Stormwater Pollution Prevention Plan

Borough of Oakland

Bergen County

NJPDES Permit No. NJG0148521

March 17, 2021

NJDEP Program Interest I.D. No. 203177

BOSWELL ENGINEERING
ENGINEERS - SURVEYORS - PLANNERS - SCIENTISTS
330 PHILLIPS AVENUE, SOUTH HACKENSACK, N.J. 07606
TEL: (201) 641-0770 • FAX: (201) 641-1831

Job No. OK-1737

To Whom it May Concern:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for purposely, knowingly, recklessly, or negligently submitting false information.

Sincerely,

____

Richard Kunze, Borough Administrator
Stormwater Program Coordinator
Borough of Oakland

SPPP Table of Contents

SPPP Form 1 – SPPP Team Members

Stormwater Program Coordinator (SPC)	
Print/Type Name and Title	Richard Kunze, Borough Administrator Stormwater Program Coordinator
Office Phone # and eMail	(201) 337-8111 ext. 2004 boroadmin@oakland-nj.org
Signature/Date	
Individual(s) Responsible for Major Development Project Stormwater Management Review	
Print/Type Name and Title	John Yakimik, P.E., Boswell Engineering Borough Engineer Representative
Print/Type Name and Title	Selwyn Joy, P.E., Boswell Engineering Hydraulic Engineer
Print/Type Name and Title	John Mayo, P.E., Boswell Engineering Hydraulic Engineer
Print/Type Name and Title	
Print/Type Name and Title	
Other SPPP Team Members	
Print/Type Name and Title	Scott Ciccarella, Streets and Roads Supervisor Employee Training Coordinator, Public Works Coordinator
Print/Type Name and Title	Lisa Duncan, Borough of Oakland Municipal Clerk Public Notice Coordinator, Local Public Education Coordinator, Ordinance Coordinator
Print/Type Name and Title	
Print/Type Name and Title	
Print/Type Name and Title	

SPPP Form 2 – Revision History

Please record changes to the signature page and updates to the approach taken to comply with the permit, e.g., new street sweeping frequency, change to shared services, etc.

	Revision Date	SPC Initials	SPPP Form Changed	Reason for Revision
1.	3/17/21	RK	1-15	2020 Annual Update
2.				
3.				
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20.				

SPPP Form 3 – Public Involvement and Participation Including Public Notice

All records must be available upon request by NJDEP.

1. Website URL where the Stormwater Pollution Prevention Plan (SPPP) is posted online:	https://www.oakland-nj.org/stormater-management
2. Date of most current SPPP:	Mar 17, 2021
3. Website URL where the Municipal Stormwater Management Plan (MSWMP) is posted online:	https://www.oakland-nj.org/stormater-management
4. Date of most current MSWMP:	October, 2006
5. Physical location and/or website URL where associated municipal records of public notices, meeting dates, minutes, etc. are kept:	63 Oak Street, Oakland, New Jersey 07436

6. Describe how the permittee complies with applicable state and local public notice requirements when providing for public participation in the development and implementation of a MS4 stormwater program:

The Borough of Oakland provides adequate public notice for public participation in the development and implementation of the MS4 stormwater program as per the Open Public Meetings Act ("Sunshine Law," N.J.S.A. 10:4-6 et seq.); statutory procedures for the enactment of ordinances (N.J.S.A. 40:49-2), including the municipal stormwater control ordinance; and the Municipal Land Use Law concerning the adoption or amendment of the MSWMP (N.J.S.A. 40:55D-13, 28 and 94) and the review of applications for development (N.J.S.A. 40:55D-12).

The Borough of Oakland also makes elements of its MS4 stormwater program available to the public by providing the current SPPP upon request as required by Part IV.F.1.g (SPPP) and posting the current SPPP on its website to the extent required by Part IV.F.1.f (SPPP); and posting the current MSWMP and all ordinances required by this permit on its website or otherwise comply with the notification requirements of N.J.A.C. 7:8-4.4(e) (https://www.oakland-nj.org/stormater-management).

The Borough of Oakland maintains records of compliance with public participation requirements at the Department of Public Works located at: 63 Oak Street, Oakland, New Jersey 07436.

SPPP Form 4 – Public Education and Outreach

All records must be available upon request by NJDEP.

1. Describe how public education and outreach events are advertised. Include specific websites and/or physical locations where materials are available.
The Borough of Oakland conducts a diverse range of public education and outreach events that total 12 points annually from a minimum of three of the five categories based on Attachment B. These events are advertised on the Borough website (https://www.oakland-nj.org/) and within the Borough calendar which is distributed in January with extra copies available at the Public Library, Municipal Building, and DPW Building. Additionally, the Borough will coordinate with local watershed groups and the AmeriCorps NJ Watershed Ambassador Program to organize volunteer events.
2. Describe how businesses and the general public within the municipality are educated about the hazards associated with illicit connections and improper disposal of waste.
The Borough of Oakland mails a brochure to our residents and businesses outlining the hazards of illicit connections and improper waste disposal. The brochure is distributed in January with our Borough calendar. Extra copies are available at our Public Library, Municipal Building, and DPW building.
3. Indicate where public education and outreach records are maintained.
Records of all public education and outreach events are kept at the Oakland Department of Public Works located at: 63 Oak Street, Oakland, New Jersey 07436.

QUICK REFERENCE ILLICIT GUIDE

ILLICIT DISCHARGE - Any liquid, not composed entirely of stormwater, that is introduced into a stormwater system. Examples include solvents, vehicle fluids, fuels, paints, household products and chlorinated swimming pool water.

ILLICIT DUMPING - Unloading or disposal of solid, semi-solid or liquid substances near or into a stormwater system. Examples include motors, containers, grass clippings and leaves.

ILLICIT SPILLS - Any intentional or accidental spill of solid, semi-solid or liquid substances into or adjacent to a stormwater system. Examples include fluids from vehicles, chemicals from drums or storage tanks, used oil, paint containers and fertilizer.

ILLICIT CONNECTIONS - Any constructed conveyance that connects non-stormwater discharges directly to a stormwater system. These illicit conveyances are located either above or below the ground and may include drains, pipes or ditches.

Stormwater system refers to storm drains, pipes, ditches, channels and ponds that convey, store, release or treat stormwater runoff.

WAYS TO REDUCE ILLICIT ACTIVITIES

HOMEOWNERS

- Dispose of household chemicals properly at designated collection sites.
- Follow label directions on pesticide and fertilizer containers and dispose of properly.
- Use yard waste as mulch or dispose of properly by bagging or composting leaves and grass clippings.
- Recycle approved containers.
- Maintain septic systems.
- De-chlorinate swimming pool water before discharging.

BUSINESSES

- Properly store and dispose of substances used in commercial processes.
- Landscape to prevent excessive runoff and erosion.
- Maintain privately owned stormwater ponds.
- Learn and comply with local environmental ordinances.

BOROUGH OF OAKLAND FOUNDED 1695 INCORPORATED 1902 NEW JERSEY

Should you have any questions on how to implement these tips, call (201) 337-8103.

WWW.OAKLAND-NJ.ORG

PROTECT WATER QUALITY

PREVENT ILLICIT ACTIVITIES

BOROUGH OF **OAKLAND**

CITIZENS - TOGETHER WE CAN PROTECT OUR WATER

BOROUGH OF OAKLAND FOUNDED 1695 INCORPORATED 1902 NEW JERSEY

SOME CAUSES MAY SEEM INSIGNIFICANT, BUT THE EFFECTS CAN BE DRAMATIC

The Borough of Oakland is a beautiful place to live, work and play. We have an abundance of gorgeous streams and lakes. The Borough is working together with citizens and businesses to protect these valuable natural resources.

One of the greatest threats to our lakes, rivers and streams is pollutants in stormwater runoff. Simply stated, stormwater runoff is the water that flows over the land during and immediately after a rainstorm. As this water flows, it collects pollutants such as sediment, leaves, pesticides and automobile fluids. These contaminants can impact wildlife, fish, plants and surface water quality.

The Borough has a New Jersey Pollutant Discharge Elimination System (NJPDES) Tier A Municipal Stormwater General Permit. Part of the NJPDES Permit requires a Stormwater Management Program that prohibits harmful pollutants from entering our stormwater systems. You can help in this effort by eliminating illicit activities.

ILLICIT ACTIVITIES

Illicit activities are those that intentionally or accidentally introduce pollutants into our stormwater systems. Illicit discharge, dumping, spills and connections pose a great risk to our water resources. Fortunately, most of these actions can be prevented in both residential and commercial areas.

With your help, we can protect and preserve the vital waterways of Oakland.

Please prevent or report any illicit activities you may see by calling (201) 337-8103.

WATER POLLUTION SOURCES

1. Illicit discharge into a stormwater system
2. Illicit dumping into a stormwater system or near a body of water
3. Illicit spills on a parking lot, road, or ground surface can flow into the nearest storm drain of a stormwater system
4. Illicit connections from a residence or business connected to a stormwater system that convey an illicit discharge

SPPP Form 5 – Post-Construction Stormwater Management in New Development and Redevelopment Program

All records must be available upon request by NJDEP.

1. How does the municipality define 'major development'?
As per Chapter 20 -- Stormwater Management the Borough of Oakland defines a "major development" as: "Any "development" that provides for ultimately disturbing one or more acres of land or increased impervious surface of 1/4 acre or more. Disturbance for the purpose of this rule is the placement of impervious surface or exposure and/or movement of soil or bedrock or clearing, cutting, or removing of vegetation."
2. Does the municipality approach residential projects differently than it does for non-residential projects? If so, how?
As per Chapter 20 -- Stormwater Management, the Borough of Oakland does not approach residential projects differently than non-residential projects. Stormwater ordinances and regulations are implemented as applicable.
3. What process is in place to ensure that municipal projects meet the Stormwater Control Ordinance?
All municipal projects are reviewed and regularly inspected by the Borough Engineer and designees to ensure compliance with the Stormwater Management Ordinance. A maintenance plan for BMPs and structural stormwater management measures as described in the Stormwater Management Ordinance is established to ensure adequate long-term operation and maintenance of required BMPs and structural stormwater management measures for any Borough project or development.

SPPP Form 5 – Post-Construction Stormwater Management in New Development and Redevelopment Program

All records must be available upon request by NJDEP.

4. Describe the process for reviewing major development project applications for compliance with the Stormwater Control Ordinance (SCO) and Residential Site Improvement Standards (RSIS). Attach a flow chart if available.

The process for reviewing major development project applications for compliance is as follows:

1. Examination of the existing and proposed site conditions to verify whether the development is subject to the Stormwater Control Ordinance(s).

2. Examination of the hydraulic, hydrologic, and geographic conditions of the development site, such as land use cover, topography, flooding history, and discharge point(s).

3. Examination of proposed stormwater management measures:

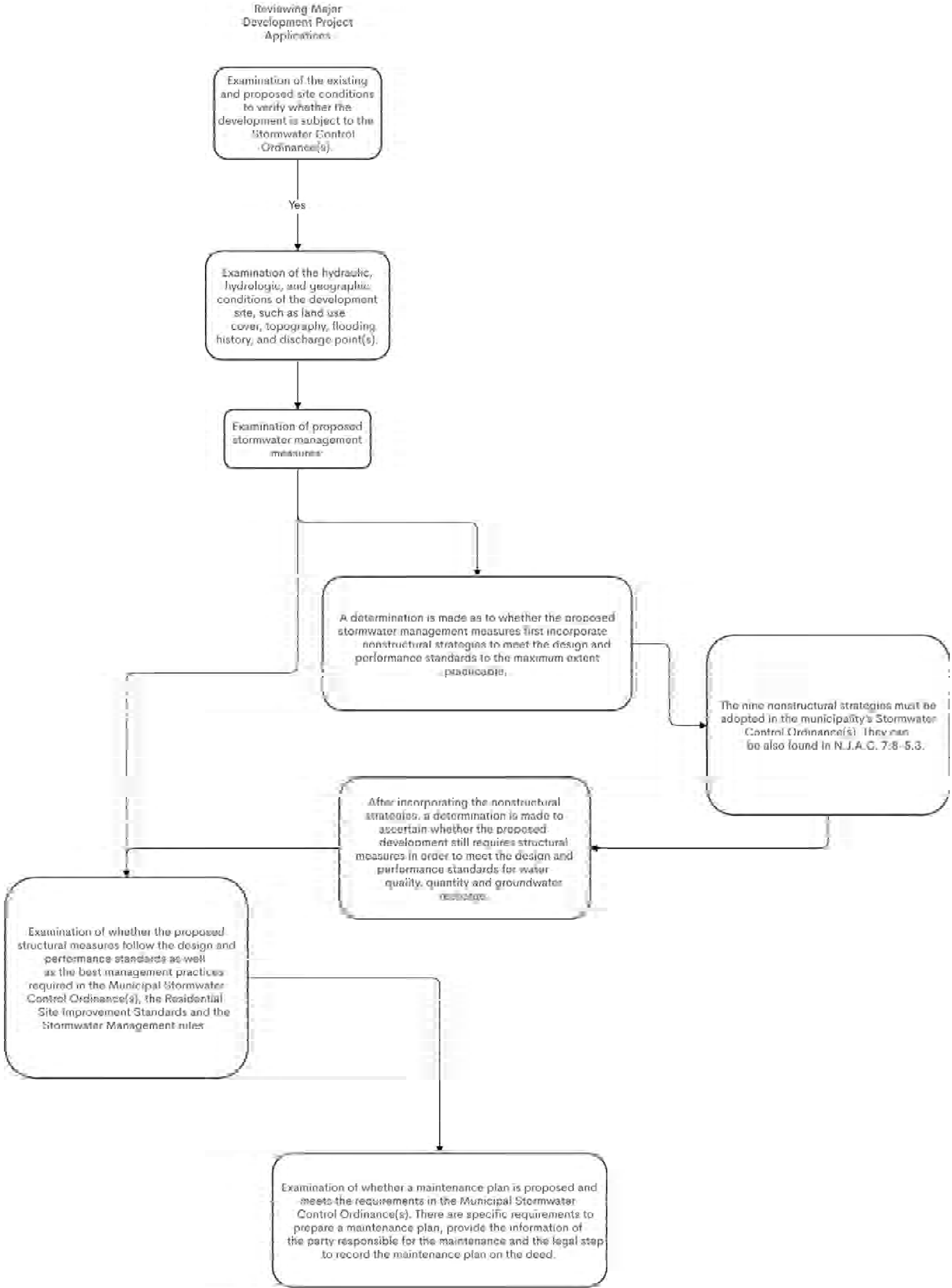
   - A determination is made as to whether the proposed stormwater management measures first incorporate nonstructural strategies to meet the design and performance standards to the maximum extent practicable. The nine nonstructural strategies must be adopted in the municipality's Stormwater Control Ordinance(s). They can be also found in N.J.A.C. 7:8-5.3. The Department has prepared a Low Impact Development Checklist that provides information to assist reviewers and designers in demonstrating that nonstructural stormwater management Tier A Municipal Stormwater Guidance Document October 2018 Chapter 3.4 Post Construction Stormwater Management in New Development and Redevelopment Page 12 measures have been implemented in a project. The checklist is available online from the Department at http://www.nj.gov/dep/stormwater/bmp_manual/NJ_SWBMP_A.pdf; and

   - After incorporating the nonstructural strategies, a determination is made to ascertain whether the proposed development still requires structural measures in order to meet the design and performance standards for water quality, quantity and groundwater recharge.

4. Examination of whether the proposed structural measures follow the design and performance standards as well as the best management practices required in the Municipal Stormwater Control Ordinance(s), the Residential Site Improvement Standards and the Stormwater Management rules. The Department provides the New Jersey Stormwater BMP manual to guide the detailed designs of stormwater management measures. The municipality's review engineers must be familiar with the design guidelines in order to perform an effective review. The New Jersey Stormwater BMP Manual is available at http://www.nj.gov/dep/stormwater/bmp_manual2.htm.

5. Examination of the maintenance plan that meets the requirements in the Municipal Stormwater Control Ordinance(s). There are specific requirements to prepare a maintenance plan, provide the information of the party responsible for the maintenance and the legal step to record the maintenance plan on the deed.

5. Does the Municipal Stormwater Management Plan include a mitigation plan?	No.
6. What is the physical location of approved applications for major development projects, Major Development Summary Sheets (permit att. D), and mitigation plans?	Records of all approved applications for major development are kept at the Oakland Municipal Building located at: 1 Municipal Plaza, Oakland, New Jersey 07436 and the Oakland Department of Public Works located at: 63 Oak Street, Oakland, New Jersey 07436.


Reviewing Major Development Project Applications
Examination of the existing and proposed site conditions to verify whether the development is subject to the Stormwater Control Ordinance(s).
Yes
Examination of the hydraulic, hydrologic, and geographic conditions of the development site, such as land use cover, topography, flooding history, and discharge point(s).
Examination of proposed stormwater management measures
A determination is made as to whether the proposed stormwater management measures first incorporate nonstructural strategies to meet the design and performance standards to the maximum extent practicable.
The nine nonstructural strategies must be adopted in the municipality's Stormwater Control Ordinance(s). They can be also found in N.J.A.C. 7:8-5.3.
After incorporating the nonstructural strategies, a determination is made to ascertain whether the proposed development still requires structural measures in order to meet the design and performance standards for water quality, quantity and groundwater recharge.
Examination of whether the proposed structural measures follow the design and performance standards as well as the best management practices required in the Municipal Stormwater Control Ordinance(s), the Residential Site Improvement Standards and the Stormwater Management rules
Examination of whether a maintenance plan is proposed and meets the requirements in the Municipal Stormwater Control Ordinance(s). There are specific requirements to prepare a maintenance plan, provide the information of the party responsible for the maintenance and the legal step to record the maintenance plan on the deed.

SPPP Form 6 – Ordinances

All records must be available upon request by NJDEP.

Ordinance permit cite IV.B.1.b.iii	Date of Adoption	Website URL	Was the DEP model ordinance adopted without change?	Entity responsible for enforcement
1. Pet Waste permit cite IV.B.5.a.i	09/14/05	https://www.oakland-nj.org/sites/g/files/vyhlif1026/f/uploads/pet_waste.pdf	YES	Police Department and the local Board of Health of the Borough of Oakland
2. Wildlife Feeding permit cite IV.B5.a.ii	09/14/05	https://www.oakland-nj.org/sites/g/files/vyhlif1026/f/uploads/wildlife_feeding.pdf	YES	Police Department and Board of Health of the Borough of Oakland
3. Litter Control permit cite IV.B5.a.iii	09/14/05	https://www.oakland-nj.org/sites/g/files/vyhlif1026/f/uploads/litter_control_ordinance.pdf	YES	Police Department of the Borough of Oakland
4. Improper Disposal of Waste permit cite IV.B.5.a.iv	09/14/05	https://www.oakland-nj.org/sites/g/files/vyhlif1026/f/uploads/disposal_of_waste_ordinance.pdf	YES	Police Department and Board of Health of the Borough of Oakland
5. Containerized Yard Waste/ Yard Waste Collection Program permit cite IV.B.5.a.v	09/14/05	https://www.oakland-nj.org/sites/g/files/vyhlif1026/f/uploads/containerized_yard_waste.pdf	YES	Police Department and Board of Health
6. Private Storm Drain Inlet Retrofitting permit cite IV.B.5.a.vi	07/28/10	https://www.oakland-nj.org/sites/g/files/vyhlif1026/f/uploads/private_storm_drain_inlet_retrofitting.pdf	YES	Police Department and/or Board of Health of the Borough of Oakland
7. Stormwater Control Ordinance permit cite IV.B.4.g and IV.B.5.a.vii	03/22/06	https://ecode360.com/35189117	YES	Police Department and/or Board of Health of the Borough of Oakland
8. Illicit Connection Ordinance permit cite IV.B.5.a.vii and IV.B.6.d	09/14/05	https://www.oakland-nj.org/sites/g/files/vyhlif1026/f/uploads/illicit_connection.pdf	YES	The Borough of Oakland Department of Public Works
9. Optional: Refuse Container/ Dumpster Ordinance permit cite IV.E.2	07/28/10	https://ecode360.com/35188315	YES	Police Department and Board of Health of the Borough of Oakland

Indicate the location of records associated with ordinances and related enforcement actions:

Records of all ordinances and related enforcement actions are kept at the Oakland Department of Public Works located at: 63 Oak Street, Oakland, New Jersey 07436.

BOROUGH OF OAKLAND
BERGEN COUNTY, NEW JERSEY

ORDINANCE NO.05-CODE-497
PET WASTE

SECTION I. Purpose:

An ordinance to establish requirements for the proper disposal of pet solid waste in the Borough of Oakland so as to protect public health, safety and welfare, and to prescribe penalties for failure to comply.

SECTION II. Definitions:

For the purpose of this ordinance, the following terms, phrases, words and their derivations shall have the meanings stated herein unless their use in the text of this Chapter clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "shall" is always mandatory and not merely directory.

a. Immediate-shall mean that the pet solid waste is removed at once, without delay.
b. Owner/Keeper-any person who shall possess, maintain, house or harbor any pet or otherwise have custody of any pet, whether or not the owner of such pet.
c. Person-any individual, corporation, company, partnership, firm, association, or political subdivision of this State subject to municipal jurisdiction.
d. Pet- a domesticated animal (other than a disability assistance animal) kept for amusement or companionship.
e. Pet solid waste-waste matter expelled from the bowels of the pet; excrement
f. Proper disposal-placement in a designated waste receptacle, or other suitable container, and discarded in a refuse container which is regularly emptied by the municipality or some other refuse collector; or disposal into a system designed to convey domestic sewage for proper treatment and disposal.

SECTION III. Requirement for Disposal:

All pet owners and keepers are required to immediately and properly dispose of their pet's solid waste deposited on any property, public or private, not owned or possessed by that person.

SECTION IV. Exemptions:

Any owner or keeper who requires the use of a disability assistance animal shall be exempt from the provisions of this section while such animal is being used for that purpose.

SECTION V. Enforcement:

The provisions of this Article shall be enforced by the Police Department and the local Board of Health of the Borough of Oakland.

SECTION VI. Violations and Penalty:

Any person(s) who is found to be in violation of the provisions of this ordinance shall be subject to a fine of $ 50.00 to $ 250.00.

SECTION VII. Severability:

Each section, subsection, sentence, clause and phrase of this ordinance is declared to be an independent section, subsection, sentence, clause and phrase, and the finding or holding of any such portion of this Ordinance to be unconstitutional, void or ineffective for any cause, or reason, shall not affect any other portion of this Ordinance.

SECTION VIII. Effective Date:

This ordinance shall be in full force and effect from and after its adoption and any publication as may be required by law.

ALL OF WHICH IS ADOPTED this 14th day of September, 2005, by the Borough of Oakland.

THIS IS TO CERTIFY THAT THIS
IS A TRUE COPY AS ADOPTED BY
THE MAYOR AND COUNCIL OF THE
BOROUGH OF OAKLAND AT A
MEETING HELD ON September 14, 2005
BOROUGH CLERK Lisa M. Duncan

BOROUGH OF OAKLAND
BERGEN COUNTY, NEW JERSEY

ORDINANCE NO. 05-CODE-500
WILDLIFE FEEDING ORDINANCE

SECTION I. Purpose:

An Ordinance to prohibit the feeding of unconfined wildlife in any public part or an any other property owned or operated by the Borough of Oakland so as to protect health, safety, and welfare, and to prescribe penalties for the failure to comply.

SECTION II. Definitions:

For the purpose of this ordinance, the following terms, phrases, words and their derivations shall have the meanings stated herein unless their use in the text of this Chapter clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "shall" is always mandatory and not merely directory.

a. Feed- to give, place, expose, deposit, distribute or scatter any edible material with the intention of feeding, attracting or enticing wildlife. Feeding does not include baiting in the legal taking of fish and/or game.
b. Person- any individual, corporation, company, partnership, firm, association, or political subdivision of this State subject to municipal jurisdiction.
c. Wildlife- all animals that are neither human nor domesticated.

SECTION III. Prohibited Conduct:

No person shall feed, in any public park or on any other property owned or operated by the Borough of Oakland any wildlife, excluding confined wildlife (for example, wildlife confined in zoos, parks or rehabilitation centers, or unconfined wildlife at environmental education centers).

SECTION IV. Enforcement:

a. This ordinance shall be enforced by the Police Department and Board of Health of the Borough of Oakland.
b. Any person found to be in violation of this ordinance shall be ordered to cease the feeding immediately.

SECTION V. Violations and Penalties:

Any person(s) who is found to be in violation of the provisions of this ordinance shall be subject to a fine of $ 50.00 to $ 250.00.

SECTION VI. Severability:

Each section, subsection, sentence, clause and phrase of this ordinance is declared to be an independent section, subsection, sentence, clause and phrase, and the finding or holding of any such portion of this Ordinance to be unconstitutional, void or ineffective for any cause, or reason, shall not affect any other portion of this Ordinance.

SECTION VII. Effective Date:

This ordinance shall be in full force and effect from and after its adoption and any publication as may be required by law.

ALL OF WHICH IS ADOPTED this 14th day of September, 2005, by the Borough of Oakland.

THIS IS TO CERTIFY THAT THIS
IS A TRUE COPY AS ADOPTED BY
THE MAYOR AND COUNCIL OF THE
BOROUGH OF OAKLAND AT A
MEETING HELD ON September 14, 2005
BOROUGH CLERK Lisa M. Duncan

BOROUGH OF OAKLAND
BERGEN COUNTY, NEW JERSEY

ORDINANCE NO. 05-CODE-498
LITTER CONTROL

SECTION I. Purpose:

An ordinance to establish requirements to control littering in the Borough of Oakland so as to protect public health, safety and welfare, and to prescribe penalties for failure to comply.

SECTION II. Definitions:

For the purpose of this ordinance, the following terms, phrases, words and their derivations shall have the meanings stated herein unless their use in the text of this Chapter clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "shall" is always mandatory and not merely directory.

a. Litter- Any used or unconsumed substance or waste material which has been discarded, whether made of aluminum, glass, plastic, rubber, paper, or other natural or synthetic material, or any combination thereof, including, but not limited to, any bottle, jar or can, or any top, cap or detachable tab of any bottle, jar or can, any unlighted cigarette, cigar, match or any flaming or glowing material or any garbage, trash, refuse, debris, rubbish, grass clippings or other lawn or garden waste, newspapers, magazines, glass, metal, plastic or paper containers or other packaging or construction material, but does not include the waste of the primary processes of mining or other extraction processes, logging, sawmilling, farming or manufacturing.
b. Litter Receptacle – a container suitable for the depositing of litter.
c. Person- any individual, corporation, company, partnership, firm, association, or political subdivision of this State subject to municipal jurisdiction.

SECTION III. Prohibited acts and regulated activities:

1. It shall be unlawful for any person to throw, drop, discard or otherwise place any litter of any nature upon public or private property other than in a litter receptacle, or having done so, to allow such litter to remain.

2. Whenever any litter is thrown or discarded or allowed to fall from a vehicle or boat in violation of this ordinance, the operator or owner, or both, of the motor vehicle or boat shall also be deemed to have violated this ordinance.

SECTION IV. Enforcement:

This ordinance shall be enforced by the Police Department of the Borough of Oakland.

SECTION V. Penalties:

An person(s) who is found to be in violation of the provisions of this ordinance shall be subject to a fine of $ 50.00 to $ 250.00.

SECTION VI. Severability:

Each section, subsection, sentence, clause and phrase of this ordinance is declared to be an independent section, subsection, sentence, clause and phrase, and the finding or holding of any such portion of this Ordinance to be unconstitutional, void or ineffective for any cause, or reason, shall not affect any other portion of this Ordinance.

SECTION VII. Effective Date:

This ordinance shall be in full force and effect from and after its adoption and any publication as may be required by law.

ALL OF WHICH IS ADOPTED this 14th day of September, 2005, by the Borough of Oakland.

THIS IS TO CERTIFY THAT THIS IS A TRUE COPY AS ADOPTED BY THE MAYOR AND COUNCIL OF THE BOROUGH OF OAKLAND AT A MEETING HELD ON Sept. 14, 2005
BOROUGH CLERK [signature]

BOROUGH OF OAKLAND
BERGEN COUNTY, NEW JERSEY

ORDINANCE NO. 05-CODE-499
IMPROPER DISPOSAL OF WASTE

SECTION I. Purpose:

An Ordinance to prohibit the spilling, dumping, or disposal of materials other than stormwater to the municipal separate storm sewer system (MS4) operated by the Borough of Oakland so as to protect health, safety, and welfare, and to prescribe penalties for the failure to comply.

SECTION II. Definitions:

For the purpose of this ordinance, the following terms, phrases, words and their derivations shall have the meanings stated herein unless their use in the text of this Chapter clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "shall" is always mandatory and not merely directory.

a. Municipal separate storm sewer system (MS4) – a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains) that is owned or operated by the Borough of Oakland or other public body, and is designed and used for collecting and conveying stormwater.
b. Person- any individual, corporation, company, partnership, firm, association, or political subdivision of this State subject to municipal jurisdiction.
c. Stormwater- water resulting from precipitation (including rain and snow) that runs off the land's surface, is transmitted to the subsurface, is captured by separate storm sewers or other sewerage or drainage facilities, or is conveyed by snow removal equipment.

SECTION III. Prohibited Conduct:

The spilling, dumping, or disposal of materials other than stormwater to the municipal separate storm sewer system operated by the Borough of Oakland is prohibited. The spilling, dumping, or disposal of materials other than stormwater in such a manner as to cause the discharge of pollutants to the municipal separate storm sewer system is also prohibited.

SECTION IV. Exceptions to Prohibition:

a. Water line flushing and discharges from potable water sources.
b. Uncontaminated ground water (e.g., infiltration, crawl space or basement sump pumps, foundation or footing drains, rising ground waters)
c. Air conditioning condensate (excluding contact and non-contact cooling water)
d. Irrigation water (including landscape and lawn watering runoff)
e. Flows from springs, riparian habitats and wetlands, water reservoir discharges and diverted stream flows
f. Residential car washing water, and residential swimming pool discharges
g. Sidewalk, driveway and street wash water
h. Flows from fire fighting activities
i. Flows from rinsing of the following equipment with clean water:
   - Beach maintenance equipment immediately following their use for their intended purposes; and
   - Equipment used in the application of salt and de-icing materials immediately following salt and de-icing material applications. Prior to rinsing with clean water, all residual salt and de-icing materials must be removed from equipment and vehicles to the maximum extent practicable using dry cleaning methods (e.g., shoveling and sweeping). Recovered materials are to be returned to storage for reuse or properly discarded.

     Rinsing of equipment, as noted in the above situation is limited to exterior, undercarriage, and exposed parts and does not apply to engines or other enclosed machinery.

SECTION V. Enforcement:

This ordinance shall be enforced by the Police Department and Board of Health of the Borough of Oakland.

SECTION VI. Penalties:

Any person(s) who continues to be in violation of the provisions of this ordinance, after being duly notified, shall be subject to a fine of $ 50.00 to $ 250.00. For oil and gas dumping, the fines are $ 200.00 to $ 1,000.00.

SECTION VII. Severability:

Each section, subsection, sentence, clause and phrase of this ordinance is declared to be an independent section, subsection, sentence, clause and phrase, and the finding or holding of any such portion of this Ordinance to be unconstitutional, void or ineffective for any cause, or reason, shall not affect any other portion of this Ordinance.

SECTION VII. Effective Date:

This ordinance shall be in full force and effect from and after its adoption and any publication as may be required by law.

ALL OF WHICH IS ADOPTED this 14th day of September, 2005, by the Borough of Oakland.

THIS IS TO CERTIFY THAT THIS IS A TRUE COPY AS ADOPTED BY THE MAYOR AND COUNCIL OF THE BOROUGH OF OAKLAND AT A MEETING HELD ON September 14, 2005
BOROUGH CLERK Rosa M. Duncan

BOROUGH OF OAKLAND
BERGEN COUNTY, NEW JERSEY

ORDINANCE NO. 05-CODE-501
CONTAINERIZED YARD WASTE

SECTION I. Purpose:

An Ordinance to establish requirements for the proper handling of yard waste in the Borough of Oakland so as to protect public health, safety and welfare, and to prescribe penalties for the failure to comply.

SECTION II. Definitions:

For the purpose of this ordinance, the following terms, phrases, words and their derivations shall have the meanings stated herein unless their use in the text of this Chapter clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "shall" is always mandatory and not merely directory.

a. Containerized – means the placement of yard waste in a trash can, bucket, bag or other vessel, such as to prevent the yard waste from spilling or blowing out into the street and coming into contact with stormwater.
b. Person – any individual, corporation, company, partnership, firm, association or political subdivision of this State subject to municipal jurisdiction.
c. Street – means any street, avenue, boulevard, road, parkway, viaduct, drive, or other way, which is an existing State, county, or municipal roadway, and includes the land between the street lines, whether improved or unimproved, and may comprise pavement, shoulders, gutters, curbs, sidewalks, parking areas, and other areas within the street lines.
d. Yard Waste- means leaves and grass clippings.

SECTION III. Prohibited Conduct:

The owner or occupant of any property, or any employee or contractor of such owner or occupant engaged to provide lawn care or landscaping services, shall not sweep, rake, blow or otherwise place yard waste, unless the yard waste is containerized, in the street. If yard waste that is not containerized is placed in the street, the party responsible for the placement of yard waste must remove the yard waste from the street or said party shall be deemed in violation of this ordinance.

SECTION IV. Enforcement:
The provisions of this ordinance shall be enforced by the Police Department and Board of Health.

SECTION V. Violations and Penalties:

Any person(s) who is found to be in violation of the provisions of this ordinance shall be subject to a fine of $ 50.00 to $ 250.00.

SECTION VI. Severability:

Each section, subsection, sentence, clause and phrase of this ordinance is declared to be an independent section, subsection, sentence, clause and phrase, and the finding or holding of any such portion of this Ordinance to be unconstitutional, void or ineffective for any cause, or reason, shall not affect any other portion of this Ordinance.

SECTION VII. Effective Date:

This ordinance shall be in full force and effect from and after its adoption and any publication as may be required by law.

ALL OF WHICH IS ADOPTED this 14th day of September, 2005, by the Borough of Oakland.

THIS IS TO CERTIFY THAT THIS
IS A TRUE COPY AS ADOPTED BY
THE MAYOR AND COUNCIL OF THE
BOROUGH OF OAKLAND AT A
MEETING HELD ON September 14, 2005
BOROUGH CLERK Lisa M. Duenca

Borough of Oakland
Bergen County, New Jersey

Ordinance 10- CODE-628

AN ORDINANCE SUPPLEMENTING CHAPTER 20 OF THE BOROUGH OF OAKLAND CODE, SO AS TO REGULATE PRIVATE STORM DRAIN INLET RETRO-FITTING

SECTION I. Purpose:

An ordinance requiring the retrofitting of existing storm drain inlets which are in direct contact with repaving, repairing, reconstruction, or resurfacing or alterations of facilities on private property, to prevent the discharge of solids and floatables (such as plastic bottles, cans, food wrappers, and other litter) to the municipal separate storm sewer system(s) operated by the Borough of Oakland so as to protect public health, safety and welfare, and to prescribe penalties for the failure to comply.

SECTION II. Definitions:

For the purpose of this ordinance, the following terms, phrases, words, and their derivations shall have the meanings stated herein unless their use in the text of this Chapter clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "shall" is always mandatory and not merely directory.

a. Municipal separate storm sewer system (MS4) – a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels, or storm drains) that is owned or operated by the Borough of Oakland or other public body, and is designed and used for collecting and conveying stormwater. NOTE: In municipalities with combined sewer systems, add the following: "MS4s do not include combined sewer systems, which are sewer systems that are designed to carry sanitary sewage at all times and to collect and transport stormwater from streets and other sources."

b. Person – any individual, corporation, company, partnership, firm, association, or political subdivision of this State subject to municipal jurisdiction.

c. Storm drain inlet – an opening in a storm drain used to collect stormwater runoff and includes, but is not limited to a grate inlet, curb-opening inlet, slotted inlet, and combination inlet.

d. Waters of the State - means the ocean and its estuaries, all springs, streams and bodies of surface or ground water whether natural or artificial, within the boundaries of the State of New Jersey or subject to its jurisdiction.

SECTION III. Prohibited Conduct

No person in control of private property (except a residential lot with one single family house) shall authorize the repaving, repairing (excluding the repair of individual potholes), resurfacing (including top coating or chip sealing with asphalt emulsion or a thin base of hot bitumen), reconstructing or altering any surface that is in direct contact with an existing storm drain inlet on that property unless the storm drain inlet either:

1. Already meets the design standard below to control passage of solid and floatable materials; or
2. Is retrofitted or replaced to meet the standard in Section IV below prior to the completion of the project.

SECTION IV. Design Standard:

Storm drain inlets identified in Section III above shall comply with the following standard to control passage of solid and floatable materials through storm drain inlets. For purposes of this paragraph, "solid and floatable materials" means sediment, debris, trash, and other floating, suspended, or settleable solids. For exemptions to this standard see Section V.3 below.

1. Design engineers shall use either of the following grates whenever they use a grate in pavement or another ground surface to collect stormwater from that surface into a storm drain or surface water body under that grate:

   a. The New Jersey Department of Transportation (NJDOT) bicycle safe grate, which is described in Chapter 24 of the NJDOT Bicycle Compatible Roadways and Bikeways Planning and Design Guidelines (April 1996); or
   b. A different grate, if each individual clear space in that grate has an area of no more that seven (7.0) square inches, or is no greater that 0.5 inches across the smallest dimension.

   Examples of grates subject to this standard include grates in grate inlets, the grate portion (non-curb-opening portion) of combination inlets, grates on storm sewer manholes, ditch grates, trench grates, and grates of spacer bars in slotted drains. Examples of ground surfaces include surfaces of roads (including bridges), driveways, parking areas, bikeways, plazas, sidewalks, lawns, fields, open channels, and stormwater basin floors.

2. Whenever design engineers use a curb-opening inlet, the clear space in that curb opening (or each individual clear space, if the curb opening has two or more clear spaces) shall have an area of no more that seven (7.0) square inches, or be no greater than two (2.0) inches across the smallest dimension.

3. This standard does not apply:

   a. Where the municipal engineer agrees that this standard would cause inadequate hydraulic performance that could not practicably be overcome by using additional or larger storm drain inlets that meet these standards;

b. Where flows are conveyed through any device (e.g., end of pipe netting facility, manufactured treatment device, or a catch basin hood) that is designed, at a minimum, to prevent delivery of all solid and floatable materials that could not pass through one of the following:

    i. A rectangular space four and five-eights inches long and one and one-half inches wide (this option does not apply for outfall netting facilities; or

    ii. A bar screen having a bar spacing of 0.5 inches.

c. Where flows are conveyed through a trash rack that has parallel bars with one-inch (1") spacing between the bars; or

d. Where the New Jersey Department of Environmental Protection determines, pursuant to the New Jersey Register of Historic Places rules at N.J.A.C. 7:4-7.2(c), that action to meet this standard is an undertaking that constitutes an encroachment or will damage or destroy the New Jersey Register listed historic property.

SECTION V. Enforcement:
This ordinance shall be enforced by the Police Department and/or Board of Health of the Borough of Oakland.

SECTION VI. Penalties:
Any person(s) who is found to be in violation of the provisions of this ordinance shall be subject to a fine of one hundred dollars ($ 100) to one thousand ($ 1000) for each storm drain inlet that is not retrofitted to meet the design standard.

SECTION VII. Severability:
Each section, subsection, sentence, clause and phrase of this Ordinance is declared to be an independent section, subsection, sentence, clause and phrase, and the finding or holding of any such portion of this Ordinance to be unconstitutional, void, or ineffective for any cause, or reason, shall not affect any other portion of this Ordinance.

SECTION VIII. Conflicts:
All sections and portions of Chapter 20 not affected by the terms of this ordinance are hereby confirmed and ratified. In the event of any inconsistency between the terms of this ordinance and other provisions of Chapter 20, the provisions of this ordinance shall govern.

SECTION IX. Effective Date:
This Ordinance shall be in full force and effect from and after its adoption and any publication as may be required by law

JOHN P. SZABO, JR., MAYOR

ATTEST:

LISA M. DUNCAN, BOROUGH CLERK

This is to certify that this is a true copy as adopted by the Mayor and Council of the Borough of Oakland at a meeting held on July 28, 2010

Borough Clerk

Chapter 20

STORMWATER MANAGEMENT

§ 20-1. STORMWATER CONTROL.

§ 20-1.1. Scope and Purpose. [Ord. #06-Code-525, § 1]

a. Policy Statement. Flood control, groundwater recharge, and pollutant reduction through nonstructural or low impact techniques shall be explored before relying on structural Best Management Practices (BMPs). Structural BMPs should be integrated with nonstructural stormwater management strategies and proper maintenance plans. Nonstructural strategies include both environmentally sensitive site design and source controls that prevent pollutants from being placed on the site or from being exposed to stormwater. Source control plans should be developed based upon physical site conditions and the origin, nature, and the anticipated quantity or amount of potential pollutants. Multiple stormwater management BMPs may be necessary to achieve the established performance standards for water quality, quantity, and groundwater recharge.

b. Purpose. It is the purpose of this section to establish minimum stormwater management requirements and controls for "major development," as defined in subsection 20-1.2.

c. Applicability.

   1. This section shall be applicable to all site plans and subdivisions for the following major developments that require preliminary or final site plan or subdivision review:

      (a) Nonresidential major developments; and

      (b) Aspects of residential major developments that are not preempted by the Residential Site Improvement Standards at N.J.A.C. 5:21.

   2. This section shall also be applicable to all major developments undertaken by Borough of Oakland.

d. Compatibility with Other Permit and Ordinance Requirements. Development approvals issued for subdivisions and site plans pursuant to this section are to be considered an integral part of development approvals under the subdivision and site plan review process and do not relieve the applicant of the responsibility to secure required permits or approvals for activities regulated by any other applicable code, rule, act, or ordinance. In their interpretation and application, the provisions of this section shall be held to be the minimum requirements for the promotion of the public health, safety, and general welfare.

This section is not intended to interfere with, abrogate, or annul any other ordinances, rule or regulation, statute, or other provision of law except that, where any provision of this section imposes restrictions different from those imposed by any other ordinance, rule or regulation, or other provision of law, the more restrictive provisions or higher standards shall control.

§ 20-1.2. Definitions. [Ord. #06-Code-525, § 2]

Unless specifically defined below, words or phrases used in this section shall be interpreted so as to give them the meaning they have in common usage and to give this section its most reasonable application. The definitions below are the same as or based on the corresponding definitions in the Stormwater Management Rules at N.J.A.C. 7:8-1.2.

CAFRA CENTERS, CORES OR NODES — Shall mean those areas within boundaries accepted by the Department pursuant to N.J.A.C. 7:8E-5B.

CAFRA PLANNING MAP — Shall mean the geographic depiction of the boundaries for Coastal Planning Areas, CAFRA Centers, CAFRA Cores and CAFRA Nodes pursuant to N.J.A.C. 7:7E-5B.3.

COMPACTION — Shall mean the increase in soil bulk density.

CORE — Shall mean a pedestrian-oriented area of commercial and civic uses serving the surrounding municipality, generally including housing and access to public transportation.

COUNTY REVIEW AGENCY — Shall mean an agency designated by the County Board of Chosen Freeholders to review municipal stormwater management plans and implementing ordinance(s). The County review agency may either be:
A County planning agency; or
A County water resource association created under N.J.S.A. 58:16A-55.5, if the ordinance or resolution delegates authority to approve, conditionally approve, or disapprove municipal stormwater management plans and implementing ordinances.

DEPARTMENT — Shall mean the New Jersey Department of Environmental Protection.

DESIGN ENGINEER — Shall mean a person professionally qualified and duly licensed in New Jersey to perform engineering services that may include, but not necessarily be limited to, development of project requirements, creation and development of project design and preparation of drawings and specifications.

DESIGNATED CENTER — Shall mean a State Development and Redevelopment Plan Center as designated by the State Planning Commission such as urban, regional, town, village, or hamlet.

DEVELOPMENT — Shall mean the division of a parcel of land into two or more parcels, the construction, reconstruction, conversion, structural alteration, relocation or enlargement of any building or structure, any mining excavation or landfill, and any use or change in the use of any building or other structure, or land or extension of use of land, by any person, for which permission is required under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq. In the case of development of agricultural lands, development means: any activity that requires a State permit; any activity reviewed by the County Agricultural Board (CAB) and the State Agricultural Development Committee (SADC), and municipal review of any activity not exempted by the Right to Farm Act, N.J.S.A. 4:1C-1 et seq.

DRAINAGE AREA — Shall mean a geographic area within which stormwater, sediments, or dissolved materials drain to a particular receiving waterbody or to a particular point along a receiving waterbody.

EMPOWERMENT NEIGHBORHOOD — Shall mean a neighborhood designated by the Urban Coordinating Council "in consultation and conjunction with" the New Jersey Redevelopment Authority pursuant to N.J.S.A. 55:19-69.

ENVIRONMENTALLY CRITICAL AREAS — Shall mean an area or feature which is of significant environmental value, including but not limited to: stream corridors; natural heritage priority sites; habitat of endangered or threatened species; large areas of contiguous open space or upland forest; steep slopes; and well head protection and groundwater recharge areas. Habitats of endangered or threatened species are identified using the Department's Landscape Project as approved by the Department's Endangered and Nongame Species Program.

EROSION — Shall mean the detachment and movement of soil or rock fragments by water, wind, ice or gravity.

IMPERVIOUS SURFACE — Shall mean a surface that has been covered with a layer of material so that it is highly resistant to infiltration by water.

INFILTRATION — Shall mean the process by which water seeps into the soil from precipitation.

MAJOR DEVELOPMENT — Shall mean any "development" that provides for ultimately disturbing one or more acres of land or increased impervious surface of 1/4 acre or more. Disturbance for the purpose of this rule is the placement of impervious surface or exposure and/or movement of soil or bedrock or clearing, cutting, or removing of vegetation.

MUNICIPALITY — Shall mean any city, borough, town, township, or village.

NODE — Shall mean an area designated by the State Planning Commission concentrating facilities and activities which are not organized in a compact form.

NUTRIENT — Shall mean a chemical element or compound, such as nitrogen or phosphorus, which is essential to and promotes the development of organisms.

PERSON — Shall mean any individual, corporation, company, partnership, firm, association, Borough of Oakland, or political subdivision of this State subject to municipal jurisdiction pursuant to the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq.

POLLUTANT — Shall mean any dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, refuse, oil, grease, sewage sludge, munitions, chemical wastes, biological materials, medical wastes, radioactive substance (except those regulated under the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.)), thermal waste, wrecked or discarded equipment, rock, sand, cellar dirt, industrial, municipal, agricultural, and construction waste or runoff, or other residue discharged directly or indirectly to the land, ground waters or surface waters of the State, or to a domestic treatment works. "Pollutant" includes both hazardous and nonhazardous pollutants.

RECHARGE — Shall mean the amount of water from precipitation that infiltrates into the ground and is not evapotranspired.

SEDIMENT — Shall mean solid material, mineral or organic, that is in suspension, is being transported, or has been moved from its site of origin by air, water or gravity as a product of erosion.

SITE — Shall mean the lot or lots upon which a major development is to occur or has occurred.

SOIL — Shall mean all unconsolidated mineral and organic material of any origin.

STATE DEVELOPMENT AND REDEVELOPMENT PLAN METROPOLITAN PLANNING AREA (PA1) — Shall mean an area delineated on the State Plan Policy Map and adopted by the State Planning Commission that is intended to be the focus for much of the State's future redevelopment and revitalization efforts.

STATE PLAN POLICY MAP — Shall mean the geographic application of the State Development and Redevelopment Plan's goals and statewide policies, and the official map of these goals and policies.

STORMWATER — Shall mean water resulting from precipitation (including rain and snow) that runs off the land's surface, is transmitted to the subsurface, or is captured by separate is transmitted to the subsurface, or is captured by separate storm sewers or other sewage or drainage facilities, or conveyed by snow removal equipment.

STORMWATER MANAGEMENT BASIN — Shall mean an excavation or embankment and related areas designed to retain stormwater runoff. A stormwater management basin may either be normally dry (that is, a detention basin or infiltration basin), retain water in a permanent pool (a retention basin), or be planted mainly with wetland vegetation (most constructed stormwater wetlands).

STORMWATER MANAGEMENT MEASURE — Shall mean any structural or nonstructural strategy, practice, technology, process, program, or other method intended to control or reduce stormwater runoff and associated pollutants, or to induce or control the infiltration or groundwater recharge of stormwater or to eliminate illicit or illegal non-stormwater discharges into stormwater conveyances.

STORMWATER RUNOFF — Shall mean water flow on the surface of the ground or in storm sewers, resulting from precipitation.

TIDAL FLOOD HAZARD AREA — Shall mean a flood hazard area, which may be influenced by stormwater runoff from inland areas, but which is primarily caused by the Atlantic Ocean.

URBAN COORDINATING COUNCIL EMPOWERMENT NEIGHBORHOOD — Shall mean a neighborhood given priority access to State resources through the New Jersey Redevelopment Authority.

URBAN ENTERPRISE ZONE — Shall mean a zone designated by the New Jersey Enterprise Zone Authority pursuant to the New Jersey Urban Enterprise Zones Act, N.J.S.A. 52:27H-60 et seq.

URBAN REDEVELOPMENT AREA — Shall mean previously developed portions of areas:

a. Delineated on the State Plan Policy Map (SPPM) as the Metropolitan Planning Area (PA1), Designated Centers, Cores or Nodes;

b. Designated as CAFRA Centers, Cores or Nodes;

c. Designated as Urban Enterprise Zones; and

d. Designated as Urban Coordinating Council Empowerment Neighborhoods.

WATERS OF THE STATE — Shall mean the ocean and its estuaries, all springs, streams, wetlands, and bodies of surface or groundwater, whether natural or artificial, within the boundaries of the State of New Jersey or subject to its jurisdiction.

WETLANDS OR WETLAND — Shall mean an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation.

§ 20-1.3. General Standards. [Ord. #06-Code-525, § 3]

a. Design and Performance Standards for Stormwater Management Measures.

   1. Stormwater management measures for major development shall be developed to meet the erosion control, groundwater recharge, stormwater runoff quantity, and stormwater runoff quality standards in subsection 22-1.4. To the maximum extent practicable, these standards shall be met by incorporating nonstructural stormwater management strategies into the design. If these strategies alone are not sufficient to meet these standards,

structural stormwater management measures necessary to meet these standards shall be incorporated into the design.

2. The standards in this section apply only to new major development and are intended to minimize the impact of stormwater runoff on water quality and water quantity in receiving water bodies and maintain groundwater recharge. The standards do not apply to new major development to the extent that alternative design and performance standards are applicable under a regional stormwater management plan or Water Quality Management Plan adopted in accordance with Department rules.

§ 20-1.4. Stormwater Management Requirements for Major Development. [Ord. #06-Code-525, § 4]

a. The development shall incorporate a maintenance plan for the stormwater management measures incorporated into the design of a major development in accordance with subsection 20-1.10.

b. Stormwater management measures shall avoid adverse impacts of concentrated flow on habitat for threatened and endangered species as documented in the Department Landscape Project or Natural Heritage Database established under N.J.S.A. 13:1B-15.147 through 15.150, particularly Helonias bullata (swamp pink) and/or Clemmys muhlnebergi (bog turtle).

c. The following linear development projects are exempt from the groundwater recharge, stormwater runoff quantity, and stormwater runoff quality requirements of subsection 20-1.4f and g.

1. The construction of an underground utility line provided that the disturbed areas are revegetated upon completion;

2. The construction of an aboveground utility line provided that the existing conditions are maintained to the maximum extent practicable; and

3. The construction of a public pedestrian access, such as a sidewalk or trail with a maximum width of 14 feet, provided that the access is made of permeable material.

d. A waiver from strict compliance from the groundwater recharge, stormwater runoff quantity, and stormwater runoff quality requirements of subsection 20-1.4f and g may be obtained for the enlargement of an existing public roadway or railroad; or the construction or enlargement of a public pedestrian access, provided that the following conditions are met:

1. The applicant demonstrates that there is a public need for the project that cannot be accomplished by any other means;

2. The applicant demonstrates through an alternative analysis, that through the use of nonstructural and structural stormwater management strategies and measures, the option selected complies with the requirements of subsections 20-1.4f and g to the maximum extent practicable;

3. The applicant demonstrates that, in order to meet the requirements of subsections 20-1.4f and g, existing structures currently in use, such as homes and buildings, would need to be condemned; and

4. The applicant demonstrates that it does not own or have other rights to areas, including the potential to obtain through condemnation lands not falling under paragraph d3 above within the upstream drainage area of the receiving stream, that would provide additional opportunities to mitigate the requirements of subsection 20-1.4f and g that were not achievable on-site.

e. Nonstructural Stormwater Management Strategies.

1. To the maximum extent practicable, the standards in subsection 20-1.4f and g shall be met by incorporating nonstructural stormwater management strategies set forth at subsection 20-1.4e into the design. The applicant shall identify the nonstructural measures incorporated into the design of the project. If the applicant contends that it is not feasible for engineering, environmental, or safety reasons to incorporate any nonstructural stormwater management measures identified in paragraph 2 below into the design of a particular project, the applicant shall identify the strategy considered and provide a basis for the contention.

2. Nonstructural stormwater management strategies incorporated into site design shall:

(a) Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss;

(b) Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces;

(c) Maximize the protection of natural drainage features and vegetation;

(d) Minimize the decrease in the "time of concentration" from preconstruction to post-construction. "Time of concentration" is defined as the time it takes for runoff to travel from the hydraulically most distant point of the watershed to the point of interest within a watershed;

(e) Minimize land disturbance including clearing and grading;

(f) Minimize soil compaction;

(g) Provide low-maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers and pesticides;

(h) Provide vegetated open-channel conveyance systems discharging into and through stable vegetated areas;

(i) Provide other source controls to prevent or minimize the use or exposure of pollutants at the site, in order to prevent or minimize the release of those pollutants into stormwater runoff. Such source controls include, but are not limited to:

(1) Site design features that help to prevent accumulation of trash and debris in drainage systems, including features that satisfy subsection 20-1.4e3 below;

(2) Site design features that help to prevent discharge of trash and debris from drainage systems;

(3) Site design features that help to prevent and/or contain spills or other harmful accumulations of pollutants at industrial or commercial developments; and

(4) When establishing vegetation after land disturbance, applying fertilizer in accordance with the requirements established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq., and implementing rules.

3. Site design features identified under subsection 20-1.4e2(1)(2) above shall comply with the following standard to control passage of solid and floatable materials through storm drain inlets. For purposes of this paragraph, "solid and floatable materials" means sediment, debris, trash, and other floating, suspended, or settleable solids. For exemptions to this standard see subsection 20-1.4e3(c) below.

(a) Design engineers shall use either of the following grates whenever they use a grate in pavement or another ground surface to collect stormwater from that surface into a storm drain or surface water body under that grate:

(1) The New Jersey Department of Transportation (NJDOT) bicycle safe grate, which is described in Chapter 2.4 of the NJDOT Bicycle Compatible Roadways and Bikeways Planning and Design Guidelines (April 1996); or

(2) A different grate, if each individual clear space in that grate has an area of no more than 7.0 square inches, or is no greater than 0.5 inch across the smallest dimension.

Examples of grates subject to this standard include grates in grate inlets, the grate portion (non-curb-opening portion) of combination inlets, grates on storm sewer manholes, ditch grates, trench grates, and grates of spacer bars in slotted drains. Examples of ground surfaces include surfaces of roads (including bridges), driveways, parking areas, bikeways, plazas, sidewalks, lawns, fields, open channels, and stormwater basin floors.

(b) Whenever design engineers use a curb-opening inlet, the clear space in that curb opening (or each individual clear space, if the curb opening has two or more clear spaces) shall have an area of no more than 7.0 square inches, or be no greater than 2.0 inches across the smallest dimension.

(c) This standard does not apply:

(1) Where the review agency determines that this standard would cause inadequate hydraulic performance that could not practicably be overcome by using additional or larger storm drain inlets that meet these standards;

(2) Where flows from the water quality design storm as specified in subsection 20-1.4g1 are conveyed through any device (e.g., end of pipe netting facility, manufactured treatment device, or a catch basin hood) that is designed, at a minimum, to prevent delivery of all solid and floatable materials that could not pass through one of the following:

[a] A rectangular space 4 5/8 inches long and 1 1/2 inches wide (this option does not apply for outfall netting facilities); or

[b] A bar screen having a bar spacing of 0.5 inch.

(3) Where flows are conveyed through a trash rack that has parallel bars with one inch spacing between the bars, to the elevation of the water quality design storm as specified in subsection 20-1.4g1; or

(4) Where the New Jersey Department of Environmental Protection determines, pursuant to the New Jersey Register of Historic Places Rules at N.J.A.C. 7:4-7.2(c), that action to meet this standard is an undertaking that constitutes an encroachment or will damage or destroy the New Jersey Register listed historic property.

4. Any land area used as a nonstructural stormwater management measure to meet the performance standards in subsections 20-1.4f and g shall meet one of the following requirements:

(a) Be dedicated to a government agency as approved by the appropriate reviewing agency, or

(b) Subjected to a conservation restriction filed with the appropriate County Clerk's office, or

(c) Subjected to an approved equivalent restriction that ensures that measure or an equivalent stormwater management measure approved by the reviewing agency is maintained in perpetuity.

5. Guidance for nonstructural stormwater management strategies is available in the New Jersey Stormwater Best Management Practices Manual. The BMP Manual may be obtained from the address identified in subsection 20-1.7, or found on the Department's website at www.njstormwater.org.

f. Erosion Control, Groundwater Recharge and Runoff Quantity Standards.

1. This paragraph contains minimum design and performance standards to control erosion, encourage and control infiltration and groundwater recharge, and control stormwater runoff quantity impacts of major development.

(a) The minimum design and performance standards for erosion control are those established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq. and implementing rules.

(b) The minimum design and performance standards for groundwater recharge are as follows:

(1) The design engineer shall, using the assumptions and factors for stormwater runoff and groundwater recharge calculations at subsection 20-1.5, either:

[a] Demonstrate through hydrologic and hydraulic analysis that the site and its stormwater management measures maintain 100% of the average annual preconstruction groundwater recharge volume for the site; or

[b] Demonstrate through hydrologic and hydraulic analysis that the increase of stormwater runoff volume from preconstruction to post-construction for the two-year storm is infiltrated.

(2) This groundwater recharge requirement does not apply to projects within the "urban redevelopment area," or to projects subject to paragraph (3) below.

(3) The following types of stormwater shall not be recharged:

[a] Stormwater from areas of high pollutant loading. High pollutant loading areas are areas in industrial and commercial developments where solvents and/or petroleum products are loaded/unloaded, stored, or applied, areas where pesticides are loaded/unloaded

or stored; areas where hazardous materials are expected to be present in greater than "reportable quantities" as defined by the United States Environmental Protection Agency (EPA) at 40 CFR 302.4; areas where recharge would be inconsistent with Department approved remedial action work plan or landfill closure plan and areas with high risks for spills of toxic materials, such as gas stations and vehicle maintenance facilities; and

[b] Industrial stormwater exposed to "source material." "Source material" means any material(s) or machinery, located at an industrial facility, that is directly or indirectly related to process, manufacturing or other industrial activities, which could be a source of pollutants in any industrial stormwater discharge to groundwater. Source materials include, but are not limited to, raw materials; intermediate products; final products; waste materials; by-products; industrial machinery and fuels, and lubricants, solvents, and detergents that are related to process, manufacturing, or other industrial activities that are exposed to stormwater.

(4) The design engineer shall assess the hydraulic impact on the groundwater table and design the site so as to avoid adverse hydraulic impacts. Potential adverse hydraulic impacts include, but are not limited to, exacerbating a naturally or seasonally high water table so as to cause surficial ponding, flooding of basements, or interference with the proper operation of subsurface sewage disposal systems and other subsurface structures in the vicinity or down gradient of the groundwater recharge area.

(c) In order to control stormwater runoff quantity impacts, the design engineer shall, using the assumptions and factors for stormwater runoff calculations at subsection 20-1.5, complete one of the following:

(1) Demonstrate through hydrologic and hydraulic analysis that for stormwater leaving the site, post-construction runoff hydrographs for the two-, ten-, and 100-year storm events do not exceed, at any point in time, the preconstruction runoff hydrographs for the same storm events;

(2) Demonstrate through hydrologic and hydraulic analysis that there is no increase, as compared to the preconstruction condition, in the peak runoff rates of stormwater leaving the site for the two-, ten-, and 100-year storm events and that the increased volume or change in

timing of stormwater runoff will not increase flood damage at or downstream of the site. This analysis shall include the analysis of impacts of existing land uses and projected land uses assuming full development under existing zoning and land use ordinances in the drainage area;

(3) Design stormwater management measures so that the post-construction peak runoff rates for the two-, ten- and 100-year storm events are 50%, 75% and 80%, respectively, of the preconstruction peak runoff rates. The percentages apply only to the post-construction stormwater runoff that is attributable to the portion of the site on which the proposed development or project is to be constructed. The percentages shall not be applied to post-construction stormwater runoff into tidal flood hazard areas if the increased volume of stormwater runoff will not increase flood damages below the point of discharge; or

(4) In tidal flood hazard areas, stormwater runoff quantity analysis in accordance with paragraphs (1), (2) and (3) above shall only be applied if the increased volume of stormwater runoff could increase flood damages below the point of discharge.

2. Any application for a new agricultural development that meets the definition of major development at subsection 20-1.2 shall be submitted to the appropriate Soil Conservation District for review and approval in accordance with the requirements of this section and any applicable Soil Conservation District guidelines for stormwater runoff quantity and erosion control. For the purposes of this section, "agricultural development" means land uses normally associated with the production of food, fiber and livestock for sale. Such uses do not include the development of land for the processing or sale of food and the manufacturing of agriculturally related products.

g. Stormwater Runoff Quality Standards.

1. Stormwater management measures shall be designed to reduce the post-construction load of total suspended solids (TSS) in stormwater runoff by 80% of the anticipated load from the developed site, expressed as an annual average. Stormwater management measures shall only be required for water quality control if an additional 1/4 acre of impervious surface is being proposed on a development site. The requirement to reduce TSS does not apply to any stormwater runoff in a discharge regulated under a numeric effluent limitation for TSS imposed under the New Jersey Pollution Discharge Elimination System (NJPDES) rules, N.J.A.C. 7:14A, or in a discharge specifically exempt under a NJPDES permit from this requirement. The water quality design storm is 1.25 inches of rainfall in two hours. Water quality

calculations shall take into account the distribution of rain from the water quality design storm, as reflected in Table 1. The calculation of the volume of runoff may take into account the implementation of nonstructural and structural stormwater management measures.

Table 1

Water Quality Design Storm Distribution

Time (minutes)	Cumulative Rainfall (inches)	Time (minutes)	Cumulative Rainfall (inches)
0	0.0000	65	0.8917
5	0.0083	70	0.9917
10	0.0166	75	1.0500
15	0.0250	80	1.0840
20	0.0500	85	1.1170
25	0.0750	90	1.1500
30	0.1000	95	1.1750
35	0.1330	100	1.2000
40	0.1660	105	1.2250
45	0.2000	110	1.2334
50	0.2583	115	1.2417
55	0.3583	120	1.2500
60	0.6250		

2. For purposes of TSS reduction calculations, Table 2 below presents the presumed removal rates for certain BMPs designed in accordance with the New Jersey Stormwater Best Management Practices Manual. The BMP Manual may be obtained from the address identified in subsection 20-1.7, or found on the Department's website at www.njstormwater.org. The BMP Manual and other sources of technical guidance are listed in subsection 20-1.7. TSS reduction shall be calculated based on the removal rates for the BMPs in Table 2 below. Alternative removal rates and methods of calculating removal rates may be used if the design engineer provides documentation demonstrating the capability of these alternative rates and methods to the review agency. A copy of any approved alternative rate or method of calculating the removal rate shall be provided to the Department at the following address: Division of Watershed Management, New Jersey Department of Environmental Protection, PO Box 418 Trenton, New Jersey, 08625-0418.

3. If more than one BMP in series is necessary to achieve the required 80% TSS reduction for a site, the applicant shall utilize the following formula to calculate TSS reduction:

   R = A + B - (AXB)/100

   Where:

   R = Total TSS percent load removal from application of both BMPs, and

   A = The TSS percent removal rate applicable to the first BMP, and

   B = The TSS percent removal rate applicable to the second BMP

Table 2

TSS Removal Rates for BMPs

Best Management Practice	TSS Percent Removal Rate
Bioretention Systems	90
Constructed Stormwater Wetland	90
Extended Detention Basin	40-60
Infiltration Structure	80
Manufactured Treatment Device	See Section 6C
Sand Filter	80
Vegetative Filter Strip	60-80
Wet Pond	50-90

4. If there is more than one on-site drainage area, the 80% TSS removal rate shall apply to each drainage area, unless the runoff from the subareas converge on site in which case the removal rate can be demonstrated through a calculation using a weighted average.

5. Stormwater management measures shall also be designed to reduce, to the maximum extent feasible, the post-construction nutrient load of the anticipated load from the developed site in stormwater runoff generated from the water quality design storm.

   In achieving reduction of nutrients to the maximum extent feasible, the design of the site shall include nonstructural strategies and structural measures that optimize nutrient removal while still achieving the performance standards in subsection 20-1.4f and g.

6. Additional information and examples are contained in the New Jersey Stormwater Best Management Practices Manual, which may be obtained from the address identified in subsection 20-1.7.

7. In accordance with the definition of FW1 at N.J.A.C. 7:9B-1.4, stormwater management measures shall be designed to prevent any increase in stormwater runoff to waters classified as FW1.

8. Special water resource protection areas shall be established along all waters designated Category One at N.J.A.C. 7:9B, and perennial or intermittent streams that drain into or upstream of the Category One waters as shown on the USGS Quadrangle Maps or in the County Soil Surveys, within the associated HUC14 drainage area. These areas shall be established for the protection of water quality, aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, and exceptional fisheries significance of those established Category One waters. These areas shall be designated and protected as follows:

   (a) The applicant shall preserve and maintain a special water resource protection area in accordance with one of the following:

      (1) A 300-foot special water resource protection area shall be provided on each side of the waterway, measured perpendicular to the waterway from the top of the bank outwards or from the centerline of the waterway where the bank is not defined, consisting of existing vegetation or vegetation allowed to follow natural succession is provided.

      (2) Encroachment within the designated special water resource protection area under paragraph (1) above shall only be allowed where previous development or disturbance has occurred (for example, active agricultural use, parking area or maintained lawn area). The encroachment shall only be allowed where applicant demonstrates that the functional value and overall condition of the special water resource protection area will be maintained to the maximum extent practicable. In no case shall the remaining special water resource protection area be reduced to less than 150 feet as measured perpendicular to the top of bank of the waterway or centerline of the waterway where the bank is undefined. All encroachments proposed under this paragraph shall be subject to review and approval by the Department.

   (b) All stormwater shall be discharged outside of and flow through the special water resource protection area and shall comply with the Standard for Off-Site Stability in the "Standards for

Soil Erosion and Sediment Control in New Jersey," established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq.

(c) If stormwater discharged outside of and flowing through the special water resource protection area cannot comply with the Standard For Off-Site Stability in the "Standards for Soil Erosion and Sediment Control in New Jersey," established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq., then the stabilization measures in accordance with the requirements of the above standards may be placed within the special water resource protection area, provided that:

(1) Stabilization measures shall not be placed within 150 feet of the Category One waterway;

(2) Stormwater associated with discharges allowed by this section shall achieve a 95% TSS post-construction removal rate;

(3) Temperature shall be addressed to ensure no impact on the receiving waterway;

(4) The encroachment shall only be allowed where the applicant demonstrates that the functional value and overall condition of the special water resource protection area will be maintained to the maximum extent practicable;

(5) A conceptual project design meeting shall be held with the appropriate Department staff and Soil Conservation District staff to identify necessary stabilization measures; and

(6) All encroachments proposed under this section shall be subject to review and approval by the Department.

(d) A stream corridor protection plan may be developed by a regional stormwater management planning committee as an element of a regional stormwater management plan, or by a municipality through an adopted municipal stormwater management plan. If a stream corridor protection plan for a waterway subject to subsection 20-1.4g8 has been approved by the Department of Environmental Protection, then the provisions of the plan shall be the applicable special water resource protection area requirements for that waterway. A stream corridor protection plan for a waterway subject to paragraph g8 shall maintain or enhance the current functional value and overall condition of the special water resource protection area as defined in paragraph g8(a)(1) above. In no case shall a stream corridor protection plan allow the reduction of the Special Water Resource Protection Area to less than 150 feet as measured perpendicular to the waterway subject to this subsection.

(e) Paragraph g8 does not apply to the construction of one individual single family dwelling that is not part of a larger development on a lot receiving preliminary or final subdivision approval on or before February 2, 2004, provided that the construction begins on or before February 2, 2009.

§ 20-1.5. Calculation of Stormwater Runoff and Groundwater Recharge. [Ord. #06-Code-525, § 5]

a. Stormwater runoff shall be calculated in accordance with the following:

1. The design engineer shall calculate runoff using one of the following methods:

(a) The USDA Natural Resources Conservation Service (NRCS) methodology, including the NRCS Runoff Equation and Dimensionless Unit Hydrograph, as described in the NRCS National Engineering Handbook Section 4 - Hydrology and Technical Release 55 - Urban Hydrology for Small Watersheds; or

(b) The Rational Method for peak flow and the Modified Rational Method for hydrograph computations.

2. For the purpose of calculating runoff coefficients and groundwater recharge, there is a presumption that the preconstruction condition of a site or portion thereof is a wooded land use with good hydrologic condition. The term "runoff coefficient" applies to both the NRCS methodology at subsection 20-1.5a1(a) and the Rational and Modified Rational Methods at subsection 20-1.5a1(b). A runoff coefficient or a groundwater recharge land cover for an existing condition may be used on all or a portion of the site if the design engineer verifies that the hydrologic condition has existed on the site or portion of the site for at least five years without interruption prior to the time of application. If more than one land cover have existed on the site during the five years immediately prior to the time of application, the land cover with the lowest runoff potential shall be used for the computations. In addition, there is the presumption that the site is in good hydrologic condition (if the land use type is pasture, lawn, or park), with good cover (if the land use type is woods), or with good hydrologic condition and conservation treatment (if the land use type is cultivation).

3. In computing preconstruction stormwater runoff, the design engineer shall account for all significant land features and structures, such as ponds, wetlands, depressions, hedgerows, or

culverts that may reduce preconstruction stormwater runoff rates and volumes.

4. In computing stormwater runoff from all design storms, the design engineer shall consider the relative stormwater runoff rates and/or volumes of pervious and impervious surfaces separately to accurately compute the rates and volume of stormwater runoff from the site. To calculate runoff from, unconnected impervious cover, urban impervious area modifications as described in the NRCS Technical Release 55 - Urban Hydrology for Small Watersheds and other methods may be employed.

5. If the invert of the outlet structure of a stormwater management measure is below the flood hazard design flood elevation as defined at N.J.A.C. 7:13, the design engineer shall take into account the effects of tailwater in the design of structural stormwater management measures.

b. Groundwater recharge may be calculated in accordance with the following:

1. The New Jersey Geological Survey Report GSR-32 A Method for Evaluating Ground-Water Recharge Areas in New Jersey, incorporated herein by reference as amended and supplemented. Information regarding the methodology is available from the New Jersey Stormwater Best Management Practices Manual; at http://www.state.nj.us/dep/njgs/; or at New Jersey Geological Survey, 29 Arctic Parkway, P.O. Box 427 Trenton, New Jersey 08625-0427; (609) 984-6587.

§ 20-1.6. A Standards for Structural Stormwater Management Measures. [Ord. #06-Code-525, § 6A]

a. Standards for structural stormwater management measures are as follows:

1. Structural stormwater management measures shall be designed to take into account the existing site conditions, including, for example, environmentally critical areas, wetlands; flood-prone areas; slopes; depth to seasonal high water table; soil type, permeability and texture; drainage area and drainage patterns; and the presence of solution-prone carbonate rocks (limestone).

2. Structural stormwater management measures shall be designed to minimize maintenance, facilitate maintenance and repairs, and ensure proper functioning. Trash racks shall be installed at the intake to the outlet structure as appropriate, and shall have parallel bars with one inch spacing between the bars to the elevation of the water quality design storm. For elevations higher than the water quality design storm, the parallel bars at the outlet structure shall be spaced no greater than 1/3 the width of the diameter of the

orifice or 1/3 the width of the weir, with a minimum spacing between bars of one inch and a maximum spacing between bars of six inches. In addition, the design of trash racks must comply with the requirements of subsection 20-1.8d.

3. Structural stormwater management measures shall be designed, constructed, and installed to be strong, durable, and corrosion resistant. Measures that are consistent with the relevant portions of the Residential Site Improvement Standards at N.J.A.C. 5:21-7.3, 7.4, and 7.5 shall be deemed to meet this requirement.

4. At the intake to the outlet from the stormwater management basin, the orifice size shall be a minimum of 2 1/2 inches in diameter.

5. Stormwater management basins shall be designed to meet the minimum safety standards for stormwater management basins at subsection 20-1.8.

b. Stormwater management measure guidelines are available in the New Jersey Stormwater Best Management Practices Manual. Other stormwater management measures may be utilized provided the design engineer demonstrates that the proposed measure and its design will accomplish the required water quantity, groundwater recharge and water quality design and performance standards established by subsection 20-1.4 of this section.

c. Manufactured treatment devices may be used to meet the requirements of subsection 20-1.4 of this section, provided the pollutant removal rates are verified by the New Jersey Corporation for Advanced Technology and certified by the Department.

§ 20-1.6B. Nonstructural Stormwater Strategies. [Ord. #06-Code-525, § 6B]

a. Buffers. Buffer areas are required along all lot and street lines separating residential uses from arterial and collector streets, separating a nonresidential use from either a residential use or residential zoning district line, and along all street lines where loading and storage areas can be seen from the street. The buffer area shall use native vegetation, which requires less fertilization and watering than non-native species. Buffer areas may be used for stormwater management by disconnecting impervious surfaces and treating runoff from these impervious surfaces. Preservation of natural wood tracts and limiting land disturbance for new construction must be incorporated where practical.

b. Curbs and Gutters. Curb cuts or flush curbs with curb stops are encouraged where practical to allow vegetated swales to be used for stormwater conveyance and to allow the disconnection of impervious areas where practical.

c. Drainage Systems. An existing ordinance may require that all streets be provided with inlets and pipes where the same are necessary for proper drainage. The use of natural vegetated swales in lieu of inlets and pipes are encouraged where practical.

d. Driveways and Access Ways. The use of pervious paving materials to minimize stormwater runoff and promote groundwater recharge should be considered for driveways and access ways where practical. Consideration should be given for subsurface soil conditions. The use of crowned driveways is also encouraged to promote disconnectivity between impervious surfaces and grass areas to promote groundwater recharge.

e. Natural Features. Natural features, such as trees, brooks, swamps, hilltops, and views, are to be preserved whenever possible, and that care be taken to preserve selected trees to enhance soil stability and landscaped treatment of the area. In addition, forested areas shall be maintained to ensure that leaf litter and other beneficial aspects of the forest are maintained in addition to the trees.

f. Nonconforming Uses, Structures or Lots. The existing ordinance may allow an applicant/owner of an existing use to propose additions or alterations that exceed the permitted building and/or lot coverage percentages. The applicant should mitigate the impact of the additional impervious surfaces unless the stormwater management plan for the development provided for these increases in impervious surfaces. This mitigation effort must address water quality, flooding and groundwater recharge.

g. Off-Site and Off-Tract Improvements. Any off-site and off-tract stormwater management and drainage improvements must conform to the "Design and Performance Standards" described.

h. Off-Street Parking and Loading. Parking lots with more than 10 spaces and all loading areas should allow for flush curb with curb stop, or curbing with curb cuts to encourage developers to allow for the discharge of impervious areas into landscaped areas for stormwater management. The use of natural vegetated swales for the water quality design storm, with overflow for larger storm events into storm sewers should be utilized where practical. A developer may demonstrate that fewer spaces would be required, provided area is set aside for additional spaces if necessary. Pervious paving may be provided in overflow parking areas.

i. Performance Standards. Pollution source control must be evaluated in order to prohibit materials or wastes from being deposited upon a lot in such form or manner that they can be transferred off the lot, directly or indirectly, by natural forces such as precipitation, evaporation or wind. Materials and wastes that might create a pollutant or a hazard shall be enclosed in appropriate containers.

j. Shade Trees. The existing ordinance may require a minimum of shade trees per lot to be planted in the front yard. In addition to this section, the Borough may have a Tree Preservation Ordinance that restricts and otherwise controls the removal of mature trees throughout the Borough. This section should recognize that the preservation of mature trees and forested areas must be considered in the management of environmental resources, particularly watershed management, air quality, and ambient heating and cooling. A "critical disturbance area" that extends beyond the driveway and building footprint where clearing of trees cannot occur shall be depicted on the plan minimizing land disturbance. Identification of forested areas and the percentage of wooded areas be protected from disturbance shall also be provided.

k. Sidewalks. Sidewalks should be designed to discharge stormwater to neighboring lawns where feasible to disconnect these impervious surfaces or use permeable paving materials where appropriate.

l. Soil Erosion and Sediment Control. The applicant shall comply with the New Jersey Soil Erosion and Sediment Control Standards and should incorporate signs to retain and protect natural vegetation; minimize and retain water runoff to facilitate groundwater recharge; and install diversions, sediment basins, and similar required structures prior to any on-site grading or disturbance.

Further guidance on the implementation of these strategies can be found in the NJDEP Stormwater Best Management Practices Manual, April 2004, as amended.

§ 20-1.7. Sources for Technical Guidance. [Ord. #06-Code-525, § 7]

a. Technical guidance for stormwater management measures can be found in the documents listed at paragraphs 1 and 2 below, which are available from Maps and Publications, New Jersey Department of Environmental Protection, 428 East State Street, P.O. Box 420, Trenton, New Jersey, 08625; telephone (609) 777-1038.

   1. Guidelines for stormwater management measures are contained in the New Jersey Stormwater Best Management Practices Manual, as amended. Information is provided on stormwater management measures such as: bioretention systems, constructed stormwater wetlands, dry wells, extended detention basins, infiltration structures, manufactured treatment devices, pervious paving, sand filters, vegetative filter strips, and wet ponds.

   2. The New Jersey Department of Environmental Protection Stormwater Management Facilities Maintenance Manual, as amended.

b. Additional technical guidance for stormwater management measures can be obtained from the following:

1. The "Standards for Soil Erosion and Sediment Control in New Jersey" promulgated by the State Soil Conservation Committee and incorporated into N.J.A.C. 2:90. Copies of these standards may be obtained by contacting the State Soil Conservation Committee or any of the Soil Conservation Districts listed in N.J.A.C. 2:90-1.3(a)4. The location, address, and telephone number of each Soil Conservation District may be obtained from the State Soil Conservation Committee, P.O. Box 330, Trenton, New Jersey 08625; (609) 292-5540;

2. The Rutgers Cooperative Extension Service, 732-932-9306; and

3. The Soil Conservation Districts listed in N.J.A.C. 2:90-1.3(a)4. The location, address, and telephone number of each Soil Conservation District may be obtained from the State Soil Conservation Committee, P.O. Box 330, Trenton, New Jersey, 08625, (609) 292-5540.

§ 20-1.8. Safety Standards for Stormwater Management Basins. [Ord. #06-Code-525, § 8]

a. This subsection sets forth requirements to protect public safety through the proper design and operation of stormwater management basins. This subsection applies to any new stormwater management basin.

The provisions of this subsection do not preempt more stringent municipal or County safety requirements for new or existing stormwater management basins. Municipal and County stormwater management plans and ordinances may, pursuant to their authority, require existing stormwater management basins to be retrofitted to meet one or more of the safety standards in subsection 20-1.8b1, 2 and 3 for trash racks, overflow grates, and escape provisions at outlet structures.

b. Requirements for Trash Racks, Overflow Grates and Escape Provisions.

1. A trash rack is a device designed to catch trash and debris and prevent the clogging of outlet structures. Trash racks shall be installed at the intake to the outlet from the stormwater management basin to ensure proper functioning of the basin outlets in accordance with the following:

(a) The trash rack shall have parallel bars, with no greater than six inch spacing between the bars.

(b) The trash rack shall be designed so as not to adversely affect the hydraulic performance of the outlet pipe or structure.

(c) The average velocity of flow through a clean trash rack is not to exceed 2.5 feet per second under the full range of stage and discharge. Velocity is to be computed on the basis of the net area of opening through the rack.

(d) The trash rack shall be constructed and installed to be rigid, durable, and corrosion resistant, and shall be designed to withstand a perpendicular live loading of 300 lbs./ft. sq.

2. An overflow grate is designed to prevent obstruction of the overflow structure. If an outlet structure has an overflow grate, such grate shall meet the following requirements:

(a) The overflow grate shall be secured to the outlet structure but removable for emergencies and maintenance.

(b) The overflow grate spacing shall be no less than two inches across the smallest dimension.

(c) The overflow grate shall be constructed and installed to be rigid, durable, and corrosion resistant, and shall be designed to withstand a perpendicular live loading of 300 lbs./ft. sq.

3. For purposes of this paragraph 3, escape provisions means the permanent installation of ladders, steps, rungs, or other features that provide easily accessible means of egress from stormwater management basins. Stormwater management basins shall include escape provisions as follows:

(a) If a stormwater management basin has an outlet structure, escape provisions shall be incorporated in or on the structure. With the prior approval of the reviewing agency identified in subsection 20-1.8c, a freestanding outlet structure may be exempted from this requirement.

(b) Safety ledges shall be constructed on the slopes of all new stormwater management basins having a permanent pool of water deeper than 2 1/2 feet. Such safety ledges shall be comprised of two steps. Each step shall be four feet to six feet in width. One step shall be located approximately 2 1/2 feet below the permanent water surface, and the second step shall be located one feet to 1 1/2 feet above the permanent water surface. See subsection 20-1.8d. for an illustration of safety ledges in a stormwater management basin.

(c) In new stormwater management basins, the maximum interior slope for an earthen dam, embankment, or berm shall not be steeper than three horizontal to one vertical.

c. Variance or Exemption from Safety Standards.

1. A variance or exemption from the safety standards for stormwater management basins may be granted only upon a written finding by the appropriate reviewing agency (municipality, County or Department) that the variance or exemption will not constitute a threat to public safety.

d. Illustration of Safety Ledges in a New Stormwater Management Basin.

§ 20-1.9. Requirements for a Site Development Stormwater Plan. [Ord. #06-Code-525, § 9]

a. Submission of Site Development Stormwater Plan.

1. Whenever an applicant seeks municipal approval of a development subject to this section, the applicant shall submit all of the required components of the Checklist for the Site Development Stormwater Plan at subsection 20-1.9c below as part of the submission of the applicant's application for subdivision or site plan approval.

2. The applicant shall demonstrate that the project meets the standards set forth in this section.

3. The applicant shall submit four copies of the materials listed in the checklist for site development stormwater plans in accordance with subsection 20-1.9c of this section.

b. Site Development Stormwater Plan Approval. The applicant's site development project shall be reviewed as a part of the subdivision or site plan review process by the municipal board or official from which municipal approval is sought. That municipal board or official shall consult the engineer retained by the Planning and/or Zoning Board (as appropriate) to determine if all of the checklist requirements have been satisfied and to determine if the project meets the standards set forth in this section.

c. Checklist Requirements. The following information shall be required:

1. Topographic Base Map. The reviewing engineer may require upstream tributary drainage system information as necessary. It is recommended that the topographic base map of the site be submitted which extends a minimum of 200 feet beyond the limits of the proposed development, at a scale of one inch equals 200 feet or greater, showing two-foot contour intervals. The map as appropriate may indicate the following: existing surface water drainage, shorelines, steep slopes, soils, erodible soils, perennial or intermittent streams that drain into or upstream of the Category One waters, wetlands and flood plains along with their appropriate buffer strips, marshlands and other wetlands, pervious or vegetative surfaces, existing man-made structures, roads, bearing and distances of property lines, and significant natural and man-made features not otherwise shown.

2. Environmental Site Analysis. A written and graphic description of the natural and man-made features of the site and its environs. This description should include a discussion of soil conditions, slopes, wetlands, waterways and vegetation on the site. Particular attention should be given to unique, unusual, or environmentally sensitive features and to those that provide particular opportunities or constraints for development.

3. Project Description and Site Plan(s). A map (or maps) at the scale of the topographical base map indicating the location of existing and proposed buildings, roads, parking areas, utilities, structural facilities for stormwater management and sediment control, and other permanent structures. The map(s) shall also clearly show areas where alterations occur in the natural terrain and cover, including lawns and other landscaping, and seasonal high ground water elevations. A written description of the site plan and justification of proposed changes in natural conditions may also be provided.

4. Land Use Planning and Source Control Plan. This plan shall provide a demonstration of how the goals and standards of subsections 20-1.3 through 20-1.6 are being met. The focus of this plan shall be to describe how the site is being developed to meet the objective of controlling groundwater recharge, stormwater quality and stormwater quantity problems at the source by land management and source controls whenever possible.

5. Stormwater Management Facilities Map. The following information, illustrated on a map of the same scale as the topographic base map, shall be included:

   (a) Total area to be paved or built upon, proposed surface contours, land area to be occupied by the stormwater management facilities and the type of vegetation thereon, and details of the proposed plan to control and dispose of stormwater.

   (b) Details of all stormwater management facility designs, during and after construction, including discharge provisions, discharge capacity for each outlet at different levels of detention and emergency spillway provisions with maximum discharge capacity of each spillway.

6. Calculations.

   (a) Comprehensive hydrologic and hydraulic design calculations for the predevelopment and post-development conditions for the design storms specified in subsection 20-1.4 of this section.

   (b) When the proposed stormwater management control measures (e.g., infiltration basins) depends on the hydrologic properties of soils, then a soils report shall be submitted. The soils report shall be based on onsite boring logs or soil pit profiles. The number and location of required soil borings or soil pits shall be determined based on what is needed to determine the suitability and distribution of soils present at the location of the control measure.

7. Maintenance and Repair Plan. The design and planning of the stormwater management facility shall meet the maintenance requirements of subsection 20-1.10.

8. Waiver from Submission Requirements. The municipal official or board reviewing an application under this section may, in consultation with the municipal engineer, waive submission of any of the requirements in subsections 20-1.9c1 through 20-1.9c6 of this section when it can be demonstrated that the information requested is impossible to obtain or it would create a hardship on the applicant to obtain and its absence will not materially affect the review process.

§ 20-1.10. Maintenance and Repair. [Ord. #06-Code-525, § 10]

a. Applicability.

1. Projects subject to review as in subsection 20-1.1c of this section shall comply with the requirements of subsection 20-1.10b and c.

b. General Maintenance.

1. The design engineer shall prepare a maintenance plan for the stormwater management measures incorporated into the design of a major development.

2. The maintenance plan shall include the following:

(a) Contain specific preventative maintenance tasks and schedules; and the name, address, and telephone number of the person or persons responsible for preventative and corrective maintenance (including replacement).

(b) Maintenance guidelines for stormwater management measures are available in the New Jersey Stormwater Best Management Practices Manual. If the maintenance plan identifies a person other than the developer (for example, a public agency or homeowners' association) as having the responsibility for maintenance, the plan shall include documentation of such person's agreement to assume this responsibility, or of the developer's obligation to dedicate a stormwater management facility to such person under an applicable ordinance or regulation.

3. Responsibility for maintenance shall not be assigned or transferred to the owner or tenant of an individual property in a residential

development or project, unless such owner or tenant owns or leases the entire residential development or project.

4. If the person responsible for maintenance identified under subsection 20-1.10b2 above is not a public agency, the maintenance plan and any future revisions based on subsection 20-1.10b7 below shall be recorded upon the deed of record for each property on which the maintenance described in the maintenance plan must be undertaken.

5. Preventative and corrective maintenance shall be performed to maintain the function of the stormwater management measure, including repairs or replacement to the structure; removal of sediment, debris, or trash; restoration of eroded areas; snow and ice removal; fence repair or replacement; restoration of vegetation; and repair or replacement of nonvegetated linings.

6. The person responsible for maintenance identified under subsection 20-1.10b2 above shall maintain a detailed log of all preventative and corrective maintenance for the structural stormwater management measures incorporated into the design of the development, including a record of all inspections and copies of all maintenance-related work orders.

7. The person responsible for maintenance identified under subsection 20-1.10b2 above shall evaluate the effectiveness of the maintenance plan at least once per year. Any adjustments to the management plan or deed shall require notification and approval from the applicable board prior to the filing of a revised deed.

8. The person responsible for maintenance identified under subsection 20-1.10b2 above shall retain and make available, upon request by any public entity with administrative, health, environmental, or safety authority over the site, the maintenance plan and the documentation required by subsection 20-1.10b6 and 7 above.

9. The requirements of subsections 20-1.10b3 and 4 do not apply to stormwater management facilities that are dedicated to and accepted by the municipality or another governmental agency.

10. In the event that the stormwater management facility becomes a danger to public safety or public health, or if it is in need, of maintenance or repair, the municipality shall so notify the responsible person in writing. Upon receipt of that notice, the responsible person shall have 14 days to effect maintenance and repair of the facility in a manner that is approved by the Municipal Engineer or his designee. The municipality, in its discretion, may extend the time allowed for effecting maintenance and repair for good cause. If the responsible person fails or refuses to perform such maintenance and repair, the municipality or County may

immediately proceed to do so and shall bill the cost thereof to the responsible person.

c. Nothing in this section shall preclude the municipality in which the major development is located from requiring the posting of a performance or maintenance guarantee in accordance with N.J.S.A. 40:55D-53.

§ 20-1.11. Penalties. [Ord. #06-Code-525, § 11]

Any person who erects, constructs, alters, repairs, converts, maintains, or uses any building, structure or land in violation of this section shall be subject to the following penalties: A fine not to exceed $500 per day for the first offense and a fine not to exceed $1,000 per day with the possibility of imprisonment for the second and subsequent offenses.

§ 20-1.12. Effective Date. [Ord. #06-Code-525, § 12]

This section shall take effect immediately upon the approval by the County review agency, or 60 days from the receipt of the ordinance by the County review agency if the County review agency should fail to act.

§ 20-2. IMPROPER DISPOSAL OF WASTE.

§ 20-2.1. Purpose. [Ord. No. 05-Code-499 § 1; Ord. #16-Code-730]

The purpose of this section is to prohibit the dumping, depositing, or other placement of any trash, landscape debris, or other material in any stream, channel, ditch, pond, or basin that regularly or periodically carries or stores stormwater so as to protect health, safety and welfare and to prescribe penalties for the failure to comply. This section is also adopted to prohibit the spilling, dumping or disposal of materials other than stormwater to the municipal separate storm sewer system (MS4) operating by the Borough of Oakland.

§ 20-2.2. Definitions. [Ord. #05-Code-499, § II]

For the purpose of this section, the following terms, phrases, words and their derivations shall have the meanings stated herein unless their use in the text of this section clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "shall" is always mandatory and not merely directory.

MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4) — Shall mean a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutter, ditches, man-made channels, or storm drains) that is owned or operated by the Borough of Oakland or other public body, and is designed and used for collecting and conveying stormwater.

PERSON — Shall mean any individual, corporation, company, partnership, firm, association, or political subdivision of this State subject to municipal jurisdiction.

STORMWATER — Shall mean water resulting from precipitation (including rain and snow) that runs off the land's surface, is transmitted to the subsurface, is captured by separate storm sewers or other sewerage or drainage facilities, or is conveyed by snow removal equipment.

§ 20-2.3. Prohibited Conduct. [Ord. No. 05-Code-499 § 3; Ord. #16-Code-730]

The dumping, depositing or other placement of any trash, landscape debris or other material in any stream channel, ditch, pond, or basin that regularly or periodically carries or stores stormwater in the Borough of Oakland is prohibited.

The spilling, dumping or disposal of materials other than stormwater in such a manner as to cause the discharge of pollutants to the municipal separate storm water sewer system is prohibited.

§ 20-2.3A. Outdoor Application of Fertilizer. [Ord. #09-Code-602, § I]

a. Purpose. The purpose of this section is to regulate the outdoor application of fertilizer so as to reduce the overall amount of excess nutrients entering waterways, thereby helping to protect and improve surface water quality. This section does not apply to fertilizer application on commercial farms.

b. Basis and Background. Elevated levels of nutrients, particularly phosphorus, in surface waterbodies can result in excessive and accelerated growth of algae and aquatic plants (eutrophication). Excessive plant growth can result in diurnal variations and extremes in dissolved oxygen and pH, which, in turn, can be detrimental to aquatic life. As algae and plant materials die off, the decay process creates a further demand on dissolved oxygen levels. The presence of excessive plant matter can also restrict use of the affected water for recreation and water supply.

   While healthy vegetated areas are protective of water quality by stabilizing soil and filtering precipitation, when fertilizers are applied to the land surface improperly or in excess of the needs of target vegetation, nutrients can be transported by means of stormwater to nearby waterways, contributing to the problematic growth of excessive aquatic vegetation. Most soils in New Jersey contain sufficient amounts of phosphorus to support adequate root growth for established turf. Over time, it is necessary to replenish available phosphorus, but generally not at the levels commonly applied. Other target vegetation, such as vegetable gardens and agricultural/horticultural plantings, will have a greater need for phosphorus application, as will the repair or establishment of new lawns or cover vegetation. A soils test and fertilizer application recommendation geared to the soil and planting type is the best means to determine the amount of nutrients to apply. Timing and placement of fertilizer application is also critical to avoid transport of nutrients to waterways through stormwater runoff. Fertilizer applied immediately prior to a runoff-producing rainfall, outside the growing season or to impervious surfaces, is not likely to be carried away by means of runoff without accomplishing the desired objective of supporting target vegetation growth. Therefore, the management of the type, amount and techniques for fertilizer application is necessary as one tool to protect water resources.

This section does not apply to application of fertilizer on commercial farms, but improper application of fertilizer on farms would be problematic as well. Stewardship on the part of commercial farmers is needed to address this potential source of excess nutrient load to waterbodies. Commercial farmers are expected to implement best management practices in accordance with conservation management plans or resource conservation plans developed for the farm by the Natural Resource Conservation Service and approved by the Soil Conservation District Board.

c. Definitions. For the purpose of this section, the following terms, phrases, words, and their derivations shall have the meanings stated herein unless their use in the text of this section clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "shall" is always mandatory and not merely directory.

BUFFER — Shall mean the land area, 25 feet in width, adjacent to any waterbody. (The Department believes that 25 feet is the appropriate buffer width to be protective of water quality. However, in situations that warrant additional flexibility, such as where lot sizes are exceptionally small or where the twenty-five-foot buffer constitutes the majority of the available property, the municipality may reduce the buffer to 10 feet in width, with the additional requirement that a drop spreader by used for fertilizer application).

COMMERCIAL FARM — Shall mean a farm management unit producing agricultural or horticultural products worth $2,500 or more annually.

FERTILIZER — Shall mean a fertilizer material, mixed fertilizer or any other substance containing one or more recognized plant nutrients, which is used for its plant nutrient content, which is designed for use or claimed to have value in promoting plant growth, and which is sold, offered for sale, or intended for sale.

IMPERVIOUS SURFACE — Shall mean a surface that has been covered with a layer of material so that it is highly resistant to infiltration by water. This term shall be used to include any highway, street, sidewalk, parking lot, driveway or other material that prevents infiltration of water into the soil.

PERSON — Shall mean any individual, corporation, company, partnership, firm, association, or political subdivision of this State subject to municipal jurisdiction.

PHOSPHORUS FERTILIZER — Shall mean any fertilizer that contains phosphorus, expressed as P205, with a guaranteed analysis of greater than zero; except that it shall not be considered to include animal (including human) vegetable manures, agricultural liming materials, or wood ashes that have not been amended to increase their nutrient content.

SOILS TEST — Shall mean a technical analysis of soil conducted by an accredited soil-testing laboratory following the protocol for such a test established by Rutgers Cooperative Research and Extension.

WATERBODY — Shall mean a surface water feature, such as a lake, river, stream, creek, pond, lagoon, bay or estuary.

d. Prohibited Conduct. No person may do any of the following:

1. Apply fertilizer when a runoff producing rainfall is occurring or predicted and/or when soils are saturated and a potential for fertilizer movement off-site exists.

2. Apply fertilizer to an impervious surface. Fertilizer inadvertently applied to an impervious surface must be swept or blown back into the target surface or returned to either its original or another appropriate container for reuse.

3. Apply fertilizer within the buffer of any waterbody.

4. Apply fertilizer more than 15 days prior to the start of or at any time after the end of the recognized growing season, March 1 to November 15.

e. Phosphorus Fertilizer Application. No person may do the following:

1. Apply phosphorus fertilizer in outdoor areas except as demonstrated to be added for the specific soils and target vegetation in accordance with a soils test and the associated annual fertilizer recommendation issued by Rutgers Cooperative Research Extension.

2. Exceptions.

(a) Application of phosphorus fertilizer needed for:

(1) Establishing vegetation for the first time, such as after land disturbance, provided the application is in accordance with the requirements established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq. and implementing rules.

(2) Reestablished or repairing a turf area.

(b) Application of phosphorus fertilizer that delivers liquid or granular fertilizer under the soil's surface, directly to the feeder roots.

(c) Application of phosphorus fertilizer to residential container plantings, flowerbeds, or vegetable gardens.

§ 20-2.4. Exceptions to Prohibition. [Ord. #05-Code-499, § IV]

a. Water line flushing and discharges from potable water sources.

b. Uncontaminated ground water (e.g., infiltration, crawl space or basement sump pumps, foundation or footing drains, rising ground waters).

c. Air conditioning condensate (excluding contact and non-contact cooling water).

d. Irrigation water (including landscape and lawn watering runoff).

e. Flows from springs, riparian habitats and wetlands, water reservoir discharges and diverted stream flows.

f. Residential car washing water, and residential swimming pool discharges.

g. Sidewalk, driveway and street wash water.

h. Flows from firefighting activities.

i. Flows from rinsing of the following equipment with clean water:

1. Beach maintenance equipment immediately following their use for their intended purposes; and

2. Equipment used in the application of salt and de-icing materials immediately following salt and de-icing material applications. Prior to rinsing with clean water, all residual salt and de-icing materials must be removed from equipment and vehicles to the maximum extent practicable using dry cleaning methods (e.g., shoveling and sweeping). Recovered materials are to be returned to storage for reuse or properly discarded.

   Rinsing of equipment, as noted in the above situation is limited to exterior, undercarriage, and exposed parts and does not apply to engines or other enclosed machinery.

§ 20-2.5. Enforcement. [Ord. #05-Code-499, § V]

This section shall be enforced by the Police Department and Board of Health of the Borough of Oakland.

§ 20-2.6. Penalties. [Ord. #05-Code-499, § VI]

Any person(s) who continues to be in violation of the provisions of this section, after being duly notified, shall be subject to a fine of $50 to $250. For oil and gas dumping, the fines are $200 to $1,000.

§ 20-3. ILLICIT CONNECTION.

§ 20-3.1. Purpose. [Ord. #05-Code-503, § I]

The purpose of this section is to prohibit illicit connections to the municipal separate storm sewer system(s) operated by the Borough of Oakland so as to protect public health, safety and welfare, and to prescribe penalties for the failure to comply.

§ 20-3.2. Definitions. [Ord. #05-Code-503, § II]

For the purpose of this section, the following terms, phrases, words and their derivations shall have the meanings stated herein unless their use in the text of this section clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "shall" is always mandatory and not merely directory. The definitions below are the same as or based on corresponding definitions in the New Jersey Pollutant Discharge Elimination System (NJPDES) rules at N.J.A.C. 7:14A-1.2.

DOMESTIC SEWAGE — Shall mean waste and wastewater from humans or household operations.

ILLICIT CONNECTION — Shall mean any physical or nonphysical connection that discharges domestic sewage, non-contact cooling water, process wastewater, or other industrial waste (other than stormwater) to the municipal separate storm sewer system operated by the Borough of Oakland, unless that discharge is authorized under a NJPDES permit other than the Tier A Municipal Stormwater General Permit (NJPDES Permit Number NJ0141852). Nonphysical connections may include, but are not limited to, leaks, flows or overflows into the municipal separate storm sewer system.

INDUSTRIAL WASTE — Shall mean nondomestic waste, including, but not limited to, those pollutants regulated under Section 307(a), (b), or (c) of the Federal Clean Water Act (33 U.S.C. § 1317 (a), (b), or (c)).

MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4) — Shall mean a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels or storm drains) that is owned or operated by the Borough of Oakland or other public body, and is designed and used for collecting and conveying stormwater.

NJPDES PERMIT — Shall mean a permit issued by the New Jersey Department of Environmental Protection to implement the New Jersey Pollutant Discharge Elimination System (NJPDES) rules at N.J.A.C. 7:14A.

NON-CONTACT COOLING WATER — Shall mean water used to reduce temperature for the purpose of cooling. Such waters do not come into direct contact with any raw material, intermediate product (other than heat) or finished product. Non-contact cooling water may however contain algaecides or biocides to control fouling of equipment such as heat exchangers, and/or corrosion inhibitors.

PERSON — Shall mean any individual, corporation, company, partnership, firm, association, or political subdivision of this State subject to municipal jurisdiction.

PROCESS WASTEWATER — Shall mean any water which, during manufacturing or processing, comes into direct contact with or results from the production or use of any raw material, intermediate product, finished product, by-product, or waste product. Process wastewater includes, but is not limited to, leachate and cooling water other than non-contact cooling water.

STORMWATER — Shall mean water resulting from precipitation (including rain and snow) that runs off the land's surface, is transmitted to the subsurface, is captured by separate storm sewers or other sewerage or drainage facilities, or is conveyed by snow removal equipment.

§ 20-3.3. Prohibited Conduct. [Ord. #05-Code-503, § III]

No person shall cause to be discharged through an illicit connection to the municipal separate storm sewer system operated by the Borough of Oakland any domestic sewage, non-contact cooling water, process wastewater, or other industrial waste (other than stormwater).

§ 20-3.4. Enforcement. [Ord. #05-Code-503, § IV]

The provisions of this section shall be enforced by the Police Department and Board of Health of the Borough of Oakland.

§ 20-3.5. Violations and Penalties. [Ord. #05-Code-503, § V]

Any person(s) who is found to be in violation of the provisions of this section shall be subject to a fine of $200 to $1,000.

§ 20-4. PRIVATE STORM DRAIN INLET RETROFITTING.

§ 20-4.1. Purpose. [Ord. #10-Code-628, § I]

The purpose of this section is to require the retrofitting of existing storm drain inlets which are in direct contact with repaving, repairing, reconstruction, or resurfacing or alterations of facilities on private property, to prevent the discharge of solids and floatables (such as plastic bottles, cans, food wrappers, and other litter) to the municipal separate storm sewer system(s) operated by the Borough of Oakland so as to protect public health, safety and welfare, and to prescribe penalties for the failure to comply.

§ 20-4.2. Definitions. [Ord. #10-Code-628, § II]

For the purpose of this section, the following terms, phrases, words and their derivations shall have the meanings stated herein unless their use in the text of this section clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "shall" is always mandatory and not merely directory.

MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4) — Shall mean a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) that is owned or operated by the Borough of Oakland or other public body, and is designed and used for collecting and conveying stormwater. Note: In municipalities with combined sewer systems, add the following: "MS4s do not include combined sewer systems, which are sewer systems that are designed to carry sanitary sewage at all times and to collect and transport stormwater from streets and other sources."

PERSON — Shall mean any individual, corporation, company, partnership, firm, association, or political subdivision of this State subject to municipal jurisdiction.

STORM DRAIN INLET — Shall mean an opening in a storm drain used to collect stormwater runoff and includes, but is not limited to a grate inlet, curb-opening inlet, slotted inlet, and combination inlet.

WATERS OF THE STATE — Shall mean the ocean and its estuaries, all springs, streams and bodies of surface or groundwater, whether natural or artificial, within the boundaries of the State of New Jersey or subject to its jurisdiction.

§ 20-4.3. Prohibited Conduct. [Ord. #10-Code-628, § III]

No person in control of private property (except a residential lot with one single-family house) shall authorize the repaving, repairing (excluding the repair of individual potholes), resurfacing (including top coating or chip sealing with asphalt emulsion or a thin base of hot bitumen), reconstructing or altering any surface that is in direct contact with an existing storm drain inlet on that property unless the storm drain inlet either:

a. Already meets the design standard below to control passage of solid and floatable materials; or

b. Is retrofitted or replaced to meet the standard in subsection 20-4.4 below prior to the completion of the project.

§ 20-4.4. Design Standard. [Ord. #10-Code-628, § IV]

Storm drain inlets identified in subsection 20-4.3 above shall comply with the following standard to control passage of solid and floatable materials through storm drain inlets. For purposes of this section, "solid and floatable materials" means sediment, debris, trash, and other floating, suspended, or settleable solids. For exemptions to this standard see subsection 20-4.4c.

a. Design engineers shall use either of the following grates whenever they use a grate in pavement or another ground surface to collect stormwater from that surface into a storm drain or surface water body under that grate:

   1. The New Jersey Department of Transportation (NJDOT) bicycle safe grate, which is described in Chapter 24 of the NJDOT Bicycle Compatible Roadways and Bikeways Planning and Design Guidelines (April 1996); or

   2. A different grate, if each individual clear space in that grate has an area of no more than 7.0 square inches, or is no greater than 0.5 inch across the smallest dimension.

   Examples of grates subject to this standard include grates in grate inlets, the grate portion (non-curb-opening portion) of combination inlets, grates on storm sewer manholes, ditch grates, trench grates, and grates of spacer bars in slotted drains. Examples of ground surfaces include surfaces of roads (including bridges), driveways, parking areas, bikeways, plazas, sidewalks, lawns, fields, open channels, and stormwater basin floors.

b. Whenever design engineers used a curb-opening inlet, the clear space in that curb opening (or each individual clear space, if the curb opening has two or more clear spaces) shall have an area of no more than 7.0 square inches, or be no greater than 2.0 inches across the smallest dimension.

c. This standard does not apply:

   1. Where the Municipal Engineer agrees that this standard would cause inadequate hydraulic performance that could not practicably be overcome by using additional or larger storm drain inlets that meet these standards;

   2. Where flows are conveyed through any device (e.g., end of pipe netting facility, manufactured treatment device, or a catch basin hood) that is designed, at a minimum, to prevent delivery of all solid and floatable materials that could not pass through one of the following:

      (a) A rectangular space 4 5/8 inches long and 1 1/2 inches wide (this option does not apply for outfall netting facilities); or

      (b) A bar screen having a bar opening of 0.5 inch.

3. Where flows are conveyed through a trash rack that has parallel bars with one inch spacing between the bars; or

4. Where the New Jersey Department of Environmental Protection determines, pursuant to the New Jersey Register of Historic Places rules at N.J.A.C. 7:4-7.2(c), that action to meet this standard is an undertaking that constitutes an encroachment or will damage or destroy the New Jersey Register listed historic property.

§ 20-4.5. Enforcement. [Ord. #10-Code-628, § V]

This section shall be enforced by the Police Department and/or Board of Health of the Borough of Oakland.

§ 20-4.6. Penalties. [Ord. #10-Code-628, § VI]

Any person(s) who is found to be in violation of the provisions of this section shall be subject to a fine of $100 to $1,000 for each storm drain inlet that is not retrofitted to meet the design standard.

§ 12-6.16. Dumpsters and Other Refuse Containers. [Ord. #10-Code-627, §§ I - VI]

a. Purpose. The purpose of this subsection is to require dumpsters and other refuse containers that are outdoors or exposed to stormwater to be covered at all times and prohibits the spilling, dumping, leaking, or otherwise discharge of liquids, semi-liquids or solids from the containers to the municipal separate storm sewer system(s) operated by the Borough of Oakland and/or the waters of the State so as to protect public health, safety and welfare, and to prescribe penalties for the failure to comply.

b. Definitions. For the purpose of this subsection, the following terms, phrases, words and their derivations shall have the meanings stated herein unless their use in the text of this subsection clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "shall" is always mandatory and not merely directory.

MUNICIPAL SEPARATE STORM SEWER SYSTEM (MS4) — Shall mean a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) that is owned or operated by the Borough of Oakland or other public body, and is designed and used for collecting and conveying stormwater. Note: In municipalities with combined sewer systems, add the following: "MS4s do not include combined sewer systems, which are sewer systems that are designed to carry sanitary sewage at all times and to collect and transport stormwater from streets and other sources."

PERSON — Shall mean any individual, corporation, company, partnership, firm, association, or political subdivision of this State subject to municipal jurisdiction.

REFUSE CONTAINER — Shall mean any waste container that a person controls whether owned, leased, or operated, including dumpsters, trash cans, garbage pails, and plastic trash bags.

STORMWATER — Shall mean water resulting from precipitation (including rain and snow) that runs off the land's surface, is transmitted to the subsurface, is captured by separate storm sewers or other sewerage or drainage facilities, or is conveyed by snow removal equipment.

WATERS OF THE STATE — Shall mean the ocean and its estuaries, all springs, streams and bodies of surface or groundwater, whether natural or artificial, within the boundaries of the State of New Jersey or subject to its jurisdiction.

c. Prohibited Conduct. Any person who controls, whether owned, leased, or operated, a refuse container or dumpster must ensure that such container or dumpster is covered at all times and shall prevent refuse from spilling out or overflowing.

Any person who owns, leases or otherwise uses a refuse container or dumpster must ensure that such container or dumpster does not leak or otherwise discharge liquids, semi-liquids or solids to the municipal separate storm sewer system(s) operated by the Borough of Oakland.

d. Exceptions to Prohibition.

1. Permitted temporary demolition containers.
2. Litter receptacles (other than dumpsters or other bulk containers).
3. Individual homeowner trash and recycling containers.
4. Refuse containers at facilities authorized to discharge stormwater under a valid NJPDES permit.
5. Large bulky items (e.g., furniture, bound carpet and padding, white goods placed curbside for pickup).

e. Enforcement. This subsection shall be enforced by the Police Department and Board of Health of the Borough of Oakland.

f. Penalties. Any person(s) who is found to be in violation of the provisions of this subsection shall be subject to a fine of $100 to $1,000.

BOROUGH OF OAKLAND
BERGEN COUNTY, NEW JERSEY

ORDINANCE NO. 05-CODE-503
ILLICIT CONNECTION ORDINANCE

SECTION I. Purpose:
An Ordinance to prohibit illicit connections to the municipal separate storm sewer system(s) operated by the Borough of Oakland so as to protect public health, safety and welfare, and to prescribe penalties for the failure to comply.

SECTION II. Definitions:
For the purpose of this ordinance, the following terms, phrases, words and their derivations shall have the meanings stated herein unless their use in the text of this Chapter clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "shall" is always mandatory and not merely directory. The definitions below are the same as or based on corresponding definitions in the New Jersey Pollutant Discharge Elimination System (NJPDES) rules at N.J.A.C. 7:14A-1.2.

a. Domestic sewage –waste and wastewater from humans or household operations.
b. Illicit connection- any physical or non-physical connection that discharges domestic sewage, non-contact cooling water, process wastewater, or other industrial waste (other than stormwater) to the municipal separate storm sewer system operated by the Borough of Oakland, unless that discharge is authorized under a NJPDES permit other than the Tier A Municipal Stormwater General Permit (NJPDES Permit Number NJ0141852). Non-physical connections may include, but are not limited to, leaks, flows or overflows into the municipal separate storm sewer system.
c. Industrial waste-non-domestic waste, including, but not limited to, those pollutants regulated under Section 307 (a), (b), or (c) of the Federal Clean Water Act (33 U.S.C. § 1317 (a), (b), or (c)).
d. Municipal separate storm sewer system (MS4)- a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, manmade channels or storm drains) that is owned or operated by the Borough of Oakland or other public body, and is designed and used for collecting and conveying stormwater.
e. NJPDES permit- a permit issued by the New Jersey Department of Environmental Protection to implement the New Jersey Pollutant Discharge Elimination System (NJPDES) rules at N.J.A.C. 7:14A

f. Non-contact cooling water- water used to reduce temperature for the purpose of cooling. Such waters do not come into direct contact with any raw material, intermediate product (other than heat) or finished product. Non-contact cooling water may however contain algaecides, or biocides to control fouling of equipment such as heat exchangers, and/or corrosion inhibitors.

g. Person- any individual, corporation, company, partnership, firm, association, or political subdivision of this State subject to municipal jurisdiction.

h. Process wastewater- any water which, during manufacturing or processing, comes into direct contact with or results from the production or use of any raw material, intermediate product, finished product, byproduct, or waste product. Process wastewater includes, but is not limited to, leachate and cooling water other than non-contact cooling water.

i. Stormwater- water resulting from precipitation (including rain and snow) that runs off the land's surface, is transmitted to the subsurface, is captured by separate storm sewers or other sewerage or drainage facilities, or is conveyed by snow removal equipment.

SECTION III. Prohibited Conduct:
No person shall cause to be discharged through an illicit connection to the municipal separate storm sewer system operated by the Borough of Oakland any domestic sewage, non-contact cooling water, process wastewater, or other industrial waste (other than stormwater).

SECTION IV. Enforcement:
The provisions of this ordinance shall be enforced by the of the Borough of Oakland.

SECTION V. Violations and Penalties:
Any person(s) who is found to be in violation of the provisions of this ordinance shall be subject to a fine of $ 200.00 to $ 1,000.00.

SECTION VI. Severability:
Each section, subsection, sentence, clause and phrase of this ordinance is declared to be an independent section, subsection, sentence, clause and phrase, and the finding or holding of any such portion of this Ordinance to be unconstitutional, void or ineffective for any cause, or reason, shall not affect any other portion of this Ordinance.

SECTION VII. Effective Date:
This ordinance shall be in full force and effect from and after its adoption and any publication as may be required by law.

ALL OF WHICH IS ADOPTED this 14th day of September, 2005, by the Borough of Oakland.

THIS IS TO CERTIFY THAT THIS
IS A TRUE COPY AS ADOPTED BY
THE MAYOR AND COUNCIL OF THE
BOROUGH OF OAKLAND AT A
MEETING HELD ON September 14, 2005
BOROUGH CLERK [signature]

SPPP Form 7 – Street Sweeping

All records must be available upon request by NJDEP.

1. Provide a written description or attach a map indicating which streets are swept as required by the NJPDES permit. Describe the sweeping schedule and indicate if any of the streets are swept by another entity through a shared service arrangement.
The Borough of Oakland has approximately 5.46 miles (28,849.9 LF) of required street sweeping within the municipality, as seen on the attached map. The Borough has evaluated these streets and has determined to maintain the existing schedule of sweeping all roads once a month.
2. Provide a written description or attach a map indicating which streets are swept that are NOT required to be swept by the NJPDES permit. Describe the sweeping schedule and indicate if any of the streets are swept by another entity through a shared service arrangement.
The Borough of Oakland intends on maintaining its existing street sweeping program for all municipal streets, which includes the sweeping of all streets a minimum of two (2) times a year. The total length of all additional street sweeping is 51.38 miles (271,306.9 LF).
3. Does the municipality provide street sweeping services for other municipalities? If so, please describe the arrangements.
The Borough of Oakland does not provide street sweeping services for other municipalities.
4. Indicate the location of records, including sweeping dates, areas swept, number of miles swept and total amount of wet tons collected each month. Note which records correspond to sweeping activities beyond what is required by the NJPDES permit, i.e., sweepings of streets within the municipality that are not required by permit to be swept or sweepings of streets outside of the municipality.
Records of all street sweeping are kept at the Oakland Department of Public Works located at: 63 Oak Street, Oakland, New Jersey 07436.

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Notes:
2015 NJDEP Orthoimagery

Required Roadways

Tier A Municipal Stormwater Permitting
Street Sweeping - Required
Borough of Oakland
Bergen County New Jersey

BOSWELL ENGINEERING
ENGINEERS - SURVEYORS - PLANNERS - SCIENTISTS
330 Phillips Avenue South Hackensack, NJ 07606
Tel: 201-641-0770 ● Fax: 201-641-1757

Scale
1 in = 1,600 ft

Job No. OK-1737

January 2021

Last Edit: 1/14/2021

Drawn By: JMW

Check By: FJR

Sheet 1 of 1

Street Sweeping -- Required Roads			
Date	Area Swept	Number of Miles Swept	Total Amount of Wet Tons/Month

Notes:
2015 NJDEP Orthoimagery

Additional Roads

County Road

Tier A Municipal Stormwater Permitting

Street Sweeping - Additional

Borough of Oakland

Bergen County
New Jersey

BOSWELL ENGINEERING
ENGINEERS - SURVEYORS - PLANNERS - SCIENTISTS
330 Phillips Avenue South Hackensack, NJ 07606
Tel: 201-641-0770 ●Fax: 201-641-1757
EST 1924

W N S E

Scale
1 in = 1,600 ft

Job No. OK-1737

January 2021

Last Edit: 1/14/2021

Drawn By: JMW

Check By: FJR

Sheet 1 of 1

Street Sweeping -- Additional Roads

Date	Area Swept	Number of Miles Swept	Total Amount of Wet Tons/Month

SPPP Form 8 – Catch Basins and Storm Drain Inlets

All records must be available upon request by NJDEP.

1. Describe the schedule for catch basin and storm drain inlet inspection, cleaning, and maintenance.
Visual inspections are performed once yearly. Grates are removed when necessary to remove accumulated material.
2. List the locations of catch basins and storm drain inlets with recurring problems, i.e., flooding, accumulated debris, etc.
No reoccurring problems have been reported or observed during routine inspection.
3. Describe what measures are taken to address issues for catch basins and storm drain inlets with recurring problems and how they are prioritized.
As previously stated, no reoccurring problems have been noted.
4. Describe the inspection schedule and maintenance plan for storm drain inlet labels on storm drains that do not have permanent wording cast into the design.
All inlets within the Borough are labeled and labels are replaced as necessary during inspections.
5. Indicate the location of records of catch basin and storm drain inlet inspections and the wet tons of materials collected during catch basin and storm drain inlet cleanings.
Records of all catch basin and storm drain inlet inspections and wet tons of material collected during catch basin and storm drain inlet cleaning are kept at the Oakland Department of Public Works located at: 63 Oak Street, Oakland, New Jersey 07436.

Inlet Cleaning Log

Catch Basin #	Inspector	Date	Inspected	Cleaned	Repaired	Labeled	Comments

SPPP Form 9 – Storm Drain Inlet Retrofitting

All records must be available upon request by NJDEP.

1. Describe the procedure for ensuring that municipally owned storm drain inlets are retrofitted.

Inlets are retrofitted as needed during paving projects.

2. Describe the inspection process to verify that appropriate retrofits are completed on municipally owned storm drain inlets.

Retrofitting inlets is included with paving projects. The municipal engineer inspectors ensure that the proper inlet head is installed.

3. Describe the procedure for ensuring that privately owned storm drain inlets are retrofitted.

All existing storm drain inlets which are in direct contact with repaving, repairing (excluding repair of individual potholes), reconstruction, resurfacing (including topcoating or chip sealing with asphalt emulsion or a thin base of hot bitumen), or alterations of facilities on property not owned or operated by the municipality (except individual single-family homes) will require construction permits from the Borough and shall be retrofitted to meet current NJDEP guidelines for the size of inlet casting and curb piece openings as required by the New Jersey Pollutant Discharge Elimination System permit (NJDES permit, rules at N.J.A.C. 7:14A). These projects shall be inspected to ensure that privately owned storm drain inlets are retrofitted. This shall be enforced by the Police Department, Superintendent of the Department of Public Works, and the Code Enforcement Officer of the Borough of Oakland.

4. Describe the inspection process to verify that appropriate retrofits are completed on privately owned storm drain inlets.

Inlets will be inspected by the building inspector to verify that they are in compliance with the "Design Standards for Storm Drain Inlets" set forth in the "Tier A Municipal Stormwater General Permit -- Attachement C".

SPPP Form 10 – Municipal Maintenance Yards and Other Ancillary Operations

All records must be available upon request by NJDEP.

Complete separate forms for each municipal yard or ancillary operation location.
Address of municipal yard or ancillary operation: Oakland Department of Public Works located at: 63 Oak Street, Oakland, New Jersey 07436.
List all materials and machinery located at this location that are exposed to stormwater which could be a source of pollutant in a stormwater discharge: Raw materials – Intermediate products – Final products – Waste materials – By-products – Machinery – Refer to Table 10-1 Fuel – Lubricants – Solvents – Detergents related to municipal maintenance yard or ancillary operations – Other –

SPPP Form 10 – Municipal Maintenance Yards and Other Ancillary Operations

All records must be available upon request by NJDEP.

Complete separate forms for each municipal yard or ancillary operation location.
Address of municipal yard or ancillary operation: Oakland Well Pump Station located at: 56 Spruce Street, Oakland, New Jersey 07436.
List all materials and machinery located at this location that are exposed to stormwater which could be a source of pollutant in a stormwater discharge: Raw materials – Intermediate products – Final products – Waste materials – By-products – Machinery – Five (5) Salt Spreaders Fuel – Lubricants – Solvents – Detergents related to municipal maintenance yard or ancillary operations – Other –

SPPP Form 10 – Municipal Maintenance Yards and Other Ancillary Operations

All records must be available upon request by NJDEP.

Complete separate forms for each municipal yard or ancillary operation location.

Address of municipal yard or ancillary operation:
Oakland Camp Todd Water Storage Tank located at: 68 Overlook Ridge, Oakland, New Jersey 07436.

List all materials and machinery located at this location that are exposed to stormwater which could be a source of pollutant in a stormwater discharge:

Raw materials –

Intermediate products –

Final products –

Waste materials –

By-products –

Machinery –

Fuel –

Lubricants –

Solvents –

Detergents related to municipal maintenance yard or ancillary operations –

Other –
Three (3) 900 gallon Brine Tanks

SPPP Form 10 – Municipal Maintenance Yards and Other Ancillary Operations

All records must be available upon request by NJDEP.

Complete separate forms for each municipal yard or ancillary operation location.
Address of municipal yard or ancillary operation: Oakland Thornton Water Storage Tank located at: 20 Thornton Road, Oakland, New Jersey 07436.
List all materials and machinery located at this location that are exposed to stormwater which could be a source of pollutant in a stormwater discharge: Raw materials – Intermediate products – Final products – Waste materials – By-products – Machinery – Thirty-two (32) Snow Plows, one (1) Salt Spreader, and one (1) Rack Body Fuel – Lubricants – Solvents – Detergents related to municipal maintenance yard or ancillary operations – Other –

SPPP Form 10 – Municipal Maintenance Yards and Other Ancillary Operations

All records must be available upon request by NJDEP.

Complete separate forms for each municipal yard or ancillary operation location.

Address of municipal yard or ancillary operation:
Oakland Compost Facility located at: Mile Marker 2.4 Skyline Drive, Oakland, New Jersey 07436.

List all materials and machinery located at this location that are exposed to stormwater which could be a source of pollutant in a stormwater discharge:

Raw materials – Leaves/Yard Waste/Wood

Intermediate products –

Final products – Compost/Mulch

Waste materials –

By-products –

Machinery –

Fuel –

Lubricants –

Solvents –

Detergents related to municipal maintenance yard or ancillary operations –

Other –

SPPP Form 10 – Municipal Maintenance Yards and Other Ancillary Operations

All records must be available upon request by NJDEP.

Complete separate forms for each municipal yard or ancillary operation location.
Address of municipal yard or ancillary operation: Oakland DPW Buildings and Grounds Yard located at: 81 Oak Street, Oakland, New Jersey 07436.
List all materials and machinery located at this location that are exposed to stormwater which could be a source of pollutant in a stormwater discharge: Raw materials – Sand/Stone/Street Sweeping & Catch Basin Debris Intermediate products – Final products – Waste materials – By-products – Machinery – Fuel – Lubricants – Solvents – Detergents related to municipal maintenance yard or ancillary operations – Other –

SPPP Form 10 – Municipal Maintenance Yards and Other Ancillary Operations

All records must be available upon request by NJDEP.

For each category below, describe the best management practices in place to ensure compliance with all requirements in permit Attachment E. If the activity in the category is not applicable for this location, indicate where it occurs.

Indicate the location of inspection logs and tracking forms associated with this municipal yard or ancillary operation, including documentation of conditions requiring attention and remedial actions that have been taken or have been planned.

1. Fueling Operations

The Borough of Oakland DPW utilizes one (1) 8,000-gallon double-wall fiberglass split wall UST (5,000-gallon gasoline/3,000-gallon diesel) system for refueling of Borough vehicles. Gasoline and diesel fuel deliveries to the DPW are by common carrier or via tank truck. All fueling operations are performed in accordance with the Best Management Practices in Attachment E. Drip pans are placed under hoses and pipe connections, inlets are blocked, and safety operations are posted during bulk fuel transfer. Equipment is immediately replaced or repaired when leaking or disrepair is discovered.

2. Vehicle Maintenance

All vehicle maintenance is performed in accordance with the Best Management Practices in Attachment E. Equipment is operated and maintained to prevent exposure of pollutants to stormwater. Whenever possible, all vehicle maintenance is performed inside of the garage located on-site. For projects that must be conducted outdoors, and last more than one day, portable tents or covers shall be placed over the equipment being serviced when not being worked on and drip pans shall be used at all times. Work will be performed in areas away from storm drains or inlets will be blocked when maintenance is being conducted outdoors.

3. On-Site Equipment and Vehicle Washing

See permit attachment E for certification and log forms for Underground Storage Tanks.

Non-applicable. All equipment and vehicle washing is performed off-site.

4. Discharge of Stormwater from Secondary Containment

Non-applicable. All material is stored inside of the garage located on-site in secondary containment and is not exposed to stormwater.

SPPP Form 10 – Municipal Maintenance Yards and Other Ancillary Operations

All records must be available upon request by NJDEP.

5. Salt and De-Icing Material Storage and Handling

All salt and de-icing material is stored and handled in accordance with the Best Management Practices in Attachment E. All salt is stored inside of the salt shed located on-site, Three (3) 900 gallon brine tanks are maintained and located at Oakland Camp Todd Water Storage Tank located at: 68 Overlook Ridge, Oakland, New Jersey 07436. Inspections and maintenance of the salt shed and brine tanks including the surrounding area are performed regularly; tracking of material from loading and unloading operations is minimized; and the area is swept regularly.

6. Aggregate Material and Construction Debris Storage

All aggregate material and construction debris is stored at the DPW Buildings and Grounds Yard at Oak Street, Oakland, New Jersey 07436. Sand and stone are stored outside and uncovered with more than a 50-foot setback from any stormwater inlet and outside of any regulated area (including but not limited to coastal areas, wetlands, and floodplains) in accordance with the Best Management Practices in Attachment E.

7. Street Sweepings, Catch Basin Clean Out and Other Material Storage

All storage of street sweeping, catch basin clean out and other material is performed in accordance with the Best Management Practices in Attachment E. These materials are stored at the DPW Buildings and Grounds Yard at Oak Street, Oakland, New Jersey 07436. Street Sweepings and Catch Basin Clean Out is stored in a covered container and are removed for disposal within six (6) months of placement.

8. Yard Trimmings and Wood Waste Management Sites

All yard trimming and wood waste is stored at the Oakland Compost Facility located at: Mile Marker 2.4 Skyline Drive, Oakland, New Jersey 07436. This material is managed in accordance with the Best Management Practices in Attachment E. The area where the material is stored is graded in a way to prevent stormwater overland flow from entering waters of the State. The windrows are constructed to prevent stormwater runoff from entering waterways of the State, on ground not susceptible to seasonal flooding, and to prevent stormwater run-on and leachate run-off. The Borough also maintains perimeter controls, protects inlets from siltation, removes trash and contains it within leak-proof containers, and implements preventative tracking measures.

9. Roadside Vegetation Management

The Borough of Oakland maintains all roadside vegetation by trimming. All areas of uncurbed roadside vegetation are monitored for erosion problems from vehicular traffic. The Borough of Oakland does not utilize herbicides for roadside vegetation management so as to prevent it from being washed by stormwater into the waters of the State and to prevent erosion caused by devegetation.

Monthly inspections are performed to ensure that the Best Management Practices in Attachment E of the Permit are being executed for Roadside Vegetation Management. Associated records and inspection logs are kept at the Oakland Department of Public Works at: 63 Oak Street, Oakland, New Jersey 07436.

SPPP Form 11 – Employee Training

All records must be available upon request by NJDEP.

A. **Municipal Employee Training:** Stormwater Program Coordinator (SPC) must ensure appropriate staff receive training on topics in the chart below as required due to job duties assigned within three months of commencement of duties and again on the frequency below. Indicate the location of associated training sign in sheets, dates, and agendas or description for each topic.

Topic	Frequency	Title of trainer or office to conduct training
1. Maintenance Yard Operations (including Ancillary Operations)	Every year	DPW and Streets & Roads Supervisors
2. Stormwater Facility Maintenance	Every year	DPW and Streets & Roads Supervisors
3. SPPP Training & Recordkeeping	Every year	DPW and Streets & Roads Supervisors
4. Yard Waste Collection Program	Every 2 years	DPW and Streets & Roads Supervisors
5. Street Sweeping	Every 2 years	DPW and Streets & Roads Supervisors
6. Illicit Connection Elimination and Outfall Pipe Mapping	Every 2 years	DPW and Streets & Roads Supervisors
7. Outfall Pipe Stream Scouring Detection and Control	Every 2 years	DPW and Streets & Roads Supervisors
8. Waste Disposal Education	Every 2 years	DPW and Streets & Roads Supervisors
9. Municipal Ordinances	Every 2 years	DPW and Streets & Roads Supervisors
10. Construction Activity/Post-Construction Stormwater Management in New Development and Redevelopment	Every 2 years	DPW and Streets & Roads Supervisors

B. **Municipal Board and Governing Body Members Training:** Required for individuals who review and approve applications for development and redevelopment projects in the municipality. This includes members of the planning and zoning boards, town council, and anyone else who votes on such projects. Training is in the form of online videos, posted at www.nj.gov/dep/stormwater/training.htm.

Within 6 months of commencing duties, watch *Asking the Right Questions in Stormwater Review Training Tool*. Once per term thereafter, watch at least one of the online DEP videos in the series available under Post-Construction Stormwater Management. Indicate the location of records documenting the names, video titles, and dates completed for each board and governing body member.

C. **Stormwater Management Design Reviewer Training:** All design engineers, municipal engineers, and others who review the stormwater management design for development and redevelopment projects on behalf of the municipality must attend the first available class upon assignment as a reviewer and every five years thereafter. The course is a free, two-day training conducted by DEP staff. Training dates and locations are posted at www.nj.gov/dep/stormwater/training.htm. Indicate the location of the DEP certificate of completion for each reviewer.

Tier A Stormwater Training

Trainer:	
Location:	
Class Name:	
Trainer:	

Name	**Date Completed**	**Signature**

Additional Notes/Topics Covered:

SPPP Form 12 – Outfall Pipes

All records must be available upon request by NJDEP.

1. **Mapping:** Attach an image or provide a link to the most current outfall pipe map. Maps shall be updated at the end of each calendar year.

   Note that ALL maps must be electronic by 21 Dec 2020 via the DEP's designated electronic submission service. For details, see http://www.nj.gov/dep/dwq/msrp_map_aid.htm.

2. **Inspections:** Describe the outfall pipe inspection schedule and indicate the location of records of dates, locations, and findings.

The Borough conducted an initial physical inspection of all outfall pipes during the mapping process. All outfalls are inspected at least once a year during dry weather conditions. Dry weather flow is defined as flow that occurs 72 hours or more after a rain event within "Chapter 3.6: MS4 Outfall Pipe Mapping and Illicit Discharge and Scour Detection and Control" of the "Tier A Municipal Stormwater Guidance Document". All sites will be placed on a prioritized list and repairs will be made in accordance with the Standards for Soil Erosion and Sediment Control in New Jersey. In addition, repairs that do not require NJDEP permits will be performed first.

Records of inspections including dates, locations, and findings are kept at the Oakland Department of Public Works located at: 63 Oak Street, Oakland, New Jersey 07436.

3. **Stream Scouring:** Describe the program in place to detect, investigate and control localized stream scouring from stormwater outfall pipes. Indicate the location of records related to cases of localized stream scouring. Such records must include the contributing source(s) of stormwater, recommended corrective action, and a prioritized list and schedule to remediate scouring cases.

When the Borough is performing the outfall condition assessment all outfall pipes are inspected for signs of scouring. All sites will be placed on a prioritized list and repairs will be made in accordance with the Standards for Soil Erosion and Sediment Control in New Jersey. In addition, repairs that do not require NJDEP permits will be performed first.

The Borough will follow each repair up with an annual inspection of the site to ensure that scouring has not resumed.

Records of localized stream scour including contributing source(s) of stormwater, recommended corrective action, and prioritized list and schedule to remediate scouring cases are kept at the Oakland Department of Public Works located at: 63 Oak Street, Oakland, New Jersey 07436.

4. **Illicit Discharges:** Describe the program in place for conducting visual dry weather inspections of municipally owned or operated outfall pipes. Record cases of illicit discharges using the DEP's Illicit Connection Inspection Report Form (www.nj.gov/dep/dwq/tier_a_forms.htm) and indicate the location of these forms and related illicit discharge records.

   Note that Illicit Connection Inspection Report Forms shall be included in the SPPP and submitted to DEP with the annual report.

The Borough conducted an initial physical inspection of all outfall pipes during the mapping process. During this process and as a part of the continued inspection of outfalls the Borough implemented and enforces an ongoing Illicit Discharge Detection and Elimination Program as follows:

- Conducting visual dry weather inspection of all outfall pipes owned and operated by the municipality;
- Investigating the source if evidence of illicit discharge is found;
- Eliminating non-stormwater discharges that are traced to their source and found to result from illicit connections;
- Documenting investigations and actions taken;
- Inspecting any newly identified outfall pipes for illicit discharges;
- Investigating dry weather flows discovered during routine inspection and maintenance; and
- Investigating all complaints and reports of illicit discharges within three months of receipt.

Outfall pipes that are found to have a dry weather flow or evidence of an intermittent non-stormwater flow will be rechecked to locate the illicit connection. If the Borough is able to locate the illicit connection and the connection is within the Borough of Oakland, we will cite the responsible party for being in violation of our Illicit Connection Ordinance and we will have the connection eliminated immediately. If, after the appropriate amount of investigation, the Borough is unable to locate the source of the illicit connection, we will submit the Closeout Investigation Form with our Annual Inspection and Recertification. If an illicit connection is found to originate from another public entity, the Borough of Oakland will report the illicit connection to the NJDEP.

Illicit connections can be reported to the Borough of Oakland Police Department.

Outfall Inspection Log

Outfall ID	Inspector	Date	Inspected		Repair		Scour		Comments
			Yes	No	Yes	No	Yes	No	

Drawn By: JMW	Scale		**Boswell Engineering**	**Stormwater Outfall Locations**
Check By: FJR	1 in = 700 ft		Engineers - Surveyors - Planners - Scientists	Borough of Oakland
January 2021	Job No. OK-1647		330 Phillips Avenue South Hackensack, NJ 07606	Bergen County New Jersey
Last Edit: 1/14/2021			Tel: 201-641-0770 ● Fax: 201-641-1757	

Notes:
NearMap Image Date: February 23, 2020

- D- Discharge Number
- County Owned Outfall
- Municipal Owned Outfall
- Private Owned Outfall
- State Owned Outfall

BOSWELL ENGINEERING

ENGINEERS • PLANNERS • SURVEYORS • SCIENTISTS

SITE PHOTOGRAPHS

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 1.

Description:

Discharge ID:
D-1

Location:
50 Hunters Run

Watercourse:
Ramapo River

Size:
18" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
Remove sediment and clear pipe opening

Photo No. 2.

Description:

Discharge ID:
D-2

Location:
31 Brandywine Place

Watercourse:
Ramapo River

Size:
18" RCP

Condition:
Fair

Scour:
Yes

Illicit Connection:
No

Repair:
Replace Headwall and Conduit Outlet Protection
NJDEP Permit Required

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 3.

Description:

Discharge ID:
D-3

Location:
16 Concord Lane

Watercourse:
Ramapo River

Size:
18" RCP

Condition:
Poor

Scour:
Yes

Illicit Connection:
No

Repair:
Install Conduit Outlet Protection and Repair Scour
NJDEP Permit Required

Photo No. 4.

Description:

Discharge ID:
D-4

Location:
57 Saratoga Drive

Watercourse:
Ramapo River

Size:
24" RCP

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
Remove pipe to headwall and establish Conduit Outlet Protection
NJDEP Permit Required

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 5.

Description:

Discharge ID:
D-5

Location:
659 Ramapo Valley Road

Watercourse:
Ramapo River

Size:
48” RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 6.

Description:

Discharge ID:
D-6

Location:
39 Thunderbird Drive

Watercourse:
Ramapo River

Size:
24” CMP

Condition:
Fair

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 7.

Description:

Discharge ID:
D-7

Location:
10 Kingsley Evans Circle

Watercourse:
Ramapo River

Size:
42" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 8.

Description:

Discharge ID:
D-8

Location:
140 West Oakland Ave

Watercourse:
Ramapo River

Size:
30" RCP-Flared End

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 9.

Description:

Discharge ID:
D-9

Location:
134 Lakeshore Dr

Watercourse:
Ramapo River

Size:
18" RCP

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 10.

Description:

Discharge ID:
D-10

Location:
19 Lenape Lane

Watercourse:
Ramapo River

Size:
15" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 11.

Description:

Discharge ID:
D-11

Location:
92 Truman Blvd

Watercourse:
Ramapo River

Size:
18" RCP

Condition:
Good

Scour:
Yes

Illicit Connection:
Investigate

Repair:
Install Headwall and Conduit Outlet Protection
NJDEP Permit Required

Photo No. 12.

Description:

Discharge ID:
D-12

Location:
162 Lakeshore Dr

Watercourse:
Ramapo River

Size:
15" CMP

Condition:
Fair

Scour:
No

Illicit Connection:
No

Repair:
Install Headwall and Conduit Outlet Protection
NJDEP Permit Required

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 13.

Description:

Discharge ID:
D-13

Location:
173 Lakeshore Dr

Watercourse:
Ramapo River

Size:
15" CMP

Condition:
Poor

Scour:
No

Illicit Connection:
No

Repair:
Replace Pipe
NJDEP Permit Required

Photo No. 14.

Description:

Discharge ID:
D-14

Location:
183 Lakeshore Dr

Watercourse:
Ramapo River

Size:
15" CMP

Condition:
Fair

Scour:
No

Illicit Connection:
No

Repair:
Clear Pipe Opening

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 15.

Description:

Discharge ID:
D-15

Location:
193 Lakeshore Dr

Watercourse:
Ramapo River

Size:
21" CMP

Condition:
Fair

Scour:
No

Illicit Connection:
No

Repair:
Install Headwall and Conduit Outlet Protection
NJDEP Permit Required

Photo No. 16.

Description:

Discharge ID:
D-16

Location:
195 Lakeshore Dr

Watercourse:
Ramapo River

Size:
40' wide dam

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 17.

Description:

Discharge ID:
D-17

Location:
129 West Oakland Ave

Watercourse:
Ramapo River

Size:
36" RCP

Condition:
Good

Scour:
Yes

Illicit Connection:
No

Repair:
Install Headwall and Conduit Outlet Protection
NJDEP Permit Required

Photo No. 18.

Description:

Discharge ID:
D-18

Location:
294 West Oakland Ave

Watercourse:
Ramapo River

Size:
42" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 19.

Description:

Discharge ID:
D-19

Location:
104 Roosevelt Blvd

Watercourse:
Ramapo River

Size:
18" RCP

Condition:
Fair

Scour:
No

Illicit Connection:
No

Repair:
Install Headwall
NJDEP Permit Required

Photo No. 20.

Description:

Discharge ID:
D-20

Location:
78 Roosevelt Blvd

Watercourse:
Ramapo River

Size:
24" CMP

Condition:
Poor

Scour:
No

Illicit Connection:
No

Repair:
Install Headwall and
Replace Pipe
NJDEP Permit Required

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 21.	
Description: Discharge ID: D-21 Location: 62 Roosevelt Blvd Watercourse: Ramapo River Size: 18" CMP Condition: Fair Scour: No Illicit Connection: No Repair: Remove sediment and clear pipe opening	

Photo No. 22.	
Description: Discharge ID: D-22 Location: Truman Field Watercourse: Ramapo River Size: Unknown Condition: Unknown Scour: Unknown Illicit Connection: No Repair: Expose pipe and Reevaluate	

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 23.

Description:

Discharge ID:
D-23

Location:
63 River Road

Watercourse:
Ramapo River

Size:
18" CMP

Condition:
Fair

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 24.

Description:

Discharge ID:
D-24

Location:
120 West Oakland Ave

Watercourse:
Ramapo River

Size:
24" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 25.

Description:

Discharge ID:
D-25

Location:
41 River Road

Watercourse:
Ramapo River

Size:
12” RCP

Condition:
Fair

Scour:
Yes

Illicit Connection:
No

Repair:
Address Scour Protection
NJDEP Permit Required

Photo No. 26.

Description:

Discharge ID:
D-26

Location:
19 River Road

Watercourse:
Ramapo River

Size:
24” RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 27.

Description:

Discharge ID:
D-27

Location:
173 Lakeshore Drive

Watercourse:
Ramapo River

Size:
24" RCP

Condition:
Poor

Scour:
Yes

Illicit Connection:
No

Repair:
Reconstruct Headwall
NJDEP Permit Required

Photo No. 28.

Description:

Discharge ID:
D-28

Location:
Recreation Field

Watercourse:
Ramapo River

Size:
54" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 29.

Description:

Discharge ID:
D-29

Location:
52 Park Drive

Watercourse:
Ramapo River

Size:
18" RCP

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
Clear pipe opening

Photo No. 30.

Description:

Discharge ID:
D-30

Location:
West Oakland Ave

Watercourse:
Ramapo River

Size:
48" HDPE

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
Install Headwall and
Conduit Outlet Protection
NJDEP Permit Required

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 31.

Description:

Discharge ID:
D-31

Location:
331 West Oakland Ave

Watercourse:
Ramapo River

Size:
18" RCP

Condition:
Poor

Scour:
No

Illicit Connection:
No

Repair:
Reconstruct Headwall
NJDEP Permit Required

Photo No. 32.

Description:

Discharge ID:
D-32

Location:
111 Doty Road

Watercourse:
Ramapo River

Size:
Unknown

Condition:
Unknown

Scour:
Unknown

Illicit Connection:
Unknown

Repair:
Expose pipe and
reevaluate

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 33.

Description:

Discharge ID:
D-33

Location:
59 Lakeview Terr

Watercourse:
Ramapo River

Size:
18” RCP

Condition:
Poor

Scour:
Yes

Illicit Connection:
No

Repair:
Repair Headwall
NJDEP Permit Required

Photo No. 34.

Description:

Discharge ID:
D-34

Location:
75 Lakeview Terr

Watercourse:
Ramapo River

Size:
15” RCP

Condition:
Unknown

Scour:
Unknown

Illicit Connection:
Unknown

Repair:
Expose pipe and reevaluate

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 35.

Description:

Discharge ID:
D-35

Location:
31 Lakeview Terr

Watercourse:
Ramapo River

Size:
18" RCP

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
Expose pipe and reevaluate

Photo No. 36.

Description:

Discharge ID:
D-36

Location:
15 Truman Blvd

Watercourse:
Ramapo River Tributary

Size:
36" CMP

Condition:
Fair

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 37.

Description:

Discharge ID:
D-37

Location:
Skyline Drive

Watercourse:
Ramapo Lake Brook

Size:
15" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 38.

Description:

Discharge ID:
D-38

Location:
Skyline Drive

Watercourse:
Ramapo Lake Brook

Size:
48" RCP-Flared End

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 39.

Description:

Discharge ID:
D-39

Location:
Skyline Drive

Watercourse:
Ramapo Lake Brook

Size:
15" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
Remove sediment and clear pipe opening

Photo No. 40.

Description:

Discharge ID:
D-40

Location:
Skyline Drive

Watercourse:
Ramapo Lake Brook

Size:
15" RCP

Condition:
Unknown

Scour:
Unknown

Illicit Connection:
Unknown

Repair:
Locate Pipe and Reevaluate

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 41.

Description:

Discharge ID:
D-41

Location:
Patriots Way

Watercourse:
Ramapo River

Size:
36" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 42.

Description:

Discharge ID:
D-42

Location:
Waters Edge

Watercourse:
Ramapo River Tributary

Size:
15" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
Clear Debris

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 43.

Description:

Discharge ID:
D-43

Location:
Waters Edge

Watercourse:
Ramapo River Tributary

Size:
24" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 44.

Description:

Discharge ID:
D-44

Location:
24 River Dell

Watercourse:
Ramapo River

Size:
24" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 45.

Description:

Discharge ID:
D-45

Location:
Hunters Run

Watercourse:
Ramapo River Tributary

Size:
15" RCP-Flared End

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 46.

Description:

Discharge ID:
D-46

Location:
Overlook Ridge

Watercourse:
Ramapo River Tributary

Size:
24" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 47.

Description:

Discharge ID:
D-47

Location:
44 Overlook Ridge

Watercourse:
Ramapo River Tributary

Size:
18" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 48.

Description:

Discharge ID:
D-48

Location:
57 Overlook Ridge

Watercourse:
Ramapo River Tributary

Size:
18" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 49.

Description:

Discharge ID:
D-49

Location:
57 Overlook Ridge

Watercourse:
Ramapo River Tributary

Size:
18" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
Clear Debris

Photo No. 50.

Description:

Discharge ID:
D-50

Location:
Ramapo River Trace

Watercourse:
Ramapo River

Size:
4'x8' Box Culvert

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 51.

Description:

Discharge ID:
D-51

Location:
Ramapo River Trace

Watercourse:
Ramapo River

Size:
18" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
Remove sediment and clear pipe opening

Photo No. 52.

Description:

Discharge ID:
D-52

Location:
6 Highland Cross

Watercourse:
Ramapo River

Size:
24" RCP

Condition:
Excellent

Scour:
Yes

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 53.

Description:

Discharge ID:
D-53

Location:
3 Winding Ridge

Watercourse:
Ramapo River Tributary

Size:
15" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
Clear Debris

Photo No. 54.

Description:

Discharge ID:
D-54

Location:
Skytop Ridge

Watercourse:
Ramapo River Tributary

Size:
24" RCP

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
Clear Debris

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 55.

Description:

Discharge ID:
D-55

Location:
Ramapo River Trace

Watercourse:
Ramapo River

Size:
24" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 56.

Description:

Discharge ID:
D-56

Location:
73 Ramapo River Trace

Watercourse:
Ramapo River

Size:
24" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 57.

Description:

Discharge ID:
D-57

Location:
10 Valley Forge Rd

Watercourse:
Ramapo River Tributary

Size:
24" RCP

Condition:
Good

Scour:
Yes

Illicit Connection:
No

Repair:
Install Conduit Outlet Protection
NJDEP Permit Required

Photo No. 58.

Description:

Discharge ID:
D-58

Location:
781 Ramapo Valley Rd

Watercourse:
Ramapo River Tributary

Size:
30" RCP

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
Remove large stone blocking pipe opening

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 59.

Description:

Discharge ID:
D-59

Location:
Raeben Ave

Watercourse:
Ramapo River Tributary

Size:
15" RCP

Condition:
Fair

Scour:
No

Illicit Connection:
No

Repair:
Clear pipe opening and install flared end section
NJDEP Permit Required

Photo No. 60.

Description:

Discharge ID:
D-60

Location:
19 Cheyenne Ct

Watercourse:
Ramapo River Tributary

Size:
18" RCP

Condition:
Fair

Scour:
Yes

Illicit Connection:
No

Repair:
Install Headwall and Conduit Outlet Protection
NJDEP Permit Required

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 61.

Description:

Discharge ID:
D-61

Location:
6 Cheyenne Ct

Watercourse:
Ramapo River Tributary

Size:
12" RCP

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
Clear pipe opening

Photo No. 62.

Description:

Discharge ID:
D-62

Location:
145 Iroquois Ave

Watercourse:
Ramapo River Tributary

Size:
24" RCP

Condition:
Good

Scour:
Yes

Illicit Connection:
No

Repair:
Install Conduit Outlet Protection
NJDEP Permit Required

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 63.	
Description: Discharge ID: D-63 Location: 61 Andrew Ave Watercourse: Ramapo River Tributary Size: 18" RCP Condition: Excellent Scour: No Illicit Connection: No Repair: No	

Photo No. 64.	
Description: Discharge ID: D-64 Location: 136 Iroquois Ave Watercourse: Ramapo River Tributary Size: 12" CMP Condition: Fair Scour: No Illicit Connection: No Repair: Install Headwall and Conduit Outlet Protection NJDEP Permit Required	

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 65.

Description:

Discharge ID:
D-65

Location:
3 Osage Rd

Watercourse:
Ramapo River Tributary

Size:
18" RCP

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
Remove vegetation and expose pipe opening

Photo No. 66.

Description:

Discharge ID:
D-66

Location:
11 Osage Rd

Watercourse:
Ramapo River Tributary

Size:
18" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 67.

Description:

Discharge ID:
D-67

Location:
23 Osage Rd

Watercourse:
Ramapo River Tributary

Size:
12" RCP

Condition:
Poor

Scour:
No

Illicit Connection:
No

Repair:
Remove sediment and clear pipe opening. Install Flared End Section
NJDEP Permit Required

Photo No. 68.

Description:

Discharge ID:
D-68

Location:
86 Andrew Ave

Watercourse:
Ramapo River Tributary

Size:
18" RCP

Condition:
Poor

Scour:
No

Illicit Connection:
No

Repair:
Expose pipe and reevaluate

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 69.

Description:

Discharge ID:
D-69

Location:
90 Andrew Ave

Watercourse:
Ramapo River Tributary

Size:
18" RCP

Condition:
Poor

Scour:
No

Illicit Connection:
No

Repair:
Expose pipe and reevaluate

Photo No. 70.

Description:

Discharge ID:
D-70

Location:
99 Chuckanutt Dr

Watercourse:
Ramapo River Tributary

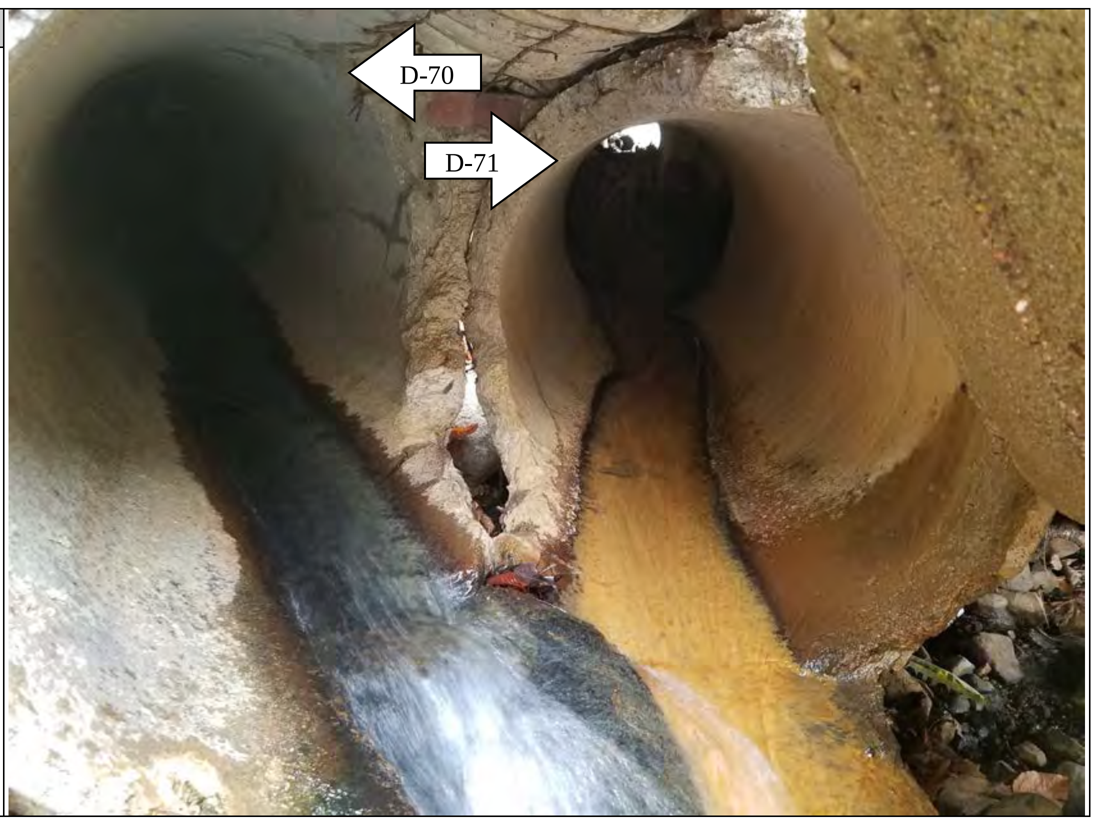
Size:
24" RCP

Condition:
Poor

Scour:
Yes

Illicit Connection:
No

Repair:
Replace Headwall
NJDEP Permit Required



CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 71.

Description:

Discharge ID:
D-71

Location:
99 Chuckanutt Dr

Watercourse:
Ramapo River Tributary

Size:
24" RCP

Condition:
Poor

Scour:
Yes

Illicit Connection:
No

Repair:
Replace Headwall
NJDEP Permit Required

Photo No. 72.

Description:

Discharge ID:
D-72

Location:
69 Chuckanutt Dr

Watercourse:
Ramapo River Tributary

Size:
24" RCP

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
Clear Debris

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 73.

Description:

Discharge ID:
D-73

Location:
9 Hopi Ct

Watercourse:
Ramapo River Tributary

Size:
30" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 74.

Description:

Discharge ID:
D-74

Location:
21 Algonquin Trail

Watercourse:
Ramapo River Tributary

Size:
18" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
Yes – White PVC Pipe

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 75.

Description:

Discharge ID:
D-75

Location:
53 Pawnee Ave

Watercourse:
Ramapo River Tributary

Size:
24" CMP

Condition:
Good

Scour:
Yes

Illicit Connection:
Investigate

Repair:
Install Headwall and
Conduit Outlet Protection
NJDEP Permit Required

Photo No. 76.

Description:

Discharge ID:
D-76

Location:
43 Pawnee Ave

Watercourse:
Ramapo River Tributary

Size:
18" CMP

Condition:
Fair

Scour:
Yes

Illicit Connection:
No

Repair:
Install Headwall and
Conduit Outlet Protection
NJDEP Permit Required

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 77.

Description:

Discharge ID:
D-77

Location:
88 Oneida Ave

Watercourse:
Pond Brook Tributary

Size:
36" CMP

Condition:
Fair

Scour:
Yes

Illicit Connection:
Yes – White PVC Pipe

Repair:
Reconstruct Headwall and Install Conduit Outlet Protection
NJDEP Permit Required

Photo No. 78.

Description:

Discharge ID:
D-78

Location:
88 Oneida Ave

Watercourse:
Pond Brook Tributary

Size:
15" RCP

Condition:
Fair

Scour:
Yes

Illicit Connection:
Yes – White PVC Pipe

Repair:
Reconstruct Headwall and Install Conduit Outlet Protection
NJDEP Permit Required

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 79.

Description:

Discharge ID:
D-79

Location:
222 Hiawatha Blvd

Watercourse:
Pond Brook Tributary

Size:
24" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 80.

Description:

Discharge ID:
D-80

Location:
11 Monhegan Ave

Watercourse:
Pond Brook Tributary

Size:
24" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 81.

Description:

Discharge ID:
D-81

Location:
55 Seton Hall Dr

Watercourse:
Pond Brook Tributary

Size:
18" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 82.

Description:

Discharge ID:
D-82

Location:
55 Seton Hall Dr

Watercourse:
Pond Brook Tributary

Size:
12" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 83.

Description:

Discharge ID:
D-83

Location:
68 Ramapo Hills Blvd

Watercourse:
Huber Lake

Size:
18" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 84.

Description:

Discharge ID:
D-84

Location:
15 Wilson St

Watercourse:
Pond Brook Tributary

Size:
42" CMP

Condition:
Fair

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 85.

Description:

Discharge ID:
D-85

Location:
15 Wilson St

Watercourse:
Pond Brook Tributary

Size:
18" RCP

Condition:
Fair

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 86.

Description:

Discharge ID:
D-86

Location:
93 Thackeray Rd

Watercourse:
Pond Brook Tributary

Size:
15" RCP

Condition:
Good

Scour:
Yes

Illicit Connection:
No

Repair:
Install Headwall
NJDEP Permit Required

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 87.

Description:

Discharge ID:
D-87

Location:
83 Thackeray Rd

Watercourse:
Pond Brook Tributary

Size:
15" RCP

Condition:
Good

Scour:
No

Illicit Connection:
Investigate

Repair:
Install Headwall and
Conduit Outlet Protection
NJDEP Permit Required

Photo No. 88.

Description:

Discharge ID:
D-88

Location:
6 Brook Hollow Rd

Watercourse:
Pond Brook Tributary

Size:
24" RCP-Flared End

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 89.

Description:

Discharge ID:
D-89

Location:
57 Thackeray Rd

Watercourse:
Pond Brook Tributary

Size:
12" RCP

Condition:
Fair

Scour:
No

Illicit Connection:
No

Repair:
Clear pipe opening and
Install Flared End Section
NJDEP Permit Required

Photo No. 90.

Description:

Discharge ID:
D-90

Location:
47 Thackeray Rd

Watercourse:
Pond Brook Tributary

Size:
2'x2' Box Culvert

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 91.

Description:

Discharge ID:
D-91

Location:
37 Thackeray Rd

Watercourse:
Pond Brook Tributary

Size:
18" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 92.

Description:

Discharge ID:
D-92

Location:
11 Mt Holyoke Dr

Watercourse:
Pond Brook Tributary

Size:
36" RCP

Condition:
Good

Scour:
Yes

Illicit Connection:
No

Repair:
Install Headwall and
Conduit Outlet Protection
NJDEP Permit Required

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 93.

Description:

Discharge ID:
D-93

Location:
11 Mt Holyoke Dr

Watercourse:
Pond Brook Tributary

Size:
15" RCP

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
Clear pipe opening and
Install Headwall
NJDEP Permit Required

Photo No. 94.

Description:

Discharge ID:
D-94

Location:
15 Mt Holyoke Dr

Watercourse:
Pond Brook Tributary

Size:
15" RCP

Condition:
Fair

Scour:
No

Illicit Connection:
No

Repair:
Clear pipe opening and
Install Headwall
NJDEP Permit Required

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 95.

Description:

Discharge ID:
D-95

Location:
Behind Well No. 9

Watercourse:
Pond Brook

Size:
24" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 96.

Description:

Discharge ID:
D-96

Location:
36 Oswego Ave

Watercourse:
Pond Brook Tributary

Size:
36" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
Install Headwall and
Conduit Outlet Protection
NJDEP Permit Required

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 97.

Description:

Discharge ID:
D-97

Location:
70 Hiawatha Blvd

Watercourse:
Pond Brook Tributary

Size:
18" RCP

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 98.

Description:

Discharge ID:
D-98

Location:
12 Oswego Ave

Watercourse:
Pond Brook Tributary

Size:
36" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
Yes – White PVC pipe

Repair:
Install Conduit Outlet Protection
NJDEP Permit Required

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 99.

Description:

Discharge ID:
D-99

Location:
27 Seminole Ave

Watercourse:
Mirror Lake

Size:
36" CMP

Condition:
Fair

Scour:
Yes

Illicit Connection:
No

Repair:
Reconstruct Headwall
NJDEP Permit Required

Photo No. 100.

Description:

Discharge ID:
D-100

Location:
15 Hiawatha Blvd

Watercourse:
Pond Brook Tributary

Size:
18" RCP

Condition:
Good

Scour:
Yes

Illicit Connection:
No

Repair:
Install Headwall
NJDEP Permit Required

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 101.

Description:

Discharge ID:
D-101

Location:
7 Hiawatha Blvd

Watercourse:
Pond Brook Tributary

Size:
15" RCP

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
Install Headwall
NJDEP Permit Required

Photo No. 102.

Description:

Discharge ID:
D-102

Location:
44 Franklin Ave

Watercourse:
Pond Brook

Size:
18" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 103.

Description:

Discharge ID:
D-103

Location:
32 Franklin Ave

Watercourse:
Pond Brook

Size:
18" RCP

Condition:
Excellent

Scour:
Yes

Illicit Connection:
No

Repair:
No

Photo No. 104.

Description:

Discharge ID:
D-104

Location:
12 Franklin Ave

Watercourse:
Pond Brook

Size:
15" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

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SITE PHOTOGRAPHS

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 105.

Description:

Discharge ID:
D-105

Location:
454 Ramapo Valley Rd

Watercourse:
Pond Brook

Size:
30" RCP

Condition:
Fair

Scour:
No

Illicit Connection:
No

Repair:
No

Notes:
Abandoned

Photo No. 106.

Description:

Discharge ID:
D-106

Location:
454 Ramapo Valley Rd

Watercourse:
Pond Brook

Size:
36" RCP

Condition:
Poor

Scour:
Yes

Illicit Connection:
No

Repair:
Repair Flared End Section and install Conduit Outlet Protection
NJDEP Permit Required

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 107.

Description:

Discharge ID:
D-107

Location:
103 Lakeshore Dr

Watercourse:
Crystal Lake

Size:
24" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 108.

Description:

Discharge ID:
D-108

Location:
79 Lakeshore Dr

Watercourse:
Crystal Lake

Size:
18" HDPE

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 109.

Description:

Discharge ID:
D-109

Location:
67 Lakeshore Dr

Watercourse:
Pond Brook

Size:
18" CMP

Condition:
Poor

Scour:
Yes

Illicit Connection:
No

Repair:
Install Headwall and Replace Pipe
NJDEP Permit Required

Photo No. 110.

Description:

Discharge ID:
D-110

Location:
64 Lakeshore Dr

Watercourse:
Pond Brook

Size:
24" CMP

Condition:
Poor

Scour:
No

Illicit Connection:
No

Repair:
Replace Pipe and Install Conduit Outlet Protection
NJDEP Permit Required

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 111.

Description:

Discharge ID:
D-111

Location:
39 Lakeshore Dr

Watercourse:
Crystal Lake

Size:
24" CMP

Condition:
Fair

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 112.

Description:

Discharge ID:
D-112

Location:
West Oakland Ave

Watercourse:
Detention Basin

Size:
36" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 113.

Description:

Discharge ID:
D-113

Location:
21 Raritan Rd

Watercourse:
Pond Brook

Size:
18” RCP

Condition:
Good

Scour:
Yes

Illicit Connection:
No

Repair:
Install Conduit Outlet Protection
NJDEP Permit Required

Photo No. 114.

Description:

Discharge ID:
D-114

Location:
18 Raritan Rd

Watercourse:
Pond Brook

Size:
36” RCP

Condition:
Poor

Scour:
Yes

Illicit Connection:
No

Repair:
Reconstruct Pipe and Headwall
NJDEP Permit Required

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 115.

Description:

Discharge ID:
D-115

Location:
53 Yawpo Ave

Watercourse:
Pond Brook Tributary

Size:
15” RCP

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
Remove sediment and clear pipe opening

Photo No. 116.

Description:

Discharge ID:
D-116

Location:
65 Yawpo Ave

Watercourse:
Pond Brook Tributary

Size:
12” CMP

Condition:
Fair

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 117.

Description:

Discharge ID:
D-117

Location:
83-85 Yawpo Ave

Watercourse:
Pond Brook Tributary

Size:
15" RCP

Condition:
Unknown

Scour:
Unknown

Illicit Connection:
Unknown

Repair:
Locate Pipe and Reevaluate

Photo No. 118.

Description:

Discharge ID:
D-118

Location:
740 McCoy Rd

Watercourse:
Pond Brook Tributary

Size:
18" RCP

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
Remove Debris

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 119.

Description:

Discharge ID:
D-119

Location:
738 McCoy Rd

Watercourse:
Pond Brook Tributary

Size:
15" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 120.

Description:

Discharge ID:
D-120

Location:
127 McCoy Rd

Watercourse:
Pond Brook Tributary

Size:
24" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 121.

Description:

Discharge ID:
D-121

Location:
38 Academy Circle

Watercourse:
Uncoded Tributary

Size:
18" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 122.

Description:

Discharge ID:
D-122

Location:
38 Academy Circle

Watercourse:
Uncoded Tributary

Size:
36" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 123.

Description:
Discharge ID:
D-123

Location:
24 Academy Circle

Watercourse:
Uncoded Tributary

Size:
18" RCP

Condition:
Good

Scour:
Yes

Illicit Connection:
No

Repair:
Install Headwall and
Conduit Outlet Protection
NJDEP Permit Required

Photo No. 124.

Description:
Discharge ID:
D-124

Location:
55 Walnut St

Watercourse:
Uncoded Tributary

Size:
15" RCP

Condition:
Fair

Scour:
Yes

Illicit Connection:
No

Repair:
Reconstruct Headwall
NJDEP Permit Required

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 125.

Description:

Discharge ID:
D-125

Location:
34 Demarest Ave

Watercourse:
Uncoded Tributary

Size:
24" CMP

Condition:
Poor

Scour:
Yes

Illicit Connection:
No

Repair:
Install Headwall and Replace Pipe
NJDEP Permit Required

Photo No. 126.

Description:

Discharge ID:
D-126

Location:
6 Bannehr St

Watercourse:
Uncoded Tributary

Size:
36" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 127.

Description:

Discharge ID:
D-127

Location:
55 McNomee St

Watercourse:
Uncoded Tributary

Size:
15" RCP

Condition:
Unknown

Scour:
Unknown

Illicit Connection:
Unknown

Repair:
Expose Pipe and Reevaluate

Photo No. 128.

Description:

Discharge ID:
D-128

Location:
43 McNomee St

Watercourse:
Uncoded Tributary

Size:
18" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 129.

Description:
Discharge ID:
D-129
Location:
26 Hickory Dr
Watercourse:
Little Pond Brook Tributary
Size:
30" RCP
Condition:
Good
Scour:
No
Illicit Connection:
No
Repair:
No

Photo No. 130.

Description:
Discharge ID:
D-130
Location:
8 Dogwood Dr
Watercourse:
Little Pond Brook Tributary
Size:
18" RCP
Condition:
Fair
Scour:
No
Illicit Connection:
No
Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 131.

Description:

Discharge ID:
D-131

Location:
50 Dogwood Drive

Watercourse:
Little Pond Brook Tributary

Size:
18" RCP

Condition:
Fair

Scour:
Yes

Illicit Connection:
No

Repair:
No

Photo No. 132.

Description:

Discharge ID:
D-132

Location:
120 Spear Street

Watercourse:
Little Pond Brook Tributary

Size:
15" RCP

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 133.

Description:

Discharge ID:
D-133

Location:
150 Page Dr

Watercourse:
Little Pond Brook Tributary

Size:
36" CMP

Condition:
Poor

Scour:
Yes

Illicit Connection:
No

Repair:
Install Headwall, Conduit Outlet Protection, and Replace Pipe
NJDEP Permit Required

Photo No. 134.

Description:

Discharge ID:
D-134

Location:
166 Page Drive

Watercourse:
Little Pond Brook Tributary

Size:
15" RCP-Flared End

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 135.

Description:

Discharge ID:
D-135

Location:
98 Grove St

Watercourse:
Little Pond Brook Tributary

Size:
36" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 136.

Description:

Discharge ID:
D-136

Location:
64 Grove St

Watercourse:
Little Pond Brook Tributary

Size:
24" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 137.

Description:

Discharge ID:
D-137

Location:
105 Nielsen Ave

Watercourse:
Little Pond Brook Tributary

Size:
24" RCP

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
Install Headwall and Conduit Outlet Protection
NJDEP Permit Required

Photo No. 138.

Description:

Discharge ID:
D-138

Location:
53 Spruce St

Watercourse:
Ramapo River Tributary

Size:
30" RCP

Condition:
Fair

Scour:
Yes

Illicit Connection:
No

Repair:
Install Conduit Outlet Protection
NJDEP Permit Required

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 139.

Description:

Discharge ID:
D-139

Location:
Great Oak Park

Watercourse:
Little Pond Brook

Size:
36" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
Investigate

Repair:
No

Photo No. 140.

Description:

Discharge ID:
D-140

Location:
Great Oak Park

Watercourse:
Little Pond Brook

Size:
24" RCP

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 141.

Description:

Discharge ID:
D-141

Location:
Great Oak Park

Watercourse:
Little Pond Brook

Size:
15" RCP

Condition:
Fair

Scour:
Yes

Illicit Connection:
No

Repair:
Reconstruct Headwall
NJDEP Permit Required

Photo No. 142.

Description:

Discharge ID:
D-142

Location:
Ramapo Valley Rd

Watercourse:
Ramapo River

Size:
15" HDPE

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
Clear Pipe Opening

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 143.

Description:

Discharge ID:
D-143

Location:
Ramapo Valley Rd

Watercourse:
Ramapo River

Size:
12” Concrete (Investigate)

Condition:
Fair

Scour:
No

Illicit Connection:
No

Repair:
Clear Pipe Opening

Photo No. 144.

Description:

Discharge ID:
D-144

Location:
33 Ramapo Valley Rd

Watercourse:
Ramapo River

Size:
Unknown

Condition:
Unknown

Scour:
Yes

Illicit Connection:
No

Repair:
Expose Pipe and Reevaluate

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 145.

Description:

Discharge ID:
D-145

Location:
22 Ramapo Terrace

Watercourse:
Ramapo River

Size:
Unknown

Condition:
Unknown

Scour:
Unknown

Illicit Connection:
Unknown

Repair:
Locate Pipe and Reevaluate

Photo No. 146.

Description:

Discharge ID:
D-146

Location:
9 Post Rd

Watercourse:
Little Pond Brook

Size:
24” RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 147.

Description:

Discharge ID:
D-147

Location:
31 Long Hill Rd

Watercourse:
Little Pond Brook

Size:
18" RCP

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 148.

Description:

Discharge ID:
D-148

Location:
62 Long Hill Rd

Watercourse:
Little Pond Brook

Size:
18" VCP

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
Install Headwall
NJDEP Permit Required

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 149.

Description:

Discharge ID:
D-149

Location:
94 Long Hill Rd

Watercourse:
Little Pond Brook

Size:
6" Aspestos (Investigate)

Condition:
Good

Scour:
Yes

Illicit Connection:
Yes - Investigate

Repair:
No

Photo No. 150.

Description:

Discharge ID:
D-150

Location:
94 Long Hill Rd

Watercourse:
Little Pond Brook

Size:
15" VCP

Condition:
Poor

Scour:
No

Illicit Connection:
No

Repair:
Clear Pipe Opening

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 151.

Description:

Discharge ID:
D-151

Location:
104 Long Hill Rd

Watercourse:
Little Pond Brook

Size:
30" RCP

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
Install Headwall
NJDEP Permit Required

Photo No. 152.

Description:

Discharge ID:
D-152

Location:
1 Laura Ln

Watercourse:
Little Pond Brook

Size:
15" RCP – Flared End

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 153.

Description:

Discharge ID:
D-153

Location:
91 Bauer Dr

Watercourse:
Hoppers Lake

Size:
18" RCP

Condition:
Unknown

Scour:
Unknown

Illicit Connection:
Unknown

Repair:
Locate Pipe and Reevaluate

Photo No. 154.

Description:

Discharge ID:
D-154

Location:
100 Bauer Dr

Watercourse:
Hoppers Lake

Size:
42" RCP

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 155.

Description:

Discharge ID:
D-155

Location:
40 Potash Rd

Watercourse:
Little Pond Brook

Size:
18" RCP

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 156.

Description:

Discharge ID:
D-156

Location:
12 Thornton Rd

Watercourse:
Unnamed Lake

Size:
15" RCP – Flared End

Condition:
Fair

Scour:
No

Illicit Connection:
No

Repair:
Clear Debris

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SITE PHOTOGRAPHS

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 157.

Description:

Discharge ID:
D-157

Location:
12 Thornton Rd

Watercourse:
Unnamed Lake

Size:
18" RCP – Flared End

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 158.

Description:

Discharge ID:
D-158

Location:
16 Thornton Rd

Watercourse:
Unnamed Lake

Size:
18" RCP – Flared End

Condition:
Good

Scour:
No

Illicit Connection:
No

Repair:
No

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 159.

Description:

Discharge ID:
D-159

Location:
16 Thornton Rd

Watercourse:
Unnamed Lake

Size:
18" RCP – Flared End

Condition:
Excellent

Scour:
No

Illicit Connection:
No

Repair:
No

Photo No. 160.

Description:

Discharge ID:
D-160

Location:
16 Thornton Rd

Watercourse:
Unnamed Lake

Size:
12" PVC

Condition:
Good

Scour:
Yes

Illicit Connection:
Investigate

Repair:
Investigate and Reevaluate

CLIENT NAME:	SITE LOCATION:	PROJECT NAME:	PROJECT NO.:
Borough of Oakland	Oakland, New Jersey	Stormwater Outfall Survey	OK-1647

Photo No. 161.

Description:

Discharge ID:
D-161

Location:
16 Thornton Rd

Watercourse:
Unnamed Lake

Size:
24" HDPE

Condition:
Good

Scour:
Unknown

Illicit Connection:
Investigate

Repair:
No

Photo No. 162.

Description:

Discharge ID:
D-162

Location:
16 Thornton Rd

Watercourse:
Unnamed Lake

Size:
18" CMP – Flared End

Condition:
Fair

Scour:
No

Illicit Connection:
No

Repair:
No

Illicit Connection Inspection Log

Outfall ID	Inspector	Date	Inspected		Investigated		Documented		Comments
			Yes	No	Yes	No	Yes	No	

Illicit Connection Inspection Report Form

Municipality Information

Municipality:____ County ____

NJPDES # :____PI ID #: ____

Team Member: ____

Date ____Effective Date of Permit Authorization (EDPA):____

Outfall #: ____Location: ____

Receiving Waterbody: ____

1. Is there a dry weather flow? Y (◉) N (○)
2. If "YES", what is the outfall flow estimate? ____ gpm
   (flow sample should be kept for further testing, and this form will need to be submitted with the Annual Report and Certification)
3. Are there any indications of an intermittent flow? Y (○) N (◉)
4. If you answered "**NO**" to BOTH questions #1 and #3, there is probably not an illicit connection and you can skip to question #7.
   (NOTE: This form **does not** need to be submitted to the Department, but should be kept with your SPPP.)

   If you answered "**YES**" to either question, please continue on to question #5.
   (NOTE: This form will need to be submitted to the Department with the Annual Report and Certification.)

5. **PHYSICAL OBSERVATIONS**:

(a) **ODOR**: Oil

(b) **COLOR**: Yellow

(c) **TURBIDITY**: Cloudy

(d) **FLOATABLES**: Petroleum

(e) **DEPOSITS/STAINS**: Sediment

(f) **VEGETATION CONDITIONS**: Excessive Gı

(g) **DAMAGE TO OUTFALL STRUCTURES**:

IDENTIFY STRUCTURE: ____

DAMAGE: Metal Corrosion

6. **ANALYSES OF OUTFALL FLOW SAMPLE:**
   * field calibrate instruments in accordance with manufacturer's instructions prior to testing.

(a) **DETERGENTS**: ____mg/L

(if sample is greater than 0.06 mg/L, the sample is contaminated with detergents [which may be from sanitary wastewater or other sources]. Further testing is required and this outfall should be given the highest priority.)

(if the sample is not greater than 0.06 mg/L and it does not show physical characteristics of sanitary wastewater [e.g., odor, floatables, and/or color] it is unlikely that it is from sanitary wastewater sources, yet there may still be an illicit connection of industrial wastewater, rinse water, backwash or cooling water. Skip to question #6c.)

(b) **AMMONIA (as N) TO POTASSIUM RATIO**: 112

(if the Ammonia to Potassium Ratio is greater than 0.6:1, then it is likely that the pollutant is sanitary sewage)

(if the Ammonia to Potassium Ratio is less than or equal to 0.6:1, then the pollutant is from another washwater source.)

(c) **FLUORIDE**: 123 mg/L

(if the fluoride levels are between 1.0 and 2.5 mg/L, then the flow is most likely from fluoride treated potable water.)

(if the sample tests below a detection limit of 0.1 mg/L for fluoride, it is likely to be from groundwater infiltration, springs or streams. In some cases, however, it is possible that the discharge could originate from an onsite well used for industrial cooling water, which will test non-detect for both detergents and fluoride. To differentiate between these cooling water discharges and groundwater infiltration, you will have to rely on temperature.)

(d) **TEMPERATURE**: ____°F

(if the temperature of the sample is over 70°F, it is most likely cooling water)

(if the temperature of the sample is under 70°F, it is most likely from ground water infiltration)

7. Is there a suspected illicit connection? Y (●) N (○)

   If "**YES**", what is the suspected source? 12

   If "**NO**", skip to signature block on the bottom of this form.

8. Has the investigation of the suspected illicit connection been completed? Y (○) N (○)

   If "**YES**", proceed to question #9.
   If "**NO**", skip to signature block on the bottom of this form.

9. Was the source of the illicit connection found? Y (●) N (○)

   If "**YES**", identify the source. asdfasdfasdf

   What plan of action will follow to eliminate the illicit connection?

   Resolution:

   If "**NO**", complete the Closeout Investigation Form and attach it to this Illicit Connection Inspection Report Form.

Inspector's Name: ____

Title: ____

Signature: ______________________________

Date: ____

If there is a dry weather flow or evidence of an intermittent flow, be sure to include this form with your Annual Report and Certification.

If there is not a dry weather flow or evidence of an intermittent flow, this form should be retained with your SPPP.

Closeout Investigation Form

Municipality Information	
	Municipality:____ County ____ NJPDES # : **NJG**____PI ID #: ____ Team Member / Title: ____

Outfall #: ____Location: ____

Receiving Waterbody: ____

Basis for Submittal:

(☐) A non-stormwater discharge was found, but no source was located within six months.

(☐) An intermittent non-stormwater discharge was observed, and three unsuccessful investigations were conducted to investigate the discharge while it was flowing.

Describe each phase of your investigation, including dates. Attach additional pages as necessary:

Inspector's Name: ____

Title: ____

Signature: ____

Date: ____

Complete and attach this form to the appropriate Illicit Connection Inspection Report Form and submit with the Annual Report and Certification.

SPPP Form 13 – Stormwater Facilities Maintenance

All records must be available upon request by NJDEP.

1. Detail the program in place for the long-term cleaning, operation and maintenance of each stormwater facility owned or operated by the municipality.

The Borough of Oakland will implement a stormwater facility maintenance program to ensure that all stormwater facilities operated by the Borough function properly. The Borough operates the following:

- Valley Forge Retention Basin (2 Basins);
- East Oak Street Retention Basin (2 Basins); and
- Mountain Lakes Retention Basin.

These stormwater facilities will be inspected annually to ensure that they are functioning properly. In high risk areas, preventative maintenance will be performed on all stormwater facilities to ensure that they do not begin to fail.

2. Detail the program in place for ensuring the long-term cleaning, operation and maintenance of each stormwater facility NOT owned or operated by the municipality.

The Borough is creating an inventory of all privately owned stormwater facilities. Letters will be sent requesting a description of the facility's stormwater structures and site specific maintenance plans, logs, and any past or present issues or concerns. Once the inventory is complete the Borough will inspect the facilities on an annual basis. Additionally the Borough is in the process of adopting a revised Stormwater Control Ordinance and will implement the procedures outlined in instances of disrepair and noncompliance.

3. Indicate the location(s) of the Stormwater Facilities Inspection and Maintenance Logs listing the type of stormwater facilities inspected, location information, inspection dates, inspector name(s), findings, preventative and corrective maintenance performed.

Records of all stormwater facilities inspection and maintenance logs are kept at the Oakland Department of Public Works at: 63 Oak Street, Oakland, New Jersey 07436.

Note that maintenance activities must be reported in the annual report and records must be available upon request. DEP maintenance log templates are available at http://www.nj.gov/dep/stormwater/maintenance_guidance.htm (select specific logs from choices listed in the Field Manuals section).

Additional Resources: The NJ Hydrologic Modeling Database contains information and maps of stormwater management basins. To view the database map, see https://hydro.rutgers.edu. To download data in an Excel format, see https://hydro.rutgers.edu/public_data/.

Private Stormwater Facility Inspection Log

Address	Name	Block	Lot	Type	Inspector	Inspected		Repairs Needed		Date	Preventative/Corrective Maintenance	Findings
						Yes	No	Yes	No			
Thornton Rd.	Oakland Industrial Park	3207	1	Detention								
Thornton Rd.	Oakland Industrial Park	3207	1	Detention								
CARDINAL DRIVE	CARDINAL ESTATES	3505.01	2	Infiltration								
18 MULLER ROAD	GARDEN STATE LUMBER	1201	2.15	Detention								
178 Bauer Drive	Proposed Building	3311	4	Detention								
RAMAPO RIVER TRACE	RAMAPO RIVER RESERVE - PHASE 4	2502	4	Detention								
RAMAPO RIVER TRACE	RAMAPO RIVER RESERVE - PHASE 4	2502	4	Detention								
RAMAPO RIVER TRACE	RAMAPO RIVER RESERVE - PHASE 4	2502	4	Detention								
RAMAPO RIVER TRACE	RAMAPO RIVER RESERVE - PHASE 4	2502	4	Detention								
65 Edison Ave.	Building & Shop	12.01	2.19	Retention \ Wet Pond								
65 Edison Ave.	Building & Shop	12.01	2.19	Retention \ Wet Pond								
Laura Lane	Subdivision	3205	2.03	Infiltration \ Detention								
Ponds Way	Long Hill Estates	3204	3	Detention								
Ponds Way	Long Hill Estates	3204	3	Detention								
222 Ramapo Valley Rd.	Korean Presbyterian Church	201 & 330	1 & 3	Detention								
16 Muller Rd.	Warehouse Building	1201	2.16	Detention								

SPPP Form 14 – Total Maximum Daily Load Information

All records must be available upon request by NJDEP.

1. Using the Total Maximum Daily Load (TMDL) reports provided on www.nj.gov/dep/dwq/msrp-tmdl-rh.htm, list adopted TMDLs for the municipality, parameters addressed, and the affected water bodies that impact the municipality's MS4 program.

The Borough of Oakland has reviewed the TMDLs as follows:

Applicable Stream TMDL(s)
- Total Maximum Daily Loads for Fecal Coliform to Address 32 Streams in the Northeast Water Region
  Fecal Coliform - 2003 : Ramapo River near Mahwah between Pompton Lake and NY
- Total Maximum Daily Load for Mercury Impairments Based on Concentration in Fish Tissue Caused Mainly by Air Deposition to Address 122 HUC 14s Statewide
  Mercury - 2011 : Crystal Lake/Pond Brook
- Total Maximum Daily Load Report for Non-Tidal Passaic River Basin Addressing Phosphorus Impairments
  Total Phosphorus - 2008 : Crystal Lake/Pond Brook
- Total Maximum Daily Load Report for the Non-Tidal Passaic River Basin Addressing Phosphorus Impairments
  Total Phosphorus - 2008 : Ramapo R (Crystal Lake br to BearSwamp Bk)
- Total Maximum Daily Load Report for the Non-Tidal Passaic River Basin Addressing Phosphorus Impairments
  Total Phosphorus - 2008 : Ramapo R (below Crystal Lake bridge)

Applicable Lake TMDL(s)
- Total Maximum Daily Loads for Pathogens to Address 25 Lakes in the Northeast Water Region
  Fecal Coliform - 2007 : Crystal Lake
- Total Maximum Daily Load Report to Address Phosphorus Impairment in Pompton Lake and Ramapo River in the Northeast Water Region
  Total Phosphorus - 2008 : Pompton Lake

Applicable Shellfish TMDL(s)
- None

2. Describe how the permittee uses TMDL information to prioritize stormwater facilities maintenance projects and to address specific sources of stormwater pollutants.

The Borough of Oakland utilizes TMDL information to prevent the specific stormwater pollutants from entering the waterways and water bodies within the municipality.

Management strategies implemented for restricting Fecal Coliform are as follows:

- Pet Waste Ordinance No. 05-CODE-497 s enacted and enforced
- Pet Waste signage and plastic bag dispensaries in public areas

Management strategies implemented for restricting Total Phosphorus are as follows:

- Fertilizer Application Ordinance No. 09-CODE-602 is enacted and enforced
- No person may apply phosphorus fertilizer in outdoor areas, except as demonstrated to be needed for the specific soils and target vegetation in accordance with a soils test

Amendment to the Northeast Water Quality Management Plan

Total Maximum Daily Loads for Fecal Coliform to Address 32 Streams in the Northeast Water Region

Watershed Management Area 3
(Pompton, Pequannock, Wanaque, and Ramapo Rivers)
Watershed Management Area 4
(Lower Passaic and Saddle Rivers)
Watershed Management Area 5
(Hackensack River, Hudson River, and Pascack Brook)
Watershed Management Area 6
(Upper & Middle Passaic, Whippany, and Rockaway Rivers)

Proposed:	January 21, 2003
Established:	March 28, 2003
Approved (by EPA Region 2):	July 29, 2003
Adopted:	June 6, 2013

New Jersey Department of Environmental Protection
Division of Watershed Management
P.O. Box 418
Trenton, New Jersey 08625-0418

Contents

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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 Northeast Water Region as being impaired by 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 32 TMDLs addressing fecal coliform loads to the waterbodies identified in Table 1.

Table 1 Fecal coliform-impaired stream segments in the Northeast 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	3	Macopin River at Macopin Reservoir	01382450	Passaic	1.8
2	3	Wanaque River at Highland Avenue	01387010	Passaic	1.5
3	3	Ramapo River Near Mahwah	01387500	Passaic and Bergen	17.7
4	4	Passaic R. below Pompton R. at Two Bridges	01389005	Passaic	1.83
5	4	Preakness Brook Near Little Falls	01389080	Passaic	8.9
6	4	Deepavaal Brook at Fairfield	01389138	Essex	6.3
7	4	Passaic River at Little Falls	01389500	Passaic and Essex	15.0
8	4	Peckman River at West Paterson	01389600	Passaic and Essex	7.7
9	4	Goffle Brook at Hawthorne	01389850	Passaic and Bergen	10.5
10	4	Diamond Brook at Fair Lawn	01389860	Passaic and Essex	2.5
11	4	WB Saddle River at Upper Saddle River	01390445	Bergen	2.4
12	4	Saddle River at Ridgewood	01390500	Bergen	24.0
13	4	Ramsey Brook at Allendale	01390900	Bergen	6.4
14	4	HoHoKus Brook at Mouth at Paramus	01391100	Bergen	6.2
15	4	Saddle River at Fairlawn	01391200	Bergen	5.0
16	4	Saddle River at Lodi	01391500	Bergen	3.8
17	5	Hackensack River at River Vale	01377000	Bergen	10.0
18	5	Musquapsink Brook at River Vale	01377499	Bergen	7.3
19	5	Pascack Brook at Westwood	01377500	Bergen	6.6
20	5	Tenakill Brook at Cedar Lane at Closter	01378387	Bergen	10.2
21	5	Coles Brook at Hackensack	01378560	Bergen	11.1
22	6	Black Brook at Madison	01378855	Morris	2.4
23	6	Passaic River near Millington	01379000	Morris and Somerset	5.2
24	6	Dead River near Millington	01379200	Somerset	21.9
25	6	Passaic River near Chatham	01379500	Somerset, Union, Essex, and Morris	25.2
26	6	Canoe Brook near Summit	01379530	Essex	17.6
27	6	Rockaway River at Longwood Valley	01379680	Sussex and Morris	11.6
28	6	Rockaway River at Blackwell Street	01379853	Morris	3.5
29	6	Beaver Brook at Rockaway	01380100	Morris	17.0
30	6	Stony Brook at Boonton	01380320	Morris	13.1
31	6	Rockaway River at Pine Brook	01381200	Morris	6.8

TMDL Number	WMA	Station Name/Waterbody	Site ID	County(s)	River Miles
32	6	Passaic River at Two Bridges	01382000	Morris and Essex	14.1
Total River Miles:					305.0

These thirty-two TMDLs will serve as management approaches or restoration plans aimed at identifying the sources of fecal coliform and for setting goals for fecal coliform load reductions in order to attain applicable surface water quality standards (SWQS).

As stated in N.J.A.C. 7:9B-1.14(c) of the New Jersey Surface Water Quality Standards, "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 contributor to FC 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 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 other than stormwater (i.e. Publicly-Owned Treatment Works, POTWs) is an insignificant fraction of a percent of the total load, these fecal coliform TMDLs will not impose any change in current practices for POTWs and will not result in changes to existing effluent limits.

Using ambient water quality data monitoring conducted during the water years 1994-2000, 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 the TMDL and will be applied to nonpoint and stormwater sources as a whole or apportioned to categories of nonpoint and stormwater sources within the study area. The extent to which nonpoint and stormwater sources have been identified and the process by which they will become identified will vary by study area based on data availability, watershed size and complexity, and pollutant sources. Implementation plans for activities to be established in these watersheds 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 EPA's May 20, 2002 guidance document entitled: "Guidelines for Reviewing TMDLs under Existing Regulations issued in 1992," (Suftin, 2002) which describes the statutory and regulatory requirements for approvable TMDLs.

2.0 Introduction

Sublist 5 (also known as List 5 or, traditionally, the 303(d) List) of the State of New Jersey's proposed *2002 Integrated List of Waterbodies* identified several waterbodies in the Northeast Water Region as being impaired by pathogens, as evidenced by the presence of high fecal coliform concentrations. This report establishes 32 TMDLs, which address fecal coliform loads to the identified waterbodies. These TMDLs serve as management approaches or restoration plans aimed toward reducing loadings of fecal coliform from various sources in order to attain applicable surface water quality standards for the pathogen indication. Several of these waterbodies are listed in Sublist 5 for impairment cause by other pollutants. 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 until such time as TMDL evaluations for all pollutants have been completed and approved by the United States Environmental Protection Agency (USEPA).

3.0 Background

3.1. 305(b) Report and 303(d) List

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 biennially prepare and submit to the United States Environmental Protection Agency (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 biennially prepare and submit to USEPA a report that identifies waters that do not meet or are not expected to meet surface water quality standards (SWQS) after implementation of technology-based effluent limitations or other required controls. This report is commonly referred to as the 303(d) List. The listed waterbodies are considered water quality-limited and require total maximum daily load (TMDLs) evaluations. For waterbodies identified on the 303(d) List, there are three possible scenarios that may result in a waterbody being removed from the 303(d) List:

Scenario 1: A TMDL is established for the pollutant of concern;
Scenario 2: A determination is made that the waterbody is meeting water quality standards (no TMDL is required); or
Scenario 3: A determination is made that a TMDL is not the appropriate mechanism for achieving water quality standards and that other control actions will result in meeting standards

Where a TMDL is required (Scenario 1), it will: 1) specify the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards**;** and 2) allocate pollutant loadings among point and nonpoint pollutant sources.

Recent EPA guidance (Suftin, 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 this TMDL report, which includes thirty-two TMDLs, addresses 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.
12. Submittal letter.

3.2. Integrated List of Waterbodies

In November 2001, USEPA issued guidance that encouraged states to integrate the 305(b) Report and the 303(d) List into one report. 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 or have a range of designated use impairments, whereas Sublist 5 constitutes the traditional 303(d) List for waters impaired or threatened by a pollutant for which one or more TMDL evaluations are needed. Where more than one pollutant is associated with the impairment for a given waterbody, that waterbody will remain in Sublist 5 until one of the three possible delisting scenarios are completed. In the case of an Integrated List, however, the waterbody is not delisted but moved to one of the other categories.

Following USEPA's guidance, the Department chose to develop an Integrated Report for New Jersey. New Jersey's proposed *2002 Integrated List of Waterbodies* is based upon these five categories and identifies water quality limited surface waters in accordance with N.J.A.C. 7:15-6 and Section 303(d) of the CWA. These TMDLs address fecal coliform impairments, as listed on Sublist 5 of the State of New Jersey's proposed *2002 Integrated List of Waterbodies.*

3.3. Total Maximum Daily Loads (TMDLs)

A Total Maximum Daily Load (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), load allocations (LAs), and a margin of safety. A TMDL is developed as a mechanism for identifying all the contributors to surface water quality impacts and setting goals for load reductions for pollutants of concern as necessary to meet the SWQS.

Once one of the three possible delisting scenarios, noted above, is completed, states have the option to remove the waterbody and specific pollutant of concern from Sublist 5 of the *2002 Integrated List of Waterbodies* or maintain the waterbody in Sublist 5 until SWQS are achieved. The State of New Jersey will be removing the waterbodies for fecal impairment from Sublist 5 once these TMDLs are approved by USEPA.

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 the elevated concentration of fecal coliform bacterial. Fecal coliform concentrations have been found to exceed New Jersey's Surface Water Quality Standards (SWQS) published at N.J.A.C. 7-9B et seq. As reported in the proposed *2002 Integrated List of Waterbodies*, the New Jersey Department of Environmental Protection (NJDEP) identified waterbodies as being impaired by fecal coliform. The Northeast Water Region listings for fecal coliform impairment are identified in Table 2. Also identified in Table 2 are the river miles and management response associated with each listed segment. All of these waterbodies have a high priority ranking, as described in the *2002 Integrated List of Waterbodies*.

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

TMDL No.	WMA	Station Name/Waterbody	Site ID	River Miles	Management Response
1	3	Macopin River at Macopin Reservoir	1382450	**1.8**	establish TMDL
	3	Pequannock River at Macopin Intake Dam	1382500	**19.1**	none; Re-assessment shows non-impairment
	3	Wanaque River at Wanaque	1387000	**0.6**	water quality monitoring needed to identify if an impairment exists
2	3	Wanaque River at Highland Ave.	1387010	**1.5**	establish TMDL
3	3	Ramapo River near Mahwah	1387500	**17.7**	establish TMDL
4	4	Passaic River below Pompton River at Two Bridges	1389005	**1.8**	establish TMDL
5	4	Preakness Brook Near Little Falls	1389080	**8.9**	establish TMDL
6	4	Deepavaal Brook at Fairfield	1389138	**6.3**	establish TMDL
7	4	Passaic River at Little Falls	1389500	**15.0**	establish TMDL
8	4	Peckman River at West Paterson	1389600	**7.7**	establish TMDL
9	4	Goffle Brook at Hawthorne	1389850	**10.5**	establish TMDL
10	4	Diamond Brook at Fair Lawn	1389860	**2.5**	establish TMDL

TMDL No.	WMA	Station Name/Waterbody	Site ID	River Miles	Management Response
	4	Passaic River at Elmwood Park	1389880	**13.8**	CSO influence
11	4	WB Saddle River at Upper Saddle River	1390445	**2.4**	establish TMDL
12	4	Saddle River at Ridgewood	1390500	**24.0**	establish TMDL
13	4	Ramsey Brook at Allendale	1390900	**6.4**	establish TMDL
14	4	HoHoKus Brook at Mouth at Paramus	1391100	**6.2**	establish TMDL
15	4	Saddle River at Fairlawn	1391200	**5.0**	establish TMDL
16	4	Saddle River at Lodi	1391500	**3.8**	establish TMDL
17	5	Hackensack River at River Vale	1377000	**10.0**	establish TMDL
18	5	Musquapsink Brook at River Vale	1377499	**7.3**	establish TMDL
19	5	Pascack Brook at Westwood	1377500	**6.6**	establish TMDL
20	5	Tenakill Brook at Cedar Lane at Closter	1378387	**10.2**	establish TMDL
	5	Hackensack River at New Milford	1378500	**1.1**	water quality monitoring needed to identify if an impairment exists
21	5	Coles Brook at Hackensack	1378560	**11.1**	establish TMDL
22	6	Black Brook at Madison	1378855	**2.4**	establish TMDL
23	6	Passaic River near Millington	1379000	**5.2**	establish TMDL
24	6	Dead River Near Millington	1379200	**21.1**	establish TMDL
25	6	Passaic River near Chatham	1379500	**25.2**	establish TMDL
26	6	Canoe Brook near Summit	1379530	**17.6**	establish TMDL
27	6	Rockaway River at Longwood Valley	1379680	**11.6**	establish TMDL
28	6	Rockaway River at Blackwell Street	1379853	**3.5**	establish TMDL
29	6	Beaver Brook at Rockaway	1380100	**17.0**	establish TMDL
30	6	Stony Brook at Boonton	1380320	**13.1**	establish TMDL
31	6	Rockaway River at Pine Brook	1381200	**6.8**	establish TMDL
	6	Whippany River at Morristown	1381500	**6.6**	TMDL completed in 1999
	6	Whippany River near Pine Brook	1381800	**6.6**	TMDL completed in 1999
32	6	Passaic River at Two Bridges	1382000	**14.1**	establish TMDL

These thirty-two TMDLs will address 305 river miles or approximately 87% of the total river miles impaired by fecal coliform (352 total FC impaired river miles) in the northeast watershed region. Based on the detailed county hydrography stream coverage, 847 stream miles, or 47% of the stream segments in the northeast region (1800 total miles) are directly affected by the 32 TMDLs due to the fact that the implementation plans cover entire watersheds; not just impaired waterbody segments.

Table 2 identifies six segments for which TMDLs will not be developed at this time based on investigations following the *2002 Integrated List of Waterbodies* proposal. These segments, which are identified as requiring a management response other than "establish TMDL," are discussed in Appendix A along with the listing Sublist to which they will be moved.

These include: #01382500, Pequannock River at Macopin Intake Dam, #01387000, Wanaque River at Wanaque, #01378500, Hackensack River at New Milford, #01381500, Whippany

River at Morristown, #01381800, Whippany River near Pine Brook, and #01389880, Passaic River at Elmwood Park. For each of these segments an explanation of the management response is provided in Appendix A.

4.1. Description of the Northeast Water Region and Sublist 5 Waterbodies

4.1.1. Watershed Management Area 3

Watershed Management Area 3 (WMA 3) includes watersheds that receive water from the Highlands portion of New Jersey. The Pequannock, Wanaque and Ramapo Rivers all flow into the Pompton River. The Pompton River is, in turn, a major tributary to the Upper Passaic River. WMA 3 contains some of the State's major water supply reservoir systems including the Wanaque Reservoir, the largest surface water reservoir in New Jersey. There are four watersheds in WMA 3: Pompton, Ramapo, Pequannock and Wanaque River Watersheds. WMA 3 lies mostly in Passaic County but also includes parts of Bergen, Morris, and Sussex Counties.

The **Pequannock River Watershed** is 30 miles long and has a drainage area of 90 square miles. The headwaters are in Sussex County and the Pequannock River flows east, delineating the Morris/Passaic County boundary line. The Pequannock River joins the Wanaque River and flows to the Pompton River in Wayne Township. Some of the major impoundments within this watershed are Kikeout Reservoir, Lake Kinnelon Reservoir, Clinton Reservoir, Canistear Reservoir, Oak Ridge Reservoir, and Echo Lake Reservoir. The great majority of the land within this watershed is forested and protected for water supply purposes and parklands.

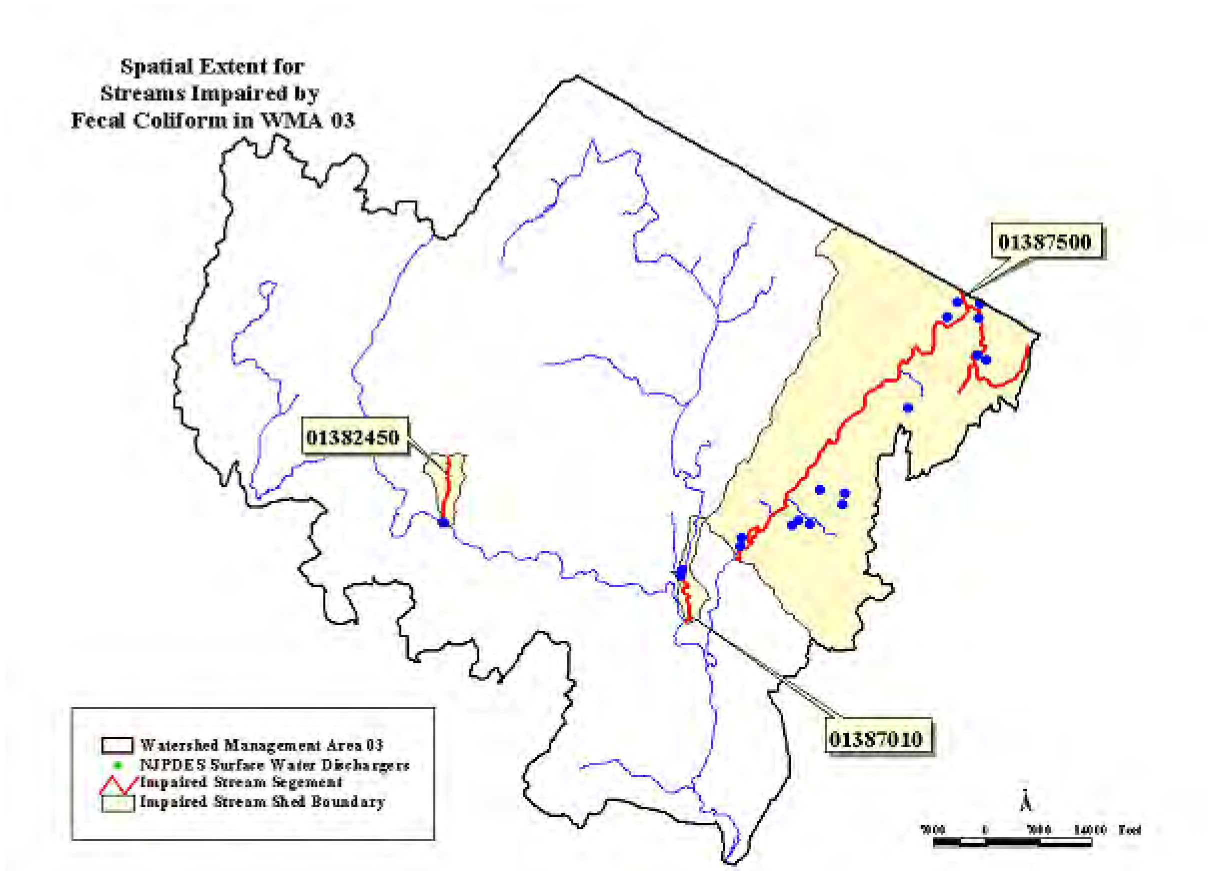
The **Ramapo River and Pompton River Watersheds** comprise a drainage area of about 160 square miles; 110 square miles of which are in New York State. The Ramapo River flows from New York into Bergen County and enters the Pequannock River to form the Pompton River in Wayne Township. The Ramapo River is 15 miles long on the New Jersey side. The Pompton River, a tributary to the Passaic River, is 7 miles long. Some of the major impoundments within this watershed include Point View Reservoir #1, Pompton Lakes, and Pines Lake. Over one-half of this watershed is undeveloped; however, new development is extensive in many areas.

