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July 7, 2015

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE, Room IA
Washington, D.C. 20426
Submitted via <eFiling> at www.ferc.gov/Documents

RE: Docket No. PF15-1-000: Comments Regarding PennEast Pipeline Project

New Jersey Conservation Foundation is submitting these reports from the New Jersey Water Supply Authority as an addendum to our scoping comments.

We are submitting these studies in response to PennEast's Resource Report #2. PennEast's Resource Report #2 should be revised to address the following information (submitted via e-filing) regarding these streams, which are a source of drinking water for millions of New Jersey residents. Many of these studies were federally funded.

The reports include:

Lockatong and Wickechoeke Creek Watersheds Restoration and Protection Plan

Appendix B: Proposed Implementation Projects

Lockatong and Wickechoeke Creek Water Quality and Flow Monitoring Project 2006-2007

Lockatong Creek Stream Visual Assessment Results and Restoration Plan

Wickechoeke Creek Stream Visual Assessment Results and Restoration Plan

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An Assessment of Municipal Plans, Policies, and Regulations Effecting Water Quality in the Lockatong and Wickecheoke Creek Watersheds

Non-Point Source Pollutant Loading Build-Out Analysis for the Lockatong and Wickecheoke Creek Watersheds

Lockatong and Wickecheoke Creeks Project Work/Quality Assurance Project Plan

Characterization and Assessment of the Lockatong and Wickecheoke Creek Watersheds

NRCS Report - Lockatong and Wickecheoke Creek Watersheds Sediment and Phosphorus Source Report

Thank you very much for considering this important additional information. Please contact me at 908-328-6406 with any questions.

Sincerely,

Alix Bacon
Regional Manager, Western Piedmont

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Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Plan

Funded, in part, by an NJDEP 319(h) grant
Contract: RP05-082

New Jersey Water Supply Authority
Watershed Protection Programs Unit

June 2009

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EXECUTIVE SUMMARY

The Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Plan was compiled from various components of the overall program, integrating results from numerous reports. Information was obtained through historical references and in-field physical, chemical, biological, and visual watershed assessments.

Background

Since its inception in 2005, the Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Plan Program has produced several supporting documents which together provide a comprehensive assessment of the physical, chemical, and biological aspects of the streams, in addition to an overall assessment of municipal actions and policies that are currently in place to protect these water resources. The New Jersey Water Supply Authority (NJWSA), in cooperation with the Natural Resources Conservation Service (NRCS), developed the Plan with funding support through in-kind services and a 319(h) grant from the New Jersey Department of Environmental Protection.

The Lockatong and Wickecheoke creeks flow into the Delaware and Raritan Canal that supplies water to water purveyors that serve approximately 1.5 million people in central New Jersey. Since 1997, several of the purveyors reported increased concentrations of total suspended solids and total organic carbon in the raw water during and immediately following precipitation events. Since the combined area of these watersheds comprise approximately 60 percent of the total drainage to the Canal, downstream of the Delaware River inflow, these watersheds could be sources for large contributions of the contaminant loading.

The watershed assessments revealed the major water quality and quantity problem as stormwater runoff. Although there was only 2 percent impervious cover (2002 NJDEP Land-Use Land-Cover GIS data) from anthropogenic activities, the destabilization effects to the stream channel represented conditions of much greater imperviousness, possibly 15 percent, or more. Naturally occurring shallow soil depths atop bedrock, with only secondary porosity, produce short-duration runoff hydrographs stemming from limited water storage in the soils. The “flashy” runoff can impart greater scour velocities and flow levels with only minimal increases in impervious land covers. Limited water storage in shallow soils also reduces the potential for ground water recharge for use as a potable water supply and the source of stream baseflow.

Program Goal

The goal of this program is to focus efforts for the restoration and protection of the watersheds toward natural conditions, to the extent feasible, for protection of the water supply, threatened and endangered species, aquatic ecology, natural aesthetics, and to support the primary goal of the Lower Delaware Wild and Scenic Rivers Protection Plan: “Maintain existing water quality in the Delaware River and its tributaries from measurably degrading, and improve it where practical.”

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Program Objectives

- Develop a watershed restoration and protection plan for both watersheds to address water quality issues such that the requirements of existing TMDLs can be met through plan implementation, incorporating the nine elements of a management plan (listed in **Appendix A**) as required by the US Environmental Protection Agency and the New Jersey Department of Environmental Protection.
- Protect the Delaware and Raritan Canal drinking water supply through reduction of sediment, nutrient, and bacterial pollution, and increase ground water recharge.
- Develop partnerships to facilitate the watershed restoration and protection plan.

Critical Issue

Visual, chemical, physical, and biological assessments of the watersheds have highlighted a critical need to reduce stormwater runoff and the associated pollutant loadings, whereby increasing ground water recharge and stream baseflow.

Critical Elements Identified For Watershed Restoration and Protection

The following list prioritizes primary sources of runoff flow and water quality contamination that were identified during the project. A rainfall event of 1.25 inches was used for the estimates.

Stormwater Runoff Flow:

1) Roadways (approximately 120,000 gallons/mile);
2) Active and inactive farms (semi-impervious conditions from fragipans and plow pans produces approximately 9,500 gallons/acre);
3) Private and public lawns, and athletic fields (semi-impervious conditions from soil compaction produces approximately 9,500 gallons/acre); and
4) Driveways and rooftops (approximately 80 gallons/100 ft^2).

Stormwater Runoff Contamination (Note: 0.0055 pound of TP load for each pound of TSS load in stream water and sediments, referencing NJWSA report):

1) Stream-channel erosion from increased flows (approximately 12,000 tons TSS/year, referencing NRCS report);
2) Roadways and roadside drainage (approximately 4,700 tons TSS/year, referencing NRCS report);
3) Agricultural fields (approximately 1,870 tons TSS/year, referencing NJSW BMP Manual)
4) Improper management of agricultural and domestic animal wastes (loads specific to animal type and site conditions);
5) Wildlife excrement (loads specific to type of animal and site conditions); and
6) All -terrain vehicles (ATV) (loads specific to activity level and site conditions).

Another critical element that was identified during the study was an imbalance in water use and water supply from ground-water wells. Increase of impervious land cover has increased runoff flow and erosion potential while decreasing aquifer recharge. Impervious cover, combined with increasing water uses from an expanding population

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and services, has continued to stress the limited ground water supply that also reduces surface water (i.e., wetlands, stream baseflow, ponds) during dry summertime conditions. Baseflows were measured in both streams during the project, showing loss or zero inflow from many sections of the watersheds, as presented in the monitoring report: ***Lockatong and Wickecheoke Creeks Water Quality and Flow Monitoring Project – 2006 through 2007*** (NJWSA, 2008).

Recommended Remediation Strategies

Five of the proposed remediation strategies have watershed-wide applications, and ten of the proposed projects are site-specific applications. More detail of these projects is presented in **Appendix B**. The major emphasis of the remediation strategies is to retain stormwater runoff and loadings by retrofits of roadside and driveway drainage; subsoiling active agricultural fields, together with microtopographic modifications to inactive farm fields; initiating or enhancing education for students, homeowners, businesses, and farmers regarding fertilizers, proper management techniques for runoff and pollutant control, and protection of the stream corridor. Effective watershed protection requires expedient implementation of the recommendations, with inter-municipal coordination and long-term commitments from each municipality. Watershed-wide strategies should readily produce enhancements to the flow regime and water quality throughout the watersheds. Site-specific strategies should provide localized remediation for sources of stormwater runoff and the associated contaminants, although universal application and management of these techniques would provide a more effective program.

The following illustrates possible remediation techniques for major sources of contamination and stream-channel destabilization.

1. Increased impervious, or semi-impervious surfaces from roadways, driveways, roofs, swimming pools, lawns (compaction from mowing and uses), recreational open spaces, parking lots, and agricultural fields (compaction from plowing, plow-pan, and fragipans).

    - Remediation:

        i. Require a selected frequency for subsoiling and simultaneous blending of organic material on active crop-farming fields, and initial subsoiling and microtopographic modifications to inactive farm fields, prior to any preservation activities;

        ii. Emphasize, through public education (flyers, Community-Day displays and brochures, and supplements to school curriculums and programs) optional techniques for retaining stormwater on both private and public lawn areas; and

        iii. Initiate a well-testing ordinance to ensure an adequate water supply from new and expanding water uses (see sample ordinance in ***An Assessment of Municipal Plans, Policies and Regulations***

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Effecting Water Quality in the Lockatong and Wickecheoke Watersheds, NJWSA, 2008).

2. Directing stormwater from lawns and agricultural fields directly into stream channels or roadside drainage ravines.

    - Remediation:

        i. Disconnect stormwater conveyance paths and retain major portions of runoff volume on private and public lawns using rain barrels (where applicable), rain gardens, curb-cuts or elimination of driveway curbs, bioretention systems, and pervious subsurface storage. Include this information as part of a Municipal Stormwater Management Plan; and

        ii. Education, via a targeted agricultural assistance program by the Hunterdon County SCD (Integrated Crop Management Services) coordinated with specific conservation options for stream corridor and stormwater controls by the NJRC&DC River-Friendly Farms program.

3. Roadside drainage-channel destabilization and associated erosion from inadequate designs and maintenance techniques.

    - Remediation:

        i. Provide annual, or biannual, training for DPW Managers and municipal road crews, including the training time as part of the required DPW continuing education units; and

        ii. Emphasize options for the design and maintenance of roadway drainage for retaining stormwater runoff volume and minimizing shear velocity. Minimize annual drainage ditch maintenance-dredging, incorporating this practice only when necessary.

4. Natural surface and ground water interconnectivity in fractured bedrock, providing inflows and outflows along the stream channel and at dispersed sites throughout the watersheds, enhancing the potential for inter-transfer of pollutants and simultaneous flow losses between the water systems.

    - Remediation:

        i. Develop a hydrogeologic map of dry- and wet-season aquifer levels and flow paths, identifying local recharge areas and potential contamination sources; and

        ii. Install continuous water-level monitors to develop an existing reference condition for determining long-term variations to aquifer

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level and supply, to ensure a continued supply for potable and aquatic-ecology functions, to provide scientific information for planning and zoning functions, and as an indicator of drought conditions for initiating water conservation measures.

5. Stream contamination emanating from stormwater runoff of development sites and other major land-disturbance activities.

   - Remediation:

     i. Development of site-specific water quality and flow targets, at designated sites along the stream, to determine "existing" water quality and "measureable change" in support of the antidegradation rules for C1 streams. A method similar to the flow-integrated technique known as FIRE (Flow-Integrated Reduction of Exceedences) that NJDEP has developed to determine reductions of total phosphorus for TMDLs could be implemented. More information on this technique is presented in the "Applicable Antidegradation Criteria" section of the ***Lockatong and Wickecheoke Creek Water quality and Flow Monitoring Project 2006 through 2007*** report (NJWSA, 2008). Applications for projects with large volumes/areas of land disturbance must provide scientific evidence that water quality at the closest downstream target site will not be measureably degraded;

     ii. Require, through amendments to the NJ Department of Agriculture's Sediment and Erosion Control Act and/or municipal policy, a shorter duration and smaller area of soil disturbance during any land moving activity;

     iii. Require filter bags for pumped seepage-water during bridge construction to remove sediment prior to discharge of this water into the stream; and

     iv. Promote land-preservation with assistance from land-acquisition organizations such as New Jersey Green Acres, Hunterdon Land Trust Alliance, New Jersey Conservation Foundation, and the New Jersey Water Supply Authority.

6. Permitted discharges with inconsistent compliance

   - Remediation:

     i. Invite representatives of discharger(s) to present quarterly updates of compliance at Township meetings; and

     ii. Notification of regulatory authorities, if necessary.

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7. Intense channel and streambank erosion from an increased flow regime, deer trails and grazing, ATV traffic, and direct egress to the channel by livestock.

    - Remediation:

        i. Streambank-stabilization through revegetation of the riparian zone, where necessary, combined with the runoff retention techniques previously described. Nearly all of the stream segments that were identified for revegetation in the ***Lockatong Creek Stream Visual Assessment Results and Restoration Plan*** and the ***Wickecheoke Creek Stream Visual Assessment Results and Restoration Plan*** are located on private property, requiring authorization for entry from the landowner(s). This remediation should be implemented after reductions in stormwater runoff flow have been achieved to ensure long-term channel stability;

        ii. Deer deterrents include fencing, planting deer-resistant vegetation, commercial deer repellents, increased harvesting, and regulatory management (i.e., no feeding, harvesting incentives, etc.). Dogs, bordered by "invisible fence" technology, are a proven deterrent. For agricultural facilities, EQIP and other Farm Bill assistance programs could be sources of funding;

        iii. Restricting ATV traffic from riparian areas could include signage along known ATV trails, municipal ordinance, education of ATV operators through required training for license/certification, and/or the formation of local patrols with enforcement contact information for residents wanting to report incidents; and

        iv. Restricting livestock access to the stream channel by fencing and vegetation; and providing other means of animal drinking water. EQIP and other Farm Bill assistance programs could be funding sources.

8. Over-application of lawn and crop fertilizers and pesticides, unmanaged livestock and domestic animal wastes, and malfunctioning or failed septic systems.

    - Remediation:

        i. Initiate an Integrated Crop Management (ICM) Services program for agricultural operations, and promote certification as a River-Friendly Farm. Both of these options are detailed in **Appendix B**; and

        ii. Distribute educational materials and request presentations from Rutger University's Cooperative Extension Service, Hunterdon County Health Department, and the South Branch Watershed Association (Raritan River), regarding proper lawn care, pet waste

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management, and septic-system care. Rutgers and the HCSCD can be contacted to test soils for available nutrients and to provide information on pesticides. The latest Wastewater Management Rules should be utilized for adopting a septic-system management ordinance/utility (see sample ordinance in ***An Assessment of Municipal Plans, Policies and Regulations Effecting Water Quality in the Lockatong and Wickecheoke Watersheds***, NJWSA, 2008).

9. Narrowing or elimination of natural vegetative buffers along riparian corridors.

   - Remediation:

     A riparian corridor-protection and/or wildlife-feeding restriction ordinance(s) could be adopted (see sample ordinances in ***An Assessment of Municipal Plans, Policies and Regulations Effecting Water Quality in the Lockatong and Wickecheoke Watersheds***, NJWSA, 2008). Fencing is an option to ban wildlife and livestock egress in agricultural or larger residential areas. NJDEP could present information on an annual basis to municipal officials and residents.

10. Abundance of geese inhabiting waterways.

    - Remediation:

      i. Maintaining vegetative buffers around ponds and lakes could be required as part of a riparian corridor-protection ordinance. A municipal ordinance for restricting wildlife feeding could be adopted (see sample ordinance in ***An Assessment of Municipal Plans, Policies and Regulations Effecting Water Quality in the Lockatong and Wickecheoke Watersheds***, NJWSA, 2008). Dogs, bordered by physical or "invisible fence" technology, are a proven deterrent; and

      ii. Addling eggs could be an alternative, with assistance from the NJ Division of Fish, Game, and Wildlife. Scare tactics, using sounds, dogs, or other physical options would also be an alternative.

Implementation of remediation projects, prioritized as above, would fulfill TMDL load-reduction requirements for total phosphorus and coliform bacteria, while reducing stormwater runoff flow and increasing infiltration for ground water recharge and stream baseflow. Sediment and bacteria loadings should be reduced proportionately with the total phosphorus load reduction and the reduction to stormwater runoff. See **Appendix B** for more detailed information on remediation strategies. **Table 1** summarizes the proposed remediation projects and their estimated cost.

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Table 1. Proposed stormwater remediation projects.

Project	Project Location	Estimated Cost
Preservation/Conservation-Land Stormwater Control	Initially – Delaware and Kingwood Townships	$564,000
Agricultural Runoff Remediation	Franklin Township	$991,000 - $1,231,000
Roadside Drainage Design/Retrofit Training	Delaware, Kingwood, Raritan, and Franklin Townships	$47,000
Road-Drainage Retrofit, Section of Pine Hill Road	Delaware Township	$1,274,000
Road-Drainage Retrofit, Section of Route 579	Franklin Township	$101,000
Road-Drainage Retrofit, Section of Goose Island Road	Raritan Township	$118,000
Road-Drainage Retrofit, Barbertown-Point Breeze Road	Kingwood Township	$72,000
Targeted Agricultural Assistance Program	Delaware, Kingwood, Raritan, and Franklin Townships	$226,000
Update Stormwater BMP Manual For Soils and Bedrock Conditions in Hunterdon County	Delaware, Kingwood, Raritan, and Franklin Townships	$33,000
Hydrogeologic Study of Copper, Lockatong, and Wickecheoke Watersheds	Delaware, Kingwood, Raritan, and Franklin Townships	$168,000
River-Friendly Farms Certification Program	Delaware, Kingwood, Raritan, and Franklin Townships	$74,000
Bioretention Applications – Recreational Areas and Private/Public Lawns	Initially - Kingwood Township	$164,000 – $298,000
Delaware Township Municipal-Garage Retrofit	Delaware Township	$265,000
Vehicle Maintenance and Storage Facility Retrofit	Delaware Township	$112,000
Sergeantsville Firehouse Parking-Lot and Municipal Park Retrofits	Delaware Township	$117,000

Continuing Efforts

Program partners, including Delaware, Kingwood, Franklin, and Raritan Townships; NJWSA; NRCS; USGS; Hunterdon County Health Department and SCD; NJDEP; NJCF; D&R Canal Commission; NJRC&DC; and residents and businesses in the watersheds continue to prioritize remediation projects for the next round of 319(h)

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funding from the NJDEP. Following acceptance by NJDEP of the Restoration and Protection Plan, current and future proposals for remediation projects should have enhanced opportunity for funding. It is anticipated that fiscal year 2010 or 2011 will provide the first opportunity for submitting implementation-project proposals. The list of Proposed Implementation Projects in Appendix B is not intended as a comprehensive list of projects, but rather an evolving list, based on available information and municipal priorities. Additional projects are anticipated to be proposed as more information, and non-public site accessibility, becomes available.

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INTRODUCTION

The Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Plan is intended to be used to guide municipal and inter-governmental efforts to ensure long-term protection of these watersheds that provide source water, via the Delaware and Raritan Canal System, for the water supply of approximately 1.5 million New Jersey residents. The watersheds are situated in Hunterdon County, New Jersey and provide approximately 60 percent of the direct drainage to the Delaware and Raritan Canal, downstream of the intake from the Delaware River. The Canal conveys water to purveyors: NJ American (Elizabethtown) Water Company, Middlesex Water Company, the Townships of East Brunswick and North Brunswick, and the City of New Brunswick. The raw water is treated for potable water uses. Since 1997, several of the purveyors reported increased concentrations of total suspended solids and total organic carbon in the raw water during, and immediately following, precipitation events. The solids and carbon require increased chemical doses for treatment that increases the residual sludge to be removed, subsequently increasing the cost of water treatment. Debris (wood and other floatables) removal from the Canal, downstream of the Lockatong and Wickecheoke Creek confluences, occurs several times each year (Buss and Shepherd, 2007). Combined average annual volumes of sediment removal at the Wickecheoke inflow and the Prallsville Lock, from October 1998 through July 2007 (Shepherd, 2007), were approximately 750 cubic yards, or 1,013 tons (1.35 tons per cubic yard, NRCS, 2007). Cost of this work was roughly estimated at more than $200,000 per year (NRCS, 2007). A study in 1987 by EBASCO Services Incorporated estimated annual costs for sediment dredging in the Canal from the Delaware River inlet at Bulls Island to the "Navagation" Canal at Trenton. Including equipment, labor, materials, stockpiling, and administrative costs, the estimated total annual cost was $317,050. The study estimated an average sediment load of 5,226 tons from 26 small tributaries, and 3,300 and 3,600 tons from Lockatong and Wickecheoke Creeks, respectively.

Municipalities within these watersheds are Kingwood, Franklin, Delaware, and Raritan Townships, three of which are listed as Tier B, with Raritan Township listed as Tier A for the NJPDES Municipal Stormwater Regulation Program. The New Jersey State Development and Redevelopment Plan classifies all of the municipal lands within the watersheds as "Areas for Conservation," either Planning Area 4B (Rural Planning Area) or 5 (Environmentally Sensitive Planning Area). **Figure 1** is a map of the project area.

This effort was partially funded by a New Jersey Department of Environmental Protection (NJDEP) 319(h) grant (contract RP05-082); and supplemented by funding and in-kind services of the New Jersey Water Supply Authority (NJWSA); and through contractual and in-kind services of the Natural Resources Conservation Service (NRCS), US Department of Agriculture.

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Figure 1. Study area - monitoring sites and sub-watershed areas. See **Table 2** for site descriptions.

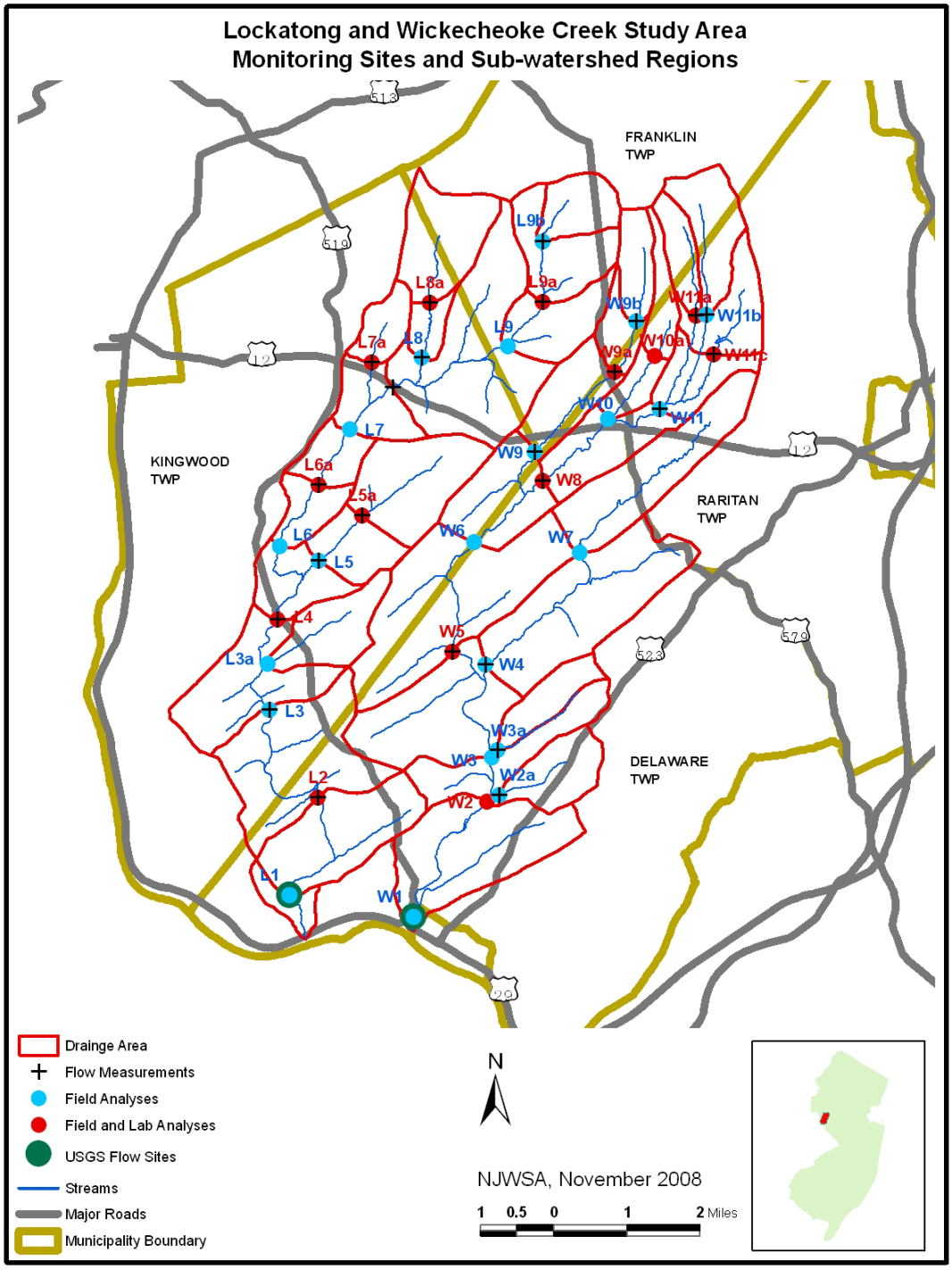

Table 2. Descriptions of monitoring sites.

Lockatong Creek Site Code	Location Description	Wickecheoke Creek Site Code	Location Description
L1	Mainstem at Raven Rock-Rosemont Road bridge	**W1**	Mainstem at State Route 29 bridge
L2	Mainstem at Strimples Mill Road bridge	**W2**	Mainstem, approximately 2/3 mile downstream of W3 (covered bridge), 200 feet downstream of W2a (Rose Brook)
L3	Mainstem at Milltown Road bridge	**W2a**	Rose Brook tributary at Lower Creek Road culvert
L3a	Tributary, at Brook Road bridge	**W3**	Mainstem at Rosemont-Sergeantsville Road bridge (covered bridge)
L4	Mainstem at County Route 519 bridge	**W3a**	Cold Run tributary at Pine Hill Road culvert
L5	Muddy Run tributary at Muddy Run Road bridge	**W4**	Plum Brook tributary at Pine Hill Road bridge
L5F	Muddy Run tributary at Barbertown-Point Breeze Road bridge	**W5**	Mainstem at Old Mill Road bridge
L5a	Muddy Run tributary at Union Road bridge	**W6**	Mainstem at Locktown Road bridge
L6	Mainstem at Barbertown-Point Breeze Road bridge	**W7**	Plum Brook tributary at Locktown-Flemington Road culvert
L6a	Mainstem at Thatcher Road bridge	**W8**	Mainstem at Whiskey Lane bridge
L7	Mainstem at Union Road bridge	**W9**	Tributary at Whiskey Lane bridge
Rt 12	Mainstem at County Route 12 bridge	**W9a**	Tributary at Goose Island Road culvert
L7a	Tributary at Lower Oak Grove Road culvert	**W9b**	Tributary at Oak Grove Road culvert
L8	Tributary at Lower Oak Grove Road culvert	**W10**	Tributary at Old Croton Road culvert
L8a	Tributary at Oak Grove Road culvert	**W10a**	Tributary at Goose Island Road culvert
L9	Tributary at Pittstown Road culvert, south channel	**W11**	Mainstem at Rake Road bridge
L9a	Tributary at Oak Grove Road culvert	**W11a**	Tributary at Oak Grove Road culvert
L9b	Tributary at Old Franklin School Road culvert	**W11b**	Tributary at Oak Grove Road culvert
		W11c	Tributary at Decker Road culvert

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All program segments and reports were reviewed by the Project Committee members (listed in the Acknowledgements section). In addition to the Management Plan, several support projects were performed concurrently and the following reports are the products of those efforts:

- Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Plan – Watershed-Based Implementation Projects (with proposed implementation projects)
- 319(h) Grant Proposal: Watershed Restoration and Protection Plan for the Lockatong and Wickecheoke Creek Watersheds
- Lockatong and Wickecheoke Creeks Water Quality and Flow Monitoring Project – 2006 through 2007;
    - Work/Quality Assurance Project Plan, Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Project;
    - Lockatong Creek Stream Visual Assessment Results and Restoration Plan;
    - Wickecheoke Creek Stream Visual Assessment Results and Restoration Plan;
- Characterization and Assessment of the Lockatong and Wickecheoke Creek Watersheds;
- An Assessment of Municipal Plans, Policies and Regulations Effecting Water Quality in the Lockatong and Wickecheoke Watersheds; and
- A Non-Point Source Pollutant Loading Build-Out Analysis in the Lockatong and Wickecheoke Creek Watersheds
- NRCS Report – Lockatong and Wickecheoke Creek Watersheds Sediment and Phosphorus Source Report.

This report integrates the results and recommendations from all of the supplemental projects, in addition to supporting stream channel and water quality protection goals from the Lower Delaware Management Plan (http://www.nps.gov/phso/sp/p07new3.htm), to provide implementation strategies for long-term protection of the water quality and quantity in the Lockatong and Wickecheoke Creek watersheds. Critical issues, regarding sources/effects of water quality and flow-regime degradation are presented in the "Critical Elements Identified For Watershed Restoration and Protection" section of the Executive Summary. A flow-chart illustrating the "Interrelationships of Watershed Reports" and digital copies of all reports (on CD) are included in **Appendix F**.

Sources and Effects of Water Quality and Quantity Changes

The following source/effect relationships were determined to be the most critical for restoring and protecting stream flow and water quality.

Sources of Increased Runoff Flow and Elevated Loads of Sediment and Nutrients include:

- Increasing impervious surfaces, and semi-impervious surfaces, (i.e., roadways, driveways, roofs, swimming pools, lawns, recreational fields, parking lots, etc) with direct flow connections to the waterways (greatly reduces ground water recharge);
- Directing stormwater from private and public lawns, athletic fields, and impervious surfaces directly to stream channels or to roadside drainage ravines;

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- Creation of stormwater erosion from deer trails and grazing, and from all-terrain vehicle (ATV) traffic into and through stream channels;
- Over-application of lawn and crop fertilizers;
- Improper disposal/management of wastes from livestock and domestic animals;
- Malfunctioning septic systems;
- Over-abundance of geese on constructed and natural ponds;
- Narrowing, or elimination of natural vegetative buffers along stream channels; and
- Land-disturbance and development activities stripping large areas of vegetation for prolonged time periods, conveying sediment, nutrients, and other contaminants into adjacent waterways.

Effects of Increased Runoff Flow and Pollutant Loads include:

- Increased upland and in-stream erosion potential;
- Stream-channel destabilization;
- Wider and shallower stream channels, susceptible to increased water temperature from exposure to the sun;
- Nutrient-enrichment supporting abundant growth of aquatic plants, causing extreme variability in daily pH and dissolved oxygen levels;
- Loss of ground water recharge, decreasing water supply, stream baseflows, and wetland, pond, and lake levels;
- Loss of habitat for both aquatic and terrestrial organisms, including threatened and endangered species, and trout;
- Turbid (cloudy) water;
- Elevated levels of bacteria and pathogens; and
- Ultimate loss of potable water supply (quantity and quality).

WATERSHED CHARACTERISTICS

Both watersheds have been classified as Category One (C1) streams. These waters receive a higher form of state protection for water quality that prohibits any measurable change in the existing water quality. The draft 2004 Integrated Listings, which is a summary of water quality levels exceeding the Surface Water Quality Standards in stream segments throughout the state, show violations of total phosphorus, fecal coliform bacteria, and water temperature for the Lockatong and Wickecheoke Creeks. Macroinvertebrates, or the combination of aquatic insects, worms, mollusks, and crustaceans, were also listed as degraded at a site in the Wickecheoke Creek. During May and July 2005, the New Jersey Department of Environmental Protection (NJDEP) developed a TMDL for fecal coliform for the Wickecheoke watershed, and a total phosphorus TMDL for each watershed, respectively. Both TMDLs were approved by the Environmental Protection Agency (EPA) in September 2005.

The drainage areas of the Lockatong and Wickecheoke Watersheds are 23.3 and 26.6 square miles, respectively. Watershed areas are defined by the US Geological Survey

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(USGS), using a numerical coding known as a Hydrologic Unit Code (HUC). The watershed sizes become smaller as the number of digits in the HUC code becomes larger. The Lockatong and Wickecheoke watersheds are each composed of three HUC14 (14 digit) drainage areas: 02040105200010 (above Rt 12), 02040105200020 (Milltown to Rt 12), and 02040105200030 (below Milltown, includes Upper Delaware River) for the Lockatong; and 02040105200040 (above Locktown), 02040105200050 (Plum Brook), and 02040105200060 (below Locktown) for the Wickecheoke. Areas of each HUC 14 are illustrated in **Figure 2**. The actual drainage area of two of the watersheds differs from the HUC 14s since some of the area within the HUC 14s, near the mouth of the streams, includes drainage outside of these watersheds.

