Amendment to the
Monmouth County Water Quality Management Plan

Total Maximum Daily Loads for Fecal Coliform to Address 2 Streams in the Atlantic Coastal Water Region

Watershed Management Area 12
(Hannabrand and Trout Brooks)

Proposed: May 2, 2005
Established: August 19, 2005
Approved: September 15, 2005
Adopted:

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1.0 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 (Department) 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. On August 9, 2004, the Department adopted the *2004 Integrated List of Waterbodies* as an amendment to the Statewide Water Quality Management Plan, 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). In the Atlantic Coastal Water Region, the *2004 Integrated List of Waterbodies* Sublist 5 identifies nine impairments with respect to pathogens, as indicated by the presence of fecal coliform concentrations in excess of standards. Of these nine impaired segments, six were identified as tidal, and will be addressed in a separate TMDL document. The North Branch Metedeconk River at Jackson Mills Rd in Freehold was addressed in a TMDL was approved on September 29, 2003 and was inadvertently left on Sublist 5. TMDLs have been developed addressing fecal coliform impairment in the waterbodies as identified in Table 1.

Table 1 Stream segments in the Atlantic Coastal Water Region identified on the *2004 Integrated List of Waterbodies.*

Impairment Number	WMA	Station Name/Waterbody	Site ID	Sublist	Proposed Action
1	12	Hannabrand Brook at Old Mill Rd near Spring Lk Heights	01407806	5	establish TMDL
2	12	Trout Brook at Richdale Rd in Colts Neck	55	5	establish TMDL
3	13	Metedeconk River N Br at Jackson Mills Rd in Freehold	6	5	TMDL previously established
4	12	Lanes Creek at Edwards Ave in Long Branch	46	5	TMDL deferred
5	12	Lappatatong Creek at 1st St- Peterson's Marina in Keyport	51	5	TMDL deferred
6	12	Mannahasset Creek at Mannahasset Ave in Long Branch	48	5	TMDL deferred
7	12	Troutmans Creek at Atlantic Ave in Long Branch	47	5	TMDL deferred
8	12	Troutmans Creek at Joline Ave in Long Branch	62	5	TMDL deferred
9	14	Mullica River at Green Bank	Mullica River at Green Bank	5	TMDL deferred

Using ambient water quality data monitoring conducted by USGS/NJDEP and Monmouth County during water years 1996-2004, summer and all season geometric means were determined for each Category 5 listed waterbody. 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 waterbody. The higher (more stringent) percent reduction value was selected as the TMDL, which was then allocated among the sources. Nonpoint and stormwater point sources are the primary contributors to fecal coliform loads in these waterbodies and can include storm-driven loads transporting fecal coliform from sources such as geese, farm operations, and domestic pets to the receiving water. Nonpoint sources can also include steady-state inputs from sources such as malfunctioning sewage conveyance systems and failing or inappropriately located septic systems. There are no wastewater treatment plants discharging to the waterbodies that are the subject of these TMDLs. This TMDL report includes implementation strategies to achieve SWQS for fecal coliform. The TMDLs in this report have been proposed by the Department as amendments to the appropriate areawide 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.

2.0 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 SWQS 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 the Atlantic Coastal Water Region, the *2004 Integrated List of Waterbodies* currently identifies nine impaired segments.

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 without violating a state's water quality standards and allocates that load capacity

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. 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 is not required to and does not approve TMDL implementation plans).
11. Public Participation.

This report establishes 2 TMDLs that address fecal coliform impairment in the waterbodies identified in Table 2. These TMDLs include management approaches to reduce loadings of fecal coliform from various sources in order to attain applicable surface water quality standards for fecal coliform. With respect to the fecal coliform impairment, the waterbodies will be moved to Sublist 4 following approval of the TMDLs by USEPA. In addition to the above mentioned fecal coliform impairment, Hannabrand Brook at Old Mill Rd in Spring Lk Heights (01407806) is also listed for pH. This waterbody will remain on Sublist 5 with respect to this pollutant and will be addressed in a future TMDL.

3.0 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 Coastal Water Region identified in Table 2. The priority ranking for both Hannabrand Brook and Trout Brook is High.

Table 2 Waterbodies listed for fecal coliform impairment in the Atlantic Coastal Water Region for which TMDLs are required.

TMDL	WMA	Station Name/Waterbody	Site ID	County(s)	River

Number					Miles
1	12	Hannabrand Brook at Old Mill Rd near Spring Lk Heights	01407806	Monmouth	3.0
2	12	Trout Brook at Richdale Rd in Colts Neck	55	Monmouth	1.1
Total River Miles: 4.1					

Applicable Water Quality Standards

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 Coastal 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.

Description of the Watershed Management Area 12

These 2 TMDLs will address 4.1 river miles. Based on the detailed county hydrography stream coverage, 6.3 stream miles are directly affected by the 2 TMDLs due to the fact that the implementation plans cover entire watersheds; not just impaired waterbody segments.

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 and Navesink/Swimming River Watersheds.

The **Shark River** drains an area of 26 mi^2. 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, Jumping Brook, Polly Pod Brook, Reevy Branch, Whale Pond Brook, and Wreck Pond Brook.

The **Navesink River** drains an area of 95 mi^2 and includes the following tributaries: Swimming River, Hockhockson Brook, Pine Brook, Yellow Brook, Big Brook, Mine Brook, and Willow Brook. The Swimming River Reservoir, a major potable water impoundment, is located in this watershed, as are many small ponds. The Navesink estuary supports substantial hard clam (*Mercenaria mercenaria*) and soft clam (*Mya aernaria*) populations.

Sublist 5 Waterbodies in WMA 12

The spatial extent of each impaired segment is identified in Figures 1 and 2 and described in Table 3. Watershed sizes and land use/land cover by percent area associated with each segment are also listed in Table 3. Land use for each streamshed is shown in Figures 3 and 4.