The **Wanaque River Watershed** has a total drainage area of 108 square miles. The headwaters of the river lie within New York State as a minor tributary to Greenwood Lake (located half in New Jersey and half in New York). The New Jersey portion lies in West Milford, Passaic County. The Wanaque River joins up with the Pequannock River in Riverdale Township. The Wanaque River is 27 miles in length. Some of the major impoundments and lakes with this watershed are the Wanaque Reservoir, Greenwood Lake, Arcadia Lake and Lake Inez. Most of the land in this watershed is undeveloped, consisting of vacant lands, reservoirs, parks and farms.

Sublist 5 Waterbodies in WMA 3

Three river segments of the thirty-two impaired segments addressed in this report, the Macopin River (#01382450), Wanaque River (#01387010), and Ramapo River (#01387500) are located in WMA 3. The spatial extent of each segment is identified in Figure 1. River miles, watershed sizes and land use\land cover by percent area associated with each segment are listed in Table 3.

Figure 1 Spatial extent of Sublist 5 segments for which TMDLs are being developed in WMA 3



Segment #01382450, the Macopin River at Macopin Reservoir, has a watershed area of approximately 1.1 mi^2. Water quality from stations #01382410 and #01382450 were used in assessing the status and spatial extent of bacterial contamination. The length of the impaired stream segment is approximately 1.8 miles and is located on the Macopin River upstream of the confluence of the Macopin and the Pequannock Rivers. A total of 1.9 stream miles (based on county hydrologic stream coverage) are located within its watershed and will be included in the implementation plan.

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

	Segment ID		
	1382450	**1387010**	**1387500**
Sublist 5 impaired river miles (miles)	1.8	1.5	17.7
Total river miles within watershed and included in the implementation plan (miles)	1.9	4.0	87.8
Watershed size (acres)	711	708	26084
Landuse/Landcover			
Agriculture	0.00%	0.00%	0.43%
Barren Land	0.15%	0.17%	0.78%
Forest	89.74%	29.65%	51.20%
Urban	4.11%	55.19%	37.64%
Water	1.97%	4.71%	3.05%
Wetlands	4.04%	10.29%	6.89%

Segment #01387010, the Wanaque River at Highland Avenue at Wanaque, is located on the Wanaque River from the inlet of the Wanaque River at Inez Lake to the confluence of the Wanaque and Pequannock Rivers. Water quality from stations #01387014 and #01387041 were used in assessing the spatial extent of bacterial contamination. The stream segment length is approximately 1.5 miles with a watershed area of approximately 708 acres or 1.1 mi^2.

Segment #01387500, the Ramapo River near Mahwah, is located on the Ramapo River between the NJ-NY borders to the inlet at Pompton Lake. Water quality from station #01387500 was used to assess the spatial extent of bacterial contamination. The impaired stream segment length is approximately 17.7 miles. A total of 87.8 stream miles are located within its watershed and will be included in the implementation plan. The total drainage area for this segment is approximately 26084 acres or 40.8 mi^2.

4.1.2. Watershed Management Area 4

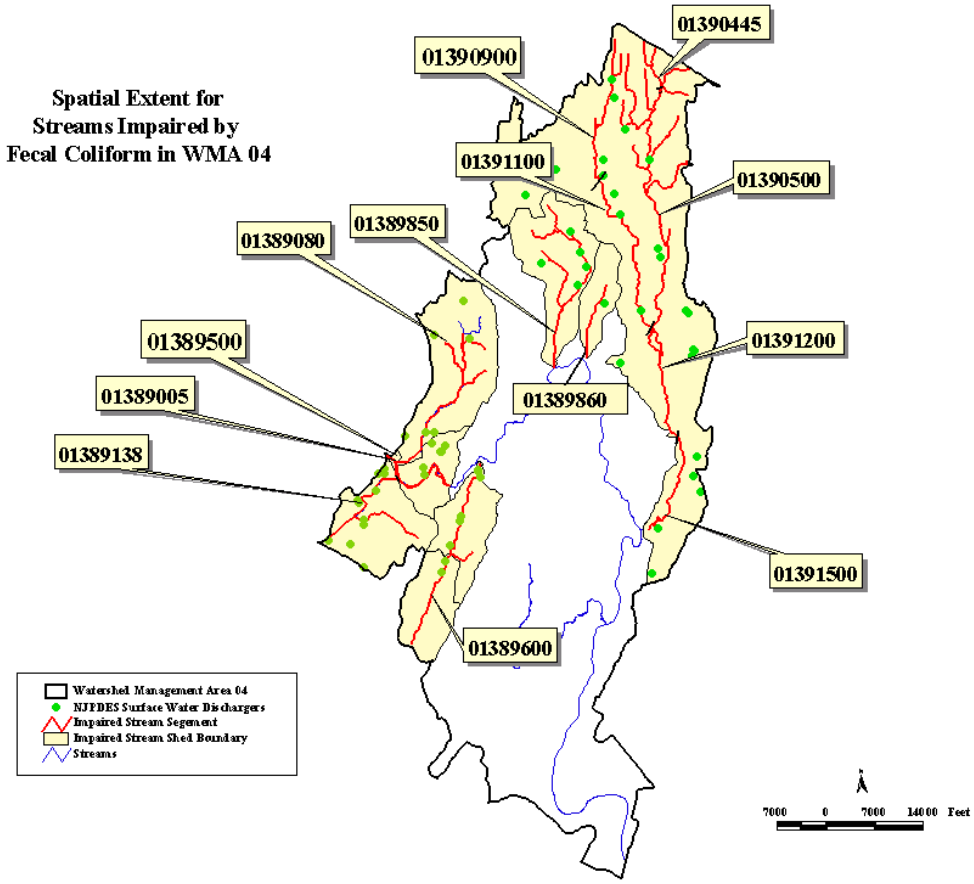
Watershed Management Area 4 (WMA 4) includes the Lower Passaic River (from the Pompton River confluence downstream to the Newark Bay) and its tributaries, including the Saddle River. The WMA 4 drainage area is approximately 180 square miles and lies within portions of Passaic, Essex, Hudson, Morris and Bergen Counties.

Two watersheds comprise WMA 4: the Lower Passaic River Watershed and Saddle River River Watershed. The **Lower Passaic River Watershed** originates from the confluence of the Pompton River downstream to the Newark Bay. This 33-mile section meanders through Bergen, Hudson, Passaic, and Essex Counties and includes a number of falls, culminating with the Great Falls at Paterson. This watershed has a drainage area of approximately 129 square miles. The major tributaries to this section of the Passaic River are the Saddle River, Preakness Brook, Second River, and Third River. The Saddle River is one of the larger tributaries to the Lower Passaic River. The **Saddle River Watershed** has a drainage area of approximately 51 square miles. Land in this watershed is extensively developed and contains many older cities and industrial centers including Newark, Paterson, Clifton, and East Orange.

Sublist 5 Waterbodies inWMA 4

Thirteen of the thirty-two TMDLs in the Northeast region are located in WMA 4. Included are several segments of the Saddle River (#01390500, #01391200 and #01391500), West Branch of the Saddle River (#01390445), Ramsey Brook (#01390900), Hohokus Brook (#01391100), the Passaic River (#01389005 and #01389500), Preakness Brook (#01389080), Deepavaal Brook (#01389138), Diamond Brook (#01389860), Goffle Brook (#01389850), and the Peckman River (#01389600). Several of these stream segments are geographically located in close proximity, thus, when these segments were found to contain similar levels of bacteria contamination (geometric means value), water quality data from these segments were grouped when calculating the TMDL. The spatial extent of each segment is identified in Figure 2. 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 4**



Given the proximity and similarity in impairment of several stations in the Saddle River watershed, six segments were grouped for the purposes of this report. These segments include: the West Branch Saddle River at Upper Saddle River (#01390445), Saddle River at Ridgewood (#01390500), Ramsey Brook at Allendale (#01390900), Hohokus Brook at Paramus (#01391100), Saddle River at Fairlawn (#01391200), and the Saddle River at Lodi (#01391500). These stream segments extend from the New York-New Jersey border to the confluence of the Saddle and Passaic Rivers and is contained within a 32933 acres, or 51.5 mi^2, watershed. The combined six stream segments total a length of 45.7 miles. The implementation plan will address all of streams located in this watershed (97.3 miles). Stations #01390445, #01390470, #01390510, #01390518, #01390900, #01391100, #01391490, and #01391500 were used to assess the status and spatial extent of bacterial contamination.

Table 4 **River miles, Watershed size, and Anderson Landuse classification for thirteen Sublist 5 segments, listed for fecal coliform, in WMA 4.**

	Segment ID		
	1390445, 1390500, 1390900, 1391100, 1391200, 1391500	**1389005,1389500, 1389080, 1389138,1389600**	**1389850,1389860**
Sublist 5 impaired river miles (miles)	45.7	29.8	10.5
Total river miles within watershed and included in the implementation plan (miles)	97.3	56.1	13.3
Watershed size (acres)	32933	14450	7590
Landuse/Landcover			
Agriculture	0.51%	0.12%	0.07%
Barren Land	0.20%	0.79%	0.27%
Forest	10.59%	20.81%	7.96%
Urban	81.89%	69.81%	88.51%
Water	1.06%	1.59%	0.46%
Wetlands	5.75%	6.88%	2.74%

Five Sublist 5 segments, the Passaic River below Pompton River at Two Bridges (#01389005), Passaic River at Little Falls (#1389500), Preakness Brook near Little Falls (#1389080), Deepavaal Brook at Fairfield (#01389138) and Peckman River at West Paterson (#01389600) were grouped based on similarities in geography and bacterial concentrations. Water quality from stations #01389500, #01389080, #01389138, #01382000, and #01389600 were used to assess the status and spatial extent of bacterial contamination. The combined length of the impaired stream segments is approximately 29.8 miles. A total of 56.1 stream miles are located within its watershed and will be included in the implementation plan. The total drainage area for this segment is approximately 14450 acres, or 22.6 mi^2.

Stream segments #01389850 and #01389860 were also grouped in calculating the TMDL percent reduction. Segment #01389850, Goffle Brook at Hawthorne, consists of the entire length of Goffle Brook to the confluence of Goffle Brook with the Passaic River. Segment #01389860, Diamond Brook at Fair Lawn, consists of the entire length of Diamond Brook to the confluence of Diamond Brook with the Passaic River. Water quality from stations #01389850 and #01389860 were used in assessing the status and spatial extent of bacterial contamination for these segments. The length of the impaired #01389850 stream segment is approximately 10.5 miles in a watershed area of approximately 5658 acres or 8.8 mi^2. A total of 13.3 river miles are in the watershed and will be included in the implementation plan. The length of the impaired #01389860 stream segment is approximately 2.5 miles in a watershed area of approximately 1932 acres or 3.0 mi^2.

4.1.3. Watershed Management Area 5

Watershed Management Area 5 (WMA 5) includes parts of Hudson and Bergen Counties and has a watershed area of approximately 165 square miles. WMA 5 is comprised of three watersheds: Hackensack River Watershed, Hudson River Watershed and Pascack Brook Watershed. The Hackensack River originates in New York State and flows south to the Newark Bay. New Jersey's portion of the river is 31 miles long. The Hackensack River Watershed is approximately 85 square miles. Major tributaries include the Pascack Brook, Berry's Creek, Overpeck Creek, and Wolf Creek. The **Pascack Brook Watershed** has a drainage area of approximately 51 square miles.

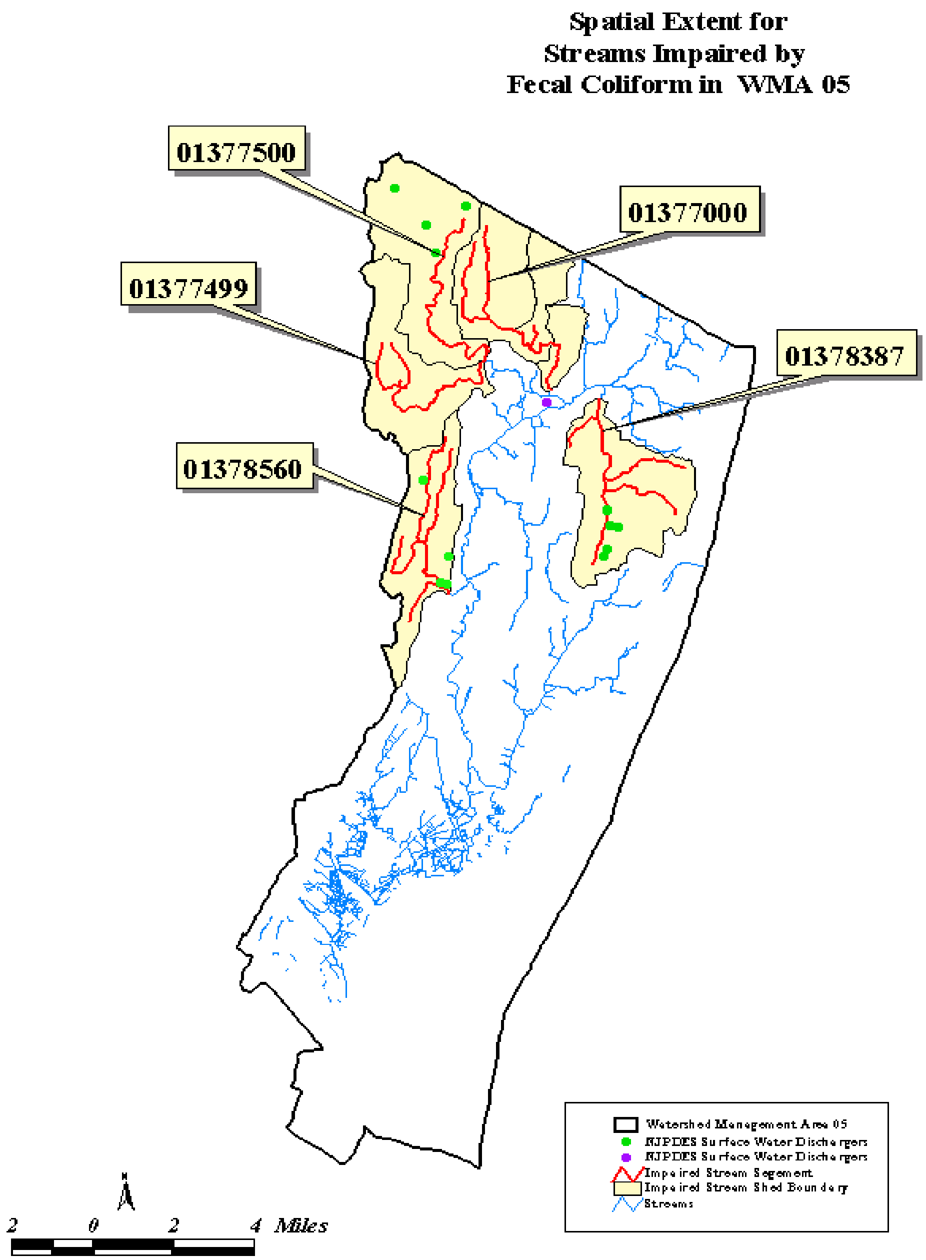
The New Jersey portion of the Hudson River is 315 miles long and begins in New York State at Lake Tear of the Clouds on the southwest side of Mount Marcy, New York's highest peak. The New Jersey portion of the **Hudson River Watershed** is approximately 29 square miles. The Hudson River forms the boundary between New Jersey and New York States.

Although WMA 5 is the most populated of all the WMAs, approximately 50% of the land is still undeveloped, with more than 30% residential development. The remaining developed land is commercial/industrial use. Much of the lower **Hackensack River Watershed** is tidal marsh known as the Hackensack Meadowlands. The Meadowlands are home to more than 700 plant and animal species including several rare and threatened species

Sublist 5 Waterbodies in WMA 5

Five of the thirty-two TMDLs in this report are located in WMA 5. Included are segments in the Hackensack River (#01377000), Pascack Brook (#01377500), Musquapsink Brook (#01377499), Tenakill Brook (#01378387), and Coles Brook (#01378560). The spatial extent of each segment is identified in Figure 3. River miles, watershed size and land use\land cover by percent area associated with each segment are listed in Table 5.

Figure 3 Spatial extent of Sublist 5 segments for which TMDLs are being developed in WMA 5



Hackensack River at River Vale, (segment #01377000) flows across the New Jersey/New York State line in River Vale/Old Tappan and extends to the inlet of the Oradell Reservoir. Water quality from stations #01377000 and #01376970 (Hackensack River at Old Tappan) were used in assessing the status and spatial extent of bacterial contamination for this segment. The length of the impaired stream segment is approximately 10.0 miles in a watershed area of approximately 5912 acres or 9.2 mi^2, however a total of 20.3 river miles are located in the watershed and will be included in the implementation plan.

Table 5 River miles, Watershed size, and Anderson Landuse classification for five Sublist 5 segments, listed for fecal coliform, in WMA 5.

	Segment ID			
	1377000	**1377499, 1377500**	**1378387**	**1378560**
Sublist 5 impaired river miles (miles)	10.0	13.8	10.2	11.1
Total river miles within watershed and included in the implementation plan (miles)	20.3	33.3	10.8	14.8
Watershed size (acres)	5902	10430	5626	4241
Landuse/Landcover				
Agriculture	0.07%	0.95%	0.17%	0.00%
Barren Land	0.42%	0.30%	0.13%	0.18%
Forest	13.85%	11.53%	11.32%	4.98%
Urban	65.52%	79.72%	84.43%	91.80%
Water	12.09%	2.31%	0.44%	0.19%
Wetlands	8.05%	5.18%	3.51%	2.84%

Pascack Brook at Westwood, segment #01377500, and Musquapsink Brook at River Vale segment #01377500, were also grouped based on similarities in geography and extent of bacterial contamination. Water quality from stations #01377499 and #01377500 were used in assessing the status and spatial extent of bacterial contamination for these segments. The combined length of the impaired stream segments is approximately 13.8 miles in a watershed area of approximately 10429 acres or 16.3 mi^2, however a total of 33.3 river miles are located within the watershed and will be included in the implementation plan.

Tenakill Brook at Cedar Lane at Closter, segment #01378387, consists of the entire length of Tenakill Brook upstream of USGS station #01378387. Water quality from this station #01378387 was used in assessing the status and spatial extent of bacterial contamination for this segment. The length of the impaired stream segment is approximately 10.2 miles in a watershed area of approximately 5625 acres or 8.8 mi^2. A total of 10.8 river miles are included in this watershed and will be included in the implementation plan

Coles Brook at Hackensack, segment #01378560, consists of the entire length of Coles Brook upstream of USGS station #01378560. Water quality from station #01378560 was used in assessing the status and spatial extent of bacterial contamination for this segment. The length of the impaired stream segment is approximately 11.1 miles in a watershed area of approximately 4240 acres or 6.6 mi^2. A total of 14.8 river miles are included in this watershed and will be included in the implementation plan.

4.1.4. Watershed Management Area 6

Watershed Management Area 6 (WMA 6) represents the area drained by waters from the upper reaches of the Passaic River Basin including the Passaic River from its headwaters in Morris County to the confluence of the Pompton River. Extensive suburban development and reliance upon ground water sources for water supply characterize WMA 6. WMA 6 lies in portions of Morris, Somerset, Sussex and Essex counties and includes the Upper & Middle Passaic River, Whippany River and Rockaway River Watersheds.

The **Upper Passaic River Watershed** is approximately 50 miles long and consists of a drainage area approximately 200 square miles in portions of Somerset, Morris, and Essex Counties. This section of the Passaic River is a significant source of drinking water for a much of northeastern New Jersey. Major tributaries to the Upper Passaic River include the Dead River, Rockaway River, Whippany River, and Black Brook. The Great Swamp National Wildlife Refuge is located within the Upper Passaic River Watershed. Approximately one-half of this watershed is undeveloped or vacant, with the remainder primarily residential and commercial; however, this watershed is facing significant development in the vacant areas. This watershed is subject to frequent flooding.

The **Middle Passaic River Watershed** includes Great Piece Meadows and Deepavaal Brook. The Great Piece Meadows is a freshwater wetland with a drainage area of approximately 12 square miles and is prone to flooding. Various owners privately own the Great Piece Meadows.

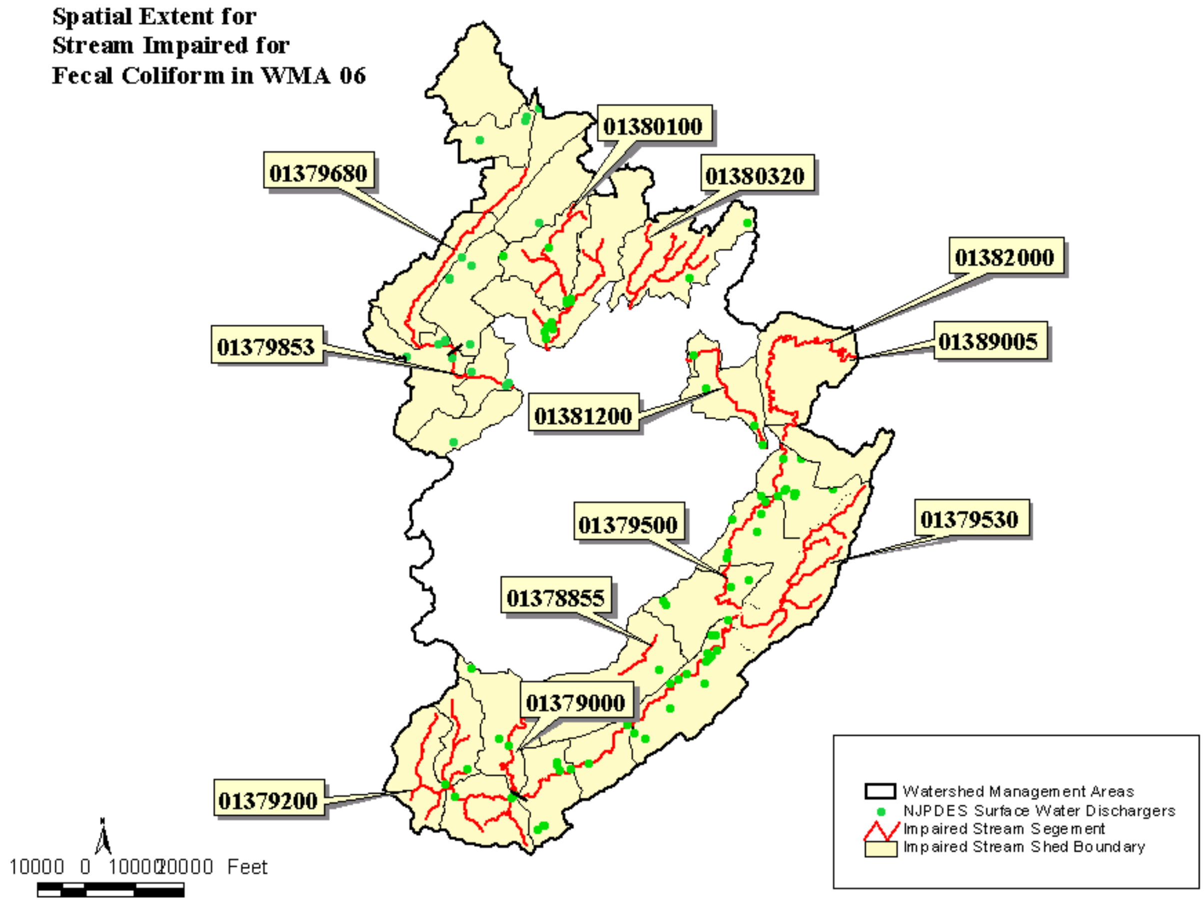
The **Rockaway River Watershed** has a drainage area of approximately 133 square miles and is approximately 37 miles long. The Rockaway River flows east to its confluence with the Whippany River at Pine Brook. Major tributaries include Stone Brook, Mill Brook, Beaver Brook, and Den Brook. The land use patterns in this area are complex and include vacant areas, parklands, residential development and industrial/commercial uses.

The **Whippany River Watershed** drains approximately 69 square miles and is located entirely within Morris County. The river is approximately 18 miles long and flows to the Passaic River. Two major tributaries are Black Brook and Troy Brook. The population is centered in Morristown, Parsippany-Troy Hills, Hanover Township and East Hanover Township.

Sublist 5 Waterbodies WMA 6

Eleven of the thirty-two TMDLs in this report are located in WMA 6. Included are segments in the Black Brook (#01378855), Dead River (#01379200), Passaic River (#01379000, #01379500, and #01382000), Rockaway River (#01379680, #01379853, and #01381200), Canoe Brook (#01379530), Beaver Brook (#01380100), and Stony Brook (#01380320). The spatial extent of each segment is identified in Figure 4. River miles, watershed size and land use\land cover by percent area associated with each segment are listed in Table 6.

Figure 4 Spatial extent of Sublist 5 segments for which TMDLs are being developed in WMA 6



Five segments, the Black Brook at Madison (#01378855), Passaic River near Millington (#01379000), Dead River near Millington (#01379200), the Passaic River near Catham (#01379500), and Canoe Brook near Summit (#01379530), comprise a large portion of the Passaic River headwater region and were grouped based on geographical similarities and bacterial geometric mean concentrations. Water quality from stations #01378855, #01379000, #01379200, #001379500, and #01379530 were used to assess the status and spatial extent of bacterial contamination. The combined length of the impaired stream segments is approximately 71.0 miles. A total of 204.8 stream miles are located within its watershed and will be included in the implementation plan. The total drainage area for this segment is approximately 66,759 acres, or 104.3 mi^2.

Table 6 River miles, Watershed size, and Anderson Landuse classification for eleven Sublist 5 segments, listed for fecal coliform, in WMA 6.

	Segment ID					
	1378855,1379000, 1379200,1379500, 1379530	**1379680 1379853**	**1380100**	**1380320**	**1381200**	**1382000**
Sublist 5 impaired river miles (miles)	71.0	15.1	16.9	13.1	6.8	14.9
Total river miles within watershed and included in the implementation plan (miles)	204.8	105.8	43.0	25.0	18.4	53.0
Watershed size (acres)	66759	39246	14528	7864	4861	11019
Landuse/Landcover						
Agriculture	2.23%	0.36%	0.16%	2.00%	1.44%	0.52%
Barren Land	0.90%	1.23%	2.66%	0.36%	1.62%	0.51%
Forest	19.21%	55.51%	63.14%	62.92%	13.07%	11.83%
Urban	51.57%	27.70%	17.22%	21.24%	66.79%	42.42%
Water	1.45%	3.75%	7.08%	4.03%	2.14%	3.00%
Wetlands	24.65%	11.44%	9.74%	9.46%	14.94%	41.72%

Rockaway River at Longwood Valley, (#01379680), and Rockaway River at Blackwell St. (#01379853) were grouped based on similarities in geography and bacterial contamination. Water quality from stations #01379680, #01379700 and #01379853 were used in assessing the spatial extent of bacterial contamination for these segments. The combined length of the impaired stream segments is approximately 15.1 miles in a watershed area of approximately 39246 acres or 61.3 mi^2. A total of 105.8 river miles are located within the watershed and will be included in the implementation plan.

Beaver Brook at Rockaway, segment #01380100, consists of the entire Beaver Brook to the confluence of Beaver Brook and the Rockaway River. Water quality from station #01380100 was used to assess the status and spatial extent of bacterial contamination. The impaired stream segment length is approximately 16.9 miles. A total of 43.0 stream miles are located within its watershed and will be included in the implementation plan. The total drainage area for this segment is approximately 14528 acres or 22.7 mi^2.

Segment #01380320, Stony Brook at Boonton, consists of the entire Stony Brook to the confluence of Stony Brook and the Rockaway River. Water quality from station #01380100 was used to assess the status and spatial extent of bacterial contamination. The impaired stream segment length is approximately 13.1 miles. A total of 25.0 stream miles are located within its watershed and will be included in the implementation plan. The total drainage area for this segment is approximately 7864 acres or 12.3 mi^2.

Segment #01381200, Rockaway River at Pine Brook, is located on the downstream portion of the Rockaway River between the outlet of the Boonton Reservoir and the confluence of the

Rockaway and the Whippany Rivers. Water quality from station #01381200 was used to assess the status and spatial extent of bacterial contamination. The impaired stream segment length is approximately 6.8 miles. A total of 18.4 stream miles are located within its watershed and will be included in the implementation plan. The total drainage area for this segment is approximately 4861 acres or 7.6 mi^2.

Segment #01382000, Passaic River at Two Bridges, is located on the Passaic River between the confluence of the Whippany and Passaic Rivers to the confluence of the Passaic and Pompton Rivers. Water quality from station #01382000 was used to assess the status and spatial extent of bacterial contamination. This segment was not grouped with other segments based on its relatively lower bacterial concentrations compared with those found in up and downstream on the Passaic River. The impaired stream segment length is approximately 14.9 miles in a drainage area of approximately 11019 acres or 17.2 mi^2. A total of 53.0 stream miles are located within its watershed and will be included in the implementation plan.

4.2. Data Sources

The Department's Geographic Information System (GIS) was used extensively to describe northeast 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.
- 2002 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 XXX 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
- 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).

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 sample taken during any 30-day period exceed 400 CFU/100 ml in FW2 waters".

All of the waterbodies covered under these TMDLs have a FW1 or FW2 classification (NJAC 7:9B-1.12). The designated use, 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 Northeast Water Region is as stated below:

In all FW1 waters, the designated uses are:
1. Set aside for posterity to represent the natural aquatic environment and its associated biota;
2. Primary and secondary contact recreation;
3. Maintenance, migration and propagation of the natural and established aquatic biota; and
4. Any other reasonable uses.

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, the 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, at least until New Jersey has the transition to *E. coli* and enterococci in the Department's SWQS and until sufficient data have been collected to either develop a TMDL or to support a proposal to move the waterbodies to one of the other four categories.

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

All point sources of fecal coliform other than stormwater for these TMDLs are listed in Appendix B. These point sources include all municipal wastewater treatment plants (Major and Minor Industrial discharges) as will as industrial treatment plants that also treat domestic wastewater (Major and Minor Industrial discharges that have limits for bacterial quality indicators in their permits). Municipal treatment plants and industrial treatment plants that may include domestic wastewater in their effluent 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 urface Water Quality Standards at N.J.A.C. 7:9B-1.(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 treatment plants.

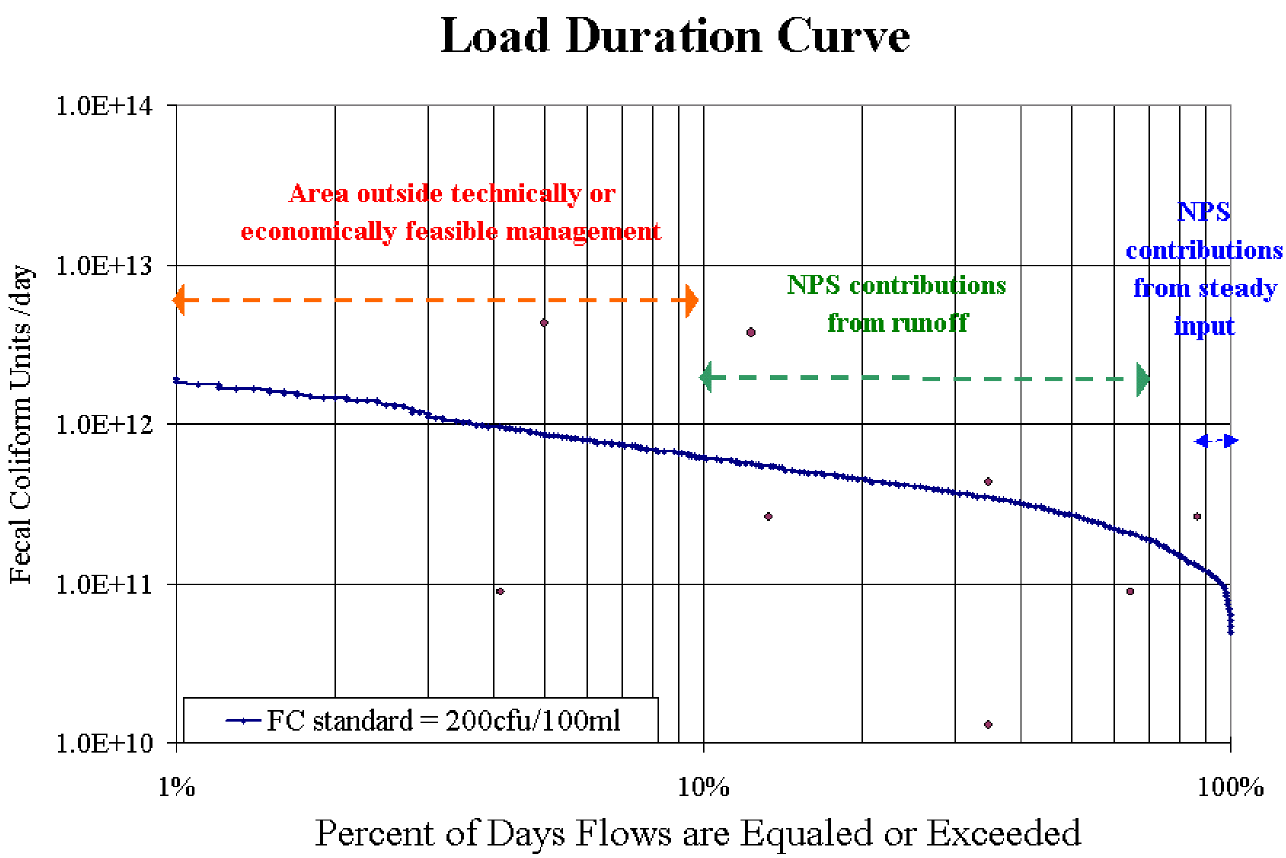
Since POTWs and industrial treatment plants routinely achieve essentially complete disinfection (less than 20 CFU/100ml), the requirement to disinfect is, in effect, more stringent than the fecal coliform effluent criteria. The percent of the total point source contribution is an insignificant fraction of the total load. Consequently, these fecal coliform TMDLs will not impose any change in current practices for POTWs and industrial treatment plants and will not result in changes to existing effluent limits. The methodology used in this report is inappropriate for use in areas affected by combined sewer overflows (CSOs) or in areas influenced by tidal action. Therefore, stream segments falling into these two categories will be excluded from the discussion of TMDLs in this report.

6.2. Assessment of Nonpoint and Stormwater Sources

Nonpoint and stormwater 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, appropriate enforcement measures will be taken to eliminate them.

When streamflow gauge 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 5 represents a LDC using the 200 CFU/100 ml criterion.

Figure 5 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.

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 model calibrations can be very difficult to calibrate. Options available to control non-point sources of fecal coliform typically include measures such as goose management strategies, pooper-scooper ordinances, and septic system maintenance. However, the effectiveness of these control measures is not easily measured. Given these considerations, detailed water quality modeling may not provide adequate insight or guidance toward the development of implementation plans for fecal coliform reductions.

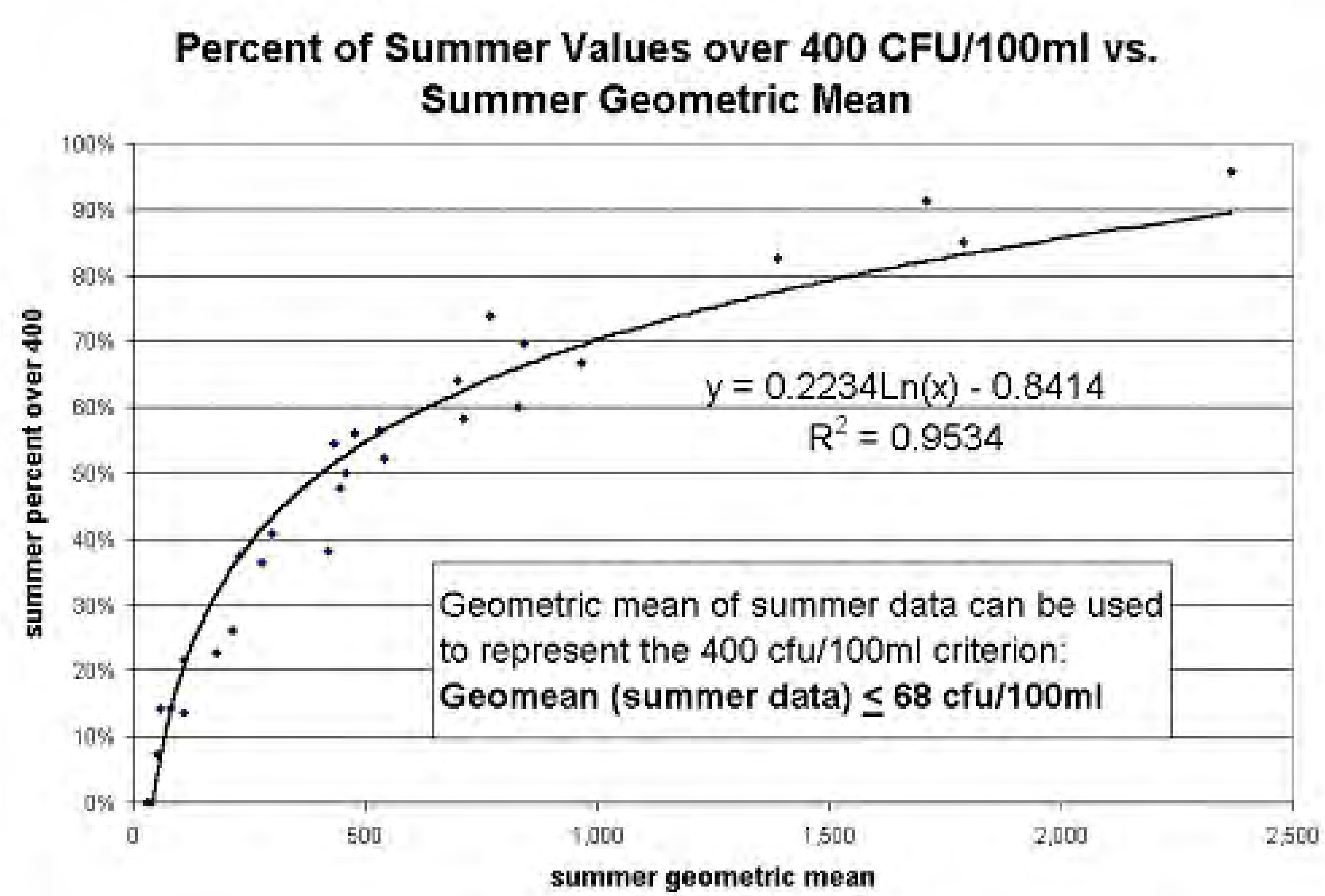
As described in EPA guidance, a TMDL identifies the loading capacity of a waterbody for a particular pollutant. EPA regulations define loading capacity as the greatest amount of loading that a waterbody can receive without violating water quality standards (40 C.F.R. 130.2). The loadings are required 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 1994-2000 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 6). Thus, each datapoint on Figure 6 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. 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 6 **Percent of summer values over 400 CFU/100ml as a function of summer geometric mean values**



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

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

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

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

$$400CFU\ criteria Percent Reduction = \frac{(Summer Geometric mean - (68 - e))}{Summer Geometric mean} \times 100\%$$ Equation 4

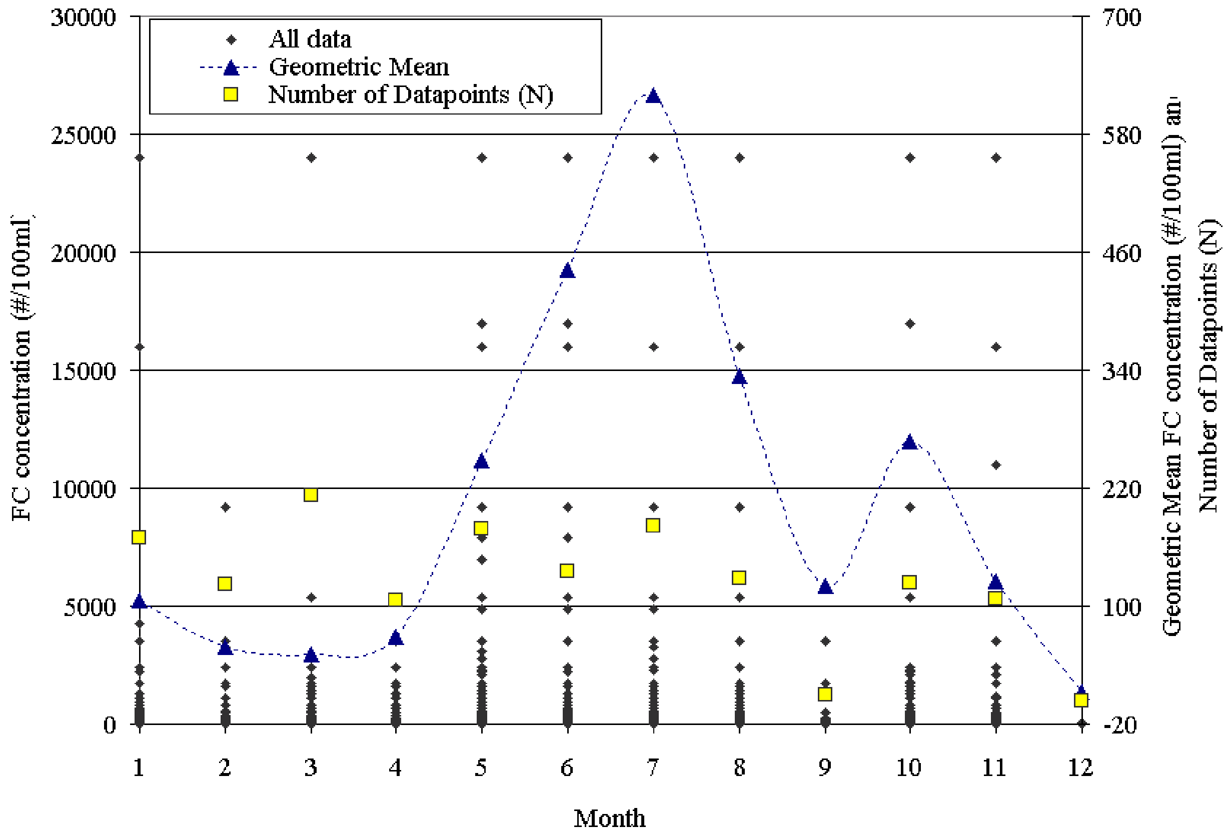
where:
e = (margin of safety)

This percent reduction can be applied to nonpoint and stormwater sources as a whole or be apportioned to categories of nonpoint and stormwater sources within the study area. The extent to which nonpoint and stormwater sources have been identified and the process by which they will become identified will vary 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 7. 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 7, 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 for meeting year round protections and designated uses.

Figure 7 **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. Implicitly, a 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 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 instream 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:

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

LC = loading capacity for a particular stream;
PR = percent reduction as specified in Tables 7-10;

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 (POTWs, industrial, etc.). WLAs are hereby established for all NJPDES-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 nonpoint sources. Both WLAs and LAs are expressed as percentage reductions for particular stream segments.

Table 7 identifies the required percent reduction necessary for each stream segment or group of segments to meet the fecal coliform SWQS. The reductions reported in these tables 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 7 were equal to the percent required to meet the 400 CFU/100ml criteria.

Table 7 TMDLs for fecal coliform-impaired stream segments in the Northeast 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 No.	WMA	Station Name/Waterbody	Sublist 5 Segment	Summer Geometric Mean CFU/100ml	MOS as a percent of the target conc.[1]	Percent Reduction (LA) without MOS	Percent Reduction (LA) with MOS	Wasteload Allocation (WLA) as a Percent Reduction, with MOS
1	3	Macopin River at Macopin Reservoir	01382450	59	46%	-16%	**37%**	**37%**
2	3	Wanaque River at Highland Avenue	01387010	208	53%	67%	**85%**	**85%**
3	3	Ramapo River near Mahwah	01387500	431	44%	84%	**91%**	**91%**

TMDL No.	WMA	Station Name/Waterbody	Sublist 5 Segment	Summer Geometric Mean CFU/100ml	MOS as a percent of the target conc.[1]	Percent Reduction (LA) without MOS	Percent Reduction (LA) with MOS	Wasteload Allocation (WLA) as a Percent Reduction, with MOS
4	4	West Branch Saddle River at Upper Saddle R.	01390445	1,144	30%	94%	**96%**	**96%**
5	4	Saddle River at Saddle River	01390500					
6	4	Saddle River at Ridgewood Ave at Ridgewood	01390900					
7	4	Hohokus Brook at Mouth at Paramus	01391100					
8	4	Saddle River at Rochelle Park	01391200					
9	4	Saddle River at Lodi	01391500					
10	4	Passaic R. below Pompton R. at Two Bridges	01389005	652	30%	90%	**93%**	**93%**
11	4	Passaic River at Little Falls	01389500					
12	4	Preakness Brook near Little Falls	01389080					
13	4	Peckman River at West Paterson	01389600					
14	4	Deepavaal Brook at Fairfield	01389138					
15	4	Diamond Brook at Fair Lawn	01389860	1,544	47%	96%	**98%**	**98%**
16	4	Goffle Brook at Hawthorne	01389850					
17	5	Hackensack River at River Vale	01377000	294	34%	77%	**85%**	**85%**
18	5	Musquapsink Brook at River Vale	01377499	709	54%	90%	**96%**	**96%**
19	5	Pascack Brook at Westwood	01377500					
20	5	Tenakill Brook at Cedar Lane at Closter	01378387	159	91%	57%	**96%**	**96%**
21	5	Coles Brook at Hackensack	01378560	1,093	68%	94%	**98%**	**98%**
22	6	Black Brook at Madison	01378855	1,370	29%	95%	**96%**	**96%**
23	6	Passaic River near Millington	01379000					
24	6	Dead River Near Millington	01379200					
25	6	Passaic River near Chatham	01379500					
26	6	Canoe Brook near Summit	01379530					
27	6	Rockaway River at Longwood Valley	01379680	373	54%	82%	**92%**	**92%**
28	6	Rockaway River at Blackwell Street	01379853					
29	6	Beaver Brook at Rockaway	01380100	362	43%	81%	**89%**	**89%**
30	6	Stony Brook at Boonton	01380320	214	32%	68%	**78%**	**78%**
31	6	Rockaway River at Pine Brook	01381200	571	28%	88%	**91%**	**91%**
32	6	Passaic River at Two Bridges	01382000	276	33%	75%	**83%**	**83%**

[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.

9.0 Follow - up Monitoring

The NJDEP's primary surface water quality monitoring unit is the Office of Water Monitoring Management. In association with the Water Resources Division of the U.S. Geological Survey, the NJDEP have 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. Although other units also perform monitoring functions, the ASMN will remain a principal source of FC monitoring.

10.0 Implementation

When bacterial sources are easily identifiable, measures outlined in section 10.2, Source Categories and Best Management Practices (BMPs), will be applied to reduce bacterial loading to meet SWQ standards. When bacterial sources are not easily identifiable, load duration curves will be used in conjunction with bacterial source tracking, if necessary, to identify pathogen sources.

Much of the stormwater discharged to the surface waters in question is discharged through "small municipal separate storm sewer systems" (small MS4s) that are proposed to be regulated under the Department's proposed Phase II NJPDES stormwater rules for the Municipal Stormwater Regulation Program. Under those proposed rules and associated draft general permits, nearly all municipalities (and various county, State, and other agencies) in the Northeast 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 small MS4, 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. The WLAs and LAs in Table 7 are not themselves "Additional Measures" under proposed N.J.A.C. 7:14A-25.6 or 25.8.

Sections 10.2 and 10.4 identify BMPs and monitoring measures that in some respects are in addition to the control measures required in these general permits. These BMPs and monitoring measures are also not "Additional Measures" under proposed N.J.A.C. 7:14A-25.6 or 25.8. However, the Department will seek to have these BMPs and monitoring measures implemented through means other than requirements in these general permits. Also, in the future, the Department may propose and adopt WQM plan amendments that identify one or more of these BMPs (or other BMPs) and monitoring measures as "Additional Measures" for some or all of the permittees under these general permits.

10.1. Load Duration Curve (LDC)

As explained in Section 6.2, a LDC can be a beneficial tool as a first step in identifying potential pathogen sources. LDCs for listed segments in the Northeast 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.

10.2. Source Categories and Best Management Practices

The TMDLs developed in this report were developed with the assistance of stakeholders in WMAs 3, 4, 5 and 6 as part of the Department's ongoing watershed management efforts. Through the creation of the watershed management planning process over the past several years, Public Advisory Committees (PACs) and Technical Advisory Committees (TACs) were created in all 20 WMAs. Whereas the PACs serve in an advisory capacity to the New Jersey Department of Environmental Protection, and examined and commented on a myriad of issues in the watersheds, the TACs were focused on the scientific, ecological, and engineering issues relevant to the mission of the PAC. The Department in collaboration with the Northeast TACs narrowed the scope of the primary sources of fecal contamination to the following:

Non-Human Sources of Fecal Coliform

- Canada geese
- Pet Waste
- Stormwater basins
- Direct stormwater discharges to waterbodies
- Farms, zoos and livestock

Human Sources of Fecal Coliform

- Malfunctioning or older improperly sized septic systems

- Failing sewage conveyance systems
- Improper garbage storage and disposal

10.3. Management Strategies

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). A combination of best management practices and direct remedies of illicit sources that are found through track-down monitoring will be used to implement these TMDLs.

10.3.1. Short-Term Management Strategies

Short-term management strategies include existing projects dubbed "Action Now" that are on the ground projects funded by the Department to address fecal and other NPS impairments to an impaired waterbody. These projects include stream bank restoration projects, ordinance development and catchbasin cleanouts. Funding sources include Clean Water Act 319(h) funds and State sources. Since 1998, 319(h) funds have provided approximately $3 million annually.Priority is given to funding projects that address TMDL implementation, development of stormwater management plans and projects that address impairment based on Sublist 5 listed waterbodies.

An example of such a project is a two-year project evaluating stormwater quality in a low-density residential area located in Hanover Township, Morris County. As part of the study, catch basin cleaning and public education and outreach were conducted. The outreach program targeted homeowners, landscapers and pet owners and was based on enhancing awareness and effecting behaviors that would reduce specific potential sources of NPS contaminants.

10.3.2. Long–Term Management Strategies

While short-term management measures will begin to reduce sources of fecal coliform in the Northeast Water Region, additional measures will be needed to verify and further reduce or eliminate these sources. Some of these measures may be implemented now, where resources are available and sources have already been identified as causing the fecal impairment. Both short-term and long-term management strategies that address fecal reduction related to these identified sources may be eligible for future Departmental funding.

Source Categories for Long-Term Management Strategies

1) Canada Geese

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 Northeast Region. Geese may produce up to 1½ pounds of fecal matter a day.

Canada Goose Damage Management Plan

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 exhaustedthe 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.

2) Stormwater Detention Basins and Impoundments

Stormwater detention basins may act as sources of fecal coliform due to the accumulation of geese and pet waste in basins. Under certain conditions, coliform will increase in numbers in basins. As a result, significant quantities of fecal coliform can be discharged during storm events.

Impoundments created by small dams across streams have been a measure commonly used for flood control by municipalities in New Jersey. In addition to flood control, the impoundments were often incorporated into public parks in order to provide recreational opportunities for residents. Many of the impoundments are surrounded by mowed turf areas, which in combination with open water serve as an ideal habitat for geese and an attraction for pet walking. Specific management measures to reduce fecal coliform inputs to these waterbodies include:

- Development of Stormwater Management Plan
- Establishment of Riparian Buffers and "no mow" zones
- No feed ordinances for all waterfowl and wildlife and signage
- Retrofit of detention/retention basins to achieve water quality control
- Conduct regularly scheduled stormwater basin cleanout and maintenance, storm sewer inlet cleanouts and street sweeping programs

3) Pet Waste

Specific management measures to reduce pet waste include:

- Adoption of pet waste disposal i.e. pooper scooper ordinances
- Signage in parks and other public recreation areas
- Provide plastic bags dispensers in public recreation areas

4) Agricultural

Agricultural activities are potential sources of fecal coliform. Possible contributors are direct contributions from livestock permitted to traverse streams and stream corridors, manure management from feeding operations, 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.

Agricultural Conservation Programs

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. There are a number of USDA farm programs currently addressing NPS pollution. A few of these 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 Wetland Reserve Program (WRP)** is designed to address the restoration of previously farmed wetlands. Easements are purchased for a 10-year, 30-year, or permanent duration.

- **Integrated Crop Management** is a best management practice designed to reduce the application of fertilizers and herbicides using soil samples and education to control nutrient and pesticide application to cropland.

- **The Farmland Preservation Program (FPP)** is designed to strengthen the agricultural industry and preserve important farmlands to enhance the economy and quality of life in the Garden State. Four different programs are available: The eight-year Program, where landowners voluntarily restrict non-agricultural development on their land for 8 years. In exchange, participants are eligible for cost-sharing grants for soil and water conservation projects, as well as other statutory benefits and protections. The Easement Purchase Program, where landowners sell the development rights on their land to the County Agriculture Development Board (CADB), non-profit organizations or directly to the State. Compensation for this sale is based upon the appraised value of the development rights on the land. The landowner retains ownership of the land and is eligible for cost-sharing grants for soil and water conservation projects and other benefits. The Fee Simple Program, where farms are acquired by the State Agriculture Development Committee (SADC, which is in but not of, the NJDA) based upon their fair market value and auction them off to private owners, after agricultural deed restrictions have been placed on the land. Lastly, there is the Easement Donation Program, where landowners donate their development easements to the SADC or the CADB. All of these programs have been in place since 1983.

- **The Soil & Water Conservation Cost-Sharing Program** is available to participants in a Farmland Preservation Program pursuant to the Agriculture Retention and Development Act. A Farmland Preservation Program (FPP) means any voluntary FPP or municipally approved FPP, the duration of which is at least 8 years, which has as its principal purpose as long term preservation of significant masses of reasonably contiguous agricultural land within agricultural development areas. The maintenance and support of increased agricultural production must be the first priority use of the land. Eligible practices include erosion control, animal waste control facilities, and water management practices. Cost sharing is provided for up to 50% of the cost to establish eligible practices.

- **The State Conservation Cost Share Program (CCSP)** is administered by the State Soil Conservation Committee and is integrated with the federal Environmental Quality Incentives Program (EQIP). It provides technical and financial assistance to producers for prevention and control of nonpoint sources of pollution. Cost sharing is provided for up to 75%, and in some cases 90% of the cost of installing approved conservation practices. Applications are approved based upon their environmental benefits and water quality enhancements.

- **Conservation Reserve Enhancement Program (CREP).** The New Jersey Departments of Environmental Protection and Agriculture, in partnership with the Farm Service Agency and Natural Resources Conservation Service, has recently submitted a proposal to the USDA to offer financial incentives for agricultural landowners to voluntarily implement conservation practices on agricultural lands. The NJ Conservation Reserve Enhancement Program (NJ CREP) will be part of the USDA's Conservation Reserve Program (CRP). 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. Following are some highlights of the New Jersey CREP proposal:

    - 30,000 acres of agricultural land are targeted for conservation, with 4,000 acres of agricultural land targeted for permanent conservation easement. Farmland enrolled but not permanently preserved will be under rental contract for 10-15 years
    - Conservation practices under the program are riparian buffers, filter strips, contour buffer strips, and grass waterways.
    - Water quality benefits of the program are expected to assist in achieving biologically healthy streams.
    - Permanent preservation of 4,000 acres of CREP lands will aid in reaching open space preservation goals.
    - The proposal is for a $100 million program representing a 3:1 Federal/State match, with New Jersey providing $23 million and USDA – Commodity Credit Corporation committing $77 million.

5) Stormwater Management

The Department has recently proposed Stormwater Management Rules and NJPDES Phase II Municipal Stormwater Regulation Rules that will establish standards and a regulatory program for stormwater management. Stormwater general permits issued by the Municipal Stormwater Regulation Program will address stormwater pollution

6) Malfunctioning and Older Improperly Sized Septic Systems; Illicit Connections of Domestic Sewage

Malfunctioning and older improperly sized septic systems contribute to fecal coliform loading in two ways: the system may fail hydraulically, where there is surface break out; or hydrogeologically, under conditions when soils are inadequate to filter pathogens. Specific management measures include the implementation of the NJPDES Municipal Stormwater Regulation Program, Sanitary Surveys, Septic System Management Programs and future sewer service area designations for service to domestic treatment works.

Sanitary surveys are conducted in an effort to evaluate the water quality of natural surface waters and identify those components that affect water quality, including geographic factors and pollution sources. The focus of the sanitary survey is to identify nonpoint and stormwater source contribution of fecal coliform within the watershed. It is accomplished by sampling for various types of fecal indicators (fecal coliform, enterococcus, fecal streptococcus, *E. coli* and coliphage) during wet and dry weather conditions. Where potential problems with septic systems are identified, as described below, a trackdown study may be warranted. This could lead to an analysis of alternatives to address any identified inadequacies, such as rehabilitation of septic systems or connection to a sewage treatment system, as appropriate.

10.4. Potential Sources of Fecal Impairment to Impaired Water Bodies

In an effort to locate pathogen sources to streams listed in this report, each stream segment was walked and potential sources noted based on the source categories listed in Section 10.2. The information gathered during those site visits is listed below by their respective WMA. The below are not considered to be a list of comprehensive sources, rather they will be used in conjunction with additional site visits, LDCs, and as appropriate, bacterial source tracking to identify actual pathogen sources.

10.4.1. Watershed Management Area 3

Macopin River at Macopin Reservoir (Site ID #01382450)

Potential sources noted within this watershed include detention basins at the upper end of Echo Lake, stables (Echo Lake Stables) located on east Echo Lake Road near Echo Lake above Macopin Gorge, and potential septic source located on Route 23 (City of Newark).

Wanaque River at Highland Avenue (Site ID #01387010)

Canada Geese were observed at a number of locations within this watershed. These areas include: the Wanaque Athletic Fields, Lake Inez, Lower Twin Lake (large geese population), and Skyland Lake. Possible problem stormwater detention basins were noted specifically at Pompton Lakes, Lake Inez and Skyland Lake. Potential failing septics noted at Dupont Village and Wanaque; these areas in the process of being sewered. . Possible pet sources observed at Lower Twin Lake and Skyland Lake.

Ramapo River near Mahwah (Site ID #01387500)

Potential sources in failing septic systems located in Oakland. Almost all Oakland is on septic systems, many failing and solid rock below ~3-feet. Stormwater outfalls present where Masonicus Brook and Mahwah Rivers converge. Canada geese observed at Ramapo College atlethic fields, and other recreational fields. Horse farms located across from Ramapo College. Crystal Lake (bathing beach) has been closed several times due to high fecal concentrations.

10.4.2. Watershed Management Area 4

Passaic River below Pompton River at Two Bridges (Site ID #01389005)

This entire segment is highly developed with many stormwater outfalls, however, much of this area was developed prior to the practice of constructing detention basins. This area may benefit from stormwater management retrofits. Sources upstream on the Pompton River at Packanack Lake (Site ID #01388600) include potential failing septic systems in the Hoffman Grove section of Wayne (110 homes potential); open manure storage observed on Black Oak Ridge Road and Cross Road. Canada Geese observed at Wayne Municipal Park (Sheffield Fields), Packanack Lake Country Club, Pompton Lakes crossroads at golf driving range, Old MacDonald Park, Pequannock Park (directly above testing site), and Kehum Park.

Preakness Brook near Little Falls (Site ID #01389080)

Potential sources include: animal agriculture from Van Pien Dairy Farm, pet sources from Tintle Park, wildlife and geese sources from Preakness Golf Course, High School on Valley Road, High Mountain Golf Course, Wetland area,

Deepavaal Brook at Fairfield (Site ID #01389138)

Geese were observed at Mountain Ridge Golf Course and Green Brook Country Club.

Passaic River at Little Falls (Site ID #01389500)

Geese observed at the Passaic County Golf Course on River Road and island middle of Passaic River. Potential human source from a significant homeless population. Several stormwater pipes observed to discharge directly to the river.

Peckman River at West Paterson (Site ID #01389600)

Geese and wildlife were observed in several areas including: town parks, reservoir lands, golf course, and Essex County park. Other potential sources included pet waste from residential areas located adjacent to the river and stormwater pipes discharging directly to river north of the golf course.

Goffle Brook at Hawthorne (Site ID #01389850)

Site visit confirmed over 200 geese, 150 ring-billed and laughing gulls, 75 ducks and 100 pigeons, and pets at Goffle Brook Park. Potential source includes failing septic systems in upper reach.

Diamond Brook at Fair Lawn (Site ID #01389860)

Geese, wildlife, pet wildlife observed at the Passaic County Park System. Geese observed at the Vander Plat Park fields. Garbage, including disposable diapers, observed behind Pathmark on Hemlock Ave. Geese observed at Fair Lawn Memorial Cemetery.

WB Saddle River at Upper Saddle River (Site ID #01390445)

Stormwater, Geese, and wildlife noted as potential sources.

Saddle River at Ridgewood (Site ID #01390500)

Potential septic system impact from homes located directly beside the river on Old Stone Church Road. Gulls, cormorants (16) and over 80 geese observed at Otto C. Pehle Section of Saddle River Park. Pets, wildlife observed throughout the watershed and potential impact from Wild Duck Pond Park.

Ramsey Brook at Allendale (Site ID #01390900)

Wildlife (geese, deer, foxes, and dogs) observed at Crestwood Park. Geese and other wildlife observed at Apple Ridge golf course, Ramsey Country Club golf course, Lake Street at Ramsey, and Napolekao Pond. Potentially failing septics in Mahwah.

HoHoKus Brook at the mouth of the Saddle River, Paramus (Site ID #01391100)

Potential failing septic systems in HoHoKus and Wyckoff. Geese observed or apparent at Whites' Pond, Saddle River Park, Glen Rock Section (50 geese observed), Dunkerhook Park, and Wild Duck Pond. Dog walking observed at Saddle River Park, Glen Rock Section and Dunkerhook Park. Poultry farm observed and appears to be an enclosed operation

Saddle River at Fairlawn (Site ID #01391200)

Wildlife (150 geese, 75 seagulls, 25 doves) observed at Saddle River park, Wild Duck Pond area. No-feed signs posted (dog and waterfowl both), however, people observed still feeding waterfowl. At the Saddle River Park at Rochelle Park, no geese were observed but physical signs apparent and ducks appear to be fed. Geese observed at Bergen County Golf Courses and Ridgewood Country Club.

Saddle River at Lodi (Site ID #01391500)

Geese and pet walking observed at the Main St. Cemetery.

10.4.3. Watershed Management Area 5

Hackensack River at River Vale (Site ID #01377000)

Geese observed at Golf Course, Open Spaces, and County Park. Septic Systems in Old Tappan recently converted to sewers.

Musquapsink Brook at River Vale (Site ID #01377499)

Canada Geese observed at elementary school ballfields and nearby cemeteries. No septics are located in this area. Pumping from the Saddle River and discharging to the Musquapsink Brook represents a potential source of FC.

Pascack Brook at Westwood (Site ID #01377500)

No septics are located in this area. Potential sources included: Woodcliff Lake Reservoir, Corporate Parks in Montvale (source of geese droppings to Bear Brook which feeds into Pascack Brook), waste management transfer station, geese around the Woodcliff Lake, stormdrains discharge into Woodcliff Lake, and street sweeping materials from DPWs for Park Ridge, Hillsdale, and Westwood.

Tenakill Brook at Cedar Lane at Closter (Site ID #01378387)

Potential sources include: failing septics in Alpine, geese and waterfowl at Tenakill Middle School ballfields, Alpine Country Club, Tenafly Park, Demarest Nature Center, and Demarest Park/Duck Pond. The municipal park is located adjacent to Demarest Duck pond along Tenakill Brook and is subjected to geese and other waterfowl depositing droppings on turf areas within the park. Demarest Duck Pond is also the receiving body for stormwater outfalls that capture runoff from nearby roads, residential areas and commercial areas. Dredging of Demarest Duck Pond is slated for completion during 2003. Demarest Borough is committed to the shoreline restoration and nonpoint source improvement to the pond and park area and has sought additional funding to stabilize 1,600 linear feet of degraded shoreline around Demarest Duck Pond along Tenakill Brook with a 20 foot wide native vegetative buffer. The Environmental Commission has already implemented several small restoration projects along Tenakill Brook and is an active participant in the Department's Watershed process.

Coles Brook at Hackensack (Site ID #01378560)

No septics or agriculture are located in this watershed. Geese/Waterfowl, disposable diapers, and dog waste observed at Van Saun Park. Potential sources of pet waste include Oradell, River Edge, Paramus, and Emerson residential areas. Geese observed at the Emerson Golf Course, Paramus Middle School alongside Bkanky Brook (feeds into Coles Brook). Zoo observed, however, recently tied to sanitary sewer.

10.4.4. Watershed Management Area 6

Black Brook at Madison (Site ID #01378855)

The headwaters of this segment include the Fairmount Country Club where geese are a contributing factor. At Green Village Packing Company on Britten Road in Green Village, residents have reported that the company has, in recent years, dumped its animal wastes and scraps into local woods. Following complaints, the company has been shipping them out via truck. Recent complaints are that the trucks leak. Other potential sources include: Miele Kennel, Rolling Knolls Landfill, Britten Road, Chatham, and wildlife (deer and geese)

Passaic River Near Millington (Site ID #01379000)

This segment is directly adjacent to the Great Swamp Wildlife Refuge, thus wildlife are a potential source. Geese populations were observed at the following locations: AT&T Corporation grounds off Madisonville Road, Somerset County Environmental Education Center ponds, Southard Park, Basking Ridge Golf Course, northeast of the intersection of White Bridge Road and Carlton Road, at the Southwest corner of the intersection of White Bridge Road and Pleasant Plains Road, east of Pleasant Plains Road, north of White Bridge Road; east of the Passaic River, north of Stone House Road; and south of White Bridge Road, east of Pleasant Plains Road in Long Hill Township. The majority of this watershed contains urbanized landuse that has many detention basins, pets, and deer. Other potential sources include: Somerset County horse stables and horse trails through Lord Stirling Park and livestock populations at the southwest corner of the intersection of White Bridge Road and Carlton Road; east of the Passaic River, north of Stone House Road; and east of Pleasant Plains Road between White Bridge Road and Sherwood Lane.

Dead River Near Millington (Site ID #01379200)

Potential sources in this watershed include: Geese (New Jersey National Golf Course, Pleasant Valley road near King George Road where a large geese population of approximately 1000 was observed), pets, livestock and pastures present.

Passaic River Near Chatham (Site ID #01379500)

The following potential sources in this watershed include: geese (at Canoe Brook Country Club, Brook Lake Country Club and Cedar Ridge Country Club), wildlife, failing septics, pets, detention basins, and landfills (Bradley Loren Landfill, Florham Park Borough Waste Landfill, Vitto Marchetto Sanitary Landfill, Passaic Township Sanitary Landfill)

Canoe Brook Near Summit (Site ID #01379530)

Geese are suspected at Essex Fells Country Club, Crestmont Country Club, East Orange Golf Club and Summit Municipal Golf Course. Wildlife, especially deer, and pets are also thought to contribute a bacteria load.

Rockaway River at Longwood Valley (Site ID #01379680)

Wildlife and failing septics noted as potential sources.

Rockaway River at Blackwell Street (Site ID #01379853)

Potential sources include Hurd Park (goose population, no riparian buffer), and landfills.

Beaver Brook near Rockaway (Site ID #01380100)

This watershed contains several lake communites; many of which are on septic systems. Thus the potential for failing septics exist throughout the watershed. A portion of this watershed is designated as wildlife management area or reservoir protection area, thus, wildlife contribution is a potential. Geese observed at Rockaway Township recreational field located off of Old Beach Glen.

Stony Brook at Boonton (Site ID #01380320)

Canada geese observed at the picnic area of Pyramid Mountain Natural Historic Area, and at Rockaway Valley athletic fields off of Rockaway Valley Road, in Caterbury, and on Hill Road. Livestock operations are located off of Hill Road abutting a tributary to the impaired segment, near intersection of Kingsland and Rockaway Valley, and at intersection of Birchwood and Valley.

Rockaway River at Pine Brook (Site ID #01381200)

Potential sources include: Sharkey Landfill, Ecology Lake Club Sanitary Land Fill, Knoll East County Club Golf Course, wildlife, and geese.

Passaic River at Two Bridges (Site ID #01382000)

Wildlife and leaking septics noted as potential sources.

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.

10.6. Reasonable Assurance

With the implementation of follow-up monitoring, source identification and source reduction, the Department is reasonably assured that New Jersey's Surface Water Quality Standards will be attained for fecal coliform. Activities directed in the watersheds to reduce fecal coliform loading shall include options, included but not limited to education projects that teach best management practices, approval of projects funded by CWA Section 319 Nonpoint Source (NPS) Grants, recommendations for municipal ordinances regarding feeding of wildlife and pooper-scooper laws, and stormwater control measures.

The fecal coliform reductions proposed in these TMDLs assume that existing NJPDES permitted municipal facilities will continue to meet New Jersey's Surface Water Quality Standard requirements for disinfection. Any future facility will be required to meet water quality standards for disinfection.

11.0 Public Participation

The Water Quality Management Planning Rules NJAC 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. Accordingly the Department shall propose each TMDL as an amendment to the appropriate areawide water quality management plan. As part of the public participation process for the development and implementation of the TMDLs for fecal coliform in the Northeast Water Region, the NJDEPs, Division of Watershed Management, Northeast Bureau worked collaboratively with a series of stakeholder groups throughout New Jersey as part of the Department's ongoing watershed management efforts.

The Department's watershed management process was designed to be a comprehensive stakeholder driven process that is representative of members from each major stakeholder group (agricultural, business and industry, academia, county and municipal officials, commerce and industry, purveyors and dischargers, and environmental groups). As stated previously, through the creation of this watershed management planning process over the past several years Public Advisory Committees (PACs) and Technical Advisory Committees (TACs) were created in all 20 WMAs. Whereas the PACs serve in an advisory capacity to the Department, and examined and commented on a myriad of issues in the watersheds, the TACs were focused on scientific, ecological, and engineering issues relevant to the mission of the PAC.

The Northeast Bureau discussed with the WMA 3, WMA 4, WMA 5 and WMA 6 TAC members the Department's TMDL process through a series of presentations and discussions that culminated in the development of the 32 TMDLs for Streams Impaired by Fecal Coliform in the Northeast Water Region. The below paragraphs outline public involvement.

- Integrated Listing Methodology presentations were made by the Northeast Bureau within the DWM to the Northeast TACs throughout the month June; requesting that they review the Integrated List and submit comments to the Department by the September deadline. Presentations were made to WMA 5 TAC on June 18, 2002; WMA 6 TAC on June 20, 2002; WMA 3 TAC on June 21, 2002; and WMA 4 TAC on June 27, 2002.
- Expedited Fecal Coliform and Lake TMDL presentations were given at the September TAC meetings. The finalized Sublist 5 list was also disseminated. The TACs were briefed about the executed Memorandum of Agreement between the Department and EPA Region 2 with the imminent timeline. The TACs were asked to review sites and think about sources for discussion at the October TAC meetings at which time the Northeast Bureau would bring maps with municipalities and impaired stream segments and other features to facilitate the conversation.
- At the October TAC meetings (WMA 5: October 15, 2002; WMA 3 October 19, 2002; WMA 4 October 24, 2002 and WMA 6 October 28, 2002) TAC members were asked to identify based on their local knowledge potential sources of impairment. Draft copies of the Northeast Fecal TMDL report were distributed for informational purposes only. TAC members were advised that the formal comment period would be during the New Jersey Register Notice, but that the Department was interested in their input on policy issues affecting the development of the TMDL.
- At the November and December TAC meetings, the draft Fecal TMDL Report was distributed for informal comments prior to the NJR Notice.

Additional public participation and input was received through the NJ EcoComplex. The Department contracted with Rutgers NJ EcoComplex (NJEC) in July 2001. The role of NJEC is to provide comments on the Department's management strategies, including those related to the development of TMDL values. NJEC consists of a review panel of New Jersey University professors who provide a review of the technical approaches developed by the Department. The New Jersey Statewide Protocol for Developing Fecal TMDLs was presented to NJEC on August 7, 2002 and was subsequently reviewed and approved. The statewide approach was also presented the Passaic TMDL Workgroup in May 2002 for their input and approval. The New Jersey's Statewide Protocol for Developing Lake and Fecal TMDLs was presented by the Northeast Bureau at the SETAC Fall Workshop on September 13, 2002 and met with their approval.

11.1. AmeriCorps Participation

AmeriCorps is a national service initiative that was started in 1993 and is the domestic Peace Corps. 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 River Assessment Teams (RATs) and Biological Assessment Teams (BATs) volunteer monitoring programs.

Representatives from the Department in conjunction with the Watershed Ambassadors conducted RATs surveys on each of the impaired segments. These visual assessments were conducted from October to December 2002.

11.2. Public Participation 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 Northeast Water Quality Management Plan. N.J.A.C. 7:15-3.4(g)5 states that when the Department proposes to amend the areawide plan on its own initiative, the Department shall give public notice by publication in a newspaper of general circulation in the planning area, shall send copies of the public notice to the applicable designated planning agency, if any, and may hold a public hearing or request written statements of consent as if the Department were an applicant. The public notice shall also be published in the New Jersey Register.

Notice of these TMDLs was published January 21, 2003 pursuant to the above noted Administrative Code, in order to provide the public an opportunity to review the TMDLs and submit comments. The Department has determined that due to the level of interest in these TMDLs, a public hearing will be held. Public notice of the hearing, provided at least 30 days before the hearing, was published in the New Jersey Register and in two newspapers of general circulation and will be mailed to the applicable designated planning agency, if any, and to each party, if any, who was requested to issue written statement of consents for the amendment.

All comments received during the public notice period and at any public hearings will become part of the record for these TMDLs. All comments will be considered in the establishment of these TMDLs and the ultimate adoption of these TMDLs. When the Department takes final agency action to establish these TMDLs, the final decision and supporting documentation will be sent to U.S.E.P.A. Region 2 for review and approval pursuant to 303(d) of the Clean Water Act (33 U.S.C. 1313(d)) and 40 CFR 130.7.

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Appendix A: Explanation of stream segments in Sublist 5 of the *2002 Integrated List of Waterbodies* for which TMDLs will not be developed in this report.

Data to support removing River Segments from List 5 to List 1 for Fecal Coliform.

- Pequannock River at Macopin Intake Dam, Station #01382500

Re-assessments of data from station #01382500, the Pequannock River at Macopin Intake Dam, indicate that the water quality standards are met at this location. Measurements taken between 2/22/1994 and 7/17/00 at Station #01382500, show a geometric mean of 34 CFU/100 ml, and that 7.8% of values are over 400 CFU/100ml.

River segments to be moved from Sublist 5 to Sublist 3 for fecal coliform.

- Wanaque River at Wanaque, #01387000;
- Hackensack River at New Milford, #01378500

Two segments listed on Sublist 5, station #01387000, the Wanaque River at Wanaque (WMA 3), and station #01378500 the Hackensack River at New Milford (WMA 5), were included on Sublist 5 based on their listings on previous 303(d) lists with no recent data to assess their current attainment status. Therefore, TMDLs will not be developed for these locations until and unless recent data indicated violations of the surface water quality standards.

River segments to be moved from Sublist 5 to Sublist 4 for fecal coliform.

- Whippany River at Morristown, #01381500;
- Whippany River near Pine Brook, #01381800

Two segments, #01381500, the Whippany River at Morristown, and #01381800, the Whippany River near Pine Brook, were included as part of the Whippany River Watershed Fecal Coliform TMDL adopted on 4/16/2000 and published in the New Jersey Register on 6/5/2000. Upon adoption of this TMDL Report, the Department will remove these two waterbodies for fecal coliform from Sublist 5 to move them to Sublist 4 as identified in the below table.

Sublist 5 river segments listed for fecal coliform for which TMDLs will not be developed in this report.

- Passaic River at Elmwood Park, #01389880

The Passaic River at Elmwood Park, segment #01389880, is located in an area affected by combined sewer overflows (CSOs). CSOs are sewage systems that use a single pipe to transport both stormwater runoff from rainstorms and sewage from households, businesses and industries to sewage treatment plants. During dry weather, combined sewers send all wastewater to the STPs. During wet weather, stormwater quickly fills the combined sewers, which carry both sanitary sewage and runoff from streets, parking lots, and rooftops. The overflows carry bacteria from the untreated sewage as well as other pollutants in the stormwater. Additional potential FC sources were identified during a site visit on October 24, 2002 and include geese (at park on River Road across from High School), homeless populations, and dog pounds/shelters.

The methodology employed in this report is not appropriate for use in areas affected CSOs, thus, this stream segment will be addressed with a separate management approach.

List of Sublist 5 segments to be moved to Categories 1, 3 or 4 based upon reassessment of data, the need for current data, or the prior completion of a TMDL report.

WMA	Station Name/Waterbody	Site ID	New Sublist Listing	Explanation
03	Pequannock River at Macopin Intake Dam	01382500	Sublist 1	Re-assessment shows non-impairment
03	Wanaque River at Wanaque	01387000	Sublist 3	Updated monitoring needed
04	Passaic River at Elmwood Park	01389880	No change	CSO influence
05	Hackensack River at New Milford	01378500	Sublist 3	Updated monitoring needed
06	Whippany River at Morristown	01381500	Sublist 4	TMDL completed in 1999
06	Whippany River near Pine Brook	01381800	Sublist 4	TMDL completed in 1999

Appendix B: Municipal POTWs Located in the TMDLs' Project Areas

WMA	Station #	NJPDES	Facility Name	Discharge Type	Receiving waterbody
3	1387500	NJ0027774.001A	Oakland Boro - Oakwood Knolls	MMI	Ramapo River via storm sewer
3	1387500	NJ0080811.001A	Oakland Twp - Riverbend	MMI	Ramapo River
3	1387500	NJ0021253.001A	Ramapo BOE - Indian High	MMI	Pond Creek (Ramapo River)
3	1387500	NJ0053112.001A	Oakland Boro - Chapel Hill Estates	MMI	Ramapo River via pond and storm sewer
3	1387500	NJ0021342.001A	Oakland Boro Skyview-Highbrook STP	MMI	Caille Lk via unnamed tributary & storm sewer
3	1387500	NJ0021946.001A	US Army - Nike Base	MMI	Darlington Brook via unnamed tributary
3	1387500	NJ0030384.001A	Oakland BOE - Manito Ave	MMI	Caille Lake via unnamed tributary and storm sewer
3	1387500	NJ0030384.001V	Oakland BOE - Manito Ave	MMI	Caille Lake via unnamed tributary and storm sewer
4	1389600	NJ0025330.001A	Cedar Grove Twp STP	MMJ	Peckman River
4	1389600	NJ0024490.004A	Verona Twp	MMJ	Peckman River
4	1389600	NJ0021687.001A	Essex County Hospital	MMJ	Peckman River
4	1389080	NJ0028002.001A	Wayne Twp - Mountain View	MMJ	Singac Brook (Preakness)
4	1389080	NJ0021261.001A	NJDHS-NJ Development Center	MMI	Passaic River
6	1379200	NJ0022845.001A	Harrison Brook STP	MMJ	Dead River
6	1379500	NJ0020427.001A	Caldwell Boro STP	MMJ	Passaic River via unnamed tributary
6	1379500	NJ0024511.001A	Livingston Twp	MMJ	Passaic River
6	1379500	NJ0025518.001A	Florham Park SA	MMJ	Passaic River
6	1379500	NJ0024937.001A	Molitor Water Pollution	MMJ	Passaic River
6	1379500	NJ0021636.001A	New Providence Boro	MMJ	Passaic River
6	1379500	NJ0024937.002A	Molitor Water Pollution	MMJ	Passaic River
6	1379500	NJ0027961.001A	Berkeley Heights	MMJ	Passaic River
6	1379500	NJ0020427.SL3A	Caldwell Boro STP	MMJ	Sludge Application
6	1379500	NJ0020427.SL3B	Caldwell Boro STP	MMJ	Sludge Application
6	1379500	NJ0020427.SL3M	Caldwell Boro STP	MMJ	Sludge Application
6	1381200	NJ0022349.001A	Rockaway Valley SA	MMJ	Rockaway River
6	1381200	NJ0024970.001A	Parsippany-Troy Hills SA	MMJ	Whippany River
6	1378855	NJ0020290.001A	Chatham Township - Main	MMI	Black Brook
6	1379200	NJ0021083.001A	Veterans Adm Medical Center	MMI	Harrisons Brook via unnamed tributary
6	1379200	NJ0022497.001A	Warren Twp SA - Stage 4	MMI	Dead River
6	1379200	NJ0050369.001A	Warren Twp SA - Stage 5	MMI	Dead River
6	1379500	NJ0020281.001A	Chatham Hill STP	MMI	Passaic River
6	1379500	NJ0052256.001A	Chatham Township - Chatham Glen	MMI	Passaic River

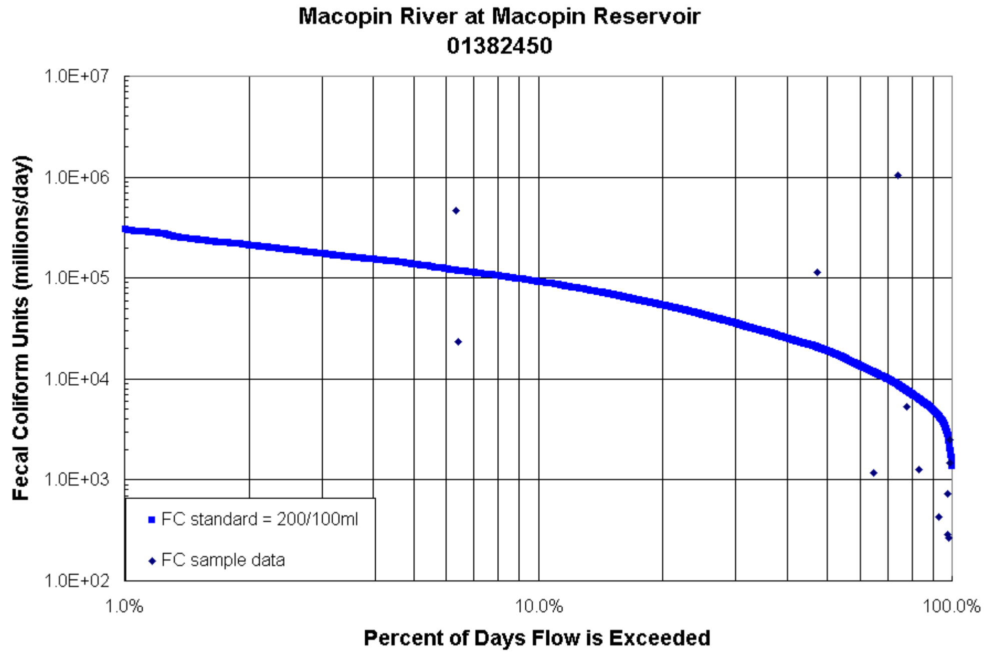
6	1379500	NJ0022489.001A	Warren Twp SA - Stage 1 & 2	MMI	Passaic River
6	1379500	NJ0024465.001A	Long Hill Twp STP - Stirling Hills	MMI	Passaic River
6	1379500	NJ0021938.001A	US Army - Nike Base	MMI	Passaic River
6	1380320	NJ0022276.001A	Stonybrook School	MMI	Untermeyer Lake via storm sewer
6	1379680	NJ0021091.001A	Jefferson Twp High - Middle School	MMI	Edison Brook
6	1379680	NJ0026867.001A	Jefferson Twp - White Rock	MMI	Mitt Pond (Russia Brook)
6	1379853	NJ0026603.001A	Randolph Twp BOE - High School	MMI	Mill Brook via unnamed tributary
6	1379853	NJ0032808.001A	Rockaway Townsquare Mall	MMI	Green Pond Brook

Appendix C: TMDL Calculations

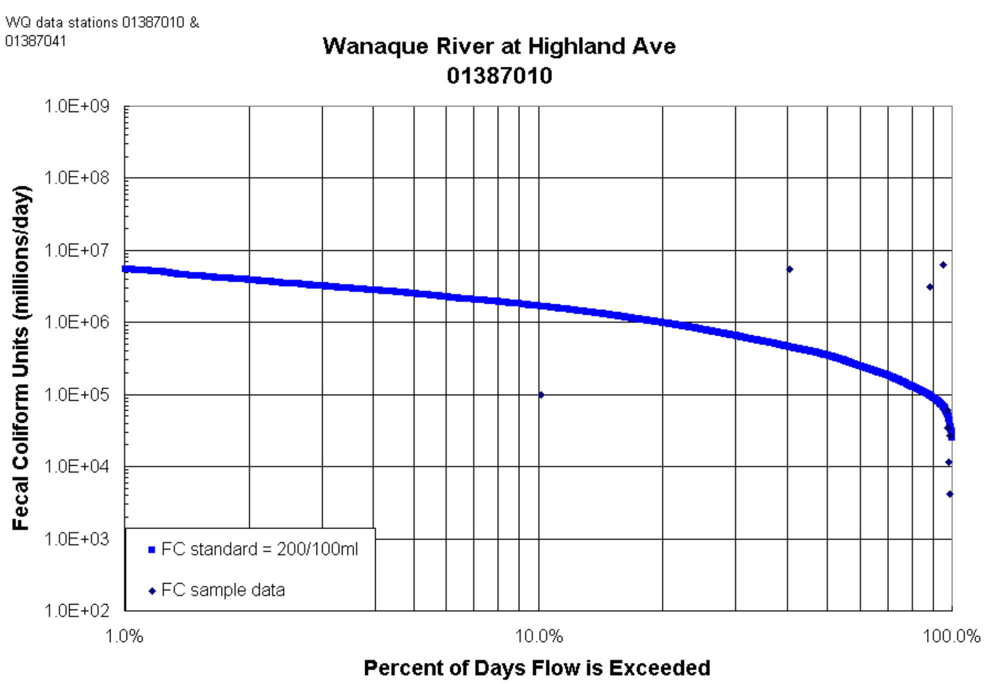
WMA	Station Names	303(d) Category 5 Segments	Water Quality Stations	Load Allocation (LA) and Margin of Safety (MOS): 200 FC/100ml Standard: Geometric mean CFU/100ml	MOS as a percent of the target concentration	Percent reduction without MOS	Percent reduction with MOS	400 FC/100ml Standard: Summer geometric mean CFU/100ml	MOS as a percent of the target concentration	Percent reduction without MOS	Percent reduction with MOS	Wasteload Allocation (WLA)
3	Macopin R at Echo Lake, Macopin R at Macopin Reservoir	01382450	01382410, 01382450	59	46%	-240%	-85%	59	46%	-16%	37%	37%
3	Wanaque R at Highland Avenue, Wanaque R at Pompton Lakes	01387010	01387010, 01387041	160	53%	-25%	42%	208	53%	67%	85%	85%
3	Ramapo R near Mahwah	01387500	01387500	291	44%	31%	61%	431	44%	84%	91%	91%
4	West Branch Saddle R at Upper Saddle River, Saddle R at Saddle River, Saddle R at Ridgewood Ave, Saddle R at Grove St., Ramsey Bk at Allendale, Hohokus Bk at Paramus, Saddle R at Rochelle Park, and Saddle R at Lodi	01390445, 01390500, 01390900, 01391100, 01391200, 01391500	01390445, 01390470, 01390510, 01390518, 01390900, 01391100, 01391490, 01391500	1,157	30%	83%	88%	1,144	30%	94%	96%	96%
4	Passaic R below Pompton R at Two Bridges, Passaic R at Little Falls, Preakness Bk, near Little Falls, Peckman R at W. Patterson, and Deepavaal Bk at Fairfield	01389005, 01389500, 01389080, 01389600, 01389138	01389500, 01389080, 01389600, 01389138	583	30%	66%	76%	652	30%	90%	93%	93%
4	Goffle Bk at Hawthorne, Diamond Bk at Fair Lawn	01389850, 01389860	01389850, 01389860	1,515	47%	87%	93%	1,544	47%	96%	98%	98%

WMA	Station Names	303(d) Category 5 Segments	Water Quality Stations	Load Allocation (LA) and Margin of Safety (MOS)								Wasteload Allocation (WLA)
				200 FC/100ml Standard				400 FC/100ml Standard				
				Geometric mean CFU/100ml	MOS as a percent of the target concentration	Percent reduction without MOS	Percent reduction with MOS	Summer geometric mean CFU/100ml	MOS as a percent of the target concentration	Percent reduction without MOS	Percent reduction with MOS	
5	Hackensack R. at Rivervale	01377000	01377000, 01376970	248	34%	19%	46%	294	34%	77%	85%	85%
5	Pascack Br at Westwood and Musquapsink Br at Rivervale	01377499, 01377500	01377499, 01377500	709	54%	72%	87%	709	54%	90%	96%	96%
5	Tenakill Br at Cedar Lane at Closter	01378387	01378387	159	91%	-26%	88%	159	91%	57%	96%	96%
5	Coles Br at Hackensack	01378560	01378560	1,093	68%	82%	94%	1,093	68%	94%	98%	98%
6	Black Brook at Madison, Passaic R nr Millington, Dead R nr Millington, Canoe Brook nr Summit, Passaic R nr Catham	01378855, 01379000, 01379200, 01379530, 01379500	01378855, 01379000, 01379200, 01379530, 01379500	675	29%	70%	79%	1,370	29%	95%	96%	96%
6	Rockaway R at Longwood Valley, Rockaway R at Berkshire Valley, Rockaway R at Blackwell St.	01379680, 01379853	01379680, 01379700, 01379853	253	54%	21%	64%	373	54%	82%	92%	92%
6	Beaver Brook at Rockaway	01380100	01380100	362	43%	45%	68%	362	43%	81%	89%	89%
6	Stony Brook at Boonton	01380320	01380320	214	32%	7%	37%	214	32%	68%	78%	78%
6	Rockaway R at Pine Brook	01381200	01381200	281	28%	29%	49%	571	28%	88%	91%	91%
6	Passaic R at Two Bridges	01382000	01382000	227	33%	12%	41%	276	33%	75%	83%	83%

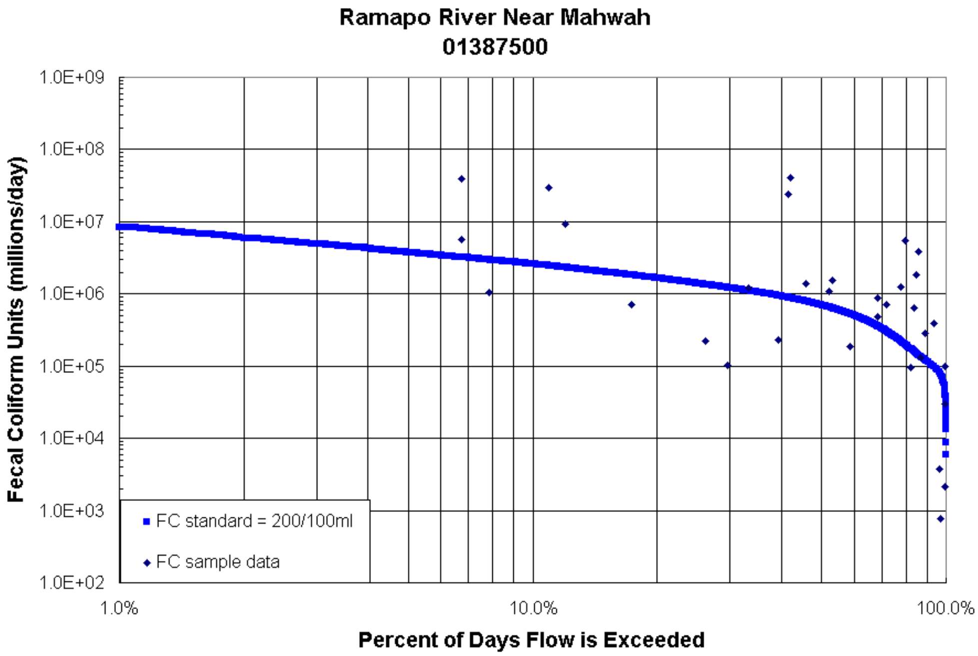
Appendix D: Load Duration Curves for each listed waterbody



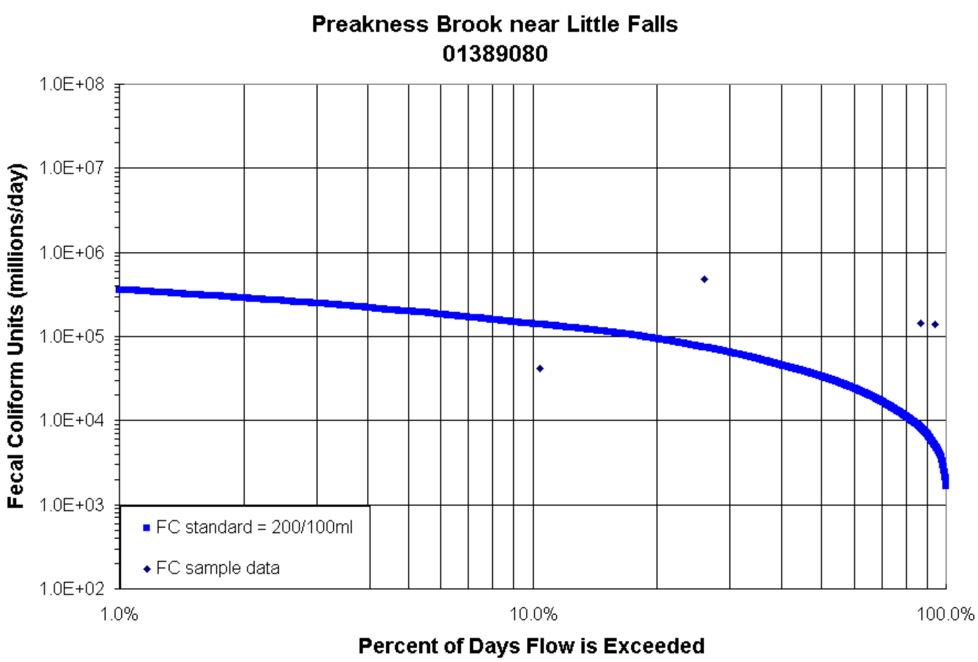
Load Duration Curve for Macopin River at Macopin Reservoir. Fecal coliform data from USGS station # 01382450 during the period 10/1997 through 8/2000. Water years 1970-2000 from USGS station # 01388500 (Pompton River at Pompton Plains NJ) were used in generating the FC standard curve.



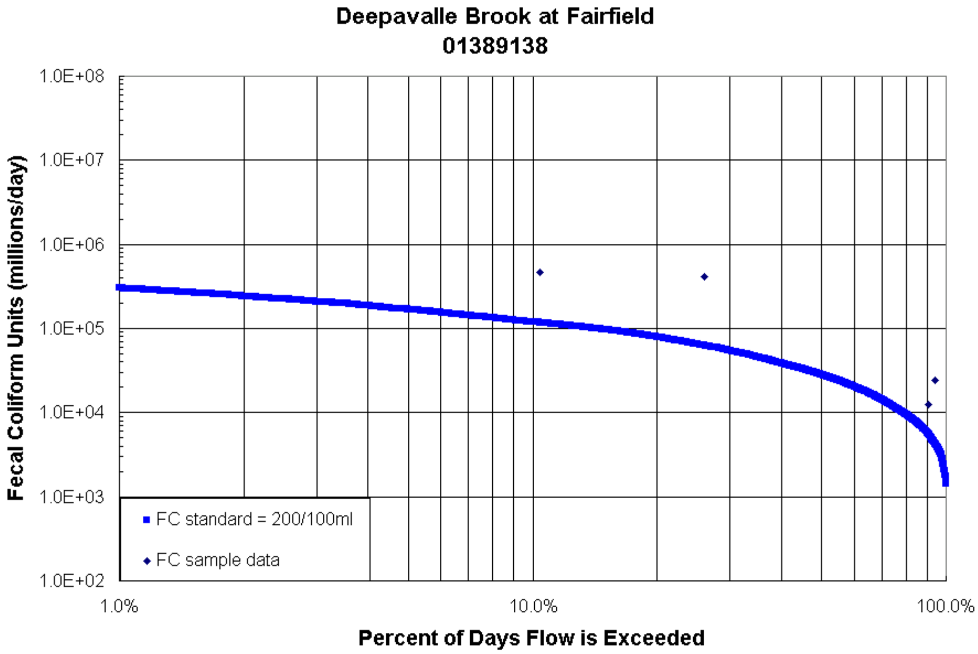
Load Duration Curve for Wanaque River at Highland Ave. Fecal coliform data from USGS station # 01387010 & 01387041 during the period 1/27/97 through 8/9/99. Water years 1970-2000 from USGS station # 01388500 (Pompton River at Pompton Plains NJ) were used in generating the FC standard curve.



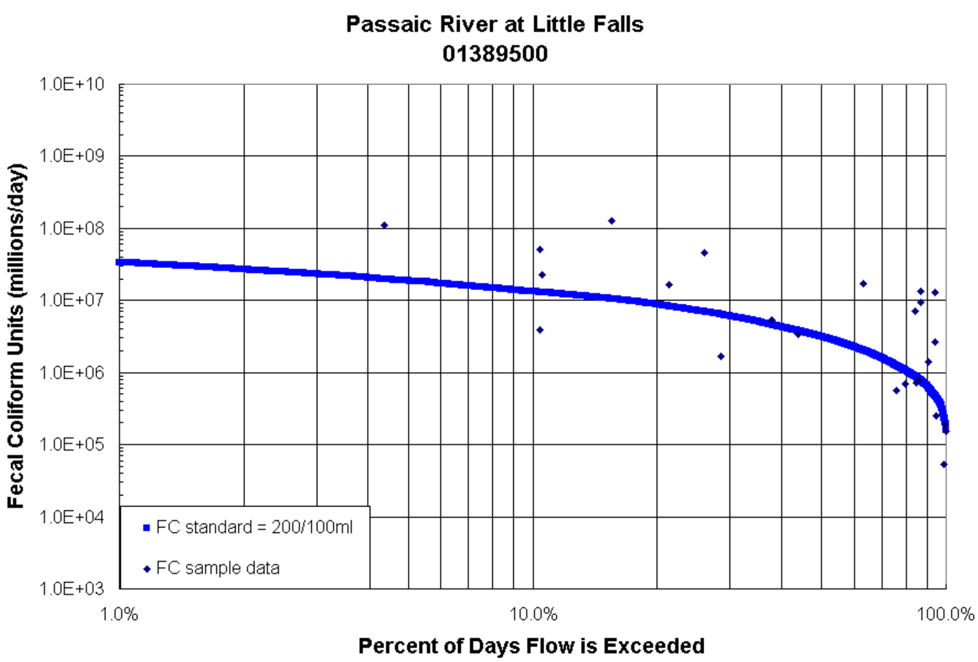
Load Duration Curve for Ramapo River Near Mahwah. Fecal coliform data from USGS station # 01387500 during the period 2/24/94 8/3/00. Water years 1970-2000 from USGS station # 01387500 (Ramapo River Near Mahwah) were used in generating the FC standard curve.



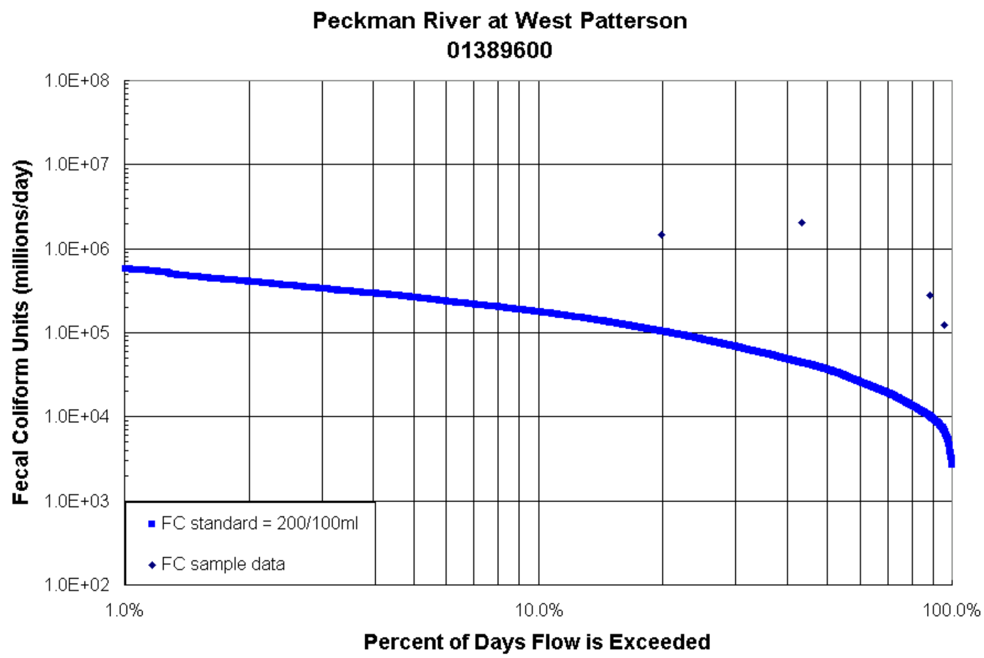
Load Duration Curve for Preakness Brook Near Little Falls. Fecal coliform data from USGS station # 01389080 during the period 4/16/98 through 9/23/98. Water years 1970-2000 from USGS station # 01389500 (Passaic River at Little Falls) were used in generating the FC standard curve.



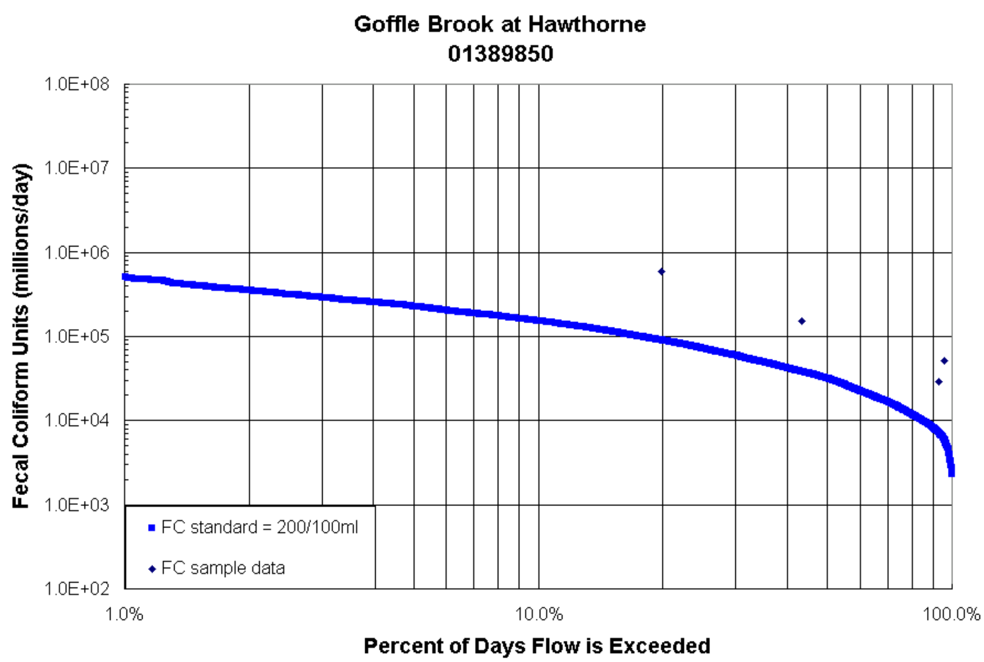
Load Duration Curve for Deepavalle Brook at Fairfield. Fecal coliform data from USGS station # 01389138 during the period 4/16/98 through 9/23/98. Water years 1970-2000 from USGS station # 01389500 (Passaic River at Little Falls) were used in generating the FC standard curve.



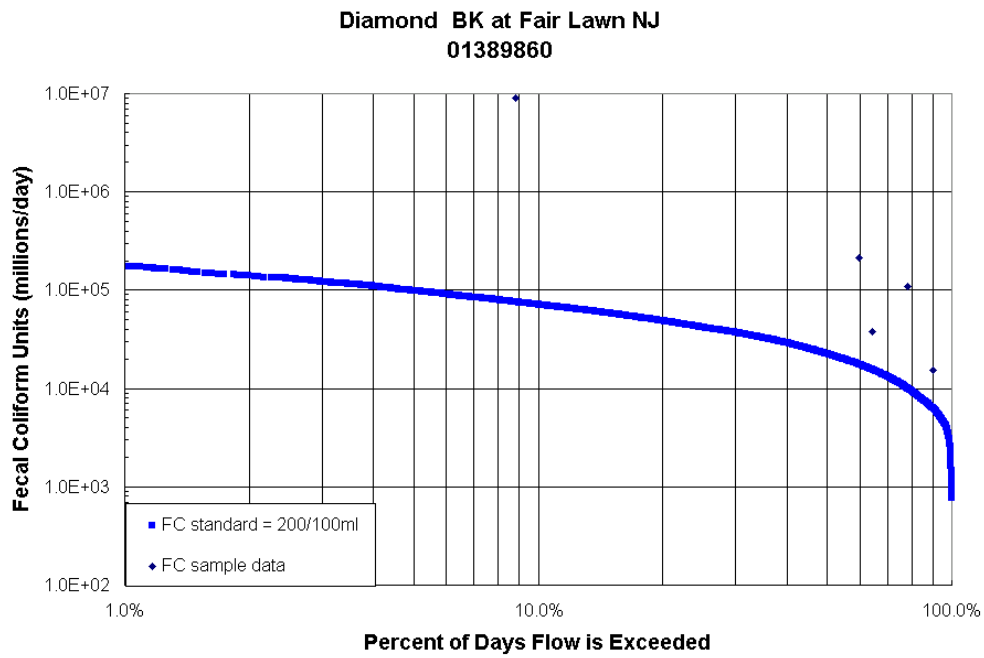
Load Duration Curve for the Passaic River at Little Falls. Fecal coliform data from USGS station # 01389500 during the period 2/18/94 through 9/23/98. Water years 1970-2000 from USGS station # 01389500 (Passaic River at Little Falls) were used in generating the FC standard curve.



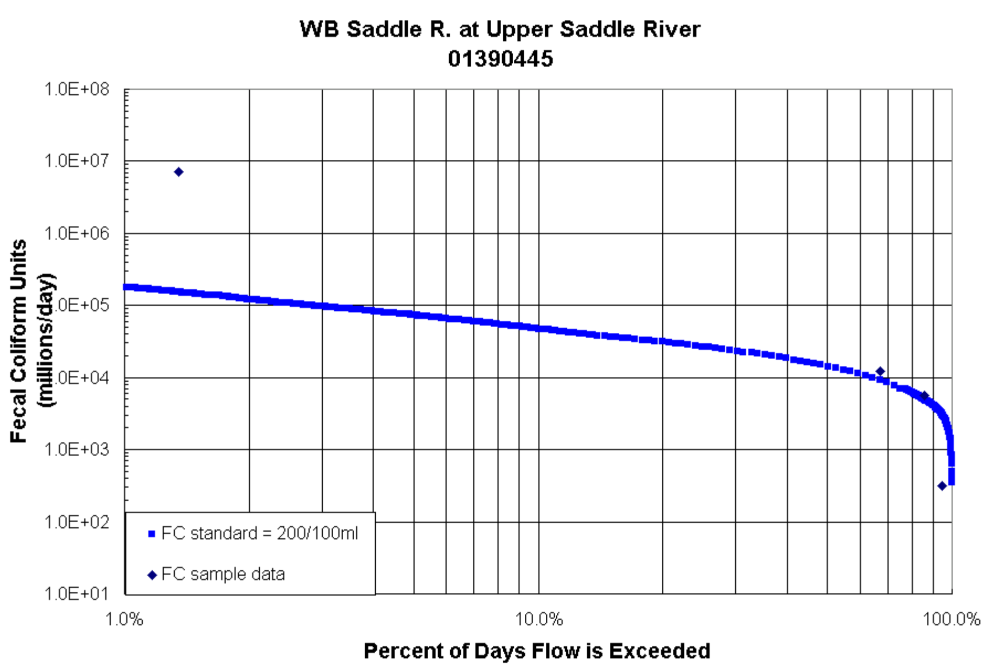
Load Duration Curve for Peckman River at West Patterson. Fecal coliform data from USGS station #01389600 during the period 4/23/98 through 9/24/98. Water years 1970-2000 from USGS station # 01388500 (Pompton River at Pompton Plains NJ) were used in generating the FC standard curve.



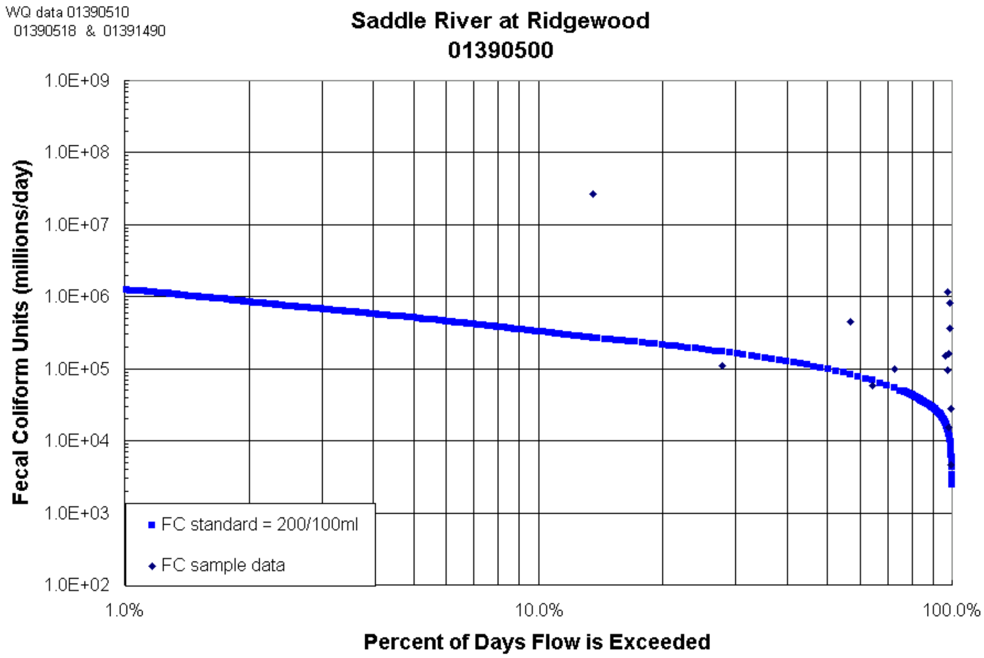
Load Duration Curve for Goffle Brook at Hawthorne. Fecal coliform data from USGS station # 01389850 during the period 4/23/98 through 9/24/98. Water years 1970-2000 from USGS station # 01388500 (Pompton River at Pompton Plains NJ) were used in generating the FC standard curve.



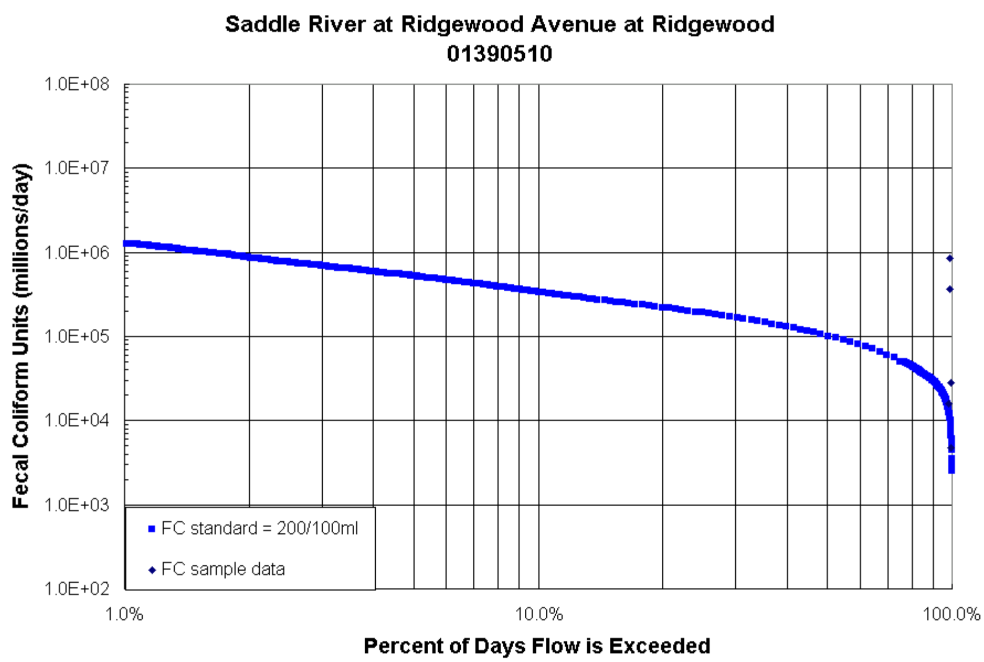
Load Duration Curve for Diamond Bk at Fair Lawn. Fecal coliform data from USGS station # 01389860 during the period 6/29/00-7/27/00. Water years 1970-2000 from USGS station # 01388500 (Pompton River at Pompton Plains NJ) were used in generating the FC standard curve



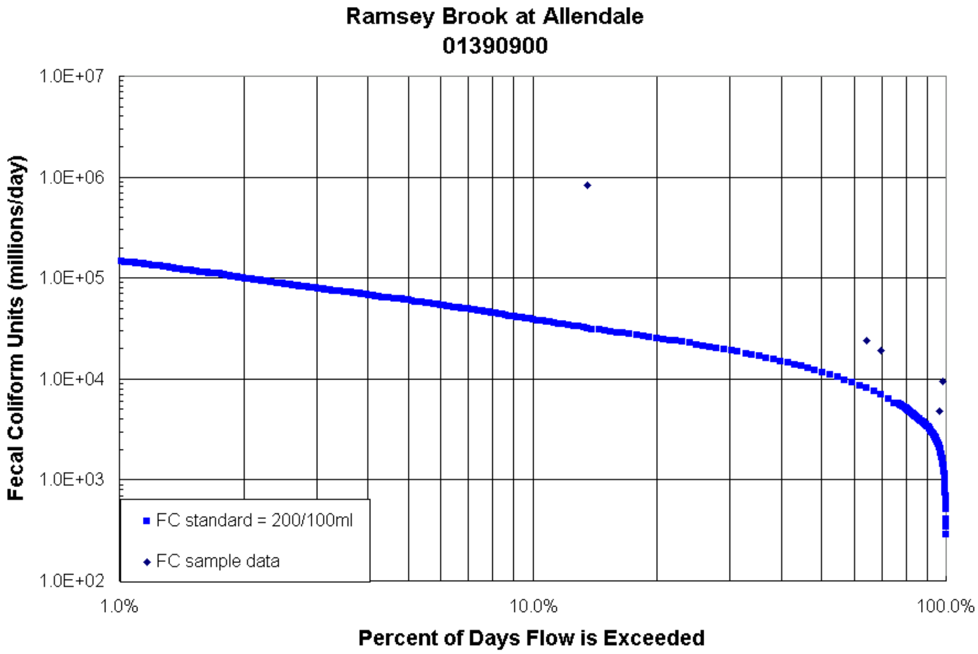
Load Duration Curve for WB Saddle R at Upper Saddle River. Fecal coliform data from USGS station # 01390445 during the period 11/4/99 through 8/7/00. Water years 1970-2001 from USGS station # 01390500 (Saddle River at Ridgewood) were used in generating the FC standard curve.



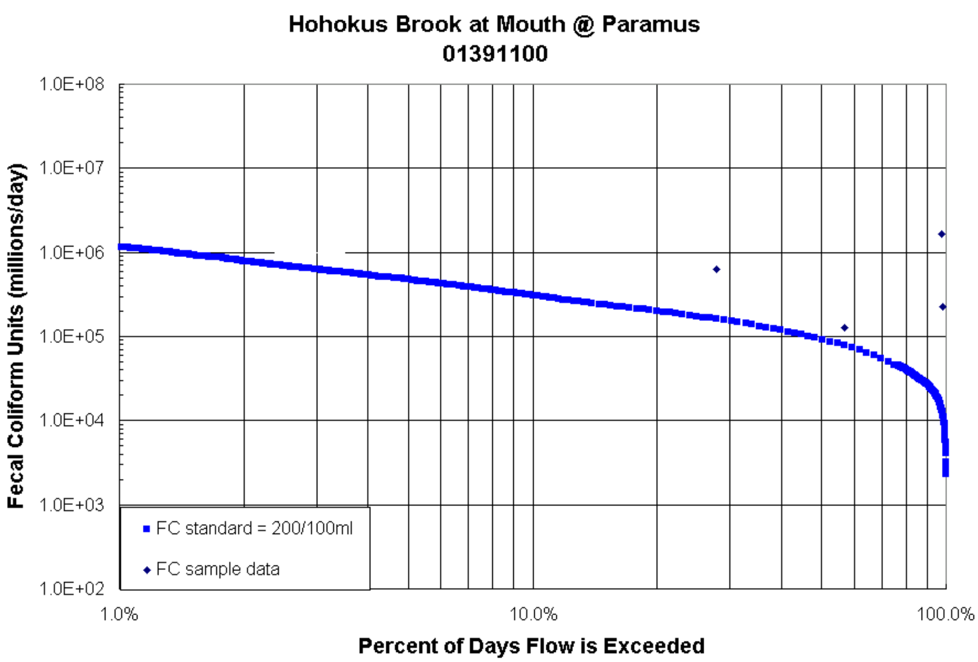
Load Duration Curve for Saddle R at Ridgwood. Fecal coliform data from USGS station # 01390510,01390518, & 01391490.during the period 11/6/97-8/9/99. Water years 1970-2001 from USGS station # 01390500 (Saddle River at Ridgewood) were used in generating the FC standard curve.



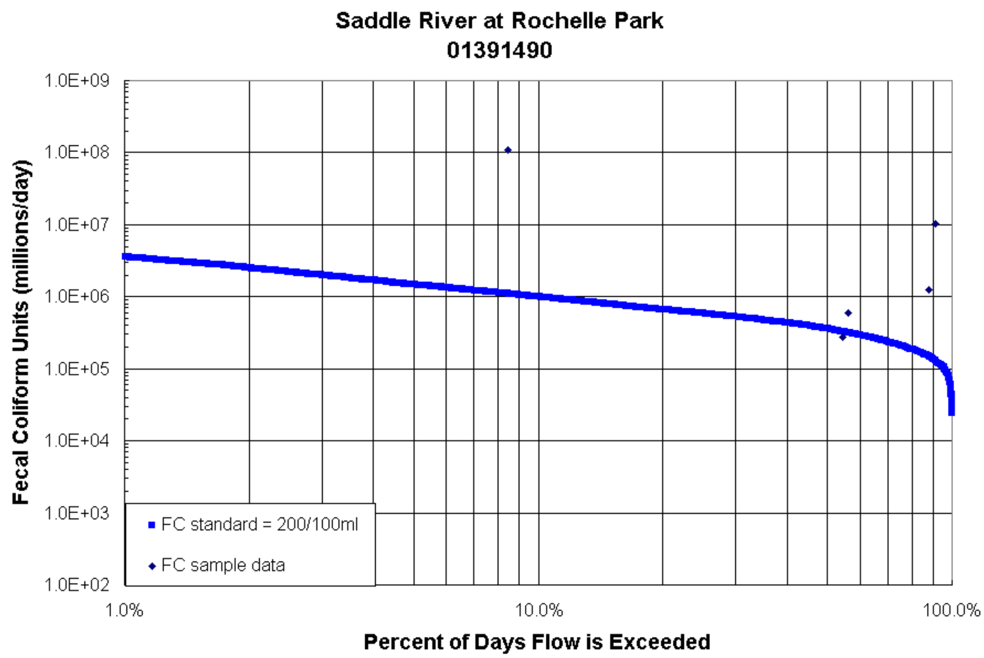
Load Duration Curve for Saddle River at Ridgewood Avenue at Ridgewood. Fecal coliform data from USGS station # 01390510 during the period 7/13/99 through 8/9/99. Water years 1970-2001 from USGS station # 01390500 (Saddle River at Ridgewood) were used in generating the FC standard curve.



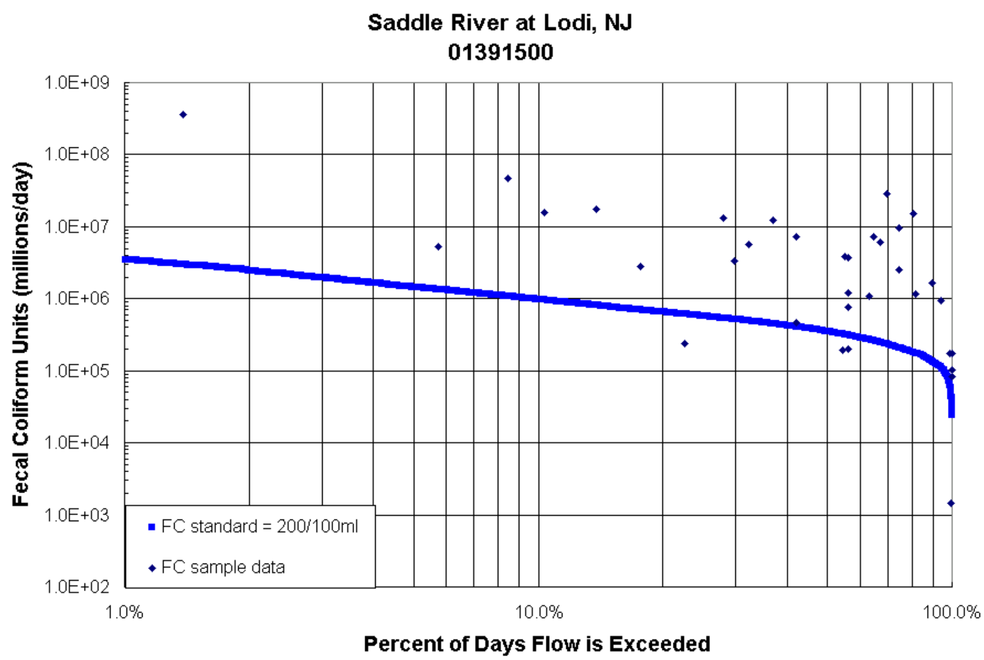
Load Duration Curve for Ramsey Brook at Allendale. Fecal coliform data from USGS station # 01390900 during the period 11/6/97 through 9/1/98. Water years 1970-2000 from USGS station # 01390500 (Saddle River at Ridgewood) were used in generating the FC standard curve.



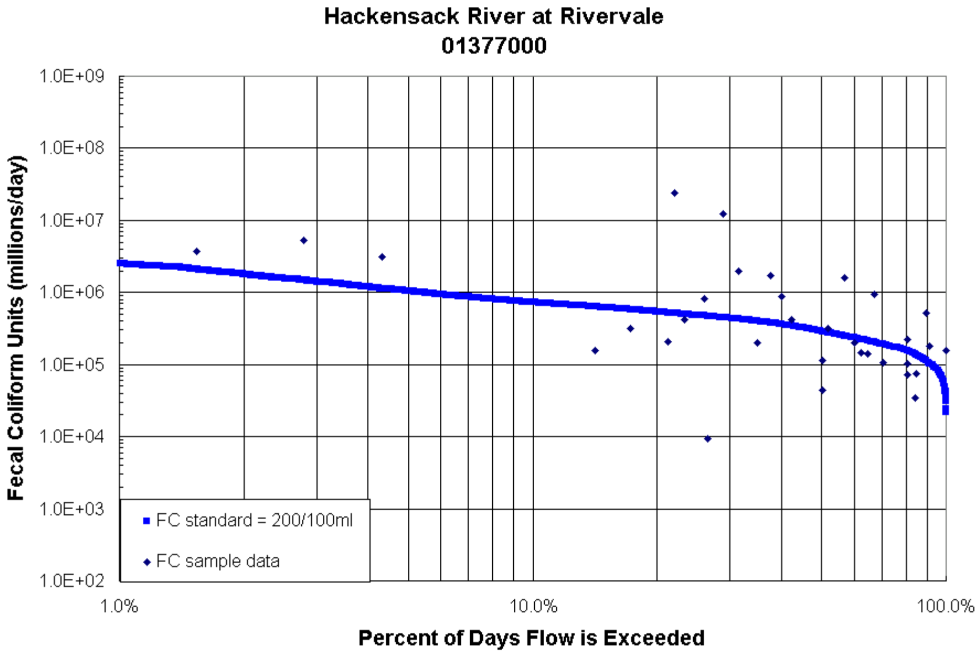
Load Duration Curve for Hohokus Brook at Mouth@ Paramus. Fecal coliform data from USGS station # 01391100 during the period 4/23/98 through 9/24/98. Water years 1970-2000 from USGS station # 01390500 (Saddle River at Ridgewood) were used in generating the FC standard curve.



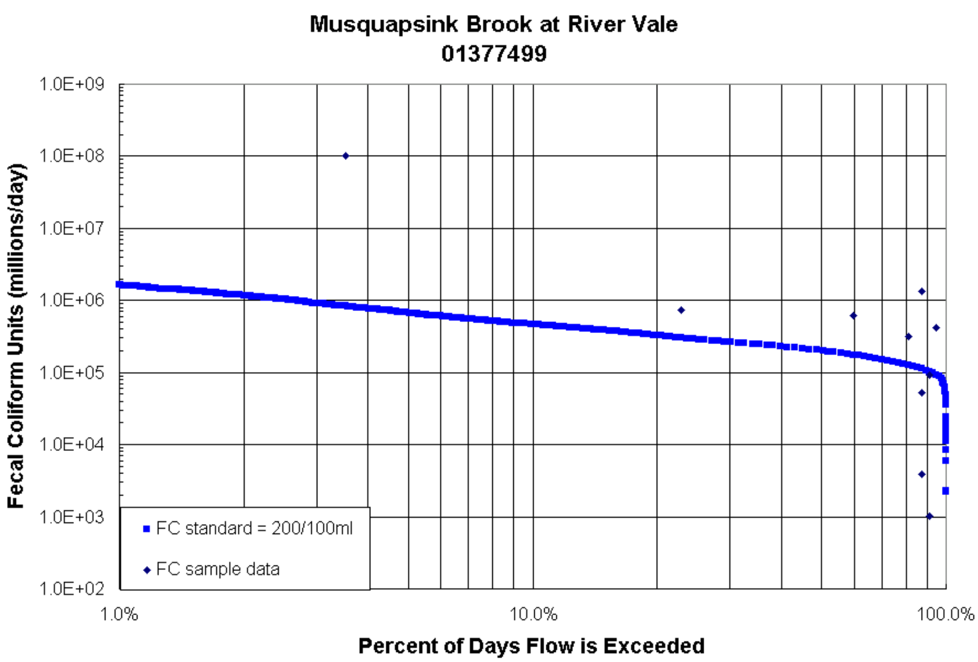
Load Duration Curve for Saddle River at Rochelle Park. Fecal coliform data from USGS station # 01391490 during the period 11/6/97 through 9/16/98. Water years 1970-2001 from USGS station # 01391500 (Saddle River at Lodi) were used in generating the FC standard curve.



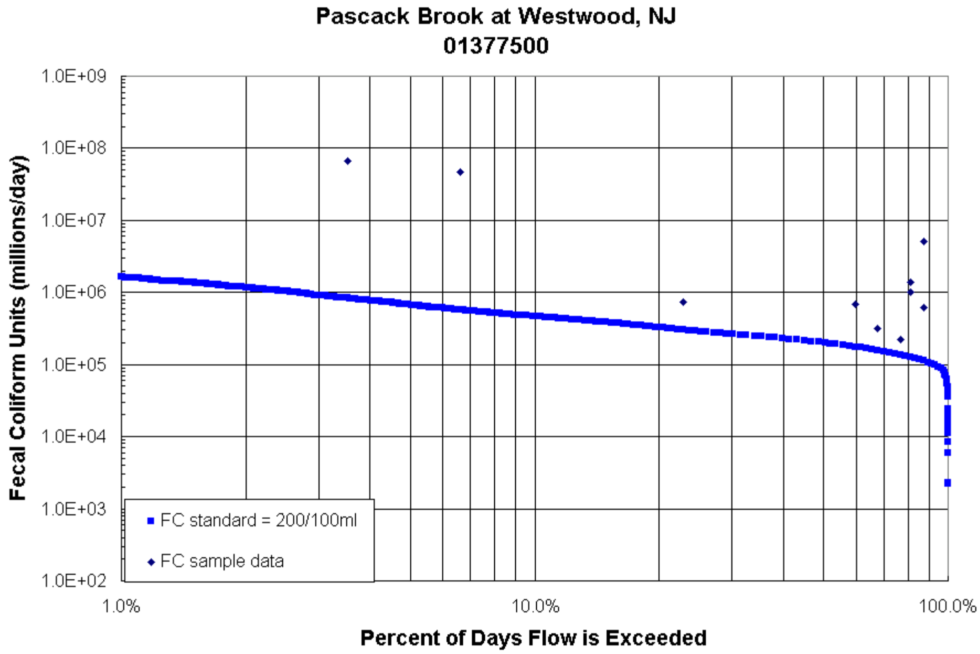
Load Duration Curve for Saddle River at Lodi. Fecal coliform data from USGS station # 01391500 during the period 2/22/94 through 9/13/00. Water years 1970-2000 from USGS station # 01391500 (Saddle River at Lodi) were used in generating the FC standard curve.



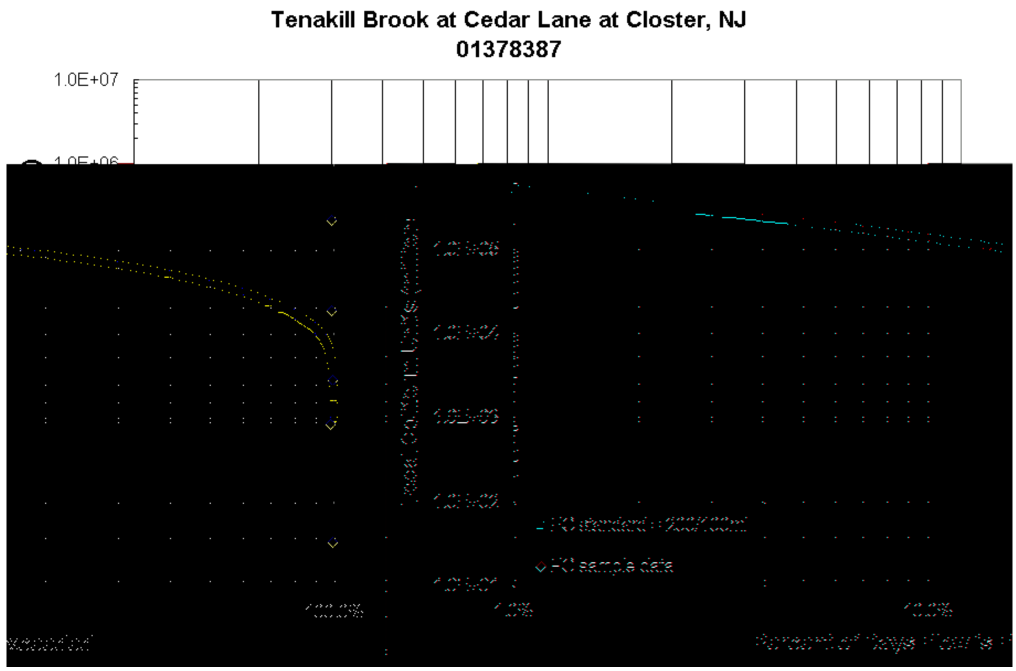
Load Duration Curve for the Hackensack River at Rivervale. Fecal coliform data from USGS station # 01377000 during the period 2/17/94 through 8/3/00. Water years 1970-2000 from USGS station # 01377000 (Hackensack River at Rivervale) were used in generating the FC standard curve.



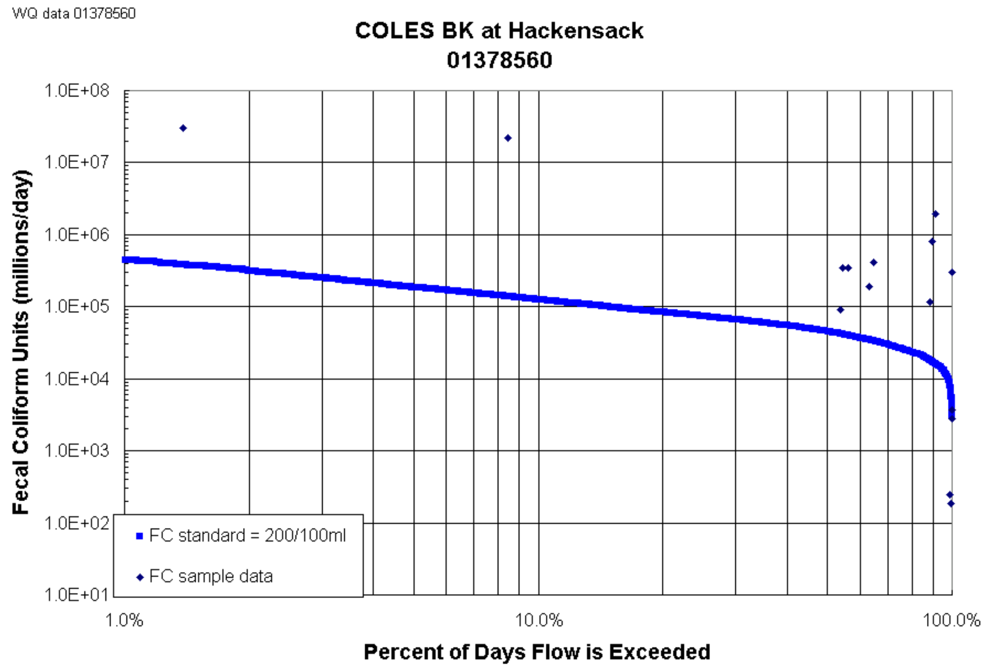
Load Duration Curve for Musquapsink Brook at River Vale. Fecal coliform data from USGS station # 01377499 during the period 7/13/99 through 9/7/00. Water years 1970-2000 from USGS station # 01377499 (Musquapsink Brook at River Vale) were used in generating the FC standard curve.



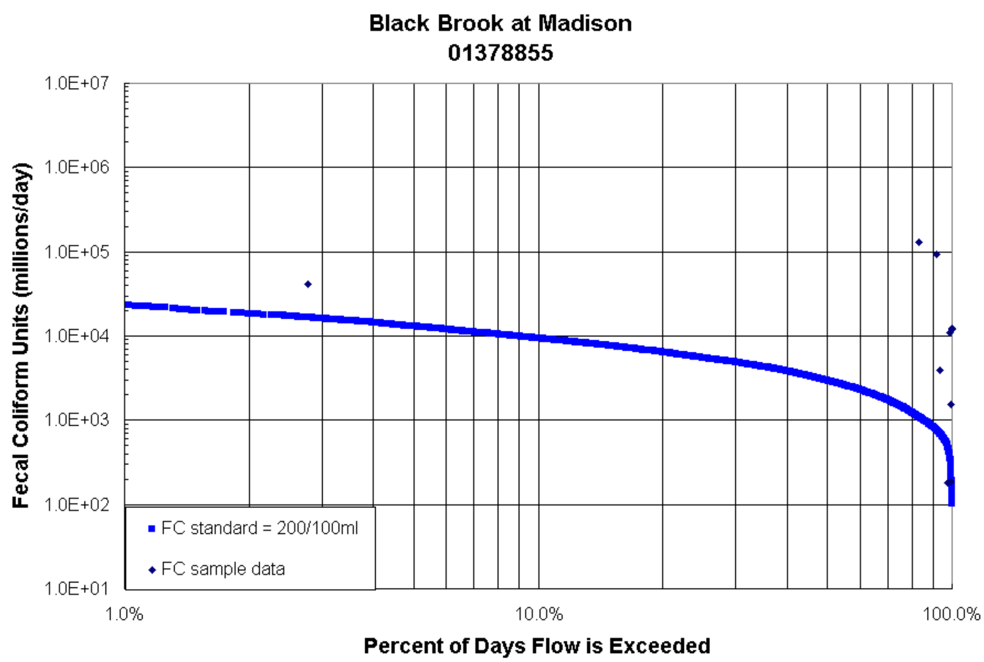
Load Duration Curve for Pascack Brook at Westwood. Fecal coliform data from USGS station # 01377500 during the period 6/1/98 through 9/6/98. Water years 1970-2000 from USGS station # 01377500 (Pascack Brook at Westwood) were used in generating the FC standard curve.



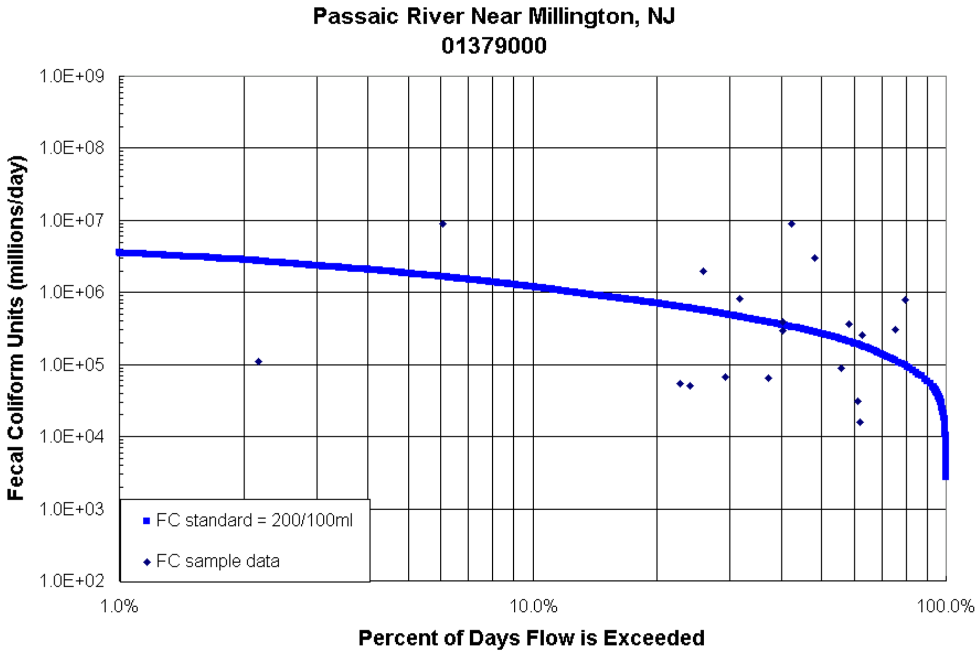
Load Duration Curve for Tenakill Brook at Cedar Lane at Closter. Fecal coliform data from USGS station # 01378387 during the period 7/13/99 through 8/9/99. Water years 1970-2001 from USGS station # 01390500 (Saddle River at Ridgewood) were used in generating the FC standard curve.



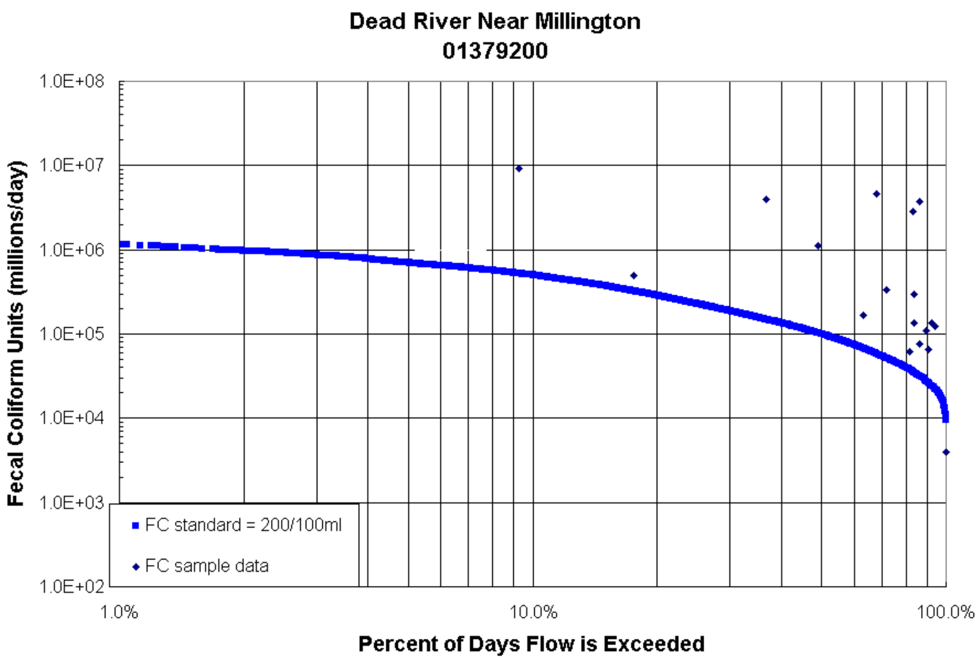
Load Duration Curve for the COLES BK at Hackensack. Fecal coliform data from USGS station # 01378560 during the period 11/5/97 through 8/23/00. Water years 1970-2001 from USGS station # 01391500 (Saddle River at Lodi) were used in generating the FC standard



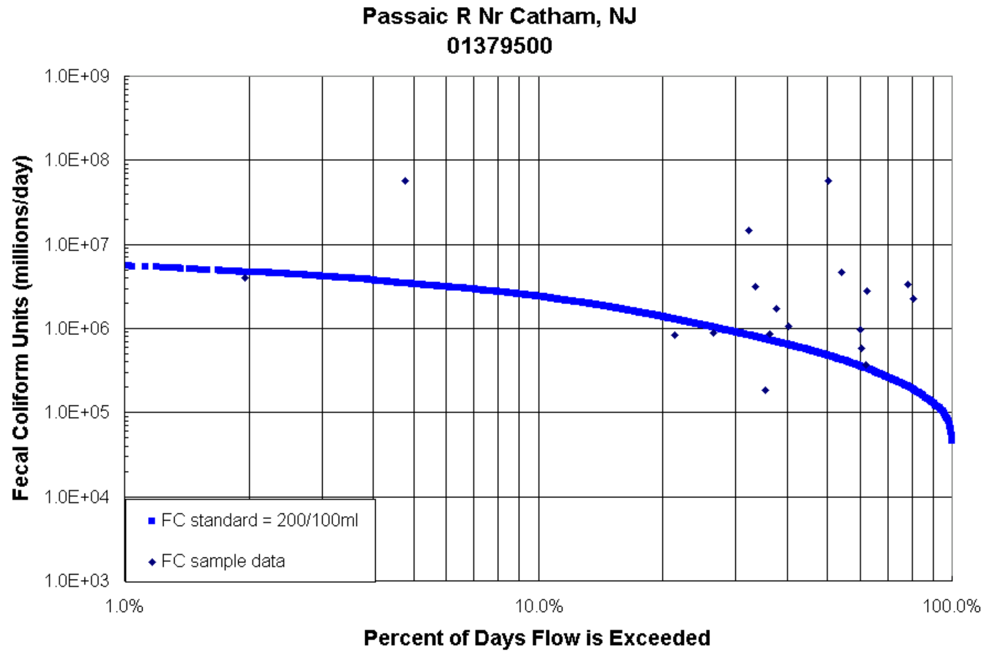
Load Duration Curve for Black Brook at Madison. Fecal coliform data from USGS station # 01378855 during the period 11/18/97 through 9/1/99. Water years 1970-2000 from USGS station # 01380500 (Rockaway River above Reservoir at Boonton) were used in generating the FC standard curve.



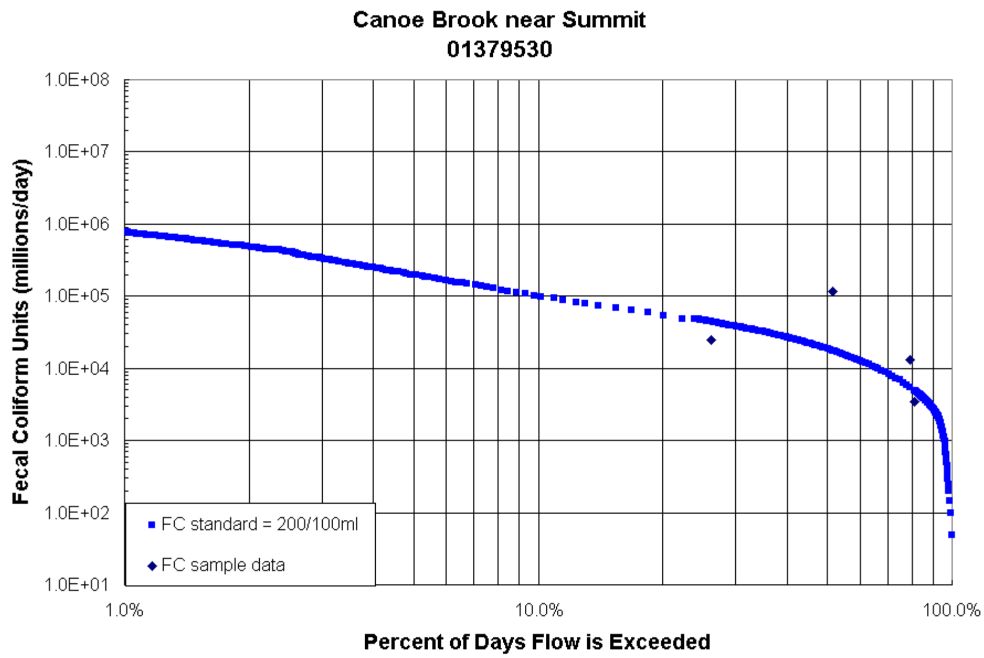
Load Duration Curve for the Passaic R Nr Millington. Fecal coliform data from USGS station # 01379000 during the period 10/1997 through 8/2000. Water years 1970-2000 from USGS station # 01379000 (Passaic R Nr Millington) were used in generating the FC standard curve.



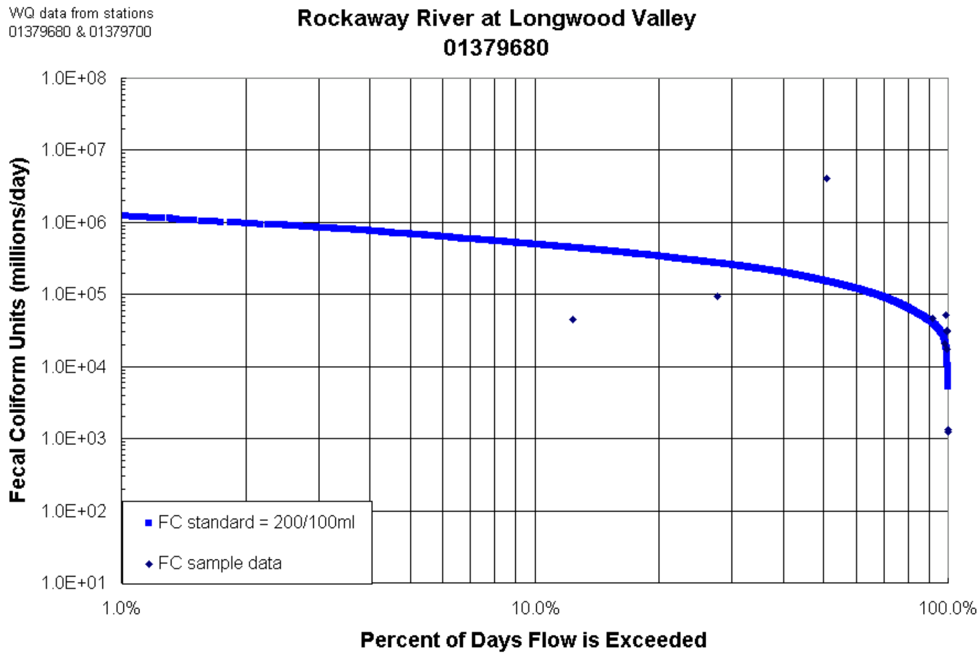
Load Duration Curve for the Dead River Near Millington. Fecal coliform data from USGS station # 01379200 during the period 10/1997 through 8/2000. Water years 1970-2000 from USGS station # 01379500 (Passaic R Nr Catham) were used in generating the FC standard curve.



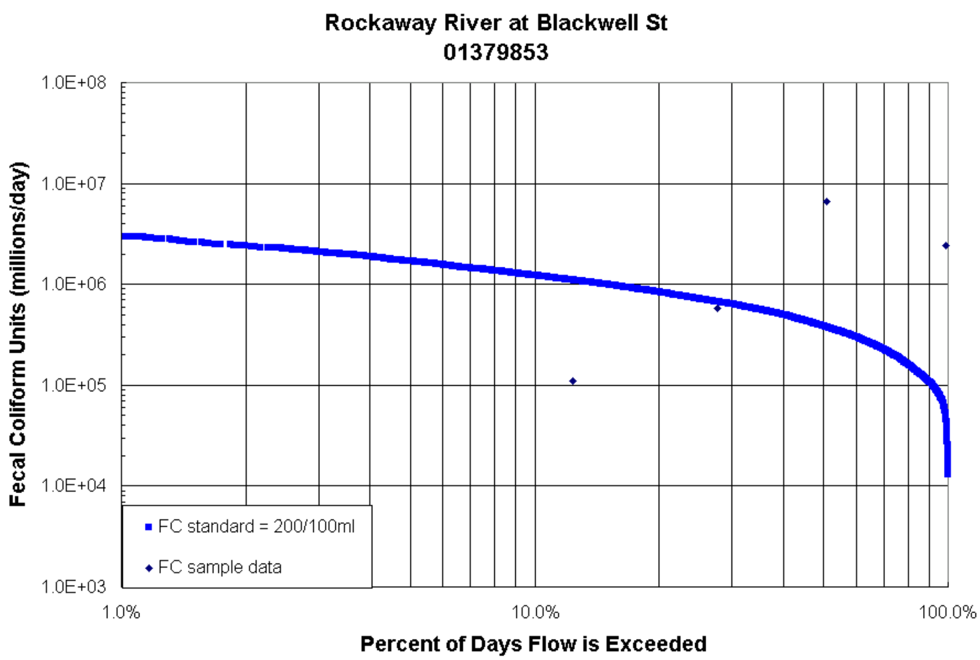
Load Duration Curve for the Passaic R Nr Catham. Fecal coliform data from USGS station # 01379500 during the period 10/1997 through 8/2000. Water years 1970-2000 from USGS station # 01379500 (Passaic R Nr Catham) were used in generating the FC standard curve.



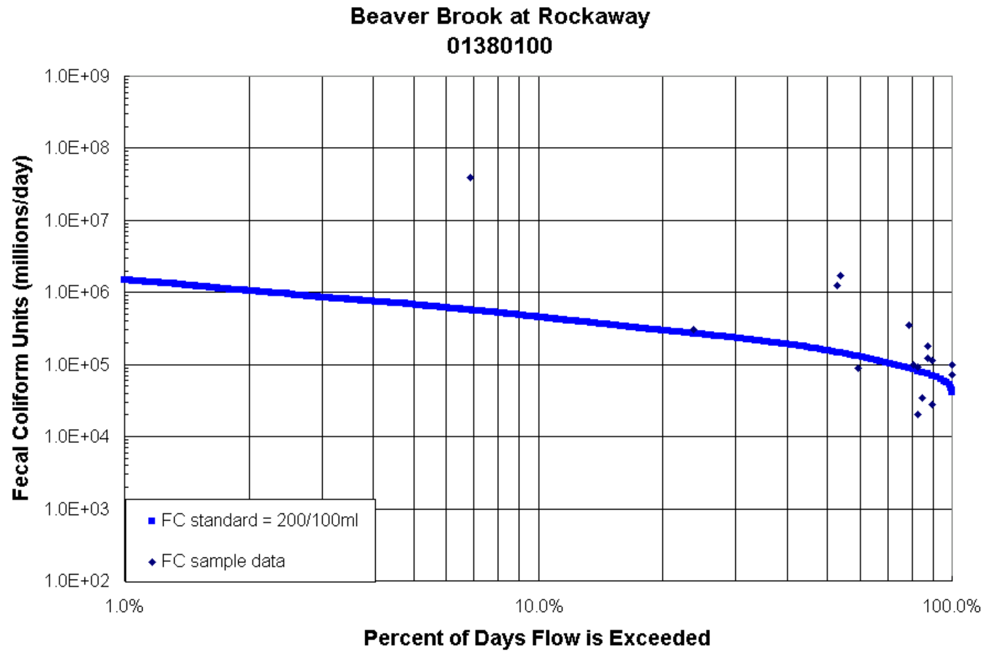
Load Duration Curve for Canoe Brook near Summit. Fecal coliform data from USGS station # 01379530 during the period 4/23/98 through 9/16/98. Water years 1970-2000 from USGS station # 01379530 (Canoe Brook near Summit) were used in generating the FC standard curve.



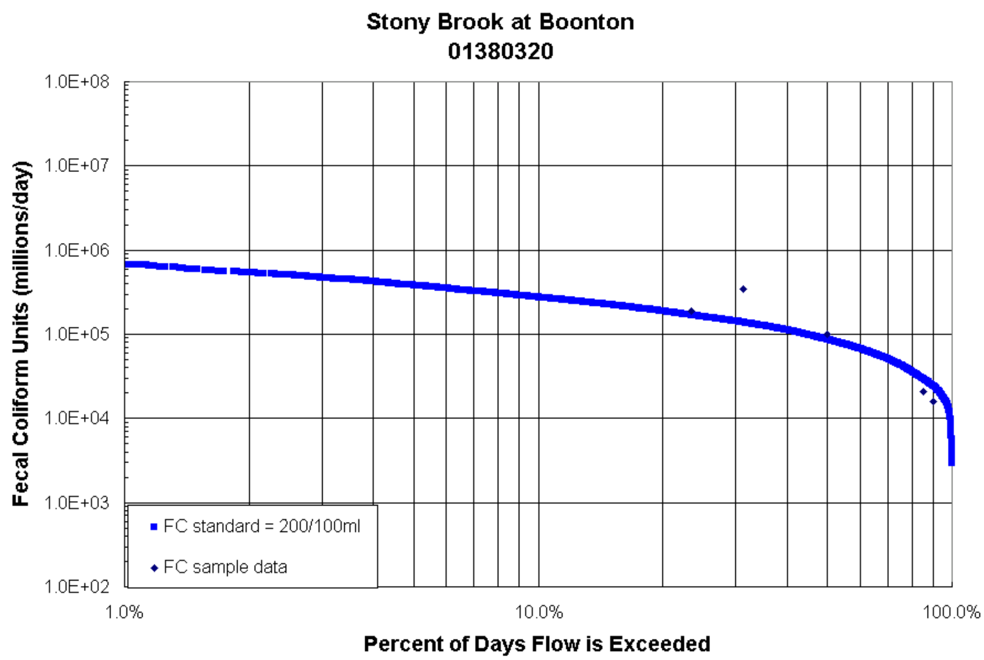
Load Duration Curve for Rockaway River at Longwood Valley. Fecal coliform data from USGS station # 01379680 & 01379700 during the period 1/27/97 through 9/2/99. Water years 1970-2000 from USGS station # 01380500 (Rockaway River above Reservoir at Boonton) were used in generating the FC standard curve.



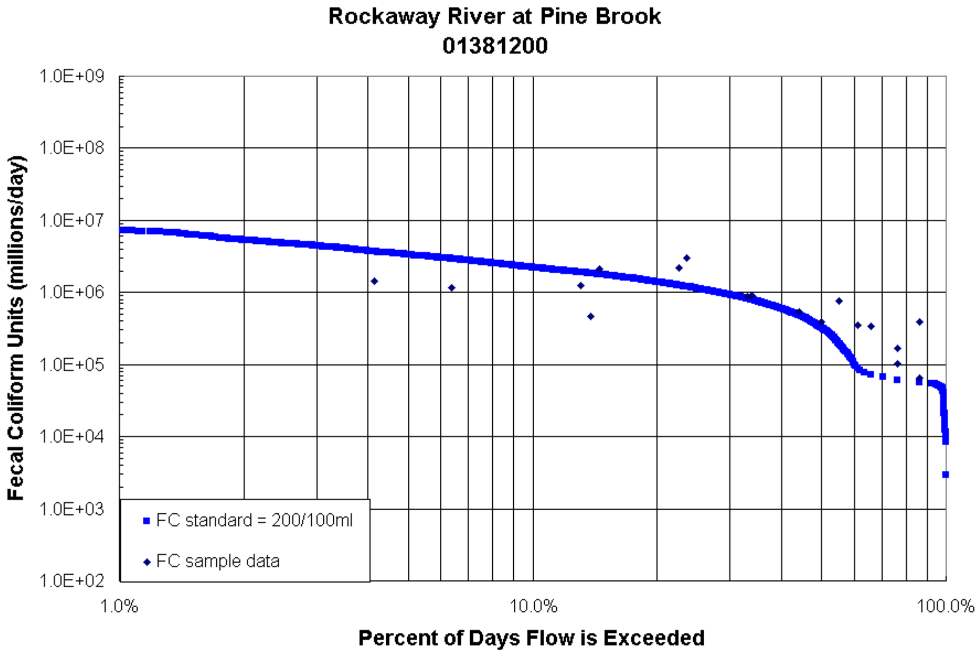
Load Duration Curve for Rockaway River at Berkshire Valley. Fecal coliform data from USGS station # 01379853 during the period 4/15/98 through 9/22/98. Water years 1970-2000 from USGS station # 01380500 (Rockaway River above Reservoir at Boonton) were used in generating the FC standard curve.



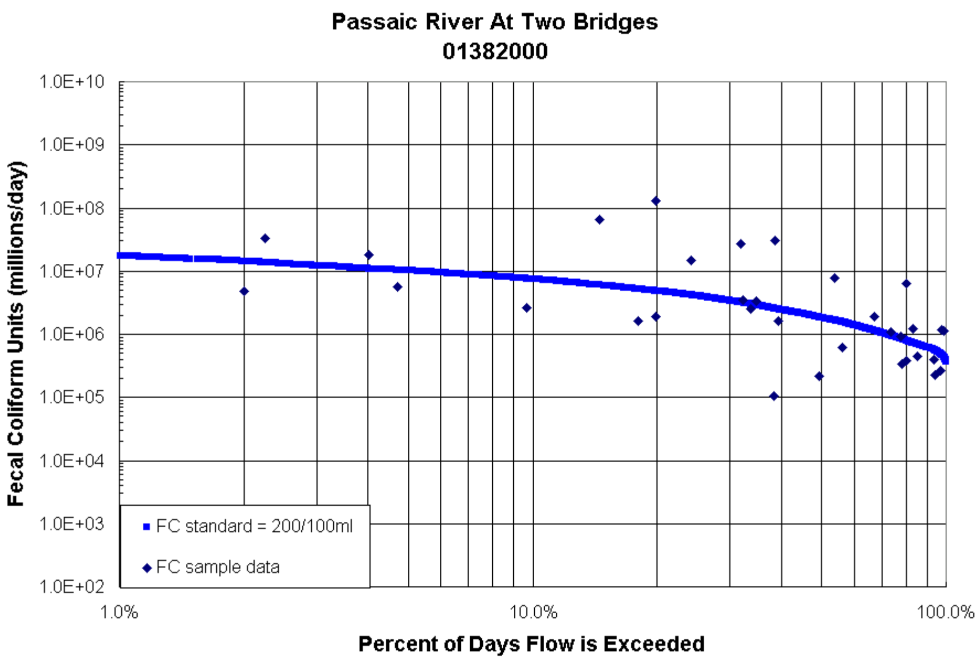
Load Duration Curve for the Beaver Brook At Rockaway. Fecal coliform data from USGS station # 01380100 during the period 11/13/97 through 8/7/2000. Water years 1970-2000 from USGS station # 01381500 (Whippany River at Morristown, NJ) were used in generating the FC standard curve.



Load Duration Curve for Stony Brook At Boonton. Fecal coliform data from USGS station # 01380320 during the period 12/13/99 through 9/7/00. Water years 1970-2000 from USGS station # 01380500 (Rockaway River above Reservoir at Boonton) were used in generating the FC standard curve.



Load Duration Curve for the Rockaway R at Pine Brook. Fecal coliform data from USGS station # 01381200 during the period 10/1997 through 8/2000. Water years 1970-2000 from USGS station # 01381000 (Rockaway River below Reservoir at Boonton, NJ) were used in generating the FC standard curve.



Load Duration Curve for the Passaic River at Two Bridges. Fecal coliform data from USGS station # 01382000 during the period 1/27/94 through 810/2000. Water years 1970-2000 from USGS station # 01381900 (Passaic R at Pine Brook, NJ) were used in generating the FC standard curve.

Bureau of Nonpoint Pollution Control

Water Pollution Management Element

Bureau of Nonpoint Pollution ControL

Industrial Stormwater Permitting Program

Municipal Stormwater Regulation Program

- Tier A Municipalities
- Tier B Municipalities
- Public Complex
- Highway Agency
- Case Manager List
- Emergency Snow Removal and Disposal Policy
- De-Icing Storage Policy
- Cleanwater Multimedia
- Stormwater Training
- TMDL Lookup

Companion Links

- www.cleanwaternj.org
- www.njstormwater.org

Onsite Wastewater Management Program

Discharge to Ground Water Permitting Program

Stormwater Management

Green Infrastructure in New Jersey

General Permits

Individual Permits

Municipality and County
Oakland Borough
Bergen County

Total Maximum Daily Load(TMDL) Information for Selected Municipality:

Applicable Stream TMDL(s)

- Total Maximum Daily Loads for Fecal Coliform to Address 32 Streams in the Northeast Water Region

  Fecal Coliform - 2003 : Ramapo River nr Mahwah between Pompton Lake and NY : View the TMDL Document

- Total Maximum Daily Load for Mercury Impairments Based on Concentration in Fish Tissue Caused Mainly by Air Deposition to Address 122 HUC 14s Statewide

  Mercury - 2011 : Crystal Lake/Pond Brook : View the TMDL Document

- Total Maximum Daily Load Report for the Non-Tidal Passaic River Basin Addressing Phosphorus Impairments

  Total Phosphorus - 2008 : Crystal Lake/Pond Brook : View the TMDL Document

- Total Maximum Daily Load Report for the Non-Tidal Passaic River Basin Addressing Phosphorus Impairments

  Total Phosphorus - 2008 : Ramapo R (Crystal Lk br to BearSwamp Bk) : View the TMDL Document

- Total Maximum Daily Load Report for the Non-Tidal Passaic River Basin Addressing Phosphorus Impairments

  Total Phosphorus - 2008 : Ramapo R (below Crystal Lake bridge) : View the TMDL Document

Applicable Lake TMDL(s)

- Total Maximum Daily Loads for Pathogens to Address 25 Lakes in the Northeast Water Region

  Fecal Coliform - 2007 : Crystal Lake : View the TMDL Document

- Total Maximum Daily Load Report to Address Phosphorus Impairment in Pompton Lake and Ramapo River in the Northeast Water Region

  Total Phosphorus - 2008 : Pompton Lake : View the TMDL Document

Applicable Shellfish TMDL(s)

None

Last Updated: March 27, 2019

Amendment to the
Northeast Water Quality Management Plan and Sussex County Water Quality Management Plan

Total Maximum Daily Loads for Pathogens to Address 25 Lakes in the Northeast Water Region

Watershed Management Area 3
(Crystal Lake, Lake Edenwold, Bubbling Springs, Erksine Lake, Forest Hill, Kitchell Lake, Lake Ioscoe, Lionhead Lake, and Skyline Lakes)
Watershed Management Area 4
(Toms Lake)
Watershed Management Area 6
(Camp Lewis Lake, Cozy Lake, Fox's Pond, Indian Lake, Intervale Lake, Lake Swannanoa, Mountain Lake, Parsippany Lake, Powder Mill Pond, Rainbow Lake, Sunrise Lake, Telemark Lake, West Lake, White Meadow Lake, and Cold Springs Pond)

Proposed: July 16, 2007
Established: September 21, 2007
Approved: September 28, 2007
Adopted: October 19, 2009

Prepared by:
New Jersey Department of Environmental Protection
and

TETRA TECH, INC.

With assistance provided by:
United States Environmental Protection Agency, Region 2

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TABLES

FIGURES

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) is required to assess the overall water quality of the State's waters and identify those waterbodies with a water quality impairment for which TMDLs may be necessary. A TMDL is developed to identify all the contributors of a pollutant of concern and the load reductions necessary to meet the Surface Water Quality Standards (SWQS) relative to that pollutant. The Department fulfills its assessment obligation under the CWA through the Integrated Water Quality Monitoring and Assessment Report, which includes the Integrated List of Waterbodies, issued biennially. On October 4, 2004 the Department adopted the *2004 Integrated List of Waterbodies* as an amendment to the Statewide Water Quality Management Plan (36 NJR 4543(a)), as part of the Department's continuing planning process pursuant to the Water Quality Planning Act at N.J.S.A. 58:11A-7 and the Water Quality Management Planning rules at N.J.A.C. 7:15-6.4(a). The *2004 Integrated List of Waterbodies* identifies twenty-five lakes as impaired with respect to pathogens in the Northeast Water Region.

The Department has recently adopted the *2006 Integrated Water Quality Monitoring and Assessment Report*, including the *2006 Integrated List of Waterbodies*, which identifies impairments based on HUC 14 Assessment Units rather than stream segments associated with discrete monitoring locations. This change in assessment methodology allows establishment of a stable base of assessment units for which the attainment or non-attainment status of all designated uses within each subwatershed or assessment unit will be identified. In addition, lakes are assessed and listed separately when impaired. The *2006 Integrated List of Waterbodies* identifies twenty-five lakes that are impaired with respect to pathogens in the Northeast Water Region. A lake is determined to be impaired if it does not fully support primary contact recreation as evidenced by beach closings in accordance with Health Department standards. The water quality trigger for beach closings is exceedance of 200 cfu/100 ml of fecal coliform (NJDOH, 2004). TMDLs are adopted for the impaired lakes listed in Table 1.

Table 1. Lakes in the Northeast Water Region impaired for pathogens for which TMDLs are adopted

TMDL Number	WMA	Lake Assessment Unit Name	County*
1	3	Crystal Lake	Bergen
2	3	Lake Edenwold	Morris
3	3	Bubbling Springs	Passaic
4	3	Erksine lake	Passaic
5	3	Forest Hill	Passaic
6	3	Kitchell Lake	Passaic
7	3	Lake Ioscoe	Passaic

TMDL Number	WMA	Lake Assessment Unit Name	County*
8	3	Lionhead Lake	Passaic
9	3	Skyline Lakes	Passaic
10	4	Toms Lake	Passaic
11	6	Camp Lewis Lake	Morris
12	6	Cozy Lake	Morris
13	6	Foxs Pond	Morris
14	6	Indian Lake	Morris
15	6	Intervale Lake	Morris
16	6	Lake Swannanoa	Morris
17	6	Mountain Lake	Morris
18	6	Parsippany Lake	Morris
19	6	Powder Mill Pond	Morris
20	6	Rainbow Lake	Morris
21	6	Sunrise Lake	Morris
22	6	Telemark Lake	Morris
23	6	West Lake	Morris
24	6	White Meadow Lake	Morris
25	6	Cold Springs Pond	Passaic

*The drainage area/lakeshed for each lake may encompass municipalities beyond the identified County in which the lake is located.

Nonpoint and stormwater point sources are the primary sources of fecal coliform loads to the impaired lakes. Source loads were estimated for land uses in each watershed using the Watershed Treatment Model (WTM) (WTM, 2001). The WTM model is a series of spreadsheets that quantifies the loading of pathogen indicators based on land use distribution, stream network length in the watershed, and annual rainfall. Traditional point sources, i.e., treatment facilities that have a sanitary waste component, were considered de minimus due to the use of effective disinfection practices by these facilities. TMDLs were developed based on an analysis of the existing pathogen indicator data compared to Health Department indicator criteria and the loading capacity has been allocated among the point and nonpoint sources.

This report establishes twenty-five TMDLs that have been adopted as amendments to the appropriate area-wide water quality management plan in accordance with N.J.A.C. 7:15-3.4(g). This report was developed consistent with EPA's May 20, 2002 guidance document entitled: "Guidelines for Reviewing TMDLs under Existing Regulations issued in 1992," (Sutfin, 2002) which describes the statutory and regulatory requirements for approvable TMDLs. These TMDLs were approved by EPA on September 28, 2007, and will be adopted as amendments to the Northeast and Sussex County Water Quality Management Plans in accordance with N.J.A.C. 7:15-3.4 (g).

1.0 INTRODUCTION

In accordance with Section 303(d) of the Federal Clean Water Act (CWA) (33 U.S.C. 1315(B)), the State of New Jersey, Department of Environmental Protection (Department) is required biennially to prepare and submit to the EPA a report that identifies waters that do not meet or are not expected to meet water quality standards after implementation of technology-based effluent limitations or other required controls. This report is commonly referred to as the 303(d) List. In accordance with Section 305(b) of the CWA, the Department is also required biennially to prepare and submit to the EPA 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 Water Quality Monitoring and Assessment Report combines these two assessments and assigns waterbodies to one of five sublists on the Integrated List of Waterbodies. 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 New Jersey 2004 *Integrated Water Quality Monitoring and Assessment Report* the water quality impairments were identified by segment name and pollutant(s) or non-attained designated use responsible for the finding that the segment was impaired. Each segment was assessed using the data from one or more discrete monitoring locations that were determined to be representative of the water quality in that segment. This impaired segment delineation method was changed in 2006.

The *New Jersey 2006 Integrated Water Quality Monitoring and Assessment Report* now identifies impairments based on designated use attainment and then lists the parameters responsible for the non-attainment of the designated use. The assessments are conducted for each of the seven categories of designated use, which include aquatic life, recreational use (primary and secondary contact), drinking water, fish consumption, shellfish harvesting (if applicable), agricultural water supply use and industrial water supply use. In addition, lakes are assessed and listed separately if impaired. In the Northeast Water Region, the *2006 Integrated List of Waterbodies* currently identifies twenty-five lakes as impaired for pathogens. These lakes do not fully support primary contact recreation as evidenced by beach closings and water quality data that demonstrate exceedance of the water quality criterion that triggers closings.

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

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

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

This report establishes twenty-five TMDLs for pathogens to address the impaired lakes in the Northeast Water Region. All of the impaired lakes were listed for fecal coliform and assigned a high priority on the *2004 Integrated List of Waterbodies* and a high priority ranking on the *2006 Integrated List of Waterbodies* Sublist 5. These TMDLs include management approaches to reduce pathogen contributions from various sources in order to attain applicable surface water quality standards and fully support the designated primary contact recreation use. These TMDLs affect the drainage areas of the impaired lakes due to the fact that the implementation measures must be applied to the contributing drainage areas, not just the impaired lakes. Following approval of the TMDLs by EPA, pathogens will be removed as a basis of impairment in the next Integrated List. In addition to the pathogen impairments, Mountain Lake was listed for mercury on the *2006 Integrated List*. This pollutant will be addressed in future TMDL efforts.

2.0 POLLUTANT OF CONCERN AND AREA OF INTEREST

The pollutant of concern for these TMDLs is pathogens. Standards are established in terms of indicator organisms which, when present in excess of the standard, suggest that the waterbody is not suitable for primary contact recreation because of an elevated risk of disease. New Jersey Surface Water Quality Standards (SWQS) include pathogen indicator criteria for the assessment of the recreational use (primary and secondary contact recreation) for all waterbodies. However, for lakes with bathing beaches, the New Jersey Health Department Standards N.J.A.C. 8:26-7.18 establish the basis for beach closings. These standards are more stringent than the Surface Water Quality Standards. As a result, the Health Department Standards will serve as the water quality target for these TMDLs. The Health Department Standards and SWQS are summarized as follows:

> **As stated in N.J.A.C. 8:26-7.18 Microbiological water quality standards for bathing beaches:**
>
> The multiple-tube fermentation technique for fecal coliforms shall be conducted in accordance with the procedures set for in Method 9222D Fecal Coliform Membrane Filter Procedure or Method 9221E.2. Fecal Coliform MPN Procedure (A-1 medium) found in the 19th edition of "Standard Methods for the Examination of Water and Wastewater." American Public Health Association, incorporated herein by reference, as amended and supplemented. The estimated fecal coliform concentrations shall not exceed 200 fecal coliform per 100 milliliters.

As stated in N.J.A.C. 7:9B-1.14(d) of the New Jersey Surface Water Quality Standards Fresh Water 2 (FW2) waters:

1. Bacterial quality (Counts/100 ml)

    ii. Primary Contact Recreation:

        (2) E. Coli levels shall not exceed a geometric mean of 126/100 ml or a single sample maximum of 235/100 ml.

The lakes assessed as impaired based on water quality data and for which TMDLs have been developed are identified in Table 2 and depicted in Figures 1 and 2.

Table 2. Impaired Waterbodies as identified on the *2004 Integrated List of Waterbodies* and the *2006 Integrated List* for which Pathogen TMDLs are being adopted

TMDL Number	WMA	Lake Assessment Unit Name	Lake Assessment Unit ID	2004 Status	2006 Status	County(s) *	Proposed Action
1	3	Crystal Lake	Crystal Lake-03	Sublist 5	Sublist 5	Bergen	Adopt TMDL
2	3	Lake Edenwold	Lake Edenwold-03	Sublist 5	Sublist 5	Morris	Adopt TMDL
3	3	Bubbling Springs	Bubbling Springs-03	Sublist 5	Sublist 5	Passaic	Adopt TMDL
4	3	Erskine lake	Erskine Lake-03	Sublist 5	Sublist 5	Passaic	Adopt TMDL
5	3	Forest Hill	Forest Hill Lake-03	Sublist 5	Sublist 5	Passaic	Adopt TMDL

TMDL Number	WMA	Lake Assessment Unit Name	Lake Assessment Unit ID	2004 Status	2006 Status	County(s) *	Proposed Action
6	3	Kitchell Lake	Kitchell Lake-03	Sublist 5	Sublist 5	Passaic	Adopt TMDL
7	3	Lake Ioscoe	Lake Ioscoe-03	Sublist 5	Sublist 5	Passaic	Adopt TMDL
8	3	Lionhead Lake	Lionhead Lake-03	Sublist 5	Sublist 5	Passaic	Adopt TMDL
9	3	Skyline Lakes	Skyline Lakes-03	Sublist 5	Sublist 5	Passaic	Adopt TMDL
10	4	Toms Lake	Toms Lake-04	Sublist 5	Sublist 5	Passaic	Adopt TMDL
11	6	Camp Lewis Lake	Camp Lewis Lake-06	Sublist 5	Sublist 5	Morris	Adopt TMDL
12	6	Cozy Lake	Cozy Lake-06	Sublist 5	Sublist 5	Morris	Adopt TMDL
13	6	Foxs Pond	Foxs Pond-06	Sublist 5	Sublist 5	Morris	Adopt TMDL
14	6	Indian Lake	Indian Lake-06	Sublist 5	Sublist 5	Morris	Adopt TMDL
15	6	Intervale Lake	Intervale Lake-06	Sublist 5	Sublist 5	Morris	Adopt TMDL
16	6	Lake Swannanoa	Lake Swannanoa-06	Sublist 5	Sublist 5	Morris	Adopt TMDL
17	6	Mountain Lake	Mountain Lake-06	Sublist 5	Sublist 5	Morris	Adopt TMDL
18	6	Parsippany Lake	Parsippany Lake-06	Sublist 5	Sublist 5	Morris	Adopt TMDL
19	6	Powder Mill Pond	Powder Mill Pond-06	Sublist 5	Sublist 5	Morris	Adopt TMDL
20	6	Rainbow Lake	Rainbow Lakes-06	Sublist 5	Sublist 5	Morris	Adopt TMDL
21	6	Sunrise Lake	Sunrise Lake-06	Sublist 5	NA	Morris	Adopt TMDL
22	6	Telemark Lake	Telemark Lake-06	Sublist 5	Sublist 5	Morris	Adopt TMDL
23	6	West Lake	West Lake-06	Sublist 5	Sublist 5	Morris	Adopt TMDL
24	6	White Meadow Lake	White Meadow Lake-06	Sublist 5	Sublist 5	Morris	Adopt TMDL
25	6	Cold Springs Pond	Cold Spring Lake 06	Sublist 5 (as Pond at Conference Center Left and Right)	Sublist 5	Passaic	Adopt TMDL

*The drainage area/lakeshed for each lake may encompass municipalities beyond the identified County in which the lake is located.

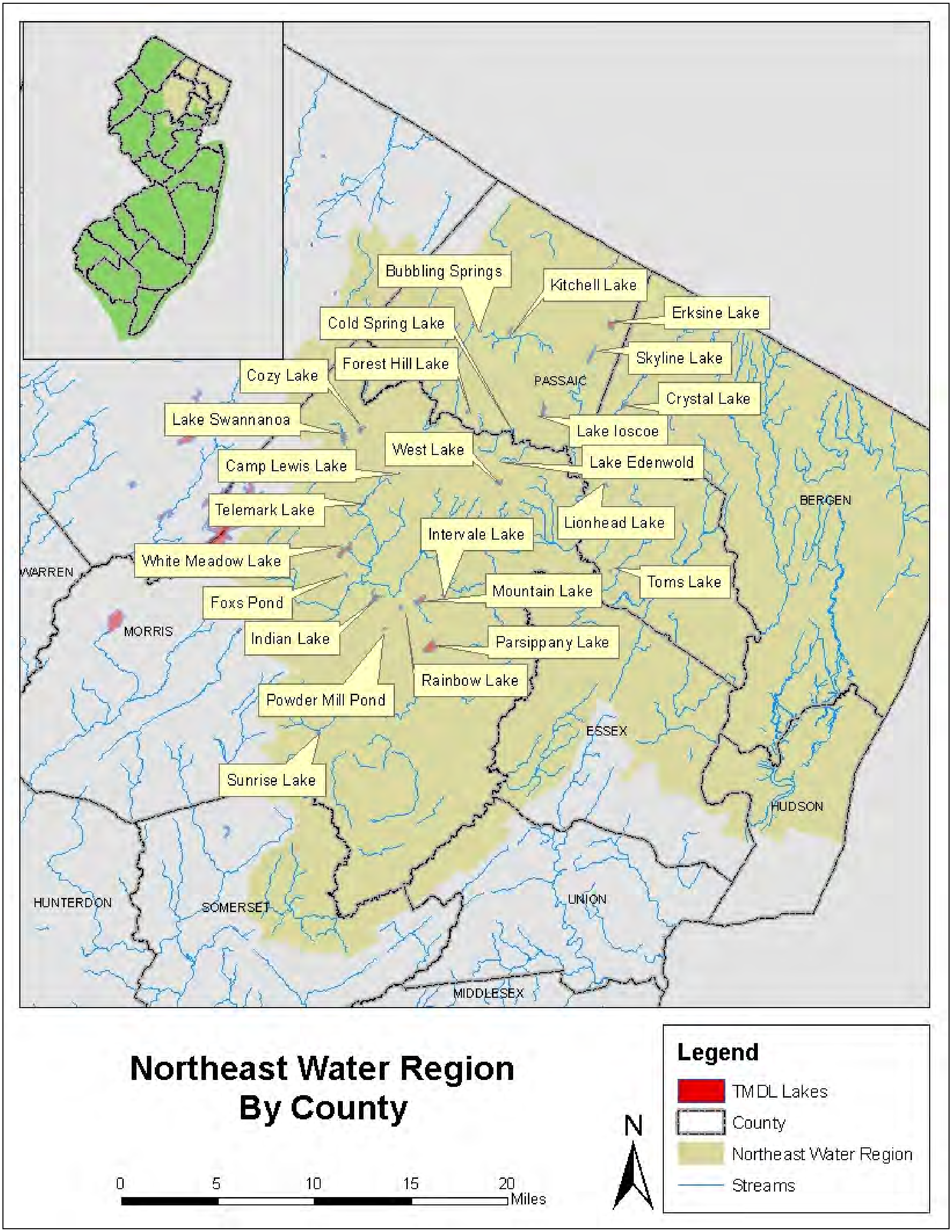

Figure 1. Pathogen impaired lakes in Northeast Water Region by county

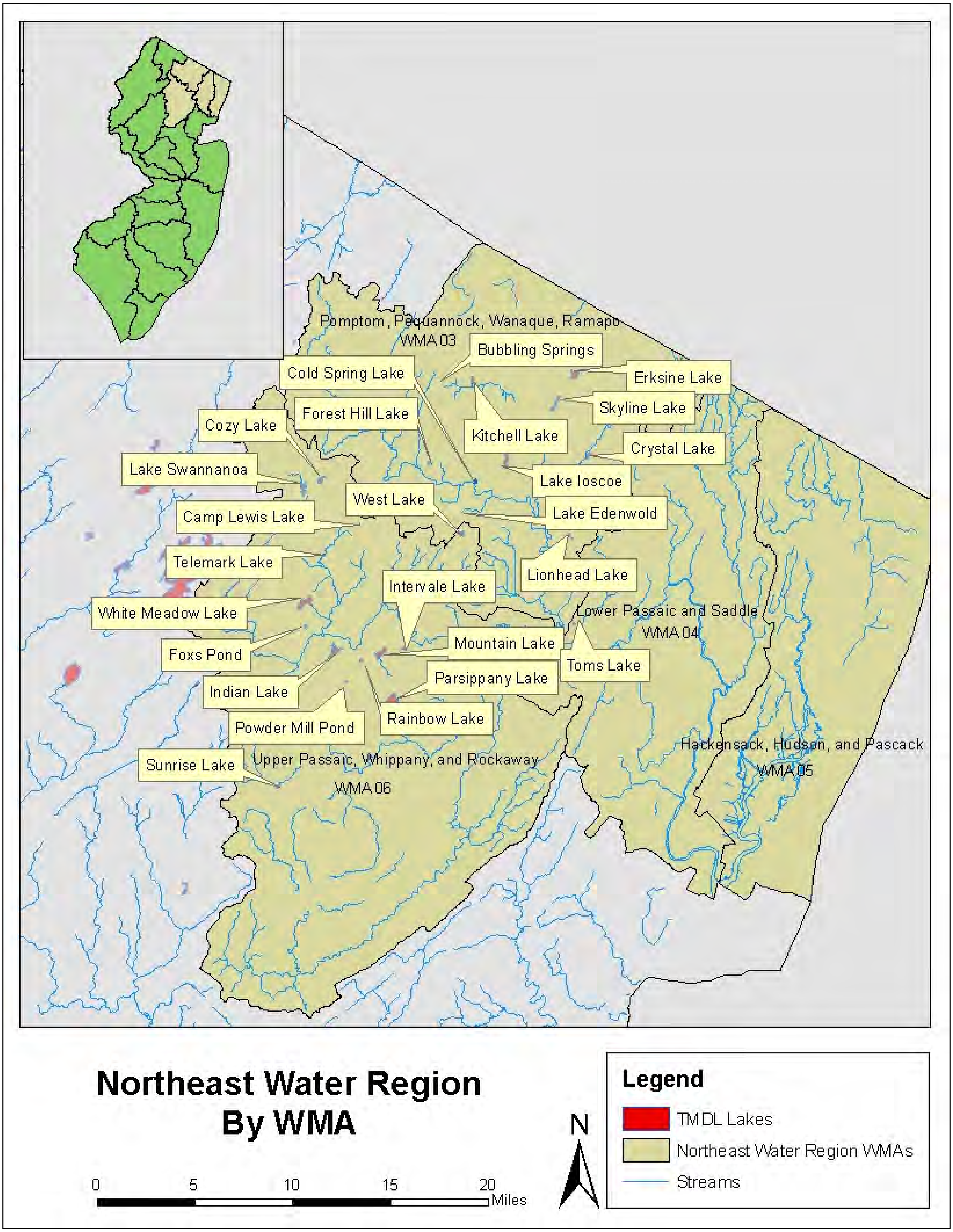

Figure 2. Pathogen impaired lakes in the Northeast Water Region by WMA.

Erskine Lake, Forest Hill Lake, Kitchell Lake, Sunrise Lake and Telemark Lake are classified as Fresh Water 2 (FW2), Trout Maintenance (TM). All other impaired lakes addressed in this document are classified as FW2, Non-Trout (NT).

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

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

3.0 SOURCE ASSESSMENT

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

3.2 Assessment of Point Sources

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

Wastewater treatment facilities and Tier A municipalities that directly discharge to the pathogen impaired lakes in the Northeast Water Region are identified in Appendix B. Per Department NJPDES Regulation, N.J.A.C. 7:14A-12.5(a), "All wastewater that could contain pathogenic organisms such as fecal coliform and/or enterococci organisms shall be subject to continuous year round disinfection prior to discharge into surface waters." Therefore, loads from wastewater treatment facilities were considered de minimus, consistent with previous pathogen TMDLs developed by the Department. The NJPDES permit limits for these point sources will not be changed as a result of these TMDLs and will remain a 200 cfu/100 ml monthly geometric mean and a 400 cfu/100 ml weekly geometric mean.] Stormwater loads from Tier A MS4 systems are point sources that can be significant. These loads were estimated using the watershed loading methods described in the nonpoint source section, as they will be addressed through BMPs.

3.3 Assessment of Nonpoint Sources

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

Watershed Treatment Model (WTM) (WTM, 2001), a steady-state spreadsheet model, was chosen to estimate nonpoint source bacteria loads for these TMDLs. WTM simulates loadings generated by watershed washoff processes. The WTM model was selected because it encompasses local rainfall data and stream length information to better tailor load estimates. In addition, it has been successfully applied in previous coastal TMDL studies, including the development of pathogen TMDLs for impaired shellfish waterbodies in New Jersey. The goal of applying WTM is to characterize all the point and nonpoint sources, as available data allows, in the existing system and to determine their relative contributions to the waterbody of interest. The loading values thus derived serve as the reference point from which reductions are made to meet TMDL targets.

The WTM model is a series of spreadsheets that quantifies the loading of pathogen indicators based on land use distribution, stream network length in the watershed, and annual rainfall. The model is designed as a planning level tool for watersheds that do not have sufficient data for complex modeling applications. Pathogen concentrations in runoff and receiving waters are highly variable due to many factors, therefore average annual land use loads derived using the WTM model are gross estimates. Although the WTM model has several tiers of data specificity, loading estimates can be calculated with simple land use data, as they were for these lake TMDLs. Land use loads are calculated on an annual basis by using a series of coefficients for runoff volume and pathogen loading derived from scientific literature. General land use categories are assigned either a coefficient that is then multiplied by an annual runoff volume to calculate an annual load (e.g., urban land uses) or an annual unit area load that is applied as a function of land use (e.g., rural land uses). These coefficients are presented in Table 3 and discussed in the WTM user manual (Caraco, 2001). According to the WTM user manual, the urban loading coefficient was based on the median urban runoff value derived from Nationwide Urban Runoff Program (NURP) monitoring data (Pitt, 1998). Loading values for rural land uses were taken from Horner et. al., 1994. Note that barren land is not represented in the WTM model, therefore it was assumed that the forest loading value was reasonable for this land use type.

Table 3. Default WTM land use categories and loading variables.

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

The watershed for each TMDL waterbody was delineated using the Hydrologic Unit Coverage (HUC-14 digit) developed by NJDEP, digital elevation model (DEM) data, the National Hydrography Dataset (NHD) stream coverage for New Jersey, and ArcHydro, a watershed delineation tool available as an extension for the ArcGIS geospatial mapping software suite. Land use data for each watershed was obtained from the 2002 land use coverage developed for New Jersey's WMAs. Land use categories were consolidated into broader groups for use in estimating land-based loads using the WTM model and for presenting the loading results. The percent impervious information for each land use category was derived from the percent impervious information in the Department's GIS land use coverage, averaged across similar land uses. The bacterial loads for urban areas in each watershed were calculated based on the default fecal coliform concentration literature value for urban land uses, the average percent impervious cover, and the annual runoff volume calculated by the WTM model. Agricultural, forest, and barren land use loads were calculated based on the specific loading rate for each category. The literature loading rate for forested land was applied to wetland areas to estimate a wetland land use load. Waterways were not included in loading calculations based on WTM model assumptions.

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

The drainage area and land use distribution of the impaired watersheds are presented in Table 4. Maps of the watershed land use distributions are presented in Appendix C.

Table 4. Land use area distribution for impaired watersheds in the Northeast Water Region

WMA	Lake Assessment Unit ID	Agriculture		Barren Land		Forest		Urban		Water		Wetland		Total Area
		km²	%	km²	%	km²	%	km²	%	km²	%	km²	%	km²
3	Bubbling Springs-03	0.00	0.0	0.00	0.2	0.10	39.0	0.14	55.4	0.01	3.7	0.00	1.7	0.25
3	Crystal Lake-03	0.07	0.3	0.13	0.7	4.10	20.7	13.65	69.0	0.85	4.3	1.00	5.0	19.79
3	Erskine Lake-03	0.00	0.0	0.00	0.0	0.72	36.3	0.80	40.3	0.45	22.5	0.02	0.9	1.99
3	Forest Hill Lake-03	0.02	3.2	0.03	3.6	0.47	65.3	0.16	22.4	0.04	5.2	0.00	0.4	0.72
3	Kitchell Lake-03	0.01	0.3	0.00	0.0	1.44	65.9	0.58	26.3	0.09	4.3	0.07	3.2	2.19
3	Lake Edenwold-03	0.03	0.2	0.02	0.1	8.77	60.3	3.50	24.0	1.35	9.3	0.88	6.1	14.54
3	Lake Ioscoe-03	0.00	0.0	0.02	0.5	3.09	67.3	0.52	11.4	0.72	15.7	0.23	5.1	4.59
3	Lionhead Lake-03	0.02	0.4	0.00	0.0	1.47	27.5	1.90	35.4	1.76	32.8	0.21	3.9	5.36
3	Skyline Lakes-03	0.01	0.2	0.02	0.2	4.84	63.0	2.26	29.4	0.19	2.5	0.36	4.7	7.67
4	Toms Lake-04	0.00	0.0	0.00	0.0	0.04	9.7	0.28	71.8	0.05	12.8	0.02	5.6	0.40
6	Camp Lewis Lake-06	0.00	0.0	0.00	0.0	0.36	74.5	0.09	19.5	0.01	1.2	0.02	4.8	0.48
6	Cold Spring Lake 06	0.00	0.0	0.00	0.0	2.99	79.8	0.31	8.3	0.26	6.9	0.19	5.1	3.74
6	Cozy Lake-06	0.08	1.8	0.04	0.9	2.68	56.9	1.46	30.9	0.16	3.3	0.29	6.1	4.71
6	Foxs Pond-06	0.00	0.0	0.03	0.9	0.87	27.9	2.03	65.5	0.07	2.1	0.11	3.6	3.10
6	Indian Lake-06	0.34	1.8	0.07	0.4	6.71	36.0	9.40	50.5	1.01	5.4	1.11	6.0	18.63
6	Intervale Lake-06	0.00	0.0	0.00	0.0	0.44	28.1	0.98	62.5	0.05	3.2	0.10	6.3	1.56
6	Lake Swannanoa-06	0.23	0.7	0.08	0.2	22.48	65.0	7.16	20.7	0.84	2.4	3.78	10.9	34.58
6	Mountain Lake-06	0.00	0.0	0.00	0.0	0.99	30.2	1.59	48.4	0.59	17.9	0.12	3.5	3.28
6	Parsippany Lake-06	0.00	0.0	0.00	0.0	0.08	2.7	2.26	76.2	0.62	21.0	0.00	0.1	2.97
6	Powder Mill Pond-06	0.08	2.0	0.02	0.6	1.48	37.0	2.10	52.6	0.06	1.5	0.25	6.3	3.99
6	Rainbow Lakes-06	0.00	0.0	0.00	0.0	0.19	29.0	0.33	50.3	0.07	11.4	0.06	9.2	0.65
6	Sunrise Lake-06	0.00	0.0	0.02	0.8	1.73	88.4	0.15	7.8	0.02	1.0	0.04	2.0	1.95
6	Telemark Lake-06	0.03	0.4	0.01	0.2	4.97	71.4	1.15	16.5	0.12	1.7	0.69	9.8	6.97
6	West Lake-06	0.00	0.0	0.00	0.0	0.59	42.7	0.46	33.3	0.26	18.9	0.07	5.1	1.39
6	White Meadow Lake-06	0.00	0.0	1.11	15.4	2.67	37.1	1.58	21.9	1.43	19.8	0.42	5.8	7.21

4.0 WATER QUALITY ANALYSIS

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

Fecal coliform data collected by county and township municipal health departments were used as the basis for TMDL development for the listed pathogen impaired lakes. These data were reviewed to identify potential data excursions in accordance with the Quality Assurance Project Plan (QAPP) that was developed for this study (QAPP, 2007). The percent reduction required to meet New Jersey bathing beach requirements was calculated based on comparing the maximum fecal coliform concentration recorded for each lake to the TMDL target (200 cfu/100 ml). The data available for each lake are included in Appendix D.

4.1 Seasonal Variation/Critical Conditions

The technical approach used to develop these TMDLs includes consideration of seasonal variability and critical conditions. The TMDL lakes are listed as impaired based on the designated primary contact bathing use. Water quality criteria for bathing beaches are established by the New Jersey Department of Health (NJDOH), which conducts monitoring at the municipal level in support of meeting the applicable criteria. Bathing beaches are typically in use during the late spring and summer months and data collection efforts are coordinated to coincide with this time period (May-September). TMDL loading reductions are based on the single sample maximum concentration identified in the record of observed in-lake water quality, therefore, TMDL development is based on the highest concentration observed for the time period of greatest exposure. Seasonal variability is of less importance because of the need to meet NJDOH bathing beach requirements during the summer critical condition period. TMDL loads are presented as average annual loads, which incorporate the summer critical condition period and the average load contributed during the other seasons.

4.2 Margin of Safety

A Margin of Safety (MOS) is provided to account for "lack of knowledge concerning the relationship between effluent limitations and water quality" (40 CFR 130.7(c)). For these TMDLs, both an implicit and explicit Margin of Safety (MOS) were incorporated. An implicit MOS was incorporated by using conservative assumptions, including treating fecal coliform as a conservative substance (source loads were estimated without including die-off rates, soil incorporation, etc.) and using conservative methods to estimate land-based loads. In addition, a 5% explicit MOS was calculated for each lake.

5.0 TMDL CALCULATIONS

Pathogen load percent reductions were calculated by comparing the maximum fecal coliform concentration recorded for each lake to the TMDL target concentration (200 cfu/100 ml). Load capacities were the remaining loads after applying the required reductions on the current loads. In addition, 5% of the load capacity was reserved as the explicit MOS (see example below). The percent reduction specified for each lake was applied equally to pathogen sources in each watershed except in cases where load reductions could be met without reducing the loads contributed by forest, wetlands and barren lands: in such cases these loadings were not reduced in the TMDL allocation. In cases where load reductions on these land use sources were greater than or equal to 99.5%, the percent reduction specified for each lake was applied equally to all pathogen sources including forest and barren land loads.

Percent Reduction = (1 – TMDL target conc./max conc.) x 100
Load Capacity = (1 – percent reduction) * overall current load (using WTM)
MOS = 5% * Load capacity
Overall percent reduction = 1 – (Load capacity – MOS) / overall current load
Overall current load = agricultural and urban land use loads + forest, wetland and barren land loads

When $1 - \frac{Load\ Capacity - MOS - Forest, Wetlands\ and\ Barren\ Land\ Load}{Agricultural\ and\ Urban\ Land\ Use\ Load} \geq 99.5\%$,

Require the same percent reduction on Forest Wetlands, and Barren land loads as on other land use loads;

Otherwise,

Zero percent reduction on Forest, Wetlands and Barren lands loads

5.1 Wasteload Allocations and Load Allocations

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

This distribution of loading capacity between WLAs and LAs is consistent with recent EPA guidance that clarifies existing regulatory requirements for establishing WLAs for stormwater discharges (Wayland, November 2002). Stormwater discharges are captured within the runoff sources quantified according to land use, as described previously. Distinguishing between regulated and unregulated stormwater is necessary in order to express WLAs and LAs numerically; however, "EPA recognizes that these allocations might be fairly rudimentary because of data limitations and variability within the system" (Wayland, November 2002, p.1). Therefore, allocations are established according to source categories as shown in Table 5. 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 5. Assignment of WLAs and LAs for stormwater point sources and nonpoint sources

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

A summary of the WLAs, LAs, and MOS is provided for each lake in Table 6 and source loads and allocations are presented in Table 7. As described above, when the loads contributed by forest/wetland/barren lands were not reduced in the TMDL allocation table, the load reduction for urban lands and agricultural lands was increased proportionally to meet the overall percent reduction required for each lake. Note that the overall percent reduction shown in Tables 6 and 7 takes into account the 5% explicit MOS if not based on the previously established stream Fecal Coliform TMDL.

In cases where impaired lakeshed is hydrologically connected to a streamshed addressed in a n established Fecal Coliform TMDL or to another impaired lakeshed, different approaches were utilized to calculate the load reduction for each "nested" watershed.

Lakeshed connected with the Fecal Coliform TMDL established streamshed

If the entire lakeshed is located within the impaired streamshed, the more stringent overall percent reduction between the lake and the stream is applied to the lakeshed. When the streamshed is part of the lakeshed, the rivershed is treated as an upper stream "lake" shed. The same approach, as described below for the nested lakesheds, was used to determine the adjusted load reduction for different areas.

Lakeshed connected with another impaired lakeshed

The following methodology was used to determine the adjusted percent reduction for the nested lake watersheds:

1. Existing pathogen loads calculated for each lake watershed (using WTM) were reduced based on the overall percent reduction that was calculated from the observed lake water quality data. The reduced load was termed the target load.
2. The target load for the upstream watershed was subtracted from the target load of the downstream watershed, giving a target load for the downstream (local) watershed area. The existing load for the downstream (local) watershed was calculated similarly.
3. If the target load for the downstream (local) watershed area was less than or equal to zero, the downstream lake's higher percent reduction needed to be applied to the upper stream lakeshed. This means that the entire drainage area of the downstream lake is ruled by the downstream lake's reduction percentage.
4. If the target load of the downstream (local) watershed area was higher than zero, the percent difference between the existing and target loads for the downstream (local) watershed was calculated. This adjusted percent reduction superseded the original downstream lake percent reduction and was used as the required percent reduction for the downstream (local) watershed area while the upstream lakeshed stayed with the original overall percent reduction. The adjusted percent reduction would be higher than the original overall percent reduction for the downstream lake when the upstream lake required a less percent reduction than the downstream lake and less than the original value if the upstream lake required a higher percent reduction than the downstream lake.

Table 6. TMDL calculations for pathogen impaired lakes in the Northeast Water Region

WMA	Lake Assessment Unit ID	WLA (10^6 colonies/yr)	LA (10^6 colonies/yr)	MOS (10^6 colonies/yr)	TMDL (10^6 colonies/yr)	Overall % Reduction	% MOS	Reduction from associated Stream TMDL
3	Bubbling Springs-03	4.88E+02	3.03E+02	4.17E+01	8.34E+02	90.50%	5.00%	
3	Crystal Lake-03[b]	3.06E+04	1.55E+04	2.43E+03	4.86E+04	94.86%	5.00%	91%
3	Erskine Lake-03	2.11E+03	7.71E+01	1.15E+02	2.30E+03	96.48%	5.00%	
3	Forest Hill Lake-03	4.74E+02	8.71E+01	2.95E+01	5.91E+02	94.86%	5.00%	
3	Kitchell Lake-03	1.77E+03	2.35E+02	1.06E+02	2.11E+03	94.84%	5.00%	
3	Lake Edenwold-03	4.91E+03	2.87E+04	1.77E+03	3.53E+04	84.17%	5.00%	
3	Lake Ioscoe-03	1.20E+03	9.92E+03	5.86E+02	1.17E+04	75.32%	5.00%	
3	Lionhead Lake-03	3.03E+03	5.00E+03	4.23E+02	8.46E+03	95.13%	5.00%	
3	Skyline Lakes-03	6.43E+03	6.30E+02	3.71E+02	7.43E+03	95.96%	5.00%	
4	Toms Lake-04[a]	1.68E+03	1.80E+02	9.77E+01	1.95E+03	93.00%	N/A	93%
6	Camp Lewis Lake-06[a]	5.91E+02	1.23E+02	3.76E+01	7.52E+02	89.00%	N/A	89%
6	Cold Spring Lake 06	3.08E+03	1.86E+03	2.60E+02	5.20E+03	80.21%	5.00%	
6	Cozy Lake-06[b]	2.79E+03	3.09E+02	1.63E+02	3.27E+03	96.83%	5.00%	92%
6	Foxs Pond-06	3.69E+03	6.91E+01	1.98E+02	3.96E+03	97.68%	5.00%	
6	Indian Lake-06	5.58E+03	2.34E+04	1.53E+03	3.05E+04	95.37%	5.00%	
6	Intervale Lake-06	1.55E+03	1.60E+03	1.66E+02	3.32E+03	96.35%	5.00%	
6	Lake Swannanoa-06[b]	3.68E+04	7.08E+03	2.31E+03	4.62E+04	92.08%	5.00%	92%
6	Mountain Lake-06	1.06E+03	3.28E+03	2.28E+02	4.56E+03	95.87%	5.00%	
6	Parsippany Lake-06	4.55E+03	2.50E+02	2.52E+02	5.05E+03	97.43%	5.00%	
6	Powder Mill Pond-06	5.40E+03	2.10E+02	2.95E+02	5.90E+03	96.48%	5.00%	
6	Rainbow Lakes-06	6.20E+03	7.33E+02	3.65E+02	7.30E+03	76.83%	5.00%	
6	Sunrise Lake-06	2.07E+02	4.02E+02	3.21E+01	6.42E+02	95.48%	5.00%	
6	Telemark Lake-06[b]	4.81E+03	9.84E+02	3.05E+02	6.10E+03	94.24%	5.00%	89%
6	West Lake-06[b]	3.63E+03	1.97E+03	2.95E+02	5.90E+03	83.04%	5.00%	78%
6	White Meadow Lake-06[b]	4.66E+03	4.93E+02	2.71E+02	5.43E+03	96.04%	5.00%	89%

a. Lakeshed located within the stream shed and goes with the stream reduction
- Toms Lake is nested with the watershed of Preakness Brook near Little Falls, on which a reduction of 93% was required (NJDEP, 2003).
- Camp Lewis Lake is nested with the watershed of Beaver Brook at Rockaway, on which a reduction of 89% was required (NJDEP, 2003).

b. lakeshed located within the stream shed and stays with its own reduction.
- Crystal Lake is nested with the watershed of Ramapo River near Mahwah, on which a reduction of 91% was required (NJDEP, 2003)
- Lake Swannanoa is nested with the watershed of Roackaway River at Longwood Valley, on which a reduction of 92% was required (NJDEP, 2003).
- Telemark Lake is nested with the watershed of Beaver Brook at Rockaway, on which a reduction of 89% was required (NJDEP, 2003).