The Lockatong and Wickecheoke Creek Watersheds are characterized by a mostly rural landscape, consisting primarily of agriculture, forest, and wetlands. Much of the soil is classified as either hydric or as having a seasonal high water table within two feet of the land surface. Except for two sections of the Wickecheoke watershed (Village of Rosemont and a small portion of Delaware Township), the potable water supply is obtained from private on-site wells. Sewage is treated on-site, via septic systems, except for the same small section of Delaware Township that is serviced by a public well is also serviced by the Delaware Township Municipal Utility Authority wastewater treatment facility. This facility discharges to Rose Brook, a tributary to Wickecheoke Creek. According to the TMDL for total phosphorus, the permitted discharge was 0.065 MGD (million gallons per day), or approximately 0.1 cfs (cubic feet per second), with an average monthly total phosphorus limit of 1.0 mg/l (milligrams per liter, also referred to as parts per million).

Shallow bedrock, having only secondary porosity (fractures), overlain with thin soil depths, and seasonal high ground water levels creates problems throughout these watersheds for locating suitable sites for septic systems, particularly in the lower two-thirds of each watershed. The size, spacing, and orientation of water-bearing fractures within the aquifer presents water supply problems to many well users during the summertime and early fall when recharge is minimal, or non-existent, and water use is maximized. Although fractures near the land surface can provide recharge to the aquifer, they can also provide a fast conveyance for surface and septic contaminants to enter nearby well-water supplies. Much of the Lockatong and Wickecheoke hydrogeography is oriented with the northwest to southeast bedrock strike direction, possibly along fractures. More information on the watershed characteristics is available in the ***Characterization and Assessment of the Lockatong and Wickecheoke Creek Watersheds*** report (NJ Water Supply Authority, 2007).

Although forests and wetlands make up almost 50 percent of the land use, agricultural and residential land uses cover nearly the same acreage and can contribute large volumes of stormwater flow containing loadings of nutrients, solids, and bacteria at levels exceeding the surface water quality standards. These loads can adversely affect human, aquatic organism, and livestock health, and increase the level of treatment required for potable water suppliers downstream of the contaminant source(s). **Tables 3 and 4** list the sub-watershed areas and the percentage of land uses in each for the Lockatong and Wickecheoke watersheds, respectively.

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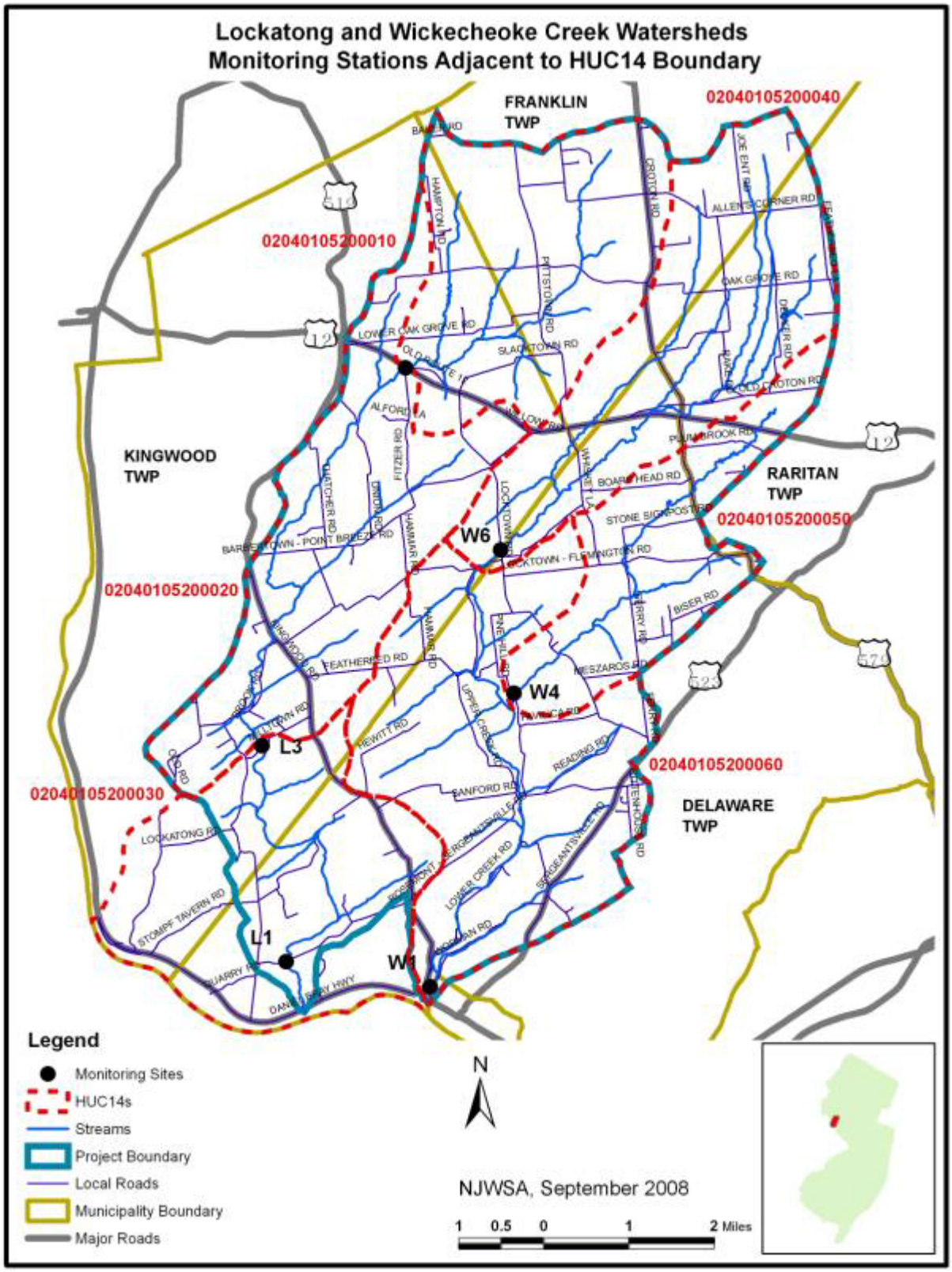
Figure 2. HUC 14 sub-watersheds in the study area.



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Data quantifying historical and existing water quality, flow, and aquatic habitat conditions within these waterways were very limited, or non-existent, at most locations. To further quantify and isolate potential sources of water quality degradation, an intensive water quality and flow-monitoring project was conducted from 2006 to 2007. More information on the monitoring project is available in the report: ***Lockatong and Wickecheoke Creek Water Quality and Flow Monitoring Project – 2006 Through 2007*** (NJ Water Supply Authority, 2008). Two Total Maximum Daily Load (TMDL) reports, developed by the New Jersey Department of Environmental Protection (NJDEP), for fecal coliform and total phosphorus, were also supported by the monitoring efforts of this project.

EXISTING WATERSHED CONDITIONS

Causes and Sources of Contamination

As determined from the NJDEP 2002 land use and land cover information, the Lockatong and Wickecheoke Creek watersheds land uses are primarily agricultural (38 and 40 percent, respectively), forested (28 and 32 percent, respectively), and wetlands (both watersheds at 18 percent). Approximately 12 percent of the Lockatong and 11 percent of the Wickecheoke watersheds are urban land uses: residential, commercial, industrial, transportation, and communication (Anderson, et al, 1976). Alone, or combined the following land uses and activities can cause large increases in stormwater runoff and contaminant loadings to the streams.

Agricultural Crop Operations

The Natural Resources Conservation Service (NRCS) studied the types of farming activities on 20 percent of the farms in the watersheds (NRCS 2007). They estimated that up to 2,032 tons of sediment is reaching the Delaware and Raritan Canal each year from crop production in the Lockatong watershed, and up to 462 tons per year in the Wickecheoke watershed. Some of the crop farms have installed waterways, terraces, and diversions to control runoff. For crop farms within 300 feet of the streams there are 142 farms covering 26 acres of fields with stormwater controls in the headwaters (upper HUC 14), and 32 farms covering 224 acres of fields with stormwater controls in the lower watershed sections (lower HUC 14), for the Lockatong and Wickecheoke watersheds respectively. This represents stormwater controls on approximately 3 percent (6,041 acres total) of the farms in the Lockatong watershed and 4 percent (6,410 acres total) of the farms in the Wickecheoke watershed. No stormwater controls were present on farms within the mid HUC 14 areas. Nearly 44 percent of the agricultural fields were within 250 feet of the stream channels. Twenty-five percent of the fields were within 50 feet of the stream channels.

Stormwater drainage from non-erosive agricultural and athletic fields can accumulate along the perimeter of the subject area and can quickly change from sheet flow (laminar) to concentrated channelized flow (turbulent). **Photos 1 and 2** show the onset and possible result of this unmanaged flow condition at an agricultural site in Delaware Township.

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Livestock

There has been more than a 50 percent reduction in the numbers of beef cattle, dairy, sheep, and swine animals in the watershed municipalities from1983 thru 2004. Numbers of equine have remained steady. Due to the reduction in numbers of animals, this source of erosion and nutrient production was not considered to be a priority unless the animals have direct access to the stream where excrement and activity would severely degrade the aquatic habitat and water quality. **Photos 3 and 4** show cattle and sheep access on a tributary to the Wickecheoke Creek and a tributary to the Lockatong Creek, respectively.

Geese and Deer

The NRCS has specified that much of the watersheds are unattractive to geese since the majority of the land use is agricultural, forest, or urban. Some of the cropland, wetlands, and waterways would provide suitable habitat, but it is difficult to determine the contribution of phosphorus, and other constituents to the streams without additional investigations on the size and locations of the geese populations. Field observations determined that two sites were frequented by geese, one in each watershed.

The estimated deer population is 50 animals per square mile, or an approximate total of 2,500 animals in the two watersheds. Spread over 32,000 acres, or about 1 deer per 13 acres, this density should not pose a significant contribution to the nutrient load.

Site observations have consistently indicated the continuous loss of understory vegetation from deer grazing. Consequently, the loss of vegetation combined with the creation of a network of deer paths causes the formation of stormwater runoff channels that readily convey eroded soil and additional flow to the receiving streams, severely reducing the buffer capacity of the wooded areas.

Table 3. Lockatong Creek – Sub-Watershed Size and Land Use (using 2002 State Land Use/Land Cover data).

Lockatong Watershed Sites[1]	Total Drainage Area (Mile^2)	Sub-Watershed Area (Acre)	Acreage/Percent of 2002 Land Use Types Per Sub-Watershed											
			Agricultural		Barren Land		Forest		Urban		Water		Wetlands	
			Acre	%	Acre	%	Acre	%	Acre	%	Acre	%	Acre	%
L0[2]	23.3	231.3	81.5	35.25	2.1	0.89	105.5	45.61	31.9	13.81	5.6	2.42	4.7	34.40
L1	22.9	1,310.5	450.8	34.40	-----	-----	600.6	45.83	161.8	12.34	16.7	1.28	80.6	6.15
L2	20.9	1,822.2	473.7	25.99	-----	-----	1,056.7	57.99	153.4	8.42	15.4	0.85	123.1	6.76
L3	18.0	1,249.3	360.6	28.87	1.3	0.10	476.7	38.15	162.7	13.02	13.8	1.10	234.2	18.75
L3a	1.2	733.4	206.8	28.19	-----	-----	209.3	28.54	79.1	10.79	-----	-----	238.2	32.48
L4	14.9	601.4	212.6	35.36	1.3	0.22	91.7	15.25	101.2	16.83	11.5	1.92	183.0	30.42
L5	2.7	544.4	201.8	37.07	3.0	0.55	87.2	16.02	63.4	11.64	-----	-----	189.0	34.71
L5F	2.2	241.4	83.4	34.55	-----	-----	33.4	13.82	18.7	7.76	-----	-----	105.9	43.88
L5a	1.9	1,191.4	472.0	39.62	2.6	0.22	212.2	17.81	140.5	11.79	-----	-----	364.1	30.56
L6	11.3	406.3	152.5	37.53	24.2	5.95	90.0	22.14	44.6	10.98	7.0	1.72	88.1	21.68
L6a	10.6	409.7	129.3	31.56	-----	-----	58.8	14.36	53.1	12.96	4.5	1.09	164.0	40.04
L7	10.0	574.8	188.0	32.71	-----	-----	98.7	17.18	110.0	19.14	3.8	0.66	174.3	30.32
Rt 12	8.5	2,232.3	1,201.3	53.81	9.4	0.42	375.4	16.82	240.6	10.78	10.2	0.46	395.3	17.71
L7a	0.6	371.8	160.3	43.10	-----	-----	103.3	27.78	39.8	10.69	1.2	0.33	67.3	18.10
L8	1.9	245.2	114.5	46.72	-----	-----	45.0	18.35	63.5	25.88	2.0	0.82	20.2	8.22
L8a	1.6	991.8	564.7	56.94	-----	-----	187.6	18.92	108.8	10.97	2.4	0.24	128.4	12.94
L9	3.1	685.7	270.1	39.39	-----	-----	264.8	38.62	58.2	8.48	2.1	0.31	90.5	13.20
L9a	2.2	793.6	449.0	56.57	-----	-----	129.4	16.31	123.9	15.61	-----	-----	91.4	11.52
L9b	0.8	502.4	351.2	69.90	-----	-----	40.3	8.01	88.2	17.56	1.8	0.35	21.0	4.19

[1] See **Table 2** for descriptions of the monitoring sites.
[2] Mouth of Lockatong Creek.

Table 4. Wickecheoke Creek – Sub-Watershed Size and Land Use using 2002 State Land Use/Land Cover data.

Wickecheoke Watershed Sites[1]	Total Drainage Area (Mile^2)	Sub-Watershed Area (Acre)	Acreage/Percent of 2002 Land Use Types Per Sub-Watershed											
			Agricultural		Barren Land		Forest		Urban		Water		Wetlands	
			Acre	%	Acre	%	Acre	%	Acre	%	Acre	%	Acre	%
W0[2]	26.62	22.8	-----	-----	-----	-----	14.4	63.31	6.4	28.25	1.9	8.43	0.003	0.01
W1	26.58	1,695.9	972.0	57.32	-----	-----	456.8	26.93	206.0	12.15	18.9	1.11	42.2	2.49
W2	23.9	808.4	529.7	65.52	-----	-----	147.2	18.21	87.5	10.82	5.5	0.68	38.6	4.77
W2a	1.0	638.1	371.2	58.17	-----	-----	86.4	13.53	159.5	25.00	-----	-----	21.0	3.29
W3	21.7	1,548.4	570.6	36.85	4.5	0.29	667.4	43.10	164.4	10.62	18.1	1.17	123.5	7.97
W3a	0.7	455.8	196.5	43.11	-----	-----	183.7	40.30	57.7	12.66	-----	-----	17.9	3.93
W4	5.3	1,996.1	580.1	29.06	0.3	0.01	857.0	42.93	284.0	14.23	7.0	0.35	267.7	13.41
W5	15.4	2,411.5	725.5	30.08	4.6	0.19	971.9	40.30	187.3	7.77	12.5	0.52	509.7	21.13
W6	11.7	936.5	285.9	30.53	5.1	0.54	205.6	21.95	92.1	9.84	15.0	1.60	332.8	35.53
W7	2.2	1,384.9	348.8	25.19	2.6	0.19	572.8	41.36	171.5	12.39	-----	-----	289.0	20.87
W8	5.8	782.2	193.8	24.78	-----	-----	238.4	30.47	91.5	11.69	12.1	1.55	246.4	31.50
W9	2.2	688.6	187.1	27.16	-----	-----	201.9	29.32	64.5	9.36	1.4	0.21	233.8	33.95
W9a	1.2	318.8	146.6	45.99	-----	-----	48.2	15.14	30.9	9.68	-----	-----	93.1	29.20
W9b	0.7	422.2	161.0	38.14	-----	-----	162.6	38.51	48.5	11.48	-----	-----	50.1	11.87
W10	1.0	285.4	98.2	34.42	-----	-----	75.7	26.53	18.7	6.54	0.7	0.25	92.0	32.25
W10a	0.6	353.6	181.4	51.30	-----	-----	85.5	24.19	48.8	13.80	-----	-----	37.9	10.71
W11	3.6	529.2	119.4	22.56	2.9	0.54	121.4	22.93	51.2	9.67	0.5	0.09	233.9	44.20
W11a	0.6	385.6	158.7	41.17	-----	-----	102.9	26.69	38.6	10.02	-----	-----	85.3	22.12
W11b	1.1	729.5	427.7	58.63	0.3	0.04	150.6	20.65	64.6	8.86	0.9	0.12	85.4	11.71
W11c	1.0	640.8	156.0	24.35	9.1	1.42	155.5	24.27	69.8	10.89	0.9	0.15	249.4	38.92

[1] See **Table 2** for descriptions of the monitoring sites.
[2] Mouth of Wickecheoke Creek.

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Photo 1. Perimeter erosion from concentrating field drainage.

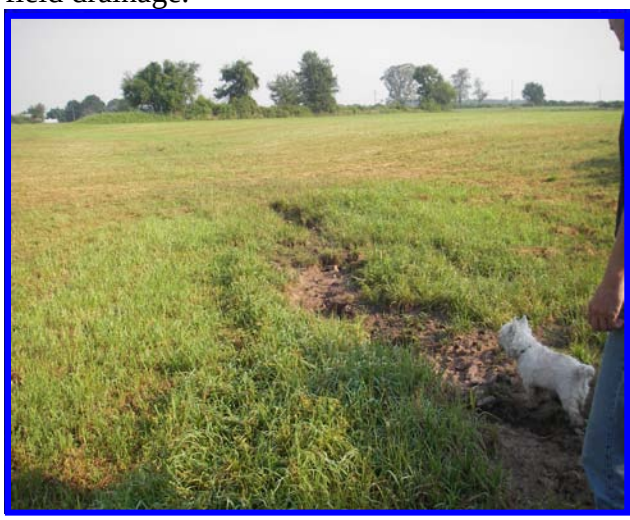

Photo 2. Effect of accumulated field runoff on a drainage channel.

Photo 3. Livestock egress to tributary of Wickecheoke Creek.

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Photo 4. Sheep egress to tributary of Lockatong Creek.

All Terrain Vehicle Impacts On the Stream Corridor

In the past 5 years All Terrain Vehicles (ATV) have become increasingly popular as a recreational item. Although recreation is the primary use, they have also become detriments to the stream banks and channels. Trails along, into, and through the stream channels has created a large increase in sediments and related nutrients to the water quality. Trees and other vegetation, that filter and store stormwater, are removed to construct new paths. Trails leading to the stream become runoff channels for stormwater flow, increasing erosion. **Photos 5 thru 8** show some of the indications that ATV activity has begun to substantially degrade the aquatic habitat and water quality. These photos were taken at locations within 200 feet of the Union Road bridge at Kingwood Park. Walking paths in public parks are becoming access roads to sections of the streams. More than 45 tons of sediment per year is likely from erosion that has been observed at accessible locations.

Roadway Stormwater Runoff and Drainage

The estimated length of public roads within the watersheds was 139.3 miles and the total length of private roads was 6.4 miles (NRCS, 2007). Unpaved, including dirt, roadways in the Lockatong watershed was 1.2 miles, and 7.2 miles in the Wickecheoke watershed. Approximately 2,949 tons of sediment per year is lost from the paved roads and 774 tons per year from unpaved roads. About 419 tons of ice-traction material, including ground iron slag, is applied to the roads each year, for a total possible sediment contribution to the streams of 4,142 tons. Large sections of Pine Hill Road, Old Mill Road, and Wickecheoke Road, all in Delaware Township except the northern segment of Wickecheoke Road that is in Kingwood Township, can contribute excessive loads of sediment, nutrients, and other chemicals to the Wickecheoke Creek and Plum Brook.

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Photos 5 thru 8. ATV trails along, and in, Lockatong Creek.

Most municipal road drains are cleared of debris on an annual basis. A backhoe or other scooping equipment is usually used to dredge the drainage channels. The channels become erodible and storm runoff begins to undercut the sides of the channels and transport volumes of additional sediment to the streams. **Photos 9 thru 12** show a few of the numerous examples of erosion that were observed along roadways.

Photos 13 and 14 show selected sections of the road surface on Pine Hill Road. **Photos 15 thru 18** show the roadside drainage ravine erosion and sediment transport along selected segments of roadway.

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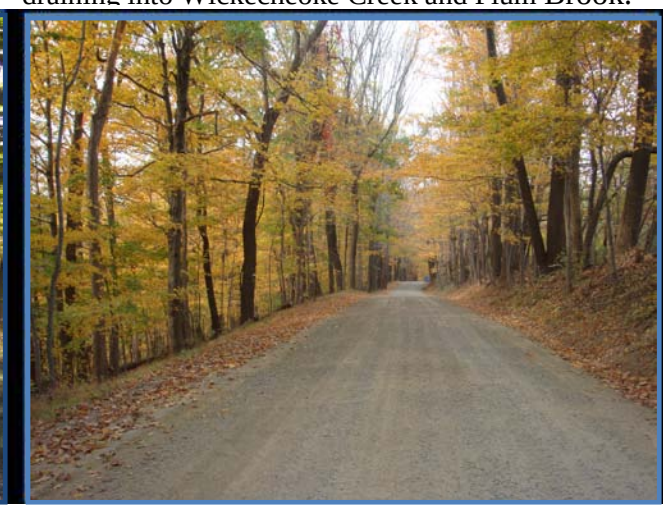
Photos 9 thru 12. Roadside drainage - erosion and transport of sediments to streams.

Photo 13. Pine Hill Road – dirt/gravel surface draining south into Plum Brook.

Photo 14. Pine Hill Road – dirt/gravel surface draining into Wickecheoke Creek and Plum Brook.



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Photos 15 thru 18. Pine Hill Road - roadside erosion and discharge to Wickecheoke Creek and Plum Brook.

In some areas of the watersheds, particularly in the Rose Brook watershed (tributary to Wickecheoke Creek), asphalt berms have been installed along roadways by County and Municipal roadway departments to contain storm runoff flows from flowing onto adjacent lands, thus directing the concentrated flows into the streams. The effects from this practice are severe erosion of stream banks and channel at the discharge, and the creation of large sediment deposition areas downstream of the inflow. More frequent discharges from the roadway onto the bordering lands, as originally constructed without the berms, provided more opportunity for flow dissipation and infiltration, reducing detrimental impacts to the streams.

Roadways that have inlet structures with a piping system for stormwater either discharge the concentrated flows to the streams, via outlets at bridge/culvert structures, or discharge into eroded drain channels that convey the flow into the stream. Many of the roadway inlet structures are higher than the elevation of the road, whereby the runoff from the road bypasses the structure and goes directly onto and infiltrates the adjoining lands. The runoff onto adjoining lands were natural drainage conditions that had existed prior to the installation of the prefabricated inlet structures and appeared to be providing successful operations. **Photo 19** shows elevated stormwater inlets, and **Photos 20 and 21** show agricultural drainage that inadvertently flows directly to an inlet structure and ultimately into an eroded drainage channel to the Wickecheoke Creek.

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Photo 19. Elevated stormwater inlets.

Photo 20. Field drainage flowing into roadside stormwater inlet.

Photo 21. Storm runoff from crop field routed directly into roadside drain.

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Malfunctioning or Failed Septic Systems

Thin soil depth, shallow and fractured bedrock, seasonally high or perched ground water table producing saturated soil, and low-permeability soils create areas that are not suitable for septic system installation and function. **Photo 22** shows a system that was installed in the floodplain of a tributary to Lockatong Creek.

On-site wastewater treatment systems should not be located up-gradient of ground water supply wells, or within the floodplain of neighboring waterways, or in areas of hydric soils and wetlands. Innovative treatment systems could be considered for areas having somewhat limited soil permeability conditions. Soil and site assessments must be conducted to assure proper operation of conventional or advanced systems. The NJ Geological Survey's Nitrate Dilution Model is required by the State for every new, modified, or replaced septic system to determine the pervious area necessary to infiltrate precipitation to maintain a ground water nitrate concentration of not more than 0.2 mg/l (milligrams per liter).

Photo 22. Septic system installed in flood plain. Photo taken during higher-flow, but the flow condition was not considered flooding.

Land Disturbance and Soil Compaction From Construction

Clayey and silty soils are prominent throughout the watersheds. During construction and building at development sites, soil compaction occurs, decreasing the permeability of the active project site for infiltration and storage of precipitation, increasing erosive runoff flows. Exposed subsoils can produce sediment-laden runoff flows. The sediment is composed of fine clay and silt particles as well as larger, heavier particles. Sediment is suspended in the flow, carried off the site and deposited into the stream. The heavier particles settle out first with the finer grains carried farther downstream before settling (sometimes days later), creating a large length of degraded stream habitat and water quality. Over time, the sediment settles out of solution, covering crevices and voids between the rock and cobble substrate that are critical habitat for the survival of aquatic macroinvertebrates and species of fish that

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cannot relocate to unimpacted stream segments. Stormwater basins that are constructed on project sites are frequently compacted from the movement of heavy equipment during construction, defeating any intent of infiltration. **Photos 23 thru 25** present examples of stormwater runoff, unpermitted stormwater pumping, and stream degradation from construction activities.

Photos 23 thru 25. Stormwater and sediment load from construction site on Barbertown-Point Breeze Road, impacting Muddy Run.

Bridge construction or replacement is not regulated for sediment control. The construction activity is scheduled to conclude in a timely manner to limit the duration of sediment disturbance and possible loadings to the stream. Unanticipated higher flows and intense precipitation events can cause extensive erosion and sediment loadings to the stream at the project site. The installation of a catchment basin with storm-water pumped through sediment filters (filter bags) has been used successfully for projects sponsored by the NJ Water Supply Authority. This is one strategy that should be considered for controlling sediment loadings at bridge-construction sites. **Photo 26** shows bare soils susceptible to erosion during the bridge replacement project at Lockatong Creek on Union Road.

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Photo 26. Potential erosion from bridge-construction site.

Inconsistent Compliance of Permitted Dischargers

Commercial and industrial discharges or water uses (permitted or illicit) can quickly degrade ambient water quality and flow conditions. An unpermitted discharge to the Wickecheoke Creek on December 19, 2006, from a breached earthen containment basin, discolored the stream for more than 3 days, releasing sediment, metals, organics, and other constituents. Treated wastewater from a municipal wastewater facility discharges into Rose Brook, a tributary to the Wickecheoke Creek. Occasionally, the stream water had a chlorine or sewage (sulfer and ammonia) odor near the confluence with the Wickecheoke Creek. Information on permit-compliance of facilities discharging to C1 streams should be presented to municipal officials and residents on a semi-annual frequency.

Stream Channel Destabilization and Erosion

The NRCS estimated that up to 12,300 tons of sediment are eroded from the stream banks and deposited to the stream channels each year. Channel destabilization and erosion are the most intensive sources of sediment loads. Historical high-flow events, since Hurricane Floyd (September 1999), have increased bank destabilization in nearly every stream channel within these watersheds. Stormwater flows from existing and new development have increased runoff flows and pollutant loads, while decreasing stream baseflows, from the increase of impervious surface. The compaction and covering of soils at development sites has been detrimental to the stream flow regimes. Existing plow-pans (mostly impervious layers about

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a foot lower than the ground surface) in agricultural crop-production fields also add to the runoff volume from the areal extent of semi-impervious surface.

Water Quality and Flow Monitoring

Results from the ***Lockatong and Wickecheoke Creek Water Quality and Flow Monitoring Project – 2006 Through 2007*** (NJ Water Supply Authority, 2008) revealed sub-basins in the watersheds that were impacted by contaminants. Results from the project were used to: 1) isolate and identify sources/causes of water quality degradation; 2) identify areas contributing baseflow to the mainstem during low-flow conditions, and quantify the contributing flows; 3) quantify pollutant loadings from sub-watershed areas; 4) quantify pollutant mass reductions that will satisfy Surface Water Quality Standards in stream reaches exceeding water quality standards; and 5) develop water quality and flow targets for defining "existing" water quality and "measurable change" for long-term protection of these C1 streams.

The water quality monitoring was conducted in two phases: the first phase was performed on mainstem sites and at the mouth of the larger tributaries; the second phase focused on further isolating sub-watershed areas that were determined in Phase 1 to be contributing to either water quality and/or quantity impacts. Phase 1 monitoring occurred from August through December 2006 with 6 sampling events, and Phase 2 monitoring was conducted from March through July 2007 with 11 sampling events, including sediment and additional bacteria sample collections. A total of 16 ambient and one sediment sampling events were performed in each watershed. A Quality Assurance Project Plan (QAPP), approved by the NJDEP Office of Quality Assurance, provided guidance throughout the project.

Nutrients (total phosphorus, nitrate, nitrite, total Kjeldahl nitrogen, and ammonia), solids (total suspended solids), turbidity, boron, coliform bacteria (fecal and Escherichia), pH, conductivity, and water temperature were analyzed to determine the magnitude and locations of contributions during both lower and higher flows. Levels of pollutants for each flow regime are shown on a sub-watershed basis in **Appendix B**.

The US Geological Survey (USGS) was contracted for installation and maintenance of continuous flow-monitoring stations, one near the mouth of each stream. The Lockatong station, located near the bridge on Raven Rock – Rosemont Road, began operation in November 2005 and the Wickecheoke station, located just upstream of the route 29 bridge, became operational in March 2006. Both monitors remain active at the writing of this report.

In addition to the USGS flow-monitoring sites, the NJWSA developed stage-discharge relationships at 12 water quality monitoring sites along Lockatong Creek, and at 13 water quality monitoring sites along the Wickecheoke Creek. The supplemental flow monitoring sites were developed to provide representative flow estimates for the shallow and fractured bedrock that underlies both watersheds. The Lockatong Creek receives most of its low-flow water supply from the northern headwater tributaries, while most of the Wickecheoke Creek low-flow water originates from springs along tributaries located within the southern 25 percent of the watershed.

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"Low-flow," for this project was defined as equal to, or less than, 10 cubic feet per second (cfs) as measured at the USGS flow-monitoring sites. "Higher flow" is greater than 10 cfs. This flow separation was supported from data collected by the Delaware River Basin Commission (DRBC) at these same sites from 2000 through 2003 (Limbeck, Smith, and Kratzer, 2004). The data showed that non-point source pollutant loadings began to increase excessively at flows greater than 10 cfs.

Total Phosphorus Load Reductions to Attain Surface Water Quality Standards

Total Maximum Daily Loads (TMDLs) for total phosphorus, developed by the NJDEP for these watersheds, were derived mostly from water quality data that were collected near the mouth of each stream. The ***Lockatong and Wickecheoke Creek Water Quality and Flow Monitoring Project – 2006 Through 2007*** (NJ Water Supply Authority, 2008) provided total phosphorus and flow data for thirty-three monitoring locations throughout the watersheds that enabled empirical mass-balance relationships to be developed between monitoring sites. The relocation of selected monitoring sites during the project to further isolate potential contamination sources, and zero flows of many headwater sites during dry summertime conditions, disallowed consistent temporal data collection between many of the sites. Therefore, average annual statistics for phosphorus loads were not used for estimating load reductions due to the temporal variability and data densities. Maximum total phosphorus concentrations, and the associated loads, were used to identify exceedences of the Surface Water Quality Standards (SWQS) and to provide estimates of the required load reductions that would attain 0.1 mg/l total phosphorus. **Figures 3 and 4** illustrate percent load reductions for areas in the Lockatong and Wickecheoke Creek watersheds, respectively, that had maximum phosphorus concentrations above the regulatory criteria. All estimated load reductions are based on the cumulative reductions of loads from all upstream watershed areas.

