Source Trackdown program.

10.0 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, siting criteria, operating methods, or other alternatives" (USEPA, 1993).

Development of effective management measures depends on accurate source assessment. Fecal coliform is contributed to the environment from a number of categories of sources including human, domestic or captive animals, agricultural practices, and wildlife. Fecal coliform 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 fecal coliform. 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 segments through "municipal separate storm sewer systems" (MS4s) are regulated under the Department's Phase II NJPDES stormwater rules for the Municipal Stormwater Regulation Program. Under these rules and associated general permits, many municipalities (and various county, State, and other agencies) in the Atlantic Region 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 Phase II 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 committed State funds as well as a portion of its 2003 Clean Water Act 319(h) pass through grant funds to assist municipalities in meeting Phase II 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.

Agricultural activities are another example of potential sources of fecal coliform. 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 fecal coliform. 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, signed a $100 million dollar CREP agreement earlier this year. The program matches $23 million of State money with $77 million from the Comodity Credit Corp. 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.

10.1. Source Trackdown

Through the watershed management process and the New Jersey Watershed Ambassadors Program, visual surveys of the impaired segment watersheds were conducted to identify potential sources of fecal coliform. Watershed partners, who are intimately familiar with local land use practices, were able to share information relative to potential fecal coliform sources. The New Jersey Watershed Ambassadors Program is a community-oriented AmeriCorps environmental program designed to raise awareness about watershed issues in New Jersey. Through this program, AmeriCorps members are placed in watershed management areas across the state to serve their local communities. Watershed Ambassadors monitor the rivers of New Jersey through visual assessments and biological assessment volunteer monitoring programs. Supplemental training is provided to prepare the members to perform river assessments on the fecal impaired segments. Each member is provided with detailed maps of the impaired segments within their watershed management area. The Department worked with and through watershed partners and AmeriCorps members to conduct visual assessments in fall of 2002 for Shark River and Jumping Brook, and spring of 2004 for Musquash Brook. The Department reviewed monitoring data, visual assessment surveys, other information supplied by watershed partners, load duration curves, and aerial photography of the impaired segments to formulate segment specific strategies. Segment specific monitoring strategies in combination with generic strategies appropriate to the sources in each segment will lead to reductions in fecal coliform loads in order to attain SWQS.

10.2. Short-Term Management Strategies

Short-term management measures include projects recently completed, underway and planned. Pertinent measures in the Atlantic Water Region are as follows:

- **Innovative Assessment of Sources of Fecal E. Coli in Pathogen Impaired Waterbodies of the Monmouth Coastal Watersheds Region**

  In SFY 03 Monmouth University received a 319(h) grant in the amount of $124,762 to perform assessement of fecal sources throughout the Monmouth Coastal Watersheds. The project will include bacterial source trackdown techniques to determine sources of fecal E. coli pollution in the Deal Lake, Shark River, and Wreck Pond subwatersheds.

- **Implementation of Stormwater Best Management Practices at Lake Alberta**

  The Township of Neptune received a 319(h) grant in the amount of $195,400 in SFY 03 to implement multiple lake and stormwater best management practices designed to improve water quality conditions in Lake Alberta by reducing the nonpoint source pollution load entering the lake. Through the installation of a stomwater intercept, a sub-surface aerator system, a line skimmer, and waterfowl deterrent measures this project will reduce the amount of total suspended solids, phosphorus, petroleum hydrocarbons, and fecal coliform entering the lake system.