- West Lake is nested with the watershed of Stony Brook at Boonton, on which a reduction of 78% was required (NJDEP, 2003).
- White Meadow Lake is nested with the watershed of Beaver Brook at Rockaway, on which a reduction of 89% was required (NJDEP, 2003).
- Cozy Lake is nested with the watershed of Roackaway River at Longwood Valley, on which a reduction of 92% was required (NJDEP, 2003).

Table 7. Northeast Water Region land-based load allocations

WMA	Lake Assessment Unit ID	Overall % Reduction	Agriculture			Barren Land			Forest/Wetland			Urban Total (WLA)			Urban Total (LA)		
			Existing Load (10^6 colonies/yr)	Percent Reduction	Allocated Load (10^6 colonies/yr)	Existing Load (10^6 colonies/yr)	Percent Reduction	Allocated Load (10^6 colonies/yr)	Existing Load (10^6 colonies/yr)	Percent Reduction	Allocated Load (10^6 colonies/yr)	Existing Load (10^6 colonies/yr)	Percent Reduction	Allocated Load (10^6 colonies/yr)	Existing Load (10^6 colonies/yr)	Percent Reduction	Allocated Load (10^6 colonies/yr)
3	Bubbling Springs-03	91%	3.58E-01	94%	2.18E-02	1.32E+00	0%	1.32E+00	3.02E+02	0%	3.02E+02	8.03E+03	94%	4.88E+02	0.00E+00	94%	0.00E+00
3	Crystal Lake-03	95%	6.28E+02	97%	2.18E+01	3.84E+02	0%	3.84E+02	1.51E+04	0%	1.51E+04	8.83E+05	97%	3.06E+04	0.00E+00	97%	0.00E+00
3	Erskine Lake-03	96%	0.00E+00	96%	0.00E+00	0.00E+00	96%	0.00E+00	2.19E+03	96%	7.71E+01	6.00E+04	96%	2.11E+03	0.00E+00	96%	0.00E+00
3	Forest Hill Lake-03	95%	2.19E+02	95%	1.12E+01	7.60E+01	95%	3.90E+00	1.40E+03	95%	7.20E+01	9.23E+03	95%	4.74E+02	0.00E+00	95%	0.00E+00
3	Kitchell Lake-03	95%	5.39E+01	95%	2.78E+00	0.00E+00	95%	0.00E+00	4.49E+03	95%	2.32E+02	3.43E+04	95%	1.77E+03	0.00E+00	95%	0.00E+00
3	Lake Edenwold-03	84%	2.92E+02	97%	7.82E+00	5.25E+01	0%	5.25E+01	2.86E+04	0%	2.86E+04	1.83E+05	97%	4.91E+03	0.00E+00	97%	0.00E+00
3	Lake Ioscoe-03	75%	0.00E+00	97%	0.00E+00	6.29E+01	0%	6.29E+01	9.86E+03	0%	9.86E+03	3.52E+04	97%	1.20E+03	0.00E+00	97%	0.00E+00
3	Lionhead Lake-03	95%	2.06E+02	98%	3.91E+00	0.00E+00	0%	0.00E+00	5.00E+03	0%	5.00E+03	1.60E+05	98%	3.03E+03	0.00E+00	98%	0.00E+00
3	Skyline Lakes-03	96%	1.37E+02	96%	5.53E+00	5.17E+01	96%	2.09E+00	1.54E+04	96%	6.23E+02	1.59E+05	96%	6.43E+03	0.00E+00	96%	0.00E+00
4	Toms Lake-04	93%	0.00E+00	94%	0.00E+00	0.00E+00	0%	0.00E+00	1.80E+02	0%	1.80E+02	2.63E+04	94%	1.68E+03	0.00E+00	94%	0.00E+00
6	Camp Lewis Lake-06	89%	0.00E+00	89%	0.00E+00	0.00E+00	89%	0.00E+00	1.12E+03	89%	1.23E+02	5.37E+03	89%	5.91E+02	0.00E+00	89%	0.00E+00

WMA	Lake Assessment Unit ID	Overall % Reduction	Agriculture			Barren Land			Forest/Wetland			Urban Total (WLA)			Urban Total (LA)		
			Existing Load (10^6 colonies/yr)	Percent Reduction	Allocated Load (10^6 colonies/yr)	Existing Load (10^6 colonies/yr)	Percent Reduction	Allocated Load (10^6 colonies/yr)	Existing Load (10^6 colonies/yr)	Percent Reduction	Allocated Load (10^6 colonies/yr)	Existing Load (10^6 colonies/yr)	Percent Reduction	Allocated Load (10^6 colonies/yr)	Existing Load (10^6 colonies/yr)	Percent Reduction	Allocated Load (10^6 colonies/yr)
6	Cold Spring Lake 06	80%	0.00E+00	80%	0.00E+00	0.00E+00	80%	0.00E+00	9.42E+03	80%	1.86E+03	1.55E+04	80%	3.08E+03	0.00E+00	80%	0.00E+00
6	Cozy Lake-06	97%	8.13E+02	97%	2.57E+01	1.22E+02	97%	3.86E+00	8.82E+03	97%	2.79E+02	8.82E+04	97%	2.79E+03	0.00E+00	97%	0.00E+00
6	Foxs Pond-06	98%	0.00E+00	98%	0.00E+00	8.55E+01	98%	1.98E+00	2.90E+03	98%	6.71E+01	1.59E+05	98%	3.69E+03	0.00E+00	98%	0.00E+00
6	Indian Lake-06	95%	3.25E+03	99%	3.03E+01	2.03E+02	0%	2.03E+02	2.32E+04	0%	2.32E+04	5.99E+05	99%	5.58E+03	0.00E+00	99%	0.00E+00
6	Intervale Lake-06	96%	0.00E+00	98%	0.00E+00	0.00E+00	0%	0.00E+00	1.60E+03	0%	1.60E+03	8.46E+04	98%	1.55E+03	0.00E+00	98%	0.00E+00
6	Lake Swannanoa-06	92%	2.26E+03	92%	1.79E+02	2.47E+02	92%	1.96E+01	7.79E+04	92%	6.16E+03	4.64E+05	92%	3.68E+04	9.04E+03	92%	7.15E+02
6	Mountain Lake-06	96%	0.00E+00	99%	0.00E+00	0.00E+00	0%	0.00E+00	3.28E+03	0%	3.28E+03	1.02E+05	99%	1.06E+03	0.00E+00	99%	0.00E+00
6	Parsippany Lake-06	97%	0.00E+00	98%	0.00E+00	0.00E+00	0%	0.00E+00	2.50E+02	0%	2.50E+02	1.87E+05	98%	4.55E+03	0.00E+00	98%	0.00E+00
6	Powder Mill Pond-06	96%	7.75E+02	96%	2.73E+01	7.27E+01	96%	2.56E+00	5.12E+03	96%	1.80E+02	1.53E+05	96%	5.40E+03	0.00E+00	96%	0.00E+00
6	Rainbow Lakes-06	77%	0.00E+00	79%	0.00E+00	0.00E+00	0%	0.00E+00	7.33E+02	0%	7.33E+02	2.92E+04	79%	6.20E+03	0.00E+00	79%	0.00E+00
6	Sunrise Lake-06	95%	0.00E+00	95%	0.00E+00	4.45E+01	95%	2.01E+00	5.24E+03	95%	2.37E+02	4.58E+03	95%	2.07E+02	3.61E+03	95%	1.63E+02
6	Telemark Lake-06	94%	2.62E+02	94%	1.51E+01	4.26E+01	94%	2.45E+00	1.68E+04	94%	9.66E+02	8.36E+04	94%	4.81E+03	0.00E+00	94%	0.00E+00

WMA	Lake Assessment Unit ID	Overall % Reduction	Agriculture			Barren Land			Forest/Wetland			Urban Total (WLA)			Urban Total (LA)		
			Existing Load (10^6 colonies/yr)	Percent Reduction	Allocated Load (10^6 colonies/yr)	Existing Load (10^6 colonies/yr)	Percent Reduction	Allocated Load (10^6 colonies/yr)	Existing Load (10^6 colonies/yr)	Percent Reduction	Allocated Load (10^6 colonies/yr)	Existing Load (10^6 colonies/yr)	Percent Reduction	Allocated Load (10^6 colonies/yr)	Existing Load (10^6 colonies/yr)	Percent Reduction	Allocated Load (10^6 colonies/yr)
6	West Lake-06	83%	0.00E+00	88%	0.00E+00	0.00E+00	0%	0.00E+00	1.97E+03	0%	1.97E+03	3.10E+04	88%	3.63E+03	0.00E+00	88%	0.00E+00
6	White Meadow Lake-06	96%	0.00E+00	96%	0.00E+00	3.29E+03	96%	1.30E+02	9.17E+03	96%	3.63E+02	1.18E+05	96%	4.66E+03	0.00E+00	96%	0.00E+00

5.2 Reserve Capacity

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

6.0 FOLLOW - UP MONITORING

Monitoring requirements for the listed lakes are established under NJDOH regulations for state bathing beaches. NJDOH regulations include sampling requirements before and during seasonal operation. Before bathing beaches are opened each year, NJDOH requires a pre-operational assessment, which includes

- A review of historical sampling and epidemiological data
- A field investigation of the bathing and surrounding areas to identify sources of potential contamination
- A sampling of waters in the bathing area and in areas of suspected sources of contamination

During the bathing season, NJDOH requires that bathing beach water be sampled one week prior to opening and at one-week intervals once in use. Samples are collected during periods of maximum user load and from depths used for bathing. In cases where water samples were found to meet the NJDOH water quality criterion for three consecutive months in the prior year, operators can apply for biweekly sampling responsibilities (NJDOH, 2004).

7.0 IMPLEMENTATION

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

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

For example, the stormwater discharged to the impaired waterbodies through "municipal separate storm sewer systems" (MS4s) are regulated under the Department's Municipal Stormwater Regulation Program. Under these rules and associated general permits, many municipalities (and various county, State, and other agencies) are 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. Measures that are currently in effect include ordinances to manage pet waste, 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 required in accordance with the Department's Municipal Stormwater Regulation program. The Department has provided State funds as well as a portion of its Clean Water Act 319(h) pass through grant funds to assist municipalities in meeting these requirements.

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

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

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

- Initiate a fact-finding and communication plan
- Enact and enforce a "no feeding" ordinance (already required per MS4 permit)
- Conduct goose damage control activities such as habitat modification
- Review and update land use policies
- Reduce or eliminate goose reproduction (permit required)
- Hunt geese to reinforce nonlethal actions (permit required)

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

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

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

Farm Services Agency performs most of the funding assistance. All agricultural technical assistance is coordinated through the locally led Soil Conservation Districts. The funding programs include:

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

- **The Conservation Reserve Program (CRP)** is designed to provide technical and financial assistance to farmers/producers to address the agricultural impacts on water quality and to maintain and improve wildlife habitat. CRP practices include the establishment of filter strips, riparian buffers and permanent wildlife habitats. This program provides the basis for the Conservation Reserve Enhancement Program (CREP).

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

Management strategies are summarized below in Table 8.

Table 8. Implementation management strategies

Source Category	Responses	Potential Responsible Entity	Funding options
Human Sources			
Inadequate (per design, operation, maintenance, location, density) on-site disposal systems	Sanitary surveys, septic management programs/ordinances	Municipality	CWA 604(b) for confirmation of inadequate condition; Environmental

Source Category	Responses	Potential Responsible Entity	Funding options
			Infrastructure Financing Program for construction of selected option
Inadequate or improperly maintained stormwater facilities; illicit connections	Measures required under Municipal Stormwater permitting program including any additional measures determined in the future to be needed through TMDL process	Municipality, State and County regulated entities, stormwater utilities	CWA 319(h); Environmental Infrastructure Financing Program for construction of selected option
Malfunctioning sewage conveyance facilities	Identify through source trackdown and repair	Owner of malfunctioning facility--compliance issue	User fees
Domestic/captive animal sources			
Pets	Pet waste ordinances	Municipalities for ordinance adoption and compliance	State source and CWA 319(h) assistance to municipalities to implement municipal stormwater regulations
Horses, livestock, zoos	Confirm through source trackdown: SCD/NRCS develop conservation management plans	Property owner	EQIP, CRP, CREP
Agricultural practices	Confirm through source trackdown; SCD/NRCS develop conservation management plans, exercise CAFO/AFO authority if applicable	Property owner	EQIP, CRP, CREP
Wildlife			
Locally excessive populations of resident Canada geese or other waterfowl	Feeding ordinances; Goose Management BMPs	Municipality for ordinance; local community groups for BMPs	State source; CWA 319(h)
Indigenous wildlife	Confirm through trackdown; riparian buffer restoration; consider revising designated uses	State	State source

7.1 Specific Projects

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

Table 9. Northeast Outreach and Restoration Projects

WMA	FY	Funding Source	Recipient	Project Title	Grant Amount
6	2003	319(h)	Rutgers Cooperative Extension	Regional Stormwater Management Plan for Troy Brook (completed) – Both Intervale Lake and Lake Parsippany are identified in the Troy Brook which include several measures that may reduce fecal loadings to these lakes.	$213,400
6	2007	319(h)	Rockaway Township	Installation of Stormwater Quality Management Structures in the Beaver Brook Watershed (White Meadow Lake)	$198,400

8.0 REASONABLE ASSURANCE

With the implementation of source reduction measures such as reducing the number of failing septic systems, leaching sewer lines, and controlling agricultural runoff, the Department has reasonable assurance that a significant improvement in the support of primary contact recreation in the impaired lakes will be attained. The results from on-going existing monitoring programs will be evaluated to determine effectiveness of the identified measures and if additional measures are needed.

9.0 PUBLIC PARTICIPATION

The Water Quality Management Planning Rules at 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 adopt each TMDL as an amendment to the appropriate area-wide water quality management plan in accordance with procedures at N.J.A.C. 7:15-3.4(g). As part of the public participation process for the development and implementation of the subject TMDLs, the Department solicited information from stakeholder groups and from the general public directly and through a web posting beginning in October 2006. Additionally in November 2006, the list of impaired lakes was distributed to the New Jersey volunteering monitoring community, through the Watershed Watch Network. The Watershed Watch Network is a program acting as an umbrella for all of the volunteer monitoring programs within New Jersey. Interested parties had the opportunity to supply the Department with information about each via e-mail. The Department specifically solicited information regarding potential sources and/or current non point sources of pollution reduction projects within the impaired watersheds. Information received regarding potential sources of fecal contamination were assessed in the development of these TMDLs.

10.0 AMENDMENT PROCESS

Notice proposing these TMDLs appeared in the July 16, 2007 New Jersey Register and in a newspaper of general circulation in order to provide the public an opportunity to review the TMDL document and submit formal comments. In addition, a public hearing was held on August 17, 2007 at the New Jersey Department of Environmental Protection Public Hearing Room, 401 E. State St., Trenton, NJ 08608. There was an informal presentation from 1:00 p.m. to 2:00 p.m., followed by the public hearing. Notice of the proposal and hearing was provided to affected municipalities and lake associations in the watershed.

No comments were received during the public notice period. One person attended the public hearing and no testimony was given. This TMDL was approved by EPA on September 28, 2007 and was adopted on October 19, 2009 as an amendment to the Northeast and Sussex County Water Quality Management Plans in accordance with New Jersey's Water Quality Management Planning Rules at N.J.A.C. 7:15-3.4 (g).

APPENDIX A: REFERENCES

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APPENDIX B: NJPDES WASTEWATER TREATMENT FACILITIES, TIER A MUNICIPALITIES, TIER B MUNICIPALITIES

Northeast Water Region Wastewater Treatment Facilities

NJPDES ID	Facility Name	Pipe	FC Limit	Permit Category*	Receiving Waters/Associated Lake
NJ0024457	Our Lady of Magnificent School	001A	NA	A	Butler Reservoir via unnamed trib/Lake Edenwold
NJ0053112	Oakland Boro - Chapel Hill Estates	001A	NA	A	Ramapo River via Mirror Lk and storm swr/Crystal Lake
NJ0021342	Oakland Boro Skyview-Highbrook STP	001A	NA	A	Caille Lk via unnmd trib & storm sewer/Crystal Lake
NJ0029858	Oakland Care Center	001A	NA	A	Hoppers Pond (Ramapo R) via storm sewer/Crystal Lake
NJ0032395	Ringwood Plaza - Ringwood Assn	001A	NA	A	Meadow Brook/Skyline Lakes
NJ0027006	Ringwood Boro - Ringwood Acres	001A	NA	A	High Mountain Bk via ditch/ Skyline Lakes
NJ0021253	Ramapo BOE - Indian High	001A	NA	A	Pond Brook (Ramapo River)/Crystal Lake
NJ0026867	Jefferson Twp - White Rock	001A	NA	A	Mitt Pond (Russia Brook) via unnmd trib/Lake Swannanoa
NJ0021091	Jefferson Twp High - Middle School	001A	NA	A	Russia Brook via unnmd trib (Edison Bk)/Lake Swannanoa

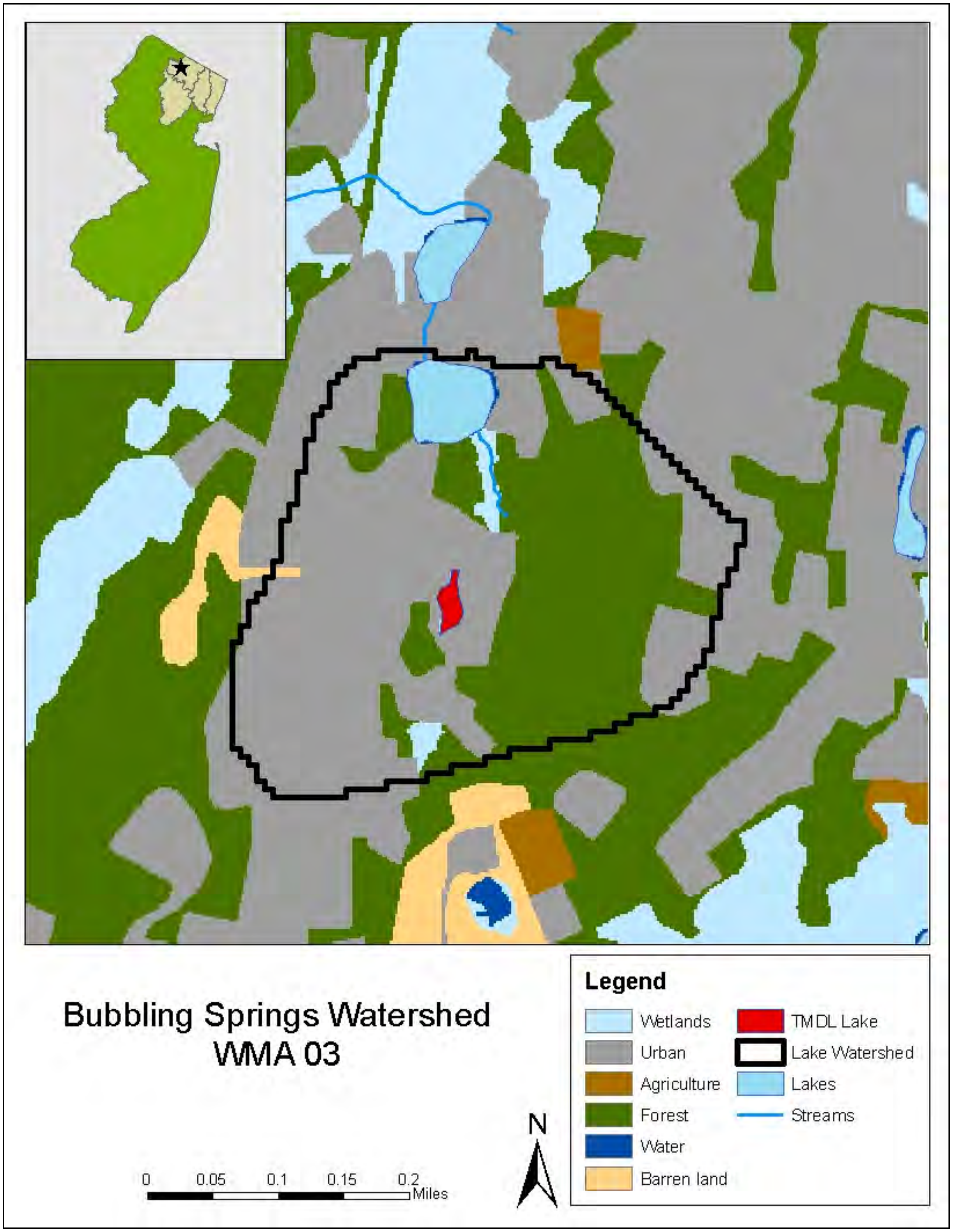
*Permit Categories: A = Sanitary Surface Water Discharge

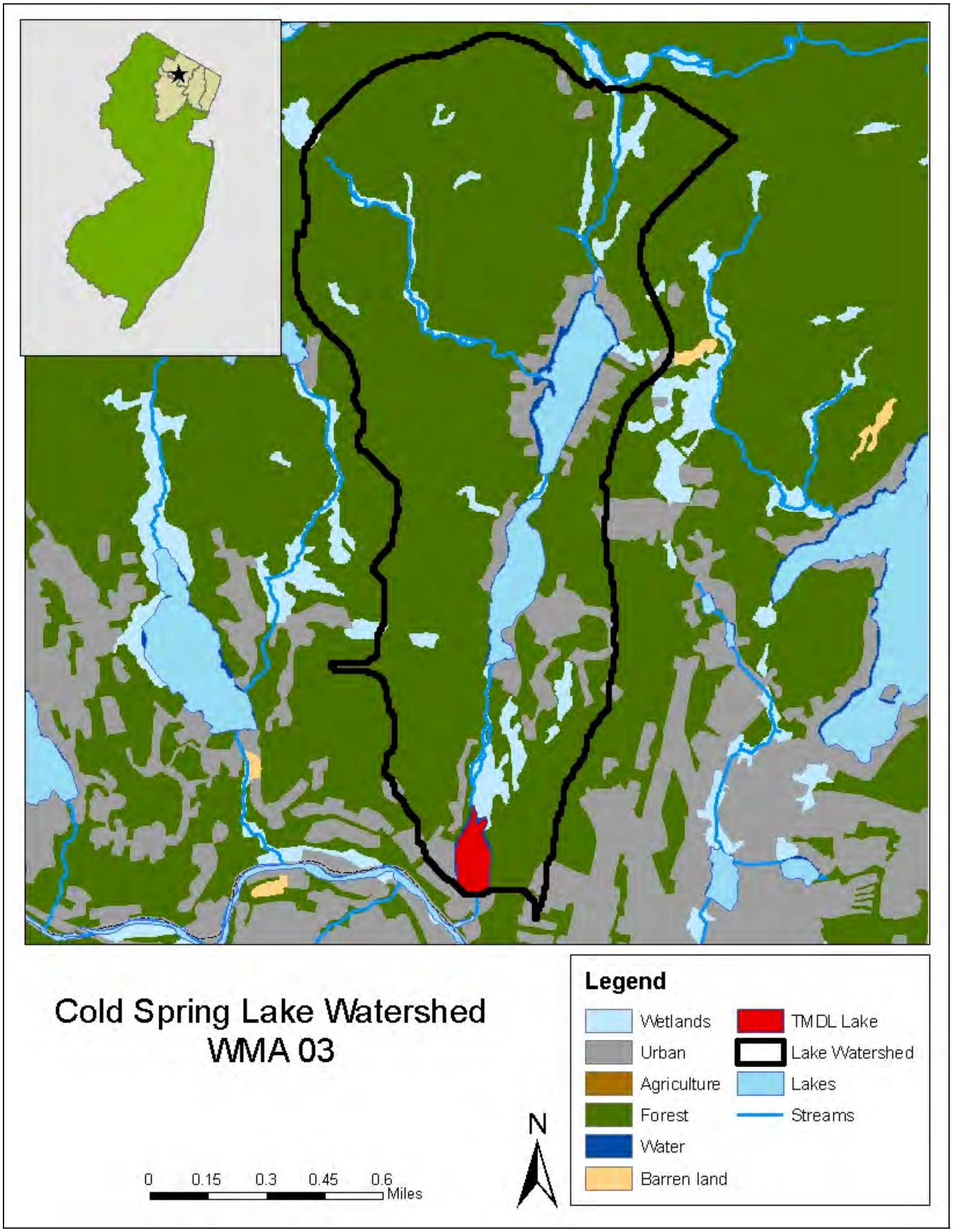
Northeast Water Region Tier A and Tier B Municipalities

Tier	Watershed	Municipality	WMA	Permit #
A	Kitchell Lake	West Milford Twp	3	NJG0148806
	Skyline Lakes	Ringwood Boro	3	NJG0152749
		Mahwah Twp	3	NJG0151211
		Wanaque Boro	3	NJG0149306
	Erksine Lake	Ringwood Boro	3	NJG0152749
	Lionhead Lake	Franklin Lakes Boro	3	NJG0154121
		Wayne Twp	3	NJG0150436
	Crystal Lake	Mahwah Twp	3	NJG0151211
		Oakland Boro	3	NJG0148521
		Franklin Lakes Boro	3	NJG0154121
		Wayne Twp	3	NJG0150436
		North Haledon Boro	3	NJG0154130
	Lake Edenwold	Kinnelon Boro	3	NJG0149781
		Butler Boro	3	NJG0149837
	Bubbling Springs	West Milford Twp	3	NJG0148806
	Forest Hill Lake	West Milford Twp	3	NJG0148806
	Toms Lake	Wayne Twp	4	NJG0150436
	Lake Swannanoa	Sparta Twp	6	NJG0148059
		Jefferson Twp	6	NJG0151793
	Cold Springs Lake	West Milford Twp	6	NJG0148806
		Bloomingdale Boro	6	NJG0153371
	Lake Ioscoe	Wanaque Boro	6	NJG0149306
		Bloomingdale Boro	6	NJG0153371
	Mountain Lake	Boonton Twp	6	NJG0148091
		Denville Twp	6	NJG0148229
		Mountain Lakes Boro	6	NJG0151386
	Intervale Lake	Boonton Twp	6	NJG0148091
		Boonton Town	6	NJG0153672
		Mountain Lakes Boro	6	NJG0151386
		Parsippany-Troy Hills Twp	6	NJG0150266
	Powder Mill Lake	Denville Twp	6	NJG0148229
		Parsippany-Troy Hills Twp	6	NJG0150266
	Foxs Pond	Rockaway Twp	6	NJG0151246
		Rockaway Boro	6	NJG0150746
	Indian Lake	Denville Twp	6	NJG0148229
		Parsippany-Troy Hills Twp	6	NJG0150266
		Randolph Twp	6	NJG0152501
		Morris Twp	6	NJG0152463
	Parsippany Lake	Parsippany-Troy Hills Twp	6	NJG0150266
	Camp Lewis Lake	Rockaway Twp	6	NJG0151246
	Cozy Lake	Jefferson Twp	6	NJG0151793
		Rockaway Twp	6	NJG0151246
	Sunrise Lake	Mendham Twp	6	NJG0150819

	White Meadow Lake	Rockaway Twp	6	NJG0151246
	Rainbow Lake	Denville Twp	6	NJG0148229
		Mountain Lakes Boro	6	NJG0151386
		Parsippany-Troy Hills Twp	6	NJG0150266
	West lake	Kinnelon Boro	6	NJG0149781
	Telemark Lake	Rockaway Twp	6	NJG0151246
B	Lake Swannanoa	Hardyston Twp	6	NJG0152269
	Sunrise Lake	Harding Twp	6	NJG0151165

APPENDIX C: LAKE WATERSHED MAPS

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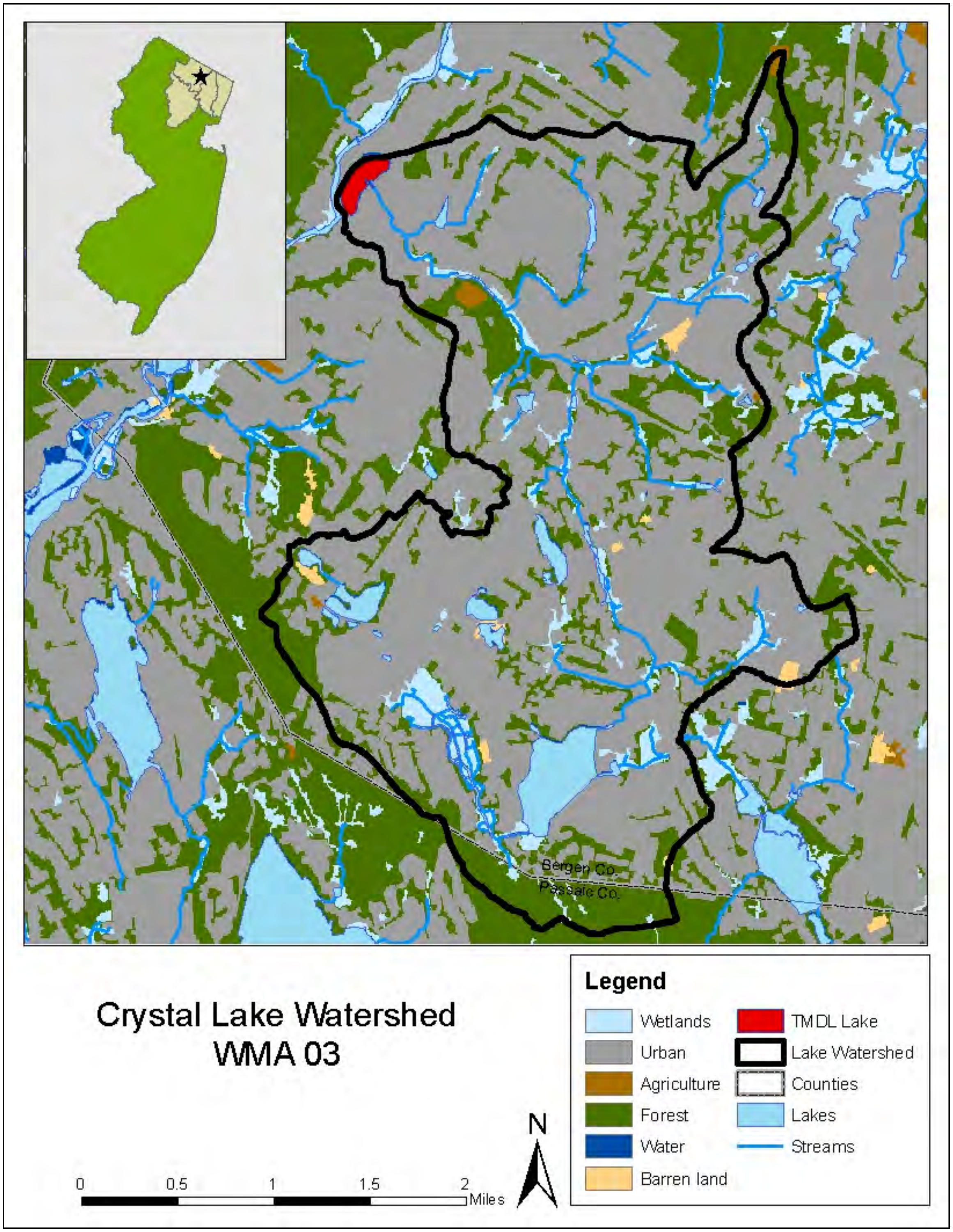

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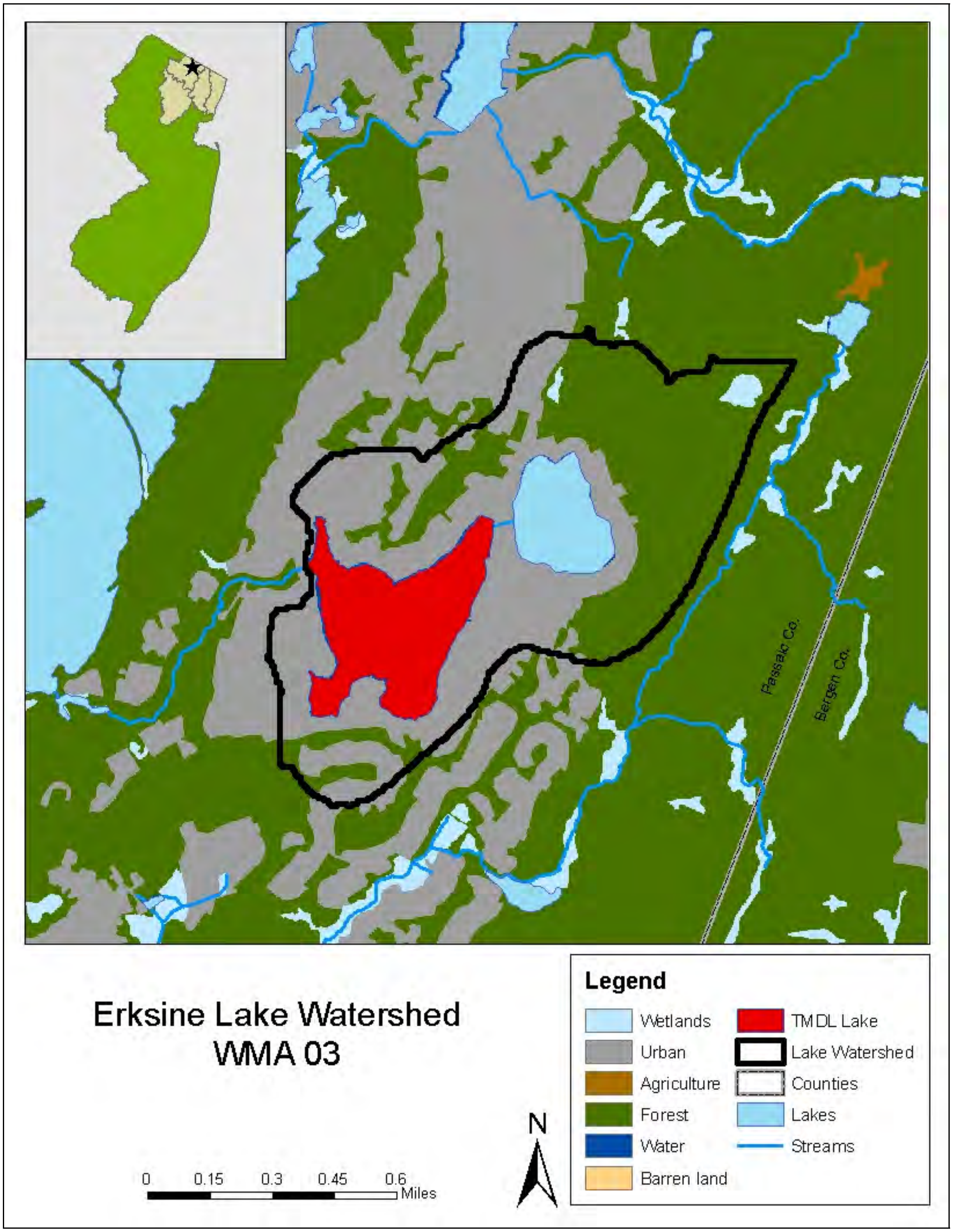
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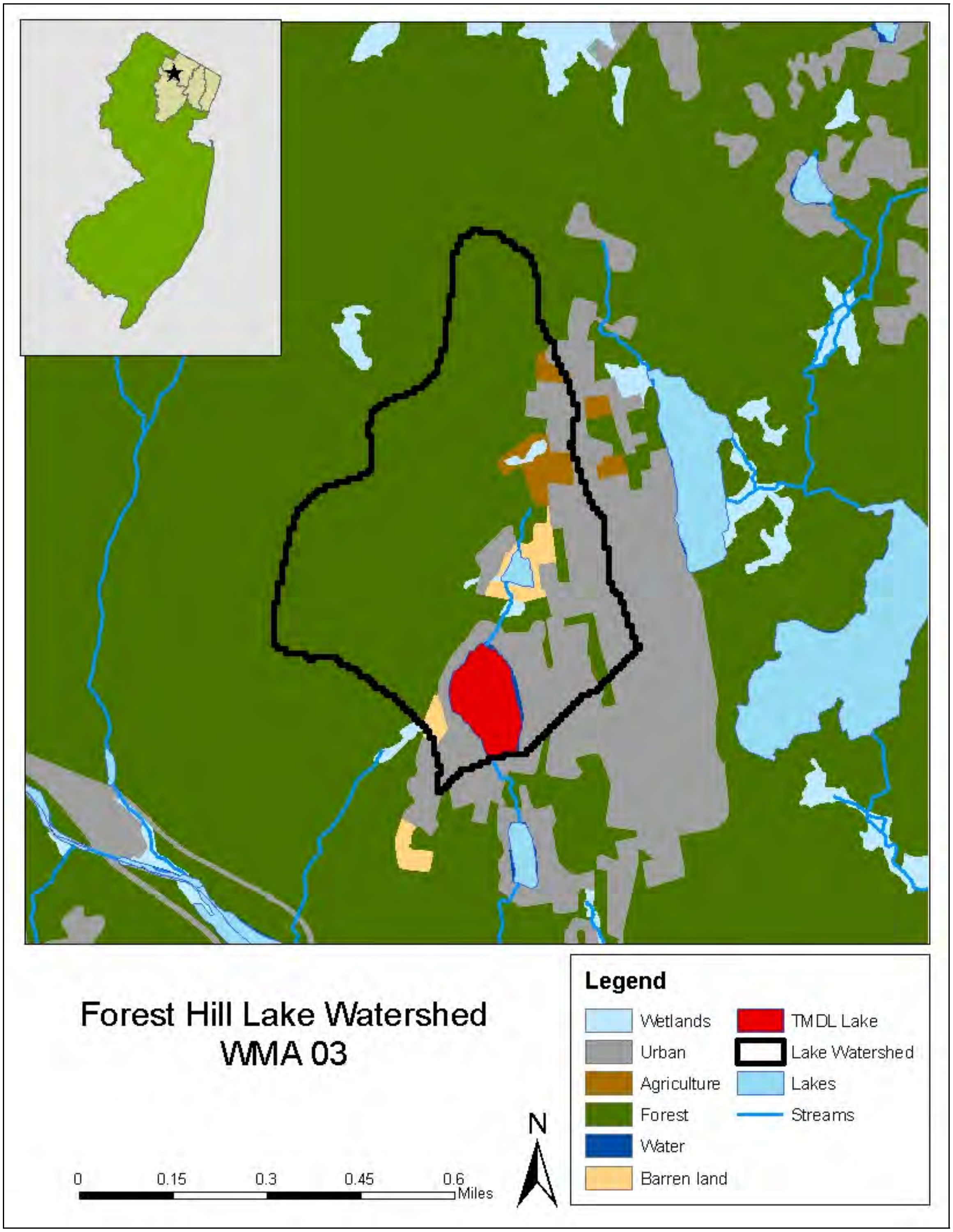
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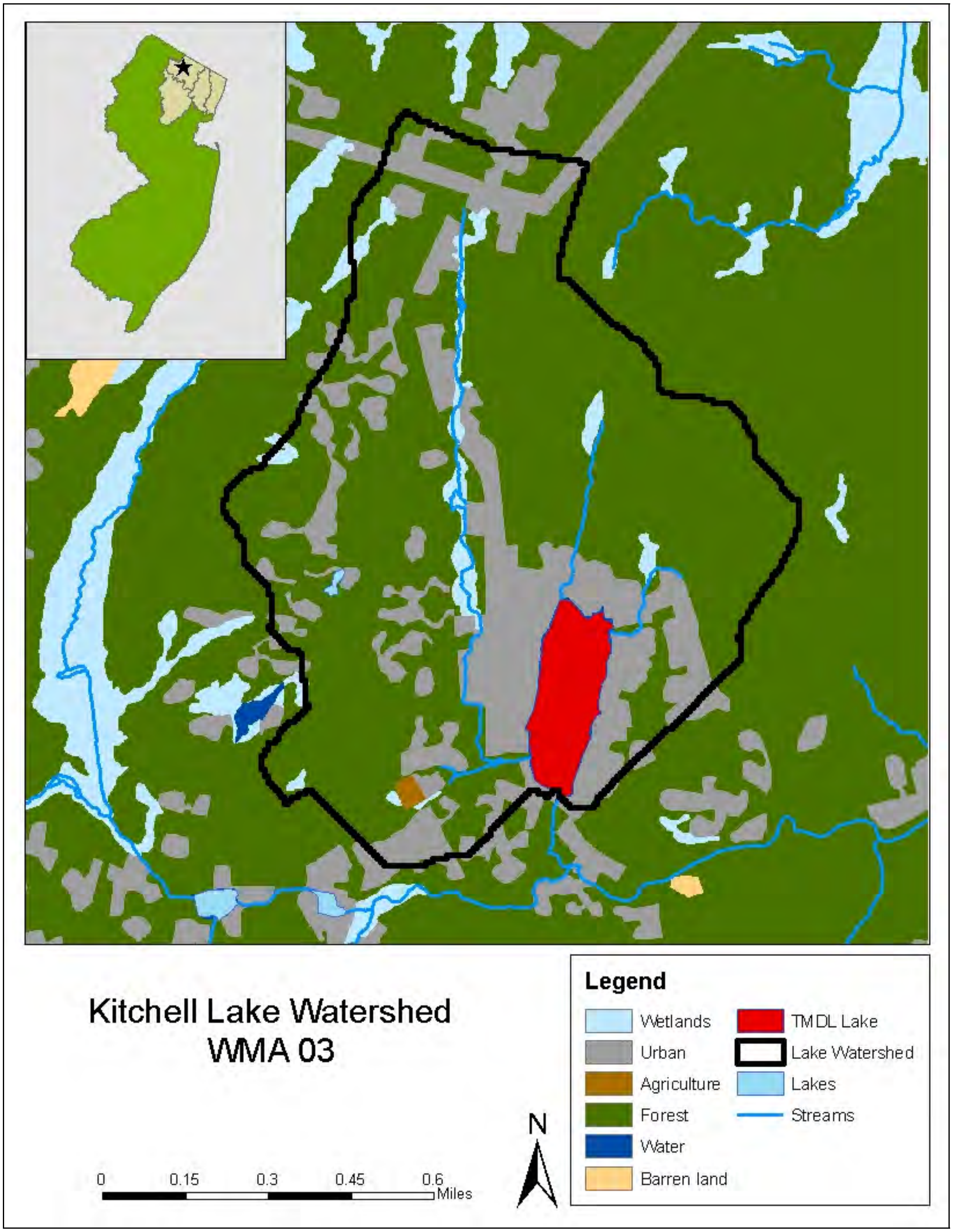
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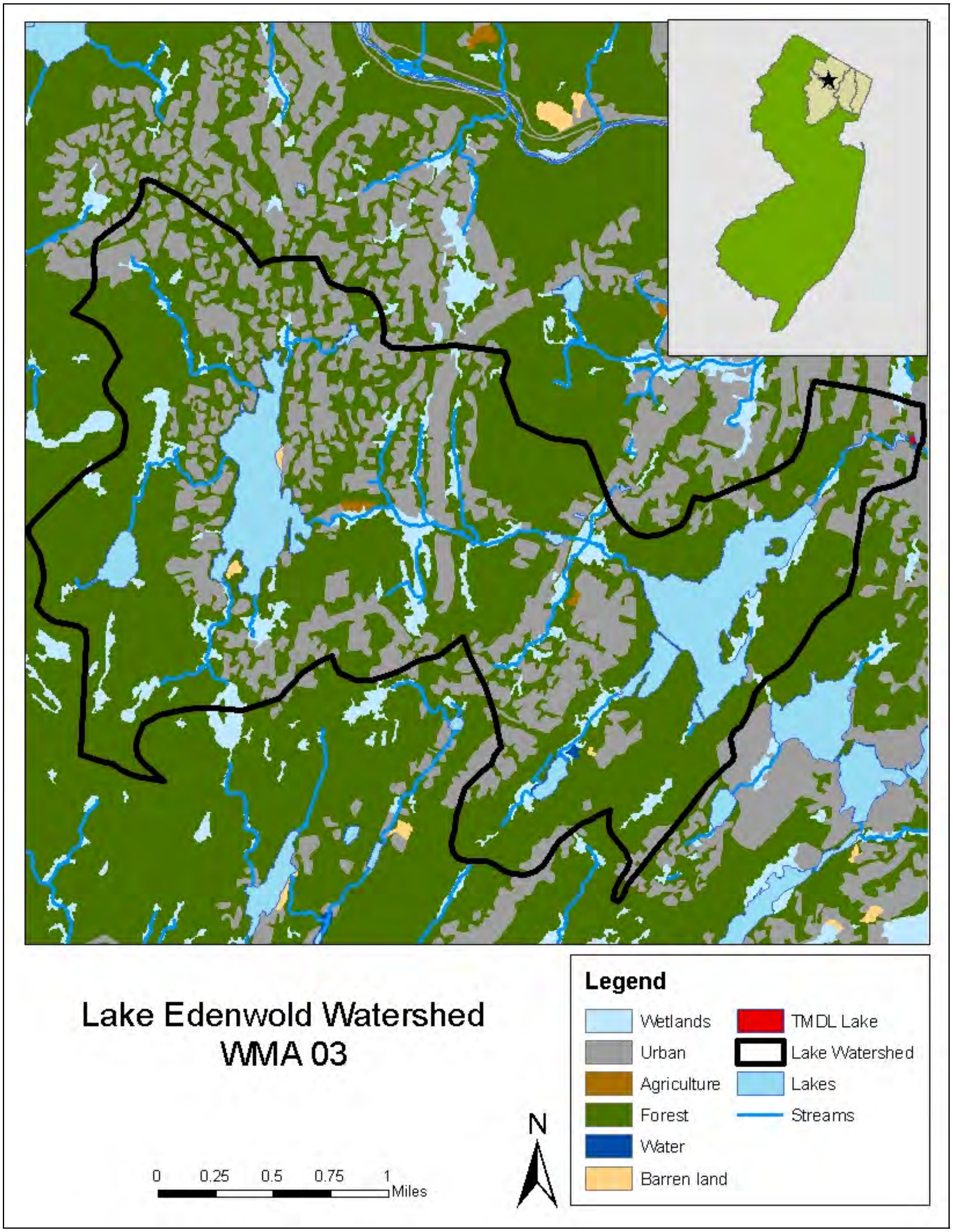
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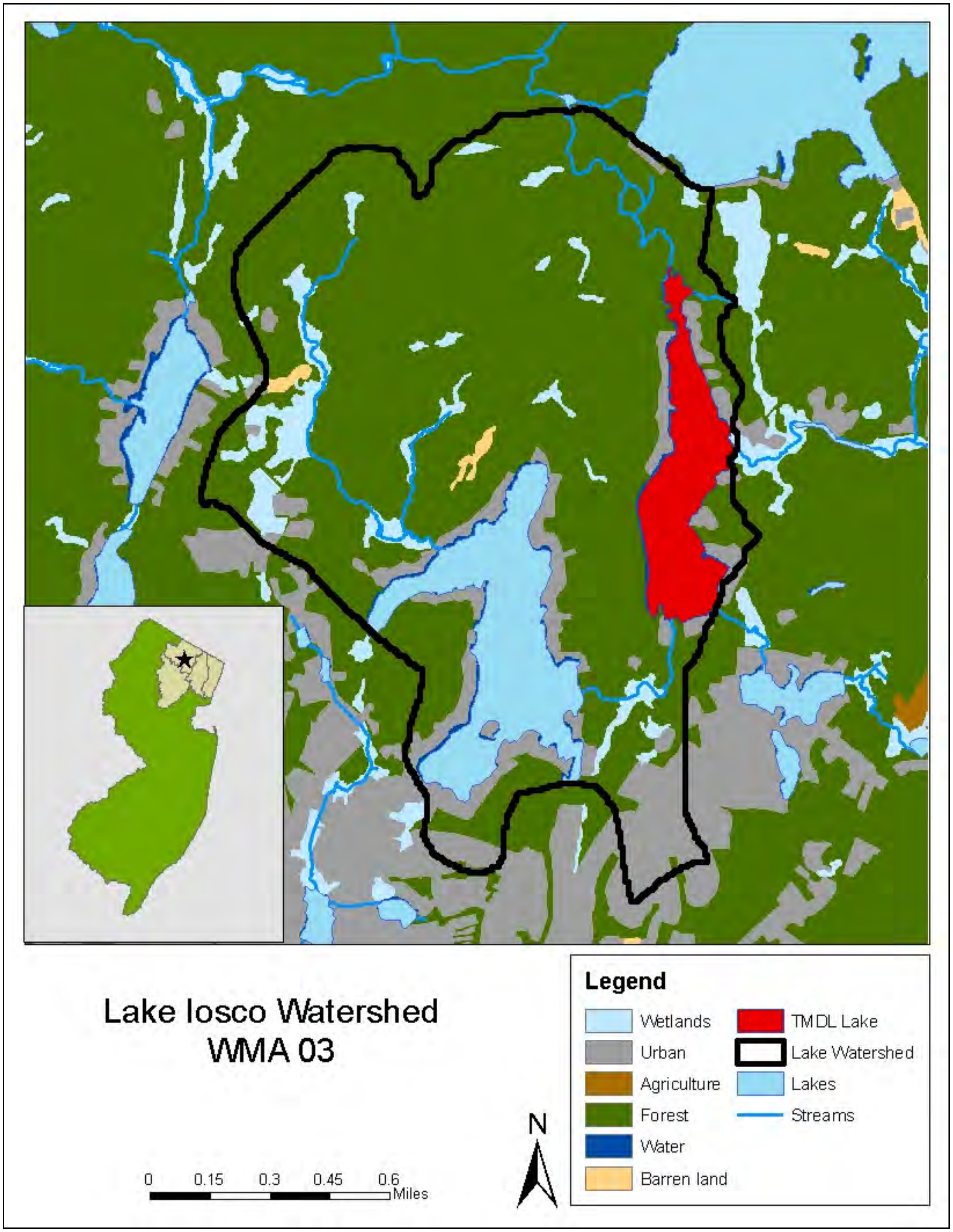
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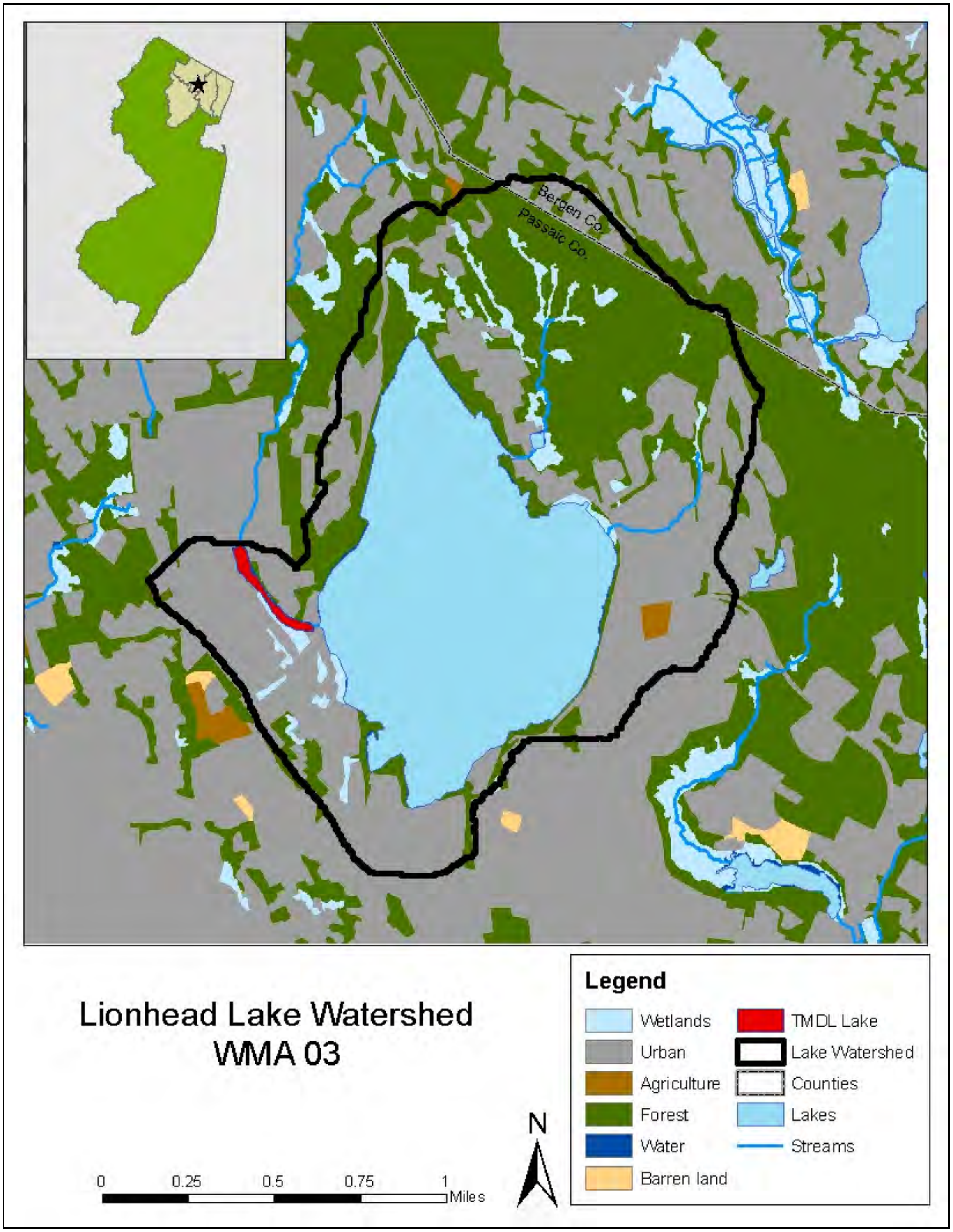
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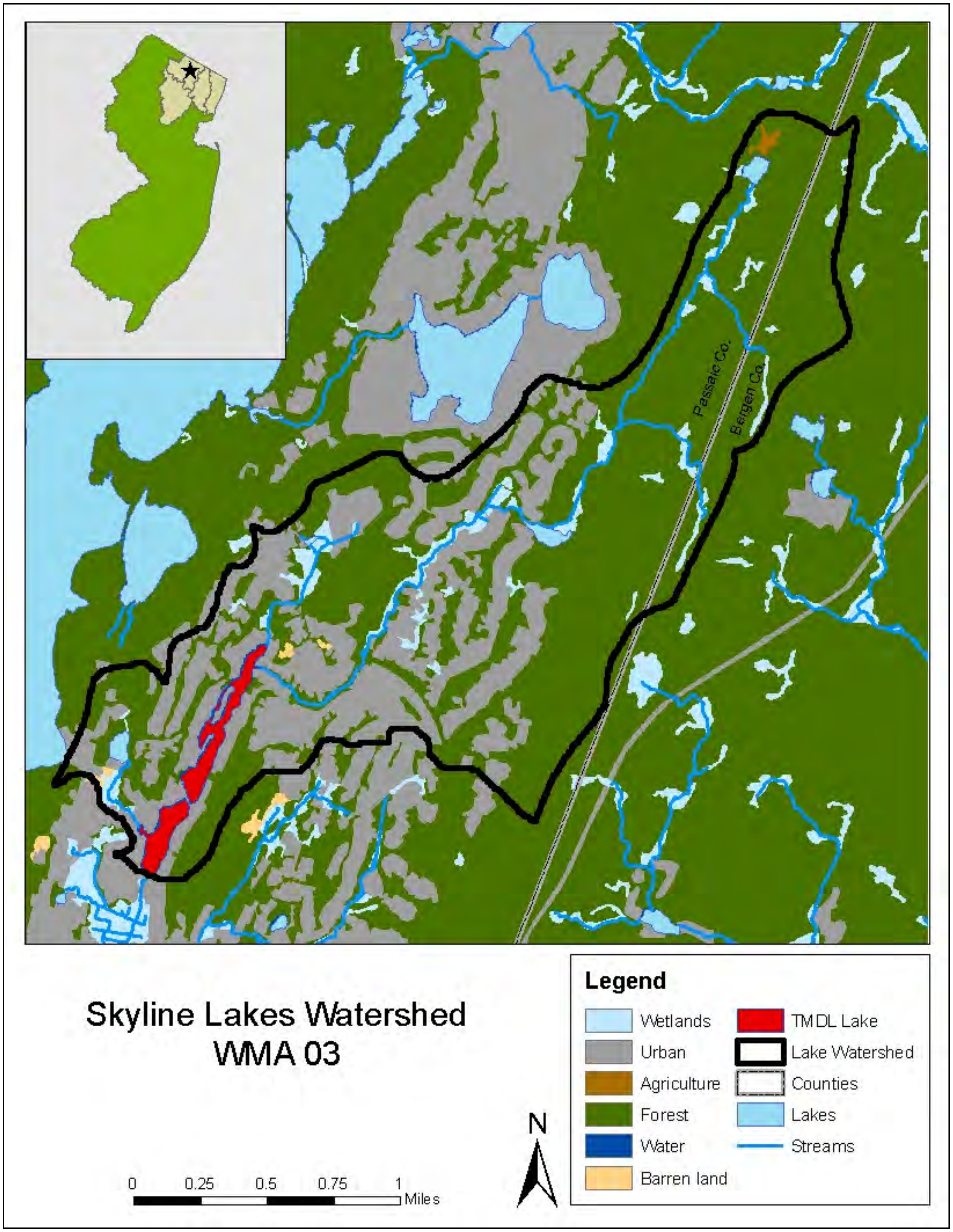

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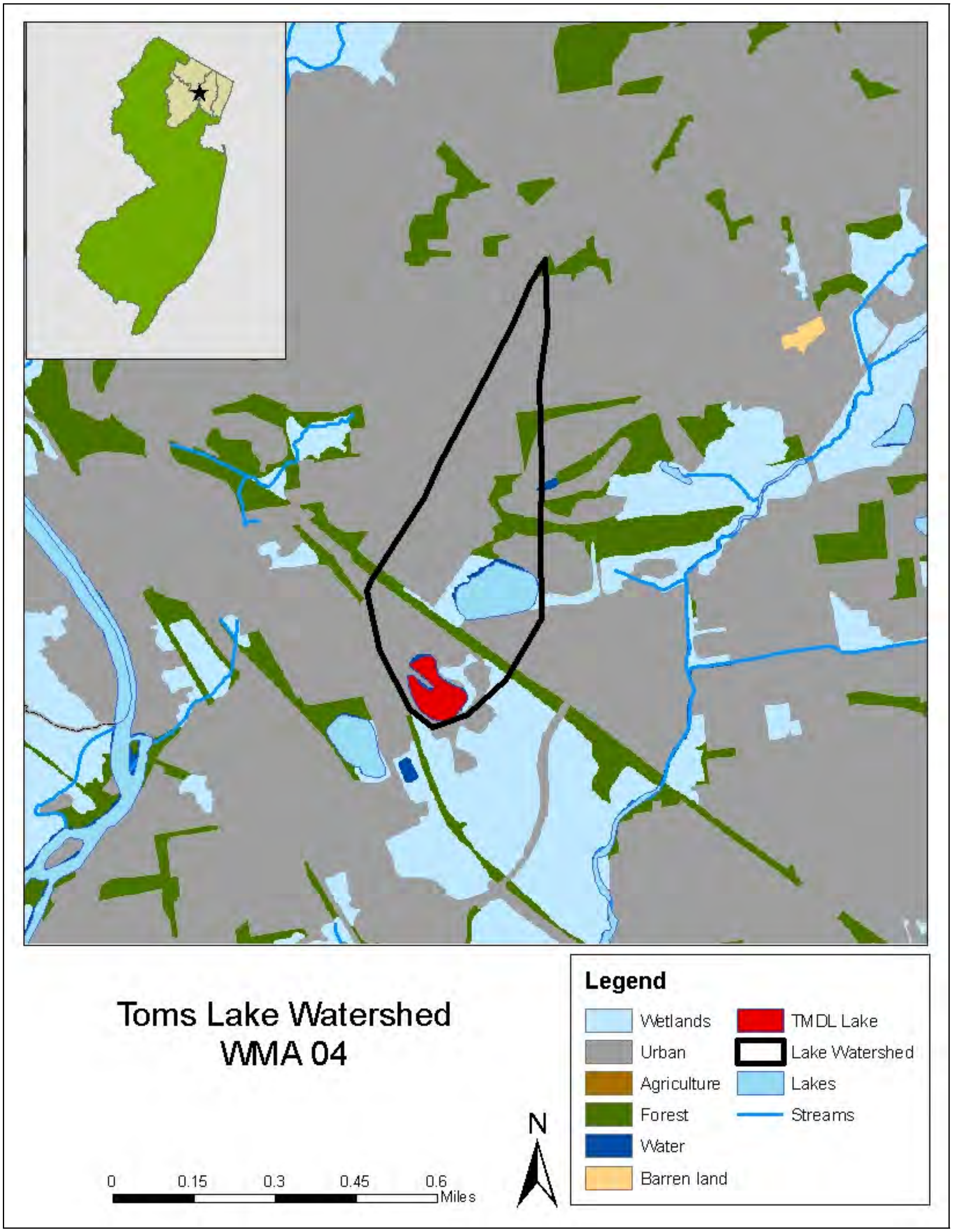
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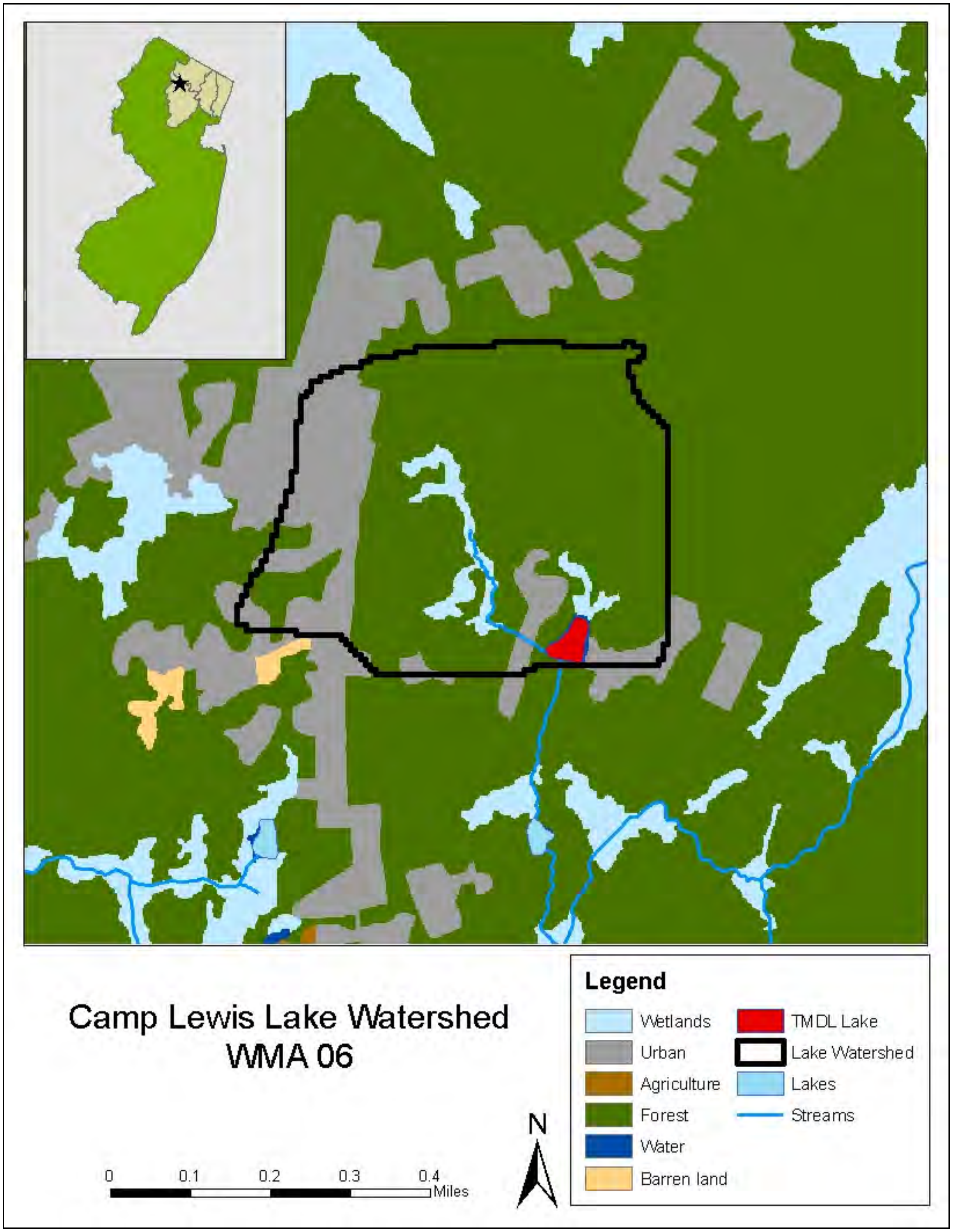
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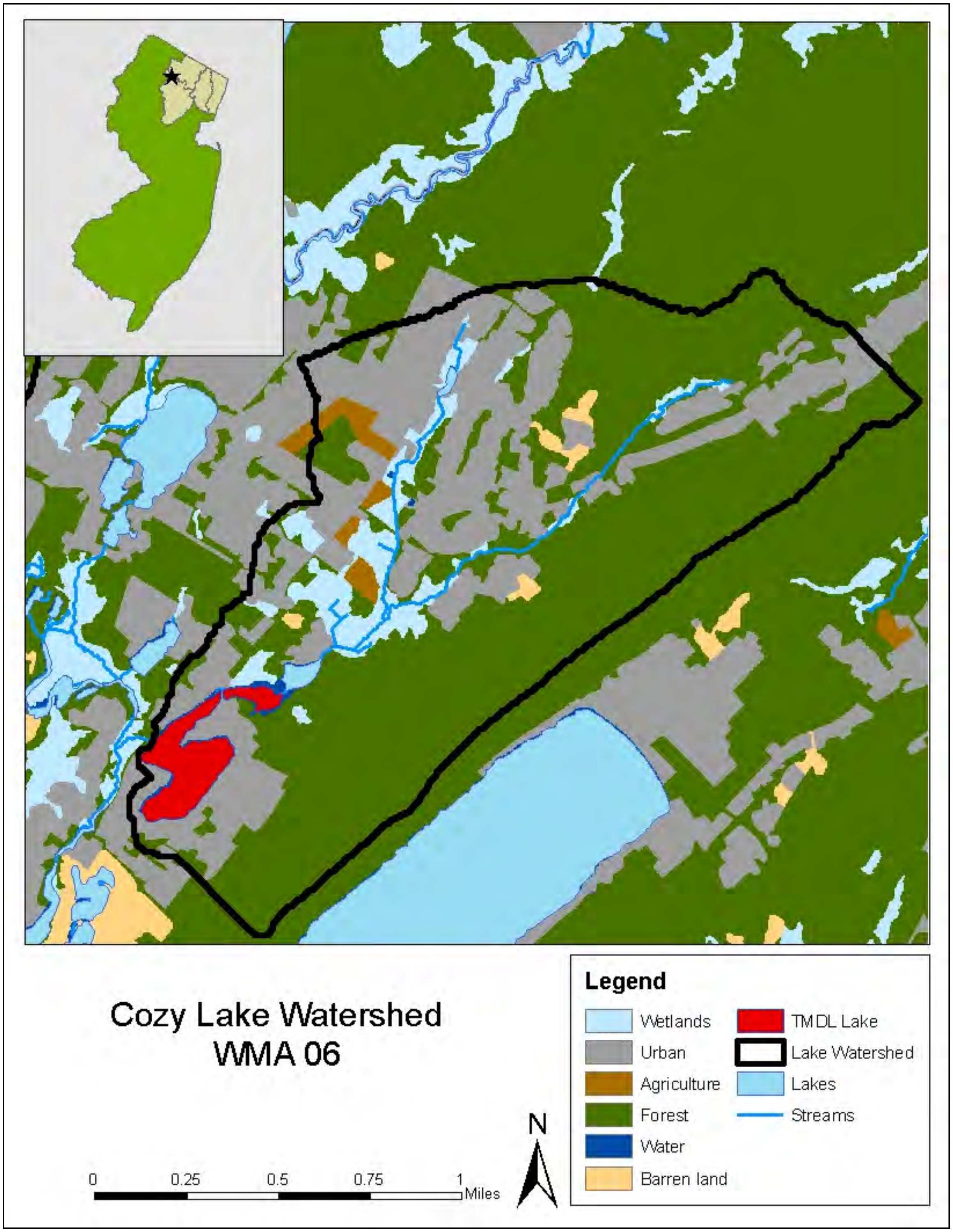
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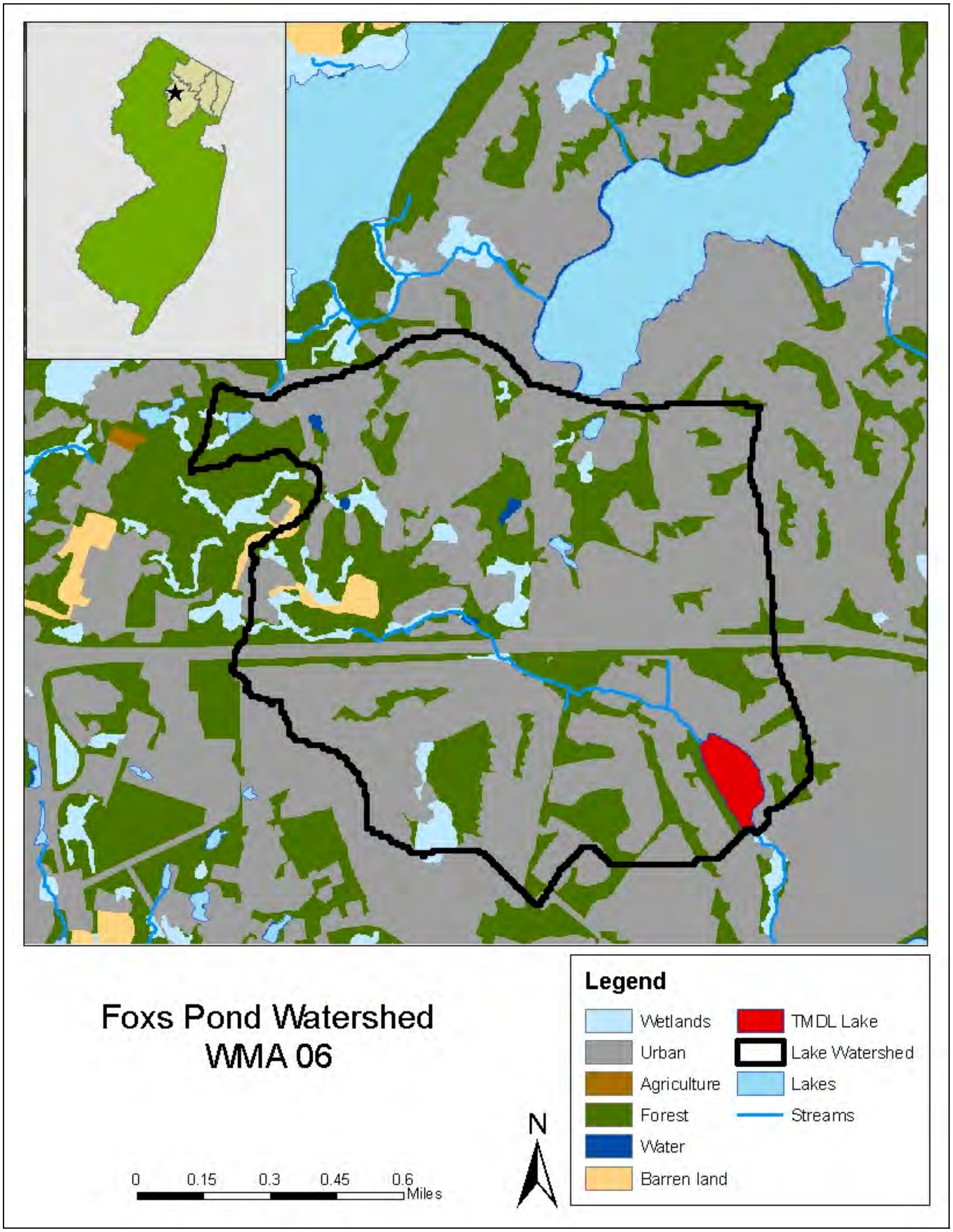
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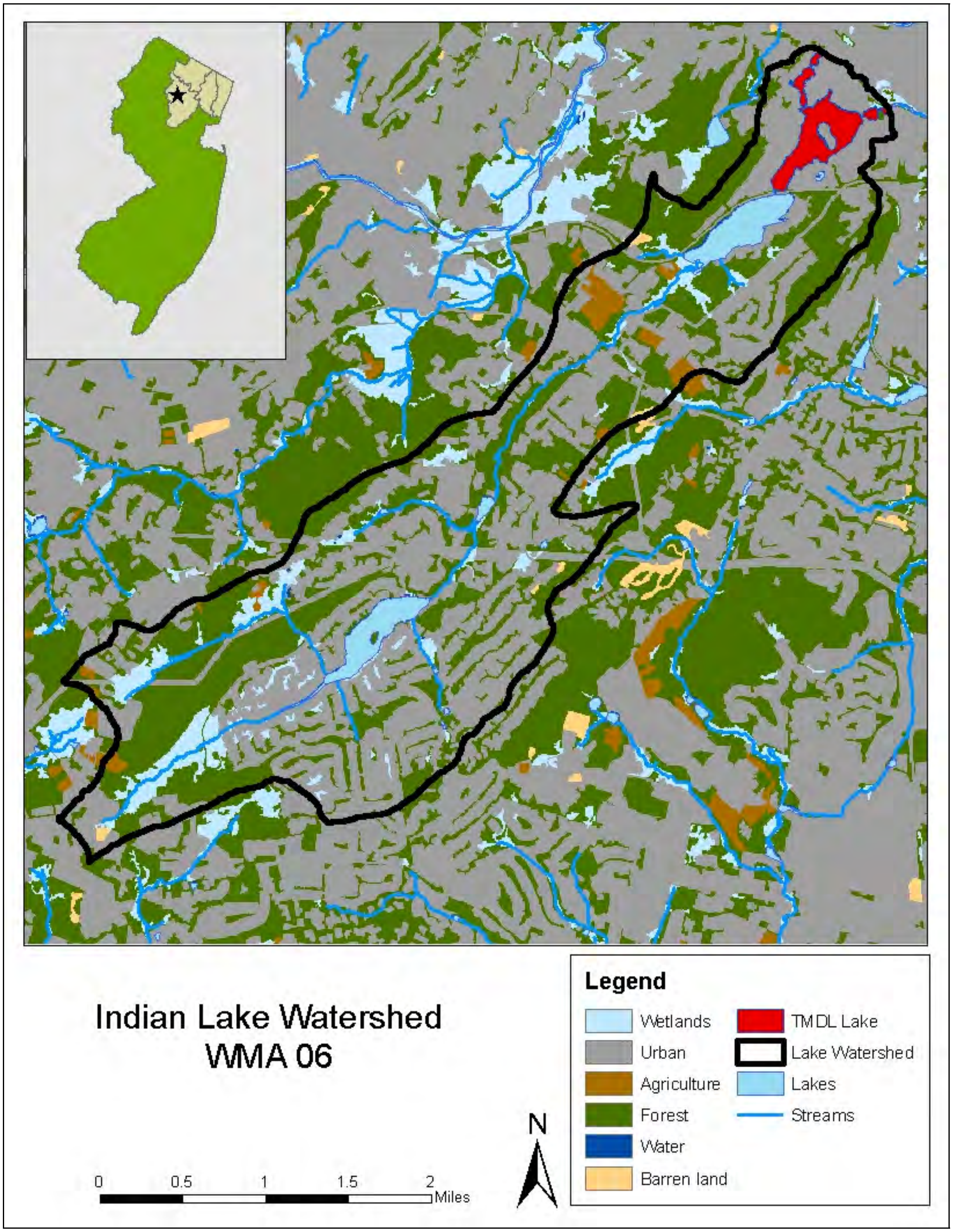
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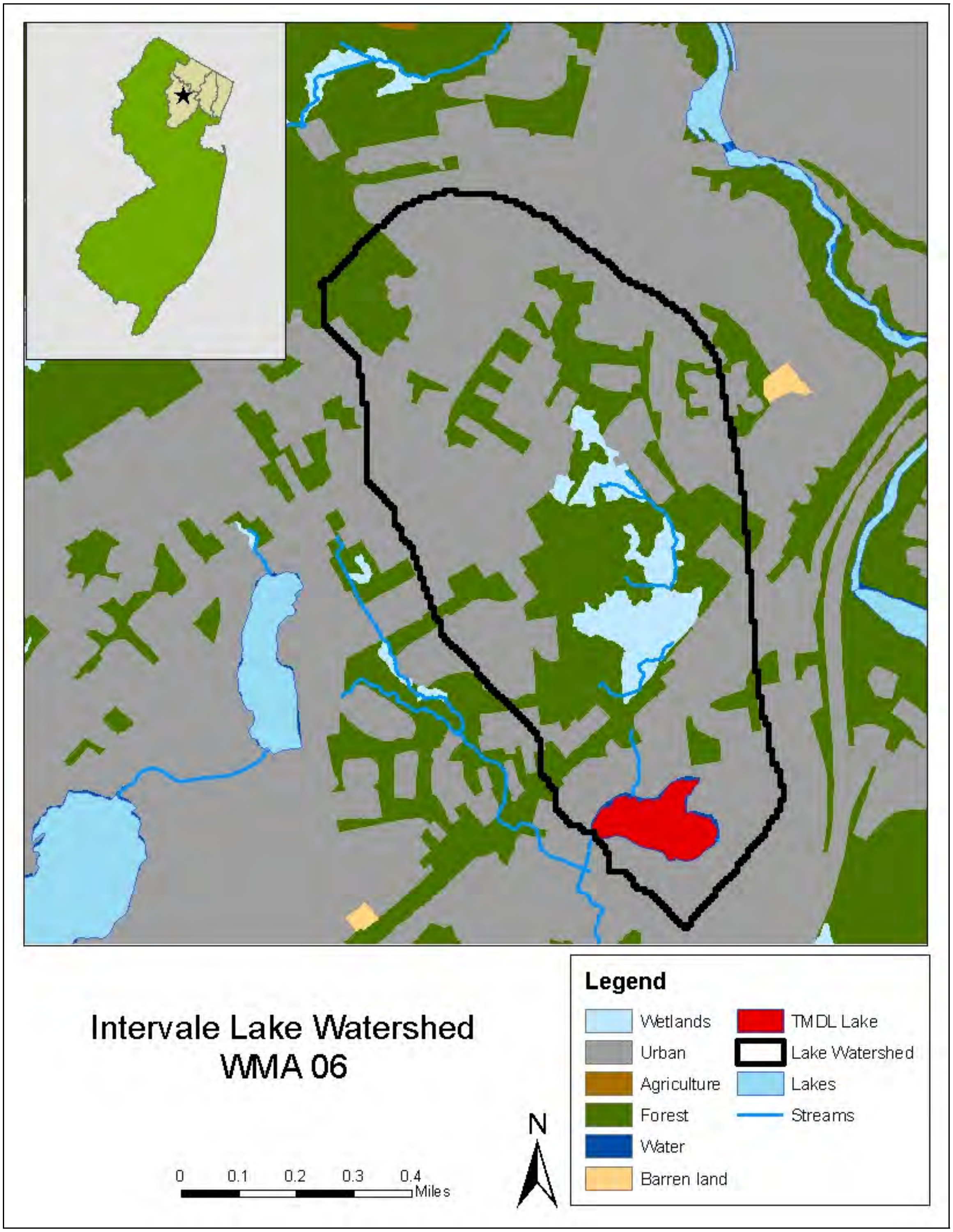
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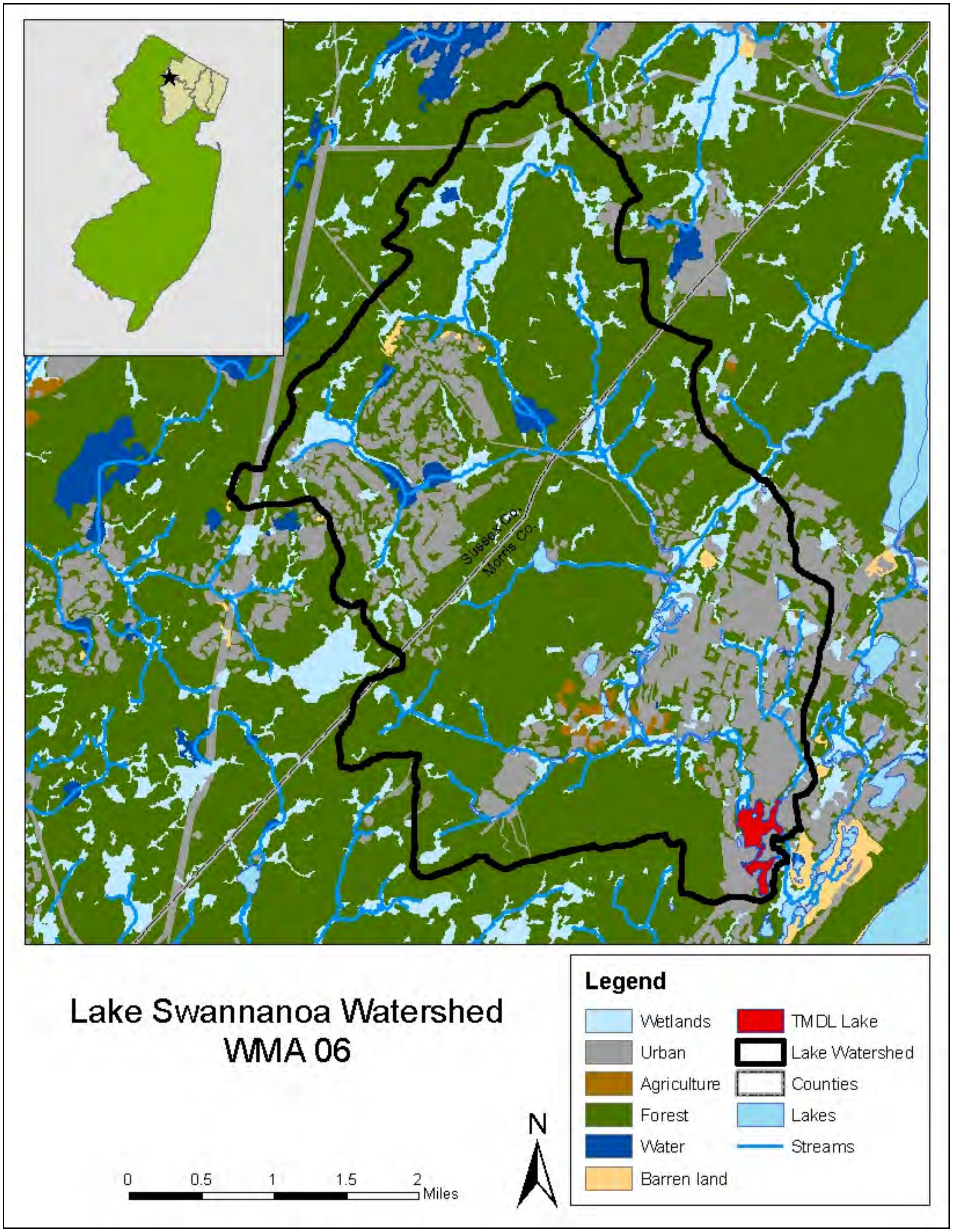
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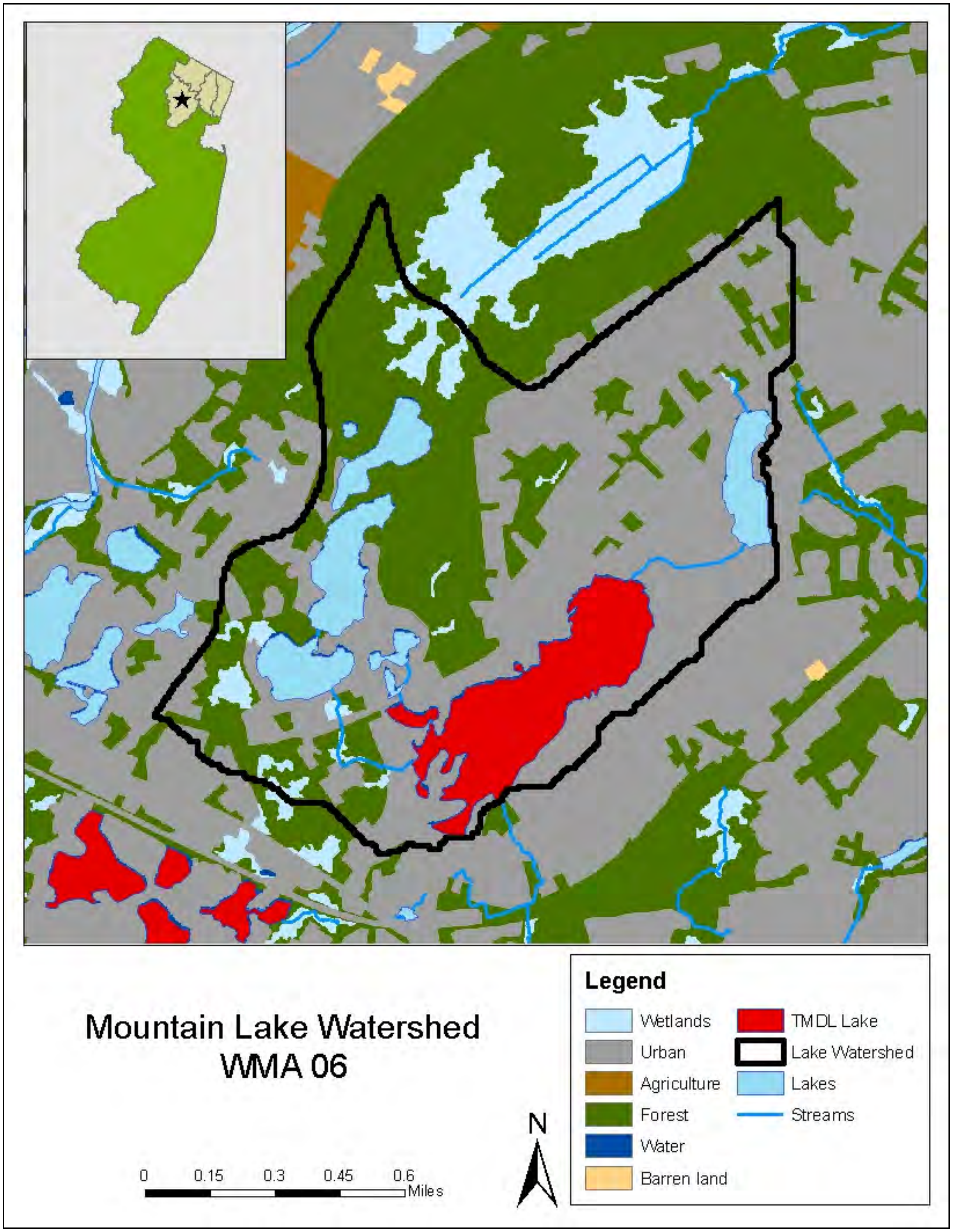
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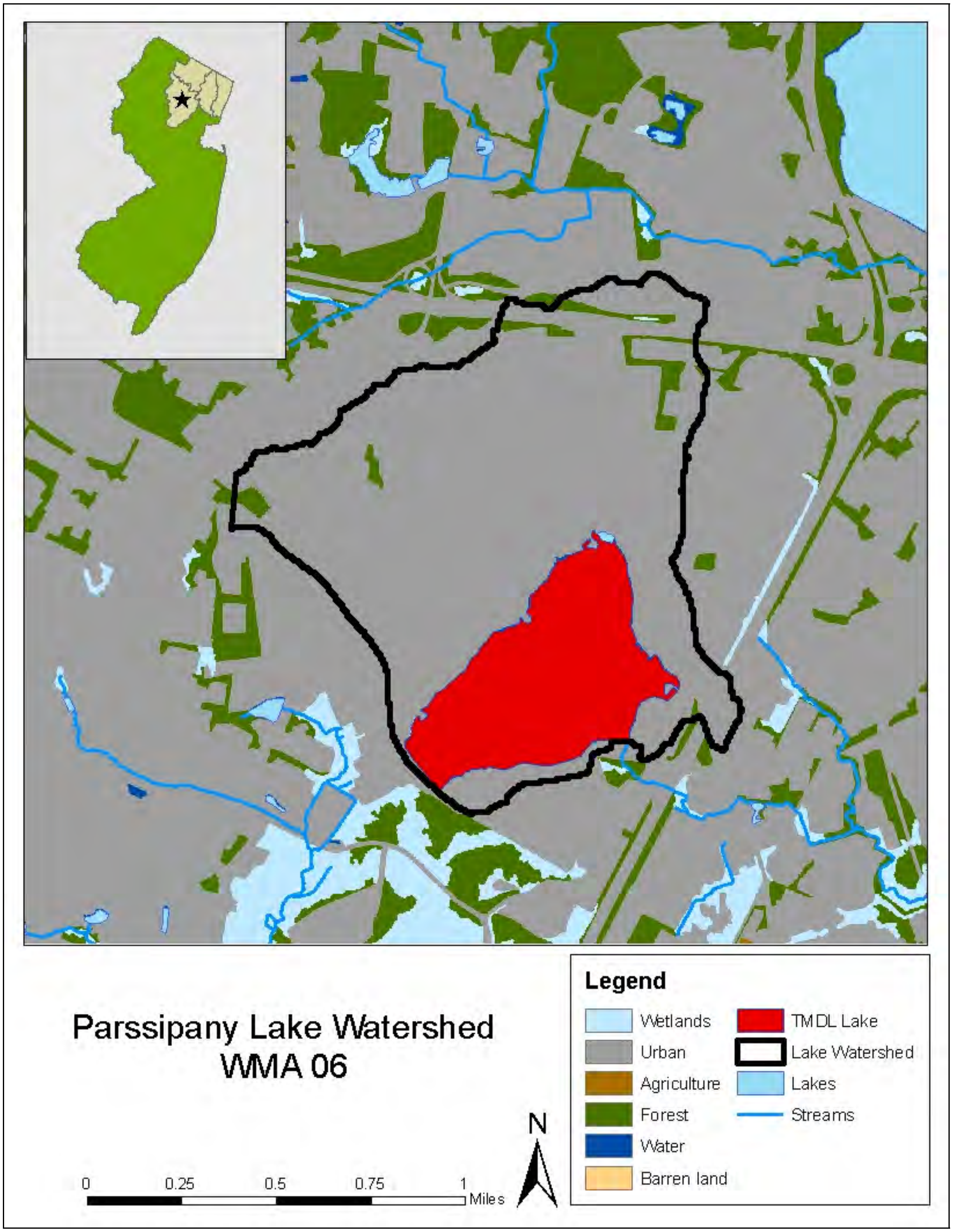
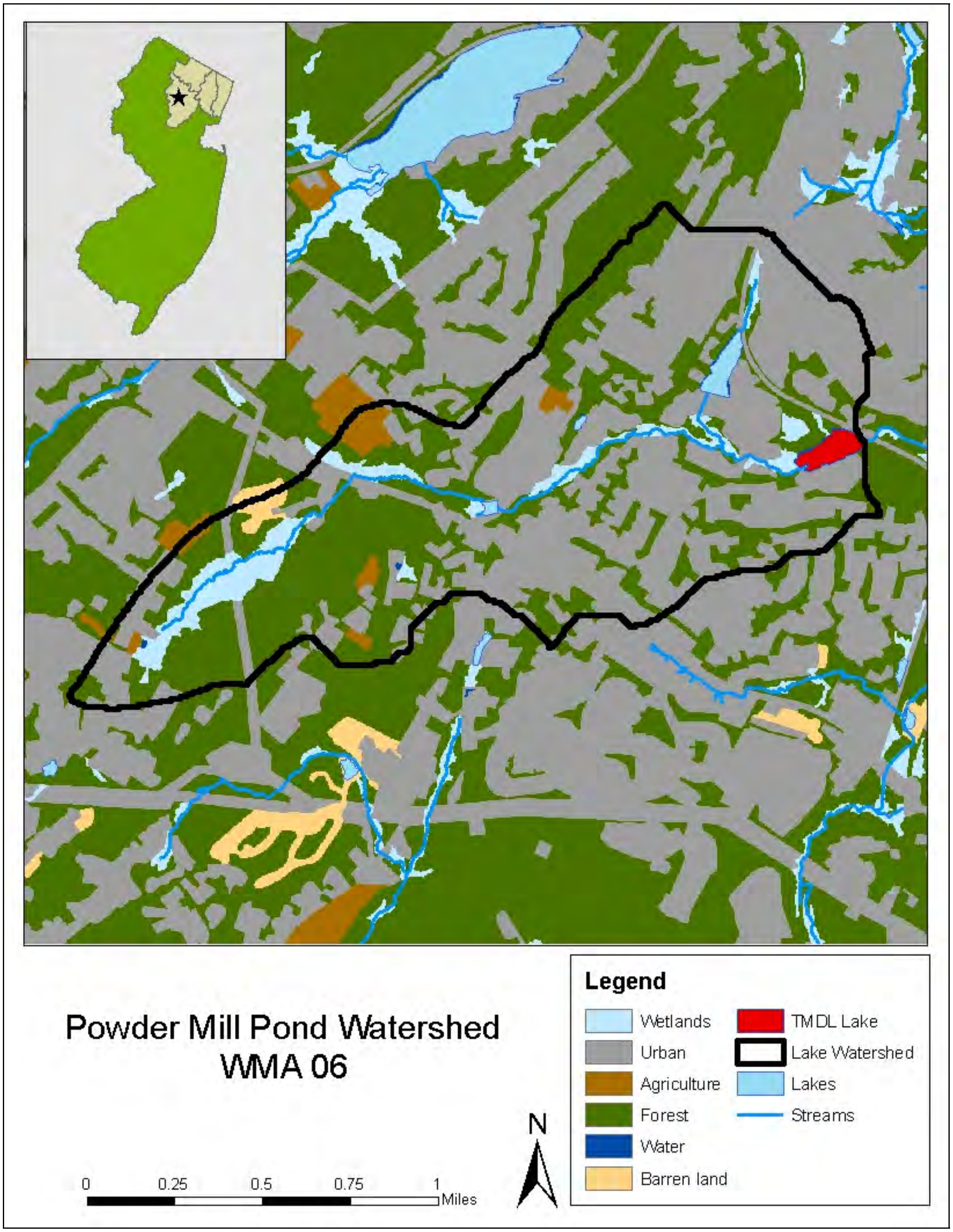
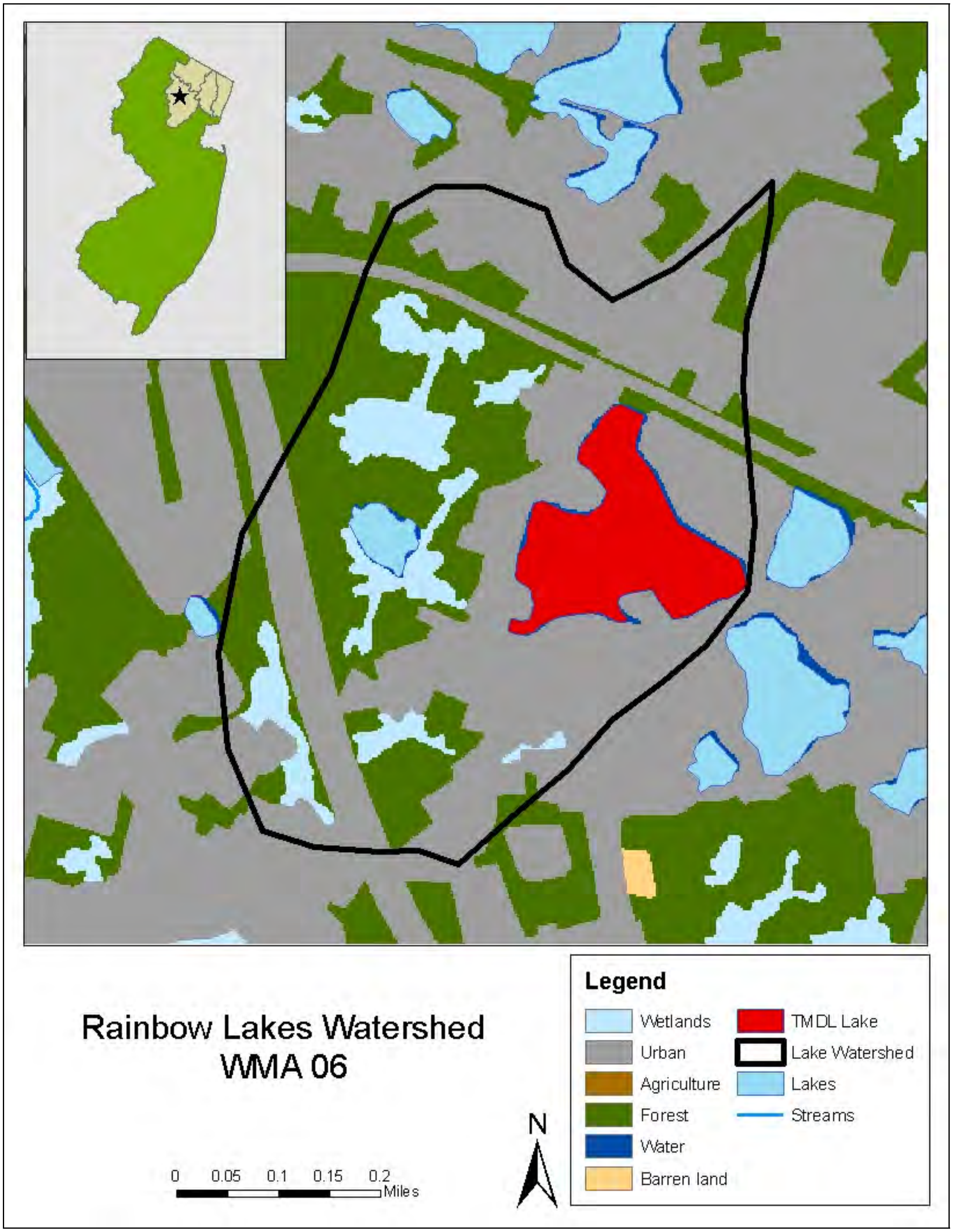
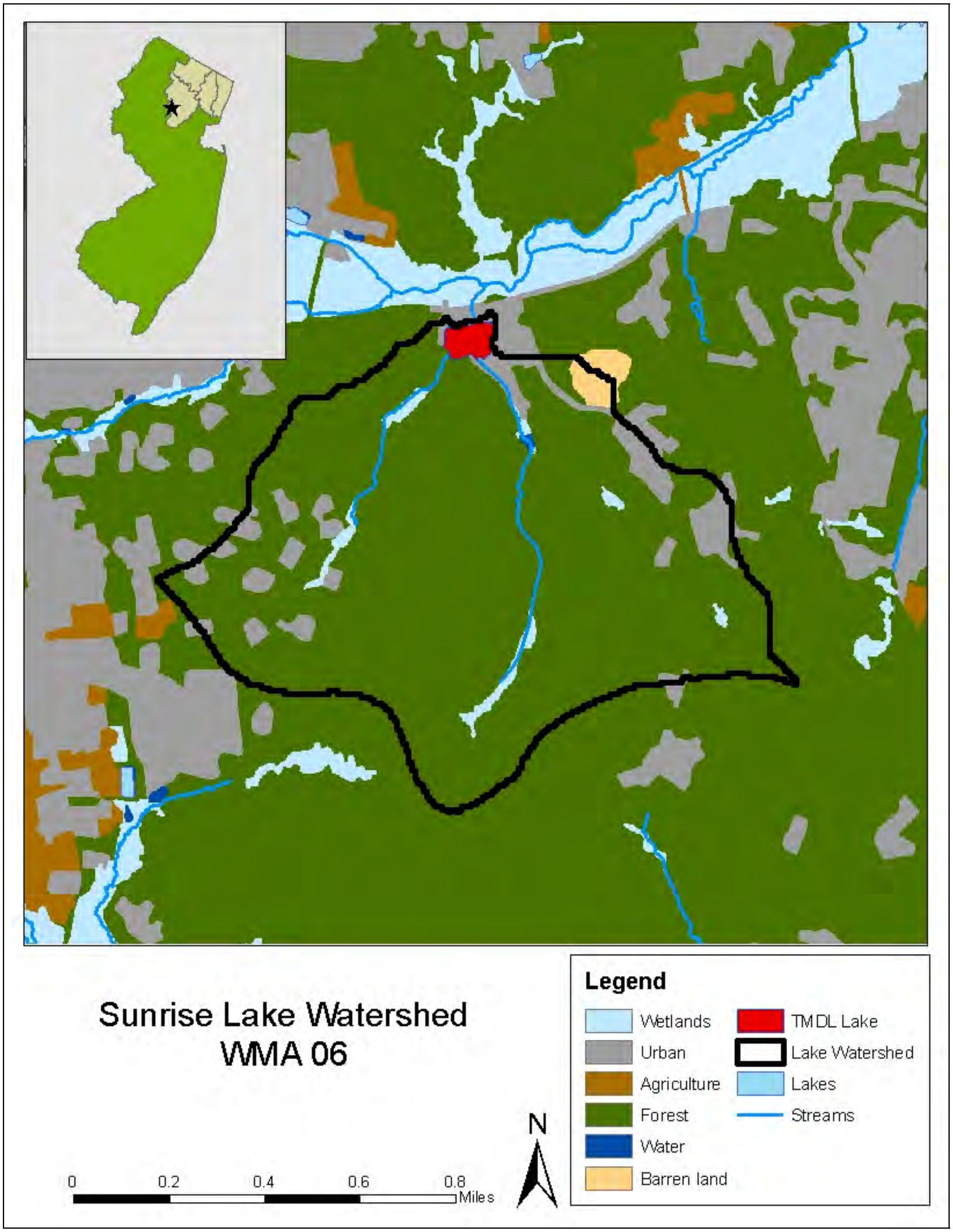
Lakes
Streams
Mountain Lake Watershed
WMA 06
0 0.15 0.3 0.45 0.6
Miles
N


Parssipany Lake Watershed
WMA 06
Legend
Wetlands
Urban
Agriculture
Forest
Water
Barren land
TMDL Lake
Lake Watershed
Lakes
Streams
N
0
0.25
0.5
0.75
1
Miles

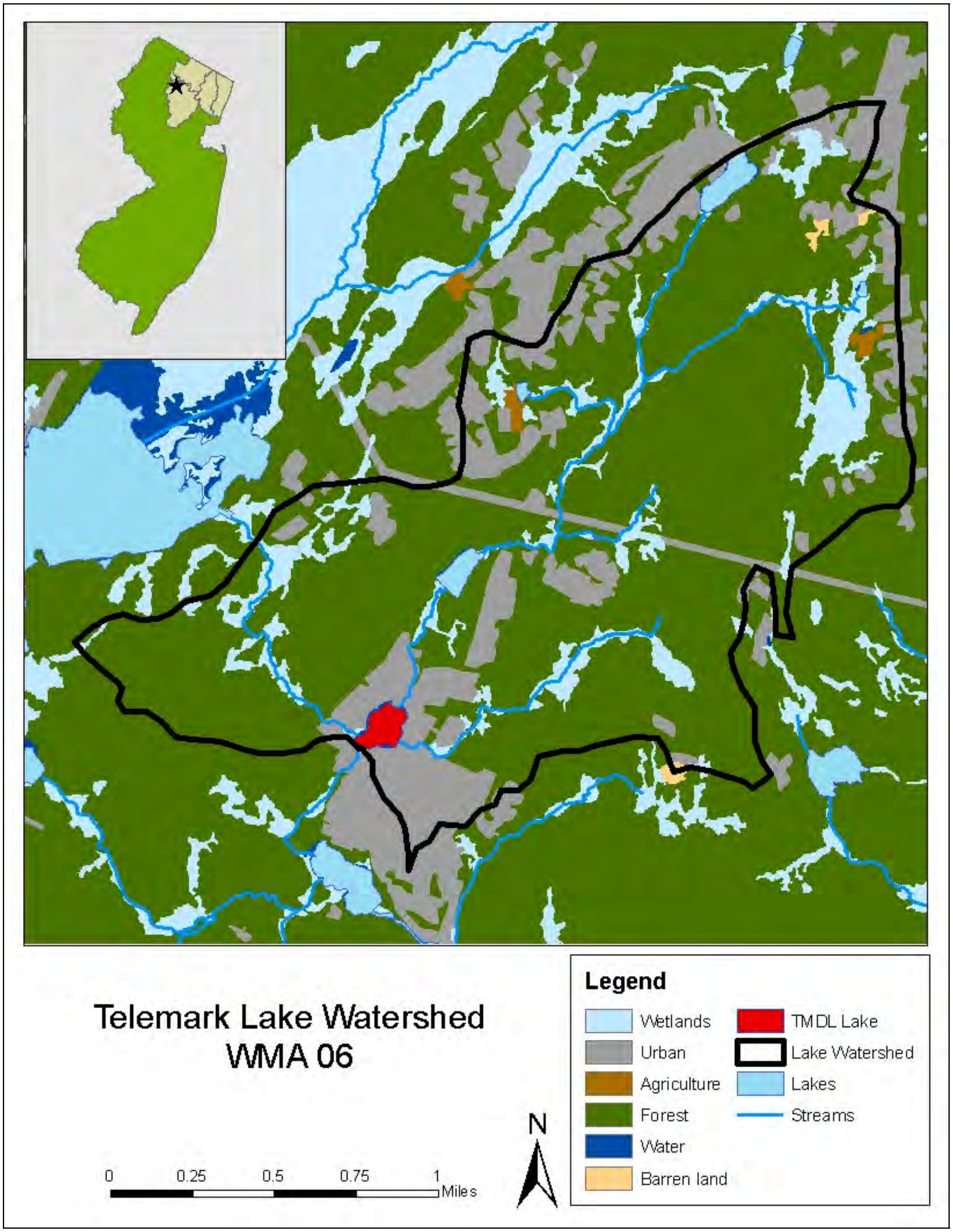


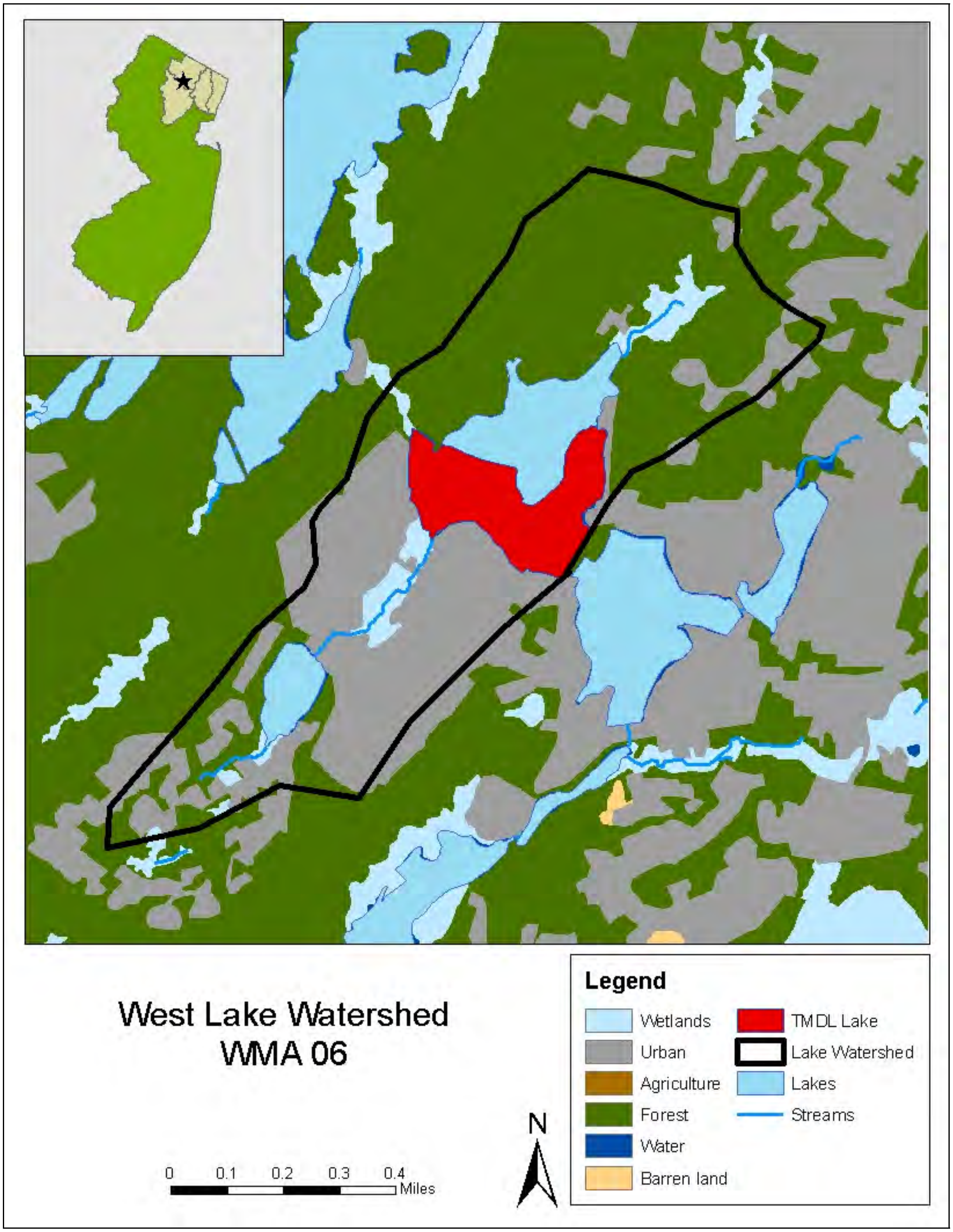
Legend
Wetlands
Urban
Agriculture
Forest
Water
Barren land
TMDL Lake
Lake Watershed
Lakes
Streams
Powder Mill Pond Watershed
WMA 06
N
0
0.25
0.5
0.75
1
Miles

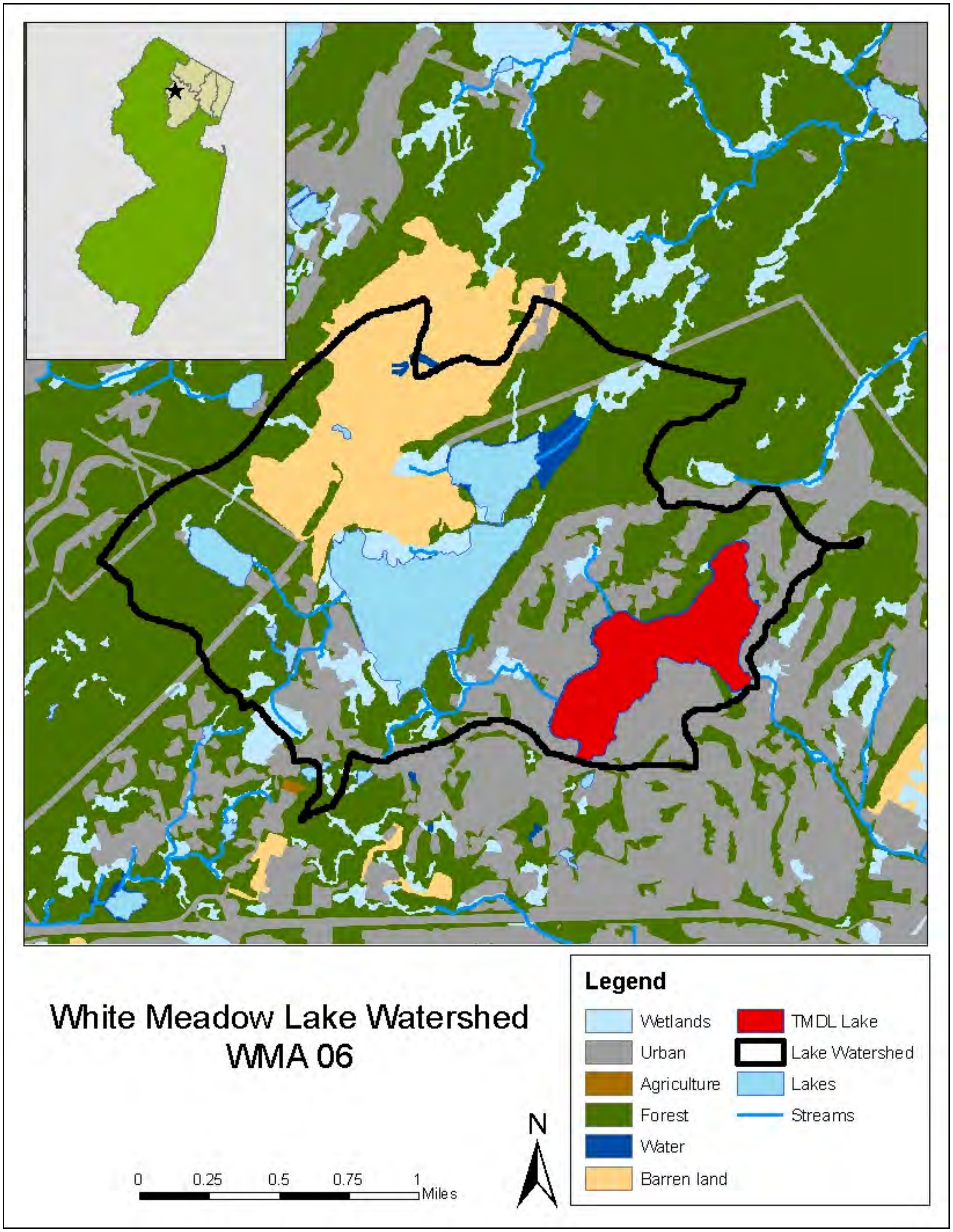

Legend
Wetlands
Urban
Agriculture
Forest
Water
Barren land
TMDL Lake
Lake Watershed
Lakes
Streams
Rainbow Lakes Watershed
WMA 06
0 0.05 0.1 0.15 0.2
Miles
N



Sunrise Lake Watershed
WMA 06
Legend
Wetlands
Urban
Agriculture
Forest
Water
Barren land
TMDL Lake
Lake Watershed
Lakes
Streams
0
0.2
0.4
0.6
0.8
Miles
N


Telemark Lake Watershed
WMA 06
Legend
Wetlands
Urban
Agriculture
Forest
Water
Barren land
TMDL Lake
Lake Watershed
Lakes
Streams
N
0
0.25
0.5
0.75
1
Miles


West Lake Watershed
WMA 06
Legend
Wetlands
Urban
Agriculture
Forest
Water
Barren land
TMDL Lake
Lake Watershed
Lakes
Streams
N
0
0.1
0.2
0.3
0.4
Miles


White Meadow Lake Watershed
WMA 06
Legend
Wetlands
Urban
Agriculture
Forest
Water
Barren land
TMDL Lake
Lake Watershed
Lakes
Streams
N
0
0.25
0.5
0.75
1
Miles

APPENDIX D: NORTHEAST WATER REGION WATER QUALITY DATA

* Highlighted values are greater than 200 cfu/100 ml of fecal coliform bacteria

WMA 03

Bubbling Springs			
count	133	mean+3stdev	717
median	5	%reduction	90%
max	2000		
stdev	213	**no data excluded**	
mean	79		
mean+3stdev	717		

Station	Date	Value	Remark
Diving	05/20/98	1	k
Inlet	05/20/98	1	k
Outlet	05/20/98	2	
Inlet	06/03/98	2	
Outlet	06/03/98	19	
Diving area	06/03/98	2	
Inlet	06/17/98	30	
Outlet	06/17/98	6	
Diving	06/17/98	1	k
Inlet	06/29/98	154	
Diving	06/29/98	1	k
Outlet	06/29/98	1	k
Diving	07/13/98	1	k
Inlet	07/13/98	5	
Beach	07/13/98	3	
Diving	07/27/98	1	k
Bathing	07/27/98	5	
Inlet	07/27/98	10	
Inlet	08/03/98	194	
Diving	08/03/98	127	
Beach	08/03/98	5	
Inlet	08/03/98	1	k
Swim Area Flag	07/20/98	2	
Diving	07/20/98	1	k
Inlet	08/10/98	800	
Diving	08/10/98	750	
Inlet	08/10/98	205	
Inlet	08/11/98	600	
Diving	08/11/98	195	
Beach Chair 2	08/11/98	179	
BeachChair3	08/11/98	51	
Swim Dock	08/11/98	294	
Inlet	08/12/98	253	
Swim Dock	08/12/98	166	
Diving Dock	08/12/98	136	
Beach Chair 2	08/12/98	165	
Beach Chair 3	08/12/98	173	
Inlet	08/13/98	1	k
Pump Pipe	08/13/98	47	
Chair2	08/13/98	37	
Chair 3	08/13/98	42	
SwimLanes Dock	08/13/98	32	
Diving Area	08/13/98	57	
Dive	08/17/98	1	k
Swim	08/17/98	1	
Inlet	08/17/98	1	k
Swim Area Flag	08/24/98	2	
Diving	08/24/98	1	k
Inlet	08/24/98	5	
BS	06/01/99	1	K
BS	06/01/99	1	K
BS	06/01/99	1	K
BS	06/07/99	6	
BS	06/07/99	4	
BS	06/07/99	10	
BS	06/15/99	28	
BS	06/15/99	2	
BS	06/15/99	11	
BS	06/21/99	1	
BS	06/21/99	2	
BS	06/21/99	1	
BS	06/28/99	1	K
BS	06/28/99	118	
BS	06/28/99	1	K
BS	07/06/99	1	K
BS	07/06/99	2	
BS	07/06/99	1	
BS	07/12/99	2	
BS	07/19/99	4	
BS	07/27/99	20	
BS	08/02/99	1	
BS	08/16/99	8	
BS	08/30/99	2	K
Bubbling Spring	05/17/00	6	
Bubbling Spring	05/24/00	34	
Bubbling Spring	06/07/00	336	
Bubbling Spring	06/09/00	2	K
Bubbling Spring	06/12/00	2	L
Bubbling Spring	06/20/00	4	
Bubbling Spring	06/27/00	64	
Bubbling Spring	07/10/00	8	
	07/18/00	24	
Bubbling Spring	07/24/00	2	K
Bubbling Spring	07/31/00	92	
Bubbling Spring	08/08/00	2	K
Bubbling Spring	08/15/00	360	
Bubbling Spring	08/17/00	2	K
Bubbling Spring	08/22/00	4	
Bubbling Spring	08/29/00	72	
Lake	06/05/01	10	
Lake	07/02/01	2	
Lake	07/16/01	2	
Lake	07/31/01	2	
Lake	08/14/01	2000	
Lake	08/16/01	10	Resample
Lake	08/21/01	326	
Lake	08/23/01	136	
Lake	08/27/01	112	
Water Full	05/21/01	4	
Dive Area	05/21/01	20	
LAKE	05/15/02	2	
DIVE AREA	05/15/02	4	
DIVE AREA	05/29/02	42	
DIVE AREA	06/11/02	190	
DIVE AREA	06/25/02	42	
DIVE AREA	07/09/02	2	
DIVE AREA	07/22/02	2	
DIVE AREA	08/06/02	338	
DIVE AREA	08/12/02	2	
DIVE AREA	08/19/02	190	

SWIM LANES	05/29/02	66	
SWIM LANES	06/11/02	208	
SWIM LANES	06/13/02	2	
SWIM LANES	06/25/02	84	
SWIM LANES	07/09/02	8	
SWIM LANES	07/22/02	2	
SWIM LANES	08/06/02	264	
SWIM LANES	08/12/02	2	
SWIM LANES	08/19/02	194	
diving area	05/24/04	2	K
	06/07/04	16	
	06/21/04	2	K
	07/06/04	2	
	07/19/04	2	K
	08/02/04	96	
	08/26/04	4	
	08/30/04	2	K
swimlanes/dock	06/21/04	2	K
	07/06/04	12	
	07/19/04	16	
	08/02/04	4	
	08/16/04	2	K
	08/30/04	2	K

Crystal Lake			
count	60	mean+3stdev	1824
median	35	%reduction	95%
max	3700		
Stdev	536	**no data excluded**	
Mean	216		
mean+3stdev	1824		

Station	**Date**	**Value**	**Remark**
CRL-1	05/23/98	10	K
CRL-1	06/07/98	100	
CRL-1	06/20/98	30	
CRL-1	06/29/98	10	K
CRL-1	07/06/98	10	K
CRL-1	07/13/98	10	K
CRL-1	07/21/98	10	K
CRL-1	07/27/98	10	K
CRL-1	08/03/98	10	K
CRL-1	08/11/98	560	
CRL-1	08/16/98	10	K
CRL-1	08/16/98	10	K
CRL-1	08/20/98	630	
CRL-1	08/24/98	10	K
CRL-1	08/28/98	20	
Lake	05/13/99	10	K
	06/06/99	160	
	07/05/99	20	
	07/12/99	20	
	07/22/99	10	K
	07/29/99	10	K
	08/05/99	10	K
	08/13/99	110	
	08/17/99	80	
	08/25/99	10	K
Crystal Lake (Ramapo Mountain Lakes, Inc.)	05/24/00	450	
Crystal Lake (Ramapo Mountain Lakes, Inc.)	06/16/00	140	
Crystal Lake (Ramapo Mountain Lakes, Inc.)	06/25/00	270	
Crystal Lake (Ramapo Mountain Lakes, Inc.)	06/28/00	150	
Crystal Lake (Ramapo Mountain Lakes, Inc.)	07/12/00	10	K
Crystal Lake (Ramapo Mountain Lakes, Inc.)	07/20/00	70	
Crystal Lake (Ramapo Mountain Lakes, Inc.)	07/28/00	1600	(TNTC)
Crystal Lake (Ramapo Mountain Lakes, Inc.)	08/03/00	250	
Crystal Lake (Ramapo Mountain Lakes, Inc.)	08/05/00	130	
Crystal Lake (Ramapo Mountain Lakes, Inc.)	08/07/00	520	
Crystal Lake (Ramapo Mountain Lakes, Inc.)	08/11/00	20	
Crystal Lake (Ramapo Mountain Lakes, Inc.)	08/16/00	740	
Crystal Lake (Ramapo Mountain Lakes, Inc.)	08/18/00	60	
Crystal Lake (Ramapo Mountain Lakes, Inc.)	08/22/00	10	
Crystal Lake (Ramapo Mountain Lakes, Inc.)	09/01/00	10	
Crystal Lake (Ramapo Mountain Lakes, Inc.)	09/07/00	30	
Crystal Lake (Ramapo Mountain Lakes, Inc.)	09/13/00	3700	
Crystal Lake (Ramapo Mountain Lakes, Inc.)	09/15/00	510	
	05/21/02	50	
	05/22/02	20	
	05/29/02	200	
	06/04/02	10	k
	06/11/02	130	
	06/17/02	1000	
	06/20/02	170	
	06/26/02	40	
	07/03/02	290	
	07/07/02	10	k
	07/17/02	110	
	07/22/02	10	k
	07/31/02	10	k
	08/06/02	10	
	08/12/02	40	
	08/21/02	160	
	08/26/02	150	

Erksine Lake			
count	287	mean+3stdev	1274
median	30	%reduction	96%
max	5400		
stdev	387	**no data excluded**	
mean	113		
mean+3stdev	1274		

Station	**Date**	**Value**	**Remark**
Erskine Lake (little)	05/23/98	10	
Erskine Lake (little)	06/05/98	40	
Erskine Lake (little)	06/11/98	50	
Erskine Lake (little)	06/18/98	30	
Erskine Lake (little)	06/22/98	10	
Erskine Lake (little)	07/05/98	10	
Erskine Lake (little)	07/12/98	10	
Erskine Lake (little)	07/19/98	30	
Erskine Lake (little)	07/26/98	50	
Erskine Lake (little)	08/03/98	10	
Erskine Lake (little)	08/14/98	10	
Erskine Lake (little)	08/18/98	20	
Erskine Lake (little)	08/29/98	10	

Erskine Lake (main)	05/23/98	10	
Erskine Lake (main)	06/05/98	10	
Erskine Lake (main)	06/11/98	20	
Erskine Lake (main)	06/18/98	30	
Erskine Lake (main)	06/22/98	70	
Erskine Lake (main)	07/05/98	10	
Erskine Lake (main)	07/12/98	10	
Erskine Lake (main)	07/19/98	110	
Erskine Lake (main)	07/26/98	50	
Erskine Lake (main)	08/03/98	10	
Erskine Lake (main)	08/14/98	10	
Erskine Lake (main)	08/18/98	20	
Erskine Lake (main)	08/29/98	10	
Erskine Lake (upper)	05/23/98	10	
Erskine Lake (upper)	06/05/98	10	
Erskine Lake (upper)	06/11/98	10	
Erskine Lake (upper)	06/18/98	70	
Erskine Lake (upper)	06/22/98	80	
Erskine Lake (upper)	07/05/98	10	
Erskine Lake (upper)	07/12/98	10	
Erskine Lake (upper)	07/19/98	10	
Erskine Lake (upper)	07/26/98	10	
Erskine Lake (upper)	08/03/98	40	
Erskine Lake (upper)	08/14/98	10	
Erskine Lake (upper)	08/18/98	10	
Erskine Lake (upper)	08/29/98	10	
ELMB	06/02/99	110	
ELMB	06/18/99	150	
ELMB	06/25/99	20	
ELMB	07/05/99	230	
ELMB	07/10/99	10	K
ELMB	07/20/99	40	
ELMB	07/29/99	340	
ELMB	08/02/99	10	K
ELMB	08/04/99	10	K
ELMB	08/09/99	40	
ELMB	08/31/99	10	K
ELLB	06/02/99	10	
ELLB	06/18/99	10	K
ELLB	06/25/99	20	
ELLB	07/05/99	20	
ELLB	07/10/99	10	K
ELLB	07/20/99	10	K
ELLB	07/29/99	10	K
ELLB	08/04/99	10	K
ELLB	08/09/99	10	
ELLB	08/31/99	10	K
ELUB	06/02/99	10	K
ELUB	06/18/99	40	
ELUB	06/25/99	10	K
ELUB	07/05/99	10	
ELUB	07/10/99	50	
ELUB	07/20/99	50	
ELUB	07/29/99	120	
ELUB	08/04/99	10	K
ELUB	08/09/99	170	
ELUB	08/20/99	100	
ELUB	08/31/99	10	K
Erskine Lake Main Beach	05/25/00	10	K
Erskine Lake Main Beach	06/01/00	10	K
Erskine Lake Main Beach	06/08/00	410	
Erskine Lake Main Beach	06/16/00	50	
Erskine Lake Main Beach	06/23/00	90	
Erskine Lake Main Beach	06/28/00	10	K
Erskine Lake Main Beach	07/03/00	10	
Erskine Lake Main Beach	07/06/00	70	
Erskine Lake Main Beach	07/12/00	30	
Erskine Lake Main Beach	07/18/00	40	
Erskine Lake Main Beach	07/30/00	120	
Erskine Lake Main Beach	08/03/00	5400	
Erskine Lake Main Beach	08/07/00	140	
Erskine Lake Main Beach	08/14/00	10	
Erskine Lake Main Beach	08/25/00	10	
Erskine Lake Main Beach	09/07/00	20	
Erskine Lake Upper Beach	05/25/00	10	K
Erskine Lake Upper	06/01/00	20	
Beach			
Erskine Lake Upper Beach	06/08/00	10	K
Erskine Lake Upper Beach	06/16/00	50	
Erskine Lake Upper Beach	06/23/00	2100	
Erskine Lake Upper Beach	06/28/00	740	
Erskine Lake Upper Beach	07/03/00	10	
Erskine Lake Upper Beach	07/06/00	590	
Erskine Lake Upper Beach	07/12/00	420	
Erskine Lake Upper Beach	07/18/00	30	
Erskine Lake Upper Beach	07/30/00	10	K
Erskine Lake Upper Beach	08/07/00	230	
Erskine Lake Upper Beach	08/14/00	120	
Erskine Lake Upper Beach	08/25/00	10	K
Erskine Lake Upper Beach	09/07/00	10	K
Erskine Lake Little Beach	05/25/00	30	
Erskine Lake Little Beach	06/01/00	10	
Erskine Lake Little Beach	06/08/00	10	
Erskine Lake Little Beach	06/16/00	20	
Erskine Lake Little Beach	06/23/00	10	
Erskine Lake Little Beach	06/26/00	10	
Erskine Lake Little Beach	06/28/00	150	
Erskine Lake Little Beach	07/06/00	30	
Erskine Lake Little Beach	07/12/00	10	K
Erskine Lake Little Beach	07/18/00	10	K
Erskine Lake Little Beach	07/30/00	1100	
Erskine Lake Little Beach	08/03/00	290	

Erskine Lake Little Beach	08/07/00	10	K
Erskine Lake Little Beach	08/14/00	240	
Erskine Lake Little Beach	08/16/00	10	K
Erskine Lake Little Beach	08/25/00	10	
Erskine Lake Little Beach	09/07/00	10	K
Main Beach	05/23/01	40	
Main Beach	05/29/01	10	
Main Beach	06/04/01	30	
Main Beach	06/18/01	230	
Main Beach	06/20/01	260	Resample; closed 6/22
Main Beach	06/27/01	190	
Main Beach	07/06/01	30	
Main Beach	07/13/01	20	
Main Beach	07/17/01	240	
Main Beach	07/20/01	10	Resample
Main Beach	07/23/01	20	
Main Beach	07/30/01	220	
Main Beach	08/01/01	10	
Main Beach	08/06/01	70	
Main Beach	08/15/01	130	
Main Beach	08/21/01	680	
Main Beach	08/24/01	40	Resample
Upper Beach	05/23/01	30	
Upper Beach	05/29/01	310	
Upper Beach	06/04/01	10	
Upper Beach	06/18/01	70	
Upper Beach	06/20/01	10	
Upper Beach	06/27/01	40	
Upper Beach	07/06/01	80	
Upper Beach	07/13/01	20	
Upper Beach	07/17/01	40	
Upper Beach	07/23/01	30	
Upper Beach	07/30/01	150	
Upper Beach	08/06/01	10	
Upper Beach	08/15/01	10	
Upper Beach	08/21/01	50	
Little Beach	05/23/01	20	
Little Beach	05/29/01	10	
Little Beach	06/04/01	10	
Little Beach	06/18/01	40	

Little Beach	06/20/01	40	
Little Beach	06/27/01	40	
Little Beach	07/06/01	20	
Little Beach	07/13/01	10	
Little Beach	07/17/01	10	
Little Beach	07/23/01	30	
Little Beach	07/30/01	10	
Little Beach	08/06/01	10	
Little Beach	08/15/01	40	
Little Beach	08/21/01	40	
MAIN BEACH	06/11/02	10	
MAIN BEACH	06/19/02	30	
MAIN BEACH	06/24/02	40	
MAIN BEACH	07/02/02	10	
MAIN BEACH	07/07/02	10	
MAIN BEACH	07/17/02	10	
MAIN BEACH	07/25/02	60	
MAIN BEACH	07/29/02	40	
MAIN BEACH	08/12/02	10	
MAIN BEACH	08/23/02	40	
MAIN BEACH	09/03/02	10	
UPPER BEACH	06/11/02	160	
UPPER BEACH	06/19/02	10	
UPPER BEACH	06/24/02	720	
UPPER BEACH	06/26/02	90	
UPPER BEACH	07/02/02	60	
UPPER BEACH	07/07/02	200	
UPPER BEACH	07/17/02	10	
UPPER BEACH	07/25/02	810	
UPPER BEACH	07/29/02	130	
UPPER BEACH	08/12/02	100	
UPPER BEACH	08/23/02	50	
UPPER BEACH	09/03/02	490	
LITTLE BEACH	06/11/02	10	
LITTLE BEACH	06/19/02	20	
LITTLE BEACH	06/24/02	20	
LITTLE BEACH	07/02/02	10	
LITTLE BEACH	07/07/02	10	
LITTLE BEACH	07/17/02	10	
LITTLE BEACH	07/25/02	60	
LITTLE BEACH	07/29/02	40	
LITTLE BEACH	08/12/02	30	
LITTLE BEACH	08/23/02	20	
LITTLE BEACH	09/03/02	20	

ERSKINE LAKE:MAIN BEACH	05/20/03	10	
	05/27/03	10	
	06/03/03	220	
	06/06/03	10	
	06/09/03	40	
	06/20/03	40	
	06/25/03	40	
	07/01/03	120	
	07/08/03	110	
	07/15/03	160	
	07/22/03	150	
	07/29/03	10	
	08/05/03	110	
	08/12/03	500	
	08/14/03	20	
	08/19/03	10	
	08/26/03	50	
	09/02/03	40	
Erskine Lake:UPPER BEACH	05/20/03	30	
	05/27/03	30	
	06/03/03	90	
	06/09/03	10	
	06/20/03	10	
	06/25/03	1200	
	07/01/03	330	
	07/03/03	10	
	07/08/03	40	
	07/15/03	90	
	07/22/03	310	
	07/29/03	30	
	08/05/03	90	
	08/12/03	860	
	08/14/03	300	
	08/19/03	440	
	08/21/03	40	
	08/26/03	40	
	09/02/03	210	
	09/04/03	10	
Erskine Lake:LITTLE BEACH	05/20/03	10	
	05/27/03	40	
	06/03/03	10	
	06/09/03	10	
	06/20/03	10	

	06/25/03	30	
	07/01/03	100	
	07/08/03	10	
	07/15/03	40	
	07/22/03	170	
	07/29/03	90	
	08/05/03	110	
	08/12/03	30	
	08/14/03	10	
	08/19/03	20	
	08/26/03	20	
	09/02/03	200	
Erskine Main	05/26/04	10	
	06/03/04	20	
	06/10/04	10	K
	06/22/04	100	
	07/14/04	70	
	07/21/04	20	
	07/29/04	80	
	08/03/04	30	
	08/10/04	10	
	08/17/04	80	
	08/24/04	40	
Erskine Upper	05/26/04	20	
	06/03/04	210	
	06/10/04	220	
	06/22/04	10	K
	07/14/04	2000	
	07/16/04	260	
	07/21/04	10	K
	07/29/04	60	
	08/03/04	10	K
	08/10/04	40	
	08/17/04	10	K
	08/24/04	10	
Erskine Lower	05/26/04	40	
	06/03/04	30	
	06/10/04	20	
	06/22/04	30	
	07/14/04	70	
	07/21/04	10	
	07/29/04	40	
	08/03/04	10	K
	08/10/04	10	
	08/17/04	20	
	08/24/04	10	K

Forest Hill Lake			
count	99	mean+3stdev	9063
median	13	% reduction	95%
max	28200		
stdev	2875	**1 value excluded (28200) Excluded. Next highest value in dataset is 3700. Also, there was no remark code**	
mean	436		
mean+3stdev	9063		

Station	Date	Value	Remarks
FHP	05/25/99	74	
FHP	06/01/99	2500	
FHP	06/03/99	13	
FHP	06/09/99	10	
FHP	06/15/99	9	
FHP	07/12/99	6	
FHP	08/17/99	15	
FHP	08/23/99	2	
FHP	08/31/99	2	K
Beach Area	05/27/98	1	
Inlet	05/27/98	1	
Beach Area	06/10/98	1	
Inlet	06/10/98	1	k
Beach Area	06/16/98	35	
Beach Area	06/23/98	14	
Inlet	06/23/98	20	
Beach Area	06/30/98	26	
Beach	07/07/98	1	k
Forest Hill	07/07/98	1	k
Beach Area	07/14/98	2	
Beach Area	07/21/98	1	k
Inlet	07/21/98	2	
Beach Area	08/04/98	2	
Inlet	08/04/98	10	
Beach Area	08/11/98	184	
Beach Area	08/18/98	80	
Inlet	08/18/98	190	
Beach Area	08/27/98	3	
Inlet	08/27/98	68	
Beach Area	09/03/98	2	
Forest Hill Park	05/24/00	44	
Forest Hill Park	05/30/00	6	
Forest Hill Park	06/05/00	2	
Forest Hill Park	06/13/00	46	
Forest Hill Park	06/20/00	8	
Forest Hill Park	07/06/00	4	
Forest Hill Park	07/12/00	8	
Forest Hill Park	07/19/00	36	
Forest Hill Park	07/25/00	2	K
Forest Hill Park	08/02/00	20	
Forest Hill Park	08/08/00	2	K
Forest Hill Park	08/15/00	108	
Forest Hill Park	08/22/00	2	K
Forest Hill Park	08/28/00	12	
Beach	05/22/01	128	
Beach	05/29/01	8	
Beach	06/04/01	68	
Beach	06/12/01	24	
Beach	06/18/01	184	
Beach	06/26/01	192	
Beach	07/02/01	110	
Beach	07/09/01	32	
Beach	07/16/01	16	
Beach	07/23/01	16	
Beach	07/31/01	14	
Beach	08/06/01	42	
Beach	08/14/01	3100	
Beach	08/17/01	40	
Beach	08/22/01	2	
Beach	08/22/01	54	
Beach	08/27/01	2	
Inlet	05/22/01	28200	
Inlet	06/04/01	186	
Inlet	06/18/01	1900	
Inlet	07/02/01	578	
Inlet	07/16/01	10	
Inlet	07/31/01	180	
Inlet	08/14/01	3700	
Inlet	08/17/01	32	
Inlet	08/27/01	82	
BEACH	05/20/02	14	
BEACH	05/28/02	2	
BEACH	06/03/02	2	
BEACH	06/10/02	4	

BEACH	06/19/02	18	
BEACH	06/24/02	2	
BEACH	07/02/02	8	
BEACH	07/08/02	2	
BEACH	07/15/02	6	
BEACH	07/22/02	2	
BEACH	07/29/02	2	
BEACH	08/13/02	4	
BEACH	08/19/02	2	
BEACH	08/26/02	4	
INLET	05/20/02	124	
Forest Hill Lake	05/24/04	10	K
	06/01/04	10	K
	06/09/04	20	
	06/15/04	10	
	06/24/04	10	K
	07/06/04	20	
	07/15/04	30	
	07/21/04	20	
	07/26/04	260	
	07/29/04	60	
	08/03/04	10	K
	08/10/04	10	K
	08/18/04	40	
	08/24/04	20	

Kitchell Lake			
count	77	mean+3stdev	1675
median	31	%reduction	95%
max	3680		
stdev	505	**no data excluded**	
mean	161		
mean+3stdev	1675		

Station	**Date**	**Value**	**Remark**
Beach	06/16/98	70	
Beach	06/23/98	39	
Beach	06/30/98	168	
Beach	07/07/98	3	
Beach	07/14/98	12	
Beach	07/21/98	31	
Beach	08/04/98	7	
Beach	08/11/98	450	
Beach	08/13/98	10	
Stream Inlet	08/13/98	6	
Beach	08/18/98	270	
Beach	08/20/98	292	
Kitchell Lake	08/24/98	2	
Beach	09/03/98	146	
KL	05/26/99	43	
KL	06/03/99	231	
KL	06/09/99	6	
KL	06/17/99	1	K
KL	06/17/99	65	
KL	06/23/99	24	
KL	06/29/99	3680	
KL	07/01/99	92	
KL	07/07/99	14	
KL	07/12/99	16	
KL	07/19/99	10	
KL	07/27/99	4	
KL	08/03/99	25	
KL	08/11/99	1	K
KL	08/17/99	41	
KL	08/23/99	4	
Kitchell Lake	06/20/00	24	
Kitchell Lake	07/05/00	30	
Kitchell Lake	07/19/00	76	
Kitchell Lake	07/24/00	12	
Kitchell Lake	08/02/00	28	
Kitchell Lake	08/08/00	124	
Kitchell Lake	08/16/00	320	
Kitchell Lake	08/18/00	44	
Kitchell Lake	08/21/00	92	
Kitchell Lake	08/28/00	240	
Kitchell Lake	08/30/00	32	
Beach	05/21/01	2	
Beach	05/29/01	20	
Beach	06/04/01	18	
Beach	06/11/01	14	
Beach	06/18/01	164	
Beach	07/02/01	196	
Beach	07/09/01	144	
Beach	07/16/01	2	
Beach	07/23/01	2	
Beach	07/31/01	316	
Beach	08/02/01	14	
Beach	08/06/01	34	
Beach	08/14/01	2500	
Beach	08/17/01	34	
Beach	08/23/01	10	
Beach	08/27/01	30	
Inlet	07/12/01	86	
	05/28/02	12	
	06/14/02	2	
	06/25/02	44	
	07/08/02	6	
	07/22/02	62	
	08/08/02	10	
	08/19/02	4	
Kitchell Lake Association	05/20/04	2	K
	06/02/04	145	
	06/14/04	130	
	06/28/04	14	
	07/12/04	88	
	07/26/04	600	
	07/29/04	260	
	07/30/04	10	
	08/09/04	26	
	08/16/04	410	
	08/18/04	136	
	08/23/04	70	

Lake Edenwold			
count	42	mean+3stdev	719
median	70	%reduction	83%
max	1200		
Stdev	198	**no data excluded**	
Mean	125		
mean+3stdev	719		

Name	**Date**	**Value**	**Remark**
LE	06/20/99	150	
LE	07/02/99	440	
LE	07/07/99	70	
LE	07/09/99	100	
LE	07/09/99	140	
LE	07/09/99	10	K
LE	07/09/99	50	
LE	07/15/99	40	

LE	07/22/99	230	
LE	07/23/99	100	
LE	07/28/99	10	
LE	08/01/99	40	
LE	08/12/99	40	
LE	08/18/99	90	
LE	08/24/99	40	
	07/15/02	10	k
	07/22/02	10	k
	08/06/02	10	k
	08/13/02	10	k
	08/19/02	60	
	08/29/02	1200	
	09/01/02	140	
Lake Edenwold, Butler	06/03/03	40	
	06/06/03	30	
	06/16/03	40	
	06/23/03	70	
	06/30/03	30	
	07/07/03	120	
	07/28/03	90	
	08/04/03	280	
	08/07/03	140	Resample
	08/11/03	150	
	08/19/03	120	
	08/25/03	50	
Lake Edenwold, Butler	06/02/04	40	
	06/17/04	170	
	06/23/04	110	
	06/29/04	480	
	07/07/04	100	
	07/20/04	50	
	07/26/04	50	
	08/04/04	90	

Lake Ioscoe			
count	24	mean+3stdev	702
median	10	%reduction	74%
max	770		
stdev	204	**no data excluded**	
mean	91		
mean+3stdev	702		

Station	**Date**	**Value**	**Remark**
Lake Ioscoe	06/06/98	680	
	06/10/98	10	
	06/26/98	10	
	07/02/98	10	K
	07/07/98	10	K
	07/14/98	10	K
	07/22/98	50	
	07/28/98	40	
	08/05/98	10	K
	08/12/98	10	K
	08/19/98	30	
	08/29/98	10	K
LI	06/07/99	10	
LI	06/20/99	20	
LI	07/02/99	20	
LI	07/09/99	770	
LI	07/13/99	60	
LI	07/15/99	100	
LI	07/22/99	10	
LI	07/28/99	10	K
LI	08/01/99	10	K
LI	08/12/99	10	K
LI	08/18/99	280	
LI	08/24/99	10	

Lionhead Lake			
count	57	mean+3stdev	2426
median	108	%reduction	95%
max	3900		
stdev	700	**no data excluded**	
mean	326		
mean+3stdev	2426		

Station	**Date**	**Value**	**Remark**
Lions Head Lake	05/23/00	108	
Lions Head Lake	05/31/00	2	K
Lions Head Lake	06/09/00	28	
Lions Head Lake	06/14/00	208	
Lions Head Lake	06/15/00	80	
Lions Head Lake	06/20/00	132	
Lions Head Lake	06/28/00	98	
Lions Head Lake	07/05/00	76	
Lions Head Lake	07/17/00	160	
Lions Head Lake	07/24/00	56	
Lions Head Lake	07/31/00	560	
Lions Head Lake	08/05/00	210	
Lions Head Lake	08/07/00	104	
Lions Head Lake	08/17/00	196	
Lions Head Lake	08/21/00	84	
Lions Head Lake	08/28/00	54	
Lions Head Lake: Wayne	05/29/01	400	
	05/31/01	128	Resample
	06/11/01	140	
	06/18/01	2800	
	06/20/01	180	Resample
	06/25/01	168	
	07/02/01	172	
	07/09/01	178	
	07/16/01	92	
	07/23/01	90	
	07/30/01	2	
	08/06/01	176	
	08/14/01	398	
	08/16/01	48	Resample
	08/20/01	72	
	08/27/01	20	
LIONS HEAD	05/20/02	82	
	05/29/02	2	
	06/03/02	1200	
	06/06/02	3900	
	06/10/02	30	
	06/17/02	466	
	06/17/02	280	
	06/24/02	12	
	07/01/02	20	
	07/01/02	32	
	07/07/02	30	
	07/08/02	210	
	07/15/02	158	
	07/22/02	18	
	07/29/02	52	
Lions Head Lake	05/17/04	60	
	06/15/04	1700	
	06/17/04	2100	
	06/30/04	140	

	07/08/04	10	K
	07/20/04	120	
	07/26/04	160	
	08/03/04	100	
	08/17/04	420	
	08/25/04	50	

Skyline Lakes			
count	167	mean+3stdev	1955
median	50	%reduction	96%
max	4700		
stdev	581	**no data excluded**	
mean	211		
mean+3stdev	1955		

Station	Date	Value	Remark
Skyline Lake	05/23/98	830	
Skyline Lake	05/28/98	10	
Skyline Lake	06/05/98	90	
Skyline Lake	06/11/98	50	
Skyline Lake	06/18/98	700	
Skyline Lake	06/22/98	650	
Skyline Lake	06/24/98	540	
Skyline Lake	06/29/98	10	
Skyline Lake	07/05/98	140	
Skyline Lake	07/12/98	40	
Skyline Lake	07/19/98	190	
Skyline Lake	07/26/98	10	
Skyline Lake	08/03/98	320	
Skyline Lake	08/05/98	170	
Skyline Lake	08/12/98	130	
Skyline Lake	08/12/98	10	
Skyline Lake	08/19/98	170	
Skyline Lakes Upper Beach	05/23/98	30	
Skyline Lakes Upper Beach	06/05/98	110	
Skyline Lakes Upper Beach	06/11/98	10	
Skyline Lakes Upper Beach	06/18/98	20	
Skyline Lakes Upper Beach	06/22/98	10	
Skyline Lakes Upper Beach	07/05/98	10	
Skyline Lakes Upper Beach	07/12/98	10	
Skyline Lakes Upper Beach	07/19/98	40	
Skyline Lakes Upper Beach	07/26/98	10	
Skyline Lakes Upper Beach	08/03/98	10	
Skyline Lakes Upper Beach	08/14/98	110	
Skyline Lakes Upper Beach	08/18/98	40	
Skyline Lakes Upper Beach	08/29/98	10	
SL	06/02/99	230	
SL	06/04/99	120	
SL	06/04/99	67	
SL	06/10/99	452	
SL	06/14/99	86	
SL	06/18/99	300	
SL	06/18/99	120	
SL	06/22/99	654	
SL	06/25/99	40	
SL	06/25/99	100	
SL	07/05/99	220	
SL	07/05/99	80	
SL	07/10/99	80	
SL	07/10/99	20	
SL	07/20/99	10	K
SL	07/20/99	120	
SL	07/29/99	10	
SL	07/29/99	100	
SL	08/04/99	10	K
SL	08/04/99	50	
SL	08/09/99	10	K
SL	08/09/99	260	
SL	08/11/99	180	
SL	08/13/99	30	
SL	08/31/99	100	
Skyline Lake Main Beach	05/25/00	40	
Skyline Lake Main Beach	06/01/00	10	K
Skyline Lake Main Beach	06/08/00	30	
Skyline Lake Main Beach	06/16/00	30	
Skyline Lake Main Beach	06/23/00	70	
Skyline Lake Main Beach	06/28/00	90	
Skyline Lake Main Beach	07/06/00	330	
Skyline Lake Main Beach	07/18/00	40	
Skyline Lake Main Beach	07/30/00	460	
Skyline Lake Main Beach	08/03/00	1200	
Skyline Lake Main Beach	08/07/00	90	
Skyline Lake Main Beach	08/14/00	50	
Skyline Lake Main Beach	09/07/00	40	
Skyline Lake Upper Beach	06/01/00	40	
Skyline Lake Upper Beach	06/16/00	20	
Skyline Lake Upper Beach	07/18/00	10	
Skyline Lake Upper Beach	07/30/00	2600	
Skyline Lake Upper Beach	08/03/00	560	
Skyline Lake Upper Beach	08/07/00	90	
Skyline Lake Upper Beach	08/14/00	120	
Skyline Lake Upper Beach	08/25/00	10	K
Main/Lower Beach	05/25/01	10	
Main/Lower Beach	05/29/01	10	
Main/Lower Beach	06/04/01	100	
Main/Lower Beach	06/18/01	390	
Main/Lower Beach	06/20/01	100	Resample
Main/Lower Beach	06/27/01	490	
Main/Lower Beach	07/06/01	50	
Main/Lower Beach	07/13/01	600	Closed 7/16
Main/Lower Beach	07/17/01	10	
Main/Lower Beach	07/23/01	100	
Main/Lower Beach	07/30/01	270	
Main/Lower Beach	08/01/01	40	Resample
Main/Lower Beach	08/06/01	130	
Main/Lower Beach	08/15/01	510	

Main/Lower Beach	08/21/01	30	
Upper Beach	05/22/01	320	
Upper Beach	05/29/01	40	
Upper Beach	05/29/01	10	
Upper Beach	06/04/01	100	
Upper Beach	06/18/01	4700	
Upper Beach	06/20/01	3400	Resample
Upper Beach	06/27/01	350	
Upper Beach	06/27/01	150	
Upper Beach	07/06/01	50	
Upper Beach	07/13/01	30	
Upper Beach	07/17/01	10	
Upper Beach	07/23/01	200	
Upper Beach	07/30/01	50	
Upper Beach	08/06/01	50	
Upper Beach	08/15/01	50	
Upper Beach	08/21/01	10	
MAIN/LOWER	05/24/02	260	
MAIN/LOWER	06/06/02	380	
MAIN/LOWER	06/11/02	130	
MAIN/LOWER	06/19/02	10	
MAIN/LOWER	06/24/02	30	
MAIN/LOWER	07/07/02	30	
MAIN/LOWER	07/08/02	30	
MAIN/LOWER	07/17/02	50	
MAIN/LOWER	07/25/02	80	
MAIN/LOWER	07/29/02	3900	
MAIN/LOWER	08/12/02	20	
MAIN/LOWER	08/23/02	50	
MAIN/LOWER	09/03/02	40	
UPPER	05/28/02	20	
UPPER	06/06/02	140	
UPPER	06/11/02	30	
UPPER	06/19/02	10	
UPPER	07/29/02	80	
SKYLINE LAKE:Main	06/03/03	120	
	06/20/03	210	
	07/01/03	30	
	07/08/03	10	
	07/22/03	200	
	08/08/03	140	
	08/14/03	40	
	08/26/03	30	
Skyline Lake:LOWER BEACH	05/20/03	10	
	05/27/03	430	
	05/30/03	40	
	06/09/03	100	
	07/29/03	50	
	08/05/03	410	
	08/12/03	510	
	08/19/03	80	
	09/02/03	110	
Skyline Lake:UPPER BEACH	05/20/03	20	
	06/09/03	30	
	06/20/03	40	
	06/25/03	240	
	07/01/03	10	
Skyline Upper Lake	05/26/04	100	
	06/03/04	130	
	06/10/04	10	
	06/22/04	80	
	07/14/04	50	
	07/21/04	10	
	07/29/04	1	K
	08/03/04	10	
	08/17/04	50	
	08/24/04	30	
Skyline Lower	05/26/04	10	
	06/10/04	80	
	06/22/04	60	
	07/14/04	40	
	07/21/04	40	
	07/29/04	30	
	08/03/04	40	
	08/10/04	20	
	08/17/04	30	
	08/24/04	30	

WMA 04

Toms Lake (WMA 04)			
count	214	mean+3stdev	662
median	12	%reduction	90%
max	2000		
stdev	194	**no data excluded**	

mean	80		
mean+3stdev	662		

Station	**Date**	**Value**	**Remark**
North Cove swim lanes	05/31/00	2	
North Cove swim lanes	06/09/00	122	
North Cove swim lanes	06/14/00	4	
North Cove swim lanes	06/20/00	42	
North Cove swim lanes	06/28/00	96	
North Cove swim lanes	07/05/00	8	
North Cove swim lanes	07/17/00	24	
North Cove swim lanes	07/24/00	2	K
North Cove swim lanes	07/31/00	4	
North Cove swim lanes	08/07/00	16	
North Cove swim lanes	08/17/00	12	
North Cove swim lanes	08/21/00	4	
North Cove swim lanes	08/28/00	4	
North Cove beach	05/23/00	278	
North Cove beach	05/25/00	2	
North Cove beach	05/31/00	136	
North Cove beach	06/09/00	114	
North Cove beach	06/14/00	84	
North Cove beach	06/20/00	16	
North Cove beach	06/28/00	96	
North Cove beach	07/05/00	2	K
North Cove beach	07/06/00	2	K
North Cove beach	07/17/00	112	
North Cove beach	07/24/00	2	K
North Cove beach	07/31/00	16	
North Cove beach	08/07/00	124	
North Cove beach	08/17/00	20	
North Cove beach	08/21/00	4	
North Cove beach	08/28/00	36	
Kilroy Park	05/31/00	2	
Kilroy Park	06/09/00	4	

Kilroy Park	06/14/00	14	
Kilroy Park	06/20/00	2	K
Kilroy Park	06/28/00	94	
Kilroy Park	07/05/00	264	
Kilroy Park	07/17/00	12	
Kilroy Park	07/24/00	24	
Kilroy Park	08/02/00	48	
Kilroy Park	08/07/00	4	
Kilroy Park	08/17/00	76	
Kilroy Park	08/21/00	52	
Kilroy Park	08/28/00	20	
Beach	05/21/01	32	
Beach	05/29/01	46	
Beach	06/04/01	4	
Beach	06/11/01	16	
Beach	06/18/01	350	
Beach	06/20/01	21	Resample
Beach	06/25/01	2	
Beach	07/02/01	28	
Beach	07/09/01	10	
Beach	07/16/01	26	
Beach	07/23/01	6	
Beach	07/30/01	2	
Beach	08/06/01	6	
Beach	08/14/01	18	
Beach	08/20/01	34	
Beach	08/27/01	14	
Swim Lanes	07/09/01	6	
Swim Lanes	07/16/01	34	
Swim Lanes	07/23/01	4	
Swim Lanes	07/30/01	2	
Swim Lanes	08/06/01	2	
Swim Lanes	08/14/01	24	
Swim Lanes	08/20/01	4	
Swim Lanes	08/27/01	2	
Kilroy Park Lake: Wayne	05/21/01	18	
see note in 2003	05/29/01	102	
	06/04/01	2	
	06/11/01	2	
	06/18/01	2	
	06/25/01	2	
	07/02/01	2	
	07/09/01	2	

	07/16/01	2	
	07/23/01	2	
	07/30/01	2	
	08/06/01	2	
	08/14/01	2	
	08/20/01	2	
	08/27/01	2	
BEACH	05/20/02	2	
BEACH	05/29/02	280	
BEACH	05/31/02	264	
BEACH	06/03/02	20	
BEACH	06/04/02	20	
BEACH	06/10/02	34	
BEACH	06/17/02	384	
BEACH	06/19/02	196	
BEACH	07/01/02	30	
BEACH	07/08/02	2	
BEACH	07/15/02	10	
BEACH	07/22/02	2	
BEACH	07/29/02	2	
BEACH	08/05/02	2	
BEACH	08/12/02	2	
SWIM LANES	05/20/02	2	
SWIM LANES	05/29/02	4	
SWIM LANES	06/03/02	184	
SWIM LANES	06/10/02	2	
SWIM LANES	06/17/02	16	
SWIM LANES	07/01/02	2	
SWIM LANES	07/08/02	2	
SWIM LANES	07/15/02	2	
SWIM LANES	07/29/02	2	
SWIM LANES	08/05/02	2	
SWIM LANES	08/12/02	2	
	05/20/02	2	
	05/29/02	14	
	06/03/02	714	
	06/05/02	102	
	06/10/02	256	
	06/10/02	262	
	06/12/02	42	
	06/17/02	22	
	06/24/02	6	
	07/01/02	32	
	07/08/02	2	
	07/15/02	24	

	07/22/02	22	
	07/29/02	74	
	08/05/02	6	
NORTH COVE:Beach	05/20/03	16	
	05/27/03	96	
	06/09/03	182	
	06/16/03	164	
	06/23/03	98	
	06/30/03	8	
	07/07/03	2	
	07/14/03	12	
	07/21/03	2	
	07/28/03	2	
	08/04/03	34	
	08/11/03	196	
	08/18/03	556	
	08/20/03	2	
	08/25/03	2	
North Cove:SWIM LANES	05/20/03	2	
	05/27/03	2	
	06/09/03	198	
	06/16/03	4	
	06/23/03	2	
	06/30/03	2	
	07/07/03	2	
	07/14/03	2	
	07/21/03	2	
	07/28/03	2	
	08/04/03	26	
	08/11/03	86	
	08/18/03	2	
	08/25/03	2	
KILROY PARK????:	05/20/03	2	
	05/27/03	2	
	06/09/03	2	
	06/16/03	2	
	06/23/03	2	
	06/30/03	2	
	07/07/03	2	
	07/14/03	2	
	07/21/03	2	
	07/28/03	2	
	08/04/03	2	
	08/11/03	2	

	08/18/03	2	
	08/25/03	2	
North Cove Lake	05/23/04	2000	
	05/24/04	318	
	05/28/04	900	
	06/01/04	187	
	06/07/04	60	
	06/09/04	88	
	06/14/04	288	
	06/16/04	196	
	06/21/04	146	
	06/28/04	50	
	07/06/04	42	
	07/12/04	212	
	07/14/04	284	
	07/16/04	73	
	07/19/04	206	
	07/21/04	6	
	07/22/04	8	
	07/26/04	10	
	08/02/04	20	
	08/09/04	16	
	08/16/04	90	
	08/23/04	22	
	08/30/04	14	
North Cove Swim Lanes	05/23/04	500	
	05/24/04	268	
	05/28/04	600	
	06/01/04	183	
	06/07/04	242	
	06/14/04	160	
	06/21/04	34	
	06/28/04	6	
	07/06/04	26	
Kilroy Park (Tom's Lake)	05/23/04	2	K
	05/24/04	1078	
	05/28/04	2	K
	06/01/04	2	K
	06/07/04	2	K
	06/14/04	2	K
	06/21/04	2	K
	06/28/04	2	K
	07/06/04	198	
	07/01/04	2	K
	07/19/04	184	
	07/26/04	130	
	08/02/04	196	
	08/09/04	2	K
	08/16/04	238	
	08/23/04	172	
	08/30/04	2	K

WMA 06

Camp Lewis			
count	84	mean+3stdev	599
median	10	%reduction	78%
max	930		
stdev	173	**no data excluded**	
mean	80		
mean+3stdev	599		

STATION	DATE	VALUE	REMARK
MOCL	05/30/98	80	
MOCL	06/06/98	10	K
MOCL	06/13/98	90	
MOCL	06/20/98	50	
MOCL	06/30/98	30	
MOCL	07/09/98	10	K
MOCL	07/16/98	10	K
MOCL	07/21/98	10	K
MOCL	07/29/98	10	K
MOCL	08/04/98	10	K
MOCL	08/12/98	500	
MOCL	08/19/98	100	
MOCL	08/26/98	40	
Beach	06/27/99	10	K
	07/09/99	10	K
	07/15/99	30	
	07/18/99	10	K
	07/30/99	10	K
	08/05/99	20	
	08/12/99	10	K
	08/19/99	10	K
	08/29/99	10	K
Camp Lewis	06/04/00	10	K
Camp Lewis	06/11/00	10	K
Camp Lewis	06/20/00	10	K
Camp Lewis	06/24/00	10	K
Camp Lewis	07/02/00	20	
Camp Lewis	07/08/00	10	K
Camp Lewis	07/21/00	10	K
Camp Lewis	07/30/00	930	
Camp Lewis	08/01/00	70	
Camp Lewis	08/12/00	510	
Camp Lewis	08/15/00	290	
Camp Lewis	08/17/00	70	
Camp Lewis	08/22/00	10	K
MOCL	06/19/01	650	
MOCL	06/22/01	20	K, resample
MOCL	06/25/01	350	
MOCL	07/03/01	10	K, resample
MOCL	07/16/01	10	
MOCL	07/23/01	10	
MOCL	08/01/01	10	
MOCL	08/08/01	10	
MOCL	08/15/01	70	K
MOCL	08/23/01	10	
	06/11/02	10	K
	06/17/02	120	
	06/24/02	10	K
	07/05/02	40	
	07/07/02	10	K
	07/19/02	10	K
	07/25/02	10	K
	07/30/02	10	K
	08/12/02	50	
Camp Lewis	05/29/03	10	k
	06/03/03	180	
	06/09/03	70	
	06/16/03	70	
	06/23/03	200	
	06/30/03	10	k
	07/08/03	10	k
	07/14/03	10	k
	07/21/03	10	k
	07/25/03	20	
	07/29/03	10	
	08/04/03	860	
	08/06/03	200	

	08/12/03	70	
	08/20/03	10	k
Camp Lewis	06/15/04	50	
	06/30/04	10	
	07/06/04	10	k
	07/21/04	140	
	07/26/04	10	k
	08/03/04	10	k
	08/10/04	10	
	08/18/04	10	
Camp Lewis	06/13/05	20	
	06/28/05	10	
	07/06/05	10	k
	07/11/05	10	
	07/19/05	10	
	08/01/05	20	
	08/15/05	240	resample

Cold Springs Pond			
count	104	mean+3stdev	421
median	20	%reduction	79%
max	960		
stdev	122	**no data excluded**	
mean	55		
mean+3stdev	421		

Station	**Date**	**Value**	**Remark**
	06/04/01	10	K
	06/20/01	10	
	06/28/01	20	
	07/11/01	10	
	07/16/01	10	K
	07/24/01	10	
	07/31/01	10	K
	08/07/01	10	K
	08/14/01	30	
	08/20/01	140	
	08/28/01	10	K
	06/04/01	20	
	06/20/01	10	
	06/28/01	10	K
	07/11/01	20	
	07/16/01	10	K

	07/24/01	10	K
	07/31/01	20	
	08/07/01	50	
	08/14/01	10	K
	08/20/01	960	
	08/22/01	400	Resample, closed
	08/25/01	70	Resample, reopened
	08/28/01	10	
	05/31/02	20	
	06/06/02	390	
	06/09/02	10	
	06/17/02	90	
	06/25/02	20	
	07/02/02	20	
	07/09/02	20	
	07/15/08	10	k
	07/18/02	10	k
	07/22/02	20	
	07/31/02	10	
	08/06/02	40	
	08/13/02	10	
	08/19/02	10	k
	08/29/02	10	
	05/28/02	480	
	05/31/02	40	
	06/09/02	10	k
	06/17/02	40	
	06/25/02	10	
	07/02/02	30	
	07/09/02	20	
	07/15/08	30	
	07/18/02	10	k
	07/22/02	10	k
	07/31/02	10	k
	08/06/02	70	
	08/13/02	30	
	08/19/02	10	k
	08/29/02	40	
Star Lake Camp, Conference Center, Left, Bloomingdale	05/29/03	40	
	06/09/03	10	K
	06/16/03	10	
	06/23/03	20	

	06/30/03	10	
	07/07/03	10	K
	07/14/03	10	
	07/21/03	10	
	07/28/03	20	
	08/04/03	30	
	08/07/03	330	
	08/11/03	170	Resample
	08/19/03	20	
	08/25/03	10	K
Star Lake Camp, Conference Center, Right, Bloomingdale	05/29/03	10	K
	06/09/03	20	
	06/16/03	20	
	06/23/03	70	
	06/30/03	10	K
	07/07/03	10	
	07/14/03	20	
	07/21/03	10	K
	07/28/03	40	
	08/04/03	40	
	08/07/03	180	
	08/11/03	310	
	08/19/03	20	
	08/25/03	60	
Star Lake Camp, Conference Center	06/02/04	80	
	06/02/04	90	
	06/17/04	60	
	06/17/04	80	
	06/23/04	10	k
	06/23/04	10	
	06/29/04	20	
	06/29/04	60	
	07/04/04	40	
	07/04/04	10	k
	07/20/04	10	
	07/20/04	10	k
	07/26/04	90	
	07/26/04	20	
	08/04/04	50	
	08/04/04	30	
	08/09/04	20	
	08/09/04	40	
	08/19/04	10	K

	08/19/04	10	k
	08/24/04	20	
	08/24/04	10	K

Cozy Lake			
count	124	mean+3stdev	2159
median	29	%reduction	97%
max	6000		
Stdev	648	**no data excluded**	
mean	215		
mean+3stdev	2159		

Station	**Date**	**Value**	**Remark**
Cozy Lakers, Inc.	06/05/98	320	
Cozy Lakers, Inc.	07/01/98	1	K
Cozy Lakers, Inc.	07/08/98	30	
Cozy Lakers, Inc.	07/15/98	2	K
Cozy Lakers, Inc.	07/22/98	180	
Cozy Lakers, Inc.	07/28/98	1	K
Cozy Lakers, Inc.	08/05/98	1	K
Cozy Lakers, Inc.	08/13/98	1	K
Cozy Lakers, Inc.	08/18/98	1	K
Cozy Lakers, Inc.	08/26/98	2200	
Cozy Lakers, Inc.	08/31/98	1	K
Cozy Lakers, Inc.	09/02/98	1	K
Cozy Lakers, Inc.-Beach	07/25/98	150	
Cozy Lakers, Inc.-Burkhart	06/12/98	82	
Cozy Lakers, Inc.-Center	06/12/98	1	K
Cozy Lakers, Inc.-Cozy Beach	06/12/98	1	K
Cozy Lakers, Inc.-Cozy Dam.	06/12/98	6000	K
Cozy Lakers, Inc.-East Birch	07/25/98	1300	
Cozy Lakers, Inc.-East Birch	07/25/98	900	
Cozy Lakers, Inc.-East Birth	06/12/98	2200	K
Cozy Lakers, Inc.-Hamlet	06/12/98	1	K
Cozy Lakers, Inc.-Horseshoe	06/12/98	309	
Cozy Lakers, Inc.-NYODA	07/25/98	265	
Cozy Lakers, Inc.-	06/12/98	254	
NYODA Falls			
Cozy Lakers, Inc-48 Horseshoe.	06/12/98	1	K
Cozy Lakers, Inc-Grove.	06/12/98	1	K
Cozy Lakers	06/01/99	2	K
	06/07/99	75	
	06/14/99	120	
	06/21/99	60	
	06/28/99	95	
	07/06/99	30	
	07/12/99	10	
	07/19/99	20	
	07/26/99	2	K
	08/02/99	1600	L
	08/09/99	1200	L
	08/05/99	390	
	08/11/99	280	
	08/12/99	20	
	08/16/99	570	
	08/19/99	240	
	08/23/99	1200	L
	08/25/99	1200	L
	08/30/99	650	
	09/01/99	425	
	09/07/99	2	K
Cozy Lake Association	05/23/00	10	K
Cozy Lake Association	06/21/00	150	
Cozy Lake Association	06/24/00	150	
Cozy Lake Association	07/02/00	10	
Cozy Lake Association	07/08/00	10	K
Cozy Lake Association	07/21/00	10	K
Cozy Lake Association	07/30/00	120	
Cozy Lake Association	08/12/00	40	
Cozy Lake Association	08/16/00	40	
Cozy Lake Association	08/22/00	10	K
	05/29/01	30	
	06/01/01	34	
	06/04/01	10	k
	06/06/01	44	
	06/10/01	10	k
	06/14/01	2	k
	06/19/01	10	
	06/20/01	138	
	06/27/01	82	
	07/05/01	26	
	07/11/01	2	k
	07/19/01	2	k
	07/26/01	30	
	08/01/01	16	
	08/09/01	18	
	08/13/01	18	
	08/16/01	8	
	08/22/01	6	
	08/29/01	4	
	09/05/01	2	k
	05/23/02	104	
	05/30/02	12	
	06/06/02	196	
	06/12/02	58	
	06/19/02	20	
	06/27/02	28	
	07/03/02	42	
	07/10/02	50	
	07/17/02	8	
	07/25/02	20	
	07/31/02	2	
	08/07/02	14	
	08/14/02	84	
	08/21/02	2	
	08/28/02	6	
Cozy Lakers	05/19/03	2	k
	05/27/03	22	
	06/02/03	366	
	06/06/03	96	
	06/09/03	174	
	06/16/03	160	
	06/24/03	98	
	06/30/03	66	
	07/07/03	84	
	07/14/03	338	
	07/15/03	224	
	07/17/03	8	
	07/21/03	62	
	07/28/03	138	
	08/04/03	138	
	08/11/03	106	
	08/19/03	4	
	08/25/03	198	
Cozy Lakers	05/25/04	2	
	06/04/04	2	k

	06/10/04	22	
	06/17/04	30	
	06/21/04	158	
	06/30/04	12	
	07/15/04	4	
	07/21/04	36	
	07/28/04	14	
	08/04/04	2	k
	08/10/04	2	k
	08/19/04	14	
	08/24/04	16	
	08/31/04	2	k

Foxs Pond			
count	205	mean+3stdev	3402
median	110	%reduction	98%
max	8200		
stdev	981	**no data excluded**	
mean	410		
mean+3stdev	3353		

STATION	**Date**	**Value**	**Remark**
MOL 1	06/09/99	210	
MOL 1	06/16/99	20	
MOL 1	06/23/99	70	
MOL 1	06/30/99	180	
MOL 1	07/07/99	160	
MOL 1	07/14/99	30	
MOL 1	07/21/99	100	
MOL 1	07/28/99	60	
MOL 1	08/04/99	110	
MOL 1	08/11/99	10	
MOL 1	08/18/99	890	
MOL 1	08/25/99	210	
MOL 1	06/07/00	320	
MOL 1	06/14/00	150	
MOL 1	06/21/00	20	
MOL 1	06/28/00	410	
MOL 1	06/30/00	50	
MOL 1	07/05/00	20	
MOL 1	07/12/00	10	K
MOL 1	07/19/00	110	
MOL 1	07/26/00	10	K

MOL 1	08/02/00	360	
MOL 1	08/04/00	410	
MOL 1	08/07/00	260	
MOL 1	08/09/00	180	
MOL 1	08/16/00	1,100	
MOL 1	08/18/00	160	
MOL 1	05/30/01	310	resample
MOL 1	06/06/01	50	
MOL 1	06/13/01	10	K
MOL 1	06/27/01	110	
MOL 1	07/03/01	50	
MOL 1	07/11/01	2400	resample
MOL 1	07/13/01	10	
MOL 1	07/17/01	110	
MOL 1	07/24/01	10	K
MOL 1	07/30/01	290	resample
MOL 1	08/01/01	140	
MOL 1	08/07/01	480	resample
MOL 1	08/09/01	120	
MOL 1	08/14/01	2,300	resample
MOL 1	08/17/01	4000	closed,resample
MOL 1	08/28/01	40	
MOL 2	06/09/99	40	
MOL 2	06/16/99	10	
MOL 2	06/23/99	10	
MOL 2	06/30/99	100	
MOL 2	07/07/99	10	
MOL 2	07/14/99	10	
MOL 2	07/21/99	10	
MOL 2	07/28/99	380	
MOL 2	08/04/99	10	
MOL 2	08/11/99	10	
MOL 2	08/18/99	10	
MOL 2	08/25/99	280	
MOL 2	06/14/00	200	
MOL 2	06/21/00	10	K
MOL 2	06/28/00	480	
MOL 2	06/30/00	40	
MOL 2	07/05/00	10	K
MOL 2	07/12/00	10	K
MOL 2	07/19/00	70	
MOL 2	07/26/00	10	
MOL 2	08/02/00	260	
MOL 2	08/04/00	140	
MOL 2	08/07/00	90	

MOL 2	08/09/00	30	
MOL 2	08/16/00	570	
MOL 2	08/18/00	50	
MOL 2	06/06/01	40	
MOL 2	06/27/01	10	
MOL 2	07/03/01	60	
MOL 2	07/11/01	140	
MOL 2	07/17/01	350	resample
MOL 2	07/19/01	20	
MOL 2	07/24/01	10	K
MOL 2	07/30/01	10	K
MOL 2	08/07/01	30	
MOL 2	08/14/01	50	
MOL 3	06/09/99	70	
MOL 3	06/16/99	210	
MOL 3	06/23/99	460	
MOL 3	06/30/99	860	
MOL 3	07/07/99	270	
MOL 3	07/14/99	190	
MOL 3	07/21/99	8,200	
MOL 3	07/28/99	10	
MOL 3	08/04/99	550	
MOL 3	08/11/99	170	
MOL 3	08/18/99	150	
MOL 3	08/25/99	140	
MOL 3	06/07/00	1,200	
MOL 3	06/14/00	200	
MOL 3	06/21/00	140	
MOL 3	06/28/00	1,500	
MOL 3	07/05/00	550	
MOL 3	07/12/00	200	
MOL 3	07/19/00	100	
MOL 3	07/26/00	5,280	
MOL 3	08/02/00	200	
MOL 3	08/09/00	4,700	
MOL 3	08/16/00	440	
MOL 3	05/30/01	60	
MOL 3	06/13/01	60	
MOL 3	06/27/01	170	
MOL 3	07/03/01	210	
MOL 3	07/11/01	30	
MOL 3	07/13/01	120	
MOL 3	07/17/01	4200	
MOL 3	07/24/01	50	
MOL 3	07/30/01	170	

MOL 3	08/07/01	380	
MOL 3	08/14/01	190	
MOL 3	08/28/01	170	
Inlet	05/14/03	230	inlet is located in Rockaway Township
	05/19/03	60	
	05/27/03	350	
	06/02/03	290	
	06/16/03	310	
	06/23/03	530	
	06/30/03	2,200	
	07/07/03	220	
	07/14/03	220	
	07/21/03	130	
	07/28/03	1,500	
	08/04/03	420	
	08/11/03	280	
	08/18/03	510	
Beach	05/14/03	50	
	05/19/03	10	K
	05/27/03	340	Not open for season
	06/02/03	3,300	Not open for season
	06/16/03	210	Not open for season
	06/23/03	1,200	Opening Week
	06/25/03	60	Resample
	06/30/03	30	
	07/07/03	10	K
	07/14/03	10	
	07/21/03	30	
	07/28/03	100	
	08/04/03	1,600	
	08/06/03	830	Resample; **Closed**
	08/08/03	600	Resample; **Closed**
	08/11/03	10	Resample; **Opened**
	08/18/03	10	K; Closed for season
Lanes	05/19/03	10	K
	05/27/03	340	Not open for season
	06/02/03	4,000	Not open for season
	06/16/03	190	
	06/23/03	2,100	Opening Week
	06/25/03	60	
	06/30/03	10	K
	07/07/03	10	K
	07/14/03	10	K
	07/21/03	10	

	07/28/03	40	
	08/04/03	350	
	08/06/03	960	Resample; **Closed**
	08/08/03	110	Resample; **Opened**
	08/11/03	10	
	08/18/03	20	Closed for season
	05/25/04	10	K
	05/25/04	140	
	06/02/04	20	
	06/02/04	10	
	06/02/04	160	
	06/07/04	340	
	06/07/04	20	
	06/07/04	20	
	06/14/04	10	
	06/14/04	10	K
	06/14/04	10	
	06/21/04	160	
	06/21/04	10	
	06/21/04	10	K
	06/28/04	10	
	06/28/04	30	
	06/28/04	20	
	07/06/04	50	
	07/06/04	40	
	07/06/04	10	K
	07/12/04	2700	
	07/12/04	10	K
	07/12/04	10	K
	07/19/04	40	
	07/19/04	90	
	07/19/04	10	K
	07/26/04	10	
	07/26/04	30	
	07/26/04	20	
	08/02/04	130	
	08/02/04	10	K
	08/02/04	10	
	08/09/04	10	K
	08/09/04	10	K
	08/09/04	30	
	08/17/04	1100	
	08/17/04	1300	
	08/17/04	1200	
	08/19/04	40	resample

	08/19/04	200	resample
	08/19/04	40	resample
	08/23/04	150	facility closed for the season
	08/23/04	300	
	08/23/04	340	

Indian Lake			
count	273	mean+3stdev	1390
median	30	%reduction	95%
max	4100		
stdev	420	**no data excluded**	
mean	130		
mean+3stdev	1390		

STATION	**DATE**	**VALUE**	**REMARK**
INDIAN/CLUB	07/06/98	20	
INDIAN/CLUBHOUSE	06/22/98	100	
INDIAN/CLUBHOUSE	06/22/98	100	
INDIAN/CLUBHOUSE	06/29/98	350	
INDIAN/CLUBHOUSE	07/13/98	30	
INDIAN/CLUBHOUSE	07/20/98	52	
INDIAN/CLUBHOUSE	07/27/98	110	
INDIAN/CLUBHOUSE	08/17/98	40	
INDIAN/CLUBHOUSE	08/24/98	100	
INDIAN/FRANKLIN	06/22/98	40	
INDIAN/FRANKLIN	06/22/98	40	
INDIAN/FRANKLIN	06/29/98	10	
INDIAN/FRANKLIN	07/13/98	10	
INDIAN/FRANKLIN	07/20/98	8	
INDIAN/FRANKLIN	07/27/98	20	
INDIAN/FRANKLIN	08/17/98	80	
INDIAN/FRANKLIN	08/24/98	90	
INDIAN/MAIN	06/22/98	10	
INDIAN/MAIN	06/22/98	10	
INDIAN/MAIN	06/29/98	10	
INDIAN/MAIN	07/06/98	10	
INDIAN/MAIN	07/13/98	10	
INDIAN/MAIN	07/20/98	10	
INDIAN/MAIN	07/27/98	10	K
INDIAN/MAIN	08/17/98	20	
INDIAN/MAIN	08/24/98	40	
INDIAN/EAST	06/22/99	10	K

INDIAN/EAST	07/05/99	90	
INDIAN/CLUB	06/24/99	80	
INDIAN/CLUB	06/22/99	860	
INDIAN/CLUB	06/25/99	80	
INDIAN/CLUB	07/08/99	190	
INDIAN/CLUB	07/16/99	10	
INDIAN/CLUB	07/21/99	90	
INDIAN/CLUB	07/29/99	130	
INDIAN/CLUB	08/04/99	10	K
INDIAN/CLUB	08/13/99	170	
INDIAN/CLUB	08/19/99	320	
INDIAN/CLUB	08/23/99	620	
INDIAN/CLUB	08/27/99	560	
INDIAN/CLUB	09/01/99	230	
INDIAN/FRANKLIN	06/24/99	20	
INDIAN/FRANKLIN	06/22/99	220	
INDIAN/FRANKLIN	06/25/99	20	
INDIAN/FRANKLIN	07/05/99	50	
INDIAN/FRANKLIN	07/08/99	40	
INDIAN/FRANKLIN	07/16/99	10	
INDIAN/FRANKLIN	07/21/99	10	
INDIAN/FRANKLIN	07/29/99	10	
INDIAN/FRANKLIN	08/04/99	10	K
INDIAN/FRANKLIN		10	K
INDIAN/FRANKLIN	08/19/99	10	K
INDIAN/FRANKLIN	08/27/99	50	
INDIAN/MAIN	07/05/99	10	
INDIAN/MAIN	07/08/99	40	
INDIAN/MAIN	07/16/99	10	
INDIAN/MAIN	07/21/99	10	K
INDIAN/MAIN	07/29/99	10	K
INDIAN/MAIN	08/04/99	10	K
INDIAN/MAIN	08/13/99	10	K
INDIAN/MAIN	08/19/99	10	K
INDIAN/MAIN	08/27/99	10	K
INDIAN/MAIN	09/01/99	10	K
INDIAN/CLUB	05/28/00	10	K
INDIAN/CLUB	06/03/00	50	
INDIAN/CLUB	06/10/00	90	
INDIAN/CLUB	06/20/00	10	
INDIAN/CLUB	06/24/00	40	
INDIAN/CLUB	07/06/00	10	
INDIAN/CLUB	07/11/00	20	
INDIAN/CLUB	07/17/00	100	
INDIAN/CLUB	07/28/00	40	

INDIAN/CLUB	08/04/00	30	
INDIAN/CLUB	08/08/00	40	
INDIAN/CLUB	08/08/00	40	
INDIAN/CLUB	08/15/00	350	
INDIAN/CLUB	08/23/00	2000	
INDIAN/CLUB	08/26/00	280	
INDIAN/CLUB	08/30/00	30	
INDIAN/CLUB	08/31/00	140	
INDIAN/FRANKLIN	05/28/00	10	K
INDIAN/FRANKLIN	06/20/00	4100	
INDIAN/FRANKLIN	06/24/00	40	
INDIAN/FRANKLIN	07/06/00	10	K
INDIAN/FRANKLIN	07/11/00	10	K
INDIAN/FRANKLIN	07/17/00	10	
INDIAN/FRANKLIN	07/28/00	60	
INDIAN/FRANKLIN	08/04/00	150	
INDIAN/FRANKLIN	08/08/00	10	
INDIAN/FRANKLIN	08/08/00	10	
INDIAN/FRANKLIN	08/15/00	270	
INDIAN/FRANKLIN	08/23/00	10	K
INDIAN/FRANKLIN	08/31/00	20	
INDIAN/MAIN	05/28/00	40	
INDIAN/MAIN	06/20/00	470	
INDIAN/MAIN	06/24/00	10	K
INDIAN/MAIN	07/06/00	10	
INDIAN/MAIN	07/11/00	60	
INDIAN/MAIN	07/17/00	10	K
INDIAN/MAIN	07/28/00	20	
INDIAN/MAIN	08/04/00	20	
INDIAN/MAIN	08/08/00	10	K
INDIAN/MAIN	08/08/00	10	
INDIAN/MAIN	08/15/00	40	
INDIAN/MAIN	08/23/00	10	K
INDIAN/MAIN	08/31/00	10	
Club	06/13/01	50	
Club	06/19/01	200	
Club	07/12/01	220	
Club	07/16/01	80	
Club	07/23/01	60	
Club	08/01/01	80	
Club	08/08/01	430	
Club	08/13/01	380	
Club	08/23/01	170	
Franklin	07/12/01	130	
Franklin	07/16/01	30	

Franklin	07/23/01	20	
Franklin	08/01/01	40	
Franklin	08/08/01	40	
Franklin	08/13/01	70	
Main	07/12/01	90	
Main	07/16/01	20	
Main	07/23/01	10	k
Main	08/01/01	10	
Main	08/08/01	20	
Main	08/13/01	20	
EAST	06/04/02	180	
EAST	08/13/02	310	
EAST	08/19/02	40	
CLUB	06/04/02	20	
CLUB	06/10/02	10	
CLUB	06/17/02	1100	
CLUB	07/05/02	100	
CLUB	07/10/02	80	
CLUB	07/15/02	160	
CLUB	07/24/02	70	
CLUB	08/01/02	40	
CLUB	08/08/02	260	
CLUB	08/28/02	30	
FRANKLIN	06/04/02	10	
FRANKLIN	06/17/02	140	
FRANKLIN	07/05/02	220	
FRANKLIN	07/10/02	30	
FRANKLIN	07/15/02	10	
FRANKLIN	07/24/02	20	
FRANKLIN	08/01/02	40	
FRANKLIN	08/08/02	370	
FRANKLIN	08/13/02	180	
FRANKLIN	08/19/02	10	
FRANKLIN	08/28/02	40	
MAIN	07/05/02	130	
MAIN	07/10/02	10	
MAIN	07/15/02	10	k
MAIN	07/24/02	10	k
MAIN	08/01/02	60	
MAIN	08/08/02	30	
MAIN	08/13/02	10	k
MAIN	08/19/02	10	k
MAIN	08/28/02	10	
Indian East	06/30/03	20	
	07/07/03	20	

	07/15/03	500	
	07/21/03	30	
	07/21/03	40	
	07/28/03	20	
	08/05/03	690	
	08/08/03	80	
	08/11/03	320	
	08/15/03	480	
	08/19/03	50	
	08/29/03	140	
Indian Club	05/23/03	10	
	06/09/03	40	
	06/30/03	90	
Indian Franklin	05/23/03	50	
	06/20/03	10	k
	06/24/03	40	
	06/30/03	10	
	07/07/03	20	
	07/15/03	210	
	07/21/03	10	
	07/17/03	3600	
	07/28/03	30	
	08/05/03	10	k
	08/11/03	30	
	08/19/03	20	
	08/29/03	140	
Indian Main	05/23/03	60	
	06/30/03	10	
	06/30/03	10	k
	07/07/03	40	
	07/15/03	10	k
	07/17/03	30	
	07/21/03	30	
	08/11/03	10	
	08/05/03	20	
	08/23/03	10	k
INDIAN/CLUB	06/08/04	110	
	06/29/04	300	
	06/22/04	650	
	06/24/04	170	
	07/05/04	20	
	07/16/04	190	
	07/20/04	40	
	07/27/04	10	k
	08/02/04	30	

	08/25/04	190	
	08/09/04	10	k
	08/19/04	30	
	06/03/04	40	
	07/01/04	80	
INDIAN/FRANKLIN	06/08/04	10	k
	06/03/04	70	
	07/01/04	50	
	06/29/04	40	
	06/24/04	40	
	07/16/04	30	
	07/20/04	10	k
	07/27/04	10	
	08/02/04	40	
	08/25/04	10	
	08/09/04	10	
INDIAN/MAIN	06/08/04	100	
	06/03/04	10	k
	07/01/04	160	
	06/29/04	3400	
	06/24/04	50	
	07/20/04	10	k
	07/27/04	20	
	08/02/04	30	
	08/25/04	140	
	08/09/04	10	k
	08/19/04	10	k
INDIAN/CLUB	05/31/05	10	k
	06/07/05	40	
	06/14/05	50	
	06/21/05	230	
	06/27/05	50	
	07/05/05	40	
	07/12/05	10	
	07/19/05	40	
	07/25/05	20	
	07/25/05	20	
	07/27/05	20	
	08/01/05	30	
	08/08/05	10	
	08/17/05	40	
	08/23/05	10	k
	08/30/05	340	
INDIAN/FRANKLIN	06/23/05	30	k
	06/27/05	40	

	07/12/05	70	
	07/19/05	40	
	07/25/05	40	
	07/27/05	10	
	08/01/05	10	k
	08/08/05	20	
INDIAN/MAIN	05/31/05	10	
	06/21/05	10	
	06/23/05	50	
	06/27/05	30	
	07/05/05	20	
	07/12/05	120	
	07/19/05	50	
	07/25/05	550	
	07/27/05	10	
	08/01/05	10	k
	08/08/05	10	k
	08/17/05	10	k
	08/23/05	10	k
	08/30/05	310	
INDIAN EAST	06/07/05	20	

Interval Lake			
count	100	mean+3stdev	2194
median	50	%reduction	96%
max	5200		
stdev	661	**no data excluded**	
mean	210		
mean+3stdev	2194		

Station	**Date**	**Value**	**Remark**
MOLI	06/11/98	1200	L
MOLI	06/17/98	5200	
MOLI	06/22/98	3700	
MOLI	06/24/98	170	
MOLI	06/30/98	2	K
MOLI	07/07/98	10	K
MOLI	07/15/98	2	K
MOLI	07/22/98	10	K
MOLI	07/28/98	10	K
MOLI	08/04/98	10	K
MOLI	08/13/98	10	K
MOLI	08/19/98	10	K

MOLI	08/26/98	10	K
IL	06/03/99	60	
IL	06/09/99	2	K
IL	06/16/99	270	
IL	06/21/99	20	
IL	06/24/99	340	
IL	06/28/99	125	
IL	07/21/99	2	L
IL	07/28/99	100	
IL	08/05/99	1600	L
IL	08/09/99	2	K
IL	08/12/99	500	
IL	08/17/99	2	K
IL	08/18/99	2	K
IL	08/25/99	2	K
IL	09/01/99	2	K
IL	09/09/99	500	
Lake Intervale	06/19/00	16	
Lake Intervale	07/05/00	8	
Lake Intervale	07/10/00	28	
Lake Intervale	07/17/00	232	
Lake Intervale	07/19/00	216	
Lake Intervale	07/24/00	8	
Lake Intervale	07/31/00	2	K
Lake Intervale	08/08/00	16	
Lake Intervale	08/14/00	272	
Lake Intervale	08/16/00	8	
Lake Intervale	08/21/00	20	
	05/29/01	76	
	06/04/01	120	
	06/11/01	190	
	06/18/01	960	
	06/20/01	250	
	06/25/01	148	
	07/02/01	150	
	07/09/01	32	
	07/16/01	2	
	07/24/01	2	k
	07/30/01	12	
	08/06/01	14	
	08/14/01	56	
	08/20/01	4	
	08/27/01	10	
	09/05/01	692	
Lake Intervale	05/31/02	58	

	06/06/02	68	
	06/12/02	132	
	06/19/02	102	
	06/25/02	92	
	07/03/02	18	
	07/10/02	64	
	07/17/02	20	
	07/24/02	50	
	07/31/02	24	
	08/07/02	18	
	08/14/02	6	
	08/21/02	32	
	08/28/02	14	
Lake Intervale	05/19/03	100	
	01/00/00	242	
	05/29/03	120	
	06/09/03	96	
	06/16/03	100	
	06/24/03	152	
	06/30/03	14	
	07/07/03	208	
	07/09/03	2	
	07/14/03	8	
	07/21/03	108	
	07/28/03	56	
	08/04/03	148	
	08/11/03	248	
	08/13/03	72	
	08/18/03	6	
	08/25/03	114	
Lake Intervale	06/04/04	44	
	06/10/04	112	
	06/17/04	36	
	06/22/04	41	
	06/30/04	10	
	07/15/04	2	k
	07/21/04	236	
	07/23/04	148	
	07/28/04	192	
	08/04/04	2	
	08/10/04	52	
	08/19/04	154	
	08/24/04	50	

Lake Swannanoa			
count	86	mean+3stdev	1209
median	40	%reduction	92%
max	2400		
Stdev	352	**no data excluded**	
mean	155		
mean+3stdev	1209		

Station	**Date**	**Value**	**Remark**
Lake Swannanoa Country Club	06/16/98	190	
Lake Swannanoa Country Club	06/23/98	31	
Lake Swannanoa Country Club	06/30/98	32	
Lake Swannanoa Country Club	07/07/98	1	
Lake Swannanoa Country Club	07/15/98	274	
Lake Swannanoa Country Club	07/17/98	62	
Lake Swannanoa Country Club	07/20/98	234	
Lake Swannanoa Country Club	07/22/98	254	
Lake Swannanoa Country Club	08/04/98	13	
Lake Swannanoa Country Club	08/10/98	28	
Lake Swannanoa Country Club	08/17/98	600	
Lake Swannanoa Country Club	08/19/98	1	K
Lake Swannanoa Country Club	08/26/98	261	
Lake Swannanoa Country Club	08/28/98	530	
Lake Swannanoa Country Club	09/01/98	410	
Lake Swannanoa Country Club	09/02/98	34	
Lake Swannanoa CC	06/18/99	26	
	06/22/99	2	
	06/29/99	12	
	07/08/99	7	
	07/13/99	10	
	07/20/99	16	

	07/26/99	18	
	08/04/99	46	
	08/11/99	1	K
	08/17/99	10	
	08/24/99	2	
	08/30/99	14	
Lake Swannanoa Country Club	06/16/00	36	
Lake Swannanoa Country Club	06/21/00	102	
Lake Swannanoa Country Club	06/27/00	6	
Lake Swannanoa Country Club	07/06/00	36	
Lake Swannanoa Country Club	07/10/00	4	
Lake Swannanoa Country Club	07/19/00	16	
Lake Swannanoa Country Club	07/24/00	240	
Lake Swannanoa Country Club	07/27/00	2	K
Lake Swannanoa Country Club	08/02/00	222	
Lake Swannanoa Country Club	08/09/00	64	
Lake Swannanoa Country Club	08/16/00	24	
Lake Swannanoa Country Club	08/22/00	168	
Lake Swannanoa Country Club	08/28/00	128	
	06/19/01	30	
	06/25/01	50	
	07/03/01	10	
	07/16/01	20	
	07/23/01	10	k
	08/01/01	160	
	08/08/01	2400	
	08/10/01	50	
	08/15/01	100	
	08/23/01	140	
	05/31/02	130	
	06/06/02	50	
	06/11/02	130	
	06/17/02	840	
	06/24/02	1700	
	06/26/02	350	

	07/05/02	20	
	07/07/02	10	k
	07/19/02	200	
	07/25/02	30	
	07/30/02	10	k
	08/12/02	10	k
	08/19/02	30	
Lake Swannanoa	06/09/03	140	
	06/23/03	360	
	06/26/03	60	
	06/30/03	60	
	07/08/03	40	
	07/14/03	30	
	07/21/03	90	
	07/29/03	40	
	08/04/03	40	
	08/20/03	40	
	08/25/03	10	k
Lake Swannanoa	06/07/04	40	
	06/15/04	40	
	06/24/04	50	
	06/30/04	40	
	07/15/04	60	
	07/21/04	80	
	07/26/04	10	k
	08/03/04	10	
	08/10/04	120	
	08/24/04	1200	
	08/28/04	80	

Mountain Lake			
count	130	mean+3stdev	1910
median	60	%reduction	96%
max	4600		
stdev	562	**no data excluded**	
mean	225		
mean+3stdev	1910		

Station	**Date**	**Value**	**Remark**
MOL02	06/02/98	20	K
MOL02	06/16/98	820	
MOL02	06/18/98	400	
MOL02	06/19/98	40	
MOL02	06/23/98	10	K
MOL02	06/29/98	10	K
MOL02	07/06/98	890	
MOL02	07/13/98	160	
MOL02	07/20/98	64	
MOL02	07/27/98	20	
MOL02	08/04/98	950	
MOL02	08/07/98	10	
MOL02	08/10/98	104	
MOL02	08/25/98	10	
MOL02	09/01/98	70	
Beach	06/01/99	10	k
	06/07/99	20	
	06/14/99	240	resample
	06/17/99	50	
	06/21/99	10	
	06/28/99	30	
	07/06/99	10	K
	07/12/99	10	K
	07/19/99	60	
	07/26/99	220	
	07/28/99	70	resample
	08/04/99	10	K
	08/09/99	10	K
	08/16/99	20	
	08/23/99	10	K
	08/30/99	70	
	09/06/99	50	
Mountain Lake	05/25/00	10	K
Mountain Lake	05/30/00	10	K
Mountain Lake	06/05/00	10	
Mountain Lake	06/12/00	120	
Mountain Lake	06/19/00	110	
Mountain Lake	06/26/00	10	
Mountain Lake	07/05/00	3800	
Mountain Lake	07/06/00	30	
Mountain Lake	07/10/00	40	
Mountain Lake	07/17/00	40	
Mountain Lake	07/24/00	10	K
Mountain Lake	07/26/00	40	
Mountain Lake	07/31/00	100	
Mountain Lake	08/07/00	290	
	05/21/01	20	
	05/29/01	10	k
	06/04/01	10	k

	06/11/01	80	
	06/18/01	10	
	06/25/01	10	k
	07/02/01	140	
	07/09/01	140	
	07/16/01	450	
	07/18/01	10	k, Resample
	07/23/01	10	k
	07/30/01	460	
	08/01/01	20	Resample
	08/06/01	10	
	08/13/01	40	
	08/20/01	670	
	08/22/01	20	
	08/27/01	210	
	08/30/01	430	Resample
	09/04/01	400	Resample
	09/06/01	10	k, Resample
	05/20/02	4	
	05/28/02	4	
	06/03/02	10	
	06/10/02	236	
	06/12/02	26	Resample
	06/17/02	74	
	06/25/02	106	
	07/01/02	98	
	07/08/02	90	
	07/15/02	101	
	07/22/02	80	
	07/29/02	170	
	08/05/02	700	
	08/07/02	72	Resample
	08/12/02	4600	
	08/14/02	2	k, Resample
	08/22/02	48	Resample
	08/26/02	380	
	08/28/02	686	Resample
	08/29/02	336	Resample
	09/03/02	484	Resample
	09/05/02	1002	Resample
Mountain	05/19/03	16	
	05/27/03	248	
	05/29/03	78	
	06/02/03	232	
	06/04/03	26	
	06/09/03	162	
	06/16/03	12	
	06/23/03	152	
	06/30/03	212	
	07/02/03	84	
	07/07/03	132	
	07/14/03	8	
	07/21/03	210	
	07/22/03	1488	
	07/28/03	112	
	08/03/03	1050	
	08/06/03	500	
	08/07/03	114	
	08/11/03	52	
	08/18/03	42	
	08/25/03	284	
	08/27/03	104	
Mountain	04/12/04	2	k
	05/24/04	6	
	06/04/04	24	
	06/07/04	40	
	06/14/04	10	
	06/21/04	16	
	06/28/04	46	
	07/06/04	18	
	07/12/04	22	
	07/19/04	52	
	07/26/04	10	
	08/02/04	560	
	08/04/04	22	resample
	08/10/04	140	
	08/17/04	516	
	08/18/04	568	resample/closed
	08/19/04	60	resample/opened
	08/24/04	98	
	08/31/04	110	

Parsippany Lake			
count	227	mean+3stdev	2014
median	30	%reduction	97%
max	7400		
stdev	618	**no data excluded**	
mean	159		

mean+3stdev	2014		

Station	**Date**	**Value**	**Remark**
MOLP-DL	05/24/98	10	K
MOLP-DL	05/31/98	20	
MOLP-DL	06/09/98	10	K
MOLP-DL	07/01/98	20	
MOLP-DL	07/07/98	60	
MOLP-DL	07/14/98	40	
MOLP-DL	07/22/98	20	
MOLP-DL	07/28/98	70	
MOLP-DL	08/05/98	10	K
MOLP-DL	08/10/98	10	K
MOLP-DL	08/20/98	30	
MOLP-HL	06/09/98	10	K
MOLP-HL	05/31/98	120	
MOLP-HL	06/09/98	20	
MOLP-HL	07/01/98	50	
MOLP-HL	07/07/98	10	K
MOLP-HL	07/14/98	10	K
MOLP-HL	07/22/98	10	
MOLP-HL	07/28/98	10	K
MOLP-HL	08/05/98	10	K
MOLP-HL	08/10/98	10	K
MOLP-HL	08/20/98	10	K
MOLP-JL	05/24/98	20	
MOLP-JL	05/24/98	30	
MOLP-JL	05/31/98	20	
MOLP-JL	07/01/98	150	
MOLP-JL	07/07/98	20	
MOLP-JL	07/14/98	110	
MOLP-JL	07/22/98	60	
MOLP-JL	07/28/98	10	K
MOLP-JL	08/05/98	10	K
MOLP-JL	08/10/98	10	K
MOLP-JL	08/20/98	10	K
DL	06/03/99	40	
DL	06/22/99	600	
DL	06/24/99	50	
DL	06/30/99	10	
DL	07/08/99	110	
DL	07/12/99	10	
DL	07/21/99	10	K
DL	07/29/99	10	K

DL	08/06/99	10	K
DL	08/13/99	30	
DL	08/19/99	10	K
DL	08/27/99	50	
HL	06/03/99	40	
HL	06/22/99	30	
HL	06/30/99	60	
HL	07/08/99	360	
HL	07/12/99	30	
HL	07/21/99	70	
HL	07/29/99	10	K
HL	08/06/99	40	
HL	08/13/99	20	
HL	08/19/99	30	
HL	08/27/99	20	
JL	06/03/99	150	
JL	06/22/99	50	
JL	07/08/99	220	
JL	08/06/99	30	
JL	08/13/99	10	K
JL	08/19/99	10	K
JL	08/27/99	120	
Johnson Beach At Lake Parsippany	07/10/00	10	K
Johnson Beach At Lake Parsippany	07/29/00	70	
Johnson Beach At Lake Parsippany	08/08/00	10	
Johnson Beach At Lake Parsippany	08/15/00	4100	
Johnson Beach At Lake Parsippany	08/25/00	10	K
Hoffman Beach At Lake Parsippany	05/29/00	10	
Hoffman Beach At Lake Parsippany	07/06/00	270	
Hoffman Beach At Lake Parsippany	07/10/00	10	K
Hoffman Beach At Lake Parsippany	07/11/00	40	
Hoffman Beach At Lake Parsippany	07/17/00	10	K
Hoffman Beach At Lake Parsippany	07/29/00	310	
Hoffman Beach At Lake Parsippany	08/02/00	120	
Hoffman Beach At Lake Parsippany	08/08/00	370	

Hoffman Beach At Lake Parsippany	08/10/00	10	
Hoffman Beach At Lake Parsippany	08/15/00	60	
Hoffman Beach At Lake Parsippany	08/25/00	10	
Drewes Beach At Lake Parsippany	05/29/00	20	
Drewes Beach At Lake Parsippany	07/06/00	70	
Drewes Beach At Lake Parsippany	07/11/00	10	K
Drewes Beach At Lake Parsippany	07/17/00	10	
Drewes Beach At Lake Parsippany	07/29/00	2700	
Drewes Beach At Lake Parsippany	08/02/00	910	
Drewes Beach At Lake Parsippany	08/08/00	40	
Drewes Beach At Lake Parsippany	08/15/00	560	
Drewes Beach At Lake Parsippany	08/25/00	30	
Lake Drewes	05/23/01	190	
Lake Drewes	05/28/01	10	k
Lake Drewes	06/05/01	180	
Hoffman Lake	05/23/01	1000	
Hoffman Lake	05/28/01	20	
Hoffman Lake	06/05/01	30	
Hoffman Lake	06/09/01	10	
Hoffman Lake	06/19/01	50	
Hoffman Lake	06/21/01	30	
Hoffman Lake	06/28/01	40	
Hoffman Lake	07/06/01	10	
Hoffman Lake	07/12/01	190	
Hoffman Lake	07/18/01	20	
Hoffman Lake	07/24/01	20	
Hoffman Lake	07/31/01	10	
Hoffman Lake	08/07/01	130	
Hoffman Lake	08/14/01	230	
Hoffman Lake	08/21/01	1400	
Hoffman Lake	08/27/01	40	
Johnson Lake	05/23/01	140	
Johnson Lake	05/28/01	100	
Johnson Lake	06/05/01	40	
Johnson Lake	06/09/01	10	
Johnson Lake	06/19/01	30	