Isolation of Potential Contamination Sources Within The Lockatong Watershed

The Lockatong watershed has been sectioned into three areas for isolating potential contamination sources: upper, middle, and lower watershed areas. The upper area is north of County route 12. The middle and lower are from route 12 to Barbertown-Point Breeze Road, and from State route 519 to Rosemont-Raven Rock Road, respectively. Although somewhat limited in scope and frequency of collections, the macroinvertebrate data collected by NJDEP, NJWSA, Delaware Township Elementary School, and the Delaware Riverkeeper Network showed moderate to no impairments, indicating good population and habitat conditions for most sampling locations along Lockatong Creek and its tributaries. The northernmost section of tributary L9 had the most impairment, having moderate to severe impairment scores.

Upper Watershed Area

Water quality results for low and higher flows in the Lockatong creek and tributaries, revealed greater levels of nutrient concentrations in the headwater streams, north of Lower Oak Grove Road, over the entire range of flows, particularly in the eastern-most tributary northeast of Pittstown Road. Although the mass of contaminants in the water (loading) was relatively low, the concentrations were high due to less flow for dilution. Nitrate, a common

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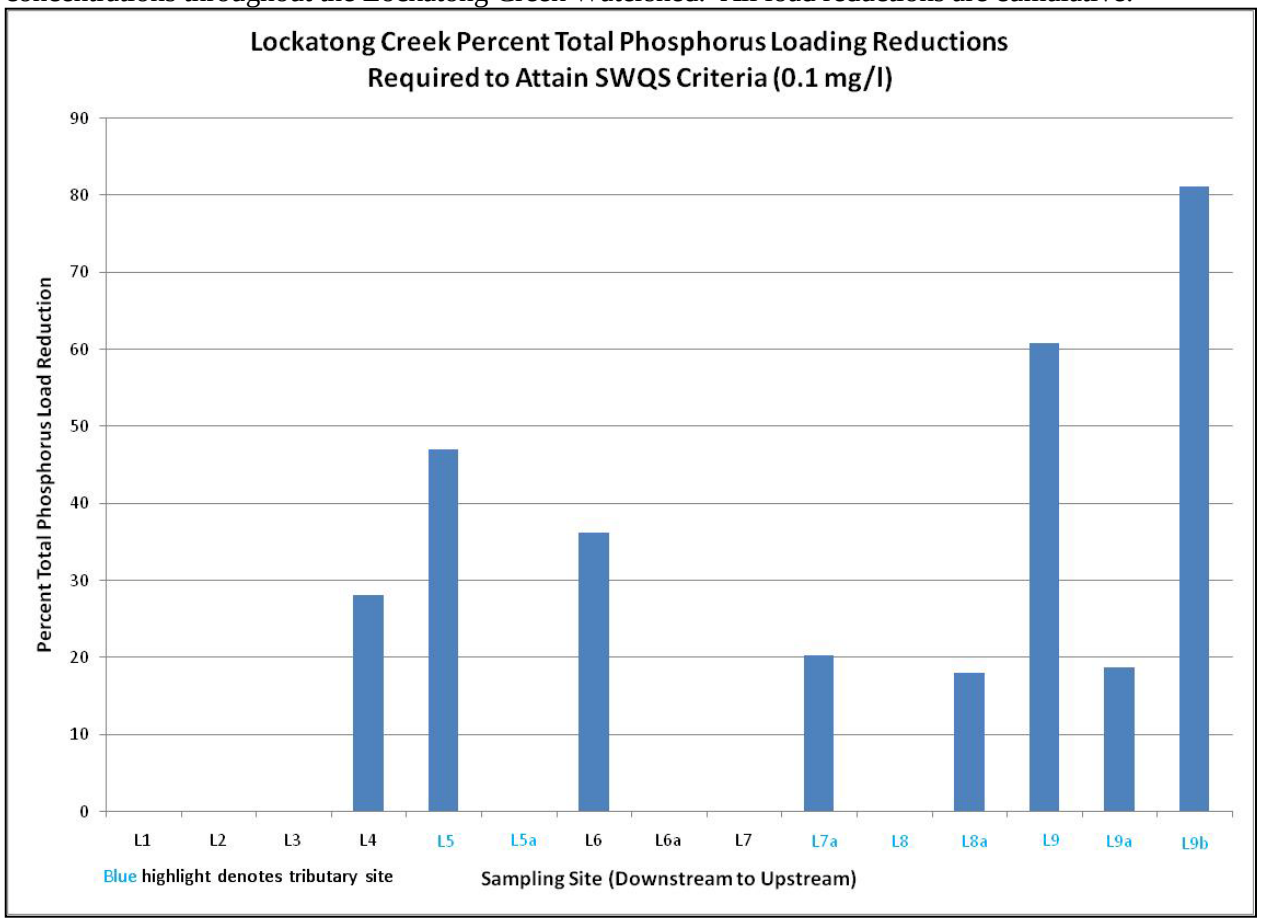
Figure 3. Estimated loading reductions to attain SWQS, targeting maximum total phosphorus concentrations throughout the Lockatong Creek Watershed. All load reductions are cumulative.



form of nitrogen in wastewater (e.g., septic leachate, livestock excrement, and illicit sewage discharges), had elevated loadings for each of the four samples collected at site L9b. The maximum concentration was 7.9 mg/l with an average daily loading of 30.6 lb/day (11,169 lb/year). Six samples were analyzed for bacteria. Three of the fecal coliform and four of the E. coliform values exceeded the 10 percent limits for exceedences. The E. coliform geometric average also exceeded the Surface Water Quality Standard (SWQS). Two of the 6 samples analyzed for total phosphorus exceeded the 0.1 mg/l SWQS with a maximum concentration of 0.482 mg/l and an average daily loading of approximately 0.99 lb/day (361 lb/year). Up to 82 percent of the entire stream baseflow during the lower flows originates from this tributary, upstream of Pittstown Road.

Boron levels were somewhat elevated above background levels. A monitoring site on Lower Oak Grove Road had exceptionally elevated boron levels, greater than those associated with agricultural applications or normal geological conditions. Consequently, the boron load produced elevated boron concentrations at every location downstream of this site. Further assessments located the source of boron just upstream of Lower Oak Grove Road at a wetland spring. Although pesticides were not analyzed during the study, they have historically been used in association with boron as an herbicide and insecticide. Therefore,

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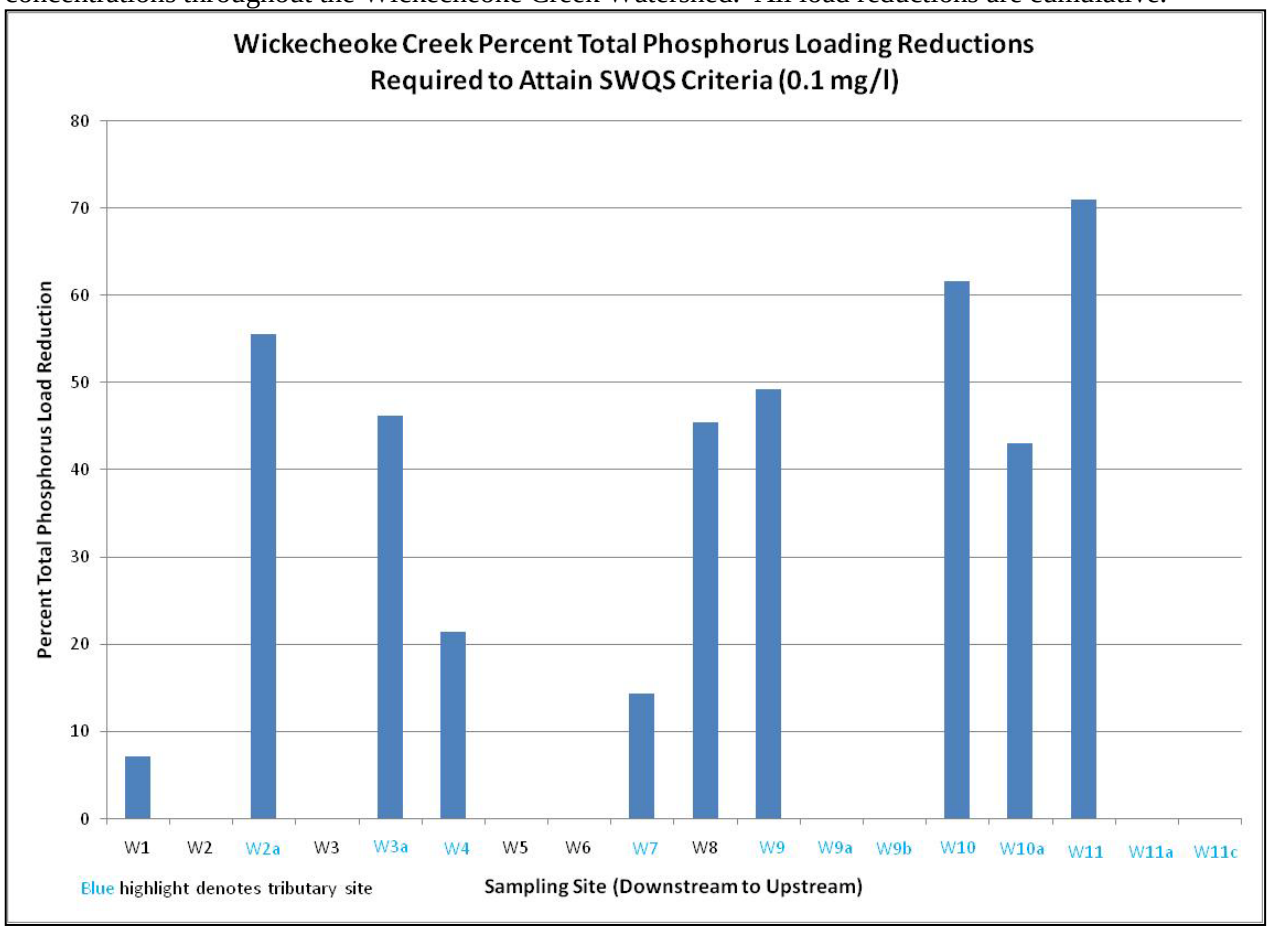
additional monitoring is required to fully assess the potential historical use of this wetland area as an agricultural waste-disposal site.

Figure 4. Estimated loading reductions to attain SWQS, targeting maximum total phosphorus concentrations throughout the Wickecheoke Creek Watershed. All load reductions are cumulative.



Fecal coliform and Escherichia coliform bacteria were consistently higher at sites north of Oak Grove Road, confirming the possibility of fecal contamination from both human and animal sources in this section of the watershed. Turbidity was consistently higher at sites upstream of Oak Grove Road, in the tributary segment along Hammond Road. Two in-stream ponds were located just upstream of the sampling site with 3 or more additional ponds further upstream. The sizes of 3 of the ponds could have been supporting carp and other fish, in addition to providing a favorable habitat for geese, whereby causing a frequent stirring of the pond substrates that cause turbid water conditions. A farm pond north of Oak Grove Road and along the east side of Pittstown Road was frequented by large flocks of geese.

Middle Watershed Area

From south of County highway route 12 to Barbertown-Point Breeze Road, additional loadings of nutrients and bacteria were entering the stream during all flows. During higher flows, boron was also increased in this section of the creek. Illicit sewage discharges and malfunctioning septic systems would provide such increases during low flow. Increases in

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boron loads during higher flows may indicate septic systems underlain by semi- or non-pervious materials, causing a ponding condition that could add loading when the adjoining soils become saturated. Septic systems installed in close proximity to the stream channel may also release contaminants during higher stream flows, as the soils become saturated. Additional reconnaissance is required to identify the specific source(s) of contamination.

Total suspended solids and turbidity were elevated in this section of stream during all flow conditions. Channel sediments were finer in this stream section and could become resuspended and cloud the water from human or animal disturbance. The water quality monitoring project determined a good relationship between sediment and water total phosphorus, fecal bacteria, and total suspended solids, indicating that resuspension of sediments may be directly affecting the water quality. During lower flows, water depths were shallow throughout this reach and field crews noted frequent sightings of people and deer wading in the stream, likely resuspending sediments.

In addition to eroding stream banks, ATV activity and stormwater sediment loads from runoff and erosion near athletic fields were adding to the sediment deposits in this reach. The section of Lockatong Creek within Kingwood Township Park was receiving stormwater runoff with sediment loads from eroding stormwater channels, mostly near the stream. The sediment load was estimated at 90 tons per year.

Lower Watershed Area

Nutrients were elevated at all flows in the lower portion of the Lockatong watershed. Boron was only elevated during the higher stream flows, possibly reflecting the characteristics of bedrock and soils near septic systems. Semi- or non-pervious materials in the vicinity of septic systems can limit the amount of leachate dispersal during dry conditions, but may provide conveyance when soils become saturated from precipitation. Septic systems located near the stream channel may also release contaminants during higher stream flows, as the soils become saturated. Fecal bacteria were lower in this stream section. Wide, shallow, and a mostly north-south oriented channel allows more exposure to sunlight. Since fecal bacteria cannot tolerate solar radiation, the lower levels in this reach may be the result of dye-off from natural ultraviolet radiation. Further investigation is warranted to determine the specific source(s).

The orientation and width of the channel, in association with the shallow water depth, provided optimal conditions for growth of aquatic plants. Through photosynthesis and respiration, aquatic plants vary the dissolved oxygen and pH of the stream during daytime and nighttime conditions. Plants increase dissolved oxygen and raise the pH during the day and produce the opposite effects at night. The channel characteristics also produce warmer water temperatures during the day. An in-stream pond, just upstream of Milltown Road, also provided ideal conditions for aquatic plant growth and warming of the water. During the study, pH and water temperature exceeded the Surface Water Quality Standards (SWQS) during the day, particularly during lower flows in July and August. Nighttime levels of pH were not monitored, but may have exceeded the lower limit of the SWQS.

A mill located along the stream on Strimples Mill Road produced a large pile of sawdust next to the stream channel from active operations. During each higher flow this material was

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naturally washed into the stream, adding organics that can disrupt aquatic habitat, lower the dissolved oxygen, increase aquatic-plant productivity, and increase bacteria populations during decomposition.

Muddy Run flowed into Lockatong Creek just upstream of route 519 (northern end of the lower watershed area). Although total phosphorus exceeded the SWQS during higher flows, the loadings were only slightly increased beyond background. The relatively lower flows in this tributary produced high concentrations with only minor increases in loadings. Bacteria levels were elevated during all flows. Manure piles and fertilizer storage near the stream may be contributing to, or may be, the contamination source(s).
Clearing and construction activity in the watershed produced sediment-laden runoff flows during each storm event and during low flows when stormwater control basins were illicitly drained by pumping. This sediment load increased total suspended solids and turbidity levels, impacting Muddy Run and Lockatong Creek to downstream of route 519.

Isolation of Potential Contamination Sources Within The Wickecheoke Watershed

The Wickecheoke watershed has been sectioned into three areas for isolating potential contamination sources: upper, middle, and lower watershed areas. The upper area is north of County route 12. The middle and lower are from route 12 to the confluence of Plum Brook, and from Rosemont-Ringoes Road (Covered Bridge) to State route 29, respectively. Although somewhat limited in scope and frequency of collections, the macroinvertebrate data collected by NJDEP and NJWSA showed mostly good population and habitat conditions for all sampling locations along Wickecheoke Creek and its tributaries.

Upper Watershed Area

All of the sites north of route 12 had somewhat elevated levels of total phosphorus and organic nitrogen during higher flows. Two sites, Wickecheoke Creek at Rake Road and a tributary on Old Croton Road, had increased phosphorus loadings, and concentrations exceeding the Surface Water Quality Standards. Although nitrate was near background levels, these same sites had higher levels of boron, coliform bacteria, suspended solids, and turbidity, indicating the possibility of illicit sewage discharge(s) and/or septic system malfunction(s). The elevated levels of suspended sediment and turbidity can result from stream egress by livestock and wildlife. Since the channel substrates in this area of the Wickecheoke watershed are mostly larger cobbles and rock, with some sand, channel substrate disturbances by wildlife should not substantially increase suspended solids or turbidity. Nearly 40 percent of the land use is agriculture, with approximately 10 percent as urban. Therefore, fertilizers and/or manure may be other sources of nutrient and bacterial contamination.

During the summer, this portion of the Wickecheoke watershed was frequently dry, indicating a lower aquifer level in this region. Further ground water studies should be conducted to quantify the available water supply.

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Middle Watershed Area

Throughout this section of the watershed, stream banks are eroded, contributing fine and coarse substrates to the channel. Except for nitrate, the levels of nutrients, suspended solids, turbidity, and boron were consistently greater in the mainstem Wickecheoke Creek, northeast of Whiskey Lane. A tributary to Wickecheoke Creek, just northwest of the mainstem and northeast of Whiskey Lane, had mostly background levels of all water quality constituents during low flows. Total phosphorus, organic nitrogen, boron, and bacteria increased substantially during higher flows, suspended solids were somewhat elevated. Agricultural activity and the possibility of leachate from septic systems or direct sewage discharge could be loading sources. Stream bank erosion was also evident in this tributary.

Water quality between Whiskey Lane and Locktown Road showed increased levels of nutrients, boron, fecal bacteria, solids, and turbidity during low and higher flows. An unauthorized discharge from the Magnesium Electron Incorporated (MEI, currently known as MEL Chemicals) facility, on December 17, 2006 created substantial increases in TSS and turbidity during the December 20, 2006 sampling run. The increased levels of sewage indicators may warrant additional monitoring for septic-system leachate and/or illicit sewage discharge(s) into the stream, downstream and upstream of the MEI facility. Geese were consistently observed on a pond near the entrance to the facility, possibly a source of additional pollutant loads.

A series of waterfalls between Kingwood-Locktown Road and Old Mill Road created the steepest stream channel slope in the Wickecheoke watershed. Although the water quickly cascades over each of the waterfalls, the pooled areas between the falls are large with very slow water velocities, deeper pool areas at the base of each fall. The slower flows, combined with shallower depths downstream of the scour pools, promote the growth of both submergent and emergent aquatic plants. The plants take in nutrients during the day and the slower velocities allow the deposition of suspended sediments. The fall-pool regime acts as a natural filter during lower flows. This sub-watershed was heavily influenced by the increased loadings at Locktown Road for total phosphorus, nitrate, TKN, boron, and bacteria. Due to the exposed and shallow bedrock, and thin soil layer in this watershed septic systems may contribute to the loadings. The combined influence of a breach in a settling basin wall at the Magnesium Electron Incorporated facility on December 17, 2006, and a breached and draining farm pond that was discharging into a tributary that confluences the Wickecheoke Creek about ½ mile upstream of Old Mill Road, substantially elevated the TSS and turbidity levels. Small groups of ducks were occasionally noted in the pooled areas.

Plum Brook confluences with Wickecheoke Creek approximately ½ mile downstream from Old Mill Road. Greater loadings of nutrients and solids were evident between Locktown-Flemington Road and Pine Hill Road. Phosphorus, boron, and fecal coliform were at increased levels over background during higher flows. Although the loadings were less in the sub-watershed area draining to Locktown-Flemington Road, inherent lower flows produced consistently higher concentrations. Turbidity was also higher at this site along with fecal coliform levels that were increased substantially during higher flows. Other than turbidity, the loadings upstream of Locktown-Flemington Road were near background conditions. The increases of phosphorus, boron, and fecal coliform during higher flows suggests the possibility of malfunctioning septic systems that could leak into the stream when

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the soils are saturated. These systems may have been installed further back from the stream channel, but may be overlaying clay or other less-permeable materials. Since agricultural land uses are lower in the Plum Brook watershed (less than 30 percent) and urban land uses (12 to 14 percent) are greater than the average for the entire Wickecheoke watershed (11 percent), septic system malfunctions are likely sources.

Lower Watershed Area

The water quality in the stream reach between Rosemont-Sergeantsville Road (covered bridge) and State route 29 indicates combined loadings from direct sewage discharge(s), septic systems, road runoff, and agriculture. Extensive channel erosion has occurred throughout this channel from increasing stormwater-runoff.

Cold Run flows into Wickecheoke Creek from the east, just north of Rosemont-Ringoes Road. Bacteria, phosphorus, and nitrate levels were commonly higher in this tributary watershed. Approximately 43 percent of the watershed area is agriculture, and more than 12 percent is urban, promoting the possibility of sewage and manure loadings. Much of the Wickecheoke flow, up to 44 percent during the lower baseflows, originates from springs in this watershed. Therefore, ground water quality from this sub-basin can influence the mainstem Wickecheoke Creek, particularly during the lower flows. The low-flow data indicate that there may be higher levels of nitrate flowing out of the ground water springs. Other sources of nitrate, bacteria, and phosphorus could be originating from septic systems on older farmsteads and homes, and/or livestock manure.

Wickecheoke Creek, upstream of Rosemont-Ringoes Road, revealed extensive increases in nutrient, coliform bacteria, boron, and suspended solids loadings during all stream flows. Turbidity was somewhat elevated throughout all flows. Relatively, loadings from Cold Run were minimally influencing the loadings of the entire sub-watershed on the mainstem. The sudden surge in loadings may be the result of contamination originating in the local vicinity of Rosemont-Ringoes Road. The seemingly localized increase in loadings during lower flow directs attention to an increased possibility of illicit sewage discharge(s) and septic leachate, and/or anthropogenic disturbance of the stream channel. Agricultural activities make up approximately 37 percent of the land use in this portion of the watershed, possibly adding to the total loadings. Stormwater runoff and erosion from Pine Hill Road and the roadside drains consistently carries large sediment loads, and the associated nutrients, metals, and solids, into Plum Brook and Wickecheoke Creek, increasing these loadings during rain events.

Rose Brook, a tributary of Wickecheoke Creek, flows from the northeast and joins the mainstem approximately 0.6 mile downstream of Rosemont-Ringoes Road. This tributary receives effluent from the Delaware Township Municipal Utility Authority. As reported in the Total Maximum Daily Load (TMDL) report from the NJDEP, the allocated discharge limits for the Delaware Township MUA (permit NJ0027561) was 1 mg/l (milligrams per liter) total phosphorus at a maximum effluent flow of 0.032 MGD (million gallons per day), or 0.05 cfs. This is equivalent to approximately 98 lb/yr (pounds per year) of total phosphorus. Total phosphorus, nitrate, and boron were higher in this sub-watershed. A chlorine odor was frequently noted in this stream during sampling. Extreme stormwater runoff events have recently become more frequent, destabilizing nearly the entire channel.

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Increased runoff from recently curbed roadways and additional stormwater being conveyed into this watershed from developments in neighboring watersheds has increased the flows and destabilization of the channel.

From Rosemont-Sergeantsville Road to route 29 the Wickecheoke Creek water quality continued to degrade, in addition to the greatest intensity of stream-bank erosion and the subsequent large quantities of sediment deposited in the channel. Most of the deposition consisted of larger cobble and boulders which become a bed-load that is not readily suspended, but rolled along the bedrock stream bottom during higher flows. Nutrient, boron, and suspended solids loadings were unusually higher in this section of the Creek, particularly during higher flows. The boron load during higher flows reached levels more than 10 times greater than that of lower flows. Older homes with malfunctioning septic systems may be contributing to the elevated water quality constituents. Direct sewage discharge is also possible. During higher flows, a tributary entering Wickecheoke Creek from the west, approximately ¼ mile downstream from Rosemont-Sergeantsville Road, conveyed water from a cattle access just upstream of the confluence. Similar to the lower section of the Lockatong Creek, this section of the Wickecheoke Creek presented a wide and shallow channel that was consistently exposed to sunlight. The increased exposure to solar radiation (ultraviolet light) was not suitable for fecal bacteria and decreased the population proportionately. The increased sunlight provided optimum conditions for aquatic plant production, while also increasing the daytime water temperature. As previously described in the Isolation of Potential Contamination Sources Within The Wickecheoke Watershed section, pH and dissolved oxygen fluctuations increase with increasing aquatic plant growth. During the study there were several pH and water temperature violations for the upper limits of these parameters in this section of the stream. Dissolved oxygen was not monitored. Nighttime pH and dissolved oxygen could have also violated the Surface Water Quality Standards, but was beyond the scope of this project.

WATERSHED REMEDIATION STRATEGIES

Recommendations from the following reports: ***Characterization and Assessment Report;*** the ***Lockatong and Wickecheoke Creek Water Quality and Flow Monitoring Project – 2006 Through 2007 Report;*** and ***An Assessment of Municipal Plans, Policies, and Regulations Effecting Water Quality in the Lockatong and Wickecheoke Watersheds*** determined that the following remediation strategies are critical for long-term protection of the quality and quantity of water within the Lockatong and Wickecheoke Creek Watersheds, and implementation of these measures should be expedited. NJDEP 319(h) grant, NJDEP Corporate Business Tax for Watershed Projects, NJWSA Source-Water Protection, EPA CARE grant, Farm Bill assistance programs, municipal, and private are some of the possible funding sources that would be available to implement selected remediation projects. **Appendix B** describes specific structural and educational remediation strategies.

Municipal Stream Protection Strategies Assessment

A separate report, ***An Assessment of Municipal Plans, Policies, and Regulations Effecting Water Quality in the Lockatong and Wickecheoke Watersheds Report*** (NJ Water Supply Authority, 2008), compares the currently adopted, and possible future remediation strategies that are available for implementation by municipalities. Sample ordinances are included for

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reference. Cross-boundary cooperation among neighboring municipalities should be developed to provide consistency for those properties and projects located between political boundaries, and to ensure open communication between upstream and downstream communities to protect the watersheds.

Structural and Educational Remediation Strategies

The Lockatong and Wickecheoke Creeks are both classified as C1. Antidegradation is defined as no measurable change in water quality. There are currently no criteria to determine changes in stream water quality or to define measurable change. A user-friendly statistical technique similar to the FIRE method that is used by the NJDEP for total phosphorus TMDLs could also be applied to selected stream sites to establish a water quality reference point. One or more sites could be used for this application. The method would define existing water quality and measurable change for application to potential, or known, point and/or non-point pollution source(s). The targeted stream site could then be used to allocate pollutant loadings throughout the contributing watershed area as part of the permitting process. More details are presented in the ***Lockatong and Wickecheoke Creek Water Quality and Flow Monitoring Project – 2006 Through 2007 Report*** (NJ Water Supply Authority, 2008).

Developed from the need for stormwater quantity and quality controls, several structural and non-structural remediation strategies are presented below. Emphasis is applied to the need for stormwater runoff controls for both private and conservation lands; agricultural crop fields and livestock pastures; residential and commercial lawns, and athletic fields; roadways and roadside drainage, including reductions in width, curbing, and unnecessary roadside storm drains in locations that had previously drained to natural infiltration areas; and expanding on public education. Those controls requiring additional expertise, via contractual services and costs, are detailed in **Appendix B**. Existing proposed projects for stormwater management should be reviewed and considered for funding, when applicable (i.e., Delaware Township's Stormwater Management Plan for projects in the Rose Brook watershed, undergoing planning but unfunded).

Scholastic and volunteer educational programs should include some or all of the following:

- Emphasis and expansion of environmental protection curriculums and programs for schools within the project municipalities, several have already initiated such programs;
- Volunteer stream-cleaning teams, for selected sections of the stream (similar to the "Adopt-a-highway" program) emphasizing visible garbage collection, water quality and aquatic habitat protection, on-site stormwater controls, and the collection and use of water quality data;
- Emphasis on water quality and quantity protection at Community Day, or other community gatherings, with recognition of the progress made by members of each stream-cleaning team;
- Distribution of information on pollution-prevention and lot-specific stormwater controls by Environmental Commissions; and
- Pursue interaction and support between all levels of municipal government through special presentations and community programs.

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MILESTONES

Both quantitative and qualitative milestones were achieved during the course of this project and can also be used for the anticipated remediation projects.

Milestones achieved during this project included:

- Coordination and expert contributions between agencies, public and private organizations and companies, municipalities, and other interested participants;
- Characterization and assessment of each watershed prior to and during the project;
- Build-out analyses for each watershed;
- Municipal assessments for each of the 4 municipalities within the project area;
- Quantification of water quality and flow characteristics, including a qualitative assessment of stream-channel stability and aquatic habitat at sites throughout the watersheds, most of which had no history of stream health assessments;
- Identification of contamination areas and potential contamination sources within the sub-watersheds;
- Continued acquisition of land for preservation of open space.
- Stream-channel stability and aquatic habitat assessments;
- Development and implementation of criteria for determining “no measurable change” and for defining “existing” water quality, for any stream type/category;
- Development of required total phosphorus load-reduction estimates for each of the 3 HUC 14 areas in each watershed to be within the SWQS;
- Comparison of in-stream loadings of bacteria and total phosphorus to those of storm-runoff events to further quantify the actual non-point source loadings; and
- Development of a Watershed Remediation and Protection Plan to assist municipalities with adopting and implementing water quality and quantity protection strategies.

Milestones anticipated from Implementation Projects, providing measurable changes to improved water quality and quantity, include:

- Reduction of sediment transport and deposition in the Canal from Lockatong and Wickecheoke loadings, including up to 2,484 tons/yr total suspended solids, equivalent to approximately 13.6 tons/yr of total phosphorus, and more than 12,000 tons/yr of bed load sediment, representing another possible 66 tons/yr of total phosphorus;
- Enhanced scholastic and community awareness of contamination sources, emphasizing the usual pathway(s) to the stream, and protection strategies;
- Determination of storm-runoff reduction from modified soil conditions, an innovative pilot program that can be applied to all post-agriculture conservation and preserved lands;
- Amend municipal roadway drainage criteria to emphasize non-erosive, pervious drainage-channel designs, and slotted/ported curbing;
- Promote water quality pollutant and runoff reduction strategies to farmers as part of their conservation plan and/or to meet the certification requirements for “River-Friendly Farm;”
- Educational program, via installation of various types of rain gardens, for controlling runoff and sediment loads from drainage around athletic fields and for educating homeowners on available options to create naturally-aesthetic on-lot stormwater controls;
- Establish water quality target points for defining existing water quality and measurable change at selected sites in each watershed;

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- Provide assistance for existing innovative stormwater management projects, including the restoration of the Rose Brook stream channel through the installation of new stormwater controls and retrofits;
- Revisions to State Erosion and Sediment Control rules for limiting the extent (acreage) and duration (time from initial disturbance) of exposure of subsurface soil to decrease the amount of sediments available for stormwater to convey into a nearby stream; and
- Review and amend the State BMP manual to highlight those methods that are effectively applicable to Hunterdon County soils, based on site-specific conditions.
- Implementation of remediation projects, as prioritized in **Appendix B**, would fulfill TMDL load-reduction requirements for total phosphorus and fecal coliform, while reducing stormwater runoff flow and increasing infiltration for ground water recharge and stream baseflow. Sediment and bacteria loading reductions are expected to be proportional to total phosphorus load reduction and the reduction to stormwater runoff.

MEASURING CHANGES TO WATER QUALITY AND QUANTITY

Each proposed implementation project includes an estimate of the expected reduction in sediment and total phosphorus loads. Projects performed in the field will have pre- and post-implementation analyses to determine the quantifiable reduction in the associated loadings. **Appendix C** compares relative levels of average water quality concentrations and loadings per parameter for low and higher flows, as measured at each sub-watershed during the monitoring project. **Appendix D** compares the effectiveness for each proposed implementation project for reducing stormwater runoff and total phosphorus and total suspended solids loadings.