Figure 1 Spatial extent of the Hannabrand Brook segment

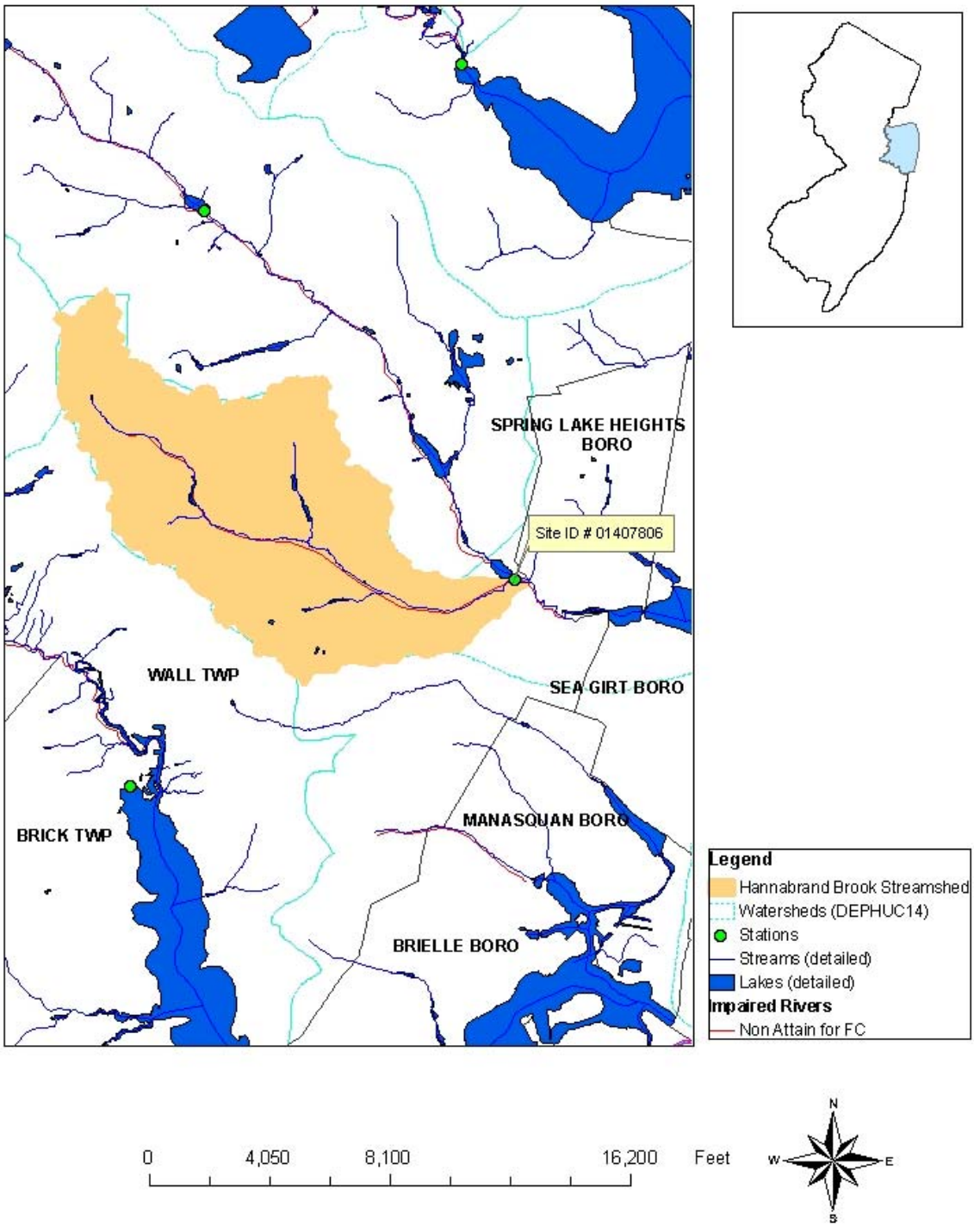


Figure 2 Spatial extent of the Trout Brook segment

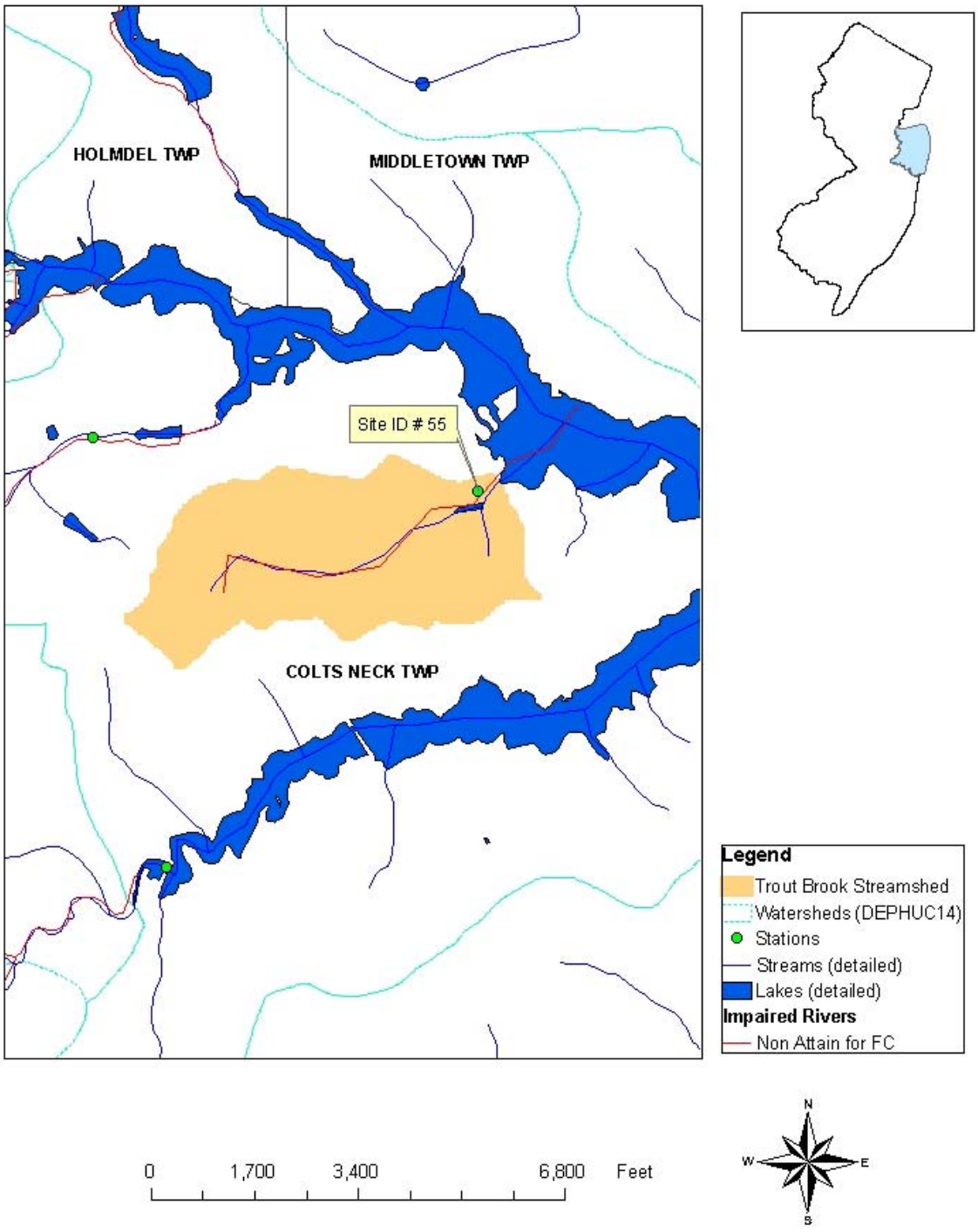


Table 3 River miles, Watershed size, and Anderson Land Use classification for the Sublist 5 segments, listed for fecal coliform, in WMA 12

	Segment ID	
	01407806	**55**
Sublist 5 impaired river miles (miles)	3.0	1.1
Total river miles within watershed and included in the implementation plan (miles)	5.1	1.2
Watershed size (acres)	2024	331
Landuse/Landcover (%)		
Agriculture	14.9	21.4
Barren Land	3.8	3.2
Forest	28	23.7
Urban	45.1	41.6
Water	0.4	0.7
Wetlands	7.7	9.5