Johnson Lake	06/21/01	10	
Johnson Lake	06/28/01	120	
Johnson Lake	07/06/01	50	
Johnson Lake	07/12/01	10	
Johnson Lake	07/18/01	30	
Johnson Lake	07/24/01	20	
Johnson Lake	07/31/01	140	
Johnson Lake	08/07/01	190	
Johnson Lake	08/14/01	10	k
Johnson Lake	08/21/01	140	
Hoffman Jetty	06/28/01	100	
Drewes Beach	05/30/02	10	k
	06/06/02	1600	
	06/24/02	30	
	07/01/02	60	
	07/22/02	10	k
	07/30/02	370	
	08/06/02	10	
	08/15/02	10	
	08/20/02	7400	
Johnson Beach	05/30/02	30	
	06/06/02	660	
	06/17/02	10	k
	06/24/02	10	k
	07/01/02	170	
	07/07/02	120	
	07/15/02	240	
	07/22/02	110	
	07/30/02	90	
	08/06/02	30	
	08/15/02	40	
	08/20/02	10	k
	08/28/02	220	
Hoffman Beach	05/30/02	120	
	06/06/02	430	
	06/17/02	50	
	06/24/02	10	
	07/01/02	20	
	07/07/02	10	k
	07/15/02	10	
	07/22/02	20	
	07/30/02	30	
	08/06/02	40	
	08/15/02	10	k
	08/20/02	170	

	08/28/02	70	
Johnson Beach Lake Parsippany	05/29/03	40	
	06/03/03	130	
	06/09/03	100	
	06/16/03	20	
	06/23/03	60	
	06/30/03	80	
	07/10/03	40	
	07/15/03	10	k
	07/21/03	20	
	07/28/03	10	
	08/12/03	30	
	08/19/03	10	k
	08/28/03	20	
Drewes Beach Lake Parsippany	05/29/03	40	
	06/03/03	30	
	06/09/03	100	
	06/16/03	120	
	06/23/03	160	
	06/30/03	10	k
	07/07/03	10	k
	07/15/03	10	k
	07/21/03	10	
	07/28/03	40	
	08/07/03	1	k
	08/12/03	700	
	08/14/03	120	
	08/19/03	10	
	08/28/03	10	k
Hoffman Beach Lake Parsippany	05/29/03	540	
	06/03/03	80	
	06/09/03	110	
	06/16/03	290	
	06/23/03	50	
	06/30/03	40	
	07/07/03	1800	
	07/10/03	60	
	07/15/03	40	
	07/21/03	60	
	07/28/03	20	
	08/12/03	130	
	08/19/03	10	
	08/28/03	10	k

Johnson Beach Lake Parsippany	05/24/04	10	k
	06/15/04	10	k
	06/22/04	20	
	07/06/04	40	
	07/20/04	10	k
	08/03/04	10	k
	08/12/04	160	
	08/17/04	20	
	08/24/04	10	
Drewes Beach Lake Parsippany	05/24/04	10	k
	06/15/04	10	
	06/22/04	20	
	06/29/04	50	
	07/20/04	50	
	08/03/04	30	
	08/12/04	40	
	08/17/04	10	k
	08/24/04	40	
Hoffman Beach Lake Parsippany	05/24/04	30	
	06/15/04	10	k
	06/22/04	10	
	06/29/04	30	
	07/06/04	10	
	07/20/04	100	
	08/03/04	20	
	08/17/04	50	
	08/24/04	120	

Powder Mill Pond			
count	92	mean+3stdev	2495
median	30	%reduction	96%
max	5400		
stdev	747	**no data excluded**	
mean	255		
mean+3stdev	2495		

Station	**Date**	**Value**	**Remark**
MOTLB	07/28/98	20	
MOTLB	08/04/98	90	
MOTLB	08/10/98	70	

MOTLD	07/15/98	10	K
MOTLD	07/28/98	20	
MOTLD	08/04/98	300	
MOTLD	08/10/98	10	K
MOTLD-left	08/07/98	40	
MOTLD-right	08/07/98	10	K
MOTLL	07/01/98	1000	
MOTLL	07/07/98	10	K
MOTLL	07/11/98	10	K
MOTLL	07/14/98	70	
MOTLL	07/17/98	10	K
MOTLL	07/22/98	30	
MOTLL	07/24/98	60	
MOTLL	08/19/98	80	
TL	07/08/99	20	
TL	07/16/99	10	K
TL	07/21/99	30	
TL	08/04/99	10	K
TL	08/13/99	40	
TL	08/19/99	10	K
TL	08/27/99	820	
TL	08/31/99	10	
Tabor Lake Corporation	07/11/00	10	K
Tabor Lake Corporation	07/17/00	1700	
Tabor Lake Corporation	07/20/00	30	
Tabor Lake Corporation	07/31/00	640	
Tabor Lake Corporation	08/03/00	40	
Tabor Lake Corporation	08/21/00	20	
Tabor Lake Corporation	08/25/00	120	
	06/05/01	10	
	06/09/01	40	
	06/19/01	2100	
	06/21/01	10	k
	06/28/01	10	
	07/06/01	80	
	07/12/01	40	
	07/18/01	70	
	07/24/01	20	
	07/31/01	20	
	08/07/01	660	

	08/14/01	120	
	08/21/01	380	
	08/23/01	30	
	05/30/02	100	
	06/24/02	10	
	06/27/02	40	
	07/01/02	20	
	07/09/02	10	k
	07/11/02	40	
	07/15/02	20	
	07/18/02	30	
	07/22/02	30	
	07/30/02	70	
	08/02/02	20	
	08/06/02	20	
	08/09/02	10	
	08/15/02	20	
	08/20/02	10	
Tabor Lake	05/29/03	10	k
	06/03/03	410	
	06/09/03	360	
	06/16/03	230	
	06/23/03	750	
	06/30/03	30	
	07/02/03	10	
	07/07/03	30	
	07/15/03	10	k
	07/21/03	10	k
	07/28/03	100	
	08/12/03	5400	
	08/14/03	360	
	08/19/03	50	
	08/21/03	10	k
	08/28/03	20	
Tabor Lake	06/01/04	10	
	06/03/04	20	
	06/08/04	30	
	06/16/04	10	
	06/22/04	10	k
	06/29/04	80	
	07/06/04	40	
	07/14/04	280	
	07/16/04	120	
	07/20/04	80	
	08/03/04	80	

	08/12/04	3600	
	08/17/04	1800	
	08/20/04	50	
	08/24/04	50	

Rainbow Lake			
count	83	mean+3stdev	510
median	40	%reduction	76%
max	820		
stdev	138	**no data excluded**	
mean	97		
mean+3stdev	510		

Station	**Date**	**Value**	**Remark**
MORL	05/24/98	10	K
MORL	06/09/98	40	
MORL	06/26/98	80	
MORL	07/01/98	210	
MORL	07/03/98	30	
MORL	07/07/98	10	K
MORL	07/14/98	30	
MORL	07/22/98	20	
MORL	07/28/98	20	
MORL	08/05/98	10	K
MORL	08/13/98	10	K
MORL	08/19/98	20	
MORL	08/26/98	10	K
RLCC	05/30/99	10	K
RLCC	06/09/99	10	K
RLCC	06/19/99	120	
RLCC	06/30/99	10	K
RLCC	07/16/99	100	
RLCC	07/21/99	410	
RLCC	07/26/99	10	
RLCC	07/29/99	430	
RLCC	08/04/99	20	
RLCC	08/13/99	70	
RLCC	08/19/99	80	
RLCC	08/27/99	170	
Rainbow Lakes Community Club	05/28/00	1	K
Rainbow Lakes Community Club	06/10/00	10	
Rainbow Lakes Community Club	07/06/00	10	K
Rainbow Lakes Community Club	07/11/00	40	
Rainbow Lakes Community Club	07/28/00	90	
Rainbow Lakes Community Club	08/08/00	10	K
Rainbow Lakes Community Club	08/15/00	380	
Rainbow Lakes Community Club	08/23/00	120	
	05/29/01	120	
	06/13/01	10	k
	06/19/01	20	
	06/25/01	460	
	06/28/01	40	
	07/03/01	340	
	07/12/01	30	
	07/16/01	20	
	07/23/01	10	
	08/01/01	60	
	08/08/01	10	
	08/13/01	350	
Rainbow Lakes	06/06/02	370	
	06/10/02	40	
	06/17/02	50	
	07/05/02	40	
	07/10/02	100	
	07/15/02	50	
	07/24/02	40	
	08/01/02	140	
	08/08/02	350	
	08/13/02	10	k
	08/19/02	10	k
Rainbow lakes Community Club	05/29/03	120	
	06/03/03	820	
	06/09/03	130	
	06/20/03	70	
	06/24/03	100	
	06/30/03	30	
	07/07/03	40	
	07/15/03	20	
	07/21/03	130	
	07/28/03	10	
	08/08/03	140	

	08/11/03	260	
	08/19/03	40	
	08/29/03	210	
Rainbow lakes Community Club	06/08/04	50	
	06/15/04	10	
	06/17/04	40	
	06/22/04	10	k
	06/29/04	20	
	07/05/04	90	
	07/15/04	80	
	07/20/04	1	k
	07/27/04	20	
	08/09/04	30	
	08/19/04	100	
	08/25/04	130	
	08/27/04	70	

Sunrise Lake			
count	73	mean+3stdev	2727
median	70	% reduction	95%
Max	4200		
stdev	791	**no data excluded**	
mean	353		
mean+3stdev	2727		

Station	**Date**	**Value**	**Remark**
Morris County Park@Lewis Morris	05/21/03	60	
	06/11/03	10	k
	06/17/03	100	
	06/24/03	20	
	07/02/03	30	
	07/18/03	40	
	07/30/03	900	
	08/06/03	2800	
	08/12/03	3000	
	08/15/03	230	
	08/19/03	170	
Beach	05/24/01	70	
Beach	05/30/01	650	
Beach	06/01/01	120	
Beach	06/15/01	180	
Beach	06/27/01	100	
Beach	07/19/01	10	
Beach	07/27/01	50	
Beach	08/03/01	20	
Beach	08/10/01	30	
Beach	08/17/01	40	
Beach	08/29/01	540	
Inlet	05/24/01	590	
Inlet	05/30/01	10	
Inlet	06/15/01	10	
Inlet	06/27/01	30	
Inlet	07/19/01	10	
Inlet	07/27/01	20	
Inlet	08/03/01	10	
Inlet	08/10/01	110	
Inlet	08/17/01	10	
Inlet	08/29/01	40	
Lake	05/24/01	10	
Lake	07/07/01	10	
Lake	08/31/01	160	
Outlet	05/30/01	210	
Outlet	06/15/01	10	
Outlet	06/27/01	10	
Outlet	07/19/01	10	
Outlet	07/27/01	10	
Outlet	08/03/01	10	
Outlet	08/10/01	20	
Outlet	08/17/01	80	
Outlet	08/29/01	70	
	05/24/02	10	
	05/28/02	50	
	06/12/02	70	
	06/17/02	110	
	06/24/02	30	
	07/03/02	40	
	07/08/02	60	
	07/17/02	140	
	08/02/02	270	
	08/08/02	200	
	08/15/02	2800	
	08/20/02	1400	
	08/22/02	2500	
	08/27/02	710	
	08/30/02	360	
Morris County	05/24/04	70	
Park@Lewis Morris			
	06/01/04	140	
	06/08/04	140	
	06/14/04	110	
	06/28/04	10	L
	07/07/04	160	
	07/14/04	380	
	07/20/04	30	
	07/26/04	160	
	08/04/04	360	
	08/10/04	40	
	08/20/04	570	
	08/25/04	4200	
	08/31/04	20	

Telemark Lake			
count	89	mean+3stdev	1300
median	30	%reduction	94%
Max	3300		
stdev	385	**no data excluded**	
mean	146		
mean+3stdev	1300		

STATION	**DATE**	**VALUE**	**REMARK**
MOLT1	05/18/98	160	
MOLT1	06/06/98	10	K
MOLT1	06/13/98	3300	CLOSED
MOLT1	06/24/98	30	
MOLT	06/30/98	240	
MOLT	07/09/98	30	
MOLT	07/16/98	50	
MOLT	07/21/98	110	
MOLT	08/04/98	10	K
MOLT	08/12/98	520	
MOLT	08/19/98	50	
MOLT	08/26/98	10	K
Beach	06/04/99	10	K
	06/19/99	10	K
	06/25/99	30	
	06/27/99	10	
	07/09/99	10	K
	06/18/99	30	
	07/23/99	10	K

	07/30/99	10	K
	08/05/99	10	K
	08/12/99	10	K
	08/19/99	20	
	08/29/99	30	
Lake Telemark	06/04/00	20	
Lake Telemark	06/21/00	40	
Lake Telemark	06/24/00	300	
Lake Telemark	07/02/00	20	
Lake Telemark	07/08/00	10	
Lake Telemark	07/21/00	30	
Lake Telemark	07/30/00	860	
Lake Telemark	08/12/00	850	
Lake Telemark	08/30/00	40	
MOLT	05/29/01	150	K
MOLT	06/04/01	70	K
MOLT	06/19/01	580	
MOLT	06/22/01	10	resample
MOLT	06/25/01	350	
MOLT	07/03/01	120	K, resample
MOLT	07/11/01	10	
MOLT	07/16/01	20	K
MOLT	07/23/01	10	
MOLT	08/08/01	10	
MOLT	08/15/01	10	
MOLT	08/23/01	10	
	06/09/02	210	
	06/17/02	160	
	06/24/02	30	
	07/05/02	40	
	07/07/02	40	
	07/19/02	40	
	07/25/02	120	
	07/30/02	170	
	08/12/02	10	K
	08/19/02	10	K
Lake Telemark	05/29/03	110	
	06/03/03	290	
	06/09/03	470	no swimming entire season
	06/16/03	280	
	06/23/03	800	
	06/26/03	40	
	06/30/03	100	
	07/08/03	130	

	07/14/03	310	
	07/21/03	30	
	07/29/03	10	k
	08/04/03	430	
	08/12/03	300	
	08/20/03	10	
	08/25/03	40	
Lake Telemark	06/15/04	10	
	06/30/04	10	
	07/06/04	10	
	07/21/04	30	
	07/26/04	40	
	08/03/04	120	
	08/10/04	40	
	08/18/04	10	
	08/24/04	10	k
Lake Telemark	06/13/05	140	
	06/20/05	40	
	06/28/05	30	
	07/06/05	10	
	07/19/05	30	
	08/01/05	10	
	08/12/05	10	k
	08/15/05	10	
	08/26/05	10	k
	08/29/05	10	**k**

West Lake			
count	138	mean+3stdev	412
median	10	%reduction	82%
max	1120		
stdev	121	**no data excluded**	
mean	48		
mean+3stdev	412		

Station	**Date**	**Value**	**Remarks**
SB	06/23/99	1	
SB	07/07/99	6	
SB	07/21/99	2	
SB	07/28/99	1	K
SB	08/04/99	1	
SB	08/11/99	1	K
SB	08/18/99	2	
SB	08/25/99	2	K
SB	09/01/99	2	K
Fayson Lake Main Beach	05/24/00	196	
Fayson Lake Main Beach	05/31/00	6	
Fayson Lake Main Beach	06/08/00	12	
Fayson Lake Main Beach	06/20/00	80	
Fayson Lake Main Beach	07/05/00	28	
Fayson Lake Main Beach	07/06/00	2	K
Fayson Lake Main Beach	07/19/00	28	
Fayson Lake Main Beach	07/25/00	12	
Fayson Lake Main Beach	08/02/00	68	
Fayson Lake Main Beach	08/09/00	80	
Fayson Lake Main Beach	08/16/00	120	
Fayson Lake Main Beach	08/23/00	2	K
Fayson Lake Main Beach	08/30/00	100	
Fayson Lake Main Beach	09/06/00	24	
Sabeys Beach	05/24/00	148	
Sabeys Beach	05/31/00	6	
Sabeys Beach	06/08/00	8	
Sabeys Beach	06/20/00	66	
Sabeys Beach	06/28/00	4	
Sabeys Beach	07/05/00	2	
Sabeys Beach	07/19/00	16	
Sabeys Beach	07/25/00	8	
Sabeys Beach	08/02/00	16	
Sabeys Beach	08/09/00	24	
Sabeys Beach	08/16/00	32	
Sabeys Beach	08/23/00	2	K
Sabeys Beach	08/30/00	4	
Sabeys Beach	09/06/00	20	
Fayson Lake: Main Beach	05/30/01	1120	
	06/06/01	208	
	06/13/01	440	
	06/27/01	10	
	07/05/01	16	
	07/12/01	30	
	07/18/01	2	
	07/25/01	10	
	08/01/01	2	k
	08/08/01	2	k
	08/15/01	62	
	08/22/01	10	
	09/05/01	4	
Fayson Lakes: Sabeys Beach	05/30/01	180	

	06/06/01	12	
	06/13/01	4	
	06/27/01	40	
	07/05/01	32	
	07/12/01	40	
	07/18/01	2	
	07/25/01	2	k
	08/01/01	2	k
	08/08/01	2	k
	08/15/01	42	
	08/22/01	50	
	09/05/01	2	
Fayson Lake: Main Beach	05/22/02	6	
	06/05/02	48	
	06/26/02	44	
	07/03/02	14	
	07/10/02	18	
	07/17/02	268	
	07/25/02	20	
	08/01/02	4	
	08/07/02	2	
	08/14/02	2	k
	08/21/02	14	
	08/28/02	2	k
Fayson Lakes: Sabeys Beach	05/22/02	6	
	06/05/02	14	
	06/26/02	2	
	07/03/02	10	
	07/10/02	8	
	07/17/02	2	k
	07/25/02	2	k
	08/01/02	2	
	08/07/02	10	
	08/14/02	6	
	08/21/02	10	
	08/28/02	4	
Fayson Lakes Main Beach	05/28/03	30	
	06/11/03	6	
	06/25/03	14	
	07/02/03	18	
	07/09/03	4	
	07/17/03	158	
	07/30/03	2	K

	08/06/03	36	
	08/27/03	58	
Fayson Lakes Sabeys Beach	05/28/03	16	
	06/11/03	4	
	06/25/03	196	
	07/02/03	2	K
	07/09/03	2	K
	07/17/03	10	
	07/30/03	2	
	08/06/03	12	
	08/20/03	6	
	08/27/03	12	
Fayson Lakes	05/20/04	60	
Main Beach	05/27/04	220	
	06/03/04	10	k
	06/10/04	10	
	06/14/04	10	
	06/24/04	60	
	07/01/04	30	
	07/08/04	10	
	07/12/04	10	k
	07/19/04	20	
	07/26/04	10	
	08/02/04	30	
	08/09/04	10	k
	08/16/04	90	
	08/23/04	200	
	08/30/04	160	
Fayson Lakes	05/27/04	120	
Sabeys Beach	06/03/04	10	k
	06/10/04	20	
	06/14/04	10	
	06/24/04	10	k
	07/01/04	10	k
	07/08/04	10	k
	07/12/04	10	k
	07/19/04	50	
	07/26/04	10	k
	08/02/04	20	
	08/09/04	10	k
	08/16/04	140	
	08/23/04	70	
	08/30/04	600	L
	09/02/04	10	k

White Meadow Lake			
count	337	mean+3stdev	1846
median	50	%reduction	96%
max	4800		
stdev	547	**no data excluded**	
mean	205		
mean+3stdev	1846		

STATION	**DATE**	**VALUE**	**REMARK**
1	05/26/99	10	K
1	05/30/99	20	
1	06/06/99	10	
1	06/22/99	10	K
1	06/28/99	30	
1	07/07/99	30	
1	07/13/99	10	K
1	07/21/99	40	
1	07/27/99	10	K
1	08/11/99	10	K
1	08/19/99	30	
1	08/26/99	310	
1	08/29/99	850	resampled
1	09/01/99	10	K, reopened
2	05/26/99	30	
2	05/30/99	10	
2	06/06/99	10	K
2	06/22/99	20	
2	06/28/99	10	K
2	07/07/99	10	
2	07/13/99	30	
2	07/21/99	310	resampled
2	07/27/99	20	
2	08/11/99	10	K
2	08/19/99	10	
2	08/26/99	3400	
2	08/29/99	50	resampled
3	05/26/99	10	K
3	05/30/99	10	
3	06/06/99	50	
3	06/22/99	20	
3	06/28/99	10	K
3	07/07/99	90	

3	07/13/99	20	
3	07/21/99	100	
3	07/27/99	60	
3	08/11/99	60	
3	08/19/99	30	
3	08/26/99	2300	closed
3	08/29/99	100	resampled
MOWM1	05/31/98	10	K
MOWM1	06/03/98	10	K
MOWM1	06/09/98	10	K
MOWM1	06/25/98	30	
MOWM1	06/29/98	10	K
MOWM1	07/06/98	10	K
MOWM1	07/13/98	50	
MOWM1	07/23/98	40	
MOWM1	07/27/98	460	
MOWM1	08/03/98	30	
MOWM1	08/06/98	10	K
MOWM1	08/13/98	10	K
MOWM1	08/20/98	3,300	
MOWM1	08/21/98	30	
MOWM2	05/31/98	10	K
MOWM2	06/03/98	10	K
MOWM2	06/09/98	10	K
MOWM2	06/25/98	90	
MOWM2	06/29/98	10	K
MOWM2	07/06/98	20	
MOWM2	07/13/98	50	
MOWM2	07/23/98	250	
MOWM2	07/27/98	230	
MOWM2	07/30/98	150	
MOWM2	08/06/98	110	K
MOWM2	08/13/98	10	K
MOWM2	08/20/98	310	
MOWM2	08/21/98	30	
MOWM3	05/31/98	20	K
MOWM3	06/03/98	40	K
MOWM3	06/09/98	10	K
MOWM3	06/25/98	130	
MOWM3	06/29/98	10	K
MOWM3	07/06/98	10	K
MOWM3	07/13/98	40	
MOWM3	07/23/98	50	
MOWM3	07/27/98	10	K
MOWM3	08/06/98	10	K

MOWM3	08/13/98	170	
MOWM3	08/20/98	480	
MOWM3	08/21/98	10	K
White Meadow Lake	05/25/00	10	
White Meadow Lake	05/25/00	10	K
White Meadow Lake	05/25/00	20	
White Meadow Lake	06/03/00	70	
White Meadow Lake	06/03/00	10	K
White Meadow Lake	06/03/00	10	K
White Meadow Lake	06/12/00	110	
White Meadow Lake	06/12/00	10	K
White Meadow Lake	06/12/00	10	K
White Meadow Lake	06/20/00	10	
White Meadow Lake	06/20/00	70	
White Meadow Lake	06/20/00	80	
White Meadow Lake	06/25/00	10	K
White Meadow Lake	06/25/00	60	
White Meadow Lake	06/25/00	10	K
White Meadow Lake	06/29/00	150	
White Meadow Lake	06/29/00	20	
White Meadow Lake	06/29/00	10	
White Meadow Lake	07/08/00	50	
White Meadow Lake	07/08/00	290	
White Meadow Lake	07/08/00	10	K
White Meadow Lake	07/14/00	20	
White Meadow Lake	07/14/00	100	
White Meadow Lake	07/14/00	10	
White Meadow Lake	08/01/00	160	
White Meadow Lake	08/01/00	40	
White Meadow Lake	08/01/00	70	
White Meadow Lake	08/09/00	4800	
White Meadow Lake	08/09/00	70	
White Meadow Lake	08/09/00	30	
White Meadow Lake	08/17/00	160	
White Meadow Lake	08/17/00	10	
White Meadow Lake	08/17/00	50	
White Meadow Lake	08/21/00	340	
White Meadow Lake	08/21/00	10	K
White Meadow Lake	08/21/00	1800	
White Meadow Lake	08/23/00	40	
White Meadow Lake	08/23/00	1100	
White Meadow Lake	08/30/00	160	
White Meadow Lake	08/30/00	10	K
White Meadow Lake	08/30/00	470	
MOWM1	05/23/01	20	K

MOWM1	05/29/01	70	K
MOWM1	06/10/01	80	K
MOWM1	06/20/01	90	K
MOWM1	06/27/01	60	K
MOWM1	07/03/01	10	
MOWM1	07/12/01	40	K
MOWM1	07/25/01	150	K
MOWM1	08/20/01	2400	
MOWM1	08/22/01	470	resample
MOWM1	08/28/01	50	K
MOWM2	05/23/01	270	K
MOWM2	05/29/01	10	
MOWM2	06/10/01	40	K
MOWM2	06/20/01	290	
MOWM2	06/27/01	180	K
MOWM2	07/03/01	40	K
MOWM2	07/12/01	10	
MOWM2	07/25/01	80	K
MOWM2	08/20/01	580	
MOWM2	08/22/01	150	K, resample
MOWM3	05/23/01	260	
MOWM3	05/29/01	90	K
MOWM3	06/10/01	210	
MOWM3	06/20/01	60	K
MOWM3	06/27/01	30	K
MOWM3	07/03/01	100	K
MOWM3	07/12/01	10	
MOWM3	07/25/01	70	K
MOWM3	08/20/01	400	
MOWM3	08/22/01	440	resample
	05/22/02	10	K
	06/08/02	10	
	06/17/02	30	
	06/19/02	260	RESAMPLE
	06/24/02	160	
	06/26/02	90	
	07/05/02	20	
	07/09/02	10	K
	07/16/02	50	
	07/31/02	40	
	08/07/02	10	K
	08/15/02	10	
	08/20/02	230	
	08/23/02	340	
2	05/22/02	10	K

	06/08/02	20	
	06/17/02	30	
	06/24/02	80	
	06/26/02	10	
	07/05/02	10	
	07/09/02	150	
	07/16/02	10	K
	07/31/02	140	
	08/07/02	390	RESAMPLE
	08/15/02	30	
	08/20/02	170	
3	05/22/02	10	K
	06/08/02	80	
	06/17/02	1100	RESAMPLE
	06/24/02	90	
	06/26/02	140	
	07/05/02	320	RESAMPLE
	07/09/02	770	RESAMPLE
	07/16/02	40	K
	07/31/02	40	
	08/07/02	20	
	08/15/02	10	
	08/20/02	340	
	08/23/02	120	
White Meadow Lake 1	05/20/03	10	k
	05/29/03	50	
	06/03/03	30	
	06/09/03	10	k
	06/17/03	10	k
	06/26/03	50	
	07/07/03	30	
	07/15/03	10	
	07/21/03	70	
	07/28/03	20	
	08/04/03	380	
	08/06/03	40	
	08/11/03	30	
	08/18/03	180	
White Meadow Lake 2	05/20/03	50	
	05/29/03	10	k
	06/03/03	70	
	06/17/03	10	
	06/26/03	40	
	07/07/03	20	
	07/15/03	40	

	07/21/03	1500	
	07/28/03	30	
	08/04/03	70	
	08/06/03	120	
	08/11/03	590	
	08/15/03	30	
	08/18/03	20	
White Meadow Lake 3	05/20/03	10	k
	05/29/03	3100	
	06/03/03	180	
	06/17/03	30	
	06/26/03	40	
	07/07/03	120	
	07/15/03	10	k
	07/21/03	80	
	07/29/03	20	
	08/04/03	180	
	08/06/03	90	
	08/11/03	20	
	08/18/03	70	
	08/18/03	70	
White Meadow Lake	07/01/04	460	
	07/01/04	10	
	07/01/04	110	
	07/07/04	10	
	07/07/04	70	
	07/07/04	150	
	07/14/04	30	
	07/14/04	550	
	07/14/04	30	
	07/16/04	90	
	07/16/04	140	
	07/16/04	40	
	07/16/04	20	
	07/20/04	660	
	07/20/04	80	
	07/20/04	10	
	07/20/04	660	
	07/22/04	50	
	07/22/04	20	
	07/22/04	20	
	07/22/04	70	
	07/26/04	40	
	07/26/04	20	
	07/26/04	130	

	07/27/04	10	
	08/04/04	350	
	08/04/04	60	
	08/04/04	20	
	08/04/04	20	
	08/13/04	60	
	08/13/04	280	
	08/13/04	60	
	08/13/04	360	
	08/17/04	90	
	08/17/04	90	
	08/17/04	70	
	08/19/04	140	
	08/19/04	60	
	08/19/04	40	
	08/19/04	1500	
	08/24/04	320	
	08/24/04	90	
	08/24/04	10	k
	08/30/04	1300	
	08/30/04	2500	
	08/30/04	10	k
	08/30/04	10	k
	08/30/04	20	
	08/30/04	1	k
	09/01/04	80	
	09/01/04	110	
	09/01/04	30	
White Meadow Lake	06/02/05	10	k
	06/02/05	10	
	06/02/05	40	
	06/15/05	200	
	06/15/05	70	
	06/12/05	10	
	06/21/05	110	
	06/21/05	680	resample
	06/21/05	210	resample
	06/23/05	30	
	06/23/05	20	
	06/30/05	230	
	06/30/05	430	
	06/30/05	40	
	07/05/05	10	
	07/05/05	470	resample
	07/05/05	20	

	07/05/05	10	k
	07/05/05	130	
	07/05/05	90	
	07/11/05	180	
	07/11/05	50	
	07/11/05	50	
	07/18/05	70	
	07/18/05	10	
	07/18/05	210	
	07/26/05	50	resample
	07/26/05	4300	resample
	07/26/05	240	resample
	07/28/05	50	
	07/28/05	260	resample
	08/01/05	20	
	08/01/05	60	
	08/01/05	370	resample
	08/09/05	10	
	08/09/05	10	k
	08/09/05	80	
	08/09/05	30	
	08/19/05	370	resample
	08/19/05	230	resample
	08/19/05	40	
	08/23/05	260	
	08/23/05	260	
	08/23/05	50	
	08/23/05	680	closed
	08/25/05	50	
	08/25/05	10	k
	08/31/05	600	closed
	08/31/05	490	closed
	08/31/05	440	resample
	08/31/05	1100	closed

BOROUGH OF OAKLAND
BERGEN COUNTY, NEW JERSEY
ORDINANCE NO. 09-CODE-602

AN ORDINANCE SUPPLEMENTING CHAPTER 20 OF THE BOROUGH OF OAKLAND CODE ENTITLED "STORMWATER MANAGEMENT " SO AS TO REGULATE THE OUTDOOR APPLICATION OF FERTILIZER

WHEREAS, the State of New Jersey has implemented legislation which requires the Borough to adopt regulations respecting the application of fertilizer, so as to protect and improve surface water quality;

NOW, THEREFORE, BE IT ORDAINED by the Mayor and Council of the Borough of Oakland as follows:

Section I. Chapter 20 of the Borough of Oakland Code is hereby supplemented by the addition thereto of the following:

20-2.3A Outdoor Application of Fertilizer

(1) Purpose.

An ordinance to regulate the outdoor application of fertilizer so as to reduce the overall amount of excess nutrients entering waterways, thereby helping to protect and improve surface water quality. This ordinance does not apply to fertilizer application on commercial farms.

(2) Basis and Background:

Elevated levels of nutrients, particularly phosphorus, in surface waterbodies can result in excessive and accelerated growth of algae and aquatic plants (eutrophication). Excessive plant growth can result in diurnal variations and extremes in dissolved oxygen and pH, which, in turn, can be detrimental to aquatic life. As algae and plant materials die off, the decay process creates a further demand on dissolved oxygen levels. The presence of excessive plant matter can also restrict use of the affected water for recreation and water supply.

While healthy vegetated areas are protective of water quality by stabilizing soil and filtering precipitation, when fertilizers are applied to the land surface improperly or in excess of the needs of target vegetation, nutrients can be transported by means of stormwater to nearby waterways, contributing to the problematic growth of excessive aquatic vegetation. Most soils in New Jersey contain sufficient amounts of phosphorus to support adequate root growth for established turf. Over time, it is necessary to replenish available phosphorus, but generally not at the levels commonly applied. Other target vegetation, such as vegetable gardens and agricultural/horticultural plantings, will have a greater need for phosphorus application, as will the repair or establishment of new lawns or cover vegetation. A soils test and fertilizer application recommendation geared to the soil and planting type is the best means to determine the amount of nutrients to apply. Timing and placement of fertilizer application is also critical to avoid transport of nutrients to waterways through stormwater runoff. Fertilizer applied immediately prior to a runoff-producing rainfall, outside the growing season or to impervious surfaces, is not likely to be carried away by means of runoff without accomplishing the desired objective of supporting target vegetation growth. Therefore, the management of the type, amount and techniques for fertilizer application is necessary as one tool to protect water resources.

This ordinance does not apply to application of fertilizer on commercial farms, but improper application of fertilizer on farms would be problematic as well. Stewardship on the part of commercial farmers is needed to address this potential source of excess nutrient load to waterbodies. Commercial farmers are expected to implement best management practices in accordance with conservation management plans or resource conservation plans developed for the farm by the Natural Resource Conservation Service and approved by the Soil Conservation District Board.

(3) Definitions:

For the purpose of this Ordinance, the following terms, phrases, words, and their derivations shall have the meanings stated herein unless their use in the text of this Ordinance clearly demonstrates a different meaning. When not inconsistent with the context, words used in the present tense include the future, words used in the plural number include the singular number, and words used in the singular number include the plural number. The word "shall" is always mandatory and not merely directory.

a. Buffer - the land area, 25 feet in width, adjacent to any waterbody. [The Department believes that 25 feet is the appropriate buffer width to be protective of water quality. However, in situations that warrant additional flexibility, such as where lot sizes are exceptionally small or where the 25 foot buffer constitutes the majority of the available property, the municipality may reduce the buffer to 10 feet in width, with the additional requirement that a drop spreader be used for fertilizer application]

b. Commercial farm - a farm management unit producing agricultural or horticultural products worth $2,500 or more annually.

c. Fertilizer - means a fertilizer material, mixed fertilizer or any other substance containing one or more recognized plant nutrients, which is used for its plant nutrient content, which is designed for use or claimed to have value in promoting plant growth, and which is sold, offered for sale, or intended for sale.

d. Impervious Surface - a surface that has been covered with a layer of material so that it is highly resistant to infiltration by water. This term shall be used to include any highway, street, sidewalk, parking lot, driveway or other material that prevents infiltration of water into the soil.

e. Person - any individual, corporation, company, partnership, firm, association, or political subdivision of this State subject to municipal jurisdiction.

f. Phosphorus fertilizer - any fertilizer that contains phosphorus, expressed as P2O5, with a guaranteed analysis of greater than zero; except that it shall not be considered to include animal (including human) vegetable manures, agricultural liming materials, or wood ashes that have not been amended to increase their nutrient content.

g. Soils Test - a technical analysis of soil conducted by an accredited soil-testing laboratory following the protocol for such a test established by Rutgers Cooperative Research and Extension.

h. Waterbody - a surface water feature, such as a lake, river, stream, creek, pond, lagoon, bay or estuary.

(4) Prohibited Conduct:

No person may do any of the following:

a. Apply fertilizer when a runoff producing rainfall is occurring or predicted and/or when soils are saturated and a potential for fertilizer movement off-site exists.

b. Apply fertilizer to an impervious surface. Fertilizer inadvertently applied to an impervious surface must be swept or blown back into the target surface or returned to either its original or another appropriate container for reuse.

c. Apply fertilizer within the buffer of any waterbody.

d. Apply fertilizer more than 15 days prior to the start of or at any time after the end of the recognized growing season, March 1 to November 15.

(5) Phosphorus Fertilizer Application

No person may do the following:

a. Apply phosphorus fertilizer in outdoor areas except as demonstrated to be needed for the specific soils and target vegetation in accordance with a soils test and the associated annual fertilizer recommendation issued by Rutgers Cooperative Research Extension.

b. Exceptions

1. Application of phosphorus fertilizer needed for

a. Establishing vegetation for the first time, such as after land disturbance, provided the application is in accordance with the requirements established under the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq. and implementing rules;

b. Reestablished or repairing a turf area.

2. Application of phosphorus fertilizer that delivers liquid or granular fertilizer under the soil's surface, directly to the feeder roots.

3. Application of phosphorus fertilizer to residential container plantings, flowerbeds, or vegetable gardens.

Section II. The provisions of this Ordinance supercede those in all prior ordinances.

Section III. All other parts, portions and provisions of Chapter 20 of the Borough of Oakland Code Entitled "Stormwater Management" not inconsistent herewith, are thus ratified and confirmed. In the event of any inconsistencies, the provisions of the Ordinance shall be deemed to govern.

Section IV: Should any part, portion or provision of this Ordinance be held unconstitutional or invalid, such decision shall not affect the validity of this Ordinance as a whole, or any other part thereof.

Section V. This Ordinance shall take effect immediately upon publication and final passage according to law.

John P. Szabo, Jr., Mayor

ATTEST

Lisa Duncan, Clerk

THIS IS TO CERTIFY THAT THIS IS A TRUE COPY AS ADOPTED BY THE MAYOR AND COUNCIL OF THE BOROUGH OF OAKLAND AT A MEETING HELD ON August 26, 2009
BOROUGH CLERK

Amendment to the Northeast, Upper Raritan, Sussex County and Upper Delaware Water Quality Management Plans

Total Maximum Daily Load Report For the Non-Tidal Passaic River Basin Addressing Phosphorus Impairments

Watershed Management Areas 3, 4 and 6

Proposed: May 7, 2007
Adopted: April 24, 2008

New Jersey Department of Environmental Protection
Division of Watershed Management
P.O. Box 418
Trenton, New Jersey 08625-0418

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1.0 Executive Summary

This Total Maximum Daily Load (TMDL) document addresses phosphorus impairments in the non-tidal Passaic River basin, i.e., the river and its tributaries upstream of Dundee Dam, including the Wanaque Reservoir. On July 5, 2005 the Department proposed two TMDL amendments to address phosphorus in the Passaic River basin. One document addressed the Wanaque Reservoir and the Passaic River and tributaries upstream of the confluence of the Pompton and Passaic Rivers. Because of the diversion of water from the Passaic and Pompton Rivers to the Wanaque Reservoir, the Wanaque Reservoir TMDL proposed phosphorus load and wasteload allocations in the Passaic River basin upstream of the confluence of Passaic and Pompton Rivers. The other July 5, 2005 proposal addressed Pompton Lake and its drainage area and provided inputs to the Wanaque Reservoir TMDL. At that time, the Department believed that proceeding with these TMDLs would expedite attainment of water quality improvement in the Passaic River basin, in which phosphorus reductions had been stayed as a result of a settlement agreement between the Department and various wastewater treatment facilities in the basin. The Department received comments on these proposals, primarily with regard to the water quality endpoint in the Wanaque Reservoir, the mass balance model used to estimate phosphorus loadings to the reservoir, the cost to achieve the wasteload allocations assigned to wastewater treatment facilities, and the feasibility of achieving the nonpoint source load reductions specified in the TMDLs. As noted in the July 5, 2005 proposal of the Wanaque Reservoir TMDL, the Department was concurrently engaged in a basin-wide study that included extensive water quality monitoring and development of dynamic flow and water quality models. The intent of the basin-wide study was to identify in-stream critical locations, in addition to the Wanaque Reservoir, that would need phosphorus load reductions in order to attain Surface Water Quality Standards. It was recognized that an outcome of the basin-wide study could be a refinement of the load and wasteload allocations identified in the July 5, 2005 proposals. In light of delays in establishing the July 5, 2005 proposals, completion of the basin-wide study and in consideration of the comments received, the Department has determined that integration of the basin-wide study with relevant findings of the July 5, 2005 proposals is the most efficient means to achieve water quality objectives in the Passaic River basin. Therefore, the July 5, 2005 proposals will not be established. This comprehensive TMDL document, in combination with the companion TMDL document addressing Pompton Lake and its drainage area, addresses the non-tidal Passaic River basin impairments identified in Tables 1 and 2.

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) is required to assess the overall water quality of the State's waters and identify those waterbodies with a water quality impairment for which TMDLs may be necessary. A TMDL is developed to identify all the contributors of a pollutant of concern and the load reductions necessary to meet the Surface Water Quality Standards (SWQS) relative to that pollutant. The Department fulfills its assessment obligation under the CWA through the Integrated Water Quality Monitoring and Assessment Report, which includes the Integrated List of Waterbodies (303(d) list) and is issued biennially. The *2004 Integrated List of Waterbodies* was adopted by the Department on October 4, 2004 (36 NJR 4543(a)) as an amendment to the Statewide Water Quality Management Plan, as part of the Department's continuing planning process pursuant to the Water Quality Planning Act at N.J.S.A.58:11A-7 and the Statewide Water Quality Management Planning rules at N.J.A.C. 7:15-6.4(a).

The *2004 Integrated List of Waterbodies* was initially relied upon to determine the scope of the study. This list identified 17 impaired segments in the non-tidal Passaic River basin as impaired for phosphorus based on in-stream concentrations of total phosphorus in excess of 0.1 mg/l. In addition, 9 stream segments were placed on Sublist 3 because additional information was needed in order to fully assess the status of the waterbodies. The Wanaque Reservoir, although not listed as impaired on the *2004 Integrated List*, had been identified as a critical location that needed to be considered in the development of TMDLs for the impaired stream segments that are a source of phosphorus load to the reservoir. In addition, water quality data evaluated for the TMDL indicate exceedances of the numeric water quality criterion for phosphorus. Subsequently, the Department proposed the *2006 Integrated List of Waterbodies*, which identifies impairments based on HUC 14 Assessment Units rather than stream segments associated with discrete monitoring locations. This change in assessment methodology allows establishment of a stable base of assessment units for which the attainment or non-attainment status of all designated uses within each subwatershed or assessment unit will be identified. The *2006 Integrated List of Waterbodies* is now approved. Tables 1 and 2 and Figure 1 below show the relevant listings and their priority ranking as they appear on the 2004 and the 2006 *Integrated Lists*. Table 2 also includes the intended action for each assessment unit as a result of the TMDL studies.

Table 1. Stream segments identified on Sublists 3 and 5 of the *2004 Integrated List* assessed for phosphorus impairment.

WMA	Site Id #	Station Name/Waterbody	2004 list TP status	Priority Ranking*
03	01388910	Pompton River at Rt 202 in Wayne	Sublist 5	Medium
03	01388100	Ramapo River at Dawes Highway	Sublist 5	Medium
03	01387500	Ramapo River near Mahwah	Sublist 5	Medium
03	01387014	Wanaque River at Pompton Lakes	Sublist 5	Medium
03	01387000	Wanaque River at Wanaque	Sublist 5	Medium
03	01382800	Pequannock River at Riverdale	Sublist 3	NA
03	01388720	Pompton River Trib at Ryerson Rd	Sublist 3	NA
04	01389880	Passaic River at Elmwood Park (combined with Passaic River at Merlot Ave in Fairlawn – 01389870)	Sublist 5	High
04	01389500	Passaic River at Little Falls (combined with Passaic River at Singac - 01389130)	Sublist 5	High
04	01389005	Passaic River Below Pompton River at Two Bridges	Sublist 5	High
04	01389138	Deepavaal Brook at Fairfield	Sublist 3	NA
04	01389860	Diamond Brook at Fair Lawn	Sublist 3	NA
04	01389600	Peckman River at West Paterson	Sublist 3	NA
04	01389080	Preakness Brook near Little Falls	Sublist 3	NA
06	01378855	Black Brook at Madison	Sublist 5	High
06	01379200	Dead River near Millington	Sublist 5	High
06	EWQ0231	Passaic River at Eagle Rock Ave in East Hanover	Sublist 5	High
06	01382000	Passaic River at Two Bridges	Sublist 5	High
06	01379500	Passaic River near Chatham	Sublist 5	High
06	01379000	Passaic River near Millington	Sublist 5	High
06	01381200	Rockaway River at Pine Brook	Sublist 5	High
06	01381500	Whippany River at Morristown	Sublist 5	High
06	01381800	Whippany River near Pine Brook	Sublist 5	Medium
06	01379530	Canoe Brook near Summit	Sublist 3	NA
06	01379800	Green Pond Brook at Dover	Sublist 3	NA
06	01379853	Rockaway River at Blackwell St	Sublist 3	NA

* Priority Ranking is only assigned to waterbodies that are on Sublist 5

Table 2. Assessment Units Analyzed from the *2006 Integrated List*

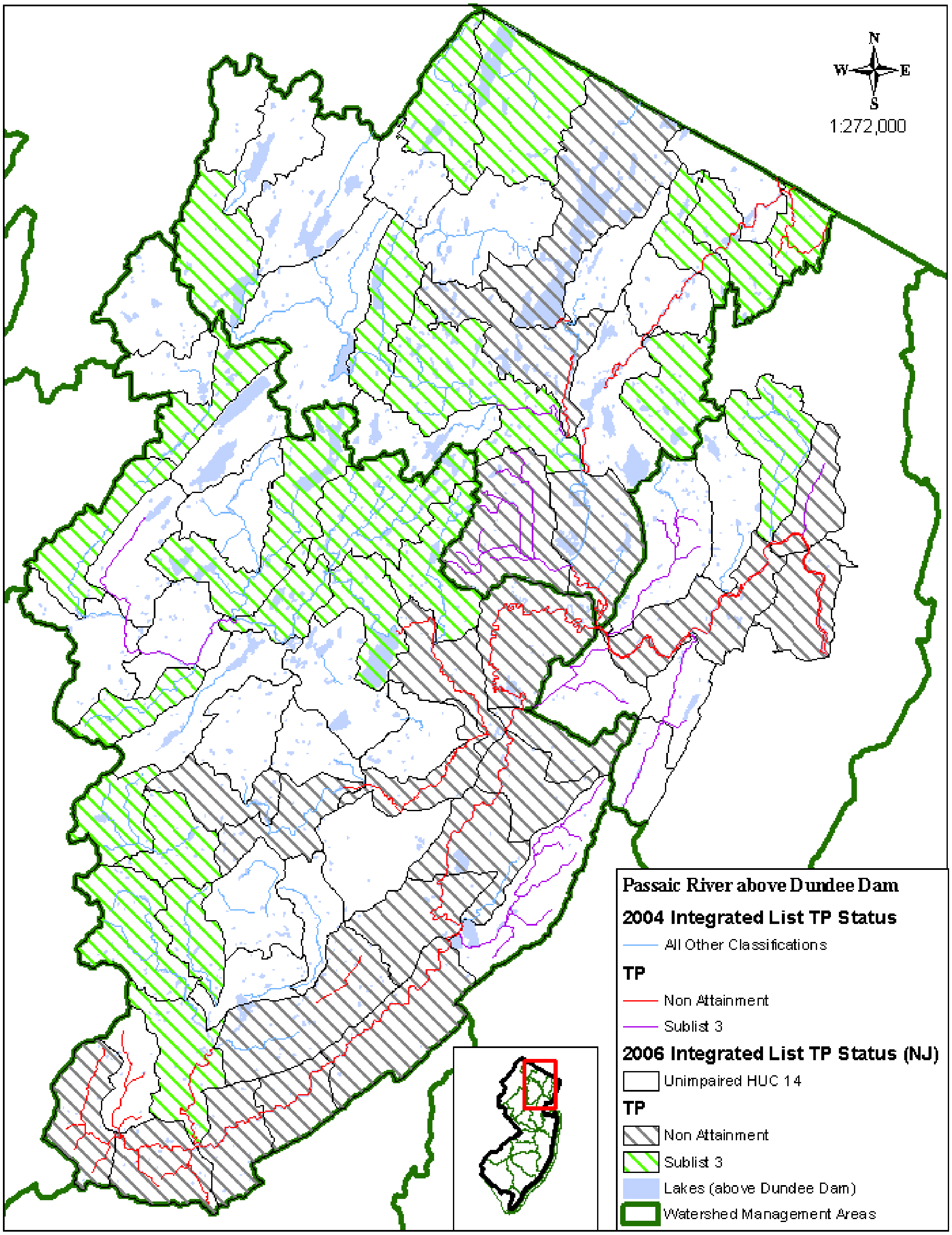
WMA	Assessment Unit ID	Assessment Unit Name	Status of TP Assessment	Priority Ranking	Proposed Action*
03	Wanaque Reservoir-03	Wanaque Reservoir-03	Sublist 3	NA	Propose TMDL
03	02030103070020	Belcher Creek (Pinecliff Lake & below)	Sublist 3	NA	WLAs and LAs assigned per Greenwood Lake TMDL
03	02030103070010	Belcher Creek (above Pinecliff Lake)	None	NA	WLAs and LAs assigned per Greenwood Lake TMDL
03	02030103070030	Wanaque R/Greenwood Lk (abv Monks gage)	Sublist 3	NA	WLAs and LAs assigned per Greenwood Lake TMDL
03	02030103070070	Wanaque R/Posts Bk (below reservoir)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
03	02030103110010	Lincoln Park tribs (Pompton River)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
03	02030103110020	Pompton River	Impaired	High	WLAs and LAs assigned per Passaic TMDL
03	02030103050080	Pequannock R (below Macopin gage)	Sublist 3		WLAs and LAs assigned per Passaic TMDL
03	02030103070060	Meadow Brook/High Mountain Brook	None		WLAs and LAs assigned per Passaic TMDL
03	02030103070050	Wanaque Reservoir (below Monks gage)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
03	02030103100010	Ramapo R (above 74d 11m 00s)	Sublist 5	NA	Addressed in companion TMDL for Pompton Lake
03	02030103100040	Ramapo R (Bear Swamp Bk thru Fyke Bk)	Sublist 3	NA	Addressed in companion TMDL for Pompton Lake
03	02030103100030	Ramapo R (above Fyke Bk to 74d 11m 00s)	Sublist 3	NA	Addressed in companion TMDL for Pompton Lake
03	02030103100020	Masonicus Brook	Sublist 3	NA	Addressed in companion TMDL for Pompton Lake
03	02030103100050	Ramapo R (Crystal Lk br to Bear Swamp Bk)	Sublist 4A*	NA	Addressed in companion TMDL for Pompton Lake
03	02030103100070	Ramapo R (below Crystal Lake bridge)	Sublist 5	NA	Addressed in companion TMDL for Pompton Lake
03	02030103100060	Crystal Lake/Pond Brook	Sublist 3	NA	Addressed in companion TMDL for Pompton Lake
03	02030103070040	West Brook/Burnt Meadow Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
03	02030103050030	Pequannock R (above Oak Ridge Reservoir outlet)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
03	02030103050060	Pequannock R (Macopin gage to Charlotteburg)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
03	02030103050010	Pequannock R (above Stockholm/Vernon Rd)	None	NA	WLAs and LAs assigned per Passaic TMDL
03	02030103050020	Pacock Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
03	02030103050040	Clinton Reservoir/Mossmans Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
03	02030103050050	Pequannock R (Charlotteburg to Oak Ridge)	None	NA	WLAs and LAs assigned per Passaic TMDL
03	02030103050070	Stone House Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
04	Dundee Lake-04	Dundee Lake-04	Sublist 3	NA	Propose TMDL
04	02030103120070	Passaic R Lwr (Fair Lawn Ave to Goffle)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
04	02030103120100	Passaic R Lwr (Goffle Bk to Pompton River)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
04	02030103120080	Passaic R Lwr (Dundee Dam to F.L. Ave)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
04	02030103120050	Goffle Brook	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL

04	02030103120040	Molly Ann Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
04	02030103120030	Preakness Brook / Naachtpunkt Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
04	02030103120060	Deepavaal Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
04	02030103120020	Peckman River (below CG Res trib)	None	NA	WLAs and LAs assigned per Passaic TMDL
04	02030103120010	Peckman River (above CG Res trib)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103040010	Passaic R Upr (Pompton R to Pine Bk)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103030170	Rockaway R (Passaic R to Boonton dam)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103020100	Whippany R (Rockaway R to Malapardis Bk)	Impaired	High	WLAs and LAs assigned per Passaic TMDL; DO eliminated as basis of impairment
06	02030103010180	Passaic R Upr (Pine Bk br to Rockaway)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103010170	Passaic R Upr (Rockaway to Hanover RR)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103020040	Whippany R(Lk Pocahontas to Wash Val Rd)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103020050	Whippany R (Malapardis to Lk Pocahontas)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103010160	Passaic R Upr (Hanover RR to Columbia Rd)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103010150	Passaic R Upr (Columbia Rd to 40d 45m)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103010060	Black Brook (Great Swamp NWR)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103010130	Passaic R Upr (40d 45m to Snyder Ave)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103010080	Dead River (above Harrisons Brook)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103010120	Passaic R Upr (Snyder to Plainfield Rd)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103010110	Passaic R Upr (Plainfield Rd to Dead River)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103010100	Dead River (below Harrisons Brook)	Impaired	High	WLAs and LAs assigned per Passaic TMDL
06	02030103030160	Montville tribs.	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103010010	Passaic R Upr (above Osborn Mills)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103010020	Primrose Brook	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103010070	Passaic R Upr (Dead R to Osborn Mills)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103020080	Troy Brook (above Reynolds Ave)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103020030	Greystone / Watnong Mtn tribs	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103020090	Troy Brook (below Reynolds Ave)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103020060	Malapardis Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103010140	Canoe Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103020070	Black Brook (Hanover)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103010030	Great Brook (above Green Village Rd)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103010040	Loantaka Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103010050	Great Brook (below Green Village Rd)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103010090	Harrisons Brook	None	NA	WLAs and LAs assigned per Passaic TMDL

06	02030103030030	Rockaway R (above Longwood Lake outlet)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030110	Beaver Brook (Morris County)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030120	Den Brook	None		WLAs and LAs assigned per Passaic TMDL
06	02030103030130	Stony Brook (Boonton)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030040	Rockaway R (Stephens Bk to Longwood Lk)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030140	Rockaway R (Stony Brook to BM 534 brdg)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030150	Rockaway R (Boonton dam to Stony Brook)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030080	Mill Brook (Morris Co)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103020010	Whippany R (above road at 74d 33m)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103020020	Whippany R (Wash. Valley Rd to 74d 33m)	Sublist 3	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030010	Russia Brook (above Milton)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030020	Russia Brook (below Milton)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030050	Green Pond Brook (above Burnt Meadow Bk)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030100	Hibernia Brook	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030060	Green Pond Brook (below Burnt Meadow Bk)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030070	Rockaway R (74d 33m 30s to Stephens Bk)	None	NA	WLAs and LAs assigned per Passaic TMDL
06	02030103030090	Rockaway R (BM 534 brdg to 74d 33m 30s)	None	NA	WLAs and LAs assigned per Passaic TMDL

*The Non-Tidal Passaic River Basin TMDL report is based on a watershed approach to address phosphorus impairments in 2 critical locations and 22 segments listed for phosphorus on the 303(d) list. This watershed TMDL includes reductions in phosphorus throughout the watershed including sources within the 22 303(d)-listed segments. The 2 critical locations were not listed on the 303(d) list but were found to be impaired through this TMDL study. The numeric in-stream criteria for total phosphorus is 0.1 mg/l unless it can be demonstrated that phosphorus is not a limiting nutrient and will not otherwise render a water unsuitable for its designated use. The 22 segments on the 303(d) list were listed due to an exceedance of the 0.1 mg/l total phosphorus criteria. Through this TMDL study and based on careful evaluation of monitoring and modeling data, it was determined that phosphorus is not a limiting nutrient in most locations and does not render these 22 303(d)-listed waters unsuitable for their designated uses. The reductions required in these waters to achieve the watershed criteria at the critical locations will further ensure that the phosphorus standards in these listed waters will continue to be met.

Figure 1. Passaic River above Dundee Dam with the *2004 and 2006 Integrated Lists* Phosphorus Assessments



The non-tidal Passaic River Basin TMDLs are based on an integration of water quality and hydrodynamic models. A water quality model, Water Quality Analysis Simulation Program 7.0 (WASP 7), and a flow model, Diffusion Analogy Surface-Water Flow Model (DAFLOW), were used to simulate water quality and flow in the non-tidal Passaic River and its major tributaries: Dead River, Whippany River, Rockaway River, Pompton River mainstem, Ramapo River downstream of Pompton Lake, Wanaque River downstream of the Wanaque Reservoir, a small stream segment of the Pequannock River, Singac Brook, and Peckman River. The WASP 7 model is a dynamic compartment model that can be used to predict a variety of water quality responses due to natural phenomena and man-made pollution for diverse aquatic systems, such as rivers, reservoirs, lakes, and coastal waters (Omni Environmental, 2007). DAFLOW model is a one-dimensional transport model designed to simulate flow by solving the diffusion analogy form of the flow equation. DAFLOW was developed by USGS and enhanced by USGS for this TMDL study (Spitz, 2007). A graphical watershed model integration tool (WAMIT) was developed for data sharing and model input calculation between WASP 7 and DAFLOW (Omni Environmental, 2007). Outside of the domain of the WASP 7/DAFLOW model, a mass balance model (Najarian, 2005) was used to simulate daily loads of total phosphorus and orthophosphorus. A reservoir model, Laterally Averaged - Wind and Temperature Enhanced Reservoir Simulation (LA-WATERS), was used to model the water quality of the Wanaque Reservoir based on loading inputs from the other models and in consideration of diversions into the Wanaque Reservoir. The LA-WATERS model and subsequent analyses link phosphorus loading with chlorophyll-a response in the Wanaque Reservoir and includes a hydrothermal component and water quality modules, which were successfully calibrated to the Wanaque Reservoir using data collected as part of the Wanaque South water supply project (Najarian Associates, 1988), and subsequently re-validated (Najarian Associates, 2000).

For assessment purposes, a waterbody is deemed impaired with respect to phosphorus when phosphorus levels exceed the numeric criteria in the Surface Water Quality Standards (SWQS). Under this approach, the narrative exception to applicability of the numeric criterion in streams and other narrative criteria are not assessed prior to listing. The SWQS allow for development of watershed or site specific criteria, where appropriate, that protect designated uses. Through this TMDL study, it was determined that the in-stream numeric criterion does not apply within the WASP 7/DAFLOW modeled domain because monitoring and simulation demonstrate that phosphorus is not rendering the waters unsuitable for the designated uses. For these assessment units, phosphorus will be removed as a basis of impairment in the next Integrated List. Critical locations where phosphorus is causing excessive primary productivity were identified to be the Wanaque Reservoir and Dundee Lake. As part of this TMDL proposal, the Department proposed, and has now adopted, watershed criteria in accordance with N.J.A.C. 7:9B-1.5(g)3 in these locations, as the best means to ensure protection of the designated uses. The watershed criteria are expressed in terms of a seasonal average concentration (June 15-September 1) of the response indicator, chlorophyll-*a*. The criteria are tailored to the unique characteristics of each critical location and are expressed as a seasonal average of 10 µg/L chlorophyll-*a* in the Wanaque Reservoir and a seasonal average of 20 μg/L chlorophyll-*a* in Dundee Lake. As the result of this TMDL study, phosphorus will not be considered as a basis for non-attainment in these waterbodies in the next Integrated List. One location, Whippany River (Rockaway River to Malapardis Brook), is listed as impaired for dissolved oxygen. Through this TMDL study it has been determined that the low dissolved oxygen levels observed are due to natural conditions. Therefore, in this location dissolved oxygen will be removed as a basis of impairment in the next Integrated List.

The wasteload allocations for wastewater treatment facilities needed to meet the watershed criteria at Wanaque Reservoir and Dundee Lake are based on a long term average year-round effluent concentration of 0.4 mg/l of total phosphorus for most wastewater discharges (see Table 14 and discussion for exceptions). The Department intends to establish monthly average, concentration-only effluent limits that will apply year round for the identified wastewater dischargers located above the confluence of the Pompton and Passaic Rivers using the methodology in the USEPA's *Technical Support Document for Water Quality-Based Toxics Control* (USEPA, 1991), assuming a 4 times per month sampling frequency and a coefficient of variation of 0.6. With these inputs, this methodology produces a monthly average effluent limit of 0.76 mg/l. Dischargers below the confluence of the Pompton and Passaic Rivers will also receive this numeric limit, which needs to be applied only from May through October to meet the watershed criteria. Dischargers in the Greenwood Lake drainage area will retain the WLAs and associated effluent limits established in the Greenwood Lake TMDL (NJDEP 2004). Five dischargers that contribute loads outside the boundaries of the model domain are assigned a wasteload allocation consistent with the allowable load in the current permits in order to maintain boundary conditions. Nonpoint and stormwater point source load reductions are also required in order to achieve the water quality targets in the study area. The percent reduction for these sources ranges from 0 to 85 percent and will be achieved through measures identified in the implementation section. Subject to the constraints of achieving the specified load reductions, attaining the watershed criteria in the Wanaque Reservoir and Dundee Lake, and accomplishing needed upgrades within the compliance schedule established in the discharge permits, modification of wasteload allocations and load allocations may be accomplished through water quality trading. EPA awarded a Targeted Watershed Grant to Rutgers University to facilitate water quality trading in the Passaic River basin. This study is expected to identify appropriate trading ratios and other trading rules that will ensure the TMDL objectives are attained within the Passaic River basin.

This TMDL Report is consistent with US EPA'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. This TMDL Report was proposed as an amendment to the Northeast, Upper Raritan, Sussex County and Upper Delaware Water Quality Management Plans (WQMP). Following the proposal, public comments were summarized and responses prepared, including minor revisions to the document as noted in the Response to Comment, included as Appendix F. This TMDL Report is adopted as an amendment to the Northeast, Upper Raritan, Sussex County and Upper Delaware Water Quality Management Plans (WQMP) in accordance with N.J.A.C.

7:15-3.4 (g). This action effectuates the establishment of the watershed criteria, which were proposed along with the TMDL, as the applicable Surface Water Quality Standards for Wanaque Reservoir and Dundee Lake, as provided for at N.J.A.C. 7:9B-1.5(g)3.

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 Water Quality Monitoring and Assessment Report combines these two assessments and assigns waterbodies to one of five sublists on the Integrated List of Waterbodies. Sublists 1 through 4 include waterbodies that are generally unimpaired (Sublist 1 and 2), have limited assessment or data availability (Sublist 3), or 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. For the non-tidal portion of the Passaic River basin, the *2004 Integrated List of Waterbodies* identified 17 impaired segments and 9 segments that had limited assessment or data availability.

The *New Jersey 2006 Integrated Water Quality Monitoring and Assessment Report*, which was approved during the pendency of this TMDL proposal, identifies impairments based on designated use attainment and then lists the parameters responsible for the non-attainment of the designated use. The assessments are conducted for each of the seven categories of designated use, which include aquatic life, recreational use (primary and secondary contact), drinking water, fish consumption, shellfish harvesting (if applicable), agricultural water supply use and industrial water supply use. The *2006 Integrated Water Quality Monitoring and Assessment Report* assessment units addressed in this TMDL report are identified in Table 2, along with the assessment status with respect to the parameter total phosphorus. The complete assessment status of the assessment units in Table 2 is identified in Appendix C.

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 waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, a margin of safety (MOS) and, as an option, a reserve capacity (RC).

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.

3.0 Pollutants of Concern and Area of Interest

Pollutants of Concern

The primary pollutant of concern for this TMDL study is phosphorus. When present in excessive amounts, phosphorus can lead to excessive primary productivity, in the form of algal and/or macrophyte growth. The presence of excessive plant biomass can, in itself, interfere with designated uses, such as swimming or boating. There are also implications from excessive algae with respect to drinking water use. Algal blooms in raw drinking water sources can cause taste and odor problems and treatment inefficiencies, having a negative impact on conventional treatment at a drinking water system. When algae are present in large amounts purveyors must increase the use of disinfectants and oxidants to treat the algae resulting in an increase in disinfection byproducts such as trihalomethanes, some of which are listed by EPA as likely carcinogens. In addition, the respiration cycle of excessive plant material can cause significant swings in pH and dissolved oxygen, which can result in violation of criteria for these parameters, which can adversely affect the aquatic community. Low dissolved oxygen can result from factors besides the respiration side of the diurnal swing associated with excessive primary productivity, which must be considered when assessing the role of phosphorus in causing observed water quality. For example, biochemical oxygen demand and nitrification of ammonia from wastewater treatment discharges consume dissolved oxygen. Besides anthropogenic sources, the natural process of breaking down normal amounts of plant and animal materials that have settled to the stream bed also consumes oxygen and is known as sediment oxygen demand (SOD). In addition, dissolved oxygen can be naturally low in some areas, such as headwaters, where surface water is derived close to ground water sources, which are low in dissolved oxygen, and have not had time to oxygenate from exposure to the atmosphere. In some parts of the study area, monitoring data and/or model simulations indicate that the dissolved oxygen criteria may not be met during critical conditions. Most of these segments are not identified as non-attaining with respect to dissolved oxygen in the 2004 and 2006 *Integrated Lists* because the non-attainment conditions, including flow and time of day, were extreme and not captured during routine monitoring. However, the non-attainment of dissolved oxygen criteria was determined to be a result of natural conditions, as discussed further below. Therefore, these areas should not be assessed as impaired in the next listing cycle.

The Department has surface water quality standards for phosphorus. As stated in N.J.A.C. 7:9B-1.14(c) of the SWQS for Fresh Water 2 (FW2) waters:

> <u>Phosphorus, Total (mg/l):</u>
>
> i. Lakes: Phosphorus as total P shall not exceed 0.05 in any lake, pond, reservoir, or in a tributary at the point where it enters such bodies of water, except where watershed or site-specific criteria are developed pursuant to N.J.A.C. 7:9B-1.5(g)3.
>
> ii. Streams: Except as necessary to satisfy the more stringent criteria in paragraph i. above or where watershed or site-specific criteria are developed pursuant to N.J.A.C. 7:9B-1.5(g)3, phosphorus as total P shall not exceed 0.1 in any stream, unless it can be demonstrated that total P is not a limiting nutrient and will not otherwise render the waters unsuitable for the designated uses.

Regarding watershed and site specific criteria, N.J.A.C. 7:9B-1.5(g)3 states:

> The Department may establish watershed or site-specific water quality criteria for nutrients in lakes, ponds, reservoirs or streams, in addition to or in place of the criteria in N.J.A.C. 7:9B-1.14, when necessary to protect existing or designated uses. Such criteria shall become part of these Water Quality Standards.

Elaborating on "…render waters unsuitable…" N.J.A.C. 7:9B-1.5(g)2 states:

> Except as due to natural conditions, nutrients shall not be allowed in concentrations that cause objectionable algal densities, nuisance aquatic vegetation, abnormal diurnal fluctuations in dissolved oxygen or pH, changes to the composition of aquatic ecosystems, or otherwise render the waters unsuitable for the designated uses.

The waterbodies listed in Tables 1 and 2 have a FW2 classification. Some also carry a C1 classification, as depicted in Figure 5. The designated uses, both existing and potential, that have been established by the Department for waters of the State classified as such are as stated below:

In all FW2 waters, the designated uses are (N.J.A.C. 7:9B-1.12):

1. Maintenance, migration and propagation of the natural and established aquatic biota;
2. Primary and secondary contact recreation;

3. Industrial and agricultural water supply;
4. Public potable water supply after conventional filtration treatment (a series of processes including filtration, flocculation, coagulation and sedimentation, resulting in substantial particulate removal but no consistent removal of chemical constituents) and disinfection; and
5. Any other reasonable uses.

Numerous waterbodies within the Passaic River basin were placed on Sublist 5 in both the 2004 and 2006 *Integrated Lists* (see Tables 1 and 2), based on data showing phosphorus in excess of the numeric in-stream criterion of 0.1 mg/l. However, data are not generally available to assess waterbodies relative to the narrative nutrient criteria and support of the designated uses. Therefore, the numeric criterion is often the sole basis for listing of a waterbody with respect to phosphorus. One of the objectives of the monitoring program conducted for this TMDL report was to determine if phosphorus was causing excessive productivity and the associated water quality effects.

Appendix E of the *TMDL for Fecal Coliform and an Interim Total Phosphorus Reduction Plan for the Whippany River Watershed* (NJDEP 1999) set forth the salient points supporting the conclusion that the numeric in-stream criterion of 0.1 mg/l did not apply in the Whippany River Watershed because phosphorus was not causing excessive primary productivity and its associated effects. Within the domain of Approach Areas 1 and 3, which are described below, the Department monitored relevant parameters under a range of flow conditions at representative locations. The details of the monitoring program and data generated are provided in the support materials for this TMDL document (TRC Omni, 2004). Diurnal dissolved oxygen and chlorophyll-*a* are the two parameters that are most illustrative of the effects of phosphorus in the waterbodies. As noted above, excessive productivity will be indicated by high concentrations of chlorophyll-*a* and diurnal dissolved oxygen patterns that exhibit a large swing and may also entail dissolved oxygen concentration at the bottom of the swing that is below the SWQS. Based on careful evaluation of the data, the Department determined that phosphorus is not responsible for causing excessive primary productivity within streams in the specified domain, except in a small portion at the terminis of the Peckman River. Therefore, except in that location, the 0.1 mg/l numeric criterion is not applicable for in-stream locations within the model domain, Approach Areas 1 and 3. Phosphorus is causing excessive primary productivity in two locations that are actually or nominally lakes: the Wanaque Reservoir and the impounded portion of the lower Passaic above Dundee Dam, also referred to as Dundee Lake. Refer to Appendix J of Omni 2007 for supporting information.

More specifically, the data show that the Upper Passaic River basin is significantly influenced by the conditions of the source waters emanating from the Great Swamp, which do not allow much light penetration due to dark color, which in turn inhibits algal growth. In addition, dissolved oxygen starts out low and remains so, with little diurnal swing. Low dissolved oxygen concentrations in the Upper and Middle Passaic River are due to two factors, the conditions of the source waters coming from Great Swamp and the natural levels of SOD. Observed SOD values in these reaches are among the highest values in the basin, as measured in 2004. The high rate of SOD materials in these reaches results from the Great Swamp and other wetlands complexes contributing abundant detritus, as well as the overall low stream velocity, which promotes settling. For example, the Whippany River (Rockaway River to Malapardis Brook; 02030103020100-01) is currently listed as non-attaining for dissolved oxygen. This location fails to meet current water quality criteria for dissolved oxygen. However, this has been determined to be because of natural conditions—dissolved oxygen starts out low, and there is significant natural SOD. Simulation of extreme reduction of phosphorus showed no improvement relative to not violating the minimum daily dissolved oxygen criterion. Therefore, at this location oxygen will be removed as a basis for impairment in the next listing cycle. The middle portion of the Passaic River is transitional with respect to productivity. Here, productivity is increasing, but not yet excessive. In a small portion of this reach, the diurnal dissolved oxygen swings in the critical 2002 summer were approaching 6 mg/l. Simulation of extreme reductions in phosphorus resulted in a slight decrease in the amplitude of the diurnal swing but did not improve the degree of violation of the minimum daily dissolved oxygen criterion (see station Passaic River at Stanley Ave, Chatham, near PA4 Chatham, (Omni Environmental, 2007). It was concluded that the observed and simulated low levels of oxygen were due to natural conditions and these areas should not be assessed as impaired with respect to oxygen in the next Integrated List. As water quality improvements may result in improved clarity and light penetration, the water quality at Chatham will be revisited following implementation of the TMDL.

At the confluence of the Pompton and Passaic Rivers, the Wanaque South intake diverts water into the Wanaque Reservoir. Water diverted at this location can, depending on pumping relative to stream flows, include both the Pompton and Passaic Rivers. As a result, phosphorus loads from both waterbodies can be directed to the reservoir, where they accumulate and cycle within the impoundment creating the opportunity for excessive primary productivity over the growing season. High levels of chlorophyll-*a* have been observed in the Wanaque Reservoir, although measured levels are lower than they would be naturally due to physical and chemical control measures exercised by NJDWSC. The Lower Passaic is notably influenced by phosphorus, with indicators of primary productivity pronounced above Dundee Dam. The waters impounded behind Dundee Dam are also known as Dundee Lake. Here, diurnal dissolved oxygen swings are extreme, with minimum daily averages for dissolved oxygen violated during the critical period, and chlorophyll-*a* levels are excessive.

Having identified that the Wanaque Reservoir and Dundee Lake were the locations where phosphorus is responsible for excessive productivity as indicated by excessive levels of chlorophyll-*a* and/or excessive diurnal dissolved oxygen swings, the Department exercised the models to determine the phosphorus reductions needed to achieve water quality conditions that would support the designated uses.

Modeling of the non-tidal Passaic River basin illustrates that achieving the numeric phosphorus criteria as "not to exceed" values in the critical locations, Wanaque Reservoir and Dundee Lake, is not necessary to achieve acceptable levels of the response indicators dissolved oxygen and chlorophyll-*a*. Selected illustrative graphs are found in Appendix E with more detailed information provided in the TMDL support documents, Omni, 2007, Najarian, 2005 and Najarian, 2007.

In its "*Protocols for Developing Nutrient TMDLs*" First Edition November 1999, and in "*Nutrient Criteria Technical Guidance Manual Lakes and Reservoirs*", First Edition April 2000, EPA lists chlorophyll-*a* as a suitable indicator for nutrient TMDLs. In the Guidance document EPA developed nutrient water quality criteria guidance for lakes and reservoirs for fourteen major Ecoregions of the United States. The guidance recommends several candidate nutrient criteria for the protection of designated uses; chlorophyll-*a*, total phosphorus, total nitrogen, and Secchi depth. In addition to the referenced EPA guidance for nutrient criteria, several states (Missouri, North Carolina, Pennsylvania, Oregon, Alabama, and Kansas) have selected chlorophyll-*a* as the common translator to address narrative criteria. Values selected in these states for various designated use range from 10 µg/L to 40 µg/L and reflect the best professional judgment of levels needed to support the designated uses in the particular setting.

The Department concurs with the finding that response indicators are a suitable target for protecting waterbodies from the effects of excessive nutrients. The Department has also concluded that the numeric criteria for phosphorus in these impounded areas are not the best indicators for determining when these waters are rendered unsuitable for the designated uses. In these locations, the response indicators chlorophyll-*a* (both locations) and dissolved oxygen, particular the degree of diurnal swing (Dundee Lake), provide a better measure of meeting water quality objectives and supporting designated uses than the default numeric criteria. In consideration of EPA guidance, the experience of other states and the model results, chlorophyll-*a* was selected as the basis for measuring attainment of water quality objectives in the critical locations.

The Department considered the physical characteristics of each critical location, existing and designated uses of the waterbodies, EPA guidance, literature values and the experiences of other states in selecting the target value for each waterbody. Through the comprehensive water quality modeling developed in this TMDL study, a direct and quantitative linkage has been established between chlorophyll-*a* and total phosphorus concentrations. This allows identification of the phosphorus reductions needed to achieve the target chlorophyll-*a* concentrations.

The Wanaque Reservoir is large and deep and is used primarily as an important water supply reservoir, providing drinking water to over 3 million people. During critical periods, such as in 2002, more than the equivalent volume of the Reservoir is pumped in and then drawn for water supply. The reservoir also serves recreational purposes, supporting trout throughout the fishing season. The Department determined that the Wanaque Reservoir warrants a conservative chlorophyll-*a* target of 10 µg/L, in consideration of its great capacity to store and cycle phosphorus, its importance as a drinking water supply reservoir as well as its value as a cold-water fishery, all of which warrant a lower allowable level of productivity.

The Dundee Dam serves to slightly widen the river for a distance of approximately one mile upstream of the dam. While nominally a lake, the average residence time in the impounded reach is simulated to be only about 1.4 days. Because of its riverine characteristics, absent a watershed criterion, the default in-stream numeric criterion for phosphorus would be more applicable here than the lake criterion. Dundee Lake is characterized as a warm water, riverine environment, which warrants a higher level of productivity. The water impounded behind Dundee Dam is relatively shallow and has a very short retention time. It is not currently used as a drinking water supply, but is permitted for use as a source of industrial water. Because of these characteristics, the Department has determined that a chlorophyll-*a* target of 20 µg/L is appropriate.

Various seasonal periods were assessed. For both locations, a seasonal average period defined as from June 15 to September 1 was found to provide a conservative outcome in terms of required phosphorus load reductions. This period was selected in order to provide an extra measure of protection for the designated uses.

Because the Department does not have surface water standards for chlorophyll-*a*, pursuant to N.J.A.C. 7:9B-1.5(g)3, the Department has established watershed criteria in terms of chlorophyll-*a* for these two critical locations in the Passaic River basin as part of this TMDL. The criteria are 10 µg/L as a seasonal average (June 15-September 1) in the Wanaque Reservoir and 20 µg/L as a seasonal average in Dundee Lake. With adoption of this TMDL report, these watershed criteria are the SWQS for these waterbodies, subject to approval by EPA. The full technical basis for the selection of these criteria is provided in Appendix E.

Area of Interest

The spatial focus of this TMDL study is the non-tidal Passaic River basin. This spatial extent includes the stream segments and HUC 14 subwatersheds identified in Tables 1 and 2 and depicted in Figure 1. Some of the HUC 14 subwatersheds have been specifically assessed as impaired with respect to phosphorus. In addition, through this TMDL study, the impounded area behind Dundee Dam, also known as Dundee Lake, and the Wanaque Reservoir have been identified as impaired with respect to phosphorus and will be addressed as well. Unimpaired subwatersheds are included in the study because loadings are taken as inputs to the model domain and WLAs and LAs are established as a result of this study. Multiple approaches to calculating loads are used in this study and the spatial extent of each approach is depicted in Figure 2. Pompton Lake and its drainage area are depicted as within the spatial extent because loadings from this area are inputs to the non-tidal Passaic River basin analysis. However, the Pompton Lake and the associated drainage area are addressed in a companion TMDL report. Greenwood Lake and its associated drainage area are also depicted because loadings are taken as a boundary condition input to this study. However, Greenwood Lake and associated drainage were addressed in a previously established TMDL (NJDEP 2004) that was approved by EPA on September 29, 2004. The Greenwood Lake drainage area, the Pompton Lake drainage area, as well as the remaining direct drainage to the Wanaque Reservoir, are covered under the spatial extents identified as Greenwood Lake TMDL spatial extent and Approach 2. Except for the direct drainage to the Wanaque

Reservoir (Greenwood Lake and Approach 2) and the headwaters taken as boundary conditions (Approach 4), the portion of the study area upstream of the confluence of the Pompton and Passaic Rivers is addressed through Approach 1, which is the integration of the WASP 7/DAFLOW model and the LA-WATERS to establish the load reductions to meet the water quality objective in the Wanaque Reservoir. The portion of the spatial extent below the confluence is addressed through Approach 3, which uses the WASP 7/DAFLOW model to establish the load reductions needed to meet the water quality objective in Dundee Lake. The headwater areas outside the explicit model domain of the WASP 7/DAFLOW model are depicted as Approach 4 and are affected by the TMDL study because loads are contributed at the model boundaries and must be maintained at current or lower levels to ensure the TMDL is achieved.

Table 3. Sublist 5 and Sublist 3 stream segments in spatial extent of non-tidal Passaic River basin TMDL study

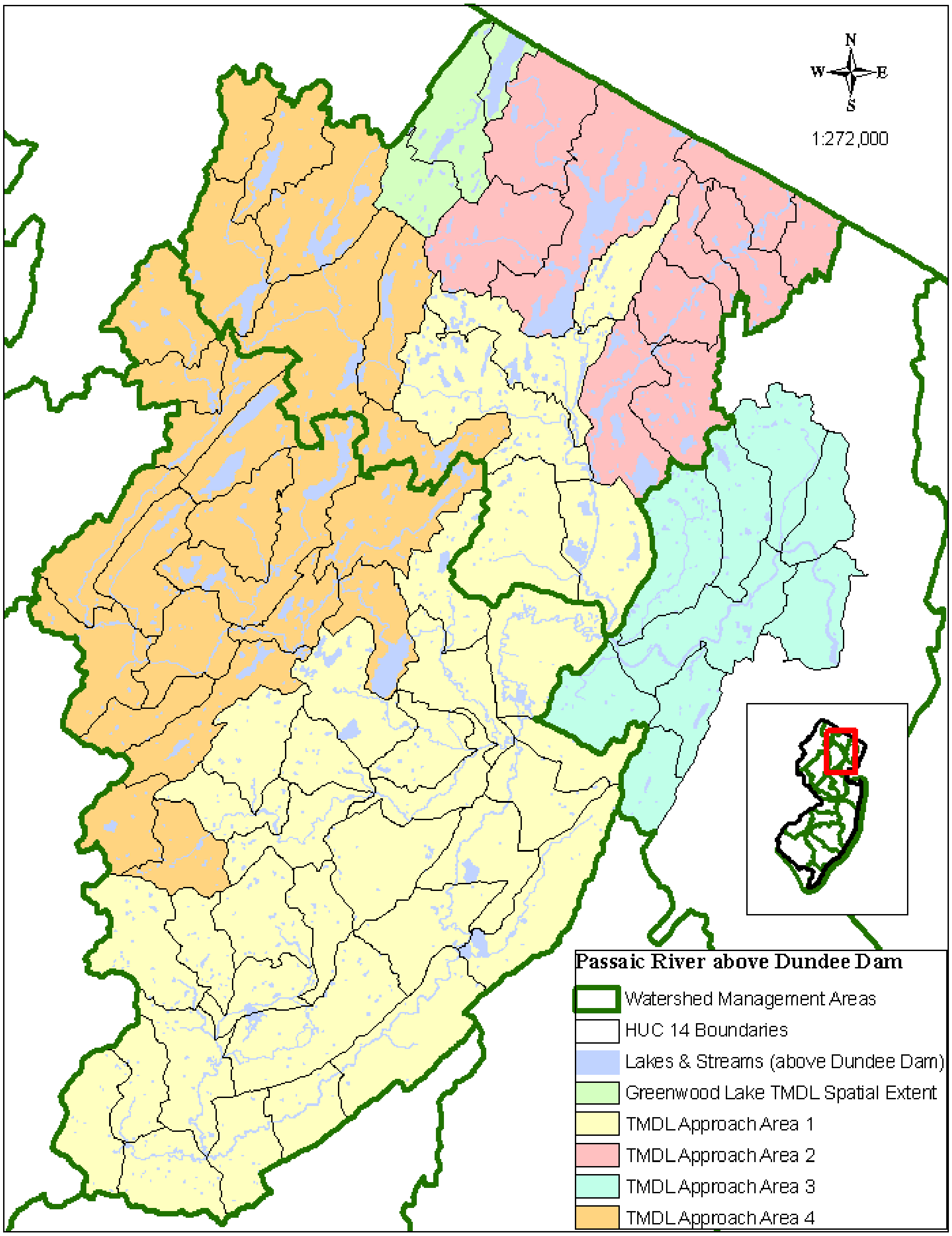
Site ID	Site Location and Waterbody/ General Description	Approx. River Miles
01388910	Pompton River at Rt 202 in Wayne	4.67
01388100	Ramapo River at Dawes Highway	1.88
01387500	Ramapo River near Mahwah	17.73
01387014	Wanaque River at Pompton Lakes	3.32
01387000	Wanaque River at Wanaque	0.55
01389880	Passaic River at Elmwood Park (combined with Passaic River at Merlot Ave in Fairlawn - 01389870)	13.73
01389500	Passaic River at Little Falls (combined with Passaic River at Singac - 01389130)	15.0
01389005	Passaic River Below Pompton River at Two Bridges	1.83
01378855	Black Brook at Madison	2.35
01379200	Dead River near Millington	21.86
EWQ0231	Passaic River at Eagle Rock Ave in East Hanover	10.33
01382000	Passaic River at Two Bridges	14.14
01379500	Passaic River near Chatham	14.90
01379000	Passaic River near Millington	5.17
01381200	Rockaway River at Pine Brook	6.77
01381500	Whippany River at Morristown	0.74
01381800	Whippany River near Pine Brook	6.61
01382800	Pequannock River at Riverdale	3.39
01388720	Pompton River Trib at Ryerson Rd	17.93
01389138	Deepavaal Brook at Fairfield	6.25
01389860	Diamond Brook at Fair Lawn	2.60
01389600	Peckman River at West Paterson	7.66
01389080	Preakness Brook near Little Falls	8.87
01379530	Canoe Brook near Summit	17.60
01379800	Green Pond Brook at Dover	4.48
01379853	Rockaway River at Blackwell St	6.08

Table 4. HUC 14 Assessment Units from *2006 Integrated List* addressed in this and related TMDL studies

WMA	HUC14	Subwatershed Name	Acres	TMDL Approach
03	Wanaque Reservoir-03	Wanaque Reservoir-03	NA	Area 2
03	02030103070020	Belcher Creek (Pinecliff Lake & below)	5782.4	Greenwood Lake
03	02030103070010	Belcher Creek (above Pinecliff Lake)	3480.1	Greenwood Lake
03	02030103070030	Wanaque R/Greenwood Lk (above Monks gage)	9360.3	Greenwood Lake, Area 2
03	02030103070070	Wanaque R/Posts Bk (below reservoir)	6915.9	Area 1
03	02030103110010	Lincoln Park tribs (Pompton River)	8394.4	Area 1
03	02030103110020	Pompton River	6963.2	Area 1
03	02030103050080	Pequannock R (below Macopin gage)	10835.8	Area 1
03	02030103070060	Meadow Brook/High Mountain Brook	3837.5	Area 1
03	02030103070050	Wanaque Reservoir (below Monks gage)	13749.4	Area 2
03	02030103100010	Ramapo R (above 74d 11m 00s)	3721.0	Area 2
03	02030103100040	Ramapo R (Bear Swamp Bk thru Fyke Bk)	3018.1	Area 2
03	02030103100030	Ramapo R (above Fyke Bk to 74d 11m 00s)	4305.5	Area 2
03	02030103100020	Masonicus Brook	2783.2	Area 2
03	02030103100050	Ramapo R (Crystal Lk br to Bear Swamp Bk)	4041.2	Area 2
03	02030103100070	Ramapo R (below Crystal Lake bridge)	7224.0	Area 2
03	02030103100060	Crystal Lake/Pond Brook	5509.0	Area 2
03	02030103070040	West Brook/Burnt Meadow Brook	7570.0	Area 2
03	02030103050030	Pequannock R (above Oak Ridge Res outlet)	6710.2	Area 4
03	02030103050060	Pequannock R (Macopin gage to Charl'brg)	5047.7	Area 4
03	02030103050010	Pequannock R (above Stockholm/Vernon Rd)	3464.2	Area 4
03	02030103050020	Pacock Brook	4590.8	Area 4
03	02030103050040	Clinton Reservoir/Mossmans Brook	8486.6	Area 4
03	02030103050050	Pequannock R (Charlotteburg to Oak Ridge)	11761.1	Area 4
03	02030103050070	Stone House Brook	4677.0	Area 4
04	Dundee Lake-04	Dundee Lake-04	NA	Area 3
04	02030103120070	Passaic R Lwr (Fair Lawn Ave to Goffle)	3590.6	Area 3
04	02030103120100	Passaic R Lwr (Goffle Bk to Pompton R)	7606.2	Area 3
04	02030103120080	Passaic R Lwr (Dundee Dam to F.L. Ave)	4784.0	Area 3
04	02030103120050	Goffle Brook	5657.9	Area 3
04	02030103120040	Molly Ann Brook	4994.2	Area 3
04	02030103120030	Preakness Brook / Naachtpunkt Brook	7121.1	Area 3
04	02030103120060	Deepavaal Brook	4867.7	Area 3
04	02030103120020	Peckman River (below CG Res trib)	3253.3	Area 3
04	02030103120010	Peckman River (above CG Res trib)	3217.2	Area 3
06	02030103040010	Passaic R Upr (Pompton R to Pine Bk)	7602.0	Area 1
06	02030103030170	Rockaway R (Passaic R to Boonton dam)	5138.4	Area 1
06	02030103020100	Whippany R (Rockaway R to Malapardis Bk)	3594.7	Area 1
06	02030103010180	Passaic R Upr (Pine Bk br to Rockaway)	3417.4	Area 1
06	02030103010170	Passaic R Upr (Rockaway to Hanover RR)	4412.7	Area 1
06	02030103020040	Whippany R(Lk Pocahontas to Wash Val Rd)	3594.5	Area 1

06	02030103020050	Whippany R (Malapardis to Lk Pocahontas)	4305.7	Area 1
06	02030103010160	Passaic R Upr (Hanover RR to Columbia Rd)	5479.7	Area 1
06	02030103010150	Passaic R Upr (Columbia Rd to 40d 45m)	5383.1	Area 1
06	02030103010060	Black Brook (Great Swamp NWR)	9089.8	Area 1
06	02030103010130	Passaic R Upr (40d 45m to Snyder Ave)	7958.8	Area 1
06	02030103010080	Dead River (above Harrisons Brook)	4864.6	Area 1
06	02030103010120	Passaic R Upr (Snyder to Plainfield Rd)	3471.7	Area 1
06	02030103010110	Passaic R Upr (Plainfield Rd to Dead R)	4278.7	Area 1
06	02030103010100	Dead River (below Harrisons Brook)	4949.9	Area 1
06	02030103030160	Montville tribs.	5065.5	Area 1
06	02030103010010	Passaic R Upr (above Osborn Mills)	6486.3	Area 1
06	02030103010020	Primrose Brook	3354.2	Area 1
06	02030103010070	Passaic R Upr (Dead R to Osborn Mills)	5694.0	Area 1
06	02030103020080	Troy Brook (above Reynolds Ave)	6439.2	Area 1
06	02030103020030	Greystone / Watnong Mtn tribs	4972.4	Area 1
06	02030103020090	Troy Brook (below Reynolds Ave)	3870.6	Area 1
06	02030103020060	Malapardis Brook	3256.4	Area 1
06	02030103010140	Canoe Brook	7691.3	Area 1
06	02030103020070	Black Brook (Hanover)	6644.3	Area 1
06	02030103010030	Great Brook (above Green Village Rd)	5071.5	Area 1
06	02030103010040	Loantaka Brook	3238.2	Area 1
06	02030103010050	Great Brook (below Green Village Rd)	3296.1	Area 1
06	02030103010090	Harrisons Brook	3485.2	Area 1
06	02030103030030	Rockaway R (above Longwood Lake outlet)	4288.8	Area 4
06	02030103030110	Beaver Brook (Morris County)	9453.2	Area 4
06	02030103030120	Den Brook	5769.4	Area 4
06	02030103030130	Stony Brook (Boonton)	7864.4	Area 4
06	02030103030040	Rockaway R (Stephens Bk to Longwood Lk)	5100.6	Area 4
06	02030103030140	Rockaway R (Stony Brook to BM 534 brdg)	3382.2	Area 4
06	02030103030150	Rockaway R (Boonton dam to Stony Brook)	4417.5	Area 4
06	02030103030080	Mill Brook (Morris Co)	3130.3	Area 4
06	02030103020010	Whippany R (above road at 74d 33m)	3875.7	Area 4
06	02030103020020	Whippany R (Wash. Valley Rd to 74d 33m)	4015.3	Area 4
06	02030103030010	Russia Brook (above Milton)	5478.7	Area 4
06	02030103030020	Russia Brook (below Milton)	3099.4	Area 4
06	02030103030050	Green Pond Brook (above Burnt Meadow Bk)	4721.3	Area 4
06	02030103030100	Hibernia Brook	5074.7	Area 4
06	02030103030060	Green Pond Brook (below Burnt Meadow Bk)	5055.7	Area 4
06	02030103030070	Rockaway R (74d 33m 30s to Stephens Bk)	5825.2	Area 4
06	02030103030090	Rockaway R (BM 534 brdg to 74d 33m 30s)	4692.5	Area 4

Figure 2. Spatial extent of non-tidal Passaic River basin study and related studies with modeling approach applied.



General description

The non-tidal Passaic River basin includes all of Watershed Management Areas 3 and 6, and a portion of Watershed Management Area 4, as described below:

Watershed Management Area 3

Watershed Management Area 3 (WMA 3) includes watersheds that drain the Highlands portion of New Jersey. WMA 3 lies mostly in Passaic County but also includes parts of Bergen, Morris, and Sussex Counties and is comprised of 21 municipalities that lie entirely or partially within the watershed boundary. There are four sub-watersheds in WMA 3: Pompton, Ramapo, Pequannock and Wanaque River watersheds. The Pequannock, Wanaque and Ramapo Rivers all flow into the Pompton River. The Pompton River is, in turn, a major tributary to the Upper Passaic River. WMA 3 contains some of the State's major water supply reservoir systems including the Wanaque Reservoir, the largest surface water reservoir in New Jersey.

The Pequannock River watershed is 30 miles long and has a drainage area of 90 square miles. The headwaters are in Sussex County and the Pequannock River flows east, delineating the Morris/Passaic County boundary line. The Pequannock River joins the Wanaque River and flows to the Pompton River in Wayne Township. Some of the major impoundments within this watershed are Kikeout Reservoir, Lake Kinnelon Reservoir, Clinton Reservoir, Canistear Reservoir, Oak Ridge Reservoir, and Echo Lake Reservoir. The great majority of the land within this watershed is forested and protected for water supply purposes or is parkland.

The Ramapo River and Pompton River watersheds comprise a drainage area of about 160 square miles; 110 square miles of which are in New York State. The Ramapo River flows from New York into Bergen County and enters the Pequannock River to form the Pompton River in Wayne Township. The Ramapo River is 15 miles long on the New Jersey side. The Pompton River, a tributary to the Passaic River, is 7 miles long. Some of the major impoundments within this watershed include Point View Reservoir #1, Pompton Lakes, and Pines Lake. Over one-half of this watershed is undeveloped; however, new development is extensive in many areas.

The Wanaque River watershed has a total drainage area of 108 square miles. The headwaters of the river lie within New York State as a minor tributary to Greenwood Lake (located half in New Jersey and half in New York). The New Jersey portion lies in West Milford, Passaic County. The Wanaque River joins up with the Pequannock River in Riverdale Township. The Wanaque River is 27 miles in length. Some of the major impoundments and lakes with this watershed are the Wanaque Reservoir, Monksville Reservoir, Greenwood Lake, and Arcadia Lake. Most of the land in this watershed is undeveloped, consisting of vacant lands, reservoirs, parks and farms.

The Wanaque Reservoir located in WMA 3 was completed in 1930 to serve as a water supply source to northern New Jersey municipalities. The reservoir is about 6 miles long and one mile wide with an area of 2300 acres of water surface and consists of 8 dams. The supporting documentation for this TMDL, prepared by Najarian Associates, describes the Wanaque Reservoir system as follows:

> The Wanaque and Monksville Reservoirs are owned and operated by the North Jersey District Water Supply Commission (NJDWSC). These two reservoirs comprise one of the largest water supply/storage systems in New Jersey. This system is the primary source of drinking water for much of Passaic, Essex, Bergen and Hudson Counties. Following the completion of the Wanaque South Project in the late 1980s, the long-term safe yield of this combined reservoir system was upgraded to 173 mgd. The system currently provides approximately 160 mgd of potable water supply to its customers (including other water companies).

Table 5. Description of Reservoirs

	Wanaque Reservoir	Monksville Reservoir
Water surface elevation	302.4 ft.	400.0 ft
Capacity of reservoir	29,630 mg	7,000 mg
Area of water surface	2,310 acres	505 acres
Width at widest point	1.2 mi	0.6
Length	6.6 mi	3.3 mi
Average width	0.5 mi	0.2 mi
Greatest depth	90 ft	100 ft
Average depth	37 ft	42 ft
Watershed area	90.1 mi^2	42.2 mi^2

> To maintain this yield, the Wanaque Reservoir utilizes inflows from three separate sources: (1) its natural tributary system, which includes the Monksville Reservoir; (2) the Pompton Lakes intake, which is located on the Ramapo River; and (3) the Two Bridges intake, which is located on the Pompton River about 750 feet upstream from the confluence with the Passaic River. The NJDWSC has the capability of pumping up to 150 mgd from the Pompton Lakes intake, and up to 250 mgd from the Two Bridges intake. By design, when the diversion from the Two Bridges intake exceeds the available flow in the Pompton River, this intake has the ability to reverse flows in the lowermost reach of the Pompton River and tap the locally impounded waters of the Passaic River. Thus, the entire upper Passaic watershed (with a drainage area of 361 square miles) becomes a contributing source to the Reservoir. To maintain water quality and protect users in the downstream portions of the Passaic, Pompton and Ramapo Rivers, the Department has implemented several restrictions on intake usage, including:

(a) no diversions during July and August unless there is a declared drought emergency; (b) no diversions from the Pompton Lakes intake when flows in the Ramapo River are below 40 mgd; and (c) no diversions when flows in the Passaic River at Little Falls are below 17.6 mgd (modified from Najarian (2005)).

Watershed Management Area 4

Watershed Management Area 4 (WMA 4) includes the Lower Passaic River (from the Pompton River confluence downstream to the Newark Bay) and its tributaries, including the Saddle River. The Saddle River is located in the tidal portion of the Passaic River Watershed, and is outside of the scope of the non-tidal Passaic studies. The WMA 4 drainage area is approximately 180 square miles and lies within portions of Passaic, Essex, Hudson, Morris and Bergen Counties.

The Lower Passaic River watershed originates from the confluence of the Pompton River downstream to the Newark Bay. This 33-mile section, of which approximately 16 miles is non-tidal, meanders through Bergen, Hudson, Passaic, and Essex Counties and includes a number of falls, including the Great Falls at Paterson.

Dundee Lake located in WMA 4 was created as a result of dam erected in 1859 by the Dundee Manufacturing Company replacing a smaller earlier dam, to harness the Passaic's water power and to make the river navigable from Newark to Paterson. The Dundee Dam curves 450 feet across the Passaic River and marks the boundary between the 17-mile tidal stretch of the Lower Passaic River to the river mouth at Newark Bay. Today, Dundee Dam and Lake are co-owned by the North Jersey District Water Supply Commission and the United Water Company. Dundee Lake is currently permitted for industrial water supply withdrawal.

Watershed Management Area 6

Watershed Management Area 6 (WMA 6) represents the area drained by waters from the upper reaches of the Passaic River Basin including the Passaic River from its headwaters in Morris County to the confluence of the Pompton River. Extensive suburban development and reliance upon ground water sources for water supply characterize WMA 6. WMA 6 lies in portions of Morris, Somerset, Sussex and Essex counties and includes the Upper and Middle Passaic River, Whippany River and Rockaway River watersheds.

The Upper Passaic River watershed is approximately 50 miles long and consists of a drainage area approximately 200 square miles in portions of Somerset, Morris, and Essex Counties. This section of the Passaic River is a significant source of drinking water for much of northeastern New Jersey. Major tributaries to the Upper Passaic River include the Dead River, Rockaway River, Whippany River, and Black Brook. The Great Swamp National Wildlife Refuge is located within the Upper Passaic River watershed. Approximately one-half of this watershed is undeveloped, including preserved open space, with the remainder primarily residential and commercial. This watershed is facing significant development pressure.

The approximately 11 square mile Middle Passaic River watershed includes Great Piece Meadows and Deepavaal Brook. The Great Piece Meadows is a freshwater wetland with a drainage area of approximately 12 square miles and is prone to flooding. Various owners privately own the Great Piece Meadows.

The Rockaway River watershed has a drainage area of approximately 133 square miles and is approximately 37 miles long. The Rockaway River flows east to its confluence with the Whippany River at Pine Brook. Major tributaries include Stone Brook, Mill Brook, Beaver Brook, and Den Brook. The land use patterns in this area are complex and include undeveloped areas, parklands, residential development and industrial/commercial uses.

The Whippany River watershed drains approximately 69 square miles and is located entirely within Morris County. The river is approximately 18 miles long and flows to the Passaic River. Two major tributaries are Black Brook and Troy Brook. The population is centered in Morristown, Parsippany-Troy Hills, Hanover Township and East Hanover Township.

Land use in the non-tidal Passaic River basin is depicted in Figure 3 and summarized in Table 6.

Figure 3. 2002 Land Use in the Passaic River above Dundee Dam

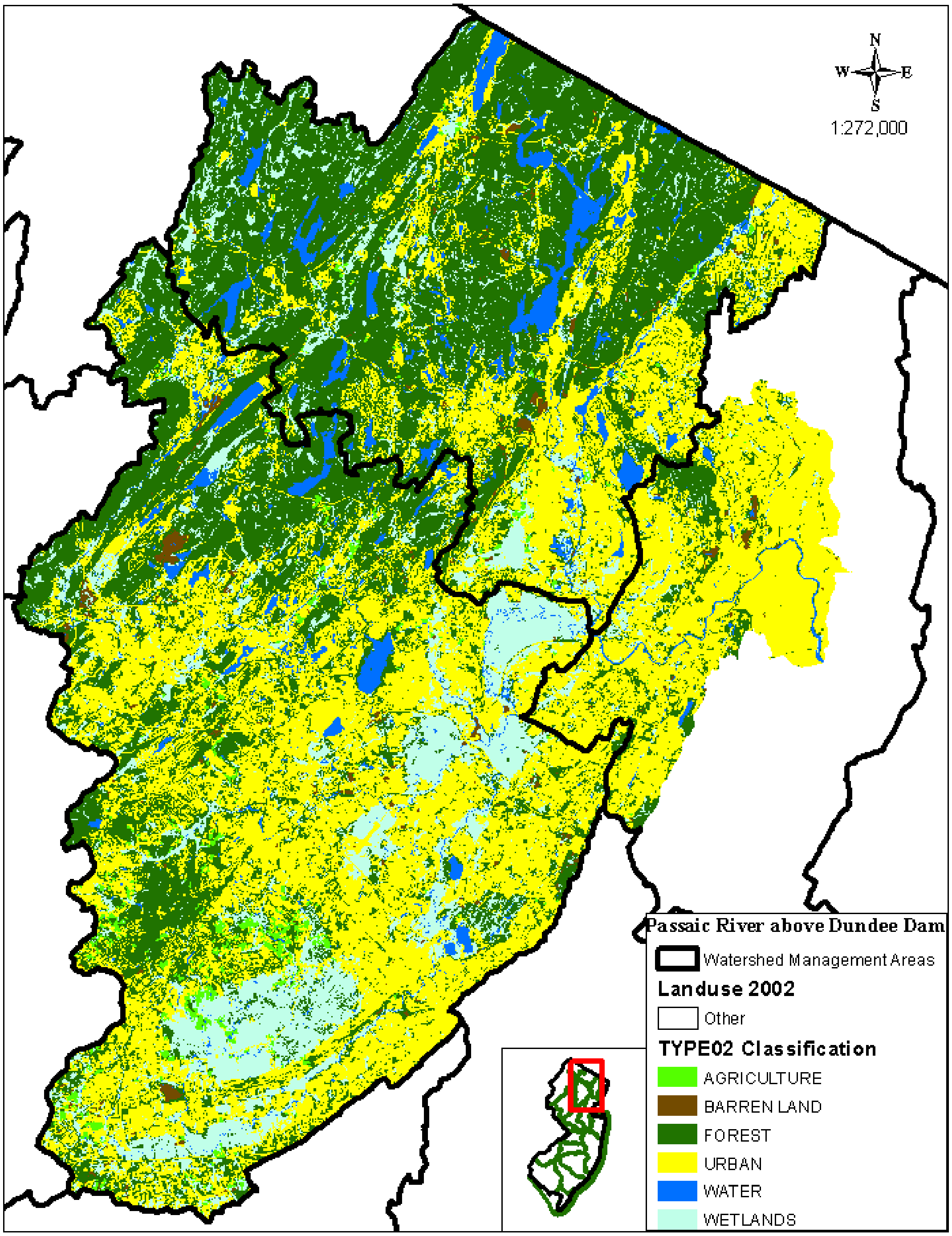


Table 6 . 2002 Land Use in the Passaic River above Dundee Dam

Land Use Classification (TYPE02)	Acres	Percent
Agriculture	281,138	1.8%
Barren Land	377,724	2.4%
Forest	4,221,843	26.8%
Urban	6,308,355	40.1%
Water	545,036	3.5%
Wetlands	4,002,509	25.4%
TOTAL	15,736,605	100%

4.0 Source Assessment

Point Sources

For the purposes of TMDL development, point sources include domestic and industrial wastewater treatment plants that discharge to surface water, combined sewer overflows, as well as stormwater discharges subject to regulation under the National Pollutant Discharge Elimination System (NPDES). This includes facilities with individual or general industrial stormwater permits and Tier A municipalities and state and county facilities regulated under the New Jersey Pollutant Discharge Elimination System (NJPDES) municipal stormwater permitting program. Point sources contributing phosphorus loads within the affected drainage area include the wastewater treatment facilities listed in Table 7 as well as combined sewer overflows and stormwater point sources, including the Tier A municipalities listed in Appendix B. Stormwater point sources, like nonpoint sources, derive their pollutant load from runoff from land surfaces and load reduction is accomplished through BMPs. The distinction is that stormwater point sources are regulated under the Clean Water Act. Combined sewer overflows are found in the City of Paterson within the spatial extent of this TMDL study. The loading from combined sewer overflows was determined and was an input to the water quality model for the study. The contribution from combined sewer overflows was found to be small and reduction of this load would result in no significant difference in the outcome. Therefore, the WLA for this source reflects the existing loading. This is a conservative assumption in that the measures required under the municipal stormwater permits will reduce the overland runoff component of CSOs.

The point sources identified in Table 7 will receive individual WLAs. Refer to Figure 4 for location of major point sources. The remaining point sources, which are stormwater point sources, are quantified with the nonpoint sources, as described below, but will be assigned a WLA that will be expressed as a percent reduction of loads associated with land uses that are more amenable achieving load reductions.

Table 7. Permitted Point Sources within the Non-Tidal Passaic River Basin that contribute TP

NJPDES Permit #	Facility Name	DSN	Effluent Permit Conditions (1), (2)			Flow (mgd) (3)	Loading (kg/day) (3)	Permitted Flow (mgd)
			Timeframe	TP (mg/l)	TP (kg/day)			
NJ0002577	NABISCO FAIR LAWN BAKERY	001A & 002A	Monthly Avg. Daily Max.	MR MR	---- ----	--	--	0.385
NJ0003476	EXXONMOBIL RESEARCH & ENGINEERING	005A	Monthly Avg. Daily Max.	1 MR	MR MR	0.0499	0.716	0.29
NJ0020281	CHATHAM HILL SEWAGE TREATMENT	001A	Monthly Avg. Weekly Avg.	---- ----	---- ----	0.0071	0.044	0.03
NJ0020290	CHATHAM TWP MAIN STP	001A	Monthly Avg.	1	----	0.6596	1.495	1
NJ0020427	CALDWELL BORO STP	001A	Monthly Avg. Weekly Avg.	4.2 / 4 MR	MR MR	3.3667	42.887	4.5
NJ0021083	VETERANS ADMIN MEDICAL CENTER-LYONS	001A	Monthly Avg. Weekly Avg.	1 MR	1.51 MR	0.0999	1.528	0.4
NJ0021091	JEFFERSON TWP HIGH-MIDDLE SCHOOL	001A	Monthly Avg. Weekly Avg.	1 1.5	0.1 0.16	0.0101	0.028	0.0275
NJ0021253	RAMAPO-INDIAN HILLS H.S. WTP	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.0068	0.009	0.0336
NJ0021342	OAKLAND-SKYVIEW-HIGH BROOK STP	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.013	0.003	0.023
NJ0021636	NEW PROVIDENCE WWTP	001A	Monthly Avg. Weekly Avg.	---- ----	---- ----	0.0275	0.208	1.5
NJ0022276	STONYBROOK SCHOOL	001A	Monthly Avg. Weekly Avg.	MR [1] MR	MR MR	0.0011	0.004	0.01
NJ0022284	KINNELON TWP HIGH SCHOOL - (4)	001A	Monthly Avg. Weekly Avg.	1 MR	0.113 MR	0.0051	0.037	0.03
NJ0022349	ROCKAWAY VALLEY REG SA	001A	Monthly Avg. Weekly Avg.	3.4 / 3.2 MR	MR MR	9.3	62.724	12
NJ0022489	WARREN TWP STAGE I-II STP	001A	Monthly Avg. Weekly Avg.	4.2 / 3.6 MR	MR MR	0.3344	3.74	0.47
NJ0022497	WARREN TWP STAGE IV STP	001A	Monthly Avg. Weekly Avg.	7.1 / 5.2 MR	MR MR	0.3129	5.857	0.8
NJ0022845	BERNARDS SA - HARRISON BROOK STP	001A	Monthly Avg. Weekly Avg.	5.2 / 5 MR	MR MR	1.7288	26.003	2.5
NJ0023698	POMPTON LAKES BOROUGH MUA	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.7377	0.814	1.2
NJ0024414	W MILFORD SHOPPING CENTER	001A	Monthly Avg. Weekly Avg.	1 MR	0.075 MR	0.0047	--	0.02
NJ0024457	OUR LADY OF THE MAGNIFICENT	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.0009	0.001	0.0012

NJ0024465	LONG HILL TWP-STIRLING HILLS STP	001A	Monthly Avg. Weekly Avg.	4.4 / 3.7 MR	MR MR	0.9091	10.627	0.9
NJ0024490	VERONA TWP STP	004A	Monthly Avg. Weekly Avg.	5.4 / 3.7 MR	MR MR	2.15	3.17	3
NJ0024511	LIVINGSTON TWP STP	001A	Monthly Avg. Weekly Avg.	4.3 / 3.9 MR	68.4/62 MR	2.8492	36.741	4.6
NJ0024902	HANOVER SEWERAGE AUTHORITY	001A	Monthly Avg. Weekly Avg.	5 / 4.5 MR	MR MR	1.9508	28.049	4.61
NJ0024911	MORRIS TWP - BUTTERWORTH STP	001A	Monthly Avg. Weekly Avg.	3.04 / 2.24 MR	MR MR	1.6506	10.773	3.3
NJ0024929	MORRIS TWP - WOODLAND STP	001A	Monthly Avg. Weekly Avg.	1 MR	7.6 MR	1.2567	2.979	2
NJ0024937	MADISON-CHATHAM JT MTG - MOLITOR	001A	Monthly Avg. Weekly Avg.	4.4 / 4 MR	MR MR	2.2971	34.579	3.5
NJ0024970	PARSIPPANY TROY HILLS	001A	Monthly Avg. Weekly Avg.	4.9 / 5 MR	MR MR	12.5092	152.045	16
NJ0025330	CEDAR GROVE TWP STP	001A	Monthly Avg.	4 / 3.5	----	1.21	1.9	2
NJ0025496	MORRISTOWN TOWN STP	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	2.9079	6.917	6.3
NJ0025518	FLORHAM PARK S.A.	001A	Monthly Avg. Weekly Avg.	3.3 / 2.9 MR	MR MR	0.8793	7.566	1.4
NJ0026174	W MILFORD TWP MUA - CRESCENT PARK STP	001A	Monthly Avg. Weekly Avg.	1 MR	---- ----	0.0284	--	0.064
NJ0026514	PLAINS PLAZA SHOPPING CENTER	001A	Monthly Avg. Weekly Avg.	---- ----	---- ----	0.0093	0.206	0.02
NJ0026689	NJDHS-GREYSTONE PARK PSYCH HOSP	001A	Monthly Avg. Weekly Avg.	1 MR	1.51 MR	0.2153	0.195	0.4
NJ0026867	JEFFERSON TWP-WHITE ROCK STP	001A	Monthly Avg. Weekly Avg.	1 MR	0.5 MR	0.0978	0.049	0.1295
NJ0027006	RINGWOOD ACRES STP	001A	Monthly Avg.	1	MR	0.0231	0.037	0.036
NJ0027201	REFLECTION LAKE GARDEN APTS	001A	Monthly Avg. Weekly Avg.	1 MR	0.02 MR	0.0013	--	0.005
NJ0027669	WEST MILFORD TWP MUA - AWOSTING	001A & 002A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.0623	--	0.045
NJ0027677	WEST MILFORD TWP MUA- OLDE MILFORD	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.097	--	0.172
NJ0027685	WEST MILFORD MUA-HIGHVIEW ACRES STP	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.0534	0.105	0.2
NJ0027774	OAKLAND-OAKWOOD KNOLLS WWTP	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.0177	0.003	0.035
NJ0027961	BERKELEY HTS WPCP	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	1.5494	23.018	3.1

NJ0028002	WAYNE TWP - MOUNTAIN VIEW	001A	Monthly Avg. Weekly Avg.	3.4 / 3.1 MR	---- ----	6.79	2.29	13.5
NJ0028291	ISP MANAGEMENT CO INC	001A	Monthly Avg. Weekly Avg.	---- ----	---- ----	--	--	0.05
NJ0028541	WEST MILFORD TWP MUA – BIRCHILL	001A	Monthly Avg. Weekly Avg.	1 MR	---- ----	0.0123	--	0.02
NJ0029386	TWO BRIDGES SEWERAGE AUTHORITY	001A	Monthly Avg. Weekly Avg.	5 / 5.3[1*] MR	MR MR	4.7503	64.459	10
NJ0029432	RINGWOOD BOE - ERSKINE SCHOOL	001A	Monthly Avg. Weekly Avg.	1 MR	---- ----	0.001	--	0.008
NJ0029858	OAKLAND CARE CENTER	001A	Monthly Avg.	1	0.11	0.0239	0.012	0.03
NJ0029912	NJDOT-HARDING REST AREA (Oct-April) - (5)	001A	Monthly Avg. Weekly Avg.	---- ----	---- ----	0.0014	0.007	0.025
NJ0032395	RINGWOOD PLAZA STP	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.0066	0.009	0.0117
NJ0050369	WARREN TWP STAGE V STP	001A	Monthly Avg. Weekly Avg.	7.1 / 5.1 MR	MR MR	0.1377	1.917	0.38
NJ0052256	CHATHAM TWP-CHATHAM GLEN STP	001A	Monthly Avg. Weekly Avg.	4.3 / 3.7 MR	MR MR	0.1214	1.591	0.155
NJ0053112	OAKLAND-CHAPEL HILL ESTATES STP	001A	Monthly Avg. Weekly Avg.	0.05 0.075	0.002 0.003	0.0069	0.001	0.01
NJ0053759	WANAQUE VALLEY REG S.A.	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.9181	1.152	1.25
NJ0080811	RAMAPO RIVER CLUB STP - Oakland Twp Riverbend	001A	Monthly Avg. Weekly Avg.	1 MR	MR MR	0.0696	0.018	0.1137
NJ0104451	BAYER CORPORATION	001A	Monthly Avg. Daily Max.	1 MR	---- ----	--	--	0.216
NJG0108880	PATERSON CITY - 31 CSOS	--	----	----	----	--	--	--

Footnotes:

(1) Current permit requirements as of April 19, 2007.

(2) Limitations or monitoring requirements with a "/" indicates the following limitations: Summer / Winter. Summer is applicable in the months of May through October. Winter limitations are applicable in the months of November through April. Limitations and monitoring requirements without a "/" apply year-round.

(3) Data summarized October 1, 1999 to November 30, 2003 (Omni Environmental, 2007)

(4) Permit revoked on October 25, 2005, due to connection to the Two Bridges Sewerage Authority W.W.T.P

(5) Permit revoked on September 30, 2003 due to connection to the Morris Township Woodland W.P.C.U.

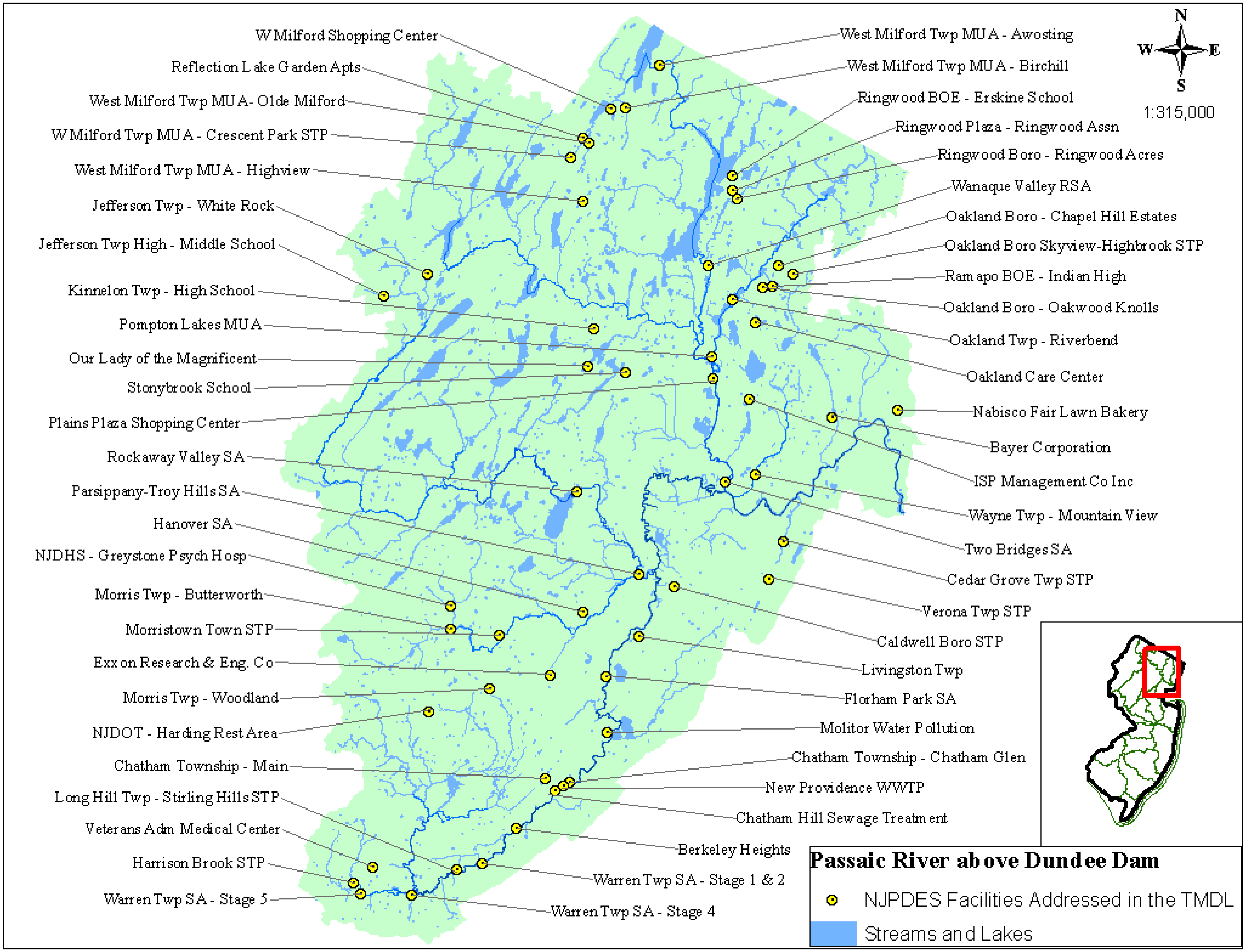
[1] Permit Condition of 1 mg/l for the monthly average TP concentration from January through December will become effective on June 1, 2011.

[1*] Permit Condition of 1 mg/l for the monthly average TP concentration from January through December will become effective at a flow of 9.639.mgd.

MR Monitor and report only.

---- Not required by permit condition.

Figure 4. NJPDES Point Source Discharges of Phosphorus in the Passaic River above Dundee Dam



Nonpoint Sources

For the purposes of TMDL development, potential nonpoint sources include stormwater discharges that are not subject to regulation under NPDES, such as Tier B municipalities, which are regulated under the NJPDES municipal stormwater permitting program, and direct stormwater runoff from land surfaces. Nonpoint sources can also include categories such as failing or inappropriately located septic systems and direct contributions from wildlife, livestock and pets. These sources are not assigned separate loads. They are adequately captured by the nonpoint source loading method described below. Tier B municipalities in the spatial extent are identified in Appendix B.

Within the WASP7 /DAFLOW modeled domain (Approach areas 1 and 3), nonpoint source contributions as well as storm driven point sources were quantified by separating stream flow into runoff and tributary baseflow. The nonpoint source loads were calculated based on the flow-weighted Event Mean Concentration (fEMCs) for each parameter and sub-basin, tributary baseflow concentrations for tributary baseflows, and an estimate of the individual contribution of surface flow and tributary baseflow from each sub-basin as determined through the hydrograph separation algorithm in WAMIT. The EMCs for NH3-N, NO3-N, OrgN, OrthoP, OrgP, DO and CBODu were calculated by averaging the data collected for this study from each storm event for each station, among storm events for each station, and lastly from different stations for each land use type (Table 8). The land use types are subdivided into residential, commercial, agricultural, forest, wetlands and barren.

Table 8. Runoff EMCs for Each Land Use Category

Constituent	Residential	Commercial	Agriculture	Wetlands	Forest*
NH3-N	0.16	0.21	0.10	0.12	0.04
NO3-N	0.94	0.65	1.42	0.76	0.26
Org-N	1.27	0.90	1.09	1.58	0.54
OrthoP	0.103	0.076	0.261	0.170	0.023
Org-P	0.217	0.149	0.183	0.186	0.064
CBOD5	2.7	4.2	3.8	5.9	1.3

* EMCs for barren land were not available for the storm water sampling events, and were assumed to be the same as forest EMCs.

Using both land use and State Soil Geographic (STASGO) layers, polygons were created consisting of different soil types and land uses. The areas of the polygons were calculated and an area-weighted curve number (CN) value was assigned to each individual polygon. By grouping areas with the same land use type, the area-weighted CN value was calculated based on the area of each polygon. These CN values estimate the amount of runoff flow that is generated by each land type in order to properly weight the EMCs for each sub-basin. Curve numbers were not used to calculate any flows for the model. Flows were provided by DAFLOW and separated into tributary baseflow and runoff. Curve numbers were used only to estimate the proportion of runoff flow that is generated by each land type in order to properly weight the EMCs for each sub-basin.

The tributary baseflow concentrations were not assumed to vary by land use type. Tributary baseflow as defined in this study is not primarily the direct discharge of groundwater to modeled streams. Tributary baseflow also reflects dry-weather discharge of tributaries within each contributing sub-basin. Tributary baseflow concentrations for constituents other than phosphorus are assumed to be constant throughout the basin, while tributary baseflow phosphorus concentrations are assumed to vary by the major stream branches (Tables 9 and 10).

Table 9. Tributary Baseflow Concentrations for Nutrients Other than Phosphorus

NH3-N (mg/l)	NO3-N (mg/l)	Org-N (mg/l)	CBOD5 (mg/l)	DO (mg/l)
0.09	0.56	0.09	2.0	3.0

Table 10. Watershed Specific Phosphorus Concentrations for Tributary Baseflow

Model Branch Groupings	TP (mg/l)	Ortho P (mg/l)
Forest Dominated (Wanaque River)	0.045	0.021
Major Tributaries (Pequannock, Ramapo, Pompton, Whippany, and Rockaway Rivers)	0.054	0.023
Upper Passaic / Minor Tributaries (Upper and Mid-Passaic River, Dead River, and Singac Brook)	0.063	0.022
Lower Passaic (Lower Passaic and Peckman Rivers)	0.060	0.031

The total volume of water from tributary baseflow and surface flow reaching the streams during a flow model time step (3 hours) is multiplied by the tributary baseflow concentrations and fEMCs to yield the nonpoint source load for each water quality parameter. For more detail on the estimation of nonpoint sources, refer to supporting documentation for this TMDL (Omni Environmental, 2007).

Within the Wanaque Reservoir direct drainage area and Pompton Lake watershed (Approach 2) a similar approach was used to evaluate nonpoint source contributions. Again the basis for this approach was a GIS analysis of the watershed's land uses and gauged USGS flow data, which was separated into baseflow and stormwater runoff components. However, EMCs were developed as part of a multi-year analysis using the unit area load (UAL) methodology rather than by the analysis of storm event water quality data. This approach provided EMCs on a composite basis for each subwatershed. EMCs for total phosphorus ranged from 0.13 mg/l in the more pristine subwatersheds (such as Ringwood Creek) to 0.30 mg/l in a more developed area (such as the Pompton Lakes subwatershed. Baseflow was assigned a constant concentration of 0.01 mg/l TP, which was found to be representative of base flow from a relatively pristine location in the watershed. For more information on this method of estimating nonpoint sources, refer to Najarian, 2005.

Table 11. UALs used to Estimate EMCs for Land Use Loads

Land Use Categories	UAL Coeff. (kg/hc/yr)	UAL Coeff. (lb/ac/yr)
Low Intensity Residential	0.7	0.623
High Intensity Residential	1.6	1.424
Comm./Ind./Trans	2/1.7/1	1.8/1.5/.9
Mixed Urban/Recreational	1.0	0.890
Crops/Pasture/Hay	1.5	1.335
Deciduous Forest	0.1	0.089
Evergreen Forest	0.1	0.089
Mixed Forest	0.1	0.089
Shrubland	0.1	0.089
Woody Wetlands	0.1	0.089
Herbaceous Wetlands	0.1	0.089
Open Water	0.1	0.089
Disturbed Areas	0.1	0.089

(modified from Najarian 2005)

5.0 Analytical Approach and TMDL Calculation

The non-tidal Passaic River Basin TMDLs are based on an integration of water quality and hydrodynamic models. A water quality model, Water Quality Analysis Simulation Program 7.0 (WASP 7), and a flow model, Diffusion Analogy Surface-Water Flow Model (DAFLOW), were used to simulate water quality and flow in the non-tidal Passaic River and its major tributaries: Dead River, Whippany River, Rockaway River, Pompton River mainstem, Ramapo River downstream of Pompton Lake, Wanaque River downstream of the Wanaque Reservoir, a small stream segment of the Pequannock River, Singac Brook, and Peckman River. The WASP 7 model is a dynamic compartment model that can be used to predict a variety of water quality responses due to natural phenomena and man-made pollution for diverse aquatic systems, such as rivers, reservoirs, lakes, and coastal waters. The model includes time varying processes of advection, dispersion, point and diffuse mass loading, and boundary exchange. WASP 7 uses as inputs time series of flow, pollutant loads and several water quality parameters (Omni Environmental, 2007). DAFLOW model is a one-dimensional transport model designed to simulate flow by solving the diffusion analogy form of the flow equation. DAFLOW was developed by USGS and enhanced by USGS for this study (Spitz, 2007). The flow model routes water downstream using time series inputs from streamflow gauges, discharges and diversions and incremental flows from tributaries and subbasins along the mainstem. A graphical watershed model integration tool (WAMIT) was developed for data sharing and model input calculation between WASP 7 and DAFLOW (Omni Environmental 2007). WAMIT includes algorithms to calculate nonpoint source loads as a function of tributary baseflow and surface waters given by a hydrograph separation scheme, sub-basin characteristics and flow-weighted runoff concentrations for different land use types, as described above under nonpoint source loads.

The LA-WATERS (Laterally Averaged - Wind and Temperature Enhanced Reservoir Simulation) model was used to link loading with concentration response in the Wanaque Reservoir. LA-WATERS is a two-dimensional (longitudinal and vertical) hydrothermal/water quality model. It was successfully calibrated to the Wanaque Reservoir using data collected as part of the Wanaque South water supply project (Najarian Associates, 1988), and then re-validated (Najarian Associates, 2000). A detailed description of LA-WATERS is provided in Najarian (1988). A simulation of baseline (existing) conditions was conducted over the selected 10-year period (1993-2002) using water quality data obtained from North Jersey District Water Supply Commission (NJDWSC), USGS and Passaic Valley Water Commission (PVWC), flow data from USGS gauging stations, pumping data from NJDWSC and meteorological data from National Climatic Data Center's Newark International Airport weather station. In response to model inputs, LA-WATERS simulates laterally averaged velocities, water temperature and constituent concentrations at all grid locations for a selected period. Simulated constituents include organic phosphorus, dissolved inorganic phosphorus, particulate inorganic phosphorus, dissolved oxygen, carbonaceous biological oxygen demand, nitrogenous biological oxygen demand and temperature. As indicated, the reservoir endpoint is based on chlorophyll-*a* concentration. A discussion of the phosphorus – chlorophyll-*a* relationship in the Wanaque Reservoir is provided in a report addendum (Najarian Associates, 2007).

To conduct future simulations of water quality in the Wanaque Reservoir, loadings were estimated in two ways. A time series of daily in-stream total phosphorus and dissolved phosphorus concentrations developed for Approach Area 1 (Omni 2007), described above, was used with the daily schedule of Wanaque South diversions to develop one portion of the reservoir's loading input. The diversion load from the

Pompton Lakes intake and the reservoir's direct tributary load were developed using a simple mass-balance model. The mass-balance model was based on an input of observed USGS flow data, reported discharger monitoring data and GIS-based non-point source assessment using hydrograph separation, a UAL-based EMC for storm flows and a separate concentration for groundwater contributions. This approach was verified using an 11-year time series (from 1992 through 2002) of observed in-stream concentrations (Najarian 2005, Litwack et al. 2006).

More detailed discussion on the above models is available in the supporting documents for this TMDL prepared under contract to the Department by Najarian Associates (Najarian 2005 and 2007), Omni Environmental (Omni, 2007), and (Spitz, 2007).

Certain boundary premises were factored into this TMDL study, as follows. TMDLs have been established for Verona Park Lake (NJDEP 2003) and Greenwood Lake (NJDEP 2004), which are within the drainage area for this TMDL study. The loading from the Greenwood Lake drainage area reflects the loading reductions needed to attain the SWQS, as specified in that TMDL. Further, water quality modeling of the Peckman River assumes attainment of the SWQS in Verona Park Lake. The companion TMDL document for Pompton Lake and associated drainage area provides inputs to this TMDL study. The Pompton Lake TMDL study includes the Ramapo River, which originates in New York and enters New Jersey with a significant phosphorus load and concentrations in excess of the SWQS. As a boundary condition for the Pompton Lake TMDL study, it was assumed that the water quality will attain New Jersey's SWQS at the border, represented by the quality measured at the Ramapo at Mahwah monitoring station. As the Ramapo River currently enters New Jersey with phosphorus concentrations in excess of the standards, it will be necessary for New York to implement measures to reduce phosphorus loads in order to realize this boundary condition. Recently, New York issued a permit for the Western Ramapo treatment facility, which is currently under construction. This facility will replace some smaller facilities and, with an effluent limit of 0.2 mg/l, will result in an overall reduction in point source phosphorus load in the Ramapo River. However, it is expected that reductions in NPS will be needed for full attainment of the boundary condition. This assumption is important for demonstrating compliance at the Mahwah station, which is in the spatial extent of the Pompton Lake/Ramapo River TMDL study. However, inputs to the non-tidal Passaic River basin TMDL study are taken from the anticipated quality of water leaving Pompton Lake, assuming the TMDL condition is achieved. This latter water quality is dependent primarily on load reductions called for in the New Jersey portion of the drainage area, as quality improves downstream of Mahwah.

Seasonal Variation, Critical Conditions, MOS and Reserve Capacity

A TMDL must account for critical conditions and seasonal variations. The summer season is the critical period for biological activity, algal blooms and associated oxygen effects (excessive swings and/or dips below criterion). Yet winter and early spring are the times when, due to diversions from the Pompton and Passaic Rivers, phosphorus loadings to the Wanaque Reservoir are usually highest. As a result, load reductions must be required year-round for sources that contribute loads to the Wanaque Reservoir. Critical conditions and seasonal variation were addressed through inclusion of a simulation period that included extreme hydrologic conditions, such as the hot, dry summer of WY2001 and the water supply drought of WY2002, during which diversions from the Pompton and Passaic were much greater than normal in winter and spring. In addition, the simulation of future conditions assumes wastewater treatment facilities are at full permitted capacity and that pumping into the Wanaque Reservoir is consistent with the full permitted water supply allocation of 173 mgd. At the Dundee Lake critical location, the critical period is during the growing season. Simulations indicate that phosphorus reductions from wastewater treatment facilities outside the months of May through October have no effect on the observed seasonal average chlorophyll-*a* levels, due to the riverine nature of Dundee Lake. Therefore, below the confluence of the Pompton and Passaic Rivers, seasonal effluent limits (May through October) are consistent with achieving the watershed criterion for Dundee Lake.

In the development of a TMDL, Section 303(d) of Clean Water Act requires specification of a Margin of Safety (MOS) – an unallocated portion of the assimilative capacity. A MOS is needed to account for a "lack of knowledge concerning the relationship between effluent limitations and water quality" (33 U.S.C. 1313(d)). In particular, a MOS accounts for uncertainties in the loading estimates, physical parameters and the linked models themselves. The MOS, as described in USEPA guidance (Sutfin, 2002), can be either explicit or implicit (i.e., addressed through conservative assumptions used in establishing the TMDL). Reserve capacity is an optional means of reserving a portion of the loading capacity to allow for future growth. An implicit MOS and reserve capacity are included by setting the chlorophyll-*a* targets below the proposed watershed criteria for the Wanaque Reservoir and Dundee Lake. Specifically, the targets are reduced to 9.6 μg/L and 19 μg/L in the Wanaque Reservoir and Dundee Lake, respectively, for the MOS. The targets are reduced to 9.2 μg/L and 18 μg/L in the Wanaque Reservoir and Dundee Lake, respectively, for a reserve capacity. The reserve capacity is established even though there is considerable unutilized capacity in existing wastewater treatment facilities to account for as yet unknown future new or expanded treatment facilities. The allocation of loading capacity, including the WLAs and LAs identified in this report, will achieve a chlorophyll-*a* level of 9.2 μg/L in the Wanaque Reservoir and 18 μg/L chlorophyll-*a* in Dundee Lake, on a seasonal average basis. This is compared to the proposed watershed criteria of 10 μg/L and 20 μg/L, respectively in these locations. There are additional conservative assumptions that provide an additional implicit MOS. Reductions in sources are not assumed in Approach Area 4 or from CSOs, yet reductions are expected as a result of implementing the minimum measures required in municipal stormwater permits.

Allocation of Loading Capacity

WLAs are established for all point sources, while LAs are established for nonpoint sources, as these terms are defined in "Source Assessment."

Stormwater discharges can be a point source or a nonpoint source, depending on NPDES regulatory jurisdiction, yet the suite of measures to achieve reduction of loads from stormwater discharges is the same, regardless of this distinction. Stormwater point sources receiving a WLA are distinguished from stormwater generating 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, with stormwater from urban land use types given wasteload allocations and stormwater from other land use types given load allocations. 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 urban land use 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.

Loads from some land uses, specifically forest, wetland, water and barren land are not readily adjustable. As a result, existing loads from these sources have been set equal to the future loads. Therefore, the overall load reduction required from land uses is obtained from land uses for which reduction measures are more practicable. Nonpoint source load reductions range from 0 to 85 percent, depending on the Approach Area. Nonpoint source loads were assumed to remain constant from the land areas in Approach Area 4, because this area is a boundary condition for Approach Area 1. Approach Area 1 requires a nonpoint source load reduction of 60 percent, except for the Greenwood Lake drainage area where a nonpoint source load reduction of 43 percent is required, with an overall reduction of 54 percent for that combined area. The Pompton Lake drainage area requires an 80 percent nonpoint source reduction, as described in the companion TMDL report for that area. The TMDL for Verona Park Lake required an 85 percent TP load reduction, and this drainage area is a boundary input to Approach Area 3.

Allocation of the loading capacity for the two critical locations is presented in Tables 12 and 13. Individual WLAs are set forth in Table 14.

Table 12. Distribution of WLAs and LAs among source categories for the Non-Tidal Passaic River Downstream of Wanaque Reservoir

Long Term Average Daily (kg/d TP)	Pompton River Basin			Upper/Mid Passaic River Basin			Lower Passaic River Basin			Total		
	Existing Condition	TMDL Allocation	Percent Reduction	Existing Condition	TMDL Allocation	Percent Reduction	Existing Condition	TMDL Allocation	Percent Reduction	Existing Condition	TMDL Allocation	Percent Reduction
Wasteload Allocations (WLAs)												
Wastewater from STP Dischargers	61	19	69%	435[1]	104[1]	76%	92	29	69%	588	152	74%
Stormwater from Residential Land Use Areas	9.5	4.5	53%	24.1	9.6	60%	8.1	3.2	60%	42	17	60%
Stormwater from Other Urban Land Use Areas	9.5	4.4	54%	24.9	10.0	60%	9.5	3.8	60%	44	18	60%
CSO Discharges	0	0	N/A	0	0	N/A	4.9	4.9	0%	4.9	4.9	0%
Load Allocations (LAs)												
Headwater Boundaries	72	26	64%[3]	26[2]	26[2]	0%	5.7	4.9	13%[4]	104	57	45%
Tributary Baseflow	7.5	7.5	0%	21.6	21.6	0%	6.3	6.3	0%	35	35	0%
Stormwater from Agricultural Land Use Areas	0.5	0.2	60%	1.2	0.5	60%	0.0	0.0	0%	1.8	0.7	60%
Stormwater from Forest and Barren Land Use Areas	1.1	1.1	0%	0.8	0.8	0%	0.2	0.2	0%	2.1	2.1	0%
Stormwater from Wetlands Land Use Areas	8.5	8.5	0%	14.2	14.2	0%	0.7	0.7	0%	23	23	0%
Loading Capacity (LC′)	**170**	**71**	**58%**	**549**	**187**	**66%**	**127**	**53**	**58%**	**845**	**310**	**63%**

1 WLAs for Chatham Township – Main (1.51kg/d) and Morris Twp – Woodland (3.03kg/d) were added to the total WLAs of the Upper/Mid Passaic River Basin
2 WLAs for Chatham Township – Main (1.51kg/d) and Morris Twp – Woodland (3.03kg/d) were subtracted from the total LAs of the Upper/Mid Passaic River Basin
3 Implementation of percent reduction through Pompton Lake and the Wanaque Reservoir TMDLs
4 Implementation of percent reduction through Verona Park Lake TMDL

Table 13. Distribution of WLAs and LAs among source categories for the Wanaque Reservoir critical location

	TMDL Allocation Type	Existing Conditions[1] **Total watershed	Existing Conditions[1] Wanaque Reservoir only	**Post-TMDL allocations	TMDL Specification* Wanaque Reservoir only		
		kg TP/day	kg TP/day	kg TP/day	kg TP/day	% of LC	Percent Reduction[2]
Loading Capacity (LC)		59.00		25.22		-	57%
Point Sources other than Stormwater							
NJPDES Dischargers[3]	WLA	0.32	0.13	0.19[4]	0.08[4]	0.3%	38%
Loading from Intake Diversions							
Diversions from Ramapo River[5]	LA	3.23	3.23	0.68	0.68	2.7%	79%
Diversions from Two Bridges[6]	LA	37.48	37.48	11.20	11.20	44.4%	70%
Internal Loading							
Sediment/Base Flow	LA	3.14	1.79	3.14	1.79	7.1%	0%
Greenwood Lake input	LA	-	7.82	-	4.67	23.9%	Greenwood Lake TMDL
Land Use Surface Runoff[7]							
Low Intensity Residential	WLA	1.90	1.08	0.88	0.43	1.7%	60%
High Intensity Residential	WLA	4.14	2.36	1.91	0.95	3.7%	60%
Commercial/Industrial/Transportation	WLA	1.82	1.04	0.84	0.42	1.6%	60%
Mixed Urban/Recreational	WLA	0.67	0.38	0.31	0.15	0.6%	60%
Crops/Pasture/Hay	LA	0.56	0.32	0.25	0.13	0.5%	60%
Deciduous Forest	LA	3.37	1.93	3.37	1.93	7.6%	0%
Evergreen Forest	LA	0.34	0.19	0.34	0.19	0.8%	0%
Mixed Forest	LA	0.83	0.47	0.83	0.47	1.9%	0%
Shrubland	LA	0.05	0.05	0.05	0.05	0.2%	0%
Woody Wetlands	LA	0.29	0.17	0.29	0.17	0.7%	0%
Herbaceous Wetlands	LA	0.03	0.02	0.03	0.02	0.1%	0%
Open Water	LA	0.67	0.38	0.67	0.38	1.5%	0%
Disturbed Areas	LA	0.16	0.16	0.16	0.16	0.6%	0%

* an implicit MOS and Reserve Capacity has been specified in terms of chlorophyll-*a* level achieved compared to target.

** The total watershed for the Wanaque Reservoir includes the Greenwood Lake drainage area. Greenwood Lake and its drainage area were addressed in a previously established TMDL by NJDEP that was approved by EPA on September 29, 2004. The loads from the Greenwood drainage area are taken as boundary conditions and input into the Wanaque Reservoir TMDL.

1 average annual loads for existing conditions based on 1993-2002 model simulation

2 = 1 - (TMDL load /Existing load)*100

3 WLA for 2 facilities within Reservoir tributary watershed downstream from the Greenwood Lake TMDL (2004)

4 The mathematic error 0.20 kg TP/day has been corrected to 0.27 kg TP/day.

5 diversion load typically equals 3%-5% of the annual river load - for river load see Table 6.2 (Najarian 2005)

6 phosphorus concentrations at diversion intake were computed per Omni Environmental, 2007

7 see Table 6.9 for associated land use areas (Najarian 2005)

Table 14. Point Sources assigned individual WLAs for Phosphorus based on TMDL Study

NJPDES Permit Number	Facility Name	**TMDL Approach**	Permitted Flow (MGD)	TMDL Wasteload Allocation	
				Long Term Average Conc. (mg/l TP)	WLA (Kg/d TP)
NJ0003476	Exxon Research & Eng Co	Approach 1	0.29	0.4	0.4
NJ0020281	Chatham Hill STP	Approach 1	0.03	0.4	0.05
NJ0020290	Chatham Township – Main (2)	Approach 1	1	0.4	1.5
NJ0020427	Caldwell Boro STP	Approach 1	4.5	0.4	6.8
NJ0021083	Veterans Adm Medical Center	Approach 1	0.4	0.4	0.61
NJ0021636	New Providence Boro	Approach 1	1.5	EEQ	de minimus
NJ0022349	Rockaway Valley SA	Approach 1	12	0.4	18.2
NJ0022489	Warren Twp SA - Stage 1 & 2	Approach 1	0.47	0.4	0.7
NJ0022497	Warren Twp SA - Stage 4	Approach 1	0.8	0.4	1.2
NJ0022845	Harrison Brook STP	Approach 1	2.5	0.4	3.8
NJ0023698	Pompton Lakes MUA	Approach 1	1.2	0.4	1.8
NJ0024465	Long Hill Twp STP - Stirling Hills	Approach 1	0.9	0.4	1.4
NJ0024511	Livingston Twp	Approach 1	4.6	0.4	7.0
NJ0024902	Hanover SA	Approach 1	4.61	0.4	7.0
NJ0024911	Morris Twp – Butterworth	Approach 1	3.3	0.4	5.0
NJ0024929	Morris Twp – Woodland (2)	Approach 1	2	0.4	3.03
NJ0024937	Molitor Water Pollution	Approach 1	3.5	0.4	5.3
NJ0024970	Parsippany-Troy Hills SA	Approach 1	16	0.4	24.2
NJ0025496	Morristown Town STP	Approach 1	6.3	0.4	9.5
NJ0025518	Florham Park SA	Approach 1	1.4	0.4	2.1
NJ0026514	Plains Plaza Shopping Center	Approach 1	0.02	0.4	0.03
NJ0026689	NJDHS – Greystone Psych Hosp	Approach 1	0.4	0.4	0.6
NJ0027006	Ringwood Boro – Ringwood Acres	Approach 1	0.036	0.4	0.05
NJ0027961	Berkeley Heights	Approach 1	3.1	0.4	4.7
NJ0028291	ISP Management Co Inc	Approach 1	0.05	Treated at Wayne (NJ0028002)	
NJ0029386	Two Bridges SA	Approach 1	10	0.4	15.1
NJ0032395	Ringwood Plaza - Ringwood Assn	Approach 1	0.01168	0.4	0.02
NJ0050369	Warren Twp SA - Stage 5	Approach 1	0.38	0.4	0.6
NJ0052256	Chatham Township - Chatham Glen	Approach 1	0.155	0.4	0.23
NJ0053759	Wanaque Valley RSA	Approach 1	1.25	0.4	1.9
	Total for Approach 1		**82.7**		**122.8**
NJ0021253	Ramapo BOE - Indian High(7)	Approach 2	0.0336	0.4	0.05
NJ0021342	Oakland Boro Skyview-Highbrook STP(7)	Approach 2	0.023	0.4	0.03
NJ0027669	West Milford Twp MUA – Awosting (6)	Approach 2	0.045	0.4	0.07
NJ0027774	Oakland Boro - Oakwood Knolls(6)	Approach 2	0.035	0.4	0.05
NJ0029432	Ringwood BOE – Erskine School(7)	Approach 2	0.008	0.4	0.01

NJ0029858	Oakland Care Center(7)	Approach 2	0.03	0.4	0.05
NJ0053112	Oakland Boro - Chapel Hill Estates(7)	Approach 2	0.01	0.4	0.02
NJ0080811	Ramapo River Club STP - Oakland Twp Riverbend(7)	Approach 2	0.1137	0.4	0.17
	Total for Approach 2		**0.3**		**0.45**
NJ0002577	Nabisco Fair Lawn Bakery (1)	Approach 3	0.385	0.4	0.6
NJ0024490	Verona Twp STP (1)	Approach 3	3	0.4	4.5
NJ0025330	Cedar Grove Twp STP (1)	Approach 3	2	0.4	3.0
NJ0028002	Wayne Twp - Mountain View (1)	Approach 3	13.5	0.4	20.4
NJ0104451	Bayer Corporation (1)	Approach 3	0.216	0.4	0.33
NJG0108880	Paterson City - 31 CSOs	Approach 3	N/A	N/A	4.9
	Total for Approach 3				**33.7**
NJ0021091	Jefferson Twp High - Middle School (3)	Approach 4	0.0275	see Table 7 for permit limits	0.10
NJ0022276	Stonybrook School (3)	Approach 4	0.01	see Table 7 for permit limits	0.04
NJ0024457	Our Lady of Magnificent School (3)	Approach 4	0.0012	see Table 7 for permit limits	0.005
NJ0026867	Jefferson Twp – White Rock (3)	Approach 4	0.1295	see Table 7 for permit limits	0.49
NJ0027685	West Milford Twp MUA – Highview (3)	Approach 4	0.2	see Table 7 for permit limits	0.76
	Total for Approach 4		**0.37**		**1.4**
NJ0024414	W Milford Shopping Center (4)	Greenwood Lake		Greenwood Lake TMDL	0.013
NJ0026174	W Milford Twp MUA - Crescent Park STP (4)	Greenwood Lake		Greenwood Lake TMDL	0.082
NJ0027201	Reflection Lake Garden Apts (4)	Greenwood Lake		Greenwood Lake TMDL	0.003
NJ0027677	West Milford Twp MUA- Olde Milford (4)	Greenwood Lake		Greenwood Lake TMDL	0.248
NJ0028541	West Milford Twp MUA – Birchill (4)	Greenwood Lake		Greenwood Lake TMDL	0.033
	Total from Greenwood Lake TMDL				**0.378**

(1) These dischargers are located in the Lower Passaic River Basin, downstream of the Passaic and Pompton Rivers. Based on the TMDL Analysis, a seasonal effluent limit (May through October) is applicable.
(2) These two facilities are located in the Great Swamp watershed and are included in the Passaic River headwater load allocation. Based on the analysis provided in Appendix D (Omni Environmental, 2007), WLAs are established for these facilities based on a LTA of 0.4 mg/l total phosphorus.
(3) These five discharge facilities are located outside model boundaries. Because of the fact that the TP loads generated by these dischargers are insignificant when compared to the boundary loads, the impact of these dischargers is de minimus. For example, assuming no natural TP load attenuation, the average total permitted load from these facilities is less than 0.71% of the total boundary load. Therefore, the WLAs established for these facilities are based on permitted flow and monthly average concentration in accordance with current permit conditions. The effluent limits set forth in the applicable NJPDES permits will remain in effect.
(4) These discharges are located within the spatial extent of the EPA approved Greenwood Lake TMDL; thus the waste load allocations set in the Greenwood Lake TMDL, which shall be expressed as load limits, apply. These loads are accounted for in the Greenwood Lake boundary condition.

(5) TP Load is based on average existing flow and concentration. Note, to estimate the loads entering Greenwood Lake, the estimated loads from the three discharges located upstream of Pinecliff Lake (i.e., W Milford Twp MUA - Crescent Park STP, Reflection Lake Garden Apartments and West Milford Twp MUA- Olde Milford) were multiplied by 0.44 to account for the retention effect of Pinecliff Lake on phosphorus, therefore the net TP load from these dischargers entering the Greenwood Lake would be0 .19kg/d as shown in table 13.
(6) These dischargers are located in the Wanaque Reservoir Watershed
(7) These dischargers are located in the Pompton Lake Watershed; see Pompton Lake/Ramapo River TMDL for complete description

In a Department review of the active NJPDES surface water point source discharges that contain phosphorus within the Passaic River basin above Dundee Dam, two facilities were found that required further description. The first is New Providence Borough STP (NJ0021636). The New Providence STP is a sanitary wastewater treatment plant that transfers all of the wastewater up to 3.0 MGD to the Joint Meeting of Essex and Union County STP (NJ0024741). The wastewater is discharged to the Passaic River only during heavy wet weather events when wastewater flows are above 3.0 MGD. Because of the intermittent nature of this discharge, the load is de minimus and did not figure into the modeled loads. Therefore, New Providence STP will be assigned a WLA of "0" and will be required to maintain existing effluent quality. Additionally, the facility will not qualify for water quality trading described in the second paragraph below. The second is ISP Management Co. Inc. (NJ0028291), which is an industrial surface water discharge with a sanitary component. Under a Department issued Treatment Works Approval (TWA), the ISP Management Co. Inc. surface water discharge will cease in the near future when the facility ties into the Wayne Twp. Mountain View STP (NJ0028002). Therefore, ISP Management Co. Inc. is addressed within the Wayne Twp. Mountain View STP calculation in the TMDL. Should the ISP Management Co. facility not tie into Wayne Twp. Mountain View STP, the discharge would be subject to the 0.4 mg/l total phosphorus LTA concentration limit.

The assignment of WLAs to point sources, other than stormwater point sources, is based on each source discharging at the permitted capacity at the same long term average effluent concentration. WLAs must be expressed as a daily load in accordance and with EPA requirements. However, effluent concentrations can and do vary on a daily basis. This variation can occur and still achieve the water quality objective provided that, on balance, reductions in point and nonpoint source loads on a long term basis conform to those needed to attain the watershed criteria that have been established through this TMDL. Except as noted below, for wastewater treatment facilities within the WASP 7/DAFLOW (Omni Environmental, 2007) and mass balance (Najarian 2005, as amended) model domains, the Department will establish year-round concentration-only effluent limits determined by applying EPA's *Technical Support Document for Water Quality-Based Toxics Control* (USEPA, 1991) methodology to the LTA of 0.4 mg/l, with a minimum of a 4 times per month sampling frequency and a coefficient of variation equal to the default value of 0.6. For these facilities, the resulting monthly average effluent limit will be 0.76 mg/l. Treatment facilities below the confluence of the Pompton and Passaic Rivers, as identified in Table 14, qualify for seasonal limits, applicable from May through October, as discussed above. Treatment facilities addressed in the Greenwood Lake TMDL will retain the WLAs and effluent limits set forth in that TMDL report. There are five treatment facilities identified in Table 14 that are outside the model domains. In order to maintain the boundary conditions, these facilities will be assigned a WLA consistent with the current permit limits. While this represents a small increase compared to the existing load contributed by these facilities, both the existing loads and the increased loads are de minimus relative to the overall boundary load (less than 0.71%). In addition, four of the facilities discharge to an impoundment, which would significantly mask any contribution from these facilities.

Dischargers will be allowed to engage in water quality trading negotiations to effect a change in effluent limits, with Department approval. It should be noted that, in June 2005 EPA awarded a Targeted Watershed grant in the amount of $900,000 to Rutgers University for the purpose of developing a water quality trading pilot with respect to the phosphorus impairment in the Passaic River basin. This project has been investigating the options for and overall viability of a trading approach in the Passaic River basin. This project will produce a set of tools and rules that will govern allowable trades within the study area. These will include trading ratios and management zones within which trades can occur and still achieve the TMDL outcomes at the critical locations. Once the proposed tools and rules are developed, they will be subject to public comment. Following this process, as well as Department and EPA approval of the protocols, interested permittees can proceed to negotiate trades that achieve the desired result in a more cost effective way. For example, it may be more cost effective for a few larger facilities to upgrade to a higher level than for all treatment facilities to upgrade to the same level. Because diversion of Pompton and Passaic River water into the Wanaque Reservoir is a loading source, another option in the portion of the watershed above the confluence of the Pompton and Passaic Rivers is to trade wastewater treatment plant upgrades for treatment of river water by NJDWSC prior to diversion to the reservoir. The Department anticipates allowing 1 year from the date of permit issuance, provided the terms of acceptable trades have been subject to public comment and approved by EPA and the Department, to negotiate trades so that treatment plant upgrades consistent with permit limits are implemented within the compliance schedules that will be set forth in the permits.

6.0 Follow-up Monitoring

The Water Resources Division of the U.S. Geological Survey and the Department have 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. A second ambient monitoring network, NJDEP's Supplemental Ambient Surface Water Network (100 stations), has improved spatial coverage for water quality monitoring in New Jersey. The data from this these networks have been used to assess the quality of freshwater streams and percent load reductions. Through this TMDL, watershed criteria are proposed for the Wanaque Reservoir and Dundee Lake expressed in terms of a seasonal average of chlorophyll-*a*. Therefore, in order to assess effectiveness of this TMDL, these locations will need to be monitored specifically for chlorophyll-*a* following implementation of the reductions called for.

7.0 Implementation Plan

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).

The Department recognizes that TMDLs alone are not sufficient to restore impaired stream segments. The TMDL establishes the required pollutant reduction targets while the implementation plan identifies some of the regulatory and non-regulatory tools to achieve the reductions, matches management measures with sources, and suggests responsible entities for non-regulatory tools. This provides a basis for aligning available resources to assist with implementation activities. Wastewater treatment plants represent the most significant source of phosphorus and needed reductions will be obtained through effluent limitations in their NJPDES permits. For nonpoint source reductions, projects proposed by the State, local government units and other stakeholders that would implement the measures identified within the impaired watershed are a priority for available State (for example, CBT) and federal (for example, 319(h)) funds. In addition, the Department's ongoing watershed management initiative will develop detailed watershed restoration plans for impaired stream segments in a priority order that will identify more specific measures to achieve the identified load reductions.

In these impaired watersheds wetlands and forest represent a significant portion of the land use. As discussed under source assessment, loads from these land uses are not readily adjustable. Agricultural land use is a small portion of the current land use. Therefore, urban land use sources must be the focus for implementation. Urban land use will be addressed primarily by stormwater regulation, including requiring adoption of fertilizer management ordinances, as described below. The limited amount of agricultural land uses will be addressed by implementation of conservation management practices tailored to each farm. Other measures are discussed further below.

Stormwater measures

The stormwater facilities subject to regulation under NPDES in this watershed must be assigned WLAs. The WLAs for these point sources are expressed in terms of the required percent reduction for nonpoint sources and are applied to the land use categories that correspond to the areas regulated under industrial and municipal stormwater programs. The BMPs required through stormwater permits, supplemented by the additional measure for fertilizer discussed below, are generally expected to achieve the required load reductions. The success of these and the other strategies described below for nonpoint source load reduction will be assessed through follow up monitoring. As needed, consistent with the concept of adaptive management, other additional measures may need to be identified and included in stormwater permits. Additional measures that may be considered in the future include, for example, more frequent street sweeping and inlet cleaning, or retrofit of stormwater management facilities to provide or enhance nutrient removal. A more detailed discussion of stormwater source control measures follows.

The NJPDES rules for the Municipal Stormwater Regulation Program require municipalities, highway agencies, and regulated "public complexes" to develop stormwater management programs consistent with the NJPDES permit requirements. The stormwater discharged through "municipal separate storm sewer systems" (MS4s) also regulated under the Department's stormwater rules. Under these rules and associated general permits, Tier A municipalities are required to implement various control measures that should substantially reduce phosphorus loadings in the impaired watersheds. These control measures include adoption and enforcement of a pet waste disposal ordinance, prohibiting the feeding of unconfined wildlife on public property, street sweeping, cleaning catch basins, performing good housekeeping at maintenance yards, and providing related public education and employee training. These basic requirements will provide for a measure of load reduction from existing development. For example, the US Department of Transportation Federal Highway Administration cites a state of California study on vacuum sweeper efficiency in which a total phosphorus removal rate of 74% was achieved, compared to mechanical sweeper efficiency rate of 40% (www.fhwa.dot.gov/environment).

Because most of the land use based phosphorus load reductions must be obtained from urban land uses, an additional measure to reduce the phosphorus load from landscape maintenance is needed in order to effectively reduce the phosphorus load originating from the extensive urban land uses. The literature supports that a significant overall phosphorus reduction can be expected from this measure alone. The USGS documented the effects of lawn fertilizer on nutrient concentrations from runoff for a study in Wisconsin and found that total phosphorus concentration in lawn runoff was directly related to phosphorus concentration in lawn soils. Further, runoff from lawn sites with phosphorus-free fertilizer application had a median total phosphorus concentration similar to that of unfertilized sites, an indication that phosphorus-free fertilizer use is an effective, low-cost practice for reducing phosphorus in runoff. A growing body of research from Wisconsin, Michigan, Minnesota and Maine concludes that phosphorus from fertilizer applied to lawns enters surface waterbodies through runoff. In fact, after 8 years of voluntary use of phosphorus-free lawn fertilizer starting in 2008, Maine is banning the sale of phosphorus fertilizer unless certain conditions are met because they found that most soils had enough phosphorus to keep a lawn healthy. Research conducted in Maine showed that in watersheds that are converted from their natural, forested condition to residential, commercial and agricultural uses, the amount of phosphorus runoff increases by a magnitude of 5 to 10 times. Minnesota has also restricted phosphorus in lawns fertilizers to protect the quality of their lakes and streams. In 2003, EPA reported that the City of Plymouth, Minnesota enacted a phosphorus fertilizer ban in 1996 and observed a 23% reduction in phosphorus inputs to their lake as compared to phosphorus loading from neighboring community. See http://www.lakeaccess.org/lakedata/lawnfertilizer/recentresults.htm

Therefore, as identified in Appendix B, the municipalities within the spatial extent of this TMDL study will be required to adopt an ordinance, consistent with a model ordinance provided by the Department, as an additional measure of the Municipal Stormwater Permit. The model ordinance can be viewed at www.state.nj.us/dep/watershedmgt/rules.htm under the section heading Water Quality Management Rules. The additional measure is as follows:

Fertilizer Management Ordinance

Minimum Standard – Municipalities identified in Appendix B shall adopt and enforce a fertilizer management ordinance, consistent with the model ordinance provided by the Department.

Measurable Goal - Municipalities identified in Appendix B shall certify annually that they have met the Fertilizer Management Ordinance minimum standard.

Implementation - Within 6 months from adoption of the TMDL, municipalities identified in Appendix B shall have fully implemented the Fertilizer Management Ordinance minimum standard.

Agricultural and other measures

Generic management strategies for nonpoint source categories, beyond those that will be implemented under the municipal stormwater regulation program, and responses are summarized below.

Table 15. Nonpoint Source Management Measures

Source Category	Responses	Potential Responsible Entity	Possible Funding options
Human Sources	Septic system management programs	Municipalities, residents, watershed stewards, property owner	319(h), State sources
Non-Human Sources	Goose management programs, riparian buffer restoration	Municipalities, residents, watershed stewards, property owner	319(h), State sources
Agricultural practices	Develop and implement conservation plans or resource management plans	Property owner	EQIP, CRP, CREP

Human and Non-Human measures

Where septic system service areas are located in close proximity to impaired waterbodies, septic surveys should be undertaken to determine if there are improper effluent disposal practices that need to be corrected. Septic system management programs should be implemented in municipalities with septic system service areas to ensure proper design, installation and maintenance of septic systems. Where resident goose populations are excessive, community based goose management programs should be supported. Through stewardship programs, areas such as commercial/corporate lawns should be converted to alternative landscaping that minimizes goose habitat and areas requiring intensive landscape maintenance. Where existing developed areas have encroached on riparian buffers, riparian buffer restoration projects should be undertaken where feasible. In the Pompton Lake drainage area an ambitious reduction of nonpoint source loads is called for. In this drainage area restoration of riparian buffers is a focus for implementation of the Pequannock River Temperature TMDLs (NJDEP, 2004). This measure is expected to provide additional load reductions needed to achieve this objective.

Agricultural measures

Several programs are available to assist farmers in the development and implementation of conservation management plans and resource management plans. 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).

Conservation Reserve Enhancement Program (CREP) 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 CREP agreement earlier this year. This program matches $23 million of State money with $77 million from the Commodity Credit Corp. within USDA. Through CREP, financial incentives are offered for agricultural landowners to voluntarily implement conservation practices on agricultural lands. NJ CREP is part of the USDA's Conservation Reserve Program (CRP). There is a ten-year enrollment period, with CREP leases ranging between 10-15 years. The State intends to augment this program to make 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.

Current Implementation Projects

The following projects are either ongoing or are anticipated to be implemented in the TMDL study area. These projects were either funded by the 319(h) grants and/or funding was provided by the Corporate Business Tax and are expected to have an immediate and positive effect on water quality. They include riparian buffer planting, goose management, septic management, stormwater retrofits, ordinances and public education.

1. Rockaway River: Restore 3,000 continuous feet of degraded buffer on Jackson Brook (tributary to Rockaway River) and develop and implement a goose management strategy in Hurd Park, Dover (project ongoing)
2. Rockaway River: Stormwater Wetland Restoration project at the Morris County Department of Public Works (DPW) site in Roxbury to reduce fecal

coliform and Total Suspended Solids (TSS) input to the Rockaway River. (work ongoing)

3. Whippany River: Development of ordinances and zoning policies to reduce NPS pollution in municipalities of the Whippany River watershed. (Work completed)
4. Posts Brook: Stormwater implementation project in the Township of West Milford. (Work ongoing)
5. Visual Assessment of Streams in WMA 3 and ranking for stream restoration; Restoration of Camp Glen Gray, Bergen County Park to address stormwater runoff from erosion sources. (Work completed)
6. Ramapo Reservation Lake: Installation of 1000 feet of riparian buffer restoration. (Completed)
7. Greenwood Lake: Identify stormwater problem areas and based on the identification of "hot spots" implement two retrofits to reduce NPS load, as funds permit. (Work ongoing)
8. Greenwood Lake: Based on Stormwater Plan identified in #7 above additional funding for stormwater implementation is anticipated for the 2007 cycle of 319(h) funding.
9. Belchers Creek: Installation of cross-sectional catch basins to reduce NPS pollutants to Pinecliff Lake. (Work completed)
10. Development of an Onsite Wastewater Treatment Systems Management Plan Greenwood Lake: The New Jersey section of the Greenwood lake watershed is located in West Milford Township. Using 604(b) funds this planning effort will include: the development of a digital database and establishment of a process for the tracking of OWTS; an update of the estimate of the lake's annual phosphorus load originating from the OWTS; Collection of sub-surface soil leachate samples to quantify the phosphorus and fecal coliform entering the lake or its tributaries; identification of potential management measures for the OWTS; an effective, aggressive, pro-active public educational initiative; an implementation schedule including budgetary and technical needs; and the development of an objective and rational prioritization scheme for the OWTS focusing on maintenance, inspection and to varying degrees rehabilitation. The grant provides for identification of potential management measures to address the prioritized OWTS within the planning area to be developed into an OWTS BMP manual. The final task will be the submission of the OWTS Management Plan by the Township to the NJDEP as a proposed amendment to the Northeast Areawide Water Quality Management Plan.
11. Watershed Based Restoration Plan for Molly Ann Brook (ongoing).
12. Verona Park Lake: Installation of 10-foot wide vegetated buffer on the lake shoreline to address large resident goose population. (Work completed)

13. Bee Meadow Pond: Development of goose management plan with 1100 feet of linear shoreline restoration with pre-implementation and post-implementation monitoring. (Post-implementation monitoring is ongoing).
14. East Lake and Bryant's Stream: Riparian restoration on Whippany tributaries. Goose management implementation included (Work completed).
15. Troy Brook: Development of regional stormwater management plan including drainage area specific objectives. (Work ongoing).
16. Speedwell Lake: Riparian restoration to address erosion, stormwater and geese. (Work completed).
17. Whippany River: Retrofit an existing stormwater detention basin to reduce NPS load, plant approximately 20,000 square feet of detention basin with native vegetation. (Work completed).
18. Development of a septic management plan in the Greenwood Lake Watershed (work ongoing).
19. Preakness Watershed Plan; offshoot of the Passaic River Priority Stream Segment (Two Bridges to Elmwood Park) Plan. (Work ongoing).
20. Pequannock River Thermal Mitigation, Monitoring and Assessment: This project addressed two nonpoint source areas that are contributing to the increased temperature due to loss or riparian canopy. Riparian restoration was undertaken at Bailey Brook in Bloomingdale and the Pequannock River in Riverdale. Another component of this project was the documentation of areas in the Pequannock River headwaters that are impacted by current or past beaver activity and the collection of flow and temperature data for all significant tributaries in the Lower Pequannock drainage. Identification and mapping of stormwater outfalls in the lower and central Pequannock drainages were also undertaken. The majority of this project is complete, the monitoring is still underway as part of this contract, to ensure a longer term database for temperature in this watershed.
21. A *WMA 3 Restoration Master Plan* was conducted over two years using a visual assessment protocol modified from the USDA methodology. This project was also funded with 319(h) funding. The project included four sub-watersheds, one of which was the Pequannock. Forty-five sites in the Pequannock Basin were identified for restoration projects. The average score based on the visual assessment for the overall basin was 7.8 SVAP (STREAM VISUAL ASSESSMENT PROTOCOL). Of the 45 sites, 24 scored below the basin average scores. Several of the Pequannock sites were rated as high priority and these sites would be priority sites for future restoration projects. Streambank restoration with replacement canopy would have a mitigating effect on temperature exceedances and limit exposure of waterbody to sunlight; thus minimizing the potential for algal growth. An addendum of the final report included a Management Strategy Table with a Habitat Enhancement category. For this category several sites on the Pequannock River and Kanouse Brook have been identified as candidates for habitat

restoration and enhancement. As part of the WMA 3 Restoration Master Plan the following sites were identified as containing deficient riparian buffers and these sites can provide a starting point for addressing riparian corridor restoration on both the mainstem Pequannock and significant tributaries feeding the river:

- Site 142- Pequannock River northwest of Route 23 between old Route 23 and Route 23 Railroad
- Site 143- Pequannock River southwest tributary of Pequannock headwaters at Rt. 23 bridge crossing
- Site 153- Clinton Brook 0.25 miles above Clinton Reservoir
- Site 155- Kanouse Brook, 0.65 miles north of confluence with Pequannock River
- Site 156- Kanouse Brook, 2.2 miles north of confluence with Pequannock River
- Site 158- Clinton Brook, 1.1 miles south of Clinton Reservoir adjacent to LaRue Road
- Site 168- Stone House Brook at confluence with Pequannock River
- Site 172- Pequannock River, 0.8 miles north of confluence with Wanaque
- Site 174- Matthew Brook
- Site 176- Van Dam Brook, Riverdale Town Park
- Site 177- Pequannock River, 0.15 miles north of confluence of Beaver Brook

This list should not be considered inclusive as it was part of a larger project for WMA 3 of which thermal mitigation was not the primary focus; therefore the list should be considered a starting point. The study also looked at ownership of land, and had public lands as a criterion for evaluation. As redevelopment occurs, inclusion of a riparian corridor to provide canopy should be implemented where feasible.

22. Other completed 319(h) projects in the watershed that support the restoration of Green Infrastructure throughout the Passaic River Basin:

- Center Street Restoration Project
- Mendham Detention Basin Retrofit
- Rockaway River stream corridor improvement at Knoll Golf Club
- Bryant Stream/Phase I and Construction for East Lake in Burnham Park
- Lakeside Restoration/East Lake in Burnham—Phase II

Priority Stream Segment Initiative

In addition to the generic and specific, current and future implementation measures identified above, the Department, through its watershed management program, has undertaken the development of watershed restoration plans for priority stream segments. Each area identifies specific measures and the means to accomplish them for specific impaired pollutant. Priority was based on the following criteria:

- Headwater area;
- Proximity to drinking water supply;

- Proximity to recreation area;
- Possibility of adverse human health conditions;
- Proximity to a lake intake;
- Existence of eutrophication;
- Phosphorus is identified as the limiting nutrient;
- Existence of use impairments;
- Ability to create a measurable change;
- Probability of human source;
- Stream Classifications;
- High success level.

Listed below are priority stream segments projects located within the TMDL Study Area, in which activities are occurring to support the development of watershed restoration plans that will, in turn, lead to implementation projects that will help address phosphorus and other pollutants of concern.

NPS Grant: Demonstration Project to Support TMDL Implementation for the Pequannock River

As identified in the Pequannock River TMDL and the Pequannock River Temperature Impairment Characterization, Assessment and Management Plan discharges into river tributaries from smaller lakes and ponds can contribute to thermal elevation in the Pequannock River and its tributaries. This occurs because impoundments slow flows, expose waters to increased sunlight and release heated surface water from impoundments over spillway outlets. Preliminary sampling by the Pequannock River Coalition has shown that small impoundments do offer a level of temperature stratification within these impoundments that may be utilized to achieve downstream temperature reductions of 3-4 degrees Fahrenheit. This project is a demonstration project and will actually occur on the West Brook in the Township of West Milford. The West Brook is impaired for temperature. The demonstration project will provide siphon piping from bottom water to provide a temperature reduction in the West Brook. This system will be monitored and documented for replication on other waterways.

Passaic River from Two Bridges to Elmwood Park Border

This project involved the development of an in-depth characterization of the current conditions relating to the pollutant of concern, fecal coliform, within the identified stream segment based on available data, and an evaluation and assessment of the findings of that characterization to evaluate and assess the short-term and long-term management measures that will be required to allow the stream to achieve full attainment of its designated uses. A Stream Characterization Report, including cost-benefit analyses, monitoring and modeling as applicable with available funds, identification of data gaps, and recommendations for further work and actions were the principal deliverables.

Future Project Recommendations

1. The development of BMPs and Model ordinances to address the reduction of fecal coliform, and other pollutants, including phosphorus, associated with nonpoint sources.
2. The development of a Watershed Management Plan of an associated waterway, Molly Ann Brook, was a direct result of the Characterization and Assessment Report findings.

Rockaway River between Route 80 and Blackwell Street in Dover

The Rockaway River Watershed Cabinet (RRWC) completed a detailed water quality sampling and analysis for a portion of the Rockaway River with a focus on fecal coliform. The RRWC is evaluating a segment of the Rockaway River in Dover Town, Wharton Borough, and Roxbury Township to develop an implementation plan consistent with the NJDEP TMDL and nonpoint source program. The stream segment begins at the Blackwell Street crossing in Dover and continues upstream to the Interstate Highway Route 80 crossing. This four-mile segment flows through developed areas of the towns as well as significant areas of undeveloped forest and wetlands. In this reach, three tributary streams, Jackson Brook, Green Pond Brook and Stephens Brook, join the Rockaway River. The goal of this evaluation was to assist with the identification of impacts to the stream and specifically evaluate nonpoint source pollution sources, storm water runoff concerns, and potential sources of bacteria (fecal coliform). Measures to reduce fecal coliform will also reduce phosphorus.

Future Project Recommendations

1. Construction of wetlands and floodplain restoration along Green Pond Brook. Currently, this area receives surface water runoff from an adjacent roller rink parking lot and surrounding roads. It is assumed that the site historically was a forested floodplain associated with Green Pond Brook. The proposed restoration action will include removal of the root mat, installation of slope stabilization, biodegradable filter fabric and excavation of a series of wetland treatment ponds connected by a meandering channel to treat storm water from a 6-acre drainage area prior to discharge into the Rockaway River. (Work ongoing)

2. Implementation of stormwater BMPs and restoration projects to include Bowlby Pond and Mckeel Brook drainage areas. Restoration activities could include reconnecting the natural drainages, and /or day lighting or improving the outfall channel connection resulting in the reduction of sediments and stream velocities thus by restoring the natural hydrology to the brooks and enhancing the fish and wildlife populations.

3. Development of a Regional Stormwater Management Plan. The plan will be designed to comply with NJDEP Storm water Regulations and permitting

requirements to be met by each municipality. The municipalities involved include Dover Town, Wharton Borough, Rockaway, Randolph, Mine Hill, Roxbury and Jefferson Townships.

8.0 Reasonable Assurance

Reasonable assurance that the TMDL will result in attainment of the proposed chlorophyll-*a* watershed criteria requires both a reduction of the current phosphorus loading and protection against increased phosphorus loading from future development. The above implementation plan describes various regulatory and non-regulatory management measures that will result in reduced phosphorus loads.

Additionally, NJDEP adopted the Stormwater Management Rules N.J.A.C 7:8, will minimize the impact of stormwater run-off from new development. The Stormwater Management Rules, N.J.A.C. 7:8, establish statewide minimum standards for stormwater management in new development, and the ability to analyze and establish region-specific performance standards targeted to the impairments and other stormwater runoff related issues within a particular drainage basin through regional stormwater management plans. The Stormwater Management Rules are currently implemented through the Residential Site Improvement Standards (RSIS) and the Department's Land Use Regulation Program (LURP) in the review of permits such as freshwater wetlands, stream encroachment, CAFRA, and Waterfront Development.

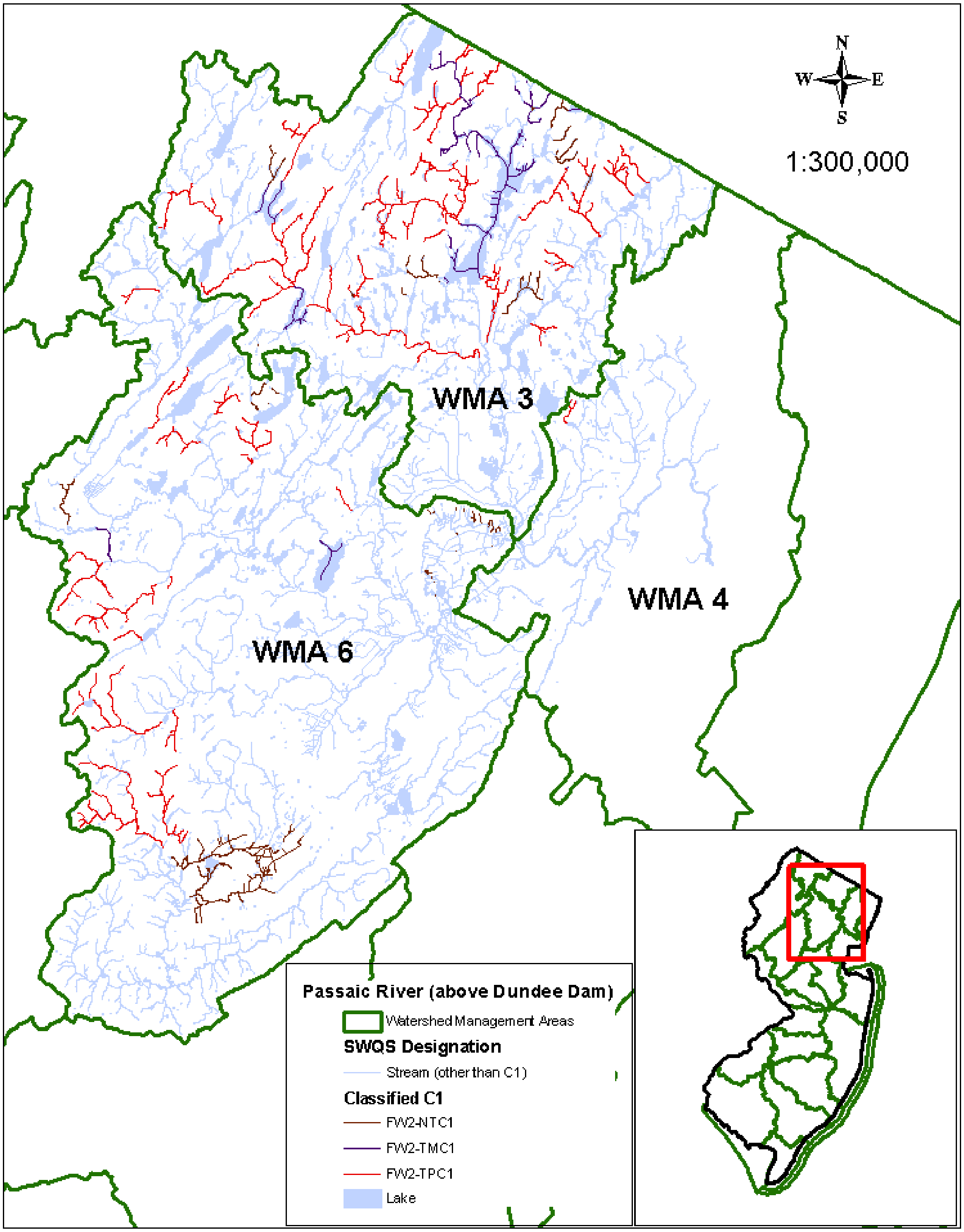
The Stormwater Management Rules focus on the prevention and minimization of stormwater runoff and pollutants in the management of stormwater. The rules require every project to evaluate methods to prevent pollutants from becoming available to stormwater runoff and to design the project to minimize runoff impacts from new development through better site design, also known as low impact development. Some of the issues that are required to be assessed for the site are the maintenance of existing vegetation, minimizing and disconnecting impervious surfaces, and pollution prevention techniques. In addition, performance standards are established to address existing groundwater that contributes to baseflow and aquifers, to prevent increases to flooding and erosion, and to provide water quality treatment through stormwater management measures for TSS and nutrients.

As part of the requirements under the municipal stormwater permitting program, municipalities are required to adopt and implement municipal stormwater management plans and stormwater control ordinances consistent with the requirements of the stormwater management rules. As such, in addition to changes in the design of projects regulated through the RSIS and LURP, municipalities will also be updating their regulatory requirements to provide the additional protections in the Stormwater Management Rules.

Furthermore, the New Jersey Stormwater Management Rules establish a 300-foot special water resource protection area (SWRPA) around Category One (C1) waterbodies and their intermittent and perennial tributaries, within the HUC 14 subwatershed. In the SWRPA, new development is typically limited to existing disturbed areas to maintain the integrity of the C1 waterbody. Category One waters receive the highest form of water quality protection in the state, which prohibits any measurable deterioration in the existing water quality. Definitions for surface water classifications, detailed segment description, and designated uses may be found in various amendments to the Surface Water Quality Standards at http://www.state.nj.us/dep/wmm/sgwqt/sgwqt.html C1 designations within the pertinent portion of the Passaic River watershed are depicted on Figure 5.

Commitment to carry out the activities described in the implementation plan to reduce phosphorus loads, including establishing NJPDES effluent limits for wastewater treatment facilities, the requirements of the Stormwater Management Rules and the Municipal Stormwater Regulation Program, present and future priority stream segment and other projects, provide reasonable assurance that the chlorophyll-*a* site watershed criteria will be attained for phosphorus in the spatial extent of the TMDL study. Follow up monitoring will identify if the strategies implemented are completely, or only partially successful. It will then be determined if other management measures can be implemented to fully attain the chlorophyll-*a* watershed criteria or if it is necessary to consider other approaches, such as use attainability. Although not currently listed as impaired, as part of this TMDL study, it was determined that a small stretch of the Peckman River at its mouth experiences excessive primary productivity. Nevertheless, this location was not identified as a critical location for which phosphorus reductions would be targeted at this time. This area is under consideration for channel modification as described in a report entitled *Peckman River Basin New Jersey Feasibility Studies for Flood Control and Ecosystem Restoration*, (ACOE, 2002). If the channel modifications were to be implemented, the mouth of the Peckman River may no longer be a site subject to excessive primary productivity. Therefore, WLAs were assigned to Peckman River dischargers as needed to attain the Dundee Lake water quality objectives. The Department will continue to monitor this situation and may determine that more stringent WLAs are needed to attain water quality objectives in the Peckman River.

Figure 5. Category One waterways in WMAs 3, 4, and 6 (as of January 1, 2007)



9.0 Public Participation

In accordance with the Water Quality Management Planning Rules each TMDL shall be proposed by the Department as an amendment to the appropriate areawide water quality management plan(s) in accordance with N.J.A.C. 7:15-3.4(g). N.J.A.C. 7:15-3.4(g)5 states that when the Department proposes to amend an areawide water quality plan on its own initiative, the Department shall give public notice by publication in a newspaper of general circulation in the planning area, shall send copies of the public notice to the applicable designated planning agency, if any, and may hold a public hearing or request written statements of consent as if the Department were an applicant. In addition, the Department is proposing watershed criteria for the Wanaque Reservoir and Dundee Lake. With adoption of this TMDL, these watershed criteria become the SWQS in accordance with N.J.A.C. 7:9B-1.5(g)3, subject to approval by EPA.

The Department has maintained a long term commitment to the stakeholder process and public participation in the development of this TMDL for the Passaic River Basin. The TMDL was developed with assistance and direct input from stakeholders in Watershed Management Areas 3, 4 and 6.

The stakeholder process in the Passaic River Basin has been continuous for over 13 years. The resulting collaborative restoration process arose out of a 1993 pilot watershed initiative in the Whippany River Watershed (1993 – 2000) and litigation over permit requirements. The Department's early meetings with dischargers in 1996 in response to a settlement agreement over proposed phosphorus permit limits coupled with the Whippany River Watershed Pilot project evolved into a comprehensive watershed management process. This model for watershed management was later refined and replicated throughout the state in twenty watershed management areas (WMAs).

The Department initiated a pilot watershed project in 1993 in the Whippany River Watershed to aid the Department in developing a comprehensive watershed process that could be replicated throughout the state. The 70 square mile Whippany River Watershed lies in the heart of the larger Passaic River Basin and was instrumental in pulling stakeholders with varied interests and backgrounds together to discuss and address issues germane to the Watershed. Stakeholders included: active watershed groups, academics, business, industry, consultants, interested public, purveyors as well as dischargers. The watershed management process has afforded New Jersey a unique opportunity to openly discuss and vet projects that need to be undertaken to ensure New Jersey achieves its statewide "clean and plentiful" water goal.

The Public Advisory Group (PAG), Technical Advisory Committee (TAC) and several subcommittees met for 6 years in an effort to achieve the goal to restore and preserve the value of the Whippany River as a vital natural resource. A main reason that the

Whippany River Watershed was selected as the state's pilot watershed project was because of the number of dischargers located in the watershed. The Department recognized a unique opportunity in having dischargers, purveyors, environmental interest groups, local and state governments come together to vet and resolve issues unique to a specific geographic location. In addition to a replicable format for watershed management, one of several significant outcomes of the pilot watershed process included: the *TMDL for Fecal Coliform and an Interim Total Phosphorus Reduction Plan for the Whippany River Watershed* adopted in December 1999 and its companion document Appendix G, *A Cleaner Whippany River Watershed NPS Pollution Control Guidance Manual for Municipal Officials, Engineers and Department of Public Works, May 2000*. A workshop was held to acquaint municipalities with the best management practices recommended by the Technical Advisory Committee's NPS Workgroup.

During this time, the Department had also been meeting with the dischargers and purveyors in the Passaic River Basin on a regular basis through The Passaic River Task Group (1996 – 1998). The first priority of the Group was common concerns on phosphorus and eutrophication. Originally, the Whippany TMDL was proposed in 1999 to address both fecal coliform and phosphorus. Subsequently, only the fecal TMDL was established, since it was determined that, in the Whippany River, phosphorus was not rendering the waters unsuitable for the designated uses and so no phosphorus impairment was present. The Department did not pursue delisting because the Whippany River is a tributary to the Passaic River Basin wherein total phosphorus had not been assessed with respect to phosphorus rendering waters unsuitable for designated uses and, at a minimum, the Wanaque Reservoir was known to be a critical location of concern with respect to phosphorus loading. Thus, study of the larger area could result in the finding that phosphorus reductions on the Whippany would be needed to achieve water quality objectives in downstream locations.

The Group met through 1998, at which time the Department began a statewide watershed process within each of 20 watershed management areas that had been delineated for this purpose. Consequently, a Public Advisory Committee (PAC) and TAC were initiated for WMA 6. After the completion of the Whippany Fecal TMDL the Department-led Whippany River Watershed PAG and its TAC evolved into the WMA 6 PAC and TAC respectively which, met regularly from 1998-2003. The WMA 6 TAC assumed the mandate to discuss water quality related issues such as TMDL requirements.

In the Fall of 2000, the Department awarded two years worth of grant funding to 16 lead entities to serve as an extension of the Department to facilitate the watershed process for all 20 watershed management areas throughout the state. Deliverables from this statewide process varied; but resulted in the creation of PACs and TACs for WMAs 3 and 4; development of an extensive watershed characterization and assessment for WMAs 3, 4, and 6; creation of water resource based open space plans; and the implementation of numerous streambank restoration projects. At the same time, in order to successfully develop a comprehensive Passaic River Basin TMDL study, a separate committee was charged to focus on nutrient impairments in the Basin. With the Department, the Workgroup prepared the *Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin,* October 2001. The primary purpose of the report was to memorialize the outcome of the discussions to develop TMDLs and other management responses. The Workgroup continued to meet monthly through 2003.

In 2004, monitoring and initial modeling results from the TMDL work conducted by Quantitative Environmental Analysis, LLC (QEA), Najarian Associates and Omni Environmental, acting under contract to the Department, were shared and made available to the Passaic River Basin stakeholders through several informational sessions. On March 23, 2004, QEA presented their findings from the Ramapo River and Pompton Lakes Study to the WMA 3 PAC. Data exchange meetings based on the information collected by Omni Environmental were held on April 15, 2004, April 27, 2004, and September 28, 2004 and all stakeholders were invited to attend. On November 18, 2004, Najarian Associates presented preliminary findings on the Wanaque TMDL to the Passaic River Basin stakeholders. The Department conducted informal meetings with stakeholders on April 27 and September 28, 2004 to present model calibration and verification. The Department then conducted a meeting on June 23, 2005 with the affected dischargers in the Basin to present the findings from the work completed by Najarian Associates for the Wanaque Reservoir and that portion of the Basin above the confluence of the Pompton and Passaic Rivers.

On July 5, 2005 the Department proposed a Phase 1 Passaic River Study TMDL for phosphorus in the Wanaque Reservoir and a TMDL for Total Phosphorus to Address Pompton Lake and Ramapo River. A public hearing on these TMDLs was held on August 4, 2005 at the Cultural Center at the Lewis Morris County Park in Morristown. After the public meeting, at the request of the commenters, the Department extended the public comment period until November 21, 2005. Nearly 100 people attended the hearing and some of the specific issues/comments raised are discussed below.

- Applicability of the phosphorus standard as a not to exceed value in the Wanaque Reservoir is inappropriate.

  Based on the thorough monitoring of the Passaic River basin and identification of critical locations and the behavior of response indicators to phosphorus loads through dynamic modeling, watershed criteria for Wanaque Reservoir and Dundee Lake were proposed through this TMDL report and, with adoption of the TMDL, are now the applicable SWQS, subject to approval by EPA. These criteria are expressed in terms of a seasonal average chlorophyll–*a* concentration specific to each location.

- Costs associated with treatment for phosphorus removal and longer term implementation consequences such as increase in sludge production and associated cost for removal, chemical usage, and total dissolved solids increases in effluent being discharged to the receiving waters;

  The goal of a TMDL is to identify the load reductions necessary to achieve the SWQS and the designated use of the waterbody. This TMDL has evaluated the Passaic River basin thoroughly and determined where reductions in phosphorus load will result in environmental improvement. Further, watershed criteria proposed through this TMDL provide a fine tuning of the load reductions to achieve results in terms of response indicators. Reductions required are reasonable and achievable. Further, trading is offered as an option to achieve the needed load reductions in the most cost effective manner.

- The LA-WATERS model and water quality data inputs should be made available to the public for use to fully evaluate the TMDL results.

  The LA-WATERS model is a proprietary model and has not been released by the owners, NJDWSC and Najarian Associates. The proprietary nature of the model was known when the TMDL study for the Passaic River basin was initiated. This fact notwithstanding, the Passaic TMDL workgroup endorsed the use of this model, as documented in the public participation process. The LA-WATERS model has been peer reviewed and accepted as a valid predictive tool for the Wanaque Reservoir. The simulation outputs compared to actual data have been presented graphically in support documentation for this TMDL, which is sufficient for evaluating the scientific validity of the tool.

- Applicability of Phase I study to headwater dischargers given the in-progress comprehensive Phase II study.

  The Department proposed the Phase I TMDL with initial hopes to jumpstart water quality improvement. However, given delays experienced in finalizing Phase I, the Phase II study has since been completed. The Department has determined that the most efficient means to achieve water quality improvement is to incorporate the relevant portions of the Phase I study into this TMDL document.

- Water supply diversions should be treated as point sources, and the North Jersey District Water Supply Authority should receive a NJPDES permit for adding phosphorus load to the Wanaque Reservoir.

It has been determined that diversions are not point sources subject to permitting under the National Pollutant Discharge Elimination System permit, as discussed in the August 5, 2005 EPA memorandum, *Agency Interpretation on Applicability of Section 402 of the Clean Water Act to Water Transfers*. Nevertheless, the Department agrees conceptually that a water supply diversion responsible for delivering pollutant loads to a water body should be considered in assigning responsibility for pollutant load reductions necessitated by the act of diverting water. In this case, the load reductions required to achieve the water quality target for the in-stream critical location is the same as that needed to achieve the water quality target in the Wanaque Reservoir. Water quality trading is an option through which NJDWSC can play a role in protecting the water quality of the Wanaque Reservoir, which is affected by the diversion of Pompton and Passaic River water into the reservoir.

- Achieving the 80 percent reduction in NPS called for is unrealistic.

As discussed in Section 5.0 of this document, this TMDL utilizes EMCs in conjunction with land use distribution and area weighted contributions of stormwater to provide a more precise estimate of the contribution of nonpoint source loadings from the land use. As a result, the final percent reduction is 60 percent in most of the drainage area requiring a reduction, ranging from 0 to 85 percent. The Department believes the identified measures will attain these load reductions. Follow up monitoring will identify if the strategies implemented through this TMDL are completely, or only partially successful. It will then be determined if other nonpoint source management measures must be implemented to fully attain water quality objectives or if it is necessary to consider other approaches, such as use attainability.

- What are the assurances that New York will attain New Jersey's SWQS at the border, a boundary assumption for the TMDL.

NJDEP has been in communication with both New York State and US EPA regarding this TMDL and the need for New York to achieve New Jersey's SWQS at the border. Progress has been made with the application of a 0.2 mg/l effluent limit on the Western Ramapo Wastewater treatment facility. It is expected, however, that NPS load reductions also will be needed in order to fully achieve the boundary objective.

- Basin dischargers are receiving special treatment since other dischargers are already receiving permits with 0.1 mg/l phosphorus requirement.

In March 2003 the Department issued a *Technical Manual for Phosphorus Evaluations for NJPDES Discharge to Surface Water Permits* (phosphorus protocol) that provides the necessary guidance to determine if the numeric criterion for phosphorus applies. The phosphorus protocol is available to all dischargers who receive a water quality based effluent limit for phosphorus based on the numeric criterion. However, in the Passaic River basin, in response to permit appeals when phosphorus limits were initially imposed there, the Department entered into settlement agreements with Passaic River basin dischargers establishing that the Department will not impose a phosphorus effluent limit until the appropriate limit has been determined through a TMDL. The settlement agreements predate and obviate the application of WQBELs pending the outcome of this TMDL.

For the Phase II study, the Department conducted additional outreach on May 19, 2006 and a presentation was made on behalf of the Department at the October 13, 2006 2nd Passaic River Symposium held at Montclair State University. The Department met with the dischargers and purveyors on September 11, 2006 to seek input on chlorophyll-*a* target endpoints for the Wanaque Reservoir and Dundee Lake Dam and to share preliminary findings on load reductions and how these should be translated into effluent limits.

Throughout the development of the TMDLs for the Passaic River Basin input was received through Rutgers New Jersey EcoComplex (NJEC). The Department contracted with the NJEC in August 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 the development of TMDLs and other management strategies. Their comments on the TMDL study have resulted in refinements to the modeling work upon which this TMDL document is based.

Notice proposing the Passaic River basin phosphorus TMDL was published on May 7, 2007 in the New Jersey Register and in a newspaper of general circulation in the affected area in order to provide the public an opportunity to review the TMDL and submit comments. In addition, a public hearing was held on June 7, 2007 at the Cultural Center at Lewis Morris County Park, 300 Mendham Road, Morristown, NJ 07962-1295. Notice of the proposal and hearing was provided to affected Designated Planning Agencies, municipalities, dischargers, and purveyors in the watershed. On October 20, 2007 the Department extended the comment period by an additional 30 days in order to afford more time for public review of the watershed model itself.

All comments received during the public notice period and at the public hearing for this TMDL study and the proposed watershed criteria upon which it is based are part of the record for this TMDL study and have been considered in finalizing this TMDL study. This final TMDL report, as well as the watershed criteria for Wanaque Reservoir and Dundee Lake have been adopted as an amendment to the Northeast, Upper Raritan, Sussex County and Upper Delaware WQMPs. As a result, the watershed criteria are now the SWQS with respect to phosphorus for the identified critical locations, subject to approval by EPA. The full summary of comments and responses can be found in Appendix F of this document.

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Appendix B: Municipalities and MS4 Designation in the Passaic River Basin

Municipal Name	County	WMA	Tier A or B	NJPDES Permit No.	Fertilizer Ordinance
Elmwood Park Borough	BERGEN	4	A	NJG0152617	Applicable
Fair Lawn Borough	BERGEN	4	A	NJG0149951	Applicable
Franklin Lakes Borough	BERGEN	3, 4	A	NJG0154121	Applicable
Garfield City	BERGEN	4	A	NJG0150282	Applicable
Glen Rock Borough	BERGEN	4	A	NJG0148300	Applicable
Mahwah Township	BERGEN	3	A	NJG0151211	Applicable
Midland Park Borough	BERGEN	4	A	NJG0152293	Applicable
Oakland Borough	BERGEN	3	A	NJG0148521	Applicable
Ramsey Borough	BERGEN	3	A	NJG0151491	Applicable
Ridgewood Village	BERGEN	4	A	NJG0152170	Applicable
Waldwick Borough	BERGEN	4	A	NJG0150321	Applicable
Wyckoff Township	BERGEN	4	A	NJG0152048	Applicable
Caldwell Borough	ESSEX	4, 6	A	NJG0152901	Applicable
Cedar Grove Township	ESSEX	4	A	NJG0150533	Applicable
Essex Fells Borough	ESSEX	4, 6	A	NJG0148792	Applicable
Fairfield Township	ESSEX	4, 6	A	NJG0150835	Applicable
Livingston Township	ESSEX	6	A	NJG0148245	Applicable
Millburn Township	ESSEX	6	A	NJG0153877	Applicable
Montclair Township	ESSEX	4	A	NJG0150568	Applicable
North Caldwell Borough	ESSEX	4, 6	A	NJG0148687	Applicable
Roseland Borough	ESSEX	6	A	NJG0152072	Applicable
Verona Township	ESSEX	4, 6	A	NJG0152897	Applicable
West Caldwell Township	ESSEX	4, 6	A	NJG0151815	Applicable
West Orange Township	ESSEX	4, 6	A	NJG0151190	Applicable
Boonton Town	MORRIS	6	A	NJG0153672	Applicable
Boonton Township	MORRIS	6	A	NJG0148091	Applicable
Butler Borough	MORRIS	3	A	NJG0149837	Applicable
Chatham Borough	MORRIS	6	A	NJG0147842	Applicable
Chatham Township	MORRIS	6	A	NJG0153630	Applicable
Denville Township	MORRIS	6	A	NJG0148229	Applicable
Dover Town	MORRIS	6	A	NJG0150495	NA
East Hanover Township	MORRIS	6	A	NJG0152056	Applicable
Florham Park Borough	MORRIS	6	A	NJG0151335	Applicable

Hanover Township	MORRIS	6	A	NJG0148971	Applicable
Harding Township	MORRIS	6	B	NJG0151165	Applicable
Jefferson Township	MORRIS	3, 6	A	NJG0151793	NA
Kinnelon Borough	MORRIS	3, 6	A	NJG0149781	Applicable
Lincoln Park Borough	MORRIS	3, 6	A	NJG0155586	Applicable
Long Hill Township	MORRIS	6	A	NJG0151424	Applicable
Madison Borough	MORRIS	6	A	NJG0150304	Applicable
Mendham Borough	MORRIS	6	A	NJG0151483	Applicable
Mendham Township	MORRIS	6	A	NJG0150819	Applicable
Mine Hill Township	MORRIS	6	A	NJG0153133	NA
Montville Township	MORRIS	3, 6	A	NJG0149403	Applicable
Morris Plains Borough	MORRIS	6	A	NJG0150002	Applicable
Morris Township	MORRIS	6	A	NJG0152463	Applicable
Morristown Town	MORRIS	6	A	NJG0153079	Applicable
Mount Arlington Borough	MORRIS	6	A	NJG0153265	NA
Mountain Lakes Borough	MORRIS	6	A	NJG0151386	Applicable
Parsippany-Troy Hills Township	MORRIS	6	A	NJG0150266	Applicable
Pequannock Township	MORRIS	3	A	NJG0148342	Applicable
Randolph Township	MORRIS	6	A	NJG0152501	Applicable
Riverdale Borough	MORRIS	3	A	NJG0152587	Applicable
Rockaway Borough	MORRIS	6	A	NJG0150746	NA
Rockaway Township	MORRIS	3, 6	A	NJG0151246	NA
Roxbury Township	MORRIS	6	A	NJG0152641	NA
Victory Gardens Borough	MORRIS	6	A	NJG0149110	NA
Wharton Borough	MORRIS	6	A	NJG0151645	NA
Bloomingdale Borough	PASSAIC	3	A	NJG0153371	Applicable
Clifton City	PASSAIC	4	A	NJG0150452	Applicable
Haledon Borough	PASSAIC	4	A	NJG0155144	Applicable
Hawthorne Borough	PASSAIC	4	A	NJG0149616	Applicable
Little Falls Township	PASSAIC	4	A	NJG0148911	Applicable
North Haledon Borough	PASSAIC	4	A	NJG0154130	Applicable
Paterson City	PASSAIC	4	A	NJG0155608	Applicable
Pompton Lakes Borough	PASSAIC	3	A	NJG0152145	Applicable
Prospect Park Borough	PASSAIC	4	A	NJG0154792	Applicable
Ringwood Borough	PASSAIC	3	A	NJG0152749	Applicable
Totowa Borough	PASSAIC	4	A	NJG0148636	Applicable
Wanaque Borough	PASSAIC	3	A	NJG0149306	Applicable
Wayne Township	PASSAIC	3, 4	A	NJG0150436	Applicable
West Milford Township	PASSAIC	3	A	NJG0148806	Applied with Greenwood Lake TMDL
West Paterson Borough	PASSAIC	4	A	NJG0151637	Applicable
Bernards Township	SOMERSET	6	A	NJG0148661	Applicable
Bernardsville Borough	SOMERSET	6	A	NJG0151068	Applicable
Bridgewater Township	SOMERSET	6	A	NJG0147893	Applicable
Far Hills Borough	SOMERSET	6	B	NJG0151599	Applicable
Warren Township	SOMERSET	6	A	NJG0154202	Applicable
Hardyston Township	SUSSEX	3, 6	B	NJG0152269	NA

Sparta Township	SUSSEX	6	A	NJG0148059	NA
Vernon Township	SUSSEX	3	B	NJG0149691	NA
Berkeley Heights Township	UNION	6	A	NJG0147923	Applicable
New Providence Borough	UNION	6	A	NJG0153494	Applicable
Summit City	UNION	6	A	NJG0153613	Applicable

Appendix C: Additional Impairments within TMDL Area

The two tables below identify the assessment units within the TMDL area of interest that have additional impairments not being addressed in the scope of this TMDL.