Educational and outreach projects will be assessed by the number of participants and the amount of progress. Municipal plan elements and/or ordinances adopted in response to the Management Plan will provide a measure of progress.

Although implementation projects can provide estimated reductions to contaminant loadings and changes in the flow regime, actual measurements of changes in water quality and flow are necessary to confirm the estimates. Overall watershed restoration can be measured through a post-implementation monitoring project, reanalyzing water quality and flow at known problem sites. Comparison of the post-implementation results with the current data will present the level of change (percentage, or mass reduction). A frequency of 4 to 5 years between monitoring programs would provide a good determination of trends in both water quality and quantity. The frequency could be adjusted pending results of the first post-implementation monitoring program.

SUBSEQUENT EFFORTS

- Results from the project reports have warranted the collection of additional information and continued efforts of remediation strategies for several watershed issues, including pesticides and illicit and/or malfunctioning/failing septic systems. Although comprehensive, results from this project warrant additional assessments of watershed areas that were not accessible during the field efforts.

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- Pesticide monitoring by NJDEP, Hunterdon County Health Department, or HC Soil Conservation District, near site L8, should be performed to determine any correlation with the high levels of boron that were found during the 2006-2007 sampling program.

- Further reconnaissance and monitoring should be conducted by the Hunterdon County Health Department and Soil Conservation District for illicit wastewater discharges and/or malfunctioning/failing septic systems at suspect locations in the watersheds that were not accessible during the study. Also, additional monitoring for nutrient, bacteria, and solids loads in the L7/Route 12, and L9 sub-watersheds should be performed to further isolate sources of contamination.

- Subsequent approval of the program reports by NJDEP should facilitate the acquisition of 319(h) funding for remediation projects. The list of Proposed Implementation Projects in **Appendix B** is not intended as a complete list, since it was compiled from currently-available information to initiate remediation efforts in the watersheds. Additional projects are anticipated to be proposed as more information, and accessibility to non-public sites, becomes available.

- Continuation of land-preservation with assistance from land-acquisition organizations such as New Jersey Green Acres, Hunterdon Land Trust Alliance, New Jersey Conservation Foundation, Hunterdon County Freeholders, and the New Jersey Water Supply Authority.

- Water quality and quantity should be reexamined, approximately every 4 to 5 years for the same group of parameters, in addition to pesticides, to determine the effectiveness of the implementation projects. Possible support for a post-assessment effort could be provided by a NJDEP 319(h) grant, NJWSA Source-Water Protection funding, Lower Delaware Management Committee funding, and/or NJDEP's Corporate Business Tax for Watershed Projects.

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Appendix A

Nine Minimum Elements of the Management Plan

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Watershed Plan Elements	Report (Section and page number where applicable)
Preliminary Step – Characterize current status, trends and projected nature of the watershed and determine issues requiring solution through a watershed restoration plan.	Characterization and Assessment of the Lockatong and Wickecheoke Creek Watersheds
Preliminary Step – Establish watershed objectives for each issue identified through the characterization and assessment process.	319(h) Grant Proposal: Watershed Restoration and Protection Plan for the Lockatong and Wickecheoke Creek Watersheds
1. An identification of the **causes and sources** or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this watershed-based plan (and to achieve any other watershed goals identified in the watershed-based plan).	Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Plan (Causes and Sources of Contamination, Pg. 22)
2. An estimate of the **load reductions needed to be achieved from management measures**, by source or group of sources listed in (1) (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time).	Lockatong and Wickecheoke Creeks Water Quality and Flow Monitoring Project – 2006 through 2007 (HUC 14s); Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Plan (Figures 3 and 4)
3. A description of the **nonpoint source management measures** that will need to be implemented to achieve the necessary load reductions (as well as to achieve other watershed goals identified in this watershed-based plan), and an identification (using a map and description) of the critical areas in which those measures will be needed to implement this plan.	Restoration and Protection Plan (Watershed Remediation Strategies, Pg. 43)
4. An estimate of the amounts of **technical and financial assistance needed, associated costs, and/or the sources and authorities** that will be relied upon to implement this plan.	Restoration and Protection Plan (Appendix B)
5. An **information/ education component** that will be used to enhance public understanding of the project and encourage the public's early and continued participation in selecting, designing, and implementing the NPS management measures.	Restoration and Protection Plan (Structural and Educational Remediation Strategies, Pg. 44)
6. A reasonably expeditious **schedule for implementing** the NPS management measures identified in this plan.	Restoration and Protection Plan (Appendix B)
7. A description of **interim, measurable milestones** for determining whether NPS management measures or other control actions are being implemented.	Restoration and Protection Plan (Milestones, Pg. 45)
8. A set of **criteria** that can be used to **determine whether loading reductions are being achieved** over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether this watershed-based plan needs to be revised or, if a NPS TMDL has been established, whether the implementation plan section of the TMDL needs to be revised.	Restoration and Protection Plan (Measuring Changes to Water Quality and Quantity, Pg. 46)
9. A **monitoring component** to evaluate the effectiveness of the implementation efforts over time, measured against the criteria in (8).	Restoration and Protection Plan(Measuring Changes to Water Quality and Quantity, Pg. 46)

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Appendix B

Proposed Implementation Projects (Separate Document)

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Appendix C

Water Quality Assessments Per Parameter For Low and Higher Flows

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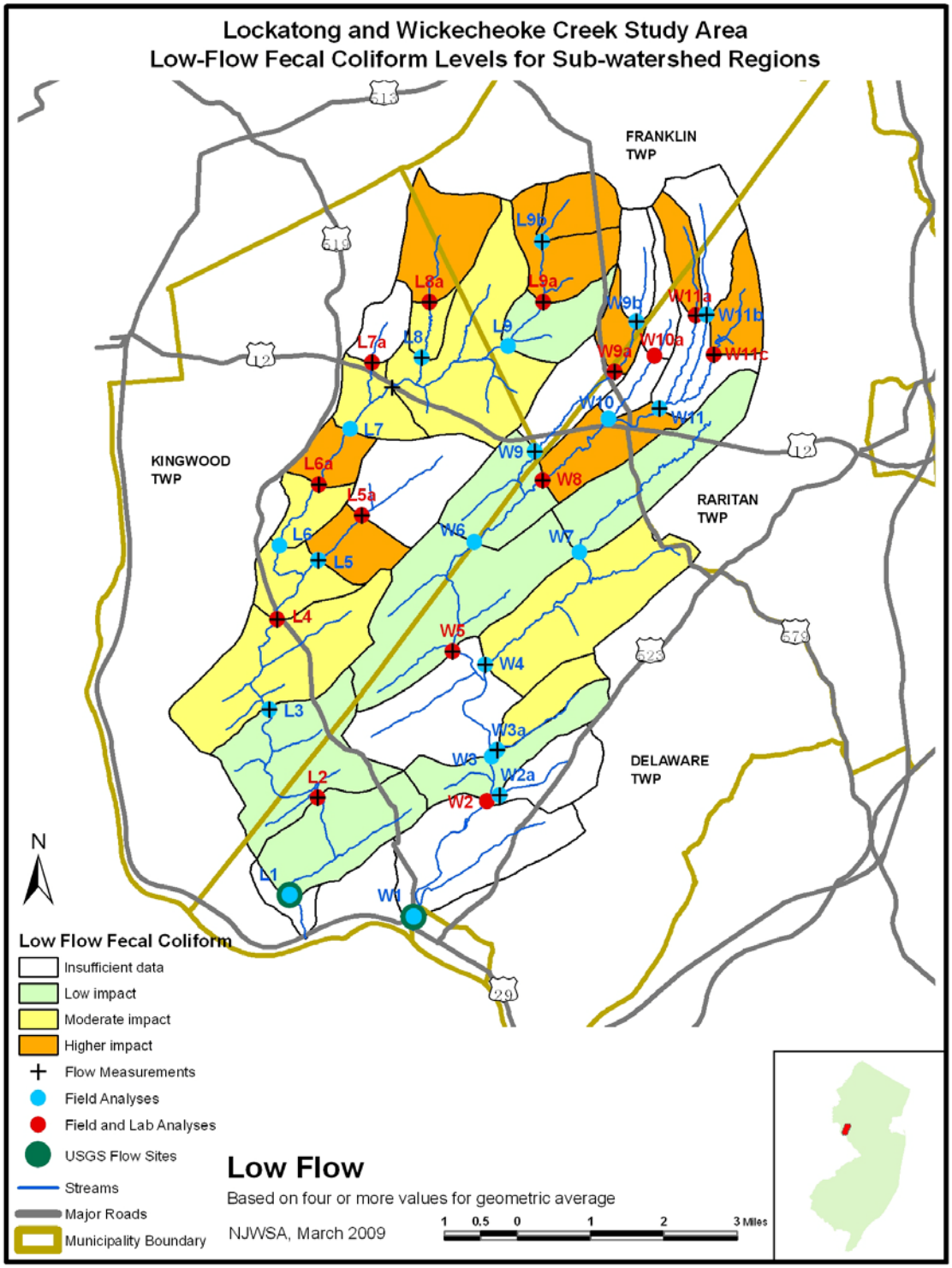
Low-Flow Results

(Relative impact assessment using average concentration and loading, where available)



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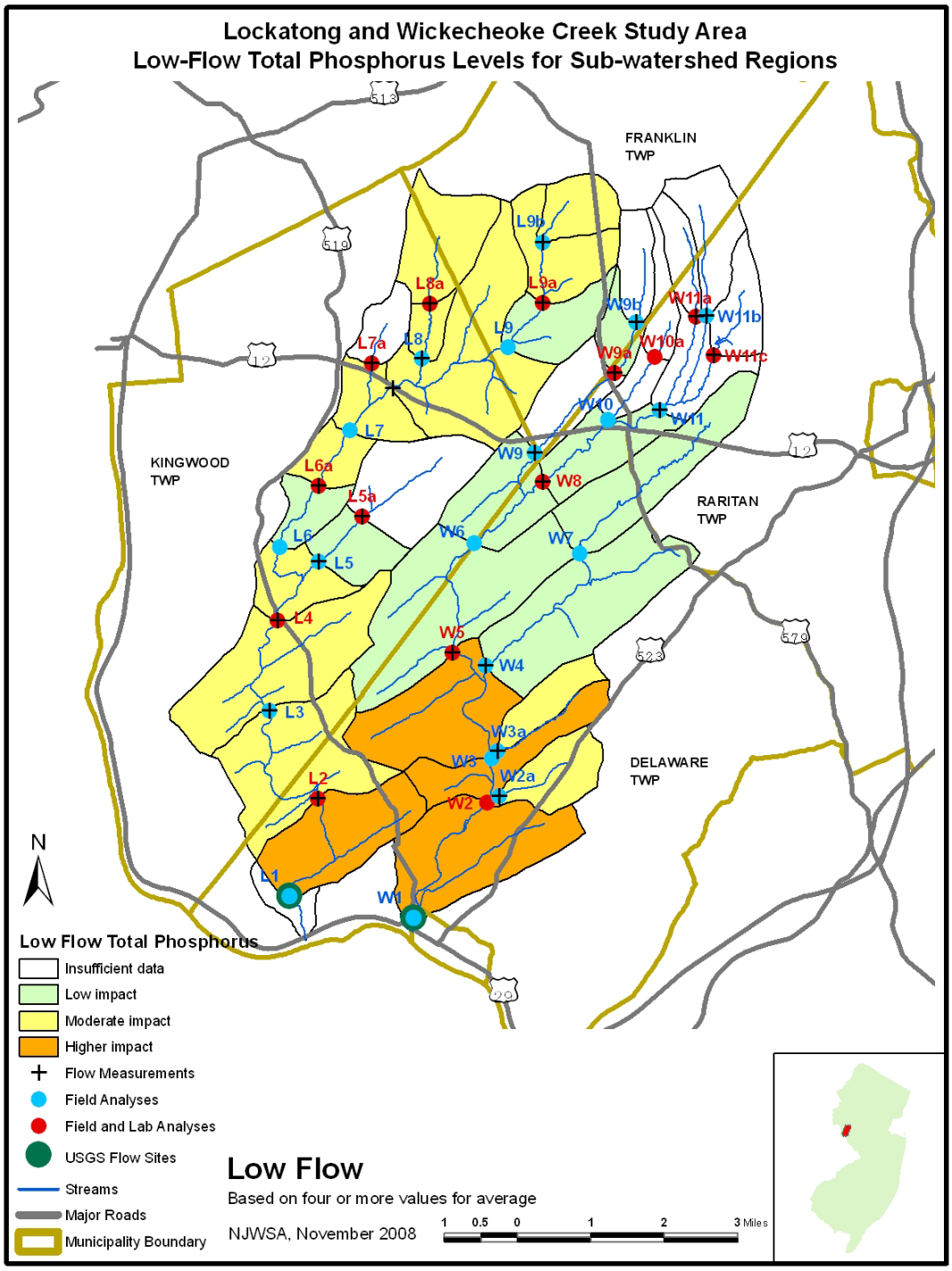

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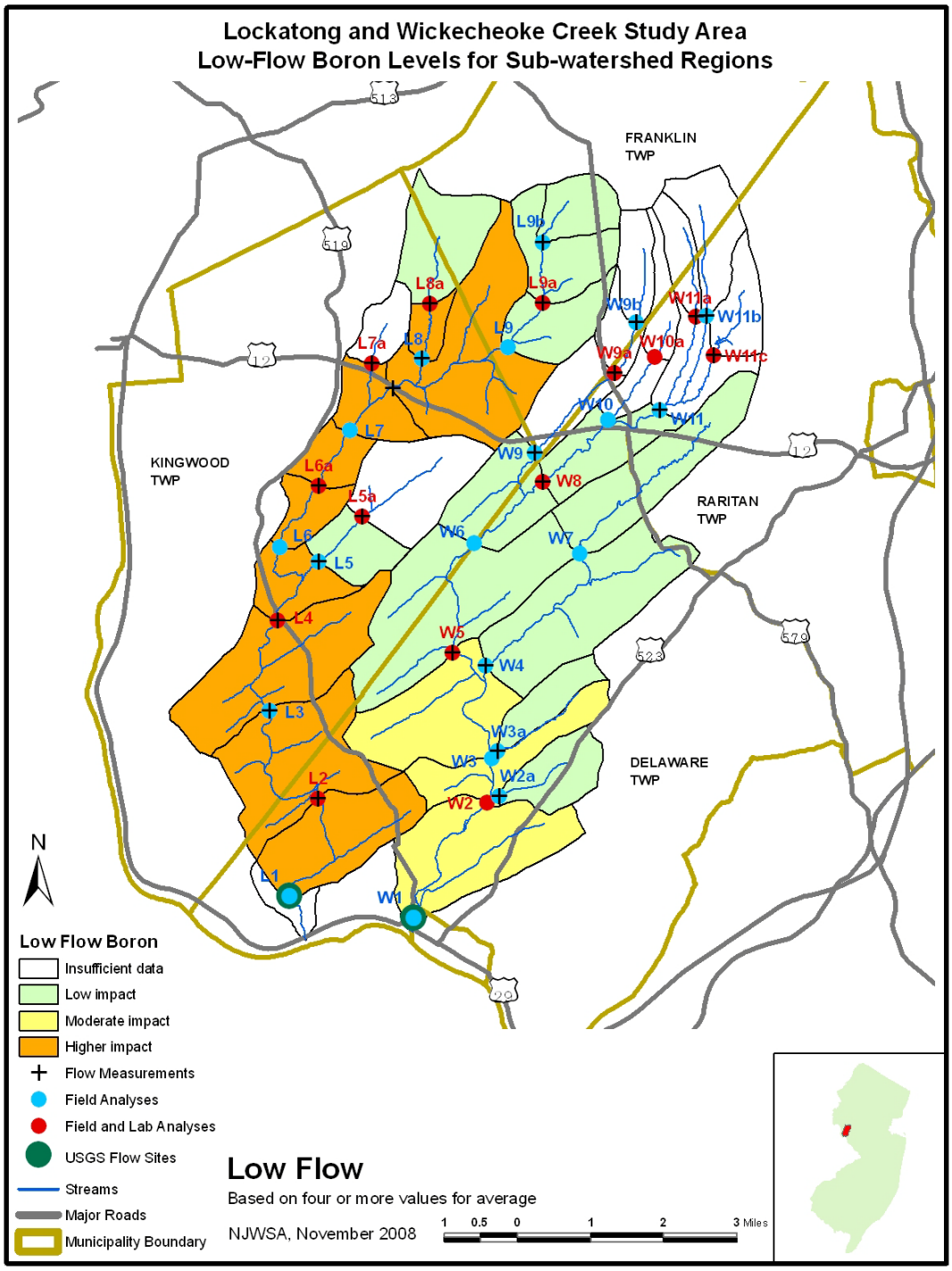

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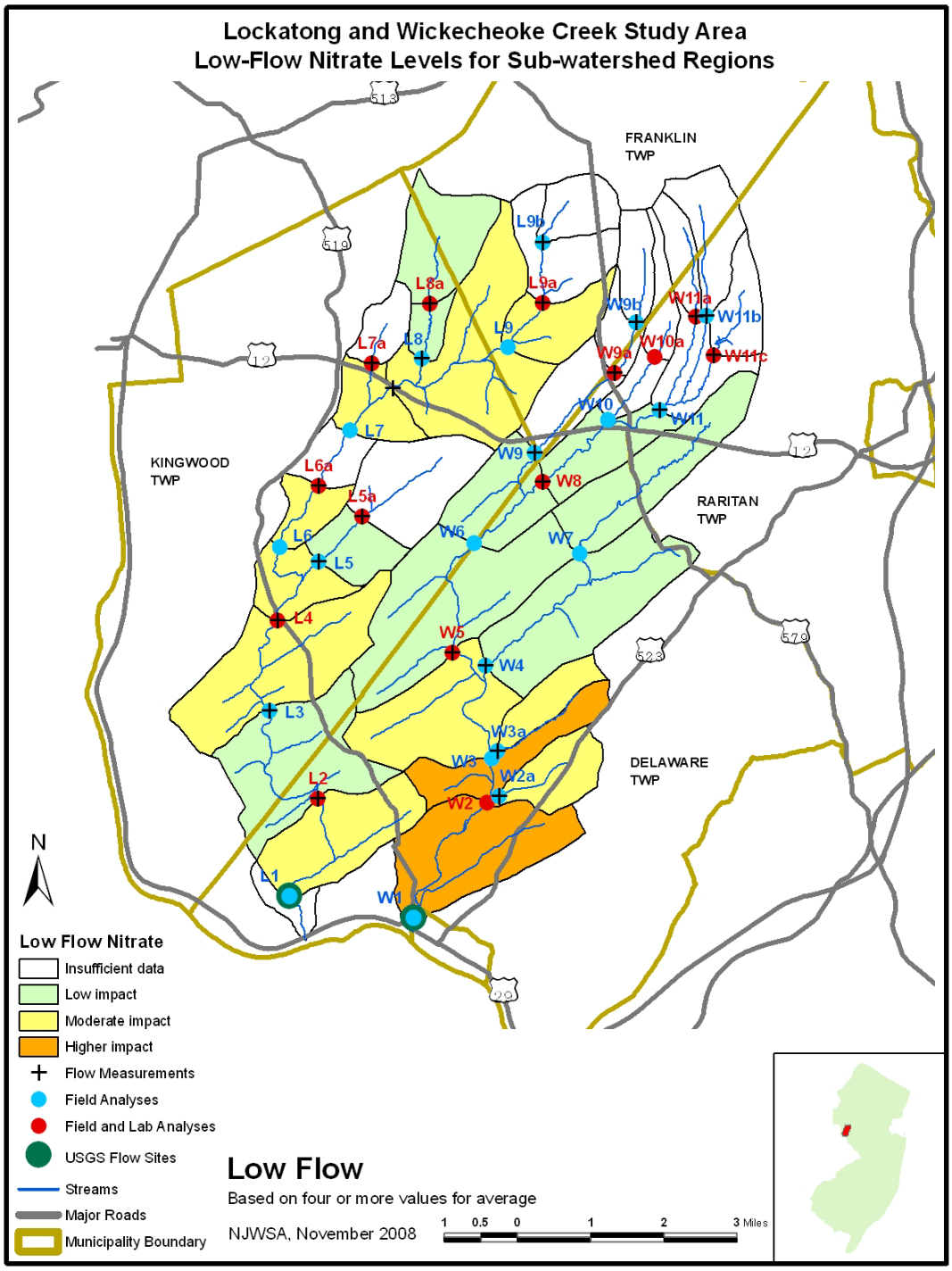

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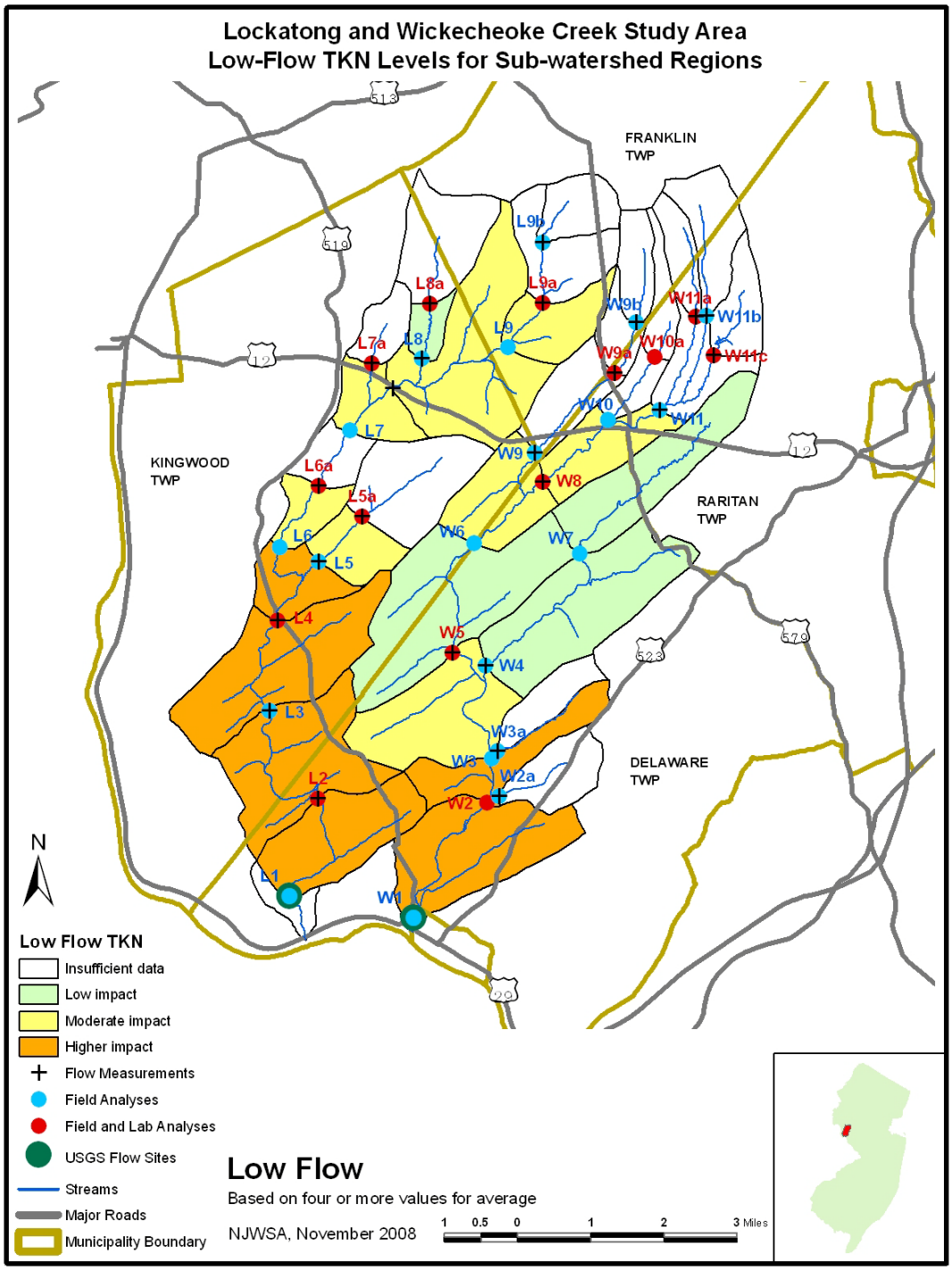

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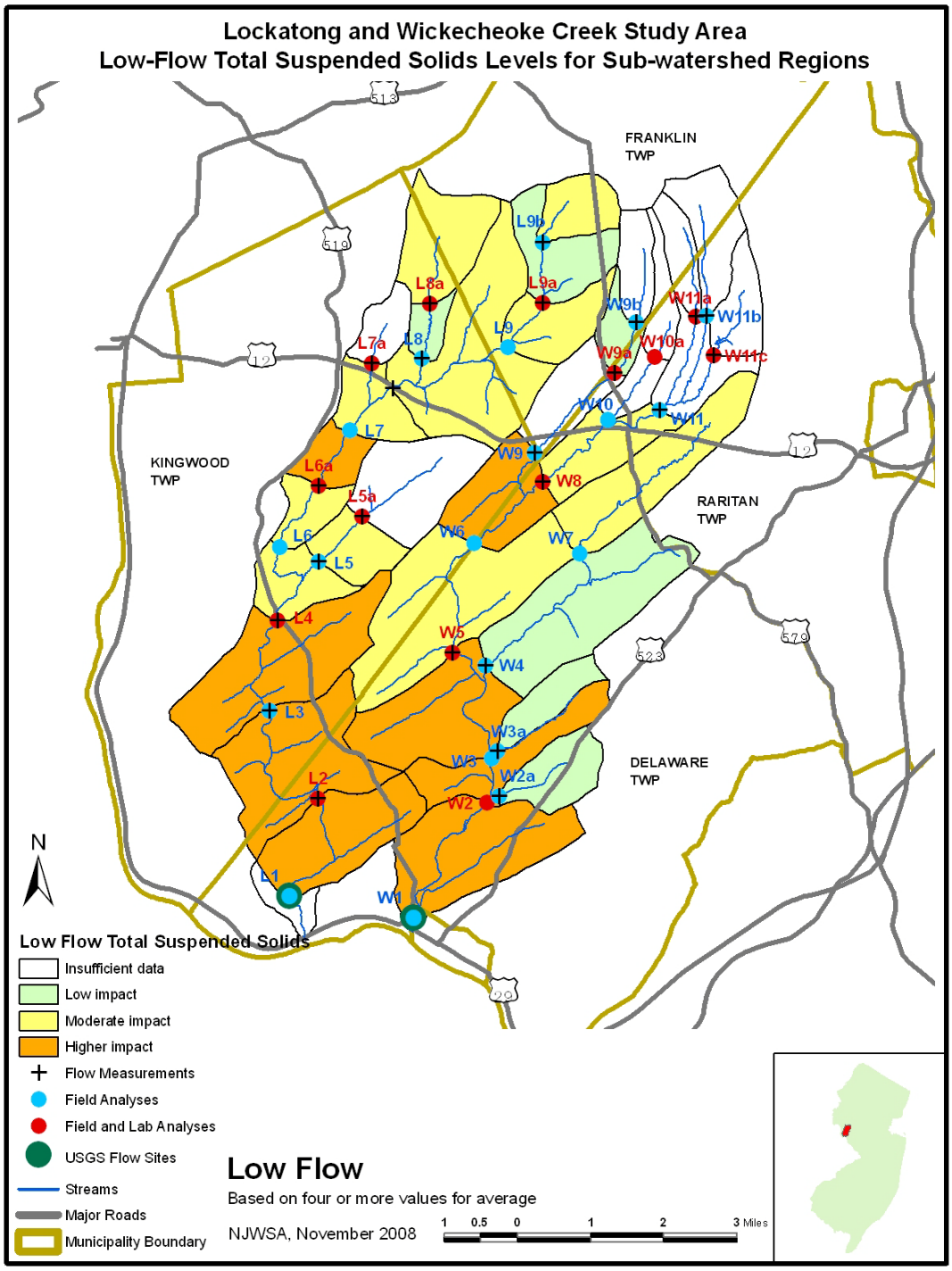

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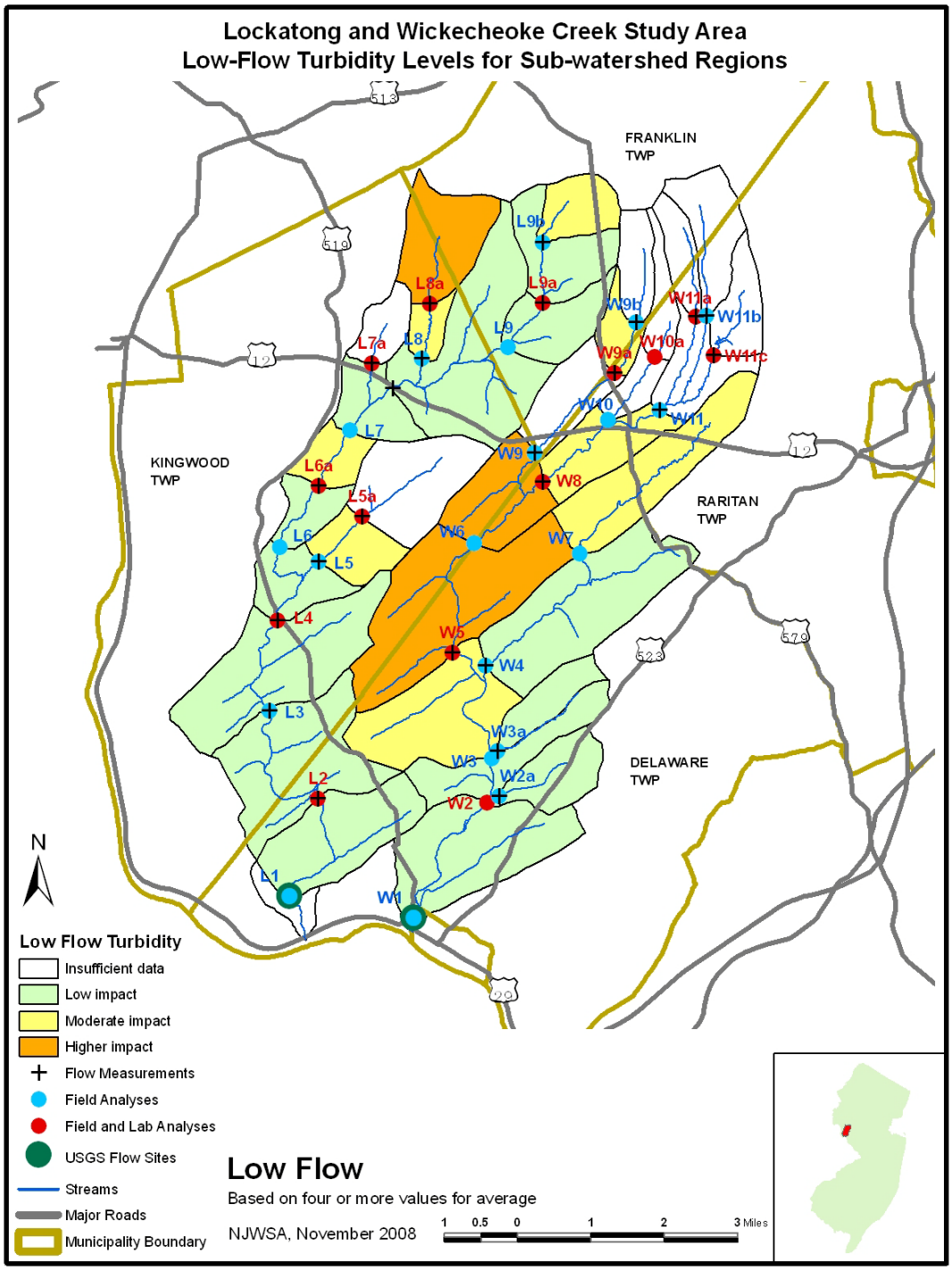