Figure 3 Land Use in the Hannabrand Brook Streamshed

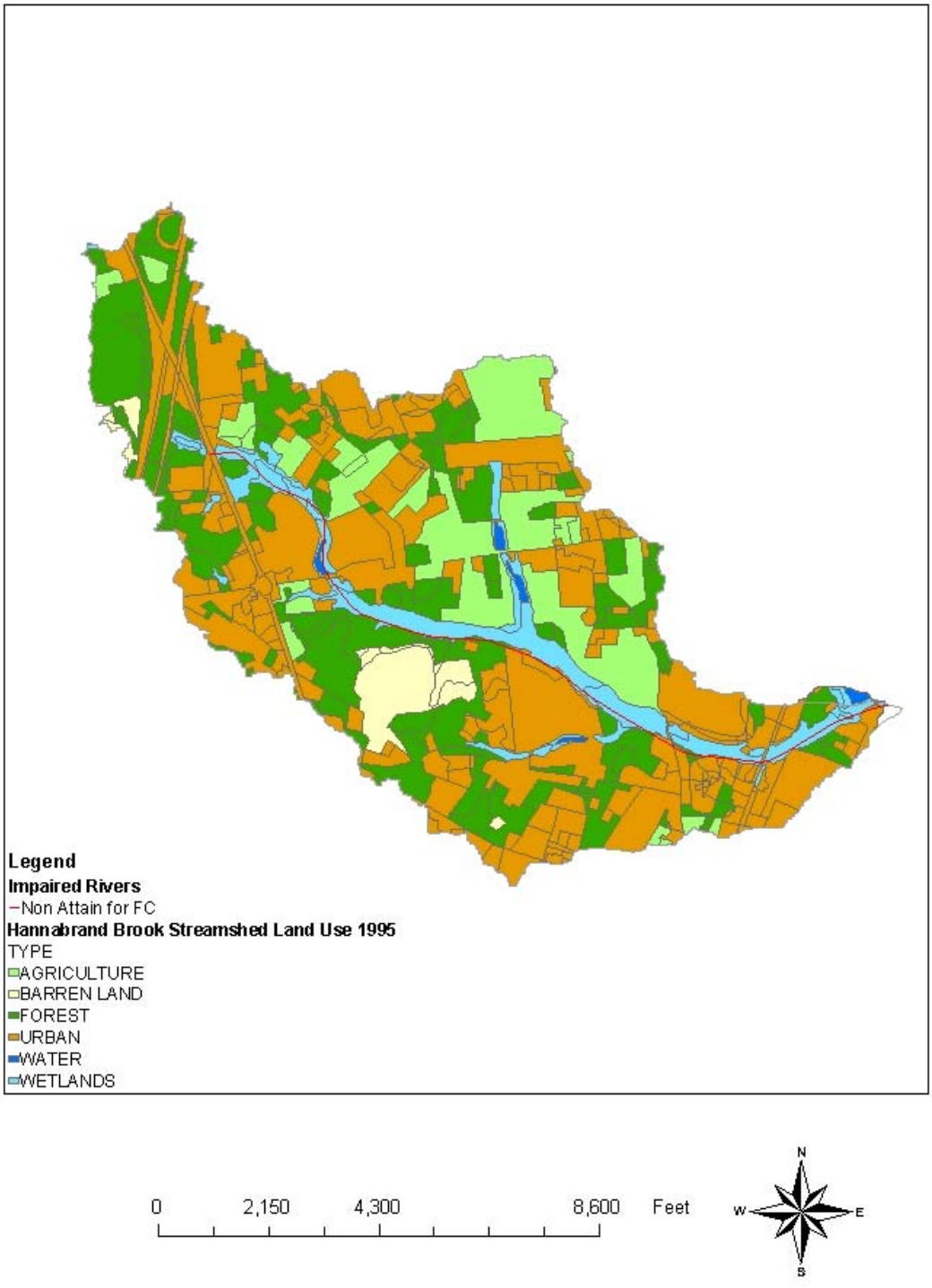
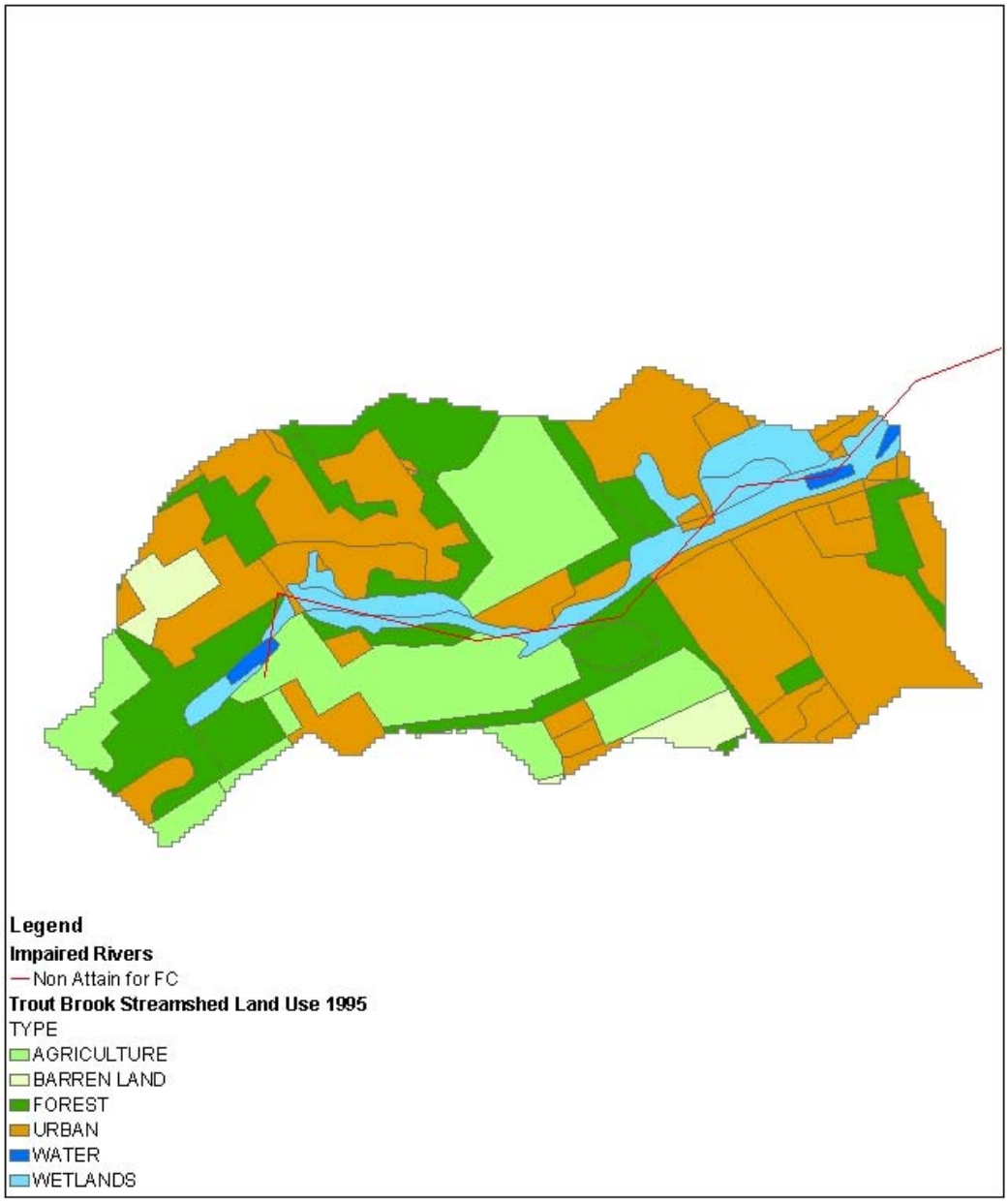


Figure 4 Land Use in the Trout Brook Streamshed



Data Sources

The Department's Geographic Information System (GIS) was used extensively to describe the Atlantic watershed characteristics. The following is general information regarding the data used to describe the watershed management area:

- "Dams in New Jersey", created 6/2003 by NJDEP, Division of Watershed Management (DWM). Unpublished.

- Land use/Land cover was taken from: "NJDEP 1995/97 Land use/Land cover Update for New Jersey (by WMA)", published 12/01/2000 by the NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA), and delineated by watershed management area.

- "NJDEP 2004 Integrated Report Results for Non-Tidal Rivers", published 6/2004 by NJDEP, Watershed Assessment Group (WAT). Online at: http://www.state.nj.us/dep/gis/digidownload/images/ir2004/ir_river_conventionals2004.gif

- "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.state.nj.us/dep/gis/digidownload/zips/statewide/stco.zip

- "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.state.nj.us/dep/gis/digidownload/zips/statewide/stmun.zip

- "NJDEP Head of Tide Points for Watercourses of New Jersey", published 1986 by NJDEP, Office of Environmental Analysis (OEA), Coast Survey Ltd. (CTD). Online at: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/hot.zip

- "NJDEP Streams of New Jersey (1:24000)", published 11/01/1998 by NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA). Online at: http://www.state.nj.us/dep/gis/strmshp.html

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

- "NJDEP Digital Elevation Grid for New Jersey (10 meter)", published 10/01/2004 by NJDEP, Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS). Online at: http://www.nj.gov/dep/gis/wmalattice.html

- "NJPDES Surface Water Discharges in New Jersey, (1:12,000)", published 09/12/2002 by NJDEP, Environmental Regulation (ER), Division of Water Quality (DWQ), Bureau of Point Source Permitting - Region 1 (PSP-R1). Online at: http://depnet/gis/digidownload/images/statewide/njpdesswd.gif

- "NJDEP 2004 Integrated Report Stations on Non-Tidal Rivers (Conventionals and Toxics)", published 6/2004 by NJDEP, Water Assessment Team (WAT). Online at:

  http://www.state.nj.us/dep/gis/digidownload/images/ir2004/ir_stations_river2004.gif

4.0 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.