HUC 14 Assessment Units based on the 2006 Integrated Water Quality Monitoring and Assessment Report

WMA	Assessment Unit ID	Assessment Unit Name	Parameter	Designated Use Impairment
03	02030103050030-01	Pequannock R(above OakRidge Res outlet)	Pollutant Unknown	Aquatic Life (General & Trout)
03	02030103050050-01	Pequannock R(Charlotteburg to OakRidge)	Pollutant Unknown	Aquatic Life (General & Trout)
03	02030103050060-01	Pequannock R(Macopin gage to Charl'brg)	Dissolved Oxygen	Aquatic Life (Trout)
03	02030103050080-01	Pequannock R (below Macopin gage)	Chlordane, DDX, Mercury, PCBs	Fish Consumption
03	02030103050080-01	Pequannock R (below Macopin gage)	Dissolved Oxygen	Aquatic Life (General & Trout)
03	02030103070020-01	Belcher Creek (Pinecliff Lake & below)	Temperature	Aquatic Life (General & Trout)
03	02030103070040-01	West Brook/Burnt Meadow Brook	Temperature	Aquatic Life (Trout)
03	02030103070050-01	Wanaque Reservior (below Monks gage)	Dissolved Oxygen, Pathogens, Temperature	Aquatic Life (General & Trout) & Primary Contact Recreation
03	02030103070060-01	Meadow Brook/High Mountain Brook	Pollutant Unknown	Aquatic Life (General & Trout)
03	02030103070070-01	Wanaque R/Posts Bk (below reservior)	Unknown Toxic	Aquatic Life (General & Trout)
03	02030103100070-01	Ramapo R (below Crystal Lake bridge)	Dissolved Oxygen, pH	Aquatic Life (General & Trout)
03	02030103110020-01	Pompton River	Chlordane, DDX, Lead, Mercury, PCBs, Unknown Toxic	Aquatic Life (General) & Fish Consumption
04	02030103120020-01	Peckman River (below CG Res trib)	Dioxin, PCBs, Pollutant Unknown	Aquatic Life (General) & Fish Consumption
04	02030103120030-01	Preakness Brook / Naachtpunkt Brook	Pollutant Unknown	Aquatic Life (General & Trout)
04	02030103120040-01	Molly Ann Brook	Pollutant Unknown	Aquatic Life (General)
04	02030103120050-01	Goffle Brook	Total dissolved solids	Aquatic Life (General)
04	02030103120060-01	Deepavaal Brook	Pollutant Unknown	Aquatic Life (General)
04	02030103120070-01	Passaic R Lwr (Fair Lawn Ave to Goffle)	Arsenic, Chlordane, Cyanide, DDX, Dioxin, Mercury, PCBs	Aquatic Life (General), Primary Contact Recreation, Drinking Water Supply, & Fish Consumption
04	02030103120080-01	Passaic R Lwr (Dundee Dam to F.L. Ave)	Arsenic, Chlordane, Cyanide, DDX, Dioxin, Mercury, Pathogens, PCBs	Aquatic Life (General), Primary & Secondary Contact Recreation, Drinking Water Supply, & Fish Consumption
04	02030103120100-01	Passaic R Lwr (Goffle Bk to Pompton R)	Arsenic, Cadmium, Chlordane, Chromium, Copper, Cyanide, DDX, Dioxin, Lead, Mercury,	Aquatic Life (General), Primary & Secondary Contact Recreation, Drinking Water Supply, & Fish Consumption

			Pathogens, PCBs, Silver, Thallium, Zinc	
06	02030103010050-01	Great Brook (below Green Village Rd)	Pollutant Unknown	Aquatic Life (General)
06	02030103010060-01	Black Brook (Great Swamp NWR)	Arsenic	Aquatic Life (General) & Drinking Water Supply
06	02030103010070-01	Passaic R Upr (Dead R to Osborn Mills)	Arsenic, Cyanide	Aquatic Life (General) & Drinking Water Supply
06	02030103010080-01	Dead River (above Harrisons Brook)	Total Suspended Solids	Aquatic Life (General)
06	02030103010100-01	Dead River (below Harrisons Brook)	Total Suspended Solids	Aquatic Life (General)
06	02030103010110-01	Passaic R Upr (Plainfield Rd to Dead R)	Arsenic, Copper, Cyanide, Lead, Mercury, Total Suspended Solids	Aquatic Life (General) & Drinking & Industrial Water Supply
06	02030103010120-01	Passaic R Upr (Snyder to Plainfield Rd)	Arsenic, Copper, Cyanide, Lead, Mercury, Total Suspended Solids	Aquatic Life (General) & Drinking & Industrial Water Supply
06	02030103010130-01	Passaic R Upr (40d 45m to Snyder Ave)	Arsenic, Copper, Cyanide, Lead, Mercury, Total Suspended Solids	Aquatic Life (General) & Drinking & Industrial Water Supply
06	02030103010150-01	Passaic R Upr (Columbia Rd to 40d 45m)	Arsenic, Copper, Cyanide, Lead, Mercury, Total Dissolved Solids, Total Suspended Solids	Aquatic Life (General) & Drinking & Industrial Water Supply
06	02030103010160-01	Passaic R Upr (HanoverRR to ColumbiaRd)	Total Dissolved Solids, Total Suspended Solids	Aquatic Life (General) & Drinking, Agric., & Industrial Water Supply
06	02030103010170-01	Passaic R Upr (Rockaway to Hanover RR)	Chlordane, DDX, Mercury, PCBs, Total Dissolved Solids, Total Suspended Solids	Aquatic Life (General), Fish Consumption, & Drinking, Agric., & Industrial Water Supply
06	02030103010180-01	Passaic R Upr (Pine Bk br to Rockaway)	Arsenic, Chlordane, DDX, Mercury, PCBs	Aquatic Life (General), Fish Consumption, & Drinking Water Supply
06	02030103020010-01	Whippany R (above road at 74d 33m)	Temperature	Aquatic Life (Trout)
06	02030103020020-01	Whippany R (Wash. Valley Rd to 74d 33m)	Temperature	Aquatic Life (Trout)
06	02030103030030-01	Rockaway R (above Longwood Lake outlet)	Mercury	Fish Consumption
06	02030103030040-01	Rockaway R (Stephens Bk to Longwood Lk)	Mercury, Pollutant Unknown	Aquatic Life (General) & Fish Consumption
06	02030103030060-01	Green Pond Brook (below Burnt Meadow Bk)	Pollutant Unknown	Aquatic Life (General)
06	02030103030070-01	Rockaway R (74d 33m 30s to Stephens Bk)	Mercury	Fish Consumption
06	02030103030090-01	Rockaway R (BM 534 brdg to 74d 33m 30s)	Mercury, Pollutant Unknown	Aquatic Life (General) & Fish Consumption
06	02030103030110-01	Beaver Brook (Morris County)	Mercury, pH	Aquatic Life (General & Trout) & Fish Consumption
06	02030103030130-01	Stony Brook (Boonton)	Pollutant Unknown	Aquatic Life (General)
06	02030103030140-01	Rockaway R (Stony Brook to BM 534 brdg)	Arsenic, Mercury, PCE/TCE, Pollutant Unknown	Aquatic Life (General), Fish Consumption, & Drinking Water Supply
06	02030103030150-01	Rockaway R (Boonton dam to Stony Brook)	Arsenic, Mercury, PCE/TCE	Aquatic Life (General & Trout), Fish Consumption, & Drinking Water Supply
06	02030103030170-01	Rockaway R (Passaic R to Boonton dam)	Mercury, PCE/TCE	Aquatic Life (General) & Fish Consumption
06	02030103040010-01	Passaic R Upr (Pompton R to Pine Bk)	Arsenic, Chlordane, DDX, Mercury, PCBs	Aquatic Life (General), Fish Consumption, & Drinking Water Supply

Lake Impairments on the *2006 Integrated Water Quality Monitoring and Assessment Report*

WMA	Assessment Unit ID	Assessment Unit Name	Parameter	Designated Use Impairment
03	Canistear Reservoir-03	Canistear Reservoir-03	Mercury	Fish Consumption
03	Clinton Reservoir-03	Clinton Reservoir-03	Mercury	Fish Consumption
03	Echo Lake-03	Echo Lake-03	Mercury	Fish Consumption
03	Green Turtle Lake-03	Green Turtle Lake-03	Mercury	Fish Consumption
03	Greenwood Lake-03	Greenwood Lake-03	Mercury	Fish Consumption
03	Greenwood Lake-03	Greenwood Lake-03	Dissolved Oxygen	Aquatic Life (General)
03	Greenwood Lake-03	Greenwood Lake-03	Total Suspended Solids	Aquatic Life (General)
03	Monksville Reservoir-03	Monksville Reservoir-03	Mercury	Fish Consumption
03	Oak Ridge Reservoir-03	Oak Ridge Reservoir-03	Mercury	Fish Consumption
03	Pompton Lake-03	Pompton Lake-03	Mercury	Fish Consumption
03	Pompton Lake-03	Pompton Lake-03	PCBs	Fish Consumption
03	Pompton Lake-03	Pompton Lake-03	Dioxin	Fish Consumption
03	Pompton Lake-03	Pompton Lake-03	DDX	Fish Consumption
03	Pompton Lake-03	Pompton Lake-03	Chlordane	Fish Consumption
03	Ramapo Lake-03	Ramapo Lake-03	Mercury	Fish Consumption
03	Shepherds Lake-03	Shepherds Lake-03	Mercury	Fish Consumption
03	Wanaque Reservoir-03	Wanaque Reservoir-03	Mercury	Fish Consumption
04	Dundee Lake-04	Dundee Lake-04	Mercury	Fish Consumption
05	Lake Tappan-05	Lake Tappan-05	Mercury	Fish Consumption
05	Oradell Reservoir-05	Oradell Reservoir-05	Mercury	Fish Consumption
06	Boonton Reservoir-06	Boonton Reservoir-06	Chlordane	Fish Consumption
06	Boonton Reservoir-06	Boonton Reservoir-06	Mercury	Fish Consumption
06	Boonton Reservoir-06	Boonton Reservoir-06	PCBs	Fish Consumption
06	Boonton Reservoir-06	Boonton Reservoir-06	Chlordane	Fish Consumption
06	Boonton Reservoir-06	Boonton Reservoir-06	Dioxin	Fish Consumption
06	Boonton Reservoir-06	Boonton Reservoir-06	DDX	Fish Consumption
06	Mountain Lake-06	Mountain Lake-06	Mercury	Fish Consumption
06	Speedwell Lake-06	Speedwell Lake-06	Mercury	Fish Consumption

Appendix D: TMDLs Completed in the Passaic River Basin: Streams

WMA	Stream Segment	Site /Segment ID/ EPA Reach No.	Municipalities in streamshed	Parameter(s)
3	Apshawa Brook	PQ15	West Milford Township	Temperature
3	Clinton Brook below Clinton Reservoir	PQ16	West Milford Township	Temperature
3	Macopin River at Echo Lake	01382410	West Milford Township	Temperature
3	Macopin River at Macopin Reservoir	01382450/ PQ 6	West Milford Township	Temperature and Fecal Coliform
3	Outlet Trib of Maple Lake	PQ14	Kinnelon Boro	Temperature
3	Pequannock- Butler	PQ10	Butler Boro	Temperature
3	Pequannock River above Clinton	PQ4	Jefferson and West Milford Townships	Temperature
3	Pequannock River below Clinton	PQ5	West Milford Township	Temperature
3	Pequannock River above	PQ7	Jefferson, Rockaway and West Milford	Temperature

	Macopin		Townships	
3	Pequannock River above Pacock	PQ1	Hardyston and Vernon Townships	Temperature
	Pequannock River below Pacock	PQ3	Hardyston and West Milford Townships	Temperature
3	Pequannock River at Macopin Intake Dam	PQ8	Bloomingdale, Butler, Pompton, Riverdale and Kinnelon Boros, and Rockaway and West Milford Townships	Temperature
3	Pequannock River at Riverdale	01382800/PQ 11	Bloomdale, Riverdale, Pompton Lakes and Butler Boros	Temperature
3	Pompton River Trib at Ryerson Rd	01388720	Riverdale, Lincoln, and Kinnelon Boros, and Pequannock, Montville and Wayne Townships	Fecal Coliform
3	Ramapo River near Mahwah	01387500	Franklin, Oakland, Ramsey, and Wanaque Boros, and Wayne and Mahwah Townships	Fecal Coliform
3	Wanaque River at Highland Avenue	01387010	Pompton Lakes and Wanaque Boros	Fecal Coliform
4	Deepavaal Brook at Fairfield	01389138	Fairfield and West Caldwell Township, and North Caldwell Boro	Fecal Coliform
4	Diamond Brook at Fair Law	01389860	Fair Lawn, Glen Rock, and Hawthorne Boros, and Ridgewood Village	Fecal Coliform
4	Goffle Brook at Hawthorne	01389850	Hawthorne and Midland Park Boros, Ridgewood Village,and Wycoff Township	Fecal Coliform
4	HoHokus Brook at Mouth at Paramus	0139110	Allendale, HoHokus, Glen Rock, Midland Park, and Waldwick Boros, Ridgewood Village, and Passaic City	Fecal Coliform
4	Passaic R. below Pompton R. at Two Bridges	01389005	Lincoln Park Boro, and Fairfield and Montville Townships	Fecal Coliform
4	Passaic River at Little Falls	01389500	Fairfield and Wayne Townships	Fecal Coliform
4	Peckman River at West Paterson	01389600	West Paterson and Verona Boros, and Cedar grove, Little Falls and West Orange Townships	Fecal Coliform
4	Preakness Brook Near Little Falls	01389080	Totowa Boro and Wayne Township	Fecal Coliform
4	Ramsey Brook at Allendale	01390900	Allendale and Ramsey Boros, and Mahwah Township	Fecal Coliform
4	Saddle River at Fairlawn	01391200	Fair Lawn and Paramus Boros, and Rochelle Park and Saddle Brook Townships	Fecal Coliform
4	Saddle River at Lodi	01391500	Allendale, Carlstadt, Fair Lawn, Glen Rock, Ho-Ho-Kus, Lodi, Maywood, Paramus, Waldwick, Wallington, and Woodridge Boros, Ridgewood Village, and Rochelle Park, and Saddle Brook Townships	Fecal Coliform
4	Saddle River at Ridgewood	01390500	Ho-Ho-Kus, Montvale, Paramus, Waldwick and Woodcliffe Lake Boros, Ridgewood Village and Upper Saddle River and Mahwah Townships	Fecal Coliform
4	West Branch Saddle River at Upper Saddle River	01390445	Mahwah and Upper Saddle River Townships	Fecal Coliform

6	Beaver Brook at Rockaway	01380100	Rockaway Boror and Denville, Chatham and Rockaway Townships	Fecal Coliform
6	Black Brook at Madison	01378855	Madison Boro and Chatham Township	Fecal Coliform
6	Canoe Brook near Summit	01379530	Essex Falls and Roseland Boros, and Livingston, Millburn, and West Orange Townships	Fecal Coliform
6	Dead River near Millington	01379200	Far Hills Boro and Warren and Bernards Township	Fecal Coliform
6	Passaic River at Tempewick Rd near Mendham	01378660	Mendham and Bernardsville Boro, and Mendham, Harding and Bernardsville Townships	Fecal Coliform
6	Passaic River at Two Bridges	01382000	Lincoln Park Boro and Fairfield and Montville Townships	Fecal Coliform
6	Passaic River near Chatham	01379500	Chatham, Florham Park, Madison, New Providence and Roseland Boros, Berkeley Heights, Chatham, East Hanover, Harding, Livingston, Long Hill, Millburn, Warren and West Caldwell Townships, and Summit City	Fecal Coliform
6	Passaic River near Millington	01379000	Bernards and Long Hill Townships	Fecal Coliform
6	Rockaway River at Blackwell Street	01379853	Rockaway, Victory Gardens, and Wharton Boro, and Dover, Mine Hill, Randolph and Rockaway Townships	Fecal Coliform
6	Rockaway River at Longwood Valley	01379680	Wharton Boro and Dover, Jefferson, Mine Hill, Randolph, Rockaway and Roxbury Townships	Fecal Coliform
6	Rockaway River at Pine Brook	01381200	Boonton, Montville and Parsippany-Troy Hills Townships	Fecal Coliform
6	Stony Brook at Boonton	01380320	Kinnelon Boro and Bernards, Boonton, Long Hill, Montville and Rockaway Townships	Fecal Coliform
6	Whippany River Near Pinebrook	1381800	Morristown, Hanover and East Hanover townships	Fecal Coliform
6	Whippany River near Morristown	13881500	Morristown, Hanover and East Hanover Townships	Fecal Coliform

Lakes

WMA	Assessment Unit Name	Assessment Unit ID	Municipalities in Lakeshed	Parameter
3	Bubbling Springs	Bubbling Springs-03	West Milford	Pathogens
3	Crystal Lake	Crystal Lake-03	Franklin Lakes, Mahwah, N. Haledon, Oakland, Wayne	Pathogens
3	Erskine Lake	Erskine Lake-03	Ringwood	Pathogens
3	Forest Hill Lake	Forest Hill Lake-03	West Milford	Pathogens
3	Greenwood Lake	Greenwood Lake-03	West Milford	Phosphorus
3	Kitchell Lake	Kitchell Lake-03	West Milford	Pathogens
3	Lake Edenwold	Lake Edenwold-03	Butler Boro, Kinnelon	Pathogens
3	Lake Ioscoe	Lake Ioscoe-03	Wanaque, Bloomingdale	Pathogens
3	Lionhead Lake	Lionhead Lake-03	Franklin Lakes, Wayne	Pathogens

WMA	Assessment Unit Name	Assessment Unit ID	Municipalities in Lakeshed	Parameter
3	Skyline Lakes	Skyline Lakes-03	Mahwah Twp, Ringwood, Wanaque	Pathogens
4	Toms Lake	Toms Lake-04	Wayne	Pathogens
4	Verona Park Lake	Verona Park Lake-04	West Orange, Verona	Phosphorus
6	Camp Lewis Lake	Camp Lewis-06	Rockaway Twp	Pathogens
6	Cold Spring Pond*	Cold Spring Pond-06	West Milford, Bloomingdale	Pathogens
6	Cozy Lake	Cozy Lake-06	Rockaway Twp, Jefferson	Pathogens
6	Fox's Pond	Foxs Pond - 06	Rockaway Boro, Rockaway Twp	Pathogens
6	Indian Lake	Indian Lake-06	Denville, Morris Twp, Parsippany Troy Hills, Randolph	Pathogens
6	Intervale Lake	Intervale Lake-06	Boonton Town, Boonton Twp, Mt. Lakes Boro, Parsippany Troy Hills	Pathogens
6	Lake Swannanoa	Lake Swannanoa-06	Hardyston Twp, Jefferson, Sparta	Pathogens
6	Mountain Lake	Mountain Lake-06	Mt. Lakes Boro, Boonton, Denville	Pathogens
6	Parsippany Lake	Parsippany Lake-06	Parsippany Troy Hills	Pathogens
6	Powder Mill Pond	Powder Mill Pond-06	Denville, Parsippany Troy Hills	Pathogens
6	Rainbow Lakes	Rainbow Lakes-06	Denville, Mt. Lakes, Parsippany Troy Hills	Pathogens
6	Sunrise Lake	Sunrise Lake-06	Harding, Mendham Twp	Pathogens
6	Telemark Lake	Telemark Lake-06	Rockaway Twp	Pathogens
6	West Lake	West Lake-06	Kinnelon Boro	Pathogens
6	White Meadow Lake	White Meadow Lake-06	Rockaway Twp	Pathogens

* Also known as Pond at Conference Center (Left & Right)

Appendix E

Rationale for Establishing Chlorophyll-*a* as Watershed Criteria to Protect Designated Uses of the Wanaque Reservoir and Dundee Lake

Background

The non-tidal Passaic River Basin TMDL study includes a system-wide water quality model that is calibrated and validated for nutrients, dissolved oxygen, and water column chlorophyll-*a*. Continuous simulations from October 1999 to November 2003 were used to account for seasonal variations and a range of hydrologic conditions. Watershed modeling analyses were performed to assess the impact of point and nonpoint source reductions of total phosphorus on dissolved oxygen, phosphorus concentrations, and chlorophyll-*a* within the model domain and, by linking with the LA-WATERS model, within the Wanaque Reservoir.

A water quality model, Water Quality Analysis Simulation Program 7.0 (WASP 7), and a flow model, Diffusion Analogy Surface-Water Flow Model (DAFLOW), were used to simulate water quality and flow in the non-tidal Passaic River, Pompton River mainstem, Ramapo River downstream of Pompton Lake, Wanaque River downstream of the Wanaque Reservoir, and a small stream segment of the Pequannock River. The WASP 7 model is an enhancement of the original WASP model (Omni Environmental, 2007). WASP 7 is a dynamic compartment model that can be used for diverse aquatic systems, such as rivers, reservoirs, lakes, and coastal waters. The model helps users to analyze, and predict a variety of water quality responses due to natural phenomena and man-made pollution. DAFLOW model is a one-dimensional transport model designed to simulate flow by solving the diffusion analogy form of the flow equation. DAFLOW was developed by USGS and enhanced by USGS for this TMDL (Spitz, 2007). A graphical watershed model integration tool (WAMIT) was developed for data sharing and model input calculation between WASP 7 and DAFLOW. A reservoir model known as Laterally Averaged - Wind and Temperature Enhanced Reservoir Simulation (LA-WATERS) was used to model the water quality of the Wanaque Reservoir. The LA-WATERS model links phosphorus loading with chlorophyll-*a* response in the Wanaque Reservoir. It includes a hydrothermal component and water quality modules, which were successfully calibrated to the Wanaque Reservoir using data collected as part of the Wanaque South water supply project (Najarian Associates, 1988), and then re-validated (Najarian Associates, 2000). A mass balance model (Najarian, 2005) was used to simulate daily loads of total phosphorus and orthophosphorus in portions of the study area outside the WASP 7/DAFLOW model domain.

Using these integrated models, several future scenarios were simulated in order to explore the impacts of increases and decreases in phosphorus loads on the key water quality parameters, namely phosphorus concentration, dissolved oxygen, and phytoplankton, measured as water column chlorophyll-*a*. Critical locations identified through this process were the Wanaque Reservoir and the lower portion of the Passaic River impounded by Dundee Dam, also known as Dundee Lake. Absent watershed or site specific criteria, the applicable Surface Water Quality Standards in these locations is a numeric criterion of 0.05 mg/l of total phosphorus. However, based on its riverine nature and the results of model simulations, the in-stream numeric criterion would be more appropriate for Dundee Lake. The comprehensive modeling of the study area both illustrates that these numeric criteria applied as “not to exceed” values is not necessary to protect designated uses. Further, an alternative criterion, established in terms of the response indicator, chlorophyll-*a*, is a better measure of what it takes to achieve water quality objectives and support designated uses in the identified critical locations and allows identification of the value that should apply in each location. Consequently, the target TMDL condition is defined as the phosphorus loading condition that satisfies water quality end points of 20 µg/l and 10 µg/l chlorophyll-*a* for Dundee Lake and the Wanaque Reservoir, respectively.

Establishing Surface Water Quality Standards

Under the Clean Water Act Section 304(a), EPA issues national criteria recommendations to states and tribes to assist them in developing their water quality standards. When EPA reviews a state or tribal water quality standard for approval under 303(c) of the Clean Water Act, the agency must determine whether the adopted designated uses are consistent with the Clean Water Act requirements and whether the adopted criteria protect the designated use. EPA’s regulations encourage states and tribes, when adopting water quality criteria as part of their water quality standards, to employ EPA’s Section 304(a) guidance, to modify EPA’s 304(a) guidance to reflect site-specific conditions or to use other scientifically defensible methods to derive criteria to protect the designated uses.

To meet the objectives of the Clean Water Act, EPA's implementing regulations specify that states must adopt criteria that contain sufficient parameters to protect existing and designated uses. Designated uses are an element of a water quality standard, expressed as a narrative statement, describing an appropriate intended human and/or aquatic life objective for a water body.

To meet the objective of protecting the designated uses, and in accordance with the Clean Water Act requirement, nutrient criteria development includes:

-Assessment of use impairment, i.e. manifestations of eutrophication, these candidates can be grouped as effect-based variables, also called response indicators. Effect-based variables usually include chlorophyll-*a*, dissolved oxygen, variation in pH, and water clarity. It is expected that assessment will vary based on designated uses.

-Assembly of all relevant information pertaining to establishing a nutrient criteria, e.g. historical and current data water quality data, physical, chemical and biological characteristics, designated uses, and reference sites.

-The selected criteria should result in quantifiable measure.

-The selected criteria should be implementable, and when criteria are met, it is expected that the water quality will support the designated uses.

-Water quality modeling, when necessary, to establish a linkage between overenrichment of nutrient concentration (causal variables of impairment) and nutrient impairment (effect or response variables of nutrient overenrichment). For example, a linkage between chlorophyll-*a* concentrations (response indicator) and phosphorus concentrations. Such linkage will help to implement the nutrient reduction needed to achieve the effect-based criteria.

-Nutrient enrichment impacts on downstream waterbodies should always be taken into consideration when proposing a site specific criterion.

Based on the above, it is apparent that the nutrient criteria development process can be complex and involve an extensive amount of data, knowledge and resources. At the same time, water quality management requires immediate and adequate measures in protecting water quality until a more comprehensive assessment can be done. The Department's strategy has been to establish default numeric criteria based on the EPA publication, *Quality Criteria for Water*, known as the red book, which was published in 1976, and to include several caveats, including a narrative exception for the applicability of the numeric criterion for streams, narrative nutrient policies and the option to establish alternative standards in addition to or in place of the default criteria.

The Department's current Surface Water Quality Standards (SWQS) for phosphorus, as stated in N.J.A.C. 7:9B-1.14(c) of the SWQS for Fresh Water 2 (FW2) waters, are as follows:

Phosphorus, Total (mg/l):
i. Lakes: Phosphorus as total P shall not exceed 0.05 in any lake, pond, reservoir, or in a tributary at the point where it enters such bodies of water, except where watershed or site-specific criteria are developed pursuant to N.J.A.C. 7:9B-1.5(g)3.

ii. Streams: Except as necessary to satisfy the more stringent criteria in paragraph i. above or where watershed or site-specific criteria are developed pursuant to N.J.A.C.

7:9B-1.5(g)3, phosphorus as total P shall not exceed 0.1 in any stream, unless it can be demonstrated that total P is not a limiting nutrient and will not otherwise render the waters unsuitable for the designated uses.

Regarding watershed and site specific criteria, N.J.A.C. 7:9B-1.5(g) 3 states:
The Department may establish watershed or site-specific water quality criteria for nutrients in lakes, ponds, reservoirs or streams, in addition to or in place of the criteria in N.J.A.C. 7:9B-1.14, when necessary to protect existing or designated uses. Such criteria shall become part of these Water Quality Standards.

Elaborating on "…render waters unsuitable…" N.J.A.C. 7:9B-1.5(g)2 states:
Except as due to natural conditions, nutrients shall not be allowed in concentrations that cause objectionable algal densities, nuisance aquatic vegetation, abnormal diurnal fluctuations in dissolved oxygen or pH, changes to the composition of aquatic ecosystems, or otherwise render the waters unsuitable for the designated uses.

The narrative part of the nutrient criteria above, as well as the nutrient policies, illustrate that the primary goal of the nutrient criteria is to protect designated uses from nutrient related impacts while providing flexibility as to what the measurable criteria might be. This is appropriate because the level of nutrient over enrichment that will produce an observable impact on waterbodies will exhibit a high degree of variability. Factors that impact the degree of nutrient enrichment that is problematic may include temperature, solar radiation, turbidity, residence time, water depth and physical, chemical and biological characteristics of a waterbody, and others. As a result, a single numeric criterion based on a causal parameter will not be the most appropriate measure for all waterbodies. Instead, the most suitable candidate criteria for the representation of water quality that support designated uses may be the response indicators, i.e. chlorophyll-*a*, diurnal dissolved oxygen, variation in pH, and water clarity. This is consistent with the Clean Water Act (CWA), and the Code of Federal Regulations (CFR) definition of "criteria," which are "elements of State water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that support a particular use." When criteria are met, it is expected that the water quality will support the designated use (40 CFR 131.3[b]).

The State has seven categories of designated use, which include aquatic life, recreational use (primary and secondary contact), drinking water, fish consumption, shellfish harvesting (if applicable), agricultural water supply use and industrial water supply use. The Surface Water Quality Standards at N.J.A.C. 7:9B-1.12 provide that, in all FW2 waters, the designated uses are:

- Maintenance, migration and propagation of the natural and established aquatic biota;
- Primary and secondary contact recreation;
- Industrial and agricultural water supply;
- 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

- Any other reasonable uses.

In assessing attainment of designated uses, as reflected in the both the 2004 and 2006 *Integrated Water Quality Monitoring and Assessment Methods Documents,* the Department takes the conservative approach of identifying waterbodies as impaired with respect to phosphorus where there is violation of numeric nutrient criteria. However, the Department is aware that what constitutes an impairment is not phosphorus enrichment, by itself, but rather the manifestations of eutrophication that may result when phosphorus causes excessive primary productivity. Specifically, when present in excessive amounts, phosphorus can lead to excessive primary productivity, in the form of algal and/or macrophyte growth. The presence of excessive plant biomass can, in itself, interfere with designated uses, such as swimming or boating. There are also implications from excessive algae with respect to drinking water use. Algal blooms in raw drinking water sources can cause taste and odor problems and treatment inefficiencies, having a negative impact on conventional treatment at a drinking water system. When algae are present in large amounts purveyors must increase the use of disinfectants and oxidants to treat the algae resulting in an increase in disinfection byproducts such as trihalomethanes, some of which are listed by EPA as likely carcinogens. In addition, the respiration cycle of excessive plant material can cause significant swings in pH and dissolved oxygen, which can result in violation of criteria for these parameters, which can adversely affect the remainder of the aquatic community. Finally, excessive algae can affect water column transparency, which would impact recreational, water supply and fishery designated uses.

Selection of response indicator

In 2002, U.S. EPA developed nutrient water quality criteria guidance for lakes and reservoirs for fourteen major Ecoregions of the United States (USEPA 2000). The guidance recommends several candidate nutrient criteria for the protection of designated uses, the recommended candidates include both nutrient concentrations based on reference conditions, and effect-based variables. Those candidates are chlorophyll-*a*, total phosphorus, total nitrogen, and Secchi depth.

Chlorophyll represents a family of chlorophyll molecules expressed as a, b, c, d. Chlorophyll-*a* is selected because of its primary role in photosynthesis. Chlorophyll-*a* is easy to measure and is a useful surrogate for measuring algal biomass, which is either the direct (nuisance algal blooms) or indirect (high/low dissolved oxygen, pH and high turbidity) cause of most problems related to excessive phosphorus enrichment.

Modeling of the non-tidal Passaic River basin illustrates that phosphorus concentration as a not to exceed value in the critical locations, Wanaque Reservoir and Dundee Lake, is not necessary to achieve acceptable levels of the response indicators dissolved oxygen and chlorophyll-*a*. Using chlorophyll-*a* as the measurable criterion to evaluate when nutrients are present in excessive amounts is desirable because chlorophyll-*a* relates directly to the impairment of uses, as noted above and is easy to measure. Secchi depth was not considered as a candidate because water column transparency could be affected by inorganic suspended solids, color, and there is a weak correlation with nutrient concentrations. Because of the comprehensive water quality modeling developed in this TMDL study, a direct and quantitative linkage has been established between chlorophyll-*a* and total phosphorus concentrations. This allows identification of the phosphorus reductions needed to achieve a given chlorophyll-*a* concentration.

Selection of criterion value

Determination of the chlorophyll-*a* threshold that is appropriate can vary depending on the physical characteristics and the designated uses of a particular waterbody. In order to select the chlorophyll-*a* threshold to apply to each critical area, five factors were taken into consideration:

1. Designated uses, grouped as recreational, aquatic life, and water supply uses
2. Characteristics of the waterbody, e.g. hydrological characteristics.
3. Assessment of relevant water quality variables associated with the selected criterion, using the non-tidal Passaic River Basin models.
4. Potential to affect downstream waters, using the Passaic River Basin wide models.
5. Relationship to the existing numeric phosphorus criteria.

Most references use a range of values to describe the trophic status of a waterbody. Based on the literature reviewed, there is some consistency on the range of chlorophyll-*a* levels representing different trophic status of a lake. Chlorophyll-*a* greater than 20 µg/l is usually used to represent a Mesotrophic to Eutrophic lake status. Moderate levels of primary productivity in a waterbody that is designated for supporting fisheries or aquatic life uses would be beneficial, and levels of chlorophyll-*a* can be higher for this use than for swimming or drinking water supply uses. The level of primary productivity in a waterbody that is designated for supporting a cold water fishery would be different than for a waterbody designated as warm water fishery. One reason is the sensitivity of a cold water fishery to oxygen levels.

In addition to the unique characteristics of the Wanaque Reservoir and Dundee Lake, the Department considered the literature and experience of other states in selecting criteria for these locations. *The Nutrient Criteria Technical Manual for Lakes and Reservoirs* discusses the relationship between chlorophyll-*a* and phosphorus and its linkage to biomass. It notes that North Carolina uses a standard of 15 µg/L chlorophyll-*a* for cold water habitats and 40 µg/L in warm water habitats. It also cites Rascke (1994) who proposed a mean growing season limit of 15 µg/L chlorophyll-*a* for water supply impoundments in the southeastern United States and a value of 25 µg/L chlorophyll-*a* for water bodies primarily used for other purposes. The Kansas Department of Health and the Environment has implemented 12 µg/L chlorophyll-*a* target for domestic water supply reservoirs, with a 10% margin of safety, and 20 µg/l chlorophyll-*a* for secondary contact recreation lakes, with a 10% margin of safety. TMDLs developed in other states have selected chlorophyll-*a* levels as the water quality endpoint for the TMDL calculation. For example, TMDLs for Lake Galena, PA, Lake Nockamixon, PA, McDaniel Lake, MO and Federal Council Grove Lake, KS used 10 µg/L as the water quality endpoint. The TMDL prepared for Dutch Fork Lake, PA used a water quality endpoint of 20 µg/L. Several other EPA approved TMDLs for lakes (Green Lane Reservoir, PA TMDL and Lake Weiss, AL TMDL) utilized 20 µg/l for chlorophyll-*a* as the TMDL water quality target. This survey indicates that chlorophyll-*a* levels across a range have been selected as protective, based on the water body characteristics and uses.

Most of the chlorophyll-*a* levels cited are based on the observations of what levels are considered to be "undesirable" primarily for recreational and aesthetic designated uses. This approach is highly dependent on the individual observer's perceptions and responses regarding suitability for use vs. chlorophyll-*a* concentrations. For example, Texas Water Conservation Association published a study in 2005 *"Development of Use-Based Chlorophyll Criteria for Recreational Uses of Reservoirs."* The study was based on analysis of approximately 1800 surveys, 16 monitoring sites in 8 reservoirs and 310 sampling events. One of the objectives of the study was to assess the relationship between chlorophyll-*a* concentrations and suitability for recreational uses. Results of the observer's responses show great variation with respect to what constitutes use impairment for a given chlorophyll-*a* concentration. For example a comparable number of those surveyed found a lake with 4 µg/l to be equally suitable to a lake with 35 µg/l chlorophyll-*a.*

North Carolina State University's watershed information database (http://www.water.ncsu.edu/watershedss/info/algae.html) suggests that a mean growing season limit of 15 µg/l chlorophyll-*a* is appropriate for drinking water reservoirs, and that a mean growing season limit of 25 µg/l is appropriate to protect all other uses, namely recreational, aesthetic, and aquatic life. However, more and less restrictive values can be found in the literature. The State of Vermont established a chlorophyll-*a* target of 3 µg/l for Lake Champlain, Vermont, a major recreational, aesthetic, and aquatic life resource. On the other hand, for all water supply impoundments in North Carolina, chlorophyll-*a* levels may not exceed 40 µg/l at any time; for waters not serving as a water supply; chlorophyll-*a* may periodically exceed 40 µg/l during the growing season. The State of Oklahoma proposed a chlorophyll-*a* concentration of 10 µg/L to protect public water supply use (Oklahoma Water Resources Board, June 2005).

Two critical locations were identified in the non-tidal Passaic River TMDL: the Wanaque Reservoir and Dundee Lake. The characteristics of these two waterbodies are significantly different.

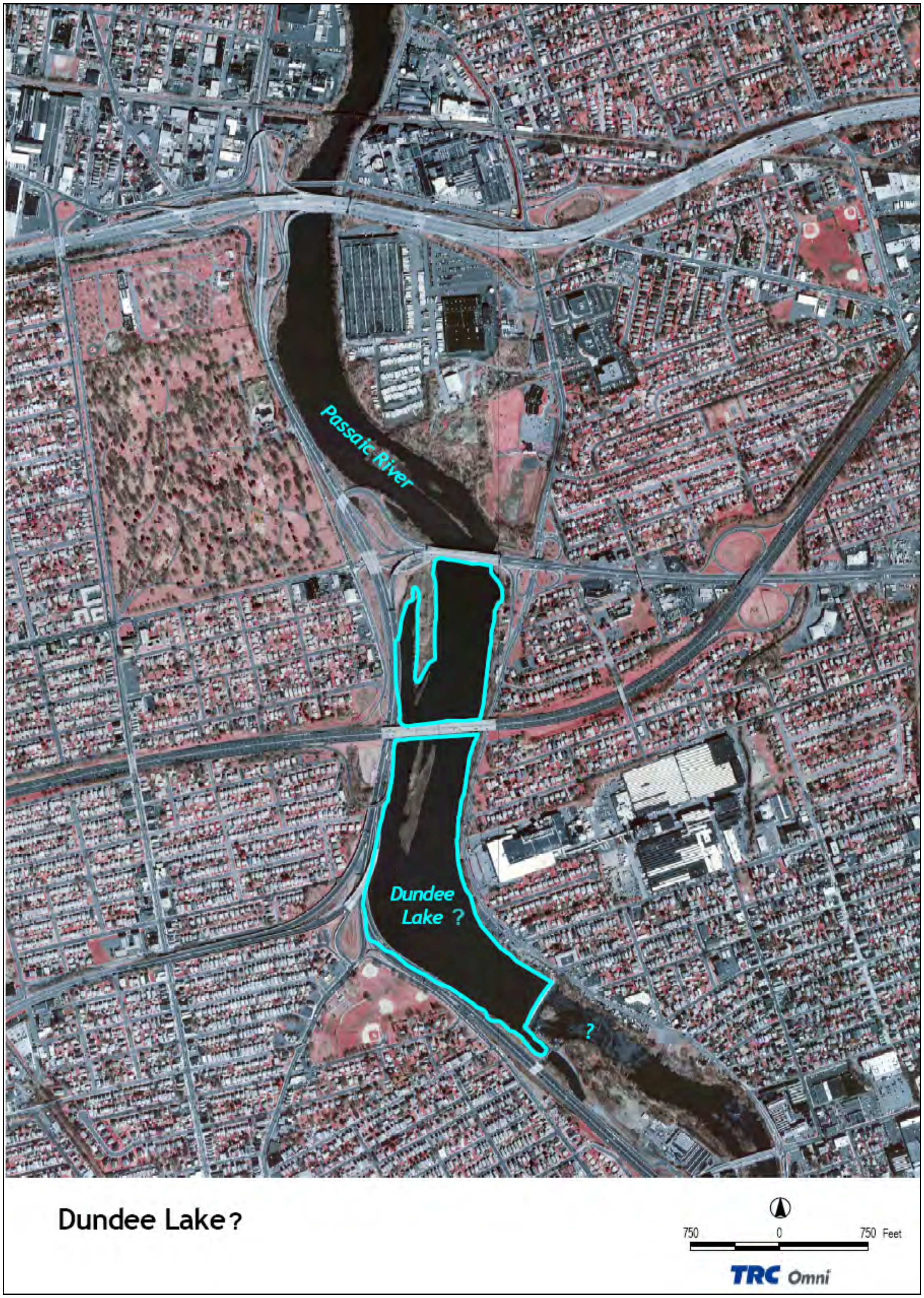
The Passaic River upstream of Dundee Dam is referred to as Dundee Lake. The aerial photo in Figure 1 shows the portion of the Passaic River designated as Dundee Lake in the NJDEP lakes GIS coverage. A bridge forms the "lake" boundary; however, the Passaic River upstream of the bridge is just as wide as it is downstream, and the Passaic River is deeper for about a mile upstream of the Dundee Dam. The portion of the river that is designated as Dundee Lake includes slightly more than 0.8 miles of river above the dam. The detention time in that portion of the river averages about 1.7 days per mile of river length. Dundee Lake is classified as a warm water fishery and is currently permitted for use as an industrial water supply.

Similar to Dundee Lake, Dutch Fork Lake in Pennsylvania functions somewhere between a lake and a slowly moving stream. Pennsylvania uses a 14 day detention time to distinguish between lakes and flowing waters. Dutch Fork Lake has a detention time of approximately 9 days, while Dundee Lake has an average detention time of 1.4 days. According to the Dutch Fork Lake TMDL (PADEP, 2003, p.5): "Hence, a 10 µg/l chlorophyll-*a* target, in addition to being infeasible and unachievable, is unnecessarily stringent in what is technically a flowing water. A 20 µg/l seasonal average chlorophyll-*a* target was used for the purpose of defining a total phosphorus TMDL for Dutch Fork Lake. This will result in a mildly eutrophic classification for

Dutch Fork Lake. Given the natural progression of all lakes and the fact that Dutch Fork Lake is 45 years old, Pennsylvania believes this is consistent with water quality standards for the Lake."

The fact that the impoundment of the Passaic River upstream of Dundee Dam constitutes an urban feature with a low detention time argues for using values in the upper end of the literature range. The Passaic River upstream of Dundee Dam has characteristics that are more like a stream than a lake. Absent a watershed criterion, the Department's default stream criterion for phosphorus would be more appropriate than the lake criterion. In 2002 the Department developed a technical manual for NJPDES Discharge to Surface Water Permits, which guides the evaluation of the applicability of the Department's numeric criterion for streams. This manual sets a seasonal average chlorophyll-*a* of 24 µg/l (seasonal average) and 32 µg/l (max 2-week mean) as the conservative threshold to determine when phosphorus is rendering waters unsuitable for designated uses. Given its characteristics, use of a similar threshold would be suitable for Dundee Lake. To be conservative, the Department proposes a seasonal average of 20 µg/L of chlorophyll-*a* for Dundee Lake. The seasonal averaging period is from June 15 to September 1. Based on the modeling, this period provides an additional degree of conservatism.

FIGURE 1 : Aerial Photo of Dundee lake



The non-tidal Passaic TMDL water quality modeling study allows assessment of the water quality that would be associated with the proposed chlorophyll-*a* criterion. The effect of wide range chlorophyll-*a* concentrations on diurnal dissolved oxygen concentrations were examined under a continuous model simulation of four years, including several critical conditions. Figure 2 below, shows the strong relationship between maximum dissolved oxygen swing and summer average chlorophyll-*a* for the Passaic River at Dundee Dam (powerful logarithmic relationship with an r^2 near 0.99). Figure 3 shows that both the "24 hr average" and the "not less than" dissolved oxygen criteria are being met under the TMDL simulation period, except for only violation to the not less than 4 mg/l criterion occurred during the drought of 2002 when the criteria was not applicable.

FIGURE 2: Relationship between DO Swing and Chlorophyll-*a*

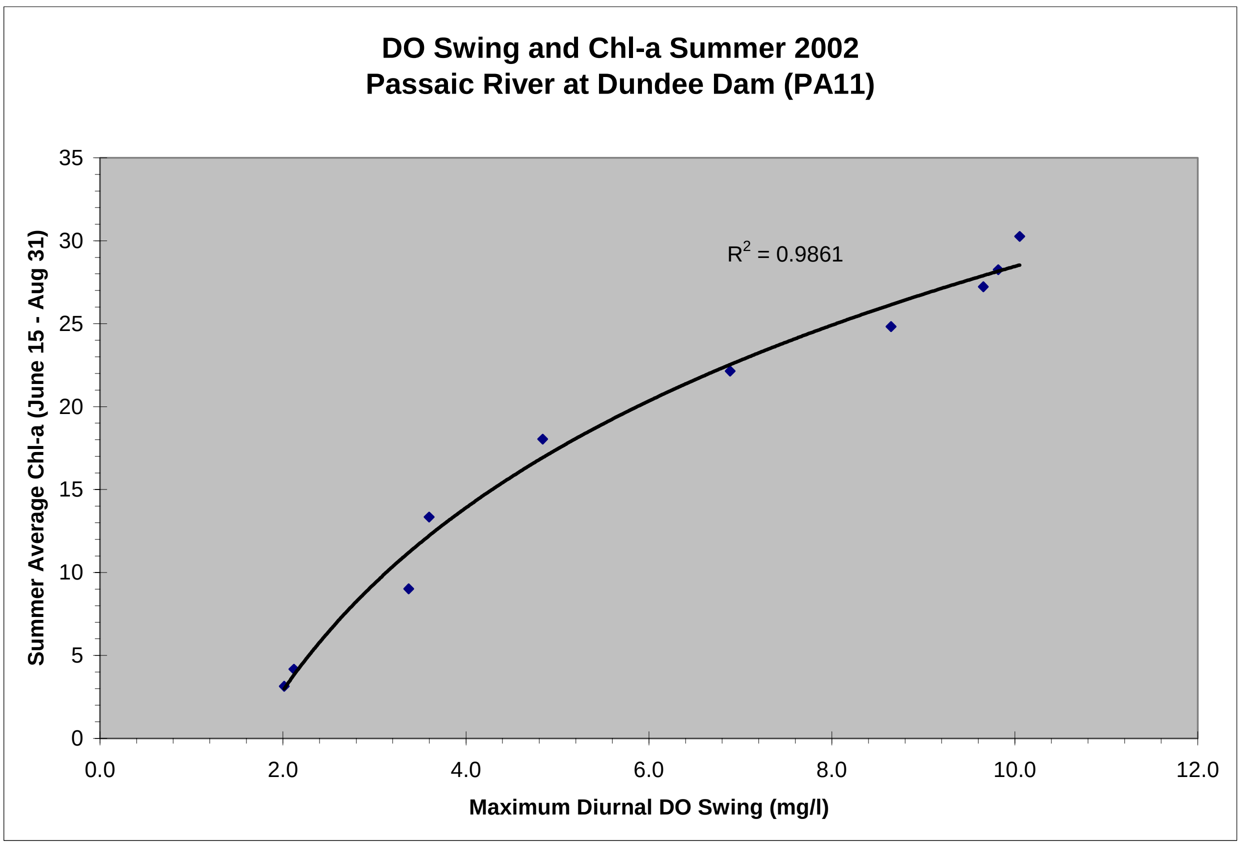
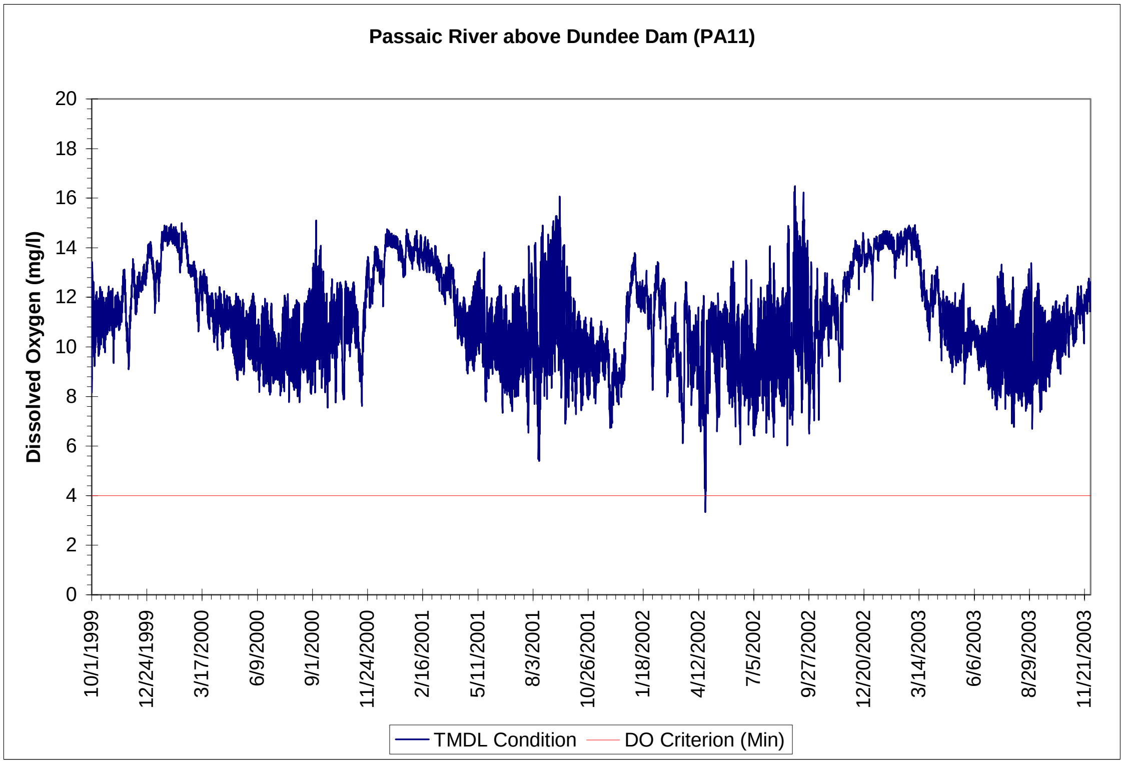
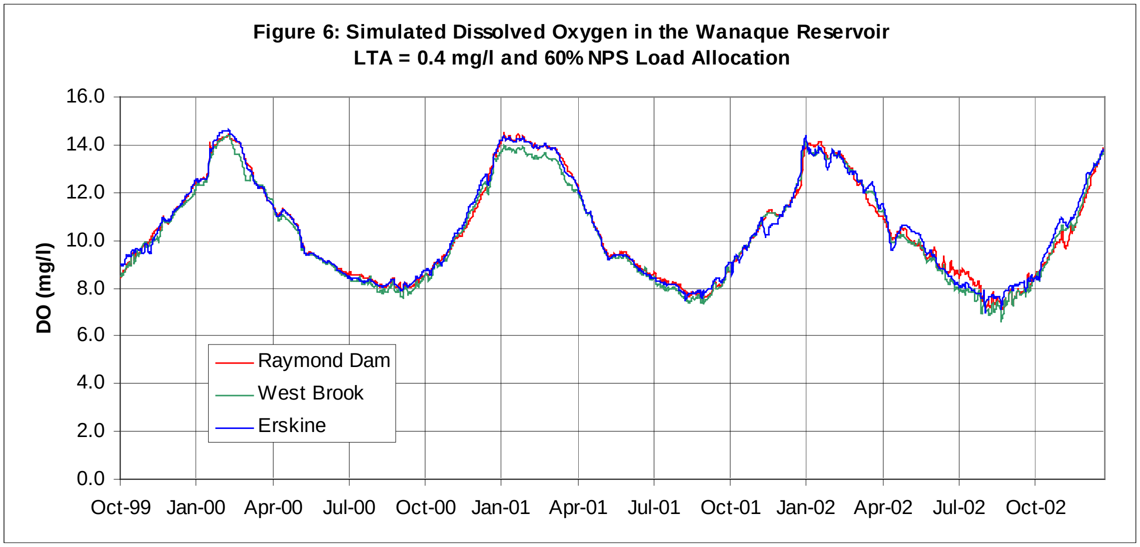


FIGURE 3 TMDL Condition in Passaic River at Dundee Dam – DO



The Wanaque Reservoir is distinctly different than Dundee Lake. The Wanaque Reservoir is large, the largest reservoir in area in New Jersey, and deep (average depth 37 feet, maximum depth 90 feet) and supports trout throughout the fishing season. It serves as a source of drinking water for 4 million people. In consideration of these characteristics, a more conservative chlorophyll-*a* target of 10 µg/L as a seasonal average is proposed. Evaluating the water quality implications of this target, Figure 4 below shows that both the “24 hr average” and the “not less than” dissolved oxygen criteria are met under the TMDL simulation period for the three locations modeled within the Reservoir.

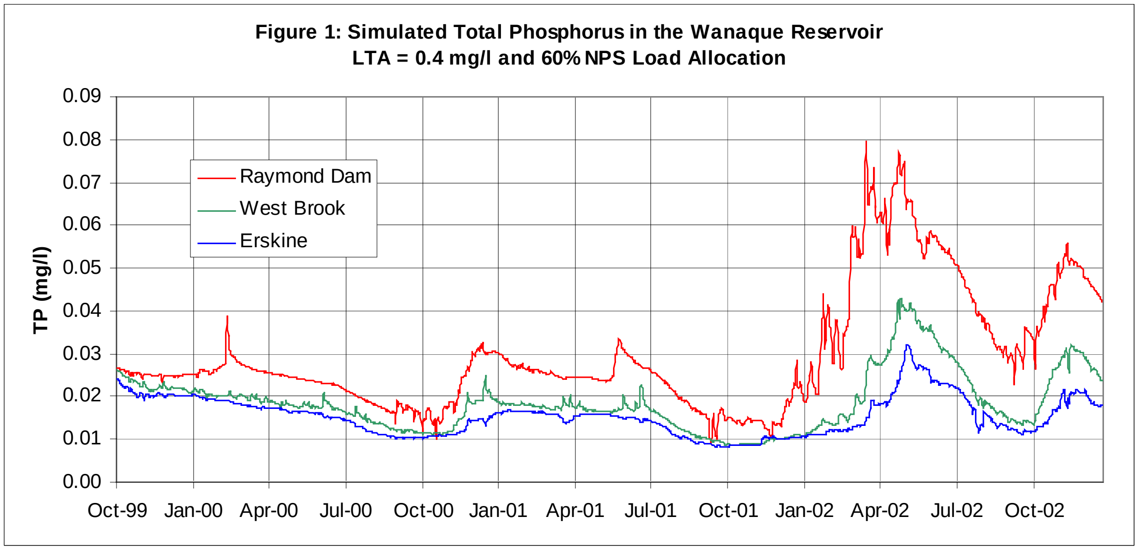
FIGURE 4 Simulated Dissolved Oxygen in the Wanaque Reservoir



Having a comprehensive water quality model allows assessment of downstream effects of a given condition. The modeling effort has identified the critical locations that require phosphorus reductions, as well as the level of phosphorus reduction needed to achieve a specified desired condition. As the study area reaches to the terminus of the non-tidal portion of the river, there is no concern about downstream effects beyond the study area.

Comparing the implications of the proposed chlorophyll-*a* criteria with the existing total phosphorus criteria shows that, on average, the appropriate default criteria are generally met. Figure 5 shows that the 0.05 µg/l total phosphorus criterion is being met for most of the model simulations. A mean total phosphorus concentration simulated from October 1999 through October 2002 shows phosphorus well below 0.03 mg/l at all three locations within the reservoir. Total phosphorus concentration exceeded the 0.05 mg/l criteria only during a few months during the drought year of 2002 and only at Raymond Dam.

FIGURE 5: Simulation of Total Phosphorus in the Wanaque Reservoir



Because of the fact that the Passaic River upstream of Dundee Dam is more like a stream than a lake, the total phosphorus concentrations at Dundee Lake were assessed against the stream total phosphorus criteria of 0.1 mg/l. Table 1 summarizes the results of the model simulation under the TMDL and existing conditions. The stream criterion is generally met, with the greatest deviation from the 0.1 mg/l TP criteria observed only during the drought year of 2002.

FIGURE 6 Total Phosphorus Concentrations in the Dundee Lake

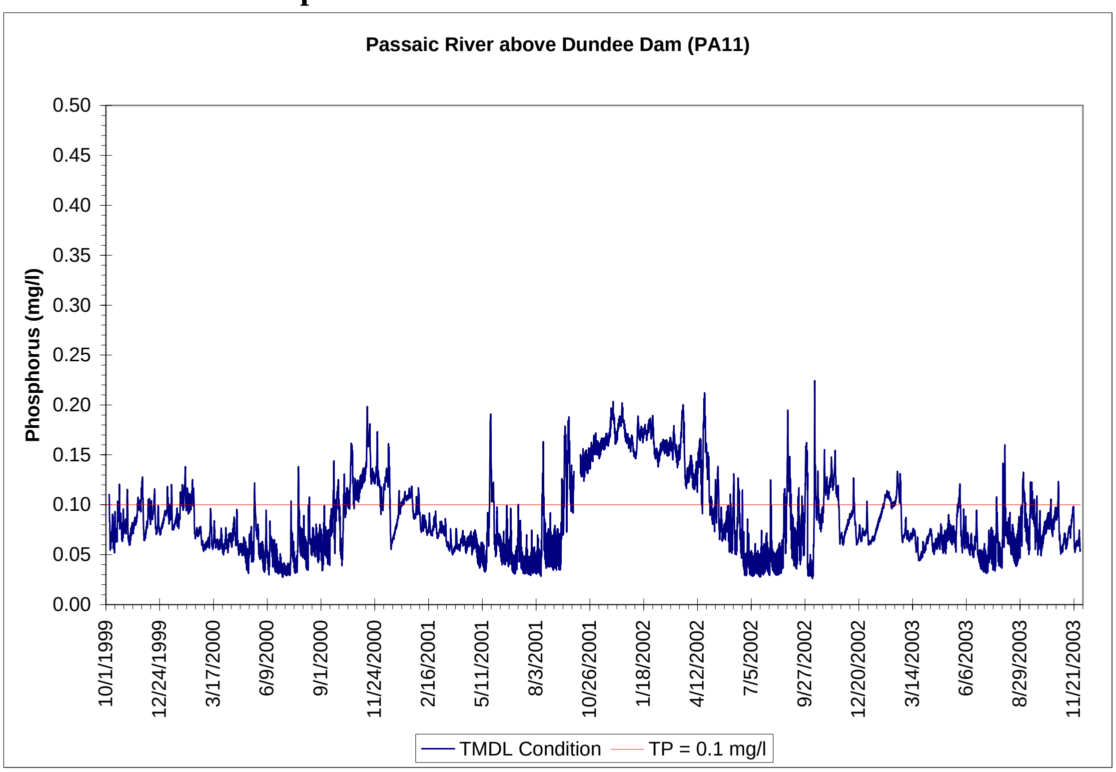


Table 1 Summary

	TP - Existing (mg/l)	TP - TMDL (mg/l)
Entire Time Period		
Count	14,971	14,971
Average	0.33	0.09
90th Percentile	0.56	0.15
Percent Rank 0.1	1%	70%
W/out WY2002		
Count	11,421	11,421
Average	0.28	0.08
90th Percentile	0.46	0.11
Percent Rank 0.1	1%	81%
W/out 2002 Water Supply Emergency		**1/24/2002 - 1/7/2003**
Count	11,531	11,531
Average	0.31	0.08
90th Percentile	0.56	0.14
Percent Rank 0.1	1%	74%

Conclusion

Chlorophyll-*a* is the common translator selected by states (Missouri, Pennsylvania, Oregon, Alabama and Kansas) to address narrative criteria and is supported by EPA in both "*Protocols for developing Nutrient TMDLs*, First Edition November 1999, which lists chlorophyll-*a* as suitable indicator for nutrient TMDLs, and in *Nutrient Criteria Technical Guidance Manual Lakes and Reservoirs"*, First Edition 2000. Chlorophyll-*a* is selected because of its primary role in photosynthesis. It is easy to measure and is a useful surrogate for measuring algal biomass, which is either the direct (nuisance algal blooms) or indirect (high/low dissolved oxygen, pH and high turbidity) cause of most problems related to excessive phosphorus enrichment. EPA's August 2002 approval of revisions to the New Jersey's phosphorus criteria specifically acknowledge that criteria may be developed through the watershed process (N.J.A.C. 7:9B-1.14 (c)5, and that it is consistent with the requirements under 40 CFR 131.11(b). Adoption of the non-tidal Passaic River basin TMDL establishes that the watershed criteria specified herein, upon approval by EPA, are the applicable surface water quality standards with respect to phosphorus within the identified domain.

Appendix F: Response to Comments: Non-tidal Passaic River Basin and Pompton Lake/Ramapo River Phosphorus TMDLs

Summary of Public Comments and Responses
The following people (listed alphabetically) submitted written and/or oral comments on one or both of the proposed TMDLs:

1. Alexander, Diane of Maraziti, Falcon, & Healey LLP for Rockaway Valley Regional Sewerage Authority, Letter and fax (same) dated July 6, 2007
2. Bongiovanni, Robert - Executive Director of Two Bridges Sewerage Authority. Letter dated July 3, 2007 (submitted with 16. below)
3. Covelli, Frank - Vice-Chairman of Wanaque Valley Regional Sewerage Authority, Letter dated November 8, 2006
4. Curran, Kelley of Great Swamp Watershed Association, Letter dated August 9, 2007
5. Decker, George - Chairman of Pompton Lakes Borough Municipal Utilities Authority, Letter dated November 7, 2006
6. Duch, Thomas - City of Garfield, Letter dated May 22, 2007
7. Filippone, Ella - Executive Director of Passaic River Coalition Watershed Association, Public Hearing, June 7, 2007
8. Filippone, Ella and Anne Kruger, Passaic River Coalition, Letter dated June 25, 2007
9. Filippone, Ella and Anne Kruger, Passaic River Coalition, Letter dated June 7, 2007
10. Goodsell, Robert of Post, Polak, Goodsell, MacNeill & Strauchler for Warren Township Sewerage Authority, Letter and fax (same) dated July 6, 2007
11. Kehrberger, Patricia of Hydroqual, Inc. for Township of Wayne, Letter and fax (same) dated July 6, 2007
12. Kehrberger, Patricia of Hydroqual, Inc. for Warren Township Sewerage Authority, Letter and fax (same) dated July 6, 2007
13. Kehrberger, Patricia of Hydroqual, Inc. for Warren Township Sewerage Authority, Letter and fax (same) dated September 19, 2007
14. Matarazzo, Pat - Chairman of Passaic River Basin Alliance, Public Hearing June 7, 2007
15. Meyers, Mark of Quantitative Environmental Analysis, LLC for Two Bridges Sewerage Authority, Technical memorandum dated July 2, 2007
16. Plambeck, Richard - Mayor of Chatham Borough, Public Hearing June 7, 2007
17. Platt, Fletcher of Hatch Mott MacDonald and Technical Advisory Committee Member, Public Hearing, June 7, 2007
18. Singer, Steven - Counselor-at-Law for Township of Wayne, Letter and fax (same) dated July 6, 2007 (submitted with 11. below)
19. Thompson, B. - Email of July 6, 2007 with forwarded July 6, 2007 letter from N. Bardach of Virotech USA, Inc.
20. Tittel, Jeff - Director of Sierra Club, Public Hearing June 7, 2007
21. United States Environmental Protection Agency – Region 2, Letter dated July 9, 2007
22. Wolfe, Bill - Director of New Jersey Chapter of Public Employee for Environmental Responsibility (PEER), Public Hearing, June 7, 2007
23. Wynne, Michael - Executive Director of Hanover Sewerage Authority, Letter and fax (same) dated July 6, 2007

A summary of comments on the proposals and the Department's responses to those comments follows. The numbers(s) in brackets at the end of each comment corresponds to the commenters(s) listed above.

Extend Comment Period:

1. Comment: The Department should extend the comment period an additional 60 days to allow sufficient time to evaluate various aspects of the Phase 2 Watershed Model. (10)

Response: The entire TMDL development process included significant information sharing with the public and multiple opportunities for public comment. For the formal proposal, the Department advertised the public hearing 30 days prior to the date of the hearing and allowed a 30 day comment period following the hearing. In addition, due to unexpected difficulties in making the model available on the web, an additional 30 days was allowed to comment on the proposed TMDLs. The Department believes that a further extension of the comment period would not be likely to raise issues or provide new information, data or findings that were not previously raised or provided during the development of the amendment or during the comment period outlined above. The Department believes that adequate opportunity for comment was provided to all commenters on this amendment without the necessity of a further extension of the comment period.

End Point:

2. Comment: Use of site-specific criteria is supported. Based upon review of the proposed criteria and supporting documentation, commenter agrees that chlorophyll-*a* represents an optimum endpoint for the Wanaque Reservoir and Dundee Lake TMDLs. In addition, based upon the modeling results presented in the proposed report and supporting technical reports, it appears that the proposed chlorophyll-*a* values of 10 ug/L for the Wanaque Reservoir and 20 ug/L for Dundee Lake are adequately protective of the applicable designated uses. Specifically, the modeling results, as presented in the various figures, indicate that compliance with the chlorophyll-*a* proposed values will minimize the current nutrient-based impairments to these two waters: excessive diurnal dissolved oxygen swings, and elevated chlorophyll-*a* levels. The referenced literature and State examples serve to further justify the selection of these values. (21)

Response: The Department acknowledges the support of the watershed criteria developed for the two critical endpoints in the Passaic River Basin. With adoption of these TMDLs as amendments to the applicable Water Quality Management Plans, these criteria are adopted watershed criteria in accordance with the New Jersey Surface Water Quality Standards, *N.J.A.C.* 7:9B-1.5(g)3. The Department plans to post watershed criteria established as part of an adopted Water Quality Management Plan on its Water Quality Standards page.

3. Comment: Commenter believes that the discussion of the criteria could be reorganized to strengthen and clarify the justification as follows: a) the detailed information in Appendix E that

taken together leads to the conclusion that designated uses are protected should be summarized there and added to the main document on page 18; b) the experience of other states could be relegated to supporting information rather than included as part of the justification. (21)

Response: The Department believes that the body of the TMDL document should summarize information that is set forth in greater detail in Appendices and/or the supporting documents that accompany the TMDL. Repeating the detailed information contained in Appendix E in the body of the TMDL does not add to the strength of the argument. The detailed information on the experiences of other states has been moved to Appendix E. In addition, the Department has revised Section 3 and Appendix E to more clearly state that designated uses will be supported with attainment of the watershed criteria.

4. Comment: On page 17 there is a reference to a New York State guidance value of 20 ug/L of chlorophyll-*a* and a New York City value of 15 ug/L chlorophyll-*a* for the New York City water supply reservoirs. Please note that both the 20 ug/L and 15 ug/L values are for total phosphorus, not chlorophyll-*a*. In addition, it should be noted that the total phosphorus value 15 ug/L relates to a chlorophyll-*a* concentration of 7.0 ug/L, and is only applied to a subset of the New York City water supply reservoirs. (21)

Response: The error noted by the commenter was based on the commenter's review of a pre-release draft. The errors referenced by the commenter were corrected prior to release of the final May 7, 2007 proposal.

5. Comment: 40 C.F.R. 131.6(a)-(f) specify the minimum requirements for a water quality standards submission to EPA. With regard to the State's submission of the site specific chlorophyll-*a* criteria for the Wanaque Reservoir and Dundee Lake, elements (b), (c) and (e) apply. Based upon the commenter's review of the applicable sections of the proposed TMDL Report, elements (b) and (c) are included in the proposal. The Department must also include the requisite Attorney General certification as part of the final submission in order to address the requirements of 40 C.F.R. 131.6(e). (21)

6. Comment: 40 C.F.R. 131.20(a)-(c) specify the Federal requirements for State review and revision of water quality standards. With regard to the State's submission of the site-specific chlorophyll-*a* criteria for the Wanaque Reservoir and Dundee Lake, the applicable 40 C.F.R. 131.20 elements that apply are (b) and (c). The Department has fulfilled the requirements of 40 C.F.R. 131.20(b) through its public participation process. The Department's submission of the final chlorophyll-*a* criteria for the Wanaque Reservoir and Dundee Lake, along with the final methodologies used for site-specific criteria development, as well as the above-referenced Attorney General certification will satisfy the requirements of 40 C.F.R. 131.20(c). (21)

Response to Comments 5 and 6: The TMDL documents, revised for adoption in accordance with the response to comments, include the final documentation of the watershed criteria (not site specific) relative to the phosphorus standard within the non-tidal Passaic River basin. The Department notes that the referenced DAG certification is required under Federal regulations to stipulate that the water quality standards have been duly adopted pursuant to State law. This certification was provided to EPA as part of the submission of the current Surface Water Quality Standards, which were approved by EPA's letter dated August 16, 2002. That letter specifically approved the revision to the "phosphorus criteria to acknowledge that criteria may be developed through the watershed process (N.J.A.C. 7:9B-1.14(c)5." The Department believes this obviates the need for the DAG certification specified at 40 C.F.R. 131.6(e). The Department will provide any documentation determined to be necessary to establish that the watershed criteria are the applicable surface water quality criteria relative to the phosphorus standard in the specified portion of the non-tidal Passaic River basin.

7. Comment: The Department needs to show that the existing standard is inappropriate or under-protective before an alternate watershed-specific criterion is developed. Further, establishing the criterion as part of the TMDL does not appear to be procedurally correct. The target for the Phase 1 TMDL was not to exceed 0.05 mg/L. The seasonal average approach appears to be a back door ruse to weaken the compliance condition. The most stringent policy should be in place to protect the public water supply. (22)

Response: Site-specific or watershed criteria can be either the same, more, or less stringent than the existing/default criteria, as stated in the adoption of amendments to the Surface Water Quality Standards proposed on December 18, 2000, see 34 N.J.R. 537(a), January 22, 2002; specifically responses to comments 247, 248 and 343-351. Establishing the criteria in terms of the response indicator, chlorophyll-*a*, is not a weakening of the criteria. Instead, development of a dynamic model that simulates the effect of nutrients, productivity and water quality effects of productivity based on the characteristics of the specific watershed has allowed the Department to set criteria that provide protection of designated uses without requiring nutrient reductions aimed at achieving a default criterion. The SWQS state that watershed criteria shall be established through the watershed process, which includes through adopting a TMDL, which establishes said criteria.

8. Comment: Selection of chlorophyll-*a* as the endpoint parameter and as a seasonal average to measure compliance for Dundee Lake and Wanaque Reservoir is appropriate. Chlorophyll-*a* as a measure of algae related to taste and odor problems in water supplies (drinking water use), algae interference in the normal operation of a water treatment plant (drinking water use), recreation use (aesthetics) and the resultant dissolved oxygen (aquatic life use) are a direct measure of meeting designated uses. (11), (12)

9. Comment: The use of chlorophyll-*a*, a response indicator of the effect of phosphorus on algal growth, as the endpoint for the TMDL is applauded. The use of chlorophyll-*a* is supported over the former approach, which applied the numerical phosphorus limit without any consideration of the effect. (23)

10. Comment: The use of summer average phytoplankton chlorophyll-*a* as a measure of whether or not nutrient concentrations are excessive is appropriate and the critical locations for this measure are the confluence of the Passaic and Pompton Rivers and in the Passaic upstream of Dundee Dam. The Department is commended for including Dundee Dam as an endpoint because it should be cleaned up so as to be suitable as a drinking water source. (7), (8), (9)

Response to Comments 8-10: The Department acknowledges these comments in support of use of chlorophyll-*a*. The Department selected chlorophyll-*a* as the appropriate response indicator for the Passaic River watershed criteria. Based on the development of a dynamic model for the Passaic River Basin that simulates the relationship between nutrients, productivity and water quality and allows identification of levels of chlorophyll-*a* that support designated uses in the critical locations.

11. Comment: While the use of chlorophyll-*a* as the response indicator for the TMDL is applauded, the selection of a summer average 10 ug/L target is very conservative and was made in the absence of any site specific data. A review of Florida lakes shows that 20 ug/L is exceeded only 2% of the time when the warm season average is 10 ug/L. This illustrates the conservative nature of the target. The selection of 10 ug/L is explained only in terms of reservoir characteristics: it is deep, and serves as a trout fishery and a drinking water supply. (15)

12. Comment: Moving from phosphorus to chlorophyll-*a* is a concern. We know phosphorus is a limiting factor. Chlorophyll-*a* is a biochemical byproduct. We all know what the standard is and that is what we should strive for. (20)

13. Comment: The seasonal average chlorophyll-*a* of 10 ug/L for the Wanaque Reservoir has not been documented as the appropriate end point and appears arbitrary. NJDEP lists the five factors taken into consideration in the selection of the chlorophyll-*a* value and cites a range of values adopted elsewhere, concluding that a conservative target is warranted for the Wanaque Reservoir. Was North Jersey District Waster Supply Commission (NJDWSC) input on the selection of the chlorophyll-*a* standard used or requested? An analysis and/or data from NJDWSC documenting the relationship of algae levels to treatment problems and/or taste and odor complaints from customers is necessary for the establishment of a protective chlorophyll-*a* standard for the reservoir. Although samples are collected monthly, values exceeding 10 ug/L are measured for most years. 15 ug/L appears to be normal for the Reservoir. NJDWSC should be an active participant in the establishment of the chlorophyll-*a* standard at their reservoir. (12)

14. Comment: The selection of 20 ug/l chlorophyll-*a* is arbitrary and not supported in the TMDL analyses. The Department's phosphorus technical guidance sets a threshold for chlorophyll-*a* of 24 ug/l as a seasonal average with a two-week mean of 32 ug/l. These values have been used for several years as a conservative threshold to determine when phosphorus is rendering waters unsuitable for designated uses. The endpoint should be the level at which Dundee Lake is not meeting designated uses. The 20 ug/L value was chosen to be conservative, an MOS was added, and the TMDL is based on an "extreme drought" year. The high sustained chlorophyll-*a* levels and extreme supersaturation of dissolved oxygen are not predicted in the Baseline Future Conditions. Absent measured impairments, the Dundee Lake endpoint should be 30 ug/l seasonal average. (11)

Response to Comments 11-14: The selected watershed criteria are appropriate and protective and were established taking into account site-specific data. The Department's Surface Water Quality Standards (SWQS) for phosphorus include narrative statements regarding allowable levels of nutrients based on the effect they have on primary productivity and water quality. These provisions recognize that phosphorus is a potential causal factor that may result in excessive primary productivity and associated water quality impacts, particularly with respect to dissolved oxygen and pH, but that it does not necessarily do so in every location. The SWQS also include a provision at N.J.A.C. 7:9B-1.5(g)3 for establishing site specific or watershed criteria with regard to phosphorus recognizing the scientific reality that the nutrient dynamics in a given setting may warrant a different numeric value for phosphorus or a different basis to assess attainment of designated uses. It is generally held that measurement of acceptable levels of nutrients is ideally done in terms of response indicators of excessive productivity, such as chlorophyll-*a* (*Protocols for Developing Nutrient TMDLs,* First Edition, November 1999; *Nutrient Criteria Technical Guidance Manual Lakes and Reservoirs*, First Edition, April 2000, EPA). Based on the cited EPA guidance and experiences of other states as discussed in Appendix E of the TMDL, the selected chlorophyll-*a* value varied and reflected a best professional judgment guided by factors such as climate, physical lake characteristics and designated uses. As set forth in Appendix E of the TMDL, the Department evaluated model simulations of water quality response in the critical locations, the particular characteristics of the critical locations and their uses, as well as literature values and EPA guidance documents to guide selection of the watershed criteria. The Passaic River Basin Nutrient TMDL Study report (Omni 2007, pp. 167-169) provides some discussion of the basis for the watershed criterion established for Dundee Lake based on a water quality target of 20 µg/l chlorophyll-*a* as a summer average. Appendix L of *The Passaic River Basin Nutrient TMDL Study report* (Omni 2007) also includes simulations of water quality response at Dundee Lake as well as throughout the river basin, given attainment of the 20 µg/l endpoint. Furthermore, the Wanaque Reservoir Supplemental report (Najarian, 2007) provides graphical outputs for total phosphorus, chlorophyll-*a*, organic phosphorus, dissolved inorganic phosphorus, water temperature and dissolved oxygen that illustrate the water quality associated with the endpoint of 10 ug/L chlorophyll-*a*. Based on this information, the selected watershed criteria are protective of designated uses.

The statement that "The high sustained chlorophyll-*a* levels and extreme supersaturation of dissolved oxygen are not predicted in the Baseline Future Conditions" is inaccurate. Extreme dissolved oxygen saturations and high chlorophyll-*a* were predicted under the Baseline Future Conditions at the critical locations, see Figures 36 and 37 on page 142 (Omni, 2007). Furthermore, actual measurements of chlorophyll-*a* and diurnal dissolved oxygen in the lower reaches of the Passaic River confirm high chlorophyll-*a* levels (97 µg/l at Market Street on August 14, 2002) and extreme supersaturation of dissolved oxygen (over 16 mg/l in August 2003). The suggested endpoint of 30 ug/l at Dundee Lake represents the Baseline Future Conditions, see graph 57 page 173. As stated above, this would result in extreme supersaturation of dissolved oxygen at the critical locations and would not be an acceptable endpoint. The use of the phosphorus protocol criteria at Dundee Lake is also not appropriate because the phosphorus protocol criteria were developed for flowing streams and this location is an impoundment. The *Technical Manual for Phosphorus Evaluations for NPDES Discharge to Surface Water Permits*, NJDEP, March 2003, which defines the criteria for determining is phosphorus is rendering waters unsuitable for the designated uses, specifically states that the "phosphorus protocol study, including application of the thresholds, is not applicable where there is a downstream impoundment. At the selected watershed criteria, the levels of biomass and associated water quality response parameters, dissolved oxygen and pH, are compatible with the actual and designated uses.

The proposed watershed criteria were presented to the regulated community and NJDWSC at the September 11, 2006 meeting. At that time, the NJDWSC indicated that this level of chlorophyll-

a will provide suitable protection for use of the Wanaque Reservoir for public potable water supply after conventional filtration treatment, as provided in the SWQS designated uses for FW-2 waters.

15. Comment: It was understood that the Phase 1 TMDL would be superseded by the Phase 2 TMDL, but it was expected that the Phase 1 TMDL would jumpstart water quality improvement and the Phase 2 TMDL would ratchet down on limits to be fully protective. The Phase 1 TMDL had an endpoint of not to exceed 0.05 mg/L of total phosphorus while the Phase 2 TMDL establishes a watershed criteria in terms of chlorophyll-*a*. Which is more protective of the drinking water use? The Department should provide a side by side comparison of the two TMDL documents. (22)

Response: The commenter is correct in stating that the purpose of the Phase 1 TMDL, which addressed phosphorus impairment in the Wanaque Reservoir, was to accelerate water quality improvement by determining and directing the phosphorus reductions needed to attain SWQS in the reservoir. However, there was no preconceived notion of what the final outcome of the overall TMDL for the Passaic River basin would be. The outcome was to be and is driven by the science of the model results. The development and application of a dynamic, basin-wide model that is capable of simulating the effects of nutrients on productivity and the associated water quality effects has enabled the Department to provide a carefully balanced implementation approach using response indicators as the water quality endpoints. Tying phosphorus reduction to attainment of levels of chlorophyll-*a* that are protective of the designated uses achieves the water quality objective without incurring unnecessary treatment expense.

The commenter is directed to Figure 5.7 in (Najarian, 2005), and Figure 1 in the supplemental report entitled *Phosphorus Chlorophyll a Relationship Wanaque Reservoir Addendum to Najarian 2005* (Najarian, 2007) for a comparison of the in-lake phosphorus concentrations as the result of the two approaches. Beyond this, given the myriad differences in the two TMDL documents (spatial extent, modeling approach, critical locations, endpoints, etc.) a side by side comparison of the documents is not appropriate. Instead, the Department has explained in the current TMDL documents that the Phase 1 TMDL has been withdrawn, provided a response to the key comments on the Phase 1 proposal, and has reiterated any relevant information from Phase 1 in the current TMDL documents.

16. Comment: The Passaic TMDL was developed for an overly conservative drought condition. NJDEP establishes wastewater treatment plant discharge effluent limits for phosphorus based a 7Q10 receiving water flow, a flow condition with a return period of 10 years. Najarian 2005 states that this time period was the third lowest in the 48 years of record, a return frequency of 16 years. Flow rates were also low; February 2002 had the lowest monthly flow in 50 years of record at Chatham and in 24 years of record at Pine Brook. The year 2002 represents a severe condition when NJDEP declared drought warning status for northeast New Jersey. From the "Wanaque Reservoir TMDL Development New Model Scenario" prepared by Najarian & Assoc. in 2007, the volume of diversion to the reservoir exceeded the reservoir during the "sustained drought" period of WY2002 (October 1, 2001 through September 30 2002) . In addition, the TMDL calculation was performed with pumping at the ultimate safe yield as provided by NJDWSC. Any carryover of phosphorus to the next year is minimal. The 2002 drought year

upon which the Passaic TMDL is based is "conservative" and the developed chlorophyll-*a* standard should not apply. (12)

17. Comment: The Passaic TMDL for Dundee Lake was developed for an overly conservative drought condition, a point noted by the New Jersey EcoComplex (NJEC). Najarian 2005 states that the rainfall in this time period was the third lowest in the 48 years of record, a return frequency of 16 years. Flow rates were also low; February 2002 had the lowest monthly flow in 50 years of record at Chatham and in 24 years of record at Pine Brook. Effluent limits are based on a 7Q10 receiving water flow, a return period of 10 years. Flow is an important driver for productivity, illustrated by the reduction in chlorophyll-*a* in Baseline Future Conditions, when plants are at full permitted flow, compared to Existing Conditions. It is recommended that the NJDEP use Water Year 2001 instead of the extreme drought year as the basis for the TMDL. (11)

Response to Comments 16 and 17: The TMDL was not developed for an overly conservative drought condition. The Passaic River Basin has experienced several drought periods in the last 15 years, notably 1994-1995, 1998-1999, and 2001-2002. From a water supply perspective, 2002 was notable but not unique. Reservoir capacity has dipped below 10 billion gallons three times since the beginning of 1993 – extensive pumpage from river intakes was needed to refill the reservoir after each event. Thus, given that this is a managed system, conditions that could produce the adverse water quality effects in the reservoir can occur more frequently (and more severely) than do purely meteorological droughts. Further, in terms of the prevalence of low-flow warm-weather conditions conducive to algal growth, 2002 was not significantly different than other recent drought periods. For instance, the average flow at the Little Falls gage (01389500) from June through September was 230 cfs in 2002, compared with 168 cfs in 1995. Similarly, 81% of the daily summer flows in 2002 were below the published 70th percentile flow of 295 cfs at that same gage, compared to 84% during the summer of 1995. The commenter states that phosphorus does not accumulate in the reservoir, presumably because water pumped in does, on occasion, exceed that which is pumped out. This situation does not occur every year and even when pumping does exceed outflow, phosphorus can settle below the level of pumpage and be available for algal growth following turnover events. Finally, even if 2002 were not utilized for the TMDL calculations, simulated algal concentrations at Dundee Lake were similar in 2001 and 2002.

18. Comment: The measurement of success of the TMDL must be based on attainment of the chlorophyll-*a* targets that will be assessed through a sufficient monitoring program. (15)

19. Comment: Confirmation is requested that the objective of the TMDL is the achievement of the designated chlorophyll-*a* level, not whether an in-stream phosphorus level of 0.4 ppm LTA has been met. (2)

Response to Comments 18 and 19: The attainment of the established watershed criteria at the critical locations is the objective of the TMDL. While the watershed criteria are established in terms of chlorophyll-*a*, attainment will depend on reducing phosphorus loads in accordance with the TMDL, which includes wasteload allocations and load allocations to point and nonpoint sources, respectively. An in-stream phosphorus level has not been specified. The TMDL is based on long term average effluent concentrations that will be applied to wastewater treatment facilities through NJPDES permitting following adoption of the TMDL. The long term average concentrations will be reflected as monthly average effluent limits in the applicable NJPDES permits, subject to water quality trading. As indicated in Table 14, most facilities will be receiving an effluent limit based on a long term average concentration of 0.4 mg/L. The Department concurs that assessment of successful implementation of the TMDL will require an adequate follow-up monitoring program, as described in the TMDL under "Follow-up Monitoring".

Models:

20. Comment: It is stated that phosphorus concentrations in baseflow (page 58 of technical document) ranged from 0.02 to 0.09 mg/l in pristine locations, and from 0.02 to 0.13 mg/l in areas affected only by nonpoint sources; one would expect there to be a greater difference. There should be discussion of the reason(s) why these two concentrations are similar. (21)

Response: The referenced document does offer an explanation that the amount of forest and wetlands in a drainage area appeared to be the most significant influence on tributary concentration. To elaborate, the Passaic River headwaters are strongly influenced by major wetland complexes, namely the Great Swamp and Great Piece Meadows. An analysis of the export of phosphorus from the Great Swamp to the Passaic River is provided in Appendix D of the Passaic River Basin Nutrient TMDL Study report (Omni 2007). In addition, data at reference locations in the Passaic River basin demonstrate that tributaries in relatively pristine areas frequently have higher phosphorus concentrations than might otherwise be expected. The Passaic River TMDL study accounted for these background phosphorus sources using the best available data.

21. Comment: Using global parameters implies that the aquatic ecosystem has similar characteristics in all of the segments (pages 98-99 of technical document). What assumptions are used to make the determination as to which parameters should be calibrated globally or locally? (21)

Response: Most parameters are applied throughout the model domain (global). The EPA Water Quality Analysis Program 7.0 (WASP7) model allows that certain parameters can be assigned localized values. In this modeling approach, local parameter values are only assigned when necessary to obtain an acceptable calibration, unless localized information is available (such as location-specific light attenuation coefficients). It is possible to divide the study area into separate models that are then linked externally and this may be necessary to achieve an acceptable calibration in some waterbodies. In the Passaic River TMDL model, calibration was successful using a single model throughout the study area.

22. Comment: In the Light Extinction Coefficients (pages 68-69 of the technical document), "The surface light energy and the light energy at the deepest measurement were used to derive the value of K." Why was it estimated this way rather than taking the average over depth? (21)

Response: As described in the Passaic River Basin Nutrient TMDL Study report (Omni 2007, p. 68), the Beer-Lambert law was used to calculate light extinction coefficient as a function of light energy at the surface and light energy at a particular depth. The light energy at the deepest measurement was used in order to obtain an estimate over the largest depth of the photic zone. This procedure is commonly used to estimate light extinction coefficients when light energy measurements are available (Wool, T.A., R.B. Ambrose, J.L. Martin, E.A. Comer, WASP Version 6.0 Draft User's Manual, pp. 11-38).

23. Comment: Regarding Table 13: specify the dates of the July and August events; more than two events should be considered if K1 will be used throughout the year; estimates for light extinction coefficients should cover more than only the summer period and during storm events; and there is no description why the K1 values vary so much between the July and August event for some of the stations and the implications of this variability. (21)

Response: Light extinction measurements were generally taken during the July and August 2003 diurnal events, which occurred July 15, 16, and 18 of 2003 and August 24, 25 and 26 of 2003. The July and August light extinction coefficients are consistent for most locations, with only two of 23 showing variability. The extent and quality of light extinction data for the Passaic River TMDL study was appropriate given the state-of-the-art for these types of modeling studies. Light extinction data was sufficient and appropriate to inform a model concerned with productivity during critical periods. Light extinction is important during low-flow summer periods when periphyton and macrophyte productivity is highest. Light extinction can vary spatially in WASP, but not temporally. The Passaic River Basin TMDL study benefited from multiple localized light extinction measurements, providing a basis to assign spatially variable values.

24. Comment: The observed Hydroqual and the observed Omni SOD data are significantly different. Do they represent one value or an averaged value? The observed values are very different than the calibrated SOD values. (page 111, Table 24 of the technical document). (21)

Response: Field measurements of SOD and sediment deposits are typically highly variable spatially and temporally due to varying flow regimes affecting deposition and scour (Rates, Constants, and Kinetics Formulations in Surface Water Quality Modeling, G. L. Bowie et. al., 1985). For the model, SOD values for large areas were needed. Taking into consideration the variability of individual site measurements, the issue of precision of SOD measurements in general, and the extensive amount of SOD data needed to characterize the SOD profile in the Passaic Basin based on data alone, SOD values were assigned by model calibration rather than assign one value or an average value. A limited number of SOD measurements at sampling stations in the Passaic River were conducted in order to perform a reality check on the calibration SOD values. It should be noted that average dissolved oxygen levels are largely influenced by hydraulics through reaeration, and by stream temperature due to solubility differences. SOD primarily influences the average DO and causes only a minor impact on the DO diurnal variation.

25. Comments: In many of the figures of the report, it is difficult to determine the importance of the difference between simulated and observed data. The differences are provided as total difference rather than percentage difference (i.e. Table 8). For other tables, the units are not provided. (i.e. Table 25). There is at times limited or no discussion of the implication of differences between simulated and observed data. Based on the figures provided how accurate is

the model? (i.e. Table 22). Whenever observed mean data is presented the number of data points used should be included (i.e. Table 26). (21)

Response: The perceived difficulty in determining the importance of differences between simulated and observed data is a result of the large-scale watershed modeling study that was conducted. The graphical presentation in Appendices E and F of the Passaic River Basin Nutrient TMDL Study report (Omni 2007) was deemed the best way to convey the overall results.

As noted, even a well-calibrated model may at times show a poor comparison between simulated and observed data; for example, a poorly characterized boundary condition may cause a poor fit, even though the model is well-calibrated and perfectly suitable to evaluate future conditions based on an assumed boundary condition. On the other hand, a poorly calibrated model can show a very good fit between simulated and observed data, perhaps due to an over-reliance on localized parameters to force a good fit, or due to a limited set of observation data under a variety of conditions. It is appropriate to provide absolute differences rather than percent differences between simulated and observed data, because the absolute magnitude provides a better sense of the importance of the difference. For instance, the percent differences for ammonia might be high simply because the ammonia levels are low. Units for the calibration statistics are concentrations (e.g. mg/l), and are provided in the example calibration graphs. For Omni sampling stations, generally 12 or 20 observations were available for the 2003 calibration period. Statistics were only derived when enough observed data were available. The model clearly captures the salient features of the system within a unified framework and with an acceptable degree of accuracy, and can be utilized to relate point and nonpoint sources of phosphorus to water quality impacts at critical locations under a variety of conditions.

26. Comment: When providing coefficients of correlation (page 93), the document should state whether the comparison between data sets is for a monthly, daily or hourly time period. The squared correlation coefficient, R^2, could be significantly different between monthly and daily datasets, and this could also give valuable insight on model performance. Are there other statistical measures that could provide insight on model accuracy and performance? (21)

Response: Descriptions of calibration statistics are provided in the Passaic River Basin Nutrient TMDL Study report (Omni 2007, p. 98). Statistics were calculated automatically within the WASP post-processor by comparing intra-day simulation values with observed values. This method is the only one available within the WASP post-processor, and is considered the preferred method when evaluating the goodness of fit for a dynamic water quality model. The use of intraday comparisons tends to exaggerate the differences between observed and predicted values.

The most relevant statistics available within the WASP post-processor were selected. "Mean Error" provides a key absolute measure of the average difference between predicted and observed concentrations. A Mean Error of zero indicates that overpredictions and underpredictions were exactly balanced. The average predicted value is provided along with the average among the observed values. These means are important because they provide a context to understand the importance of the Mean Error. The predicted and observed standard deviations provide an indication of how well the model captured the variability about the mean. Finally, the squared correlation coefficient, R^2, is provided as a measure of the degree to which model predictions and observations vary together linearly. Appendix G includes graphical representations of predicted versus measured total phosphorus concentrations for stations throughout the model domain, providing another measure of model performance. The calibration procedure consisted primarily of plotting the discrete observed data and the continuous simulated data together, and comparing them. Limited statistics were considered to provide some guidance during calibration. Based on the many representations of model performance, and thorough evaluation by the Department and the New Jersey EcoComplex, the model clearly captures the salient features of the system within a unified framework and with an acceptable degree of accuracy, and can be utilized to relate point and nonpoint sources of phosphorus to water quality impacts at critical locations under a variety of conditions.

27. Comment: What is limiting biological productivity in the different stream segments? (Page 149 of the technical document) For example, if in certain locations DO is not very sensitive to phosphorus reductions, but these areas are very sensitive to changes in velocity and light, couldn't this be evaluated in the model analysis? (21)

Response: Biological productivity is influenced dynamically by a number of factors, including nutrient availability, flow, velocity, light penetration, temperature, and substrate. Some of these factors can be evaluated independently through model sensitivity. The purpose of this study was to determine the extent to which phosphorus was affecting biological productivity. Where phosphorus was found to be causing excessive productivity and related water quality impacts, the purpose was to determine the amount of phosphorus reduction that would achieve water quality objectives, expressed in terms of the watershed criteria as chlorophyll-*a* criteria at the critical locations. The study did conclude that other factors were responsible for water quality effects in the portions of the basin. For example, lack of light penetration due to naturally occurring dark water was the reason for low observed productivity in upper reaches of the basin, even when phosphorus was present in sufficient quantities to support high productivity; and low dissolved oxygen was found to be a naturally occurring condition in some locations either because source waters were naturally low in dissolved oxygen or because of high natural SOD from large wetlands complexes.

28. Comment: Why not incorporate shading in the TMDL analysis? (21)

Response: Generally, the modeled streams in this study are higher order streams for which shading would not be expected to be as significant a factor as in smaller streams. For this reason, data on percent canopy cover were not collected during the data collection phase. As expected, it was not necessary to incorporate shading to obtain a meaningful calibration. Few, if any, large watershed studies of this magnitude incorporate shading into the water quality analyses. In terms of using shading as a management response, this may be effective for a limited spatial extent in smaller tributaries, but productivity was not found to be an issue in these smaller order stream areas.

29. Comment: Does the reduction in phosphorus loads have an effect on biological productivity throughout at different stations in the watershed? Chlorophyll-*a* graphs could accompany phosphorus graphs for each location in Figures 26-48 of the technical document. (21)

Response: The overall conclusion of the study was that phosphorus was responsible for causing excessive primary productivity in the identified critical locations, but not elsewhere in the basin. Therefore, focus was on simulated outcomes of reductions at the critical locations. Chlorophyll-*a* graphs showing the impact of phosphorus reductions in the body of the Passaic River Basin Nutrient TMDL Study report (Omni 2007) are provided for locations where phytoplankton is important. Appendix J provides a more complete set of graphs showing the impact of extreme phosphorus reductions on chlorophyll-*a* and dissolved oxygen throughout the basin.

30. Comment: A major assumption in the TMDL model is "that phosphorus is a conservative constituent and the dominant factor in determining in-stream concentrations of phosphorus in the Passaic system is the relative dilution, depending on available streamflow, of a significant and relatively constant wastewater discharge load." This seems to hold true at current phosphorus loadings in the Passaic and Pompton Rivers, which exceed surface water quality standards several-fold. However, there is inadequate narrative detail describing the range of in-stream phosphorus concentrations for which the conservative mass-balance assumption is valid. Please explain in greater detail why the assumptions made at current loadings will remain valid when TMDLs are implemented and dischargers reduce their loadings. (21)

Response: This assumption is only used in a limited way for estimating loadings to the Wanaque Reservoir from direct drainage to the reservoir outside the domain of the dynamic model and for loadings to Pompton Lake. Loading reductions from dischargers are not significant in these drainage areas and exceedances of existing numeric criteria are not significant. Therefore, the loading assumptions from the limited drainage areas where this approach was used are believed to remain valid in the future scenario.

31. Comment: In Table 3-1, the R^2 for the mass balance model for the Ramapo River at Pompton Lakes is 0.244. According to the analysis, the reason for low correlations seems to be partially due to greater uncertainty in measuring phosphorus samples with concentrations below 0.10 mg/l. Please identify background literature that supports this claim. What is the correlation between observed and simulated phosphorus concentrations for all data above 0.10 mg/l? (21)

Response: Background literature supporting the statement made regarding the greater uncertainty in measuring phosphorus samples with concentrations below 0.10 mg/l can be found in numerous references; the report provides two: USEPA, (1993) "Guidance on Evaluation, Resolution, and Documentation of Analytical Problems Associated with Compliance Monitoring: Washington, D.C., U.S. Government Printing Office, USEPA 821-B-93-001, June 1993; and, USEPA, (1985) "U.S. Code of Federal Regulations, Title 50," Washington, D.C., U.S. Government Printing Office, November 13, 1985, 46906. Statistical analysis, including correlation between observed and simulated phosphorus concentrations for data above 0.10 mg/l, would be of limited usefulness and not technically supported because of the small number of observations- only 10 data points exceeded the 0.10mg/L TP concentration.

32. Comment: On page 3-3 of the technical document for the Pompton Lake TMDL, please identify either the literature sources or the monitoring data on which the estimated baseflow concentration of 0.01 mg/l is founded. Please explain whether the baseflow concentration could vary based on the specific soils and bedrock present in the watershed? (21)

Response: It is important to note that the base flow component referred to in Pompton Lake TMDL document should not be confused with the tributary baseflow component used in the dynamic modeling for the overall Passaic River Basin TMDL document. Tributary baseflow in the latter document is the in-stream total phosphorus concentrations taken under 70th percentile low flow and includes both groundwater and residual from surface runoff/interflow. In the Pompton Lake document, the base flow concentration consists of ground water only. A base flow separation method was used with areal runoff loading coefficients to derive nonpoint source loadings in the Pompton Lake document. While ground water phosphorus concentration may vary based on local conditions, but in this region, based on the USGS ground water data for Passaic County, the 90th percentile dissolved phosphorus is 0.01 mg/L and the mode of the data is also 0.01 mg/L. This substantiates the use of this value for the base flow/ground water component in the Pompton Lake TMDL.

33. Comment: An explanation is needed as to how septic systems are incorporated into the TMDL analysis. The Wanaque Reservoir watershed seems to be impacted by septic system runoff since relatively high nitrate concentrations are found in West Brook, Cupsaw Brook and Erskine Brook, while the total phosphorus concentrations are similar for all tributaries. (See Table 2-6 on Page 2-4 of the technical document). Although one can surmise that these subwatersheds do not have sewer service, there could be an alternative explanation. The documents provide no information regarding the location of non-sewered areas or the failure rates of septic tanks in both the Wanaque Reservoir watershed and the greater Passaic-Pompton-Ramapo watershed. Furthermore, do areal phosphorus loadings for urban areas differ if they are served by separate storm water and sanitary sewer systems, combined sewer systems, or septic systems? This could be useful in determining the reduction in non-point source pollution that could be reasonably expected and also in providing more details on BMP implementation. (21)

Response: The majority of TMDL Approach Areas 1 and 3 are covered by centralized sewer systems. The majority of TMDL Approach Area 2 and 4 is serviced by individual septic systems and is taken as a headwater boundary condition to the TMDL model. Areas served by septic systems can be expected to contribute higher concentrations of nitrate either overland from failing systems or through groundwater entering the streams, because this compound is soluble and very mobile. However, the same is not true of phosphorus. The TMDLs and the technical documents address phosphorus loading from all nonpoint sources by hydrograph separation and assigning EMCs for each land use category. EMCs are derived through monitoring or Unit Areal Loads, and the non-storm load is estimated using the tributary baseflow monitoring results or groundwater data, depending on the approach applied (see discussion of Approach Areas in the TMDL document). Phosphorus is generally immobilized in the soil matrix, which is borne out by data on ground water concentrations of phosphorus in the basin (see response to Comment 32). Absent information about a particular septic system problem, the approaches used for nonpoint sources are believed to adequately account for septic system loading. Nevertheless, malfunctioning septic systems (e.g., those that result in a discharge directly to a water body) are identified as potential sources in Section 4.0 Source Assessment (page 34) and in Section 7.0 Implementation Plan (page 48), but the Department is not aware of any actual malfunctions. This potential 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; rather, they are ephemeral events that are addressed through compliance and enforcement measures as they occur. Regarding different loadings delivered by separate storm sewer areas compared to combined sewer areas, the loading coefficient method is not used in the very limited spatial extent of the study area in which combined sewers are used. In any case, phosphorus loadings from combined sewers were calculated separately from other stormwater loadings, as shown in Table 14 of the Passaic TMDL.

34. Comment: The Wanaque Reservoir model appears to over-estimate algal biomass during the 2002 drought period and the Wanaque Reservoir TMDL scenario results were incorrectly compared with the seasonal average target. (15)

Response: The observation that algal biomass is over-estimated during the 2002 drought is true in some locations and is believed to be the result of operational practices to prevent algal blooms during this period (e.g., application of alum, ultrasound treatment, aeration, etc.) Note that the model tracked the observed data during year 2002 at the Erskine station (Figure 4.15), where no alum was applied. Also, the available database indicates a relatively high nitrate concentration response to diversion loading at Raymond Dam during this period – concentrations that are largely unaffected by such practices. Since the model generally tracked the chlorophyll-*a* concentration data during other drought years (e.g., 1995, 1998), it is not overly conservative in predicting reservoir chlorophyll-*a* concentrations, absent taking extraordinary measures to suppress expression of algae.

35. Comment: The areas in the Wanaque Reservoir where characterizations are performed are not appropriate to determine the real background from undeveloped portions of the contributing drainage areas or to reveal how funky the reservoir gets when the pumps are turned on. (20)

Response: The TMDL modeling approach addressed the entire Wanaque Reservoir, and both graphic and/or tabular outputs for several stations within the reservoir representing both background (Erskine) and "hot spots" (Raymond Dam and West Brook) within the reservoir were presented in the supporting documentation (Najarian, 2005). The critical locations reflective of the most severe effects from diversion pumping were specifically modeled, ensuring that the critical location is accounted for when specifying load reductions.

36. Comment: The reservoir model does not accurately represent non-diversion and diversion loads to the reservoir; the dynamics of diversion events are not modeled accurately. (15)

37. Comment: The Department needs to explain the rationale for the parameters used in the reservoir water quality. (15)

38. Comment: Cycling of phosphorus in the Wanaque Reservoir is an important component of the model simulations that form the basis of the TMDL calculation. Insufficient data is provided to confirm that the Reservoir model accurately describes phosphorus dynamics. The Department has access to a numerical simulation model, in-reservoir monitoring data, and well-defined reservoir hydraulics to defensibly support its TMDL. Data on Reservoir-wide chlorophyll-*a* concentrations, as well as water treatments that NJDWSC implements, should be made available

so as to confirm the effectiveness of the TMDL in protecting the designated use of public water supply. (15)

Response to Comments 36-38: These comments were made on the Phase 1 TMDL and were repeated for the Phase 2 TMDL. The reservoir model is a hydrothermal/water quality model that was designed and is appropriate for evaluating the effect of diversion scenarios on water quality and trophic state in the reservoir. The reservoir model, Laterally Averaged - Wind and Temperature Enhanced Reservoir Simulation (LA-WATERS) simulates laterally averaged velocities, water temperature and constituent concentrations at all grid locations for a selected period. Simulated constituents include organic phosphorus, dissolved inorganic phosphorus, particulate inorganic phosphorus, dissolved oxygen, carbonaceous biological oxygen demand, nitrogenous biological oxygen demand and temperature. In addition, a relationship was derived between phosphorus and chlorophyll-*a.* The model simulates responses in these parameters, given specified loading inputs from diversion and natural drainage sources and the hydraulic dynamics of inflow/outflow volumes in this managed reservoir system. The Najarian 2005 TMDL study report provides sufficient data for the evaluation of model performance and results. Data is provided in the form of graphic outputs, summary loading budgets, and error analysis. For the Phase 2 TMDL, which targets a watershed criteria expressed as chlorophyll-*a*, additional information regarding the simulation of chlorophyll-*a* response, as well as tabular chlorophyll-*a* data for the Wanaque Reservoir at Raymond Dam, were provided in a supplemental report (Najarian, 2007). While the actual model code was developed under funding of the NJDWSC and remains proprietary to that agency, the reservoir model has been extensively documented in two prior reports ("Influence of Wanaque South Diversion on the Trophic Level of Wanaque Reservoir and its Water Quality Management Program", Najarian 1988 and "A preliminary assessment of water quality status of the upper Passaic River and re-verification of the Wanaque Reservoir model", Najarian 2000). Further, the model's hydrothermal and water quality algorithms have been published in peer-reviewed journals ("Mixed-Layer Hydrothermal Reservoir Model," M. ASCE. Journal Hydraulic Engineering. 120 (7), 846-862 and "A Multicomponent Model of Phosphorus Dynamics in Reservoirs," Water Resources Bulletin, 20, No. 5:777-788).

39. Comment: Key aspects of the Passaic TMDL are supported as technically defensible; however, it is also technically flawed in several key aspects that need to be addressed before adoption. The Wanaque Reservoir TMDL is flawed since only one alternative was evaluated. The seasonal average chlorophyll-*a* in Tables 1 and 2 of Najarian 2007 shows the summer average chlorophyll-*a* is 9.2 mg/L. It appears that the TMDL for Wanaque Reservoir including the MOS was the product of a guess that the TMDL LTA for Dundee Lake would "work" for the reservoir. More interchange between the river and reservoir modeling should be performed. The integrated model framework of DAFLOW plus the dynamic Passaic River Model plus the Wanaque Reservoir Model (the product of years of development and considerable public and discharger monies) has not been fully utilized to arrive at a TP load scenario for the reservoir. Model runs for existing conditions, Baseline Future Conditions, Most Extreme Reduction of Phosphorus (MERP) and TMDL scenarios with alternate LTAs and seasonal phosphorus reduction are needed. These analyses would provide an understanding of how the reservoir chlorophyll-*a* is influenced by management of the Passaic River phosphorus. (12)

40. Comment: The final Wanaque Reservoir TMDL was determined with a single reservoir model projection. It was not used to determine load reductions, including diversion loads, required to meet the new chlorophyll-*a* standard; a TMDL has not been established. (13)

41. Comment: Only one run of LA-WATERS was done to confirm that the chlorophyll-*a* in the reservoir would not exceed 10 ug/L with the LTA of 0.4 mg/L and 60% NPS reduction. This does not establish that the criterion could not be met by less stringent LTAs. (10)

Response to Comments 39-41: More than one TMDL scenario was evaluated to arrive at the TMDL for Wanaque Reservoir. As stated in Omni 2007, p. 172, "Time series of phosphorus concentration predictions were provided to NJDEP and their technical consultant for the Wanaque Reservoir TMDL Study (Najarian and Associates) in order to predict the summer average phytoplankton in the Wanaque Reservoir associated with each phosphorus reduction scenario. Several combinations of point source effluent concentrations and nonpoint source phosphorus reductions were tested. Through an iterative process, it was determined that a point source long-term average (LTA) effluent concentration of 0.4 mg/l TP and a 60% reduction of phosphorus loads from runoff associated with urban and agricultural land uses will satisfy the water quality end point in the Wanaque Reservoir." According to the iterative simulations performed by Najarian and Associates based on Wanaque South intake concentration boundaries provided by Omni Environmental, the wasteload allocations and load allocations established by the TMDL were the highest allowable while still satisfying the water quality target, with a margin of safety and an allowance for reserve capacity, in the Wanaque Reservoir.

42. Comment: LA-WATERS does not directly model chlorophyll-*a*, unlike current state of practice using mathematical models to predict the impacts of nutrient dynamics. The model was calibrated to total phosphorus data with chlorophyll-*a* based on organic phosphorus. It is therefore not an appropriate tool to determine the chlorophyll-*a* levels under alternative loading conditions. (13)

Response: The reservoir model does not directly model chlorophyll-*a*, however, the model does adequately predict observed chlorophyll-*a* concentrations by using the observed relationship between the simulated organic phosphorus and observed chlorophyll-*a* concentrations. A full discussion of the phosphorus-chlorophyll-*a* relationship was provided in the supplemental report for the Wanaque Reservoir modeling (Najarian, 2007). Because the model prediction of observed chlorophyll-*a* concentrations is based on nutrient loading, which is directly modeled, the model is an appropriate tool for use in developing the TMDL.

43. Comment: The basis of Najarian Wanaque Reservoir Model is flawed by incorrect loading assumptions for its calibration. The calibration/validation of the Wanaque Reservoir Model was presented in Najarian 2000 and Najarian 2005 as based on the assumption that total phosphorus is conservative in the Passaic River and that point source phosphorus is not attenuated. Reservoir loads used for the calibration and validation were calculated based on the assumption of phosphorus as conservative. Najarian 2000 and Najarian 2005 acknowledge the shortcoming of the load development methodology. Therefore, in the Phase 2 TMDL, the Wanaque Reservoir Model calibration and validation should have been checked using Passaic Model total phosphorus and ortho-P results at Two Bridges for all model years. Since this was not done, the

model may not be properly calibrated. Use of the Reservoir Model is questionable when calibration and validation may be in doubt. Additional Wanaque Reservoir Model runs should be performed to address this concern. (12)

Response: The prediction of phosphorus concentration at the Wanaque South intake used to provide a boundary condition for the Wanaque Reservoir model in the Phase 1 TMDL, while based on a simplified dilution model, is consistent with the prediction generated by the Passaic River model (Omni 2007) for the existing condition in the Phase 2 TMDL. The Passaic River TMDL model, which accounts for attenuation and other kinetics throughout the system, was used to generate the future condition phosphorus concentrations at the Wanaque South intake for the Wanaque Reservoir simulations. Both models compare favorably with one another and with the observed data. This is expected, since both models are calibrated to match the observed conditions. The reservoir model calibration/validation was based on actual data. The calibrated model is then used to simulate what would happen in the reservoir if inputs are altered. How future loads are estimated does not affect the calibration; the reservoir model simulates the effect of phosphorus loads once delivered into the reservoir.

44. Comment: The LA-WATERS model was developed to determine the impact of diversion waters on the water quality it the reservoir. The same model determined that diversions to the reservoir would not cause an excessive detriment to water quality (Najarian 1988). The current results contradict the previous results. (13)

Response: It is not correct to assume that the Najarian 2005 TMDL study using LA-WATERS represents a direct continuation of the methodologies of previous relevant studies using LA-WATERS, such as the study of the impact of diversion waters on the water quality of the reservoir in 1988. The Najarian 2005 TMDL study and refinement of LA-WATERS represents the culmination of a series of studies dating back to 1987 regarding water quality issues in the Wanaque Reservoir and its intake site. In each successive study, improvements were made to address limitations of the previous studies. Thus, comments regarding previous study limitations and inconsistencies are irrelevant. The primary intent of the Najarian (2000) Report (entitled "A preliminary assessment of water quality status of the upper Passaic River and re-verification of the Wanaque Reservoir model") was to assess the water quality status of the River. Thus, its analysis of the Passaic River dealt with a statistical assessment of water quality data. While this approach successfully addressed water quality status issues, it was of limited use in addressing the long-term loading regime of the river. Difficulties included the limited availability of data for selected analysis periods and uncertainties in the calculation of monthly average loads based on a limited number of observations. For such reasons, the Najarian 2000 Report did not form the basis for the 2005 Najarian TMDL study. Rather, a new model-based approach was developed during the 2002 Watershed Characterization studies for WMA 3, 4 and 6. This mass-balance approach was then refined and enhanced as part of the Najarian 2005 TMDL study. This method provides a simulation of daily in-stream total phosphorus concentrations and diversion loads. The approach was then verified using the entire set of available data – a procedure that sidestepped the limitations of the 2000 report. As such, the Najarian 2005 TMDL study does not represent an outgrowth of the 2000 study but, rather, a totally different approach developed to reduce the limitations of the 2000 study. Thus, as the result of subsequent model validation studies, the accuracy and reliability of the model was improved as new information became available. As the improved simulation of the river-loading regime allowed for a more accurate simulation of Reservoir inputs, the Najarian 2005 TMDL and the supplemental report to the Wanaque TMDL, (Najarian, 2007), supersede the relevant findings of the earlier reports.

45. Comment: A number of model constants and coefficients have large variations over the model domain or are unusual, as follows:

-The settling applied to particulate inorganic phosphorus ranges from 0-40% depending on location. Although the model report states that the fraction available for settling is 60%, the model inputs have a fraction dissolved of 0.6 and therefore a fraction particulate of 0.4. This would only be calculated with partition coefficient values on the high end of the range combined with the 97th percentile of the solids measurements made for the TMDL study.

-Organic phosphorus is subject to settling in the same reaches, but only at a rate of 10%. The fraction particulate for BOD, algae and organic nitrogen is zero and they are not subject to settling. These inconsistencies have not been explained.

-The rates at which phosphorus variables settle changes dramatically from segment to segment. Settling is entered as flows, which can be considered settling velocity multiplied by the surface area of the segment. The model has some large sections of the river with constant settling flows, which results in variations in settling velocity from segment to segment. Other sections of the river have velocities that may change by a couple of orders of magnitude and back over only a few segments as well as many areas with zero settling flows.

-The SOD values and ammonia fluxes also vary greatly on a spatial basis. These values are model inputs and do not respond to changes in loads, although the WASP model is capable of calculating nutrient and SOD fluxes. By specifying fluxes as model inputs, the TMDL analysis cannot track mass rigorously.

-There are a number of model parameters that the Wanaque Reservoir and Passaic River models have in common. Some values are consistent, but others are not: The growth rate used in the WASP model is nearly half the value used in LA-WATERS. Respiration and death are lumped in LA-WATERS and considered separately in the river model; the combined values from the river model are 2.5 times greater at 20 degrees Celsius and show much greater temperature dependence. The phosphorus half saturation values are inconsistent; the value used in the Wanaque Reservoir would require ten times the phosphorus to reach half of the maximum growth rate, thereby inducing a phosphorus growth limitation at a much higher concentration. The river model considers the impact of nitrogen concentration on algal growth, which the reservoir model cannot account for. Both models settle organic phosphorus, but in the reservoir model, organic phosphorus represents algal biomass, which does not settle in the river model. (13)

Response: The Passaic River WASP model was a complex undertaking that involved combining multiple processes and datasets within a single modeling framework. The model choice, calibration and validation were performed using the most appropriate scientific tools available. The modeling framework developed exclusively for the Passaic River Basin is described in detail in the Passaic River Basin Nutrient TMDL Study report (Omni 2007). Assumptions used in a river model may reasonably differ in a model designed to simulate a reservoir, given the significant differences in hydrology. Regarding phosphorus settling and SOD in the river model:

Phosphorus Settling

Inorganic phosphorus settling in the Passaic River comprises more than physical settling of particulate material. It also incorporates processes occurring in the river that are not explicitly simulated by WASP7. "Settling rates were used to represent the physical settling of organic and inorganic particulate phosphorus, adsorption of orthophosphate to the sediment bed and extra phosphorus uptake by macrophytes in certain areas of the Passaic River and its tributaries due to influence of wetland meadows." (Omni 2007, p. 102)

The settling of inorganic phosphorus involves two parameters: the fraction of particulate inorganic phosphorus available for settling and settling velocities. Figure 1 of the supplemental comments by HydroQual relates water column TSS with particulate inorganic phosphorus, which is not applicable to the context of inorganic phosphorus settling adopted in the model. Since the phosphorus settling component lumps multiple wetland meadow processes involving inorganic phosphorus uptake which are not explicitly represented in WASP7, settling rates used for inorganic phosphorus can not be used as a basis for the particulate settling of other water quality constituents. Applying similar settling rates to particulate BOD, organic nitrogen and organic phosphorus would be incorrect.

Natural processes such as the excess phosphorus uptake by algae and the adsorption of inorganic phosphorus to the bottom sediment vary spatially in large and diverse systems such as the Passaic River Basin. The different settling rates were applied to the Passaic River Basin in order to capture the spatial variability of natural processes represented in the settling component.

The usage of the settling component to address processes that are not explicitly simulated in WASP7 does not jeopardize the model performance for establishing the TMDL. The calibration of inorganic and organic phosphorus is excellent for the great majority of sampling stations. This is evidence that all sources, sinks and processes affecting the phosphorus transformations in the system are being accounted for adequately in the model.

Sediment Oxygen Demand

Sediment Oxygen Demand (SOD) and Ammonia fluxes were assumed as steady state and spatially variable parameters in the Passaic River model. Previous versions of the WASP model were able to simulate the diagenesis of organic matter in the sediment. However, WASP7 does not have this capability. WASP7 was the most recent version of the model when the Passaic River modeling was initiated. WASP7 included several improvements from its previous versions, most importantly the inclusion of benthic algae as a state variable. The simulation of benthic algae was a key factor for the Passaic River modeling. Most of the primary productivity in the Passaic River and its tributaries is due to the presence of benthic algae and macrophytes. Phytoplankton is of significance only in the lower sections of the Passaic River near Dundee Lake. The previous versions of the WASP model were not able to simulate the effect of attached algae and plants. Given the importance of primary productivity for the TMDL, the WASP7 framework was the appropriate choice for the Passaic River modeling.

In addition, the dynamic simulation of SOD is not justified for the Passaic River Basin. Simulating SOD response based on measurements introduces substantial uncertainty into the modeling framework. A meaningful calibration requires several SOD measurements over time and in multiple locations. In the case of the Passaic River, SOD results from the decomposition of macrophytes and residual organic matter that are accumulated in the sediment bed. Major floods could cause significant re-suspension of this particulate material. A sediment transport model would be necessary to account for these losses. Settling of organic matter discharged by treatment facilities is significant when BOD concentrations are high. Presently, the discharge of organic material by treatment facilities is not significant and BOD concentrations are very low throughout the Passaic River Basin.

Decomposition of particulate organic material from phytoplankton is clearly not impacting SOD in the lower Passaic River. Phytoplankton is of significance only at the most downstream sections of the Passaic River where SOD is low. Relatively low SOD levels measured by HydroQual in 2003 at sampling station PA11 (1.4 and 0.4 g/m2/day) support the assumption that phytoplankton settling and decomposition is not affecting SOD in the downstream branches of the Passaic River.

There are no short-term processes affecting SOD in the Passaic River Basin. Organic material from attached algae and plant decomposition is not significantly mobile, BOD levels are very low, and phytoplankton decomposition is believed to be of importance in the lower sections of the Passaic River. In addition, there are not enough data to support a formal calibration of the dynamics of SOD in the Passaic River Basin. Therefore, it is very reasonable to assume SOD and ammonia fluxes as spatially variable and steady state parameters.

46. Comment: The Dundee Lake portion of the Passaic TMDL model was not well-calibrated for chlorophyll-*a*, tending to over-predict by a factor of 2. (11)

Response: As explained in detail in the Passaic River Basin Nutrient TMDL Study report (Omni 2007, pp. 116-118), the Passaic TMDL model is well-calibrated for chlorophyll-*a* particularly in the most downstream branch of the Passaic River, in which Dundee Lake is located. It does not over-predict chlorophyll-*a* by a factor of two. Several factors influencing phytoplankton growth are not subject to calibration, namely stream water temperatures and solar radiation inputs. Similarly, transport-related inputs, which are defined by the flow model and were previously calibrated, also influence phytoplankton growth. Phytoplankton growth rate is the most important chlorophyll-*a* calibration parameter; a value of 1.25/day was chosen as the final calibrated parameter, which is within the range suggested by the literature for phytoplankton growth rate. Two PVSC stations with a significant number of chlorophyll-*a* data throughout the simulation period were chosen for calibration: PVSC1 (Passaic at Totowa Avenue) and PVSC4 (Passaic at Market St.). Omni chlorophyll-*a* data, which consisted of three low flow events sampled in 2003, were used for validation purposes. A good fit of chlorophyll-*a* was obtained for the entire basin. The peak measured chlorophyll-*a* concentration of 97 µg/l at PVSC4 on 8/14/2002 was captured perfectly. Furthermore, the mean errors were -3.3 and 4.7 µg/l at PVSC1 and PVSC4, respectively.

47. Comment: The Passaic River TMDL model does not include any settling for algae. The settling of algae can be an important component of algal loss, especially in shallow waterbodies and/or water bodies with a long detention time (low flow). A run of the model introducing a modest settling rate dramatically reduces the chlorophyll-*a* concentration in the lake. If an

important process such as algal settling that is normally included in eutrophication modeling is absent, an explanation is needed. (11)

Response: Most of the primary productivity in the Passaic River and its tributaries is due to the presence of benthic algae and macrophytes. Phytoplankton is of significance only in the lower sections of the Passaic River near Dundee Lake. Phytoplankton settling could potentially increase seasonal sediment oxygen demand (SOD) at shallow and slow moving water bodies. However, the decomposition of particulate organic material from phytoplankton clearly does not impact SOD in the Passaic River, since measured SOD is low at the sections of the Passaic River where phytoplankton growth is significant. Model calibration demonstrates that settling of phytoplankton in the relatively limited branch of the Passaic where significant phytoplankton growth occurs is not important to capture observed phytoplankton growth patterns.

Attenuation:

48. Comment: The TMDL does not take location and/or size of point sources into account. The TMDL assigned the same wasteload allocation to all dischargers based on an LTA of 0.4 mg/L of total phosphorus. There is no attempt to take into account attenuation of phosphorus loads in the Passaic River. Total phosphorus (TP) is not conservative in the Passaic, especially at low-flow conditions. Using the watershed model, the effect of the WTSA plants at the point of discharge and at the identified endpoints was calculated. At current concentrations, the WTSA contribution to Wanaque South load is less than 5 percent and at the 0.4 LTA less than 1 percent. The graphs submitted show the negligible impact of WTSA facilities. The phosphorus discharged by WTSA, whose three plants are located a significant distance from both endpoints, attenuates before it reaches the endpoints. A properly formulated Passaic TMDL must account for the attenuation associated with these long distances in determining the LTAs for the various dischargers. The TMDL should be less stringent than the LTA of 0.4 mg/L proposed basin-wide. (12)

49. Comment: The commenter expressed appreciations for the efforts made by the NJDEP and Omni Environmental that resulted in the 2007 TMDL, but believes that it is still seriously flawed and does not represent the sound science needed to justify imposing limits. Specifically, the 2007 TMDL fails to account for attenuation, instead imposing a “uniform” effluent limit on all STPs. For treatment plants, which are 35, 39 and 41.5 miles upstream of the Wanaque Reservoir end point and 50, 54, and 57 miles upstream of the Dundee Lake endpoint, HydroQual’s utilization of the model establishes that essentially only 1% of the phosphorus in the effluent from these three plants reaches either of the two endpoints. The 2007 TMDL improperly assumes that *all* of the phosphorus from the WTSA sewage treatment plants, located 35, 39 and 41.5 miles upstream from the confluence of the Pompton and Passaic River, and 50, 54 and 57 miles upstream of Dundee Lake, reaches these TMDL endpoints. A 0.4 mg/l LTA for *all* dischargers is inappropriate, inequitable and not supported by the very science on which the TMDL purports to be based. Individualized LTAs can and should be calculated, reflecting each sewage treatment plant’s effective phosphorus load contribution to the endpoints. The WTSA plants’ contribution is *de minimus* and they should only be required to continue to meet their EEQ-calculated limits. It would be arbitrary, capricious and unreasonable for the Department to adopt a TMDL that would require the expenditure of significant public funds and production of

adverse environmental impacts from the addition of chemicals and the increased generation of sludge to remove phosphorus given attenuation that established in the model. (10)

Response to Comments 48 and 49: The Passaic River Basin model does not assume phosphorus is conservative and does account for attenuation. As described in detail in the Passaic River Basin Nutrient TMDL Study report (Omni 2007), the dynamics of nutrient cycling as well as loss mechanisms for water column phosphorus-attenuation mechanisms were simulated using the Water Quality Analysis Program 7.0 (WASP7). Model results show that the degree of attenuation depends greatly on the flow and diversion conditions, and most of the phosphorus load that originates in the Dead River persists to both of the end points. For example, approximately 70-80% of the phosphorus load from point sources that discharge to the Dead River reaches Two Bridges. In 2001, over 60% of the phosphorus load from point sources that discharge to the Dead River reached Dundee Lake; in 2002, just under 40% of the phosphorus load reached Dundee Lake. The difference between the two years is primarily due to increased water supply diversions from the Passaic River in 2002.

Therefore, attenuation does not render phosphorus originating in the Dead River watershed irrelevant to the end points in Wanaque reservoir and Dundee Lake. The commenter's analysis of the influence of WTSA phosphorus load on phosphorus concentration at the endpoints is inappropriate, since it uses the annual maximum total phosphorus concentration as the basis of comparison. However, the commenter's analysis does demonstrate the importance of WTSA phosphorus load to the phytoplankton concentration at Dundee Lake: Figure 3 in the July 6, 2007 comment letter provided by HydroQual on behalf of Warren Township SA depicts chlorophyll-*a* concentrations with different contributions from Warren Township's treatment facilities. This figure shows that, even if all other point sources in the entire basin were reduced to an LTA of 0.4 mg/l total phosphorus, allowing WTSA to discharge at its permitted maximum concentration would increase the growing season average phytoplankton concentration at Dundee Lake by about 25%.

In accordance with USEPA's Protocol for Developing Nutrient TMDLs (1999), "the administering agency must find an acceptable combination of allocations that adequately protects water quality standards (p. 7-1)." There are many factors that might affect the allocation decisions, including economics, equitability, and implementation. Alternatives in terms of assigning wasteload allocations among multiple dischargers include: equal percentage treatment; equal effluent concentration, and various allocation schemes that result in variable wasteload allocations. In the case of the Passaic River TMDL, an equal effluent concentration was assigned to all wastewater dischargers as the most equitable alternative for the wasteload allocation scheme.

Notwithstanding the above, given the large number of dischargers in the basin, the affected dischargers are best equipped to evaluate the capabilities of the individual facilities and determine if there are ways to maximize efficiency and cost effectiveness in achieving the water quality objectives through water quality trading. This was a key reason that this basin was selected for award of a Targeted Watershed Grant from EPA to develop such a program. Dischargers will have one year from the date of NJPDES permit issuance to negotiate trades, which, upon approval, would be incorporated into NJPDES permits.

Alternatives:

50. Comment: The Passaic TMDL was developed without consideration of alternatives. The impacts of phosphorus within the Passaic River Basin can be addressed in a more cost-effective manner. No other reservoir management alternatives beyond the historic pumping and diversions that took place during the 1993-2002 time period were considered. Alternate management scenarios could include reduced pumping during severe drought conditions, examination of the use of the Monksville Reservoir stored water instead of diversions, and/or direct routing of the diversion to the NJDWSC water treatment plant during severe or critical situations where diverted water never enters the reservoir while delivering the same amount of pumped water for raw water supply. Due to the enormous cost of implementing the proposed Passaic TMDL, the NJDEP must explore these cost-effective alternatives to satisfy the TMDL goals. The Passaic TMDL was developed for reduction of Wanaque South phosphorus load without consideration of the relocation of the Two Bridges Wastewater Treatment Facility outfall downstream of the intake. A preliminary analysis indicates this action could result in a 20% reduction in phosphorus load to the reservoir, and could well result in significantly less stringent, less costly LTAs. In light of the costs associated with implementing this TMDL, it is in the best interest of all affected parties to address the impacts of phosphorus in the most cost effective manner. (12)

51. Comment: The TMDL should include a thorough analysis of alternatives for achieving the chlorophyll-*a* criteria at both endpoints that reduce the phosphorus removal requirements for the STPs and for the nonpoint sources. *N.J.A.C.* 7:15-7.2(h) requires that, where feasible, "the TMDL proposal shall include the various management options and alternatives which will ensure that the surface water quality standards will be attained." Thus, the Department is obligated to provide such option and alternatives, or demonstrate why doing so is not feasible. The TMDL must address: NJDWSC operational modifications, water treatment by NJDWSC prior to diversion or release into the Wanaque Reservoir, relocation of the Two Bridges STP outfall and aeration at Dundee Lake. Aeration could be put in place on a trial basis to ascertain its viability and impact on chlorophyll-*a* levels, which could reduce the TP reduction needed at the STPs. The burden of establishing the viability of more cost-effective alternatives should not be on the dischargers or members of the public. The objective should be to properly identify the problem created by phosphorus loads within the river system and determine the most cost-effective manner to address that problem. The Department needs to devote the time and resources to evaluate the viability of aeration at Dundee Lake. (10)

52. Comment: The Department failed to consider the use of in-stream aeration as a cost effective alternative technology. Citing *N.J.A.C.* 7:15-7.6(d)4, *N.J.A.C.* 7:9B-1.5(e)1, and *N.J.A.C.* 7:15-7.2(h)1, the Department did not select the most cost effective and environmentally sound means of addressing water quality concern in Dundee Lake. The TMDL report contains no study of the costs of achieving those goals, nor of any alternatives, and does not address the negative environmental consequences of imposing more stringent limits on all wastewater facilities. In accordance with its regulations, the Department should have considered the allocation of an equal effluent concentration to each source, the allocation of an equal percent removal to each source, the allocation of an equal effluent mass loading to each source and the minimization of

the total treatment expenditure for the entire waterbody segment. Surface Water Quality Standards state that water-quality based effluent limitations should be established in a cost effective manner "so as to minimize total expenditures." Regulations require that TMDLs should take into consideration all management options and alternatives for ensuring that the water quality standards will be attained and that "[m]inimization of the total treatment expenditure for the entire waterbody segment" is one of the approaches to be considered in the development of allocation options. *N.J.S.A.* 58:10A-8 states that prior to establishing more stringent effluent limits the DEP must "determine if there is a reasonable relationship between the economic and social costs of achieving such limitation,…and the social and environmental benefits to be obtained…" The Department requested that dischargers report on costs to achieve potential effluent limits. A review of the reports reveals the costs are staggering. In-stream aeration, by contrast, would meet water quality objectives at a fraction of the cost. The TMDL report should be withdrawn and a roundtable of interested parties (should be) convened to explore the use of innovative solutions to meet the identified water quality objectives. (18)

53. Comment: The Passaic TMDL for the Dundee Lake endpoint was developed without consideration of any other alternatives beyond phosphorus removal. One such alternative is in-stream aeration. Reducing supersaturation of dissolved oxygen through mechanical means may disrupt algal productions as well. Manufacturers of aeration equipment were contacted and costs associated with installation and O&M are significantly less than those for phosphorus removal. Further, aeration equipment could be installed and begin achieving water quality improvement much more quickly. The next step would be to determine specifications for installation in Dundee Lake and possibly piloting the operation. (11)

54. Comment: The Department did not address other alternatives to achieve appropriate controls to achieve the Wanaque Reservoir endpoint, such as altering the withdrawal and and pumping scenarios used by NJDWSC, as recommended in the New Jersey EcoComplex July 30, 2002 Interim Report. (1), (2), (15), (23)

Response to Comments: 50-54: *N.J.A.C.* 7:9B-1.5(e)1 states policies for applying water quality-based effluent limitations and does not apply to TMDL development. This provision allows for assignment of different WQBELs to different dischargers, provided the overall water quality objectives are met, to achieve a more beneficial solution on a study area basis. The Department is providing an opportunity, through water quality trading, to achieve the TMDL objective in a more cost effective way. *N.J.A.C.* 7:15-7.2(h) refers to the Department's commitment to identify the management measures that are expected to attain the load reductions called for through the TMDL study, not a requirement for a cost effectiveness analysis of alternative means to attain the load reductions. The Department sets forth these measures in the implementation plan section of the TMDL. Within the implementation plan, the Department identifies regulatory and non-regulatory tools to achieve the reductions, matches management measures with actual or potential implementing entities, and identifies possible funding sources for non-regulatory measures.

Regarding the cost for phosphorus removal at wastewater treatment facilities, a recent report, "Advanced Wastewater Treatment to Achieve Low Concentrations of Phosphorus" (EPA 910 R 07 002, April 2007), contains findings indicating phosphorus removal at the levels called for in these TMDLs is feasible, low cost on a per user basis and provides ancillary benefits by enhancing removal of other pollutants, such as pharmaceuticals. Specifically, phosphorus removal to 0.3 mg/L was achievable using enhanced biological nutrient removal and the monthly residential sewer rates charged ranged from $18 to $46. Several treatment authorities did respond to the Department's request to provide cost estimates for achieving phosphorus reductions. While the total cost for upgrading all of the facilities was stated to be in the millions of dollars, the number of people and businesses served by the collected facilities is very large and the costs spread out over a number of years, so that the impact to an individual user is not expected to be significant.

Several alternative approaches were suggested by commenters in lieu of requiring reductions from the point source discharges. Under the Clean Water Act, the expectation is that, where a TMDL identifies that pollutant loading is causing exceedance of water quality standards, attainment of the standards will be achieved by reductions of the pollutant load. Further, the pollutant load reduction is expected to come primarily from regulated sources. Where non-regulated sources contribute to the load and load reductions from these sources are identified in lieu of obtaining all needed reductions from regulated sources, there must be reasonable assurance that reductions from non-regulated sources will be achieved. Other outcomes are possible where exceedances are due to natural conditions (standards are adjusted), technology does not exist to attain the water quality standards (variance option), or there is no reasonable way to attain the standards and support the designated use (use attainability option). Here, point sources are responsible for a substantial amount of the phosphorus loading to the system and the load reductions required are clearly achievable.

With regard to the specific alternatives suggested: In-stream aeration might mask a portion of the problem by ameliorating some of the adverse water quality effects, such as attenuating dissolved oxygen swing, but there is no evidence that it would reduce excessive primary productivity sufficiently to achieve the water quality objectives. In addition, there would be implementation issues with such an approach: installing infrastructure within a riverine system subject to flooding would be problematic; and there is no regulatory or institutional framework to cause such a system to be built, maintained and compliance assured. Therefore, options that do not address the root cause of the water quality problem or use the stream for treatment, such as in-stream aeration or addition of alum directly to the waterbodies, cannot be entertained. Relocation of the TBSA outfall, if proposed, would be considered. However, if proposed, the model would have to be rerun with new assumptions since loading to the Dundee Lake endpoint would increase if TBSA effluent is no longer diverted into Wanaque Reservoir. Regarding the role of NJDWSC operations, there are two factors to be considered. NJDWSC supplies drinking water to more than 3 million of New Jersey's residents. Management of the system needs to be flexible enough to allow the maximum safe yield without deleterious water quality impacts. While safe yield and allocation decisions do consider water quality implications, directing NJDWSC to change operations for the primary purpose of minimizing the requirement for dischargers to reduce the introduction of a pollutant into the river system is not appropriate. FW2 waters are to be suitable for drinking water use with conventional treatment. Therefore, the quality of the water at the Wanaque South intake point must support the drinking water use, with or without diversion activities.

55. Comment: The endpoint in Dundee Lake is to be measured between June 15 and September 1, but the effluent limit is intended to apply from May through October. Based on an independent run of the model, the target condition was met with effluent limits at 0.4 mg/L only in June, July and August. To meet the Passaic TMDL for Dundee Lake, phosphorus removal at the Lower Passaic treatment plants is only necessary from June through August. (11)

Response: It is true that during the critical simulation year of 2002, conditions favorable to produce high phytoplankton concentrations were limited to July and August. However, the TMDL is intended to be protective during future summer conditions. While summer algal blooms are most common during July and August, periods conducive to high algal production can occur anytime from May through October. For instance, the most critical months for algal growth during 2001 were September and early October. In 2004, late June through the first week of July was the most critical periods. While the model demonstrates the fact that seasonal phosphorus reductions provide the same level of protection at Dundee Lake as year-round reductions, it would be short-sighted and incorrect to apply the seasonal limits only to the months that happened to be critical during the 2002 simulation year.

56. Comment: Was the potential for the permanent lowering of Dundee Dam, which was as possible outcome of a study conducted by the Federal Energy Regulatory Commission (FERC), considered as part of the TMDL process? (18)

Response: The Federal Energy Regulation Commission (FERC) and the Department have not received an application for a permanent lowering of the Dundee Lake dam. Although the dam owner has removed the hydroelectric operation, the owner has maintained the FERC license. The dam was recently repaired and the Department has determined that it is in safe condition. Therefore, the lowering of Dundee Dam is not an imminent physical change to the system that should be considered in the TMDL.

57. Comment: Efforts should be concentrated on protecting and restoring the “Green Infrastructure” in the Passaic River Basin, especially in the Highlands, as it has been shown that water treatment costs increase as forest cover in the watershed decreases. (9)

Response: The Department concurs that maintaining and replacing areas of natural vegetation (“green infrastructure”) have a positive impact on water quality. While preserving land with natural land cover can help with minimizing future degradation, it will not address existing water quality concerns. The Department recognizes this in the discussion of Category One waters and the associated Special Water Resource Protection Areas in Section 8, Reasonable Assurance. Restoring riparian vegetation can help improve existing water quality and is included as one of the measures identified in Section 7, Implementation Measures. This section has been enhanced to identify the known stream bank restoration and similar management measures that have been completed within the basin.

NJDWSC Responsibility:

58. Comment: The Department should require that the North Jersey District Water Supply Commission (NJDWSC) also assume appropriate responsibility for the level of phosphorus that enters the Wanaque Reservoir. The NJDWSC plays a central role in the phosphorus issue as it relates to the Wanaque Reservoir endpoint, yet the Department does not require that NJDWSC take any responsibility for reducing the phosphorus load it diverts into the Reservoir. NJDWSC must participate in the solution to its phosphorus problem. The TMDL suggests that NJDWSC might be a trading partner, yet provides no description of how that might occur. Potentially, NJDWSC can undertake treatment or some other measures that will significantly reduce the TP reaching this endpoint (or which will ensure that the 10 ug/L chlorophyll-*a* seasonal average criterion is met) that are less costly than requiring the STPs to reduce phosphorus to a year-round LTA of 0.4 mg/l. Unless the Department imposes obligations on NJDWSC to take actions to reduce the TP load, NJDWSC will have no incentive to do so, and no incentive to "trade" with the STPs. As part of or in conjunction with this TMDL, the Department should exercise the authority it has over NJDWSC to address phosphorus. There are at least two sources of such authority. The first is found in the statutory and regulatory provisions that govern NJDWSC's water diversion permit. The second is found in the federal Clean Water Act's pollutant discharge elimination system permit requirements, when those requirements are properly applied in a manner consistent with the recent United States Supreme Court holdings and those of the federal Court of Appeals. (10)

59. Comment: The North Jersey District Water Supply Commission should be required to secure a NJPDES permit for diversion of Passaic River waters into the Wanaque Reservoir. WTSA respectfully submits that the Department must impose responsibility on NJDWSC by requiring NJDWSC to obtain a NJPDES permit for its addition of a phosphorus load to the Wanaque Reservoir. In light of judicial interpretations of the CWA, including South Florida Water Mgt. Dist. v. Miccosukee Tribe of Indians, 541 U.S. 93, 124 S.Ct. 1537 (2004) ("Miccosukee"), (also cited were *National Wildlife Federation v. Gorsuch,* 693 F.2d 156, 165 (D.C.Cir. 1982), *Catskill Mountains Ch. Of Trout Unltd, Inc. v. City of New York*, 273 F3d 481 (2d Cir. 2001), *Catskill Mountains Ch. Of Trout Unltd, Inc. v. City of New York*, 451 F.3d 77 (2d Cir. 2006) and *Friends of the Everglades, Inc. v. South Florida Water Management District*, 2006 WL 3635465 (S.D.Fl. 2006)), the need to address phosphorus in the Wanaque Reservoir, and the critical role NJDWSC plays in introducing the phosphorus load into the reservoir, the Department should not "defer" to the 2005 EPA Memorandum. Instead, the Department should require that NJDWSC obtain a NJPDES permit. The diversion of water from the Passaic River by pumping it some 17 miles north into the Wanaque Reservoir is a transfer into a distinct water body. Water from the Passaic is only diverted when NJDWSC elects to draw off water at a rate that exceeds the Pompton River flow, causing an uptake of Passaic River water into the Pompton River, and, hence, into the intake. Therefore, the NJDWSC operates a "point source" that "discharges pollutants," in that phosphorus is "added" to the Reservoir as a result of the transfer of waters from the Passaic to the Reservoir. This being the case, the Department should require that NJDWSC obtain a NJPDES permit. Such a permit would not necessarily mean that NJDWSC would be solely responsible for reducing the phosphorus load into the Reservoir so as to achieve the 10 ug/l chlorophyll-*a* seasonal average, but it would require that NJDWSC meaningfully participate in achieving the required reduction. (10)

60. Comment: Even if it were determined that a NJPDES permit is not required, under its water diversion permit, North Jersey District Water Supply Commission should be required to reduce the amount of phosphorous coming into the Wanaque Reservoir from the Passaic River so as to mitigate any adverse impacts that such phosphorus has on water quality in the Reservoir. The Department's current regulations expressly state that the party transferring water from one body to another "is responsible for mitigating adverse impacts…caused as a result of the diversion." *N.J.A.C.* 7:19-2.14. Nothing in the 2005 Najarian TMDL Report, the 2005 TMDL, or the proposed 2007 TMDL addresses that NJDWSC's diversion practices have caused the alleged impairment of the Reservoir. The 2007 TMDL was developed without consideration of any other Reservoir management alternatives, instead accepting as a "given" the historic pumping and diversions that took place during the 1993-2002 time period. No attempt was made to investigate other possibilities, either in the pumping protocol or in direct treatment of the diverted water. The 1988 Najarian Report concluded that, provided that NJDWSC implemented appropriate management and diversion practices, there would be no cause for concern with impacts of the diversion on water quality within the Reservoir. If the 2005 Najarian TMDL Report is correct in its conclusion that the diversion of water from the Passaic has adversely impacted the water quality within the Reservoir, the obvious and critical questions are why haven't NJDWSC's diversion practices achieved the result predicted in the 1988 Najarian Report and can NJDWSC better monitor those practices so as to mitigate adverse impacts, as required by the Department and regulation? The conclusions in the 2005 Najarian TMDL Report are inexplicably at odds with the conclusion reached in the 1998 Najarian Report. No explanation has been given for abandoning the conclusions in the 1988 Najarian Report that, when properly managed, diversion of water from the Pompton and Passaic Rivers, even "under the severest of operating conditions," and "at times of unusual flow periods" and "[d]uring unusual hydrologic events associated with prolonged dry years," will not have any long term impact on water quality in the Wanaque Reservoir. If the answer is that Dr. Najarian's 1988 conclusions, based on the simulations conducted at that time, have proven to be incorrect, then surely the Department is justified in now requiring NJDWSC to take some direct responsibility for addressing the impacts of the diversion of water from the Passaic. Had the 1988 simulations demonstrated such adverse impacts, either the Department would not have approved the diversions, or it would have conditioned such approval on specific, affirmative actions to address those impacts. In addition to more responsible management of its diversion practices, NJDWSC should be the party responsible for ensuring the quality of the water it discharges into the Reservoir by its diversion of water or certainly participate in that responsibility. (10)

61. Comment: Commenter believes the Supreme Court decision in Miccosukee (*South Florida Water Management District v. Miccosukee Tribe of Indians*, 541 U.S. 93, 124 S.Ct. 1537 (2004)), requires a NPDES permit be issued to NJDWSC because they divert river water to the Wanaque Reservoir. The Department must justify why it believes this is not required and has failed to modify its position to meet the US Supreme Court decision. NJDWSC should be required to mitigate any effects of their discharge on the reservoir. Further, NJDWSC should have a NPDES permit to discharge reservoir water to the river, based on a recent Federal Court decision (cited were *National Wildlife Federation v. Gorsuch*, 693 F.2d 156, 165 (D.C.Cir. 1982), *South Florida Water Management District v. Miccosukee Tribe of Indians*, 541 U.S. 93, 124 S.Ct. 1537 (2004), *Catskill Mountains Ch. Of Trout Unltd, Inc. v. City of New York*, 273 F3d 481 (2d Cir. 2001), *Catskill Mountains Ch. Of Trout Unltd, Inc. v. City of New York*, 451 F.3d 77

(2d Cir. 2006) and *Friends of the Everglades, Inc. v. South Florida Water Management District,* 2006 WL 3635465 (S.D.Fl. 2006)). After applying permit requirements to NJDWSC, the Department should recalculate the TMDL based upon the limitations that would be imposed on other dischargers. (10)

Response to Comments 58-61: The Department does not interpret the Supreme Court decision in Miccosukee as requiring the State of New Jersey to issue discharge permits to regulate purveyors under NJPDES, the State NPDES program. The Department's interpretation is consistent with EPA's determination that water diversions are not point sources requiring a NPDES permit under the Clean Water Act. See, USEPA, Agency Interpretation on Application of 401 of the Clean Water Act to Water Transfers. EPA has proposed its interpretation as a rule. 71 Fed. Reg. 32887. In support of their position that EPA's interpretation of the Clean Water Act and the Miccosukee decision are incorrect, the commenters refer to other federal court decisions, such as Catskill Mountains Ch. Of Trout Unlimited, Inc. v. City of New York, 451 F. 3d 77 (2d Cir. 2006) and Friends of the Everglades, Inc. v. South Florida Water Mgt Dist. 2006 WL 3635465 (S.D.Fl. 2006). They contend that, based on these decisions, the Department is obligated to issue a NJPDES permit to the NJDWSC for its water diversion permit. However, the federal court decisions the commenters cite involve different facts, and these decisions are not from the Third Circuit. Therefore, the decisions do not create controlling precedent.

The Department believes that the most appropriate way to address water quality effects of water supply diversion activities is through State authorities related to safe yield and allocation decision making. The role of NJDWSC operations is discussed above in response to comments 49-53. To reiterate, NJDWSC supplies drinking water to more than 3 million of New Jersey's residents. Management of the system needs to be flexible enough to allow the maximum safe yield without deleterious water quality impacts. While safe yield and allocation decisions do consider water quality implications, directing NJDWSC to change operations for the primary purpose of minimizing the requirement for dischargers to reduce the introduction of a pollutant into the river system is not appropriate. FW2 waters are to be suitable for drinking water use with conventional treatment. Therefore, the quality of the water at the Wanaque South intake point must be consistent with support of the drinking water use, with or without diversion activities. Water quality trading is an option, but not a requirement, through which NJDWSC can play a role in protecting the water quality of the Wanaque Reservoir as affected by the diversion of Pompton and Passaic River water into the reservoir.

The load reduction required to achieve the water quality target for the in-stream critical location is the same as that needed to achieve the water quality target in the Wanaque Reservoir. The difference is the applicability of seasonal effluent limits. Commenters suggest that some or all of the burden of achieving the phosphorus load reductions outside the May through October season should be borne by NJDWSC because it is the act of diverting water into the Wanaque Reservoir that dictates year round reductions from dischargers in the portion of the river basin affected by the diversion. With reference to the decision on the Wanaque South Diversion, background on this permit decision is in order. The grant application for the Wanaque South project diversions was approved by the New Jersey Water Supply Council on September 25, 1978. The initial evaluation of water quality impacts due to the Wanaque South Project was presented as an appendix within the "Wanaque South Project Economic Feasibility Study" (1981). This assessment indicated that there may be impacts to temperature and dissolved oxygen in the Passaic River due to diversions at the Two Bridges site. As the Department's total phosphorus (TP) standard was not established until 1980 (after the initiation of the Feasibility Study), impacts due to TP were not assessed at that time. In 1981, the Department did conduct an in-house screening-level (Vollenweider) assessment of TP impacts that suggested that the reservoir could be in a mesotrophic state and that expanded diversions could result in possible degradation of the reservoir's trophic state. Thus, the Department included a provision for a "reservoir phosphorus management study" within the Wanaque South water diversion permits (No. 1651 and 1685), which were issued on April 30, 1982. The 1988 Najarian report was developed in response to this permit condition. The 1988 study concluded that "…the proposed Wanaque South diversion would not have a lasting impact on the water quality of the Wanaque Reservoir." The study also found no long-term impairment with respect to the trophic state of the Reservoir. This predicted result was attributed in part to the reservoir's relatively short residence time (approximately 6-8 months). However, while the residence time is short based on a mathematical comparison of volume in and volume out, in practice, the reservoir is not pumped dry. There is always a residual pool and settled phosphorus can accumulate and be available for biological activity as the result of turnover events. Measured and predicted levels of chlorophyll-*a* are in excess of those associated with maintenance of a mesotrophic condition. This is likely due to the fact that the NJDWSC has needed to divert river water at frequencies and rates that were not anticipated in 1988 -- due to extended dry-weather (drought) conditions over much of the past decade. In response, over the past decade, NJDWSC has implemented various management strategies to reduce transient water quality impacts to the reservoir from river diversions. These strategies have been helpful in the control of peak phosphorus concentrations and nuisance algal blooms within the Reservoir. However, such management programs can, at best, only partially mitigate worst-case conditions. Further, the addition of chemicals (alum) on an ongoing basis is not an appropriate approach for reservoir management. Additional means are needed to protect reservoir water quality.

Impacts from TP Removal:

62. Comment: The TMDL fails to consider the following negative impacts associated with pretreatment for phosphorus: increase in sludge production; increase in total dissolved solids; negative impacts on incinerator operation; an increase in aluminum in plant effluent as a result of chemical addition. Public policy is not well served where a water quality enhancement is attained at the expense of a diminution of other water quality criteria or other negative environmental impacts. There are alternatives to imposing phosphorus limits that would achieve the desired environmental benefit without the negative consequences. (18)

63. Comment: There are several negative impacts that would result from phosphorus removal, as follows:

-As a result of chemical treatment to meet the phosphorus LTA of 0.4 mg/l, STPs will have significant increased sludge disposal costs from increase sludge production, estimated to increase from 19% (with biological removal) to 37% (chemical removal only).

-Total Dissolved Solids (TDS) will increase in the effluent when meeting phosphorus LTA of 0.4 mg/l. TDS will negatively impact water quality, which will impact drinking water supplies and drinking water quality through potential additional treatment requirements.

-Chemical sludge from the phosphorus removal process will impact incinerators. It will increase ash production and possibly produce "clinkers" which plug drop holes of multiple hearth incinerators and may require certain incinerator improvements.

-Chemical treatment for phosphorus removal will increase aluminum (or iron) in effluent. (11)

Response to Comments 62 and 63: The TMDL specifies WLAs in terms of total phosphorus to achieve the water quality goals for the Wanaque Reservoir and Dundee Lake. The comments presume that the only available treatment technology is chemical addition. However, the Department believes that the WLAs can be achieved through a variety of treatment options. The Department encourages permittees to utilize biological nutrient removal (BNR) wherever feasible based on site and process constraints. The use of BNR has the benefit of reducing nitrates while avoiding increases in the levels of TDS and affecting sludge treatment and disposal options. The Department is working with New York DEC and the EPA to develop a TMDL to address dissolved oxygen issues in the New York/New Jersey Harbor, which may require the NJPDES facilities in the Passaic River Basin to implement nitrogen removal. This is a further incentive to use BNR wherever feasible to achieve the required phosphorus reductions. Further, by developing and applying a dynamic model within the Passaic basin, the Department has taken care to require only the level of phosphorus load reductions needed in order to achieve water quality objectives. By carefully evaluating the model simulations, the Department was able to determine the critical locations where primary productivity is causing water quality problems and develop criteria in terms of the response indicator, chlorophyll-*a*, that equate to protection of the designated uses. Seasonal limits are also offered where appropriate.

64. Comment: The Department should consider a particular trademarked commercial product identified by the commenter which the commenter indicates has proven to be extremely effective and economical at controlling phosphate levels in contaminated water and contaminated soil, in the plans to establish phosphate contamination limits for the Passaic River Watershed. (19)

Response: The Department appreciates that information provided by the commenter, but can not endorse any proprietary water quality device or material. The New Jersey Corporation for Advanced Technology (NJCAT) has a procedure by which developers of new technology can demonstrate performance claims. Additional information is available at www.njcat.org.

65. Comment: Achieving the significant phosphorus reductions called for in the TMDL may not be technologically, ecologically, economically or socially achievable. Therefore, commenter suggests dischargers evaluate their systems and determine the retrofits that will reduce phosphorus and nitrogen loadings to the extent feasible, given these considerations, similar to the improvements made at RVRSA. (9)

66. Comment: Biological technologies should be selected over "chemical" technologies for nutrient removal. (9)

67. Comment: The Department should investigate innovative technology that will reduce phosphorus loadings with fewer undesirable side effects and at reduced cost, like RVRSA did. (7)

Response to Comments 65-67: The Department believes the phosphorus reductions called for in the TMDL are fully achievable and at reasonable cost. The Department supports biological nutrient removal because it is a more cost effective removal technology that produces fewer harmful by-products than chemical treatment. The Department recognizes the innovative work of RVRSA and Wayne Township in incorporating such approaches for nutrient removal and will continue to rely on the regulated community to determine the best means to achieve permit limits, given site and process constraints that apply to each one, as well as outcomes that may come from water quality trading.

Permit Requirements:

68. Comment: Five of the sewage treatment plants listed in the proposed TMDL are located in West Milford and are regulated under the Greenwood Lake TMDL for Phosphorus. These facilities should also be required to meet whatever standards are set for total phosphorus, nitrate and ammonia in the Passaic TMDL. Further, the WMP for this area has not been done in 20 years. The Department needs to do its part in getting the load reductions by enforcing the requirement to do a WMP. (7), (9)

Response: The allocation of loading capacity for Greenwood Lake was addressed in the September 2004 TMDL and included WLAs for the associated NJPDES discharges. The allocation of loading capacity established in the Greenwood Lake TMDL is protective of the SWQS and did not need to be reassessed by the Passaic TMDL. Rather, the loadings that would result from successful implementation of the TMDL in this watershed were taken as a boundary condition input to the Passaic River basin TMDL. Requirements for load reductions are required whether or not there is a current WMP.

69. Comment: Monthly average permit limits based on a long term average in the stream should be used. No limitation based on a shorter time period is necessary or warranted. (23)

Response: The long term average used in the modeling study is that required in wastewater treatment effluent in order to achieve the watershed criteria, expressed as seasonal average concentrations of chlorophyll-*a* at the two critical locations. There is no long term average stream concentration objective expressed in this study. As indicated in the TMDL, the Department intends to express the WLAs set forth in the TMDL in terms of monthly average effluent limits.

70. Comment: A TMDL must be expressed in terms of daily limit. How can a long term average be compliant with CWA requirements? The proposed 0.76 mg/L limit is 7 times less stringent than the criterion. The Department should enforce the 0.1 mg/L that is required unless the phosphorus protocol demonstrations are made, which has not occurred. (22)

71. Comment: The 0.4 mg/L limit is too liberal and should be 0.1 mg/L, as is recommended for impaired waters. Commenter is disturbed about the concept of averaging and believes it doesn't really work. (20)

Response to Comments 70 and 71: According to an USEPA memorandum issued November 15, 2006, all TMDLs and associated load allocations and wasteload allocations should be expressed in terms of daily time increments, which these TMDLs do. The November 15, 2006 memorandum further states that TMDL submissions may include alternative, non-daily pollutant load expressions in order to facilitate implementation of the applicable water quality standards. It should be noted that the November 15, 2006 memorandum makes clear that although TMDLs are to be expressed in terms of a daily load, this does not affect a NPDES permitting authority ability to establish permit effluent limits, which "… may be written in a form that derives from, and complies with, applicable water quality standards…". Additionally, The National Pollutant Discharge Elimination System (NPDES) regulations at 40 CFR 122.45(d) allow numerical NPDES effluent limitations for continuous discharges to be expressed, unless impracticable, as average weekly and average monthly discharge limitations for publicly owned treatment works (POTWs) and as daily maximums and monthly averages for other dischargers. The EPA Protocol for Developing Nutrient TMDLs, EPA 841-B-91-007 (pg. 7-3) also describes these acceptable practices. The current TMDL and proposed approach for applying effluent limits comply with USEPA guidance and the requirements of the Clean Water Act.

As the result of the Passaic River basin TMDL, the 0.1 mg/l total phosphorus SWQS has been superseded within the modeled domain by watershed criteria expressed in terms of chlorophyll-*a* at the identified critical locations. Commenters appear to refer to the practice of applying the SWQS as an end-of-pipe effluent limit where the discharge of a pollutant from a facility is in quantifiable amounts and is to a waterbody identified as impaired with respect to that pollutant. Because of the narrative criteria that accompany the in-stream numeric criterion for phosphorus, a phosphorus evaluation protocol was developed to determine when the numeric criterion does not apply in light of the narrative criteria, which is commonly known as the phosphorus protocol. As a result of the Phosphorus Settlement Agreement, WQBELs for phosphorus are not to be applied except through a TMDL study with respect to most significant dischargers in the Passaic River basin. Therefore, the end-of-pipe limit approach and phosphorus protocol do not apply. In any case, NJPDES effluent limits must conform with a WLA from an adopted TMDL, in lieu of a WQBEL established any other way. The TMDL establishes WLAs based on a total phosphorus long-term average (LTA) effluent concentration of 0.4 mg/L for most dischargers, to achieve the watershed criteria set in order to be protective of the designated uses of the affected waterbodies. The Department has also stated the intent to express this LTA as a monthly average of 0.76 mg/L in the NJPDES permits for the identified facilities, subject to water quality trading.

Seasonal Limits:

72. Comment: Seasonal limits have been found to be sufficiently protective of the river, yet phosphorus removal on a year-round basis has been imposed on dischargers upstream of the reservoir intake. Seasonal limits, either tied to the use of the Wanaque South Pumping Station, or a reservoir level, would be sufficiently protective of the environment and would result in a

significant cost savings to the public and decreased pollutant load to the environment. The Department has imposed additional requirements upon dischargers without regard to whether the discharge is being pumped into the reservoir. The determination to treat effluent when water is not transferred to the reservoir must be revisited. Treating effluent to meet a limitation that is not appropriate is a waste of public funds and results in the use of chemicals that increases sludge production and Total Dissolved Solid discharges. The Department should have reviewed and offered for public comment its consideration of the option of seasonal phosphorus control during periods when NJDWSC is not pumping water from the Passaic River Basin into the Wanaque Reservoir. Seasonal effluent limits should be applied to dischargers upstream of the Wanaque South Pump Station because of the intermittent but predictable diversion of water to the Wanaque Reservoir. The application of effluent limits should be related to water supply needs, as indicated by the pumping schedule or reservoir water level. (2) (15)

73. Comment: The Department has failed to provide relief from stringent limits during periods when phosphorus control cannot provide a benefit to the Wanaque Reservoir. Strict adherence to year round phosphorus removal does not bear any relationship to goal of protecting the Reservoir. Treating effluent to meet a limitation that is not appropriate is a waste of public funds and results in the use of chemicals that are not warranted. Chemical precipitation and additional TDS and sludge production can be avoided through judicious establishment of compliance levels, tied to the use of the Wanaque South pump station or a reservoir level, to achieve benefit at cost savings to the public. The Department should have reviewed and offered for public comment its consideration of the option of seasonal phosphorus control during periods when NJDWSC is not pumping water from the Passaic River Basin into the Wanaque Reservoir. (1)

74. Comment: The limit of 0.76 mg/L, which is applied seasonally to protect the River, should be applicable to all dischargers, not just those downstream of the Reservoir intake. The Department has proposed limitations to protect the Wanaque Reservoir from diversions from the river system. It is believed that such diversions have not occurred in approximately four years. It does not seem appropriate to protect this use on a continuous basis when diversion does not occur at any reasonable frequency. (23)

Response to Comments 72-74: As discussed in the response to Comment 55, the Department believes seasonal limits are only appropriate for discharges below the confluence of the Pompton and Passaic River. Tying effluent limits to an unpredictable pumping regimen outside the control of the regulated entity is institutionally impracticable. Regarding the opportunity to provide input on the concept of seasonal limits, multiple opportunities were provided. In addition to the opportunity for formal public comment provided with the formal notice and public hearing for the proposed watershed criteria, TMDL and anticipated effluent limits that will emanate from the TMDL, prior to the proposal, there were at least two opportunities for public comment on these issues. At the May 19, 2006 Data Exchange Meeting on the Passaic River Basin TMDL, the Department requested input on the watershed criteria. At the June 4, 2007 meeting between the Department and the affected dischargers, a presentation was made on the Non-tidal Passaic and Pompton Lake TMDLs in which the Department presented information regarding the intent to apply seasonal limits for some discharges as well as the basis for seasonal limits. Some of these points were raised and responded to at those events.

Margin of Safety:

75. Comment: Confirmation is requested that the issue of margin of safety will be revisited once the TMDL is implemented and that antibacksliding and antidegradation policies will not preclude the Department from undertaking appropriate remedies and revisions at that time if deemed warranted. (1), (2)

Response: Antidegradation policies are required to be implemented should a permittee request to expand its discharge beyond the levels currently authorized. As the TMDL has allocated the total the phosphorus loading for the Passaic River Basin, a request for a new or expanded treatment plant would need to: maintain the phosphorus loading authorized in its NJPDES permit, obtain an allocation of the loading contained in the reserve capacity or obtain a reallocation of load from another NJPDES facility. With regard to antibacksliding, under Section 402(o) of the Federal Act (33 U.S.C. §1342(o)), "A permit may not be renewed, reissued, or modified… to contain effluent limitations which are less stringent than the comparable effluent limitations in the previous permit." However, as described by the regulation and the USEPA Technical Support Document for Water Quality-based Toxics Control (EPA/505/2-90-001), establishing less stringent limits based on water quality is allowed where: material or substantial facility changes justify relaxation, events beyond control can not be remediated, the permittee has installed and properly operated the facility and is still unable to meet the limit, or new information (such as a revised TMDL) justifies relaxation of water quality-based permit limitation. In either situation, it is not expected that the loading capacity contained in the MOS for these TMDLs would be further reallocated as WLAs and LAs. If the water quality response based on follow-up monitoring warrants and a subsequent TMDL study that includes improved predictive capabilities is developed, it is possible that revised WLAs and LAs could result.

76. Comment: The TMDL's numerous conservative assumptions, including inclusion of the 2002 drought conditions, comprise a sufficient Margin of Safety, so as to meet the definition of an "implicit" Margin of Safety and are thus sufficient to meet EPA's requirements for a TMDL calculation. The addition of an "explicit" Margin of Safety is unnecessary. The MOS is used to assign load allocations that are protective of a water quality endpoint, based upon uncertainty in the TMDL calculation, and should not be embodied additionally in the site-specific criterion itself. (15)

Response: In this study, the MOS and reserve capacity are provided for by setting a target lower than the established watershed criteria, not in addition to a specified additional allocation of the loading capacity as suggested by the commenter. EPA guidance does allow an MOS to be implicit, explicit or a combination of both. An MOS is needed to account for a "lack of knowledge concerning the relationship between effluent limitations and water quality" (33 U.S.C. 1313(d)). EPA directs that it may "prove feasible to include margins of safety in more than one TMDL analytical step. For example, relatively conservative numeric targets and source estimates could be developed that, in combination, create an overall margin of safety adequate to account for the uncertainty of the analysis" (Protocol for Developing Nutrient TMDLs, EPA). EPA requirements for an approvable TMDL also require consideration of critical conditions and seasonal variation when setting the TMDL and associated WLAs and LAs, neither of which is allowed to serve as the MOS. The fact that the TMDL study complies with requirements for critical conditions and seasonal variations does not constitute an implicit MOS.

Water Quality Trading:

77. Comment: Water quality trading is opposed and this provision should be eliminated from the proposed TMDL for the following reasons:

- Discharges cause the greatest degradation of water and biota in the water in the immediate vicinity of the discharge, not miles away where another discharge occurs.
- Changes in the composition of a discharge will change the ecology of the receiving water. This is especially true if there are changes in nutrient loadings. In a trading situation, evaluating the benefits and damages to the ecology at two different locations will be impossible.
- If some dischargers can buy credits, then the overall reductions in loadings will be less, and the water will be less clean than if all dischargers meet the same requirements.
- Marketing credits will result in inequities that will probably be controlled by political and economic forces.
- Everyone needs clean water to drink, but who will bear the costs of cleaning up the water from dischargers who buy credits?
- Enforcement of trading agreements has been poor in other parts of the United States.
- No environmental organizations were invited to be part of the review team established by Rutgers on the trading project; thus the study completed by Rutgers did not have the oversight of a critical stakeholder for the Passaic River, and has a tendency to represent only sewerage authority interests and not those of the general public.

(7), (9)

Response: In the case of nutrient impacts on dissolved oxygen and phytoplankton, it is not true that “discharges cause the greatest degradation of water and biota in the water in the immediate vicinity of the discharge.” In fact, it is far more common for dissolved oxygen and productivity impacts to occur substantially downstream from nutrient point sources. Phosphorus is considered a pollutant because it can stimulate excessive productivity. The TMDL analysis demonstrated the two locations where phosphorus is responsible for excessive primary productivity. Water quality targets were developed for these two discrete locations. The trading program will consist of a trading currency among point sources that will result in a condition the same as or better than the TMDL premise, as demonstrated by modeling runs of trading scenarios. Under the trading program, if some dischargers buy credits, then by definition there must be a discharger or dischargers that are selling credits in order to maintain the TMDL outcome at the critical locations.

With respect to creating untenable economic circumstances for some users, the Department believes that the responsible entities for each discharge will only seek trades that are consistent with discharge of their fiscal responsibility, which includes managing the system so that user costs are set only as high as necessary to satisfy water quality as well as public health and safety obligations.

The scientific, economic, and legal feasibility of water quality trading in the non-tidal Passaic River basin is under study. With finalization of the TMDL specification, the research on trading can be finalized. The final trading proposal, including trading ratios and rules, will be presented to the public for comment and must be approved by both the Department and EPA prior to implementation through NJPDES permits.

78. Comment: The trading concept is opposed. It doesn't belong in New Jersey. We should be cleaning up the sources. (20)

Response: The Department believes that water quality trading represents a viable means to determine if more efficient and cost effective means are feasible to attain water quality objectives and to implement them. The Department anticipates providing a 1 year period from the date of permit issuance to negotiate trades, provided the trading tool and rules have been approved by the Department and EPA. To be approvable, a viable trading option would have to ensure that the TMDL condition in the Wanaque Reservoir and Dundee Lake are met and that there is full enforceable accountability for required load reductions.

79. Comment: If available, the trading ratios developed under the trading program should be included in the TMDL report. If these ratios are not yet available, then the trading ratios will need to be separately public noticed and sent for EPA approval. (21)

Response: Rutgers Cooperative Research and Extension received an EPA Targeted Watershed Grant in 2005 to develop, evaluate and implement a water quality trading program for the non-tidal Passaic River Basin. Upon completion of the trading study, there will be an opportunity for public comment on the study, and both the Department and EPA will need to approve the trading tools and rules prior to their use in formulating a trade. In addition to the public comment on and agency approval of the tools and rules, the public will have the opportunity to comment on specific trades as they are reflected in NJPDES permits.

80. Comment: The voluntary "Water Quality Trading Program" suggested in the TMDL cannot be substituted for properly addressing the attenuation of phosphorus, particularly when the preliminary indications are that the Department has or will impose artificial constraints and requirements on key components of such a trading program. Given its failure to properly allocate loading as part of the TMDL, the Department must entertain comments on the trading project and address such comments in formulating the eventual TMDL that will be submitted to EPA for approval. The Department cannot relegate to a potential, voluntary trading program the scientifically sound allocation of initial responsibility for phosphorus reductions. Once the proper initial responsibility for phosphorus removal is established, water quality trading may be appropriate. The unsoundness of relying on trading is compounded by the uncertainty of whether the trading project will be implemented and whether there will be sufficient parties reducing phosphorus in effluent enough to trade with potential credit "purchasers" is unknown. (10)

81. Comment: The Department is considering imposing unsound, artificial, and unfair conditions or restrictions on trading. First it proposed that there would be a maximum trading ratio of 1.0, which is not supported mathematically and will discourage STPs that are further from the model endpoints to trade with closer STPs to have the closer STPs remove additional phosphorus. The

Department is also considering that credits be accumulated and recalculated annually, based not on actual flow but on permitted flow. For an STP that is operating close to its permitted flow, this calculation of credits may not be particularly troublesome. However, for an STP whose actual flow is far below its permitted flow, this formula will significantly discourage trading from the buyer's perspective. Where, as under the proposed trading project, such credits are calculated annually, this trading disincentive does not serve any rational purpose. The effect on effluent limits that would follow from attenuation cannot be relegated to a voluntary trading program and must be addressed in the phosphorus effluent limit for each STP. If trading is to occur, the "trading ratios" will then be incorporated within each STP's limit, which actually simplifies the trading calculations. The disincentives to trading reverse the Department's concept of "cost efficiency," which the trading project would try to promote. (10)

82. Comment: Unless the Department requires that NJDWSC take responsibility, it will not do so and it will have no incentive to "trade" with other dischargers. The entity that should pay for such treatment of the diverted river water is NJDWSC, the party diverting it. Only by providing NJDWSC with its own financial incentive to reduce the phosphorus load coming into the Wanaque Reservoir will this critical party have an interest in participating in any trading program. WTSA agrees that a properly formulated trading program can help achieve the most cost-effective approach to reducing phosphorus loads at the critical endpoints. To be effective and fair, all potential trading partners must have appropriately determined financial incentives to participate. (10)

83. Comment: NJDEP has indicated that trading ratios will be capped at 1.0. That clearly is not appropriate for WTSA in view of the significant attenuation of WTSA loads. If trading ratios are indeed capped at 1.0, there will be no reason for WTSA to participate. If the Department were to insist on "capping" the trading ratios at 1.0, the result would be ignore the significant attenuation that occurs, and would be unfair to WTSA, as it would improperly assign a much greater contribution of TP than WTSA's facilities in fact contribute. (12)

Response to Comments 80-83: No final determinations on the trading program have been made. When the trading study is complete, it will be subject to public comment as well as Department and EPA approval. Issues related to attenuation and alternatives to phosphorus reduction are addressed in responses to Comments 48-54.

Nonpoint Source Load Reduction:

84. Comment: The Department should support and help implement programs which will provide a reduction of phosphorus and nitrogen. An open and forthright planning process is needed to attain meaningful reductions. (9)

85. Comment: A real commitment from the State of New Jersey, both regulatory and financially, would be needed to deal with point and nonpoint problems in this reservoir. A 60% reduction cannot be assured when septic management systems are not mandated; when goose management and riparian buffer restoration efforts are voluntary and underfunded, with inputs from these sources uncontrollable and unmanageable; and when conservation plans and resource

management plans on farmland to reduce agricultural inputs are not mandatory. Given the lack of confidence in achieving the NPS load reduction, more must be required of point sources. (22)

86. Comment: Commenter is concerned about how reductions will be achieved. Parking lots will not be ripped up. Money is running out to buy up stream corridors. We don't require retrofitting of stormwater when we do redevelopment. A regulatory and financial commitment is needed from the Department to get the NPS reductions. Goose management and fertilizer ordinances are not going to do it. (20)

87. Comment: There is concern about achieving NPS reductions; commenter is relying on Department's assertion that these reductions are feasible. (14)

Response to 84-87: The Department has been and continues to be committed to reducing phosphorus sources derived from stormwater point sources as well as nonpoint sources through best management practices. Stormwater sources regulated as NJPDES point sources are subject to several measures that are expected to significantly reduce phosphorus loads from urban areas. Through their NJPDES permit, Tier A communities are required to implement street sweeping and outlet cleaning, as well as to adopt ordinances regarding proper yard and pet waste management, and limiting wildlife feeding. In addition, municipalities within the spatial extent of the model will be required to adopt the fertilizer management ordinance limiting the application of phosphorus through lawn fertilization. Based on studies in other areas, implementation of a fertilizer ordinance alone is expected to achieve a 20% reduction in phosphorus inputs to the Passaic River and its lakes and tributaries. Additionally, each year the Department funds NPS reduction projects through the federally funded 319(h) program. These funds are to be used to implement programs and projects designed to reduce nonpoint source pollution. Projects include, but are not limited to, riparian buffer restoration and stormwater retrofits. Relevant projects in the drainage area have been cited in the TMDL document. Although agriculture is not a significant land use in the drainage area, the Department regularly coordinates with the Department of Agriculture to address water quality issues related to agricultural land uses and there are a number of cited funding programs available to accomplish agricultural BMPs. Finally, the Department recognizes the importance of continued public education as key to the overall abatement of NPS pollution. To aid in the public education, the Department continues to support the New Jersey Watershed Ambassadors program. The NJWA program is a community-oriented AmeriCorps environmental program designed to raise awareness about water issues, including nonpoint source pollution in New Jersey.

88. Comment: What assurance is there that New York will address the need to reduce phosphorus load entering New Jersey, without which the TMDL objectives cannot be met. (7), (20)

Response: New York has already applied a phosphorus limit on the Western Ramapo treatment facility that will begin the process of reducing phosphorus loads entering New Jersey. New Jersey believes this permit action signifies a willingness to cooperate and expects to continue to work with New York to assess the loading reduction accomplished and the extent to which additional load reductions are needed.

89. Comment: Commenter recognizes that the cost for achieving required point source controls is not insignificant and wants to be sure that it is well spent, since ratepayers and taxpayers would need to pay for it. Regarding nonpoint source control, while the commenter is willing to pass the proposed fertilizer ordinance, there is concern that in some affected municipalities, much of the fertilizer application occurs by way of landscapers. Landscapers apply fertilizer from tanks and there is no way to know what is in them, which will make enforcement challenging. Limiting the application of phosphorus from fertilizer is better accomplished regionally or statewide and though legislation or rules, even if new legislation or rules are needed to address this issue. (16)

90. Comment: The Department should regulate landscapers to get reductions from the fertilizer source. (14)

91. Comment: The Department should urge the State Senate and Assembly that a more productive tactic would be to introduce and pass legislation controlling non-point source phosphorus contribution via banning the sale and use of phosphorus laden fertilizers and detergents in New Jersey. (3)

Response to comments 89-91: As a requirement of the TMDL, municipalities listed in Appendix B of the TMDL documents must adopt and enforce a fertilizer application ordinance. The fertilizer ordinance applies to all persons, defined as any individual, corporation, company, partnership, firm, association, or political subdivision of this State subject to municipal jurisdiction. The landscaping industry falls under this definition and is required to comply with the conditions of the ordinance. The purpose of the fertilizer ordinance is to regulate the outdoor application of fertilizer so as to reduce the overall amount of excess nutrients entering waterways, thereby helping to protect and improve surface water quality. The Department agrees that a regional or statewide plan may be a more effective means to manage the fertilizers source of phosphorus. An initial step towards this approach is the Memorandum of Understanding (MOU) between the Department and members of the lawn care industry to reduce phosphorus by 50 percent the pounds of phosphorus applied in lawn care products in New Jersey Watersheds by 2010 as compared to a 2006 base year.

92. Comment: The City of Garfield has adopted a Fertilizer Management Ordinance and will provide a certified copy when passed by the Mayor and Council. (6)

Response: The Department appreciates the initiative demonstrated by the City of Garfield to reduce phosphorus loads in advance of adoption of the TMDL.

93. Comment: The proposed TMDL requires a basin-wide uniform reduction in non-point source phosphorus of 60%. Municipalities identified in Appendix B will be required to adopt a Fertilizer Management Ordinance and to undertake other phosphorus reducing measures. The uniform NPS reduction ignores phosphorus attenuation that occurs in the river system. Given the 99% attenuation and greater settling of organic phosphorus which makes up most of NPS phosphorus, it is likely that none of the NPS phosphorus from Warren arrives at Two Bridges, which is some 35 miles away, or at Dundee Lake which is 50 miles distant. There is no reason to require that Warren Township to adopt a Fertilizer Management Ordinance or undertake other NPS phosphorus reducing measures. (10)

Response: The commenter is incorrect to assume that none of the stormwater phosphorus load from Warren arrives at Two Bridges. In fact, attenuation of wet-weather phosphorus loads is much less than dry-weather, so nearly all of the wet-weather load from Warren will reach Two Bridges. Attenuation, while not as significant for stormwater loads, is fully accounted for by the Passaic River TMDL model.

95. Comment: There is substantial uncertainty as to whether the nonpoint and stormwater point source load reduction targets can be achieved. Therefore, Wayne requests confirmation that those phosphorus effluent limits applicable to the point source dischargers, which derive from the TMDL process, will not be amended in the future in the event that the nonpoint and stormwater point source load reduction targets are not met. (18)

96. Comment: The NPS load reduction for Township of Wayne may not be achievable. Wayne already has a fertilizer ordinance in place. If the nonpoint source reduction is not achieved, there is concern that the impacts of the lack of water quality improvements will be placed on the STPs by additionally lowering their loadings. (11)

Response to 95 and 96: The Department fully expects through the various management measures outlined in Section 7 Implementation Plan of the TMDL report that nonpoint and stormwater point source target reductions will be met comprehensively throughout the basin. The Department is committed to assisting with achieving these reductions through enforcing the municipal stormwater permit requirements, requiring the fertilizer management ordinance, the fertilizer MOU, and funding projects. The Department does not anticipate that the STPs will have to additionally lower their loadings in the future to meet the TMDL requirements. However, there can be no guarantee regarding future permit limits that may be imposed given the many physical variables, as well as potential for changes in regulatory requirements that may occur. Water quality response to implementation of the load reductions in the TMDL will be assessed and the need for adaptive management will be determined over time.

Data Availability:

97. Comment: Because the supporting documentation for the Wanaque Reservoir Model is not sufficient to facilitate a detailed technical review, the proposed TMDL should not be adopted. The model contains uncertainty in the loading to the Wanaque Reservoir from diversions and in how well the model responds to the diversion loads discharged to the reservoir. Although this particular model is proprietary to Najarian and Associates, input and output files for the 1/1/93 to 12/31/02 calibration can be provided. This includes daily 1993-2002 diversion inputs used for the baseline model case (date, location, flow, phosphorus concentration), the monthly diversion data. In addition, an integral component of the Passaic TMDL modeling analysis, the USGS DAFLOW Model and report has yet to be released. (12)

98. Comment: The Department has continued to withhold information critical to a thorough evaluation of the TMDL, which is necessary to enable the submission of all relevant comments. The Department continues to refuse to make available the LA-WATERS Wanaque Reservoir Model. Given the significant expenditure of public funds that the proposed TMDL is likely to

require of the dischargers, it would be in the public's interest to make the model and the water quality inputs available. Based on the meaningful input provided given availability of the Phase 2 model, allowing public access to models is the only way to ensure that the Department will have the benefit of an open and transparent TMDL process. (10)

99. Comment: It is not possible to perform a complete technical and scientific evaluation of the TMDL due to lack of access or delayed access to data and model inputs. Insufficient information is provided about observed algal concentrations, their relationship to diversion inputs in the Wanaque Reservoir, and the reservoir concentration of phosphorus that would maintain acceptable algal concentrations for the protection of drinking water. Insufficient data is provided to confirm that the Reservoir model accurately describes phosphorus dynamics. Data provided in figures in insufficient. The Omni modeled was not made available until late in the public comment period. (15)

100. Comment: The Department has failed to provide the data that supports key determinations made with respect to the Wanaque Reservoir. This information must be provided in accordance with OPRA. Lack of access to requested information is particularly egregious because RVRSA paid its fair share toward development of the TMDL. (1), (2)

Response to Comments 97-100: The Department has addressed all OPRA requests that were made with respect to the Phase 1 TMDL and provided all information in its possession in response to these requests. Certain information is not available in the form requested; however, the Department believes that the available information is sufficient to allow an assessment that the studies provide a sound basis for the TMDL and the WLAs and LAs established as an outcome. As stated previously, the Najarian 2005 TMDL study report provides sufficient data for the evaluation of model results. Data is provided in the form of graphical outputs, summary loading budgets, and error analysis. Tabular chlorophyll-*a* data for the Wanaque Reservoir at Raymond Dam were also provided in the supplemental report for the Wanaque Reservoir modeling, (Najarian, 2007). While the actual model code was developed under funding of the NJDWSC and remains proprietary to that agency, the reservoir model has been extensively documented in two prior reports ("Influence of Wanaque South Diversion on the Trophic Level of Wanaque Reservoir and its Water Quality Management Program", Najarian 1988 and "A preliminary assessment of water quality status of the upper Passaic River and re-verification of the Wanaque Reservoir model", Najarian 2000). Further, the model's hydrothermal and water quality algorithms have been published in peer-reviewed journals ("Mixed-Layer Hydrothermal Reservoir Model," M. ASCE. Journal Hydraulic Engineering. 120 (7), 846-862 and "A Multicomponent Model of Phosphorus Dynamics in Reservoirs," Water Resources Bulletin, 20, No. 5:777-788). With regard to the Passaic River basin model, the comment period was extended to allow additional time to evaluate to that model. The flow Model Diffusion Analogy Surface-Water Flow Model, published by USGS in 2007, entitled, "Simulation of Surface-Water Conditions in the Non-Tidal Passaic River Basin, New Jersey Scientific Investigations Report 2007-5052" was used to simulate flow in the non-tidal Passaic River and its major tributaries.

In addition, this TMDL has been the subject of more public involvement than any other in the State, as described in the TMDL document and reiterated in response to Comments 101-102. The Department has conducted stakeholder discussions on phosphorus TMDLs for the Passaic

River Basin as far back as 1996. One outcome of that extensive process was selection of LA-WATERS as the appropriate tool to assess nutrient and productivity in the Wanaque Reservoir under current conditions and to determine phosphorus loading reductions needed to achieve water quality objectives. This determination was made with full knowledge that this model was proprietary. Specifically, the October 2001 "Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin", memorialized the outcome of the discussions with stakeholders and the work of the Passaic River Basin TMDL Work Group regarding the plan to develop the TMDL. Included was the recommendation to use LA-WATERS to develop a water quality objective for the Wanaque Reservoir to protect designated uses.

Public Participation:

101. Comment: Public participation has been severely restricted in the process of developing this proposal. Before further action is taken the Department should undertake the following activities:

- Convene a Technical Advisory Committee to peer review the scientific investigations and the conclusions that have been reached in this process;
- Convene a Public Advisory Group to study and evaluate the economic and ecologic costs and benefits to be derived from the implementation of this proposed TMDL;
- Ask for public comment on the outputs from these groups.

(8)

Response: The Department does not agree that public participation has been severely restricted in this TMDL development process. In fact no other TMDL has had the degree of participation and discussion that is the hallmark of the Passaic River Basin TMDL. Section 9 Public Participation in both TMDL documents chronicle the various workgroups and key meetings that the Department has convened and had with all stakeholders groups (including the commenter) throughout the past 14 years. The Passaic TMDL Work Group, which met monthly from 2001-2003, was a technical advisory committee that led to the development of the proposed Passaic TMDLs as articulated in the *Passaic Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin* document. From 2004 to 2007 the Department convened stakeholder meetings to present and discuss key findings and to seek input from the public on the TMDL. Information obtained from this process informed the development of the Passaic TMDLs. Components of the TMDL were also reviewed by the NJ EcoComplex academic panel and presented at conferences and in peer reviewed journals.

A cost benefit analysis is not a requirement of the State's TMDL process. Nevertheless, the Department did request cost estimates from dischargers in September 2007. Responses were received from some dischargers, which indicate that phosphorus removal costs will be significant, but the needed phosphorus reductions are both achievable and reasonable. Use of BNR technology at plants where this technology is feasible can accomplish needed reductions that will require an initial capital cost and low operation and maintenance costs and will have minimal adverse side effects associated with chemical removal. , The TMDL provides that, upon approval of a trading tool, the Department will make water quality trading an option for specified treatment plants within the Passaic River Basin, which may identify viable cost effective options beyond a uniform reduction of phosphorus at each facility.

102. Comment: The Department violated the premise of the Clean Water Act by not publicizing the development of the TMDL for the fresh water Passaic and the Ramapo. There should have been briefings during development. The TMDL would have benefited from broader public participation. (7)

Response: In addition to the Clean Water Act's public process requirement, the Department's Water Quality Management Planning rules at *N.J.A.C.* 7:15-7.2(f) require the Department to informally initiate a public process prior to the development of each TMDL including informational sessions as needed. The Department has fully complied with both the spirit and intent of the requirement to provide opportunities for public comment. As set forth in the response to Comment 101, the Department has gone to extraordinary lengths to maintain an open public process in the development of these TMDLs. The Department publicized the development of the Passaic River Basin TMDLs by including stakeholders in the TMDL development process throughout the past 14 years through various workgroups and milestone informational sessions as set forth in Section 9 of both TMDL documents. In preparation of the TMDL proposal, the public was formally noticed: through direct correspondence by the Department, by public notice as published in the May 7, 2007 New Jersey Register; and through newspapers of general circulation in the affected area. In addition, a public hearing was held on June 7, 2007 at the Cultural Center at Lewis Morris County Park, 300 Mendham Road, Morristown, NJ. Notice of the proposal and hearing was provided to affected Designated Planning Agencies, municipalities, dischargers, and purveyors in the watershed.

TMDL Administrative Comments:

103. Comment: There are data and information required for defining the Passaic River Basin TMDL equations that are missing from the TMDL report. While this data and information may be found in the supporting documents, the TMDL report should provide this information in order to present and support these TMDL equations. (21)

Response: Highly complex TMDL studies that cover large areas, such as the subject TMDL studies, preclude inclusion of the supporting data and other information within the TMDL document itself. As noted by the commenter, the data and information upon which the TMDLs are based are found in the cited support documents, which were made available along with and are part of the TMDL reports. The commenter is referred to other complex studies, such as the Delaware Estuary PCB TMDLs established as a collaborative effort among EPA, the affected states and DRBC, wherein the TMDL document summarizes the findings and the detailed information is found in several volumes of supporting information.

104. Comment: For the Passaic River basin TMDL, the entire TMDL equation must be presented by assigning numeric values to the wasteload allocation (WLA), load allocation (LA), explicit margin of safety, and reserve capacity. Some of this essential information is missing from the TMDL report, most notably in Table 12, which provides the TMDL for the area between the Wanaque Reservoir and Dundee Dam, and Table 13, which provides the TMDL for the Wanaque

Reservoir. Table 12 currently provides allocations of TP per day in the following broad categories: headwaters, NPS runoff, NPS baseflow, CSO discharges and STP discharges. These allocations are divided between three geographic areas: Pompton, Upper/Mid Passaic and Lower Passaic. These categories must be broken down further to include: the names of the affected tributary waters along with the individual LA for each tributary, the identification of the different New Jersey land use categories by size with their current loads, percent reductions, and TMDL allocations, the method for identifying MS4 areas and identification of their loads in the WLA by MS4 name and permit number, and the names, permit numbers, and individual WLAs of the other permitted discharges in the contributing watershed. (21)

Response: Tables 12 and 13 have been modified to clarify the TMDL and WLAs and LAs for each endpoint and to correct minor errors. It should be noted that the MOS and reserve capacity have been factored into the Passaic River basin TMDL by targeting a level of chlorophyll-*a* that is below the criterion. Therefore, there is no quantified amount of the loading capacity attributed to these components. This means of providing a MOS and reserve capacity is allowed according to EPA guidance (May 20, 2002 Sutfin Memorandum). A more detailed areal breakdown is not appropriate or necessary because a key finding of this TMDL study is that the in-stream numeric criterion does not apply within the modeled domain. Watershed criteria have been established at the two critical locations, the Wanaque Reservoir and Dundee Dam Lake. A tributary by tributary breakdown of loading allocation would only be appropriate to demonstrate attainment of the in-stream criterion, which clearly does not apply here. Regarding specific requested additions, the Department notes the following points. Permitted point sources, other than stormwater point sources, were identified by permit number in Tables 7 and 14. The location of dischargers was provided in Figure 4 and footnotes to Table 14 provide information relevant to the established WLA (e.g., location in outside boundary of modeled domain, location below confluence of Pompton and Passaic Rivers thereby warranting seasonal limits). For additional clarity, Table 14 has been modified to indicate within which TMDL Approach Area each discharge is located, and to correct minor errors. Tables 12 and 13 have been revised to identify the assignment of WLAs and LAs to distinguish stormwater point sources from nonpoint sources by land use type, as described in the text, including existing loads and loads under the TMDL specification. Permit numbers have been added for stormwater point source permittees in Appendix B. Land use information was provided in Table 6 and Figure 3 for the overall Passaic River drainage area. A land use breakdown for the Pompton Lake drainage area is provided in Table 6.9 of Najarian 2005. Note that the method for Approach Areas 1, 3 and 4 is described in Section 4, Source Assessment, and explained in greater detail in Omni 2007. For Approach Area 2, the UAL coefficients were used to derive an EMC for storm-driven loads and applied in combination with an estimate of groundwater concentration, using a base flow separation method to obtain nonpoint source loads.

105. Comment: In the Passaic River Basin TMDL, Table 13 is missing the following from the TMDL equation: explicit margin of safety, reserve capacity (if any), the identification of the specific permitted discharges located in this TMDL's contributing watershed, a table assigning the different land uses to either the WLA or the LA portion of the equation, and the distribution and size of the different land uses in this contributing watershed. (21)

Response: Table 13, which provides information for the Wanaque endpoint, has been revised to distinguish between WLAs and LAs for stormwater point sources and nonpoint sources, respectively. The MOS and reserve capacity have been factored into the Passaic River basin TMDL by targeting a level of chlorophyll-*a* that is below the established watershed criteria. Therefore, there is no quantified amount of the loading capacity attributed to these components. This means of providing a MOS and reserve capacity is allowed according to EPA guidance Sutfin 2002. Regarding land use information, the land use areas are found in Najarian 2005, Table 6.9, as indicated in footnote 7 of Table 13. As described in response to Comment 104, for Approach Area 2, UAL coefficients were used to derive an EMC for storm-driven loads and applied in combination with an estimate of groundwater concentration, using a base flow separation method, to obtain nonpoint source loads. Existing and TMDL loadings derived from these methods are provided in Table 13. Point sources, other than stormwater point sources, were identified in Table 14 by permit number. This table has been modified as described in response to Comment 104 for additional clarity. Stormwater point sources are identified by permit number in Appendix B.

106. Comment: In the Passaic River Basin TMDL, the data used to develop the TMDLs must be identified in a general way in the TMDL report. A summary of the major observations, such as dissolved oxygen and chlorophyll-*a* levels in the Passaic River at Dundee Dam and the Passaic River at Two Bridges, should also be provided. (21)

Response: Detailed observations and data are included in the supporting documents. The TMDL does provide a summary of key water quality findings in Section 3. The findings identify locations where phosphorus is causing excessive primary productivity and where it does not and why, and where observed low dissolved oxygen is the result of naturally occurring conditions. A summary statement about chlorophyll-*a* levels in Wanaque Reservoir has been added for completeness.

107. Comment: In the Passaic River Basin TMDL, a summary of boundary conditions should be provided in the TMDL report. (21)

Response: The boundaries are identified in Figure 2 entitled “Spatial extent of non-tidal Passaic River basin study and related studies with modeling approach applied” (page 23). A discussion of the TMDL approaches is found in section “Area of Interest” (page 18-19). Boundary conditions are summarized on page 11 and then discussed in greater detail on page 123-124 of the Omni Environmental Final Report. Boundary conditions are also addressed in section 5.4 Conditions for TMDL Development in the Najarian Report (page 5-3).

108. Comment: In the Passaic River Basin TMDL, other information and data which support the TMDL analysis and delisting conclusions must be identified in the TMDL report by providing adequate references, including document name and relevant page number(s), to the supporting documents. For instance, when the TMDL report states that 2004 Sublist 5 listings were shown to not be impaired by TP, the reference to the data or information supporting this claim must be provided in the body of the TMDL report. (21)

Response: Section III, Watershed Modeling Analysis, of the Passaic River Basin TMDL document (Omni, 2007) provides adequate discussion and relevant graphs for the interpretation of the narrative criteria for phosphorus for all of the five sub-watersheds studied that leads to the conclusion that phosphorus is only "rendering unsuitable" in the identified critical locations. In addition, comprehensive graphical model simulation outputs in terms of the response indicators, dissolved oxygen and chlorophyll-*a* concentration under different model conditions, are provided in Appendix J in the Passaic River Basin TMDL Appendices (Omni, 2007). References to these sections will be included in the TMDL document.

109. Comment: In the Passaic River Basin TMDL, for reasonable assurance, please provide as much detail as possible regarding the reductions in phosphorus loading expected from the implementation actions identified in the TMDL report. (21)

Response: The Department expects to achieve the needed levels of nonpoint source reduction through a suite of management measures, as described in the implementation section. Significant reductions in phosphorus load are expected from implementation of the measures required under the municipal stormwater regulation program. These include street sweeping, yard and pet waste management, and limitations on wildlife feeding. For example, the US Department of Transportation Federal Highway Administration cites a State of California study on vacuum sweeper efficiency where 74% TP was removed, with an efficiency rate of 40% attributed to mechanical sweepers– see www.fhwa.dot.gov/environment. In addition, adoption of the fertilizer management ordinance will be required of those municipalities that are within the model domain. The literature supports that a significant (20%) overall phosphorus reduction can be expected from this measure alone. The USGS documented the effects of lawn fertilizer on nutrient concentrations from runoff for a study in Wisconsin and found that total phosphorus concentration in lawn runoff was directly related to phosphorus concentration in lawn soils. Further, runoff from lawn sites with phosphorus-free fertilizer application had a median total phosphorus concentration similar to that of unfertilized sites, an indication that phosphorus-free fertilizer use is an effective, low-cost practice for reducing phosphorus in runoff. A growing body of research from Wisconsin, Michigan, Minnesota and Maine concludes that phosphorus from fertilizer applied to lawns enters surface waterbodies through runoff. After 8 years of voluntary use of phosphorus-free lawn fertilizer starting in 2008, Maine is banning the sale of phosphorus fertilizer unless certain conditions are met because of the finding that most soils had enough phosphorus to keep a lawn healthy. This mirrors information available about soils in New Jersey as well. Research conducted in Maine showed that in watersheds that are converted from their natural, forested condition to residential, commercial and agricultural uses, the amount of phosphorus runoff increases by a magnitude of 5 to 10 times. Minnesota has also restricted phosphorus in lawns fertilizers to protect the quality of their lakes and streams. In 2003, EPA reported that the City of Plymouth, Minnesota enacted a phosphorus fertilizer ban in 1996 and observed a 23% reduction in phosphorus inputs to their lake as compared to phosphorus loading from neighboring community. See http://www.lakeaccess.org/lakedata/lawnfertilizer/recentresults.htm

In addition to measures to be implemented through the Municipal Stormwater Regulation Program, the implementation section describes numerous restoration projects funded with 319(h) funds that are located within the study drainage area. The National Grants Reporting Tracking database provides a tool for estimating load reductions from measures, including those that achieve phosphorus reduction. For example, a 1998 319(h) funded detention basin retrofit project in Mendham Township estimated using the "Spreadsheet Tool for Estimating Pollutant Load" or "STEPL" model that a 160 pound per year reduction in phosphorus may be expected as a result of the completion of the project. The cumulative effect of these projects will enhance the phosphorus reduction achieved through regulated stormwater and contribute to the overall reduction required. The Department remains committed to targeting future 319(h) funds, as well as available State funds, for example, Corporate Business Tax, to achieve water quality objectives.

110. Comment: In the Passaic River Basin TMDL, please explain the difference between the Ortho-P values in Tables 9 and 10 when both tables have the heading “Tributary Baseflow Concentrations for Contributing Watersheds.” (21)

Response: Table 9 was intended to provide tributary baseflow values for parameters other than phosphorus, while Table 10 was intended to provide tributary baseflow values for phosphorus species, which vary by watershed. The titles of the tables will be revised to be more clear and the phosphorus value will be omitted in Table 9, as this was an error.

111. Comment: In the Passaic River Basin TMDL, why is there no decrease in P loading from CSO discharges? (21)

Response: As background, the Department regulates all portions of combined sewer systems by general permit. The permit relies upon the development and implementation of best management practices, technology-based control measures, self-monitoring, and permit compliance certification to comply with the requirements of the Federal Clean Water Act (CWA) as defined by the National CSO Control Policy. The TMDL addressed CSO discharges in section 4.0 Source Assessment (page 29) under the discussion on Point Sources. It was determined that the CSO load was insignificant in that elimination of this load would result in no significant difference in the outcome of the TMDL. Therefore, because the means for achieving load reductions would entail costly measures such as eliminating CSOs or providing end of pipe treatment, such reductions were deemed an inefficient means of achieving the objective and were not required or factored into the TMDL. Nevertheless, some reductions are expected to be achieved through the Long Term Control Plans for the affected CSOs, which will provide a conservative assumption within the TMDL.

112. Comment: In the Passaic River Basin TMDL, “Baseline Future Condition” is better described as “Upper Bound Condition” on phosphorus loading since it assumes that every NJDPES is discharging at their permitted limit to the watershed (p. 120 of technical document). (21)

Response: Both expressions, baseline future conditions and upper bound conditions, were used interchangeably throughout the study. The descriptor suggested by the commenter for the table would be accurate; however, no change has been made because the descriptor in the TMDL is fully explained as to meaning and is used extensively in the TMDL and supporting documentation. There would be no value added from the effort to change the descriptor throughout the documents.

113. Comment: In the Pompton Lake/Ramapo TMDL document, there should be explanatory text to describe how both the Reckhow model and the mass balance model are used in order to determine the final loading capacity, WLAs, LAs, and margin of safety. How was one modeling approach selected over the other for the TMDL values? If the mass balance model alone was used to determine these, then the discussion must be based on the use of the mass balance model and calculation of implicit margin of safety, the 6% explicit margin of safety, and the 1% reserve capacity. (21)

Response: Section 6 of the TMDL document provides an explanation of the two technical approaches considered as well as an explanation for selection of the mass balance approach over the Reckhow approach. The two approaches gave similar outcomes. However use of the mass balance approach for the Pompton Lake/Ramapo River TMDL would allow the use of a consistent approach throughout Approach Area 2, the remainder of which is addressed in the Passaic River basin TMDL. In addition, the mass balance approach was able to provide daily loadings as a boundary condition input to the Passaic River basin TMDL, while the Reckhow approach does not. Section 6.2 will be revised to provide greater clarity on the integration of the approaches as well as this additional elaboration on the selection of the mass balance approach. With regard to the MOS and the Reserve Capacity, a significant MOS is integral to the Reckhow model and an additional 6% MOS was stipulated values with respect to loadings under the mass balance approach. The mass balance MOS value was deemed sufficient, given the significant MOS already incorporated in the Reckhow model. The 1% Reserve Capacity was provided to allow for the possibility that there may be a new or expanded wastewater treatment facility in the future, although there are no planned new or expanded facilities at this time.

114. Comment: Pertinent information currently in the Wanaque TMDL needs to be presented in the Ramapo River-Pompton Lake TMDL document and this document should be able to “stand alone.” These items are currently described with regard to the Reckhow model alone. (21)

Response: The information in the Wanaque TMDL, or Passaic River basin TMDL, is not pertinent to the Ramapo River-Pompton Lake TMDL calculations. The latter study addresses a distinct drainage area that contributes, in terms of a boundary condition, to the Passaic River basin TMDL study, but the converse is not true. Therefore, the Pompton Lake/Ramapo River TMDL is a stand-alone document. Because the Pompton Lake/Ramapo River document has not yet been approved and contains information relevant to the Passaic River basin TMDL, the pertinent information from the Pompton Lake/Ramapo TMDL document is included in the Passaic River basin TMDL so that it is also a stand alone document.

115. Comment: In the Pompton Lake/Ramapo TMDL, on page 15-16, the Najarian Mass Balance Model is described in the Source Assessment Section. This should be located in Section 6.0, Technical Approach. Furthermore, the results of the model, including graphs of observed versus simulated loadings and coefficient of correlation, should be included. (21)

Response: The Department agrees that some of the discussion under Source Assessment is more appropriate in Technical Approach and will modify the document accordingly. However, the Department believes that the supporting details are more appropriately provided in the support document, Najarian 2005, which is part of the TMDL.

116. Comment: In the Pompton Lake/Ramapo TMDL, NJDEP states the following regarding phosphorus concentrations for the Ramapo River between Mahwah and Pompton Lake (see Page 23): “Given the required boundary condition of water quality meeting the standard of 0.1 mg/L at the state border/Mahwah station and the fact that the Ramapo River is a “losing” stream, the in-stream standard of 0.1 mg/L will be met in the Ramapo River, without further demonstration.” The term “losing stream” is unclear. This concept could be demonstrated by including graphs comparing the phosphorus concentrations in the Ramapo River at Mahwah versus downstream at Oakland. In general, meeting a stricter WQS in a downstream lake doesn’t necessarily mean that a higher WQS in an upstream segment will be met due to greater variability and higher peak to average P ratios in river phosphorus concentrations. In addition, Ramapo River is a “losing stream” given current phosphorus loads, but will it remain a “losing stream” once the TMDL is implemented? Please explain this linkage and identify mechanisms by which the Pompton River’s phosphorus concentration decreases further downstream from Mahwah. (21)

Response: A losing stream is one in which stream flow is lost to ground water at a greater rate than groundwater enters the stream. In the relevant portion of the Ramapo River, a well field is located which draws water at a rate so as to induce the losing stream condition. The stream flows, which contain higher concentrations of phosphorus, are drawn into the ground water and are replaced with ground water, which contains lower concentrations of phosphorus. This hydrologic condition is not expected to change as the result of implementing the TMDL. The supporting document, Najarian, 2005, pages 3-4,3-5, and Figures 3.6a, 3.6b, 3.7a and 3.7b, provide a detailed explanation and justification for the conclusion drawn that the Ramapo River is a losing stream. In addition, water quality sampling conducted for the Passaic River TMDL study demonstrates the same result. Commenter is referred to the synoptic sampling done at the two locations, as illustrated in the graph provided in the Passaic River Basin TMDL- Phase I data summary and analysis (Omni, 2004) page 7 slide 6. It should be noted that the called for reduction from New York is of primary importance in meeting the in-stream criterion at the Mahwah station, as it is very close to the border. The reductions called for in New Jersey are to attain the more stringent lake criteria in Pompton Lake. Comparison of the observed TP concentrations between Ramapo River and Mahwah and Ramapo River at Pompton Lake show a clearly significant decrease in TP concentrations.

117. Comment: For Pompton Lake, the Qa, Areal Water Load (m/yr), is 375 m/yr, which exceeds the recommended range for the Reckhow model of 1.2-190 m/yr. Please discuss using the Reckhow approach when this discrepancy exists. (21)

Response: Although the areal water load for Pompton Lake is outside the calibration range (375 m/year), the model still remains a good choice since it has the broadest range of lake characteristics in its database. While the target concentration for the lake is well within the range, the areal phosphorus load provides a better representation of a lake's intrinsic loading characteristics. Also, it is the model's prediction of target condition that would be used to calculate the TMDL. If current loads are higher than the range that can produce reliable model results, this has no affect on the model's reliability to predict the target condition under reduced loads.

118. Comment: In the Pompton Lake/Ramapo TMDL, the current title of Table 13 does not make sense. The title should explain that this is the loading capacity or TMDL for total phosphorus including WLAs, LAs, explicit margin of safety and reserve capacity for the New Jersey portion only of the Pompton Lake watershed. (21)

Response: The referenced table includes information regarding both New Jersey and New York sources, providing a summary of all source loads, as reflected in the title. The title will be modified to indicate that the table provides the TMDL components for the Pompton Lake endpoint and WLAs and LAs that apply to sources originating in New Jersey.

119. Comment: In the Pompton Lake/Ramapo TMDL, the allocations in the column labeled "TMDL Specification" add up to 17.4, not 17.3 kg TP/day which has been identified as the loading capacity. Please reconcile these two numbers. (21)

120. Comment: The "TMDL Specification" for "Point Sources other than Stormwater NJPDES Dischargers" is given as 0.4 kg TP/day yet the summation of these individual WLAs in Table 12 is 0.37 kg TP/day. Please reconcile these two numbers so that the same number is used in both tables for this category of sources. (21)

Response to Comments 119 and 120: The difference between the values in Table 12 and Table 13 is negligible. However, the Department has resolved the imprecision caused by conventional rounding as requested by the commenter.

121. Comment: In the Pompton Lake/Ramapo TMDL, there are certain allocations under the "Land Use Surface Runoff" section which appear to conflict or are not identified. Clarify how "low intensity residential" and "high intensity residential" do not overlap with the category called "mixed urban/recreational." Please provide some description in the document of the source category "disturbed areas." Please explain why it is reasonable to assign a load of 0 kg TP/day to the category "Crops/Pasture/Hay." Finally, please explain the Sediment/Base Flow load and how is it estimated. In the Source Assessment Section whether this load is a sediment flux load, a groundwater inflow load, or a combination thereof could be provided. (21)

Response: Table 5 provides the Anderson Land Use/Land Cover codes that were grouped into each land use category descriptor used in the document. The descriptions of what is covered under each code can be found in LAND USE LAND COVER CLASSIFICATION SYSTEM, (Derived from: A Land Use and Land Cover Classification, System for Use with Remote Sensor Data, U. S. Geological Survey Professional Paper 964, 1976; edited by NJDEP, which is available at http://www.nj.gov/dep/gis/digidownload/metadata/lulc95/anderson.html. A footnote will be added to Table 5 referring to this source, which will be added to the References Section. For convenience, the Department had grouped several code types under an unofficial descriptor, "mixed urban/recreational". There is no overlap with the residential land uses, as the codes included in "mixed urban/recreational" include "transportation, communication and utilities", "other urban or built-up" and "recreational land." "Disturbed areas" are the same as "barren land" commonly used in other TMDLs. The "crops/pasture/hay" category appears to have a zero value in the future because, after the 80% reduction, the value is less than 0.05 and is lost due to rounding to maintain significant figures. The table will be revised to clarify this. The term "sediment/base flow" refers to the portion of the mass balance equation that represents ground water base flow and storm water flows, derived as described in the TMDL document.

122. Comment: In the Pompton Lake/Ramapo TMDL, the names of the land use categories which have been assigned daily loads do not match the names of the categories which were divided into WLAs and LAs. Please make clear, for the categories actually used, which are in the WLA and which are in the LA. (21)

Response: The Department has revised the table to clarify WLA and LA by category.

123. Comment: In the Pompton Lake/Ramapo TMDL, Table 12 (page 25) does not identify that the units represent total phosphorus. (21)

Response: The Department has revised the table to clarify that the units represent total phosphorus.