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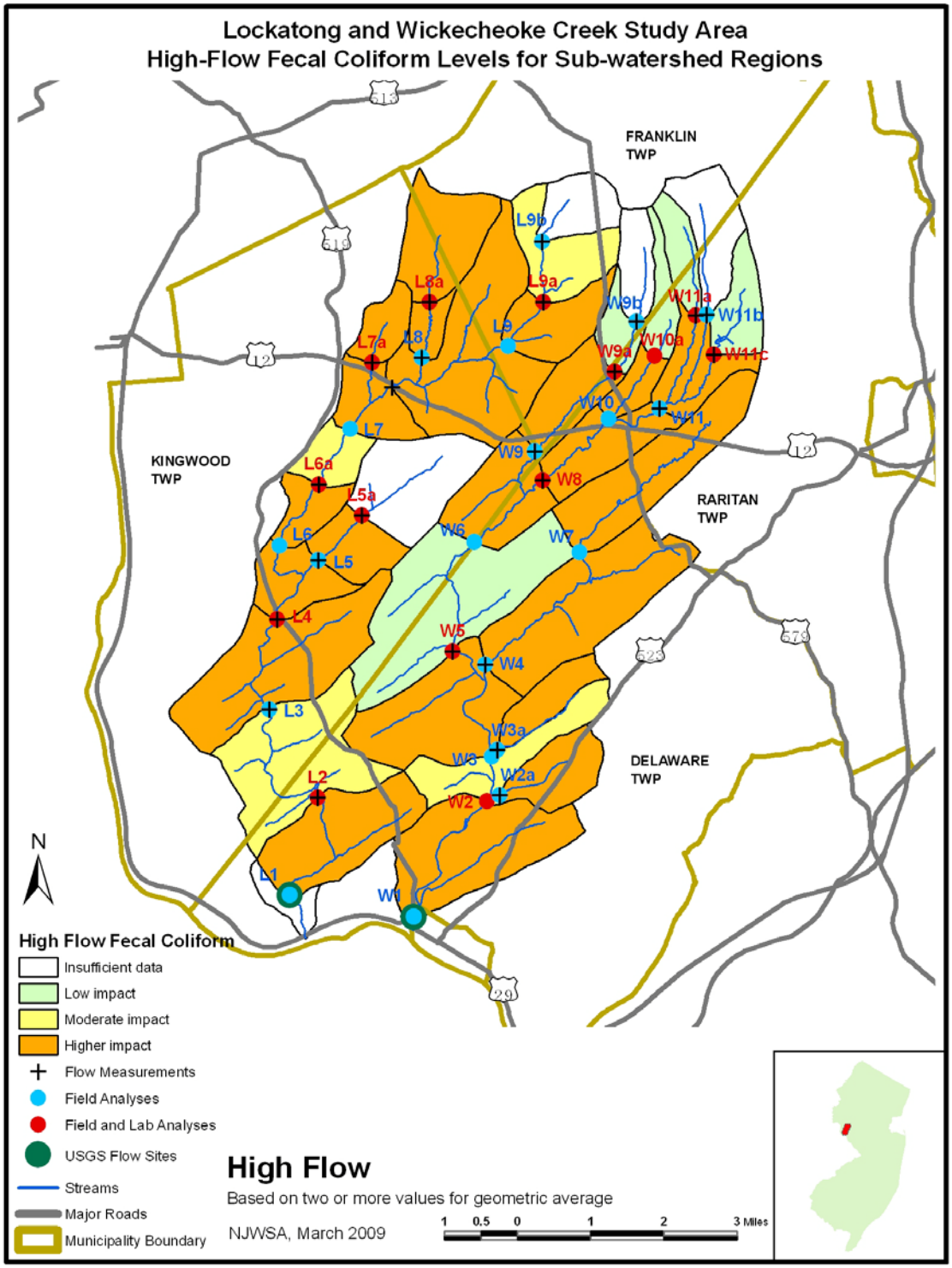
Higher-Flow Results

(Relative impact assessment using average concentration and loading, where available)



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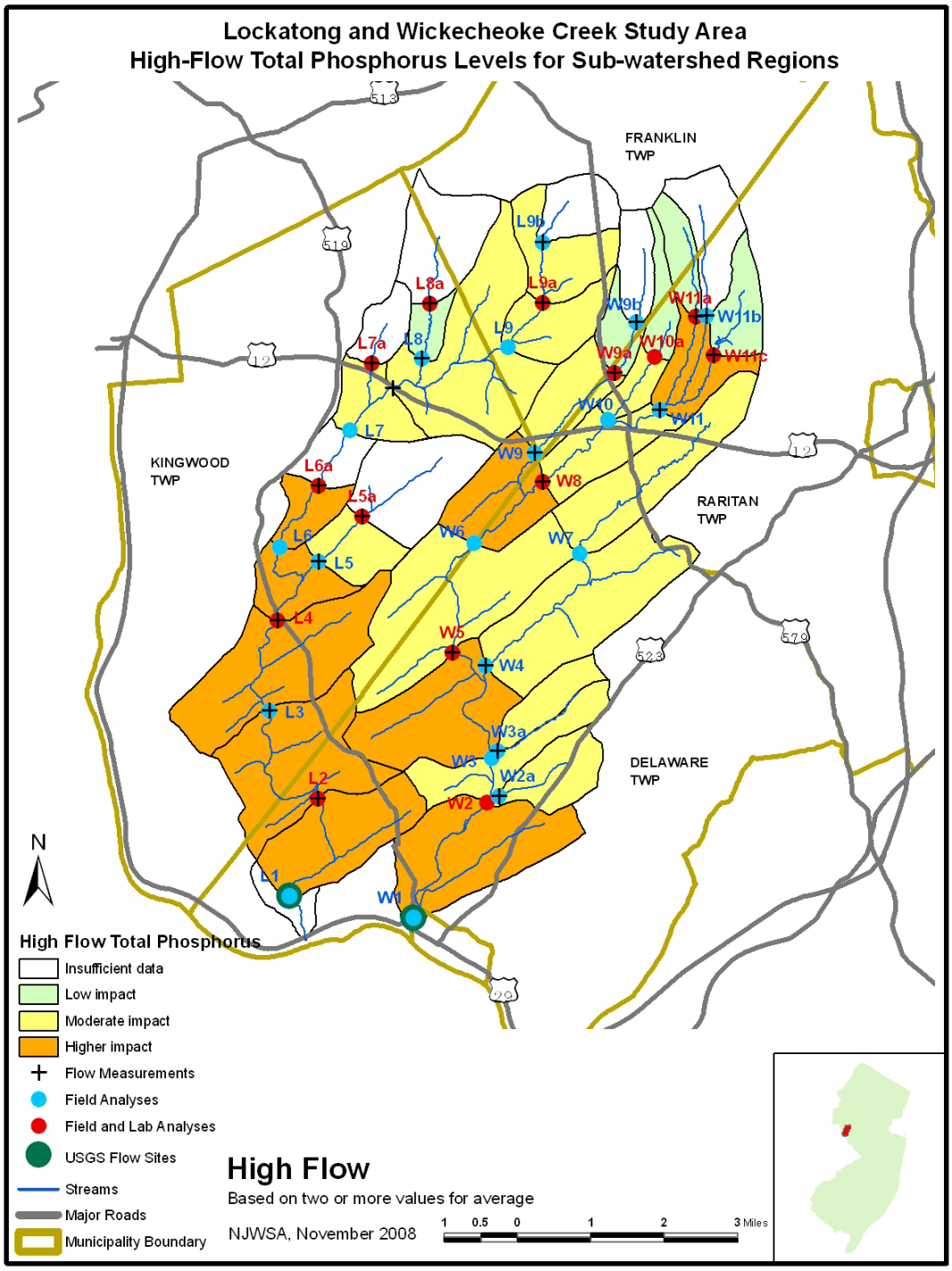

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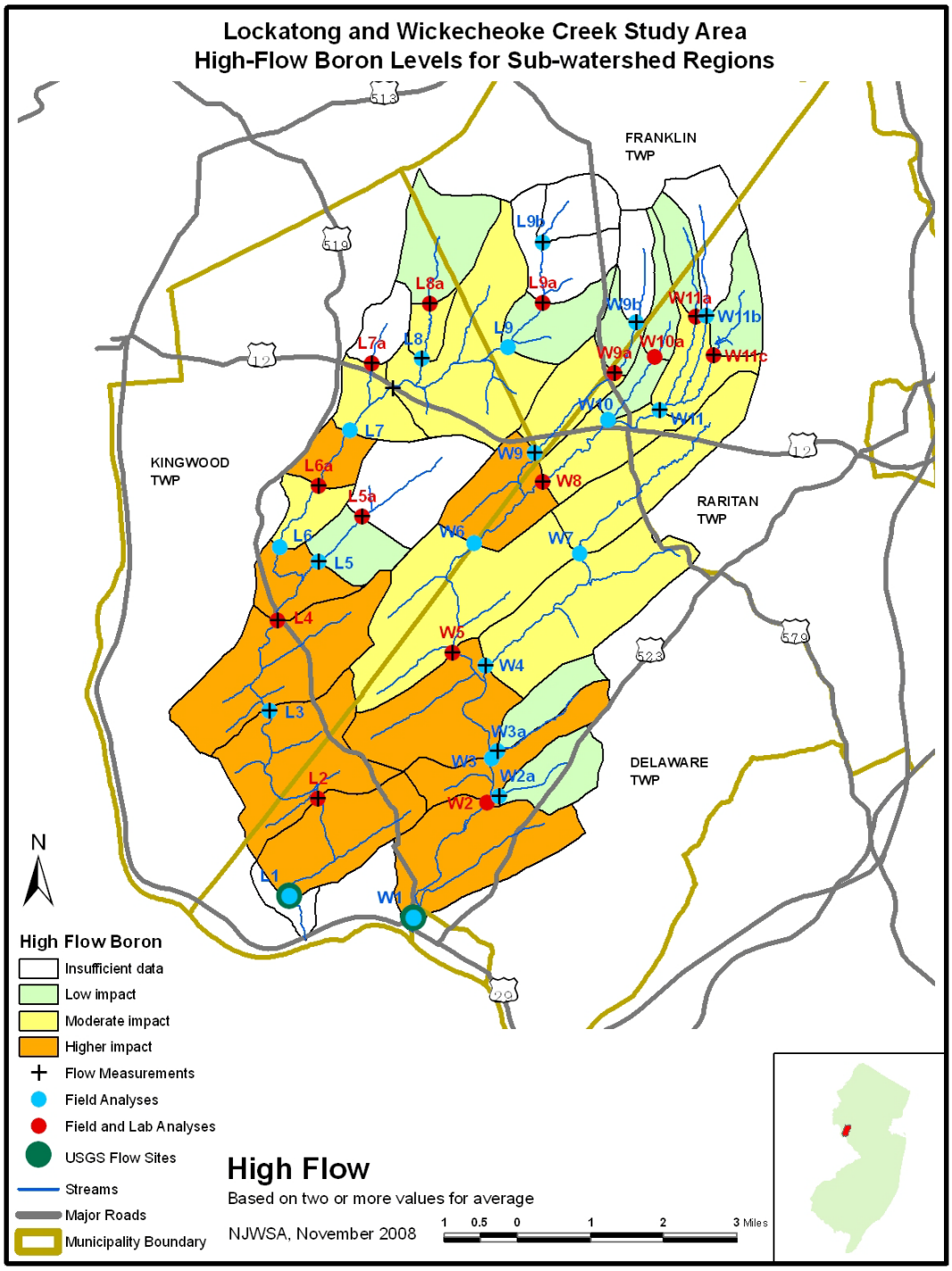

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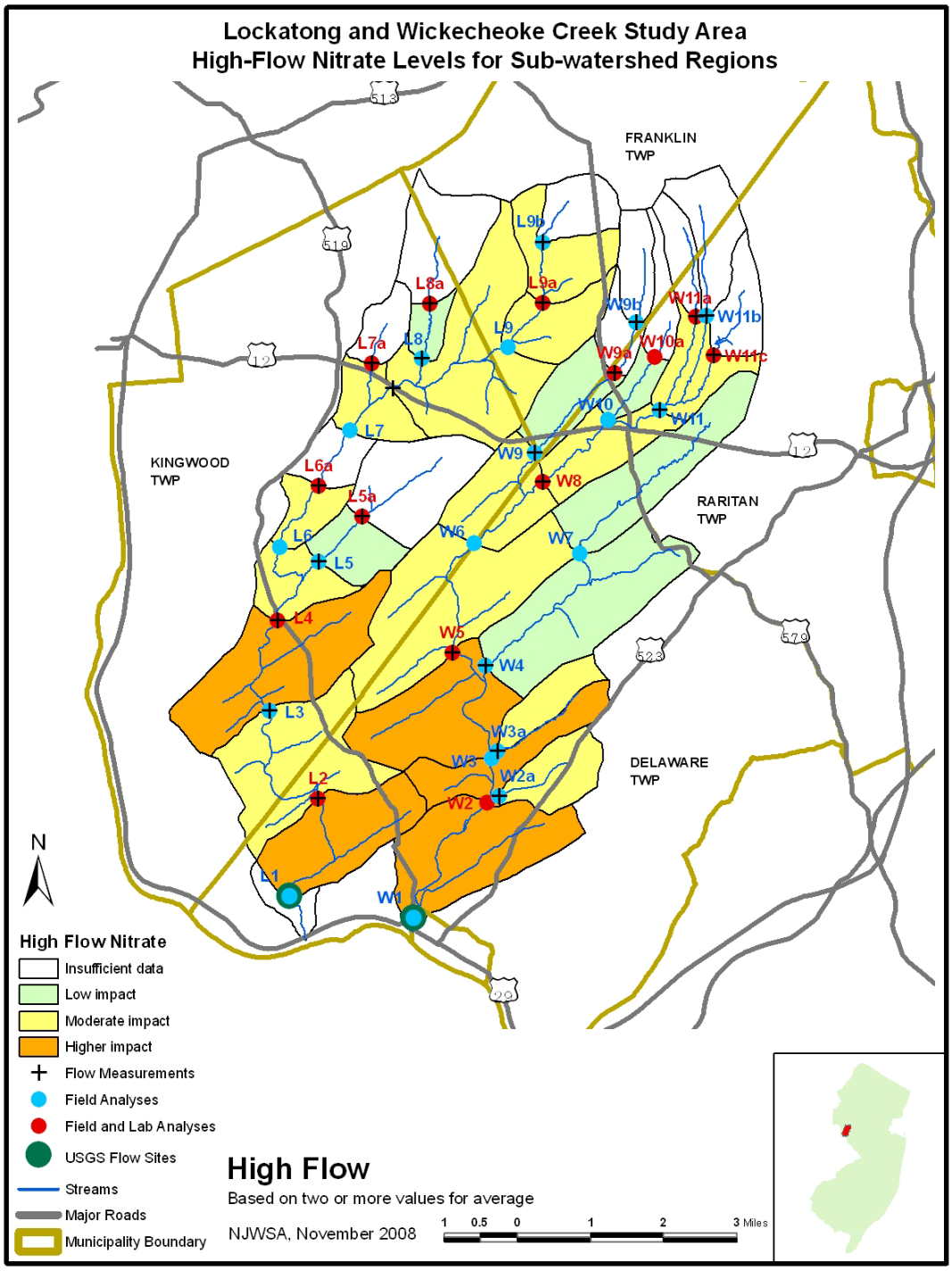

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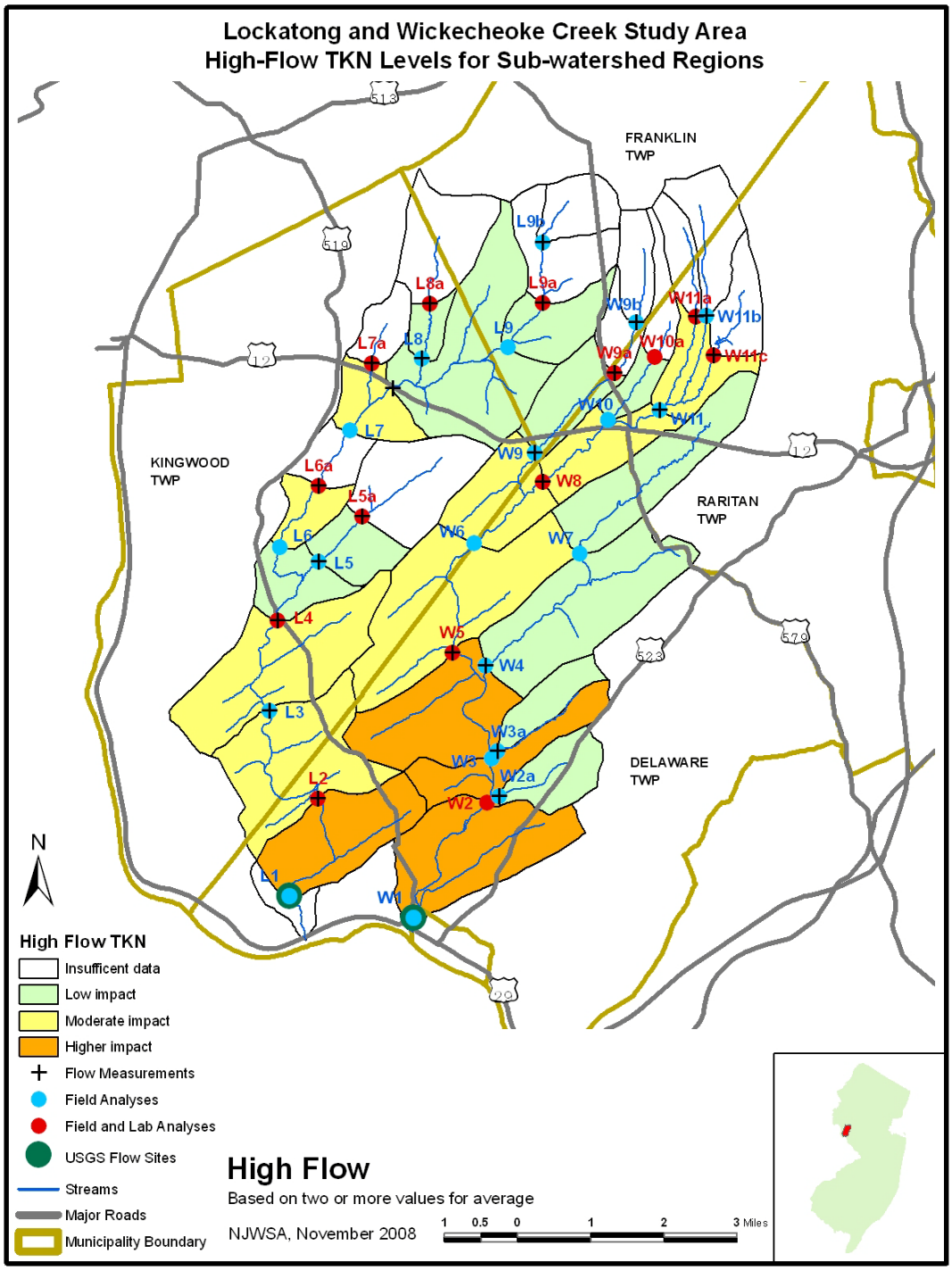

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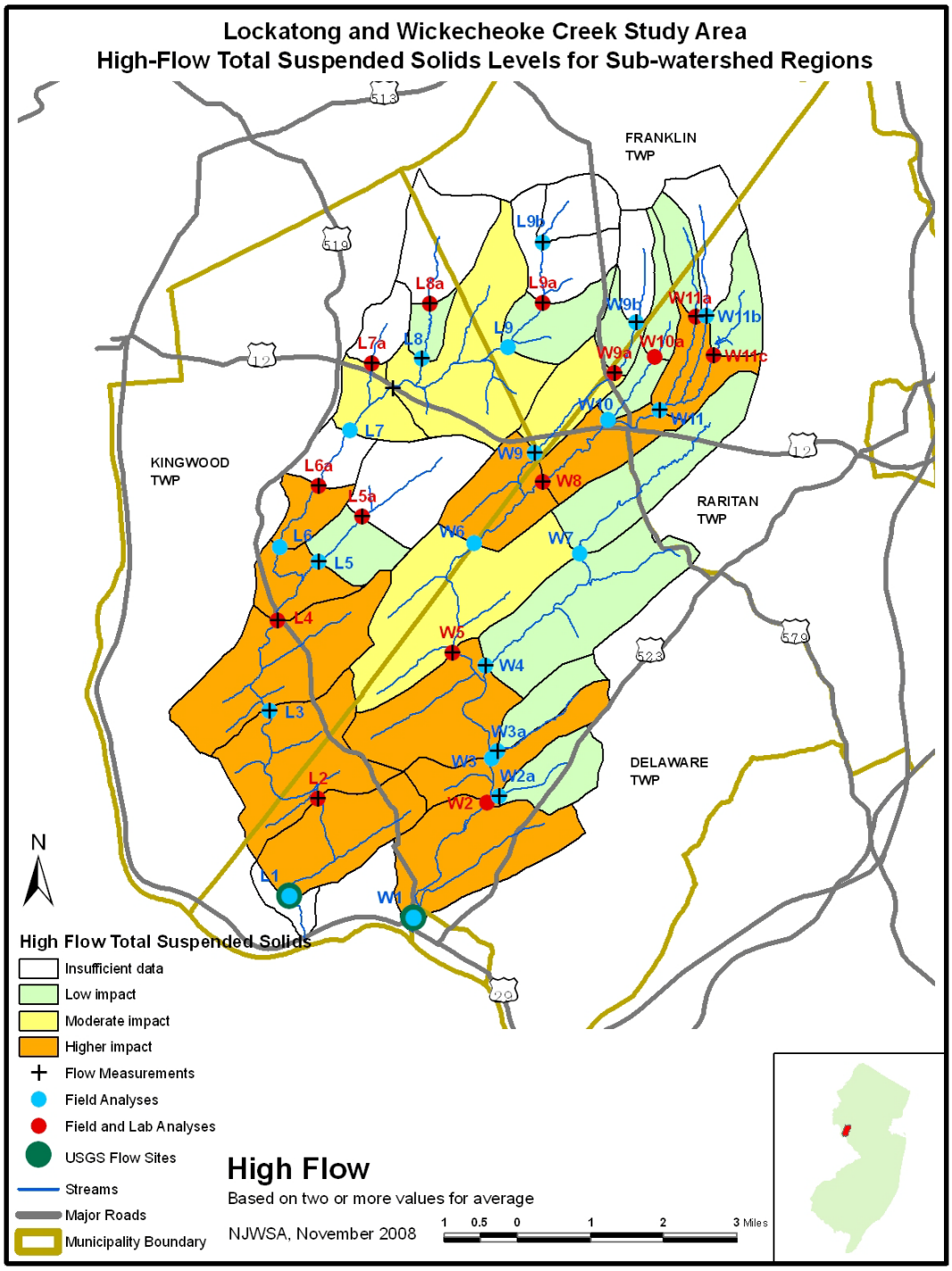

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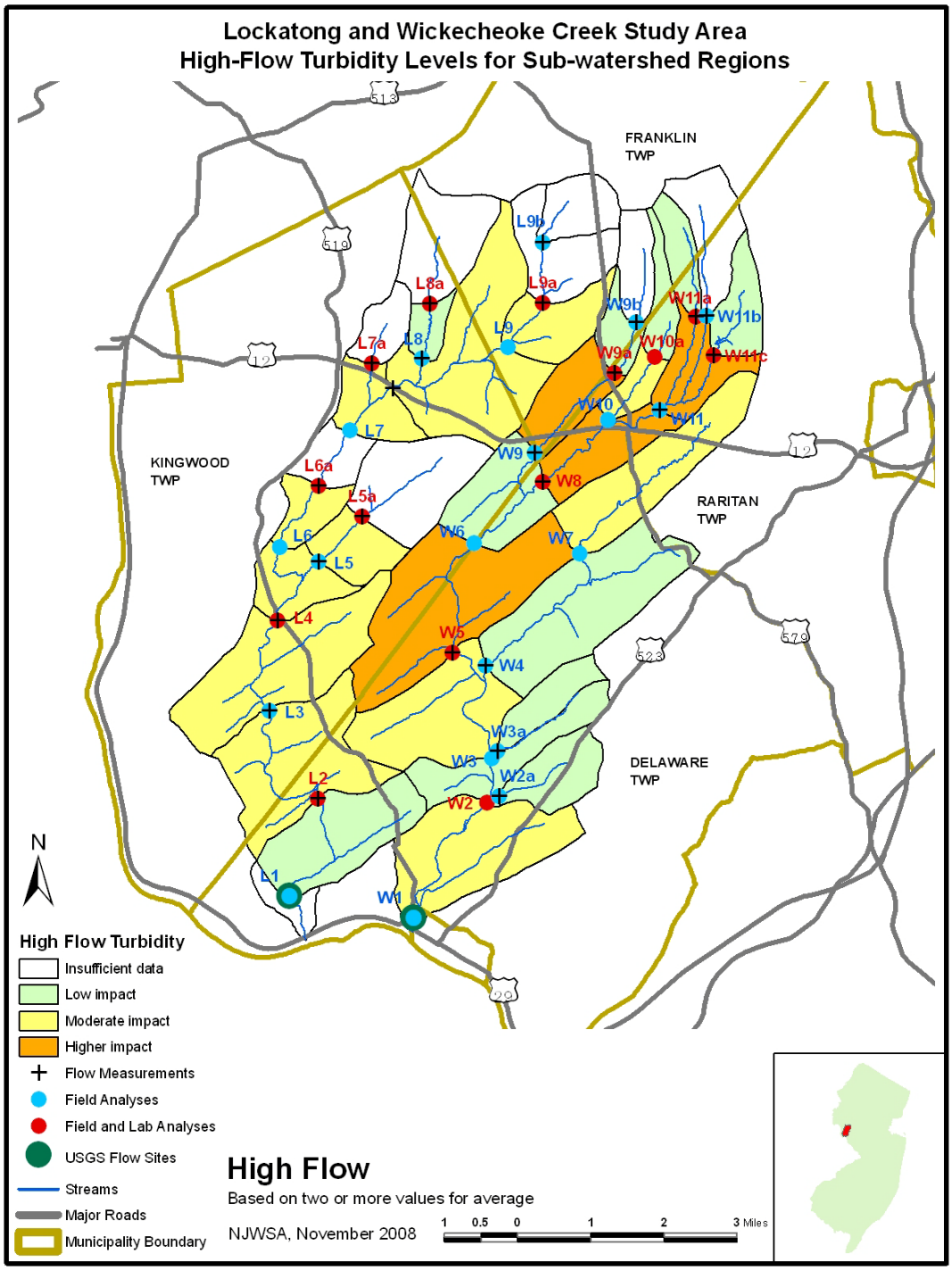

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Appendix D

Comparison of Implementation-Project Effectiveness

Potential stormwater contaminant and quantity reductions, and estimated unit cost, for watershed remediation/protection projects.

Watershed-Wide Restoration Projects	Priority	Water Quantity	Water Quality	Infiltration	Erosion Reduction	Annual Runoff Reduction	Annual Load Reduction	Cost Estimate
Rehabilitation of Preserved/Conservation Lands	High	X	X	X	X	412,000 gal/acre for 1.25" or less rain events	1.3 lb/acre TP; 300 lb/acre TSS	$50/acre
Agricultural Runoff Remediation, Franklin Twp	High	X	X	X	X		1.3 lb/acre TP; 300 lb/acre TSS	$6,200 - $7,700/acre
Roadside Drainage Design/Retrofit Training	High	X	X		X	304,000 gal/mi for 1.25" or less rain events	Up to 150 lb/mile TP[1]; Up to 14 tons/mile TSS[2]	$337/mile
Targeted agricultural assistance program	High		X				11.6 lb/acre TP; 2,100 lb/acre TSS	$170/acre
Bioretention Applications – Recreational Areas and Private/Public Lawns	High	X	X	X	X	350,000 gal/acre for 1.25" or less rain events	1.26 lb/acre TP;179 lb/acre TSS	$8,400 - $15,400/acre
Rain gardens	High	X	X	X	X	19,600 gal/acre for 1.25" or less rain events	0.03 lb/acre TP 4.8 lb/acre TSS	Up to $5.50/sq ft
Update BMP manual for local soil and geologic conditions	High	X	X	X	X	638,000 gal/acre[3] for 1.25" or less rain events	Up to 0.6 lb/acre[3] TP Up to 77 lb/acre[3] TSS	$21/acre[3]
River-Friendly Farms Certifications	High	X	X		X	Pending existing controls	Up to 1.3 lb/acre TP Up to 300 lb/acre TSS	$190/acre
Watershed Hydrogeologic Study	High	X	X					$168,000

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Site-Specific Projects	Priority	Water Quantity	Water Quality	Infiltration	Erosion Reduction	Annual Runoff Reduction	Annual Load Reduction	Cost Estimate
Del Twp Municipal Garage Retrofit - Rain Garden and Bioretention Swales	Moderate	X	X			7,500 gal/1,000 ft^2 for 1.25" or less rain event	Up to 3.1 lb TP[4] Up to 530 lb TSS[5]	$185,000 total Or, $28,500/acre
Sergeantsville Firehouse Parking-Lot and Municipal Park Retrofit	Moderate	X	X			300 gal/1,000 ft^2 for 1.25" or less rain event	Up to 1.1 lb TP[4] Up to 180 lb TSS[5]	$64,000 total Or, $40,000/acre
Vehicle Maintenance and Storage – SW of Pine Hill/Old Mill Road intersection - Bioretention Swales and check dams	Moderate	X	X[6]			480 gal/1,000 ft^2 for 1.25" or less rain event	Up to 3.8 lb TP[4] Up to 360 lb TSS[5]	$119,000 total Or, $66,100/acre
Roadway Drain Retrofits								
Barbertown-Pt Breeze Road at Fitzer Road intersection, Kingwood Twp	Moderate	X	X	X	X	15,000 gal/300 feet @ 20% retainment using 1.25" event	0.4 lb TP 41 lb TSS	$73,000
Pine Hill Road, Delaware Twp – mid section of approx. 1,250' drains directly to Wickecheoke Creek (see map)	High	X	X		X	205,000 gallons @ 20% retainment using 1.25" event	2.1 lb TP 200 lb TSS	$230,000
Rt 579 just south of Oak Grove Road, Franklin Twp	Moderate	X	X	X	X	15,000 gal/300 feet @ 20% retainment using 1.25" event	0.4 lb TP 41 lb TSS	$101,000

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Roadway Drain Retrofits	Priority	Water Quantity	Water Quality	Infiltration	Erosion Reduction	Annual Runoff Reduction	Annual Load Reduction	Cost Estimate
Goose Island Road at W9a, Raritan Twp	Moderate	X	X	X	X	15,000 gal/300 feet @ 20% retainment using 1.25" event	0.4 lb TP 41 lb TSS	$120,000

[1] Based on 0.55% ratio of TP to TSS (Lock/Wick Monitoring Report)
[2] Based on up to 80 percent reduction in TSS (NJSW BMP manual), and loading estimate by NRCS
[3] Impervious land cover
[4] Based on up to 50 percent reduction in TP (NJSW BMP manual)
[5] Based on up to 90 percent reduction in TSS (NJSW BMP manual)
[6] Stormwater runoff may contain metals and other constituents

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Appendix E

Responses to Comments Received From NJDEP

Comment: In the characterization and assessment section the Municipal Ordinance assessment is still blank and labeled "In Progress"; as is the Build out Analysis. These sections need to be completed in the Final version.