Assessment of Point Sources other than Stormwater

There are no wastewater treatment facilities that discharge into the impaired segments for which TMDLs are being established.

Assessment of Nonpoint and Stormwater Point Sources

Nonpoint and stormwater point sources include runoff from various land uses that transport fecal coliform from sources such as geese, farms, and domestic pets to the receiving water. Nonpoint sources also include inputs that do not depend on precipitation events such as failing sewage conveyance systems, and failing or inappropriately located septic systems. Stormwater point sources are distinguished from nonpoint sources that derive from stormwater in that they are regulated under the NJPDES program.

5.0 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:

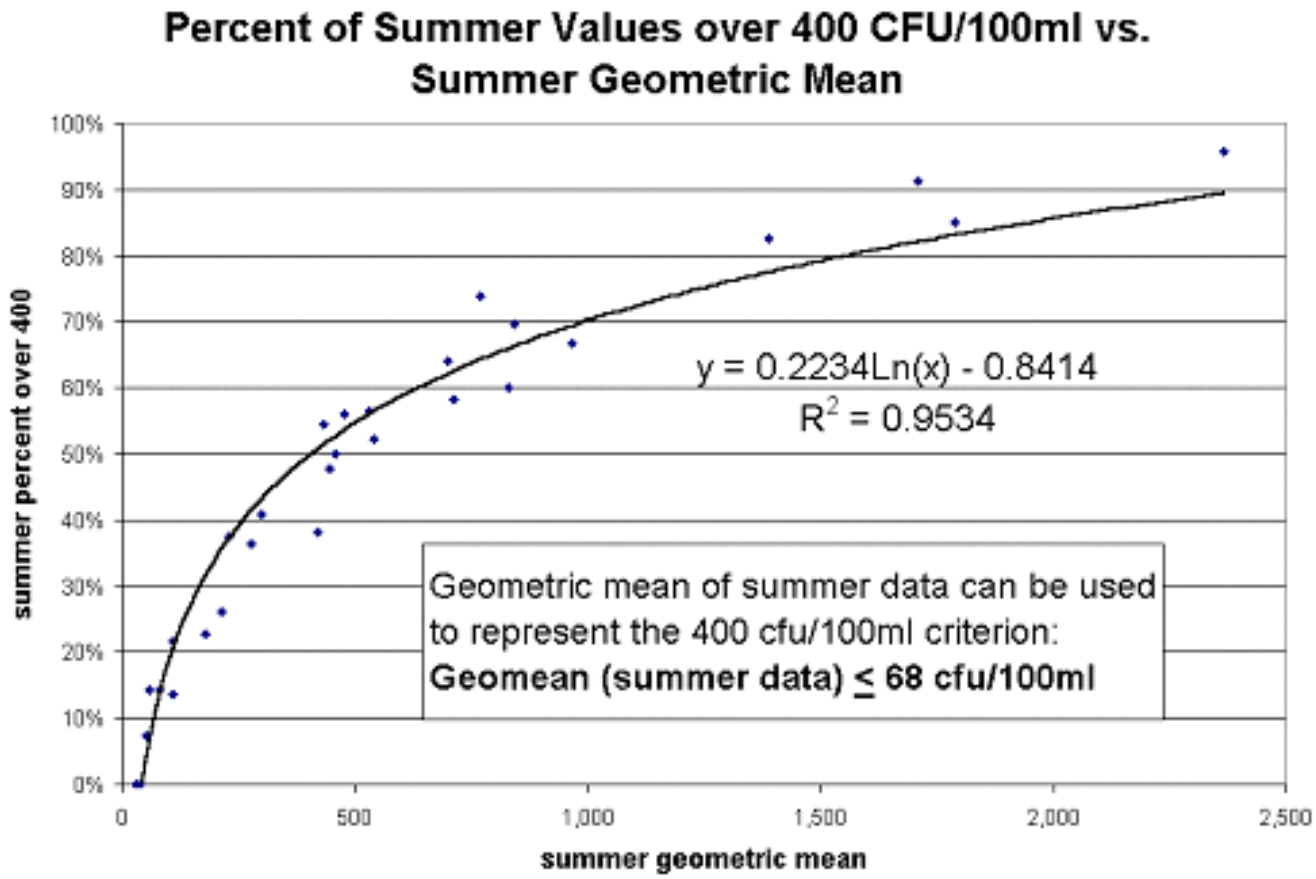
- expressing a bacteria TMDL in terms of concentration provides a direct link between existing water quality and the numeric target;
- using concentration in a bacteria TMDL is more relevant and consistent with the water quality standards, which apply for a range of flow and environmental conditions;
- 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 criterion, 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 criterion. A summer geometric mean can be used to represent the 400 criterion by regressing the percent over 400 CFU/100 ml against the geometric mean (Figure 5). Thus, each datapoint in Figure 5 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 the discussion of seasonal variation and critical conditions.

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



$y = 0.2234\text{Ln}(x) - 0.8414$ 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 criterion, equations 2 and 3 were applied. Equations 2 and 4 were used in satisfying the 400 CFU/100ml criterion.

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

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

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

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

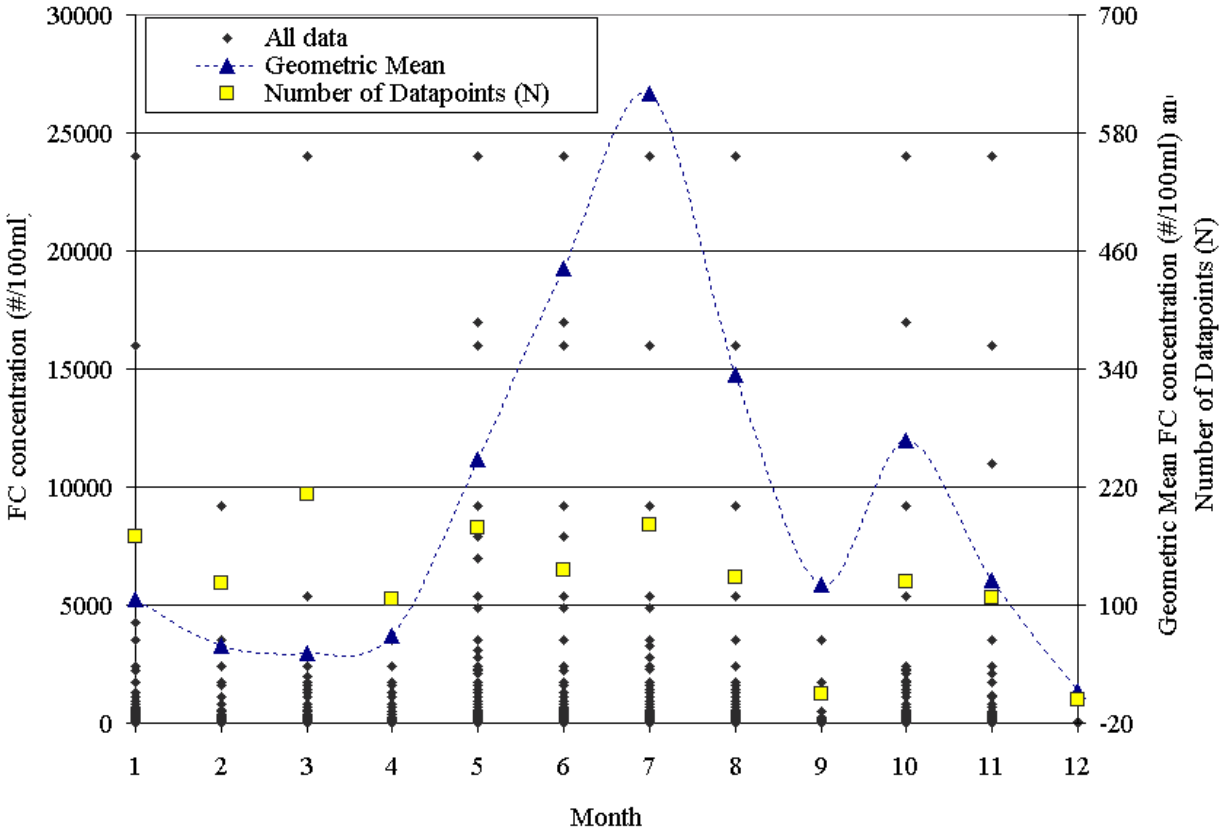
where:
e = (margin of safety)