124. Comment: In the Pompton Lake/Ramapo TMDL, Table 4 (page 13) provides the size of each land use area in the entire Pompton Lake watershed. There must be a table which provides these sizes for the focus of the TMDL which is only the New Jersey portion (47 mi^2) of the total watershed (160 mi^2). Also, the 1995/97 land use coverage should be replaced with the 2002 land use coverage. (21)

Response: The values shown in the TMDL for land uses used in the Reckhow approach are from the Pompton Lake and Ramapo River TMDL Study, QEA 2004. The consultant combined the 1995/1997 land use/land cover for New Jersey and the 2000 New York land use information to develop nonpoint source loading. Comparison of the 1995/1997 and 2002 coverage showed no significant change in the New Jersey land use assessment by category. In any case, the Reckhow approach was not ultimately used to calculate the TMDL. In the mass balance approach, land use from New Jersey only was used to estimate the baseflow versus groundwater values for phosphorus, as described in the TMDL.

125. Comment: In the Pompton Lake/Ramapo TMDL, Figure 2 (page 11), the map of the New Jersey portion of the watershed, does not identify the approximate location for the collection of monitoring data from the Passaic Valley Water Commission and from the North Jersey District Water Supply Commission. Also, there is a monitoring location labeled "AN0267" on the map that is not discussed. Is this possibly the location for collection of benthic macroinvertebrate (AMNET) data? What were the results? (21)

Response: In the Pompton Lake/Ramapo TMDL, the sample locations used for the TMDL have been included. The benthic macroinvertebrate (AMNET) site labeled "AN0267" is irrelevant to the TMDL and has been removed from Figure 2. The PVWC (at Pompton Lake inlet) and NJDWSC (same as 1388000 – additional label) sample locations will be added.

126. Comment: In the Pompton Lake/Ramapo TMDL, on page 7, the last sentence of the third paragraph states "Attainment status with respect to designated uses and the parameters identified as responsible for the non-attainment for the assessment units in Table 2 are identified in Appendix B." The designated use impairments do not appear in Appendix B. (21)

Response: This information will be added to Appendix B.

127. Comment: In the Pompton Lake/Ramapo TMDL, at the top of page 16, is the statement "Two stations within the Pompton Lake watershed were selected as the critical locations, Ramapo River at Pompton Lake and Ramapo River at Mahwah." The two monitoring stations used as the critical locations were called "Ramapo River at Dawes Highway" and "Ramapo River near Mahwah" in the 2004 303(d) list. Should these names be used? (21)

Response: The "Ramapo River at Pompton Lake" is a station that is no longer sampled, replaced by one nearby entitled "Ramapo River at Dawes Highway", which is the name used in the 2004 listing. "Ramapo River at Mahwah" was inadvertently used and should be "Ramapo River near Mahwah". This will be changed in the document.

128. Comment: In the Pompton Lake/Ramapo TMDL, the opening description of reasonable assurance, provided in this section on page 33, does not accurately describe the EPA definition or use of reasonable assurance. Since this information is identified on page 8 as "an EPA requirement for approval which will be addressed in the TMDL document," a more accurate definition should be provided. EPA uses reasonable assurance to determine that TMDL reductions in nonpoint sources are reasonable when they are offsetting required reductions from point sources. Please provide as much detail as possible in terms of the reductions expected from the implementation actions identified in the TMDL report. (21)

Response: The opening of the Reasonable Assurance Section was not intended as a restatement of the EPA definition. The Department understands the purpose of reasonable assurance and sees no conflict between that requirement and the statement in the TMDL document. Regarding the means to achieve the identified nonpoint source and stormwater point source reductions, please refer to the response to Comment 109. In this drainage area, an even more ambitious reduction is called for and is expected to be achieved by, in addition to the measures described, an emphasis on funding riparian restoration projects, which is consistent with measures identified to be needed to address temperature impairments in the Pequannock River temperature TMDLs approved by EPA in 2004.

129. Comment: In the Pompton Lake/Ramapo TMDL, on page 21, the discussion of the explicit margin of safety focuses on the Reckhow model's 33.3% MOS yet the final TMDL is based on a 6% MOS using the mass balance approach. The document does not provide discussion of the 6% MOS which was used. Please provide this information. (21)

Response: The 6% MOS was chosen to reflect the degree of confidence in the data and model used and is comparable to the explicit MOS used in other TMDLs.

130. Comment: In the Pompton Lake/Ramapo TMDL, the fourth paragraph on page 21 begins "An implicit margin of safety is provided by using conservative critical conditions…" This section needs discussion of the conservative assumptions that may have been employed to determine the critical condition(s). The discussion of providing an implicit margin of safety by targeting total phosphorus instead of dissolved phosphorus is correct. The implicit margin of

safety is not associated with the selection of critical conditions or the use of total phosphorus as the target pollutant versus dissolved or particulate phosphorus (since water quality standards have taken this into account already), but with conservative modeling assumptions. (21)

Response: The comment appears to be internally inconsistent. It is assumed the commenter intended to state that "The discussion of providing an implicit margin of safety by targeting total phosphorus instead of dissolved phosphorus is *not* correct." The implicit MOS section will be revised to eliminate the discussion of total versus dissolved phosphorus.

131. Comment: In the Pompton Lake/Ramapo TMDL, The discussion of reserve capacity on page 23 should also state the number, that is, 0.2 kg TP/day (1% of the TMDL) that has been chosen for reserve capacity. (21)

Response: This information is provided in Table 13, but will be added to the Reserve Capacity Section for completeness.

132. Comment: In Figure 1 of the Pompton Lake/Ramapo TMDL document (page 10), the map should include Wanaque Reservoir and the diversion pipe since it is a part of the hydrological system. (21)

Response: The Wanaque diversion location is not within the spatial extent of the Pompton Lake/Ramapo River TMDL study and therefore it is not necessary to add this information to the cited map.

TMDL Should Address Nitrogen:

133. Comment: The TMDL does not deal with all the issues. In 1999, the nitrogen got so high that it nearly shut down PVWC. (20)

134. Comment: Given the long standing objective of the Public Advisory Committee for WMA 6 to set appropriate target levels for nitrogen, as well as phosphorus, through scientific investigation, the commenter believes that the studies upon which this TMDL proposal is based should have evaluated the impacts of nitrogen concentrations with respect to dissolved oxygen and chlorophyll-*a*. Both nitrogen and phosphorus are nutrients that contribute to algal growth and affect suitability of waterbodies for use as water supplies, which is the highest use and must be protected. Phosphorus was found not to be limiting productivity in a number of locations. In these locations, reducing both nitrogen and phosphorus should reduce algal growth. Consequently, the Department should address nitrogen in the Passaic TMDL. The goals of chlorophyll-*a* for the Wanaque Reservoir and Dundee Lake will not be achieved unless loadings of both phosphorus and nitrogen are reduced. The Highlands Draft Regional Master Plan and the NY/NJ Harbor TMDL are targeting nitrate as a parameter that must be limited or reduced. It is bothersome that the Highlands do not have a database that could inform the TMDL plan to make it more comprehensive; instead the TMDL proposal is piecemeal and has inaccuracies. Nitrogen and ammonia reductions are needed to assist the Lower Passaic River Restoration project

because, in that part of the river, nitrogen is the nutrient of concern to control algal growth. (7), (8), (9)

Response to Comments 133 and 134: The modeling study for this TMDL did include nitrogen species. However, a TMDL for nitrogen species in the Passaic River itself is not warranted at this time because the waters are not listed as impaired with respect to nitrogen species. It is important to note that ammonia is currently very low throughout the Passaic River basin due to existing point source requirements. As noted in *The Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin*, October 2001, vetted and approved by the Passaic TMDL Workgroup Workgroup, October 31, 2001, and still true today, there are no documented exceedances of the 10 mg/l SWQS for nitrate. However, nitrate is identified as an emerging issue with a critical location at Little Falls where water is withdrawn directly into a drinking water facility. Currently, purveyors are required to perform additional monitoring if nitrate levels above 5 mg/l are found. Furthermore, the Department has begun to implement water quality based effluent limitations (WQBELs) for nitrate upon renewal of NJPDES permits based on compliance with the 10 mg/l nitrate criterion under low design flow conditions (7Q10). The Department is assessing what additional measures may be appropriate to address the issue statewide.

The focus of this TMDL is the phosphorus impairment as it relates to excessive primary productivity and related water quality effects. While it is true that both nitrogen and phosphorus are necessary to support plant and algal growth, it is not true that nitrogen reductions are necessary to achieve the phytoplankton chlorophyll-*a* goals for the Wanaque Reservoir and Dundee Lake. Since both nitrogen and phosphorus are necessary to support plant and algal growth, reducing either or both nutrients to low levels could theoretically limit plant and algal growth. In practice, however, phosphorus is generally targeted to constrain productivity in freshwater systems. Natural and nonpoint sources of nitrate in freshwater systems are generally sufficient to support high levels of productivity, and are more difficult to control than phosphorus. In addition, it would not be desirable to induce nitrogen limitation, which tends to promote nuisance algae in freshwater systems. While neither nitrogen nor phosphorus is low enough currently to limit primary productivity, by establishing watershed criteria in terms of the response indicator chlorophyll-*a* in the two critical locations, Dundee Lake and Wanaque Reservoir, and requiring phosphorus reductions that will attain these criteria as demonstrated by the models, the water quality objectives for this study will be met.

While watershed-wide nitrogen reductions are not necessary to achieve water quality objectives in the non-tidal Passaic River system, they may be necessary to achieve water quality objectives in the NY/NJ Harbor. The model developed for the Non-Tidal Passaic River Basin Nutrient TMDL Study is calibrated for ammonia, nitrate, and organic nitrogen, and can therefore be used to translate a load allocation for the Passaic River at Dundee into wasteload and load allocations throughout the system. Upon completion of the New York/New Jersey Harbor Estuary TMDL, carbon and/or nitrogen reductions may be called for to achieve dissolved oxygen standards in the harbor. If so, the non-tidal Passaic River basin model can be used to allocate loads among sources in the non-tidal Passaic River basin.

135. Comment: The commenter asks what the maximum long-term average concentration of total nitrogen would be to keep summer averages of chlorophyll-*a* below 10μg/L or 20 μg/L. (9)

Response: It was determined in this TMDL study that phosphorus is causing excessive primary productivity in two locations in the Passaic River Basin, the Wanaque Reservoir and Dundee Lake. In these locations, the Department has established watershed criteria in the form of chlorophyll-*a* as well as the phosphorus reductions needed to attain these criteria. As discussed in the response to Comments 133-134, nitrogen reductions are not needed in order to attain the water quality objectives in the non-tidal Passaic River with respect to eutrophication. However, nitrogen reductions may be required in the future, in response to the NY/NJ Harbor TMDL or as determined necessary to ensure the drinking water use is protected.

General Comments:

136. Comment: The existence of a phosphorus problem in the Wanaque Reservoir has not been supported. No limitation based upon discharge to the Reservoir should be imposed until it is demonstrated that phosphorus is causing the impairments. (23)

Response: Water quality data clearly identifies violations of water quality criteria for phosphorus.

137. Comment: The Great Swamp Watershed Association and Ten Towns Great Swamp Watershed Management Committee (TTC) collaborated on the collection of water quality sampling for the Omni Environmental February 2007 Report (Appendix D, Page D-2 of the Omni Report). Specifically, sample collection at certain sites that was conducted by TTC are improperly attributed to GSWA at sites PRin, PB1, LB1, GB1, BB1 and PRout. (4)

Response: The Department has posted a revised Appendix D of the 2007 Omni Report in order to make it clear that the data used for the analysis were provided through collaboration between the Ten Towns Great Swamp Watershed Management Committee and the Great Swamp Watershed Association.

138. Comment: A State mandated program requires water purveyors to add polyphosphate to potable water for corrosion control. This practice increases total phosphorus in STP influent. (11)

Response: Currently there is no mandated State program for the addition of polyphosphate to drinking water. The commenter may be referring to the National Primary Drinking Water Regulations for Lead and Copper (40 C.F.R. 9, 141 and 142), which, since the early 1990's have required all public community water systems serving populations greater that 50,000 to do a corrosion optimization study and then after state approval implement the recommendations of the study. In many cases the study outcome was the addition of polyphosphate, sometimes with pH adjustment. However, other outcomes also included increasing existing pH levels with lime or soda ash, adding silicates, or no action at all. Additionally, for systems serving less that 50,000, if more than 10 % of sampling results exceeded established action levels during semiannual testing for lead and copper, those systems also were required to consider treatment to reduce corrosion with the distribution system.

For the systems that opted to use polyphosphates, the amount of polyphosphate dosed to the system would be that needed to achieve the goal of minimizing the levels of lead and copper in the water system. This amount can vary significantly depending on the quality of the raw water, but is not known to be a significant source of phosphorus in sewage influent.

139. Comment: The TMDL is contrary to the settlement agreements reached with various Passaic River Basin dischargers, including WTSA. The spirit of those agreements has been disregarded and sound science and economic responsibility has been ignored. (10)

Response: The Department believes that both the intent and specific requirements of the Phosphorus Settlement Agreements have been met. Per their individual Stipulation of Settlement, each of the permittees agreed to participate in the watershed planning process, including the TMDL development process. All dischargers, as well as other affected parties, were invited to participate in this process. As a component of this process, the Department developed *The Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin*, October 2001, with the Passaic River TMDL Work Group to identify the technical approaches to address impairments as identified in the 303(d) list in the non-tidal Passaic River Basin. The Passaic Technical Approach was vetted at several workgroup meetings and consensus was reached at the October 31, 2001 Passaic River TMDL Workgroup on its content. It was agreed that a watershed modeling effort was needed in order to determine where within the Passaic River basin phosphorus was causing excessive primary productivity and what level of phosphorus reduction would be needed to address this response where it was determined to be occurring. Dischargers who were a party to the settlement agreed to participate in the cost of developing a workplan for the study and for carrying out the study itself as well as identifying and implementing low cost phosphorus reductions measures until the TMDL study was completed. The Department agreed to establish phosphorus effluent limits only as determined needed as a result of the TMDL. These steps have been accomplished. The resultant Passaic River basin TMDL is the outcome of the application of sound science to study the problem, with ample opportunities for review and input from affected parties. By establishing watershed criteria that in terms of the response variable chlorophyll-*a*, at levels that will support the designated uses, and providing for seasonal limits where appropriate, the Department has fine tuned the pollutant reductions to require only that expenditure needed to attain water quality standards. After the required reductions are incorporated in revised NJPDES permits and upon approval of an acceptable trading tool, the Department will provide an opportunity for dischargers to determine if a more cost effective means to attain the pollutant load reductions is feasible through water quality trading.

140. Comment: Please consider issues of concern to Pompton Lakes Borough MUA as you move forward with the TMDL implementation process: The plant continues to operate within its current permit limits; our customer base is limited to the residents—11,000; a more stringent phosphorus limit will place an enormous burden on our customers; there is no room at the plant site to construct and operate additional treatment units. (5)

141. Comment: Please consider issues of concern to Wanaque Valley Regional Sewerage Authority as you move forward with the TMDL implementation process: The plant continues to

operate within its current permit limits; our customer base is limited to the residents—10,616; a more stringent phosphorus limit will place an enormous burden on our customers. (3)

142. Comment: TBSA supports and applauds NJDEP's efforts to develop a scientifically defensible solution to water quality issues in the Passaic River Basin. Significant amount of time, money and effort have been expended to determine the appropriate regulatory response to nutrient enrichment in the Passaic and TBSA is anxious to commence implementation of the TMDL and to continue to work in partnership with the NJDEP to achieve water quality improvements in the Passaic, provided identified issues are addressed re: data availability, alternative approaches and seasonal limits. (2)

Response to Comments 141 and 142: The Department has made every effort to ensure that the pollutant load reductions called for are needed to attain surface water quality standards. Further, by establishing watershed criteria in terms of the response variable chlorophyll-*a* at levels needed to support designated uses and providing for seasonal limits where appropriate, the Department has fine-tuned the pollutant reductions to require only that expenditure needed to attain water quality standards. After the required reductions are incorporated in revised NJPDES permits and upon approval of an acceptable trading tool, the Department will also provide an opportunity for dischargers to determine if a more cost effective means to attain the pollutant load reductions is feasible through water quality trading.

143. Comment: Commenter is happy to see progress in achieving a proposal with a scientific basis. (16)

144. Comment: The Department is commended for its efforts to resolve the issue of Phosphorus regulation in a scientifically defensible manner and for moving forward with the Phase 2 TMDL study. RVRSA is fully committed to making the investment necessary to discharge its obligation to protect the environment and reaffirms its desire to work cooperatively with the NJDEP to achieve improvements in water quality. (1)

145. Comment: Although it comes after years of attempting to implement phosphorus control without a study, the Department is commended for moving forward with the current study. (23)

146. Comment: Commenter thanks the Department for going the extra measure to complete the Phase 2 TMDL. Some areas can be criticized, but this is a good starting point and we should move forward. (17)

147. Comment: While there are some missing data and issues to address, we have enough here, grounded in science, that we can move forward. (14)

Response to Comments 142-147: The Department acknowedges the commenters' support for the comprehensive modeling of the Passaic River Basin which has produced a science-based solution that will address water quality impairments in the basin.

148. Comment: Phosphorus removed from effluent should be reused as fertilizer. (9)

Response: Residuals are generated by domestic and industrial wastewater treatment plants. Residuals are managed in variety of ways, including the development of marketable residuals products (also called biosolids) that are used to fertilize or condition the soil. Examples include pellets, compost, and alkaline materials. Beneficial use of residuals as a fertilizer or soil conditioner is regulated under the New Jersey Pollutant Discharge Elimination System regulation at *N.J.A.C.* 7:14A-20. Subchapter 20 of the NJPDES rules defines the standards for the use or disposal of residual. The Department encourages beneficial reuse of sludge. However, as described in these TMDLs, application of phosphorus fertilizer is intended to be limited as one of the management measures needed to achieve pollutant load reductions. Therefore, extensive use of phosphorus containing biosolids would be counterproductive in the basin.

149. Comment: Phosphorus may be coming from leaking sewer pipes; this source may be reducible. (9)

Response: While the potential that leaking sewers exist in the study area cannot be discounted, the model is adequately calibrated without considering this source. In general, sewerage treatment facilities are responsible for the proper collection, treatment, analysis, and discharge of wastewater received from separate sanitary or combined sewer systems. To assure compliance, the Department imposes significant penalties and/or requires remediation for unpermitted discharges to the waters of the State. Responsible entities must undertake an active monitoring and preventive maintenance program to identify problems, install new sewer lines, clean blocked lines, repair lines that are subject to leaks and infiltration, and conduct all maintenance activities to assure maximum system capacity and to prevent sanitary sewer leaks and overflows. Treatment facilities are required to report all overflows and flooding, whether from sanitary or combined sewage systems, so that repairs and preventive action can be taken to minimize the extent of environmental and human health impacts.

Phase 1 TMDL

150. Comment: The Proposed TMDL continues to ignore key criticisms made by Rutgers New Jersey EcoComplex TMDL Advisory Committee ("NJEC"). A review of the New Jersey EcoComplex interim reports, which were issued in conjunction with the 2005 TMDL, continues to raise serious questions with the newly proposed 2007 TMDL. An examination of the proposed 2007 TMDL reveals that the Department, without explanation, has elected to continue to ignore key questions and criticisms raised by NJEC in 2005. Two examples stand out:

1. In NJEC's Interim Report to the Department, dated November 13, 2003, NJEC recognized that the year 2002 (when a severe drought occurred), could have been an anomaly and questioned whether it should be included or rejected as an outlier. The NJEC later estimated that the 2002 rainfall did correspond to the lowest 10^{th} percentile of precipitation over 100 years and thus represented an anomaly that would result in too stringent a condition. Also, the 9-year simulation (omitting 2002) was not provided as requested by NJEC.
2. In its July 30, 2002 Interim Report, NJEC identified one task of the Department as being the analysis of the relationship between phosphorous concentrations and indicators of primary productivity, as a way to better establish quantifiable endpoints. In doing so, NJEC recommended use of the LA-WATERS model in order to study management strategies and specifically alternative pumping scenarios for NJDWSC. (10)

Response: The comments made by the NJEC were assessed and modifications made, as appropriate, to the TMDL study. With regard to the specific issues identified, the Department believes inclusion of 2002 in the simulation is appropriate, as addressed more fully in the response to Comments 16 and 17. The appropriateness of alternative management measures to achieve the watershed criteria in Wanaque Reservoir is addressed more specifically in response to Comments 58-61.

151. Comment: Commenter includes by reference comments made on the proposed July 5, 2005 *Phase 1 Passaic River Study TMDL for Phosphorus in the Wanaque Reservoir and the TMDL for Total Phosphorus to Address Pompton Lake and Ramapo River* contained in letters dated September 6, 2005 and November 21, 2005 as comments on the current TMDL proposal. The Department agreed not to adopt the Phase 1 TMDL under a Superior Court Order and should not use Phase 1 TMDL information until comments on that document are addressed and information requested through OPRA is provided. Issues include:

a) Evidence of a phosphorus impairment in the Passaic River basin has not been provided

b) The purpose of the Passaic phosphorus studies was to determine the level of phosphorus that causes impairment; attainment of 0.05mg/L numeric criterion was never envisioned. The Phase 1 TMDL eliminated the option to demonstrate that phosphorus was not causing an observed impairment.

c) The Phase 1 TMDL was not identified by the Department as a tool intended to address phosphorus impairment in the Passaic River; as provided for in the Phosphorus Settlement Agreement, the workplan to do so was to be provided for review by the affected parties.

d) It is noted that the Department used the LA-WATERS model for the Reservoir, the NJDEP mass balance model from 1987 and water characteristic studies done by NJDWSC. In response to questions at the DEP's presentation on June 23, 2005, representatives of Najarian Associates indicated that the LA-WATERS model incorrectly predicted the effects of adding Passaic River water to the Reservoir. This being the case, why continue to use the model? The 1987 model did not include a study of phosphorus and has been considered unsuitable for the purpose until the present time. The NJDEP study that resulted from the 1987 model specifically indicates that a comprehensive model of the river is needed. Why is this model now suitable?

e) The TMDL requires an 80% reduction in nonpoint sources. This does not appear to be achievable. The Department sent a misleading letter to municipalities telling them their only obligation was to adopt a fertilizer ordinance.

f) The diversion of water into the Wanaque Reservoir by North Jersey District Water Supply Commission is responsible for any impairment that exists there. They should be the entity responsible for load reductions and receive a NJPDES permit for the diversion, in accordance with the recent Supreme Court ruling.

g) Throughout the Phase 1 process, the Department has indicated that the Phase 2 TMDL could result in less stringent limits, but was unable to explain how at the August 4, 2005 public hearing. The Department then stated that, when the study of the lower section of the river is completed, a 0.1 mg/l limit will be established. It appears that the Department again intends to impose more stringent limits without any scientific study or basis.

h) The Department has not responded to the OPRA requests filed in order to be able to review data and documents related to the study; the comment period should continue to be extended for at least 30 days from the time that the information is provided for review.

i) NJ Ecocomplex comments on the studies that provided the basis for the Phase 1 TMDL were not addressed. There was no final NJEC report provided on the Phase 1 TMDL.

j) As it appears the work for the Phase 2 TMDL is nearing completion, the Phase 1 TMDL should not be adopted. The Phase 2 TMDL results should be presented to the public. (23)

Response: As stated in the TMDL, the July 5, 2005 proposals entitled *Phase 1 Passaic River Study TMDL for Phosphorus in the Wanaque Reservoir and the TMDL for Total Phosphorus to Address Pompton Lake and Ramapo River* were withdrawn and pertinent information from those proposals incorporated into the current TMDLs. Many of the comments made on the Phase 1 TMDL had as their resolution proceeding with the Phase 2 TMDL in lieu of the Phase 1 TMDL. Proposal of the current TMDLs along with the withdrawal of the Phase 1 TMDL renders moot most of the issues identified in the previous comment letters. Responses to specific points in the cited letters are as follows:

a) The purpose of the Phase 1 TMDL was to address phosphorus impairment in the Wanaque Reservoir, not the entire Passaic River basin. The Wanaque Reservoir was identified as an expected critical location early in the larger Passaic River basin TMDL planning process and, in the course of TMDL development, it was determined that water quality in the Wanaque Reservoir, in addition to several locations in the river system, exceeded the Surface Water Quality Standards in terms of the numeric criteria and data was provided in the Phase 1 TMDL support documents. This constitutes impairment, absent establishment of a watershed or site specific criterion. As a result, a TMDL was required to be and was developed for the reservoir.

b) The Passaic phosphorus studies were to determine what action was needed to address phosphorus impairment in the Passaic River, which means to attain the SWQS. In accordance with the SWQS, the Phase 1 and Pompton Lake TMDLs used the numeric criterion as a target, absent documentation that a watershed specific criterion was appropriate. The Phase 1 TMDL necessarily required load reductions from discharges to the Passaic River system, but did not attempt to reach conclusions about attainment of the in-stream numeric criterion of 0.1 mg/L. The option to conduct a study under the *Technical Manual for Phosphorus Evaluations for NJPDES Discharge to Surface Water Permits* is provided in the SWQS only with respect to the in-stream numeric criterion, not for the lake/reservoir numeric criterion. Therefore, the Phase 1 TMDL neither created nor eliminated an opportunity with respect to the phosphorus protocol. In any case, in accordance with the findings of the current proposal, watershed specific criteria have been developed in place of the numeric criterion for the Wanaque Reservoir and Dundee Lake critical locations and the watershed criteria have been used as the endpoints in these locations.

c) The intention to use the LA-WATERS model to determine the loading capacity of the Wanaque Reservoir had been established in the *Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin*, which was shared through extensive public participation that included the regulated parties. The Phase 1 TMDL accomplished that objective of the Technical Approach and did not address the reductions needed to address phosphorus impairment in the river itself. As was always intended, the Phase 2 TMDL is the tool that addresses the listing of the river as impaired for phosphorus.

d) This comment is moot in that the model used to simulate river loadings in the Phase 2 TMDL was developed as an outcome of the workplan designed to address the in-stream phosphorus impairments and the Phase 1 TMDL has been withdrawn. Nevertheless, as regards the Phase 1 TMDL, representatives of Najarian Associates never stated that the Reservoir TMDL model incorrectly predicted the effects of adding Passaic River water to the Reservoir. NJDEP's 1987 model addressed all relevant water quality constituents, including phosphorus. However, the NJDEP study was not part of the Najarian 2005 TMDL study. An independently developed mass-balance model for the watershed was used to simulated relevant river conditions for the Phase 1 TMDL.

e) The TMDLs within the spatial extent call for a range of nonpoint source and stormwater point source reductions that range from 0 to 85. The Department identifies the suite of measures that are expected to achieve those reductions. Some measures are non-regulatory while other are regulatory in nature, such as the phosphorus ordinance. Both the Phase 1 and current TMDL clearly state that the measures required under the Municipal Stormwater Regulation permit are the primary means expected to result in the necessary phosphorus reductions from urban areas. The letter sent to municipalities for both the Phase 1 and the Phase 2 TMDL was the required notification that an additional requirement would be added to their Municipal Stormwater Permit, upon adoption of the TMDL. Through adaptive management, in response to follow-up monitoring, it may be necessary to institute other nonpoint source or stormwater point source control measures, but this is not currently proposed. The commenter's suggestion that the Department misled municipalities as to their obligations as a result of the TMDL is incorrect.

f) As stated in the response to Comments 58-61, the load reduction required to achieve the water quality target for the in-stream critical location is the same as that needed to achieve the water quality target in the Wanaque Reservoir. The difference is the applicability of seasonal effluent limits. With regard to NJDWSC responsibility to remove phosphorus prior to diverting it to the Wanaque in order to achieve water quality requirements, the Department does not interpret the Supreme Court decision in <u>Miccosukee</u> as requiring the State of New Jersey to issue discharge permits to regulate purveyors under NJPDES, the State NPDES program. The Department believes that the most appropriate way to address water quality effects of water supply diversion activities is through State authorities related to safe yield and allocation decision making. NJDWSC supplies drinking water to more than 3 million of New Jersey's residents. Management of the system needs to be flexible enough to allow the maximum safe yield without deleterious water quality impacts. While safe yield and allocation decisions do consider water quality implications, directing NJDWSC to change operations for the primary purpose of minimizing the requirement for dischargers to reduce the introduction of a pollutant into the river system is not appropriate. FW2 waters are to be suitable for drinking water use with conventional treatment. Therefore, the quality of the water at the Wanaque South intake point must be consistent with support of the drinking water use, with or without diversion activities. Water quality trading is an option, but not a requirement, through which NJDWSC can play a role in protecting the water quality of the Wanaque Reservoir as affected by the diversion of Pompton and Passaic River water into the reservoir.

g) The basis of the commenter's assertion is unclear. At the time the Phase 1 TMDL was proposed, the outcome of the Phase 2 work was not known and could not be predicted with accuracy. This necessarily would mean that the WLAs and associated effluent limits resulting from the Phase 2 work could be more or less stringent than identified in the Phase 1 TMDL. Again, the Phase 1 TMDL has been withdrawn and is superseded by the currently proposed TMDL.

h) The Department has fully responded to the OPRA request. Because the Phase 1 TMDL has been withdrawn, extension of the comment period for that TMDL is moot. The currently proposed TMDL was presented prior to the public hearing and a 30 day comment period was provided. The comment period was further extended by 30 days to provide additional time for commenters to assess the Passaic River basin model.

i) The NJEC comments on the Phase 1 TMDL that remain relevant with respect to the Phase 2 TMDL have been addressed within the Phase 2 TMDL document.

j) Again, the Phase 1 TMDL has been withdrawn and the currently proposed TMDL supersedes it.

Amendment to the Northeast Water Quality Management Plan

Total Maximum Daily Load Report to Address Phosphorus Impairment in Pompton Lake and Ramapo River in the Northeast Water Region

Watershed Management Area 3

Proposed: May 7, 2007
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New Jersey Department of Environmental Protection
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1.0 Executive Summary

This Total Maximum Daily Load (TMDL) document addresses phosphorus impairments in the Pompton Lake drainage area and is based on two supporting documents: "Pompton Lake and Ramapo River TMDL Support Study" (QEA, 2004), and "Development of a TMDL for the Wanaque Reservoir and Cumulative WLAs/LAs for the Passaic River Watershed" (Najarian, 2005). This TMDL is a companion document to the comprehensive TMDL document addressing the remainder of the non-tidal Passaic River basin entitled "Total Maximum Daily Load Report For the Non-Tidal Passaic River Basin Addressing Phosphorus Impairments" (2008).

On July 5, 2005 the Department of Environmental Protection (Department) proposed TMDLs in two reports addressing phosphorus in portions of the Passaic River basin. One document addressed the Wanaque Reservoir and the Passaic River and tributaries upstream of the confluence of the Pompton and Passaic Rivers. Because of the diversion of water from the Passaic and Pompton Rivers to the Wanaque Reservoir, the Wanaque Reservoir TMDL resulted in phosphorus load and wasteload allocations in the Passaic River basin upstream of the confluence of Passaic and Pompton Rivers. The other July 5, 2005 proposal addressed Pompton Lake and its drainage area and provided inputs to the Wanaque Reservoir TMDL. At that time, the Department believed that proceeding with these TMDLs would expedite attainment of water quality improvement in the Passaic River basin, in which phosphorus reductions had been stayed as a result of a settlement agreement between the Department and various wastewater treatment facilities in the basin. The Department received comments on these proposals, primarily with regard to the water quality endpoint in the Wanaque Reservoir, the mass balance model used to estimate phosphorus loadings to the reservoir, the cost to achieve the effluent improvements, and the feasibility of achieving the nonpoint source load reductions specified in the TMDLs. As noted in the July 5, 2005 proposal of the Wanaque Reservoir TMDL, the Department was engaged in a basin-wide study that included extensive water quality monitoring and development of dynamic flow and water quality models. The intent of the basin-wide study was to identify in-stream critical locations, in addition to the Wanaque Reservoir, that would call for phosphorus load reductions. It was recognized that an outcome of the basin-wide study could be a refinement of the load and wasteload allocations identified in the July 5, 2005 proposals. In light of delays in establishing the July 5, 2005 proposals, completion of the basin-wide study and in consideration of the comments received, the Department has determined that integration of the basin-wide study with relevant findings of the July 5, 2005 proposals is the most efficient means to achieve water quality objectives in the Passaic River basin. Therefore, the July 5, 2005 proposals will not be established. This Total Maximum Daily Load (TMDL) document addresses phosphorus impairments in the Pompton Lake drainage area and is a companion document to the comprehensive TMDL document addressing the remainder of the non-tidal Passaic River basin, providing boundary condition inputs to that study.

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) is required to assess the overall water quality of the State's waters and identify those waterbodies with a water quality impairment for which TMDLs may be necessary. A TMDL is developed to identify all the contributors of a pollutant of concern and the load reductions necessary to meet the Surface Water Quality Standards (SWQS) relative to that pollutant. The Department fulfills its assessment obligation under the CWA through the Integrated List of Waterbodies, issued biennially. The *2004 Integrated List of Waterbodies* was adopted by the Department on October 4, 2004 (36 NJR 4543(a)) as an amendment to the Statewide Water Quality Management Plan, as part of the Department's continuing planning process pursuant to the Water Quality Planning Act at N.J.S.A.58:11A-7 and the Statewide Water Quality Management

Planning rules at N.J.A.C. 7:15-6.4(a). The *2004 Integrated List of Waterbodies* Sublist 5 identifies the Ramapo River near Mahwah and Ramapo River at Dawes Highway on Sublist 5 as being impaired for phosphorus, as indicated by elevated total phosphorus (TP) levels in the stream segments. Pompton Lake was not listed on the *2004 Integrated List of Waterbodies* as being impaired for phosphorus; however, data evaluated in the development of this TMDL report indicate the lake is impaired, as indicated by exceedances of the Surface Water Quality Standard (SWQS) of 0.05 mg/l of total phosphorus (TP) in lake water samples. The Department had proposed and subsequently has adopted the *2006 Integrated List of Waterbodies*, which identifies impairments based on HUC 14 Assessment Units rather than stream segments associated with discrete monitoring locations. This change in assessment methodology allows establishment of a stable base of assessment units for which the attainment or non-attainment status of all designated uses within each subwatershed or assessment unit will be identified.

A TMDL is required to be developed for each of the impairments listed on Sublist 5. A TMDL is developed to identify all the contributors of a pollutant of concern and the load reductions necessary to meet the Surface Water Quality Standards (SWQS) relative to that pollutant. TMDLs are proposed to address the phosphorus impairment in the waterbodies identified in Table 1 and 2.

Table 1 Stream segments identified on Sublists 5 of the *2004 Integrated List* assessed for phosphorus impairment.

WMA	Site Id #	Station Name/Waterbody	2004 list TP status	Priority Ranking*
3	01387500	Ramapo River near Mahwah	Sublist 5	Medium
3	01388100	Ramapo River at Dawes Highway	Sublist 5	Medium

Table 2 Assessment Units Addressed from the *2006 Integrated List of Waterbodies*

Assessment Unit ID	Assessment Unit Name	2006 TP Status	Priority Ranking	Proposed Action	Acres	Stream Mile
02030103100040	Ramapo R (Bear Swamp Bk thru Fyke Bk)	Sublist 3	NA	Establish WLAs and LAs	3,018	9.5
02030103100030	Ramapo R (above Fyke Bk to 74d 11m 00s)	Sublist 3	NA	Establish WLAs and LAs	4,305	17.9
02030103100020	Masonicus Brook	Sublist 3	NA	Establish WLAs and LAs	2,783	7.3
02030103100050	Ramapo R (Crystal Lk br to BearSwamp Bk)	Sublist 4A*	NA	Establish WLAs and LAs	4,041	16.8
02030103100070	Ramapo R (below Crystal Lake bridge)**	Sublist 5	NA	Establish TMDL	7,224	7224
02030103100060	Crystal Lake/Pond	Sublist 3	NA	Establish	5,509	16.6

	Brook			WLAs and LAs		
02030103100010	Ramapo R (above 74d11m005)**	Sublist 5	NA	Establish TMDL	3,720	7.7
Pompton Lake-03	Pompton Lake	Sublist 3	NA	Establish TMDL	N/A	N/A

* The above Sublist 4A listings on the 2006 *Integrated List of Waterbodies* were classified based on a proposed TMDL that was not established.
** The above noted HUC 14 assessment units include the impaired stream segments identified in the *2004 Integrated List*.

This TMDL is based on a boundary condition in which the inflow from New York State, as calculated at the Mahwah station, attains the State SWQS for TP of 0.1 mg/l. This will require a 76 percent TP reduction from the combined sources upstream of Mahwah station. In addition, an overall TP load reduction of 68 percent is required within New Jersey. Wastewater treatment facilities are assigned a wasteload allocation consistent with a long term average effluent concentration of 0.4 mg/l. The Department intends to establish monthly average, concentration-only effluent limits that will apply year round for the wastewater dischargers using the methodology in the USEPA's *Technical Support Document for Water Quality-Based Toxics Control* (USEPA, 1991), assuming a 4 times per month sampling frequency and a coefficient of variation of 0.6. With these inputs, this methodology produces a monthly average effluent limit of 0.76 mg/l. Subject to the constraints of achieving the specified load reductions, attaining the watershed criteria in the Wanaque Reservoir and Dundee Lake, and accomplishing needed upgrades within the compliance schedule established in the discharge permits, modification of wasteload allocations and load allocations may be accomplished through water quality trading. EPA has awarded a Targeted Watershed Grant to Rutgers University to facilitate water quality trading in the Passaic River basin. This study is expected to identify suitable trading ratios and rules for trading within and between management zones within the Passaic River basin. In addition, loads from land uses generating stormwater point sources and nonpoint sources are assigned wasteload and load allocations consistent with an 80 percent reduction, applied to land uses where load reductions are practicable. To achieve this ambitious objective, the measures required under the Municipal Stormwater Regulation Program, an additional measure restricting application of phosphorus fertilizer, and other measures, such as riparian restoration will be needed.

The required load reductions were determined after evaluating two approaches, a Reckhow modeling of Pompton Lakes and a mass-balance model developed in previous studies of the Passaic River Basin (NJDEP, 1997) and further refined by Najarian in 2005. The loading analyses from both studies called for similar load reduction outcomes. To provide a consistent loading analysis for Approach Area 2, as described in the companion TMDL study for the non-tidal Passaic River basin, the mass-balance approach was selected in order to generate daily loading at the outlet of Pompton Lake, which serves as an input to the companion study.

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

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 Water Quality Monitoring and Assessment Report combines these two assessments and assigns waterbodies to one of five sublists on the Integrated List of Waterbodies. 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.

Sublist 5 of the State of New Jersey's *2004 Integrated List of Waterbodies* identified Ramapo River near Mahwah and Ramapo River at Dawes Highway as being impaired for phosphorus, as evidenced by elevated total phosphorus (TP). Pompton Lake was not listed as phosphorus-impaired, but the TP concentration in over 70 percent of lake water samples collected near the dam in a later study exceeded the surface water quality standard (QEA, 2004). Therefore, the Department determined that the lake is phosphorus-impaired and requires the development of a phosphorus TMDL to address this impairment.

The *New Jersey 2006 Integrated Water Quality Monitoring and Assessment Report* identifies impairments based on designated use attainment and then lists the parameters responsible for the non-attainment of the designated use. The assessments are conducted for each of the seven categories of designated use, which include aquatic life, recreational use (primary and secondary contact), drinking water, fish consumption, shellfish harvesting (if applicable), agricultural water supply use and industrial water supply use. The *2006 Integrated Water Quality Monitoring and Assessment Report* assessment units addressed in this TMDL report with respect to phosphorus are identified in Table 2. Two of the assessment units include the stream segments that were listed as impaired on the *2004 Integrated List*. While all of the assessment units are identified as having had a TMDL established, the Pompton Lake TMDL proposed in 2005 was not established. Instead, the assessment units listed as impaired are addressed through this TMDL study. Attainment status with respect to designated uses and the parameters identified as responsible for the non-attainment for the assessment units in Table 2 are identified in Appendix B.

A TMDL represents the assimilative or carrying capacity of a waterbody, taking into consideration point and nonpoint source 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 sources in the form of wasteload allocations (WLAs), nonpoint sources in the form of load allocations (LAs), and a margin of safety (MOS). A TMDL is developed to identify all the contributors to surface water quality impacts and set load reductions for pollutants of concern needed to meet 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 this TMDL report addresses the following items in the May 20, 2002 guideline document:

1. Identification of waterbody, 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 TMDLs for portions of the Ramapo River and Pompton Lake and proposes management measures in an implementation plan to attain applicable surface water quality standards and designated uses in the river and lake.

3.0 Pollutant of Concern and Area of Interest

Pollutant of Concern

The pollutant of concern for this TMDL report is phosphorus. When present in excessive amounts, this nutrient can lead to excessive primary productivity in the form of algal and/or macrophyte overgrowth. The presence of excessive plant biomass can, in itself, interfere with designated uses, such as swimming or boating. In addition, the respiration cycle of excessive plant material can cause significant swings in pH and dissolved oxygen, which can result in violation of criteria for these parameters and can adversely affect the remainder of the aquatic community. Algal blooms can also affect taste and odor, an issue of importance with respect to drinking water standards.

As stated in N.J.A.C. 7:9B-1.14(c) of the SWQS for Fresh Water 2 (FW2) waters:

Phosphorus, Total (mg/l):

> i. Lakes: Phosphorus as total P shall not exceed 0.05 in any lake, pond or reservoir, or in a tributary at the point where it enters such bodies of water, except where watershed or site-specific criteria are developed pursuant to N.J.A.C. 7:9B-1.5(g)3.
>
> ii. Streams: Except as necessary to satisfy the more stringent criteria in paragraph i. above or where watershed or site-specific criteria are developed pursuant to N.J.A.C. 7:9B1.5(g)3, phosphorus as total P shall not exceed 0.1 in any stream, unless it can be demonstrated that total P is not a limiting nutrient and will not otherwise render the waters unsuitable for the designated uses.

Regarding site specific criteria, N.J.A.C. 7:9B-1.5(g)3 states:

> The Department may establish watershed or site-specific water quality criteria for nutrients in lakes, ponds, reservoirs or streams, in addition to or in place of the criteria in N.J.A.C. 7:9B-1.14, when necessary to protect existing or designated uses. Such criteria shall become part of these Water Quality Standards.

Elaborating on "…render waters unsuitable…" N.J.A.C. 7:9B-1.5(g)2 states:

> Except as due to natural conditions, nutrients shall not be allowed in concentrations that cause objectionable algal densities, nuisance aquatic vegetation, abnormal diurnal fluctuations in dissolved oxygen or pH, changes to the composition of aquatic ecosystems, or otherwise render the waters unsuitable for the designated uses.

The waterbodies listed in Tables 1 and 2 have a FW2 classification. The designated uses, both existing and potential, that have been established by the Department for waters of the State classified as such are as stated below:

In all FW2 waters, the designated uses are (N.J.A.C. 7:9B-1.12):

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

Area of Interest

Figure 1 shows the spatial extent of the entire Pompton Lake watershed. The New Jersey portion of the watershed is shown in Figure 2. The Mahwah station (USGS 01387500) is located on the Ramapo River near Mahwah, Bergen County, approximately 1.3 miles downstream of the NY/NJ borderline and 8 miles upstream of Pompton Lake. Pompton Lake is a 71-hectare artificial impoundment on the Ramapo River formed by the Pompton Lake Dam. The lake is located in Passaic County between Wayne Township and the Borough of Pompton Lakes. The dam is owned by the North Jersey District Water Supply Commission (NJDWSC), which uses the lake water as a supplemental drinking water source for the Wanaque Reservoir. The Ramapo Pump Station, located just below the lake outlet, is one of the three intakes feeding the Wanaque Reservoir and has a capacity of delivering up to 150 million gallon per day (MGD), on an "as needed basis," to the Wanaque Reservoir. As a result, the phosphorus loads from the Pompton Lake drainage area serve as an input to both endpoints of the non-tidal Passaic River basin TMDL, which is a companion study. Pompton Lake is mainly fed by the Ramapo River. It also receives some ungaged inflow from Acid Brook and smaller tributaries. The Ramapo River continues downstream of Pompton Lake Dam, draining into the Pompton River, a tributary of the Passaic River. The Ramapo River at Dawes Highway (USGS 01388100) station is located approximately 0.5 miles downstream of the outlet of Pompton Lake and is included in the spatial extent of this study because it reflects the quality of water leaving the lake.

The Pompton Lake watershed covers about 160 mi^2 (41,440 ha) of which 29 percent (47 mi^2) falls within New Jersey's Watershed Management Area (WMA) 3 and 71 percent (113 mi^2) within New York State. Some of the Pompton Lake's characteristics are summarized in Table 3. Figure 3 shows the land use coverage within the watershed and Table 4 summarized the distribution of land use by acreage.

Table 3 Characteristics of Pompton Lake

Lake Area (acre)	Lakeshed Area (acre)	Inflow (m^3/yr)	Avg. Diversion flow (m^3/yr)	Ave. Outflow (m^3/yr)	Areal Water load (m/yr)
175	102,400	2.6E+08	1.0E+07	2.5E+08	375

Except lakeshed area, all the data are obtained from QEA's study on Pompton Lake (QEA, 2004).

Figure 1 Location of the Pompton Lake Watershed

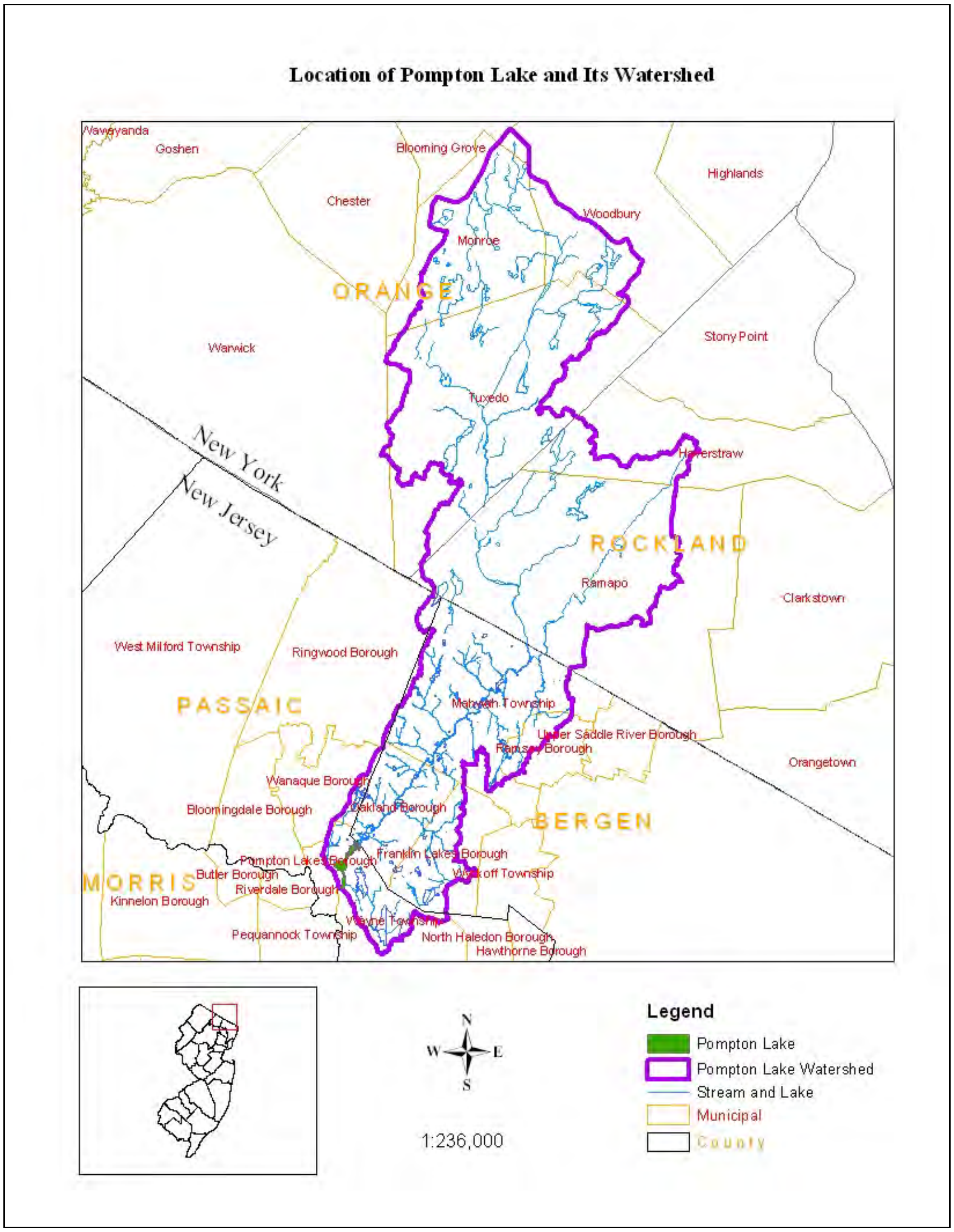


Figure 2 New Jersey Portion of Pompton Lake Watershed

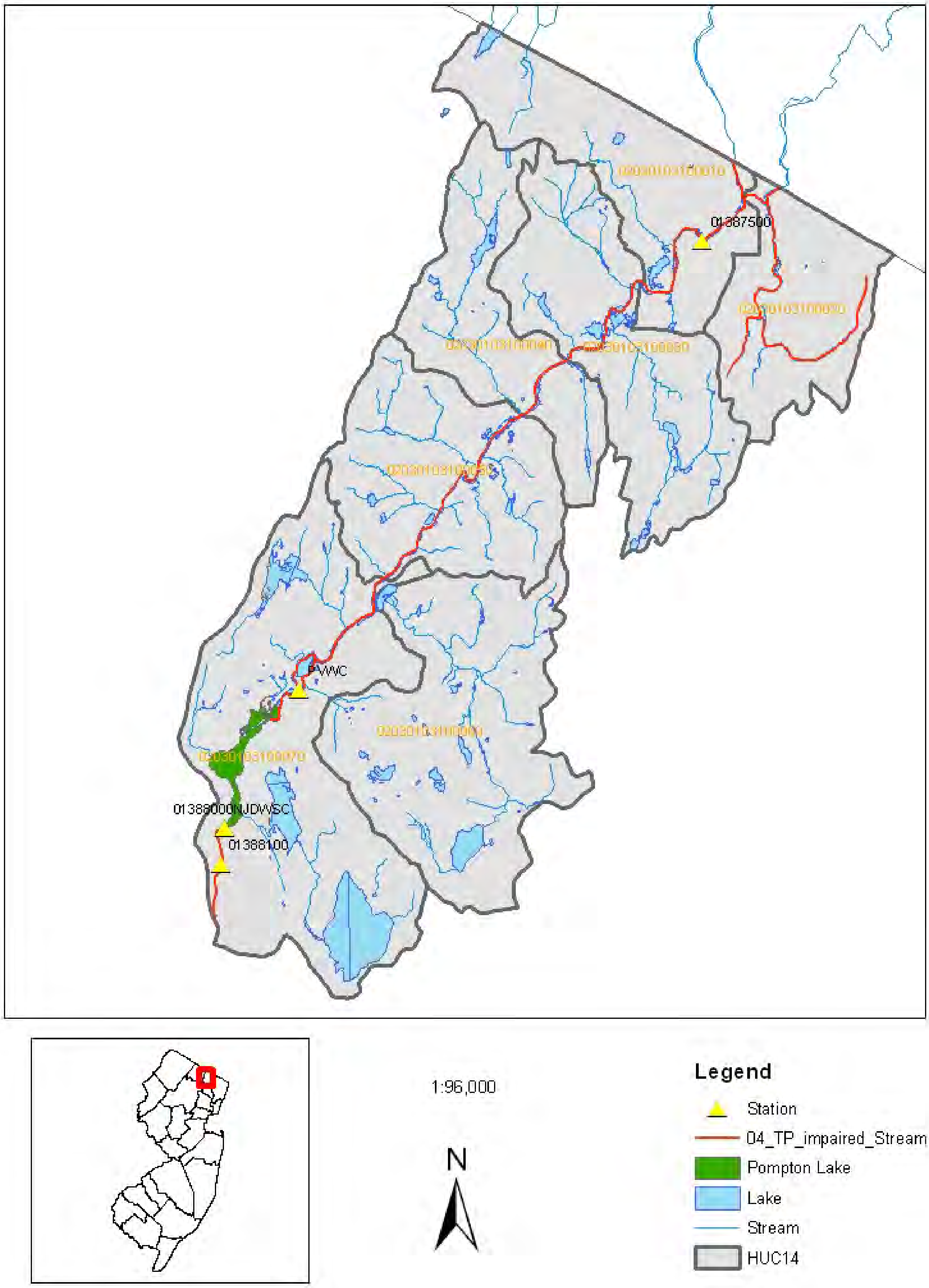


Figure 3 Pompton Lake Watershed land use GIS coverage

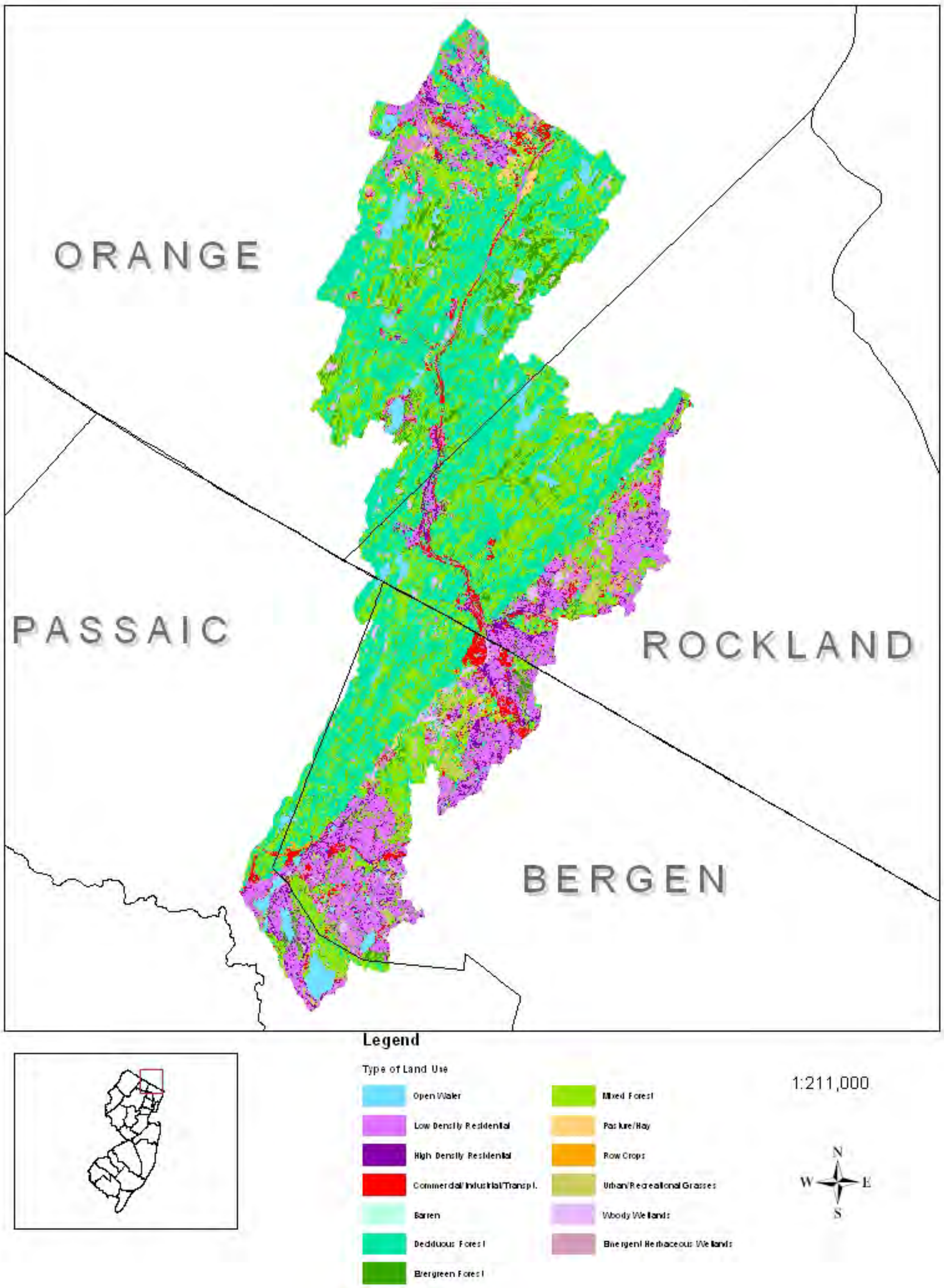


Table 4 Land Use Types in the Pompton Lake Watershed

Land Use	Area (ha)
Agriculture	440
Barren Land	110
Forest	31,755
Water	1,813
Wetlands	1,368
Recreational	290
Residential-High, Medium	2,058
Residential-Low, Rural	5,694
Other Urban	412
Commercial	1,280
Industrial	371

Table 4-2 of Pompton Lake and Ramapo River TMDL Support Study, QEA 2004

Geographic Information System (GIS) Coverage

Geographic Information System (GIS) data from the Department and for New York was used extensively to describe the lake and its watershed, specifically the following data:

- 1995/97 Land use/Land cover Update, published 12/01/2000 by NJDEP Bureau of Geographic Information and Analysis, delineated by watershed management area.
- NJDEP Countywide Lakes and Streams (Shapefile) with Name Attributes for Passaic and Bergen Counties to describe the lakes and streams located within the watershed. http://www.nj.gov/dep/gis/lakesshp.html and http://www.nj.gov/dep/gis/strmshp.html
- Lakeshed and subbasins were delineated based on NJDEP 10-meter Digital Elevation Grid for WMA 3. (http://www.nj.gov/dep/gis/wmalattice.html) The manual QC check was conducted on the boundaries automatically generated by NJBASIN and necessary modifications were made to appropriately delineate the lakeshed and subbasins.
- NJDEP's 2000 Census Block Shapefile http://www.nj.gov/dep/gis/stateshp.html#CENBLK
- NJDEP's 2002 Orthophotography Image for Passaic and Bergen Counties. http://njgin.nj.gov/OIT_IW/index.jsp
- National Land Cover Data (NLCD) for New York, last updated in July 2000. The data was produced under the direction of the USGS as part of the Multi-Resolution Land Characterization (MRLC) Regional Land Cover Characterization Project. The data used the NLCD Land Cover Classification Systems to categorize land use. http://edcsgs9.cr.usgs.gov/pub/data/landcover/states/
- Ramapo River and Pompton Lake Hydrology coverage (7.5 minute Quad Sheet) downloaded from Cornell University Geospatial Data Information Repository (CUGIR) was used to derive the entire lake boundary coverage. Hydrography (Census 2000) shapefiles were downloaded from CUGIR to describe the streams and lakes located in NY-side. http://cugir.mannlib.cornell.edu/browse_map/browse_map.html

4.0 Source Assessment

For the purposes of TMDL development, point sources include domestic and industrial wastewater treatment plants that discharge to surface water, combined sewer overflows, as well as stormwater discharges subject to regulation under the National Pollutant Discharge Elimination System (NPDES). This includes facilities with individual or general industrial stormwater permits and Tier A municipalities and state and county facilities regulated under the New Jersey Pollutant Discharge Elimination System (NJPDES) municipal stormwater permitting program. Point sources contributing phosphorus loads within the affected drainage area include the wastewater treatment facilities listed in Table 6, as well as stormwater point sources, including the Tier A municipalities listed in Appendix A. Stormwater point sources, like nonpoint sources, derive their pollutant load from runoff from land surfaces and load reduction is accomplished through BMPs. The distinction is that stormwater point sources are regulated under the Clean Water Act.

For the purpose of TMDL development, potential nonpoint sources include stormwater discharges that are not subject to regulation under NPDES, including Tier B municipalities, which are regulated under the NJPDES municipal stormwater permitting program, and direct stormwater runoff from land surfaces, as well as failing or inappropriately located septic systems, and direct contributions from wildlife, livestock and pets. These sources are not assigned separate loads. They are adequately captured by the nonpoint source loading method. There are no Tier B municipalities within the spatial extent of the study.

Based on the TMDL support documents: "Pompton Lake and Ramapo River TMDL Support Study" (QEA, 2004), and "Development of a TMDL for the Wanaque Reservoir and Cumulative WLAs/LAs for the Passaic River Watershed" (Najarian, 2005) potential sources of phosphorus to the river and lake were evaluated and the annual loading of phosphorus from different sources was quantified using different approaches.

In the QEA study, phosphorus loadings from New York State were estimated based on the relationship between flow and phosphorus concentrations at the Ramapo River near Mahwah station (01387500), and therefore, phosphorus loading at Mahwah represents both point and nonpoint sources combined. Phosphorus loadings from New Jersey, on the other hand, were calculated based on a separate assessment of point and nonpoint source loadings. The nonpoint source loads for total phosphorus were estimated using the Unit Areal Load (UAL) methodology, which applies pollutant export coefficients obtained from literature sources to the land use patterns within the watershed, as described in USEPA's Clean Lakes Program guidance manual (Reckhow, 1979b). As part of TMDL development, the Department reviewed phosphorus export coefficients from an extensive database (Appendix C). The selected values for the land use categories existing in Pompton Lake watershed are summarized in Table 5.

Phosphorus loads were characterized on an annual scale (kg TP/yr) or (lbs TP/yr). Long-term pollutant loads are typically more critical to overall lake water quality than the load at any particular short-term time period (e.g. day). Storage and recycling mechanisms in the lake, such as luxury uptake and sediments dynamics, allow phosphorus to be used as needed regardless of the rate of delivery to the system. Also empirical lake models use annual loads rather than daily or monthly loads to estimate in-lake concentrations.

Table 5 Phosphorus Export Coefficients (Unit Areal Loads)

Land use/Land Cover	LU/LC Codes*	UAL (kg TP/ha/yr)
medium / high density residential	1120	1.6
low density / rural residential	1130, 1140	0.7
Commercial	1200	2.0
Mixed urban/other urban	1400, 1700, 1800	1.0
Agricultural	2000	1.5
Forest, wetland, water	1750, 2140, 2150, 4000, 6000, 5000, 7430	0.1
Barren land	7000	0.5

* Based on the description of code found in LAND USE LAND COVER CLASSIFICATION SYSTEM, which is available at http://www.nj.gov/dep/gis/digidownload/metadata/lulc95/anderson.html.

Units: 1 hectare (ha) = 2.47 acres
1 kilogram (kg) = 2.2 pounds (lbs)
1 kg/ha/yr = 0.89 lbs/acre/yr

A UAL of 0.07 kg TP/ha/yr was used to estimate air deposition of phosphorus directly onto the lake surface. This value was developed from statewide mean concentrations of total phosphorus from the New Jersey Air Deposition Network (Eisenreich and Reinfelder, 2001).

Loads from point sources, other than stormwater point sources, that are a significant source of phosphorus within New Jersey were calculated based on the Department's DMRs (Daily Monitoring Reports) as an average load for the period 1997- 2000 for each New Jersey facility. Table 6 lists the dischargers of interest within the Pompton Lake watershed and their current loads.

Table 6 Point source discharges, other than stormwater point sources, that are a source of phosphorus into the Pompton Lake watershed- NJ

NJPDES #	Facility Name	Current Flow (mgd)[2]	Current Load (kg/d)
NJ0029858	OAKLAND CARE CENTER	0.0239	0.012
NJ0053112	OAKLAND-CHAPEL HILL ESTATES STP	0.0069	0.001
NJ0080811	RAMAPO RIVER CLUB STP	0.0696	0.018
NJ0027774	OAKLAND-OAKWOOD KNOLLS WWTP	0.0177	0.003
NJ0021253	RAMAPO-INDIAN HILLS H.S. WTP	0.0068	0.009
NJ0021342	OAKLAND-SKYVIEW-HIGH BROOK STP	0.0130	0.003

In the Najarian approach, a mass-balance model developed in a previous study of the Passaic River was refined to simulate the impact of point sources and nonpoint source load on the concentration in the river. The approach was based on a GIS analysis of the watershed's land uses and gauged USGS flow data, which was separated into baseflow and stormwater runoff components. Event mean concentrations (EMCs) were developed as part of a multi-year analysis using the unit area load (UAL) methodology which provided EMCs on a composite basis for each subwatershed. Baseflow was assigned a constant concentration of 0.01 mg/l TP, which was found to be representative of base flow from a relatively pristine location in the watershed.

5.0 Water Quality Analysis

The United States Geological Survey (USGS) in collaboration with the Department has collected monitoring data at two stations:

- Station 01387500, located on the Ramapo River near Mahwah, 8 miles upstream of Pompton Lake. During a period 1970-2003, 146 sets of TP and flow results were obtained. From this number, 96 TP results (66%) exceeded SWQS of 0.1 mg/l TP. This station was used to assess the Ramapo River between the New York border and Pompton Lake.
- Station 01388000, located in Pompton Lake, less than 10 meters upstream of the dam. Vertically-integrated composite samples were collected from 1987 through 1996 water year. During this time, 137 total phosphorus results were obtained, 96 TP results (70%) exceeded SWQS for lakes (0.05 mg/l).
- Station 01388100, located approximately 0.5 miles downstream of the outlet of Pompton Lake, was sampled during the period 2000-2002 and 8 TP results were obtained. There was one exceedance (12.5%). Instantaneous dissolved oxygen results were also obtained and 2 of 8 samples violated the standard (25%).

In addition to these stations, water quality data were collected by:

- The Passaic Valley Water Commission (PVWC) sampled Ramapo River at Pleasure Land, Oakland. This station is located just upstream of the lake. Collection of water quality data was ceased in 2001.
- The North Jersey District Water Supply Commission (NJDWSC) collects surface water samples on the lakeside of the diversion channel for the Ramapo River 700 Pump Station, less than 10 meters upstream of the dam.
- The Department and QEA conducted a one-day sampling event to provide a snapshot assessment of in-lake water quality and to collect bathymetric data of the lake. Results from this sampling event are described in detail in the QEA study (QEA, 2004).

The observation of frequency exceedances above the standard is presented in Table 7.

Table 7 Frequency of violations of selected water quality standards from long-term monitoring stations

Substance	SWQS*	Percent Violations (%)				
		USGS 0137500	USGS 01388100	PVWC Oakland	NJWSC Pompton Lake	USGS 01388000 Pompton Lake
Total phosphorus (stream)	<0.1 mg/l	66	12.5	17	Na	Na
Total phosphorus (lake)	< 0.05 mg/l	N/a			71	70
Chlorophyll-a	seasonal mean <24µg/L	17		-	22	-
	Summer	33		-	40	-
	Autumn	-		-	20	-
	Spring	0		-	33	-
	Winter	-		-	0	-
Dissolved oxygen	>5 mg/l (24-hour average)	1.6		6.4	1.3	2.2
Dissolved oxygen	>4 mg/l (instantaneous)	1.1	25	6.4	0.7	2.2

Adapted from Table 3-2 of Pompton Lake and Ramapo River TMDL Support Study, QEA 2004

Na -not applicable

* Based on FW2-NT SWQS and the Department's Technical Manual for Phosphorus Evaluation (NJDEP, 2003a), applicable to streams only.

Analysis of the data available for the Ramapo River indicates that the river is a "losing" stream. The water quality in the downstream reach is substantially (approximately 30%) better than the quality at Mahwah station. A losing stream is one in which stream flow is lost to ground water at a greater rate than groundwater enters the stream. In the relevant portion of the Ramapo River, a well field is located which draws water at a rate so as to induce the "losing" stream condition. The stream flows, which contain higher concentrations of phosphorus, are drawn into the ground water and are replaced with ground water, which contains lower concentrations of phosphorus.

6.0 Technical Approach

The TMDL equation is as follows:

TMDL = loading capacity
= Sum of the wasteload allocations (WLAs) + sum of load allocations (LAs) + margin of safety (MOS) + reserve capacity (RC).

Two approaches for determining existing loads and the loading capacity, which would then be allocated among the TMDL component parts, were considered and are described below.

6.1 Using Reckhow Model

The first approach uses the Reckhow model to determine the loading capacity of Pompton Lake. To estimate the annual load currently entering into the Pompton Lake, some assumptions were made (QEA, 2004):

- Phosphorus loads from significant point sources, other than stormwater point sources, were derived from DMR data for the permitted wastewater treatment facilities in the watershed within New Jersey. Loadings from point sources within New York were not distinguished from nonpoint sources; the state boundary was taken as a boundary condition.
- Nonpoint source loads were estimated using land use coverage distribution in categories, as presented in Table 4, and the phosphorus export coefficients (Unit Areal Loads presented in Table 5. Land uses were estimated separately for the part of watershed north from the Mahwah station (01387500), the part of watershed entering the lake, and the part of the watershed draining directly to the lake, excluding Ramapo River watershed.
- The loads estimated directly from the water quality data and flow data at the Mahwah station were compared to the loads estimated using land use coverage and UAL. It was assumed that the loads estimated directly from monitoring data are likely to be more accurate because of the large amount of TP/flow data, and the quality of the regression of TP versus flow. The phosphorus load calculated using monitoring results was used for the further calculations of total TP load to Pompton Lake.

The Department evaluated empirical models to relate annual phosphorus load and steady-state in-lake concentration of total phosphorus. The Department surveyed the commonly used models in Table 9. These empirical models consist of equations derived from simplified mass balances that have been fitted to large datasets of actual lake measurements. The resulting regressions can be applied to lakes that fit within the range of hydrology, morphology and loading of the lakes in the model database. The Reckhow (1979a) model was selected because the hydrologic, morphological and loading characteristics of Pompton Lake fit well within the assumptions of the model and because it appeared to give the best predictive results for phosphorus concentration. These characteristics are summarized in Table 10. Although the areal water load for Pompton Lake is outside the calibration range (375 m/year), the model still remains a good choice since it has the broadest range of lake characteristics in its database. While the target concentration for the lake is well within the range, the areal phosphorus load provides a better representation of a lake's intrinsic loading characteristics. Also, it is the model's prediction of target condition that would be used to calculate the TMDL. If current loads are higher than the range that can produce reliable model results, this has no affect on the model's reliability to predict the target condition under reduced loads.

Table 8 Empirical models considered by the Department

Reference	Steady-state TP concentration in lake (mg/l)	Secondary term	Application
Rast, Jones and Lee, 1983	$1.81 \times NPL^{0.81}$	$NPL = \left(\frac{P_a \times DT / D_m}{1 + \sqrt{DT}} \right)$	expanded database of mostly large lakes
Vollenweider and Kerekes, 1982	$1.22 \times NPL^{0.87}$	$NPL = \left(\frac{P_a \times DT / D_m}{1 + \sqrt{DT}} \right)$	mostly large natural lakes
Reckhow, 1980	$\frac{P_a}{13.2}$	none	Upper bound for closed lake
Reckhow, 1979a	$\frac{P_a}{(11.6 + 1.2 \times Q_a)}$	$Q_a = \frac{Q_i}{A_l}$	General north temperate lakes, wide range of loading concentration, areal loading, and water load
Walker, 1977	$\frac{P_a \times DT / D_m}{(1 + 0.824 \times DT^{0.454})}$	none	oxic lakes with $D_m / DT < 50$ m/yr
Jones and Bachmann, 1976	$\frac{0.84 \times P_a}{(D_m \times (0.65 + DT^{-1}))}$	none	may overestimate P in shallow lakes with high D_m / DT
Vollenweider, 1975	$\frac{P_a}{(D_m \times (DT^{-1} + S))}$	$S = 10 / D_m$	Overestimate P lakes with high D_m / DT
Dillon-Kirchner, 1975	$\frac{P_a}{\left(13.2 + D_m / DT\right)}$	none	low loading concentration range
Dillon-Rigler, 1974	$P_a \times DT / D_m \times (1 - R)$	R = phosphorus retention coefficient	general form
Ostrofksy, 1978	Dillon-Rigler, 1974	$R = 0.201 \times e^{(-0.0425 \times Q_a)} + 0.5743 \times e^{-0.00949 * Q_a}$	lakes that flush infrequently
Kirchner-Dillon, 1975	Dillon-Rigler, 1974	$R = 0.426 \times e^{\left(-0.271 \times D_m / DT\right)} + 0.5743 \times e^{-0.00949 * D_m / DT}$	general application
Larsen-Mercier, 1975	Dillon-Rigler, 1974	$R = \frac{1}{1 + \sqrt{1 / DT}}$	Unparameterized form

where:

NPL = normalized phosphorus loading
P_a = areal phosphorus loading (g/m²/yr)
DT = detention time (yr)
D_m = mean depth (m)
Q_a = areal water load (m/yr)
Q_i = total inflow (m³/yr)
A_l = area of lake (m²)

S = settling rate (per year)

The Reckhow (1979a) model is described in USEPA Clean Lakes guidance documents: “Quantitative Techniques for the Assessment of Lake Quality” (Reckhow, 1979b) and “Modeling Phosphorus Loading and Lake Response Under Uncertainty” (Reckhow *et al*, 1980). The derivation of the model is summarized in Appendix D. The model relates TP load to steady state TP concentration, and is generally applicable to north temperate lakes.

Table 9 Hydrologic and loading characteristics of Pompton Lake

Parameters	**Ranges of Characteristics Reckhow Model can fit**		**Pompton Lake**	
	Min	**Max**	**Current condition**	**Target Condition**[3]
TP Conc. (mg/l)	0.004	0.135	0.063	0.02
Avg. Influent TP Conc. (mg/l)[2]	-	0.298	0.08	
Q_a, Areal Water Load (m/yr)	1.2	190	375	N/A
P_a, Areal TP Load (g/m^2/yr)	0.07	31.4	28.8	

Note:
1. Predicted in-lake annual average concentration using Reckhow model (see section below).
2. Calculated using Pa*DT/Dm.
3. As explained below, the target concentration is 0.02 mg/l after considering the seasonal variability. The other parameters under target condition were all calculated based on the target concentration.

Current Condition

Using lake physical parameters and estimated TP external loads, the predicted steady-state in-lake phosphorus concentration calculated using the Reckhow (1979a) model predicts an in-lake TP concentration of 0.063 mg/l (QEA, 2004). The predicted in-lake concentration compares well with observed in-lake mean phosphorus concentrations—at the USGS station located about 35 ft. upstream of the lake outlet, the mean phosphorus concentration for the period of record 1987 through 1996 is 0.08 mg/l. In 2003, several locations within the lake were sampled, and results show that the mean phosphorus concentration was 0.06 mg/l, with data ranging between 0.05 and 0.07 mg/l. Data from NJDWSC/Pompton Lake Station from 1993 to 2001 were also investigated; this data revealed an average TP concentration of 0.11 mg/l, nearly twice the average concentration computed using the Reckhow model. However, it is important to point out that these data are not representative of the in-lake concentration, since they are lake surface water samples, taken one foot from the lake surface. In contrast, both the USGS and the one day sampling event were taken as depth integrated samples. The predicted TP concentration is representative of the depth-integrated concentration.

Reference Condition

A reference condition for Pompton Lake was estimated by calculating external loads as if the land use throughout the lakeshed were completely forest and wetlands and the loads from septic tank systems and internal recycling were assumed to be zero. Estimates of air deposition loads were included to calculate the reference condition. Using the same physical parameters and external loads from forest, wetlands and air deposition, a reference steady-state phosphorus concentration was calculated for Pompton Lake using the Reckhow (1979a) formulation as listed in Table 8. The reference condition was developed to estimate what the TP concentration would be under pristine conditions and assure that the target concentration based on the SWQS are achievable. For Pompton Lake, the target steady state concentration is 0.03 mg/l while the steady state concentration under the reference condition is only 0.014 mg/l. Therefore, the target concentration is achievable and is used for the TMDL calculations.

Seasonal Variation/Critical Conditions

The peak (based on the 90th percentile) to mean ratio was examined for the in-lake phosphorus concentration sampled by USGS at Pompton lake, station # 01388000 for period of record 1983 through 1996, the peak-to-mean ratio was estimated to be 1.62, this site-specific peak-to-mean ratio would result in target phosphorus concentrations of 0.031 mg/l. which compares well to previous target phosphorus concentrations set for other lakes in NJ. For example, a critical condition of 0.03 mg/l was chosen based on the peak-to-mean ratios of 1.56 and 1.48 observed from Strawbridge Lake and Sylvan Lake, respectively ((Strawbridge Lake, NJDEP 2000a; Sylvan Lake, NJDEP 2000b). Therefore, the Department determined that a target phosphorus concentration of 0.03 mg TP/l is appropriate for use in this TMDL. Since it is the annual pollutant load rather than the load at any particular time that determines overall lake water quality, the target phosphorus concentration of 0.03 mg TP/l accounts for critical conditions.

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)). A MOS is required in order to account for uncertainty in the loading estimates, physical parameters and the model itself. The margin of safety, as described in USEPA guidance (Sutfin, 2002), can be either explicit or implicit (i.e., addressed through conservative assumptions used in establishing the TMDL). When using the Reckhow model to calculate the TMDL, both an implicit and an explicit MOS are provided.

An explicit MOS has been included to account for the uncertainty and is built into the model itself. As described in Reckhow *et al* (1980), the Reckhow (1979a) model has an associated standard error of 0.128, calculated on log-transformed predictions of phosphorus concentrations. Transforming the terms in the model error analysis from Reckhow *et al* (1980) yields the following (Appendix D):

$$MoS_p = \sqrt{1/\left((1-\rho)*4.5\right)} \times \left(10^{0.128} - 1\right),$$

where: MoS_p = margin of safety as a percentage over the predicted phosphorus concentration;

ρ = the probability that the real phosphorus concentration is less than or equal to the predicted phosphorus concentration plus the margin of safety as a concentration.

Setting the probability to 90% yields a MOS of 51% when expressed as a percentage over predicted phosphorus concentration or estimated external load. The external load for each lake was therefore multiplied by 1.51 to calculate an "upper bound" estimate of steady-state phosphorus concentration. An additional explicit MOS was included in the analyses by setting the upper bound calculations equal to the target phosphorus concentration of 0.03 mg TP/l, as described in the next section and shown in Table 10. Note that the explicit MOS is equal to 51% when expressed as a percentage over the predicted phosphorus concentration; when expressed as a percentage of total loading capacity, the MOS is equal to 33.3%:

$$\left(MoS_{lc} = \frac{MoS_p \times P}{P + \left(MoS_p \times P\right)} = \frac{MoS_p}{1 + MoS_p} = \frac{0.51}{1.51} = 0.333 \right),$$

where: MoS_p = margin of safety expressed as a percentage over the predicted phosphorus concentration or external load;
MoS_{lc} = margin of safety as a percentage of total loading capacity;
P = predicted phosphorus concentration (or external load).

Target Condition

As discussed above, when considering the seasonal variation, the steady state concentration of phosphorus in the lake must be equal to or less than 0.03 mg/l to avoid exceeding the 0.05 mg/l phosphorus criterion. Using Reckhow (1979a), any predicted concentration has a MOS of 51% when expressed as a percentage over the predicted phosphorus concentration. To assure compliance with the 0.03 mg/l target, the predicted concentration can not be higher than 0.02 mg/l (0.02 + 0.02*51% = 0.03 mg/l) considering the effect of the MOS. Therefore, 0.02 mg/l is chosen as the target concentration to attain the standard while 0.03 mg/l is defined as the upper boundary target condition. The load corresponding to a 0.03 mg/l in-lake concentration is defined as the allowable loading capacity of the lake. The overall reduction to attain the standard level in Pompton Lake was calculated by comparing the current concentration (calculated using Reckhow Model) to 0.02 mg/l, the target concentration (Table 11). For Pompton Lake, the load corresponding to 0.02 mg/l is 17.9 kg/day following the relationship given by Reckhow model.

Table 10 Current condition, reference condition, target condition and load- based on QEA TMDL study

Current condition [TP] (mg/l)	Reference Condition [TP] (mg/l)	Upper Bound Target Condition [TP] (mg/l)	Target Condition [TP] (mg/l)	Overall Load Corresponding to target 0.02 (kg/d)
0.063	0.014	0.03	0.02	17.9

6.2 Using Mass-balance Model

The second approach uses a mass-balance model to project long-term phosphorus concentration at the river intake sites under alternate point source and nonpoint source reduction scenarios. The result was checked for in-lake response using the Reckhow model when determining the final loading capacity for this TMDL.

Under this approach, it is initially assumed that the boundary condition at the New York State line (Ramapo River near Mahwah) reflects full compliance with the stream standard for TP of 0.1 mg/l, which requires a 76% reduction of the current loading from New York. Then it was determined that the a scenario of a long-term-average (LTA) effluent concentration of 0.4 mg/l from wastewater discharges and an 80% reduction of adjustable nonpoint and stormwater point sources would produce a loading of 17.3 kg/day to Pompton Lake. This load when input into the Reckow model, produces a corresponding concentration of 0.019 mg/l, which is consistent with the target concentration of 0.02 mg/l determined through application of the Reckhow model. Since the results of two studies are comparable, the loading analysis based on the mass balance method was used in order to use a consistent basis within Approach Area 2, as described in the companion TMDL study for the non-tidal Passaic River basin, and to provide loadings on a daily basis, which is a necessary input to the Passaic River basin TMDL. The loadings were calculated as follows.

To determine the daily loadings, an 11-year time series (from 1992 through 2002) of in-stream concentrations were generated using an input of observed USGS flow data, reported DMR data and GIS-based land-use statistics. Comparing the simulated results with observed in-stream concentration at each control site, the mass-balance model simulates the overall magnitude, variability and trend of the observed data over the long-term (10-year) simulation period. Two stations within the Pompton Lake watershed were selected as the critical locations, Ramapo River at Pompton Lake (later replaced by station known as Ramapo River at Dawes Highway) and Ramapo River near Mahwah. The governing equation is:

$$C_{Riv} Q_{Riv} = \sum C_{Dis} Q_{Dis} + C_{NP} (Q_{Riv} - Q_{Dis})$$

where:

C_{Riv} = observed concentration in river;
C_{Dis} = reported effluent concentration;
C_{NP} = estimated NPS concentration;
Q_{Riv} = observed daily flow in river, and
Q_{Dis} = reported effluent flow rate.

The left side of the above equation represents the constituent mass flux at an in-stream site; the right side represents the cumulative upstream discharge load plus the total nonpoint source load.

The point source load was represented, on a monthly basis, as the cumulative upstream facility load (based on reported mean DMR data loads for the upstream facilities, or computed as reported effluent concentration times flow for each facility).

In order to provide an estimate of stormwater runoff load, the nonpoint source was set equal to the sum of the daily runoff and base loads, as described in Source Assessment, as follows:

$$L_{NP} = C_{NP} (Q_{Riv} - Q_{Dis}) = C_{Run} Q_{Run} + C_{BF} (Q_{BF} - Q_{Dis})$$

where:

L_{NP} = estimated NPS load;
C_{NP} = estimated NPS concentration;

C_{Run} = runoff concentration;
C_{BF} = base flow concentration;
Q_{Run} = estimated daily runoff flow;
Q_{BF} = estimated daily base flow; and
Q_{Dis} = reported effluent flow rate.

6.3 Conclusions

As described above, the identified loading of 17.9 kg/d (using Reckhow only) or 17.4 kg/d (using the mass-balance approach) will achieve the target concentration in Pompton Lakes. Given the required boundary condition of water quality meeting the standard of 0.1 mg/l at the state border/Mahwah station, which requires a 76 percent reduction in load in the New York portion of the drainage area, and the fact that the Ramapo River is a "losing" stream, the in-stream standard of 0.1 mg/l will be met in the Ramapo R (above 74d11m005) Assessment Unit (02030103100010), without further demonstration. Because of the close proximity of the Dawes Highway station to the outlet of Pompton Lake, that station reflects lake water quality and so, if the target condition for the lake is achieved, the in-stream SWQS of 0.1 mg/l will be achieved in the Ramapo R (below Crystal Lake bridge) Assessment Unit (02030103100070) with the loading reductions identified for the Pompton Lake drainage area.

Reserve Capacity

Reserve capacity is an optional means of reserving a portion of the loading capacity to allow for future growth. The primary means by which future growth could increase phosphorus load is through the development of forest land within the lakeshed. Phosphorus contributions from future development are expected to be controlled through implementation of the Stormwater Management Rules, which establish quality standards for TSS and nutrients. The follow up monitoring and implementation plan will require the collection of more detailed information about the lakeshed, which may result in revisions to the loading capacity and/or allocations. With regard to nonpoint sources, the loading capacities and accompanying load allocations must be attained in consideration of any new sources that may accompany future development. A reserve capacity of 0.2 kg TP/day has been specified for point sources to allow for future growth.

7.0 Allocations

WLAs are established for all point sources, while LAs are established for nonpoint sources, as these terms are defined in "Source Assessment." Individual WLAs are assigned to wastewater treatment facilities. Stormwater discharges can be a point source or a nonpoint source, depending on NPDES regulatory jurisdiction, yet the suite of measures to achieve reduction of loads from stormwater discharges is the same, regardless of this distinction. Stormwater point sources receiving a WLA are distinguished from stormwater generating areas receiving a LA on the basis of land use, but both are expressed as a percent reduction. 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 12. 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 11 Distribution of WLAs and LAs among nonpoint and stormwater point sources

Source Category	TMDL Allocation Type
Low Intensity Residential	WLA
High Intensity Residential	WLA
Commercial/Industrial/Transportation	WLA
Mixed Urban/Recreational	WLA
Crops/Pasture/Hay	LA
Deciduous Forest	LA
Evergreen Forest	LA
Mixed Forest	LA
Shrubland	LA
Woody Wetlands	LA
Herbaceous Wetlands	LA
Open Water	LA
Disturbed Areas	LA

Individual WLAs are identified in Table 13. The assignment of WLAs to point sources, other than stormwater point sources, is based on each source discharging at the permitted capacity at the same long term average effluent concentration. WLAs must be expressed as a daily load in accordance and with EPA requirements. However, effluent concentrations can and do vary on a daily basis. This variation can occur and still achieve the water quality objective provided that, on balance, reductions in point and nonpoint source loads on a long term basis conform to those needed to attain SWQS. The Department intends to establish concentration-only effluent limits determined by applying EPA's Technical Support Document for Water Quality-Based Toxics Control (USEPA, 1991) methodology to the LTA of 0.4 mg/l, assuming a 4 times per month sampling frequency and a coefficient of variation equal to the default value of 0.6. The resulting monthly average effluent limit would be 0.76 mg/l.

Dischargers will be allowed to engage in water quality trading negotiations to effect a change in effluent limits, with Department approval. It should be noted that, in June 2005 EPA awarded a Targeted Watershed grant in the amount of $900,000 to Rutgers University for the purpose of developing a water quality trading pilot with respect to the phosphorus impairment in the Passaic River basin. This project has been investigating the options for and overall viability of a trading approach in the Passaic River basin. This project will produce a set of tools and rules that will govern allowable trades within the study area. These are expected to include trading ratios and management zones within which trades can occur and still achieve the TMDL outcomes at the critical locations. Once the proposed tools and rules are developed, they will be subject to public comment. Following this process, as well as Department and EPA approval of the protocols, interested permittees can proceed to negotiate trades that achieve the desired result in a more cost effective way. For example, it may be more cost effective for a few larger facilities to upgrade to a higher level than for all treatment facilities to upgrade to the same level. The Department anticipates allowing 1 year from the date of permit issuance to negotiate trades so that treatment plant upgrades consistent with permit limits are implemented within the compliance schedules that will be set forth in the permits.

The allocation of loading capacity is reflected in Tables 13 and 14. Because some land use loads are not readily adjustable (forest, wetland, water, barren), the overall land use based-reductions must be achieved from land uses that can be more readily affected by management measures. Therefore, an 80 percent reduction will be required for the remaining more readily adjustable nonpoint sources. An additional 6% MOS is stipulated to account for uncertainty in the land use load estimation. This MOS was believed to be adequate because of the significant MOS already incorporated through the Reckhow model. Although there are no known plans for new or expanded wastewater treatment facilities, an additional 1% is allocated for Reserve Capacity. The distribution of loading capacity is shown in Figure 4.

Table 12 WLAs for Treatment Facilities in the NJ Portion of the Pompton Lake Watershed

NJPDES #	Facility Name	Current Flow (mgd)[1]	Current TP Load (kg/d)[2]	Permitted Flow (mgd)	TP WLA (kg/d)[3]
NJ0029858	OAKLAND CARE CENTER	0.0239	0.012	0.0300	0.05
NJ0053112	OAKLAND-CHAPEL HILL ESTATES STP	0.0069	0.001	0.0100	0.02
NJ0080811	RAMAPO RIVER CLUB STP	0.0696	0.018	0.1137	0.17
NJ0027774	OAKLAND-OAKWOOD KNOLLS WWTP	0.0177	0.003	0.0350	0.05
NJ0021253	RAMAPO-INDIAN HILLS H.S. WTP	0.0068	0.009	0.0336	0.05
NJ0021342	OAKLAND-SKYVIEW-HIGH BROOK STP	0.0130	0.003	0.0230	0.03

1 current flows are based on NJDEP's Municipal STP Flow Database for 2002
2 current total phosphorus loads are based on facility's reported 1997-2000 discharge load
3 based on a LTA effluent concentration of 0.40 mg/l total phosphorus

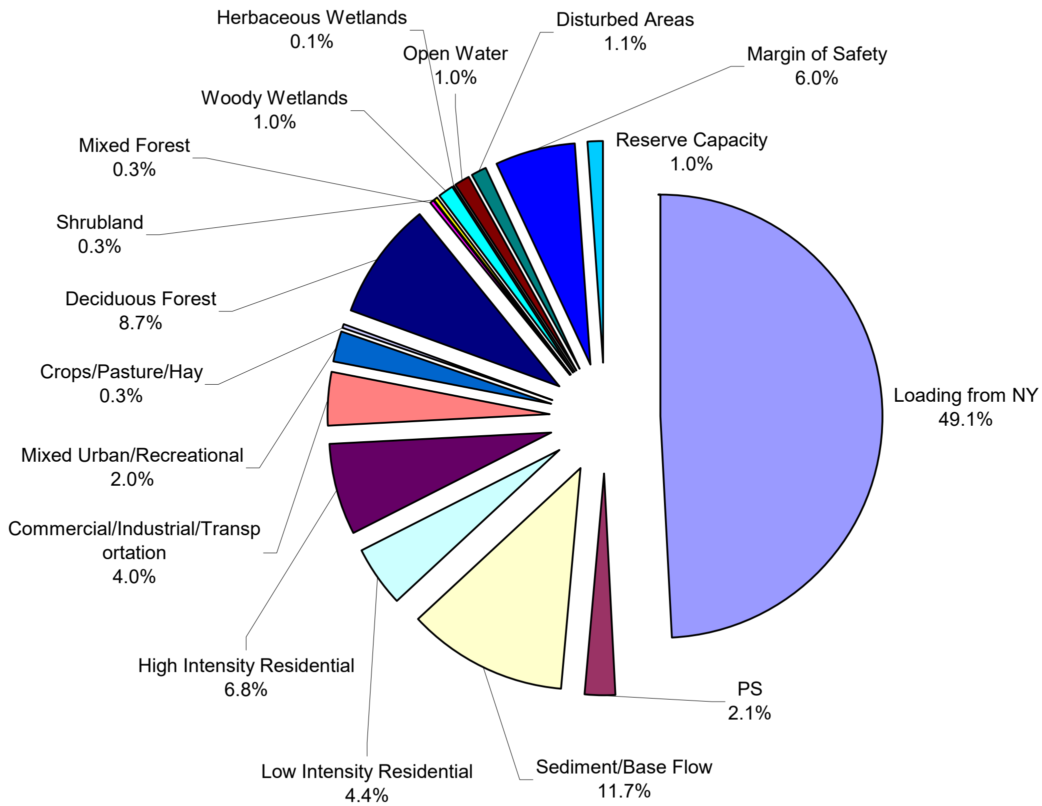
Table 13 TMDL components for Pompton Lake and for Ramapo River watershed including WLAs and LAs for New Jersey sources

Adapted fromTable 6-2 "Development of a TMDL for the Wanaque Reservoir and Cumulative WLAs/LAs for the Passaic River Watershed" (Najarian, 2005)

	TMDL Allocation Type	Existing Conditions[1]		TMDL Specification		Percent
		kg TP/day	% of LC	kg TP/day	% of LC	Reduction[2]
Cumulative Watershed Load (CWL)		54.6	100%	17.4	100%	68%
Point Sources other than Stormwater						
NJPDES Dischargers[3]	WLA	0.05	0.1%	0.37 (0.4)[5]	2.1%	0%
Internal Loading						
Sediment/Base Flow	n/a	2.0	3.7%	2.0	11.7%	0%
Boundary Inputs						
New York[4]	n/a	35.2	64.5%	8.5	49.1%	76%
Land Use Surface Runoff						
Low Intensity Residential	WLA	3.9	7.0%	0.8	4.4%	80%
High Intensity Residential	WLA	5.9	10.8%	1.2	6.8%	80%
Commercial/Industrial/Transportation	WLA	3.5	6.3%	0.7	4.0%	80%
Mixed Urban/Recreational	WLA	1.8	3.2%	0.4	2.0%	80%
Crops/Pasture/Hay	LA	0.2	0.4%	0.04	0.3%	80%
Deciduous Forest	LA	1.5	2.7%	1.5	8.7%	0%
Evergreen Forest	LA	0.01	0.0%	0.01	0.0%	0%
Mixed Forest	LA	0.05	0.1%	0.05	0.3%	0%
Shrubland	LA	0.05	0.1%	0.05	0.3%	0%
Woody Wetlands	LA	0.2	0.3%	0.2	1.0%	0%
Herbaceous Wetlands	LA	0.01	0.0%	0.01	0.1%	0%
Open Water	LA	0.2	0.3%	0.2	1.0%	0%
Disturbed Areas	LA	0.2	0.3%	0.2	1.1%	0%
Other Allocations						
Margin of Safety	n/a	n/a	n/a	1.0	6.0%	n/a
Reserve Capacity	n/a	n/a	n/a	0.2	1.0%	n/a

1 average annual loads for existing conditions based on 1993-2002 model simulation
2 = 1 - (TMDL load /Existing load)*100
3 a detailed listing of individual discharge facilities is provided in Table 12
4 includes PS and NPS discharges to the Ramapo River within New York State
5 Rounded value used in Cumulative Watershed Load summation.

Figure 4 Loading Capacity Distribution at Pompton Lake



8.0 Follow-up Monitoring and Lake Characterization Plan

The Water Resources Division of the U.S. Geological Survey and the Department have 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. A second ambient monitoring network, the Department's Supplemental Ambient Surface Water Network (100 stations), has improved spatial coverage for water quality monitoring in New Jersey. The data from these networks have been used to assess the quality of freshwater streams and percent load reductions. The ambient networks will be the means to determine the effectiveness of TMDL implementation and the need for additional management strategies.

In addition, a supplemental characterization and assessment study will be completed for Pompton Lake. This study should include sediment sampling, at a minimum. This will assist in refining implementation options for nonpoint sources and developing a more detailed restoration plan. Implementation measures currently envisioned are described below.

9.0 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).

The Department recognizes that TMDLs alone are not sufficient to restore impaired stream segments. The TMDL establishes the required pollutant reduction targets while the implementation plan identifies some of the regulatory and non-regulatory tools to achieve the reductions, matches management measures with sources, and suggests responsible entities for non-regulatory tools. This provides a basis for aligning available resources to assist with implementation activities. Wastewater treatment facilities will receive NJPDES permits with effluent limitations consistent with the WLAs. Projects proposed by the State, local government units and other stakeholders that would implement the measures identified within the impaired watershed are a priority for available State (for example, CBT) and federal (for example, 319(h)) funds. In addition, the Department's ongoing watershed management initiative will develop detailed watershed restoration plans for impaired stream segments in a priority order that will identify more specific measures to achieve the identified load reductions.

In these impaired watersheds wetlands and forest represent a significant portion of the land use. As discussed under source assessment, loads from these land uses are not readily adjustable. Urban and agricultural land use sources must be the focus for implementation. Urban land use will be addressed primarily by stormwater regulation, including requiring adoption of fertilizer management ordinances, as described below. Agricultural land uses represent a very minor component of the existing land use, but can be addressed by implementation of conservation management practices tailored to each farm. Other measures are discussed further below. To achieve the ambitious nonpoint source reduction objective for this drainage area, emphasis will also be placed on riparian restoration, already envisioned in the Pequannock River watershed in response to the temperature TMDL established for that watershed.

Stormwater measures

The stormwater facilities subject to regulation under NPDES in this watershed must be assigned WLAs. The WLAs for these point sources are expressed in terms of the required percent reduction for nonpoint sources and are applied to the land use categories that correspond to the areas regulated under industrial and municipal stormwater programs. The BMPs required through stormwater permits, including the additional measure discussed below, are generally expected to achieve the required load reductions. The success of these measures will be assessed through follow up monitoring. As needed through adaptive management, other additional measures may need to be identified and included in stormwater permits. Follow up monitoring or watershed restoration plans may determine that other additional measures are required, which would then be incorporated into municipal stormwater permits. Additional measures that may be considered include, for example, more frequent street sweeping and inlet cleaning, or retrofit of stormwater management facilities to include nutrient removal. .A more detailed discussion of stormwater source control measures follows.

The NJPDES rules for the Municipal Stormwater Regulation Program require municipalities, highway agencies, and regulated "public complexes" to develop stormwater management programs consistent with the NJPDES permit requirements. The stormwater discharged through "municipal separate storm sewer systems" (MS4s) also regulated under the Department's stormwater rules. Under these rules and associated general permits, Tier A municipalities are required to implement various control measures that should substantially reduce phosphorus loadings in the impaired watersheds. These control measures include adoption and enforcement of a pet waste disposal ordinance, prohibiting the feeding of unconfined wildlife on public property, street sweeping, cleaning catch basins, performing good housekeeping at maintenance yards, and providing related public education and employee training. These basic requirements will provide for a measure of load reduction from existing development. For example, the US Department of Transportation Federal Highway Administration cites a state of California study on vacuum sweeper efficiency in which a total phosphorus removal rate of 74% was achieved, compared to mechanical sweeper efficiency rate of 40% (www.fhwa.dot.gov/environment).

Because most of the land use based phosphorus load reductions must be obtained from urban land uses, an additional measure to reduce the phosphorus load from landscape maintenance is needed in order to effectively reduce the phosphorus load originating from the urban land uses.

The literature supports that a significant overall phosphorus reduction can be expected from this measure alone. The USGS documented the effects of lawn fertilizer on nutrient concentrations from runoff for a study in Wisconsin and found that total phosphorus concentration in lawn runoff was directly related to phosphorus concentration in lawn soils. Further, runoff from lawn sites with phosphorus-free fertilizer application had a median total phosphorus concentration similar to that of unfertilized sites, an indication that phosphorus-free fertilizer use is an effective, low-cost practice for reducing phosphorus in runoff. A growing body of research from Wisconsin, Michigan, Minnesota and Maine concludes that phosphorus from fertilizer applied to lawns enters surface waterbodies through runoff. In fact, after 8 years of voluntary use of phosphorus-free lawn fertilizer starting in 2008, Maine is banning the sale of phosphorus fertilizer unless certain conditions are met because they found that most soils had enough phosphorus to keep a lawn healthy. Research conducted in Maine showed that in watersheds that are converted from their natural, forested condition to residential, commercial and agricultural uses, the amount of phosphorus runoff increases by a magnitude of 5 to 10 times. Minnesota has also restricted phosphorus in lawns fertilizers to protect the quality of their lakes and streams. In 2003, EPA reported that the City of Plymouth, Minnesota enacted a phosphorus fertilizer ban in 1996 and observed a 23% reduction in phosphorus inputs to their lake as compared to phosphorus loading from neighboring community. See http://www.lakeaccess.org/lakedata/lawnfertilizer/recentresults.htm

Therefore, all municipalities within the spatial extent of this TMDL study will be required to adopt an ordinance, consistent with a model ordinance provided by the Department, as an additional measure of the Municipal Stormwater Permit. This model ordinance has been posted on www.state.nj.us/dep/watershedmgt//rules.htm under the section heading Water Quality Management Planning Rules. The additional measure is as follows:

Fertilizer Management Ordinance

Minimum Standard – Municipalities identified in Appendix A shall adopt and enforce a fertilizer management ordinance, consistent with a model ordinance provided by the Department, that conforms with the Department's ordinance provided by the Department.

Measurable Goal - Municipalities identified in Appendix A shall certify annually that they have met the Fertilizer Management Ordinance minimum standard.

Implementation - Within 6 months from adoption of the TMDL, municipalities identified in Appendix A shall have fully implemented the Fertilizer Management Ordinance minimum standard.

Agricultural and other measures

Generic management strategies for nonpoint source categories, beyond those that will be implemented under the Municipal Stormwater Regulation program, and responses are summarized below.

Table 14 Nonpoint source management measures

Source Category	Responses	Potential Responsible Entity	Possible Funding options
Human Sources	Septic system management programs	Municipalities, residents, watershed stewards, property owner	319(h), State sources
Non-Human Sources	Goose management programs, riparian buffer restoration	Municipalities, residents, watershed stewards, property owner	319(h), State sources
Agricultural practices	Develop and implement conservation plans or resource management plans	Property owner	EQIP, CRP, CREP

Human and Non-Human measures

Where septic system service areas are located in close proximity to impaired waterbodies, septic surveys should be undertaken to determine if there are improper effluent disposal practices that need to be corrected. Septic system management programs should be implemented in municipalities with septic system service areas to ensure proper design, installation and maintenance of septic systems. Where resident goose populations are excessive, community based goose management programs should be supported. Through stewardship programs, areas such as commercial/corporate lawns should be converted to alternative landscaping that minimizes goose habitat and areas requiring intensive landscape maintenance. Where existing developed areas have encroached on riparian buffers, riparian buffer restoration projects should be undertaken where feasible. In the Pompton Lake drainage area an ambitious reduction of nonpoint source loads is called for. In this drainage area restoration of riparian buffers will be particularly important and already is a focus for implementation of the Pequannock River temperature TMDLs (NJDEP, 2004). This measure is expected to provide the additional load reductions needed to achieve the reduction objective in this TMDL.

Agricultural measures

Several programs are available to assist farmers in the development and implementation of conservation management plans and resource management plans. 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).

Conservation Reserve Enhancement Program (CREP) 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 CREP agreement earlier this year. This program matches $23 million of State money with $77 million from the Commodity Credit Corp. within USDA. Through CREP, financial incentives are offered for agricultural landowners to voluntarily implement conservation practices on agricultural lands. NJ CREP is part of the USDA's Conservation Reserve Program (CRP). There is a ten-year enrollment period, with CREP leases ranging between 10-15 years. The State intends to augment this program to make 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.

Current Implementation Projects Update

The following projects are either ongoing or are anticipated to be implemented in the TMDL study area. These projects were funded using 319(h) grants and are expected to have an immediate and positive effect on water quality.

- Ramapo Reservation Lake: Installation of 1000 feet of riparian buffer restoration. (Completed)
- Visual Assessment of Streams in WMA 3 and ranking for stream restoration including restoration of Sheffield Brook in Wayne (Completed) One of the highest ranked projects proposed for when additional funding is available was: Acid Brook/Pompton Lake NPS Mitigation and Riparian Enhancement Project This project would stabilize approximately 1,000 linear feet of eroding shoreline along the northern end of Pompton Lake and 300 linear feet of streambank along Acid Brook at its mouth where it empties into Pompton Lake. The proposed restoration would re-establish a naturalized, native vegetated buffer, which would stabilize soils and mitigate the impacts of harmful waterfowl populations. The buffer would be of varying widths, totaling approximately 20,000 square feet. The project will reduce sediment and pollutant loading in the lake by retrofitting existing stormwater outfalls utilizing Best Management Practices, (BMPs) to treat nonpoint source (NPS) pollutants prior to entering the lake. Currently, the existing outfalls capture runoff from nearby roadways and residential areas and discharge directly into Pompton Lake. This is a priority project due to available public space, volumes of stormwater currently untreated prior to release, and volunteer and local support.

- Pequannock River Thermal Mitigation, Monitoring and Assessment: This project addressed two nonpoint source areas that are contributing to the increased temperature due to loss or riparian canopy. Riparian restoration was undertaken at Bailey Brook in Bloomingdale and the Pequannock River in Riverdale. Another components of this project were the documentation of areas in the Pequannock River headwaters that are impacted by current or past beaver activity and the collection of flow and temperature data for all significant tributaries in the Lower Pequannock drainage. Identification and mapping of stormwater outfalls in the lower and central Pequannock drainages were also undertaken. The majority of this project is complete, the monitoring is still underway as part of this contract, to ensure a longer term database for temperature in this watershed.
- A *WMA 3 Restoration Master Plan* was conducted over two years using a visual assessment protocol modified from the USDA methodology. This project was also funded with 319h funding. The project included four sub-watersheds, one of which was the Pequannock. Forty-five sites in the Pequannock Basin were identified for restoration projects. The average score based on the visual assessment for the overall basin was 7.8 SVAP (STREAM VISUAL ASSESSMENT PROTOCOL). Of the 45 sites, 24 scored below the basin average scores. Several of the Pequannock sites were rated as high priority and these sites would be priority sites for future restoration projects. Streambank restoration with replacement canopy would have a mitigating effect on temperature exceedances and limit expose of waterbody to sunlight; thus minimizing the potential for algal growth. An addendum of the final report included a Management Strategy Table with a Habitat Enhancement category. For this category several sites on the Pequannock River and Kanouse Brook have been identified as candidates for habitat restoration and enhancement. As part of the WMA 3 Restoration Master Plan the following sites were identified as containing deficient riparian buffers and these sites can provide a starting point for addressing riparian corridor restoration on both the mainstem Pequannock and significant tributaries feeding the river:
- Site 142- Pequannock River northwest of Route 23 between old Route 23 and Route 23 Railroad
- Site 143- Pequannock River southwest tributary of Pequannock headwaters at Rt. 23 bridge crossing
- Site 153- Clinton Brook 0.25 miles above Clinton Reservoir
- Site 155- Kanouse Brook, 0.65 miles north of confluence with Pequannock River
- Site 156- Kanouse Brook, 2.2 miles north of confluence with Pequannock River
- Site 158- Clinton Brook, 1.1 miles south of Clinton Reservoir adjacent to LaRue Road
- Site 168- Stone House Brook at confluence with Pequannock River
- Site 172- Pequannock River, 0.8 miles north of confluence with Wanaque
- Site 174- Matthew Brook
- Site 176- Van Dam Brook, Riverdale Town Park
- Site 177- Pequannock River, 0.15 miles north of confluence of Beaver Brook

This list should not be considered inclusive as it was part of a larger project for WMA 3 of which thermal mitigation was not the primary focus; therefore the list should be considered a starting point. The study also looked at ownership of land, and had public lands as a criterion for evaluation. As redevelopment occurs, inclusion of a riparian corridor to provide canopy should be implemented where feasible.

Priority Stream Segment Initiative

In addition to the generic and specific, current and future implementation measures identified above, the Department, through its watershed management program, has undertaken the development of watershed restoration plans for priority stream segments. Each area identifies specific measures and the means to accomplish them for specific impaired pollutant. Priority was based on the following criteria:

- Headwater area;
- Proximity to drinking water supply;
- Proximity to recreation area;
- Possibility of adverse human health conditions;
- Proximity to a lake intake;
- Existence of eutrophication;
- Phosphorus is identified as the limiting nutrient;
- Existence of use impairments;
- Ability to create a measurable change;
- Probability of human source;
- Stream Classifications;
- High success level.

Listed below is the priority stream segment project located in WMA 3within the TMDL Study Area, in which activities are occurring to support the development of watershed restoration plans.

NPS Grant: Demonstration Project to Support TMDL Implementation for the Pequannock River

As identified in the Pequannock River TMDL and the Pequannock River Temperature Impairment Characterization, Assessment and Management Plan discharges into river tributaries from smaller lakes and ponds can contribute to thermal elevation in the Pequannock River and its tributaries. This occurs because impoundments slow flows, expose waters to increased sunlight and release heated surface water from impoundments over spillway outlets. Preliminary sampling by the Pequannock River Coalition has shown that small impoundments do offer a level of temperature stratification within these impoundments that may be utilized to achieve downstream temperature reductions of 3-4 F. This project is a demonstration project and will actually occur on the West Brook in the Township of West Milford. The West Brook is impaired for temperature. The demonstration project will provide siphon piping from bottom water to provide a temperature reduction in the West Brook. This system will be monitored and documented for replication on other waterways.

10.0 Reasonable Assurance

Reasonable assurance that the TMDL will result in attainment of the SWQS requires both a reduction of the current phosphorus loading and protection against increased phosphorus loading from future development. The above implementation plan describes various management measures, both regulatory and nonregulatory, that will result in the needed reduction in phosphorus loads.

Additionally, NJDEP adopted the Stormwater Management Rules N.J.A.C 7:8, which minimizes the impact of stormwater run-off from new development. The Stormwater Management Rules, N.J.A.C. 7:8, establish statewide minimum standards for stormwater management in new development, and the ability to analyze and establish region-specific performance standards targeted to the impairments and other stormwater runoff related issues within a particular drainage basin through regional stormwater management plans. The Stormwater Management Rules are currently implemented through the Residential Site Improvement Standards (RSIS) and the Department's Land Use Regulation Program (LURP) in the review of permits such as freshwater wetlands, stream encroachment, CAFRA, and Waterfront Development

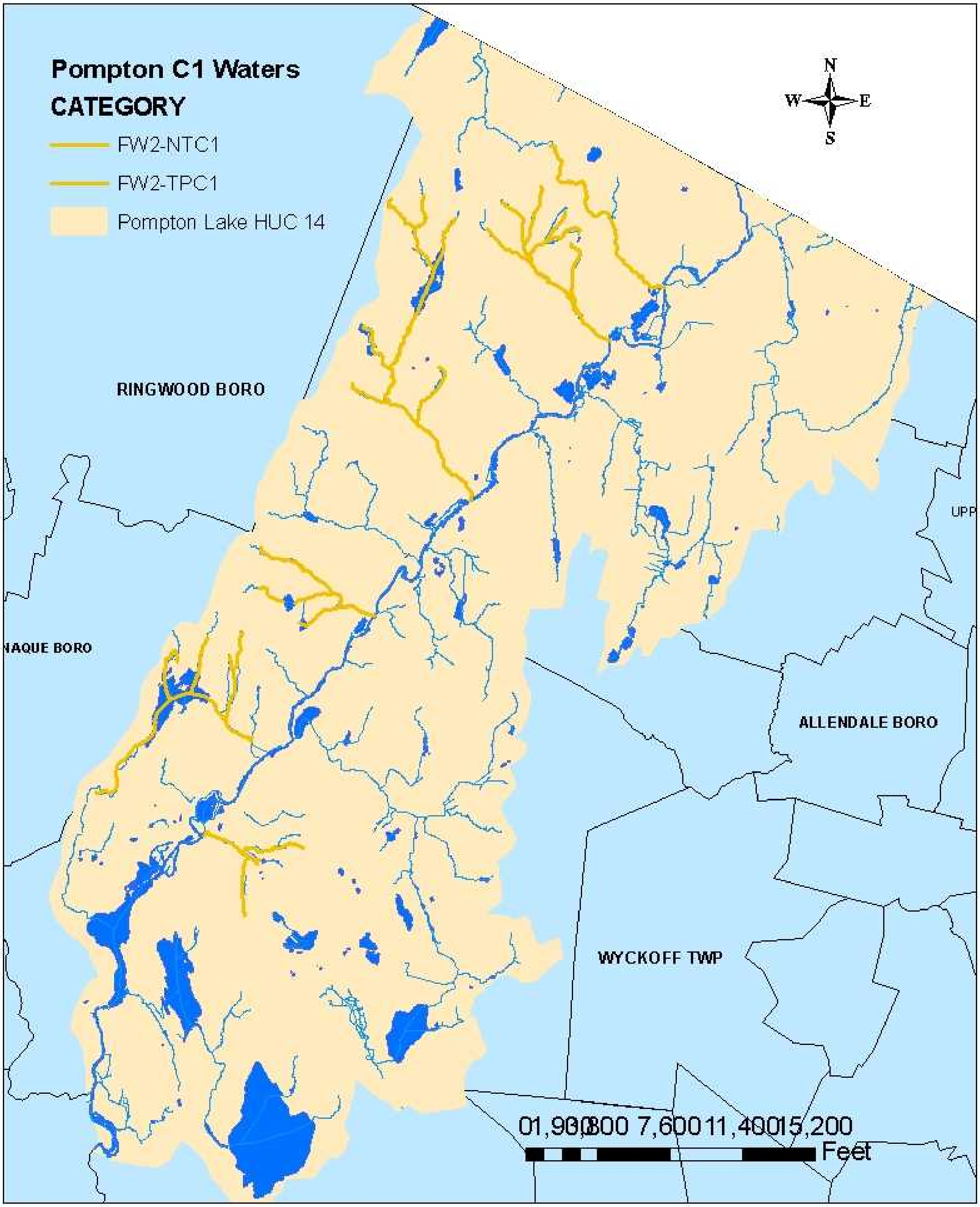
The Stormwater Management Rules focus on the prevention and minimization of stormwater runoff and pollutants in the management of stormwater. The rules require every project to evaluate methods to prevent pollutants from becoming available to stormwater runoff and to design the project to minimize runoff impacts from new development through better site design, also known as low impact development. Some of the issues that are required to be assessed for the site are the maintenance of existing vegetation, minimizing and disconnecting impervious surfaces, and pollution prevention techniques. In addition, performance standards are established to address existing groundwater that contributes to baseflow and aquifers, to prevent increases to flooding and erosion, and to provide water quality treatment through stormwater management measures for TSS and nutrients

As part of the requirements under the municipal stormwater permitting program, municipalities are required to adopt and implement municipal stormwater management plans and stormwater control ordinances consistent with the requirements of the stormwater management rules. As such, in addition to changes in the design of projects regulated through the RSIS and LURP, municipalities are updating their regulatory requirements to provide the additional protections in the Stormwater Management Rules.

Furthermore, the New Jersey Stormwater Management Rules establish a 300-foot special water resource protection area (SWRPA) around Category One (C1) waterbodies and their intermittent and perennial tributaries, within the HUC 14 subwatershed. In the SWRPA, new development is typically limited to existing disturbed areas to maintain the integrity of the C1 waterbody. C1 waters receive the highest form of water quality protection in the state, which prohibits any measurable deterioration in the existing water quality. Definitions for surface water classifications, detailed segment description, and designated uses may be found in various amendments to the Surface Water Quality Standards at www.state.nj.us/dep/wmm/sgwqt/sgwqt.html.

C1 designations within the pertinent portion of the Passaic River watershed are depicted on Figure 5

Figure 5: **C1 Waterbodies**



Commitment to carry out the activities described in the implementation plan to reduce phosphorus loads and the requirements of the Stormwater Management Rules and the Municipal Stormwater Regulation Program provide reasonable assurance that the SWQS will be attained for phosphorus in the spatial extent of the TMDL study. Follow up monitoring will identify if the strategies implemented are completely, or only partially successful. It will then be determined if other management measures can be implemented to fully attain the SWQS or if it is necessary to consider other approaches, such as use attainability.

11.0 Public Participation

In accordance with the Water Quality Management Planning Rules each TMDL shall be proposed by the Department as an amendment to the appropriate areawide water quality management plan(s) in accordance with N.J.A.C. 7:15-3.4(g). N.J.A.C. 7:15-3.4(g)5 states that when the Department proposes to amend an areawide water quality plan on its own initiative, the Department shall give public notice by publication in a newspaper of general circulation in the planning area, shall send copies of the public notice to the applicable designated planning agency, if any, and may hold a public hearing or request written statements of consent as if the Department were an applicant.

The Department has maintained a long term commitment to the stakeholder process and public participation in the development of this TMDL for the Passaic River Basin. The TMDL was developed with assistance and direct input from stakeholders in Watershed Management Areas 3, 4 and 6.

The stakeholder process in the Passaic River Basin has been continuous for over 13 years. The resulting collaborative restoration process arose out of a 1993 pilot watershed initiative in the Whippany River Watershed (1993 – 2000) and litigation over permit requirements. The Department's early meetings with dischargers in 1996 in response to a settlement agreement over proposed phosphorus permit limits coupled with the Whippany River Watershed Pilot project evolved into a comprehensive watershed management process. This model for watershed management was later refined and replicated throughout the state in twenty watershed management areas (WMAs).

The Department initiated a pilot watershed project in 1993 in the Whippany River Watershed to aid the Department in developing a comprehensive watershed process that could be replicated throughout the state. The 70 square mile Whippany River Watershed lies in the heart of the larger Passaic River Basin and was instrumental in pulling stakeholders with varied interests and backgrounds together to discuss and address issues germane to the Watershed. Stakeholders included: active watershed groups, academics, business, industry, consultants, interested public, purveyors as well as dischargers. The watershed management process has afforded New Jersey a unique opportunity to openly discuss and vet projects that need to be undertaken to ensure New Jersey achieves its statewide "clean and plentiful" water goal.

The Public Advisory Group (PAG), Technical Advisory Committee (TAC) and several subcommittees met for 6 years in an effort to achieve the goal to restore and preserve the value of the Whippany River as a vital natural resource. A main reason that the Whippany River Watershed was selected as the state's pilot watershed project was because of the number of dischargers located in the watershed. The Department recognized a unique opportunity in having dischargers, purveyors, environmental interest groups, local and state governments come together to vet and resolve issues unique to a specific geographic location. In addition to a replicable format for watershed management, one of several significant outcomes of the pilot watershed process included: the *Total Maximum Daily Load for Fecal Coliform and an Interim Reduction Plan for the Whippany River Watershed* adopted in December

1999 and its companion document Appendix G *Whippany River Watershed NPS Pollution Control Guidance Manual for Municipal Officials, Engineers and Department of Public Works, May 2000*. A workshop was held to acquaint municipalities with the best management practices recommended by the Technical Advisory Committee's NPS Workgroup.

During this time, the Department had also been meeting with the dischargers and purveyors in the Passaic River Basin on a regular basis through The Passaic River Task Group (1996 – 1998). The first priority of the Group was common concerns on phosphorus and eutrophication. Originally, the Whippany TMDL was proposed in 1999 to address both fecal coliform and phosphorus. Subsequently, only the fecal TMDL was established, since it was determined that, in the Whippany River, phosphorus was not rendering the waters unsuitable for the designated uses and so no phosphorus impairment was present. The Department did not pursue delisting because the Whippany River is a tributary to the Passaic River Basin wherein total phosphorus had not been assessed with respect to phosphorus rendering waters unsuitable for designated uses and, at a minimum, the Wanaque Reservoir was known to be a critical location of concern with respect to phosphorus loading. Thus, study of the larger area could result in the finding that phosphorus reductions on the Whippany would be needed to achieve water quality objectives in downstream locations.

The Group met through 1998, at which time the Department began a statewide watershed process within each of 20 watershed management areas that had been delineated for this purpose. Consequently, a Public Advisory Committee (PAC) and TAC were initiated for WMA 6. After the completion of the Whippany Fecal TMDL the Department-led Whippany River Watershed PAG and its TAC evolved into the WMA 6 PAC and TAC respectively which, met regularly from 1998-2003. The WMA 6 TAC assumed the mandate to discuss water quality related issues such as TMDL requirements.

In the Fall of 2000, the Department awarded two years worth of grant funding to 16 lead entities to serve as an extension of the Department to facilitate the watershed process for all 20 watershed management areas throughout the state. Deliverables from this statewide process varied; but resulted in the creation of PACs and TACs for WMAs 3 and 4; development of an extensive watershed characterization and assessment for WMAs 3, 4, and 6; creation of water resource based open space plans; and the implementation of numerous streambank restoration projects. At the same time, in order to successfully develop a comprehensive Passaic River Basin TMDL study, a separate committee was charged to focus on nutrient impairments in the Basin. With the Department, the Workgroup prepared the *Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin,* October 2001. The primary purpose of the report was to memorialize the outcome of the discussions to develop TMDLs and other management responses. The Workgroup continued to meet monthly through 2003.

In 2004, monitoring and initial modeling results from the TMDL work conducted by Quantitative Environmental Analysis, LLC (QEA), Najarian Associates and Omni Environmental, acting under contract to the Department, were shared and made available to the Passaic River Basin stakeholders through several informational sessions. On March 23, 2004, QEA presented their findings from the Ramapo River and Pompton Lakes Study to the WMA 3 PAC. Data exchange meetings based on the information collected by Omni Environmental were held on April 15, 2004, April 27, 2004, and September 28, 2004 and all stakeholders were invited to attend. On November 18, 2004, Najarian Associates presented preliminary findings on the Wanaque TMDL to the Passaic River Basin stakeholders. The Department conducted informal meetings with stakeholders on April 27 and September 28, 2004 to present model calibration and verification. The Department then conducted a meeting on June 23, 2005 with the affected dischargers in the Basin to present the findings from the work completed by Najarian Associates for the Wanaque Reservoir and that portion of the Basin above the confluence of the Pompton and Passaic Rivers.

On July 5, 2005 the Department proposed a Phase 1 Passaic River Study TMDL for phosphorus in the Wanaque Reservoir and a TMDL for Total Phosphorus to Address Pompton Lake and Ramapo River. A public hearing on these TMDLs was held on August 4, 2005 at the Cultural Center at the Lewis Morris County Park in Morristown. Nearly 100 people attended the hearing, some of the specific issues/comments raised are discussed below. After the public meeting at the request of the commenters the Department extended the public comment period until November 21, 2005.

- Applicability of the phosphorus standard as a not to exceed value in the Wanaque Reservoir is inappropriate.

  Based on the thorough monitoring of the Passaic River basin and identification of critical locations through dynamic modeling, watershed criteria for Wanaque Reservoir and Dundee Lake were developed as part of the current TMDL work. These criteria are expressed in terms of a seasonal average chlorophyll–a concentration specific to each location. The existing numeric criteria in the SWQS remain applicable in the scope of the Pompton Lake TMDL because no basis to establish a watershed criterion there has been identified.

- Costs associated with treatment for phosphorus removal and longer term implementation consequences such as increase in sludge production and associated cost for removal, chemical usage, and total dissolved solids increases in effluent being discharged to the receiving waters;

  The goal of a TMDL is to identify the load reductions necessary to achieve the SWQS and the designated use of the waterbody. The point source dischargers in the Pompton Lake drainage are currently achieving excellent effluent quality and the proposed LTA will not be a burden. Further, trading is an option to achieve the needed load reductions in the most cost effective manner.

- The LA-WATERS model and water quality data inputs should be made available to the public for use to fully evaluate the TMDL results.

  The LA-WATERS model is a proprietary model and has not been released by the owners, NJDWSC and Najarian Associates. The proprietary nature of the model was known when the TMDL study for the Passaic River basin was initiated. This fact notwithstanding, the Passaic TMDL workgroup endorsed the use of this model, as documented in the public participation process. The LA-WATERS has been peer reviewed and accepted as a valid predictive tool for the Wanaque Reservoir. The simulation outputs compared to actual data have been presented graphically in support documentation for this TMDL, which is sufficient for evaluating the scientific validity of the tool. The Pompton Lake/Ramapo River TMDLs provides inputs to LA-WATERS, but does not use this model in determining load reductions needed within the study area.

- Applicability of Phase I study to headwater dischargers given the in-progress comprehensive Phase II study.

The Department proposed the Phase I TMDL with initial hopes to jumpstart water quality improvement. However, given delays experienced in finalizing Phase I, the Phase II study has since been completed. The Department has determined that the most efficient means to achieve water quality improvement is to incorporate the relevant portions of the Phase I study into this TMDL document.

- Water supply diversions should be treated as point sources, and the North Jersey District Water Supply Authority should receive a NJPDES permit for adding phosphorus load to the Wanaque Reservoir.

  It has been determined that diversions are not point sources subject to permitting under the National Pollutant Discharge Elimination System permit, as discussed in the August 5, 2005 EPA memorandum, *Agency Interpretation on Applicability of Section 402 of the Clean Water Act to Water Transfers*. Nevertheless, the Department agrees conceptually that a water supply diversion responsible for delivering pollutant loads to a water body should be considered in assigning responsibility for pollutant load reductions necessitated by the act of diverting water. In this case, the load reductions required to achieve the water quality target for the in-stream critical location is the same as that needed to achieve the water quality target in the Wanaque Reservoir. Water quality trading is an option through which NJDWSC can play a role in protecting the water quality of the Wanaque Reservoir, which is affected by the diversion of Pompton and Passaic River water into the reservoir. This issue is not relevant within the Pompton Lake/Ramapo River TMDLs.

- Achieving the 80 percent reduction in NPS called for is unrealistic.

  In the Pompton Lake drainage area, an 80 percent reduction is still required to achieve SWQS. While ambitious, the Department believes the identified measures will attain the required nonpoint source load reductions. Follow up monitoring will identify if the strategies implemented through this TMDL are completely, or only partially successful. It will then be determined if other nonpoint source management measures must be implemented to fully attain water quality objectives or if it is necessary to consider other approaches, such as use attainability.

- What are the assurances that New York will attain New Jersey's SWQS at the border, a boundary assumption for the TMDL.

  NJDEP has been in communication with both New York State and US EPA regarding this TMDL and the need for New York to achieve New Jersey's SWQS at the border. Progress has been made with the application of a 0.2 mg/l effluent limit on the Western Ramapo Wastewater treatment facility. It is expected, however, that NPS load reductions also will be needed in order to fully achieve the boundary objective.

- Basin dischargers are receiving special treatment since other dischargers are already receiving permits with 0.1 mg/l phosphorus requirement.

  In March 2003 the Department issued a *Technical Manual for Phosphorus Evaluations for NJPDES Discharge to Surface Water Permits* that provides the necessary guidance to determine if the numeric criterion for phosphorus applies. The "exit ramp protocol" is available to all dischargers who receive a water quality based effluent limit for phosphorus based on the numeric criterion. However, in the Passaic River basin, in response to permit appeals when phosphorus limits were initially imposed there, the Department entered into settlement agreements with Passaic River basin dischargers establishing that the Department will not impose a phosphorus effluent limit until the appropriate limit has been determined through a TMDL. The settlement agreements predate and obviate the application of WQBELs pending the outcome of this TMDL.

For the Phase II study, the Department conducted additional outreach on May 19, 2006 and a presentation was made on behalf of the Department at the October 13, 2006 2nd Passaic River Symposium held at Montclair State University. The Department met with the dischargers and purveyors on September 11, 2006 to seek input on chlorophyll-a target endpoints for the Wanaque Reservoir and Dundee Lake Dam and to share preliminary findings on load reductions and how these should be translated into effluent limits.

Throughout the development of the TMDLs for the Passaic River Basin input was received through Rutgers New Jersey EcoComplex (NJEC). The Department contracted with the NJEC in August 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 the development of TMDLs and other management strategies. Their comments have resulted in refinement to model calibration resulting in this TMDL document.

Notice proposing the Passaic River basin phosphorus TMDL was published on May 7, 2007 in the New Jersey Register and in a newspaper of general circulation in the affected area in order to provide the public an opportunity to review the TMDL and submit comments. In addition, a public hearing was held June 7, 2007 at the Cultural Center at Lewis Morris County Park, 300 Mendham Road, Morristown, NJ 07962-1295. Notice of the proposal and hearing was provided to affected municipalities, dischargers, and purveyors in the watershed.

All comments received during the public notice period for this TMDL study and at the public hearing are part of the record for this TMDL and have been considered in finalizing this TMDL study. This TMDL has been adopted as an amendment to the Northeast WQMP. The full summary of comments and responses can be found in Appendix F.

Appendix A Municipalities Located in the Pompton Lake and Ramapo River and their MS4 Designation

Municipality	County	WMA(s)	Tier A or B	NJPDES Permit No.	Fertilizer ordinance required
Franklin Lakes Borough	Bergen	3,4	A	NJG0154121	Yes
Mahwah Township	Bergen	3,4	A	NJG0151211	Yes
Ramsey Borough	Bergen	3,4	A	NJG0151491	Yes
Oakland Borough	Bergen	3	A	NJG0148521	Yes
Pompton Lakes Borough	Passaic	3	A	NJG0152145	Yes
Ringwood Borough	Passaic	3	A	NJG0152749	Yes
Wanaque Borough	Passaic	3	A	NJG0149306	Yes
Wayne Township	Passaic	3, 4	A	NJG0150436	Yes

Appendix B Additional Impairments within TMDL Area

The two tables below identify the assessment units within the TMDL area of interest that have additional impairments not being addressed in the scope of this TMDL.

HUC 14 Assessment Units based on the proposed *2006 Integrated Water Quality Monitoring and Assessment Report*

WMA	Assessment Unit ID	Assessment Unit Name	Parameter	Designated Use Impairment
03	02030103100070-01	Ramapo R (below Crystal Lake bridge)	Dissolved Oxygen, pH	Aquatic Life (General & Trout)

Lake Impairments based on the proposed *2006 Integrated Water Quality Monitoring and Assessment Report*

WMA	Assessment Unit ID	Assessment Unit Name	Parameter	Designated Use Impairment
03	Pompton Lake-03	Pompton Lake-03	Mercury	Fish Consumption
03	Pompton Lake-03	Pompton Lake-03	PCBs	Fish Consumption
03	Pompton Lake-03	Pompton Lake-03	Dioxin	Fish Consumption
03	Pompton Lake-03	Pompton Lake-03	DDX	Fish Consumption
03	Pompton Lake-03	Pompton Lake-03	Chlordane	Fish Consumption
03	Ramapo Lake-03	Ramapo Lake-03	Mercury	Fish Consumption

Appendix C   Database of Phosphorus Export Coefficients

In December 2001, the Department concluded a contract with the USEPA, Region 2, and a contracting entity, TetraTech, Inc., the purpose of which was to identify export coefficients applicable to New Jersey. As part of that contract, a database of literature values was assembled that includes approximately four-thousand values accompanied by site-specific characteristics such as location, soil type, mean annual rainfall, and site percent-impervious. In conjunction with the database, the contractor reported on recommendations for selecting values for use in New Jersey. Analysis of mean annual rainfall data revealed noticeable trends, and, of the categories analyzed, was shown to have the most influence on the reported export coefficients. Incorporating this and other contractor recommendations, the Department took steps to identify appropriate export values for these TMDLs by first filtering the database to include only those studies whose reported mean annual rainfall was between 40 and 51 inches per year. From the remaining studies, total phosphorus values were selected based on best professional judgment for eight land uses categories.

The sources incorporated in the database include a variety of governmental and non-governmental documents. All values used to develop the database and the total phosphorus values in this document are included in the below reference list.

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Appendix D: Summary of Reckhow (1979a) model derivation

The following general expression for phosphorus mass balance in lake assumes the removal of phosphorus from a lake occurs through two pathways, the outlet (M_o) and the sediments (ϕ):

$$V \cdot \frac{dP}{dt} = M_i - M_o - \phi \qquad \textbf{Equation 1}$$

where:
- V = lake volume (10^3 m³)
- P = lake phosphorus concentration (mg/l)
- M_i = annual mass influx of phosphorus (kg/yr)
- M_o = annual mass efflux of phosphorus (kg/yr)
- ϕ = annual net flux of phosphorus to the sediments (kg/yr).

The sediment removal term is a multidimensional variable (dependent on a number of variables) that has been expressed as a phosphorus retention coefficient, a sedimentation coefficient, or an effective settling velocity. All three have been shown to yield similar results; Reckhow's formulation assumes a constant effective settling velocity, which treats sedimentation as an areal sink.

Assuming the lake is completely mixed such that the outflow concentration is the same as the lake concentration, the phosphorus mass balance can be expressed as:

$$V \cdot \frac{dP}{dt} = M_i - v_s \cdot P \cdot A - P \cdot Q \qquad \textbf{Equation 2}$$

where:
- v_s = effective settling velocity (m/yr)
- A = area of lake (10^3 m²)
- Q = annual outflow (10^3 m³/yr).

The steady-state solution of Equation 2 can be expressed as:

$$P = \frac{P_a}{v_s + z/T} = \frac{P_a}{v_s + Q_a} \qquad \textbf{Equation 3}$$

where:
- P_a = areal phosphorus loading rate (g/m²/yr)
- z = mean depth (m)
- T = hydraulic detention time (yr)
- Q_a = Q/A = areal water load (m/yr).

Using least squares regression on a database of 47 north temperate lakes, Reckhow fit the effective settling velocity using a function of areal water load: $P = \frac{P_a}{11.6 + 1.2 \cdot Q_a}$. **Equation 4**

Derivation of Margin of Safety from Reckhow *et al* (1980)

As described in Reckhow *et al* (1980), the Reckhow (1979a) model has an associated standard error of 0.128, calculated on log-transformed predictions of phosphorus concentrations. The model error analysis from Reckhow *et al* (1980) defined the following confidence limits:

$$P_L = P - h \cdot \left(10^{(\log P - 0.128)} - P\right)$$
$$P_U = P + h \cdot \left(10^{(\log P + 0.128)} - P\right)$$
$$\rho \geq 1 - \frac{1}{2.25 \cdot h^2}$$

where:

P_L = lower bound phosphorus concentration (mg/l);
P_U = upper bound phosphorus concentration (mg/l);
P = predicted phosphorus concentration (mg/l);
h = prediction error multiple
ρ = the probability that the real phosphorus concentration lies within the lower and upper bound phosphorus concentrations, inclusively.

Assuming an even-tailed probability distribution, the probability (ρ_u) that the real phosphorus concentration is less than or equal to the upper bound phosphorus concentration is:

$$\rho_u = \rho + \frac{1-\rho}{2} = \rho + \frac{1}{2} - \frac{\rho}{2} = \rho \cdot \left(1 - \frac{1}{2}\right) + \frac{1}{2} = \frac{1}{2} \cdot \rho + \frac{1}{2}$$

Substituting for ρ as a function of *h*:

$$\rho_u = \frac{1}{2} \cdot \left(1 - \frac{1}{2.25 \cdot h^2}\right) + \frac{1}{2} = \frac{1}{2} - \frac{1}{4.5 \cdot h^2} + \frac{1}{2} = 1 - \frac{1}{4.5 \cdot h^2}$$

Solving for *h* as a function of the probability that the real phosphorus concentration is less than or equal to the upper bound phosphorus concentration:

$$\frac{1}{4.5 \cdot h^2} = 1 - \rho_u$$
$$h^2 = \frac{1}{4.5(1 - \rho_u)}$$
$$h = \sqrt{\frac{1}{4.5(1 - \rho_u)}}$$

Expressing Margin of Safety (MoS_p) as a percentage over the predicted phosphorus concentration yields:

$$MoS_p = \frac{P_U}{P} - 1 = \frac{P_U - P}{P}$$

Substituting the equation for P_U:

$$MoS_p = \frac{P + h \cdot \left(10^{(\log P + 0.128)} - P\right) - P}{P} = \frac{h \cdot \left(10^{(\log P + 0.128)} - P\right)}{P}$$

$$P \cdot MoS_p = h \cdot \left(10^{(\log P + 0.128)} - P\right)$$

$$\frac{P \cdot MoS_p}{h} = 10^{(\log P + 0.128)} - P$$

$$\frac{P \cdot MoS_p}{h} + P = 10^{(\log P + 0.128)}$$

Taking the log of both sides and solving for margin of safety:

$$\log\left(\frac{P \cdot MoS_p}{h} + P\right) = \log P + 0.128$$

$$\log\left(\frac{P \cdot MoS_p}{h} + P\right) - \log P = 0.128$$

$$\log\left(P\left(\frac{MoS_p}{h} + 1\right)\right) - \log P = 0.128$$

$$\log P + \log\left(\frac{MoS_p}{h} + 1\right) - \log P = 0.128$$

$$\log\left(\frac{MoS_p}{h} + 1\right) = 0.128$$

$$\frac{MoS_p}{h} + 1 = 10^{0.128}$$

$$\frac{MoS_p}{h} = 10^{0.128} - 1$$

$$MoS_p = h\left(10^{0.128} - 1\right)$$

Finally, substituting for *h* yields Margin of Safety (MoS_p) as a percentage over the predicted phosphorus concentration, expressed as a function of the probability (ρ_u) that the real phosphorus concentration is less than or equal to the upper bound phosphorus concentration:

$$MoS_p = \sqrt{1 / \left((1 - \rho_u) * 4.5\right)} \times \left(10^{0.128} - 1\right)$$

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Appendix F: Response to Comments: Non-tidal Passaic River Basin and Pompton Lake/Ramapo River Phosphorus TMDLs

Summary of Public Comments and Responses
The following people (listed alphabetically) submitted written and/or oral comments on one or both of the proposed TMDLs:

1. Alexander, Diane of Maraziti, Falcon, & Healey LLP for Rockaway Valley Regional Sewerage Authority, Letter and fax (same) dated July 6, 2007
2. Bongiovanni, Robert - Executive Director of Two Bridges Sewerage Authority. Letter dated July 3, 2007 (submitted with 16. below)
3. Covelli, Frank - Vice-Chairman of Wanaque Valley Regional Sewerage Authority, Letter dated November 8, 2006
4. Curran, Kelley of Great Swamp Watershed Association, Letter dated August 9, 2007
5. Decker, George - Chairman of Pompton Lakes Borough Municipal Utilities Authority, Letter dated November 7, 2006
6. Duch, Thomas - City of Garfield, Letter dated May 22, 2007
7. Filippone, Ella - Executive Director of Passaic River Coalition Watershed Association, Public Hearing, June 7, 2007
8. Filippone, Ella and Anne Kruger, Passaic River Coalition, Letter dated June 25, 2007
9. Filippone, Ella and Anne Kruger, Passaic River Coalition, Letter dated June 7, 2007
10. Goodsell, Robert of Post, Polak, Goodsell, MacNeill & Strauchler for Warren Township Sewerage Authority, Letter and fax (same) dated July 6, 2007
11. Kehrberger, Patricia of Hydroqual, Inc. for Township of Wayne, Letter and fax (same) dated July 6, 2007
12. Kehrberger, Patricia of Hydroqual, Inc. for Warren Township Sewerage Authority, Letter and fax (same) dated July 6, 2007

13. Kehrberger, Patricia of Hydroqual, Inc. for Warren Township Sewerage Authority, Letter and fax (same) dated September 19, 2007
14. Matarazzo, Pat - Chairman of Passaic River Basin Alliance, Public Hearing June 7, 2007
15. Meyers, Mark of Quantitative Environmental Analysis, LLC for Two Bridges Sewerage Authority, Technical memorandum dated July 2, 2007
16. Plambeck, Richard - Mayor of Chatham Borough, Public Hearing June 7, 2007
17. Platt, Fletcher of Hatch Mott MacDonald and Technical Advisory Committee Member, Public Hearing, June 7, 2007
18. Singer, Steven - Counselor-at-Law for Township of Wayne, Letter and fax (same) dated July 6, 2007 (submitted with 11. below)
19. Thompson, B. - Email of July 6, 2007 with forwarded July 6, 2007 letter from N. Bardach of Virotech USA, Inc.
20. Tittel, Jeff - Director of Sierra Club, Public Hearing June 7, 2007
21. United States Environmental Protection Agency – Region 2, Letter dated July 9, 2007
22. Wolfe, Bill - Director of New Jersey Chapter of Public Employee for Environmental Responsibility (PEER), Public Hearing, June 7, 2007
23. Wynne, Michael - Executive Director of Hanover Sewerage Authority, Letter and fax (same) dated July 6, 2007

A summary of comments on the proposals and the Department's responses to those comments follows. The numbers(s) in brackets at the end of each comment corresponds to the commenters(s) listed above.

Extend Comment Period:

1. Comment: The Department should extend the comment period an additional 60 days to allow sufficient time to evaluate various aspects of the Phase 2 Watershed Model. (10)

Response: The entire TMDL development process included significant information sharing with the public and multiple opportunities for public comment. For the formal proposal, the Department advertised the public hearing 30 days prior to the date of the hearing and allowed a 30 day comment period following the hearing. In addition, due to unexpected difficulties in making the model available on the web, an additional 30 days was allowed to comment on the proposed TMDLs. The Department believes that a further extension of the comment period would not be likely to raise issues or provide new information, data or findings that were not previously raised or provided during the development of the amendment or during the comment period outlined above. The Department believes that adequate opportunity for comment was provided to all commenters on this amendment without the necessity of a further extension of the comment period.

End Point:

2. Comment: Use of site-specific criteria is supported. Based upon review of the proposed criteria and supporting documentation, commenter agrees that chlorophyll-*a* represents an optimum endpoint for the Wanaque Reservoir and Dundee Lake TMDLs. In addition, based upon the modeling results presented in the proposed report and supporting technical reports, it appears that the proposed chlorophyll-*a* values of 10 ug/L for the Wanaque Reservoir and 20 ug/L for Dundee Lake are adequately protective of the applicable designated uses. Specifically, the modeling results, as presented in the various figures, indicate that compliance with the chlorophyll-*a* proposed values will

minimize the current nutrient-based impairments to these two waters: excessive diurnal dissolved oxygen swings, and elevated chlorophyll-*a* levels. The referenced literature and State examples serve to further justify the selection of these values. (21)

Response: The Department acknowledges the support of the watershed criteria developed for the two critical endpoints in the Passaic River Basin. With adoption of these TMDLs as amendments to the applicable Water Quality Management Plans, these criteria are adopted watershed criteria in accordance with the New Jersey Surface Water Quality Standards, *N.J.A.C.* 7:9B-1.5(g)3. The Department plans to post watershed criteria established as part of an adopted Water Quality Management Plan on its Water Quality Standards page.

3. Comment: Commenter believes that the discussion of the criteria could be reorganized to strengthen and clarify the justification as follows: a) the detailed information in Appendix E that taken together leads to the conclusion that designated uses are protected should be summarized there and added to the main document on page 18; b) the experience of other states could be relegated to supporting information rather than included as part of the justification. (21)

Response: The Department believes that the body of the TMDL document should summarize information that is set forth in greater detail in Appendices and/or the supporting documents that accompany the TMDL. Repeating the detailed information contained in Appendix E in the body of the TMDL does not add to the strength of the argument. The detailed information on the experiences of other states has been moved to Appendix E. In addition, the Department has revised Section 3 and Appendix E to more clearly state that designated uses will be supported with attainment of the watershed criteria.

4. Comment: On page 17 there is a reference to a New York State guidance value of 20 ug/L of chlorophyll-*a* and a New York City value of 15 ug/L chlorophyll-*a* for the New York City water supply reservoirs. Please note that both the 20 ug/L and 15 ug/L values are for total phosphorus, not chlorophyll-*a*. In addition, it should be noted that the total phosphorus value 15 ug/L relates to a chlorophyll-*a* concentration of 7.0 ug/L, and is only applied to a subset of the New York City water supply reservoirs. (21)

Response: The error noted by the commenter was based on the commenter's review of a pre-release draft. The errors referenced by the commenter were corrected prior to release of the final May 7, 2007 proposal.

5. Comment: 40 C.F.R. 131.6(a)-(f) specify the minimum requirements for a water quality standards submission to EPA. With regard to the State's submission of the site specific chlorophyll-*a* criteria for the Wanaque Reservoir and Dundee Lake, elements (b), (c) and (e) apply. Based upon the commenter's review of the applicable sections of the proposed TMDL Report, elements (b) and (c) are included in the proposal. The Department must also include the requisite Attorney General certification as part of the final submission in order to address the requirements of 40 C.F.R. 131.6(e). (21)

6. Comment: 40 C.F.R. 131.20(a)-(c) specify the Federal requirements for State review and revision of water quality standards. With regard to the State's submission of the site-specific chlorophyll-*a* criteria for the Wanaque Reservoir and Dundee Lake, the applicable 40 C.F.R. 131.20 elements that apply are (b) and (c). The Department has fulfilled the requirements of 40 C.F.R. 131.20(b) through its public participation process. The Department's submission of the final chlorophyll-*a* criteria for the

Wanaque Reservoir and Dundee Lake, along with the final methodologies used for site-specific criteria development, as well as the above-referenced Attorney General certification will satisfy the requirements of 40 C.F.R. 131.20(c). (21)

Response to Comments 5 and 6: The TMDL documents, revised for adoption in accordance with the response to comments, include the final documentation of the watershed criteria (not site specific) relative to the phosphorus standard within the non-tidal Passaic River basin. The Department notes that the referenced DAG certification is required under Federal regulations to stipulate that the water quality standards have been duly adopted pursuant to State law. This certification was provided to EPA as part of the submission of the current Surface Water Quality Standards, which were approved by EPA's letter dated August 16, 2002. That letter specifically approved the revision to the "phosphorus criteria to acknowledge that criteria may be developed through the watershed process (N.J.A.C. 7:9B-1.14(c)5." The Department believes this obviates the need for the DAG certification specified at 40 C.F.R. 131.6(e). The Department will provide any documentation determined to be necessary to establish that the watershed criteria are the applicable surface water quality criteria relative to the phosphorus standard in the specified portion of the non-tidal Passaic River basin.

7. Comment: The Department needs to show that the existing standard is inappropriate or under-protective before an alternate watershed-specific criterion is developed. Further, establishing the criterion as part of the TMDL does not appear to be procedurally correct. The target for the Phase 1 TMDL was not to exceed 0.05 mg/L. The seasonal average approach appears to be a back door ruse to weaken the compliance condition. The most stringent policy should be in place to protect the public water supply. (22)

Response: Site-specific or watershed criteria can be either the same, more, or less stringent than the existing/default criteria, as stated in the adoption of amendments to the Surface Water Quality Standards proposed on December 18, 2000, see 34 N.J.R. 537(a), January 22, 2002; specifically responses to comments 247, 248 and 343-351. Establishing the criteria in terms of the response indicator, chlorophyll-*a*, is not a weakening of the criteria. Instead, development of a dynamic model that simulates the effect of nutrients, productivity and water quality effects of productivity based on the characteristics of the specific watershed has allowed the Department to set criteria that provide protection of designated uses without requiring nutrient reductions aimed at achieving a default criterion. The SWQS state that watershed criteria shall be established through the watershed process, which includes through adopting a TMDL, which establishes said criteria.

8. Comment: Selection of chlorophyll-*a* as the endpoint parameter and as a seasonal average to measure compliance for Dundee Lake and Wanaque Reservoir is appropriate. Chlorophyll-*a* as a measure of algae related to taste and odor problems in water supplies (drinking water use), algae interference in the normal operation of a water treatment plant (drinking water use), recreation use (aesthetics) and the resultant dissolved oxygen (aquatic life use) are a direct measure of meeting designated uses. (11), (12)

9. Comment: The use of chlorophyll-*a*, a response indicator of the effect of phosphorus on algal growth, as the endpoint for the TMDL is applauded. The use of chlorophyll-*a* is supported over the former approach, which applied the numerical phosphorus limit without any consideration of the effect. (23)

10. Comment: The use of summer average phytoplankton chlorophyll-*a* as a measure of whether or not nutrient concentrations are excessive is appropriate and the critical locations for this measure are the

confluence of the Passaic and Pompton Rivers and in the Passaic upstream of Dundee Dam. The Department is commended for including Dundee Dam as an endpoint because it should be cleaned up so as to be suitable as a drinking water source. (7), (8), (9)

Response to Comments 8-10: The Department acknowledges these comments in support of use of chlorophyll-*a*. The Department selected chlorophyll-*a* as the appropriate response indicator for the Passaic River watershed criteria. Based on the development of a dynamic model for the Passaic River Basin that simulates the relationship between nutrients, productivity and water quality and allows identification of levels of chlorophyll-*a* that support designated uses in the critical locations.

11. Comment: While the use of chlorophyll-*a* as the response indicator for the TMDL is applauded, the selection of a summer average 10 ug/L target is very conservative and was made in the absence of any site specific data. A review of Florida lakes shows that 20 ug/L is exceeded only 2% of the time when the warm season average is 10 ug/L. This illustrates the conservative nature of the target. The selection of 10 ug/L is explained only in terms of reservoir characteristics: it is deep, and serves as a trout fishery and a drinking water supply. (15)

12. Comment: Moving from phosphorus to chlorophyll-*a* is a concern. We know phosphorus is a limiting factor. Chlorophyll-*a* is a biochemical byproduct. We all know what the standard is and that is what we should strive for. (20)

13. Comment: The seasonal average chlorophyll-*a* of 10 ug/L for the Wanaque Reservoir has not been documented as the appropriate end point and appears arbitrary. NJDEP lists the five factors taken into consideration in the selection of the chlorophyll-*a* value and cites a range of values adopted elsewhere, concluding that a conservative target is warranted for the Wanaque Reservoir. Was North Jersey District Waster Supply Commission (NJDWSC) input on the selection of the chlorophyll-*a* standard used or requested? An analysis and/or data from NJDWSC documenting the relationship of algae levels to treatment problems and/or taste and odor complaints from customers is necessary for the establishment of a protective chlorophyll-*a* standard for the reservoir. Although samples are collected monthly, values exceeding 10 ug/L are measured for most years. 15 ug/L appears to be normal for the Reservoir. NJDWSC should be an active participant in the establishment of the chlorophyll-*a* standard at their reservoir. (12)

14. Comment: The selection of 20 ug/l chlorophyll-*a* is arbitrary and not supported in the TMDL analyses. The Department's phosphorus technical guidance sets a threshold for chlorophyll-*a* of 24 ug/l as a seasonal average with a two-week mean of 32 ug/l. These values have been used for several years as a conservative threshold to determine when phosphorus is rendering waters unsuitable for designated uses. The endpoint should be the level at which Dundee Lake is not meeting designated uses. The 20 ug/L value was chosen to be conservative, an MOS was added, and the TMDL is based on an "extreme drought" year. The high sustained chlorophyll-*a* levels and extreme supersaturation of dissolved oxygen are not predicted in the Baseline Future Conditions. Absent measured impairments, the Dundee Lake endpoint should be 30 ug/l seasonal average. (11)

Response to Comments 11-14: The selected watershed criteria are appropriate and protective and were established taking into account site-specific data. The Department's Surface Water Quality Standards (SWQS) for phosphorus include narrative statements regarding allowable levels of nutrients based on the effect they have on primary productivity and water quality. These provisions recognize that phosphorus is a potential causal factor that may result in excessive primary productivity and associated water quality impacts, particularly with respect to dissolved oxygen and pH, but that it does not necessarily do so in every location. The SWQS also include a provision at N.J.A.C. 7:9B-1.5(g)3 for establishing site specific or watershed criteria with regard to phosphorus recognizing the scientific reality that the nutrient dynamics in a given setting may warrant a different numeric value for phosphorus or a different basis to assess attainment of designated uses. It is generally held that measurement of acceptable levels of nutrients is ideally done in terms of response indicators of excessive productivity, such as chlorophyll-*a* (*Protocols for Developing Nutrient TMDLs*, First Edition, November 1999; *Nutrient Criteria Technical Guidance Manual Lakes and Reservoirs*, First Edition, April 2000, EPA). Based on the cited EPA guidance and experiences of other states as discussed in Appendix E of the TMDL, the selected chlorophyll-*a* value varied and reflected a best professional judgment guided by factors such as climate, physical lake characteristics and designated uses. As set forth in Appendix E of the TMDL, the Department evaluated model simulations of water quality response in the critical locations, the particular characteristics of the critical locations and their uses, as well as literature values and EPA guidance documents to guide selection of the watershed criteria. The Passaic River Basin Nutrient TMDL Study report (Omni 2007, pp. 167-169) provides some discussion of the basis for the watershed criterion established for Dundee Lake based on a water quality target of 20 µg/l chlorophyll-*a* as a summer average. Appendix L of *The Passaic River Basin Nutrient TMDL Study report* (Omni 2007) also includes simulations of water quality response at Dundee Lake as well as throughout the river basin, given attainment of the 20 µg/l endpoint. Furthermore, the Wanaque Reservoir Supplemental report (Najarian, 2007) provides graphical outputs for total phosphorus, chlorophyll-*a*, organic phosphorus, dissolved inorganic phosphorus, water temperature and dissolved oxygen that illustrate the water quality associated with the endpoint of 10 ug/L chlorophyll-*a*. Based on this information, the selected watershed criteria are protective of designated uses.

The statement that "The high sustained chlorophyll-*a* levels and extreme supersaturation of dissolved oxygen are not predicted in the Baseline Future Conditions" is inaccurate. Extreme dissolved oxygen saturations and high chlorophyll-*a* were predicted under the Baseline Future Conditions at the critical locations, see Figures 36 and 37 on page 142 (Omni, 2007). Furthermore, actual measurements of chlorophyll-*a* and diurnal dissolved oxygen in the lower reaches of the Passaic River confirm high chlorophyll-*a* levels (97 µg/l at Market Street on August 14, 2002) and extreme supersaturation of dissolved oxygen (over 16 mg/l in August 2003). The suggested endpoint of 30 ug/l at Dundee Lake represents the Baseline Future Conditions, see graph 57 page 173. As stated above, this would result in extreme supersaturation of dissolved oxygen at the critical locations and would not be an acceptable endpoint. The use of the phosphorus protocol criteria at Dundee Lake is also not appropriate because the phosphorus protocol criteria were developed for flowing streams and this location is an impoundment. The *Technical Manual for Phosphorus Evaluations for NPDES Discharge to Surface Water Permits*, NJDEP, March 2003, which defines the criteria for determining is phosphorus is rendering waters unsuitable for the designated uses, specifically states that the "phosphorus protocol study, including application of the thresholds, is not applicable where there is a downstream impoundment. At the selected watershed criteria, the levels of biomass and associated water quality response parameters, dissolved oxygen and pH, are compatible with the actual and designated uses.

The proposed watershed criteria were presented to the regulated community and NJDWSC at the September 11, 2006 meeting. At that time, the NJDWSC indicated that this level of chlorophyll-*a* will provide suitable protection for use of the Wanaque Reservoir for public potable water supply after conventional filtration treatment, as provided in the SWQS designated uses for FW-2 waters.

15. Comment: It was understood that the Phase 1 TMDL would be superseded by the Phase 2 TMDL, but it was expected that the Phase 1 TMDL would jumpstart water quality improvement and the Phase 2 TMDL would ratchet down on limits to be fully protective. The Phase 1 TMDL had an endpoint of not to exceed 0.05 mg/L of total phosphorus while the Phase 2 TMDL establishes a watershed criteria in terms of chlorophyll-*a*. Which is more protective of the drinking water use? The Department should provide a side by side comparison of the two TMDL documents. (22)

Response: The commenter is correct in stating that the purpose of the Phase 1 TMDL, which addressed phosphorus impairment in the Wanaque Reservoir, was to accelerate water quality improvement by determining and directing the phosphorus reductions needed to attain SWQS in the reservoir. However, there was no preconceived notion of what the final outcome of the overall TMDL for the Passaic River basin would be. The outcome was to be and is driven by the science of the model results. The development and application of a dynamic, basin-wide model that is capable of simulating the effects of nutrients on productivity and the associated water quality effects has enabled the Department to provide a carefully balanced implementation approach using response indicators as the water quality endpoints. Tying phosphorus reduction to attainment of levels of chlorophyll-*a* that are protective of the designated uses achieves the water quality objective without incurring unnecessary treatment expense.

The commenter is directed to Figure 5.7 in (Najarian, 2005), and Figure 1 in the supplemental report entitled *Phosphorus Chlorophyll a Relationship Wanaque Reservoir Addendum to Najarian 2005* (Najarian, 2007) for a comparison of the in-lake phosphorus concentrations as the result of the two approaches. Beyond this, given the myriad differences in the two TMDL documents (spatial extent, modeling approach, critical locations, endpoints, etc.) a side by side comparison of the documents is not appropriate. Instead, the Department has explained in the current TMDL documents that the Phase 1 TMDL has been withdrawn, provided a response to the key comments on the Phase 1 proposal, and has reiterated any relevant information from Phase 1 in the current TMDL documents.

16. Comment: The Passaic TMDL was developed for an overly conservative drought condition. NJDEP establishes wastewater treatment plant discharge effluent limits for phosphorus based a 7Q10 receiving water flow, a flow condition with a return period of 10 years. Najarian 2005 states that this time period was the third lowest in the 48 years of record, a return frequency of 16 years. Flow rates were also low; February 2002 had the lowest monthly flow in 50 years of record at Chatham and in 24 years of record at Pine Brook. The year 2002 represents a severe condition when NJDEP declared drought warning status for northeast New Jersey. From the “Wanaque Reservoir TMDL Development New Model Scenario” prepared by Najarian & Assoc. in 2007, the volume of diversion to the reservoir exceeded the reservoir during the “sustained drought” period of WY2002 (October 1, 2001 through September 30 2002) . In addition, the TMDL calculation was performed with pumping at the ultimate safe yield as provided by NJDWSC. Any carryover of phosphorus to the next year is minimal. The 2002 drought year upon which the Passaic TMDL is based is “conservative” and the developed chlorophyll-*a* standard should not apply. (12)

17. Comment: The Passaic TMDL for Dundee Lake was developed for an overly conservative drought condition, a point noted by the New Jersey EcoComplex (NJEC). Najarian 2005 states that the rainfall in this time period was the third lowest in the 48 years of record, a return frequency of 16 years. Flow rates were also low; February 2002 had the lowest monthly flow in 50 years of record at Chatham and in 24 years of record at Pine Brook. Effluent limits are based on a 7Q10 receiving water flow, a return period of 10 years. Flow is an important driver for productivity, illustrated by the reduction in chlorophyll-*a* in Baseline Future Conditions, when plants are at full permitted flow, compared to

Existing Conditions. It is recommended that the NJDEP use Water Year 2001 instead of the extreme drought year as the basis for the TMDL. (11)

Response to Comments 16 and 17: The TMDL was not developed for an overly conservative drought condition. The Passaic River Basin has experienced several drought periods in the last 15 years, notably 1994-1995, 1998-1999, and 2001-2002. From a water supply perspective, 2002 was notable but not unique. Reservoir capacity has dipped below 10 billion gallons three times since the beginning of 1993 – extensive pumpage from river intakes was needed to refill the reservoir after each event. Thus, given that this is a managed system, conditions that could produce the adverse water quality effects in the reservoir can occur more frequently (and more severely) than do purely meteorological droughts. Further, in terms of the prevalence of low-flow warm-weather conditions conducive to algal growth, 2002 was not significantly different than other recent drought periods. For instance, the average flow at the Little Falls gage (01389500) from June through September was 230 cfs in 2002, compared with 168 cfs in 1995. Similarly, 81% of the daily summer flows in 2002 were below the published 70th percentile flow of 295 cfs at that same gage, compared to 84% during the summer of 1995. The commenter states that phosphorus does not accumulate in the reservoir, presumably because water pumped in does, on occasion, exceed that which is pumped out. This situation does not occur every year and even when pumping does exceed outflow, phosphorus can settle below the level of pumpage and be available for algal growth following turnover events. Finally, even if 2002 were not utilized for the TMDL calculations, simulated algal concentrations at Dundee Lake were similar in 2001 and 2002.

18. Comment: The measurement of success of the TMDL must be based on attainment of the chlorophyll-*a* targets that will be assessed through a sufficient monitoring program. (15)

19. Comment: Confirmation is requested that the objective of the TMDL is the achievement of the designated chlorophyll-*a* level, not whether an in-stream phosphorus level of 0.4 ppm LTA has been met. (2)

Response to Comments 18 and 19: The attainment of the established watershed criteria at the critical locations is the objective of the TMDL. While the watershed criteria are established in terms of chlorophyll-*a*, attainment will depend on reducing phosphorus loads in accordance with the TMDL, which includes wasteload allocations and load allocations to point and nonpoint sources, respectively. An in-stream phosphorus level has not been specified. The TMDL is based on long term average effluent concentrations that will be applied to wastewater treatment facilities through NJPDES permitting following adoption of the TMDL. The long term average concentrations will be reflected as monthly average effluent limits in the applicable NJPDES permits, subject to water quality trading. As indicated in Table 14, most facilities will be receiving an effluent limit based on a long term average concentration of 0.4 mg/L. The Department concurs that assessment of successful implementation of the TMDL will require an adequate follow-up monitoring program, as described in the TMDL under “Follow-up Monitoring”.

Models:

20. Comment: It is stated that phosphorus concentrations in baseflow (page 58 of technical document) ranged from 0.02 to 0.09 mg/l in pristine locations, and from 0.02 to 0.13 mg/l in areas affected only by nonpoint sources; one would expect there to be a greater difference. There should be discussion of the reason(s) why these two concentrations are similar. (21)

Response: The referenced document does offer an explanation that the amount of forest and wetlands in a drainage area appeared to be the most significant influence on tributary concentration. To elaborate, the Passaic River headwaters are strongly influenced by major wetland complexes, namely the Great Swamp and Great Piece Meadows. An analysis of the export of phosphorus from the Great Swamp to the Passaic River is provided in Appendix D of the Passaic River Basin Nutrient TMDL Study report (Omni 2007). In addition, data at reference locations in the Passaic River basin demonstrate that tributaries in relatively pristine areas frequently have higher phosphorus concentrations than might otherwise be expected. The Passaic River TMDL study accounted for these background phosphorus sources using the best available data.

21. Comment: Using global parameters implies that the aquatic ecosystem has similar characteristics in all of the segments (pages 98-99 of technical document). What assumptions are used to make the determination as to which parameters should be calibrated globally or locally? (21)

Response: Most parameters are applied throughout the model domain (global). The EPA Water Quality Analysis Program 7.0 (WASP7) model allows that certain parameters can be assigned localized values. In this modeling approach, local parameter values are only assigned when necessary to obtain an acceptable calibration, unless localized information is available (such as location-specific light attenuation coefficients). It is possible to divide the study area into separate models that are then linked externally and this may be necessary to achieve an acceptable calibration in some waterbodies. In the Passaic River TMDL model, calibration was successful using a single model throughout the study area.

22. Comment: In the Light Extinction Coefficients (pages 68-69 of the technical document), "The surface light energy and the light energy at the deepest measurement were used to derive the value of K." Why was it estimated this way rather than taking the average over depth? (21)

Response: As described in the Passaic River Basin Nutrient TMDL Study report (Omni 2007, p. 68), the Beer-Lambert law was used to calculate light extinction coefficient as a function of light energy at the surface and light energy at a particular depth. The light energy at the deepest measurement was used in order to obtain an estimate over the largest depth of the photic zone. This procedure is commonly used to estimate light extinction coefficients when light energy measurements are available (Wool, T.A., R.B. Ambrose, J.L. Martin, E.A. Comer, WASP Version 6.0 Draft User's Manual, pp. 11-38).

23. Comment: Regarding Table 13: specify the dates of the July and August events; more than two events should be considered if K1 will be used throughout the year; estimates for light extinction coefficients should cover more than only the summer period and during storm events; and there is no description why the K1 values vary so much between the July and August event for some of the stations and the implications of this variability. (21)

Response: Light extinction measurements were generally taken during the July and August 2003 diurnal events, which occurred July 15, 16, and 18 of 2003 and August 24, 25 and 26 of 2003. The July and August light extinction coefficients are consistent for most locations, with only two of 23 showing variability. The extent and quality of light extinction data for the Passaic River TMDL study was appropriate given the state-of-the-art for these types of modeling studies. Light extinction data was sufficient and appropriate to inform a model concerned with productivity during critical periods. Light extinction is important during low-flow summer periods when periphyton and macrophyte productivity is highest. Light extinction can vary spatially in WASP, but not temporally. The Passaic River Basin

TMDL study benefited from multiple localized light extinction measurements, providing a basis to assign spatially variable values.

24. Comment: The observed Hydroqual and the observed Omni SOD data are significantly different. Do they represent one value or an averaged value? The observed values are very different than the calibrated SOD values. (page 111, Table 24 of the technical document). (21)

Response: Field measurements of SOD and sediment deposits are typically highly variable spatially and temporally due to varying flow regimes affecting deposition and scour (Rates, Constants, and Kinetics Formulations in Surface Water Quality Modeling, G. L. Bowie et. al., 1985). For the model, SOD values for large areas were needed. Taking into consideration the variability of individual site measurements, the issue of precision of SOD measurements in general, and the extensive amount of SOD data needed to characterize the SOD profile in the Passaic Basin based on data alone, SOD values were assigned by model calibration rather than assign one value or an average value. A limited number of SOD measurements at sampling stations in the Passaic River were conducted in order to perform a reality check on the calibration SOD values. It should be noted that average dissolved oxygen levels are largely influenced by hydraulics through reaeration, and by stream temperature due to solubility differences. SOD primarily influences the average DO and causes only a minor impact on the DO diurnal variation.

25. Comments: In many of the figures of the report, it is difficult to determine the importance of the difference between simulated and observed data. The differences are provided as total difference rather than percentage difference (i.e. Table 8). For other tables, the units are not provided. (i.e. Table 25). There is at times limited or no discussion of the implication of differences between simulated and observed data. Based on the figures provided how accurate is the model? (i.e. Table 22). Whenever observed mean data is presented the number of data points used should be included (i.e. Table 26). (21)

Response: The perceived difficulty in determining the importance of differences between simulated and observed data is a result of the large-scale watershed modeling study that was conducted. The graphical presentation in Appendices E and F of the Passaic River Basin Nutrient TMDL Study report (Omni 2007) was deemed the best way to convey the overall results.

As noted, even a well-calibrated model may at times show a poor comparison between simulated and observed data; for example, a poorly characterized boundary condition may cause a poor fit, even though the model is well-calibrated and perfectly suitable to evaluate future conditions based on an assumed boundary condition. On the other hand, a poorly calibrated model can show a very good fit between simulated and observed data, perhaps due to an over-reliance on localized parameters to force a good fit, or due to a limited set of observation data under a variety of conditions. It is appropriate to provide absolute differences rather than percent differences between simulated and observed data, because the absolute magnitude provides a better sense of the importance of the difference. For instance, the percent differences for ammonia might be high simply because the ammonia levels are low. Units for the calibration statistics are concentrations (e.g. mg/l), and are provided in the example calibration graphs. For Omni sampling stations, generally 12 or 20 observations were available for the 2003 calibration period. Statistics were only derived when enough observed data were available. The model clearly captures the salient features of the system within a unified framework and with an acceptable degree of accuracy, and can be utilized to relate point and nonpoint sources of phosphorus to water quality impacts at critical locations under a variety of conditions.

26. Comment: When providing coefficients of correlation (page 93), the document should state whether the comparison between data sets is for a monthly, daily or hourly time period. The squared correlation coefficient, R^2, could be significantly different between monthly and daily datasets, and this could also give valuable insight on model performance. Are there other statistical measures that could provide insight on model accuracy and performance? (21)

Response: Descriptions of calibration statistics are provided in the Passaic River Basin Nutrient TMDL Study report (Omni 2007, p. 98). Statistics were calculated automatically within the WASP post-processor by comparing intra-day simulation values with observed values. This method is the only one available within the WASP post-processor, and is considered the preferred method when evaluating the goodness of fit for a dynamic water quality model. The use of intraday comparisons tends to exaggerate the differences between observed and predicted values.

The most relevant statistics available within the WASP post-processor were selected. "Mean Error" provides a key absolute measure of the average difference between predicted and observed concentrations. A Mean Error of zero indicates that overpredictions and underpredictions were exactly balanced. The average predicted value is provided along with the average among the observed values. These means are important because they provide a context to understand the importance of the Mean Error. The predicted and observed standard deviations provide an indication of how well the model captured the variability about the mean. Finally, the squared correlation coefficient, R^2, is provided as a measure of the degree to which model predictions and observations vary together linearly. Appendix G includes graphical representations of predicted versus measured total phosphorus concentrations for stations throughout the model domain, providing another measure of model performance. The calibration procedure consisted primarily of plotting the discrete observed data and the continuous simulated data together, and comparing them. Limited statistics were considered to provide some guidance during calibration. Based on the many representations of model performance, and thorough evaluation by the Department and the New Jersey EcoComplex, the model clearly captures the salient features of the system within a unified framework and with an acceptable degree of accuracy, and can be utilized to relate point and nonpoint sources of phosphorus to water quality impacts at critical locations under a variety of conditions.

27. Comment: What is limiting biological productivity in the different stream segments? (Page 149 of the technical document) For example, if in certain locations DO is not very sensitive to phosphorus reductions, but these areas are very sensitive to changes in velocity and light, couldn't this be evaluated in the model analysis? (21)

Response: Biological productivity is influenced dynamically by a number of factors, including nutrient availability, flow, velocity, light penetration, temperature, and substrate. Some of these factors can be evaluated independently through model sensitivity. The purpose of this study was to determine the extent to which phosphorus was affecting biological productivity. Where phosphorus was found to be causing excessive productivity and related water quality impacts, the purpose was to determine the amount of phosphorus reduction that would achieve water quality objectives, expressed in terms of the watershed criteria as chlorophyll-*a* criteria at the critical locations. The study did conclude that other factors were responsible for water quality effects in the portions of the basin. For example, lack of light penetration due to naturally occurring dark water was the reason for low observed productivity in upper reaches of the basin, even when phosphorus was present in sufficient quantities to support high productivity; and low dissolved oxygen was found to be a naturally occurring condition in some locations either because source waters were naturally low in dissolved oxygen or because of high natural SOD from large wetlands complexes.

28. Comment: Why not incorporate shading in the TMDL analysis? (21)

Response: Generally, the modeled streams in this study are higher order streams for which shading would not be expected to be as significant a factor as in smaller streams. For this reason, data on percent canopy cover were not collected during the data collection phase. As expected, it was not necessary to incorporate shading to obtain a meaningful calibration. Few, if any, large watershed studies of this magnitude incorporate shading into the water quality analyses. In terms of using shading as a management response, this may be effective for a limited spatial extent in smaller tributaries, but productivity was not found to be an issue in these smaller order stream areas.

29. Comment: Does the reduction in phosphorus loads have an effect on biological productivity throughout at different stations in the watershed? Chlorophyll-*a* graphs could accompany phosphorus graphs for each location in Figures 26-48 of the technical document. (21)

Response: The overall conclusion of the study was that phosphorus was responsible for causing excessive primary productivity in the identified critical locations, but not elsewhere in the basin. Therefore, focus was on simulated outcomes of reductions at the critical locations. Chlorophyll-*a* graphs showing the impact of phosphorus reductions in the body of the Passaic River Basin Nutrient TMDL Study report (Omni 2007) are provided for locations where phytoplankton is important. Appendix J provides a more complete set of graphs showing the impact of extreme phosphorus reductions on chlorophyll-*a* and dissolved oxygen throughout the basin.

30. Comment: A major assumption in the TMDL model is "that phosphorus is a conservative constituent and the dominant factor in determining in-stream concentrations of phosphorus in the Passaic system is the relative dilution, depending on available streamflow, of a significant and relatively constant wastewater discharge load." This seems to hold true at current phosphorus loadings in the Passaic and Pompton Rivers, which exceed surface water quality standards several-fold. However, there is inadequate narrative detail describing the range of in-stream phosphorus concentrations for which the conservative mass-balance assumption is valid. Please explain in greater detail why the assumptions made at current loadings will remain valid when TMDLs are implemented and dischargers reduce their loadings. (21)

Response: This assumption is only used in a limited way for estimating loadings to the Wanaque Reservoir from direct drainage to the reservoir outside the domain of the dynamic model and for loadings to Pompton Lake. Loading reductions from dischargers are not significant in these drainage areas and exceedances of existing numeric criteria are not significant. Therefore, the loading assumptions from the limited drainage areas where this approach was used are believed to remain valid in the future scenario.

31. Comment: In Table 3-1, the R^2 for the mass balance model for the Ramapo River at Pompton Lakes is 0.244. According to the analysis, the reason for low correlations seems to be partially due to greater uncertainty in measuring phosphorus samples with concentrations below 0.10 mg/l. Please identify background literature that supports this claim. What is the correlation between observed and simulated phosphorus concentrations for all data above 0.10 mg/l? (21)

Response: Background literature supporting the statement made regarding the greater uncertainty in measuring phosphorus samples with concentrations below 0.10 mg/l can be found in numerous references; the report provides two: USEPA, (1993) "Guidance on Evaluation, Resolution, and

Documentation of Analytical Problems Associated with Compliance Monitoring: Washington, D.C., U.S. Government Printing Office, USEPA 821-B-93-001, June 1993; and, USEPA, (1985) "U.S. Code of Federal Regulations, Title 50," Washington, D.C., U.S. Government Printing Office, November 13, 1985, 46906. Statistical analysis, including correlation between observed and simulated phosphorus concentrations for data above 0.10 mg/l, would be of limited usefulness and not technically supported because of the small number of observations- only 10 data points exceeded the 0.10mg/L TP concentration.

32. Comment: On page 3-3 of the technical document for the Pompton Lake TMDL, please identify either the literature sources or the monitoring data on which the estimated baseflow concentration of 0.01 mg/l is founded. Please explain whether the baseflow concentration could vary based on the specific soils and bedrock present in the watershed? (21)

Response: It is important to note that the base flow component referred to in Pompton Lake TMDL document should not be confused with the tributary baseflow component used in the dynamic modeling for the overall Passaic River Basin TMDL document. Tributary baseflow in the latter document is the in-stream total phosphorus concentrations taken under 70th percentile low flow and includes both groundwater and residual from surface runoff/interflow. In the Pompton Lake document, the base flow concentration consists of ground water only. A base flow separation method was used with areal runoff loading coefficients to derive nonpoint source loadings in the Pompton Lake document. While ground water phosphorus concentration may vary based on local conditions, but in this region, based on the USGS ground water data for Passaic County, the 90th percentile dissolved phosphorus is 0.01 mg/L and the mode of the data is also 0.01 mg/L. This substantiates the use of this value for the base flow/ground water component in the Pompton Lake TMDL.

33. Comment: An explanation is needed as to how septic systems are incorporated into the TMDL analysis. The Wanaque Reservoir watershed seems to be impacted by septic system runoff since relatively high nitrate concentrations are found in West Brook, Cupsaw Brook and Erskine Brook, while the total phosphorus concentrations are similar for all tributaries. (See Table 2-6 on Page 2-4 of the technical document). Although one can surmise that these subwatersheds do not have sewer service, there could be an alternative explanation. The documents provide no information regarding the location of non-sewered areas or the failure rates of septic tanks in both the Wanaque Reservoir watershed and the greater Passaic-Pompton-Ramapo watershed. Furthermore, do areal phosphorus loadings for urban areas differ if they are served by separate storm water and sanitary sewer systems, combined sewer systems, or septic systems? This could be useful in determining the reduction in non-point source pollution that could be reasonably expected and also in providing more details on BMP implementation. (21)

Response: The majority of TMDL Approach Areas 1 and 3 are covered by centralized sewer systems. The majority of TMDL Approach Area 2 and 4 is serviced by individual septic systems and is taken as a headwater boundary condition to the TMDL model. Areas served by septic systems can be expected to contribute higher concentrations of nitrate either overland from failing systems or through groundwater entering the streams, because this compound is soluble and very mobile. However, the same is not true of phosphorus. The TMDLs and the technical documents address phosphorus loading from all nonpoint sources by hydrograph separation and assigning EMCs for each land use category. EMCs are derived through monitoring or Unit Areal Loads, and the non-storm load is estimated using the tributary baseflow monitoring results or groundwater data, depending on the approach applied (see discussion of Approach Areas in the TMDL document). Phosphorus is generally immobilized in the soil matrix, which is borne out by data on ground water concentrations of phosphorus in the basin (see response to Comment 32). Absent information about a particular septic system problem, the approaches used for nonpoint sources are believed to adequately account for septic system loading. Nevertheless, malfunctioning septic systems (e.g., those that result in a discharge directly to a water body) are identified as potential sources in Section 4.0 Source Assessment (page 34) and in Section 7.0 Implementation Plan (page 48), but the Department is not aware of any actual malfunctions. This potential 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; rather, they are ephemeral events that are addressed through compliance and enforcement measures as they occur. Regarding different loadings delivered by separate storm sewer areas compared to combined sewer areas, the loading coefficient method is not used in the very limited spatial extent of the study area in which combined sewers are used. In any case, phosphorus loadings from combined sewers were calculated separately from other stormwater loadings, as shown in Table 14 of the Passaic TMDL.

34. Comment: The Wanaque Reservoir model appears to over-estimate algal biomass during the 2002 drought period and the Wanaque Reservoir TMDL scenario results were incorrectly compared with the seasonal average target. (15)

Response: The observation that algal biomass is over-estimated during the 2002 drought is true in some locations and is believed to be the result of operational practices to prevent algal blooms during this period (e.g., application of alum, ultrasound treatment, aeration, etc.) Note that the model tracked the observed data during year 2002 at the Erskine station (Figure 4.15), where no alum was applied. Also, the available database indicates a relatively high nitrate concentration response to diversion loading at Raymond Dam during this period – concentrations that are largely unaffected by such practices. Since the model generally tracked the chlorophyll-*a* concentration data during other drought years (e.g., 1995, 1998), it is not overly conservative in predicting reservoir chlorophyll-*a* concentrations, absent taking extraordinary measures to suppress expression of algae.

35. Comment: The areas in the Wanaque Reservoir where characterizations are performed are not appropriate to determine the real background from undeveloped portions of the contributing drainage areas or to reveal how funky the reservoir gets when the pumps are turned on. (20)

Response: The TMDL modeling approach addressed the entire Wanaque Reservoir, and both graphic and/or tabular outputs for several stations within the reservoir representing both background (Erskine) and "hot spots" (Raymond Dam and West Brook) within the reservoir were presented in the supporting documentation (Najarian, 2005). The critical locations reflective of the most severe effects from diversion pumping were specifically modeled, ensuring that the critical location is accounted for when specifying load reductions.

36. Comment: The reservoir model does not accurately represent non-diversion and diversion loads to the reservoir; the dynamics of diversion events are not modeled accurately. (15)

37. Comment: The Department needs to explain the rationale for the parameters used in the reservoir water quality. (15)

38. Comment: Cycling of phosphorus in the Wanaque Reservoir is an important component of the model simulations that form the basis of the TMDL calculation. Insufficient data is provided to confirm that the Reservoir model accurately describes phosphorus dynamics. The Department has

access to a numerical simulation model, in-reservoir monitoring data, and well-defined reservoir hydraulics to defensibly support its TMDL. Data on Reservoir-wide chlorophyll-*a* concentrations, as well as water treatments that NJDWSC implements, should be made available so as to confirm the effectiveness of the TMDL in protecting the designated use of public water supply. (15)

Response to Comments 36-38: These comments were made on the Phase 1 TMDL and were repeated for the Phase 2 TMDL. The reservoir model is a hydrothermal/water quality model that was designed and is appropriate for evaluating the effect of diversion scenarios on water quality and trophic state in the reservoir. The reservoir model, Laterally Averaged - Wind and Temperature Enhanced Reservoir Simulation (LA-WATERS) simulates laterally averaged velocities, water temperature and constituent concentrations at all grid locations for a selected period. Simulated constituents include organic phosphorus, dissolved inorganic phosphorus, particulate inorganic phosphorus, dissolved oxygen, carbonaceous biological oxygen demand, nitrogenous biological oxygen demand and temperature. In addition, a relationship was derived between phosphorus and chlorophyll-*a*. The model simulates responses in these parameters, given specified loading inputs from diversion and natural drainage sources and the hydraulic dynamics of inflow/outflow volumes in this managed reservoir system. The Najarian 2005 TMDL study report provides sufficient data for the evaluation of model performance and results. Data is provided in the form of graphic outputs, summary loading budgets, and error analysis. For the Phase 2 TMDL, which targets a watershed criteria expressed as chlorophyll-*a*, additional information regarding the simulation of chlorophyll-*a* response, as well as tabular chlorophyll-*a* data for the Wanaque Reservoir at Raymond Dam, were provided in a supplemental report (Najarian, 2007). While the actual model code was developed under funding of the NJDWSC and remains proprietary to that agency, the reservoir model has been extensively documented in two prior reports ("Influence of Wanaque South Diversion on the Trophic Level of Wanaque Reservoir and its Water Quality Management Program", Najarian 1988 and "A preliminary assessment of water quality status of the upper Passaic River and re-verification of the Wanaque Reservoir model", Najarian 2000). Further, the model's hydrothermal and water quality algorithms have been published in peer-reviewed journals ("Mixed-Layer Hydrothermal Reservoir Model," M. ASCE. Journal Hydraulic Engineering. 120 (7), 846-862 and "A Multicomponent Model of Phosphorus Dynamics in Reservoirs," Water Resources Bulletin, 20, No. 5:777-788).

39. Comment: Key aspects of the Passaic TMDL are supported as technically defensible; however, it is also technically flawed in several key aspects that need to be addressed before adoption. The Wanaque Reservoir TMDL is flawed since only one alternative was evaluated. The seasonal average chlorophyll-*a* in Tables 1 and 2 of Najarian 2007 shows the summer average chlorophyll-*a* is 9.2 mg/L. It appears that the TMDL for Wanaque Reservoir including the MOS was the product of a guess that the TMDL LTA for Dundee Lake would "work" for the reservoir. More interchange between the river and reservoir modeling should be performed. The integrated model framework of DAFLOW plus the dynamic Passaic River Model plus the Wanaque Reservoir Model (the product of years of development and considerable public and discharger monies) has not been fully utilized to arrive at a TP load scenario for the reservoir. Model runs for existing conditions, Baseline Future Conditions, Most Extreme Reduction of Phosphorus (MERP) and TMDL scenarios with alternate LTAs and seasonal phosphorus reduction are needed. These analyses would provide an understanding of how the reservoir chlorophyll-*a* is influenced by management of the Passaic River phosphorus. (12)

40. Comment: The final Wanaque Reservoir TMDL was determined with a single reservoir model projection. It was not used to determine load reductions, including diversion loads, required to meet the new chlorophyll-*a* standard; a TMDL has not been established. (13)

41. Comment: Only one run of LA-WATERS was done to confirm that the chlorophyll-*a* in the reservoir would not exceed 10 ug/L with the LTA of 0.4 mg/L and 60% NPS reduction. This does not establish that the criterion could not be met by less stringent LTAs. (10)

Response to Comments 39-41: More than one TMDL scenario was evaluated to arrive at the TMDL for Wanaque Reservoir. As stated in Omni 2007, p. 172, "Time series of phosphorus concentration predictions were provided to NJDEP and their technical consultant for the Wanaque Reservoir TMDL Study (Najarian and Associates) in order to predict the summer average phytoplankton in the Wanaque Reservoir associated with each phosphorus reduction scenario. Several combinations of point source effluent concentrations and nonpoint source phosphorus reductions were tested. Through an iterative process, it was determined that a point source long-term average (LTA) effluent concentration of 0.4 mg/l TP and a 60% reduction of phosphorus loads from runoff associated with urban and agricultural land uses will satisfy the water quality end point in the Wanaque Reservoir." According to the iterative simulations performed by Najarian and Associates based on Wanaque South intake concentration boundaries provided by Omni Environmental, the wasteload allocations and load allocations established by the TMDL were the highest allowable while still satisfying the water quality target, with a margin of safety and an allowance for reserve capacity, in the Wanaque Reservoir.

42. Comment: LA-WATERS does not directly model chlorophyll-*a*, unlike current state of practice using mathematical models to predict the impacts of nutrient dynamics. The model was calibrated to total phosphorus data with chlorophyll-*a* based on organic phosphorus. It is therefore not an appropriate tool to determine the chlorophyll-*a* levels under alternative loading conditions. (13)

Response: The reservoir model does not directly model chlorophyll-*a*, however, the model does adequately predict observed chlorophyll-*a* concentrations by using the observed relationship between the simulated organic phosphorus and observed chlorophyll-*a* concentrations. A full discussion of the phosphorus-chlorophyll-*a* relationship was provided in the supplemental report for the Wanaque Reservoir modeling (Najarian, 2007). Because the model prediction of observed chlorophyll-*a* concentrations is based on nutrient loading, which is directly modeled, the model is an appropriate tool for use in developing the TMDL.

43. Comment: The basis of Najarian Wanaque Reservoir Model is flawed by incorrect loading assumptions for its calibration. The calibration/validation of the Wanaque Reservoir Model was presented in Najarian 2000 and Najarian 2005 as based on the assumption that total phosphorus is conservative in the Passaic River and that point source phosphorus is not attenuated. Reservoir loads used for the calibration and validation were calculated based on the assumption of phosphorus as conservative. Najarian 2000 and Najarian 2005 acknowledge the shortcoming of the load development methodology. Therefore, in the Phase 2 TMDL, the Wanaque Reservoir Model calibration and validation should have been checked using Passaic Model total phosphorus and ortho-P results at Two Bridges for all model years. Since this was not done, the model may not be properly calibrated. Use of the Reservoir Model is questionable when calibration and validation may be in doubt. Additional Wanaque Reservoir Model runs should be performed to address this concern. (12)

Response: The prediction of phosphorus concentration at the Wanaque South intake used to provide a boundary condition for the Wanaque Reservoir model in the Phase 1 TMDL, while based on a simplified dilution model, is consistent with the prediction generated by the Passaic River model (Omni 2007) for the existing condition in the Phase 2 TMDL. The Passaic River TMDL model, which accounts for attenuation and other kinetics throughout the system, was used to generate the future condition phosphorus concentrations at the Wanaque South intake for the Wanaque Reservoir simulations. Both models compare favorably with one another and with the observed data. This is expected, since both models are calibrated to match the observed conditions. The reservoir model calibration/validation was based on actual data. The calibrated model is then used to simulate what would happen in the reservoir if inputs are altered. How future loads are estimated does not affect the calibration; the reservoir model simulates the effect of phosphorus loads once delivered into the reservoir.

44. Comment: The LA-WATERS model was developed to determine the impact of diversion waters on the water quality it the reservoir. The same model determined that diversions to the reservoir would not cause an excessive detriment to water quality (Najarian 1988). The current results contradict the previous results. (13)

Response: It is not correct to assume that the Najarian 2005 TMDL study using LA-WATERS represents a direct continuation of the methodologies of previous relevant studies using LA-WATERS, such as the study of the impact of diversion waters on the water quality of the reservoir in 1988. The Najarian 2005 TMDL study and refinement of LA-WATERS represents the culmination of a series of studies dating back to 1987 regarding water quality issues in the Wanaque Reservoir and its intake site. In each successive study, improvements were made to address limitations of the previous studies. Thus, comments regarding previous study limitations and inconsistencies are irrelevant. The primary intent of the Najarian (2000) Report (entitled “A preliminary assessment of water quality status of the upper Passaic River and re-verification of the Wanaque Reservoir model”) was to assess the water quality status of the River. Thus, its analysis of the Passaic River dealt with a statistical assessment of water quality data. While this approach successfully addressed water quality status issues, it was of limited use in addressing the long-term loading regime of the river. Difficulties included the limited availability of data for selected analysis periods and uncertainties in the calculation of monthly average loads based on a limited number of observations. For such reasons, the Najarian 2000 Report did not form the basis for the 2005 Najarian TMDL study. Rather, a new model-based approach was developed during the 2002 Watershed Characterization studies for WMA 3, 4 and 6. This mass-balance approach was then refined and enhanced as part of the Najarian 2005 TMDL study. This method provides a simulation of daily in-stream total phosphorus concentrations and diversion loads. The approach was then verified using the entire set of available data – a procedure that sidestepped the limitations of the 2000 report. As such, the Najarian 2005 TMDL study does not represent an outgrowth of the 2000 study but, rather, a totally different approach developed to reduce the limitations of the 2000 study. Thus, as the result of subsequent model validation studies, the accuracy and reliability of the model was improved as new information became available. As the improved simulation of the river-loading regime allowed for a more accurate simulation of Reservoir inputs, the Najarian 2005 TMDL and the supplemental report to the Wanaque TMDL, (Najarian, 2007), supersede the relevant findings of the earlier reports.

45. Comment: A number of model constants and coefficients have large variations over the model domain or are unusual, as follows:

-The settling applied to particulate inorganic phosphorus ranges from 0-40% depending on location. Although the model report states that the fraction available for settling is 60%, the model inputs have a fraction dissolved of 0.6 and therefore a fraction particulate of 0.4. This would only be calculated with partition coefficient values on the high end of the range combined with the 97th percentile of the solids measurements made for the TMDL study.

-Organic phosphorus is subject to settling in the same reaches, but only at a rate of 10%. The fraction particulate for BOD, algae and organic nitrogen is zero and they are not subject to settling. These inconsistencies have not been explained.

-The rates at which phosphorus variables settle changes dramatically from segment to segment. Settling is entered as flows, which can be considered settling velocity multiplied by the surface area of the segment. The model has some large sections of the river with constant settling flows, which results in variations in settling velocity from segment to segment. Other sections of the river have velocities that may change by a couple of orders of magnitude and back over only a few segments as well as many areas with zero settling flows.

-The SOD values and ammonia fluxes also vary greatly on a spatial basis. These values are model inputs and do not respond to changes in loads, although the WASP model is capable of calculating nutrient and SOD fluxes. By specifying fluxes as model inputs, the TMDL analysis cannot track mass rigorously.

-There are a number of model parameters that the Wanaque Reservoir and Passaic River models have in common. Some values are consistent, but others are not: The growth rate used in the WASP model is nearly half the value used in LA-WATERS. Respiration and death are lumped in LA-WATERS and considered separately in the river model; the combined values from the river model are 2.5 times greater at 20 degrees Celsius and show much greater temperature dependence. The phosphorus half saturation values are inconsistent; the value used in the Wanaque Reservoir would require ten times the phosphorus to reach half of the maximum growth rate, thereby inducing a phosphorus growth limitation at a much higher concentration. The river model considers the impact of nitrogen concentration on algal growth, which the reservoir model cannot account for. Both models settle organic phosphorus, but in the reservoir model, organic phosphorus represents algal biomass, which does not settle in the river model. (13)

Response: The Passaic River WASP model was a complex undertaking that involved combining multiple processes and datasets within a single modeling framework. The model choice, calibration and validation were performed using the most appropriate scientific tools available. The modeling framework developed exclusively for the Passaic River Basin is described in detail in the Passaic River Basin Nutrient TMDL Study report (Omni 2007). Assumptions used in a river model may reasonably differ in a model designed to simulate a reservoir, given the significant differences in hydrology. Regarding phosphorus settling and SOD in the river model:

Phosphorus Settling

Inorganic phosphorus settling in the Passaic River comprises more than physical settling of particulate material. It also incorporates processes occurring in the river that are not explicitly simulated by WASP7. "Settling rates were used to represent the physical settling of organic and inorganic particulate phosphorus, adsorption of orthophosphate to the sediment bed and extra phosphorus uptake by macrophytes in certain areas of the Passaic River and its tributaries due to influence of wetland meadows." (Omni 2007, p. 102)

The settling of inorganic phosphorus involves two parameters: the fraction of particulate inorganic phosphorus available for settling and settling velocities. Figure 1 of the supplemental comments by HydroQual relates water column TSS with particulate inorganic phosphorus, which is not applicable to the context of inorganic phosphorus settling adopted in the model. Since the phosphorus settling component lumps multiple wetland meadow processes involving inorganic phosphorus uptake which are not explicitly represented in WASP7, settling rates used for inorganic phosphorus can not be used as a basis for the particulate settling of other water quality constituents. Applying similar settling rates to particulate BOD, organic nitrogen and organic phosphorus would be incorrect.

Natural processes such as the excess phosphorus uptake by algae and the adsorption of inorganic phosphorus to the bottom sediment vary spatially in large and diverse systems such as the Passaic

River Basin. The different settling rates were applied to the Passaic River Basin in order to capture the spatial variability of natural processes represented in the settling component.

The usage of the settling component to address processes that are not explicitly simulated in WASP7 does not jeopardize the model performance for establishing the TMDL. The calibration of inorganic and organic phosphorus is excellent for the great majority of sampling stations. This is evidence that all sources, sinks and processes affecting the phosphorus transformations in the system are being accounted for adequately in the model.

Sediment Oxygen Demand

Sediment Oxygen Demand (SOD) and Ammonia fluxes were assumed as steady state and spatially variable parameters in the Passaic River model. Previous versions of the WASP model were able to simulate the diagenesis of organic matter in the sediment. However, WASP7 does not have this capability. WASP7 was the most recent version of the model when the Passaic River modeling was initiated. WASP7 included several improvements from its previous versions, most importantly the inclusion of benthic algae as a state variable. The simulation of benthic algae was a key factor for the Passaic River modeling. Most of the primary productivity in the Passaic River and its tributaries is due to the presence of benthic algae and macrophytes. Phytoplankton is of significance only in the lower sections of the Passaic River near Dundee Lake. The previous versions of the WASP model were not able to simulate the effect of attached algae and plants. Given the importance of primary productivity for the TMDL, the WASP7 framework was the appropriate choice for the Passaic River modeling.

In addition, the dynamic simulation of SOD is not justified for the Passaic River Basin. Simulating SOD response based on measurements introduces substantial uncertainty into the modeling framework. A meaningful calibration requires several SOD measurements over time and in multiple locations. In the case of the Passaic River, SOD results from the decomposition of macrophytes and residual organic matter that are accumulated in the sediment bed. Major floods could cause significant re-suspension of this particulate material. A sediment transport model would be necessary to account for these losses. Settling of organic matter discharged by treatment facilities is significant when BOD concentrations are high. Presently, the discharge of organic material by treatment facilities is not significant and BOD concentrations are very low throughout the Passaic River Basin.

Decomposition of particulate organic material from phytoplankton is clearly not impacting SOD in the lower Passaic River. Phytoplankton is of significance only at the most downstream sections of the Passaic River where SOD is low. Relatively low SOD levels measured by HydroQual in 2003 at sampling station PA11 (1.4 and 0.4 g/m2/day) support the assumption that phytoplankton settling and decomposition is not affecting SOD in the downstream branches of the Passaic River.

There are no short-term processes affecting SOD in the Passaic River Basin. Organic material from attached algae and plant decomposition is not significantly mobile, BOD levels are very low, and phytoplankton decomposition is believed to be of importance in the lower sections of the Passaic River. In addition, there are not enough data to support a formal calibration of the dynamics of SOD in the Passaic River Basin. Therefore, it is very reasonable to assume SOD and ammonia fluxes as spatially variable and steady state parameters.

46. Comment: The Dundee Lake portion of the Passaic TMDL model was not well-calibrated for chlorophyll-*a*, tending to over-predict by a factor of 2. (11)

Response: As explained in detail in the Passaic River Basin Nutrient TMDL Study report (Omni 2007, pp. 116-118), the Passaic TMDL model is well-calibrated for chlorophyll-*a* particularly in the most downstream branch of the Passaic River, in which Dundee Lake is located. It does not over-predict chlorophyll-*a* by a factor of two. Several factors influencing phytoplankton growth are not subject to calibration, namely stream water temperatures and solar radiation inputs. Similarly, transport-related inputs, which are defined by the flow model and were previously calibrated, also influence phytoplankton growth. Phytoplankton growth rate is the most important chlorophyll-*a* calibration parameter; a value of 1.25/day was chosen as the final calibrated parameter, which is within the range suggested by the literature for phytoplankton growth rate. Two PVSC stations with a significant number of chlorophyll-*a* data throughout the simulation period were chosen for calibration: PVSC1 (Passaic at Totowa Avenue) and PVSC4 (Passaic at Market St.). Omni chlorophyll-*a* data, which consisted of three low flow events sampled in 2003, were used for validation purposes. A good fit of chlorophyll-*a* was obtained for the entire basin. The peak measured chlorophyll-*a* concentration of 97 µg/l at PVSC4 on 8/14/2002 was captured perfectly. Furthermore, the mean errors were -3.3 and 4.7 µg/l at PVSC1 and PVSC4, respectively.

47. Comment: The Passaic River TMDL model does not include any settling for algae. The settling of algae can be an important component of algal loss, especially in shallow waterbodies and/or water bodies with a long detention time (low flow). A run of the model introducing a modest settling rate dramatically reduces the chlorophyll-*a* concentration in the lake. If an important process such as algal settling that is normally included in eutrophication modeling is absent, an explanation is needed. (11)

Response: Most of the primary productivity in the Passaic River and its tributaries is due to the presence of benthic algae and macrophytes. Phytoplankton is of significance only in the lower sections of the Passaic River near Dundee Lake. Phytoplankton settling could potentially increase seasonal sediment oxygen demand (SOD) at shallow and slow moving water bodies. However, the decomposition of particulate organic material from phytoplankton clearly does not impact SOD in the Passaic River, since measured SOD is low at the sections of the Passaic River where phytoplankton growth is significant. Model calibration demonstrates that settling of phytoplankton in the relatively limited branch of the Passaic where significant phytoplankton growth occurs is not important to capture observed phytoplankton growth patterns.

Attenuation:

48. Comment: The TMDL does not take location and/or size of point sources into account. The TMDL assigned the same wasteload allocation to all dischargers based on an LTA of 0.4 mg/L of total phosphorus. There is no attempt to take into account attenuation of phosphorus loads in the Passaic River. Total phosphorus (TP) is not conservative in the Passaic, especially at low-flow conditions. Using the watershed model, the effect of the WTSA plants at the point of discharge and at the identified endpoints was calculated. At current concentrations, the WTSA contribution to Wanaque South load is less than 5 percent and at the 0.4 LTA less than 1 percent. The graphs submitted show the negligible impact of WTSA facilities. The phosphorus discharged by WTSA, whose three plants are located a significant distance from both endpoints, attenuates before it reaches the endpoints. A properly formulated Passaic TMDL must account for the attenuation associated with these long distances in determining the LTAs for the various dischargers. The TMDL should be less stringent than the LTA of 0.4 mg/L proposed basin-wide. (12)

49. Comment: The commenter expressed appreciations for the efforts made by the NJDEP and Omni Environmental that resulted in the 2007 TMDL, but believes that it is still seriously flawed and does not represent the sound science needed to justify imposing limits. Specifically, the 2007 TMDL fails to account for attenuation, instead imposing a "uniform" effluent limit on all STPs. For treatment plants, which are 35, 39 and 41.5 miles upstream of the Wanaque Reservoir end point and 50, 54, and 57 miles upstream of the Dundee Lake endpoint, HydroQual's utilization of the model establishes that essentially only 1% of the phosphorus in the effluent from these three plants reaches either of the two endpoints. The 2007 TMDL improperly assumes that *all* of the phosphorus from the WTSA sewage treatment plants, located 35, 39 and 41.5 miles upstream from the confluence of the Pompton and Passaic River, and 50, 54 and 57 miles upstream of Dundee Lake, reaches these TMDL endpoints. A 0.4 mg/l LTA for *all* dischargers is inappropriate, inequitable and not supported by the very science on which the TMDL purports to be based. Individualized LTAs can and should be calculated, reflecting each sewage treatment plant's effective phosphorus load contribution to the endpoints. The WTSA plants' contribution is *de minimus* and they should only be required to continue to meet their EEQ-calculated limits. It would be arbitrary, capricious and unreasonable for the Department to adopt a TMDL that would require the expenditure of significant public funds and production of adverse environmental impacts from the addition of chemicals and the increased generation of sludge to remove phosphorus given attenuation that established in the model. (10)

Response to Comments 48 and 49: The Passaic River Basin model does not assume phosphorus is conservative and does account for attenuation. As described in detail in the Passaic River Basin Nutrient TMDL Study report (Omni 2007), the dynamics of nutrient cycling as well as loss mechanisms for water column phosphorus-attenuation mechanisms were simulated using the Water Quality Analysis Program 7.0 (WASP7). Model results show that the degree of attenuation depends greatly on the flow and diversion conditions, and most of the phosphorus load that originates in the Dead River persists to both of the end points. For example, approximately 70-80% of the phosphorus load from point sources that discharge to the Dead River reaches Two Bridges. In 2001, over 60% of the phosphorus load from point sources that discharge to the Dead River reached Dundee Lake; in 2002, just under 40% of the phosphorus load reached Dundee Lake. The difference between the two years is primarily due to increased water supply diversions from the Passaic River in 2002.

Therefore, attenuation does not render phosphorus originating in the Dead River watershed irrelevant to the end points in Wanaque reservoir and Dundee Lake. The commenter's analysis of the influence of WTSA phosphorus load on phosphorus concentration at the endpoints is inappropriate, since it uses the annual maximum total phosphorus concentration as the basis of comparison. However, the commenter's analysis does demonstrate the importance of WTSA phosphorus load to the phytoplankton concentration at Dundee Lake: Figure 3 in the July 6, 2007 comment letter provided by HydroQual on behalf of Warren Township SA depicts chlorophyll-*a* concentrations with different contributions from Warren Township's treatment facilities. This figure shows that, even if all other point sources in the entire basin were reduced to an LTA of 0.4 mg/l total phosphorus, allowing WTSA to discharge at its permitted maximum concentration would increase the growing season average phytoplankton concentration at Dundee Lake by about 25%.

In accordance with USEPA's Protocol for Developing Nutrient TMDLs (1999), "the administering agency must find an acceptable combination of allocations that adequately protects water quality standards (p. 7-1)." There are many factors that might affect the allocation decisions, including economics, equitability, and implementation. Alternatives in terms of assigning wasteload allocations among multiple dischargers include: equal percentage treatment; equal effluent concentration, and various allocation schemes that result in variable wasteload allocations. In the case of the Passaic

River TMDL, an equal effluent concentration was assigned to all wastewater dischargers as the most equitable alternative for the wasteload allocation scheme.

Notwithstanding the above, given the large number of dischargers in the basin, the affected dischargers are best equipped to evaluate the capabilities of the individual facilities and determine if there are ways to maximize efficiency and cost effectiveness in achieving the water quality objectives through water quality trading. This was a key reason that this basin was selected for award of a Targeted Watershed Grant from EPA to develop such a program. Dischargers will have one year from the date of NJPDES permit issuance to negotiate trades, which, upon approval, would be incorporated into NJPDES permits.