Response: Narrative was amended to reflect these changes.

Comment: The contract specifies Estimates of Load reductions from Management Measures (page 2 scope of Work). "HUC 17 loading estimates will be provided, with breakdowns by land use type, and BMP category, so that a full understanding of the load reductions can be gained. The load estimates and reduction analyses will be preformed using BASINS, USEPA's modeling platform" please outline where in the report is this information.

Response:

HUC 17 Delineation

The study plan had described the delineation of sub-watersheds as HUC17s. A mapped delineation as a GIS layer was acquired from USGS, but no attributes for characterizing or defining HUC17s was available (personal communication with NJGS and USGS). Therefore, the original reference to HUC17 was considered a typographical error. The project study areas were further segmented to an average sub-watershed size of approximately 1.25 mi^2, providing a much smaller scale for water quality and quantity assessments. The mapped HUC17s presented 13 sub-watershed areas, whereas the project sub-watershed sizes provided 35 sub-areas for assessments, nearly 3 times the coverage of the HUC17s.

BASINS Modeling System

In 2006, the BASINS modeling system was undergoing extensive modifications to enable it to compensate for the changed programming language from ArcInfo 3.1 to ArcGIS 8.0, from Avenue language to Visual Basic language. A beta version update to the system was completed by EPA in 2007 for integrating PLOAD and HSPF (Hydrological Simulation Program Fortran) with ArcGIS. The BASINS system was undergoing testing and further adjustments at that time. The Lockatong and Wickecheoke Creek Watersheds Project used loading estimates for existing and build-out land use and cover based on the PLOAD model technique. The “Export Coefficient Method,” of the PLOAD model was used to estimate total phosphorus, total suspended solids, and total nitrogen loading for existing land uses and cover versus possible future changes to these uses and cover. The use of this model and the application of the Flow Integrated Reduction of Exceedances (FIRE) method for determining total phosphorus load reductions in each HUC 14 were consistent with the techniques used to develop the total phosphorus TMDLs.

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The Natural Resources Conservation Service (NRCS) used their RUSLE (Revised Universal Soil Loss Equation) model to predict soil loss from agricultural fields and an empirical model to estimate loadings from road runoff and stream-channel erosion.

Although HSPF can be used to simulate projected changes to water quality and quantity from land use changes, the program requires extensive hydrological and water quality data, including ground water conveyance and quality. Interconnected fractures in the watersheds create a very heterogenous water conveyance system that requires a more extensive study of the ground water hydrology to properly model any interactions between surface and ground water.

Since more than 37 percent of the watersheds land use was agriculture and approximately one third was forested, the Natural Resources Conservation Service applied results from the NRCS Sediment, Erosion, and Animal Waste (SESAW) Study to determine sheet and rill erosion, in addition to the RUSLE model to determine sediment loading potentials from cropland. An empirical relationship was used for estimating sediment loads from erodible stream banks. A GIS analysis was performed to determine the amount of imperviousness due to roadways. Layman's Guide to Access Road Construction: Design Guidelines was combined with information from each municipality including the application of deicing materials to estimate the amount of sediment loss from road surfaces within the watersheds.

The average size of sub-basin areas that were monitored during the project for flow and water quality was approximately 1.25 mi2. This scale of watershed segmentation provided a good measure of existing loadings, enhancing the isolation of possible source(s) of contamination. Sub-basins were ranked for remediation using the measured pollutant concentrations and loads. Most pollutant loads were widespread throughout the watersheds due to the diffuse nature of land uses. Discrete remediation projects, with a few exceptions, targeting individual subwatershed areas may not provide adequate enhancements to either water quality or flow since the problem sites/sources are widespread in the rural watersheds. Although several site-specific remediation projects are listed for implementation, watershed-wide projects must be implemented to control the existing effects of stormwater.

Comment: On page 8 of the scope of work under the Watershed Restoration and Protection Plan section: "the plan will include a priority system and a ranking for implementation of the recommendations, using a combination of cost effectiveness ,availability of funding, potential for modification of existing practices and the degree of certainty that a practice will be implemented." Please outline where this information can be found

Response: Narrative was amended to reflect these changes in **Appendices B and D** of the *Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Plan*.

Comment: In the section of Recommended Watershed-Based Implementation projects, the identified projects need more information. We were hoping that they would have the detail that was provided in the Mulhockaway plan that was submitted by the NJWSA. Many of the projects outlined do not include specific site locations, this makes me wonder how you can provide an estimate of tons per year of reduced erosion, if you do not have the project sites identified. Please provide specific locations with an estimate of load reductions per site and BMP measure. Below are some examples of projects listed without supporting information.

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Response: Narrative was amended to reflect these changes in **Appendix B** of the *Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Plan*.

Comment: On page 3 in the section titled Recommended Watershed-based Implementation projects; Project name- Rehabilitation of Conservation Lands - The location and size of each parcel needs to be Identified; along with the specific BMP measure to be utilized and the associated anticipated benefits per location. Also please give an estimated cost per location.

Response: Narrative was amended to reflect these changes in **Appendix B** of the *Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Plan*.

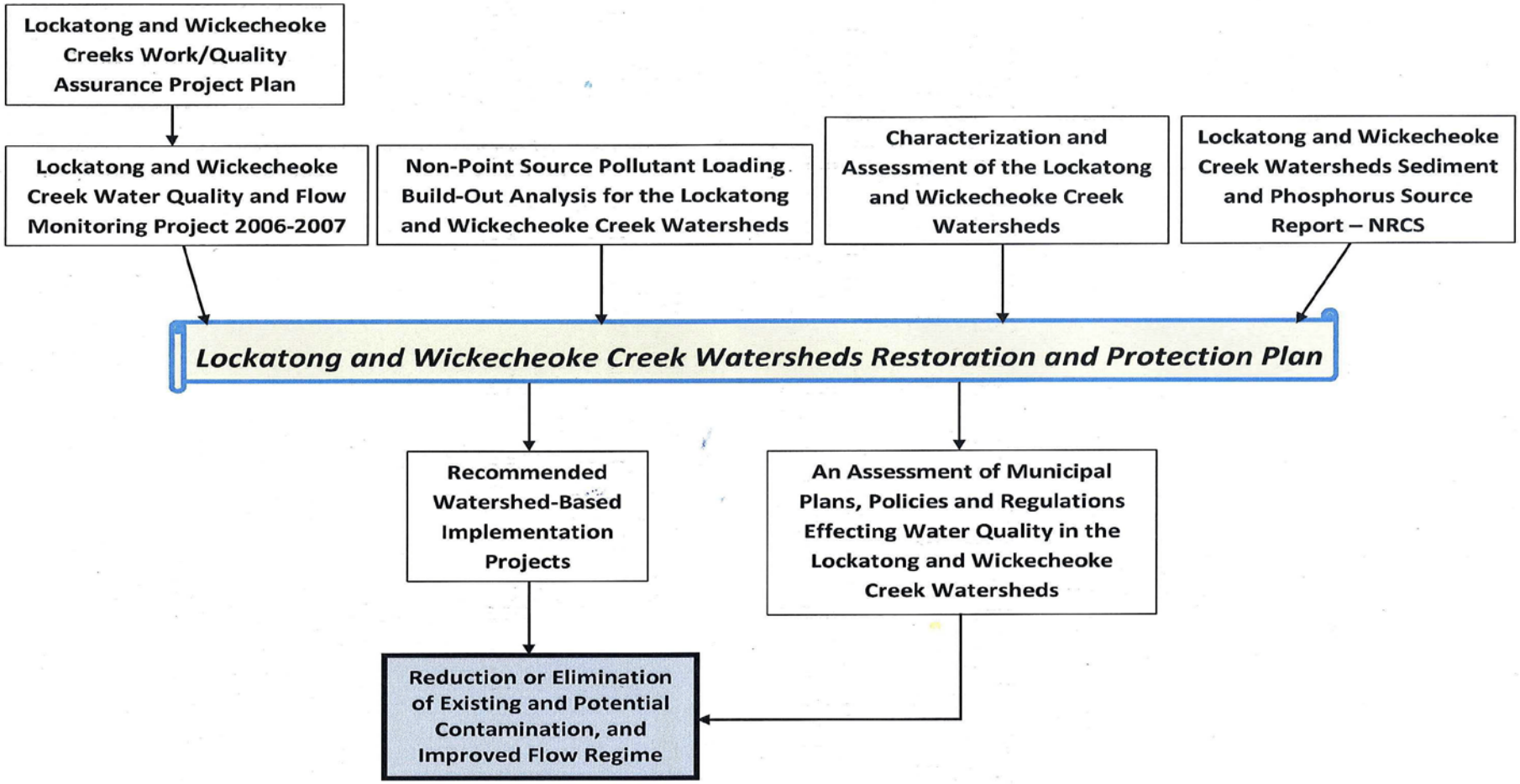
Comment: On page 5 the Roadside Drainage Design/Retrofit Training project; please specify where the retrofits are to be located and what methods at each location are going to achieve the stated sediment loading reduction by 3/4. Please detail what the" innovative strategy to reduce roadway sediment loads" is, i.e. please list specific methods/BMP's are to be used to reduce the sediment loadings. Also please list the cost per site.

Response: Narrative was amended to reflect these changes in **Appendix B** of the *Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Plan*.

Comment: On page 11 the Streambank Stabilization Measures project; please specify where the stabilization projects are to be located besides the Kingwood Park location, also please include what type of stabilization methods are to be implemented at each site. Also include the anticipated loading reductions for each method per site and the associated cost per measure per site.

Response: Narrative was amended to reflect these changes in **Appendices B and D** of the *Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Plan*.

Appendix F
Digital Copies (CD) and
Interrelationships of Watershed Reports



Reports located on NJ Water Supply Authority (Watershed Protection Programs Unit) website:
http://www.njwsa.org/WPU/lock_wick.htm

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Document Content(s)

Lock Wick Crk Mgt Plan 113010.PDF.....1-74

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Appendix B

Proposed Implementation Projects

The following projects are proposed to provide reductions in stormwater runoff and pollutant loadings. Each strategy is applicable to the specified location(s) and site-remediation activities to reduce runoff flows and the associated water quality constituent loads. The techniques are conceptual with estimated costs, and require further site assessments for design and implementation details. Italicized projects have immediate watershed-wide applications. Road-Drainage Retrofit projects are listed under Roadside Drainage Design/Retrofit Training as site-specific field demonstrations for each municipality.

- ***Roadside Drainage Design/Retrofit Training***
    - **Road-Drainage Retrofit, Delaware Township**
    - **Road-Drainage Retrofit, Franklin Township**
    - **Road-Drainage Retrofit, Raritan Township**
    - **Road-Drainage Retrofit, Kingwood Township**
- ***Targeted Agricultural Assistance Program***
- ***Update Stormwater BMP Manual for Soils and Bedrock Conditions in Hunterdon County***
- ***Hydrogeologic Study of the Copper, Lockatong, and Wickecheoke Watersheds***
- ***River-Friendly Farms Certification***
- **Preservation/Conservation-Land Stormwater Control**
- **Agricultural Runoff Remediation**
- **Bioretention Applications – Recreational Areas and Private/Public Lawns**
- **Delaware Township Municipal-Garage Retrofit**
- **Vehicle Maintenance and Storage Retrofit**
- **Sergeantsville Firehouse Parking-Lot and Municipal Park Retrofits**

Other possible remediation strategies include: public education and outreach through Community-Day presentations, mailings (e.g., flyers or brochures), website information, and other municipal and county programs; restrictions on all-terrain vehicle access to riparian areas; supplementing school curriculums and projects with classroom and in-stream water quality and hydrology classes and presentations; and initiating "Clean-Stream Teams" for creating responsible groups of students and landowners to maintain specific sections of the streams, similar to the "Adopt-A-Highway Program." Nearly all implementation projects can be initiated during the first year of funding with the exception of the Agricultural Runoff Remediation and the Road-Drainage Retrofit of Pine Hill Road projects that may be cost-prohibitive. The two projects that may have reduced emphasis due to cost could be partitioned to several smaller projects, reducing the up-front cost. Once initiated, each project could be completed within three to four years. The specific funding source(s) for each project needs to be identified and committed prior to initiating the projects.

Cost estimates were derived from similar project designs by Omni Environmental, Inc. for various BMPs proposed in the *Mulhockaway Creek Stormwater Management and Watershed Restoration Plan* (NJWSA, 2007), from the Natural Resources Conservation Service (NRCS), the Hunterdon County

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Soil Conservation District (HCSCD), the US Geological Survey (USGS), and the New Jersey Water Supply Authority (NJWSA). Prioritization of the projects was dependent on three factors: Flow/Load-Reduction (or flow protection); Implementation Potential, ability to have the project initiated during the first year of implementation; and Municipal Priority, interest by municipality for project support.

Microsoft Virtual Earth™ and Word™ programs were used to develop illustrations of the aerial extent and conceptual design of each potential remediation project.

Project Name:	**Preservation/Conservation Land Stormwater Control**	**Date:** 04/14/2009	**Flow/Load-Reduction Priority:** High
Location:	Delaware Twp, Block 30, Lot 1, and Kingwood Twp, Block 20, Lot 1	Parcel Size: 147.5 acres, and 71.7 acres	**Implementation Potential:** High
Remediation Type:	Subsoiling and microtopography		**Municipal Priority:** High
Issues and Concerns: Greater runoff flows from compacted soils, increased impervious cover, and greater intensity storm events have enhanced overland flow. Soils in the watershed are somewhat poorly drained. This situation is exacerbated by decades of agricultural production involving extensive tillage and other field operations. Over time, the soils have become compacted and have lost much of the inherent ability to retain and infiltrate rainwater. Much of the agricultural and former agricultural lands are in grass or grass/forb/brush cover, which controls most soil erosion. However, evidence in the stream corridor suggests that the flow regime is increasing in volume and erosive velocities.			
Existing Condition Based on Field Evaluation: Assessments of active croplands throughout the watersheds revealed mostly crop production practices that stabilize soils and prevent erosion. There were, however, erosion problems in the drainage channels along the perimeter of many active, as well as preserved, agricultural fields. Overland flow drains from the fields into these channels, concentrating the flow in the narrow channels and increasing the stream-bank erosion, ultimately depositing the sediment in the main channel. Soils are somewhat poorly drained and compacted from decades of agricultural operations. Block 30, Lot 1 in Delaware Township is a 147.5 acre property in the Lockatong watershed that had been an active crop farm, but sections are now inactive and undergoing succession. This parcel has been preserved through efforts by Delaware Township, NJDEP Green Acres Program, NJ Conservation Foundation, Hunterdon Land Trust Alliance, and NJ Water Supply Authority. Approximately 21 acres of the inactive areas could be retrofitted, as an innovative pilot project, to retain additional stormwater and the associated water quality constituents through vegetative and micro-topographic modifications (**Figure A1**). Block 20, Lot 1 in Kingwood Township is a 71.7 acre, active crop farm in the Lockatong watershed that has been preserved solely through efforts by Kingwood Township (**Figure A2**). This parcel could be used to illustrate increased stormwater infiltration through innovations of farming practices to include the periodic fracturing of any plowpan or fragipan.			

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Proposed Solutions:
The Delaware Township parcel will incorporate very innovative techniques for decreasing runoff and increasing ground water recharge. Rehabilitation of approximately 21 acres of Conservation Lands (preserved land, formerly agriculture) will improve infiltration, retain stormwater, and improve soil quality through subsoiling (deep single chisel plow), and with the creation of micro-topography and establishment of warm season grasses and woody vegetation. (Includes US Geological Survey (USGS) rainfall and runoff monitoring). Generally, micro-topography is the establishment of random uneven areas within the field in roughly 'crescent' shapes, on the contour. The broad intent is to mimic the natural conditions on the surface that may have existed prior to conversion to agriculture.
The Kingwood Township parcel would be used to determine the effectiveness of a subsoiling technique, similar to that used for the micro-topography project, for fracturing the plowpan and any fragipan whereby increasing infiltration and reducing runoff, while mixing organics into the soil. The available project area is approximately 8 acres.
The work should be done using common farm equipment such as moldboard plow, offset disk, or front end loader in order to make the technology economically transferable to other lands, both public and private, in the future. Township DPW, and NJWSA equipment could be used for subsoiling, and for establishing small, temporary berms and weirs to direct and retain runoff for monitoring purposes. Information acquired from this project would be applicable to thousands of acres of preserved lands state-wide.

Anticipated Benefits:
An estimated 40 to 50 percent decrease in runoff, up to 400,000 gallons/acre/yr, with an associated increase in ground water recharge. Up to 0.65 lb/acre/yr and 150 lb/acre/yr reduction in total phosphorus (TP) and total suspended solids (TSS), respectively, could be achieved based on the *NJSW BMP Manual, Appendix C, Sample Municipal Stormwater Management Plan*'s expected loadings of 1.3 lb/acre/year TP and 300 lb/acre/yr TSS for Agricultural. The sediment and flow reductions will increase proportionately as the technique is applied to other Conservation Lands throughout these watersheds and ultimately throughout the State. This technique could also be adapted to commercial lands having the typical condition of smoothed, compacted, high maintenance turf.

Major Implementation Issues:
The project will be applied to a total of 29 acres of public and preserved lands that are in agriculture or recently abandoned from crop production. The host municipality and the preservation partners will have to approve the site locations. This work is anticipated to be completed using common farm equipment, rather than excavating equipment. Soils in the watershed may have some limitations for the tillage and shaping of the land.

Possible Funding Sources: EPA 319(h) through NJDEP, NJWSA, NRCS, USGS, Kingwood Township, Delaware Township

Partners/Stakeholders: Municipal officials, NJDEP, NRCS, USGS, NJCF, Hunterdon County SCD, NJWSA

Task	Description	Estimated Cost[1]
1	Prepare and present concept plan for each site to NJDEP, HCSCD, and municipal officials	$5,000
2	Site topographic survey, and soils boring and testing (2 sites)	$52,000
3	Preparation of design plans, permits, and Administrative Report	$13,000

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4	Preparation of Stormwater BMP Maintenance Plan (NJDEP requirement)			$3,000
5	**Installation of BMP retrofits**			
	Activity	**Unit Cost**	**Quantity**	
	Equipment mobilization/erosion control[2]	$35/foot	1,000	$35,000
	Installation of 4 continuous-recording discharge measurement stations (2 per site) O&M for 3 years	$27,800 $47,400	4	$300,800
	Installation of precipitation monitors (1 per site) O&M for 3 years	$2,300 $6,930	2	$18,400
	Installation of automatic water sampler (2 per site) O&M for 3 years	$7,600 $13,740	4	$30,400
	Active farm plowing and installation of crescents on inactive farm fields	6,000		$6,000
	NRCS Technical and Administrative Costs	41,000		$41,000
	NJWSA Technical and Administrative Costs	22,400		$22,400
	Vegetative Planting	$2,500	2	$5,000
	Closeout and Contingency	7%		$32,100
			Total Installation and Operation Cost	$491,100
			Total Project Cost (50% per site)	**$564,100**

[1] Costs were based on estimates by the NRCS and USGS and represent the total for both project sites. USGS will supply automated water quality samplers at no cost. Municipal DPW and/or NJWSA will supply heavy equipment at no cost. NRCS and USGS will seek matching funds, and NJWSA will provide in-kind services up to 50 percent of staff charges.

[2] Soil disturbance in existing agricultural areas may be partially exempt from the NJ Soil Erosion and Sediment Control Standards.

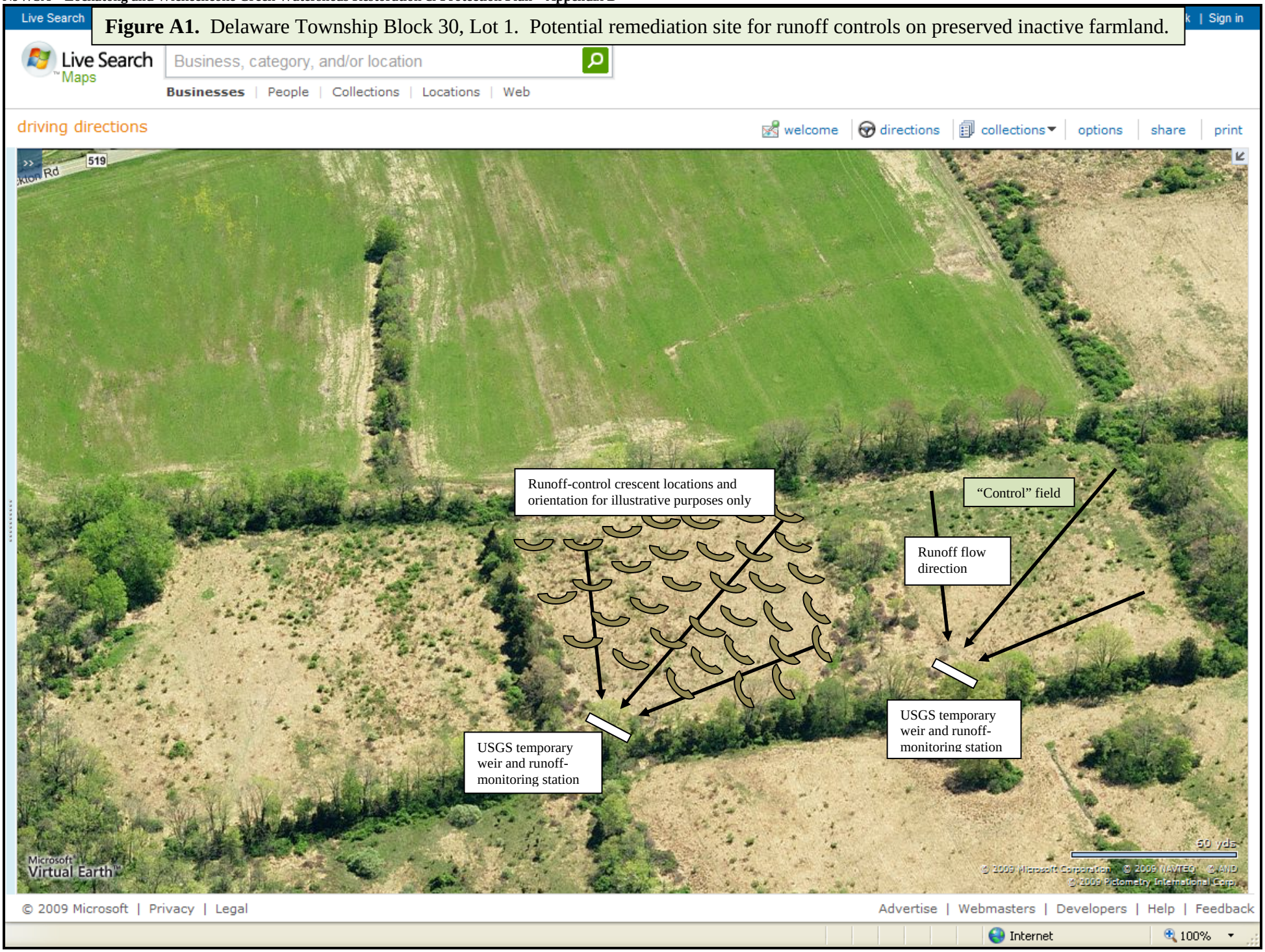

Figure A1. Delaware Township Block 30, Lot 1. Potential remediation site for runoff controls on preserved inactive farmland.

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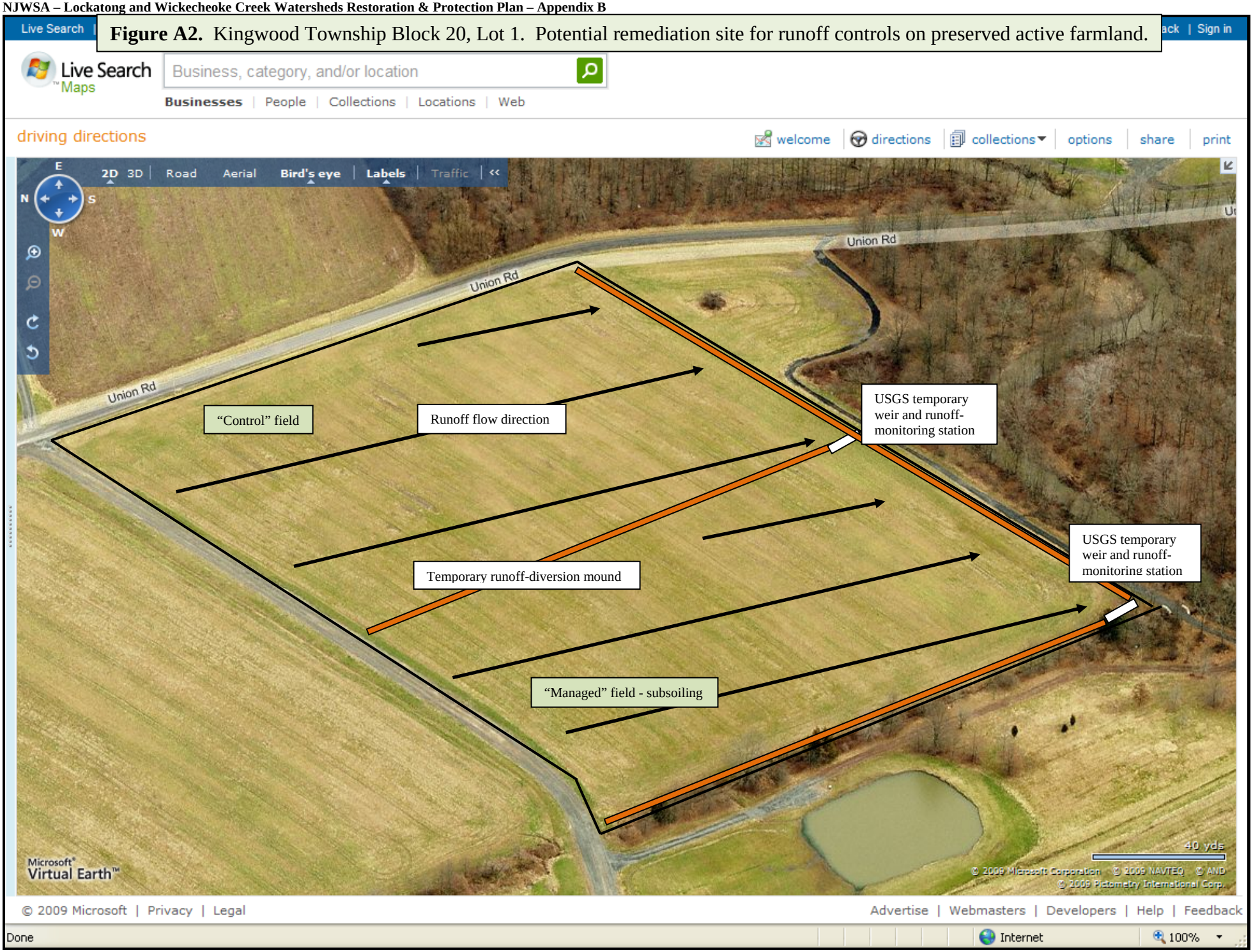
Figure A2. Kingwood Township Block 20, Lot 1. Potential remediation site for runoff controls on preserved active farmland.



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Project Name:	**Agricultural Runoff Remediation**	**Date:** 04/14/2009	**Flow/Load-Reduction Priority:** High
Location:	Franklin Twp, Block 37, Lots 35, 42, 31.0004	Parcel Size: Approximately 160 acres	**Implementation Potential:** May be cost-prohibited
Remediation Type:	Bioretention swales, and/or constructed wetland		**Municipal Priority:** Moderate

Issues and Concerns:
Stormwater runoff from the site is routed to a C1 tributary to Lockatong Creek. Large areas of impervious cover quickly convey stormwater off the site, creating very flashy and increased flows in the Lockatong Creek during storm events. The flow in this tributary contributes a large portion of the total baseflow during dry-weather conditions in the summertime. Loss of recharge, or increased water use may alter the flow regime of the Lockatong Creek. Bacterial and nitrogen levels were more elevated in this section of the project area than any other watershed areas.

Existing Condition Based on Field Evaluation:
The commercial plant production includes more than 118 acres, with a large portion of impervious ground cover: greenhouses, plastic-sheet weed control, and operations buildings. Runoff during storms exits the western edge of the property and flows into a tributary of Lockatong Creek, possibly heated from the dark plastic weed-control sheeting, and carrying nutrients, solids, and any pesticides from routine operations. Neighboring parcels were also active in commercial plant production operations. The total potential runoff from 1.25 inch storms, or less, for the combined parcel areas is approximately 56 million gallons per year. Historically, extreme runoff events have washed potted plants downstream. An estimated total suspended solids (TSS) and total phosphorus (TP) loads are 48,000 and 208 pounds per year, respectively, using the criteria from the *NJSW BMP Manual, Appendix C, Sample Municipal Stormwater Management Plan*. Although water quality data collected during this project had only 6 samples from a site downstream of these activities (L9b, Old Franklin School Road), 3 of the fecal coliform and 4 of the E. coliform values exceeded the 10 percent limits for exceedences. The E. coliform geometric average also exceeded the Surface Water Quality Standard (SWQS). Nitrate was elevated for each of the 4 samples that were collected, with an average concentration of 7.5 mg/l and a maximum loading of approximately 68 lb/day. Two of the 6 samples analyzed for total phosphorus exceeded the 0.1 mg/l SWQS with a maximum loading of approximately 4.5 lb/day. Further sampling should be conducted to identify specific source(s) of contamination.

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Proposed Solutions:
Bioretention swales (Option A), 20 feet wide, could be constructed along the side and down-gradient perimeter of each plant-production area to collect stormwater runoff from the impervious areas while providing solids and nutrient retention, as well as reduction of the flow volume through evapotranspiration and infiltration. The design will be dependent on the available area along the perimeter of each impervious area, soil depth and depth to ground water, and topography. Design and maintenance criteria are presented in *New Jersey Stormwater Best Management Practices Manual, Chapter 9.1, Bioretention Systems.* Wetlands (Option B) could be constructed to retain direct and piped runoff at a selected location(s). Design and maintenance criteria are presented in *New Jersey Stormwater Best Management Practices Manual, Chapter 9.2, Standard for Constructed Stormwater Wetlands.* A combination of Plan A and Plan B would provide a more versatile design for siting the stormwater controls (**Figures B1, B2, and B3**). As a third option, an innovative system could be installed to capture, route for irrigation, and reuse stormwater. This type of system would be designed for the specific site and is therefore not included in this proposal. Combinations of the remediation strategies, in addition to assistance from NJRC&DC for River-Friendly Farms, would provide a versatile design for the site characteristics.

Anticipated Benefits:
The NJDEP BMP Design Manual provides pollutant loading values for agricultural areas of 1.3 lbs/acre/year total phosphorus (TP) and 300 lbs/acre/year total suspended solids (TSS). This is equivalent to 208 lbs/yr TP and 48,000 lb/yr TSS for a 160 acre agricultural area. A bioretention swale will retain up to 90 percent of TSS and up to 60 percent of TP, while a constructed wetland will retain up to 90 percent of TSS and 50 percent of TP. The remediation strategy, in available areas between and along the perimeter of each impervious area, should retain runoff from the 1.25 inch rain event, ultimately reducing flashy runoff flows and the associated increase in scour velocity to the Lockatong Creek.