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.

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 6. 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 6, 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



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 TMDL 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.

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, 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 ($x_{standard}$), $y_{standard} = \text{Log}(200) = 2.301$, 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 criterion: $y_{target} = 2.301 - n^* s_{\bar{y}}$
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 criterion will be defined as: $\frac{(GM - (200 - e))}{GM} \cdot 100\%$

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

6.0 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.

Wasteload Allocations and Load Allocations

There are no wastewater discharges in the segments for which TMDLs are being established. WLAs are established for NJPDES-regulated stormwater, while LAs are established for all stormwater sources that are not subject to NJPDES regulation, and for all nonpoint sources.

Both WLAs and LAs are expressed as percentage reductions for particular stream segments. Stormwater point sources receiving a WLA are distinguished from areas receiving a LA on the basis of land use.

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 4. 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 4 Distribution of WLAs and LAs among source categories

Source category	**TMDL allocation**
Nonpoint and Stormwater Sources	
medium / high density residential	WLA
low density / rural residential	WLA
commercial	WLA
industrial	WLA
Mixed urban / other urban	WLA
agricultural	LA
forest, wetland, water	LA
barren land	LA

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 criterion are located in Appendix A. In all cases, the 400 CFU/100ml criterion 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 criterion.

Table 5 TMDLs for fecal coliform-impaired stream segments in the Atlantic Coastal Water Region as identified in Sublist 5 of the 2004 Integrated List of Waterbodies. The reductions reported in this table represent the higher, or more stringent, percent reduction required of the two fecal coliform criteria.

TMDL Number	WMA	303(d) Category 5 Segments	Water Quality Stations	Station Names	Wasteload Allocation/Load Allocation (LA) and Margin of Safety (MOS)				
					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	01407806	01407806	Hannabrand Brook at Old Mill Rd near Spring Lk Heights	9	384	47%	82%	91%
2	12	55	55	Trout Brook at Richdale Rd in Colts Neck	7	355	45%	81%	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 term in Section 5

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, and both WLAs and LAs are expressed as percentage reductions for particular stream segments. 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.

7.0 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.

8.0 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. 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 established. 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.

Geese are migratory birds that are protected by the Migratory Bird Treaty Act of 1918 and other Federal and State Laws. Resident Canada geese are those birds that do not migrate, but are 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 and other pest waterfowl have been identified as one of several primary sources of pathogen loading to impaired water bodies in the Atlantic Coastal Region. Geese may produce up to 1½ pounds of fecal matter a day.

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, solutions 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.

Other wildlife contributions include significant deer populations that 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.

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 early last 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.

Management strategies 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
Inadequate or improperly maintained stormwater facilities; illicit connections	Measures required under Phase II 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	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

Source Category	Responses	Potential Responsible Entity	Funding options
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

Source Trackdown

Efforts to identify sources include visual assessments and planned track-down monitoring, where appropriate.

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 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.

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 methodolgy 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 Bureau's methodology includes evaluation of long-term microbial results as well as data (GIS Land use coverage, aerial photographs, visual assesments) of actual and potential sources, stormwater monitoring to deliantae 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 will be utilized on select TMDL segments as indicated.

Visual Assessment:

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 March/April 2005.

The Department reviewed monitoring data, visual assessment surveys, other information supplied by watershed partners 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.

Segment Specific Recommendations

Hannabrand Brook at Old Mill Rd near Spring Lk Heights (Site ID # 01407806)

This segment's primary land uses are residential, forest and agricultural. Potential sources include wildlife and livestock. Several small ponds are present within the watershed and may attract waterfowl. There is a large golf course present in the northwest portion of the watershed; the impaired segment runs through the center of it. Monitoring: fecal sampling is recommended to refine the extent of the impairment and to identify potential sources. Strategies: Phase II stormwater program; goose management; install agricultural BMPs.

Trout Brook at Richdale Rd in Colts Neck (Site ID# 55)

This segment's primary land uses are residential, forest and agricultural. Potential sources are primarily wildlife (geese, other waterfowl and deer). There is a small pond west of Richdale Road that is known to attract large numbers of waterfowl. Deer are present throughout the watershed. Monitoring: microbial source tracking (MST) and fecal coliform (FC) in order to refine the extent of the impairment and significant sources. Strategies: Phase II stormwater program; goose management; install agricultural BMPs.

Short-Term Management Strategies

Short-term management measures include projects recently completed, underway and planned. Pertinent measures in the Atlantic Coastal 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 assessment of fecal sources throughout the Monmouth Coastal Watersheds. The project will include bacterial source trackdown techniques to determine sources of fecal coliform pollution in the Deal Lake, Shark River, and Wreck Pond subwatersheds.

9.0 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 New Jersey's Surface Water Quality Standards will be attained for fecal coliform. 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.

10.0 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.
- Expedited fecal coliform TMDL presentation was given at a special meeting of interested members of the PAC on 11/6/02.
- A meeting was held in Wall Township to discuss these TMDLs on 4/6/05.
- The Department held discussions with the Monmouth County Water Resources Association regarding these TMDLs.

Additionally, beginning in March of 2005, GIS maps, including aerial photographs as well as USGS topographical maps of each segment were made available on the Department's website for review and comment. Interested parties had the opportunity to supply the Department with information about each TMDL segment via e-mail. The Department specifically solicited information regarding potential sources and/or current non point sources of pollution reduction projects within the impaired streamsheds.

Additional input was received through the Rutgers University NJ EcoComplex (NJEC). 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 were proposed by the Department as an amendment to the Monmouth County Water Quality Management Plan.

The notice proposing the TMDLs was published on May 2, 2005 in the New Jersey Register and the Asbury Park Press. 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 June 20, 2005 at the Wall Township Municipal Building in Wall, New Jersey. The public comment period ended on July 5 2005.

Department initiated changes include the following:

1. The New Jersey Environmental Management System (NJEMS), which contains NJPDES permitted facility information evaluated during TMDL development, has been listed under "Data Sources". This has been added to the document.
2. Addition of the priority designation for the subject TMDLs on Sublist 5 of the Integrated List and the notation of other impairments that have not yet been addressed in the segments.

Three comment letters were received on the proposed TMDLs. Three (K. Thomas Kellers, Steve Taylor and Stanley Manciniak) people attended the public hearing; one testified.

The following people submitted written and/or oral comments on the proposal:

1. Jennifer A. Murphy and David J. Jablonski, Mid-Atlantic Environmental Law Center (written comments)
2. Vincent Domidion and Benjamin Forester, Monmouth County Water Resources Association and the Township of Colts Neck (written comment)
3. K. Thomas Kellers, Chair of the Wreck Pond Brook Regional Stormwater Management Planning Committee (oral comment)
4. Barbara Sachau (written comment)

A summary of comments to the proposal, and the Department's Responses to those comments follow. The numbers(s) in brackets at the end of each comment corresponds to the commenters(s) listed above.