Alternatives:

50. Comment: The Passaic TMDL was developed without consideration of alternatives. The impacts of phosphorus within the Passaic River Basin can be addressed in a more cost-effective manner. No other reservoir management alternatives beyond the historic pumping and diversions that took place during the 1993-2002 time period were considered. Alternate management scenarios could include reduced pumping during severe drought conditions, examination of the use of the Monksville Reservoir stored water instead of diversions, and/or direct routing of the diversion to the NJDWSC water treatment plant during severe or critical situations where diverted water never enters the reservoir while delivering the same amount of pumped water for raw water supply. Due to the enormous cost of implementing the proposed Passaic TMDL, the NJDEP must explore these cost-effective alternatives to satisfy the TMDL goals. The Passaic TMDL was developed for reduction of Wanaque South phosphorus load without consideration of the relocation of the Two Bridges Wastewater Treatment Facility outfall downstream of the intake. A preliminary analysis indicates this action could result in a 20% reduction in phosphorus load to the reservoir, and could well result in significantly less stringent, less costly LTAs. In light of the costs associated with implementing this TMDL, it is in the best interest of all affected parties to address the impacts of phosphorus in the most cost effective manner. (12)

51. Comment: The TMDL should include a thorough analysis of alternatives for achieving the chlorophyll-*a* criteria at both endpoints that reduce the phosphorus removal requirements for the STPs and for the nonpoint sources. *N.J.A.C.* 7:15-7.2(h) requires that, where feasible, "the TMDL proposal shall include the various management options and alternatives which will ensure that the surface water quality standards will be attained." Thus, the Department is obligated to provide such option and alternatives, or demonstrate why doing so is not feasible. The TMDL must address: NJDWSC operational modifications, water treatment by NJDWSC prior to diversion or release into the Wanaque Reservoir, relocation of the Two Bridges STP outfall and aeration at Dundee Lake. Aeration could be put in place on a trial basis to ascertain its viability and impact on chlorophyll-*a* levels, which could reduce the TP reduction needed at the STPs. The burden of establishing the viability of more cost-effective alternatives should not be on the dischargers or members of the public. The objective should be to properly identify the problem created by phosphorus loads within the river system and determine the most cost-effective manner to address that problem. The Department needs to devote the time and resources to evaluate the viability of aeration at Dundee Lake. (10)

52. Comment: The Department failed to consider the use of in-stream aeration as a cost effective alternative technology. Citing *N.J.A.C.* 7:15-7.6(d)4, *N.J.A.C.* 7:9B-1.5(e)1, and *N.J.A.C.* 7:15-7.2(h)1, the Department did not select the most cost effective and environmentally sound means of

addressing water quality concern in Dundee Lake. The TMDL report contains no study of the costs of achieving those goals, nor of any alternatives, and does not address the negative environmental consequences of imposing more stringent limits on all wastewater facilities. In accordance with its regulations, the Department should have considered the allocation of an equal effluent concentration to each source, the allocation of an equal percent removal to each source, the allocation of an equal effluent mass loading to each source and the minimization of the total treatment expenditure for the entire waterbody segment. Surface Water Quality Standards state that water-quality based effluent limitations should be established in a cost effective manner "so as to minimize total expenditures." Regulations require that TMDLs should take into consideration all management options and alternatives for ensuring that the water quality standards will be attained and that "[m]inimization of the total treatment expenditure for the entire waterbody segment" is one of the approaches to be considered in the development of allocation options. *N.J.S.A.* 58:10A-8 states that prior to establishing more stringent effluent limits the DEP must "determine if there is a reasonable relationship between the economic and social costs of achieving such limitation,…and the social and environmental benefits to be obtained…" The Department requested that dischargers report on costs to achieve potential effluent limits. A review of the reports reveals the costs are staggering. In-stream aeration, by contrast, would meet water quality objectives at a fraction of the cost. The TMDL report should be withdrawn and a roundtable of interested parties (should be) convened to explore the use of innovative solutions to meet the identified water quality objectives. (18)

53. Comment: The Passaic TMDL for the Dundee Lake endpoint was developed without consideration of any other alternatives beyond phosphorus removal. One such alternative is in-stream aeration. Reducing supersaturation of dissolved oxygen through mechanical means may disrupt algal productions as well. Manufacturers of aeration equipment were contacted and costs associated with installation and O&M are significantly less than those for phosphorus removal. Further, aeration equipment could be installed and begin achieving water quality improvement much more quickly. The next step would be to determine specifications for installation in Dundee Lake and possibly piloting the operation. (11)

54. Comment: The Department did not address other alternatives to achieve appropriate controls to achieve the Wanaque Reservoir endpoint, such as altering the withdrawal and and pumping scenarios used by NJDWSC, as recommended in the New Jersey EcoComplex July 30, 2002 Interim Report. (1), (2), (15), (23)

Response to Comments: 50-54: *N.J.A.C.* 7:9B-1.5(e)1 states policies for applying water quality-based effluent limitations and does not apply to TMDL development. This provision allows for assignment of different WQBELs to different dischargers, provided the overall water quality objectives are met, to achieve a more beneficial solution on a study area basis. The Department is providing an opportunity, through water quality trading, to achieve the TMDL objective in a more cost effective way. *N.J.A.C.* 7:15-7.2(h) refers to the Department's commitment to identify the management measures that are expected to attain the load reductions called for through the TMDL study, not a requirement for a cost effectiveness analysis of alternative means to attain the load reductions. The Department sets forth these measures in the implementation plan section of the TMDL. Within the implementation plan, the Department identifies regulatory and non-regulatory tools to achieve the reductions, matches management measures with actual or potential implementing entities, and identifies possible funding sources for non-regulatory measures.

Regarding the cost for phosphorus removal at wastewater treatment facilities, a recent report, "Advanced Wastewater Treatment to Achieve Low Concentrations of Phosphorus" (EPA 910 R 07

002, April 2007), contains findings indicating phosphorus removal at the levels called for in these TMDLs is feasible, low cost on a per user basis and provides ancillary benefits by enhancing removal of other pollutants, such as pharmaceuticals. Specifically, phosphorus removal to 0.3 mg/L was achievable using enhanced biological nutrient removal and the monthly residential sewer rates charged ranged from $18 to $46. Several treatment authorities did respond to the Department's request to provide cost estimates for achieving phosphorus reductions. While the total cost for upgrading all of the facilities was stated to be in the millions of dollars, the number of people and businesses served by the collected facilities is very large and the costs spread out over a number of years, so that the impact to an individual user is not expected to be significant.

Several alternative approaches were suggested by commenters in lieu of requiring reductions from the point source discharges. Under the Clean Water Act, the expectation is that, where a TMDL identifies that pollutant loading is causing exceedance of water quality standards, attainment of the standards will be achieved by reductions of the pollutant load. Further, the pollutant load reduction is expected to come primarily from regulated sources. Where non-regulated sources contribute to the load and load reductions from these sources are identified in lieu of obtaining all needed reductions from regulated sources, there must be reasonable assurance that reductions from non-regulated sources will be achieved. Other outcomes are possible where exceedances are due to natural conditions (standards are adjusted), technology does not exist to attain the water quality standards (variance option), or there is no reasonable way to attain the standards and support the designated use (use attainability option). Here, point sources are responsible for a substantial amount of the phosphorus loading to the system and the load reductions required are clearly achievable.

With regard to the specific alternatives suggested: In-stream aeration might mask a portion of the problem by ameliorating some of the adverse water quality effects, such as attenuating dissolved oxygen swing, but there is no evidence that it would reduce excessive primary productivity sufficiently to achieve the water quality objectives. In addition, there would be implementation issues with such an approach: installing infrastructure within a riverine system subject to flooding would be problematic; and there is no regulatory or institutional framework to cause such a system to be built, maintained and compliance assured. Therefore, options that do not address the root cause of the water quality problem or use the stream for treatment, such as in-stream aeration or addition of alum directly to the waterbodies, cannot be entertained. Relocation of the TBSA outfall, if proposed, would be considered. However, if proposed, the model would have to be rerun with new assumptions since loading to the Dundee Lake endpoint would increase if TBSA effluent is no longer diverted into Wanaque Reservoir. Regarding the role of NJDWSC operations, there are two factors to be considered. NJDWSC supplies drinking water to more than 3 million of New Jersey's residents. Management of the system needs to be flexible enough to allow the maximum safe yield without deleterious water quality impacts. While safe yield and allocation decisions do consider water quality implications, directing NJDWSC to change operations for the primary purpose of minimizing the requirement for dischargers to reduce the introduction of a pollutant into the river system is not appropriate. FW2 waters are to be suitable for drinking water use with conventional treatment. Therefore, the quality of the water at the Wanaque South intake point must support the drinking water use, with or without diversion activities.

55. Comment: The endpoint in Dundee Lake is to be measured between June 15 and September 1, but the effluent limit is intended to apply from May through October. Based on an independent run of the model, the target condition was met with effluent limits at 0.4 mg/L only in June, July and August. To meet the Passaic TMDL for Dundee Lake, phosphorus removal at the Lower Passaic treatment plants is only necessary from June through August. (11)

Response: It is true that during the critical simulation year of 2002, conditions favorable to produce high phytoplankton concentrations were limited to July and August. However, the TMDL is intended to be protective during future summer conditions. While summer algal blooms are most common during July and August, periods conducive to high algal production can occur anytime from May through October. For instance, the most critical months for algal growth during 2001 were September and early October. In 2004, late June through the first week of July was the most critical periods. While the model demonstrates the fact that seasonal phosphorus reductions provide the same level of protection at Dundee Lake as year-round reductions, it would be short-sighted and incorrect to apply the seasonal limits only to the months that happened to be critical during the 2002 simulation year.

56. Comment: Was the potential for the permanent lowering of Dundee Dam, which was as possible outcome of a study conducted by the Federal Energy Regulatory Commission (FERC), considered as part of the TMDL process? (18)

Response: The Federal Energy Regulation Commission (FERC) and the Department have not received an application for a permanent lowering of the Dundee Lake dam. Although the dam owner has removed the hydroelectric operation, the owner has maintained the FERC license. The dam was recently repaired and the Department has determined that it is in safe condition. Therefore, the lowering of Dundee Dam is not an imminent physical change to the system that should be considered in the TMDL.

57. Comment: Efforts should be concentrated on protecting and restoring the “Green Infrastructure” in the Passaic River Basin, especially in the Highlands, as it has been shown that water treatment costs increase as forest cover in the watershed decreases. (9)

Response: The Department concurs that maintaining and replacing areas of natural vegetation (“green infrastructure”) have a positive impact on water quality. While preserving land with natural land cover can help with minimizing future degradation, it will not address existing water quality concerns. The Department recognizes this in the discussion of Category One waters and the associated Special Water Resource Protection Areas in Section 8, Reasonable Assurance. Restoring riparian vegetation can help improve existing water quality and is included as one of the measures identified in Section 7, Implementation Measures. This section has been enhanced to identify the known stream bank restoration and similar management measures that have been completed within the basin.

NJDWSC Responsibility:

58. Comment: The Department should require that the North Jersey District Water Supply Commission (NJDWSC) also assume appropriate responsibility for the level of phosphorus that enters the Wanaque Reservoir. The NJDWSC plays a central role in the phosphorus issue as it relates to the Wanaque Reservoir endpoint, yet the Department does not require that NJDWSC take any responsibility for reducing the phosphorus load it diverts into the Reservoir. NJDWSC must participate in the solution to its phosphorus problem. The TMDL suggests that NJDWSC might be a trading partner, yet provides no description of how that might occur. Potentially, NJDWSC can undertake treatment or some other measures that will significantly reduce the TP reaching this endpoint (or which will ensure that the 10 ug/L chlorophyll-*a* seasonal average criterion is met) that are less costly than requiring the STPs to reduce phosphorus to a year-round LTA of 0.4 mg/l. Unless the Department imposes obligations on NJDWSC to take actions to reduce the TP load, NJDWSC will have no incentive to do

so, and no incentive to “trade” with the STPs. As part of or in conjunction with this TMDL, the Department should exercise the authority it has over NJDWSC to address phosphorus. There are at least two sources of such authority. The first is found in the statutory and regulatory provisions that govern NJDWSC’s water diversion permit. The second is found in the federal Clean Water Act’s pollutant discharge elimination system permit requirements, when those requirements are properly applied in a manner consistent with the recent United States Supreme Court holdings and those of the federal Court of Appeals. (10)

59. Comment: The North Jersey District Water Supply Commission should be required to secure a NJPDES permit for diversion of Passaic River waters into the Wanaque Reservoir. WTSA respectfully submits that the Department must impose responsibility on NJDWSC by requiring NJDWSC to obtain a NJPDES permit for its addition of a phosphorus load to the Wanaque Reservoir. In light of judicial interpretations of the CWA, including South Florida Water Mgt. Dist. v. Miccosukee Tribe of Indians, 541 U.S. 93, 124 S.Ct. 1537 (2004) (“Miccosukee”), (also cited were *National Wildlife Federation v. Gorsuch*, 693 F.2d 156, 165 (D.C.Cir. 1982), *Catskill Mountains Ch. Of Trout Unltd, Inc. v. City of New York*, 273 F3d 481 (2d Cir. 2001), *Catskill Mountains Ch. Of Trout Unltd, Inc. v. City of New York*, 451 F.3d 77 (2d Cir. 2006) and *Friends of the Everglades, Inc. v. South Florida Water Management District*, 2006 WL 3635465 (S.D.Fl. 2006)), the need to address phosphorus in the Wanaque Reservoir, and the critical role NJDWSC plays in introducing the phosphorus load into the reservoir, the Department should not “defer” to the 2005 EPA Memorandum. Instead, the Department should require that NJDWSC obtain a NJPDES permit. The diversion of water from the Passaic River by pumping it some 17 miles north into the Wanaque Reservoir is a transfer into a distinct water body. Water from the Passaic is only diverted when NJDWSC elects to draw off water at a rate that exceeds the Pompton River flow, causing an uptake of Passaic River water into the Pompton River, and, hence, into the intake. Therefore, the NJDWSC operates a “point source” that “discharges pollutants,” in that phosphorus is “added” to the Reservoir as a result of the transfer of waters from the Passaic to the Reservoir. This being the case, the Department should require that NJDWSC obtain a NJPDES permit. Such a permit would not necessarily mean that NJDWSC would be solely responsible for reducing the phosphorus load into the Reservoir so as to achieve the 10 ug/l chlorophyll-*a* seasonal average, but it would require that NJDWSC meaningfully participate in achieving the required reduction. (10)

60. Comment: Even if it were determined that a NJPDES permit is not required, under its water diversion permit, North Jersey District Water Supply Commission should be required to reduce the amount of phosphorous coming into the Wanaque Reservoir from the Passaic River so as to mitigate any adverse impacts that such phosphorus has on water quality in the Reservoir. The Department’s current regulations expressly state that the party transferring water from one body to another “is responsible for mitigating adverse impacts…caused as a result of the diversion.” *N.J.A.C.* 7:19-2.14. Nothing in the 2005 Najarian TMDL Report, the 2005 TMDL, or the proposed 2007 TMDL addresses that NJDWSC’s diversion practices have caused the alleged impairment of the Reservoir. The 2007 TMDL was developed without consideration of any other Reservoir management alternatives, instead accepting as a “given” the historic pumping and diversions that took place during the 1993-2002 time period. No attempt was made to investigate other possibilities, either in the pumping protocol or in direct treatment of the diverted water. The 1988 Najarian Report concluded that, provided that NJDWSC implemented appropriate management and diversion practices, there would be no cause for concern with impacts of the diversion on water quality within the Reservoir. If the 2005 Najarian TMDL Report is correct in its conclusion that the diversion of water from the Passaic has adversely impacted the water quality within the Reservoir, the obvious and critical questions are why haven’t NJDWSC’s diversion practices achieved the result predicted in the 1988 Najarian Report and can

NJDWSC better monitor those practices so as to mitigate adverse impacts, as required by the Department and regulation? The conclusions in the 2005 Najarian TMDL Report are inexplicably at odds with the conclusion reached in the 1998 Najarian Report. No explanation has been given for abandoning the conclusions in the 1988 Najarian Report that, when properly managed, diversion of water from the Pompton and Passaic Rivers, even "under the severest of operating conditions," and "at times of unusual flow periods" and "[d]uring unusual hydrologic events associated with prolonged dry years," will not have any long term impact on water quality in the Wanaque Reservoir. If the answer is that Dr. Najarian's 1988 conclusions, based on the simulations conducted at that time, have proven to be incorrect, then surely the Department is justified in now requiring NJDWSC to take some direct responsibility for addressing the impacts of the diversion of water from the Passaic. Had the 1988 simulations demonstrated such adverse impacts, either the Department would not have approved the diversions, or it would have conditioned such approval on specific, affirmative actions to address those impacts. In addition to more responsible management of its diversion practices, NJDWSC should be the party responsible for ensuring the quality of the water it discharges into the Reservoir by its diversion of water or certainly participate in that responsibility. (10)

61. Comment: Commenter believes the Supreme Court decision in <u>Miccosukee</u> (*South Florida Water Management District v. Miccosukee Tribe of Indians*, 541 U.S. 93, 124 S.Ct. 1537 (2004)), requires a NPDES permit be issued to NJDWSC because they divert river water to the Wanaque Reservoir. The Department must justify why it believes this is not required and has failed to modify its position to meet the US Supreme Court decision. NJDWSC should be required to mitigate any effects of their discharge on the reservoir. Further, NJDWSC should have a NPDES permit to discharge reservoir water to the river, based on a recent Federal Court decision (cited were *National Wildlife Federation v. Gorsuch*, 693 F.2d 156, 165 (D.C.Cir. 1982), *South Florida Water Management District v. Miccosukee Tribe of Indians*, 541 U.S. 93, 124 S.Ct. 1537 (2004), *Catskill Mountains Ch. Of Trout Unltd, Inc. v. City of New York*, 273 F3d 481 (2d Cir. 2001), *Catskill Mountains Ch. Of Trout Unltd, Inc. v. City of New York*, 451 F.3d 77 (2d Cir. 2006) and *Friends of the Everglades, Inc. v. South Florida Water Management District*, 2006 WL 3635465 (S.D.Fl. 2006)). After applying permit requirements to NJDWSC, the Department should recalculate the TMDL based upon the limitations that would be imposed on other dischargers. (10)

Response to Comments 58-61: The Department does not interpret the Supreme Court decision in <u>Miccosukee</u> as requiring the State of New Jersey to issue discharge permits to regulate purveyors under NJPDES, the State NPDES program. The Department's interpretation is consistent with EPA's determination that water diversions are not point sources requiring a NPDES permit under the Clean Water Act. See, USEPA, <u>Agency Interpretation on Application of 401 of the Clean Water Act to Water Transfers</u>. EPA has proposed its interpretation as a rule. 71 Fed. Reg. 32887. In support of their position that EPA's interpretation of the Clean Water Act and the <u>Miccosukee</u> decision are incorrect, the commenters refer to other federal court decisions, such as <u>Catskill Mountains Ch. Of Trout Unlimited, Inc. v. City of New York</u>, 451 <u>F. 3d</u> 77 (2d Cir. 2006) and <u>Friends of the Everglades, Inc. v. South Florida Water Mgt Dist</u>. 2006 WL 3635465 (S.D.Fl. 2006). They contend that, based on these decisions, the Department is obligated to issue a NJPDES permit to the NJDWSC for its water diversion permit. However, the federal court decisions the commenters cite involve different facts, and these decisions are not from the Third Circuit. Therefore, the decisions do not create controlling precedent.

The Department believes that the most appropriate way to address water quality effects of water supply diversion activities is through State authorities related to safe yield and allocation decision making. The role of NJDWSC operations is discussed above in response to comments 49-53. To reiterate, NJDWSC supplies drinking water to more than 3 million of New Jersey's residents. Management of the system needs to be flexible enough to allow the maximum safe yield without deleterious water quality impacts. While safe yield and allocation decisions do consider water quality implications, directing NJDWSC to change operations for the primary purpose of minimizing the requirement for dischargers to reduce the introduction of a pollutant into the river system is not appropriate. FW2 waters are to be suitable for drinking water use with conventional treatment. Therefore, the quality of the water at the Wanaque South intake point must be consistent with support of the drinking water use, with or without diversion activities. Water quality trading is an option, but not a requirement, through which NJDWSC can play a role in protecting the water quality of the Wanaque Reservoir as affected by the diversion of Pompton and Passaic River water into the reservoir.

The load reduction required to achieve the water quality target for the in-stream critical location is the same as that needed to achieve the water quality target in the Wanaque Reservoir. The difference is the applicability of seasonal effluent limits. Commenters suggest that some or all of the burden of achieving the phosphorus load reductions outside the May through October season should be borne by NJDWSC because it is the act of diverting water into the Wanaque Reservoir that dictates year round reductions from dischargers in the portion of the river basin affected by the diversion. With reference to the decision on the Wanaque South Diversion, background on this permit decision is in order. The grant application for the Wanaque South project diversions was approved by the New Jersey Water Supply Council on September 25, 1978. The initial evaluation of water quality impacts due to the Wanaque South Project was presented as an appendix within the "Wanaque South Project Economic Feasibility Study" (1981). This assessment indicated that there may be impacts to temperature and dissolved oxygen in the Passaic River due to diversions at the Two Bridges site. As the Department's total phosphorus (TP) standard was not established until 1980 (after the initiation of the Feasibility Study), impacts due to TP were not assessed at that time. In 1981, the Department did conduct an in-house screening-level (Vollenweider) assessment of TP impacts that suggested that the reservoir could be in a mesotrophic state and that expanded diversions could result in possible degradation of the reservoir's trophic state. Thus, the Department included a provision for a "reservoir phosphorus management study" within the Wanaque South water diversion permits (No. 1651 and 1685), which were issued on April 30, 1982. The 1988 Najarian report was developed in response to this permit condition. The 1988 study concluded that "…the proposed Wanaque South diversion would not have a lasting impact on the water quality of the Wanaque Reservoir." The study also found no long-term impairment with respect to the trophic state of the Reservoir. This predicted result was attributed in part to the reservoir's relatively short residence time (approximately 6-8 months). However, while the residence time is short based on a mathematical comparison of volume in and volume out, in practice, the reservoir is not pumped dry. There is always a residual pool and settled phosphorus can accumulate and be available for biological activity as the result of turnover events. Measured and predicted levels of chlorophyll-*a* are in excess of those associated with maintenance of a mesotrophic condition. This is likely due to the fact that the NJDWSC has needed to divert river water at frequencies and rates that were not anticipated in 1988 -- due to extended dry-weather (drought) conditions over much of the past decade. In response, over the past decade, NJDWSC has implemented various management strategies to reduce transient water quality impacts to the reservoir from river diversions. These strategies have been helpful in the control of peak phosphorus concentrations and nuisance algal blooms within the Reservoir. However, such management programs can, at best, only partially mitigate worst-case conditions. Further, the addition of chemicals (alum) on an ongoing basis is not an appropriate approach for reservoir management. Additional means are needed to protect reservoir water quality.

Impacts from TP Removal:

62. Comment: The TMDL fails to consider the following negative impacts associated with pretreatment for phosphorus: increase in sludge production; increase in total dissolved solids; negative impacts on incinerator operation; an increase in aluminum in plant effluent as a result of chemical addition. Public policy is not well served where a water quality enhancement is attained at the expense of a diminution of other water quality criteria or other negative environmental impacts. There are alternatives to imposing phosphorus limits that would achieve the desired environmental benefit without the negative consequences. (18)

63. Comment: There are several negative impacts that would result from phosphorus removal, as follows:

-As a result of chemical treatment to meet the phosphorus LTA of 0.4 mg/l, STPs will have significant increased sludge disposal costs from increase sludge production, estimated to increase from 19% (with biological removal) to 37% (chemical removal only).

-Total Dissolved Solids (TDS) will increase in the effluent when meeting phosphorus LTA of 0.4 mg/l. TDS will negatively impact water quality, which will impact drinking water supplies and drinking water quality through potential additional treatment requirements.

-Chemical sludge from the phosphorus removal process will impact incinerators. It will increase ash production and possibly produce "clinkers" which plug drop holes of multiple hearth incinerators and may require certain incinerator improvements.

-Chemical treatment for phosphorus removal will increase aluminum (or iron) in effluent. (11)

Response to Comments 62 and 63: The TMDL specifies WLAs in terms of total phosphorus to achieve the water quality goals for the Wanaque Reservoir and Dundee Lake. The comments presume that the only available treatment technology is chemical addition. However, the Department believes that the WLAs can be achieved through a variety of treatment options. The Department encourages permittees to utilize biological nutrient removal (BNR) wherever feasible based on site and process constraints. The use of BNR has the benefit of reducing nitrates while avoiding increases in the levels of TDS and affecting sludge treatment and disposal options. The Department is working with New York DEC and the EPA to develop a TMDL to address dissolved oxygen issues in the New York/New Jersey Harbor, which may require the NJPDES facilities in the Passaic River Basin to implement nitrogen removal. This is a further incentive to use BNR wherever feasible to achieve the required phosphorus reductions. Further, by developing and applying a dynamic model within the Passaic basin, the Department has taken care to require only the level of phosphorus load reductions needed in order to achieve water quality objectives. By carefully evaluating the model simulations, the Department was able to determine the critical locations where primary productivity is causing water quality problems and develop criteria in terms of the response indicator, chlorophyll-*a*, that equate to protection of the designated uses. Seasonal limits are also offered where appropriate.

64. Comment: The Department should consider a particular trademarked commercial product identified by the commenter which the commenter indicates has proven to be extremely effective and economical at controlling phosphate levels in contaminated water and contaminated soil, in the plans to establish phosphate contamination limits for the Passaic River Watershed. (19)

Response: The Department appreciates that information provided by the commenter, but can not endorse any proprietary water quality device or material. The New Jersey Corporation for Advanced

Technology (NJCAT) has a procedure by which developers of new technology can demonstrate performance claims. Additional information is available at www.njcat.org.

65. Comment: Achieving the significant phosphorus reductions called for in the TMDL may not be technologically, ecologically, economically or socially achievable. Therefore, commenter suggests dischargers evaluate their systems and determine the retrofits that will reduce phosphorus and nitrogen loadings to the extent feasible, given these considerations, similar to the improvements made at RVRSA. (9)

66. Comment: Biological technologies should be selected over "chemical" technologies for nutrient removal. (9)

67. Comment: The Department should investigate innovative technology that will reduce phosphorus loadings with fewer undesirable side effects and at reduced cost, like RVRSA did. (7)

Response to Comments 65-67: The Department believes the phosphorus reductions called for in the TMDL are fully achievable and at reasonable cost. The Department supports biological nutrient removal because it is a more cost effective removal technology that produces fewer harmful by-products than chemical treatment. The Department recognizes the innovative work of RVRSA and Wayne Township in incorporating such approaches for nutrient removal and will continue to rely on the regulated community to determine the best means to achieve permit limits, given site and process constraints that apply to each one, as well as outcomes that may come from water quality trading.

Permit Requirements:

68. Comment: Five of the sewage treatment plants listed in the proposed TMDL are located in West Milford and are regulated under the Greenwood Lake TMDL for Phosphorus. These facilities should also be required to meet whatever standards are set for total phosphorus, nitrate and ammonia in the Passaic TMDL. Further, the WMP for this area has not been done in 20 years. The Department needs to do its part in getting the load reductions by enforcing the requirement to do a WMP. (7), (9)

Response: The allocation of loading capacity for Greenwood Lake was addressed in the September 2004 TMDL and included WLAs for the associated NJPDES discharges. The allocation of loading capacity established in the Greenwood Lake TMDL is protective of the SWQS and did not need to be reassessed by the Passaic TMDL. Rather, the loadings that would result from successful implementation of the TMDL in this watershed were taken as a boundary condition input to the Passaic River basin TMDL. Requirements for load reductions are required whether or not there is a current WMP.

69. Comment: Monthly average permit limits based on a long term average in the stream should be used. No limitation based on a shorter time period is necessary or warranted. (23)

Response: The long term average used in the modeling study is that required in wastewater treatment effluent in order to achieve the watershed criteria, expressed as seasonal average concentrations of chlorophyll-*a* at the two critical locations. There is no long term average stream concentration objective expressed in this study. As indicated in the TMDL, the Department intends to express the WLAs set forth in the TMDL in terms of monthly average effluent limits.

70. Comment: A TMDL must be expressed in terms of daily limit. How can a long term average be compliant with CWA requirements? The proposed 0.76 mg/L limit is 7 times less stringent than the criterion. The Department should enforce the 0.1 mg/L that is required unless the phosphorus protocol demonstrations are made, which has not occurred. (22)

71. Comment: The 0.4 mg/L limit is too liberal and should be 0.1 mg/L, as is recommended for impaired waters. Commenter is disturbed about the concept of averaging and believes it doesn't really work. (20)

Response to Comments 70 and 71: According to an USEPA memorandum issued November 15, 2006, all TMDLs and associated load allocations and wasteload allocations should be expressed in terms of daily time increments, which these TMDLs do. The November 15, 2006 memorandum further states that TMDL submissions may include alternative, non-daily pollutant load expressions in order to facilitate implementation of the applicable water quality standards. It should be noted that the November 15, 2006 memorandum makes clear that although TMDLs are to be expressed in terms of a daily load, this does not affect a NPDES permitting authority ability to establish permit effluent limits, which "… may be written in a form that derives from, and complies with, applicable water quality standards…". Additionally, The National Pollutant Discharge Elimination System (NPDES) regulations at 40 CFR 122.45(d) allow numerical NPDES effluent limitations for continuous discharges to be expressed, unless impracticable, as average weekly and average monthly discharge limitations for publicly owned treatment works (POTWs) and as daily maximums and monthly averages for other dischargers. The EPA Protocol for Developing Nutrient TMDLs, EPA 841-B-91-007 (pg. 7-3) also describes these acceptable practices. The current TMDL and proposed approach for applying effluent limits comply with USEPA guidance and the requirements of the Clean Water Act.

As the result of the Passaic River basin TMDL, the 0.1 mg/l total phosphorus SWQS has been superseded within the modeled domain by watershed criteria expressed in terms of chlorophyll-*a* at the identified critical locations. Commenters appear to refer to the practice of applying the SWQS as an end-of-pipe effluent limit where the discharge of a pollutant from a facility is in quantifiable amounts and is to a waterbody identified as impaired with respect to that pollutant. Because of the narrative criteria that accompany the in-stream numeric criterion for phosphorus, a phosphorus evaluation protocol was developed to determine when the numeric criterion does not apply in light of the narrative criteria, which is commonly known as the phosphorus protocol. As a result of the Phosphorus Settlement Agreement, WQBELs for phosphorus are not to be applied except through a TMDL study with respect to most significant dischargers in the Passaic River basin. Therefore, the end-of-pipe limit approach and phosphorus protocol do not apply. In any case, NJPDES effluent limits must conform with a WLA from an adopted TMDL, in lieu of a WQBEL established any other way. The TMDL establishes WLAs based on a total phosphorus long-term average (LTA) effluent concentration of 0.4 mg/L for most dischargers, to achieve the watershed criteria set in order to be protective of the designated uses of the affected waterbodies. The Department has also stated the intent to express this LTA as a monthly average of 0.76 mg/L in the NJPDES permits for the identified facilities, subject to water quality trading.

Seasonal Limits:

72. Comment: Seasonal limits have been found to be sufficiently protective of the river, yet phosphorus removal on a year-round basis has been imposed on dischargers upstream of the reservoir intake. Seasonal limits, either tied to the use of the Wanaque South Pumping Station, or a reservoir

level, would be sufficiently protective of the environment and would result in a significant cost savings to the public and decreased pollutant load to the environment. The Department has imposed additional requirements upon dischargers without regard to whether the discharge is being pumped into the reservoir. The determination to treat effluent when water is not transferred to the reservoir must be revisited. Treating effluent to meet a limitation that is not appropriate is a waste of public funds and results in the use of chemicals that increases sludge production and Total Dissolved Solid discharges. The Department should have reviewed and offered for public comment its consideration of the option of seasonal phosphorus control during periods when NJDWSC is not pumping water from the Passaic River Basin into the Wanaque Reservoir. Seasonal effluent limits should be applied to dischargers upstream of the Wanaque South Pump Station because of the intermittent but predictable diversion of water to the Wanaque Reservoir. The application of effluent limits should be related to water supply needs, as indicated by the pumping schedule or reservoir water level. (2) (15)

73. Comment: The Department has failed to provide relief from stringent limits during periods when phosphorus control cannot provide a benefit to the Wanaque Reservoir. Strict adherence to year round phosphorus removal does not bear any relationship to goal of protecting the Reservoir. Treating effluent to meet a limitation that is not appropriate is a waste of public funds and results in the use of chemicals that are not warranted. Chemical precipitation and additional TDS and sludge production can be avoided through judicious establishment of compliance levels, tied to the use of the Wanaque South pump station or a reservoir level, to achieve benefit at cost savings to the public. The Department should have reviewed and offered for public comment its consideration of the option of seasonal phosphorus control during periods when NJDWSC is not pumping water from the Passaic River Basin into the Wanaque Reservoir. (1)

74. Comment: The limit of 0.76 mg/L, which is applied seasonally to protect the River, should be applicable to all dischargers, not just those downstream of the Reservoir intake. The Department has proposed limitations to protect the Wanaque Reservoir from diversions from the river system. It is believed that such diversions have not occurred in approximately four years. It does not seem appropriate to protect this use on a continuous basis when diversion does not occur at any reasonable frequency. (23)

Response to Comments 72-74: As discussed in the response to Comment 55, the Department believes seasonal limits are only appropriate for discharges below the confluence of the Pompton and Passaic River. Tying effluent limits to an unpredictable pumping regimen outside the control of the regulated entity is institutionally impracticable. Regarding the opportunity to provide input on the concept of seasonal limits, multiple opportunities were provided. In addition to the opportunity for formal public comment provided with the formal notice and public hearing for the proposed watershed criteria, TMDL and anticipated effluent limits that will emanate from the TMDL, prior to the proposal, there were at least two opportunities for public comment on these issues. At the May 19, 2006 Data Exchange Meeting on the Passaic River Basin TMDL, the Department requested input on the watershed criteria. At the June 4, 2007 meeting between the Department and the affected dischargers, a presentation was made on the Non-tidal Passaic and Pompton Lake TMDLs in which the Department presented information regarding the intent to apply seasonal limits for some discharges as well as the basis for seasonal limits. Some of these points were raised and responded to at those events.

Margin of Safety:

75. Comment: Confirmation is requested that the issue of margin of safety will be revisited once the TMDL is implemented and that antibacksliding and antidegradation policies will not preclude the Department from undertaking appropriate remedies and revisions at that time if deemed warranted. (1), (2)

Response: Antidegradation policies are required to be implemented should a permittee request to expand its discharge beyond the levels currently authorized. As the TMDL has allocated the total the phosphorus loading for the Passaic River Basin, a request for a new or expanded treatment plant would need to: maintain the phosphorus loading authorized in its NJPDES permit, obtain an allocation of the loading contained in the reserve capacity or obtain a reallocation of load from another NJPDES facility. With regard to antibacksliding, under Section 402(o) of the Federal Act (33 U.S.C. §1342(o)), "A permit may not be renewed, reissued, or modified… to contain effluent limitations which are less stringent than the comparable effluent limitations in the previous permit." However, as described by the regulation and the USEPA Technical Support Document for Water Quality-based Toxics Control (EPA/505/2-90-001), establishing less stringent limits based on water quality is allowed where: material or substantial facility changes justify relaxation, events beyond control can not be remediated, the permittee has installed and properly operated the facility and is still unable to meet the limit, or new information (such as a revised TMDL) justifies relaxation of water quality-based permit limitation. In either situation, it is not expected that the loading capacity contained in the MOS for these TMDLs would be further reallocated as WLAs and LAs. If the water quality response based on follow-up monitoring warrants and a subsequent TMDL study that includes improved predictive capabilities is developed, it is possible that revised WLAs and LAs could result.

76. Comment: The TMDL's numerous conservative assumptions, including inclusion of the 2002 drought conditions, comprise a sufficient Margin of Safety, so as to meet the definition of an "implicit" Margin of Safety and are thus sufficient to meet EPA's requirements for a TMDL calculation. The addition of an "explicit" Margin of Safety is unnecessary. The MOS is used to assign load allocations that are protective of a water quality endpoint, based upon uncertainty in the TMDL calculation, and should not be embodied additionally in the site-specific criterion itself. (15)

Response: In this study, the MOS and reserve capacity are provided for by setting a target lower than the established watershed criteria, not in addition to a specified additional allocation of the loading capacity as suggested by the commenter. EPA guidance does allow an MOS to be implicit, explicit or a combination of both. An MOS is needed to account for a "lack of knowledge concerning the relationship between effluent limitations and water quality" (33 U.S.C. 1313(d)). EPA directs that it may "prove feasible to include margins of safety in more than one TMDL analytical step. For example, relatively conservative numeric targets and source estimates could be developed that, in combination, create an overall margin of safety adequate to account for the uncertainty of the analysis" (Protocol for Developing Nutrient TMDLs, EPA). EPA requirements for an approvable TMDL also require consideration of critical conditions and seasonal variation when setting the TMDL and associated WLAs and LAs, neither of which is allowed to serve as the MOS. The fact that the TMDL study complies with requirements for critical conditions and seasonal variations does not constitute an implicit MOS.

Water Quality Trading:

77. Comment: Water quality trading is opposed and this provision should be eliminated from the proposed TMDL for the following reasons:

- Discharges cause the greatest degradation of water and biota in the water in the immediate vicinity of the discharge, not miles away where another discharge occurs.
- Changes in the composition of a discharge will change the ecology of the receiving water. This is especially true if there are changes in nutrient loadings. In a trading situation, evaluating the benefits and damages to the ecology at two different locations will be impossible.
- If some dischargers can buy credits, then the overall reductions in loadings will be less, and the water will be less clean than if all dischargers meet the same requirements.
- Marketing credits will result in inequities that will probably be controlled by political and economic forces.
- Everyone needs clean water to drink, but who will bear the costs of cleaning up the water from dischargers who buy credits?
- Enforcement of trading agreements has been poor in other parts of the United States.
- No environmental organizations were invited to be part of the review team established by Rutgers on the trading project; thus the study completed by Rutgers did not have the oversight of a critical stakeholder for the Passaic River, and has a tendency to represent only sewerage authority interests and not those of the general public.

(7), (9)

Response: In the case of nutrient impacts on dissolved oxygen and phytoplankton, it is not true that "discharges cause the greatest degradation of water and biota in the water in the immediate vicinity of the discharge." In fact, it is far more common for dissolved oxygen and productivity impacts to occur substantially downstream from nutrient point sources. Phosphorus is considered a pollutant because it can stimulate excessive productivity. The TMDL analysis demonstrated the two locations where phosphorus is responsible for excessive primary productivity. Water quality targets were developed for these two discrete locations. The trading program will consist of a trading currency among point sources that will result in a condition the same as or better than the TMDL premise, as demonstrated by modeling runs of trading scenarios. Under the trading program, if some dischargers buy credits, then by definition there must be a discharger or dischargers that are selling credits in order to maintain the TMDL outcome at the critical locations.

With respect to creating untenable economic circumstances for some users, the Department believes that the responsible entities for each discharge will only seek trades that are consistent with discharge of their fiscal responsibility, which includes managing the system so that user costs are set only as high as necessary to satisfy water quality as well as public health and safety obligations.

The scientific, economic, and legal feasibility of water quality trading in the non-tidal Passaic River basin is under study. With finalization of the TMDL specification, the research on trading can be finalized. The final trading proposal, including trading ratios and rules, will be presented to the public for comment and must be approved by both the Department and EPA prior to implementation through NJPDES permits.

78. Comment: The trading concept is opposed. It doesn't belong in New Jersey. We should be cleaning up the sources. (20)

Response: The Department believes that water quality trading represents a viable means to determine if more efficient and cost effective means are feasible to attain water quality objectives and to implement them. The Department anticipates providing a 1 year period from the date of permit issuance to negotiate trades, provided the trading tool and rules have been approved by the Department and EPA. To be approvable, a viable trading option would have to ensure that the TMDL condition in the Wanaque Reservoir and Dundee Lake are met and that there is full enforceable accountability for required load reductions.

79. Comment: If available, the trading ratios developed under the trading program should be included in the TMDL report. If these ratios are not yet available, then the trading ratios will need to be separately public noticed and sent for EPA approval. (21)

Response: Rutgers Cooperative Research and Extension received an EPA Targeted Watershed Grant in 2005 to develop, evaluate and implement a water quality trading program for the non-tidal Passaic River Basin. Upon completion of the trading study, there will be an opportunity for public comment on the study, and both the Department and EPA will need to approve the trading tools and rules prior to their use in formulating a trade. In addition to the public comment on and agency approval of the tools and rules, the public will have the opportunity to comment on specific trades as they are reflected in NJPDES permits.

80. Comment: The voluntary "Water Quality Trading Program" suggested in the TMDL cannot be substituted for properly addressing the attenuation of phosphorus, particularly when the preliminary indications are that the Department has or will impose artificial constraints and requirements on key components of such a trading program. Given its failure to properly allocate loading as part of the TMDL, the Department must entertain comments on the trading project and address such comments in formulating the eventual TMDL that will be submitted to EPA for approval. The Department cannot relegate to a potential, voluntary trading program the scientifically sound allocation of initial responsibility for phosphorus reductions. Once the proper initial responsibility for phosphorus removal is established, water quality trading may be appropriate. The unsoundness of relying on trading is compounded by the uncertainty of whether the trading project will be implemented and whether there will be sufficient parties reducing phosphorus in effluent enough to trade with potential credit "purchasers" is unknown. (10)

81. Comment: The Department is considering imposing unsound, artificial, and unfair conditions or restrictions on trading. First it proposed that there would be a maximum trading ratio of 1.0, which is not supported mathematically and will discourage STPs that are further from the model endpoints to trade with closer STPs to have the closer STPs remove additional phosphorus. The Department is also considering that credits be accumulated and recalculated annually, based not on actual flow but on permitted flow. For an STP that is operating close to its permitted flow, this calculation of credits may not be particularly troublesome. However, for an STP whose actual flow is far below its permitted flow, this formula will significantly discourage trading from the buyer's perspective. Where, as under the proposed trading project, such credits are calculated annually, this trading disincentive does not serve any rational purpose. The effect on effluent limits that would follow from attenuation cannot be relegated to a voluntary trading program and must be addressed in the phosphorus effluent limit for each STP. If trading is to occur, the "trading ratios" will then be incorporated within each STP's limit, which actually simplifies the trading calculations. The disincentives to trading reverse the Department's concept of "cost efficiency," which the trading project would try to promote. (10)

82. Comment: Unless the Department <u>requires</u> that NJDWSC take responsibility, it will not do so and it will have no incentive to "trade" with other dischargers. The entity that should pay for such treatment of the diverted river water is NJDWSC, the party diverting it. Only by providing NJDWSC with its own financial incentive to reduce the phosphorus load coming into the Wanaque Reservoir will this critical party have an interest in participating in any trading program. WTSA agrees that a

properly formulated trading program can help achieve the most cost-effective approach to reducing phosphorus loads at the critical endpoints. To be effective and fair, all potential trading partners must have appropriately determined financial incentives to participate. (10)

83. Comment: NJDEP has indicated that trading ratios will be capped at 1.0. That clearly is not appropriate for WTSA in view of the significant attenuation of WTSA loads. If trading ratios are indeed capped at 1.0, there will be no reason for WTSA to participate. If the Department were to insist on "capping" the trading ratios at 1.0, the result would be ignore the significant attenuation that occurs, and would be unfair to WTSA, as it would improperly assign a much greater contribution of TP than WTSA's facilities in fact contribute. (12)

Response to Comments 80-83: No final determinations on the trading program have been made. When the trading study is complete, it will be subject to public comment as well as Department and EPA approval. Issues related to attenuation and alternatives to phosphorus reduction are addressed in responses to Comments 48-54.

Nonpoint Source Load Reduction:

84. Comment: The Department should support and help implement programs which will provide a reduction of phosphorus and nitrogen. An open and forthright planning process is needed to attain meaningful reductions. (9)

85. Comment: A real commitment from the State of New Jersey, both regulatory and financially, would be needed to deal with point and nonpoint problems in this reservoir. A 60% reduction cannot be assured when septic management systems are not mandated; when goose management and riparian buffer restoration efforts are voluntary and underfunded, with inputs from these sources uncontrollable and unmanageable; and when conservation plans and resource management plans on farmland to reduce agricultural inputs are not mandatory. Given the lack of confidence in achieving the NPS load reduction, more must be required of point sources. (22)

86. Comment: Commenter is concerned about how reductions will be achieved. Parking lots will not be ripped up. Money is running out to buy up stream corridors. We don't require retrofitting of stormwater when we do redevelopment. A regulatory and financial commitment is needed from the Department to get the NPS reductions. Goose management and fertilizer ordinances are not going to do it. (20)

87. Comment: There is concern about achieving NPS reductions; commenter is relying on Department's assertion that these reductions are feasible. (14)

Response to 84-87: The Department has been and continues to be committed to reducing phosphorus sources derived from stormwater point sources as well as nonpoint sources through best management practices. Stormwater sources regulated as NJPDES point sources are subject to several measures that are expected to significantly reduce phosphorus loads from urban areas. Through their NJPDES permit, Tier A communities are required to implement street sweeping and outlet cleaning, as well as to adopt ordinances regarding proper yard and pet waste management, and limiting wildlife feeding. In addition, municipalities within the spatial extent of the model will be required to adopt the fertilizer management ordinance limiting the application of phosphorus through lawn fertilization. Based on studies in other areas, implementation of a fertilizer ordinance alone is expected to achieve a 20%

reduction in phosphorus inputs to the Passaic River and its lakes and tributaries. Additionally, each year the Department funds NPS reduction projects through the federally funded 319(h) program. These funds are to be used to implement programs and projects designed to reduce nonpoint source pollution. Projects include, but are not limited to, riparian buffer restoration and stormwater retrofits. Relevant projects in the drainage area have been cited in the TMDL document. Although agriculture is not a significant land use in the drainage area, the Department regularly coordinates with the Department of Agriculture to address water quality issues related to agricultural land uses and there are a number of cited funding programs available to accomplish agricultural BMPs. Finally, the Department recognizes the importance of continued public education as key to the overall abatement of NPS pollution. To aid in the public education, the Department continues to support the New Jersey Watershed Ambassadors program. The NJWA program is a community-oriented AmeriCorps environmental program designed to raise awareness about water issues, including nonpoint source pollution in New Jersey.

88. Comment: What assurance is there that New York will address the need to reduce phosphorus load entering New Jersey, without which the TMDL objectives cannot be met. (7), (20)

Response: New York has already applied a phosphorus limit on the Western Ramapo treatment facility that will begin the process of reducing phosphorus loads entering New Jersey. New Jersey believes this permit action signifies a willingness to cooperate and expects to continue to work with New York to assess the loading reduction accomplished and the extent to which additional load reductions are needed.

89. Comment: Commenter recognizes that the cost for achieving required point source controls is not insignificant and wants to be sure that it is well spent, since ratepayers and taxpayers would need to pay for it. Regarding nonpoint source control, while the commenter is willing to pass the proposed fertilizer ordinance, there is concern that in some affected municipalities, much of the fertilizer application occurs by way of landscapers. Landscapers apply fertilizer from tanks and there is no way to know what is in them, which will make enforcement challenging. Limiting the application of phosphorus from fertilizer is better accomplished regionally or statewide and though legislation or rules, even if new legislation or rules are needed to address this issue. (16)

90. Comment: The Department should regulate landscapers to get reductions from the fertilizer source. (14)

91. Comment: The Department should urge the State Senate and Assembly that a more productive tactic would be to introduce and pass legislation controlling non-point source phosphorus contribution via banning the sale and use of phosphorus laden fertilizers and detergents in New Jersey. (3)

Response to comments 89-91: As a requirement of the TMDL, municipalities listed in Appendix B of the TMDL documents must adopt and enforce a fertilizer application ordinance. The fertilizer ordinance applies to all persons, defined as any individual, corporation, company, partnership, firm, association, or political subdivision of this State subject to municipal jurisdiction. The landscaping industry falls under this definition and is required to comply with the conditions of the ordinance. The purpose of the fertilizer ordinance is to regulate the outdoor application of fertilizer so as to reduce the overall amount of excess nutrients entering waterways, thereby helping to protect and improve surface water quality. The Department agrees that a regional or statewide plan may be a more effective means to manage the fertilizers source of phosphorus. An initial step towards this approach is the Memorandum of Understanding (MOU) between the Department and members of the lawn care industry to reduce phosphorus by 50 percent the pounds of phosphorus applied in lawn care products in New Jersey Watersheds by 2010 as compared to a 2006 base year.

92. Comment: The City of Garfield has adopted a Fertilizer Management Ordinance and will provide a certified copy when passed by the Mayor and Council. (6)

Response: The Department appreciates the initiative demonstrated by the City of Garfield to reduce phosphorus loads in advance of adoption of the TMDL.

93. Comment: The proposed TMDL requires a basin-wide uniform reduction in non-point source phosphorus of 60%. Municipalities identified in Appendix B will be required to adopt a Fertilizer Management Ordinance and to undertake other phosphorus reducing measures. The uniform NPS reduction ignores phosphorus attenuation that occurs in the river system. Given the 99% attenuation and greater settling of organic phosphorus which makes up most of NPS phosphorus, it is likely that none of the NPS phosphorus from Warren arrives at Two Bridges, which is some 35 miles away, or at Dundee Lake which is 50 miles distant. There is no reason to require that Warren Township to adopt a Fertilizer Management Ordinance or undertake other NPS phosphorus reducing measures. (10)

Response: The commenter is incorrect to assume that none of the stormwater phosphorus load from Warren arrives at Two Bridges. In fact, attenuation of wet-weather phosphorus loads is much less than dry-weather, so nearly all of the wet-weather load from Warren will reach Two Bridges. Attenuation, while not as significant for stormwater loads, is fully accounted for by the Passaic River TMDL model.

95. Comment: There is substantial uncertainty as to whether the nonpoint and stormwater point source load reduction targets can be achieved. Therefore, Wayne requests confirmation that those phosphorus effluent limits applicable to the point source dischargers, which derive from the TMDL process, will not be amended in the future in the event that the nonpoint and stormwater point source load reduction targets are not met. (18)

96. Comment: The NPS load reduction for Township of Wayne may not be achievable. Wayne already has a fertilizer ordinance in place. If the nonpoint source reduction is not achieved, there is concern that the impacts of the lack of water quality improvements will be placed on the STPs by additionally lowering their loadings. (11)

Response to 95 and 96: The Department fully expects through the various management measures outlined in Section 7 Implementation Plan of the TMDL report that nonpoint and stormwater point source target reductions will be met comprehensively throughout the basin. The Department is committed to assisting with achieving these reductions through enforcing the municipal stormwater permit requirements, requiring the fertilizer management ordinance, the fertilizer MOU, and funding projects. The Department does not anticipate that the STPs will have to additionally lower their loadings in the future to meet the TMDL requirements. However, there can be no guarantee regarding future permit limits that may be imposed given the many physical variables, as well as potential for changes in regulatory requirements that may occur. Water quality response to implementation of the load reductions in the TMDL will be assessed and the need for adaptive management will be determined over time.

Data Availability:

97. Comment: Because the supporting documentation for the Wanaque Reservoir Model is not sufficient to facilitate a detailed technical review, the proposed TMDL should not be adopted. The model contains uncertainty in the loading to the Wanaque Reservoir from diversions and in how well the model responds to the diversion loads discharged to the reservoir. Although this particular model is proprietary to Najarian and Associates, input and output files for the 1/1/93 to 12/31/02 calibration can be provided. This includes daily 1993-2002 diversion inputs used for the baseline model case (date, location, flow, phosphorus concentration), the monthly diversion data. In addition, an integral component of the Passaic TMDL modeling analysis, the USGS DAFLOW Model and report has yet to be released. (12)

98. Comment: The Department has continued to withhold information critical to a thorough evaluation of the TMDL, which is necessary to enable the submission of all relevant comments. The Department continues to refuse to make available the LA-WATERS Wanaque Reservoir Model. Given the significant expenditure of public funds that the proposed TMDL is likely to require of the dischargers, it would be in the public's interest to make the model and the water quality inputs available. Based on the meaningful input provided given availability of the Phase 2 model, allowing public access to models is the only way to ensure that the Department will have the benefit of an open and transparent TMDL process. (10)

99. Comment: It is not possible to perform a complete technical and scientific evaluation of the TMDL due to lack of access or delayed access to data and model inputs. Insufficient information is provided about observed algal concentrations, their relationship to diversion inputs in the Wanaque Reservoir, and the reservoir concentration of phosphorus that would maintain acceptable algal concentrations for the protection of drinking water. Insufficient data is provided to confirm that the Reservoir model accurately describes phosphorus dynamics. Data provided in figures in insufficient. The Omni modeled was not made available until late in the public comment period. (15)

100. Comment: The Department has failed to provide the data that supports key determinations made with respect to the Wanaque Reservoir. This information must be provided in accordance with OPRA. Lack of access to requested information is particularly egregious because RVRSA paid its fair share toward development of the TMDL. (1), (2)

Response to Comments 97-100: The Department has addressed all OPRA requests that were made with respect to the Phase 1 TMDL and provided all information in its possession in response to these requests. Certain information is not available in the form requested; however, the Department believes that the available information is sufficient to allow an assessment that the studies provide a sound basis for the TMDL and the WLAs and LAs established as an outcome. As stated previously, the Najarian 2005 TMDL study report provides sufficient data for the evaluation of model results. Data is provided in the form of graphical outputs, summary loading budgets, and error analysis. Tabular chlorophyll-*a* data for the Wanaque Reservoir at Raymond Dam were also provided in the supplemental report for the Wanaque Reservoir modeling, (Najarian, 2007). While the actual model code was developed under funding of the NJDWSC and remains proprietary to that agency, the reservoir model has been extensively documented in two prior reports ("Influence of Wanaque South Diversion on the Trophic Level of Wanaque Reservoir and its Water Quality Management Program", Najarian 1988 and "A preliminary assessment of water quality status of the upper Passaic River and re-verification of the Wanaque Reservoir model", Najarian 2000). Further, the model's hydrothermal and water quality algorithms have been published in peer-reviewed journals ("Mixed-Layer Hydrothermal Reservoir Model," M. ASCE. Journal Hydraulic Engineering. 120 (7), 846-862 and "A Multicomponent Model of Phosphorus Dynamics in Reservoirs," Water Resources Bulletin, 20, No. 5:777-788). With regard to the Passaic River basin model, the comment period was extended to allow additional time to evaluate to that model. The flow Model Diffusion Analogy Surface-Water Flow Model, published by USGS in 2007, entitled, "Simulation of Surface-Water Conditions in the Non-Tidal Passaic River Basin, New Jersey Scientific Investigations Report 2007-5052" was used to simulate flow in the non-tidal Passaic River and its major tributaries.

In addition, this TMDL has been the subject of more public involvement than any other in the State, as described in the TMDL document and reiterated in response to Comments 101-102. The Department has conducted stakeholder discussions on phosphorus TMDLs for the Passaic River Basin as far back as 1996. One outcome of that extensive process was selection of LA-WATERS as the appropriate tool to assess nutrient and productivity in the Wanaque Reservoir under current conditions and to determine phosphorus loading reductions needed to achieve water quality objectives. This determination was made with full knowledge that this model was proprietary. Specifically, the October 2001 "Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin", memorialized the outcome of the discussions with stakeholders and the work of the Passaic River Basin TMDL Work Group regarding the plan to develop the TMDL. Included was the recommendation to use LA-WATERS to develop a water quality objective for the Wanaque Reservoir to protect designated uses.

Public Participation:

101. Comment: Public participation has been severely restricted in the process of developing this proposal. Before further action is taken the Department should undertake the following activities:

- Convene a Technical Advisory Committee to peer review the scientific investigations and the conclusions that have been reached in this process;
- Convene a Public Advisory Group to study and evaluate the economic and ecologic costs and benefits to be derived from the implementation of this proposed TMDL;
- Ask for public comment on the outputs from these groups.

(8)

Response: The Department does not agree that public participation has been severely restricted in this TMDL development process. In fact no other TMDL has had the degree of participation and discussion that is the hallmark of the Passaic River Basin TMDL. Section 9 Public Participation in both TMDL documents chronicle the various workgroups and key meetings that the Department has convened and had with all stakeholders groups (including the commenter) throughout the past 14 years. The Passaic TMDL Work Group, which met monthly from 2001-2003, was a technical advisory committee that led to the development of the proposed Passaic TMDLs as articulated in the *Passaic Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin* document. From 2004 to 2007 the Department convened stakeholder meetings to present and discuss key findings and to seek input from the public on the TMDL. Information obtained from this process informed the development of the Passaic TMDLs. Components of the TMDL were also reviewed by the NJ EcoComplex academic panel and presented at conferences and in peer reviewed journals.

A cost benefit analysis is not a requirement of the State's TMDL process. Nevertheless, the Department did request cost estimates from dischargers in September 2007. Responses were received from some dischargers, which indicate that phosphorus removal costs will be significant, but the needed phosphorus reductions are both achievable and reasonable. Use of BNR technology at plants where this technology is feasible can accomplish needed reductions that will require an initial capital cost and low operation and maintenance costs and will have minimal adverse side effects associated with chemical removal. , The TMDL provides that, upon approval of a trading tool, the Department will make water quality trading an option for specified treatment plants within the Passaic River Basin, which may identify viable cost effective options beyond a uniform reduction of phosphorus at each facility.

102. Comment: The Department violated the premise of the Clean Water Act by not publicizing the development of the TMDL for the fresh water Passaic and the Ramapo. There should have been briefings during development. The TMDL would have benefited from broader public participation. (7)

Response: In addition to the Clean Water Act's public process requirement, the Department's Water Quality Management Planning rules at *N.J.A.C.* 7:15-7.2(f) require the Department to informally initiate a public process prior to the development of each TMDL including informational sessions as needed. The Department has fully complied with both the spirit and intent of the requirement to provide opportunities for public comment. As set forth in the response to Comment 101, the Department has gone to extraordinary lengths to maintain an open public process in the development of these TMDLs. The Department publicized the development of the Passaic River Basin TMDLs by including stakeholders in the TMDL development process throughout the past 14 years through various workgroups and milestone informational sessions as set forth in Section 9 of both TMDL documents. In preparation of the TMDL proposal, the public was formally noticed: through direct correspondence by the Department, by public notice as published in the May 7, 2007 New Jersey Register; and through newspapers of general circulation in the affected area. In addition, a public hearing was held on June 7, 2007 at the Cultural Center at Lewis Morris County Park, 300 Mendham Road, Morristown, NJ. Notice of the proposal and hearing was provided to affected Designated Planning Agencies, municipalities, dischargers, and purveyors in the watershed.

TMDL Administrative Comments:

103. Comment: There are data and information required for defining the Passaic River Basin TMDL equations that are missing from the TMDL report. While this data and information may be found in the supporting documents, the TMDL report should provide this information in order to present and support these TMDL equations. (21)

Response: Highly complex TMDL studies that cover large areas, such as the subject TMDL studies, preclude inclusion of the supporting data and other information within the TMDL document itself. As noted by the commenter, the data and information upon which the TMDLs are based are found in the cited support documents, which were made available along with and are part of the TMDL reports. The commenter is referred to other complex studies, such as the Delaware Estuary PCB TMDLs established as a collaborative effort among EPA, the affected states and DRBC, wherein the TMDL document summarizes the findings and the detailed information is found in several volumes of supporting information.

104. Comment: For the Passaic River basin TMDL, the entire TMDL equation must be presented by assigning numeric values to the wasteload allocation (WLA), load allocation (LA), explicit margin of safety, and reserve capacity. Some of this essential information is missing from the TMDL report, most notably in Table 12, which provides the TMDL for the area between the Wanaque Reservoir and Dundee Dam, and Table 13, which provides the TMDL for the Wanaque Reservoir. Table 12 currently provides allocations of TP per day in the following broad categories: headwaters, NPS

runoff, NPS baseflow, CSO discharges and STP discharges. These allocations are divided between three geographic areas: Pompton, Upper/Mid Passaic and Lower Passaic. These categories must be broken down further to include: the names of the affected tributary waters along with the individual LA for each tributary, the identification of the different New Jersey land use categories by size with their current loads, percent reductions, and TMDL allocations, the method for identifying MS4 areas and identification of their loads in the WLA by MS4 name and permit number, and the names, permit numbers, and individual WLAs of the other permitted discharges in the contributing watershed. (21)

Response: Tables 12 and 13 have been modified to clarify the TMDL and WLAs and LAs for each endpoint and to correct minor errors. It should be noted that the MOS and reserve capacity have been factored into the Passaic River basin TMDL by targeting a level of chlorophyll-*a* that is below the criterion. Therefore, there is no quantified amount of the loading capacity attributed to these components. This means of providing a MOS and reserve capacity is allowed according to EPA guidance (May 20, 2002 Sutfin Memorandum). A more detailed areal breakdown is not appropriate or necessary because a key finding of this TMDL study is that the in-stream numeric criterion does not apply within the modeled domain. Watershed criteria have been established at the two critical locations, the Wanaque Reservoir and Dundee Dam Lake. A tributary by tributary breakdown of loading allocation would only be appropriate to demonstrate attainment of the in-stream criterion, which clearly does not apply here. Regarding specific requested additions, the Department notes the following points. Permitted point sources, other than stormwater point sources, were identified by permit number in Tables 7 and 14. The location of dischargers was provided in Figure 4 and footnotes to Table 14 provide information relevant to the established WLA (e.g., location in outside boundary of modeled domain, location below confluence of Pompton and Passaic Rivers thereby warranting seasonal limits). For additional clarity, Table 14 has been modified to indicate within which TMDL Approach Area each discharge is located, and to correct minor errors. Tables 12 and 13 have been revised to identify the assignment of WLAs and LAs to distinguish stormwater point sources from nonpoint sources by land use type, as described in the text, including existing loads and loads under the TMDL specification. Permit numbers have been added for stormwater point source permittees in Appendix B. Land use information was provided in Table 6 and Figure 3 for the overall Passaic River drainage area. A land use breakdown for the Pompton Lake drainage area is provided in Table 6.9 of Najarian 2005. Note that the method for Approach Areas 1, 3 and 4 is described in Section 4, Source Assessment, and explained in greater detail in Omni 2007. For Approach Area 2, the UAL coefficients were used to derive an EMC for storm-driven loads and applied in combination with an estimate of groundwater concentration, using a base flow separation method to obtain nonpoint source loads.

105. Comment: In the Passaic River Basin TMDL, Table 13 is missing the following from the TMDL equation: explicit margin of safety, reserve capacity (if any), the identification of the specific permitted discharges located in this TMDL's contributing watershed, a table assigning the different land uses to either the WLA or the LA portion of the equation, and the distribution and size of the different land uses in this contributing watershed. (21)

Response: Table 13, which provides information for the Wanaque endpoint, has been revised to distinguish between WLAs and LAs for stormwater point sources and nonpoint sources, respectively. The MOS and reserve capacity have been factored into the Passaic River basin TMDL by targeting a level of chlorophyll-*a* that is below the established watershed criteria. Therefore, there is no quantified amount of the loading capacity attributed to these components. This means of providing a MOS and reserve capacity is allowed according to EPA guidance Sutfin 2002. Regarding land use information, the land use areas are found in Najarian 2005, Table 6.9, as indicated in footnote 7 of Table 13. As described in response to Comment 104, for Approach Area 2, UAL coefficients were used to derive an

EMC for storm-driven loads and applied in combination with an estimate of groundwater concentration, using a base flow separation method, to obtain nonpoint source loads. Existing and TMDL loadings derived from these methods are provided in Table 13. Point sources, other than stormwater point sources, were identified in Table 14 by permit number. This table has been modified as described in response to Comment 104 for additional clarity. Stormwater point sources are identified by permit number in Appendix B.

106. Comment: In the Passaic River Basin TMDL, the data used to develop the TMDLs must be identified in a general way in the TMDL report. A summary of the major observations, such as dissolved oxygen and chlorophyll-*a* levels in the Passaic River at Dundee Dam and the Passaic River at Two Bridges, should also be provided. (21)

Response: Detailed observations and data are included in the supporting documents. The TMDL does provide a summary of key water quality findings in Section 3. The findings identify locations where phosphorus is causing excessive primary productivity and where it does not and why, and where observed low dissolved oxygen is the result of naturally occurring conditions. A summary statement about chlorophyll-*a* levels in Wanaque Reservoir has been added for completeness.

107. Comment: In the Passaic River Basin TMDL, a summary of boundary conditions should be provided in the TMDL report. (21)

Response: The boundaries are identified in Figure 2 entitled "Spatial extent of non-tidal Passaic River basin study and related studies with modeling approach applied" (page 23). A discussion of the TMDL approaches is found in section "Area of Interest" (page 18-19). Boundary conditions are summarized on page 11 and then discussed in greater detail on page 123-124 of the Omni Environmental Final Report. Boundary conditions are also addressed in section 5.4 Conditions for TMDL Development in the Najarian Report (page 5-3).

108. Comment: In the Passaic River Basin TMDL, other information and data which support the TMDL analysis and delisting conclusions must be identified in the TMDL report by providing adequate references, including document name and relevant page number(s), to the supporting documents. For instance, when the TMDL report states that 2004 Sublist 5 listings were shown to not be impaired by TP, the reference to the data or information supporting this claim must be provided in the body of the TMDL report. (21)

Response: Section III, Watershed Modeling Analysis, of the Passaic River Basin TMDL document (Omni, 2007) provides adequate discussion and relevant graphs for the interpretation of the narrative criteria for phosphorus for all of the five sub-watersheds studied that leads to the conclusion that phosphorus is only "rendering unsuitable" in the identified critical locations. In addition, comprehensive graphical model simulation outputs in terms of the response indicators, dissolved oxygen and chlorophyll-*a* concentration under different model conditions, are provided in Appendix J in the Passaic River Basin TMDL Appendices (Omni, 2007). References to these sections will be included in the TMDL document.

109. Comment: In the Passaic River Basin TMDL, for reasonable assurance, please provide as much detail as possible regarding the reductions in phosphorus loading expected from the implementation actions identified in the TMDL report. (21)

Response: The Department expects to achieve the needed levels of nonpoint source reduction through a suite of management measures, as described in the implementation section. Significant reductions in phosphorus load are expected from implementation of the measures required under the municipal stormwater regulation program. These include street sweeping, yard and pet waste management, and limitations on wildlife feeding. For example, the US Department of Transportation Federal Highway Administration cites a State of California study on vacuum sweeper efficiency where 74% TP was removed, with an efficiency rate of 40% attributed to mechanical sweepers– see www.fhwa.dot.gov/environment. In addition, adoption of the fertilizer management ordinance will be required of those municipalities that are within the model domain. The literature supports that a significant (20%) overall phosphorus reduction can be expected from this measure alone. The USGS documented the effects of lawn fertilizer on nutrient concentrations from runoff for a study in Wisconsin and found that total phosphorus concentration in lawn runoff was directly related to phosphorus concentration in lawn soils. Further, runoff from lawn sites with phosphorus-free fertilizer application had a median total phosphorus concentration similar to that of unfertilized sites, an indication that phosphorus-free fertilizer use is an effective, low-cost practice for reducing phosphorus in runoff. A growing body of research from Wisconsin, Michigan, Minnesota and Maine concludes that phosphorus from fertilizer applied to lawns enters surface waterbodies through runoff. After 8 years of voluntary use of phosphorus-free lawn fertilizer starting in 2008, Maine is banning the sale of phosphorus fertilizer unless certain conditions are met because of the finding that most soils had enough phosphorus to keep a lawn healthy. This mirrors information available about soils in New Jersey as well. Research conducted in Maine showed that in watersheds that are converted from their natural, forested condition to residential, commercial and agricultural uses, the amount of phosphorus runoff increases by a magnitude of 5 to 10 times. Minnesota has also restricted phosphorus in lawns fertilizers to protect the quality of their lakes and streams. In 2003, EPA reported that the City of Plymouth, Minnesota enacted a phosphorus fertilizer ban in 1996 and observed a 23% reduction in phosphorus inputs to their lake as compared to phosphorus loading from neighboring community. See http://www.lakeaccess.org/lakedata/lawnfertilizer/recentresults.htm

In addition to measures to be implemented through the Municipal Stormwater Regulation Program, the implementation section describes numerous restoration projects funded with 319(h) funds that are located within the study drainage area. The National Grants Reporting Tracking database provides a tool for estimating load reductions from measures, including those that achieve phosphorus reduction. For example, a 1998 319(h) funded detention basin retrofit project in Mendham Township estimated using the "Spreadsheet Tool for Estimating Pollutant Load" or "STEPL" model that a 160 pound per year reduction in phosphorus may be expected as a result of the completion of the project. The cumulative effect of these projects will enhance the phosphorus reduction achieved through regulated stormwater and contribute to the overall reduction required. The Department remains committed to targeting future 319(h) funds, as well as available State funds, for example, Corporate Business Tax, to achieve water quality objectives.

110. Comment: In the Passaic River Basin TMDL, please explain the difference between the Ortho-P values in Tables 9 and 10 when both tables have the heading “Tributary Baseflow Concentrations for Contributing Watersheds.” (21)

Response: Table 9 was intended to provide tributary baseflow values for parameters other than phosphorus, while Table 10 was intended to provide tributary baseflow values for phosphorus species, which vary by watershed. The titles of the tables will be revised to be more clear and the phosphorus value will be omitted in Table 9, as this was an error.

111. Comment: In the Passaic River Basin TMDL, why is there no decrease in P loading from CSO discharges? (21)

Response: As background, the Department regulates all portions of combined sewer systems by general permit. The permit relies upon the development and implementation of best management practices, technology-based control measures, self-monitoring, and permit compliance certification to comply with the requirements of the Federal Clean Water Act (CWA) as defined by the National CSO Control Policy. The TMDL addressed CSO discharges in section 4.0 Source Assessment (page 29) under the discussion on Point Sources. It was determined that the CSO load was insignificant in that elimination of this load would result in no significant difference in the outcome of the TMDL. Therefore, because the means for achieving load reductions would entail costly measures such as eliminating CSOs or providing end of pipe treatment, such reductions were deemed an inefficient means of achieving the objective and were not required or factored into the TMDL. Nevertheless, some reductions are expected to be achieved through the Long Term Control Plans for the affected CSOs, which will provide a conservative assumption within the TMDL.

112. Comment: In the Passaic River Basin TMDL, "Baseline Future Condition" is better described as "Upper Bound Condition" on phosphorus loading since it assumes that every NJDPES is discharging at their permitted limit to the watershed (p. 120 of technical document). (21)

Response: Both expressions, baseline future conditions and upper bound conditions, were used interchangeably throughout the study. The descriptor suggested by the commenter for the table would be accurate; however, no change has been made because the descriptor in the TMDL is fully explained as to meaning and is used extensively in the TMDL and supporting documentation. There would be no value added from the effort to change the descriptor throughout the documents.

113. Comment: In the Pompton Lake/Ramapo TMDL document, there should be explanatory text to describe how both the Reckhow model and the mass balance model are used in order to determine the final loading capacity, WLAs, LAs, and margin of safety. How was one modeling approach selected over the other for the TMDL values? If the mass balance model alone was used to determine these, then the discussion must be based on the use of the mass balance model and calculation of implicit margin of safety, the 6% explicit margin of safety, and the 1% reserve capacity. (21)

Response: Section 6 of the TMDL document provides an explanation of the two technical approaches considered as well as an explanation for selection of the mass balance approach over the Reckhow approach. The two approaches gave similar outcomes. However use of the mass balance approach for the Pompton Lake/Ramapo River TMDL would allow the use of a consistent approach throughout Approach Area 2, the remainder of which is addressed in the Passaic River basin TMDL. In addition, the mass balance approach was able to provide daily loadings as a boundary condition input to the Passaic River basin TMDL, while the Reckhow approach does not. Section 6.2 will be revised to provide greater clarity on the integration of the approaches as well as this additional elaboration on the selection of the mass balance approach. With regard to the MOS and the Reserve Capacity, a significant MOS is integral to the Reckhow model and an additional 6% MOS was stipulated values with respect to loadings under the mass balance approach. The mass balance MOS value was deemed sufficient, given the significant MOS already incorporated in the Reckhow model. The 1% Reserve Capacity was provided to allow for the possibility that there may be a new or expanded wastewater treatment facility in the future, although there are no planned new or expanded facilities at this time.

114. Comment: Pertinent information currently in the Wanaque TMDL needs to be presented in the Ramapo River-Pompton Lake TMDL document and this document should be able to "stand alone." These items are currently described with regard to the Reckhow model alone. (21)

Response: The information in the Wanaque TMDL, or Passaic River basin TMDL, is not pertinent to the Ramapo River-Pompton Lake TMDL calculations. The latter study addresses a distinct drainage area that contributes, in terms of a boundary condition, to the Passaic River basin TMDL study, but the converse is not true. Therefore, the Pompton Lake/Ramapo River TMDL is a stand-alone document. Because the Pompton Lake/Ramapo River document has not yet been approved and contains information relevant to the Passaic River basin TMDL, the pertinent information from the Pompton Lake/Ramapo TMDL document is included in the Passaic River basin TMDL so that it is also a stand alone document.

115. Comment: In the Pompton Lake/Ramapo TMDL, on page 15-16, the Najarian Mass Balance Model is described in the Source Assessment Section. This should be located in Section 6.0, Technical Approach. Furthermore, the results of the model, including graphs of observed versus simulated loadings and coefficient of correlation, should be included. (21)

Response: The Department agrees that some of the discussion under Source Assessment is more appropriate in Technical Approach and will modify the document accordingly. However, the Department believes that the supporting details are more appropriately provided in the support document, Najarian 2005, which is part of the TMDL.

116. Comment: In the Pompton Lake/Ramapo TMDL, NJDEP states the following regarding phosphorus concentrations for the Ramapo River between Mahwah and Pompton Lake (see Page 23): "Given the required boundary condition of water quality meeting the standard of 0.1 mg/L at the state border/Mahwah station and the fact that the Ramapo River is a "losing" stream, the in-stream standard of 0.1 mg/L will be met in the Ramapo River, without further demonstration." The term "losing stream" is unclear. This concept could be demonstrated by including graphs comparing the phosphorus concentrations in the Ramapo River at Mahwah versus downstream at Oakland. In general, meeting a stricter WQS in a downstream lake doesn't necessarily mean that a higher WQS in an upstream segment will be met due to greater variability and higher peak to average P ratios in river phosphorus concentrations. In addition, Ramapo River is a "losing stream" given current phosphorus loads, but will it remain a "losing stream" once the TMDL is implemented? Please explain this linkage and identify mechanisms by which the Pompton River's phosphorus concentration decreases further downstream from Mahwah. (21)

Response: A losing stream is one in which stream flow is lost to ground water at a greater rate than groundwater enters the stream. In the relevant portion of the Ramapo River, a well field is located which draws water at a rate so as to induce the losing stream condition. The stream flows, which contain higher concentrations of phosphorus, are drawn into the ground water and are replaced with ground water, which contains lower concentrations of phosphorus. This hydrologic condition is not expected to change as the result of implementing the TMDL. The supporting document, Najarian, 2005, pages 3-4,3-5, and Figures 3.6a, 3.6b, 3.7a and 3.7b, provide a detailed explanation and justification for the conclusion drawn that the Ramapo River is a losing stream. In addition, water quality sampling conducted for the Passaic River TMDL study demonstrates the same result. Commenter is referred to the synoptic sampling done at the two locations, as illustrated in the graph provided in the Passaic River Basin TMDL- Phase I data summary and analysis (Omni, 2004) page 7 slide 6. It should be noted that the called for reduction from New York is of primary importance in meeting the in-stream criterion at the Mahwah station, as it is very close to the border. The reductions called for in New Jersey are to attain the more stringent lake criteria in Pompton Lake. Comparison of the observed TP concentrations between Ramapo River and Mahwah and Ramapo River at Pompton Lake show a clearly significant decrease in TP concentrations.

117. Comment: For Pompton Lake, the Qa, Areal Water Load (m/yr), is 375 m/yr, which exceeds the recommended range for the Reckhow model of 1.2-190 m/yr. Please discuss using the Reckhow approach when this discrepancy exists. (21)

Response: Although the areal water load for Pompton Lake is outside the calibration range (375 m/year), the model still remains a good choice since it has the broadest range of lake characteristics in its database. While the target concentration for the lake is well within the range, the areal phosphorus load provides a better representation of a lake's intrinsic loading characteristics. Also, it is the model's prediction of target condition that would be used to calculate the TMDL. If current loads are higher than the range that can produce reliable model results, this has no affect on the model's reliability to predict the target condition under reduced loads.

118. Comment: In the Pompton Lake/Ramapo TMDL, the current title of Table 13 does not make sense. The title should explain that this is the loading capacity or TMDL for total phosphorus including WLAs, LAs, explicit margin of safety and reserve capacity for the New Jersey portion only of the Pompton Lake watershed. (21)

Response: The referenced table includes information regarding both New Jersey and New York sources, providing a summary of all source loads, as reflected in the title. The title will be modified to indicate that the table provides the TMDL components for the Pompton Lake endpoint and WLAs and LAs that apply to sources originating in New Jersey.

119. Comment: In the Pompton Lake/Ramapo TMDL, the allocations in the column labeled "TMDL Specification" add up to 17.4, not 17.3 kg TP/day which has been identified as the loading capacity. Please reconcile these two numbers. (21)

120. Comment: The "TMDL Specification" for "Point Sources other than Stormwater NJPDES Dischargers" is given as 0.4 kg TP/day yet the summation of these individual WLAs in Table 12 is 0.37 kg TP/day. Please reconcile these two numbers so that the same number is used in both tables for this category of sources. (21)

Response to Comments 119 and 120: The difference between the values in Table 12 and Table 13 is negligible. However, the Department has resolved the imprecision caused by conventional rounding as requested by the commenter.

121. Comment: In the Pompton Lake/Ramapo TMDL, there are certain allocations under the "Land Use Surface Runoff" section which appear to conflict or are not identified. Clarify how "low intensity residential" and "high intensity residential" do not overlap with the category called "mixed urban/recreational." Please provide some description in the document of the source category "disturbed areas." Please explain why it is reasonable to assign a load of 0 kg TP/day to the category "Crops/Pasture/Hay." Finally, please explain the Sediment/Base Flow load and how is it estimated. In the Source Assessment Section whether this load is a sediment flux load, a groundwater inflow load, or a combination thereof could be provided. (21)

Response: Table 5 provides the Anderson Land Use/Land Cover codes that were grouped into each land use category descriptor used in the document. The descriptions of what is covered under each code can be found in LAND USE LAND COVER CLASSIFICATION SYSTEM, (Derived from: A Land Use and Land Cover Classification, System for Use with Remote Sensor Data, U. S. Geological Survey Professional Paper 964, 1976; edited by NJDEP, which is available at http://www.nj.gov/dep/gis/digidownload/metadata/lulc95/anderson.html. A footnote will be added to Table 5 referring to this source, which will be added to the References Section. For convenience, the Department had grouped several code types under an unofficial descriptor, "mixed urban/recreational". There is no overlap with the residential land uses, as the codes included in "mixed urban/recreational" include "transportation, communication and utilities", "other urban or built-up" and "recreational land." "Disturbed areas" are the same as "barren land" commonly used in other TMDLs. The "crops/pasture/hay" category appears to have a zero value in the future because, after the 80% reduction, the value is less than 0.05 and is lost due to rounding to maintain significant figures. The table will be revised to clarify this. The term "sediment/base flow" refers to the portion of the mass balance equation that represents ground water base flow and storm water flows, derived as described in the TMDL document.

122. Comment: In the Pompton Lake/Ramapo TMDL, the names of the land use categories which have been assigned daily loads do not match the names of the categories which were divided into WLAs and LAs. Please make clear, for the categories actually used, which are in the WLA and which are in the LA. (21)

Response: The Department has revised the table to clarify WLA and LA by category.

123. Comment: In the Pompton Lake/Ramapo TMDL, Table 12 (page 25) does not identify that the units represent total phosphorus. (21)

Response: The Department has revised the table to clarify that the units represent total phosphorus.

124. Comment: In the Pompton Lake/Ramapo TMDL, Table 4 (page 13) provides the size of each land use area in the entire Pompton Lake watershed. There must be a table which provides these sizes for the focus of the TMDL which is only the New Jersey portion (47 mi^2) of the total watershed (160 mi^2). Also, the 1995/97 land use coverage should be replaced with the 2002 land use coverage. (21)

Response: The values shown in the TMDL for land uses used in the Reckhow approach are from the Pompton Lake and Ramapo River TMDL Study, QEA 2004. The consultant combined the 1995/1997 land use/land cover for New Jersey and the 2000 New York land use information to develop nonpoint source loading. Comparison of the 1995/1997 and 2002 coverage showed no significant change in the New Jersey land use assessment by category. In any case, the Reckhow approach was not ultimately used to calculate the TMDL. In the mass balance approach, land use from New Jersey only was used to estimate the baseflow versus groundwater values for phosphorus, as described in the TMDL.

125. Comment: In the Pompton Lake/Ramapo TMDL, Figure 2 (page 11), the map of the New Jersey portion of the watershed, does not identify the approximate location for the collection of monitoring data from the Passaic Valley Water Commission and from the North Jersey District Water Supply Commission. Also, there is a monitoring location labeled "AN0267" on the map that is not discussed. Is this possibly the location for collection of benthic macroinvertebrate (AMNET) data? What were the results? (21)

Response: In the Pompton Lake/Ramapo TMDL, the sample locations used for the TMDL have been included. The benthic macroinvertebrate (AMNET) site labeled "AN0267" is irrelevant to the TMDL and has been removed from Figure 2. The PVWC (at Pompton Lake inlet) and NJDWSC (same as 1388000 – additional label) sample locations will be added.

126. Comment: In the Pompton Lake/Ramapo TMDL, on page 7, the last sentence of the third paragraph states "Attainment status with respect to designated uses and the parameters identified as responsible for the non-attainment for the assessment units in Table 2 are identified in Appendix B." The designated use impairments do not appear in Appendix B. (21)

Response: This information will be added to Appendix B.

127. Comment: In the Pompton Lake/Ramapo TMDL, at the top of page 16, is the statement "Two stations within the Pompton Lake watershed were selected as the critical locations, Ramapo River at Pompton Lake and Ramapo River at Mahwah." The two monitoring stations used as the critical locations were called "Ramapo River at Dawes Highway" and "Ramapo River near Mahwah" in the 2004 303(d) list. Should these names be used? (21)

Response: The "Ramapo River at Pompton Lake" is a station that is no longer sampled, replaced by one nearby entitled "Ramapo River at Dawes Highway", which is the name used in the 2004 listing. "Ramapo River at Mahwah" was inadvertently used and should be "Ramapo River near Mahwah". This will be changed in the document.

128. Comment: In the Pompton Lake/Ramapo TMDL, the opening description of reasonable assurance, provided in this section on page 33, does not accurately describe the EPA definition or use of reasonable assurance. Since this information is identified on page 8 as "an EPA requirement for approval which will be addressed in the TMDL document," a more accurate definition should be provided. EPA uses reasonable assurance to determine that TMDL reductions in nonpoint sources are reasonable when they are offsetting required reductions from point sources. Please provide as much detail as possible in terms of the reductions expected from the implementation actions identified in the TMDL report. (21)

Response: The opening of the Reasonable Assurance Section was not intended as a restatement of the EPA definition. The Department understands the purpose of reasonable assurance and sees no conflict between that requirement and the statement in the TMDL document. Regarding the means to achieve the identified nonpoint source and stormwater point source reductions, please refer to the response to Comment 109. In this drainage area, an even more ambitious reduction is called for and is expected to be achieved by, in addition to the measures described, an emphasis on funding riparian restoration projects, which is consistent with measures identified to be needed to address temperature impairments in the Pequannock River temperature TMDLs approved by EPA in 2004.

129. Comment: In the Pompton Lake/Ramapo TMDL, on page 21, the discussion of the explicit margin of safety focuses on the Reckhow model's 33.3% MOS yet the final TMDL is based on a 6% MOS using the mass balance approach. The document does not provide discussion of the 6% MOS which was used. Please provide this information. (21)

Response: The 6% MOS was chosen to reflect the degree of confidence in the data and model used and is comparable to the explicit MOS used in other TMDLs.

130. Comment: In the Pompton Lake/Ramapo TMDL, the fourth paragraph on page 21 begins "An implicit margin of safety is provided by using conservative critical conditions…" This section needs discussion of the conservative assumptions that may have been employed to determine the critical condition(s). The discussion of providing an implicit margin of safety by targeting total phosphorus instead of dissolved phosphorus is correct. The implicit margin of safety is not associated with the selection of critical conditions or the use of total phosphorus as the target pollutant versus dissolved or particulate phosphorus (since water quality standards have taken this into account already), but with conservative modeling assumptions. (21)

Response: The comment appears to be internally inconsistent. It is assumed the commenter intended to state that "The discussion of providing an implicit margin of safety by targeting total phosphorus instead of dissolved phosphorus is *not* correct." The implicit MOS section will be revised to eliminate the discussion of total versus dissolved phosphorus.

131. Comment: In the Pompton Lake/Ramapo TMDL, The discussion of reserve capacity on page 23 should also state the number, that is, 0.2 kg TP/day (1% of the TMDL) that has been chosen for reserve capacity. (21)

Response: This information is provided in Table 13, but will be added to the Reserve Capacity Section for completeness.

132. Comment: In Figure 1 of the Pompton Lake/Ramapo TMDL document (page 10), the map should include Wanaque Reservoir and the diversion pipe since it is a part of the hydrological system. (21)

Response: The Wanaque diversion location is not within the spatial extent of the Pompton Lake/Ramapo River TMDL study and therefore it is not necessary to add this information to the cited map.

TMDL Should Address Nitrogen:

133. Comment: The TMDL does not deal with all the issues. In 1999, the nitrogen got so high that it nearly shut down PVWC. (20)

134. Comment: Given the long standing objective of the Public Advisory Committee for WMA 6 to set appropriate target levels for nitrogen, as well as phosphorus, through scientific investigation, the commenter believes that the studies upon which this TMDL proposal is based should have evaluated the impacts of nitrogen concentrations with respect to dissolved oxygen and chlorophyll-*a*. Both nitrogen and phosphorus are nutrients that contribute to algal growth and affect suitability of waterbodies for use as water supplies, which is the highest use and must be protected. Phosphorus was found not to be limiting productivity in a number of locations. In these locations, reducing both nitrogen and phosphorus should reduce algal growth. Consequently, the Department should address nitrogen in the Passaic TMDL. The goals of chlorophyll-*a* for the Wanaque Reservoir and Dundee Lake will not be achieved unless loadings of both phosphorus and nitrogen are reduced. The Highlands Draft Regional Master Plan and the NY/NJ Harbor TMDL are targeting nitrate as a parameter that must be limited or reduced. It is bothersome that the Highlands do not have a database that could inform the TMDL plan to make it more comprehensive; instead the TMDL proposal is piecemeal and has inaccuracies. Nitrogen and ammonia reductions are needed to assist the Lower

Passaic River Restoration project because, in that part of the river, nitrogen is the nutrient of concern to control algal growth. (7), (8), (9)

Response to Comments 133 and 134: The modeling study for this TMDL did include nitrogen species. However, a TMDL for nitrogen species in the Passaic River itself is not warranted at this time because the waters are not listed as impaired with respect to nitrogen species. It is important to note that ammonia is currently very low throughout the Passaic River basin due to existing point source requirements. As noted in *The Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin*, October 2001, vetted and approved by the Passaic TMDL Workgroup Workgroup, October 31, 2001, and still true today, there are no documented exceedances of the 10 mg/l SWQS for nitrate. However, nitrate is identified as an emerging issue with a critical location at Little Falls where water is withdrawn directly into a drinking water facility. Currently, purveyors are required to perform additional monitoring if nitrate levels above 5 mg/l are found. Furthermore, the Department has begun to implement water quality based effluent limitations (WQBELs) for nitrate upon renewal of NJPDES permits based on compliance with the 10 mg/l nitrate criterion under low design flow conditions (7Q10). The Department is assessing what additional measures may be appropriate to address the issue statewide.

The focus of this TMDL is the phosphorus impairment as it relates to excessive primary productivity and related water quality effects. While it is true that both nitrogen and phosphorus are necessary to support plant and algal growth, it is not true that nitrogen reductions are necessary to achieve the phytoplankton chlorophyll-*a* goals for the Wanaque Reservoir and Dundee Lake. Since both nitrogen and phosphorus are necessary to support plant and algal growth, reducing either or both nutrients to low levels could theoretically limit plant and algal growth. In practice, however, phosphorus is generally targeted to constrain productivity in freshwater systems. Natural and nonpoint sources of nitrate in freshwater systems are generally sufficient to support high levels of productivity, and are more difficult to control than phosphorus. In addition, it would not be desirable to induce nitrogen limitation, which tends to promote nuisance algae in freshwater systems. While neither nitrogen nor phosphorus is low enough currently to limit primary productivity, by establishing watershed criteria in terms of the response indicator chlorophyll-*a* in the two critical locations, Dundee Lake and Wanaque Reservoir, and requiring phosphorus reductions that will attain these criteria as demonstrated by the models, the water quality objectives for this study will be met.

While watershed-wide nitrogen reductions are not necessary to achieve water quality objectives in the non-tidal Passaic River system, they may be necessary to achieve water quality objectives in the NY/NJ Harbor. The model developed for the Non-Tidal Passaic River Basin Nutrient TMDL Study is calibrated for ammonia, nitrate, and organic nitrogen, and can therefore be used to translate a load allocation for the Passaic River at Dundee into wasteload and load allocations throughout the system. Upon completion of the New York/New Jersey Harbor Estuary TMDL, carbon and/or nitrogen reductions may be called for to achieve dissolved oxygen standards in the harbor. If so, the non-tidal Passaic River basin model can be used to allocate loads among sources in the non-tidal Passaic River basin.

135. Comment: The commenter asks what the maximum long-term average concentration of total nitrogen would be to keep summer averages of chlorophyll-*a* below 10µg/L or 20 µg/L. (9)

Response: It was determined in this TMDL study that phosphorus is causing excessive primary productivity in two locations in the Passaic River Basin, the Wanaque Reservoir and Dundee Lake. In these locations, the Department has established watershed criteria in the form of chlorophyll-*a* as well as the phosphorus reductions needed to attain these criteria. As discussed in the response to Comments 133-134, nitrogen reductions are not needed in order to attain the water quality objectives in the non-tidal Passaic River with respect to eutrophication. However, nitrogen reductions may be required in the future, in response to the NY/NJ Harbor TMDL or as determined necessary to ensure the drinking water use is protected.

General Comments:

136. Comment: The existence of a phosphorus problem in the Wanaque Reservoir has not been supported. No limitation based upon discharge to the Reservoir should be imposed until it is demonstrated that phosphorus is causing the impairments. (23)

Response: Water quality data clearly identifies violations of water quality criteria for phosphorus.

137. Comment: The Great Swamp Watershed Association and Ten Towns Great Swamp Watershed Management Committee (TTC) collaborated on the collection of water quality sampling for the Omni Environmental February 2007 Report (Appendix D, Page D-2 of the Omni Report). Specifically, sample collection at certain sites that was conducted by TTC are improperly attributed to GSWA at sites PRin, PB1, LB1, GB1, BB1 and PRout. (4)

Response: The Department has posted a revised Appendix D of the 2007 Omni Report in order to make it clear that the data used for the analysis were provided through collaboration between the Ten Towns Great Swamp Watershed Management Committee and the Great Swamp Watershed Association.

138. Comment: A State mandated program requires water purveyors to add polyphosphate to potable water for corrosion control. This practice increases total phosphorus in STP influent. (11)

Response: Currently there is no mandated State program for the addition of polyphosphate to drinking water. The commenter may be referring to the National Primary Drinking Water Regulations for Lead and Copper (40 C.F.R. 9, 141 and 142), which, since the early 1990's have required all public community water systems serving populations greater that 50,000 to do a corrosion optimization study and then after state approval implement the recommendations of the study. In many cases the study outcome was the addition of polyphosphate, sometimes with pH adjustment. However, other outcomes also included increasing existing pH levels with lime or soda ash, adding silicates, or no action at all. Additionally, for systems serving less that 50,000, if more than 10 % of sampling results exceeded established action levels during semiannual testing for lead and copper, those systems also were required to consider treatment to reduce corrosion with the distribution system.

For the systems that opted to use polyphosphates, the amount of polyphosphate dosed to the system would be that needed to achieve the goal of minimizing the levels of lead and copper in the water system. This amount can vary significantly depending on the quality of the raw water, but is not known to be a significant source of phosphorus in sewage influent.

139. Comment: The TMDL is contrary to the settlement agreements reached with various Passaic River Basin dischargers, including WTSA. The spirit of those agreements has been disregarded and sound science and economic responsibility has been ignored. (10)

Response: The Department believes that both the intent and specific requirements of the Phosphorus Settlement Agreements have been met. Per their individual Stipulation of Settlement, each of the permittees agreed to participate in the watershed planning process, including the TMDL development process. All dischargers, as well as other affected parties, were invited to participate in this process. As a component of this process, the Department developed *The Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin*, October 2001, with the Passaic River TMDL Work Group to identify the technical approaches to address impairments as identified in the 303(d) list in the non-tidal Passaic River Basin. The Passaic Technical Approach was vetted at several workgroup meetings and consensus was reached at the October 31, 2001 Passaic River TMDL Workgroup on its content. It was agreed that a watershed modeling effort was needed in order to determine where within the Passaic River basin phosphorus was causing excessive primary productivity and what level of phosphorus reduction would be needed to address this response where it was determined to be occurring. Dischargers who were a party to the settlement agreed to participate in the cost of developing a workplan for the study and for carrying out the study itself as well as identifying and implementing low cost phosphorus reductions measures until the TMDL study was completed. The Department agreed to establish phosphorus effluent limits only as determined needed as a result of the TMDL. These steps have been accomplished. The resultant Passaic River basin TMDL is the outcome of the application of sound science to study the problem, with ample opportunities for review and input from affected parties. By establishing watershed criteria that in terms of the response variable chlorophyll-*a*, at levels that will support the designated uses, and providing for seasonal limits where appropriate, the Department has fine tuned the pollutant reductions to require only that expenditure needed to attain water quality standards. After the required reductions are incorporated in revised NJPDES permits and upon approval of an acceptable trading tool, the Department will provide an opportunity for dischargers to determine if a more cost effective means to attain the pollutant load reductions is feasible through water quality trading.

140. Comment: Please consider issues of concern to Pompton Lakes Borough MUA as you move forward with the TMDL implementation process: The plant continues to operate within its current permit limits; our customer base is limited to the residents—11,000; a more stringent phosphorus limit will place an enormous burden on our customers; there is no room at the plant site to construct and operate additional treatment units. (5)

141. Comment: Please consider issues of concern to Wanaque Valley Regional Sewerage Authority as you move forward with the TMDL implementation process: The plant continues to operate within its current permit limits; our customer base is limited to the residents—10,616; a more stringent phosphorus limit will place an enormous burden on our customers. (3)

142. Comment: TBSA supports and applauds NJDEP's efforts to develop a scientifically defensible solution to water quality issues in the Passaic River Basin. Significant amount of time, money and effort have been expended to determine the appropriate regulatory response to nutrient enrichment in the Passaic and TBSA is anxious to commence implementation of the TMDL and to continue to work in partnership with the NJDEP to achieve water quality improvements in the Passaic, provided identified issues are addressed re: data availability, alternative approaches and seasonal limits. (2)

Response to Comments 141 and 142: The Department has made every effort to ensure that the pollutant load reductions called for are needed to attain surface water quality standards. Further, by establishing watershed criteria in terms of the response variable chlorophyll-*a* at levels needed to support designated uses and providing for seasonal limits where appropriate, the Department has fine-tuned the pollutant reductions to require only that expenditure needed to attain water quality standards.

After the required reductions are incorporated in revised NJPDES permits and upon approval of an acceptable trading tool, the Department will also provide an opportunity for dischargers to determine if a more cost effective means to attain the pollutant load reductions is feasible through water quality trading.

143. Comment: Commenter is happy to see progress in achieving a proposal with a scientific basis. (16)

144. Comment: The Department is commended for its efforts to resolve the issue of Phosphorus regulation in a scientifically defensible manner and for moving forward with the Phase 2 TMDL study. RVRSA is fully committed to making the investment necessary to discharge its obligation to protect the environment and reaffirms its desire to work cooperatively with the NJDEP to achieve improvements in water quality. (1)

145. Comment: Although it comes after years of attempting to implement phosphorus control without a study, the Department is commended for moving forward with the current study. (23)

146. Comment: Commenter thanks the Department for going the extra measure to complete the Phase 2 TMDL. Some areas can be criticized, but this is a good starting point and we should move forward. (17)

147. Comment: While there are some missing data and issues to address, we have enough here, grounded in science, that we can move forward. (14)

Response to Comments 142-147: The Department acknowedges the commenters' support for the comprehensive modeling of the Passaic River Basin which has produced a science-based solution that will address water quality impairments in the basin.

148. Comment: Phosphorus removed from effluent should be reused as fertilizer. (9)

Response: Residuals are generated by domestic and industrial wastewater treatment plants. Residuals are managed in variety of ways, including the development of marketable residuals products (also called biosolids) that are used to fertilize or condition the soil. Examples include pellets, compost, and alkaline materials. Beneficial use of residuals as a fertilizer or soil conditioner is regulated under the New Jersey Pollutant Discharge Elimination System regulation at *N.J.A.C.* 7:14A-20. Subchapter 20 of the NJPDES rules defines the standards for the use or disposal of residual. The Department encourages beneficial reuse of sludge. However, as described in these TMDLs, application of phosphorus fertilizer is intended to be limited as one of the management measures needed to achieve pollutant load reductions. Therefore, extensive use of phosphorus containing biosolids would be counterproductive in the basin.

149. Comment: Phosphorus may be coming from leaking sewer pipes; this source may be reducible. (9)

Response: While the potential that leaking sewers exist in the study area cannot be discounted, the model is adequately calibrated without considering this source. In general, sewerage treatment facilities are responsible for the proper collection, treatment, analysis, and discharge of wastewater received from separate sanitary or combined sewer systems. To assure compliance, the Department imposes significant penalties and/or requires remediation for unpermitted discharges to the waters of the State. Responsible entities must undertake an active monitoring and preventive maintenance program to identify problems, install new sewer lines, clean blocked lines, repair lines that are subject to leaks and infiltration, and conduct all maintenance activities to assure maximum system capacity and to prevent sanitary sewer leaks and overflows. Treatment facilities are required to report all overflows and flooding, whether from sanitary or combined sewage systems, so that repairs and preventive action can be taken to minimize the extent of environmental and human health impacts.

Phase 1 TMDL

150. Comment: The Proposed TMDL continues to ignore key criticisms made by Rutgers New Jersey EcoComplex TMDL Advisory Committee ("NJEC"). A review of the New Jersey EcoComplex interim reports, which were issued in conjunction with the 2005 TMDL, continues to raise serious questions with the newly proposed 2007 TMDL. An examination of the proposed 2007 TMDL reveals that the Department, without explanation, has elected to continue to ignore key questions and criticisms raised by NJEC in 2005. Two examples stand out:

1. In NJEC's Interim Report to the Department, dated November 13, 2003, NJEC recognized that the year 2002 (when a severe drought occurred), could have been an anomaly and questioned whether it should be included or rejected as an outlier. The NJEC later estimated that the 2002 rainfall did correspond to the lowest 10th percentile of precipitation over 100 years and thus represented an anomaly that would result in too stringent a condition. Also, the 9-year simulation (omitting 2002) was not provided as requested by NJEC.
2. In its July 30, 2002 Interim Report, NJEC identified one task of the Department as being the analysis of the relationship between phosphorous concentrations and indicators of primary productivity, as a way to better establish quantifiable endpoints. In doing so, NJEC recommended use of the LA-WATERS model in order to study management strategies and specifically alternative pumping scenarios for NJDWSC. (10)

Response: The comments made by the NJEC were assessed and modifications made, as appropriate, to the TMDL study. With regard to the specific issues identified, the Department believes inclusion of 2002 in the simulation is appropriate, as addressed more fully in the response to Comments 16 and 17. The appropriateness of alternative management measures to achieve the watershed criteria in Wanaque Reservoir is addressed more specifically in response to Comments 58-61.

151. Comment: Commenter includes by reference comments made on the proposed July 5, 2005 *Phase 1 Passaic River Study TMDL for Phosphorus in the Wanaque Reservoir and the TMDL for Total Phosphorus to Address Pompton Lake and Ramapo River* contained in letters dated September 6, 2005 and November 21, 2005 as comments on the current TMDL proposal. The Department agreed not to adopt the Phase 1 TMDL under a Superior Court Order and should not use Phase 1 TMDL information until comments on that document are addressed and information requested through OPRA is provided. Issues include:

a) Evidence of a phosphorus impairment in the Passaic River basin has not been provided

b) The purpose of the Passaic phosphorus studies was to determine the level of phosphorus that causes impairment; attainment of 0.05mg/L numeric criterion was never envisioned. The Phase 1 TMDL eliminated the option to demonstrate that phosphorus was not causing an observed impairment.

c) The Phase 1 TMDL was not identified by the Department as a tool intended to address phosphorus impairment in the Passaic River; as provided for in the Phosphorus Settlement Agreement, the workplan to do so was to be provided for review by the affected parties.

d) It is noted that the Department used the LA-WATERS model for the Reservoir, the NJDEP mass balance model from 1987 and water characteristic studies done by NJDWSC. In response to questions at the DEP's presentation on June 23, 2005, representatives of Najarian Associates indicated that the LA-WATERS model incorrectly predicted the effects of adding Passaic River water to the Reservoir. This being the case, why continue to use the model? The 1987 model did not include a study of phosphorus and has been considered unsuitable for the purpose until the present time. The NJDEP study that resulted from the 1987 model specifically indicates that a comprehensive model of the river is needed. Why is this model now suitable?

e) The TMDL requires an 80% reduction in nonpoint sources. This does not appear to be achievable. The Department sent a misleading letter to municipalities telling them their only obligation was to adopt a fertilizer ordinance.

f) The diversion of water into the Wanaque Reservoir by North Jersey District Water Supply Commission is responsible for any impairment that exists there. They should be the entity responsible for load reductions and receive a NJPDES permit for the diversion, in accordance with the recent Supreme Court ruling.

g) Throughout the Phase 1 process, the Department has indicated that the Phase 2 TMDL could result in less stringent limits, but was unable to explain how at the August 4, 2005 public hearing. The Department then stated that, when the study of the lower section of the river is completed, a 0.1 mg/l limit will be established. It appears that the Department again intends to impose more stringent limits without any scientific study or basis.

h) The Department has not responded to the OPRA requests filed in order to be able to review data and documents related to the study; the comment period should continue to be extended for at least 30 days from the time that the information is provided for review.

i) NJ Ecocomplex comments on the studies that provided the basis for the Phase 1 TMDL were not addressed. There was no final NJEC report provided on the Phase 1 TMDL.

j) As it appears the work for the Phase 2 TMDL is nearing completion, the Phase 1 TMDL should not be adopted. The Phase 2 TMDL results should be presented to the public. (23)

Response: As stated in the TMDL, the July 5, 2005 proposals entitled *Phase 1 Passaic River Study TMDL for Phosphorus in the Wanaque Reservoir and the TMDL for Total Phosphorus to Address Pompton Lake and Ramapo River* were withdrawn and pertinent information from those proposals incorporated into the current TMDLs. Many of the comments made on the Phase 1 TMDL had as their resolution proceeding with the Phase 2 TMDL in lieu of the Phase 1 TMDL. Proposal of the current TMDLs along with the withdrawal of the Phase 1 TMDL renders moot most of the issues identified in the previous comment letters. Responses to specific points in the cited letters are as follows:

a) The purpose of the Phase 1 TMDL was to address phosphorus impairment in the Wanaque Reservoir, not the entire Passaic River basin. The Wanaque Reservoir was identified as an expected critical location early in the larger Passaic River basin TMDL planning process and, in the course of TMDL development, it was determined that water quality in the Wanaque Reservoir, in addition to several locations in the river system, exceeded the Surface Water Quality Standards in terms of the numeric criteria and data was provided in the Phase 1 TMDL support documents. This constitutes impairment, absent establishment of a watershed or site specific criterion. As a result, a TMDL was required to be and was developed for the reservoir.

b) The Passaic phosphorus studies were to determine what action was needed to address phosphorus impairment in the Passaic River, which means to attain the SWQS. In accordance with the SWQS, the Phase 1 and Pompton Lake TMDLs used the numeric criterion as a target, absent documentation that a watershed specific criterion was appropriate. The Phase 1 TMDL necessarily required load reductions from discharges to the Passaic River system, but did not attempt to reach conclusions about attainment of the in-stream numeric criterion of 0.1 mg/L. The option to conduct a study under the *Technical Manual for Phosphorus Evaluations for NJPDES Discharge to Surface Water Permits* is provided in the SWQS only with respect to the in-stream numeric criterion, not for the lake/reservoir numeric criterion. Therefore, the Phase 1 TMDL neither created nor eliminated an opportunity with respect to the phosphorus protocol. In any case, in accordance with the findings of the current proposal, watershed specific criteria have been developed in place of the numeric criterion for the Wanaque Reservoir and Dundee Lake critical locations and the watershed criteria have been used as the endpoints in these locations.

c) The intention to use the LA-WATERS model to determine the loading capacity of the Wanaque Reservoir had been established in the *Technical Approaches to Restore Impaired Waterbodies within the Non-tidal Passaic River Basin*, which was shared through extensive public participation that included the regulated parties. The Phase 1 TMDL accomplished that objective of the Technical Approach and did not address the reductions needed to address phosphorus impairment in the river itself. As was always intended, the Phase 2 TMDL is the tool that addresses the listing of the river as impaired for phosphorus.

d) This comment is moot in that the model used to simulate river loadings in the Phase 2 TMDL was developed as an outcome of the workplan designed to address the in-stream phosphorus impairments and the Phase 1 TMDL has been withdrawn. Nevertheless, as regards the Phase 1 TMDL, representatives of Najarian Associates never stated that the Reservoir TMDL model incorrectly predicted the effects of adding Passaic River water to the Reservoir. NJDEP's 1987 model addressed all relevant water quality constituents, including phosphorus. However, the NJDEP study was not part of the Najarian 2005 TMDL study. An independently developed mass-balance model for the watershed was used to simulated relevant river conditions for the Phase 1 TMDL.

e) The TMDLs within the spatial extent call for a range of nonpoint source and stormwater point source reductions that range from 0 to 85. The Department identifies the suite of measures that are expected to achieve those reductions. Some measures are non-regulatory while other are regulatory in nature, such as the phosphorus ordinance. Both the Phase 1 and current TMDL clearly state that the measures required under the Municipal Stormwater Regulation permit are the primary means expected to result in the necessary phosphorus reductions from urban areas. The letter sent to municipalities for both the Phase 1 and the Phase 2 TMDL was the required notification that an additional requirement would be added to their Municipal Stormwater Permit, upon adoption of the TMDL. Through adaptive management, in response to follow-up monitoring, it may be necessary to institute other nonpoint source or stormwater point source control measures, but this is not currently proposed. The commenter's suggestion that the Department misled municipalities as to their obligations as a result of the TMDL is incorrect.

f) As stated in the response to Comments 58-61, the load reduction required to achieve the water quality target for the in-stream critical location is the same as that needed to achieve the water quality target in the Wanaque Reservoir. The difference is the applicability of seasonal effluent limits. With regard to NJDWSC responsibility to remove phosphorus prior to diverting it to the Wanaque in order to achieve water quality requirements, the Department does not interpret the Supreme Court decision in Miccosukee as requiring the State of New Jersey to issue discharge permits to regulate purveyors under NJPDES, the State NPDES program. The Department believes that the most appropriate way to address water quality effects of water supply diversion activities is through State authorities related to safe yield and allocation decision making. NJDWSC supplies drinking water to more than 3 million of New Jersey's residents. Management of the system needs to be flexible enough to allow the maximum safe yield without deleterious water quality impacts. While safe yield and allocation decisions do consider water quality implications, directing NJDWSC to change operations for the primary purpose of minimizing the requirement for dischargers to reduce the introduction of a pollutant into the river system is not appropriate. FW2 waters are to be suitable for drinking water use with conventional treatment. Therefore, the quality of the water at the Wanaque South intake point must be consistent with support of the drinking water use, with or without diversion activities. Water quality trading is an option, but not a requirement, through which NJDWSC can play a role in protecting the water quality of the Wanaque Reservoir as affected by the diversion of Pompton and Passaic River water into the reservoir.

g) The basis of the commenter's assertion is unclear. At the time the Phase 1 TMDL was proposed, the outcome of the Phase 2 work was not known and could not be predicted with accuracy. This necessarily would mean that the WLAs and associated effluent limits resulting from the Phase 2 work could be more or less stringent than identified in the Phase 1 TMDL. Again, the Phase 1 TMDL has been withdrawn and is superseded by the currently proposed TMDL.

h) The Department has fully responded to the OPRA request. Because the Phase 1 TMDL has been withdrawn, extension of the comment period for that TMDL is moot. The currently proposed TMDL was presented prior to the public hearing and a 30 day comment period was provided. The comment period was further extended by 30 days to provide additional time for commenters to assess the Passaic River basin model.

i) The NJEC comments on the Phase 1 TMDL that remain relevant with respect to the Phase 2 TMDL have been addressed within the Phase 2 TMDL document.

j) Again, the Phase 1 TMDL has been withdrawn and the currently proposed TMDL supersedes it.

Amendment to the Atlantic, Cape May, Lower Delaware, Lower Raritan-Middlesex, Mercer, Monmouth, Northeast, Ocean, Sussex, Tri-County, Upper Delaware and Upper Raritan Water Quality Management Plans

Total Maximum Daily Load for Mercury Impairments Based on Concentration in Fish Tissue Caused Mainly by Air Deposition to Address 122 HUC 14s Statewide

Proposed: June 15, 2009
Established: September 10, 2009
Approved: September 25, 2009
Adopted: June 10, 2010

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Executive Summary

In accordance with Section 305(b) and 303(d) of the Federal Clean Water Act (CWA), the State of New Jersey, Department of Environmental Protection (Department or NJDEP) published the *2008 Integrated Water Quality Monitoring and Assessment Report*, which provides information on water quality conditions and trends, and various management strategies and actions being employed to protect and improve water quality. The report includes the List of Water Quality Limited Waters, also known as the 303(d) List, which identifies waters that do not attain an applicable designated use because of a known pollutant and for which a TMDL must be established. On March 3, 2008, the Department proposed the *2008 List of Water Quality Limited Waters* (40NJR4835(c)) 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 in accordance with the Water Quality Management Planning rules at N.J.A.C. 7:15-6.4(a). The Environmental Protection Agency has approved this list. The *2008 List of Water Quality Limited Waters* identifies 256 waters as impaired with respect to mercury, as indicated by the presence of mercury concentrations in fish tissue in excess of New Jersey fish consumption advisories and/or not complying with the Surface Water Quality Standards (SWQS) for mercury at N.J.A.C. 7:9B.

A TMDL has been developed to address mercury impairment in 122 waters identified in Table 1 below. These are waters whose main source of contamination is air deposition. Waters that are tidal, where there are other significant sources of mercury or where cooperative efforts have been or are expected to be undertaken are not addressed in this TMDL pending additional study.

Table 1. Assessment Units Covered by this TMDL

Watershed Management Area (WMA)	Assessment Unit ID	Waterbody Name	2006 Integrated list	2008 Integrated list
01	02040104090020	Clove Brook (Delaware R)	Sublist 5	Sublist 5
01	02040104130010	Little Flat Brook (Beerskill and above)	Sublist 5	Sublist 5
01	02040104140010	Big Flat Brook (above Forked Brook)	Sublist 5	Sublist 5
01	02040105030020	Swartswood Lake and tribs	Sublist 5	Sublist 5
01	02040105030030	Trout Brook	Sublist 5	Sublist 5
01	02040105050040	Yards Creek	Sublist 3	Sublist 3*
01	02040105090040	Mountain Lake Brook	Sublist 5	Sublist 5
01	02040105140040	Merrill Creek	Sublist 5	Sublist 5
01	02040105140060	Pohatcong Ck (Springtown to Merrill Ck)	Sublist 3	Sublist 3*
01	02040105150020	Lake Hopatcong	Sublist 5	Sublist 5
01	02040105150060	Cranberry Lake / Jefferson Lake & tribs	Sublist 5	Sublist 5
02	02020007040040	Highland Lake/Wawayanda Lake	Sublist 5	Sublist 5
03	02030103050020	Pacock Brook	Sublist 5	Sublist 5
03	02030103050030	Pequannock R (above OakRidge Res outlet)	Sublist 5	Sublist 5
03	02030103050040	Clinton Reservior/Mossmans Brook	Sublist 5	Sublist 5

03	02030103050060	Pequannock R(Macopin gage to Charl'brg)	Sublist 5	Sublist 5
03	02030103050080	Pequannock R (below Macopin gage)	Sublist 5	Sublist 5
03	02030103070030	Wanaque R/Greenwood Lk(aboveMonks gage)	Sublist 5	Sublist 5
03	02030103070050	Wanaque Reservior (below Monks gage)	Sublist 5	Sublist 5
03	02030103110020	Pompton River	Sublist 5	Sublist 5
06	02030103010170	Passaic R Upr (Rockaway to Hanover RR)	Sublist 5	Sublist 5
06	02030103020040	Whippany R(Lk Pocahontas to Wash Val Rd)	Sublist 5	Sublist 5
06	02030103020080	Troy Brook (above Reynolds Ave)	Sublist 5	Sublist 5
06	02030103030030	Rockaway R (above Longwood Lake outlet)	Sublist 5	Sublist 5
06	02030103030040	Rockaway R (Stephens Bk to Longwood Lk)	Sublist 5	Sublist 5
06	02030103030070	Rockaway R (74d 33m 30s to Stephens Bk)	Sublist 5	Sublist 5
06	02030103030090	Rockaway R (BM 534 brdg to 74d 33m 30s)	Sublist 5	Sublist 5
06	02030103030110	Beaver Brook (Morris County)	Sublist 5	Sublist 5
06	02030103030140	Rockaway R (Stony Brook to BM 534 brdg)	Sublist 5	Sublist 5
06	02030103030150	Rockaway R (Boonton dam to Stony Brook)	Sublist 5	Sublist 5
06	02030103030170	Rockaway R (Passaic R to Boonton dam)	Sublist 5	Sublist 5
08	02030105010030	Raritan River SB(above Rt 46)	Sublist 5	Sublist 5
08	02030105010040	Raritan River SB(74d 44m 15s to Rt 46)	Sublist 3	Sublist 3*
08	02030105010050	Raritan R SB(LongValley br to 74d44m15s)	Sublist 3	Sublist 3*
08	02030105010060	Raritan R SB(Califon br to Long Valley)	Sublist 3	Sublist 3*
08	02030105020040	Spruce Run Reservior / Willoughby Brook	Sublist 5	Sublist 5
08	02030105020090	Prescott Brook / Round Valley Reservior	Sublist 5	Sublist 5
08	02030105020100	Raritan R SB(Three Bridges-Prescott Bk)	Sublist 3	Sublist 3*
08	02030105040010	Raritan R SB(Pleasant Run-Three Bridges)	Sublist 3	Sublist 3*
08	02030105040040	Raritan R SB(NB to Pleasant Run)	Sublist 3	Sublist 3*
09	02030105080020	Raritan R Lwr (Rt 206 to NB / SB)	Sublist 3	Sublist 3*
09	02030105080030	Raritan R Lwr (Millstone to Rt 206)	Sublist 3	Sublist 3*
09	02030105120080	South Fork of Bound Brook	Sublist 3	Sublist 3*
09	02030105120100	Bound Brook (below fork at 74d 25m 15s)	Sublist 3	Sublist 3*
09	02030105120140	Raritan R Lwr(I-287 Piscatway-Millstone)	Sublist 5	Sublist 5
09	02030105130050	Lawrence Bk (Church Lane to Deans Pond)	Sublist 3	Sublist 3*
09	02030105130060	Lawrence Bk (Milltown to Church Lane)	Sublist 3	Sublist 3*

09	02030105140020	Manalapan Bk(incl LkManlpn to 40d16m15s)	Sublist 3	Sublist 3*
09	02030105140030	Manalapan Brook (below Lake Manalapan)	Sublist 5	Sublist 5
09	02030105160030	Duhernal Lake / Iresick Brook	Sublist 3	Sublist 3*
10	02030105090050	Stony Bk(Province Line Rd to 74d46m dam)	Sublist 3	Sublist 3*
10	02030105100130	Bear Brook (below Trenton Road)	Sublist 3	Sublist 5
10	02030105110020	Millstone R (HeathcoteBk to Harrison St)	Sublist 3	Sublist 5
10	02030105110110	Millstone R (BlackwellsMills to BedenBk)	Sublist 3	Sublist 3*
10	02030105110140	Millstone R(AmwellRd to BlackwellsMills)	Sublist 3	Sublist 3*
10	02030105110170	Millstone River (below Amwell Rd)	Sublist 3	Sublist 3*
12	02030104060020	Matawan Creek (above Ravine Drive)	Sublist 3	Sublist 3*
12	02030104060030	Matawan Creek (below Ravine Drive)	Sublist 5	Sublist 5
12	02030104070070	Swimming River Reservior / Slope Bk	Sublist 3	Sublist 3*
12	02030104070090	Nut Swamp Brook	Sublist 3	Sublist 5
12	02030104090030	Deal Lake	Sublist 3	Sublist 3*
12	02030104090080	Wreck Pond Brook (below Rt 35)	Sublist 3	Sublist 5
12	02030104100050	Manasquan R (gage to West Farms Rd)	Sublist 5	Sublist 5
13	02040301030040	Metedeconk R SB (Rt 9 to Bennetts Pond)	Sublist 5	Sublist 5
13	02040301060050	Dove Mill Branch (Toms River)	Sublist 5	Sublist 5
13	02040301070010	Shannae Brook	Sublist 5	Sublist 5
13	02040301070030	Ridgeway Br (Hope Chapel Rd to HarrisBr)	Sublist 5	Sublist 5
13	02040301070040	Ridgeway Br (below Hope Chapel Rd)	Sublist 5	Sublist 5
13	02040301070080	Manapaqua Brook	Sublist 3	Sublist 5
13	02040301070090	Union Branch (below Blacks Br 74d22m05s)	Sublist 5	Sublist 5
13	02040301080030	Davenport Branch (above Pinewald Road)	Sublist 3	Sublist 5
13	02040301090050	Cedar Creek (GS Parkway to 74d16m38s)	Sublist 5	Sublist 5
13	02040301130030	Mill Ck (below GS Parkway)/Manahawkin Ck	Sublist 3	Sublist 3*
13	02040301130050	Westecunk Creek (above GS Parkway)	Sublist 5	Sublist 5
13	02040301140020	Mill Branch (below GS Parkway)	Sublist 3	Sublist 3*
13	02040301140030	Tuckerton Creek (below Mill Branch)	Sublist 3	Sublist 3*
14	02040301150080	Batsto R (Batsto gage to Quaker Bridge)	Sublist 5	Sublist 5
14	02040301160030	Mullica River (Rt 206 to Jackson Road)	Sublist 5	Sublist 5
14	02040301160140	Mullica River (39d40m30s to Rt 206)	Sublist 5	Sublist 5
14	02040301160150	Mullica R (Pleasant Mills to 39d40m30s)	Sublist 5	Sublist 5
14	02040301180060	Oswego R (Andrews Rd to Sim Place Resv)	Sublist 3	Sublist 3*
14	02040301180070	Oswego River (below Andrews Road)	Sublist 5	Sublist 5

14	02040301190050	Wading River WB (Jenkins Rd to Rt 563)	Sublist 5	Sublist 5
14	02040301200010	Beaver Branch (Wading River)	Sublist 5	Sublist 5
14	02040301200050	Bass River EB	Sublist 3	Sublist 3*
15	02040302030020	GEHR (AC Expressway to New Freedom Rd)	Sublist 5	Sublist 5
15	02040302040050	Collings Lakes trib (Hospitality Branch)	Sublist 5	Sublist 5
15	02040302040130	GEHR (Lake Lenape to Mare Run)	Sublist 5	Sublist 5
15	02040302050120	Middle River / Peters Creek	Sublist 3	Sublist 3*
16	02040206210050	Savages Run (above East Creek Pond)	Sublist 5	Sublist 5
16	02040206210060	East Creek	Sublist 5	Sublist 5
17	02040206030010	Salem River (above Woodstown gage)	Sublist 5	Sublist 5
17	02040206070030	Canton Drain (above Maskell Mill)	Sublist 5	Sublist 5
17	02040206080050	Cohansey R (incl CornwellRun - BeebeRun)	Sublist 3	Sublist 5
17	02040206090030	Cohansey R (Rocaps Run to Cornwell Run)	Sublist 5	Sublist 5
17	02040206100060	Nantuxent Creek (above Newport Landing)	Sublist 3	Sublist 3*
17	02040206130010	Scotland Run (above Fries Mill)	Sublist 5	Sublist 5
17	02040206130040	Scotland Run (below Delsea Drive)	Sublist 5	Sublist 5
17	02040206140010	MauriceR(BlkwtrBr to/incl WillowGroveLk)	Sublist 5	Sublist 5
17	02040206150050	Muddy Run (incl ParvinLk to Palatine Lk)	Sublist 3	Sublist 3*
17	02040206180050	Menantico Creek (below Rt 552)	Sublist 3	Sublist 3*
18	02040202100020	Pennsauken Ck NB (incl StrwbrdgLk-NJTPK)	Sublist 3	Sublist 5
18	02040202110030	Cooper River (above Evesham Road)	Sublist 5	Sublist 5
18	02040202110040	Cooper R (Wallworth gage to Evesham Rd)	Sublist 5	Sublist 5
18	02040202110050	Cooper River (Rt 130 to Wallworth gage)	Sublist 5	Sublist 5
18	02040202120010	Big Timber Creek NB (above Laurel Rd)	Sublist 5	Sublist 5
18	02040202120020	Big Timber Creek NB (below Laurel Rd)	Sublist 5	Sublist 5
18	02040202120030	Big Timber Creek SB (above Lakeland Rd)	Sublist 5	Sublist 5
18	02040202120040	Big T Ck SB(incl Bull Run to LakelandRd)	Sublist 5	Sublist 5
18	02040202120050	Big Timber Creek SB (below Bull Run)	Sublist 5	Sublist 5
18	02040202120060	Almonesson Creek	Sublist 5	Sublist 5
18	02040202120090	Newton Creek (LDRV-Kaighn Ave to LT Ck)	Sublist 5	Sublist 5
18	02040202120100	Woodbury Creek (above Rt 45)	Sublist 5	Sublist 5
18	02040202130030	Chestnut Branch (above Sewell)	Sublist 5	Sublist 5
18	02040202150020	Raccoon Ck (Rt 45 to/incl Clems Run)	Sublist 3	Sublist 3*
18	02040202150040	Raccoon Ck (Russell Mill Rd to Rt 45)	Sublist 5	Sublist 5
19	02040202030050	Bucks Cove Run / Cranberry Branch	Sublist 5	Sublist 5
19	02040202050050	Friendship Ck (below/incl Burrs Mill Bk)	Sublist 3	Sublist 3*

19	02040202050060	Rancocas Creek SB(above Friendship Ck)	Sublist 3	Sublist 3*
19	02040202050080	Rancocas Ck SB (Vincentown-FriendshipCk)	Sublist 3	Sublist 3*
19	02040202050090	Rancocas Ck SB (BobbysRun to Vincentown)	Sublist 3	Sublist 3*
20	02040201090030	LDRV tribs (Assiscunk Ck to Blacks Ck)	Sublist 5	Sublist 5

* Data became available in these assessment units after the 2008 list was approved indicating fish tissue levels that would result in listing of these waters in accordance with the current listing methodology; therefore, these assessment units will also be addressed in this TMDL.

The target for the TMDL is a concentration of 0.18 µg/g in fish tissue, which is the concentration at which the recommended rate of fish consumption for the high risk population is not more than 1 meal per week of top trophic level fish. At this concentration unlimited consumption is appropriate for the general population. An overall reduction of 84.3% in existing mercury loads is required to achieve the target. In its *New Jersey Mercury Reduction Plan*, the Department outlines measures needed to achieve these reductions.

The TMDLs in this report were proposed on June 15, 2009 and, having completed the public participation process, shall be adopted by the Department as amendments to the Atlantic, Cape May, Lower Delaware, Lower Raritan-Middlesex, Mercer, Monmouth, Northeast, Ocean, Sussex, Tri-County, Upper Delaware and Upper Raritan Water Quality Management Plans in accordance with N.J.A.C. 7:15-6.4. This TMDL report was developed consistent with the United States Environmental Protection Agency's (USEPA or EPA) May 20, 2002 guidance document entitled, "Guidelines for Reviewing TMDLs under Existing Regulations issued in 1992" (Sutfin, 2002), which describes the general statutory and regulatory requirements for approvable TMDLs, as well as EPA's more specific guidance memo for the subject type of TMDL, dated September 29, 2008 and entitled "Elements of Mercury TMDLs Where Mercury Loadings are Predominantly from Air Deposition" (Hooks, 2008).

1.0. Introduction

Mercury is a persistent, bio-accumulative toxin that can be found in solid, liquid, or vapor form. Mercury can cause a variety of harmful health effects including damage to the brain, central nervous system, and kidneys and is particularly harmful to children and pregnant and nursing women. Mercury comes from various natural and anthropogenic sources, including volcanic activity, burning of some forms of coal, use in dental procedures and manufacturing, use and disposal of products containing mercury. Most often, mercury enters the environment in gas or particulate form and is deposited on surfaces, often through precipitation, which washes deposited mercury into waterways. There it undergoes a natural chemical process and is converted to a more toxic form – methyl mercury. The methyl mercury builds up in the tissues of fish and animals, increasing its concentration as it moves up through the food chain, which results in high levels of mercury in some of the foods we eat. At certain levels, fish consumption advisories are triggered.

Mercury contamination in the environment is ubiquitous, not only in New Jersey, but worldwide. Mercury contamination is a global issue because the overwhelming source of mercury is air deposition. Consequently, mercury pollution will not be abated on a state by state basis alone, but must be controlled by regional, national and international efforts. In recognition of this, the New England Interstate Water Pollution Control Commission (NEIWPCC) established the *Northeast Regional Mercury Total Maximum Daily Load* dated October 24, 2007 (Northeast Regional TMDL), a regional TMDL for the states of Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island and Vermont which addressed impairments due to mercury contamination of waterbodies where the main source of mercury contamination is air deposition. It was approved by EPA on December 20, 2007. As EPA has approved establishment of regional TMDLs for mercury impairments where the primary source is air deposition using the NEIWPCC approach, the Department has determined that it is appropriate for New Jersey to develop a similar TMDL for comparable impairments in New Jersey, not only to recommend a course of action to reduce mercury contamination in New Jersey, but to further emphasize that substantial source reductions from outside New Jersey will be needed to achieve water quality objectives. Therefore, New Jersey has developed a statewide TMDL that will complement the Northeast Regional TMDL developed for the northeast states.

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 Surface Water Quality Standards (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 Department combines these reports into the Integrated Water Quality Monitoring and Assessment Report and assigns each designated use within the assessment unit to one of five sublists. An assessment unit is listed as Sublist 1 if all designated uses are assessed and attained. (The Department does not include the fish consumption use for this sublist.) If some but not all uses are attained, an assessment unit is placed on Sublist 2 for attained uses. If the Department did not have data to assess a use, the assessment unit is placed on Sublist 3 for that use. If a use is not attained, the assessment unit will be placed on Sublist 5, or Sublist 4 if there is an approved TMDL, there are other enforceable management measures in effect or the impairment is due to pollution, not a pollutant. Sublist 5 constitutes the list of waters for which a TMDL may be required, also known as the 303(d) list. In accordance with the *2008 Integrated Water Quality Monitoring and Assessment Methods*, although there is a State-wide fish consumption advisory for mercury, only waters with actual fish tissue monitoring data that exceed the threshold which results in a consumption restriction (greater than 0.07 mg/kg) are placed on Sublist 5. All other assessment units are listed on Sublist 3 for this use. Based on the TMDL analysis, which demonstrates that reduction of natural sources of mercury would be needed in order to achieve the level necessary to allow unlimited consumption for high risk populations, the Department intends to revise its Assessment Method when developing future Integrated Water Quality Monitoring and Assessment Reports to allow that a limit of 1 meal per week for the high risk population would be considered as attaining the use with respect to mercury-based fish consumption (listing threshold would be results greater than 0.18 μg/g).

The *2008 List of Water Quality Limited Waters* currently identifies 256 Assessment Units as impaired due to mercury in surface water and/or fish tissue. This report establishes 122 TMDLs for mercury contamination based on fish tissue concentration whose source is largely air deposition. Waters where there are other significant sources of mercury in a waterbody, as indicated by a water column concentration in excess of the Surface Water Quality Standards, documentation of high levels of mercury in ground water or the presence of hazardous waste sites where mercury is a contaminant of concern, are deferred at this time, pending additional study. Tidal waters are also excluded because the approach used in this TMDL is intended for waters not affected by tidal dynamics. In addition, areas that are included in the spatial extent of the on-going interstate effort to address mercury impairments in the New York/New Jersey Harbor are excluded from this TMDL. A similar interstate effort is an appropriate means of addressing mercury impairments in the shared waters of the Atlantic Ocean and the Delaware River and Estuary, and these waters are deferred as well.

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 waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and a margin of safety (MOS).

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. EPA has also issued guidance for the development of TMDLs for mercury impairments that are due primarily to air deposition (Hooks, 2008).

2.0. Pollutant of Concern, Applicable Surface Water Quality Standards, and Area of Interest

2.1 Pollutant of Concern

The pollutant of concern for these TMDLs is mercury. According to the current assessment methodology, an assessment unit is listed as impaired for mercury if the data show water column concentrations in excess of the Surface Water Quality Standards (SWQS) or fish tissue concentrations that would result in any limitations on fish consumption. These advisories are not SWQS, but they do indicate a limitation on the use of the waters. As previously discussed, this TMDL is limited to assessment units where impairment is attributed to fish tissue in excess of advisory thresholds, where the mercury is primarily from air deposition. The assessment units addressed are identified in Table 1. These listings have a medium priority ranking in the *2008 List of Water Quality Limited Waters* (40NJR4835(c)).

2.2 Applicable Surface Water Quality Standards and Fish Consumption Advisory Criteria

Most of the waters addressed in this report are classified in the Surface Water Quality Standards (SWQS) at N.J.A.C. 7:9B as Fresh Water 2 (FW2), either Non-Trout (NT), Trout Maintenance (TM) or Trout Production (TP). Some waters are classified as Pinelands (PL) or Freshwater 1 (FW1). A few Assessment Units include waters classified as FW2-NT/SE1 or FW2-NT/SE2. If the measured salinity is less than 3.5 parts per thousand at mean high tide, the FW2-NT classification applies. The TMDL does not apply to fresh or saline tidal waters. If the majority of the waters in the HUC 14 subwatershed are fresh and non-tidal, that assessment unit was included in this TMDL. Therefore, even though portions of some assessment units are noted as including the SE (Saline Estuarine) designation, these designations are not affected and are not discussed below. Table 2 below lists the surface water classifications for the assessment units addressed in this document and Table 3 provides the numeric criteria for mercury.

Table 2. Surface Water Classifications for the Assessment Units Addressed Under this TMDL

WMA	Assessment Unit ID	Waterbody Name	Surface Water Classifications
01	2040104090020	Clove Brook (Delaware River)	FW1, FW1-TP, FW2-TPC1, FW2-TPMC1
01	2040104130010	Little Flat Brook (Beerskill And Above)	FW1, FW2-TP, FW2-TPC1, FW2-NTC1
01	2040104140010	Big Flat Brook (Above Forked Brook)	FW1, FW2-NTC1
01	2040105030020	Swartswood Lake And Tributaries	FW2-TM, FW2-TMC1, FW2-NT, FW2-NTC1
01	2040105030030	Trout Brook	FW2-TPC1, FW2-NT
01	2040105050040	Yards Creek	FW2-TPC1, FW2-NT
01	2040105090040	Mountain Lake Brook	FW2-TM, FW2-NT

01	2040105140040	Merrill Creek	FW2-TPC1, FW2-TM
01	2040105140060	Pohatcong Creek (Springtown To Merrill Creek)	FW2-TPC1, FW2-TMC1
01	2040105150020	Lake Hopatcong	FW2-TM, FW2-NT
01	2040105150060	Cranberry Lake / Jefferson Lake & Tributaries	FW2-TMC1, FW2-NT, FW2-NTC1
02	2020007040040	Highland Lake/Wawayanda Lake	FW2-NT, FW2-NTC1
03	2030103050020	Pacock Brook	FW1, FW1-TP, FW2-NTC1
03	2030103050030	Pequannock River (Above Oak Ridge Reservoir Outlet)	FW1-TP, FW1-TM, FW2-TP, FW2-TPC1, FW2-TMC1, FW2-NT
03	2030103050040	Clinton Reservior/Mossmans Brook	FW1, FW2-TPC1, FW2-TP, FW2-TMC1, FW2-NTC1
03	2030103050060	Pequannock River (Macopin Gage To Charl'brg)	FW1-TM, FW2-TPC1, FW2-TP, FW2-TM, FW2-TMC1, FW2-NT
03	2030103050080	Pequannock River (Below Macopin Gage)	FW2-TPC1, FW2-TP, FW2-NTC1, FW2-TM, FW2-NT
03	2030103070030	Wanaque River /Greenwood Lake (Above Monks Gage)	FW2-TPC1, FW2-TM, FW2-TMC1, FW2-NT, FW2-NTC1
03	2030103070050	Wanaque Reservoir (Below Monks Gage)	FW2-TPC1, FW2-TMC1, FW2-NTC1
03	2030103110020	Pompton River	FW2-NT
06	2030103010170	Passaic River Upper (Rockaway To Hanover Rr)	FW2-NT
06	2030103020040	Whippany River(Lake Pocahontas To Washington Valley Rd)	FW2-TM, FW2-NT
06	2030103020080	Troy Brook (Above Reynolds Ave)	FW2-NT
06	2030103030030	Rockaway River (Above Longwood Lake Outlet)	FW2-NTC1
06	2030103030040	Rockaway River (Stephens Brook To Longwood Lake)	FW2-NTC1
06	2030103030070	Rockaway RIVER (74d 33m 30s To Stephens Brook)	FW1, FW2-NTC1, FW2-TPC1, FW2-TMC1
06	2030103030090	Rockaway River (BM 534 Bridge To 74d 33m 30s)	FW2-NTC1, FW2-NT
06	2030103030110	Beaver Brook (Morris County)	FW2-TPC1, FW2-TMC1, FW2-NTC1
06	2030103030140	Rockaway River (Stony Brook To BM 534 Bridge)	FW2-NTC1
06	2030103030150	Rockaway River (Boonton Dam To Stony Brook)	FW2-TMC1, FW2-NTC1, FW2-NT
06	2030103030170	Rockaway River (Passaic River To Boonton Dam)	FW2-NT
08	2030105010030	Raritan River South Branch (Above Route 46)	FW2-NT, FW2-TM, FW2-NTC1
08	2030105010040	Raritan River South Branch(74d 44m 15s To Route 46)	FW2-NTC1, FW2-TPC1, FW2-NT, FW2-TMC1

08	2030105010050	Raritan River South BRANCH(Longvalley Brook To 74d44m15s)	FW2-TPC1, FW2-NT
08	2030105010060	Raritan River South Branch(Califon Brook To Long Valley)	FW2-TPC1, FW2-NT
08	2030105020040	Spruce Run Reservior / Willoughby Brook	FW2-TPC1, FW2-TMC1, FW2-TM, FW2-NT
08	2030105020090	Prescott Brook / Round Valley Reservoir	FW2-TPC1, FW2-TM, FW2-NT
08	2030105020100	Raritan River South Branch(Three Bridges-Prescott Brook)	FW2-TM, FW2-NT
08	2030105040010	Raritan River South Branch(Pleasant Run-Three Bridges)	FW2-NT
08	2030105040040	Raritan River South Branch(North Branch To Pleasant Run)	FW2-NT
09	2030105080020	Raritan River Lower (Route 206 To North Branch / South Branch)	FW2-NT
09	2030105080030	Raritan River Lower (Millstone To Route 206)	FW2-NT
09	2030105120080	South Fork Of Bound Brook	FW2-NT
09	2030105120100	Bound Brook (Below Fork At 74d 25m 15s)	FW2-NT
09	2030105120140	Raritan River Lwr(I-287 Piscatway-Millstone)	FW2-NT
09	2030105130050	Lawrence Brook (Church Lane To Deans Pond)	FW2-NT
09	2030105130060	Lawrence Brook (Milltown To Church Lane)	FW2-NT
09	2030105140020	Manalapan Brook(Incl Lakemanlpn To 40d16m15s)	FW2-NT
09	2030105140030	Manalapan Brook (Below Lake Manalapan)	FW2-NT
09	2030105160030	Duhernal Lake / Iresick Brook	FW2-NT
10	2030105090050	Stony Brook(Province Line Rd To 74d46m Dam)	FW2-NT
10	2030105100130	Bear Brook (Below Trenton Road)	FW2-NT
10	2030105110020	Millstone River (Heathcotebk To Harrison St)	FW2-NT
10	2030105110110	Millstone River (Blackwellsmills To Beden Brook)	FW2-NT
10	2030105110140	Millstone River(Amwellrd To Blackwellsmills)	FW2-NT
10	2030105110170	Millstone River (Below Amwell Rd)	FW2-NT
12	2030104060020	Matawan Creek (Above Ravine Drive)	FW2-NT/SE1
12	2030104060030	Matawan Creek (Below Ravine Drive)	FW2-NT/SE1
12	2030104070070	Swimming River Reservoir / Slope Brook	FW2-NTC1
12	2030104070090	Nut Swamp Brook	FW2-NT/SE1
12	2030104090030	Deal Lake	FW2-NT/SE1
12	2030104090080	Wreck Pond Brook (Below Route 35)	FW2-NT, FW2-NT/SE1
12	2030104100050	Manasquan River (Gage To West Farms Road)	FW2-TMC1, FW2-NTC1

13	2040301030040	Metedeconk River South Branch (Rt 9 To Bennetts Pond)	FW2-TMC1, FW2-NTC1
13	2040301060050	Dove Mill Branch (Toms River)	FW2-NTC1, PL
13	2040301070010	Shannae Brook	FW2-NT, PL
13	2040301070030	Ridgeway Brook (Hope Chapel Rd To Harrisbrook)	PL
13	2040301070040	Ridgeway Brook (Below Hope Chapel Rd)	PL, FW2-NT/SE1
13	2040301070080	Manapaqua Brook	PL, FW2-NT/SE1
13	2040301070090	Union Branch (Below Blacks Brook 74d22m05s)	PL, FW2-NT/SE1
13	2040301080030	Davenport Branch (Above Pinewald Road)	PL
13	2040301090050	Cedar Creek (GS Parkway To 74d16m38s)	PL
13	2040301130030	Mill Creek (Below Gs Parkway)/Manahawkin Creek	PL, FW2-NT, FW2-NTC1/SE1
13	2040301130050	Westecunk Creek (Above Garden State Parkway)	PL
13	2040301140020	Mill Branch (Below Garden State Parkway)	FW2-NT/SE1
13	2040301140030	Tuckerton Creek (Below Mill Branch)	PL, FW2-NTC1/SE1, FW2-NT/SE1
14	2040301150080	Batsto River (Batsto Gage To Quaker Bridge)	FW1, PL
14	2040301160030	Mullica River (Route 206 To Jackson Road)	PL
14	2040301160140	Mullica River (39d40m30s To Rt 206)	PL
14	2040301160150	Mullica RIVER (Pleasant Mills To 39d40m30s)	PL
14	2040301180060	Oswego River (Andrews Rd To Sim Place Reservoir)	PL
14	2040301180070	Oswego River (Below Andrews Road)	PL
14	2040301190050	Wading River West Branch (Jenkins Road To Route 563)	PL
14	2040301200010	Beaver Branch (Wading River)	PL
14	2040301200050	Bass River East Branch	PL, FW1
15	2040302030020	Great Egg Harbor (Atlantic City Expressway To New Freedom Road)	PL, FW2-NT
15	2040302040050	Collings Lakes Tributary (Hospitality Branch)	PL
15	2040302040130	Great Egg Harbor (Lake Lenape To Mare Run)	PL
15	2040302050120	Middle River / Peters Creek	FW1, /SE1 C1, FW2-NTC1/SE1
16	2040206210050	Savages Run (Above East Creek Pond)	FW1, PL,
16	2040206210060	East Creek	FW1, PL, FW2-NTC1/SE1, FW2-NT/SE1
17	2040206030010	Salem River (Above Woodstown Gage)	FW2-NTC1, FW2-NT
17	2040206070030	Canton Drain (Above Maskell Mill)	FW2-NT/SE1

17	2040206080050	Cohansey River (Including Cornwell Run – Beebe Run)	FW2-NT/SE1
17	2040206090030	Cohansey R (Rocaps Run To Cornwell Run)	FW2-NT/SE1
17	2040206100060	Nantuxent Creek (Above Newport Landing)	FW1, FW2-NTC1/SE1, FW2-NT/SE1
17	2040206130010	Scotland Run (Above Fries Mill)	FW2-NT
17	2040206130040	Scotland Run (Below Delsea Drive)	FW2-NT
17	2040206140010	Mauriceriver(Blackwater Book To Include Willow Grovelake)	FW2-NT, FW2-NTC1
17	2040206150050	Muddy Run (Including Parvin Lake To Palatine Lake)	FW2-NT, FW2-NTC1
17	2040206180050	Menantico Creek (Below Route 552)	FW2-NT, FW2-NTC1
18	2040202100020	Pennsauken Creek North Branch (Including Strawbridge Lake-Njtpk)	FW2-NT
18	2040202110030	Cooper River (Above Evesham Road)	FW2-NT
18	2040202110040	Cooper River (Wallworth Gage To Evesham Road)	FW2-NT
18	2040202110050	Cooper River (Route 130 To Wallworth Gage)	FW2-NT
18	2040202120010	Big Timber Creek North Branch (Above Laurel Road)	FW2-NT
18	2040202120020	Big Timber Creek North Branch (Below Laurel Road)	FW2-TPC1, FW2-NT
18	2040202120030	Big Timber Creek South Branch (Above Lakeland Road)	FW2-NT
18	2040202120040	Big Timber Creek South Branch(Including Bull Run To Lakeland Road)	FW2-NT
18	2040202120050	Big Timber Creek South Branch (Below Bull Run)	FW2-NT
18	2040202120060	Almonesson Creek	FW2-NT
18	2040202120090	Newton Creek (Ldrv-Kaighn Ave To Lt Creek)	FW2-NT
18	2040202120100	Woodbury Creek (Above Rt 45)	FW2-NT/SE2
18	2040202130030	Chestnut Branch (Above Sewell)	FW2-NT/SE2
18	2040202150020	Raccoon Creek (Rt 45 To/Include Clems Run)	FW2-NT/SE2
18	2040202150040	Raccoon Creek (Russell Mill Road To Route 45)	FW2-NT/SE2
19	2040202030050	Bucks Cove Run / Cranberry Branch	PL
19	2040202050050	Friendship Creek (Below/Including Burrs Mill Brook)	PL
19	2040202050060	Rancocas Creek South Branch(Above Friendship Creek)	PL
19	2040202050080	Rancocas Creek South Branch (Vincentown-Friendship Creek)	PL, FW2-NT
19	2040202050090	Rancocas Creek South Branch (Bobbys Run To Vincentown)	FW2-NT
20	2040201090030	Lower Delaware River Tributaries (Assiscunk Creek To Blacks Creek)	FW2-NT

C1 refers to Category One, a specific category of water relevant with respect to the antidegradation policies in the SWQS.

In all FW1 waters, the designated uses are (NJAC 7:9B-1.12):

1. Set aside for posterity to represent the natural aquatic environment and its associated biota;
2. Primary and secondary contact recreation;
3. Maintenance, migration and propagation of the natural and established aquatic biota; and
4. Any other reasonable uses.

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

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

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

1. Cranberry bog water supply and other agricultural uses;
2. Maintenance, migration and propagation of the natural and established biota indigenous to this unique ecological system;
3. 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;
4. Primary and secondary contact recreation; and
5. Any other reasonable uses.

Table 3. Mercury Water Column Criteria (µg/l)

Toxic substance	Fresh Water (FW2) Criteria		
	Aquatic		Human Health
	Acute	Chronic	
Mercury	1.4(d) (s)	0.77(d) (s)	0.05(h)(T)

d = criterion expressed as a function of the water effects ratio
T = total
h = noncarcinogenic effect-based human health criteria
s = dissolved

Surface water quality criteria for FW1 waters are that they shall be maintained as to quality in their natural state. PL waters shall be maintained as to quality in their existing state or that quality necessary to attain or protect the designated uses, whichever is more stringent.

In addition N.J.A.C. 7:9B-1.5(a) 4 includes the requirement that "Toxic substances in water shall not be at levels that are toxic to humans or the aquatic biota so as to render them unfit for human consumption."

Fish consumption advisories are jointly issued by the New Jersey Department of Environmental Protection and the New Jersey Department of Health and Senior Services. They provide advice to the general population and high-risk individuals (for example, women of childbearing age and children) concerning the number of meals that represent safe levels of consumption of recreational fish from New Jersey waters. Fish consumption advisories for mercury include information on how to limit risk by providing guidance on the types and sizes of fish and the number of meals to eat. They are not promulgated standards, but they are used for determining whether the fish consumption use is met. Where fish tissue levels exceed the advisory thresholds, a waterbody is listed on the 303(d) list. The New Jersey fish consumption advisories are as follows:

Table 4. New Jersey Fish Consumption Advisory Thresholds (from Toxics in Biota Committee 1994)

Advisories for the high risk population*	
Mercury (TR) Concentration in Fish Tissue	**Advisory**
Greater than 0.54 µg/g (ppm)	Do not eat
Between 0.19 and 0.54 µg/g (ppm)	One meal per month
Between 0.08 and 0.18 µg/g (ppm)	One meal per week
0.07 µg/g (ppm) or less	Unlimited consumption
Advisories for the general population	
Mercury (TR) Concentration in Fish Tissue	**Advisory**
Greater than 2.81 µg/g (ppm)	Do not eat
Between 0.94 and 2.81 µg/g (ppm)	One meal per month
Between 0.35 and 0.93 µg/g (ppm)	One meal per week
0.34 µg/g (ppm) or less	Unlimited consumption

TR – Total Recoverable Mercury

* The high risk population consists of women of childbearing years, pregnant and nursing mothers and children.

Under the current assessment methodology, an assessment unit was listed as not attaining the fish consumption use if fish tissue data indicated that any restriction of consumption would be necessary, in other words if the fish tissue concentration was above 0.07 µg/g. However, based on this TMDL analysis, this level in fish tissue can be caused solely by natural sources of mercury in some waters (see Section 5 *TMDL Calculations* below). Therefore, the Department intends to revise the assessment methodology in the development of future lists (2010) to reflect a minimal level of consumption advisory for the high risk population. It is expected that the future assessment method will use a tissue concentration of greater than 0.18 μg/g as the listing threshold, which would allow consumption by the high risk population of one meal per week. Therefore, the target for this TMDL is 0.18 μg/g total mercury fish tissue concentration. Big Timber Creek would not have been listed using this listing threshold, however, because it is listed on the 2008 303(d) list, it will be included in this TMDL document. All other waters included in this TMDL exceed the 0.18 ug/g fish tissue target.

Because fish consumption advisories are not SWQS and a TMDL must demonstrate attainment of the applicable SWQS, it is necessary to demonstrate that using this fish tissue target will also attain the applicable SWQS for mercury. This is done using bioaccumulation factors (BAFs), to convert the levels found in the fish tissue to a water column value so there can be a direct comparison with the State's current water quality criterion of 0.050 μg/L as total mercury. There is no numerical standard for waters classified as PL or FW1. The 0.18 ug/g fish tissue target is a human health endpoint which is protective of all waters, regardless of a waterbody's designation. NJAC 7:9B-1.5(a) 4's narrative standard regarding toxic substances is applicable to all waters. Absent a numeric standard for FW1 and PL waters, the narrative standard was applied and implemented using the 0.18 ug/g mercury fish tissue target. In addition the target of 0.18 μg/L requires the reduction of mercury to near natural background levels (see TMDL calculations in section 5 below) and as such is protective of waters with PL and FW1 designations.

New Jersey is engaged in an ongoing effort to develop regional BAFs. As this work is not complete, the EPA national default values will be used for this TMDL. A BAF of 1,690,000 L/kg was selected, which is based on the averaging of EPA national default values for trophic level 3 and trophic level 4 fish of 2,700,000 and 680,000 L/kg, respectively. Averaging the two values assumes a diet of 50% of these higher trophic level fish. This BAF is for methyl mercury. A further conversion to a corresponding total mercury concentration in the water column can be calculated by using the ratio of dissolved methyl mercury to total mercury. Data available from the various regions of New Jersey show that the ratios range from 0.059 to 0.005 (pers. comm. G. A. Buchanan, NJDEP, May 5, 2009). A ratio of 0.055 can be calculated from national data (EPA, 1997). The water column mercury concentration, 0.021 ug/L, expressed as total mercury using the selected BAF and the most conservative conversion factor (0.005) is lower than the mercury surface water criterion of 0.050 ug/L. Therefore, the use of a fish tissue criterion as a TMDL target ensures that the SWQS will be met if the TMDL fish tissue target is met.

The following formula was used for this comparison:

WCV (μg/L) =[Fish Tissue Value (mg/kg)/BAF (L/kg) x 1000 μg/mg] / dissolved MeHg to total Hg

Where:

WCV = water column mercury concentration
Fish Tissue Value = 0.18 mg/kg
BAF = 1,690,000 L/kg

Therefore:

WCV (μg/L)(as total Hg) = [0.18 mg/Kg/1,690,000 L/kg x 1000 μg/mg]/ 0.005 = **0.021 μg/L total Hg**

In other words, when a fish tissue target of 0.18 mg/kg is met, the water column mercury concentration would be 0.021 µg/L, which is below the surface water quality criterion of 0.050 µg/L).

2.3 Area of Interest

In accordance with the *2008 Integrated Water Quality Monitoring and Assessment Methods*, although there is a State-wide fish consumption advisory for mercury, only waters with actual fish tissue monitoring data that exceed the threshold which results in a consumption restriction (greater than 0.07 mg/kg) are placed on Sublist 5. All other assessment units are listed on Sublist 3 for this use.

The *2008 List of Water Quality Limited Waters* currently identifies 256 assessment units as impaired due to mercury in surface water and/or fish tissue. This report establishes 122 TMDLs for mercury contamination based on fish tissue concentration whose source is largely air deposition. Waters where there are other significant sources of mercury in a waterbody, as indicated by a water column concentration in excess of the Surface Water Quality Standards (61 listings), documentation of high levels of mercury in ground water (15 listings) or the presence of hazardous waste sites where mercury is a contaminant of concern (8), are deferred at this time, pending additional study. Tidal waters (35) are also excluded because the approach used in this TMDL is intended for waters not affected by tidal dynamics. In addition, areas that are included in the spatial extent of the on-going interstate effort to address mercury impairments in the New York/New Jersey Harbor are excluded from this TMDL (6). A similar interstate effort is an appropriate means of addressing mercury impairments in the shared waters of the Atlantic Ocean (37) and the Delaware River and Estuary (9) and these waters are deferred as well. See Appendix A for a listing of the deferred assessment units.

Additional fish tissue data not available when the *2008 List of Water Quality Limited Waters* was developed were evaluated and 37 additional assessment units were found to have fish tissue concentrations that would have resulted in listing of those assessment units under the current assessment methodology (see those indicated with an asterisk in Table 1). These assessment units also meet the other criteria for being addressed under this TMDL (no other significant sources, non-tidal, outside the spatial extent of interstate study). Therefore, these assessment units will be addressed under this TMDL.

As additional fish tissue data is obtained, it is expected that other assessment units will be identified that conform to the parameters established for this TMDL approach and would appropriately be addressed by this TMDL, had the data been available. Therefore, in addition to the impaired waters listed Table 1, this TMDL may, in appropriate circumstances, also apply to waterbodies that are identified in the future as being impaired for mercury. For such waterbodies, this TMDL may apply if, after listing the waters for mercury impairment and taking into account all relevant comments submitted on the Impaired Waters List, the Department determines, with EPA approval of the list, that this TMDL should apply to future mercury impaired waterbodies. Under these circumstances, the assessment units will be placed on Sublist 4.

The assessment units addressed in this TMDL are listed in Table 1 and depicted in Figure 1. The assessment units encompass 724,236 acres throughout the state.

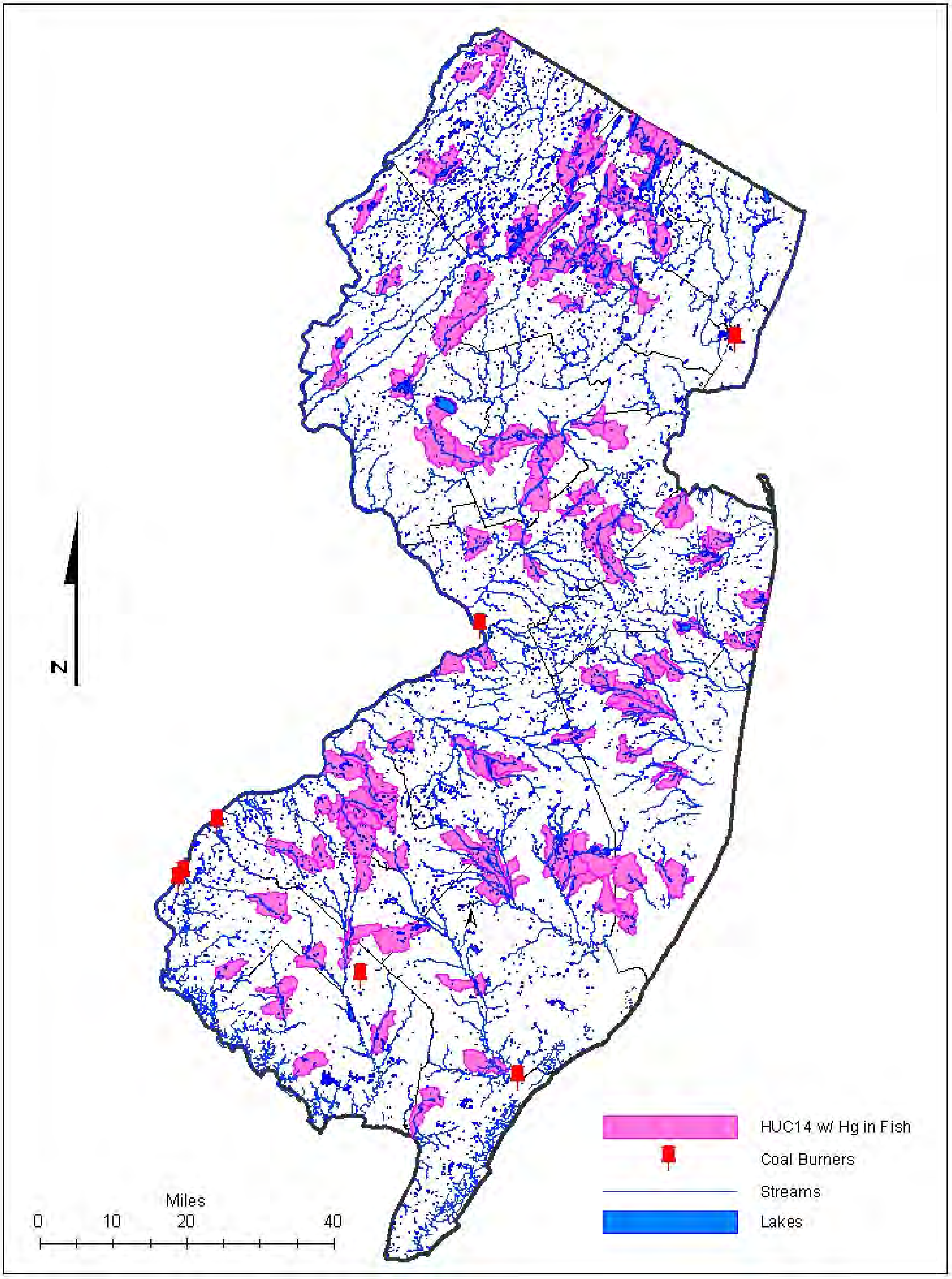


Figure 1. Assessment Units Addressed in this TMDL

3.0. Data Analysis

3.1 Fish Tissue Data

Beginning in 1994, research on freshwater fish found mercury concentrations exceeding the risk-based health advisories established by the State of New Jersey. Additional data were developed and reported in Academy of Natural Sciences, Philadelphia (ANSP) (1999), Ashley and Horwitz (2000), Horwitz et al. (2005) and Horwitz et al. (2006). The Department's Routine Monitoring Program for fish tissue began in 2002. The purpose of this monitoring program is to enhance waterbody assessments; amend existing advisories or, if necessary, develop new advisories; assist the NJDEP in evaluating trends in contaminant concentrations of these selected species; and to determine the need for additional research and monitoring studies. The sampling program is based on a rotating assessment of contamination in five regions of the state on a 5-year cycle. The regions consist of:

1. Passaic River Region;
2. Marine/Estuarine Coastal Region;
3. Raritan River Region;
4. Atlantic Coastal Inland Waterways Region; and
5. Upper and Lower Delaware River Region.

Sampling in the Passaic Region was conducted in 2002-2003 and the Marine/Estuarine Region in 2004-06. The results were reported in Horwitz, et al. (2005 and 2006). In the third year of the cycle, the Raritan River Region was sampled for freshwater fish, blue crabs and marine fish. In 2006-2007, species important to recreational anglers in the Raritan estuaries and adjacent oceanic waters and in two southern New Jersey coastal bays were sampled.

The initial data set consulted included 2,474 samples that had been analyzed for mercury in fish tissue in the waters of New Jersey collected through the above sampling programs and from localized investigations. All fish were analyzed using microwave digestion and cold vapor atomic absorption. Based on an evaluation of data quality, all samples before 1990 were excluded because of issues with background contamination in the labs analyzing samples. A small number of fish tissue samples were derived from whole fish samples. Only samples where the fillets were analyzed were retained to ensure a consistent basis for comparison. Locations with known mercury contamination from other sources were eliminated to avoid influences beyond air deposition (water column exceedances, presence of hazardous sites with mercury, groundwater levels with elevated mercury). All tidal areas were excluded, including those from the areas of on-going or anticipated interstate studies (New York/New Jersey Harbor, Atlantic Ocean and Delaware River and Bay). The final data set used for this TMDL analysis included 1,368 samples from 26 different species (see Appendix B).

This TMDL is based on the linear relationship between mercury levels in the air and water and that a BAF can relate fish tissue concentration to water column concentration. This means that if the existing load is responsible for the observed mercury levels in fish, then one can calculate the load that will result in the target concentration in fish and the associated water column concentration using the BAF, to ensure the SWQS are attained. The steady state bioaccumulation equation is:

$$C_{fish\ t1} = BAF * C_{water\ t1}$$

where:

$C_{fish\ t1}$ and $C_{water\ t1}$ represent methyl mercury concentration in fish and water at time t_l, respectively;

BAF represents the bioaccumulation factor, which is constant for a given age and length fish in a specific water body.

For a future time, $t_{2,}$ when mercury concentrations have changed, but all other parameters remain constant, the following equation applies:

$$C_{fish\ t2} = BAF * C_{water\ t2}.$$

Combining both equations produces the following:

$$C_{fish\ t1/}C_{fish\ t2} = C_{water\ t1/}C_{water\ t2}\ .$$

Then, with methyl mercury water column concentrations being proportional to mercury air deposition load, therefore:

$$C_{fish\ t1/}C_{fish\ t2} = L_{air\ t1}/ L_{air\ t2}$$

where:

$L_{air\ t1}$ and $L_{air\ t2}$ represent mercury loads from the air deposition at time 1 and time 2.

Mercury concentration in fish increases with both age and length (see Figure 2). In order to derive a representative existing fish tissue concentration as a basis to calculate the load reduction required to achieve the target concentration, it is necessary to statistically standardize the data. The fish tissue mercury concentrations were statistically adjusted to a “standard-length fish”. Because many fish are larger than the standard length and therefore higher in mercury, the TMDL analysis targets the 90^{th} percentile mercury tissue concentration of the distribution of all length-standardized fish evaluated. This will provide an implicit margin of safety and be more protective than using a mean or median concentration value. In addition, because growth rates and levels of mercury accumulation will vary between waterbodies, using the 90^{th} percentile tissue concentration will be protective of waterbodies with higher levels of accumulation.

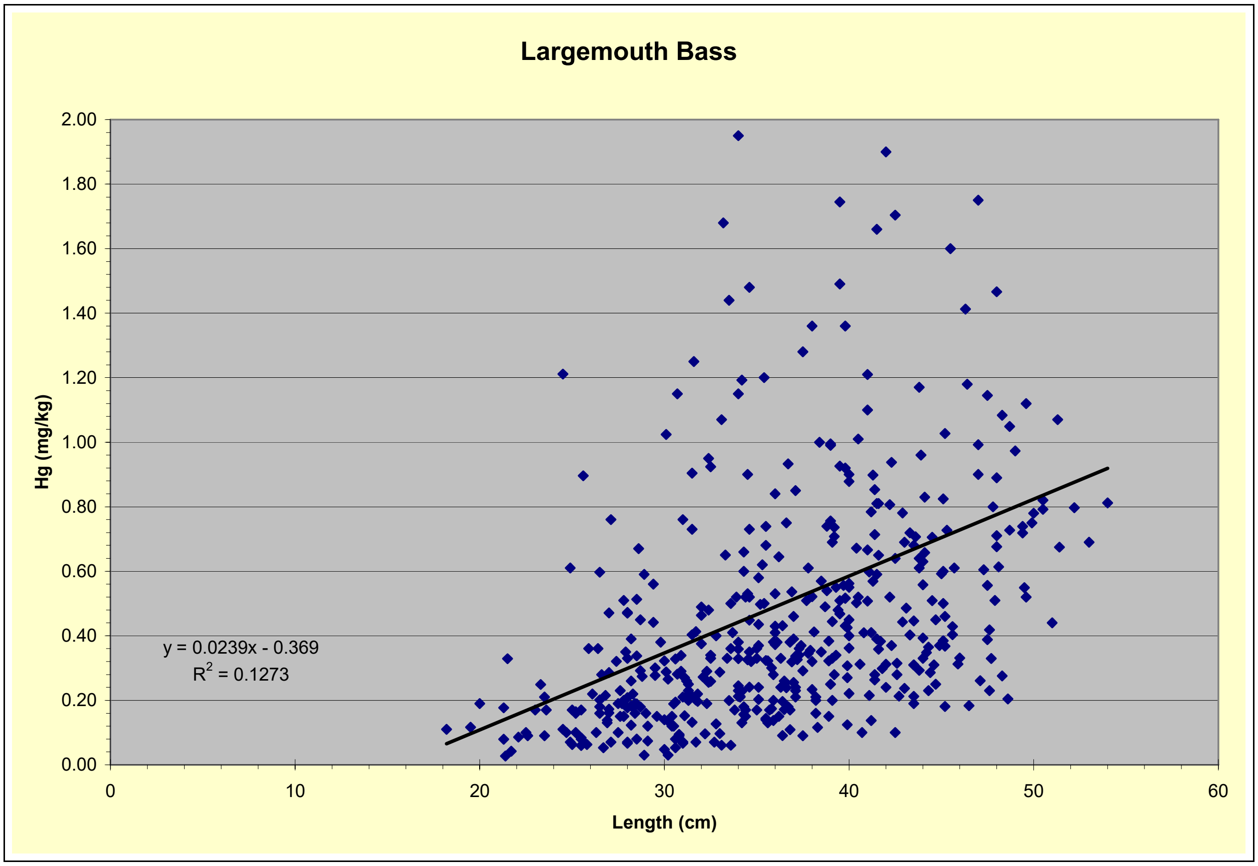


Figure 2. Relationship Between Length and Mercury Concentration in Fish Tissue

The Northeast Regional TMDL analyzed four different species of top trophic level fish, comparing the mean, 80th and 90th percentile concentrations. The authors chose the smallmouth bass (*Micropterous dolomieu*), because of the rate of bioaccumulation of mercury and its ubiquitous distribution throughout the Northeast States. The smallmouth bass is not well distributed throughout New Jersey, therefore it was not an appropriate indicator species for this TMDL. However, the largemouth bass (*Micropterus salmoides*), of the same genus and with the same diet of crayfish, frogs and fish, is well distributed throughout New Jersey. Samples are available from 69% of the listed assessment areas. The chain pickerel was also considered because it is represented by the second largest number of samples in the data set and has a high average mercury concentration (see tables 5 and 6 below). Its diet consists of invertebrates and fish. However, it is not as well distributed throughout New Jersey. Because of the larger sample size and better distribution, the largemouth bass was chosen to be the indicator for this TMDL effort. Using either fish yields a similar reduction factor.

Table 5. Data on Methyl Mercury Concentration in Fish Fillet Samples (n = number of samples, Average = arithmetic mean concentration)

Species List	2000-2007		1990-1999	
	n	Average	n	Average
American Eel	72	0.4	6	0.47
Black Crappie	15	0.15	32	0.19
Bluegill	75	0.14	2	0.03
Bluegill Sunfish	3	0.07	20	0.18
Brown Bullhead	32	0.07	79	0.19
Brown Trout	2	0.08	1	0.2
Chain Pickerel	82	0.658	166	0.685
Channel Catfish	9	0.22	10	0.15
Common Carp	36	0.11	5	0.04
Hybrid Striped Bass	0		6	0.27
Lake Trout	5	0.14	12	0.46
Largemouth Bass	152	0.54	224	0.56
Mud sunfish	0		3	1.01
Northern Pike	6	0.29	6	0.24
Pike	0		3	0.39
Pumpkinseed Sunfish	0		19	0.37
Rainbow Trout	0		6	0.11
Redbreast Sunfish	16	0.16	4	0.24
Rock Bass	19	0.33	4	0.46
Smallmouth Bass	13	0.34	22	0.47
Striped x White Bass Hybrid	5	0.29	0	
Walleye	10	0.4	6	0.74
White Catfish	8	0.19	15	0.27
White perch	12	0.18	22	0.42
White Sucker	3	0.23	0	
Yellow Bullhead	33	0.23	32	0.63
Yellow Perch	27	0.36	28	0.51

An analysis of covariance model was used to estimate the length-adjusted concentrations of mercury in largemouth bass. Scatter plots indicated that a log transformation for mercury would approximately linearize the relationship between mercury and length, so the model used the log to the base 10 of mercury as the dependent variable. The independent variables were length and water body. Water bodies were considered to be fixed effects. The result of this analysis was to create a length-adjusted mercury concentration for each water body.

A model was also run in order to determine whether the length-adjusted concentrations changed over time. In order to do this, an independent variable defining the decade in which the sample was taken (1992 – 1999 vs. 2000 – 2007) was included in the model along with length and water body. This model was significant ($p < 0.001$) with an R-square of 82%. Mercury concentrations varied significantly ($p < 0.001$) with length, waterbody and the decade in which the samples were taken.

Because decade was a significant effect, the two decades were analyzed separately. The adjusted estimates were calculated at the mean length of 35.11cm for data collected from 1992-1999 and 39.78 cm for data collected from 2000-2007.

For the 1992-1999, the data set included 49 water bodies. The number of fish sampled from each water body ranged from 1 to 12. The independent variables included length and water body. This model run was significant ($p < 0.001$) with an R-square of 89%. Mercury concentration varied significantly ($p < 0.001$) with both length and waterbody. The 90th percentile of the length-adjusted mercury concentration is $10^{(0.0448)}$ = 1.109 µg/g.

The 2000-2007 dataset included 46 water bodies. The number of fish sampled from each water body ranged from 3 to 5. The independent variables included length and water body. This model run was significant ($p < 0.001$) with an R-square of 85%. Mercury concentration varied significantly ($p < 0.001$) with both length and waterbody. The 90th percentile of the length adjusted mercury concentration is $10^{(0.0607)}$ = 1.150 µg/g.

The statistical analyses were performed in SAS version 9.1.3.

Because the mercury concentration varies with the waterbody, the 90th percentile fish tissue concentration is used to calculate the reduction factor. This will be protective of all the waterbodies, even those with higher fish tissue mercury concentrations.

Table 6. Mercury Concentrations Related to Fish Length for 2000-2007 Data

Species	Standard Length (cm)	Mean Hg Concentration (ppm) at Standard Length	80th percentile Hg Concentration (ppm) at Standard Length	90th percentile Hg Concentration (ppm) at Standard Length
Largemouth bass	35.11	0.531	0.64	1.15
Chain pickerel	41.61	0.59	1.26	1.29

Figure 3 shows the distribution of methyl mercury concentrations in all species in the 2000–2007 data set and concentrations in the largemouth bass for the same period. The graph shows that targeting the 90th percentile concentration in largemouth bass corresponds to the 93rd percentile concentration for all fish species. Therefore, targeting the concentration of 90th percentile for largemouth bass, means that approximately 93% of all fish populations tested will comply with the TMDL target concentration. There is much environmental variability. Some lakes will show decreases in mercury more quickly, some more slowly. Both the Minnesota and the Northeast States regional TMDLs were based on the 90th percentile concentration. Therefore the 90th percentile target is in keeping with mercury TMDLs EPA has previously approved.

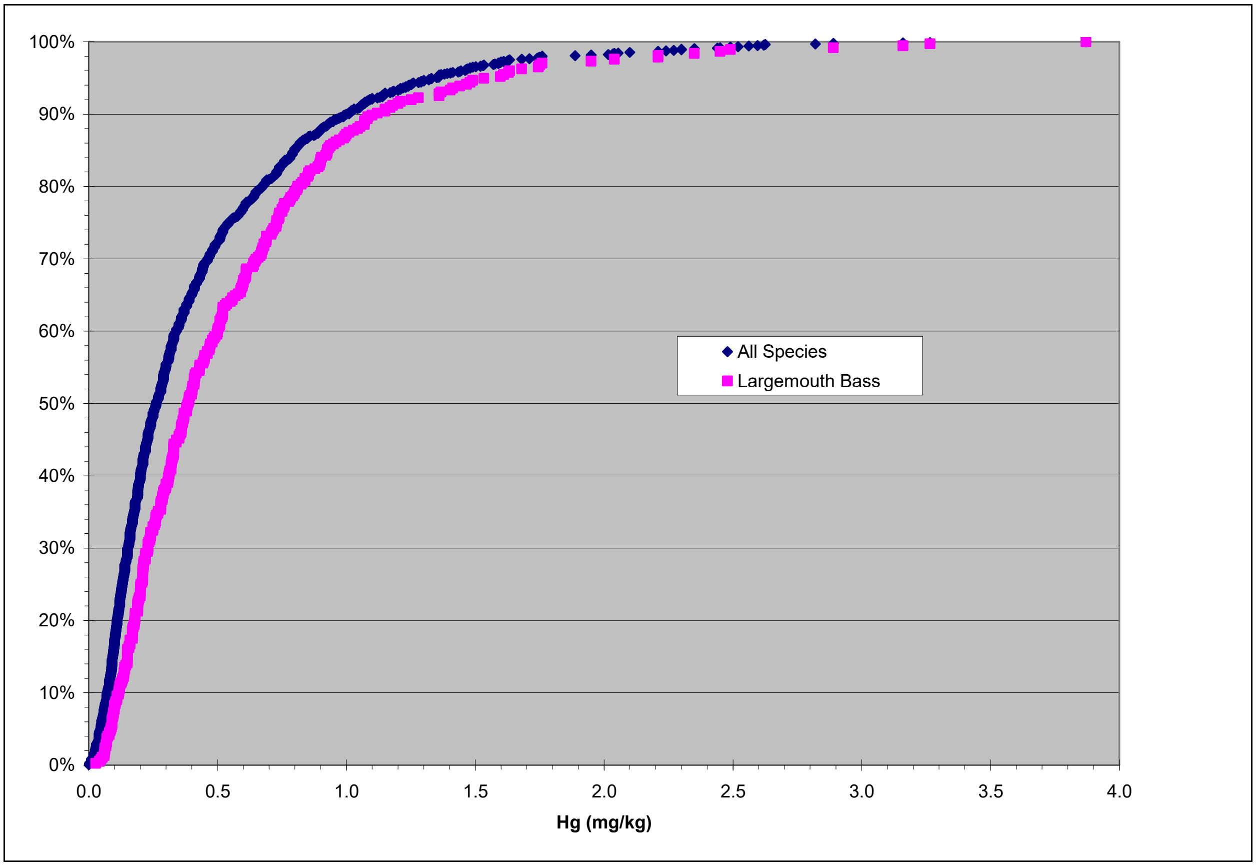


Figure 3. Cumulative Distribution of Mercury Concentrations in Fish Tissues

Based on the linear relationship premise, a Reduction Factor (RF) based on the existing and target fish tissue concentrations is calculated as follows:

RF= (EFMC-TFMC)/EFMC

where:
EFMC = the existing fish mercury concentration for the selected fish species.
TFMC = target fish mercury concentration

or:
0.84 = (1.15 µg/g-0.18 µg/g) /1.15 µg/g

As discussed above, the EFCM for this study is 1.15 µg/g, which represents the 90th percentile concentration based on standard length for largemouth bass. The target fish tissue concentration is 0.18 µg/g, which will allow a consumption rate of 1 meal per week for the high risk population. For unlimited consumption of fish for the high risk population, the reduction factor would need to be 0.94. As discussed below, natural sources of mercury, which cannot be reduced, make this reduction factor unattainable. However, the TMDL calculation includes an implicit margin of safety based on a number of conservative assumptions. Therefore, it is possible that unlimited consumption for the high risk population may be attainable if the identified anthropogenic reductions are achieved. In any case, although this TMDL target will not allow unlimited consumption of top trophic level fish for high risk groups using the multiple conservative assumptions in this analysis, mercury will be reduced at all trophic levels, allowing greater options for safe consumption of fish at the lower trophic levels and one meal per week of the top trophic levels by the high risk population.

4.0. Source Assessment

In order to evaluate and characterize mercury loadings on a statewide basis source assessments are critical. Source assessments include identifying the types of sources and their relative contributions to mercury loadings and are necessary to develop proper management responses to reduce loadings and attain water quality targets.

Air deposition is the primary source of the mercury impairments addressed in this TMDL. A recent study was undertaken in partnership with the states and USEPA Regional Air and Water Offices to use atmospheric deposition modeling to quantify contributions of specific sources and source categories to mercury deposition within each of the lower 48 states (ICF, 2008). The annual simulation was performed based on data that represented late 90's emission profiles for most source categories. The primary modeling system used for this study is the Regional Modeling System for Aerosols and Deposition (REMSAD). REMSAD is a three-dimensional grid model designed to calculate the concentrations of pollutants by simulating the physical and chemical processes in the atmosphere that affect pollutant concentrations. REMSAD simulates both wet and dry deposition of mercury. REMSAD also includes algorithms for the reemission of previously deposited mercury (originating from anthropogenic and natural sources) into the atmosphere from land and water surfaces. The Particle and Precursor Tagging Methodology (PPTM) feature allows the user to tag or track emissions from selected sources or groups of sources, and quantify their contribution to mercury deposition throughout the modeling domain and simulation period. Results from the Community Multiscale Air Quality (CMAQ) modeling system were used to enhance the analysis of the effects of global background on mercury deposition. The outputs from three global models were used to specify the boundary conditions for both REMSAD and CMAQ and thus represent a plausible range of global background contributions based on current scientific understanding.

Preparation and quality assurance of the mercury emissions inventory were critical for the air deposition load modeling. Based on the emissions data utilized by USEPA in the Clean Air Mercury Rule (CAMR) modeling, detailed summaries of the top emitters in the CAMR mercury inventory for each state were prepared and provided to the appropriate EPA regional offices and state agencies for review. An effort was made to update emissions to the 2001 timeframe in addition to the general QA/QC that performed by the states and EPA regions. Then based on the state's input, any errors in the data were corrected. Table 7 lists New Jersey's emission inventory as it was used in the model. This inventory was developed based on the Department's 2001 mercury emission estimates (ICF, 2008). For the total of the three forms of mercury emission load, approximately 60% was due to air point sources and 40% from air nonpoint sources. Air point sources include fuel combustion-electric utilities, industrial facilities and other combustion facilities. Air nonpoint sources include human cremation, fluorescent lamp breakage, miscellaneous volatilization and other non-stationary sources.

Table 7. Summary of Emissions Inventory of New Jersey in Tons per Year (tpy) (ICF, 2008)

Facility Name	HG0* (tpy)	HG2* (tpy)	HGP* (tpy)	Total (tpy)
B.L. England	0.094	0.016	0.004	0.114
Hudson*	0.011	0.028	0.003	0.041
Mercer	0.030	0.015	0.011	0.057
Deepwater	0.002	0.004	0.000	0.006
Logan Generating Company - L.P.	0.001	0.000	0.000	0.002
Chambers Cogeneration - L.P.	0.010	0.006	0.004	0.021
Co Steel Raritan	0.090	0.011	0.011	0.112
Atlantics States Cast Iron Pipe	0.033	0.004	0.004	0.041
U.S. Pipe & Fndy. Co	0.019	0.011	0.000	0.030
Co Steel Sayreville*	0.178	0.022	0.022	0.222
Essex County RRF*	0.047	0.123	0.042	0.212
Camden RRF*	0.011	0.029	0.010	0.050
Union County RRF	0.003	0.008	0.003	0.014
Gloucester County	0.002	0.005	0.002	0.009
Warren Energy RF	0.001	0.001	0.001	0.003
Howarddown	0.002	0.001	0.001	0.004
Hoeganese	0.005	0.003	0.002	0.010
Camden County Muassi	0.005	0.003	0.002	0.010
Stony Brook Regional Sewerage Authority	0.011	0.007	0.005	0.023
Bayshore Regional Sewerage Authority	0.004	0.002	0.002	0.008
Somerset Raritan Valley Sewerage Authority	0.007	0.004	0.003	0.014
Northwest Bergen County Utilities Authority	0.005	0.003	0.002	0.010
Parsippany – Troy Hills Township WWTP	0.004	0.003	0.002	0.009
Atlantic County Utilities Authority	0.003	0.002	0.001	0.006
Gloucester County Utilities Authority	0.001	0.001	0.000	0.002
Point Source Total	0.579	0.312	0.137	1.030
Non-point Source	0.464	0.096	0.055	0.613
Total	1.043	0.408	0.192	1.643

*HG0 - elemental mercury vapor; HG2 - divalent mercury compounds in gas phase; HGP - divalent mercury compounds in particulate phase.

As summarized in Table 8 below, a total of 594 kg of annual mercury load due to air deposition was estimated for New Jersey. "Background" refers to the effects of initial and boundary concentrations and embodies the effects of global emissions, altogether, about 52% of the total load. Emissions from New Jersey are contributing 12.5% of the total load. The emissions from five surrounding states contribute 26% of the total load.

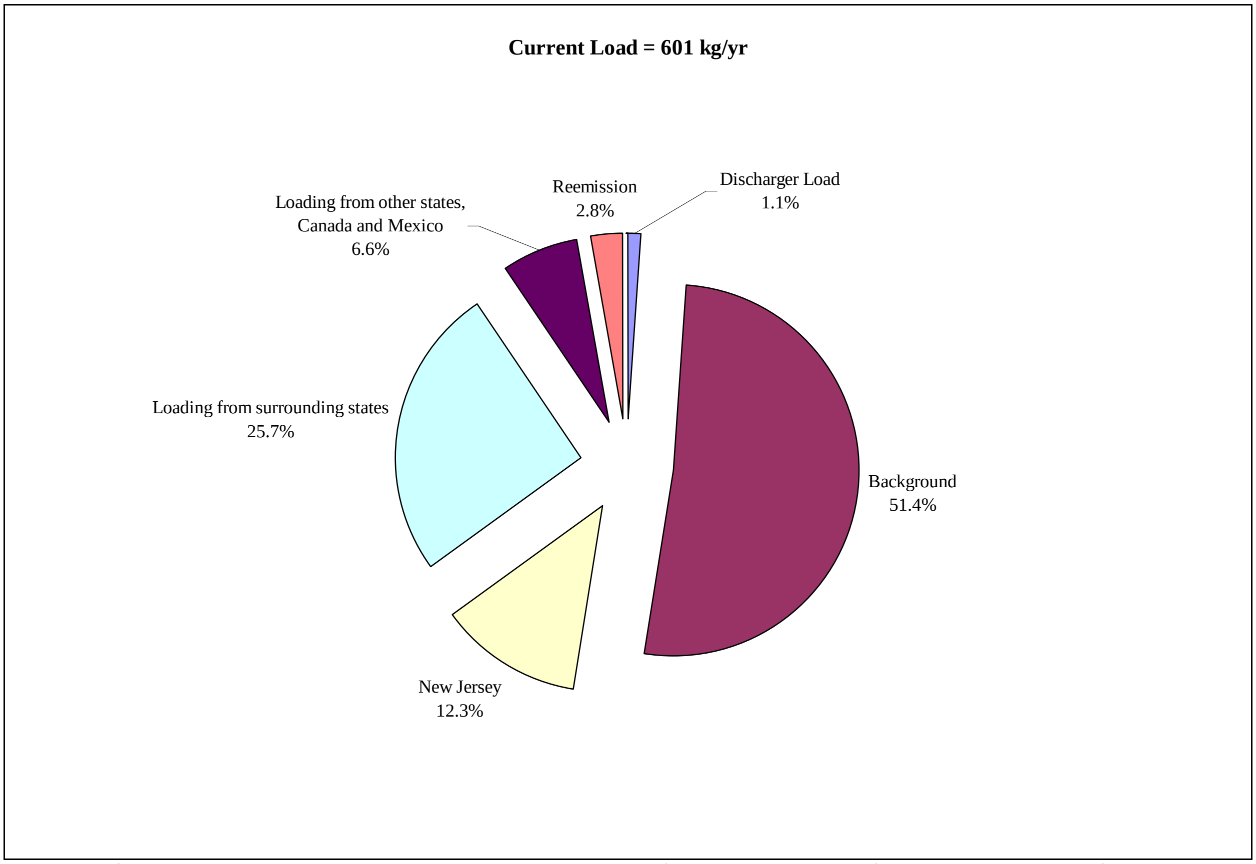
Table 8. Mercury Air Deposition Load for New Jersey (pers. com. D. Atkinson, March 26, 2009, see Appendix D)

Category	Load (kg/yr)	Percent of Total Load
Background	309.0	52.0%
Background-reemission	16.9	2.8%
New Jersey	74.1	12.5%
Loading from the surrounding state (Total)	154.6	26.0%
Pennsylvania	102.8	17.3%
Maryland	25.1	4.2%
New York	13.7	2.3%
Delaware	11.1	1.9%
Connecticut	1.8	0.3%
Loading from other states, Canada and Mexico	39.6	6.7%
Total	594.2	100%

Under the Clean Water Act (CWA), air deposition is a nonpoint source of mercury. Mercury deposited from air sources reaches the surface water as the result of direct deposition on the water surface and through stormwater runoff. Under the CWA, stormwater discharges subject to regulation under the National Pollutant Discharge Elimination System (NPDES) are a point source. In New Jersey, this includes facilities with individual or general industrial stormwater permits and Tier A municipalities and state and county facilities regulated under the New Jersey Pollutant Discharge Elimination System (NJPDES) municipal stormwater permitting program. Stormwater discharges that are not subject to regulation under NPDES, such as Tier B municipalities regulated under the NJPDES municipal stormwater permitting program, and direct stormwater runoff from land surfaces are nonpoint sources. Stormwater point sources derive their pollutant load from runoff from land surfaces and the necessary load reduction for this TMDL will be accomplished in the same way as for stormwater that is a nonpoint source, that is by reducing the air deposition load. The distinction is that, under the Clean Water Act stormwater point sources are assigned a WLA while nonpoint sources are assigned a LA. For this TMDL, the proportion of the air deposition loading attributed to stormwater point sources has been estimated by determining the amount of urban land located within Tier A municipalities. Based on NJDEP's 2002 land use coverage, the area of urban land use within the Tier A municipalities is about 25.6% of the entire state. Applying this percentage to the entire load due to air deposition is the best approximation of the air deposition load subject to stormwater regulation and this proportion of the air deposition load will be assigned a WLA.

Surface water discharges of sanitary and industrial wastewater that have the potential to discharge mercury are the other potential point source category which must be assigned a WLA. The Department reviewed over 240 existing major and minor municipal surface water discharge locations. Industrial surface water dischargers with mercury limits in their permits regulated under the New Jersey Pollutant Discharge Elimination System (NJPDES) were also included as the potential point sources for this TMDL. Since this TMDL is limited to non-tidal water, facilities discharging to coastal water were excluded. By examining the locations of the outfall pipes, approximately two-thirds of initially identified municipal and industrial surface water discharge facilities were used to estimate the point source loading from them.

Various sources of data were assessed in order to estimate an appropriate loading to attribute to discharge facilities. Due to the high detection limit of the standard method for analyzing the samples collected from the dischargers, mercury concentrations reported to date were generally listed as non-detected in the Monitoring Report Forms. Dental facilities are believed to be the largest source of mercury reaching wastewater treatment plants. Through the recently adopted New Jersey Pollutant Discharge Elimination System, Requirements for Indirect Users – Dental Facilities rules, N.J.A.C. 7:14A-21.12, dental facilities that generate amalgam waste are required to comply with best management practices and install amalgam separators. The amalgam separators will allow the mercury containing amalgam to be collected and recycled, thereby reducing the amount entering the environment through sludge incineration. The Department required major wastewater treatment facilities to carryout baseline monitoring of their effluent to determine mercury levels prior to implementation of the new dental requirements. However, the data from this monitoring effort are not yet available for use in this TMDL. As part of the New York-New Jersey Harbor TMDL development, in 2000 and 2001 a total of 30 samples were collected from 11 Publicly Owned Treatment Works (POTWs) in New Jersey which discharge to the Harbor (GLEC, 2008). Total recoverable mercury concentrations ranged from 8.32 to 74.9 ng/L, with a mean of 30.09 ng/L and a median of 19.75 ng/L. The Department believes that the mercury effluent concentrations found in these facilities will serve as an appropriate representation of effluent quality in the state. Therefore, the median concentration of 19.75 ng/L was used as a typical mercury concentration for treatment facilities. The total permitted flows for selected facilities is about 250 MGD. Using that flow and the selected median concentration, the total mercury load from these facilities is estimated to be 6.8 kg/year. This loading (6.8 kg/yr) is also a conservative assumption of the existing point source load since the permitted flow was used instead of the actual flow. The loading attributed to discharge facilities is insignificant at approximately 1% of the total load. Figure 4 shows the distribution of the current total load of mercury.



Note: Load from stormwater is not distinguished because it is derived from and is a subset of the air deposition load from the different air sources identified.

Figure 4. Distribution of the Current Mercury Load

5.0. TMDL Calculation

Methods similar to those used in the *Northeast Regional TMDL* (2007) are employed below to calculate the TMDL. A total source load (TSL), described in Section 4, and reduction factor (RF), as described in Section 3, are used to define the TMDL by applying the reduction factor to the total source load, as shown in Equation 1 below.

$$TMDL = TSL \times (1-RF)$$

where:

- TMDL is the total maximum daily load (kg/yr) that is expected to result in attainment of the target fish tissue mercury concentration.
- TSL is the existing total source load (kg/yr), and is equal to the sum of the existing point source load and the existing nonpoint source load
- RF is the reduction factor required to achieve the target fish mercury concentration.

To allow a consumption rate for the high risk population of one meal per week, the required reduction is 84.3 % (1 - 0.18/1.15 = 84.3%). The total existing loading from air deposition and the treatment facilities discharging into non-tidal waters is 601.kg/yr. In this load, 6.8 kg/yr (about 1%) comes from NJPDES regulated facilities with discharges to surface water in non-tidal waters. Due to the insignificant percentage contribution from this source category, reductions from this source category are not required in this TMDL. Therefore, individual WLAs are not being assigned to the various facilities through this TMDL. Individual facilities have been and will continue to be assessed to determine if a water quality based effluent limit should be assigned to prevent localized exceedances of SWQS and to ensure that the aggregate WLA is not exceeded. As discussed above and in the Reasonable Assurance section below, the recently implemented dental amalgam rules are expected to significantly reduce the amounts of mercury entering wastewater treatment facilities. At this time, it is not known what effect this will have on effluent concentrations. The post-implementation monitoring will be assessed to determine the effect of best management practices (BMPs) for the handling of dental amalgam waste and installation and proper operation of amalgam separators and the need for adaptive management with regard to this source in air deposition impacted waterbodies. Waterbodies that may be impacted by NJPDES regulated facilities with discharges to surface water (those with water column exceedances of the SWQS) have been excluded from the TMDL and will be addressed individually at a later date.

Based on results of several paleolimnological studies (NEIWPCC, et.al. 2007) in the Northeast, the natural mercury deposition is estimated to range between 15 % and 25 % of deposition fluxes for circa 2000. Natural sources cannot be controlled and are expected to remain at the same long-term average. It is assumed, in this study, that 25% of the background and background reemission is due to natural sources and can not be reduced (Ruth Chemerys and John Graham Pers. Comm. April 28, 2009). Twenty-five percent of the background and background reemission load is about 81.5 kg/yr, which is 13.6% of the total existing load. Including the load of 6.8 kg/yr attributed to surface water dischargers, the portion of the existing load that is not expected to be reduced is about 14.7%. If 0.07 ug/g (the fish concentration for unlimited consumption by the high risk population) were used as the TMDL target, the required reduction would be 93.9% of the existing load, which is greater than the entire anthropogenic load of 85.3% (1-14.7%) and clearly unattainable. For this reason, the concentration level (0.18 ug/g) that allows the high risk population to consume fish once per week was used as the target for this TMDL and will also be used as the threshold in future assessments of impairment. In order to achieve the overall 84.3% reduction of the existing load to attain the target of 0.18 mg/kg in fish tissue, a reduction of 98.8% of the anthropogenic source load would be needed. An implicit margin of safety (MOS) is used in this study, therefore, the MOS term of the TMDL equation is set to zero. Figure 5 presents the distribution of the TMDL to achieve the target concentration that will allow one meal per week by the high risk population.

Table 9. Mercury TMDL for One Meal per Week by High Risk Population

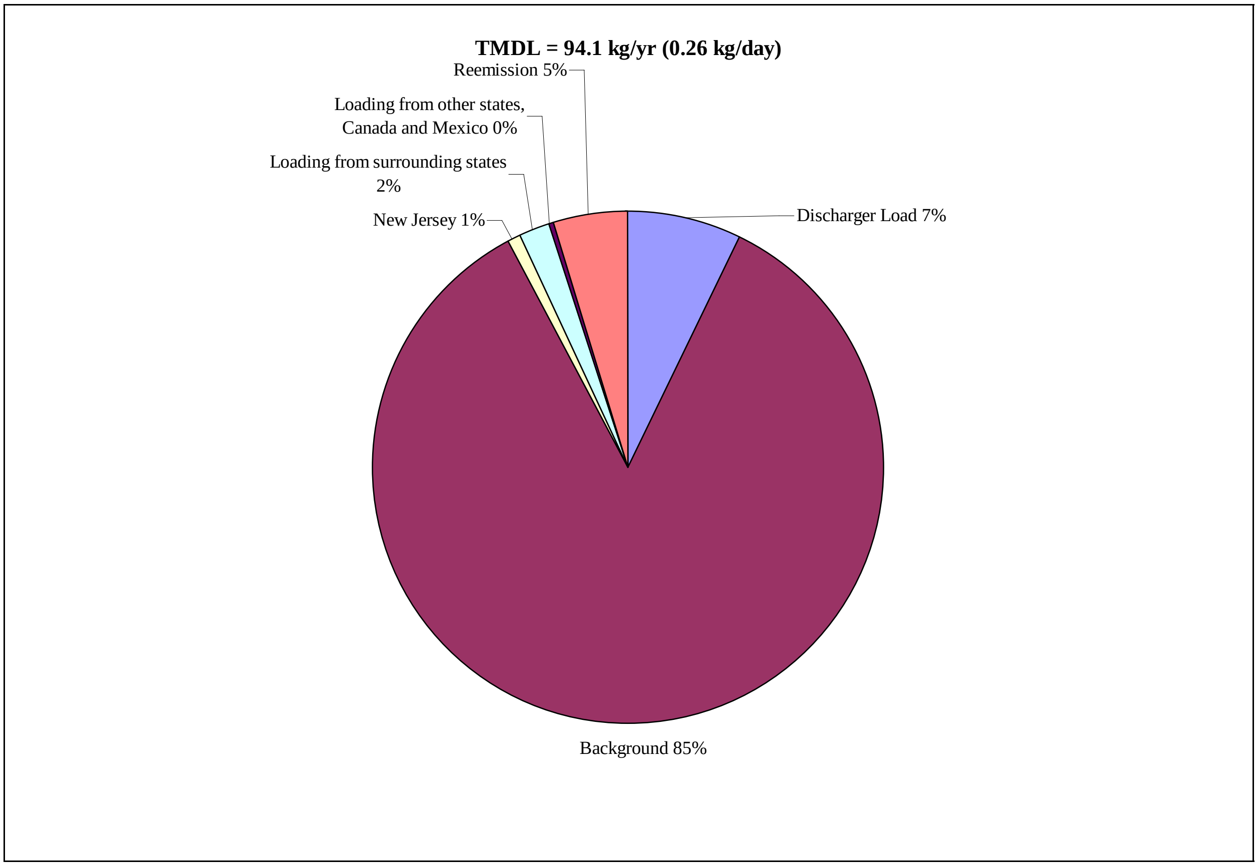
Category	Existing Load (kg/yr)	TMDL Load		Percent Reduction
		kg/yr	kg/day	
Total Annual Load	**601.0**	**94.1**	**0.26**	**84.3%**
Discharger Load (WLA)	6.8	6.8	0.02	-
Air Deposition Load (LA/WLA)	594.2	87.3	0.24	85.3%
Background due to natural source	77.3	77.3	0.21	-
Background due to anthropogenic sources	231.8	2.6	0.01	98.9%
New Jersey	74.1	0.8	0.002	98.9%
Loading from surrounding states	154.6	1.8	0.005	98.9%
Loading from other states, Canada and Mexico	39.6	0.4	0.001	98.9%
reemission due to natural source	4.2	4.2	0.01	-
Reemission due to anthropogenic source	12.7	0.1	0.0004	98.9%

Note: The TMDL loadings presented in the above table were rounded to 0.1 kg/yr. Percents of required reductions were calculated based on values with more significant digits. Using the values from the table to calculate the percent reduction may generate inaccurate results.

Table 10. Distribution of Air Deposition Load between LA and WLA under the TMDL Condition

Air Deposition Load	Annual Load (kg/yr)	Daily Load (kg/day)	Percent of Loading Capacity
Total	87.3	0.24	92.8%
WLA	22.3	0.06	23.7%
LA	65.0	0.18	69.1%

The urban storm water WLA portion of the air deposition load is derived by applying the percentage of urban land within Tier A municipalities (25.6%) to the overall air deposition load (87.3 kg/yr) based on the assumption that this load reaches the water bodies through regulated stormwater sources (see discussion in Section 4). Thus, under the TMDL conditions the WLA has been approximated to be 22.3 kg/yr (87.3 * 0.256), equivalent to 0.06 kg/day (Table 10). The air deposition rate under the TMDL condition is not available to conduct a more precise calculation of the stormwater WLA. More accuracy in developing this WLA is not necessary because the major source of mercury in stormwater is air deposition. Mercury in stormwater must be reduced by reducing air deposition and not through the usual stormwater measures. Therefore a WLA that represents an approximation of the total stormwater load is sufficient for the purposes of this TMDL. Individual stormwater WLAs would not change the response.



Note: Load from stormwater is not distinguished because it is derived from and is a subset of the air deposition load from the different air sources identified.

Figure 5. Distribution of TMDL for One Meal per Week by High Risk Population

As discussed in Section 5.2, multiple conservative assumptions have been made so that the calculated TMDL includes an implicit Margin of Safety (MOS). Therefore, the MOS term of the TMDL equation is set equal to zero. As explained above, a reduction of 85.3% (1-88.3/601) is the highest possible overall reduction that can be expected. The required reduction to achieve unlimited consumption for the high risk population is higher, (1 – 0.07/1.15 = 93.9%). Nevertheless, given the multiple conservative assumptions, this reduction may be achievable. Data gathered following implementation of the TMDL will be used to evaluate success in achieving goals.

5.1. Seasonal Variation/Critical Conditions

40 CFR 130.7(c)(1) requires that “TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numerical WQS with seasonal variations”. Calculated TMDLs shall take into account critical conditions for stream flow, loading, and water quality parameters.”

The relative contribution of local, regional, and long-range sources of mercury to fish tissue levels in a waterbody are affected by the speciation of natural and anthropogenic emission sources. The amount of bioavailable methyl mercury in water and sediments is a function of the relative rates of mercury methylation and demethylation. Factors such as pH, length of the aquatic food chain, temperature and dissolved organic carbon can affect bioaccumulation. (EPA, 2009). These factors influence the extent to which mercury bioaccumulates in fish and may vary seasonally and spatially. However, mercury concentrations in fish tissue represent accumulation of the life span of a fish. Use of a fish tissue target integrates spatial and temporal variability, making seasonal variation and critical conditions less significant. In addition, the TMDL fish target value is human health-based, reflecting a longer- term exposure.

In New Jersey, data show levels of mercury in some species of fish in the Pinelands sampling region are generally higher compared to fish in other sampling regions of the state. The reductions called for in this TMDL will attain the target fish tissue concentration in the Pinelands, thereby ensuring that the target is met statewide, within the areas addressed by the TMDL.

5.2. Margin of Safety

A TMDL must include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality (CWA 303(d)(1)(C), 40C.F.R.130.7(c)(1)). EPA's 1991 TMDL Guidance explains that the MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS must be described.

The MOS included in this TMDL is implicit because of the following conservative assumptions:

- The 90th percentile fish mercury concentration based on the largemouth bass, *Micropterus salmoides*. This species of fish has the highest concentration of the species that are ubiquitous throughout the state
- The percent reduction does not account for additional reductions in methyl mercury that may occur as a result of the implementation of ongoing state and federal programs to reduce sulfur emissions. Reductions in sulfur deposition and sulfate-reducing bacterial activity will decrease the rate of mercury methylation. This TMDL does not account for potential mercury reductions associated with decreased sulfur deposition.

6.0. Monitoring

The Department has engaged in various monitoring efforts that have provided significant insight into mercury contamination issues, some of which are described below. In order to effectively assess progress toward achieving mercury reduction objectives, several monitoring programs are recommended, including:

- A primary monitoring strategy for measuring the levels of mercury and calculating trends is the previously mentioned Routine Fish Monitoring Program for Toxics in Fish. This comprehensive program divides the State's waters into five regions that are sampled on a rotating basis for contaminants in fish. Since mercury is persistent in the environment, accumulates in biological tissue, and biomagnifies in the food chain, adverse impacts to non-aquatic, piscivorous (fish eating) organisms may arise from very low surface water concentrations. Fish tissue sampling provides a cost-effective measure to understanding the effects of mercury in the food chain and the environment.

- A mercury water monitoring program is needed to understand the extent and magnitude of the State's mercury contamination and its effect on aquatic organisms. Such a program must have a comprehensive scope and long-term sampling period. Recent mercury studies from the United State Geological Survey (USGS) have suggested the use of screening tools to target areas where elevated concentrations of mercury may occur. These studies have suggested looking at the presence of wetlands within watersheds, dissolved organic carbon and suspended sediment concentrations, and stream flow. High dissolved oxygen content (DOC) and suspended sediment concentrations, increased stream flow, and larger wetland areas may point to elevated mercury concentrations. The sampling requirements would consist of total and methyl mercury in the water column as well as methyl mercury in fish tissue. The locations would extend to all regions of the state such as the Pinelands, Northern New Jersey, Delaware Estuary, and Atlantic Estuary. Each region would have at least five randomized sampling locations as well as a reference site, which are small undeveloped watersheds with no known sources of mercury contamination other than air deposition. This sampling is not needed on a yearly basis, but quarterly sampling once every 2-5 years is appropriate. An ongoing project, that is targeting local air source reduction by sampling for mercury in fish, water column, and leaves at four locations from 2007 to 2013, is expected to impact the development of the statewide mercury monitoring program by refining sampling frequencies, protocols, and objectives. In addition, an ongoing study in collaboration with USGS involves establishing a baseline for natural background levels for mercury in surface waters to discern the location of impairments that may have anthropogenic sources in addition to atmospheric deposition e.g. mercurial pesticides on orchard, crops and golf courses and which may have other natural sources, e.g. geologic. This evaluative monitoring has been completed in the Inner and Outer Coastal Plain, Raritan River Basin, Papakating and Wallkill River Watersheds. The investigation is ongoing in the Millstone River Basin, Crosswicks Creek Watershed and Passaic River Basin.

- One hundred POTWs in New Jersey submitted baseline data on mercury concentrations in their treatment plant effluent. These samples were analyzed using the most sensitive analytical method for mercury in wastewater, Method 1631E. This baseline data will be used to determine the effectiveness of the implementation of the dental BMPs and the installation of the amalgam separators. These POTWs are required to conduct additional mercury sampling and analyses, using the same analytical method, after amalgam separator installation.

- In-stream monitoring to evaluate effectiveness of the dental amalgam rule is required at target locations upstream and downstream of the POTW discharge. The monitoring sites will be sampled semi-annually to evaluate ambient water quality before and after the rule's implementation to observe the significance of the reductions. Currently, only one site has been targeted. This project needs to expand by selecting suitable locations based on reviewing the POTW effluent data.

- Air sampling under the National Mercury Monitoring Deposition Network is required to continue to monitor long-term loadings and trends from atmospheric deposition. This program currently has only one site in the New Brunswick area. Additional sites in southern and northern portions of the state this network are needed to improve knowledge of depositional rates for different regions of the state and assist in atmospheric deposition source track down.

Monitoring studies already carried out have provided the following information:

- The Department's Air Program has collected speciated ambient mercury concentration data from several Tekran units that can be used to estimate dry deposition. To date, over two years' data from units at two locations, Elizabeth and New Brunswick have been checked for quality and are in the process of being evaluated. Data on wet deposition is being collected in New Brunswick and is analyzed by the National Mercury Deposition Network.

- Water monitoring data collected by NJDEP/USGS in the Ambient and Supplemental Surface Water Networks show that of the 1,752 results since 1997, nearly 67% had concentrations less than the detection levels. None of the total mercury values exceeded the current acute freshwater aquatic life criterion for dissolved mercury of 1.4 microgram per liter (ug/l) or the chronic criterion of 0.77 ug/l, but 3% of the samples exceeded the human health criterion of 0.05 ug/l. Other mercury studies and projects by NJDEP and USGS over the years show similar results, the majority of mercury concentrations are below detection levels. Detection levels have improved since 1997 with detection levels between 0.04 and 0.1 ug/l to detection levels between 0.01 and 0.02 ug/l since 2004.