Major Implementation Issues:
Success of this remediation project would require landowner approval of the remediation strategy and maintenance program. A qualified contractor would be selected to construct and maintain the retrofit according to the manufacturer's recommended maintenance program. Costs could inhibit implementation, but could be reduced through prioritization and remediation of critical runoff areas. The potential implementation sites require field inspection to determine appropriate use, other locations may also provide favorable conditions for runoff control(s).

Possible Funding Sources: EPA 319(h) through NJDEP, Private, Conservation Reserve Enhancement Program (CREP), Environmental Quality Incentive Program (EQIP), NJ Environmental Infrastructure Financing Program

Partners/Stakeholders: Franklin Township officials, Hunterdon County SCD, NJDEP, Hunterdon County Agriculture Development Board, NJRC&DC

Task	Description	Estimated Cost[1]
1	Prepare and present concept plan to Hunterdon County SCD, NJDEP, and municipal officials	$5,000
2	Site topographic survey and soils testing	$5,000
3	Pre-application meeting with Hunterdon County SCD, NJDEP, and municipal officials. Preparation of design plans and permits.	$10,000
4	Preparation of Stormwater BMP Maintenance Plan (NJDEP requirement)	$2,000

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5	**Installation of BMP retrofits**			
	Activity	**Unit Cost**	**Quantity**	
	Equipment mobilization/erosion control[2]	$35/foot	4,500	$157,500
Option A	Construction of bioretention swales/check dams	$8/foot[2]	100,000	$800,000
	Vegetative Planting	$2,500	20	$50,000
	Closeout and Contingency	20%		$201,500
			Total Construction Cost:	$1,209,000
			Total Project Cost:	**$1,231,000**
			Annual O&M Cost:	$2,000
Option B	Construction of wetland/bioretention	$6/foot[2]	100,000	$600,000
	Vegetative Planting	$2,500	20	$50,000
	Closeout and Contingency	20%		$161,500
			Total Construction Cost	$969,000
			Total Project Cost	**$991,000**
			Annual O&M Cost	$2,000

[1] Costs were estimated based on similar designs by Omni Environmental, Inc. for various BMPs proposed in the *Mulhockaway Creek Stormwater Management and Watershed Restoration Plan* (NJWSA, 2007). The project could be partitioned into several smaller projects to offset the overall cost .

[2] Soil disturbance in existing agricultural areas may be partially exempt from the NJ Soil Erosion and Sediment Control Standards.

Figure B1. Franklin Township Block 37, Lot 42 (southern section). Potential stormwater runoff remediation for agricultural facility.

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Figure B2. Franklin Township Block 37, Lot 42 (central section). Potential stormwater runoff remediation for agricultural facility.

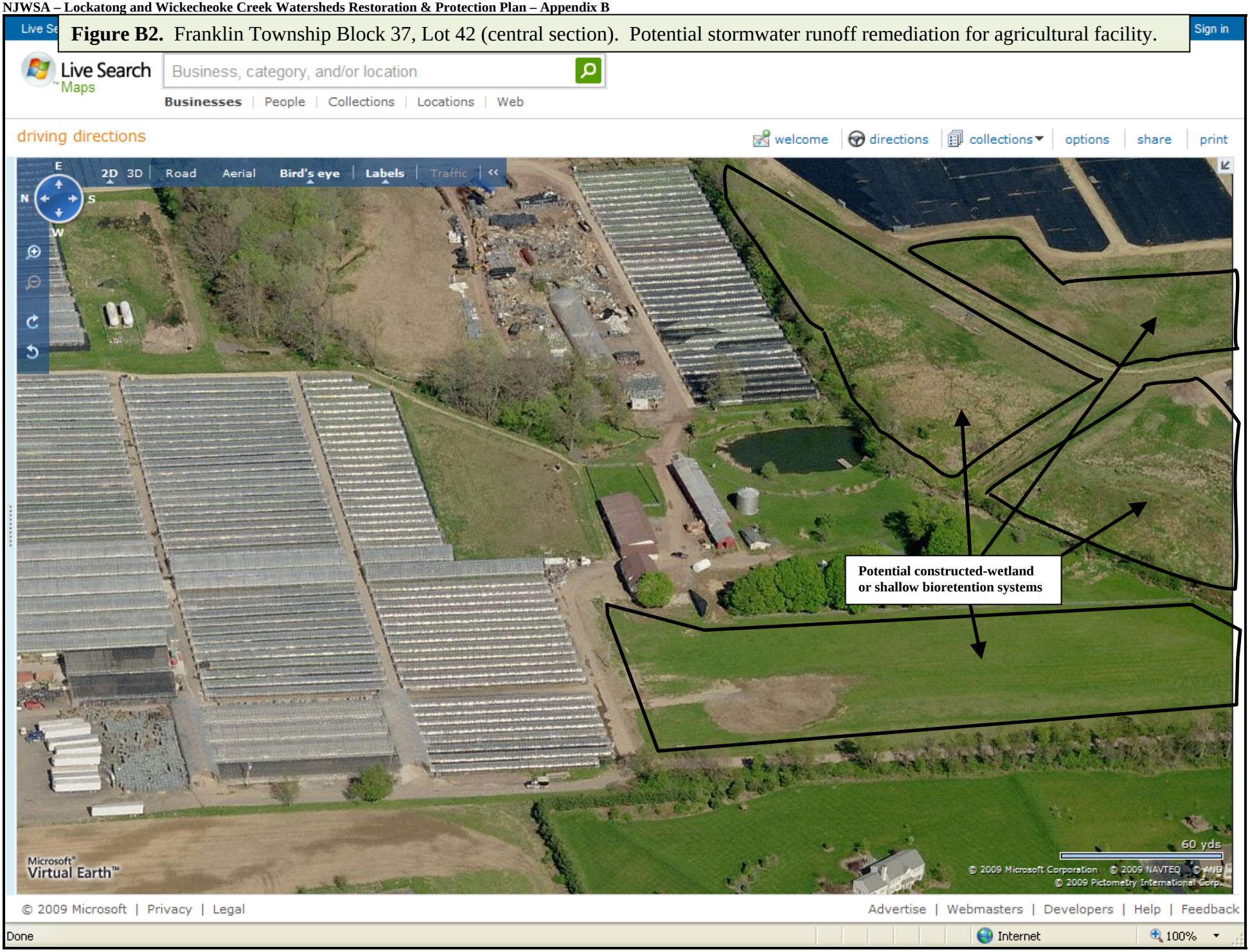

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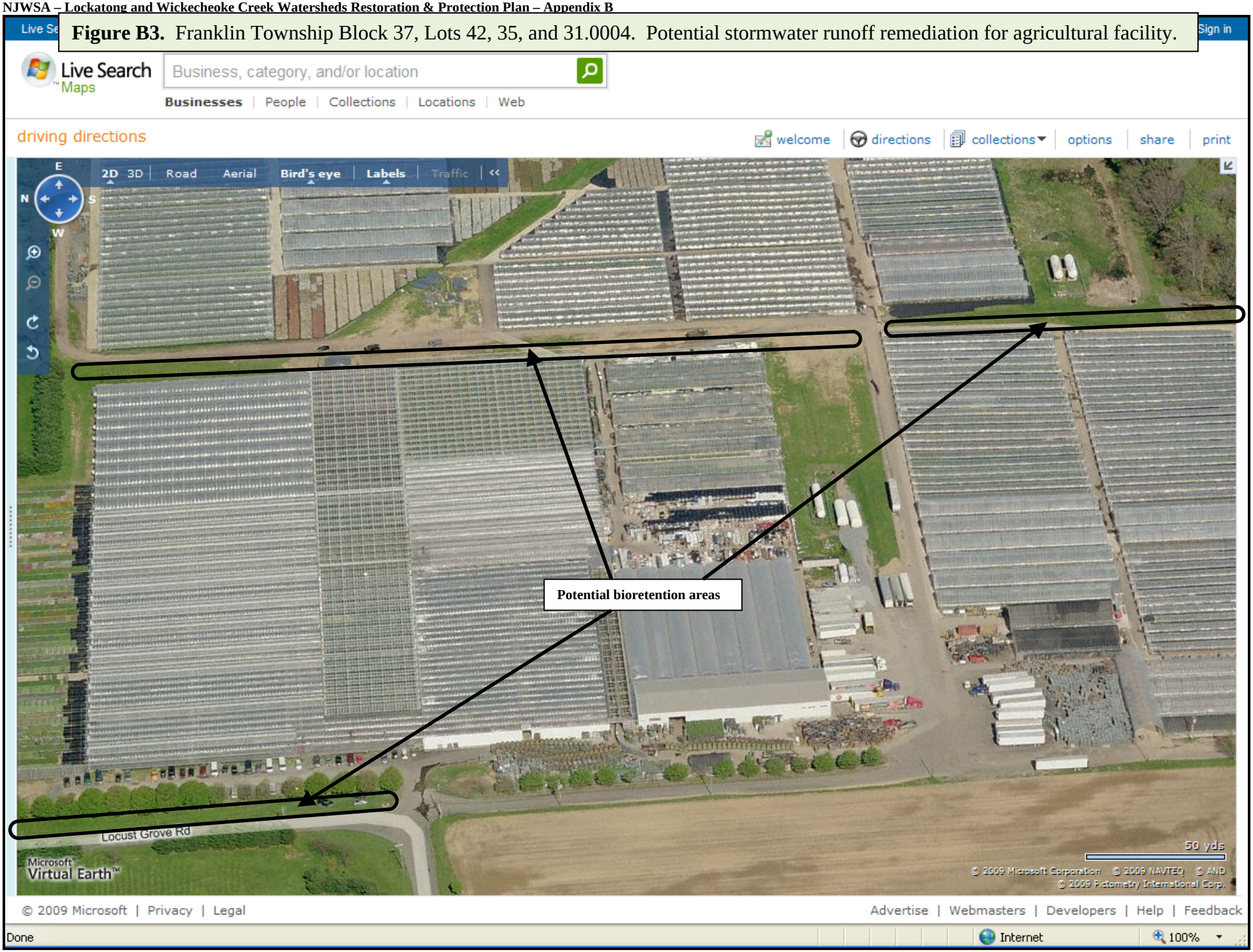
Figure B3. Franklin Township Block 37, Lots 42, 35, and 31.0004. Potential stormwater runoff remediation for agricultural facility.



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Project Name:	**Roadside Drainage Design/Retrofit Training**	**Date:** 04/14/2009	**Flow/Load-Reduction Priority:** High
Location:	Franklin, Kingwood, Delaware, and Raritan Townships, Hunterdon County	Watershed-wide remediation strategy	**Implementation Potential:** Moderate
Remediation Type:	Bioretention swale, check dam, and subsurface storage/infiltration		**Municipal Priority:** High

Issues and Concerns:
Incised, steep-sided roadway drainage channels, contribute up to 3,700 tons/year of sediment, via direct erosion and washoff from the road surfaces, to the Lockatong and Wickecheoke creeks. The majority of roads throughout Franklin, Kingwood, Delaware, and Raritan Townships exhibit eroding drainage channels.

Existing Condition Based on Field Evaluation:
Roadside drainage ditches contributing sediment, via erosion, are prevalent throughout both watersheds. Annual clearing of sediment and debris from these channels, by dredging, further destabilizes the channel banks from loss of vegetation, and deepens the ravines causing more confined flow and increased erosive energy. Approximately 139 miles of roads traverse the watersheds, that contribute on an average annual basis 28.8 tons of sediment per mile of paved roads and 93.9 tons of sediment per mile of unpaved roads.

Proposed Solutions:
This proposed project provides innovative road-drainage design and maintenance training for municipal DPW officials and road crews, through classroom and field training, as part of the DPW Manager certification and recertification programs. The Department of Public Works Manager position requires an initial nine courses of training be completed prior to taking the New Jersey State Certified Public Works exam (N.J.S.A.40A:9-154.6b). These courses are all offered through Rutgers University. Courses in the Technical Unit for Operations Resource Management include operations in road maintenance. This course should present the "operations" for installation and maintenance of stable roadway drainage to retain stormwater flow, reduce erosion, and improve water quality, as required by each Municipal Stormwater Management Plan. Every three years the certification must be renewed, requiring 20 contract hours, equivalent to 2 units of continuing education (N.J.S.A.40A:9-154.6h). This would provide another opportunity for reiterating the NJDEP requirements for proper stormwater management and the options for retrofitting roadway drainage designs and existing installations. An annual roadway design and maintenance workshop would be requied, as part of the 20 contract hours of continuing education for each Township Department of Public Works Manager, and include the Township Engineer, and road crews. The training would include classroom and hands-on field instruction for drainage-design options, construction and maintenance techniques, and retrofits of existing eroding swales. Proper equipment, frequency of drainage-ravine clearing, and stormwater-storage designs would also be emphasized as part of this training. Hunterdon County Engineering and the Soil Conservation District, and Rutgers University could provide annual training workshops as part of the 20 contract hours of

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continuing education, and as a mandatory requirement of the Stormwater Management Rule. Existing stable, and eroding drainage ditches would be used as examples to highlight design criteria for new projects and retrofits to the existing installations. Annual field assessments, guided by the instructors, would be followed by physical remediation of short sections of failing drainage channels. Field training would be presented to each municipality to provide a retrofitted-drainage model in each locality for future reference. The next four proposals are for "Road Drainage Retrofit" projects, one for each municipality, that could be used as potential candidates for field training.

Anticipated Benefits:
This type of training program could be used state-wide, and provide an annual resolve to sections of deteriorating or failing road-drainage channels. The Road-Drainage Retrofit projects that are proposed for each municipality in the following sections could be implemented in conjunction with the training.

Major Implementation Issues:
Implementation is dependent on the available funding to provide on-going annual training, and acceptance by Rutgers and State to modify curriculum to include emphasis on roadway drainage design retrofits. ROW must be available, purchase or easement, from neighboring landowners to provide adequate area for drainage retrofits.

Possible Funding Sources: EPA 319(h) through NJDEP; Hunterdon County; NJ Environmental Infrastructure Financing Program; Franklin, Delaware, Kingwood, and Raritan Townships

Partners/Stakeholders: Franklin, Delaware, Kingwood, and Raritan Townships, Hunterdon County SCD, NJDEP, NJWSA, NJ Environmental Infrastructure Financing Program, Hunterdon County Engineering

Task	Description	Estimated Cost[1]
1	Planning meeting with Rutgers University, HC Engineering, municipal DPW managers, and HCSCD	$5,000
2	Develop modifications to curriculum and training manual	$30,000
3	Training-manual publication	$4,000
	Contingency (20%)	$7,800
	Total Project Cost	**$46,800**
	Annual Operations Cost	$2,000

[1] Cost estimates were provided by the Hunterdon County Soil Conservation District.

Existing eroded roadside drain.

Potential retrofit to roadside drain.

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Project Name:	**Road-Drainage Retrofit, Delaware Township**	**Date:** 04/14/2009	**Flow/Load-Reduction Priority:** High
Location:	Pine Hill Road, Delaware Township	Roadside drainage length: 400 feet	**Implementation Potential:** May be cost-prohibited
Remediation Type:	Bioretention swale, enhanced lateral drainage, and wetland		**Municipal Priority:** Lower (due to cost)

Issues and Concerns:
Eroded County and municipal roadway drainage channels, contribute up to 3,700 tons/year of sediment, via direct erosion and washoff from the road surfaces, to the Lockatong and Wickecheoke creeks. Pine Hill Road is the largest dirt/gravel road with the steepest grade in the Wickecheoke watershed.

Existing Condition Based on Field Evaluation:
Approximately 1.4 miles of this dirt/gravel roadway traverses the steepest road gradients in the Wickecheoke watershed (**Figure C1**). Some sections of the road approach a slope of 40 percent. Much of the upgradient lawns, fields, and driveways drain to the roadside ditches, supplementing the stormwater runoff from the road. The outflow from the drainage ditches either discharges from elevated outflow pipes onto steep hill slopes, up to 61 percent grade, that convey the runoff directly to Wickecheoke Creek; or it flows along the road and discharges directly to one of two tributaries of Wickecheoke Creek: Plum Brook in the northern section or Cold Run in the southern section. The volume of runoff combined with the erosive velocity from the steep gradients destabilizes the drainage channels and the roadway, increasing loads from sediment, nutrients, and contaminants from vehicles to the streams.

Proposed Solutions:
Stormwater piping with inlets, as necessary at roadway intersections, would be installed in road sections that exceed 5 percent slope to minimize, or eliminate, erosion of the drainage channels. The piping would discharge to constructed stormwater wetlands with energy dissipaters in the forebay, or at a minimum, the discharge could terminate at energy dissipaters before entering the stream. Design and maintenance criteria are presented in *New Jersey Stormwater Best Management Practices Manual, Chapter 9.2, Standard for Constructed Stormwater Wetlands.* Drainage ravines less than 5 percent would be armored with rock and vegetation, and retrofitted where applicable with vegetated swales and gravel check-dams. Swales would be constructed according to design requirements in the *NJ Soil Erosion and Sediment Control Standards*, wider bottom widths and maximum side slopes of 3:1. Road segments draining laterally through pipes and discharging onto the steep drop to the Wickecheoke Creek, could have additional lateral drainage pipes installed between the existing pipes to disconnect the large volume of flow currently routed to the existing discharge locations. All outflow pipes would be installed or retrofitted to be even with the natural ground surface to eliminate the added force associated with falling water. All existing drainage being routed to the roadside swales should be reduced through public education and installation of bioretention systems (i.e., rain gardens, vegetated swales, and other shallow basins) upgradient of Pine Hill Road. Design and maintenance criteria are presented in *New Jersey Stormwater Best Management Practices Manual, Chapter 7, Landscaping*; and *Rain Garden Manual for New Jersey*, by the Native Plant Society of New

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Jersey. Driveway curbing should be eliminated or sequenced with cuts to allow stormwater to flow onto and into the adjacent lawn or woods. These designs are contingent upon width of the ROW easement; soil depth; depth to ground water; and gradient.

Anticipated Benefits:
Although the NJDEP BMP Design Manual does not provide pollutant loading values for roadway or roadside drainage ravines, the NRCS has determined that approximately 105.5 tons/mile/year of sediment is lost from unpaved roads in Delaware Township, or 148 tons/year from an unpaved roadway length of 1.4 miles. Using 30 feet as the road width, this section of roadway would contribute approximately 10.7 lb/year of TP, based on an estimated unit areal load (UAL) of 2.1 lb TP/acre/year for Commercial land use in the *NJSW BMP Manual, Appendix C, Sample Municipal Stormwater Management Plan*. With an assumed 20 percent retention of flow, suspended and dissolved pollutants should also be reduced by 20 percent. For this road section, a reduction of up to 29.6 tons/year and 2.1 lbs/year of sediment and TP loadings, respectively, could be obtained.

Major Implementation Issues:
Implementation is dependent on the width of the available roadway ROW, and the willingness of adjacent landowners to volunteer or sell land, where necessary, for construction of energy dissipaters and/or wetlands. The Delaware Township Committee would have to approve the retrofit. The Township Department of Public Works could perform and/or contract the retrofit, necessary, with a qualified consultant. A Letter-Of-Interpretation (LOI) should be prepared to determine the status of linear wetlands. Permits need to be acquired from the NJDEP for any anticipated land disturbance within 300 feet of any of these C1 streams.

Possible Funding Sources:
EPA 319(h) grant through NJDEP, Delaware Township, NJ Environmental Infrastructure Financing Program

Partners/Stakeholders: Delaware Township DPW and municipal officials, Hunterdon County SCD, NJDEP, Hunterdon County Engineering

Task	Description			Estimated Cost[1]
1	Prepare concept plan and present to property management/ownership			$5,000
2	Pre-application meeting with Hunterdon County SCD and NJDEP. Preparation of design plans and permits.			$15,000
3	Site topographic survey and soils testing			$6,000
4	Prepare final design plans			$5,000
5	Preparation of Stormwater BMP Maintenance Plan (NJDEP requirement)			$2,000
6	Preparation of construction documents, and solicitation of quotes for contractors and review			$3,500
7	**Installation of BMP retrofits**			
	Activity	**Unit Cost**	**Quantity**	
	Equipment mobilization/erosion control	$35/foot	7,000	$245,000
	Repair of existing drainage pipes	$50/foot	150	$7,500
	Construction of bioengineered swales/stone check-dams	$100/foot	1,250	$125,000
	Installation of drainage pipe and inlets	$100/foot	6,300	$630,000

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	Wetland/Bioretention construction	$10/foot^2	2,000	$20,000
	Vegetation Plantings	$4,000	1	$4,000
	Closeout and Contingency	20%		$206,300
			Total Construction Cost	$1,237,800
			Total Project Cost	**$1,274,300**
			Annual O&M Cost	$1,000

[1] Costs were estimated based on designs by Omni Environmental, Inc. for various BMPs proposed in the *Mulhockaway Creek Stormwater Management and Watershed Restoration Plan* (NJWSA, 2007). Efforts and costs for this project could be divided into separate roadway segments to offset the overall cost.

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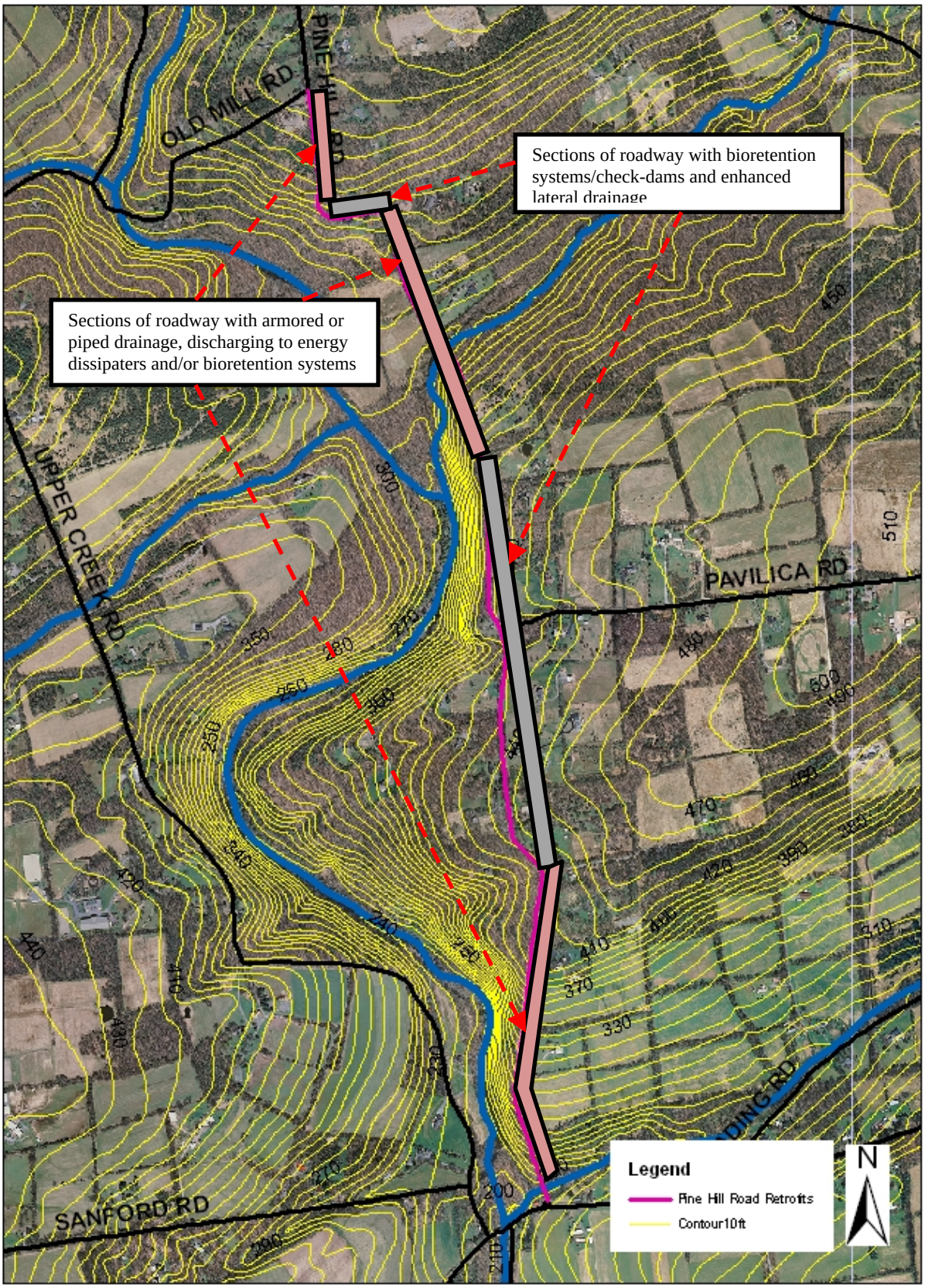
Figure C1. **Delaware Township, Pine Hill Road Potential Roadway Drainage Retrofit**



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Project Name:	**Road-Drainage Retrofit, Franklin Township**	**Date:** 04/14/2009	**Flow/Load-Reduction Priority:** Moderate
Location:	County Route 579, Franklin Township, Block 49, Lot 40	Roadside drainage length: 500 feet	**Implementation Potential:** Moderate
Remediation Type:	Bioretention swale and check dams		**Municipal Priority:** Moderate

Issues and Concerns:
Incised, steep-sided roadway drainage channels, contribute up to 3,700 tons/year of sediment, via direct erosion and washoff from the road surfaces, to the Lockatong and Wickecheoke creeks.

Existing Condition Based on Field Evaluation:
Roadside drainage ditches contributing sediment, via erosion, are prevalent throughout both watersheds. Annual clearing of sediment and debris from these channels by dredging further destabilizes the channel banks from loss of vegetation, and deepens the ravines causing more confined flow and increased erosive energy. This proposed project targets approximately 400 feet of roadside drainage along the west side of County Route 579, just south of Oak Grove Road, that is severely eroded and incised.

Proposed Solutions:
A vegetated bioretention swale with intermittently-spaced check-dams would be constructed along the west side of this road section (**Figure D1**). Design and maintenance criteria are presented in *New Jersey Stormwater Best Management Practices Manual, Chapter 9.1, Bioretention Systems*. Retrofitting the drainage channel with a crescent shaped cross-section and vegetative cover (additional stone armor where necessary), in addition to check dams, would lessen the scour velocity, retain an estimated 20 percent or more of the flow, and provide shallower water depths to promote evapotransporation. Swales should be constructed according to design requirements in the *NJ Soil Erosion and Sediment Control Standards*, wider bottom widths and maximum side slopes of 3:1. Stormwater storage/infiltration could be enhanced by deepening the channel, where possible, and filling the lower section with gravel, and covering with geotextile material, as demonstrated by Hunterdon County Engineering on road drainage swales along Pittstown Road. The design will be dependent on the width of the easement, soil depth, depth to ground water, and gradient.

Anticipated Benefits:
Although the NJDEP BMP Design Manual does not provide pollutant loading values for roadway or roadside drainage ravines, the NRCS has determined that approximately 37.6 tons/mile/year of sediment is lost from paved roads in Franklin Township, or 3.6 tons/year from a paved roadway length of 500 feet. Using 50 feet as the road width, this section of roadway would contribute approximately 1.2 lb/year of TP, based on the NJSW BMP Manual. With a 20 percent retention of flow, suspended and dissolved pollutants should also be reduced by 20 percent. For this road section, up to 0.7 tons/year and 0.2 lbs/year of sediment and TP loadings, respectively, could be reduced.

Major Implementation Issues:
Implementation is dependent on the width of the available roadway ROW. An additional ROW easement would require the neighboring landowners' approval for an easement, or land purchase. The retrofit would require approval from Hunterdon County Engineering. A Letter-Of-Interpretation (LOI) should be prepared to determine wetlands status.

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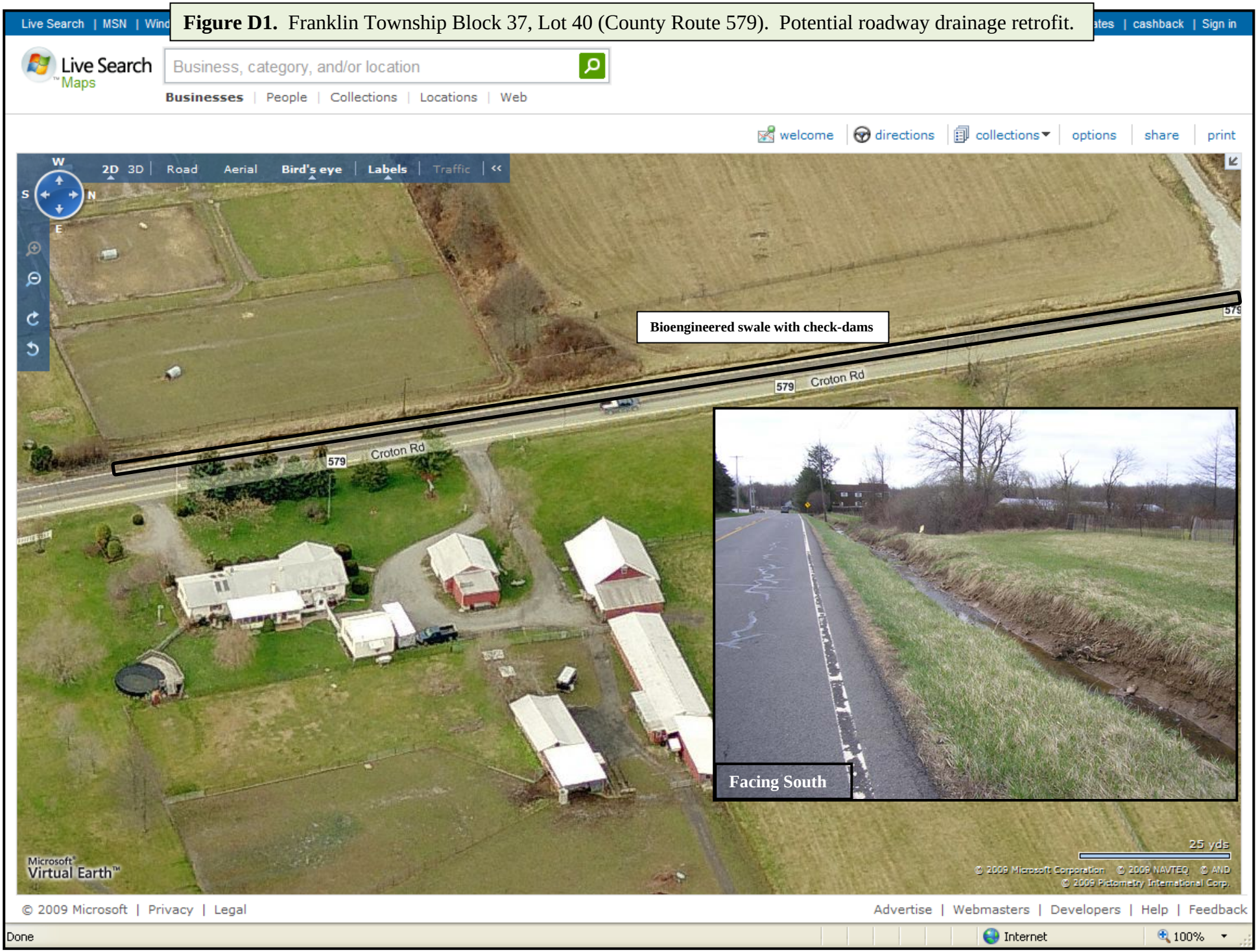
Possible Funding Sources: Hunterdon County Engineering, NJ Environmental Infrastructure Financing Program				
Partners/Stakeholders: Hunterdon County Engineering, Franklin Township, Hunterdon County SCD, NJDEP				
Task	**Description**			**Estimated Cost[1]**
1	Pre-application meeting with Hunterdon County SCD. Preparation of design plans and permits.			$5,000
2	Preparation of Stormwater BMP Maintenance Plan (NJDEP requirement)			$2,000
3	Preparation of construction documents, and solicitation of quotes for contractors and review			$2,500
4	**Installation of BMP retrofits**			
	Activity	**Unit Cost**	**Quantity**	
	Equipment mobilization/erosion control	$35/foot	500	$17,500
	Repair of existing drainage pipes	$50/foot	100	$5,000
	Construction of bioengineered swales/stone check dams	$100/foot	500	$50,000
	Vegetation Plantings	$4,000	1	$4,000
	Closeout and Contingency	20%		$15,300
			Total Construction Cost	$91,800
			Total Project Cost	**$101,300**
			Annual O&M Cost	$1,000

[1] Costs were estimated based on designs by Omni Environmental, Inc. for various BMPs proposed in the *Mulhockaway Creek Stormwater Management and Watershed Restoration Plan* (NJWSA, 2007).