Comment 1.
The Department does not indicate that it developed the Atlantic Coastal Water Region (AWR) TMDL 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 Department does not express a rationale for not using the Pathogen Protocol. The Pathogen Protocol is the more specific guidance document, and should have been utilized in the development of the AWR TMDL. (1)

Response 1.
The USEPA guidance document "Protocol for Developing Pathogen TMDLs" establishes an organizational framework for states to utilize in the development of pathogen TMDLs. The

Department did utilize this guidance in the development of New Jersey's statewide protocol for fecal coliform TMDLs. This document is included as a reference in the References Section of the AWR TMDL.

Comment 2.
The AWR TMDL does not contain an analysis of the sampling data used to construct the AWR TMDL. The proposed TMDL does not distinguish between the two stream segments in any manner regarding sampling data and the SWQS exceedances evidenced by that sampling data. At the least, the AWR TMDL should be more specific as to; the date and time of sampling events, the location of sampling events, (including which stream segment and the sample location in that stream segment), the type of samples collected for each sampling; date, the sampling methods employed, the method(s) of analysis and the detected concentration of the sample. (1)

Response 2.
All data used in the TMDL process is publicly accessible through the internet at http://waterdata.usgs.gov/nj/nwis/qw. All water quality data for each stream segment was fully assembled prior to performing the calculations found in Section 5.0 Water Quality Analysis of the TMDL document. This analysis was done for each segment separately. The sampling information has been added to the document as an appendix for added convenience. The Department performs an analysis of all available water quality data for assessed waters statewide to determine compliance with the Surface Water Quality Standards biennially to compile the Integrated Water Quality Monitoring and Assessment Report. The methods the Department used to develop the 2004 Integrated List of Water Bodies are described in detail in the 2004 Integrated Water Quality Monitoring and Assessment Methods Document. All water bodies that appear on Sublist 5 of the Integrated List have been assessed relative to the New Jersey Surface Water Quality Standards and found to be in non-attainment of the standards.

Comment 3.
The Department contends there are no wastewater treatment discharges or other point sources within the impaired watersheds (AWR TMDL, p. 14). The Department does not provide any information regarding the location of these facilities, sewage conveyances, or sanitary sewers. The Department does not consider the possibility that conveyances, sanitary sewers, and septic systems are discharging directly to one of the streams. If point source discharges are present they should be assigned a WLA. Further, the Department does not address the permitting and inspection process for the installation and maintenance of septic systems. In addition, the Department is required to investigate complaints from citizens about water quality. The Department does not provide this information, and therefore, the AWR TMDL is inadequate because it does not contain a fully developed assessment of point sources within the impaired watersheds. (1)

Response 3.
In Section 6.0 TMDL Calculations of the AWR TMDL, the Department states that there are no wastewater treatment plants within the impaired watersheds. The statement regarding wastewater treatment discharges refers only to this subset of point sources. As there are no wastewater treatment discharges, as stated, no map of locations is provided and there are no numeric WLAs, other than zero, to be assigned. The Department states in Section 4.0 Source Assessment that "There are no point sources, other than stormwater, that discharge to the impaired segments…". These are the only point sources, as this term is applied in TMDL development, in the impaired segments. WLAs are established for stormwater discharges subject to regulation under the Clean Water Act. In accordance with EPA guidance discussed in the document, stormwater point sources receive a WLA expressed as a percentage reduction for particular stream segments on the basis of land use. The Department

recognizes sewage conveyances and septic malfunctions as potential sources of fecal coliform in Section 4.0 Source Assessment and in Section 8.0 Implementation, but is not aware of any current or ongoing malfunctions. For this potential source to be an actual source would be as the result of a malfunction, not by design. The Department investigates reports of noncompliance with NJPDES permits, illegal point and nonpoint discharges, and accidental discharges. These discharges are not considered ongoing point sources that warrant a WLA other than zero; rather, they are ephemeral events that are promptly addressed through compliance and enforcement measures as they occur. Segment specific recommendations include track down monitoring, as appropriate, to identify if any human sources, e.g., malfunctioning conveyance systems or septic systems, are actually present. If such sources are found to exist, they will be referred for appropriate compliance measures and/or management measures. With regard to permitting of septic systems, Chapter 199 establishes requirements for septic system design and installation. Permitting for these systems is a local function, except that the Department certifies designs for development that includes 50 or more reality improvements.

Comment 4.
The Department mischaracterizes nonpoint sources of pathogen impairment by including sanitary sewer overflows (SSOs) as a nonpoint source of pathogen impairment. The Department contends that nonpoint sources include "inputs" that are not dependent on precipitation events including Sanitary Sewer Overflows (SSOs), (AWR TMDL, p. 14). (1)

Response 4.
The commenter is correct that sanitary sewer overflows are point sources. However, there are no legally existing SSOs in New Jersey. Any discharge from a sanitary sewer line would be an event that is subject to compliance and enforcement action, and is, therefore, not characterized as an on-going point source. To avoid any confusion, the Department has revised the language in the TMDL document.

Comment 5.
The Department does not discuss whether domestic or industrial wastewater sludge or other solid wastes are being land applied within the impaired watersheds. (1)

Response 5.
No dedicated domestic or industrial wastewater sludge land application sites are present within the impaired watersheds.

Comment 6.
The Department defines stormwater point sources, and distinguishes NJPDES permitted stormwater discharges from nonpoint sources, but does not indicate if any NJPDES stormwater point sources are within either of the two stream segments. The Department states, "stormwater discharged to the impaired segments through 'small municipal separate storm sewer systems' (MS4s) are regulated under the Department's Phase II Municipal Stormwater Regulation Program" (AWR TMDL, p. 25). The Department has failed to identify the location of these MS4s within the impaired watersheds. In addition, the Department indicates, "these measures are to be phased in over a timeframe specified in the Department's Phase II permitting program", but does not specify when this will occur (AWR TMDL, p. 25). The MS4 program should be fast tracked for these two areas in order to actually implement the reductions through MS4 permits. (1)

Response 6.

With regard to MS4s, the Department has supplied the Tier A and Tier B classifications for the municipalities within the areas affected by the TMDLs as an appendix. All 566 municipalities within the State are assigned regulated as either Tier A or Tier B. Tier A municipalities are located within the more densely populated regions of the state or have drainage to the coast. Tier B municipalities are more rural and in non-coastal regions. Both Tier A and Tier B municipalities have NJPDES permits, but only Tier A municipalities are considered point sources under the Clean Water Act. This is explained in the TMDL report. Also explained are Statewide Basic Requirements (SBRs) applicable to each tier. More detail regarding the municipal stormwater permitting program can be found at the Department's website at stormwater.org. The TMDL report explains that stormwater point sources are addressed by assigning a percent reduction as a WLA to land uses that are deemed equivalent to the areas regulated as point sources. Therefore, the location of these point sources is the urban land use area given in Figures 3 and 4 in the TMDL report. The implementation schedule for the municipal stormwater permitting 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 requirements, such as street sweeping and inlet cleanout, are now operative.

Comment 7.

The Department contends, "[r]elating 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" (AWR TMDL, p. 14). The Department further contends the above facts warrant using "a concentration set to meet the state water quality standard" to express load capacity (AWR TMDL, p. 15). The Department is essentially proposing to establish the loading capacity for the two streams as the SWQS. This is inadequate because the purpose of the TMDL is to ensure compliance with the SWQS. In addition, this method requires a less detailed analysis of the sources of pathogen impairment, and broader, less specific, decision-making regarding reductions in the identified sources of pathogen impairment. This is evidenced by the broad, generalized nature of the AWR TMDL as a whole. The Department should allocate more resources to the source assessment portion of the TMDL. (1)

Response 7.