10.3. Long–Term Management Strategies

Long term strategies include source trackdown as well as selection and implementation of specific management measures that will address the identified sources. Source categories and responses are summarized below:

Source Category	Responses	Potential Responsible Entity	Funding options
Human Sources			
Inadequate (per design, operation, maintenance, location, density) on-site disposal systems	Confirm inadequate condition; evaluate and select cost effective alternative, such as rehabilitation or replacement of systems, or connection to centralized treatment system	Municipality, MUA, RSA	CWA 604(b) for confirmation of inadequate condition; Environmental Infrastructure Financing Program for construction of selected option

Source Category	Responses	Potential Responsible Entity	Funding options
Inadequate or improperly maintained stormwater facilities; illicit connections	Measures required under Phase II Stormwater permitting program plus additional measures as determined 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	Owner of malfunctioning facility--compliance issue	User fees
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 Phase II 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			
Nuisance concentrations, eg. resident Canada geese	Feeding ordinances; Goose Management BMPs	Municipalities for ordinance; Community Plans for BMPs	State source; CWA 319(h)
Indigenous wildlife	Confirm through trackdown; consider revising designated uses	State	State source

10.4. Segment Specific Recommendations

Shark River Near Neptune City (Site ID # 014007750)

This segment's primary land uses are forest and wetlands. Waterfowl were observed throughout the watershed as well as in the stream itself. A trunk sewer line runs parallel to the stream in the southern portion of the segment. Potential sources include: wildlife, livestock, and domestic pets; investigations performed by local volunteer monitoring groups have led to the discovery of potential municipal sanitary sewer leaks. Monitoring: Fecal coliform to narrow down the scope of impairment. Determine presense/location of any human sources through coliphage and MAR monitoring. Strategies: Phase II stormwater program; goose management; investigate leaking sewer lines, correct any malfunctions found.

Jumping Brook Near Neptune City (Site ID# 01407760)

This segment's primary land uses are residential and commercial. Potential sources include wildlife, domestic animals as well as humans. The suspected human input would be from potential leaking sewer lines throughout the watershed. Investigations performed by local volunteer monitoring groups have led to the discovery of municipal sanitary sewer leaks. One such documented leak occurred in September 2002. Monitoring: Determine location of any human sources through coliphage and MAR monitoring. Strategies: Phase II Stormwater program and corrective action for leaking sewer lines.

Musquash Brook (Site ID #01407706)

This segment is within a highly urbanized area and lacks a sufficient riparian buffer throughout. The primary streamside land use is residential, both single family housing as well as multifamily housing. Trash and construction debris were observed throughout the segment. Field observations have indicated areas in which the odor of sewage was present. Monitoring: Trackdown monitoring for human sources using coliphage and MAR. Strategies: Phase II stormwater and fix leaking sewer lines, if found; riparian restoration where opportunities are found.

10.5. Pathogen Indicators and Bacterial 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 than fecal coliform (USEPA, 2001). 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 10-15 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.

BST methods have already been successfully employed at the NJDEP in the past decade. Since 1988, the Department's Bureau of Marine Water Monitoring 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, MAR and DNA fingerprinting analyses of *E. coli* are underway in the Manasquan estuary to identify potential pathogen sources (Palladino and Tiedemann, 2002). These studies along with additional sampling within the watershed will be used to implement the necessary percent load reduction. Beginning in Summer 2004 the Department will commence a statewide BST program for 2 years to aide in furthur development and refinement of implementation strategies for fecal coliform reductions.

10.6. Reasonable Assurance

With the implementation of follow-up monitoring, source identification and source reduction as described for each segment, the Department has reasonable assurance that New Jersey's Surface Water Quality Standards will be attained for fecal coliform. The Department proposes to undertake the identified monitoring responses in 2005. As a generalized strategy, the Department proposes the following with regard to categorical sources: 1) As septic system sources and leaking sewer lines are identified through the monitoring responses, municipalities will be encouraged to enter the Environmental Infrastructure Financing Program, which includes New Jersey's State Revolving Fund, to evaluate, select and implement the best overall solution to such problems; 2) To address storm water point sources, the Phase II stormwater permitting program requires control measures to be phased in from the effective date of authorization to 60 months from that date. These measures will be expedited through the Water Quality Management Planning program as amendments to the WQMPs are proposed; 3) Through continuing engagement of watershed partners, measures to identify and address other sources will be pursued, including encouragement and support of community based goose management programs, where appropriate. The Department has dedicated a portion of its Corporate Business Tax to carry out the segment specific source trackdown recommendations. State sources and a portion of FY 2003 319(h) funds will be dedicated to assisting municipalities in implementing the requirements of the Phase II municipal stormwater permitting program.