- In response to the need for detection of low levels of mercury, the Department initiated a preliminary study of low level mercury occurrence in surface waters. Using EPA's method 1631E, the project consisted of 33 filtered samples with accompanying field blanks at 23 unique stations across the state. The detection level at the Wisconsin laboratory being used was 0.04 ppt. Results did not exceed any of the existing surface water quality criteria. Mercury concentrations did not appear to be influenced by land use, but did appear to increase with stream flow. The findings suggest that air deposition is a major influence on in-stream mercury concentrations. In 2007, the Department conducted a follow-up study to determine seasonal variability in total and methyl mercury concentrations at 7 reference stations, small undeveloped watersheds with no known sources of mercury contamination other than air deposition. Although total mercury showed no seasonal patterns, methyl mercury had elevated levels during the summer due to higher methylation rates during the warmer months. In addition, the project verified new sampling protocols that allow one person to conduct low level mercury sampling, thereby reducing manpower requirements and allowing this sampling to be incorporated into an ambient or routine program.

- A 150 well, statewide, shallow Ground Water Quality Monitoring Network, which was stratified as a function of land use, has been established and is sampled on a 5 year cycle for mercury and other contaminants. During the first 5 year sampling cycle from 1999 to 2004, mercury concentrations were found to range from <0.01 to 1.7 ug/L in ground water from 148 wells and only 5 of those were detectable above the laboratory reporting limits. In addition, other ground water data has been collected under the Private Well Testing Act that required private wells in 9 Southern New Jersey counties to test for mercury. A total of 25,270 wells were tested with a concentration range of 114.2 ug/l to "not detected". Approximately 1% had concentrations above the drinking water maximum contaminate level (MCL) of 2 ug/l. An analysis of the data showed no obvious geographic or land use patterns for the elevated mercury results.

7.0. Reasonable Assurance

New Jersey has a long history of working toward the reduction of mercury contamination within the state and working with interstate organizations to reduce the mercury both coming into and leaving the state. Much progress has been made. Because of New Jersey's past successes in the reduction of mercury, the actions New Jersey has underway and its commitment to implementing further actions as necessary, including working with neighboring states to reduce sources originating from outside the state, there is reasonable assurance that the goals of the TMDL will be met.

New Jersey began working to reduce mercury releases to the environment in 1992 with the formation of a Mercury Task Force. That Task Force examined the many routes and sources of mercury exposure and found air emissions to be the number one source of mercury contamination in New Jersey. The Task Force identified the largest source of mercury air emissions in New Jersey as Municipal Solid Waste (MSW) Incinerators. The Task Force recommended a statewide mercury emission standard for MSW Incinerators, which was implemented in 1996. In addition to the MSW incinerator standards, New Jersey passed the "Dry Cell Battery Management Act" in 1992, banning the use of mercury in certain batteries. These two efforts reduced MSW incinerator mercury emissions by 97% between 1992 and 2006.

In 1998, New Jersey convened a second Mercury Task Force. The second Task Force consisted of representatives from government, emission sources, public interest groups, academia, and fishing organizations. This Task Force was charged with reviewing the current science on mercury impacts on human health and ecosystems, inventorying and assessing mercury sources, and developing a comprehensive mercury reduction plan for NJ. The "New Jersey Mercury Task Force Report" published in December 2001 established a goal of the virtual elimination of anthropogenic sources of mercury and provided recommendations and targets for further reducing mercury emissions in New Jersey. The Task Force Report is available at http://www.nj.gov/dep/dsr/mercury_task_force.htm

In 2007 the Department's Mercury Workgroup evaluated New Jersey's progress towards meeting the goals and recommendations of the Task Force and began putting together a Mercury Reduction Plan to identify the necessary additional actions to continue to reduce mercury emissions in New Jersey. The reduction plan will serve as the implementation plan for these TMDLs.

Below is a summary of actions that have been taken to reduce New Jersey's mercury loadings.

- To participate in and support regional, national, and global efforts to reduce mercury uses, releases, and exposures New Jersey is a member of the Interstate Mercury Education and Reduction Clearinghouse (IMERC), a member of the Northeast Waste Management Officials Association (NEWMOA), the Quicksilver Caucus, Northeast States for Consolidated Air Use Management (NESCAUM), Environmental Council of the States (ECOS), and Toxics in Packaging.

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- In conjunction with NEWMOA, informational brochures were developed for tanning salons and property managers concerning the management of mercury containing fluorescent lamps. The brochures were sent to every tanning salon and property management company in the state.

- New Jersey works with interstate organizations to assist in the development of federal legislation that minimizes the use of mercury in products. The Department is a member of and works with the Northeast Waste Management Officials Association (NEWMOA) on mercury issues. The Department will participate in any effort conducted by NEWMOA or other interstate organization to develop federal legislation to minimize the use of mercury in products.

- On December 6, 2004, New Jersey adopted regulations to establish new requirements for coal-fired boilers, in order to decrease emissions of mercury. These rules are located at http://www.state.nj.us/dep/aqm/Sub27-120604.pdf.

- On December 6, 2004, New Jersey adopted regulations to establish new requirements for iron or steel melters in order to decrease emissions of mercury. The Department provided three years to reduce mercury contamination of scrap through elimination and separation measures. If the source reduction measures do not achieve emission reduction, the rule requires the installation and operation of mercury air pollution control and requires achieving mercury standard starting 1/2010. These rules are located at http://www.state.nj.us/dep/aqm/Sub27-120604.pdf.

- On December 6, 2004, New Jersey adopted regulations to establish new requirements for Hospital/medical/infectious waste (HMIW) incinerators in order to prevent or decrease emissions of mercury by ensuring that the mercury emissions from HMIW incinerators will be maintained at low levels. These rules are located at http://www.state.nj.us/dep/aqm/Sub27-120604.pdf.

- The Department has closely monitored mercury sewage sludge levels and has taken action where existing authority would allow the imposition of a sewage sludge limit or a discharge limitation. For example, the POTW with the highest sewage sludge mercury concentrations was identified and the industry responsible voluntarily agreed to shut down all production of mercury-containing diagnostic kits. Increased focus on removing mercury from products, as well as the proposed dental rule noted above, should continue the decreasing trend of detectable concentrations of mercury found in sewage sludge.

- On December 6, 2004, New Jersey adopted revised regulations to establish new requirements for municipal solid waste (MSW) incinerators in order to prevent or decrease emissions of mercury by requiring MSW incinerators to further reduce their mercury emissions. These rules are located at http://www.state.nj.us/dep/aqm/Sub27-120604.pdf.

- The Department has included all mercury containing products in the Universal Waste Rule which allows generators of waste mercury containing products to manage the waste under less stringent regulations than the Hazardous Waste Regulations. In addition, every county in the state holds at least one household hazardous waste (HHW) collection per year. Most counties hold multiple collections and 3 counties (Burlington, Monmouth, and Morris) have permanent collection sites. Households generating mercury containing products can properly dispose of the items at their county's collection.

- Legislation banning the sale of mercury thermometers was passed in April 2005.

- The New Jersey Legislature passed the Mercury Switch Removal Act of 2005 requiring automobile recycling facilities to remove mercury auto switches from vehicles prior to sending the vehicles for recycling. Automobile recyclers located in New Jersey were required to begin removing the mercury auto switches in May 2006. Manufacturers have stopped using mercury switches in convenience lighting.

- The Department adopted new rules on October 1, 2007 to curtail the release of mercury from dental facilities into the environment. The new rules, under most circumstances, exempt a dental facility from the requirement to obtain an individual permit for its discharge to a POTW, if it implements best management practices (BMPs) for the handling of dental amalgam waste and installs and properly operates an amalgam separator. Dental facilities were required to implement the BMPs by October 1, 2008 and must install and operate an amalgam separator by October 1, 2009. These measures are expected to prevent at least 95 percent of the mercury wastes from being sent to the

POTW and result in approximately 2,550 pounds of mercury removed from the environment each year.

- The Department participated in the Quicksilver Caucus, which developed methods for the retirement and sequestering of mercury.

The out of state contributions to the depositional load of mercury are too great for New Jersey to eliminate mercury contamination of fish tissue by reducing sources originating within its borders alone. New Jersey will work with EPA and other states to eliminate mercury sources nationwide. EPAs efforts to issue MACT (Maximum Achievable Control Technology) standards for utilities to reduce the depositional load of mercury are supported by New Jersey. In October 2008, the New England Interstate Water Pollution Control Commission (NEIWPCC), on behalf of seven states, submitted a petition under the Clean Water Act Section 319(g) requesting EPA to convene an interstate conference to address mercury deposition to the Northeast from upwind states. The petition builds on the Northeast States' regional mercury TMDL (approved by EPA in 2007), which indicates that reductions in mercury deposition from outside the region are needed to meet water quality standards. New Jersey will participate actively in this conference when it is held.

8.0. Implementation Plan

The implementation actions below are the recommendations of the Department's Mercury Task Force (NJDEP, 2009) intended to reduce anthropogenic sources of mercury:

1) Consider developing legislation that reflects the provisions of the Mercury Education and Reduction Model Act prepared by the Northeast Waste Management Officials' Association (NEWMOA), as part of the New England Governors' Mercury Action Plan. This plan addresses mercury-containing products and limits the sale of mercury for approved purposes. Provisions of the model legislation have been adopted by 16 states, including all of the New England states.

2) Continue monitoring of mercury in environmental media. Needed follow-up monitoring is described in Section 6 and is essential for determining the effectiveness of the mercury Total Maximum Daily Load (TMDL).

3) New Jersey contributes only 12.5% to the state mercury deposition; 52% is background deposition (natural and anthropogenic) and the remaining percentage comes from surrounding states, Mexico, and Canada. Reductions required in this TMDL can not be achieved from the New Jersey anthropogenic air sources alone. Mercury reductions on the nationwide and global scales are necessary to meet the TMDL targets set up above.

4) The Department plans to update its mercury water quality criteria based upon the EPA recommended Clean Water Act Section 304(a) for methyl mercury in fish tissue. This criterion requires the development of regional bioaccumulation factors (BAFs) to address differences in the rate of methylation based on other water quality parameters such as pH and

dissolved organic carbon. While the EPA's recommended Clean Water Act Section 304(a) water quality criterion is based on a methyl mercury fish tissue concentration value of 0.3 mg/kg, New Jersey plans to develop criteria based upon a methyl mercury fish tissue concentration of 0.18 mg/kg which is based upon consumption of 1 meal per week by high risk individuals. Updating the mercury criteria based on EPA's recommendation will require calculating BAFs for New Jersey that involves additional surface water and fish tissue sampling. This information will also be used to reevaluate the previously proposed wildlife mercury criteria using updated regional BAFs. The revised mercury criteria will be used to develop TMDLs for areas of the State not covered by the Total Maximum Daily Load for Mercury Impairments Based on Concentration in Fish Tissue Caused Mainly by Air Deposition. In calculating an updated, revised mercury SWQS for human health and wildlife, the Department will divide the state into four regional waters: Pinelands, Non-Pinelands, Delaware Estuary tidal waters, and Atlantic tidal waters. Surface water and fish tissue data will be collected and used to develop new BAFs for each region of the state. The data results will then be applied in calculating the mercury criteria for each region. In 2009, the Department expects to begin data collection in the Pinelands region with plans to continue collection in non-Pinelands water the following year. The next action is to collect data for the Delaware Estuary and Atlantic tidal waters.

5) The existing regulations concerning mercury will continue to be implemented, enforced, and evaluated for effectiveness. This includes the regulations on mercury emissions from air sources, the removal of automobile mercury switches and the dental amalgam regulations.

9.0. Public Participation

There have been various efforts to inform and educate the general public as well as the regulated community about the effects of mercury and the need to reduce anthropogenic sources. The regulatory controls regarding mercury are described in Section 7 and some of the outreach to the general public are noted below.

Over the years the Department, in cooperation with the Department of Health and Senior Services has conducted a great deal of public outreach to the fishing community to inform them of the fish consumption advisories. Surveys were done to determine how best to reach the public. As a result the fish advisories are posted in both Spanish and English. Brochures have been developed and are distributed to doctors and WIC (the federal Women, Infants and Children nutrition program) centers. The Department of Health seafood inspectors distribute and check for postings as part of their inspections.

Currently the Department's Urban Fishing Program educates children from the Newark Bay Complex and throughout New Jersey about their local watershed. Children learn about how people's actions affect the water and human health, and what they can do to help. The NJDEP's Divisions of Watershed Management and Science, Research and Technology in conjunction with the Division of Fish and Wildlife, the Hackensack RiverKeeper, the City of Bayonne and the Municipal Utilities Authority of Bayonne have offered the program for over 10 years. The first several years of the Urban Watershed Program were conducted only in the Newark Bay

Complex. The program has now expanded to other urban areas around the state. Trenton and Camden have participated over the last three years, and we hope to add several more cities in the future.

In conjunction with NEWMOA, informational brochures were developed for tanning salons and property managers concerning the management of mercury containing fluorescent lamps. The brochures were sent to every tanning salon and property management company in the state.

There has been additional public outreach and opportunity for comment for the TMDL itself. In accordance with N.J.A.C. 7:15–7.2(g), this TMDL was proposed by the Department as an amendment to the Atlantic, Cape May, Lower Delaware, Lower Raritan-Middlesex, Mercer, Monmouth, Northeast, Ocean, Sussex, Tri-County, Upper Delaware and Upper Raritan Water Quality Management Plans.

Notice proposing this TMDL was published on June 15, 2009 in the New Jersey Register and in newspapers of general circulation in the affected area in order to notify the public of the opportunity to review the TMDL and submit comments. In addition, an informational presentation followed by a public hearing for the proposed TMDL was held on July 15, 2009. Notice of the proposal and the hearing was also provided to affected Designated Planning Agencies and dischargers in the affected watersheds. One member of the public attended the hearing and declined to comment. No comments were submitted during the public comment period. Various minor edits to the proposal document have been made for clarification.

10.0. Data Sources

Geographic Information System (GIS) data from the Department was used extensively to describe the areas addressed in this document.

- State Boundary of New Jersey, Published by New Jersey Office of Information Technology (NJOIT), Office of Geographic Information Systems (OGIS), May 20, 2008. On line at: https://njgin.state.nj.us/NJ_NJGINExplorer/jviewer.jsp?pg=DataDownloads

- Watersheds (Subwatersheds by name - DEPHUC14), Drainage basins are delineated from 1:24,000-scale (7.5-minute) USGS quadrangles. The delineations have been developed for general purpose use by USGS District staff over the past 20 years. Arc and polygon attributes have been included in the coverage with basin names and ranks of divides, and 14-digit hydrologic unit codes. *Originator:* U.S. Geological Survey, William H. Ellis, Jr. *Publication_Date:* 19991222 http://www.state.nj.us/dep/gis/digidownload/zips/statewide/dephuc14.zip

- NJDEP 2002 Waters of New Jersey (Lakes and Ponds), *Edition* 2008-05-01. The data was created by extracting water polygons which represented lakes and ponds from the 2002 land use/land cover (LU/LC) layer from NJ DEP's geographical information systems (GIS) database http://www.state.nj.us/dep/gis/digidownload/zips/statewide/njwaterbody.zip

- NJDEP 2002 Waters of New Jersey (Rivers, Bays and Oceans), *Version* 20080501; *Edition:* 20080501. The data was created by extracting water polygons which represented Rivers, Bays and Oceans from the 2002 land use/land cover (LU/LC) layer from NJ DEP's geographical information systems (GIS) database. *Online Linkage* http://www.state.nj.us/dep/gis/digidownload/zips/statewide/njarea.zip

- NJPDES Surface Water Discharges in New Jersey, (1:12,000), Version 20090126, *Edition:* 2009-01-26. This is a 2009 update of the 2002 data. New Jersey Pollutant Discharge Elimination System (NJPDES) surface water discharge pipe GIS point coverage compiled from GPSed locations, NJPDES databases, and permit applications. This coverage contains the surface water discharge points and the receiving waters coordinates for the active as well as terminated pipes. *Online Linkeage*: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/njpdesswd.zip

- NJDEP Surface Water Quality Standards of New Jersey *Edition:* 200812. This data is a digital representation of New Jersey's Surface Water Quality Standards in accordance with "Surface Water Quality Standards for New Jersey Waters" as designated in N.J.A.C. 7:9 B. The Surface Water Quality Standards (SWQS) establish the designated uses to be achieved and specify the water quality (criteria) necessary to protect the State's waters. Designated uses include potable water, propagation of fish and wildlife, recreation, agricultural and industrial supplies, and navigation. These are reflected in use classifications assigned to specific waters. When interpreting the stream classifications and anti-degradation designations, the descriptions specified in the SWQS at N.J.A.C. 7:9B-1.15 always take precedence. The GIS layer reflects the stream classifications and anti-degradation designations adopted as of June 16, 2008, and it is only supplemental to SWQS and is not legally binding. http://www.state.nj.us/dep/gis/digidownload/zips/statewide/swqs.zip

- “Water Management Areas”, created 03/2002 by NJDEP, Division of Watershed Management, the last update January, 2009. *Online Linkage*. http://www.state.nj.us/dep/gis/digidownload/zips/statewide/depwmas.zip

- NJDEP Known Contaminated Site List for New Jersey, 2005, *Edition:* 200602; The Known Contaminated Sites List for New Jersey 2005 are those sites and properties within the state where contamination of soil or ground water has been identified or where there has been, or there is suspected to have been, a discharge of contamination. This list of Known Contaminated Sites may include sites where remediation is either currently under way, required but not yet initiated or has been completed. http://www.state.nj.us/dep/gis/digidownload/zips/statewide/kcsl.zip

- Groundwater Contamination Areas (CKE); this data layer contains information about areas in the state which are specified as the Currently Known Extent (CKE) of ground water pollution. CKE areas are geographically defined areas within which the local ground water resources are known to be compromised because the water quality exceeds drinking water and ground water quality standards for specific contaminants. NJDEP Currently Known Extent of Groundwater Contamination (CKE) for New Jersey, 2007. *Edition:* 200703. *Online Linkage:* http://www.state.nj.us/dep/gis/digidownload/zips/statewide/cke.zip

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Appendix A

Listed Assessment units that were excluded from the Statewide TMDL

Waterbody	Name	Reason for Exclusion from TMDL
02030103120070-01	Passaic River Lwr (Fair Lawn Ave to Goffle)	Mercury in surface water
02030103120080-01	Passaic River Lwr (Dundee Dam to F.L. Ave)	Mercury in surface water
02030103120090-01	Passaic River Lwr (Saddle R to Dundee Dam)	Mercury in surface water
02030103150030-01	Passaic River Lwr (Second R to Saddle R)	Mercury in surface water
02030103150040-01	Passaic River Lwr (4th St br to Second R)	Mercury in surface water
02030103150050-01	Passaic River Lwr (Nwk Bay to 4th St brdg)	Mercury in surface water
02030103170030-01	Hackensack River (above Old Tappan gage)	Mercury in surface water
02030103170060-01	Hackensack River (Oradell to Old Tappan gage)	Mercury in surface water
02030103180030-01	Hackensack River (Ft Lee Rd to Oradell gage)	Mercury in surface water
02030103180080-01	Hackensack River (Rt 3 to Bellmans Ck)	Mercury in surface water
02030103180090-01	Hackensack River (Amtrak bridge to Rt 3)	Mercury in surface water
02030103180100-01	Hackensack River (below Amtrak bridge)	Mercury in surface water
02030104010020-01	Kill Van Kull West	Mercury in surface water
02030104010020-02	Newark Bay / Kill Van Kull (74d 07m 30s)	Mercury in surface water
02030104010030-01	Kill Van Kull East	Mercury in surface water
02030104010030-02	Upper NY Bay / Kill Van Kull (74d07m30s)	Mercury in surface water
02030104020030-01	Arthur Kill North	Mercury in surface water
02030104030010-01	Arthur Kill South	Mercury in surface water
02030104050120-01	Arthur Kill waterfront (below Grasselli)	Mercury in surface water
02040105210060-01	Jacobs Creek (above Woolsey Brook)	Mercury in surface water
02040105230050-01	Assunpink Creek (Shipetaukin to Trenton Rd)	Mercury in surface water
02040201050040-01	Crosswicks Creek (Walnford to Lahaway Ck)	Mercury in surface water
02040201050050-01	Crosswicks Creek (Ellisdale trib - Walnford)	Mercury in surface water
02040201050070-01	Crosswicks Creek (Doctors Ck-Ellisdale trib)	Mercury in surface water
02040206140040-01	Blackwater Branch (above/incl Pine Br)	Mercury in surface water
02040206140050-01	Blackwater Branch (below Pine Branch)	Mercury in surface water
02040206200010-01	Middle Branch / Slab Branch	Mercury in surface water
02040206200020-01	Muskee Creek	Mercury in surface water
02040301020040-01	Muddy Ford Brook	Mercury in surface water
02040301070080-01	Manapaqua Brook	Mercury in surface water
02040301170010-01	Hammonton Creek (above 74d43m)	Mercury in surface water
02040301170020-01	Hammonton Creek (Columbia Rd to 74d43m)	Mercury in surface water
02040302020020-01	Absecon Creek SB	Mercury in surface water
02040302020030-01	Absecon Creek (AC Reserviors) (gage to SB)	Mercury in surface water
02030103010180-01	Passaic River Upr (Pine Bk br to Rockaway)	Mercury in surface water
02030103040010-01	Passaic River Upr (Pompton R to Pine Bk)	Mercury in surface water
02030103120100-01	Passaic River Lwr (Goffle Bk to Pompton R)	Mercury in surface water
02030103180060-01	Berrys Creek (above Paterson Ave)	Mercury in surface water
02030103180070-01	Berrys Creek (below Paterson Ave)	Mercury in surface water
02030105160070-01	South River (below Duhernal Lake)	Mercury in surface water
02040202020030-01	Rancocas Creek NB (incl Mirror Lk-Gaunts Bk)	Mercury in surface water
02040202020040-01	Rancocas Creek NB (NL dam to Mirror Lk)	Mercury in surface water
02040202100060-01	Pennsauken Creek (below NB / SB)	Mercury in surface water
02040301020050-01	Metedeconk River NB (confluence to Rt 9)	Mercury in surface water
02040301040020-01	Metedeconk River (Beaverdam Ck to confl)	Mercury in surface water
02040302050060-01	Great Egg Harbor River (Miry Run to Lake Lenape)	Mercury in surface water

02040302050130-01	Great Egg Harbor River (GEH Bay to Miry Run)	Mercury in surface water
Delaware River 1	Delaware River 1C2	Mercury in surface water
Delaware River 2	Delaware River 1C3	Mercury in surface water
Delaware River 3	Delaware River 1C4	Mercury in surface water
Delaware River 4	Delaware River 1D1	Mercury in surface water
Delaware River 5	Delaware River 1D2	Mercury in surface water
Delaware River 6	Delaware River 1D3	Mercury in surface water
Delaware River 7	Delaware River 1D4	Mercury in surface water
Delaware River 8	Delaware River 1D5	Mercury in surface water
Delaware River 9	Delaware River 1D6	Mercury in surface water
Delaware River 10	Delaware River 1E1	Mercury in surface water
Delaware River 11	Delaware River 1E2	Mercury in surface water
Delaware River 12	Delaware River 1E3	Mercury in surface water
Delaware River 13	Delaware River 1E4	Mercury in surface water
Delaware River 14	Delaware River 1E5	Mercury in surface water
Delaware River 15	Delaware River 2	Mercury in surface water
Delaware River 16	Delaware River 3	Mercury in surface water
Delaware River 17	Delaware River 4	DRBC
Delaware River 18	Delaware River 5A	DRBC
Delaware River 19	Delaware River 5B	DRBC
Delaware River 20	Delaware River 5C	DRBC
02040204910010-02	Delaware Bay (Cape May Pt to Dennis Ck) offshore	DRBC
02040204910010-01	Delaware Bay (CapeMay Pt to Dennis Ck) inshore	DRBC
02040204910040-01	Delaware Bay (Cohansey R to FishingCk)	DRBC
02040204910020-02	Delaware Bay (Dennis Ck to Egg Islnd Pt) offshore	DRBC
02040204910020-01	Delaware Bay (DennisCk to Egg Islnd Pt) inshore	DRBC
02040301200030-02	Wading River (below Rt 542)	Tidal
02040301200080-02	Mullica River (GSP bridge to Turtle Ck)	Tidal
02040301210010-02	Mullica River (below GSP bridge)	Tidal
02030104020030-02	Elizabeth River (below Elizabeth CORP BDY)	Tidal
02030104030010-02	Morses Creek / Piles Creek	Tidal
02030104080040-01	Shrewsbury River (above Navesink River)	Tidal
02030104090040-01	Shark River (above Remsen Mill gage)	Tidal
02030104090060-01	Shark River (below Remsen Mill gage)	Tidal
02030104910020-01	Sandy Hook Bay (east of Thorns Ck)	Tidal
02040201030010-01	Duck Creek and UDRV to Assunpink Ck	Tidal
02030104060010-01	Cheesequake Creek / Whale Creek	Tidal
02030104070110-01	Navesink River (below Rt 35) / Lower Shrewsbury	Tidal
02040301080060-01	Toms River Lwr (Rt 166 to Oak Ridge Pkwy)	Tidal
02030104070110-01	Navesink River (below Rt 35) / Lower Shrewsbury	Tidal
02030104060060-01	Pews Creek to Shrewsbury River	Tidal
02040301080060-01	Toms River Lwr (Rt 166 to Oak Ridge Pkwy)	Tidal
02040301200030-02	Wading River (below Rt 542)	Tidal
02030104080010-01	Little Silver Creek / Town Neck Creek	Tidal
02040301200080-02	Mullica River (GSP bridge to Turtle Ck)	Tidal
02040301210010-02	Mullica River (below GSP bridge)	Tidal
02040302020010-01	Absecon Creek NB	Tidal
02040302020040-01	Absecon Creek (below gage)	Tidal

02030104080010-01	Little Silver Creek / Town Neck Creek	Tidal
02030104080020-01	Parkers Creek / Oceanport Creek	Tidal
02030104080030-01	Branchport Creek	Tidal
02040201070030-01	Shady Brook / Spring Lake / Rowan Lake	Tidal
02040202120080-01	Big Timber Creek (below NB/SB confl)	Tidal
02040202130040-01	Mantua Creek (Edwards Run to rd to Sewell)	Tidal
02040202140040-01	Moss Branch / Little Timber Creek (Repaupo)	Tidal
02040202140050-01	Repaupo Creek (below Tomlin Sta Rd) / Cedar Swamp	Tidal
02040202160020-01	Oldmans Creek (Rt 45 to Commissioners Rd)	Tidal
02040206090080-01	Cohansey River (Greenwich to 75d17m50s)	Tidal
02040206090100-01	Cohansey River (below Greenwich)	Tidal
02030104010010-01	Newark Airport Peripheral Ditch	Tidal
02040206100040-01	Cedar Creek (above Rt 553)	Tidal
02040206160030-01	Maurice River (Union Lake to Sherman Ave)	Other sources of Hg
02030103030070-01	Rockaway River (74d 33m 30s to Stephens Bk)	Other sources of Hg
02030103100070-01	Ramapo River (below Crystal Lake bridge)	Other sources of Hg
02040201050060-01	Ellisdale Trib (Crosswicks Creek)	Other sources of Hg
02040201070020-01	Crosswicks Creek (below Doctors Creek)	Other sources of Hg
02030103100060-01	Crystal Lake / Pond Brook	Other sources of Hg
02030104060040-01	Chingarora Creek to Thorns Creek	Other sources of Hg
02030104060050-01	Waackaack Creek	Other sources of Hg
02030105160090-01	Red Root Creek / Crows Mill Creek	Hg in groundwater
02030105160100-01	Raritan River Lwr (below Lawrence Bk)	Hg in groundwater
02040105230020-01	Assunpink Creek (New Sharon Br to/incl Lake)	Hg in groundwater
02040105230030-01	New Sharon Branch (Assunpink Creek)	Hg in groundwater
02040105230040-01	Assunpink Creek (Trenton Rd to New Sharon Br)	Hg in groundwater
02040105240010-01	Shabakunk Creek	Hg in groundwater
02040105240050-01	Assunpink Creek (below Shipetaukin Ck)	Hg in groundwater
02040201030010-01	Duck Creek and UDRV to Assunpink Ck	Hg in groundwater
02040201040040-01	Jumping Brook (Monmouth Co)	Hg in groundwater
02040301160020-01	Mullica River (above Jackson Road)	Hg in groundwater
02040301170040-01	Mullica River (Batsto R to Pleasant Mills)	Hg in groundwater
02040301170060-01	Mullica River (Rt 563 to Batsto River)	Hg in groundwater
02040301170080-01	Mullica River (Lower Bank Rd to Rt 563)	Hg in groundwater
02040301170130-01	Mullica River (Turtle Ck to Lower Bank Rd)	Hg in groundwater
02040301190050-01	Wading River WB (Jenkins Rd to Rt 563)	Hg in groundwater
02040301200020-01	Wading River (Rt 542 to Oswego River)	Hg in groundwater
02030103180040-01	Overpeck Creek	HEP
02030103180050-01	Hackensack River (Bellmans Ck to Ft Lee Rd)	HEP
02030104050060-01	Rahway River (Robinsons Br to Kenilworth Blvd)	HEP
02030104050100-01	Rahway River (below Robinsons Branch)	HEP
02030105120170-01	Raritan River Lwr (Lawrence Bk to Mile Run)	HEP
02030105160100-01	Raritan River Lwr (below Lawrence Bk)	HEP
02040302940010-01	Atlantic Ocean (34th St to Corson Inl) inshore	Tidal
02040302940010-02	Atlantic Ocean (34th St to Corson Inl) offshore	Tidal
02040302920010-01	Atlantic Ocean (Absecon In to Ventnor) inshore	Tidal
02040302920010-02	Atlantic Ocean (Absecon In to Ventnor) offshore	Tidal
02040301920010-02	Atlantic Ocean (Barnegat to Surf City) offshore	Tidal
02040301920010-01	Atlantic Ocean (Barnegat to Surf City)inshore	Tidal

02040302940050-01	Atlantic Ocean (CM Inlet to Cape May Pt) inshore	Tidal
02040302940050-02	Atlantic Ocean (CM Inlet to Cape May Pt) offshore	Tidal
02030902940020-01	Atlantic Ocean (Corson to Townsends Inl) inshore	Tidal
02030902940020-02	Atlantic Ocean (Corson to Townsends Inl) offshore	Tidal
02040302930010-01	Atlantic Ocean (Great Egg to 34th St) inshore	Tidal
02040302930010-02	Atlantic Ocean (Great Egg to 34th St) offshore	Tidal
02040301920030-01	Atlantic Ocean (Haven Bch to Lit Egg) inshore	Tidal
02040301920030-02	Atlantic Ocean (Haven Bch to Lit Egg) offshore	Tidal
02040302940040-01	Atlantic Ocean (Hereford to Cape May In) inshore	Tidal
02040302940040-02	Atlantic Ocean (Hereford to Cape May In) offshore	Tidal
02040301910020-01	Atlantic Ocean (Herring Is to Rt 37) inshore	Tidal
02040301910020-02	Atlantic Ocean (Herring Is to Rt 37) offshore	Tidal
02040302910010-01	Atlantic Ocean (Ltl Egg to Absecon In) inshore	Tidal
02040302910010-02	Atlantic Ocean (Ltl Egg to Absecon In) offshore	Tidal
02040301910010-01	Atlantic Ocean (Manasquan/Herring Is) inshore	Tidal
02040301910010-02	Atlantic Ocean (Manasquan/Herring Is) offshore	Tidal
02030104920020-01	Atlantic Ocean (Navesink R to Whale Pond) inshore	Tidal
02030104920020-02	Atlantic Ocean (Navesink R to Whale Pond) offshore	Tidal
02040301910030-01	Atlantic Ocean (Rt 37 to Barnegat Inlet) inshore	Tidal
02040301910030-02	Atlantic Ocean (Rt 37 to Barnegat Inlet) offshore	Tidal
02030104920010-01	Atlantic Ocean (Sandy H to Navesink R) inshore	Tidal
02030104920010-02	Atlantic Ocean (Sandy H to Navesink R) offshore	Tidal
02030104930020-01	Atlantic Ocean (Shark R to Manasquan) inshore	Tidal
02030104930020-02	Atlantic Ocean (Shark R to Manasquan) offshore	Tidal
02040301920020-01	Atlantic Ocean (Surf City to Haven Be) inshore	Tidal
02040301920020-02	Atlantic Ocean (Surf City to Haven Be) offshore	Tidal
02030902940030-01	Atlantic Ocean (Townsends to Hereford In) inshore	Tidal
02030902940030-02	Atlantic Ocean (Townsends to Hereford In) offshore	Tidal
02040302920020-01	Atlantic Ocean (Ventnor to Great Egg) inshore	Tidal
02040302920020-02	Atlantic Ocean (Ventnor to Great Egg) offshore	Tidal
02030104930010-01	Atlantic Ocean (Whale Pond to Shark R) inshore	Tidal

Appendix B

Fish Tissue Data

Location	Species	Field (or lab) Total Length (cm)	Hg (mg/kg) ug/g wet wt	Year
Alcyon Lake	Largemouth Bass	28.6	0.67	1992
Alcyon Lake	Largemouth Bass	33.7	0.41	1992
Batsto Lake	Yellow Bullhead	23.7	0.23	1992
Batsto Lake	Brown Bullhead	26.5	0.18	1992
Batsto Lake	Chain Pickerel	57.3	1.06	1992
Batsto Lake	Largemouth Bass	27.1	0.76	1992
Batsto Lake	Largemouth Bass	35.4	1.20	1992
Batsto Lake	Largemouth Bass	37.5	1.28	1992
Big Timber Creek	Black Crappie	15.5	0.07	1992
Big Timber Creek	Brown Bullhead	29.4	0.05	1992
Big Timber Creek	Brown Bullhead	31	0.06	1992
Big Timber Creek	Channel Catfish	42.3	0.09	1992
Big Timber Creek	White Catfish	33.4	0.08	1992
Big Timber Creek	White Catfish	29.6	0.09	1992
Big Timber Creek	Largemouth Bass	33.0	0.10	1992
Big Timber Creek	Largemouth Bass	28.2	0.12	1992
Big Timber Creek	Largemouth Bass	25.5	0.06	1992
Clementon Lake	Chain Pickerel	35.5	0.14	1992
Clementon Lake	Chain Pickerel	33	0.16	1992
Clementon Lake	Chain Pickerel	40	0.16	1992
Clementon Lake	Chain Pickerel	50.5	0.32	1992
Clementon Lake	Chain Pickerel	48.6	0.37	1992
Clementon Lake	Chain Pickerel	47.6	0.38	1992
Clementon Lake	Largemouth Bass	35.9	0.28	1992
Clementon Lake	Largemouth Bass	38.7	0.49	1992
Clinton Reservoir	Largemouth Bass	28.2	0.39	1992
Clinton Reservoir	Largemouth Bass	34.3	0.60	1992
Clinton Reservoir	Largemouth Bass	34.6	0.73	1992
Clinton Reservoir	Largemouth Bass	44.1	0.83	1992
Clinton Reservoir	Largemouth Bass	36.0	0.84	1992
Clinton Reservoir	Largemouth Bass	37.1	0.85	1992
Cooper River Park Lake	Black Crappie	16.7	0.04	1992
Cooper River Park Lake	Black Crappie	18.1	0.10	1992
Cooper River Park Lake	Black Crappie	18.4	0.12	1992
Cooper River Park Lake	Largemouth Bass	19.5	0.12	1992
Cooper River Park Lake	Largemouth Bass	21.4	0.03	1992
Cooper River Park Lake	Largemouth Bass	21.7	0.04	1992
Cooper River Park Lake	Largemouth Bass	25.5	0.08	1992
Cooper River Park Lake	Largemouth Bass	28	0.07	1992
Cooper River Park Lake	Largemouth Bass	30.8	0.09	1992

Cooper River Park Lake	Largemouth Bass	32.2	0.10	1992
Cooper River Park Lake	Largemouth Bass	32.8	0.13	1992
Cooper River Park Lake	Largemouth Bass	35.5	0.14	1992
Cooper River Park Lake	Largemouth Bass	43.5	0.31	1992
Cooper River Park Lake	Largemouth Bass	44	0.56	1992
Cooper River Park Lake	Largemouth Bass	22.1	0.09	1992
Cooper River Park Lake	Largemouth Bass	25.5	0.08	1992
Cooper River Park Lake	Largemouth Bass	28	0.07	1992
Cooper River Park Lake	Largemouth Bass	30.8	0.09	1992
Cooper River Park Lake	Largemouth Bass	35.5	0.14	1992
Cooper River Park Lake	Largemouth Bass	43.5	0.31	1992
Cranberry Lake	Chain Pickerel	42.4	0.27	1992
Cranberry Lake	Chain Pickerel	56.9	0.37	1992
Cranberry Lake	Chain Pickerel	55.5	0.37	1992
Cranberry Lake	Hybrid Striped Bass	38.2	0.29	1992
Cranberry Lake	Hybrid Striped Bass	37	0.31	1992
Cranberry Lake	Hybrid Striped Bass	52	0.43	1992
Crystal Lake	Brown Bullhead	19.8	0.02	1992
Crystal Lake	Brown Bullhead	20	0.05	1992
Dundee Lake	Brown Bullhead	27.1	0.19	1992
Dundee Lake	Brown Bullhead	29.3	0.20	1992
East Creek Lake	Chain Pickerel	31.5	0.79	1992
East Creek Lake	Chain Pickerel	34..5	1.03	1992
East Creek Lake	Chain Pickerel	41.4	1.33	1992
East Creek Lake	Chain Pickerel	39	1.33	1992
East Creek Lake	Chain Pickerel	51	1.59	1992
East Creek Lake	Chain Pickerel	40	1.76	1992
East Creek Lake	Chain Pickerel	50	2.30	1992
East Creek Lake	Chain Pickerel	46.2	2.44	1992
East Creek Lake	Chain Pickerel	52.5	2.82	1992
East Creek Lake	Yellow Bullhead	26.8	1.29	1992
East Creek Lake	Yellow Bullhead	27.4	1.47	1992
Evans Lake	Largemouth Bass	27.8	0.15	1992
Evans Lake	Largemouth Bass	21.5	0.33	1992
Harrisville Lake	Chain Pickerel	40	0.99	1992
Harrisville Lake	Chain Pickerel	33.5	1.21	1992
Harrisville Lake	Chain Pickerel	28.3	1.71	1992
Harrisville Lake	Chain Pickerel	45.7	1.74	1992
Harrisville Lake	Chain Pickerel	51.4	2.10	1992
Harrisville Lake	Yellow Bullhead	27.5	1.36	1992
Lake Carasaljo	Chain Pickerel	34.9	0.28	1992
Lake Hopatcong	Chain Pickerel	35.1	0.19	1992
Lake Hopatcong	Chain Pickerel	48	0.22	1992
Lake Hopatcong	Chain Pickerel	47.3	0.35	1992
Lake Hopatcong	Chain Pickerel	45	0.37	1992
Lake Hopatcong	Chain Pickerel	53	0.64	1992
Lake Hopatcong	Largemouth Bass	39.9	0.27	1992
Lake Hopatcong	Largemouth Bass	41.4	0.28	1992
Lake Hopatcong	Largemouth Bass	29.5	0.30	1992

Lake Nummy	Chain Pickerel	35	1.36	1992
Lake Nummy	Yellow Bullhead	26.7	0.32	1992
Lake Nummy	Yellow Bullhead	27.8	0.32	1992
Lake Nummy	Yellow Bullhead	28.1	0.32	1992
Lenape Lake	Chain Pickerel	35.5	0.25	1992
Lenape Lake	Chain Pickerel	44.8	0.54	1992
Lenape Lake	Chain Pickerel	49.7	0.89	1992
Marlton Lake	Largemouth Bass	38	1.36	1992
Maskells Mill Lake	Chain Pickerel	28	0.37	1992
Merrill Creek	Rainbow Trout	25.3	0.04	1992
Merrill Creek	Rainbow Trout	24.7	0.08	1992
Merrill Creek Reservoir	Rainbow Trout	32.1	0.14	1992
Merrill Creek Reservoir	Rainbow Trout	37.5	0.14	1992
Merrill Creek Reservoir	Rainbow Trout	38.6	0.24	1992
Merrill Creek Reservoir	Lake Trout	51.3	0.44	1992
Merrill Creek Reservoir	Lake Trout	51.6	0.77	1992
Merrill Creek Reservoir	Lake Trout	53.2	0.79	1992
Merrill Creek Reservoir	Lake Trout	56.4	0.69	1992
Merrill Creek Reservoir	Largemouth Bass	30.9	0.29	1992
Merrill Creek Reservoir	Largemouth Bass	43.9	0.96	1992
Merrill Creek Reservoir	Largemouth Bass	41.0	1.21	1992
Monksville Reservoir	Chain Pickerel	39.3	0.21	1992
Monksville Reservoir	Chain Pickerel	42.4	0.36	1992
Monksville Reservoir	Chain Pickerel	64	1.14	1992
Monksville Reservoir	Largemouth Bass	28.7	0.45	1992
Monksville Reservoir	Largemouth Bass	33.9	0.52	1992
Monksville Reservoir	Largemouth Bass	38.4	1.00	1992
Mountain Lake	Largemouth Bass	31.8	0.22	1992
Mountain Lake	Largemouth Bass	37.4	0.37	1992
Mountain Lake	Largemouth Bass	47.0	0.90	1992
New Brooklyn Lake	Chain Pickerel	18.7	0.10	1992
New Brooklyn Lake	Chain Pickerel	37.7	0.23	1992
New Brooklyn Lake	Chain Pickerel	46.6	0.79	1992
Newton Creek, North	Brown Bullhead	29	0.02	1992
Newton Creek, North	Brown Bullhead	34.4	0.03	1992
Newton Creek, North	Brown Bullhead	32.3	0.03	1992
Newton Creek, North	Brown Bullhead	32.4	0.03	1992
Newton Creek, North	Channel Catfish	36.5	0.08	1992
Newton Creek, North	Channel Catfish	47.1	0.12	1992
Newton Creek, South	Brown Bullhead	25.9	0.04	1992
Newton Creek, South	Brown Bullhead	26.1	0.06	1992
Newton Creek, South	Brown Bullhead	29.5	0.18	1992
Newton Creek, South	Chain Pickerel	25.3	0.10	1992
Newton Creek, South	Largemouth Bass	37.1	0.23	1992
Newton Creek, South	Largemouth Bass	36.6	0.24	1992
Newton Creek, South	Largemouth Bass	30.7	1.15	1992
Newton Lake	Black Crappie	18.4	0.09	1992
Newton Lake	Black Crappie	19.4	0.11	1992
Newton Lake	Black Crappie	20.4	0.13	1992

Newton Lake	Largemouth Bass	30	0.05	1992
Newton Lake	Largemouth Bass	30.6	0.05	1992
Newton Lake	Largemouth Bass	33.6	0.06	1992
Newton Lake	Largemouth Bass	33.1	0.06	1992
Newton Lake	Largemouth Bass	25.8	0.06	1992
Newton Lake	Largemouth Bass	25.0	0.06	1992
Newton Lake	Largemouth Bass	31.0	0.07	1992
Newton Lake	Largemouth Bass	31.0	0.07	1992
Newton Lake	Largemouth Bass	29.1	0.07	1992
Newton Lake	Largemouth Bass	45.2	0.18	1992
Newton Lake	Largemouth Bass	41.1	0.22	1992
Newton Lake	Largemouth Bass	45.6	0.40	1992
Rancocas Creek	Channel Catfish	45.6	0.11	1992
Rockaway River	Brown Bullhead	31	0.12	1992
Rockaway River	Chain Pickerel	34	0.15	1992
Rockaway River	Chain Pickerel	30.6	0.15	1992
Rockaway River	Chain Pickerel	38.8	0.25	1992
Rockaway River	Chain Pickerel	40.7	0.29	1992
Rockaway River	Chain Pickerel	44.7	0.31	1992
Rockaway River	Rainbow Trout	53.6	0.04	1992
Rockaway River	Yellow Bullhead	21.2	0.15	1992
Rockaway River near Whippany	Largemouth Bass	26.4	0.36	1992
Rockaway River near Whippany	Largemouth Bass	28.9	0.59	1992
Rockaway River near Whippany	Largemouth Bass	31.5	0.73	1992
Round Valley Reservoir	Lake Trout	40	0.06	1992
Round Valley Reservoir	Lake Trout	54.4	0.14	1992
Round Valley Reservoir	Lake Trout	75.5	0.14	1992
Saw Mill Lake	Brown Bullhead	36.5	0.05	1992
Saw Mill Lake	Brown Bullhead	33.1	0.06	1992
Saw Mill Lake	Brown Bullhead	39.5	0.07	1992
Saw Mill Lake	Brown Bullhead	37.9	0.07	1992
Saw Mill Lake	Northern Pike	53.4	0.27	1992
Shadow Lake	Largemouth Bass	29.1	0.12	1992
Shadow Lake	Largemouth Bass	30.4	0.15	1992
Shadow Lake	Largemouth Bass	36.7	0.18	1992
Shadow Lake	Largemouth Bass	31.2	0.26	1992
Spring Lake	Largemouth Bass	37.1	0.21	1992
Spring Lake	Largemouth Bass	49.9	0.75	1992
Spring Lake	Largemouth Bass	47.8	0.80	1992
Spruce Run Reservoir	Hybrid Striped Bass	33.1	0.17	1992
Spruce Run Reservoir	Hybrid Striped Bass	37.1	0.19	1992
Spruce Run Reservoir	Hybrid Striped Bass	38.2	0.22	1992
Spruce Run Reservoir	Largemouth Bass	25.2	0.10	1992
Spruce Run Reservoir	Largemouth Bass	28.4	0.19	1992
Spruce Run Reservoir	Largemouth Bass	41.2	0.41	1992
Spruce Run Reservoir	Largemouth Bass	43.8	0.64	1992
Stafford Forge Main Line	Chain Pickerel	26.6	0.59	1992
Stafford Forge Main Line	Chain Pickerel	27.7	0.63	1992
Stafford Forge Main Line	Chain Pickerel	29.9	0.85	1992

Strawbridge Lake	Black Crappie	15.3	0.13	1992
Strawbridge Lake	Black Crappie	14.8	0.24	1992
Strawbridge Lake	Black Crappie	14.3	0.24	1992
Swartswood Lake	Chain Pickerel	39.6	0.09	1992
Swartswood Lake	Chain Pickerel	43.3	0.10	1992
Swartswood Lake	Chain Pickerel	42.3	0.12	1992
Swartswood Lake	Smallmouth Bass	30.8	0.12	1992
Swartswood Lake	Smallmouth Bass	35.5	0.18	1992
Swartswood Lake	Smallmouth Bass	37.5	0.29	1992
Wading River	Chain Pickerel	39.4	0.66	1992
Wading River	Chain Pickerel	40.8	0.68	1992
Wading River	Chain Pickerel	34.3	0.82	1992
Wading River	Chain Pickerel	37.3	1.09	1992
Wading River	Chain Pickerel	43.6	1.23	1992
Wanaque Reservoir	Chain Pickerel	38.7	0.33	1992
Wanaque Reservoir	Chain Pickerel	55.5	0.93	1992
Wanaque Reservoir	Smallmouth Bass	27.5	0.34	1992
Wanaque Reservoir	Smallmouth Bass	37.9	0.51	1992
Wanaque Reservoir	Largemouth Bass	32.8	0.40	1992
Wanaque Reservoir	Largemouth Bass	37.8	0.61	1992
Wanaque Reservoir	Largemouth Bass	36.6	0.75	1992
Wanaque Reservoir	Largemouth Bass	40.5	1.01	1992
Wanaque Reservoir	Largemouth Bass	43.8	1.17	1992
Wanaque Reservoir	Largemouth Bass	46.4	1.18	1992
Wilson Lake	Chain Pickerel	37.8	0.24	1992
Wilson Lake	Chain Pickerel	36.3	0.38	1992
Wilson Lake	Chain Pickerel	50.6	1.06	1992
Wilson Lake	Chain Pickerel	34.4	1.53	1992
Woodstown Memorial Lake	Black Crappie	17.5	0.08	1992
Woodstown Memorial Lake	Largemouth Bass	24.5	0.11	1992
Woodstown Memorial Lake	Largemouth Bass	27.8	0.20	1992
Woodstown Memorial Lake	Largemouth Bass	27.6	0.23	1992
Woodstown Memorial Lake	Largemouth Bass	39.3	0.34	1992
Woodstown Memorial Lake	Largemouth Bass	45.1	0.50	1992
Big Timber Creek	Channel Catfish	42.3	0.09	1993
Budd Lake	White Catfish	33.8	0.17	1993
Budd Lake	Northern Pike	54.8	0.11	1993
Budd Lake	Northern Pike	64	0.11	1993
Budd Lake	Northern Pike	68.5	0.14	1993
Canistear Reservoir	Largemouth Bass	36	0.41	1993
Canistear Reservoir	Largemouth Bass	42.2	0.52	1993
Canistear Reservoir	Largemouth Bass	40	0.55	1993
Canistear Reservoir	Largemouth Bass	45.7	0.61	1993
Canistear Reservoir	Largemouth Bass	43.5	0.68	1993
Canistear Reservoir	Largemouth Bass	39.1	0.69	1993
Canistear Reservoir	Largemouth Bass	38.8	0.74	1993
Carnegie Lake	Largemouth Bass	39.1	0.20	1993
Carnegie Lake	Largemouth Bass	32.3	0.29	1993
Carnegie Lake	Largemouth Bass	35.1	0.37	1993

Carnegie Lake	Largemouth Bass	44.7	0.45	1993
Carnegie Lake	Largemouth Bass	35.1	0.58	1993
Carnegie Lake	Largemouth Bass	51.3	1.07	1993
Corbin City Impoundment #3	Brown Bullhead	26.7	0.07	1993
Crystal Lake	Black Crappie	19.1	0.04	1993
Crystal Lake	Black Crappie	20.7	0.18	1993
Crystal Lake	Largemouth Bass	23.5	0.09	1993
Crystal Lake	Largemouth Bass	30.0	0.14	1993
Crystal Lake	Largemouth Bass	42.6	0.28	1993
Manasquan Reservoir	Largemouth Bass	31	0.76	1993
Manasquan Reservoir	Largemouth Bass	38.9	2.35	1993
Manasquan Reservoir	Largemouth Bass	36.4	2.45	1993
Manasquan Reservoir	Largemouth Bass	40	2.49	1993
Manasquan Reservoir	Largemouth Bass	38	2.89	1993
Manasquan Reservoir	Largemouth Bass	41.1	3.16	1993
Manasquan Reservoir	Largemouth Bass	40.3	3.87	1993
Maskells Mill Lake	Black Crappie	20.8	0.20	1993
Maskells Mill Lake	Black Crappie	26.3	0.29	1993
Maskells Mill Lake	Brown Bullhead	25.4	0.23	1993
Maskells Mill Lake	Brown Bullhead	28.9	0.31	1993
Maskells Mill Lake	Brown Bullhead	28.9	0.47	1993
Maskells Mill Lake	Largemouth Bass	25.9	0.36	1993
Maskells Mill Lake	Largemouth Bass	32.4	0.48	1993
Mullica River	Chain Pickerel	40.7	1.21	1993
New Brooklyn Lake	Chain Pickerel	46.2	0.82	1993
New Brooklyn Lake	Chain Pickerel	59.7	1.30	1993
Round Valley Reservoir	Largemouth Bass	25.2	0.16	1993
Round Valley Reservoir	Largemouth Bass	37.1	0.24	1993
Round Valley Reservoir	Largemouth Bass	35.1	0.24	1993
Spruce Run Reservoir	Northern Pike	63.2	0.41	1993
Spruce Run Reservoir	Northern Pike	64.2	0.39	1993
Woodstown Memorial Lake	Black Crappie	19.5	0.10	1993
Woodstown Memorial Lake	Black Crappie	37.3	0.22	1993
Batsto Lake	Bluegill sunfish	18.5	0.31	1994
Batsto Lake	Bluegill sunfish	22	0.33	1994
Batsto Lake	Bluegill sunfish	20	0.56	1994
Batsto Lake	Brown bullhead	30.5	0.16	1994
Batsto Lake	Brown bullhead	30	0.16	1994
Batsto Lake	Brown bullhead	28	0.16	1994
Batsto Lake	Brown bullhead	30	0.21	1994
Batsto Lake	Brown bullhead	30	0.25	1994
Batsto Lake	Chain pickerel	29	0.38	1994
Batsto Lake	Chain pickerel	29.5	0.43	1994
Batsto Lake	Chain pickerel	28.5	0.44	1994
Batsto Lake	Chain pickerel	30	0.44	1994
Batsto Lake	Chain pickerel	38	0.79	1994
Batsto Lake	Largemouth bass	27	0.47	1994
Batsto Lake	Largemouth bass	26.5	0.60	1994
Batsto Lake	Largemouth bass	31.5	0.90	1994

Batsto Lake	Largemouth bass	32.5	0.92	1994
Batsto Lake	Largemouth bass	34	1.15	1994
Carnegie Lake	Bluegill sunfish	16.2	0.06	1994
Carnegie Lake	Bluegill sunfish	16.8	0.02	1994
Carnegie Lake	Bluegill sunfish	17.5	0.05	1994
Carnegie Lake	White perch	20	0.13	1994
Carnegie Lake	White perch	20.5	0.19	1994
Carnegie Lake	White perch	21.1	0.11	1994
Carnegie Lake	White perch	21.2	0.20	1994
Carnegie Lake	White perch	21.4	0.19	1994
Carnegie Lake	Largemouth bass	43.0	0.24	1994
Carnegie Lake	Largemouth bass	45.2	0.37	1994
Carnegie Lake	Largemouth bass	43.5	0.45	1994
Carnegie Lake	Largemouth bass	48.0	0.68	1994
Carnegie Lake	Largemouth bass	54.0	0.81	1994
Merrill Creek Reservoir	Largemouth bass	41.0	0.67	1994
Merrill Creek Reservoir	Largemouth bass	39.5	0.93	1994
Merrill Creek Reservoir	Largemouth bass	36.7	0.93	1994
Merrill Creek Reservoir	Largemouth bass	41.0	1.10	1994
Merrill Creek Reservoir	Largemouth bass	49.6	1.12	1994
Monksville Reservoir	Largemouth bass	31.3	0.20	1994
Monksville Reservoir	Largemouth bass	31.2	0.21	1994
Monksville Reservoir	Largemouth bass	28.5	0.51	1994
Monksville Reservoir	Largemouth bass	41.2	0.78	1994
Monksville Reservoir	Largemouth bass	39	1.00	1994
Wilson Lake	Pumpkinseed sunfish	20.4	0.26	1994
Wilson Lake	Pumpkinseed sunfish	18.5	0.60	1994
Wilson Lake	Pumpkinseed sunfish	18.2	1.52	1994
Wilson Lake	Yellow perch	22	0.48	1994
Wilson Lake	Yellow perch	24.5	0.65	1994
Wilson Lake	Yellow perch	26.1	0.72	1994
Wilson Lake	Yellow perch	30	1.08	1994
Wilson Lake	Yellow perch	2.95	1.23	1994
Wilson Lake	Largemouth bass	35.5	0.74	1994
Wilson Lake	Largemouth bass	40.0	0.88	1994
Wilson Lake	Largemouth bass	25.6	0.90	1994
Wilson Lake	Largemouth bass	34.5	0.90	1994
Wilson Lake	Largemouth bass	47.0	1.75	1994
Carnegie Lake	Brown bullhead	30.1	0.03	1995
Carnegie Lake	Brown bullhead	31.1	0.05	1995
Carnegie Lake	Brown bullhead	28.2	0.06	1995
Carnegie Lake	Brown bullhead	28.5	0.10	1995
Carnegie Lake	Brown bullhead	29.4	0.12	1995
Carnegie Lake	Channel catfish	56.6	0.12	1995
Carnegie Lake	Channel catfish	61.8	0.16	1995
Carnegie Lake	Channel catfish	56.2	0.18	1995

Carnegie Lake	Channel catfish	41.2	0.44	1995
East Creek Lake	Brown bullhead	33.2	2.62	1995
East Creek Lake	Chain pickerel	31.2	0.65	1995
East Creek Lake	Chain pickerel	33.5	0.78	1995
East Creek Lake	Chain pickerel	35	0.99	1995
East Creek Lake	Chain pickerel	33.3	1.14	1995
East Creek Lake	Chain pickerel	33.7	1.35	1995
East Creek Lake	Pumpkinseed sunfish	11.3	0.35	1995
East Creek Lake	Pumpkinseed sunfish	11.4	0.43	1995
East Creek Lake	Pumpkinseed sunfish	11.4	0.53	1995
East Creek Lake	Yellow bullhead	11.7	0.30	1995
East Creek Lake	Yellow bullhead	22.3	0.73	1995
East Creek Lake	Yellow perch	18	0.67	1995
East Creek Lake	Yellow perch	20	0.82	1995
East Creek Lake	Yellow perch	22	0.90	1995
East Creek Lake	Yellow perch	24	0.95	1995
East Creek Lake	Yellow perch	20.1	1.01	1995
East Creek Lake	Largemouth bass	33.1	1.07	1995
East Creek Lake	Largemouth bass	33.5	1.44	1995
East Creek Lake	Largemouth bass	34	1.95	1995
East Creek Lake	Largemouth bass	38	2.04	1995
East Creek Lake	Largemouth bass	42	2.21	1995
Harrisville Lake	Chain pickerel	27.5	0.90	1995
Harrisville Lake	Chain pickerel	24.5	0.94	1995
Harrisville Lake	Chain pickerel	25	1.20	1995
Harrisville Lake	Chain pickerel	33.5	1.48	1995
Harrisville Lake	Chain pickerel	45	2.27	1995
Harrisville Lake	mud sunfish	11.1	0.76	1995
Harrisville Lake	mud sunfish	17.5	0.95	1995
Harrisville Lake	mud sunfish	18.5	1.32	1995
Harrisville Lake	Yellow bullhead	15.5	0.96	1995
Harrisville Lake	Yellow bullhead	32.5	2.52	1995
Lake Nummy	Chain pickerel	33.3	0.47	1995
Lake Nummy	Chain pickerel	33.3	0.49	1995
Lake Nummy	Chain pickerel	33.6	0.60	1995
Lake Nummy	Chain pickerel	33.7	0.63	1995
Lake Nummy	Chain pickerel	33.2	0.64	1995
Lake Nummy	Yellow bullhead	25.7	0.21	1995
Lake Nummy	Yellow bullhead	11	0.23	1995
Lake Nummy	Yellow bullhead	25.5	0.31	1995
Lake Nummy	Yellow bullhead	25.1	0.34	1995
Lake Nummy	Yellow perch	22.3	0.52	1995
Lake Nummy	Yellow perch	20	0.53	1995
Lake Nummy	Yellow perch	22.3	0.53	1995
Lake Nummy	Yellow perch	22.3	0.54	1995
Lake Nummy	Yellow perch	22.1	0.59	1995

Manasquan Reservoir	Black crappie	17.5	0.35	1995
Manasquan Reservoir	Black crappie	16.5	0.51	1995
Manasquan Reservoir	Black crappie	16.5	0.53	1995
Manasquan Reservoir	Bluegill sunfish	15	0.16	1995
Manasquan Reservoir	Bluegill sunfish	15.5	0.22	1995
Manasquan Reservoir	Bluegill sunfish	16.8	0.22	1995
Manasquan Reservoir	Bluegill sunfish	16.5	0.31	1995
Manasquan Reservoir	Bluegill sunfish	16.5	0.37	1995
Manasquan Reservoir	Brown bullhead	24	0.06	1995
Manasquan Reservoir	Brown bullhead	21.5	0.11	1995
Manasquan Reservoir	Brown bullhead	22	0.12	1995
Manasquan Reservoir	Brown bullhead	26	0.15	1995
Manasquan Reservoir	Brown bullhead	24	0.16	1995
Manasquan Reservoir	Chain pickerel	21.6	0.08	1995
Manasquan Reservoir	Chain pickerel	20	0.13	1995
Manasquan Reservoir	Chain pickerel	24.1	0.15	1995
Manasquan Reservoir	Chain pickerel	39.8	0.48	1995
Manasquan Reservoir	Yellow perch	19.5	0.11	1995
Manasquan Reservoir	Yellow perch	18	0.12	1995
Manasquan Reservoir	Yellow perch	21	0.17	1995
Manasquan Reservoir	Largemouth bass	27	0.29	1995
Manasquan Reservoir	Largemouth bass	28	0.47	1995
Manasquan Reservoir	Largemouth bass	39.5	1.49	1995
Manasquan Reservoir	Largemouth bass	39.5	1.75	1995
Manasquan Reservoir	Largemouth bass	44.5	2.21	1995
Merrill Creek Reservoir	Black crappie	25.3	0.09	1995
Merrill Creek Reservoir	Black crappie	26.1	0.12	1995
Merrill Creek Reservoir	Bluegill sunfish	14.6	0.05	1995
Merrill Creek Reservoir	Bluegill sunfish	172	0.09	1995
Merrill Creek Reservoir	Bluegill sunfish	25.4	0.16	1995
Merrill Creek Reservoir	Brown bullhead	26	0.12	1995
Merrill Creek Reservoir	Brown bullhead	27.9	0.14	1995
Merrill Creek Reservoir	Brown bullhead	29.5	0.14	1995
Merrill Creek Reservoir	Brown bullhead	25.4	0.16	1995
Merrill Creek Reservoir	Brown bullhead	25.1	0.17	1995
Merrill Creek Reservoir	Lake trout	56.7	0.38	1995
Merrill Creek Reservoir	Lake trout	56.5	0.44	1995
Merrill Creek Reservoir	Lake trout	60	0.46	1995
Merrill Creek Reservoir	Lake trout	58.6	0.51	1995
Merrill Creek Reservoir	Lake trout	64	0.73	1995
Merrill Creek Reservoir	Smallmouth bass	38.5	0.44	1995
Merrill Creek Reservoir	Smallmouth bass	40.1	0.44	1995
Merrill Creek Reservoir	Smallmouth bass	42.5	0.49	1995
Merrill Creek Reservoir	Smallmouth bass	39.3	0.63	1995
Merrill Creek Reservoir	Smallmouth bass	43.3	0.68	1995
Merrill Creek Reservoir	Yellow perch	31.2	0.20	1995
Merrill Creek Reservoir	Yellow perch	30.1	0.22	1995
Merrill Creek Reservoir	Yellow perch	34	0.32	1995
Monksville Reservoir	Brown bullhead	31.8	0.04	1995

Monksville Reservoir	Brown bullhead	31	0.06	1995
Monksville Reservoir	Brown bullhead	29	0.06	1995
Monksville Reservoir	Brown bullhead	28.5	0.09	1995
Monksville Reservoir	Brown bullhead	29.2	0.13	1995
Monksville Reservoir	Brown trout	45	0.20	1995
Monksville Reservoir	Pumpkinseed sunfish	19.2	0.09	1995
Monksville Reservoir	Pumpkinseed sunfish	18.1	0.14	1995
Monksville Reservoir	Pumpkinseed sunfish	18	0.25	1995
Monksville Reservoir	Smallmouth bass	31.6	0.26	1995
Monksville Reservoir	Smallmouth bass	27	0.28	1995
Monksville Reservoir	Smallmouth bass	37	0.33	1995
Monksville Reservoir	Walleye	35.5	0.30	1995
Monksville Reservoir	Walleye	41.4	0.42	1995
Monksville Reservoir	Walleye	42	0.48	1995
Monksville Reservoir	Walleye	47.6	0.80	1995
Monksville Reservoir	Walleye	45.9	0.98	1995
Monksville Reservoir	Walleye	52.2	1.44	1995
Monksville Reservoir	White perch	24.5	0.19	1995
Monksville Reservoir	White perch	26.8	0.55	1995
Monksville Reservoir	White perch	27	0.58	1995
Monksville Reservoir	White perch	28.5	0.74	1995
Monksville Reservoir	White perch	32.1	0.79	1995
Mullica River	Brown bullhead	25.5	0.26	1995
Mullica River	Brown bullhead	24.5	0.28	1995
Mullica River	Brown bullhead	22	0.40	1995
Mullica River	Chain pickerel	23.5	0.25	1995
Mullica River	Chain pickerel	30	0.45	1995
Mullica River	Chain pickerel	33.2	0.49	1995
Mullica River	Chain pickerel	46	0.62	1995
Mullica River	Chain pickerel	50.5	0.92	1995
Mullica River	Pumpkinseed sunfish	13	0.12	1995
Mullica River	Pumpkinseed sunfish	13	0.21	1995
Mullica River	Pumpkinseed sunfish	17	0.52	1995
Mullica River	White catfish	29.6	0.23	1995
Mullica River	White catfish	29	0.25	1995
Mullica River	White catfish	29	0.35	1995
Mullica River	White perch	18.3	0.34	1995
Mullica River	White perch	17.4	0.35	1995
Mullica River	White perch	20	0.36	1995
Mullica River	White perch	19	0.36	1995
Mullica River	White perch	21	0.51	1995
New Brooklyn Lake	Black crappie	21	0.08	1995
New Brooklyn Lake	Black crappie	21.8	0.16	1995
New Brooklyn Lake	Black crappie	21.5	0.19	1995

New Brooklyn Lake	Chain pickerel	20.5	0.13	1995
New Brooklyn Lake	Chain pickerel	29.7	0.20	1995
New Brooklyn Lake	Chain pickerel	34	0.25	1995
New Brooklyn Lake	Chain pickerel	43.9	0.48	1995
New Brooklyn Lake	Chain pickerel	32.5	0.64	1995
New Brooklyn Lake	Pumpkinseed sunfish	15.4	0.22	1995
New Brooklyn Lake	Pumpkinseed sunfish	16	0.28	1995
New Brooklyn Lake	Pumpkinseed sunfish	16.5	0.30	1995
New Brooklyn Lake	Yellow bullhead	20	0.05	1995
New Brooklyn Lake	Yellow bullhead	24.1	0.06	1995
New Brooklyn Lake	Yellow bullhead	23,8	0.08	1995
New Brooklyn Lake	Yellow bullhead	25.9	0.09	1995
New Brooklyn Lake	Yellow bullhead	26.9	0.20	1995
New Brooklyn Lake	Largemouth bass	23.3	0.25	1995
New Brooklyn Lake	Largemouth bass	27.4	0.32	1995
New Brooklyn Lake	Largemouth bass	31.7	0.41	1995
Wading River	Brown bullhead	31.5	0.62	1995
Wading River	Chain pickerel	42.5	0.46	1995
Wading River	Chain pickerel	35.1	0.49	1995
Wading River	Chain pickerel	28.5	0.55	1995
Wading River	Chain pickerel	22.3	0.55	1995
Wading River	Chain pickerel	32	0.71	1995
Wading River	White catfish	30.3	0.49	1995
Wading River	White catfish	30	0.60	1995
Wading River	Yellow bullhead	20.2	1.01	1995
Wading River	Yellow bullhead	30.3	1.59	1995
Wanaque Reservoir	Bluegill sunfish	17.2	0.07	1995
Wanaque Reservoir	Brown bullhead	35.8	0.01	1995
Wanaque Reservoir	Brown bullhead	36.2	0.03	1995
Wanaque Reservoir	Brown bullhead	34	0.07	1995
Wanaque Reservoir	Chain pickerel	51	0.12	1995
Wanaque Reservoir	Chain pickerel	47.5	0.18	1995
Wanaque Reservoir	Chain pickerel	50.5	0.37	1995
Wanaque Reservoir	Chain pickerel	47	0.41	1995
Wanaque Reservoir	Chain pickerel	50.6	0.43	1995
Wanaque Reservoir	Chain pickerel	56	0.73	1995
Wanaque Reservoir	Smallmouth bass	38.5	0.27	1995
Wanaque Reservoir	Smallmouth bass	29.6	0.29	1995
Wanaque Reservoir	Smallmouth bass	46.2	0.36	1995
Wanaque Reservoir	White catfish	41.5	0.12	1995
Wanaque Reservoir	White catfish	40.5	0.17	1995
Wanaque Reservoir	White catfish	37.1	0.17	1995
Wanaque Reservoir	White catfish	37.7	0.28	1995
Wanaque Reservoir	White catfish	42.9	0.33	1995
Wanaque Reservoir	White perch	27.2	0.35	1995
Wanaque Reservoir	White perch	30.7	0.63	1995

Wanaque Reservoir	White perch	36.8	0.65	1995
Wanaque Reservoir	White perch	32.1	0.75	1995
Wanaque Reservoir	White perch	33.9	1.18	1995
Wanaque Reservoir	Yellow bullhead	23.9	0.03	1995
Wanaque Reservoir	Largemouth bass	37.9	0.36	1995
Wanaque Reservoir	Largemouth bass	34.6	0.45	1995
Wanaque Reservoir	Largemouth bass	39.5	0.51	1995
Wanaque Reservoir	Largemouth bass	41.4	0.71	1995
Wanaque Reservoir	Largemouth bass	41.4	0.85	1995
Wilson Lake	Chain pickerel	29.5	0.66	1995
Wilson Lake	Chain pickerel	30.5	0.88	1995
Wilson Lake	Chain pickerel	25.7	0.91	1995
Wilson Lake	Chain pickerel	47	1.14	1995
Wilson Lake	Chain pickerel	47	1.30	1995
Boonton Reservoir	Brown Bullhead	30.5	0.01	1996
Boonton Reservoir	Brown Bullhead	32.8	0.02	1996
Boonton Reservoir	White Catfish	40	0.54	1996
Boonton Reservoir	Largemouth Bass	35	0.33	1996
Boonton Reservoir	Largemouth Bass	45.1	0.60	1996
Boonton Reservoir	Largemouth Bass	41.6	0.81	1996
Butterfly Bogs	Brown Bullhead	30.6	0.08	1996
Butterfly Bogs	Chain Pickerel	33.9	0.78	1996
Cedar Lake	Brown Bullhead	31.5	0.06	1996
Cedar Lake	Chain Pickerel	47.9	0.24	1996
Cedar Lake	Chain Pickerel	49.6	0.31	1996
Cedar Lake	Chain Pickerel	64.7	0.76	1996
Cedar Lake	Largemouth Bass	39	0.25	1996
Cedar Lake	Largemouth Bass	41.5	0.59	1996
Cedar Lake	Largemouth Bass	43.8	0.61	1996
Crater Lake	Brown Bullhead	30	0.39	1996
Crater Lake	Yellow Perch	21.6	0.29	1996
Crater Lake	Yellow Perch	19.9	0.43	1996
Crater Lake	Yellow Perch	27.9	0.58	1996
DeVoe Lake	Brown Bullhead	27	0.09	1996
DeVoe Lake	Chain Pickerel	41.5	0.14	1996
DeVoe Lake	Chain Pickerel	43	0.25	1996
DeVoe Lake	Chain Pickerel	48.5	0.27	1996
DeVoe Lake	Largemouth Bass	31.7	0.07	1996
DeVoe Lake	Largemouth Bass	34.1	0.21	1996
DeVoe Lake	Largemouth Bass	36.5	0.26	1996
Double Trouble Lake	Chain Pickerel	18.1	0.74	1996
Double Trouble Lake	Chain Pickerel	37.7	1.24	1996
Double Trouble Lake	Chain Pickerel	46.7	1.60	1996
Double Trouble Lake	Chain Pickerel	52.4	2.24	1996
Double Trouble Lake	Chain Pickerel	57.6	2.30	1996
Double Trouble Lake	Yellow Bullhead	26.1	0.82	1996
Double Trouble Lake	Yellow Bullhead	28.3	1.09	1996
Double Trouble Lake	Yellow Bullhead	26.6	1.18	1996
Echo Lake Reservoir	Largemouth Bass	30.4	0.12	1996

Echo Lake Reservoir	Largemouth Bass	34.4	0.15	1996
Echo Lake Reservoir	Largemouth Bass	29	0.16	1996
Echo Lake Reservoir	Largemouth Bass	35	0.17	1996
Green Turtle Lake	Chain Pickerel	28.1	0.11	1996
Green Turtle Lake	Chain Pickerel	44.7	0.14	1996
Green Turtle Lake	Chain Pickerel	44.6	0.15	1996
Green Turtle Lake	Yellow Perch	20.8	0.09	1996
Green Turtle Lake	Yellow Perch	24.6	0.10	1996
Green Turtle Lake	Largemouth Bass	23.6	0.17	1996
Green Turtle Lake	Largemouth Bass	26.1	0.22	1996
Green Turtle Lake	Largemouth Bass	34.7	0.32	1996
Greenwood Lake	White perch	18.3	0.00	1996
Greenwood Lake	White perch	19.2	0.02	1996
Greenwood Lake	Largemouth Bass	36.2	0.15	1996
Greenwood Lake	Largemouth Bass	34.3	0.18	1996
Greenwood Lake	Largemouth Bass	31.4	0.21	1996
Greenwood Lake	Largemouth Bass	36.3	0.24	1996
Greenwood Lake	Largemouth Bass	40	0.40	1996
Grovers Mill Pond	Brown Bullhead	33	0.08	1996
Grovers Mill Pond	Brown Bullhead	32.2	0.40	1996
Grovers Mill Pond	Chain Pickerel	35.3	0.12	1996
Grovers Mill Pond	Chain Pickerel	35.2	0.16	1996
Grovers Mill Pond	Chain Pickerel	37.2	0.16	1996
Grovers Mill Pond	Chain Pickerel	36.5	0.18	1996
Grovers Mill Pond	Largemouth Bass	31.3	0.25	1996
Grovers Mill Pond	Largemouth Bass	35.8	0.30	1996
Grovers Mill Pond	Largemouth Bass	35	0.36	1996
Grovers Mill Pond	Largemouth Bass	41.5	0.39	1996
Grovers Mill Pond	Largemouth Bass	28	0.47	1996
Hainesville Pond	Chain Pickerel	39.3	0.14	1996
Hainesville Pond	Chain Pickerel	36.6	0.14	1996
Hainesville Pond	Chain Pickerel	36.5	0.15	1996
Hainesville Pond	Largemouth Bass	30.3	0.13	1996
Hainesville Pond	Largemouth Bass	31.0	0.21	1996
Hainesville Pond	Largemouth Bass	31.3	0.23	1996
Malaga Lake	Chain Pickerel	32	0.73	1996
Malaga Lake	Chain Pickerel	29.3	0.88	1996
Malaga Lake	Chain Pickerel	36.2	0.97	1996
Malaga Lake	Chain Pickerel	31	0.99	1996
Malaga Lake	Chain Pickerel	34	1.38	1996
Malaga Lake	Largemouth Bass	32.4	0.95	1996
Passaic River at Hatfield Swamp	Pumpkinseed Sunfish	12.4	0.08	1996
Passaic River at Hatfield Swamp	Pumpkinseed Sunfish	12.6	0.09	1996
Passaic River at Hatfield Swamp	Black Crappie	18.1	0.30	1996
Passaic River at Hatfield Swamp	Black Crappie	18.9	0.32	1996
Passaic River at Hatfield Swamp	Bluegill Sunfish	18.9	0.19	1996
Passaic River at Hatfield Swamp	Black Crappie	20	0.21	1996

Passaic River at Hatfield Swamp	Black Crappie	20	0.22	1996
Passaic River at Hatfield Swamp	Yellow Bullhead	21.4	0.11	1996
Passaic River at Hatfield Swamp	Largemouth Bass	23	0.17	1996
Passaic River at Hatfield Swamp	Largemouth Bass	23.5	0.21	1996
Passaic River at Hatfield Swamp	Largemouth Bass	36	0.53	1996
Pompton River at Lincoln Park	Pike	27.8	0.17	1996
Pompton River at Lincoln Park	Pike	42	0.41	1996
Pompton River at Lincoln Park	Pike	66.6	0.59	1996
Pompton River at Lincoln Park	Yellow Perch	21	0.21	1996
Pompton River at Lincoln Park	Yellow Perch	24	0.26	1996
Pompton River at Lincoln Park	Largemouth Bass	35.4	0.50	1996
Pompton River at Lincoln Park	Largemouth Bass	35.5	0.68	1996
Raritan River at Millstone River	Brown Bullhead	25.4	0.06	1996
Raritan River at Millstone River	Brown Bullhead	27.5	0.07	1996
Raritan River at Millstone River	Channel Catfish	39.8	0.15	1996
Raritan River at Millstone River	Largemouth Bass	32.5	0.33	1996
Raritan River at Millstone River	Largemouth Bass	36.3	0.33	1996
Raritan River at Millstone River	Largemouth Bass	44.9	0.37	1996
Raritan River at Millstone River	Largemouth Bass	37	0.46	1996
Ridgeway Branch of Tom's River	Brown Bullhead	26.4	0.17	1996
Ridgeway Branch of Tom's River	Brown Bullhead	27	0.44	1996
Ridgeway Branch of Tom's River	Brown Bullhead	22.8	1.15	1996
Ridgeway Branch of Tom's River	Brown Bullhead	25.6	1.57	1996
Ridgeway Branch of Tom's River	Chain Pickerel	36	1.22	1996
Rockaway River near Whippany	Black Crappie	17.9	0.21	1996
Rockaway River near Whippany	Bluegill Sunfish	14.5	0.12	1996
Rockaway River near Whippany	Largemouth Bass	39.8	0.92	1996
South Branch Raritan River at Neshanic Station	Brown Bullhead	17.2	0.08	1996
South Branch Raritan River at Neshanic Station	Redbreast Sunfish	15.7	0.09	1996
South Branch Raritan River at Neshanic Station	Redbreast Sunfish	15.9	0.15	1996
South Branch Raritan River at Neshanic Station	Rock Bass	15	0.09	1996
South Branch Raritan River at Neshanic Station	Smallmouth Bass	20.7	0.18	1996
South Branch Raritan River at Neshanic Station	Largemouth Bass	18.2	0.11	1996
Speedwell Lake	Bluegill Sunfish	18.3	0.12	1996
Speedwell Lake	Bluegill Sunfish	19.7	0.13	1996
Speedwell Lake	Brown Bullhead	21	0.01	1996
Speedwell Lake	Largemouth Bass	27.5	0.10	1996
Speedwell Lake	Largemouth Bass	32.5	0.34	1996
Speedwell Lake	Largemouth Bass	36.1	0.38	1996
Steenykill Lake	Largemouth Bass	26.5	0.16	1996
Steenykill Lake	Largemouth Bass	27.5	0.19	1996
Steenykill Lake	Largemouth Bass	27.7	0.19	1996
Steenykill Lake	Largemouth Bass	27.8	0.15	1996
Steenykill Lake	Largemouth Bass	28.3	0.22	1996

Steenykill Lake	Largemouth Bass	29.6	0.15	1996
Sunset Lake	Bluegill Sunfish	11.2	0.05	1996
Sunset Lake	Chain Pickerel	30.7	0.09	1996
Sunset Lake	Largemouth Bass	22.5	0.10	1996
Sunset Lake	Largemouth Bass	33.8	0.17	1996
Sunset Lake	Largemouth Bass	38.2	0.21	1996
Sunset Lake	Largemouth Bass	38.5	0.35	1996
Sunset Lake	Largemouth Bass	53	0.69	1996
Wawayanda Lake	Chain Pickerel	35	0.25	1996
Wawayanda Lake	Chain Pickerel	39.5	0.28	1996
Wawayanda Lake	Chain Pickerel	40.5	0.29	1996
Wawayanda Lake	Chain Pickerel	37.9	0.31	1996
Wawayanda Lake	Chain Pickerel	42	0.34	1996
Wawayanda Lake	Chain Pickerel	42.4	0.44	1996
Oak Ridge Reservoir	Yellow Bullhead	24.5	0.25	1997
Oak Ridge Reservoir	Chain Pickerel	25	0.24	1997
Oak Ridge Reservoir	Chain Pickerel	28	0.29	1997
Oak Ridge Reservoir	Chain Pickerel	30.6	0.30	1997
Oak Ridge Reservoir	Brown Bullhead	33	0.02	1997
Oak Ridge Reservoir	Brown Bullhead	34.5	0.02	1997
Oak Ridge Reservoir	Smallmouth Bass	40.2	0.49	1997
Oak Ridge Reservoir	Chain Pickerel	58	0.30	1997
Oak Ridge Reservoir	Largemouth Bass	36.8	0.38	1997
Oak Ridge Reservoir	Largemouth Bass	42.5	0.64	1997
Oak Ridge Reservoir	Largemouth Bass	48	0.71	1997
Oak Ridge Reservoir	Largemouth Bass	48	0.89	1997
Pompton River at Pequannock River	Black Crappie	19.3	0.24	1997
Pompton River at Pequannock River	Pumpkinseed Sunfish	14.5	0.35	1997
Pompton River at Pequannock River	Pumpkinseed Sunfish	14.1	0.78	1997
Pompton River at Pequannock River	Redbreast Sunfish	13.7	0.32	1997
Pompton River at Pequannock River	Redbreast Sunfish	15.8	0.41	1997
Pompton River at Pequannock River	Rock Bass	19.2	0.54	1997
Pompton River at Pequannock River	Rock Bass	21.1	0.54	1997
Pompton River at Pequannock River	Rock Bass	22	0.68	1997
Pompton River at Pequannock River	Smallmouth Bass	29.6	0.57	1997
Pompton River at Pequannock River	Smallmouth Bass	36.8	1.02	1997
Pompton River at Pequannock River	Smallmouth Bass	25.4	1.10	1997
Pompton River at Pequannock River	Smallmouth Bass	27.8	1.14	1997
Pompton River at Pequannock River	Yellow Bullhead	26.2	0.80	1997
Pompton River at Pequannock River	Largemouth Bass	39	0.99	1997
Pompton River at Pequannock River	Largemouth Bass	39.8	1.36	1997
Whitesbog Pond	Chain Pickerel	23	0.43	1997
Whitesbog Pond	Chain Pickerel	31.5	0.58	1997
Whitesbog Pond	Chain Pickerel	34.3	0.74	1997
Whitesbog Pond	Chain Pickerel	32.5	0.76	1997
Whitesbog Pond	Chain Pickerel	39.6	1.02	1997
Willow Grove Lake	Brown Bullhead	33	0.23	1997

Willow Grove Lake	Brown Bullhead	32.4	0.28	1997
Willow Grove Lake	Chain Pickerel	31	0.76	1997
Willow Grove Lake	Chain Pickerel	48.1	1.03	1997
Willow Grove Lake	Chain Pickerel	36.5	1.13	1997
Willow Grove Lake	Chain Pickerel	45.2	1.26	1997
Willow Grove Lake	Chain Pickerel	53	1.29	1997
Willow Grove Lake	White Catfish	43	0.17	1997
Willow Grove Lake	Yellow Bullhead	28	0.82	1997
Willow Grove Lake	Yellow Bullhead	30.5	0.91	1997
Willow Grove Lake	Largemouth Bass	33.2	1.68	1997
Mullica River @ Green Bank	American Eel	45.7	0.51	1999
Mullica River @ Green Bank	American Eel	69	0.49	1999
Mullica River @ New Gretna	American Eel	42.5	0.3	1999
Mullica River, below dam @ Batsto Village	American Eel	29.7	0.65	1999
Mullica River, below dam @ Batsto Village	American Eel	39.5	0.04	1999
Mullica River, below dam @ Batsto Village	American Eel	46.3	0.8	1999
Stewart Lake (Woodbury)	Bluegill	15.9	0.03	1999
Stewart Lake (Woodbury)	Bluegill	16.4	0.03	1999
Stewart Lake (Woodbury)	Black Crappie	18.3	0.1	1999
Stewart Lake (Woodbury)	Brown Bullhead	25.4	0.01	1999
Stewart Lake (Woodbury)	Brown Bullhead	27.3	0.01	1999
Stewart Lake (Woodbury)	Brown Bullhead	31.1	0.04	1999
Stewart Lake (Woodbury)	Common Carp	43.8	0.01	1999
Stewart Lake (Woodbury)	Common Carp	49.3	0.04	1999
Stewart Lake (Woodbury)	Common Carp	54.5	0.08	1999
Stewart Lake (Woodbury)	Common Carp	59.8	0.03	1999
Stewart Lake (Woodbury)	Common Carp	65.8	0.03	1999
Stewart Lake (Woodbury)	Largemouth Bass	35.9	0.2	1999
Stewart Lake (Woodbury)	Largemouth Bass	38.9	0.15	1999
Stewart Lake (Woodbury)	Largemouth Bass	43.5	0.19	1999
Boonton Reservoir	rock bass	20.7	0.13	2002
Boonton Reservoir	rock bass	22.2	0.27	2002
Boonton Reservoir	rock bass	22.3	0.22	2002
Boonton Reservoir	rock bass	22.3	0.26	2002
Boonton Reservoir	smallmouth bass	38.9	0.39	2002
Boonton Reservoir	smallmouth bass	41.0	0.39	2002
Boonton Reservoir	smallmouth bass	43.4	0.52	2002
Boonton Reservoir	smallmouth bass	48.4	0.75	2002
Boonton Reservoir	largemouth bass	41.6	0.36	2002
Boonton Reservoir	largemouth bass	45.0	0.59	2002
Boonton Reservoir	largemouth bass	48.3	1.08	2002
Boonton Reservoir	largemouth bass	48.7	0.73	2002
Boonton Reservoir	largemouth bass	52.2	0.80	2002
Branch Brook Park	bluegill	14.5	0.16	2002
Branch Brook Park	bluegill	15.3	0.15	2002
Branch Brook Park	bluegill	15.5	0.24	2002

Branch Brook Park	common carp	60.5	0.10	2002
Branch Brook Park	common carp	69.0	0.19	2002
Branch Brook Park	common carp	69.5	0.19	2002
Branch Brook Park	common carp	72.5	0.07	2002
Canistear Reservoir	bluegill	18.5	0.11	2002
Canistear Reservoir	yellow perch	20.5	0.29	2002
Canistear Reservoir	bluegill	21.0	0.10	2002
Canistear Reservoir	bluegill	21.8	0.11	2002
Canistear Reservoir	yellow bullhead	24.5	0.12	2002
Canistear Reservoir	yellow bullhead	25.1	0.17	2002
Canistear Reservoir	yellow perch	25.3	0.18	2002
Canistear Reservoir	yellow perch	27.5	0.22	2002
Canistear Reservoir	yellow bullhead	27.6	0.16	2002
Canistear Reservoir	yellow bullhead	28.6	0.19	2002
Canistear Reservoir	chain pickerel	41.5	0.19	2002
Canistear Reservoir	chain pickerel	41.8	0.25	2002
Canistear Reservoir	chain pickerel	44.0	0.14	2002
Canistear Reservoir	chain pickerel	47.2	0.16	2002
Canistear Reservoir	bluegill	21.2	0.23	2002
Canistear Reservoir	largemouth bass	41.7	0.38	2002
Canistear Reservoir	largemouth bass	43.8	0.29	2002
Canistear Reservoir	largemouth bass	44.5	0.51	2002
Canistear Reservoir	largemouth bass	51.4	0.67	2002
Clinton Reservoir	redbreast sunfish	12.7	0.25	2002
Clinton Reservoir	redbreast sunfish	13.2	0.19	2002
Clinton Reservoir	redbreast sunfish	13.8	0.16	2002
Clinton Reservoir	redbreast sunfish	14.1	0.16	2002
Clinton Reservoir	rock bass	15.8	0.18	2002
Clinton Reservoir	rock bass	15.9	0.19	2002
Clinton Reservoir	rock bass	18.2	0.65	2002
Clinton Reservoir	yellow bullhead	28.2	0.43	2002
Clinton Reservoir	yellow bullhead	28.3	0.74	2002
Clinton Reservoir	yellow bullhead	28.4	0.44	2002
Clinton Reservoir	yellow bullhead	29.7	0.45	2002
Clinton Reservoir	white sucker	44.5	0.25	2002
Clinton Reservoir	chain pickerel	45.2	0.61	2002
Clinton Reservoir	white sucker	45.5	0.19	2002
Clinton Reservoir	white sucker	46.8	0.24	2002
Clinton Reservoir	chain pickerel	53.0	0.43	2002
Echo Lake Reservoir	bluegill	16.4	0.10	2002
Echo Lake Reservoir	bluegill	17.9	0.06	2002
Echo Lake Reservoir	bluegill	18.5	0.11	2002
Echo Lake Reservoir	bluegill	19.0	0.11	2002
Echo Lake Reservoir	yellow bullhead	22.4	0.09	2002
Echo Lake Reservoir	yellow bullhead	22.9	0.14	2002
Echo Lake Reservoir	yellow bullhead	26.4	0.16	2002
Echo Lake Reservoir	yellow bullhead	28.6	0.07	2002
Echo Lake Reservoir	chain pickerel	43.5	0.20	2002
Echo Lake Reservoir	chain pickerel	45.6	0.27	2002

Echo Lake Reservoir	chain pickerel	62.8	0.37	2002
Echo Lake Reservoir	largemouth bass	45.6	0.43	2002
Echo Lake Reservoir	largemouth bass	48.1	0.61	2002
Echo Lake Reservoir	largemouth bass	49.4	0.72	2002
Echo Lake Reservoir	largemouth bass	50.5	0.79	2002
Green Turtle Lake	bluegill	17.7	0.07	2002
Green Turtle Lake	bluegill	17.9	0.09	2002
Green Turtle Lake	bluegill	18.6	0.14	2002
Green Turtle Lake	bluegill	19.9	0.58	2002
Green Turtle Lake	largemouth bass	31.7	0.20	2002
Green Turtle Lake	largemouth bass	32.5	0.26	2002
Green Turtle Lake	largemouth bass	38.9	0.32	2002
Green Turtle Lake	largemouth bass	40.0	0.36	2002
Green Turtle Lake	largemouth bass	49.4	0.74	2002
Greenwood Lake	bluegill	19.0	0.08	2002
Greenwood Lake	bluegill	19.1	0.13	2002
Greenwood Lake	bluegill	19.2	0.07	2002
Greenwood Lake	bluegill	20.1	0.09	2002
Greenwood Lake	yellow bullhead	21.4	0.06	2002
Greenwood Lake	yellow bullhead	23.6	0.09	2002
Greenwood Lake	yellow bullhead	23.7	0.07	2002
Greenwood Lake	yellow bullhead	23.8	0.11	2002
Greenwood Lake	walleye		0.18	2002
Greenwood Lake	walleye		0.28	2002
Greenwood Lake	walleye		0.28	2002
Greenwood Lake	walleye		0.30	2002
Greenwood Lake	walleye		0.47	2002
Greenwood Lake	largemouth bass	39.9	0.31	2002
Greenwood Lake	largemouth bass	42.0	0.31	2002
Greenwood Lake	largemouth bass	42.6	0.31	2002
Greenwood Lake	largemouth bass	42.7	0.21	2002
Greenwood Lake	largemouth bass	44.4	0.29	2002
Monksville reservoir	bluegill	17.8	0.11	2002
Monksville reservoir	bluegill	18.5	0.08	2002
Monksville reservoir	yellow bullhead	19.4	0.11	2002
Monksville reservoir	bluegill	19.8	0.17	2002
Monksville reservoir	bluegill	19.9	0.13	2002
Monksville reservoir	yellow bullhead	23.0	0.13	2002
Monksville reservoir	yellow perch	27.6	0.17	2002
Monksville reservoir	yellow perch	34.9	0.17	2002
Monksville reservoir	chain pickerel	35.5	0.15	2002
Monksville reservoir	chain pickerel	38.4	0.19	2002
Monksville reservoir	walleye	44.4	0.44	2002
Monksville reservoir	walleye	47.8	0.55	2002
Monksville reservoir	chain pickerel	51.1	0.31	2002
Monksville reservoir	walleye	51.6	0.42	2002
Monksville reservoir	walleye	54.0	0.35	2002
Monksville reservoir	walleye	59.8	0.78	2002
Monksville Reservoir	Largemouth bass	26.5	0.20	2002

Monksville Reservoir	Largemouth bass	28.0	0.18	2002
Monksville Reservoir	Largemouth bass	31.5	0.13	2002
Monksville Reservoir	Largemouth bass	36.9	0.32	2002
Monksville Reservoir	Largemouth bass	44.0	0.39	2002
Oak Ridge Reservoir	bluegill	17.5	0.15	2002
Oak Ridge Reservoir	bluegill	18.1	0.11	2002
Oak Ridge Reservoir	bluegill	19.9	0.24	2002
Oak Ridge Reservoir	bluegill	20.0	0.28	2002
Oak Ridge Reservoir	yellow bullhead	23.8	0.10	2002
Oak Ridge Reservoir	yellow bullhead	28.5	0.23	2002
Oak Ridge Reservoir	largemouth bass	41.3	0.90	2002
Oak Ridge Reservoir	largemouth bass	41.6	0.65	2002
Oak Ridge Reservoir	largemouth bass	42.2	0.81	2002
Oak Ridge Reservoir	largemouth bass	45.1	0.82	2002
Pompton River at Lincoln Park	black crappie	17.5	0.19	2002
Pompton River at Lincoln Park	black crappie	20.3	0.29	2002
Pompton River at Lincoln Park	rock bass	20.8	0.64	2002
Pompton River at Lincoln Park	black crappie	21.4	0.15	2002
Pompton River at Lincoln Park	rock bass	21.5	0.60	2002
Pompton River at Lincoln Park	rock bass	23.7	0.83	2002
Pompton River at Lincoln Park	common carp	49.5	0.22	2002
Pompton River at Lincoln Park	common carp	49.9	0.47	2002
Pompton River at Lincoln Park	common carp	57.5	0.28	2002
Pompton River at Lincoln Park	common carp	58.7	0.39	2002
Pompton River at Lincoln Park	largemouth bass	34.6	0.35	2002
Pompton River at Lincoln Park	largemouth bass	35.2	0.50	2002
Pompton River at Lincoln Park	largemouth bass	39.2	0.74	2002
Rockaway River at Powerville	bluegill	15.8	0.11	2002
Rockaway River at Powerville	bluegill	16.0	0.11	2002
Rockaway River at Powerville	bluegill	16.1	0.13	2002
Rockaway River at Powerville	yellow bullhead	16.6	0.10	2002
Rockaway River at Powerville	yellow bullhead	22.5	0.28	2002
Rockaway River at Powerville	rock bass	23.3	0.29	2002
Rockaway River at Powerville	yellow bullhead	23.5	0.14	2002
Rockaway River at Powerville	rock bass	23.9	0.41	2002
Rockaway River at Powerville	rock bass	24.1	0.34	2002
Rockaway River at Powerville	rock bass	24.5	0.32	2002
Shepherds lake	redbreast sunfish	14.6	0.19	2002
Shepherds lake	rock bass	15.3	0.20	2002
Shepherds lake	redbreast sunfish	15.6	0.18	2002
Shepherds lake	redbreast sunfish	15.9	0.20	2002
Shepherds lake	rock bass	20.9	0.15	2002
Shepherds lake	brown bullhead	28.9	0.06	2002
Shepherds lake	brown bullhead	29.5	0.13	2002
Shepherds lake	brown bullhead	36.1	0.07	2002
Shepherds lake	largemouth bass	39.0	0.76	2002
Shepherds Lake	largemouth bass	39.2	0.71	2002
Shepherds Lake	largemouth bass	39.7	0.56	2002
Shepherds Lake	largemouth bass	40.4	0.67	2002

Shepherds Lake	largemouth bass	41.1	0.60	2002
Speedwell Lake	bluegill	15.4	0.10	2002
Speedwell Lake	bluegill	15.8	0.10	2002
Speedwell Lake	bluegill	18.6	0.13	2002
Speedwell Lake	bluegill	20.5	0.16	2002
Speedwell Lake	chain pickerel	25.9	0.09	2002
Speedwell Lake	chain pickerel	31.8	0.11	2002
Speedwell Lake	common carp	57.7	0.13	2002
Speedwell Lake	chain pickerel	59.6	0.26	2002
Speedwell Lake	common carp	61.7	0.10	2002
Speedwell Lake	common carp	62.5	0.14	2002
Speedwell Lake	common carp	63.6	0.05	2002
Split Rock Reservoir	bluegill	21.2	0.13	2002
Split Rock Reservoir	bluegill	21.4	0.21	2002
Split Rock Reservoir	bluegill	22.0	0.10	2002
Split Rock Reservoir	bluegill	22.6	0.12	2002
Split Rock Reservoir	yellow perch	26.2	0.10	2002
Split Rock Reservoir	yellow perch	29.5	0.15	2002
Split Rock Reservoir	yellow perch	30.0	0.13	2002
Split Rock Reservoir	yellow perch	30.0	0.34	2002
Split Rock Reservoir	brown bullhead	30.7	0.04	2002
Split Rock Reservoir	brown bullhead	39.0	0.04	2002
Split Rock Reservoir	chain pickerel	46.8	0.30	2002
Split Rock Reservoir	chain pickerel	49.0	0.32	2002
Split Rock Reservoir	chain pickerel	54.5	0.30	2002
Split Rock Reservoir	chain pickerel	57.0	0.32	2002
Split Rock Reservoir	chain pickerel	61.0	0.26	2002
Split Rock Reservoir	largemouth bass	35.5	0.32	2002
Split Rock Reservoir	largemouth bass	35.9	0.38	2002
Split Rock Reservoir	largemouth bass	38.0	0.32	2002
Split Rock Reservoir	largemouth bass	39.4	0.48	2002
Split Rock Reservoir	largemouth bass	40.5	0.52	2002
Wanaque Reservoir	yellow bullhead	18.8	0.10	2002
Wanaque Reservoir	yellow bullhead	19.9	0.08	2002
Wanaque Reservoir	bluegill	20.2	0.22	2002
Wanaque Reservoir	bluegill	20.4	0.23	2002
Wanaque Reservoir	bluegill	20.6	0.27	2002
Wanaque Reservoir	bluegill	21.2	0.41	2002
Wanaque Reservoir	yellow bullhead	22.2	0.16	2002
Wanaque Reservoir	yellow bullhead	22.9	0.17	2002
Wanaque Reservoir	largemouth bass	30.7	0.28	2002
Wanaque Reservoir	largemouth bass	34.2	0.23	2002
Wanaque Reservoir	largemouth bass	45.2	1.03	2002
Wanaque Reservoir	largemouth bass	48.0	1.47	2002
Wawayanda Lake	bluegill	17.9	0.14	2002
Wawayanda Lake	bluegill	18.2	0.21	2002
Wawayanda Lake	bluegill	18.3	0.21	2002
Wawayanda Lake	chain pickerel	26.4	0.23	2002
Wawayanda Lake	chain pickerel	27.1	0.23	2002
Wawayanda Lake	yellow bullhead	27.1	0.30	2002

Wawayanda Lake	chain pickerel	28.0	0.23	2002
Wawayanda Lake	yellow bullhead	28.3	0.45	2002
Wawayanda Lake	yellow bullhead	29.9	0.36	2002
Wawayanda Lake	chain pickerel	33.9	0.50	2002
Wawayanda Lake	chain pickerel	44.5	0.44	2002
Wawayanda Lake	largemouth bass	33.0	0.29	2002
Wawayanda Lake	largemouth bass	33.4	0.33	2002
Wawayanda Lake	largemouth bass	42.9	0.78	2002
Wawayanda Lake	largemouth bass	44.1	0.66	2002
Wawayanda Lake	largemouth bass	45.3	0.73	2002
Weequachic Lake	bluegill	16.4	0.12	2002
Weequachic Lake	bluegill	17.3	0.15	2002
Weequachic Lake	bluegill	17.4	0.09	2002
Weequachic Lake	white perch	17.7	0.10	2002
Weequachic Lake	white perch	17.9	0.08	2002
Weequachic Lake	white perch	18.0	0.09	2002
Weequachic Lake	brown bullhead	27.2	0.03	2002
Weequachic Lake	brown bullhead	30.0	0.03	2002
Weequachic Lake	brown bullhead	31.0	0.03	2002
Weequachic Lake	common carp	50.5	0.04	2002
Weequachic Lake	common carp	56.2	0.08	2002
Weequachic Lake	common carp	71.0	0.10	2002
Weequachic Lake	largemouth bass	34.0	0.21	2002
Weequachic Lake	largemouth bass	35.1	0.20	2002
Weequachic Lake	largemouth bass	45.9	0.31	2002
Weequachic Lake	largemouth bass	47.5	0.39	2002
Mullica River	American Eel	49.5	0.29	2004
Mullica River	American Eel	63.5	0.33	2004
Mullica River	American Eel	64.9	0.18	2004
Mullica River	American Eel	73.2	0.2	2004
Mullica River	American Eel	77	0.2	2004
Below New Market Pond Dam	American eel	68.2	0.08673	2006
Below New Market Pond Dam	American eel	69.9	0.11418	2006
Bound Brook @ Shepard Rd.	American eel	51.3	0.08569	2006
Bound Brook @ Shepard Rd.	American eel	54.3	0.08921	2006
Bound Brook @ Shepard Rd.	American eel	61.3	0.20208	2006
Budd Lake	bluegill	17.8	0.09949	2006
Budd Lake	bluegill	18.2	0.1561	2006
Budd Lake	bluegill	18.8	0.12716	2006
Budd Lake	brown bullhead	25.6	0.02337	2006
Budd Lake	brown bullhead	27.2	0.0193	2006
Budd Lake	brown bullhead	31.5	0.01034	2006
Budd Lake	white catfish	34.3	0.18067	2006
Budd Lake	white catfish	35.6	0.21846	2006
Budd Lake	white catfish	42.1	0.27947	2006
Budd Lake	northern pike	74.1	0.30651	2006
Budd Lake	northern pike	78.4	0.45883	2006
Budd Lake	northern pike	81	0.19917	2006
Budd Lake	largemouth bass	35.7	0.16964	2006
Budd Lake	largemouth bass	36.4	0.43134	2006

Budd Lake	largemouth bass	36.9	0.53606	2006
Budd Lake	largemouth bass	43.1	0.48615	2006
Budd Lake	largemouth bass	47.6	0.41803	2006
Carnegie Lake	Bluegill sunfish	16.7	0.06306	2006
Carnegie Lake	Bluegill sunfish	17.9	0.05655	2006
Carnegie Lake	Bluegill sunfish	19	0.10097	2006
Carnegie Lake	white perch	20.8	0.23403	2006
Carnegie Lake	white perch	20.8	0.14171	2006
Carnegie Lake	white perch	21	0.16152	2006
Carnegie Lake	largemouth bass	34.3	0.15636	2006
Carnegie Lake	largemouth bass	38.3	0.11614	2006
Carnegie Lake	largemouth bass	43.3	0.40243	2006
Carnegie Lake	largemouth bass	44.3	0.36529	2006
Carnegie Lake	largemouth bass	49.6	0.51996	2006
Davidson Mill Pond	bluegill	18.1	0.18292	2006
Davidson Mill Pond	bluegill	19	0.0504	2006
Davidson Mill Pond	bluegill	20.3	0.14941	2006
Davidson Mill Pond	chain pickerel	43.5	0.27161	2006
Davidson Mill Pond	chain pickerel	43.9	0.24405	2006
Davidson Mill Pond	chain pickerel	48.3	0.35285	2006
Davidson Mill Pond	American eel	75.2	0.20145	2006
Davidson Mill Pond	American eel	79	0.20049	2006
Davidson Mill Pond	largemouth bass	37.7	0.5091	2006
Davidson Mill Pond	largemouth bass	40.4	0.50194	2006
Davidson Mill Pond	largemouth bass	41.3	0.56886	2006
DeVoe Lake	brown bullhead	30.9	0.07703	2006
DeVoe Lake	brown bullhead	32.5	0.12689	2006
DeVoe Lake	brown bullhead	35.7	0.16058	2006
DeVoe Lake	chain pickerel	45.8	0.26277	2006
DeVoe Lake	chain pickerel	50	0.38873	2006
DeVoe Lake	chain pickerel	50.5	0.50737	2006
Duhernal Lake	bluegill	18.4	0.04042	2006
Duhernal Lake	bluegill	20.2	0.07774	2006
Duhernal Lake	bluegill	22.3	0.16006	2006
Duhernal Lake	brown bullhead	31.6	0.03663	2006
Duhernal Lake	brown bullhead	33.5	0.02588	2006
Duhernal Lake	brown bullhead	34.5	0.05482	2006
Duhernal Lake	largemouth bass	36.4	0.19646	2006
Duhernal Lake	largemouth bass	36.5	0.1712	2006
Duhernal Lake	largemouth bass	39.2	0.2798	2006
Farrington Lake	bluegill	17.2	0.09828	2006
Farrington Lake	bluegill	17.8	0.1512	2006
Farrington Lake	bluegill	18.7	0.11982	2006
Farrington Lake	yellow perch	20.6	0.17985	2006
Farrington Lake	yellow perch	20.7	0.22166	2006
Farrington Lake	yellow perch	25.7	0.41141	2006
Farrington Lake	brown bullhead	29.8	0.03402	2006
Farrington Lake	brown bullhead	34.7	0.04048	2006
Farrington Lake	brown bullhead	36.5	0.01656	2006
Farrington Lake	chain pickerel	43.2	0.19105	2006

Farrington Lake	chain pickerel	45.8	0.20378	2006
Farrington Lake	chain pickerel	48.8	0.48139	2006
Farrington Lake	largemouth bass	39.8	0.51737	2006
Farrington Lake	largemouth bass	41	0.50762	2006
Farrington Lake	largemouth bass	42.3	0.93764	2006
Farrington Lake	largemouth bass	46.3	1.41272	2006
Farrington Lake	largemouth bass	49	0.97277	2006
Lamington River @ Lamington	redbreast sunfish	15.8	0.12666	2006
Lamington River @ Lamington	redbreast sunfish	16.1	0.16744	2006
Lamington River @ Lamington	redbreast sunfish	16.6	0.14858	2006
Lamington River @ Lamington	smallmouth bass	18.6	0.13566	2006
Lamington River @ Lamington	smallmouth bass	20.6	0.18452	2006
Lamington River @ Lamington	smallmouth bass	22	0.12535	2006
Lamington River @ Lamington	brown trout	23.7	0.07503	2006
Lamington River @ Lamington	brown trout	26.1	0.08884	2006
Lamington River @ Lamington	American eel	53.7	0.18808	2006
Lamington River @ Lamington	American eel	60.2	0.39376	2006
Lamington River @ Lamington	American eel	63.2	0.24738	2006
Manalapan Lake	bluegill	18.4	0.04791	2006
Manalapan Lake	bluegill	18.4	0.07113	2006
Manalapan Lake	bluegill	18.6	0.04947	2006
Manalapan Lake	black crappie	21	0.09823	2006
Manalapan Lake	black crappie	21.4	0.10733	2006
Manalapan Lake	black crappie	22.8	0.14389	2006
Manalapan Lake	American eel	49.5	0.07662	2006
Manalapan Lake	American eel	53.4	0.12536	2006
Manalapan Lake	American eel	59.7	0.17554	2006
Manalapan Lake	largemouth bass	38	0.23315	2006
Manalapan Lake	largemouth bass	39.1	0.32996	2006
Manalapan Lake	largemouth bass	40.8	0.40945	2006
New Market Pond	bluegill	16.5	0.06683	2006
New Market Pond	bluegill	17	0.06511	2006
New Market Pond	bluegill	17.3	0.0888	2006
New Market Pond	black crappie	20.6	0.05647	2006
New Market Pond	black crappie	22.5	0.08984	2006
New Market Pond	black crappie	24.1	0.05213	2006
New Market Pond	brown bullhead	33.3	0.02354	2006
New Market Pond	brown bullhead	33.5	0.00063	2006
New Market Pond	American eel	34	0.02819	2006
New Market Pond	brown bullhead	34.5	0.00419	2006
New Market Pond	American eel	46.6	0.04004	2006
New Market Pond	American eel	48.5	0.10651	2006
New Market Pond	common carp	50.7	0.04819	2006
New Market Pond	common carp	52.7	0.05352	2006
New Market Pond	common carp	53	0.03293	2006
New Market Pond	largemouth bass	35.9	0.13736	2006
New Market Pond	largemouth bass	36.8	0.10944	2006
New Market Pond	largemouth bass	41.4	0.26315	2006
Raritan River @ Millstone River	redbreast sunfish	18.2	0.13396	2006
Raritan River @ Millstone River	redbreast sunfish	18.2	0.16323	2006

Raritan River @ Millstone River	redbreast sunfish	19.3	0.10685	2006
Raritan River @ Millstone River	smallmouth bass	30.9	0.29331	2006
Raritan River @ Millstone River	smallmouth bass	31	0.33445	2006
Raritan River @ Millstone River	white catfish	32.6	0.20333	2006
Raritan River @ Millstone River	white catfish	35.7	0.21395	2006
Raritan River @ Millstone River	smallmouth bass	37.3	0.26906	2006
Raritan River @ Millstone River	white catfish	40.1	0.23869	2006
Raritan River @ Millstone River	channel catfish	48.7	0.35862	2006
Raritan River @ Millstone River	channel catfish	53	0.17138	2006
Raritan River @ Millstone River	American eel	57.6	0.10876	2006
Raritan River @ Millstone River	common carp	57.9	0.12682	2006
Raritan River @ Millstone River	common carp	59.7	0.15017	2006
Raritan River @ Millstone River	channel catfish	63.7	0.16402	2006
Raritan River @ Millstone River	common carp	65.9	0.00431	2006
Raritan River @ Millstone River	American eel	70.6	0.24336	2006
Raritan River @ Millstone River	American eel	71	0.29174	2006
Raritan River at Millstone River	largemouth bass	32.4	0.25569	2006
Raritan River at Millstone River	largemouth bass	37.2	0.32619	2006
Raritan River at Millstone River	largemouth bass	43	0.6896	2006
Rosedale Lake in Pennington	bluegill	18.4	0.05062	2006
Rosedale Lake in Pennington	bluegill	18.7	0.06377	2006
Rosedale Lake in Pennington	bluegill	20.2	0.10783	2006
Rosedale Lake in Pennington	black crappie	24.1	0.10195	2006
Rosedale Lake in Pennington	black crappie	25.7	0.11855	2006
Rosedale Lake in Pennington	black crappie	30.8	0.12335	2006
Rosedale Lake in Pennington	common carp	62.2	0.11683	2006
Rosedale Lake in Pennington	common carp	64.1	0.10668	2006
Rosedale Lake in Pennington	common carp	66.8	0.10278	2006
Rosedale Lake in Pennington	largemouth bass	40	0.22114	2006
Rosedale Lake in Pennington	largemouth bass	47.6	0.22991	2006
Rosedale Lake in Pennington	largemouth bass	47.7	0.3298	2006
Round Valley Reservoir	bluegill	21.5	0.11044	2006
Round Valley Reservoir	bluegill	21.9	0.11996	2006
Round Valley Reservoir	bluegill	22	0.09508	2006
Round Valley Reservoir	white catfish	36.8	0.08206	2006
Round Valley Reservoir	white catfish	40	0.0991	2006
Round Valley Reservoir	lake trout	43.9	0.08773	2006
Round Valley Reservoir	channel catfish	50.2	0.11492	2006
Round Valley Reservoir	lake trout	52.2	0.10409	2006
Round Valley Reservoir	lake trout	53.7	0.2057	2006
Round Valley Reservoir	lake trout	54.9	0.12745	2006
Round Valley Reservoir	channel catfish	58.7	0.4599	2006
Round Valley Reservoir	channel catfish	61.8	0.06823	2006
Round Valley Reservoir	lake trout	66.5	0.18896	2006
Round Valley Reservoir	largemouth bass	30.6	0.19463	2006
Round Valley Reservoir	largemouth bass	41.8	0.2981	2006
Round Valley Reservoir	largemouth bass	45.1	0.38514	2006
South Branch Raritan River at Neshanic Station	redbreast sunfish	16.9	0.10381	2006

South Branch Raritan River at Neshanic Station	redbreast sunfish	17.7	0.09302	2006
South Branch Raritan River at Neshanic Station	redbreast sunfish	17.9	0.12138	2006
South Branch Raritan River at Neshanic Station	rock bass	20.4	0.24498	2006
South Branch Raritan River at Neshanic Station	rock bass	20.6	0.16647	2006
South Branch Raritan River at Neshanic Station	rock bass	21.1	0.2056	2006
South Branch Raritan River at Neshanic Station	smallmouth bass	34.9	0.31523	2006
South Branch Raritan River at Neshanic Station	common carp	37.2	0.05298	2006
South Branch Raritan River at Neshanic Station	smallmouth bass	41.1	0.38035	2006
South Branch Raritan River at Neshanic Station	common carp	42.7	0.05706	2006
South Branch Raritan River at Neshanic Station	common carp	46.1	0.04491	2006
South Branch Raritan River at Neshanic Station	smallmouth bass	49.9	0.39461	2006
South Branch Raritan River at Neshanic Station	American eel	63	0.29096	2006
South Branch Raritan River at Neshanic Station	American eel	69.9	0.22739	2006
South Branch Raritan River at Neshanic Station	American eel	72.5	0.25548	2006
South Branch Raritan River at Neshanic Station	largemouth bass	20	0.18969	2006
South Branch Raritan River at Neshanic Station	largemouth bass	21.3	0.17653	2006
South Branch Raritan River at Neshanic Station	largemouth bass	26.9	0.1382	2006
Spring Lake	common carp	48.3	0.04448	2006
Spring Lake	common carp	54.5	0.00202	2006
Spring Lake	common carp	64.6	0.0799	2006
Spruce Run Reservoir	channel catfish	41	0.06091	2006
Spruce Run Reservoir	striped x white bass hybrid	42.4	0.14346	2006
Spruce Run Reservoir	striped x white bass hybrid	48	0.18523	2006
Spruce Run Reservoir	striped x white bass hybrid	49.2	0.22875	2006
Spruce Run Reservoir	striped x white bass hybrid	53.6	0.39913	2006
Spruce Run Reservoir	striped x white bass hybrid	54.3	0.51704	2006
Spruce Run Reservoir	channel catfish	55.6	0.22611	2006
Spruce Run Reservoir	channel catfish	56.3	0.32477	2006
Spruce Run Reservoir	common carp	57.8	0.12598	2006
Spruce Run Reservoir	common carp	58.1	0.12418	2006
Spruce Run Reservoir	common carp	58.3	0.13401	2006
Spruce Run Reservoir	northern pike	65.5	0.31375	2006

Spruce Run Reservoir	northern pike	68.5	0.24939	2006
Spruce Run Reservoir	northern pike	76.8	0.20958	2006
Spruce Run Reservoir	largemouth bass	28.7	0.17957	2006
Spruce Run Reservoir	largemouth bass	35.8	0.17422	2006
Spruce Run Reservoir	largemouth bass	39.8	0.43026	2006
Spruce Run Reservoir	largemouth bass	42.9	0.44294	2006
Spruce Run Reservoir	largemouth bass	47.3	0.60489	2006
Weston Mill Pond	bluegill	17.7	0.06793	2006
Weston Mill Pond	bluegill	18.6	0.11264	2006
Weston Mill Pond	bluegill	18.9	0.2196	2006
Weston Mill Pond	yellow perch	25.3	0.27386	2006
Weston Mill Pond	black crappie	25.8	0.19928	2006
Weston Mill Pond	yellow perch	26.3	0.14497	2006
Weston Mill Pond	black crappie	26.9	0.28312	2006
Weston Mill Pond	black crappie	26.9	0.22769	2006
Weston Mill Pond	brown bullhead	27.1	0.01612	2006
Weston Mill Pond	brown bullhead	28.2	0.05252	2006
Weston Mill Pond	yellow perch	29.3	0.39874	2006
Weston Mill Pond	brown bullhead	35.7	0.0256	2006
Weston Mill Pond	chain pickerel	38.9	0.16182	2006
Weston Mill Pond	chain pickerel	45.9	0.28877	2006
Weston Mill Pond	chain pickerel	48	0.48049	2006
Weston Mill Pond	American eel	49.8	0.10278	2006
Weston Mill Pond	American eel	50.2	0.11332	2006
Weston Mill Pond	American eel	55.1	0.13674	2006
Weston Mill Pond	largemouth bass	38	0.52104	2006
Weston Mill Pond	largemouth bass	38.1	0.41189	2006
Weston Mill Pond	largemouth bass	39.5	0.46808	2006
Atsion Lake	American eel	31.2	0.33	2007
Atsion Lake	American eel	32.1	0.27	2007
Atsion Lake	American eel	51.7	0.52	2007
Atsion Lake	chain pickerel	33.2	0.47	2007
Atsion Lake	chain pickerel	39.6	0.69	2007
Atsion Lake	chain pickerel	44.7	0.82	2007
Batsto Lake	brown bullhead	32.9	0.29	2007
Batsto Lake	brown bullhead	33.4	0.22	2007
Batsto Lake	brown bullhead	36.18	0.16	2007
Batsto Lake	chain pickerel	23.7	0.30	2007
Batsto Lake	chain pickerel	35	0.78	2007
Batsto Lake	chain pickerel	35.5	0.85	2007
Batsto Lake	chain pickerel	35.9	0.44	2007
Batsto Lake	largemouth bass	35.5	1.25	2007
Batsto Lake	largemouth bass	35.6	1.07	2007
Batsto Lake	largemouth bass	36.7	0.85	2007
Batsto Lake	largemouth bass	37.2	0.10	2007
Cedar Lake	American eel	48.7	0.16	2007
Cedar Lake	American eel	54.2	0.18	2007
Cedar Lake	American eel	63.9	0.22	2007
Cedar Lake	largemouth bass	32.8	0.18	2007
Cedar Lake	largemouth bass	38.8	0.31	2007

Cedar Lake	largemouth bass	47	1.63	2007
Cedar Lake	white perch	30.7	0.33	2007
Cedar Lake	white perch	31.8	0.22	2007
Cedar Lake	white perch	37.4	0.51	2007
Cedarville Ponds	chain pickerel	30.6	0.65	2007
Cedarville Ponds	chain pickerel	32.5	0.46	2007
Cedarville Ponds	chain pickerel	34.4	0.53	2007
Cedarville Ponds	chain pickerel	35.4	0.54	2007
Cedarville Ponds	chain pickerel	43.1	0.69	2007
Cedarville Ponds	yellow perch	28	0.31	2007
Cedarville Ponds	yellow perch	28.8	0.33	2007
Cedarville Ponds	yellow perch	29.8	0.35	2007
Deal Lake	American eel	31	0.30	2007
Deal Lake	American eel	60	0.05	2007
Deal Lake	largemouth bass	38	0.09	2007
Deal Lake	largemouth bass	39.8	0.12	2007
Deal Lake	largemouth bass	40.2	0.14	2007
Deal Lake	white perch	16.3	0.02	2007
Deal Lake	white perch	18.1	0.04	2007
Deal Lake	white perch	20.2	0.18	2007
East Creek Lake	American eel	43.2	1.05	2007
East Creek Lake	American eel	51.8	1.02	2007
East Creek Lake	American eel	53.9	1.24	2007
East Creek Lake	chain pickerel	33.6	1.14	2007
East Creek Lake	chain pickerel	41.1	1.46	2007
East Creek Lake	chain pickerel	42.9	1.05	2007
East Creek Lake	largemouth bass	30.5	1.05	2007
East Creek Lake	largemouth bass	39.4	1.40	2007
East Creek Lake	largemouth bass	44.6	1.37	2007
Harrisville Lake	American eel	27.4	0.47	2007
Harrisville Lake	American eel	40.5	0.58	2007
Harrisville Lake	American eel	54.1	0.73	2007
Harrisville Lake	chain pickerel	27.6	1.05	2007
Harrisville Lake	chain pickerel	29.4	0.61	2007
Harrisville Lake	chain pickerel	30.4	0.91	2007
Harrisville Lake	chain pickerel	31.3	1.05	2007
Lake Absegami	American eel	31.6	0.36	2007
Lake Absegami	American eel	32.7	0.29	2007
Lake Absegami	American eel	47.5	0.80	2007
Lake Absegami	chain pickerel	35.3	1.32	2007
Lake Absegami	chain pickerel	35.4	1.26	2007
Lake Absegami	chain pickerel	43.5	1.24	2007
Lake Absegami	chain pickerel	47.6	1.62	2007
Lake Absegami	chain pickerel	58.7	1.39	2007
Lake Manahawkin	American eel	46.3	1.50	2007
Lake Manahawkin	American eel	56.1	1.43	2007
Lake Manahawkin	American eel	79.6	1.89	2007
Lake Manahawkin	largemouth bass	33.6	1.08	2007
Lake Manahawkin	largemouth bass	35.2	0.93	2007

Lake Manahawkin	largemouth bass	45.1	1.76	2007
Lake Nummy	yellow bullhead	29.2	0.44	2007
Lake Nummy	yellow bullhead	29.7	0.26	2007
Lake Nummy	yellow bullhead	33.4	0.79	2007
Lake Nummy	chain pickerel	46.2	1.07	2007
Lake Nummy	chain pickerel	56	2.56	2007
Lake Oswego	American eel	49.6	0.70	2007
Lake Oswego	American eel	60.5	0.46	2007
Lake Oswego	chain pickerel	26.6	0.82	2007
Lake Oswego	chain pickerel	27.7	0.76	2007
Lake Oswego	chain pickerel	42.1	0.42	2007
Lake Oswego	chain pickerel	46.8	2.05	2007
Lefferts Lake	brown bullhead	27.8	0.07	2007
Lefferts Lake	brown bullhead	28.8	0.10	2007
Lefferts Lake	brown bullhead	29.1	0.10	2007
Lefferts Lake	chain pickerel	43.9	0.11	2007
Lefferts Lake	chain pickerel	44.7	0.19	2007
Lefferts Lake	chain pickerel	46.7	0.21	2007
Lefferts Lake	yellow perch	23.8	0.10	2007
Lefferts Lake	yellow perch	24.4	0.12	2007
Lefferts Lake	yellow perch	25.3	0.09	2007
Lenape Lake	American eel	53	0.42	2007
Lenape Lake	American eel	58.7	1.06	2007
Lenape Lake	American eel	62.4	0.89	2007
Lenape Lake	largemouth bass	40	1.60	2007
Lenape Lake	largemouth bass	44.6	1.04	2007
Lenape Lake	largemouth bass	45.9	1.61	2007
Manasquan Reservoir	American eel	54.2	0.08	2007
Manasquan Reservoir	American eel	58	0.05	2007
Manasquan Reservoir	American eel	82.4	0.17	2007
Manasquan Reservoir	largemouth bass	40.1	0.10	2007
Manasquan Reservoir	largemouth bass	44.5	0.21	2007
Manasquan Reservoir	largemouth bass	49.2	0.40	2007
Maple Lake	American eel	44.1	0.81	2007
Maple Lake	American eel	48.6	0.81	2007
Maple Lake	American eel	53.6	1.02	2007
Maple Lake	largemouth bass	33.1	0.43	2007
Maple Lake	largemouth bass	33.7	0.84	2007
Maple Lake	largemouth bass	34.7	0.86	2007
Maple Lake	largemouth bass	38	1.48	2007
Marlu Lake	common carp	64.4	0.04	2007
Marlu Lake	common carp	66.6	0.04	2007
Marlu Lake	common carp	67.9	0.04	2007
Marlu Lake	largemouth bass	34.5	0.08	2007
Marlu Lake	largemouth bass	41.4	0.09	2007
Marlu Lake	largemouth bass	44.2	0.14	2007
Parvin Lake	American eel	63.1	0.12	2007
Parvin Lake	American eel	64.9	0.12	2007
Parvin Lake	chain pickerel	45.7	0.24	2007
Parvin Lake	chain pickerel	47.7	0.21	2007

Parvin Lake	chain pickerel	51.4	0.19	2007
Parvin Lake	largemouth bass	35.9	0.16	2007
Parvin Lake	largemouth bass	39.5	0.21	2007
Parvin Lake	largemouth bass	43.3	0.26	2007
Parvin Lake	largemouth bass	44.6	0.19	2007
Parvin Lake	largemouth bass	49	0.27	2007
Pohatcong Lake	American eel	44.3	0.44	2007
Pohatcong Lake	American eel	45.3	0.95	2007
Pohatcong Lake	American eel	66.2	0.72	2007
Pohatcong Lake	largemouth bass	41.7	0.78	2007
Pohatcong Lake	largemouth bass	41.7	0.69	2007
Pohatcong Lake	largemouth bass	42.7	0.61	2007
Pohatcong Lake	largemouth bass	43	0.64	2007
Pohatcong Lake	yellow perch	26.5	0.14	2007
Pohatcong Lake	yellow perch	31.2	0.36	2007
Pohatcong Lake	yellow perch	34.6	0.83	2007
Shenandoah Lake	American eel	46.8	0.42	2007
Shenandoah Lake	American eel	47.9	0.24	2007
Shenandoah Lake	American eel	75.5	0.42	2007
Shenandoah Lake	chain pickerel	35.3	0.34	2007
Shenandoah Lake	chain pickerel	41.2	0.23	2007
Shenandoah Lake	chain pickerel	41.4	0.32	2007
Shenandoah Lake	largemouth bass	40.5	0.37	2007
Shenandoah Lake	largemouth bass	41.6	0.46	2007
Shenandoah Lake	largemouth bass	43.2	0.65	2007
Swimming River Reservoir	American eel	42.2	0.04	2007
Swimming River Reservoir	American eel	66.1	0.07	2007
Swimming River Reservoir	American eel	68.9	0.08	2007
Swimming River Reservoir	largemouth bass	40	0.09	2007
Swimming River Reservoir	largemouth bass	42.7	0.09	2007
Swimming River Reservoir	largemouth bass	50.1	0.15	2007
Wading River	chain pickerel	36.3	2.60	2007
Wading River	chain pickerel	37.5	2.63	2007
Wading River	chain pickerel	40.7	2.03	2007
Wilson Lake	chain pickerel	34.7	1.58	2007
Wilson Lake	chain pickerel	37	1.36	2007
Wilson Lake	chain pickerel	54.7	2.02	2007
Wilson Lake	largemouth bass	35.4	1.53	2007
Wilson Lake	largemouth bass	38.9	1.63	2007
Wilson Lake	largemouth bass	40.9	3.27	2007
Wilson Lake	yellow perch	28	1.25	2007
Wilson Lake	yellow perch	28	1.46	2007
Wilson Lake	yellow perch	30	0.87	2007

Appendix C

Non-Tidal Surface Water NJPDES Facility List to Quantify Potential Hg Load

NJPDES Permit Number	Facility Name	Permitted Flow	Description
NJ0000876	HERCULES INC - KENVIL	0.7	Industrial
NJ0020036	DEPT OF VETERANS AFFAIRS	0.08	Municipal minor
NJ0020184	NEWTOWN WASTEWATER TREATMENT PLANT	1.4	Municipal major
NJ0020206	ALLENTOWN BORO WWTP	0.238	Municipal minor
NJ0020281	CHATHAM HILL STP	0.03	Municipal minor
NJ0020290	CHATHAM TWP MAIN STP	1	Municipal minor
NJ0020354	BRANCHBURG NESHANIC STP	0.055	Municipal minor
NJ0020389	CLINTON TOWN WWTP	2.03	Municipal major
NJ0020419	LONG POND SCHOOL WTP	0.01	Municipal minor
NJ0020427	CALDWELL WASTEWATER TREATMENT PLANT	4.5	Municipal major
NJ0020532	HARRISON TOWNSHIP TREATMENT PLANT	0.8	Municipal minor
NJ0020605	ALLAMUCHY SEWERAGE TREATMENT PLANT	0.6	Municipal minor
NJ0020711	WARREN CO TECHNICAL SCHOOL STP	0.012	Municipal minor
NJ0021083	VETERANS AFFAIRS NJ HEALTH CARE SYSTEM-LYONS	0.4	Municipal minor
NJ0021091	JEFFERSON TWP HIGH-MIDDLE SCHOOL	0.0275	Municipal minor
NJ0021105	ARTHUR STANLICK SCHOOL	0.013	Municipal minor
NJ0021113	WASHINGTON BORO WWTP	1.5	Municipal major
NJ0021253	INDIAN HILLS HIGH SCHOOL	0.0336	Municipal minor
NJ0021326	MEDFORD LAKES BOROUGH STP	0.55	Municipal minor
NJ0021334	MENDHAM BORO	0.45	Municipal minor
NJ0021342	SKYVIEW/HIBROOK WTP	0.023	Municipal minor
NJ0021369	HACKETTSTOWN MUA	3.48	Municipal major
NJ0021571	SPRINGFIELD TWP ELEM SCH STP	0.0075	Municipal minor
NJ0021636	NEW PROVIDENCE WWTP	1.5	Municipal major
NJ0021717	BUENA BOROUGH MUA	0.4	Municipal major
NJ0021865	FIDDLER'S ELBOW CTRY CLUB WWTP	0.03	Municipal minor
NJ0021890	MILFORD SEWER UTILITY	0.4	Municipal minor
NJ0021954	CLOVERHILL STP	0.5	Municipal minor
NJ0022047	RARITAN TOWNSHIP MUA STP	3.8	Municipal major
NJ0022063	SUSSEX COUNTY HOMESTEAD WTP	0.05	Municipal minor
NJ0022101	BLAIR ACADEMY	0.05	Municipal minor
NJ0022110	EDUCATIONAL TESTING SERVICE	0.08	Municipal minor
NJ0022144	HAGEDORN PSYCHIATRIC HOSPITAL	0.052	Municipal minor
NJ0022250	WOODSTOWN WASTEWATER TREATMENT PLANT	0.53	Municipal minor
NJ0022276	STONYBROOK SCHOOL	0.01	Municipal minor
NJ0022349	ROCKAWAY VALLEY REG SA	12	Municipal major
NJ0022381	NORTHERN BURLINGTON COUNTY	0.0135	Municipal minor
NJ0022390	NPDC SEWAGE TREATMENT PLANT	0.5	Municipal minor
NJ0022438	HELEN A FORT MIDDLE SCHOOL	0.05	Municipal minor

NJ0022489	WARREN TWP SEWERAGE AUTH STAGE I-II STP	0.47	Municipal minor
NJ0022497	WARREN STAGE IV STP	0.8	Municipal minor
NJ0022586	MARLBORO PSYCHIATRIC HOSP STP	1	Municipal major
NJ0022675	ROXBURY TOWNSHIP	2	Municipal major
NJ0022764	RIVER ROAD STP	0.1172	Municipal minor
NJ0022781	POTTERSVILLE STP	0.048	Municipal minor
NJ0022845	HARRISON BROOK STP	2.5	Municipal major
NJ0022918	ROOSEVELT BORO WTP	0.25	Municipal minor
NJ0022985	WRIGHTSTOWN BOROUGH STP	0.337	Municipal minor
NJ0023001	SALVATION ARMY CAMP TECUMSEH	0.018	Municipal minor
NJ0023124	MONTGOMERY HIGH SCHOOL STP	0.035	Municipal minor
NJ0023175	ROUND VALLEY MIDDLE SCHOOL	0.009	Municipal minor
NJ0023311	KINGWOOD TWP SCHOOL	0.0048	Municipal minor
NJ0023493	WASHINGTON TOWNSHIP MUA WTP	0.5	Municipal minor
NJ0023540	NAVAL WEAPONS STATION EARLE	0.37	Municipal minor
NJ0023663	CARRIER FOUNDATION WTP	0.04	Municipal minor
NJ0023698	POMPTON LAKES BORO MUA	1.2	Municipal major
NJ0023728	PINE BROOK STP	8.8	Municipal major
NJ0023736	PINELANDS WASTEWATER COMPANY	0.5	Municipal minor
NJ0023787	EAST WINDSOR WATER POLLUTION CONTROL PLANT	4.5	Municipal major
NJ0023841	LOUNSBERRY HOLLOW MIDDLE SCH STP	0.032	Municipal minor
NJ0023949	LEGENDS RESORT & COUNTRY CLUB	0.35	Municipal minor
NJ0024031	ELMWOOD WTP	2.978	Municipal major
NJ0024040	WOODSTREAM STP	1.7	Municipal major
NJ0024091	UNION TWP ELEMENTARY SCHOOL	0.011	Municipal minor
NJ0024104	UNITED WATER PRINCETON MEADOWS	1.64	Municipal major
NJ0024163	BIG `N` SHOPPING CENTER STP	0.02	Municipal minor
NJ0024414	WEST MILFORD SHOPPING CENTER STP	0.02	Municipal minor
NJ0024457	OUR LADY OF THE MAGNIFICAT	0.0012	Municipal minor
NJ0024465	LONG HILL TOWNSHIP OF STP	0.9	Municipal minor
NJ0024490	VERONA TWP WTP	4.1	Municipal major
NJ0024511	LIVINGSTON WATER POLLUTION CONTROL FACILITY	4.6	Municipal major
NJ0024716	PHILLIPSBURG TOWN STP	3.5	Municipal major
NJ0024759	EWING-LAWRENCE SA WTP	16	Municipal major
NJ0024791	RIDGEWOOD VILLAGE WPC FACILITY	5	Municipal major
NJ0024813	NORTHWEST BERGEN CNTY UA	16.8	Municipal major
NJ0024821	PEMBERTON TOWNSHIP MUA STP	2.5	Municipal major
NJ0024864	SOMERSET RARITAN VALLEY SA	21.3	Municipal major
NJ0024902	HANOVER SEWERAGE AUTHORITY	4.61	Municipal major
NJ0024911	BUTTERWORTH WATER POLLUTION CONTROL UTILITY	3.3	Municipal major
NJ0024929	WOODLAND WATER POLLUTION CONTROL UTILITY(WPCU	2	Municipal major
NJ0024937	MOLITOR WATER POLLUTION CONTROL FACILITY	5	Municipal major
NJ0024970	PARSIPPANY TROY HILLS	16	Municipal major
NJ0025160	HAMMONTON WTPF	1.6	Municipal major
NJ0025330	CEDAR GROVE STP	2	Municipal major

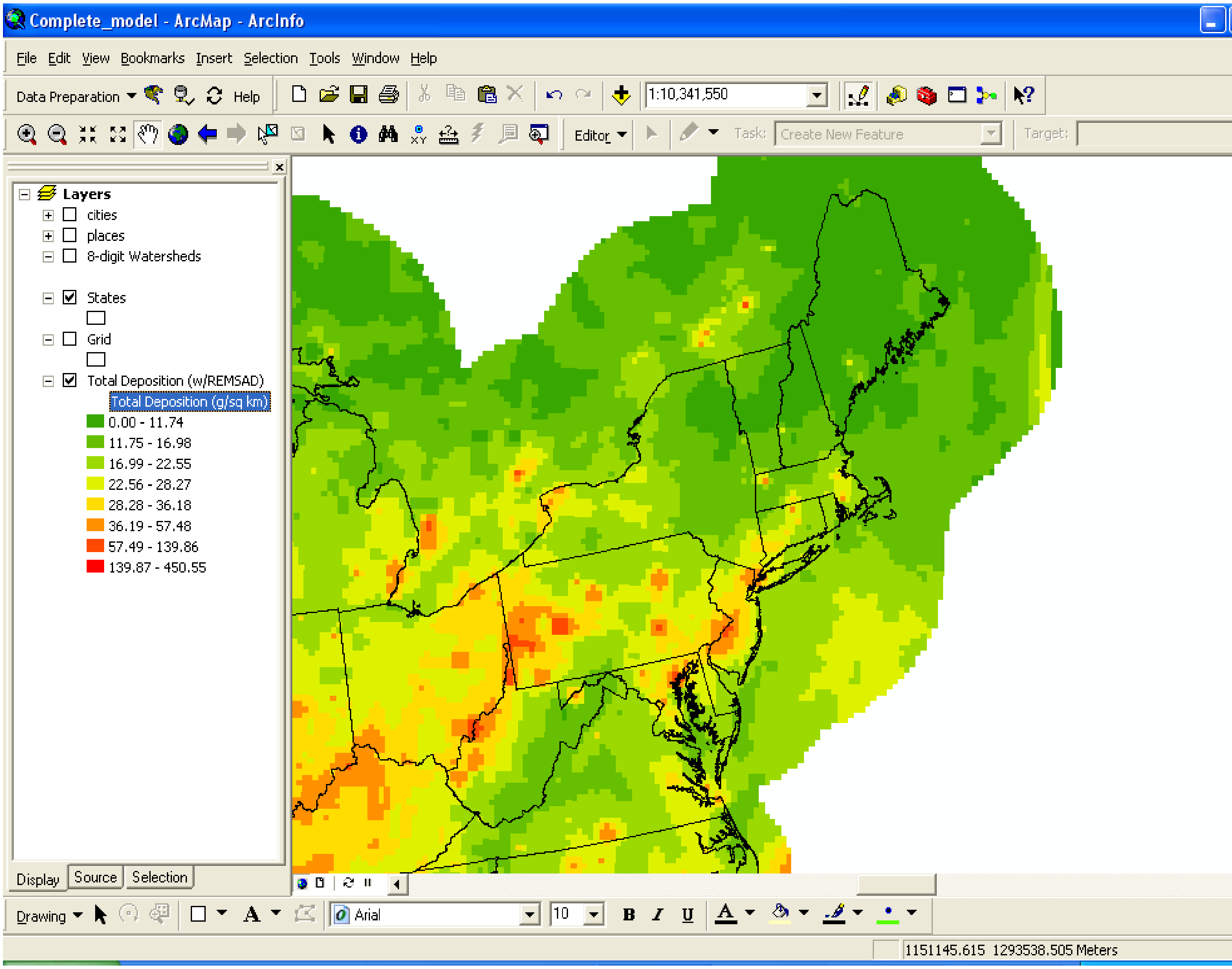
NJ0025496	MORRISTOWN SEWER UTILITY	6.3	Municipal major
NJ0025518	FLORHAM PARK SEWERAGE AUTH	1.4	Municipal major
NJ0026174	CRESCENT PARK STP	0.064	Municipal minor
NJ0026387	BERNARDSVILLE STP	0.8	Municipal minor
NJ0026689	GREYSTONE PARK PSYCH HOSPITAL	0.4	Municipal minor
NJ0026697	READINGTON TWP PUBLIC SCHOOL	0.017	Municipal minor
NJ0026719	ALBERT C WAGNER YOUTH CORRECTIONAL FACILITY	1.3	Municipal minor
NJ0026727	COLORADO CAFE WTP	0.0175	Municipal minor
NJ0026824	CHESTER SHOPPING CENTER	0.011	Municipal minor
NJ0026832	MEDFORD TWP WASTEWATER TREATMENT PLANT	1.75	Municipal major
NJ0026867	WHITE ROCK STP	0.1295	Municipal minor
NJ0026891	BURNT HILL TREATMENT PLANT #1	0.0153	Municipal minor
NJ0026905	STAGE II TREATMENT PLANT	0.48	Municipal minor
NJ0027006	RINGWOOD ACRES TREATMENT PLANT	0.036	Municipal minor
NJ0027031	HOLMDEL BD OF ED VILLAGE SCHOOL STP	0.01	Municipal minor
NJ0027049	POPE JOHN XXIII HIGH SCH WTP	0.022	Municipal minor
NJ0027057	SPARTA PLAZA WTP	0.05	Municipal minor
NJ0027065	SPARTA ALPINE SCHOOL	0.025	Municipal minor
NJ0027227	TRUMP NATIONAL GOLF COURSE	0.0005	Municipal minor
NJ0027464	HANOVER MOBILE VILLAGE ASSOC	0.02	Municipal minor
NJ0027511	CALIFORNIA VILLAGE SEWER PLANT	0.032	Municipal minor
NJ0027529	CAREONE @HOLMDEL	0.025	Municipal minor
NJ0027553	LESTER D. WILSON ELEM SCHOOL	0.0075	Municipal minor
NJ0027561	DELAWARE TOWNSHIP MUA	0.065	Municipal minor
NJ0027596	SPARTAN VILLAGE MOBILE HOME PK	0.038	Municipal minor
NJ0027669	AWOSTING STP	0.045	Municipal minor
NJ0027677	OLDE MILFORD ESTATES STP	0.172	Municipal minor
NJ0027685	HIGHVIEW ACRES STP	0.2	Municipal minor
NJ0027715	MERCER CO CORRECTION CTR STP	0.09	Municipal minor
NJ0027731	PRINCETON HEALTHCARE SYSTEM	0.296	Industrial
NJ0027774	OAKWOOD KNOLLS WWTP	0.035	Municipal minor
NJ0027821	MUSCONETCONG SEWERAGE AUTHORITY	5.79	Municipal major
NJ0027961	BERKELEY HEIGHTS WPCF	3.1	Municipal major
NJ0028002	MOUNTAIN VIEW STP	13.5	Municipal major
NJ0028304	QUALITY INN OF LEDGEWOOD	0.04	Municipal minor
NJ0028436	RARITAN TWP MUA-FLEMINGTON	2.35	Municipal major
NJ0028479	NJ TRAINING SCHOOL FOR BOYS	0.15	Municipal minor
NJ0028487	MOUNTAINVIEW CORRECTIONAL INSTITUTION	0.26	Municipal minor
NJ0028541	BIRCH HILL PARK STP	0.02	Municipal minor
NJ0028665	MOBILE ESTATES OF SOUTHAMPTON INC	0.06	Municipal minor
NJ0028894	KITTATINNY REG HS BD OF ED	0.045	Municipal minor
NJ0029041	REGENCY @ SUSSEX APT	0.08	Municipal minor
NJ0029386	TWO BRIDGES WASTEWATER TREATMENT PLANT	10	Municipal major
NJ0029432	ROBERT ERSKINE SCHOOL STP	0.008	Municipal minor
NJ0029475	HIGHTSTOWN BORO AWWTP	1	Municipal major

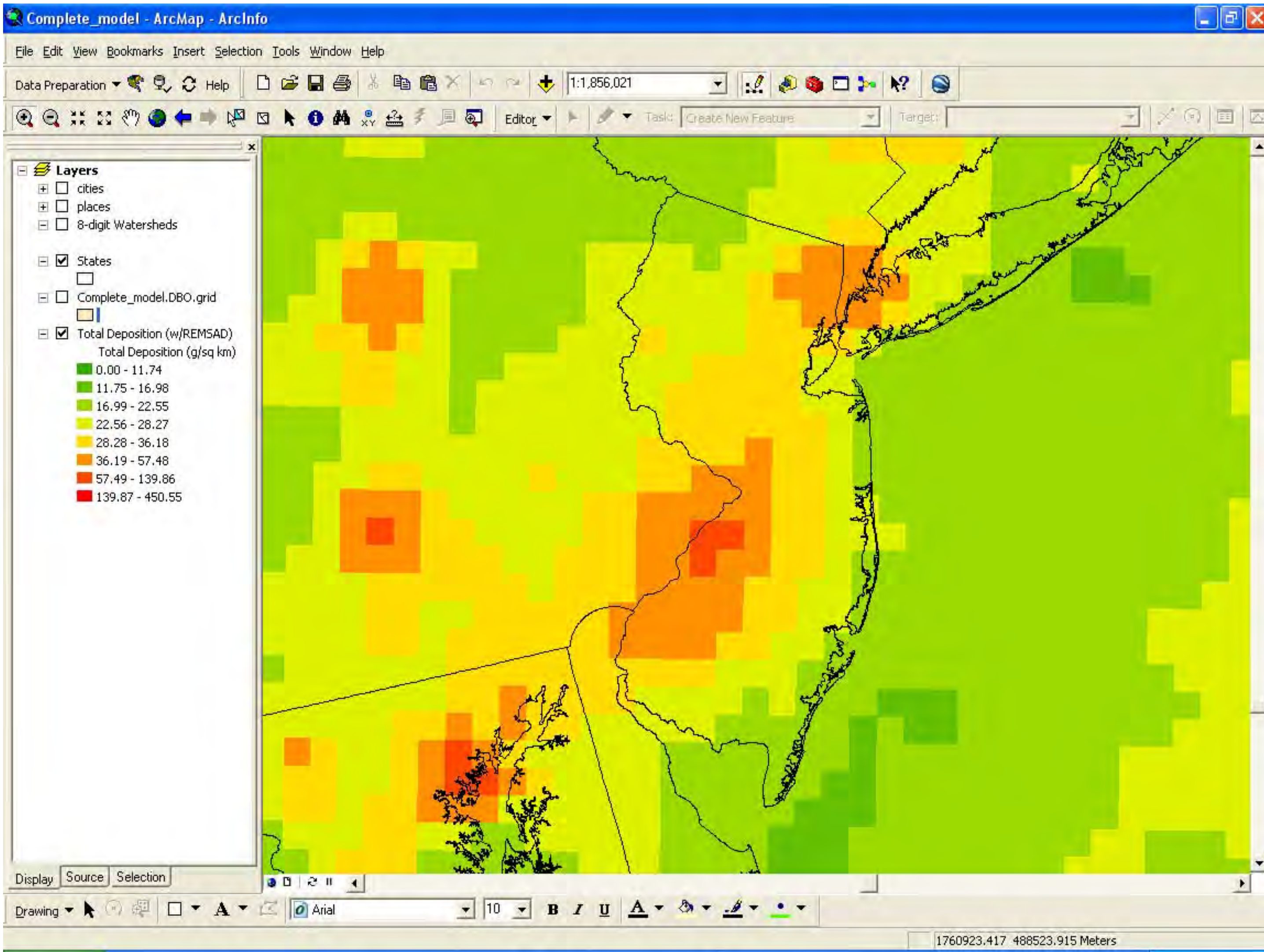
NJ0029831	FRENCHTOWN WASTEWATER TREATMENT PLANT	0.15	Municipal minor
NJ0029858	OAKLAND CARE CENTER INC	0.03	Municipal minor
NJ0031046	NORTH WARREN REG SCH DIST WTF	0.02	Municipal minor
NJ0031119	STONY BROOK RSA- RIVER ROAD STP	13.06	Municipal major
NJ0031585	HIGH POINT REGIONAL HS	0.03	Municipal minor
NJ0031615	CAMDEN COUNTY VOC & TECH SCHOOL	0.058	Municipal minor
NJ0031674	REMINGTON'S RESTAURANT	0.028	Municipal minor
NJ0031771	COLTS NECK INN HOTEL	0.006	Municipal minor
NJ0032395	RINGWOOD PLAZA STP	0.01168	Municipal minor
NJ0033995	ENVIRONMENTAL DISPOSAL CORP	2.1	Municipal major
NJ0035084	EXXONMOBIL RESEARCH & ENGINEERING CO	0.22	Industrial
NJ0035114	BELVIDERE AREA WWTF	0.5	Municipal minor
NJ0035301	STONY BROOK RGNL SEWERAGE AUTH	0.3	Municipal minor
NJ0035319	STONY BROOK RSA	0.3	Municipal minor
NJ0035483	OXFORD AREA WTF	0.5	Municipal minor
NJ0035670	ALEXANDRIA MIDDLE SCHOOL	0.011	Municipal minor
NJ0035718	HOLMDEL WASTEWATER TREATMENT FACILITY	0.04	Municipal minor
NJ0050130	RIVERSIDE FARMS STP	0.145	Municipal minor
NJ0050369	WARREN STAGE V STP	0.38	Municipal minor
NJ0050580	HAMPTON COMMONS WASTEWATER FACILITY	0.05	Municipal minor
NJ0052256	CHATHAM GLEN STP	0.155	Municipal minor
NJ0053112	CHAPEL HILL ESTATES STP	0.01	Municipal minor
NJ0053350	SUSSEX CNTY MUA UPPER WALLKILL FACILITY	3	Municipal major
NJ0053759	WANAQUE VALLEY REGIONAL SEWERAGE AUTHORITY	1.25	Municipal major
NJ0055395	BURLINGTON CNTY RESOURCE RECOVERY COMPLEX	2.075	Industrial
NJ0060038	PIKE BROOK STP	0.67	Municipal minor
NJ0067733	OXBRIDGE WASTEWATER TREATMENT PLANT	0.16	Municipal minor
NJ0069523	CHERRY VALLEY STP	0.286	Municipal minor
NJ0080811	RAMAPO RIVER RESERVE WWTP	0.1137	Municipal minor
NJ0098663	HOMESTEAD TREATMENT UTILITY	0.25	Municipal minor
NJ0098922	READINGTON-LEBANON SA	0.8	Municipal minor
NJ0100528	GLEN MEADOWS/TWIN OAKS STP	0.025	Municipal minor
NJ0102270	EVOINK DEGUSSA CORP	0.015	Industrial
NJ0102563	ROUTE 78 OFFICE AREA WWTF	0.09653	Municipal minor
NJ0109061	LONG VALLEY VILLAGE WTP	0.244	Municipal minor
NJ0136603	MORRIS LAKE WTP	0.2	Municipal minor
NJG0005134	HERCULES GROUNDWATER TREATMT AT GEO SPEC CHEM	0.432	Industrial

Footnote: TMDL Section 4.0 - Source Assessment describes list construction.

Appendix D

Mercury Air Deposition Load for New Jersey (provided by Mr. Dwight Atkinson of EPA)

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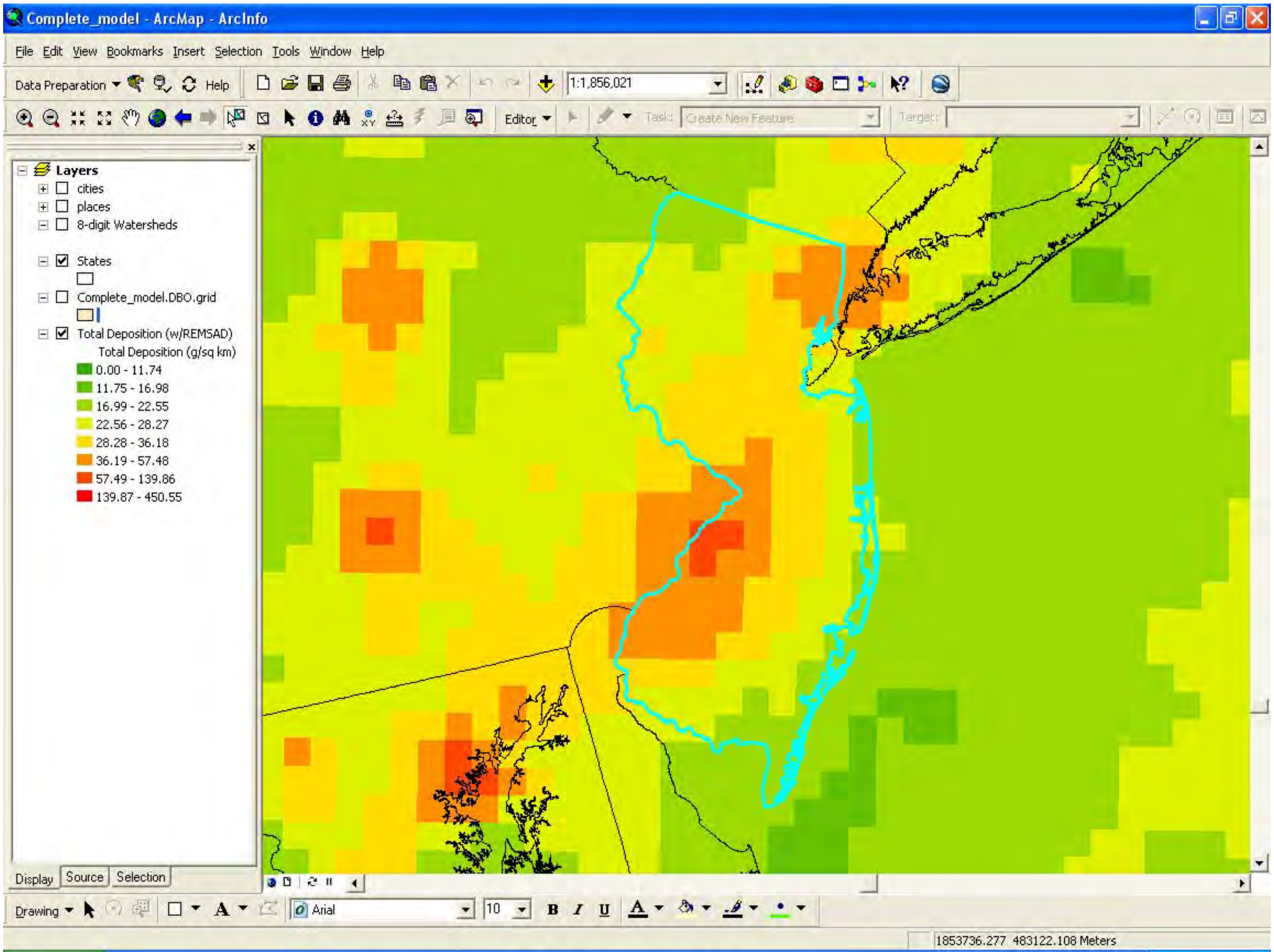
File Edit View Bookmarks Insert Selection Tools Window Help
Data Preparation
Help
1:1,856,021
Editor
Task: Create New Feature
Target:
Layers
cities
places
8-digit Watersheds
States
Complete_model.DBO.grid
Total Deposition (w/REMSAD)
Total Deposition (g/sq km)
0.00 - 11.74
11.75 - 16.98
16.99 - 22.55
22.56 - 28.27
28.28 - 36.18
36.19 - 57.48
57.49 - 139.86
139.87 - 450.55
Display Source Selection
Drawing
Arial
10
1760923.417 488523.915 Meters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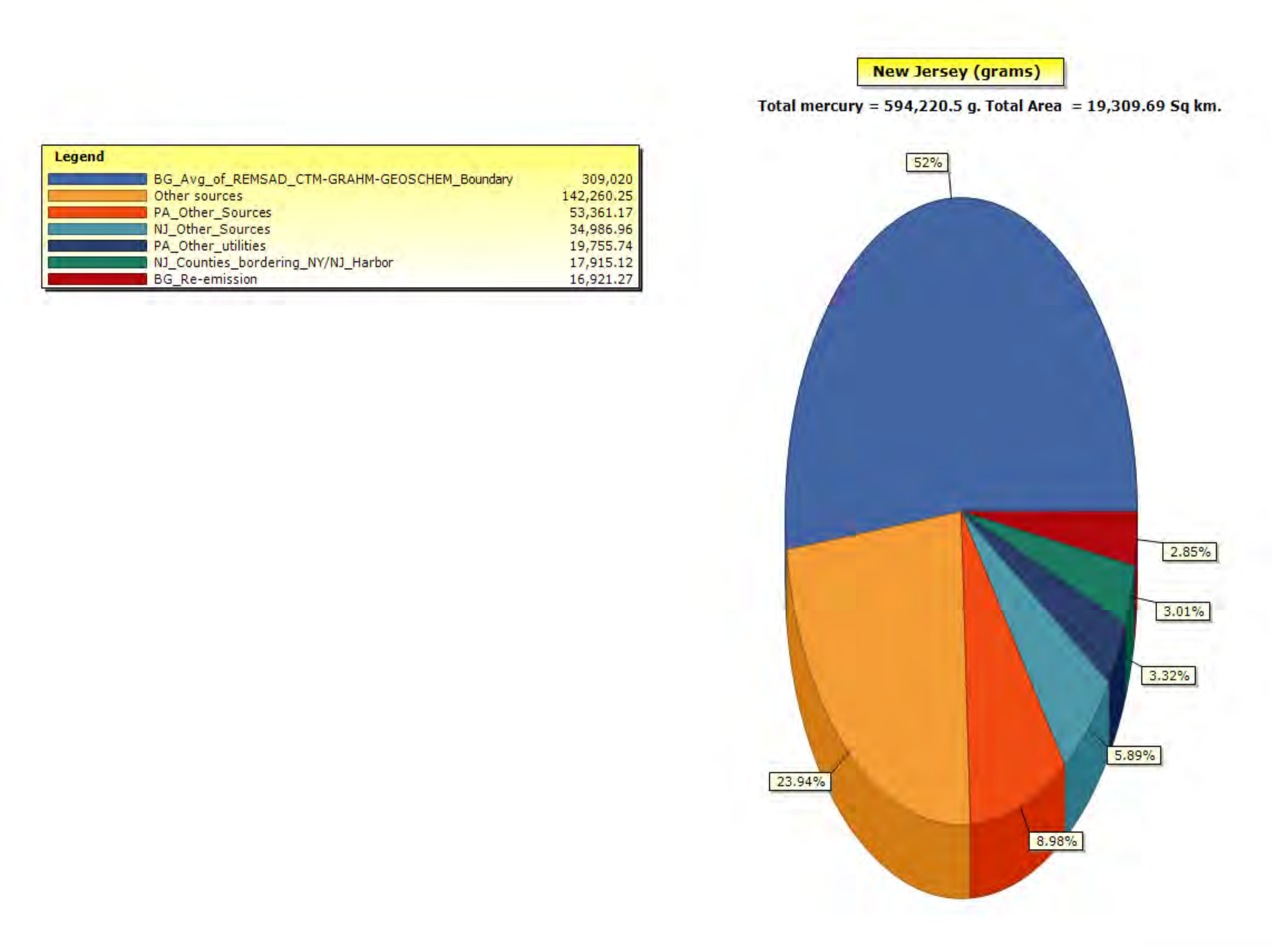
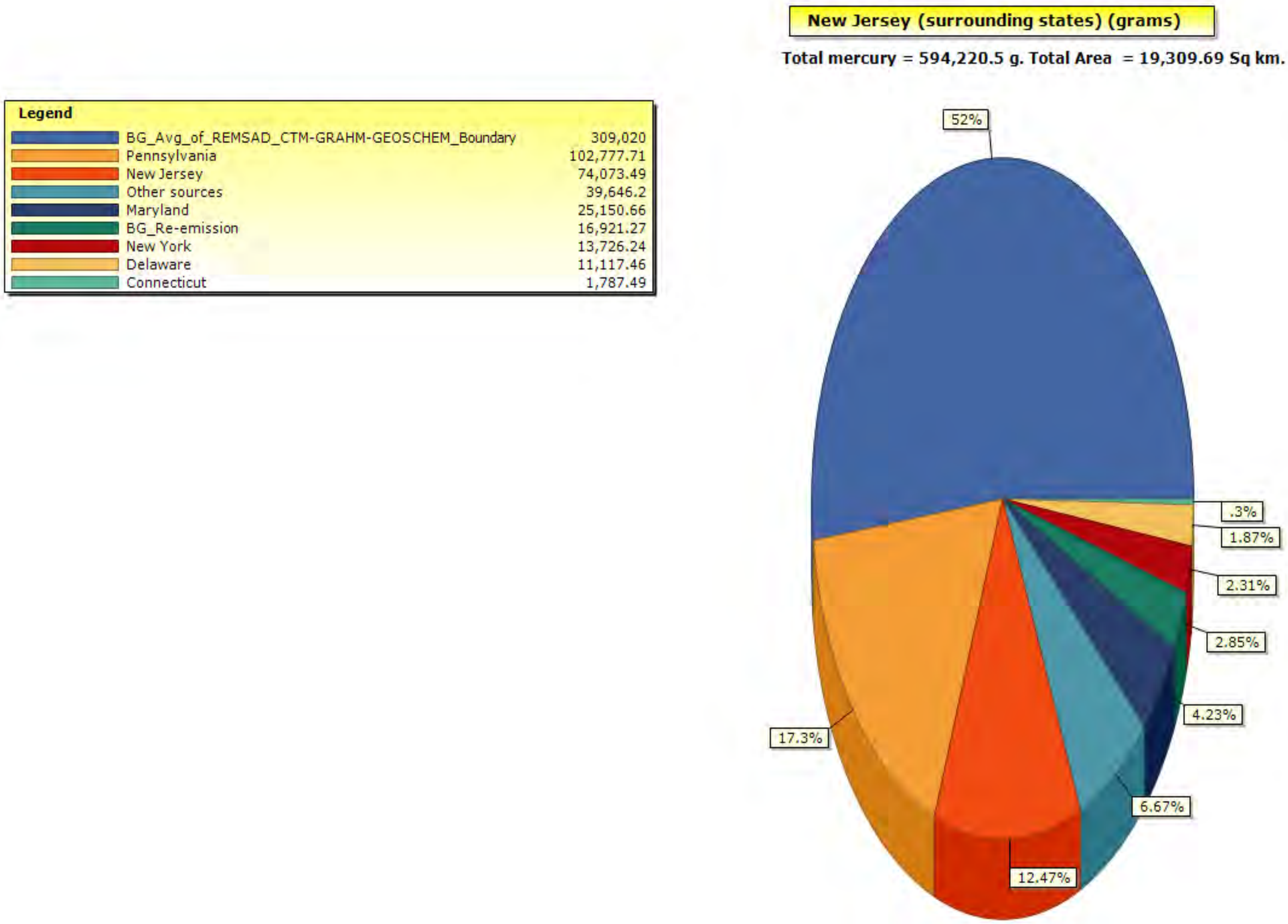
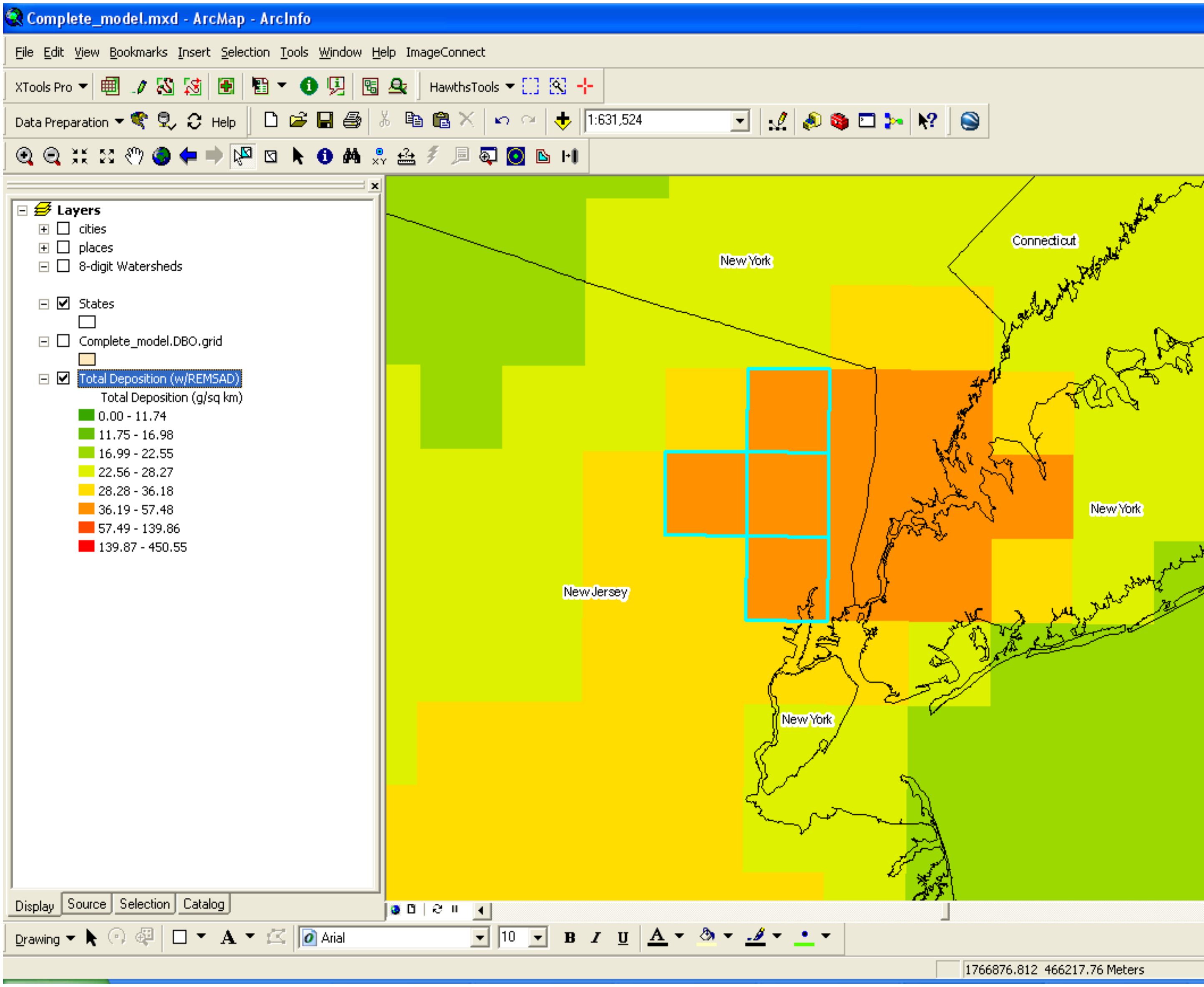
Data Preparation
Help
1:1,856,021
Editor
Task: Create New Feature
Target:
Layers
cities
places
8-digit Watersheds
States
Complete_model.DBO.grid
Total Deposition (w/REMSAD)
Total Deposition (g/sq km)
0.00 - 11.74
11.75 - 16.98
16.99 - 22.55
22.56 - 28.27
28.28 - 36.18
36.19 - 57.48
57.49 - 139.86
139.87 - 450.55
Display
Source
Selection
Drawing
Arial
10
1853736.277 483122.108 Meters


New Jersey (grams)
Total mercury = 594,220.5 g. Total Area = 19,309.69 Sq km.
Legend
BG_Avg_of_REMSAD_CTM-GRAHM-GEOSCHEM_Boundary 309,020
Other sources 142,260.25
PA_Other_Sources 53,361.17
NJ_Other_Sources 34,986.96
PA_Other_utilities 19,755.74
NJ_Counties_bordering_NY/NJ_Harbor 17,915.12
BG_Re-emission 16,921.27
52%
2.85%
3.01%
3.32%
5.89%
23.94%
8.98%


New Jersey (surrounding states) (grams)
Total mercury = 594,220.5 g. Total Area = 19,309.69 Sq km.
Legend
BG_Avg_of_REMSAD_CTM-GRAHM-GEOSCHEM_Boundary 309,020
Pennsylvania 102,777.71
New Jersey 74,073.49
Other sources 39,646.2
Maryland 25,150.66
BG_Re-emission 16,921.27
New York 13,726.24
Delaware 11,117.46
Connecticut 1,787.49
52%
.3%
1.87%
2.31%
2.85%
4.23%
6.67%
12.47%
17.3%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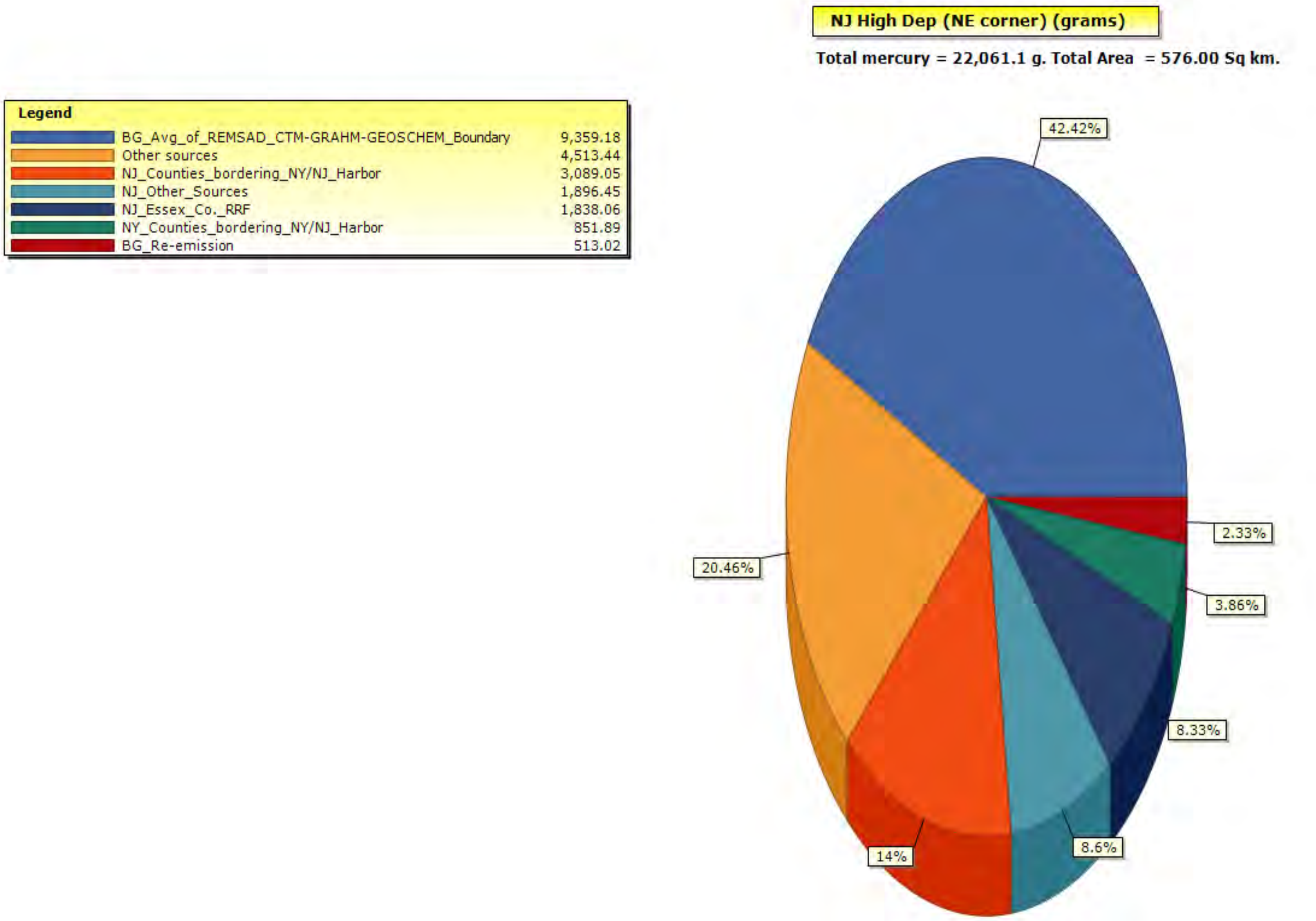
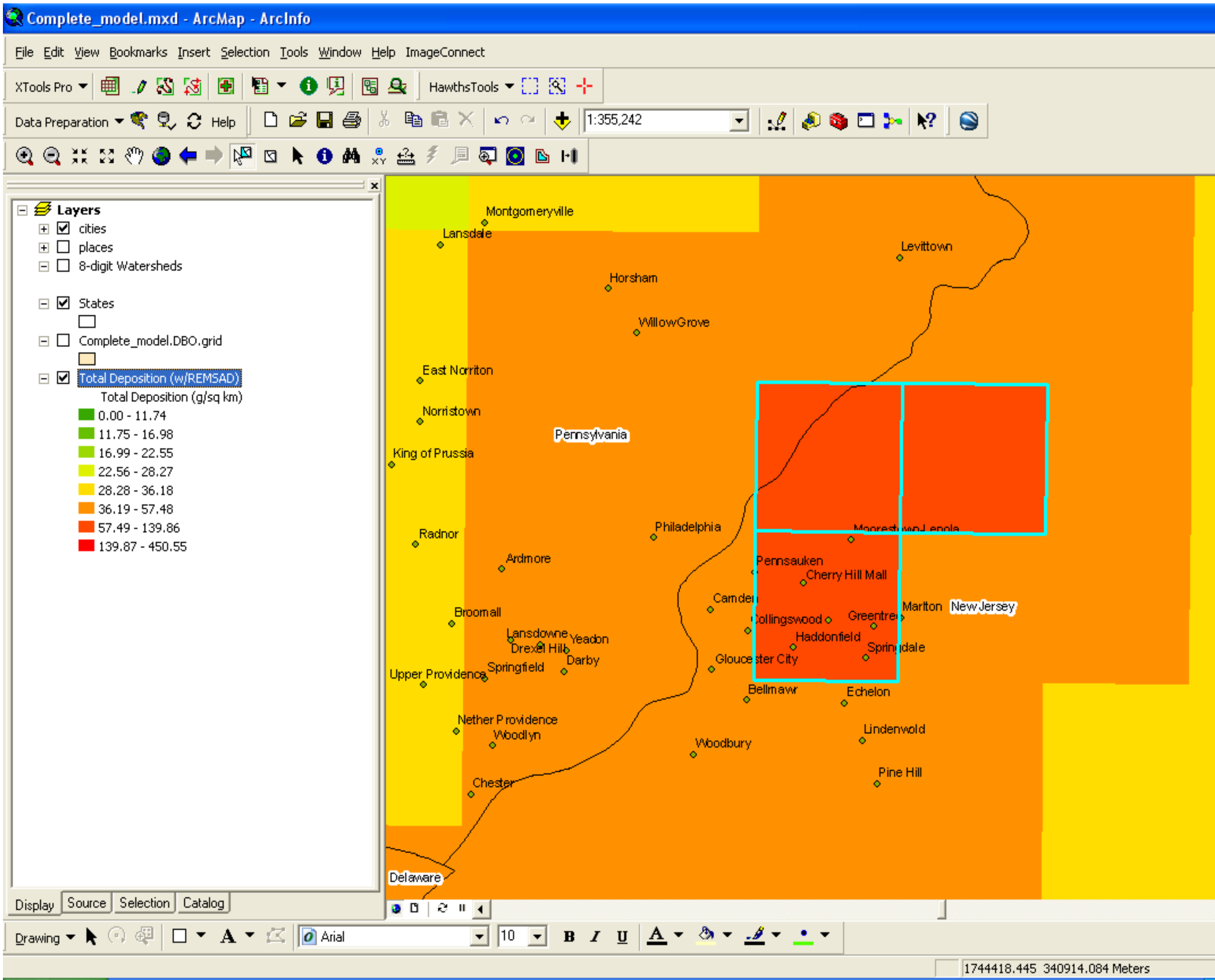
XTools Pro
HawthsTools
Data Preparation
Help
1:631,524
Layers
cities
places
8-digit Watersheds
States
Complete_model.DBO.grid
Total Deposition (w/REMSAD)
Total Deposition (g/sq km)
0.00 - 11.74
11.75 - 16.98
16.99 - 22.55
22.56 - 28.27
28.28 - 36.18
36.19 - 57.48
57.49 - 139.86
139.87 - 450.55
New York
Connecticut
New York
New Jersey
New York
Display
Source
Selection
Catalog
Drawing
Arial
10
1766876.812 466217.76 Meters


NJ High Dep (NE corner) (grams)
Total mercury = 22,061.1 g. Total Area = 576.00 Sq km.
Legend
BG_Avg_of_REMSAD_CTM-GRAHM-GEOSCHEM_Boundary 9,359.18
Other sources 4,513.44
NJ_Counties_bordering_NY/NJ_Harbor 3,089.05
NJ_Other_Sources 1,896.45
NJ_Essex_Co._RRF 1,838.06
NY_Counties_bordering_NY/NJ_Harbor 851.89
BG_Re-emission 513.02
42.42%
20.46%
14%
8.6%
8.33%
3.86%
2.33%


Complete_model.mxd - ArcMap - ArcInfo
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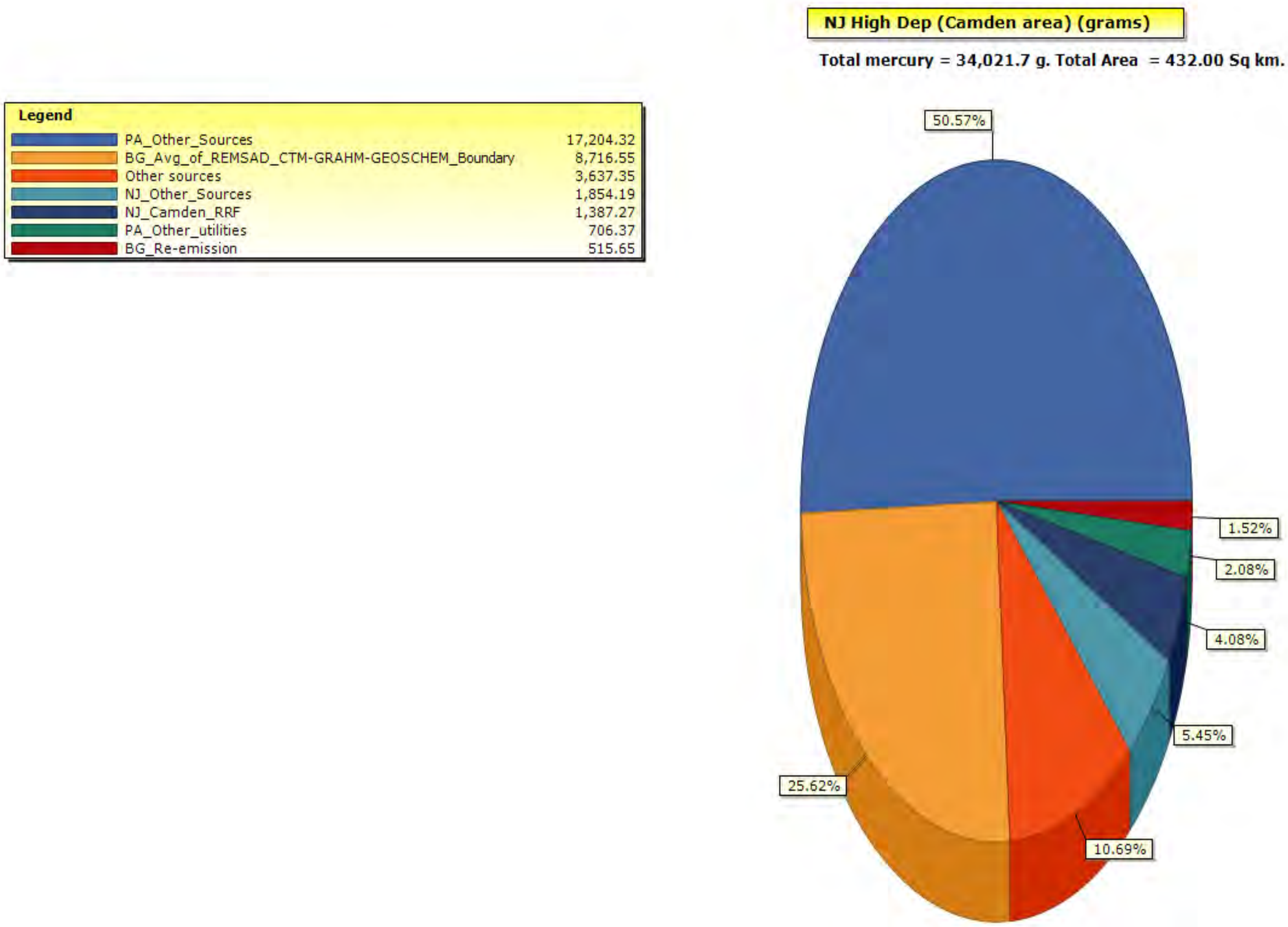
XTools Pro
HawthsTools
Data Preparation
Help
1:355,242
Layers
cities
places
8-digit Watersheds
States
Complete_model.DBO.grid
Total Deposition (w/REMSAD)
Total Deposition (g/sq km)
0.00 - 11.74
11.75 - 16.98
16.99 - 22.55
22.56 - 28.27
28.28 - 36.18
36.19 - 57.48
57.49 - 139.86
139.87 - 450.55
Display
Source
Selection
Catalog
Montgomeryville
Lansdale
Levittown
Horsham
Willow Grove
East Norriton
Norristown
Pennsylvania
King of Prussia
Philadelphia
Radnor
Ardmore
Pennsauken
Cherry Hill Mall
Camden
Marlton
New Jersey
Broomall
Collingswood
Greentree
Lansdowne
Yeadon
Haddonfield
Drexel Hill
Darby
Springfield
Upper Providence
Bellmawr
Echelon
Nether Providence
Woodlyn
Woodbury
Lindenwold
Chester
Pine Hill
Delaware
Drawing
Arial
10
1744418.445 340914.084 Meters


NJ High Dep (Camden area) (grams)
Total mercury = 34,021.7 g. Total Area = 432.00 Sq km.
Legend
PA_Other_Sources 17,204.32
BG_Avg_of_REMSAD_CTM-GRAHM-GEOSCHEM_Boundary 8,716.55
Other sources 3,637.35
NJ_Other_Sources 1,854.19
NJ_Camden_RRF 1,387.27
PA_Other_utilities 706.37
BG_Re-emission 515.65
50.57%
1.52%
2.08%
4.08%
5.45%
25.62%
10.69%

SPPP Form 15 – Optional Measures

All records must be available upon request by NJDEP.

1. Describe any Best Management Practice(s) the permittee has developed that extend beyond the requirements of the Tier A MS4 NJPDES permit that prevents or reduces water pollution.
None currently in place.
2. Has the permittee adopted a Refuse Container/Dumpster Ordinance?
The Borough of Oakland adopted Ordinance No. 10-CODE-627 "Regulating Refuse Containers/Dumpsters" on July 28, 2010.

Attachment D – Major Development Stormwater Summary

General Information

1. Project Name:
2. Municipality: County: Block(s): Lot(s):
3. Site Location (State Plane Coordinates – NAD83): E: N:
4. Date of Final Approval for Construction by Municipality:
   Date of Certificate of Occupancy:
5. Project Type (check all that apply):
   Residential ☐ Commercial ☐ Industrial ☐ Other (please specify) ___________________________________
6. Soil Conservation District Project Number:
7. Did project require an NJDEP Land Use Permit? Yes ○ No ○ Land Use Permit #:
8. Did project require the use of any mitigation measures? Yes ○ No ○
   If yes, which standard was mitigated? ____

Site Design Specifications

1. Area of Disturbance (acres): Area of Proposed Impervious (acres):
2. List all Hydrologic Soil Groups:
3. Please Identify the Amount of Each Best Management Practices (BMPs) Utilized in Design Below:
   Bioretention Systems ___ Constructed Wetlands ___ Dry Wells ___ Extended Detention Basins ___
   Infiltration Basins ___ Combination Infiltration/Detention Basins ___ Manufactured Treatment Devices___
   Pervious Paving Systems ___ Sand Filters ___ Vegetative Filter Strips ___ Wet Ponds ___
   Grass Swales ___ Subsurface Gravel Wetlands ___ Other ___________________________

Storm Event Information

Storm Event - Rainfall (inches and duration): 2 yr.: ________________ 10 yr.: _______________

100 yr.: ______________ WQDS: _______________

Runoff Computation Method:
NRCS: Dimensionless Unit Hydrograph ☐ NRCS: Delmarva Unit Hydrograph ☐ Rational ☐ Modified Rational ☐
Other: ______________________________

Basin Specifications (answer all that apply)

If more than one basin, attach multiple sheets

1. Type of Basin: Surface/Subsurface (select one): Surface ○ Subsurface ○
2. Owner (select one):
   ○ Public ○ Private: If so, Name: Phone number:
3. Basin Construction Completion Date:
4. Drain Down Time (hr.):
5. Design Soil Permeability (in./hr.):
6. Seasonal High Water Table Depth from Bottom of Basin (ft.): Date Obtained:
7. Groundwater Recharge Methodology (select one): 2 Year Difference ○ NJGRS ○ Other ○ NA ○
8. Groundwater Mounding Analysis (select one): Yes ○ No ○ If, Yes Methodology Used:
9. Maintenance Plan Submitted: Yes ○ No ○ Is the Basin Deed Restricted: Yes ○ No ○

Comments:

Name of Person Filling Out This Form: _______________________ Signature: _______________________

Title: ____ Date: ____________________________

Basin Specifications (answer all that apply) *If more than one basin, attach multiple sheets*
1. Type of Basin: Surface/Subsurface (select one): Surface ○ Subsurface ○
2. Owner (select one): ○ Public ○ Private: If so, Name: Phone number:
3. Basin Construction Completion Date:
4. Drain Down Time (hr.):
5. Design Soil Permeability (in./hr.):
6. Seasonal High Water Table Depth from Bottom of Basin (ft.): Date Obtained:
7. Groundwater Recharge Methodology (select one): 2 Year Difference ○ NJGRS ○ Other ○ NA ○
8. Groundwater Mounding Analysis (select one): Yes ○ No ○ If, Yes Methodology Used:
9. Maintenance Plan Submitted: Yes ○ No ○ Is the Basin Deed Restricted: Yes ○ No ○

Basin Specifications (answer all that apply) *If more than one basin, attach multiple sheets*
1. Type of Basin: Surface/Subsurface (select one): Surface ○ Subsurface ○
2. Owner (select one): ○ Public ○ Private: If so, Name: Phone number:
3. Basin Construction Completion Date:
4. Drain Down Time (hr.):
5. Design Soil Permeability (in./hr.):
6. Seasonal High Water Table Depth from Bottom of Basin (ft.): Date Obtained:
7. Groundwater Recharge Methodology (select one): 2 Year Difference ○ NJGRS ○ Other ○ NA ○
8. Groundwater Mounding Analysis (select one): Yes ○ No ○ If, Yes Methodology Used:
9. Maintenance Plan Submitted: Yes ○ No ○ Is the Basin Deed Restricted: Yes ○ No ○

Basin Specifications (answer all that apply) *If more than one basin, attach multiple sheets*
1. Type of Basin: Surface/Subsurface (select one): Surface ○ Subsurface ○
2. Owner (select one): ○ Public ○ Private: If so, Name: Phone number:
3. Basin Construction Completion Date:
4. Drain Down Time (hr.):
5. Design Soil Permeability (in./hr.):
6. Seasonal High Water Table Depth from Bottom of Basin (ft.): Date Obtained:
7. Groundwater Recharge Methodology (select one): 2 Year Difference ○ NJGRS ○ Other ○ NA ○
8. Groundwater Mounding Analysis (select one): Yes ○ No ○ If, Yes Methodology Used:
9. Maintenance Plan Submitted: Yes ○ No ○ Is the Basin Deed Restricted: Yes ○ No ○

Name of Person Filling Out This Form: ________________________ Signature: ________________________

Title: ____ Date: ____________________________

Major Development Project List

Provide the following information for each approved development or redevelopment project that is regulated by the Tier A MS4 NJPDES Permit, and not exempted under N.J.A.C. 7:8-1.6(b).

Tier A Municipality: ____________________		NJPDES#: NJG________________			PI ID#: ______________		Calendar Year: ________
Project Name	Block(s) / Lot(s)	5G3 Construction Stormwater Permit Auth.#	NJDEP Land Use Permit Required? (Y/N)	Total Area of Disturbance (acres)	Increase of Impervious > ¼ acre? (Y/N)	Variance or Exemption Granted As Per Part IV.B.4.h of the Tier A MS4 Permit	Design Reviewer(s)
			Y☐ N☐		Y☐ N☐	Y☐ N☐	
			Y☐ N☐		Y☐ N☐	Y☐ N☐	
			Y☐ N☐		Y☐ N☐	Y☐ N☐	
			Y☐ N☐		Y☐ N☐	Y☐ N☐	
			Y☐ N☐		Y☐ N☐	Y☐ N☐	
			Y☐ N☐		Y☐ N☐	Y☐ N☐	
			Y☐ N☐		Y☐ N☐	Y☐ N☐	
			Y☐ N☐		Y☐ N☐	Y☐ N☐	
			Y☐ N☐		Y☐ N☐	Y☐ N☐	
			Y☐ N☐		Y☐ N☐	Y☐ N☐	
			Y☐ N☐		Y☐ N☐	Y☐ N☐	
			Y☐ N☐		Y☐ N☐	Y☐ N☐	

Attachment E – Best Management Practices for Municipal Maintenance Yards and Other Ancillary Operations

The Tier A Municipality shall implement the following practices at municipal maintenance yards and other ancillary operations owned or operated by the municipality. Inventory of Materials and Machinery, and Inspections and Good Housekeeping shall be conducted at all municipal maintenance yards and other ancillary operations. All other Best Management Practices shall be conducted whenever activities described below occur. Ancillary operations include but are not limited to impound yards, permanent and mobile fueling locations, and yard trimmings and wood waste management sites.

Inventory of Materials and Machinery

The SPPP shall include a list of all materials and machinery located at municipal maintenance yards and ancillary operations which could be a source of pollutants in a stormwater discharge. The materials in question include, but are not limited to: raw materials; intermediate products; final products; waste materials; by-products; machinery and fuels; and lubricants, solvents, and detergents that are related to the municipal maintenance yard operations and ancillary operations. Materials or machinery that are not exposed to stormwater at the municipal maintenance yard or related to its operations do not need to be included.

Inspections and Good Housekeeping

1. Inspect the entire site, including the site periphery, monthly (under both dry and wet conditions, when possible). Identify conditions that would contribute to stormwater contamination, illicit discharges or negative impacts to the Tier A Municipality's MS4. Maintain an inspection log detailing conditions requiring attention and remedial actions taken for all activities occurring at Municipal Maintenance Yards and Other Ancillary Operations. This log must contain, at a minimum, a record of inspections of all operations listed in Part IV.B.5.c. of this permit including dates and times of the inspections, and the name of the person conducting the inspection and relevant findings. This log must be kept on-site with the SPPP and made available to the Department upon request. See the Tier A Municipal Guidance document (www.nj.gov/dep/dwq/tier_a_guidance.htm) for additional information.

2. Conduct cleanups of spills of liquids or dry materials immediately after discovery. All spills shall be cleaned using dry cleaning methods only. Clean up spills with a dry, absorbent material (i.e., kitty litter, sawdust, etc.) and sweep the rest of the area. Dispose of collected waste properly. Store clean-up materials, spill kits and drip pans near all liquid transfer areas, protected from rainfall.

3. Properly label all containers. Labels shall be legible, clean and visible. Keep containers in good condition, protected from damage and spillage, and tightly closed when not in use. When practical, store containers indoors. If indoor storage is not practical, containers may be stored outside if covered and placed on spill platforms or clean pallets. An area that is graded and/or bermed to prevent run-through of stormwater may be used in place of spill platforms or clean pallets. Outdoor storage locations shall be regularly maintained.

Fueling Operations

1. Establish, maintain and implement standard operating procedures to address vehicle fueling; receipt of bulk fuel deliveries; and inspection and maintenance of storage tanks, including the associated piping and fuel pumps.

   a. Place drip pans under all hose and pipe connections and other leak-prone areas during bulk transfer of fuels.

   b. Block storm sewer inlets, or contain tank trucks used for bulk transfer, with temporary berms or temporary absorbent booms during the transfer process. If temporary berms or booms are being used instead of blocking the storm sewer inlets, all hose connection points associated with the transfer of fuel shall be within the temporarily bermed or boomed area during the loading/unloading of bulk fuels. A trained employee shall be present to supervise the bulk transfer of fuel.

   c. Clearly post, in a prominent area of the facility, instructions for safe operation of fueling equipment. Include all of the following:
      - "Topping off of vehicles, mobile fuel tanks, and storage tanks is strictly prohibited"
      - "Stay in view of fueling nozzle during dispensing"
      - Contact information for the person(s) responsible for spill response.

   d. Immediately repair or replace any equipment, tanks, pumps, piping and fuel dispensing equipment found to be leaking or in disrepair.

Discharge of Stormwater from Secondary Containment

The discharge pipe/outfall from a secondary containment area (e.g. fuel storage, de-icing solution storage, brine solution) shall have a valve and the valve shall remain closed at all times except as described below. A municipality may discharge stormwater accumulated in a secondary containment area if a visual inspection is performed to ensure that the contents of aboveground storage tank have not come in contact with the stormwater to be discharged. Visual inspections are only effective when dealing with materials that can be observed, like petroleum. If the contents of the tank are not visible in stormwater, the municipality shall rely on previous tank inspections to determine with some degree of certainty that the tank has not leaked. If the municipality cannot make a determination with reasonable certainty that the stormwater in the secondary containment area is uncontaminated by the contents of the tank, then the stormwater shall be hauled for proper disposal.

Vehicle Maintenance

1. Operate and maintain equipment to prevent the exposure of pollutants to stormwater.

2. Whenever possible, conduct vehicle and equipment maintenance activities indoors. For projects that must be conducted outdoors, and that last more than one day, portable tents or covers shall be placed over the equipment being serviced when not being worked on, and drip pans shall be used at all times. Use designated areas away from storm drains or block storm drain inlets when vehicle and equipment maintenance is being conducted outdoors.

On-Site Equipment and Vehicle Washing and Wash Wastewater Containment

1. Manage any equipment and vehicle washing activities so that there are no unpermitted discharges of wash wastewater to storm sewer inlets or to waters of the State.

2. Tier A Municipalities which cannot discharge wash wastewater to a sanitary sewer or which cannot otherwise comply with 1, above, may temporarily contain wash wastewater prior to proper disposal under the following conditions:

   a. Containment structures shall not leak. Any underground tanks and associated piping shall be tested for integrity every 3 years using appropriate methods determined by "*The List of Leak Detection Evaluations for Storage Tank Systems*" created by the National Work Group on Leak Detection Evaluations (NWGLDE) or as determined appropriate and certified by a professional engineer for the site specific containment structure(s)**.**

   b. For any cathodically protected containment system, provide a passing cathodic protection survey every three years.

   c. Operate containment structures to prevent overfilling resulting from normal or abnormal operations, overfilling, malfunctions of equipment, and human error. Overfill prevention shall include manual sticking/gauging of the tank before each use unless system design prevents such measurement. Tank shall no longer accept wash wastewater when determined to be at 95% capacity. Record each measurement to the nearest ½ inch.

   d. Before each use, perform inspections of all visible portions of containment structures to ensure that they are structurally sound, and to detect deterioration of the wash pad, catch basin, sump, tank, piping, risers, walls, floors, joints, seams, pumps and pipe connections or other containment devices. The wash pad, catch basin, sump and associated drains should be kept free of debris before each use. Log dates of inspection; inspector's name, and conditions. This inspection is not required if system design prevents such inspection.

   e. Containment structures shall be emptied and taken out of service immediately upon detection of a leak. Complete all necessary repairs to ensure structural integrity prior to placing the containment structure back into service. Any spills or suspected release of hazardous substances shall be immediately reported to the NJDEP Hotline (1-877-927-6337) followed by a site investigation in accordance with N.J.A.C. 7:26C and N.J.A.C 7:26E if the discharge is confirmed.

   f. All equipment and vehicle wash wastewater placed into storage must be disposed of in a legally permitted manner (e.g. pumped out and delivered to a duly permitted and/or approved wastewater treatment facility).

   g. Maintain a log of equipment and vehicle wash wastewater containment structure clean-outs including date and method of removal, mode of transportation (including name of hauler if applicable) and the location of disposal. See Underground Vehicle Wash Water Storage Tank Use Log at end of this attachment.

   h. Containment structures shall be inspected annually by a NJ licensed professional engineer. The engineer shall certify the condition of all structures including: wash pad, catch basin, sump, tank, piping, risers to detect deterioration in the, walls, floors, joints, seams, pumps and pipe connections or other containment devices using the attached Engineer's Certification of Annual Inspection of Equipment and Vehicle Wash Wastewater Containment Structure. This certification may be waived for self-contained systems on a case-by-case basis. Any such waiver would be issued in writing by the Department.

3. Maintain all logs, inspection records, and certifications on-site. Such records shall be made available to the Department upon request.

Salt and De-icing Material Storage and Handling

1. Store material in a permanent structure.
2. Perform regular inspections and maintenance of storage structure and surrounding area.
3. Minimize tracking of material from loading and unloading operations.
4. During loading and unloading:
   a. Conduct during dry weather, if possible;
   b. Prevent and/or minimize spillage; and
   c. Minimize loader travel distance between storage area and spreading vehicle.
5. Sweep (or clean using other dry cleaning methods):
   a. Storage areas on a regular basis;
   b. Material tracked away from storage areas;
   c. Immediately after loading and unloading is complete.
6. Reuse or properly discard materials collected during cleanup.
7. Temporary outdoor storage is permitted only under the following conditions:
   a. A permanent structure is under construction, repair or replacement;
   b. Stormwater run-on and de-icing material run-off is minimized;
   c. Materials in temporary storage are tarped when not in use;
   d. The requirements of 2 through 6, above are met; and
   e. Temporary outdoor storage shall not exceed 30 days unless otherwise approved in writing by the Department;
8. Sand must be stored in accordance with Aggregate Material and Construction Debris Storage below.

Aggregate Material and Construction Debris Storage

1. Store materials such as sand, gravel, stone, top soil, road millings, waste concrete, asphalt, brick, block and asphalt based roofing scrap and processed aggregate in such a manner as to minimize stormwater run-on and aggregate run-off via surface grading, dikes and/or berms (which may include sand bags, hay bales and curbing, among others) or three sided storage bays. Where possible the open side of storage bays shall be situated on the upslope. The area in front of storage bays and adjacent to storage areas shall be swept clean after loading/unloading.

2. Sand, top soil, road millings and processed aggregate may only be stored outside and uncovered if in compliance with item 1 above and a 50-foot setback is maintained from surface water bodies, storm sewer inlets, and/or ditches or other stormwater conveyance channels.

3. Road millings must be managed in conformance with the "Recycled Asphalt Pavement and Asphalt Millings (RAP) Reuse Guidance" (see www.nj.gov/dep/dshw/rrtp/asphaltguidance.pdf) or properly disposed of as solid waste pursuant to N.J.A.C. 7:26-1 et seq.

4. The stockpiling of materials and construction of storage bays on certain land (including but not limited to coastal areas, wetlands and floodplains) may be subject to regulation by the Division of Land Use Regulation (see www.nj.gov/dep/landuse/ for more information).

Street Sweepings, Catch Basin Clean Out, and Other Material Storage

1. For the purposes of this permit, this BMP is intended for road cleanup materials as well as other similar materials. Road cleanup materials may include but are not limited to street sweepings, storm sewer clean out materials, stormwater basin clean out materials and other similar materials that may be collected during road cleanup operations. These BMPs do not cover materials such as liquids, wastes which are removed from municipal sanitary sewer systems or material which constitutes hazardous waste in accordance with N.J.A.C. 7:26G-1.1 et seq.

2. Road cleanup materials must be ultimately disposed of in accordance with N.J.A.C. 7:26-1.1 et seq. See the "Guidance Document for the Management of Street Sweepings and Other Road Cleanup Materials" (www.nj.gov/dep/dshw/rrtp/sweeping.htm).

3. Road cleanup materials placed into storage must be, at a minimum:

   a. Stored in leak-proof containers or on an impervious surface that is contained (e.g. bermed) to control leachate and litter; and

   b. Removed for disposal (in accordance with 2, above) within six (6) months of placement into storage.

Yard Trimmings and Wood Waste Management Sites

1. These practices are applicable to any yard trimmings or wood waste management site:

   a. Owned and operated by the Tier A Municipality;
      i. For staging, storing, composting or otherwise managing yard trimmings, or
      ii. For staging, storing or otherwise managing wood waste, and

   b. Operated in compliance with the Recycling Rules found at N.J.A.C. 7:26A.

2. Yard trimmings or wood waste management sites must be operated in a manner that:

   a. Diverts stormwater away from yard trimmings and wood waste management operations; and
   b. Minimizes or eliminates the exposure of yard trimmings, wood waste and related materials to stormwater.

3. Yard trimmings and wood waste management site specific practices:

   a. Construct windrows, staging and storage piles:
      i. In such a manner that materials contained in the windrows, staging and storage piles (processed and unprocessed) do not enter waterways of the State;
      ii. On ground which is not susceptible to seasonal flooding;
      iii. In such a manner that prevents stormwater run-on and leachate run-off (e.g. use of covered areas, diversion swales, ditches or other designs to divert stormwater from contacting yard trimmings and wood waste).

   b. Maintain perimeter controls such as curbs, berms, hay bales, silt fences, jersey barriers or setbacks, to eliminate the discharge of stormwater runoff carrying leachate or litter from the site to storm sewer inlets or to surface waters of the State.

   c. Prevent on-site storm drain inlets from siltation using controls such as hay bales, silt fences, or filter fabric inlet protection.

   d. Dry weather run-off that reaches a municipal stormwater sewer system is an illicit discharge. Possible sources of dry weather run-off include wetting of piles by the site operator; uncontrolled pile leachate or uncontrolled leachate from other materials stored at the site.

   e. Remove trash from yard trimmings and wood waste upon receipt.

   f. Monitor site for trash on a routine basis.

   g. Store trash in leak-proof containers or on an impervious surface that is contained (e.g. bermed) to control leachate and litter;

   h. Dispose of collected trash at a permitted solid waste facility.

   i. Employ preventative tracking measures, such as gravel, quarry blend, or rumble strips at exits.

Roadside Vegetation Management

1. Tier A Municipalities shall restrict the application of herbicides along roadsides in order to prevent it from being washed by stormwater into the waters of the State and to prevent erosion caused by de-vegetation, as follows: Tier A Municipalities shall not apply herbicides on or adjacent to storm drain inlets, on steeply sloping ground, along curb lines, and along unobstructed shoulders. Tier A Municipalities shall only apply herbicides within a 2 foot radius around structures where overgrowth presents a safety hazard and where it is unsafe to mow.

ENGINEERS CERTIFICATION OF ANNUAL INSPECTION OF EQUIPMENT AND VEHICLE WASH WASTEWATER CONTAINMENT STRUCTURE

(Complete a separate form for each vehicle wash wastewater containment structure)

Permittee: ________________________________ NJPDES Permit No: ________________________

Containment Structure Location: ____

The annual inspection of the above referenced vehicle wash wastewater containment structure was conducted on _____________ (date). The containment structure and appurtenances have been inspected for:

1. The integrity of the structure including walls, floors, joints, seams, pumps and pipe connections
2. Leakage from the structure's piping, vacuum hose connections, etc.
2 Bursting potential of tank.
3. Transfer equipment
4. Venting
5. Overflow, spill control and maintenance.
6. Corrosion, splits, and perforations to tank, piping and vacuum hoses

The tank and appurtenances have been inspected for all of the above and have been determined to be:

Acceptable ___________

Unacceptable ___________

Conditionally Acceptable ____________

List necessary repairs and other conditions: ____

____

____

____

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe the submitted information is true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment (N.J.A.C. 7:14A-2.4(d)).

Name (print): ________________________________ Seal:

Signature: ________________________________

Date: ________________________________

Underground Vehicle Wash Water Storage Tank Use Log

Name and Address of Facility ______________________________

Facility Permit Number _____________________________________

Tank ID Number ___________________ Tank Location ___________________

Tank Volume ______________ gallons Tank Height _______________ inches

95% Volume ______________ gallons 95% Volume _______________ inches

Date and Time	Inspector	Height of Product Before Introducing Liquid (inches)	Is Tank Less Than 95% Full? (Y/N)	Visual Inspection Pass? (Y/N)	Comments

Notes: The volume of liquid in the tank should be measured **before** each use.

Liquid **should not be introduced** if the tank contains liquid at 95% of the capacity or greater.

A visual inspection of all exposed portions of the collection system should be performed before each use. Use the comments column to document the inspection and any repairs.

Underground Vehicle Wash Water Storage Tank Pump Out Log

Name and Address of Facility ____________________________
Facility Permit Number __________________________________

Tank ID Number _________________ Tank Location _________________
Tank Volume _____________ gallons

Date and Time of Pump Out	Volume of Liquid Removed	Waste Hauler *	Destination of the Liquid Disposal *

*** The Permittee must maintain copies of all hauling and disposal records and make them available for inspection.**