While the purpose of a TMDL is to identify the load of a pollutant that can be assimilated by a waterbody and still attain surface water quality standards and support designated uses, allocate that loading capacity to point sources, nonpoint sources and a margin of safety, the means to achieve the standards is through implementation of management measures that will result in the necessary load reductions. The Department believes that the technical approach used to establish the loading capacity should consider the uncertainties (gaps and variability) in the data, the ability to model and predict concentration response relative to loadings, and the predictability of achieving a load reduction from applying a given management measure. The approach used in these TMDLs is appropriate to the parameter being addressed, including the variability and unpredictability of sources and effectiveness of management measures. The inclusion of both an implicit and explicit Margin of Safety (MOS) as part of the TMDL calculation is a reflection of the uncertainties and provides for reasonable assurance that the standard will be met. EPA has accepted this TMDL approach in over 170 previously approved TMDLs. With regard to identification and implementation of management measures, the Department has gathered information on the impaired segments. Detailed stream characterization information has been gathered from many useful sources including: solicited public input, stream-walks conducted by Department-trained AmeriCorps members, and field visits. This information, as well as the generic approaches that apply to source types wherever they are found to exist, is the basis for the preliminary implementation plan, which includes a plan for

source trackdown and identification, as needed. Through its watershed management initiative, the Department is developing detailed watershed restoration workplans for each stream segment with a TMDL, on a priority basis. These workplans take the preliminary implementation plan to the next level and are the basis for targeting available funds, as discussed in the TMDL report, to effect specific projects to achieve load reductions. The Department believes it is more effective in achieving water quality improvement to devote resources to implementation measures than to attempt to precisely quantify and model fecal coliform loads.

Comment 8.
The Department does not provide a discussion regarding why it chose to focus solely on bacteria when discussing the load capacity being expressed as a concentration (AWR TMDL, p. 15). The Department does not discuss viruses or protozoa, generally grouped under the pathogen heading. (1)

Response 8.
Waterbodies are listed as impaired when a water quality standard or designated use is not attained. TMDLs are then prepared to determine the load reductions of a pollutant necessary to attain the standard/designated use. The TMDL for fecal coliform does not discuss other pathogens, such as viruses or protozoa, because the SWQS are expressed in terms of fecal coliform and there are no standards for specific pathogens, such as viruses or protozoa. The Department assesses streams for sanitary quality by using fecal coliform because it is a widely accepted indicator of the sanitary quality of the water. As stated in EPA Protocol for Developing Pathogen TMDLs, pathogenic organisms present in polluted water are few and difficult to isolate; therefore, an indicator organism is chosen because it is more easily sampled and measured. Indicator organisms are assumed to indicate the presence of all human pathogenic organisms.

Comment 9.
The Department does not provide sufficient detail on the relationship between the proposed percent reductions, the assigned WLAs and LAs and the eight source categories listed in Table 4 (AWR TMDL, p. 23). In addition, the Department does not adequately explain how the percent reductions, the assigned WLAs and LAs and the calculated MOS will result in the two stream segments meeting the SWQS in the future. The implementation plan proposed by the Department for the AWR TMDL is insufficient because it lacks the specificity required to implement the purpose of the TMDL process, which is to ensure the attainment of the established water quality standards. (1)

Response 9.
The TMDL approach employed here does not attempt to model the relationship between load and concentration as previously explained. The Department's strategy is to reduce the nonpoint and stormwater point sources to the extent practicable using BMPs, based on the reasonable initial assumption that, if sources are controlled, SWQS will be attained. If, through follow up monitoring, it is determined that SWQS are not met, then, in accordance with the adaptive management paradigm, the Department will identify additional measures, such as stormwater management retrofits, that will be implemented in order to attain SWQS.

Comment 10. The Department should provide a greater level of detail as to why, "strategies for source reduction will apply equally well to new development as to existing development", in particular, the Department needs to discuss how it intends to implement the source reductions to new development in the impaired watersheds. (1)

Response 10. New development is expected to contribute a de minimus load relative to the existing land use it replaces. This is because stormwater associated with newly developed areas will be

controlled by the new stormwater management control requirements, and, in MS4 regulated areas, by the requirements in the municipal stormwater permitting rules. This is expected to effectively avoid increases in storm driven sources, thereby preventing the water quality problems that are attributed to the existing development.

Comment 11.
There is no information provided regarding where the 115 monitoring stations in the Ambient Stream Monitoring Network (ASMN) program are in relation to the impaired stream segments. In addition, the Department does not provide a link between the follow-up monitoring and the verification of attainment of the established percent reductions for the identified sources of pathogen impairment. (1)

Response 11.
Figures 1 and 2 in the TMDL report identify the locations of the monitoring stations within the impaired segments that were used to assess the segments, resulting in placement on Sublist 5 of the Integrated List. The ASMN program was used to compile the list of impaired waterbodies and will be used to evaluate SWQS attainment in the future. If the ASMN monitoring data demonstrates compliance with the SWQS, then TMDL implementation will be deemed successful and the waterbody will be placed on Sublist 1. The follow-up monitoring discussed in the implementation section is intended for relative source identification to inform targeting management measures, not for effectiveness evaluation.

Comment 12.
The Department does not indicate why it has not been identifying and preventing unauthorized discharges from the wastewater collection systems in the impaired watersheds prior to the proposal of this TMDL. (1)

Response 12.
While the Department does not explicitly state it in the document, the Department and the entities maintaining the wastewater collection systems routinely respond to unauthorized discharges as they are identified.

Comment 13.
The Department offers no timeframe when they intend to implement the proposed management strategies in the impaired watersheds or when the fecal coliform SWQS for the impaired streams will be attained. (1)

Response 13.
The elements of the plan for attaining the SWQS will proceed over time and may be adjusted, as needed, through adaptive management, to respond to results of the ambient monitoring program, which will be assessed at least every two years, until attainment of SWQS is demonstrated. The Department is currently engaged in source track down efforts for the fecal coliform TMDLs established in 2003. Plans are being developed to expand this project to carry out the track down monitoring for the current suite of proposed fecal coliform TMDLs. Once the data are available from the current and expanded monitoring projects they will be assessed and will inform further development and/or refinement of management measures to implement the TMDLs. In addition, it should be noted that the measures required under the municipal stormwater permitting program are currently operative. Further, 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. 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 fecal coliform sources in the impaired segments for which TMDLs were completed. Follow up monitoring will determine where efforts need to be stepped up or redirected to attain SWQS. For example, if it is determined that additional measures are needed to address stormwater sources subject to the municipal stormwater permitting rules, these measures will become requirements under the general permits issued by the Department. Finally, the TMDL process and adoption of the TMDLs as amendments to the applicable area-wide 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.

Comment 14.
The Department states, "[e]fforts to identify sources include visual assessments and planned track-down monitoring, where appropriate" (AWR TMDL, p. 29). The Department does not provide an explanation as to its rationale for not conducting these activities prior to proposing the AWR TMDL. In addition, the Department will need to elaborate on its course of action, if the source track-down efforts result in findings contrary to the AWR TMDL or shows the AWR TMDL is inadequate. (1)

Response 14.
Detailed stream characterization information was gathered from many useful sources including: solicited public input, stream-walks conducted by Department-trained AmeriCorps members, and field visits. The Department relied on these information resources to tailor the segment specific recommendations in the implementation section. The data collected through track-down monitoring is intended and will be evaluated and used to inform implementation decisions. The Department's ambient monitoring network will be an on-going means to determine if SWQS have been and continue to be maintained or if adaptive management will direct refinement/enhancement of management measures.