The fecal coliform reductions proposed in these TMDLs assume that existing New Jersey Pollution Discharge Elimination Systems (NJPDES) permitted municipal facilities will continue to adhere to requirements for disinfection that will meet New Jersey's SWQS. Any future facility will be required to meet water quality standards for disinfection.

The Department's ambient monitoring network and new emphasis on BST beginning in summer 2004, will be the means to determine if the strategies identified have been effective. Where trackdown monitoring has been recommended, the results of this monitoring as well as ambient monitoring will be evaluated to determine if additional strategies for source reduction are needed.

11.0 Public Participation

The Water Quality Management Planning Rules N.J.A.C. 7:15-7.2 require 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 shall propose 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 TMDLs for fecal coliform in the Atlantic Coastal Region, the Department worked collaboratively with a series of stakeholder groups as part of the Department's ongoing watershed management efforts.

- The WMA 12 Public Advisory Committee's (PAC) executive committee was briefed about the executed MOA between the Department and EPA region 2 and copies of the MOA were distributed at the Executive Committee meeting held on 10/28/02.
- Presentation was made to the PAC executive committee on 11/25/02; requested PAC review and comment on the list and maps of the streams scheduled for expedited TMDLs.

- Expedited fecal coliform TMDL presentation was given at a special meeting of interested members of the PAC on 11/6/02.
- The PAC was informed of the Department's intent to move forward with a TMDL for the Shark River and its tributaries. The minutes from the 11/6/02 meeting were provided and the members were given an opportunity to provide further comment on 3/3/04.
- A meeting was held with the Shark River Coalition to discuss the TMDL and the Coalition's ongoing work within the watershed on 3/29/04.

Additional input was received through the Rutgers University NJ EcoComplex (NJEC). The Department contracted with NJEC in July 2001. The NJEC consists of a review panel of New Jersey University professors whose role is to provide comments on the Department's technical approaches for development of TMDLs and management strategies. The New Jersey Statewide Protocol for Developing Fecal TMDLs was presented to NJEC on August 7, 2002 and was subsequently reviewed and approved. The protocol was also presented at the SETAC Fall Workshop on September 13, 2002 and met with approval.

Amendment Process

In accordance with N.J.A.C. 7:15–7.2(g), these TMDLs are hereby proposed by the Department as an amendment to the Monmouth County Water Quality Management Plan.

Notice proposing these TMDLs was published April 19, 2004 in the New Jersey Register and in newspapers which? of general circulation in the affected area in order to provide the public an opportunity to review the TMDLs and submit comments. In addition, a public hearing will be held on May 19, 2004. Notice of the proposal and the hearing has also been provided to applicable designated planning agencies and to affected municipalities.

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Appendix A: TMDL Calculations

				Load Allocation (LA) and Margin of Safety (MOS)											
				200 FC/100ml Standard					400 FC/100ml Standard						
WMA	**303(d) Category 5 Segments**	**Water Quality Stations**	**Station Names**	N (# of values)	Geometric mean CFU/100ml	MOS as a percent of the target concentration	Percent reduction without MOS	Percent reduction with MOS	Summer N	Summer geometric mean CFU/100ml	MOS as a percent of the target concentration	Percent reduction without MOS	Percent reduction with MOS	**Wasteload Allocation (WLA)**	**Period of record used in analysis**
12	11	11	Musquash Brook	19	34	48%	-483%	-205%	5	52	48%	-31%	32%	32%	2/10/98 - 12/10/02
12	01407760	01407760	Jumping Brook Near Neptune City	9	401	38%	50%	69%	9	401	38%	83%	89%	89%	8/2/01 - 8/7/02
12	01407705	01407750	Shark River	35	126	37%	-59%	0%	19	348	37%	80%	88%	88%	5/20/85 - 6/12/91

Appendix B: Load Duration Curves for each listed waterbody