Comment 15. The commenters state that the stream corridor is well vegetated, and contains agricultural land uses, and residential development on individual septic systems. Commenters believe that expanded monitoring at Laird and Lovett Roads would be the only option to isolate any concentrated bacterial source. Further, addition of the Rapid Bio-Assessment monitoring by the Monmouth County Health Department represents the needed enhancement of monitoring and will be more than a sufficient response. (2)

Response 15. The Department acknowledges the monitoring efforts made by the Monmouth County Health Department and other watershed partners and acknowledges the land use details provided by the commenter. Septic systems and agricultural land uses are potential sources that will be further assessed as part of the implementation strategies. The Department does not believe that an enhanced monitoring program that includes Rapid Bio-Assessment will aid the efforts to address fecal coliform impairment. Macroinvertebrate monitoring will not inform the trackdown or elimination of fecal coliform sources. The Department has recommended trackdown monitoring at the existing site on the Trout Brook as well as one additional site. This monitoring includes additional fecal coliform at both sites as well as microbial source tracking (MST) at the existing site. The Department would, however, be more than willing to work with the Monmouth County Health Department to choose an additional fecal coliform monitoring site at the appropriate location on Trout Brook.

Comment 16. The Wreck Pond Brook Regional Stormwater Management Planning Committee suspects that the data used by the NJDEP may be out of date. In addition, their preliminary information gathered through the Regional Stormwater Management Planning process indicates that a 91 percent reduction may not be practical. The Committee intends to address the TMDL issue thereto under NJAC 7:8-3.5C. If the data suggests otherwise than what it is proposed the Committee may offer an amendment under chapter 7:15 which provides for amendments to the Monmouth County Area Wide Water Quality Management Plan. (3)

Response 16. The data for Hannabrand Brook was collected in 2001 and 2002. The Department must rely on the best available information in development of TMDLs. The 91 percent reduction is obtained based on the statistical analysis of the data. It is recognized that this is a significant reduction rate. It should be noted that this percent reduction also includes a substantial margin of safety, expressed as 47 percent of the target concentration. This includes 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. 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. Once the measures outlined in the implementation plan are effectuated, follow up monitoring data will be assessed to determine if the standards have been attained. It is possible that standards will be attained with a smaller percent reduction, given the statistical uncertainty. If standards are not attained after implementing the management measures, additional measures will be evaluated and the implementation plan amended.

Comment 17.
The commenter feels that there is too much focus on birds and wildlife as the polluters, when the pollution should be attributed to the large human population in this state, and on factories and farming practices. Stormwater inlets should be cleaned up and pet waste collected. Wildlife and birds should be removed from this TMDL. (4)

Response 17.
The Department agrees that human sources, stormwater, pet waste and agriculture are among the sources of fecal coliform found in the waterbodies and has included them in the TMDL, but cannot ignore the wildlife sources as contributing to the fecal coliform present in the waterbodies. Wildlife populations in general are not a focus of implementation strategies. Overpopulation of certain wildlife species resulting from human activities, such as populations of Canada Geese, is a locally significant source of fecal contamination.

References

Bowman, A.M., C. Hagedorn, and K. Hix (2000) Determining sources of fecal pollution in the Blackwater River watershed. p. 44-54. In T. Younos and J. Poff (ed.), Abstracts, Virginia Water Research Symposium 2000, VWRRC Special Report SR-19-2000, Blacksburg.

Goyal, S.M. (1987) Methods in Phage Ecology. pp. 267-287. In: Phage Ecology, S.M. Goyal, C.P. Gerba and G. Bitton (Eds.) John Wiley and Sons, New York.

Graves, Alexandria K., Charles Hagedorn, Alison Teetor, Michelle Mahal, Amy M. Booth, and Raymond B. Reneau, Jr. (2002) Antibiotic Resistance Profiles to Determine Sources of Fecal Contamination in a Rural Virginia Watershed. Journal of Environmental Quality 31: 1300-1308.

National Research Council (2001) Assessing the TMDL Approach to water quality management. National Academy Press, Washington, D.C.

New Jersey Department of Environmental Protection (1998) Identification and Setting of Priorities for Section 303(d) Water Quality Limited Waters in New Jersey, Office of Environmental Planning.

New Jersey Department of Environmental Protection (2004) Surface Water Quality Standards. Water Monitoring and Standards.

New Jersey Department of Environmental Protection (2004) New Jersey 2004 Integrated Water Quality Monitoring and Assessment Report. Water Monitoring and Standards.

New Jersey Department of Environmental Protection (1999) Initial Surface Water Quality Characterization and Assessment Report for Watershed Management Area 12 (Monmouth Watersheds). Division of Science, Research, and Technology.

New Mexico Environmental Department (2002) TMDL for Fecal Coliform on three Cimarron River Tributaries in New Mexico.
Online at: http://www.nmenv.state.nm.us/swqb/CimarronTMDL.html

Palladino, M. A., and Tiedemann, J. (2001) Differential Identification of E. coli in the Manasquan River Estuary by Multiple Antibiotic Resistance Testing and DNA Fingerprinting Analysis. Monmouth University, NJ.

Saunders, William and Maidment, D. (1996) A GIS Assessment of Nonpoint Source Pollution in the San Antonio- Nueces Coastal Basin. Center for Research in Water Resources. Online Report 96-1:

Stiles, Thomas C. (2001) A Simple Method to Define Bacteria TMDLs in Kansas. Presented at the WEF/ASIWPCA TMDL Science Issues Conference, March 7, 2001.

Sutfin, C.H. (2002) Memo: EPA Review of 2002 Section 303(d) Lists and Guidelines for Reviewing TMDLs under Existing Regulations issued in 1992. Office of Wetlands, Oceans and Watersheds, U.S.E.P.A.

Thomann, R.V. and J.A. Mueller (1987) Principles of Surface Water Quality Modeling and Control, Harper & Row, Publishers, New York.

USEPA (1986) Implementation Guidance for Ambient Water Quality Criteria for Bacteria. EPA-823-D-00-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA (1993) Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters. EPA-840-B-92-002. Washington, DC.

USEPA (1997) Compendium of tools for watershed assessment and TMDL development. EPA841-B-97-006. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USEPA (2001) Protocol for Developing Pathogen TMDLs. EPA841-R-00-002. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

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	**Final Percent Reduction**	**Period of record used in analysis**
12	01407806	01407806	Hannabrand Brook at Old Mill Rd near Spring Lk Heights	9	384	47%	48%	72%	9	384	47%	82%	91%	91%	8/2/01 - 8/7/02
12	55	55	Trout Brook	27	53	45%	-280%	-108%	7	355	45%	81%	89%	89%	10/22/96 - 3/23/04

Appendix B: Tier A Municipalities

NJPDES Permit Number	Municipality	Discharge Type	Stream Segment
NJG0151564	Colts Neck Twp	Tier A	Trout Brook
NJG0153214	Wall Twp	Tier A	Hannabrand Brook

Appendix C: Fecal Coliform Sampling Data

Water Quality Sample Locations	Site ID	Date	Result (MPN)
Hannabrand Brook at Old Mill Rd. near Spring Lk Heights	01407806	8/2/2001	260
		8/9/2001	490
		8/23/2001	110
		8/30/2001	330
		7/10/2002	800
		7/17/2002	110
		7/24/2002	5000
		7/31/2002	300
		8/7/2002	300
Trout Brook At Richdale Rd. in Colts Neck	55	10/22/1996	300
		12/19/1996	90
		3/25/1997	2
		6/24/1997	300
		10/29/1997	80
		12/23/1997	1600

		2/23/1998	10
		5/27/1998	440
		10/27/1998	130
		03/09/1999	10
			460
		06/29/1999	780
		10/19/1999	10
		03/14/2000	480
		06/27/2000	110
		10/24/2000	4
		12/27/2000	10
		3/27/2001	200
		6/26/2001	50
		10/23/2001	410
		12/18/2001	130
		10/15/2002	160
		6/18/2002	10
		12/17/2002	10

		3/26/2002 03/26/2003 09/17/2003 03/23/2004	10 800 10