Figure D1. Franklin Township Block 37, Lot 40 (County Route 579). Potential roadway drainage retrofit.



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Project Name:	**Road-Drainage Retrofit, Raritan Township**	**Date:** 04/14/2009	**Flow/Load-Reduction Priority:** Moderate
Location:	Goose Island Road, just east of County Route 579, Raritan Township, Block 21, Lots 2.0001 and 2.0002	Roadside drainage length: 650 feet	**Implementation Potential:** Moderate
Remediation Type:	Bioretention swale and check-dams		**Municipal Priority:** Moderate

Issues and Concerns:
Incised and eroded roadway drainage channels, contribute up to 3,700 tons/year of sediment, via direct erosion and washoff from the road surfaces, to the Lockatong and Wickecheoke creeks.

Existing Condition Based on Field Evaluation:
Annual clearing of sediment and debris from this roadside channel by dredging further destabilizes the channel from loss of vegetation, and increases the depth of the ditch causing more confined flow and increased erosive energy. This proposed project targets approximately 400 feet of roadside drainage along the south side of Goose Island Road, just east of County Route 579, that contributes sediment loads to a tributary of Wickecheoeke Creek, designated as C1.

Proposed Solutions:
A vegetated bioretention swale with intermittently-spaced check-dams (if warranted) would be constructed along the west side of this road section (**Figure E1**). Design and maintenance criteria are presented in *New Jersey Stormwater Best Management Practices Manual, Chapter 9.1, Bioretention Systems.* Retrofitting the channel with a crescent-shaped cross-section and vegetative cover (additional stone armor where necessary), in addition to check dams, would lessen the scour velocity, retain an estimated 20 percent or more of the flow, and provide shallower water depths to promote evapotransporation. Swales should be constructed according to design requirements in the *NJ Soil Erosion and Sediment Control Standards*, wider bottom widths and maximum side slopes of 3:1. Stormwater storage/infiltration can be enhanced by deepening the channel, where possible, and filling the lower section with gravel, and covering with geotextile material, as demonstrated by Hunterdon County Engineering on road drainage swales along Pittstown Road. The design will be dependent on the width of the ROW easement, soil depth, depth to ground water, and gradient.

Anticipated Benefits:
Although the NJDEP BMP Design Manual does not provide pollutant loading values for roadway or roadside drainage ravines, the NRCS has determined that approximately 27.4 tons/mile/year of sediment is lost from paved roads in Raritan Township, or 3.4 tons/year from a paved roadway length of 650 feet. Using 30 feet as the road width, this section of roadway would contribute approximately 0.9 lb/year of TP, based on an estimated unit areal load (UAL) of 2.1 lb TP/acre/year for Commercial land use in the NJSW BMP Manual. With a 20 percent retention of flow, suspended and dissolved pollutants should also be reduced by 20 percent. For this road section, up to 0.7 tons/year and 0.2 lbs/year of sediment and TP loadings, respectively, could be reduced.

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Major Implementation Issues:
Implementation is dependent on the width of the available roadway ROW. An additional ROW easement would require the neighboring landowners' approval, or land purchase. The Raritan Township Committee would have to approve the retrofit. The Township Department of Public Works would perform the retrofit with assistance, as required, from a qualified consultant. A Letter-Of-Interpretation (LOI) should be processed to determine the status of linear wetlands.

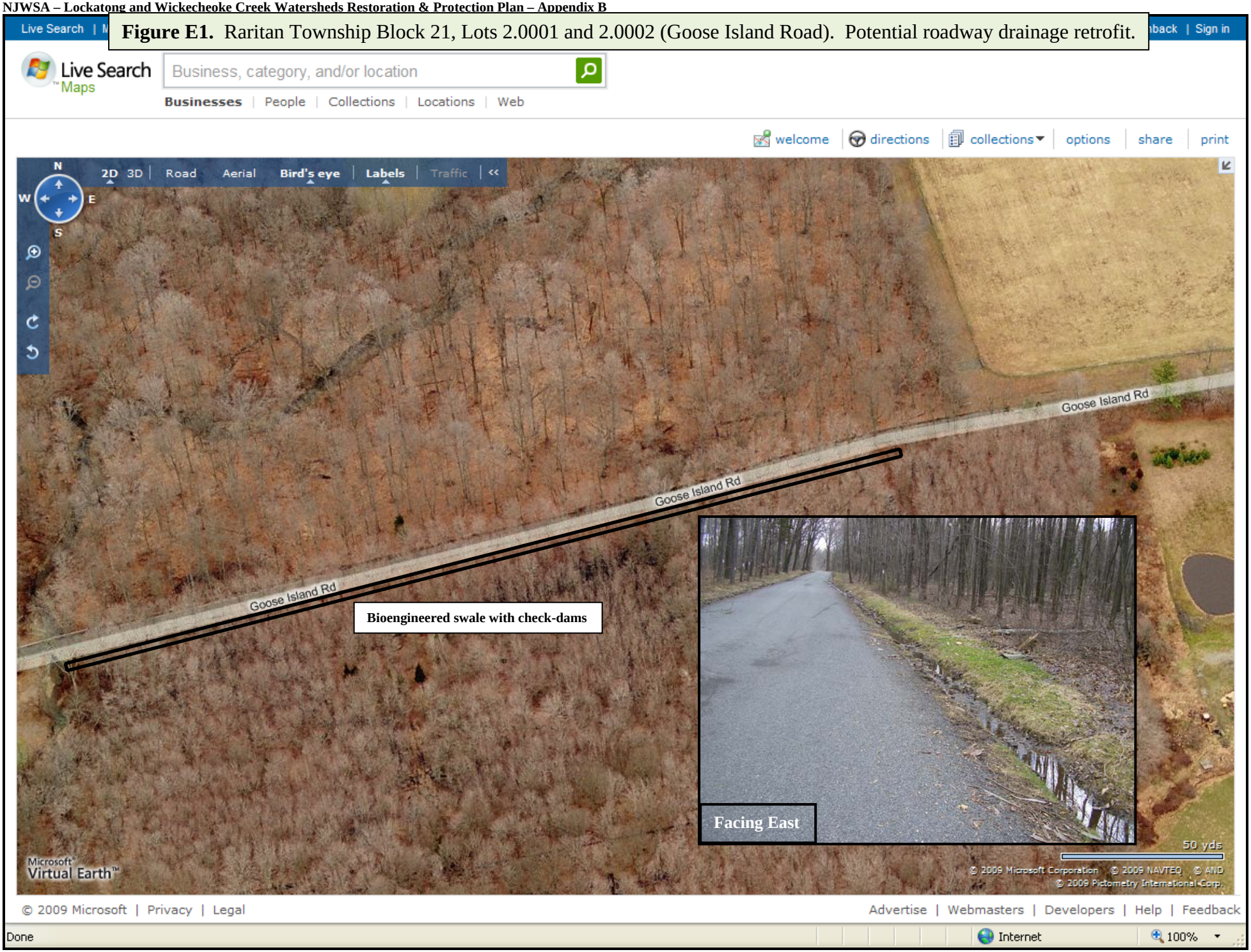
Possible Funding Sources:
EPA 319(h) grant through NJDEP, Raritan Township, NJ Environmental Infrastructure Financing Program

Partners/Stakeholders: Raritan Township DPW and municipal officials, Hunterdon County SCD, NJDEP

Task	Description			Estimated Cost[1]
1	Pre-application meeting with Hunterdon County SCD. Preparation of design plans and permits.			$5,000
2	Preparation of Stormwater BMP Maintenance Plan (NJDEP requirement)			$2,000
3	Preparation of construction documents, and solicitation of quotes for contractors and review			$2,500
4	**Installation of BMP retrofits**			
	Activity	**Unit Cost**	**Quantity**	
	Equipment mobilization/erosion control	$35/foot	650	$22,750
	Repair of existing drainage pipes	$50/foot	50	$2,500
	Construction of bioengineered swales and stone check-dams	$100/foot	650	$65,000
	Closeout and Contingency	20%		$18,050
			Total Construction Cost	$108,300
			Total Project Cost	**$117,800**
			Annual O&M Cost	$1,000

[1] Costs were estimated based on designs by Omni Environmental, Inc. for various BMPs proposed in the *Mulhockaway Creek Stormwater Management and Watershed Restoration Plan* (NJWSA, 2007).

Figure E1. Raritan Township Block 21, Lots 2.0001 and 2.0002 (Goose Island Road). Potential roadway drainage retrofit.



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Project Name:	**Road-Drainage Retrofit, Kingwood Township**	**Date:** 04/14/2009	**Flow/Load-Reduction Priority:** Moderate
Location:	Barbertown-Point Breeze Road, just east of Fitzer Road intersection, Kingwood Township, Block 22, Lot 1	Roadside drainage length: 350 feet	**Implementation Potential:** Moderate
Remediation Type:	Bioretention swale and check-dams		**Municipal Priority:** Moderate

Issues and Concerns:
The Natural Resources Conservation Service has reported that incised and eroded roadway drainage channels contribute up to 3,700 tons/year of sediment, via direct erosion and washoff from the road surfaces, to the Lockatong and Wickecheoke creeks.

Existing Condition Based on Field Evaluation:
Annual clearing of sediment and debris from this roadside channel by dredging further destabilizes the channel from loss of vegetation, and increases the depth of the ditch causing more confined flow and increased erosive energy. This proposed project targets approximately 350 feet of roadside drainage along the south side of Barbertown-Point Breeze Road, just east of the Fitzer Road intersection, that contributes sediment loads to Muddy Run, a tributary of Lockatong Creek, designated as C1.

Proposed Solutions:
A vegetated bioretention swale with intermittently-spaced check-dams (if needed) would be constructed along the south side of this road section (**Figure F1**). Design and maintenance criteria are presented in *New Jersey Stormwater Best Management Practices Manual, Chapter 9.1, Bioretention Systems.* Retrofitting the channel with a crescent shaped cross-section and vegetative cover (additional stone armor where necessary), in addition to check dams, would lessen the scour velocity, retain an estimated 20 percent or more of the flow, and provide shallower water depths to promote evapotransporation. Swales should be constructed according to design requirements in the *NJ Soil Erosion and Sediment Control Standards*, wider bottom widths and maximum side slopes of 3:1. Stormwater storage/infiltration could be enhanced by deepening the channel and filling the lower section with gravel, and capping with geotextile material. The design will be dependent on the width of the ROW easement, soil depth, depth to ground water, and gradient.

Anticipated Benefits:
Although the NJDEP BMP Design Manual does not provide pollutant loading values for roadway or roadside drainage ravines, the NRCS has determined that approximately 28 tons/mile/year of sediment is lost from paved roads in Kingwood Township, or 1.9 tons/year from a paved roadway length of 350 feet. Using 30 feet as the road width, this section of roadway would contribute approximately 0.5 lb/year of TP, based on an estimated unit areal load (UAL) of 2.1 lb TP/acre/year for Commercial land use (NJ BMP Manual). With a 20 percent retention of flow, suspended and dissolved pollutants should also be reduced by 20 percent. For this road section, a reduction of up to 0.4 tons/year and 0.1 lbs/year of sediment and TP loadings, respectively, could be obtained.

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Major Implementation Issues:
Implementation is dependent on the width of the available roadway ROW. Expansion of the ROW easement would require the neighboring landowners' approval, or land purchase. The Kingwood Township Committee would have to approve the retrofit. The Township Department of Public Works would perform the retrofit with assistance, as required, from a qualified consultant. A Letter-Of-Interpretation (LOI) should be processed to determine the status of linear wetlands.

Possible Funding Sources:
EPA 319(h) grant through NJDEP, Kingwood Township, NJ Environmental Infrastructure Financing Program

Partners/Stakeholders: Kingwood Township DPW and municipal officials, Hunterdon County SCD, NJDEP

Task	Description			Estimated Cost[1]
1	Pre-application meeting with Hunterdon County SCD. Preparation of design plans and permits.			$5,000
2	Preparation of Stormwater BMP Maintenance Plan (NJDEP requirement)			$2,000
3	Preparation of construction documents, and solicitation of quotes for contractors and review			$2,500
4	**Installation of BMP retrofits**			
	Activity	**Unit Cost**	**Quantity**	
	Equipment mobilization/erosion control	$35/foot	350	$12,250
	Repair of existing drainage pipes	$50/foot	100	$5,000
	Construction of bioengineered swales/stone check-dams	$100/foot	350	$35,000
	Closeout and Contingency	20%		$10,450
			Total Construction Cost	$62,700
			Total Project Cost	**$72,200**
			Annual O&M Cost	$1,000

[1] Costs were estimated based on designs by Omni Environmental, Inc. for various BMPs proposed in the *Mulhockaway Creek Stormwater Management and Watershed Restoration Plan* (NJWSA, 2007).

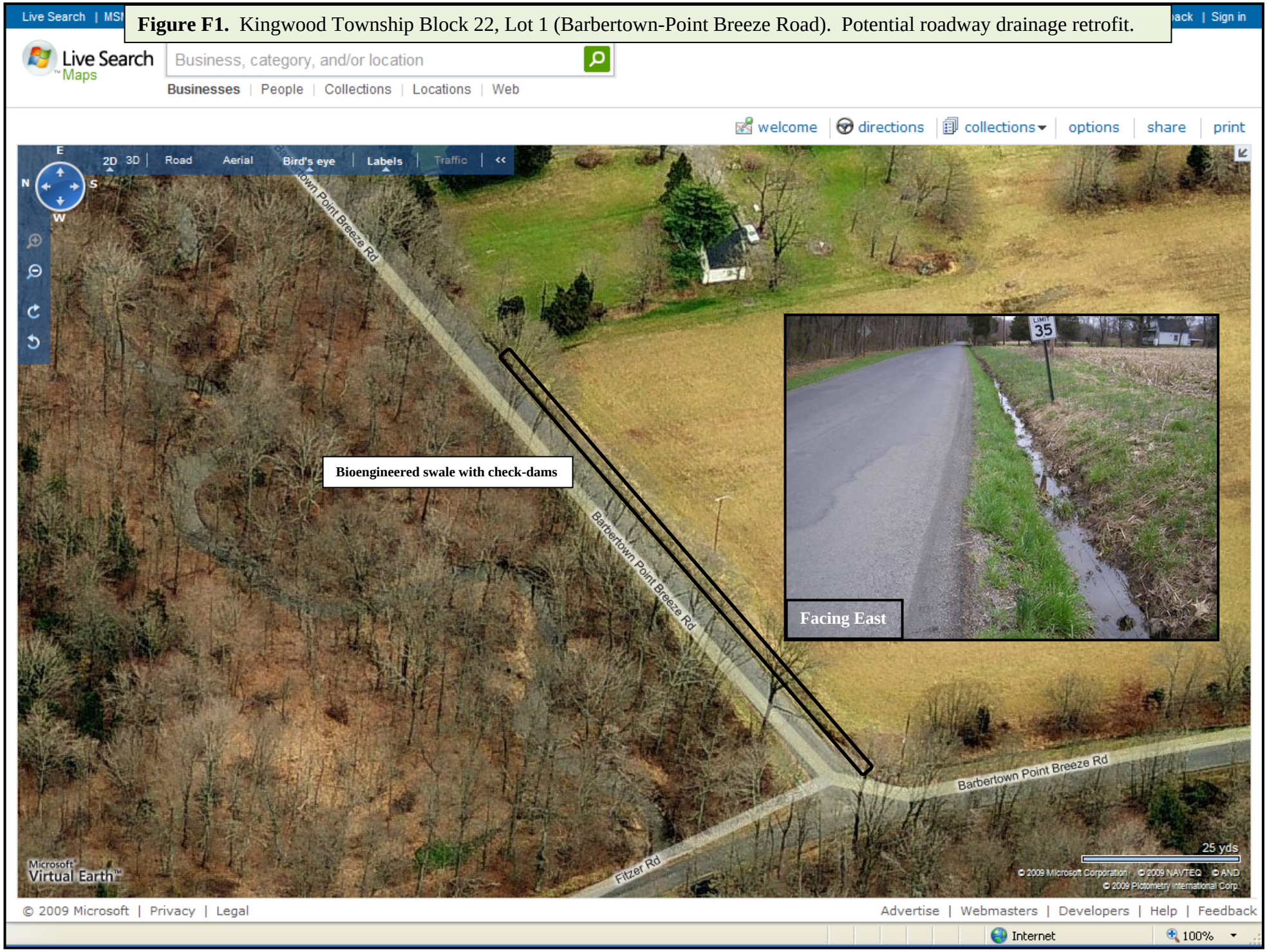

Figure F1. Kingwood Township Block 22, Lot 1 (Barbertown-Point Breeze Road). Potential roadway drainage retrofit.

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Project Name:	**Targeted Agricultural Assistance Program**	**Date:** 04/14/2009	**Flow/Load-Reduction Priority:** High
Location:	Franklin, Kingwood, Delaware, and Raritan Townships, Hunterdon County	Watershed-wide remediation strategy	**Implementation Potential:** High
Remediation Type:	Nutrient management plans and integrated-pest management services		**Municipal Priority:** High

Issues and Concerns:
Agriculture operations will continue to be a significant portion of the land use in the Lockatong and Wickecheoke Creek Watersheds and serve to maintain the rural character of the communities. However, these operations can contribute to the problems in the watersheds, including erosion, bacterial contamination, localized nutrient enrichment and increased stream temperatures. Erosion from agricultural operations results from non-conservation plowing, lack of riparian buffers, animals with direct access to the stream and/or over-grazing of pastures. Bacterial contamination is commonly caused by animal feces directly deposited in the stream, or poor manure management (storage or use as fertilizer). Nutrient enrichment can occur from poorly applied manure or over-application of fertilizers. Increased stream temperatures from agricultural areas are typically the result of poor riparian buffers and exposure of the stream to sunlight. The New Jersey Water Supply Authority (NJWSA) and Hunterdon County Soil Conservation District (HCSCD) have identified locations where animals have direct access to the stream and the riparian buffer is too narrow, in poor condition, or non-existent.

Existing Condition Based on Field Evaluation:
The Lockatong and Wickecheoke Creeks have violations of water quality standards for total phosphorus, pH, temperature, and bacteria. Animals have direct access to the stream in many locations and the riparian buffer is sparse in places. Since 2000, the streams have consistently had violations of the total phosphorus water quality standard. While the turbidity and total suspended solids concentrations are well below water quality standards during low to moderate flow conditions, they exceed water quality standards during wet-weather runoff events. Visual inspection of the streams demonstrate the significant sediment and erosion processes occurring in stream channels throughout the watershed.

Through provision of Integrated Crop Management (ICM) Services, HCSCD has uncovered several prevalent trends in the County. Many continually farmed tracts are over limed with pH levels above optimum while others required lime, indicating that lime is applied without evaluation of its necessity for crop production. Optimizing pH levels maximizes nutrient availability and crop growth, while reducing the amount of nutrients in runoff. Balanced nutrient levels reduce nutrient runoff by maximizing crop growth. Phosphorus is usually found at or above optimal levels, but farmers still apply fertilizers that contain it. Manure is often applied without a soil test and without knowledge of the soil's and/or crop's ability to incorporate the nutrients. Use of pesticides is typically based on the presence of a pest or weed rather than the economic and biological damage thresholds.

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Proposed Solutions:
A comprehensive Targeted Agricultural Assistance Program is recommended to address agricultural issues in the watershed, particularly those related to erosion management. The program would be implemented by the Hunterdon County Soil Conservation District and voluntary for landowners but provide funding to initiate planning and implementation of efforts to minimize the impacts of agricultural practices on water bodies. The targeted program includes: nutrient management plans, integrated crop management (ICM) services, and an implementation coordinator, using existing farm bill assistance programs. Integration with the "River Friendly Farms" certification program could be possible. Details for each of the programs components are explained below.

- Nutrient Management Plans: Hunterdon County Soil Conservation District would be developed for all agricultural operations with two or more animal equivalent units (AEUs). An AEU is 1,000 pounds of live weight of any animal on an annualized basis, meaning the weight can be normalized by the amount of time the animal is present on the property. Nutrient management plans would also be developed for smaller operations where animals (livestock, poultry, canine) are kept within 300 feet of a water body or wetland and a water quality benefit could be realized by such management. Plans would be developed at no cost to the landowner/agricultural operation. Implementation funding would be sought through EQIP and other Farm Bill assistance programs.
- Integrated Crop Management (ICM) Services: Hunterdon County Soil Conservation District would work with the agricultural operation to develop an ICM approach to agricultural production on that farm which would include the establishment of thresholds for nutrients, pesticides and herbicides based on soil tests, pest infestation and pest threats. ICM benefits the agricultural operation by optimizing production and eliminating the overuse of fertilizers and pesticides based on scientific and economic principals and proven agronomic practices.
- Implementation Coordinator: Hunterdon County Soil Conservation District would develop an outreach, education and monitoring coordinator position to identify and target high impact operations or locations where water quality benefits can be cooperatively achieved. The coordinator would also publicize the project, elicit participation and document implementation.

Anticipated Benefits:
The ICM Services provided by the HCSCD will educate landowners and tenant farmers about the appropriate amount of manure and/or chemicals to use to maximize their benefit and reduce production costs associated with over-application. Optimizing chemical use will result in better crop uptake and fewer nutrients migrating to the stream. The HCSCD program has already resulted in elimination and reduction of lime, fertilizer and pesticide applications.

Major Implementation Issues:
The success of the Targeted Agricultural Assistance Program will depend largely on the receptiveness of landowners and agricultural operations to participate in the program. In particular, this program will be open to smaller operations, which are not typically the focus of similar programs due to their smaller size. Finding funds to support the program and implementation may also be difficult.

Possible Funding Sources:
EPA 319(h) grant through NJDEP, NJWSA, EQIP and other Farm Bill assistance programs

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Partners/Stakeholders: Delaware, Kingwood, Raritan, and Franklin Townships; NJDEP; HCSCD; NRCS; NJWSA		
Task	**Description**	**Estimated Cost[1]**
1	Program management/coordination	$48,000
2	Preparation of Nutrient Management Plans for 40 farms, or 1,000 acres	$44,800
3	Integrated Crop Management services (farmer training, and soil assessments for 1,500 acres)	$112,500
	Contingency (10%)	$20,500
	Total Project Cost	**$225,800**
	Annual Operation Cost	$48,000

[1] Proposal and cost estimates were provided by the Hunterdon County Soil Conservation District.

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Project Name:	**Update Stormwater BMP Manual For Soils and Bedrock Conditions in Hunterdon County**	**Date:** 04/14/2009	**Flow/Load-Reduction Priority:** High
Location:	Franklin, Kingwood, Delaware, and Raritan Townships, Hunterdon County	Watershed-wide remediation strategy	**Implementation Potential:** High
Remediation Type:	Increased Stormwater-Control Effectiveness		**Municipal Priority:** High

Issues and Concerns:
Natural soil and bedrock conditions in Hunterdon County, including the Lockatong and Wickecheoke Creek watersheds, create unresolved design and construction limitations for stormwater controls. Seasonally high ground water levels, shallow bedrock with limited and non-homogenous secondary porosity, and clay soils, create conditions that can be inappropriate for many of the recommended BMP designs.

Existing Condition Based on Field Evaluation:
Presently, approximately half of the constructed stormwater basins in the watersheds are seasonally ponded, and can contain water for weeks when underlain with clayey subsoils and shallow bedrock, even during dry summertime conditions.

Proposed Solutions:
Addition of design and structural modifications, and site limitations/requirements, to the recommended stormwater-control techniques to provide more effective stormwater containment and infiltration/evapotransporation for both residential and commercial properties. Off-site stormwater-routing design requirements should be included in site plans to ensure continuous soil stability enroute to the adjacent stream(s). On-site stormwater controls, such as rain gardens, subsurface storage/infiltration, rain barrels, and others, should be required to minimize the runoff volume from rooftops, parking lots, and driveways that is frequently routed to roadside drainage ravines and streams. Rain-barrel effectiveness is reviewed in: *Combined Sewer Overflow Rooftop Type Analysis and Rain Barrel Demonstration Project*, Department of Environmental Programs Metropolitan Washington Council of Governments, December 2001. Other watersheds with similar soils and geology would benefit from the BMP amendments.

Anticipated Benefits:
Anticipated benefits include: additional ground water recharge, reduced erosion potential, and reduced mosquito and geese populations by reducing the number and volume of wet stormwater basins. Storm-runoff would be more effectively captured on-site and infiltrated, reducing the downstream runoff volume ultimately associated with higher stream flow volume and contaminant loadings, while increasing baseflows proportionately.

Major Implementation Issues:
Although the revised BMP techniques would be applicable to new development, existing development may require volunteer BMP installations and retrofits. The amended techniques will require acceptance by the NJDEP prior to implementation in municipal site-plan reviews for new development.

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Possible Funding Sources: EPA 319(h) grant through NJDEP, NJ Environmental Infrastructure Financing Program, NJWSA, Municipalities		
Partners/Stakeholders: Delaware, Kingwood, Raritan, and Franklin Townships; HCSCD; NRCS; NJWSA		
Task	**Description**	**Estimated Cost[1]**
1	Program management/coordination	$26,000
2	Publication and materials	$4,000
	Contingency (10%)	$3,000
	Total Project Cost	**$33,000**

[1] Proposal and cost estimates were provided by the Hunterdon County Soil Conservation District.

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Project Name:	**Hydrogeologic Study of the Copper, Lockatong, and Wickecheoke Watersheds**	**Date:** 04/14/2009	**Flow Protection Priority:** High
Location:	Franklin, Kingwood, Delaware, and Raritan Townships, Hunterdon County	Watershed-wide remediation strategy	**Implementation Potential:** High
Remediation Type:	Identification of Seasonal Ground Water Flow Characteristics, Recharge Areas, and Potential Sources of Aquifer and Surface Water Contamination		**Municipal Priority:** High

Issues and Concerns:
Franklin, Kingwood, and Delaware Townships are entirely dependent on ground water as the sole source of residential drinking water supply as well as a commercial, industrial, institutional and agricultural water supply. Ground water discharge (baseflow) to stream systems in the townships also provides a very significant ecological function particularly during dry-flow/drought periods. Two of the principal stream systems that drain through these three townships (Lockatong and Wickecheoke Creeks) also contribute flow to the Delaware and Raritan Canal which is a significant water supply source in central New Jersey. Fractured bedrock provides an interconnection between the surface and ground water, potentially providing a fast transport of water quality contaminants to wells and streams. The aquifer system has not been studied to identify the magnitude and direction of flow nor the quantity or quality of the water supply. Overuse and contamination of the ground water is known to be influencing the quantity and quality of the stream flow.

Existing Condition Based on Field Evaluation:
Boron, which has commonly been associated with pesticides in agricultural practices, has been located in very high concentrations at springs within the Lockatong headwaters. High levels of nitrate concentrations in the streams may also be originating from contaminated ground water from historical livestock operations. Ground water uses, of less than 100,000 gallons per day, in the watersheds do not have limitations on effects to wetland and stream ecology, or potable water supply. Many segments of the Lockatong and Wickechoeke mainstem are dry or losing flow during the dry summertime conditions. Future increases in water uses, without knowledge of the water-supply limitations, would continue to decrease stream baseflows, dilution for point-source pollution, and potable water supplies.

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Proposed Solutions:

Task 1: Well records compilation by watershed and GIS Mapping.
Well records for the individual watersheds will be compiled and entered into GIS layers for mapping. This will be a very useful resource for individual, commercial and other use applicants for new wells, well replacements, increased water uses, and subdivision applications; consultants; and information for individual residents as well as for Township officials. It will provide a supportive database/tool for the Townships' planning efforts and implementation of ground water protection provisions.

Analyses of the collected data by watershed and geologic units will provide a reference for ground water use in comparison to recharge (GSR 32 and baseflow methods); identify areas and portions of watersheds where ground water use may be in excess of or approaching the threshold of 20% of recharge; and provide a platform for future planning of ground water use in these three watersheds and portions thereof.

Task 2: Groundwater-Level Monitoring Network Development
Ground water level monitoring networks will be developed for the Copper, Lockatong, and Wickecheoke Creek Watersheds. Copper Creek is included in this study to determine the extent of subsurface flow that may be outflowing from the Lockatong Creek watershed into the Copper Creek watershed through a network of fractures. The continuous monitoring of water levels over time will provide an understanding of water-level responses seasonally; during extended wet and dry periods; significant droughts, and long-term trends. A drought-warning target system, based on static water level, can be produced with continuous monitoring. This could initiate voluntary water conservation measures when aquifer levels reach designated elevations.

Task 3: Development of water-level contour maps for the three principal watersheds in the Townships

Task 4: GIS Mapping of geology; principal aquifers; areas of ground water depletion; outflow and inflow to streams; and areas of ground water quality concerns

Task 5: Updated required recharge area using Nitrate Dilution Modeling with the 2.0 mg/l nitrate planning standard

Anticipated Benefits:
Collectively, these project outputs will fulfill basic data needs and provide a powerful technical support/planning tool that will greatly assist the Townships in pursuing planning and implementing their missions/responsibilities to safeguard and use water resources wisely, optimally, and appropriately for the public benefit. This will provide long-term assurance for protection of stream baseflow and quality.

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Major Implementation Issues:
UBR-M2 Associates Project Team developed this project proposal and do not anticipate any implementation issues. The UBR-M2 Associates Project Team has significant experience in ground water resources development, planning, management, and protection. The Townships have the capacity and ability to provide significant in-kind assistance during the project and there are many water resources professionals residing in the subject Townships.

Possible Funding Sources: EPA 319(h) through NJDEP, Municipal, NJWSA

Partners/Stakeholders: Delaware, Kingwood, Franklin, and Raritan Townships; NJWSA; Hunterdon County Health Department; Hunterdon County Planning; Hunterdon County SCD; NJDEP; Contractor

Task	Description			Estimated Cost[1]
1	Data compilation/GIS mapping for Task 1			$20,000
2	Establish water-level monitoring network for Task 2			$40,000
3	Development of ground water levels mapping for Task 3			$40,000
4	GIS mapping for Task 4			$20,000
5	Nitrate dilution modeling for Task 5			$20,000
	Closeout and Contingency	20%		$28,000
			Total Project Cost	**$168,000**
			Annual O&M Cost	$3,000

[1] Proposal and cost estimates were provided by the URB-M2 Associates Project Team (professional hydrogeologists for the Townships of Kingwood and Delaware).

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Project Name:	**River-Friendly Farms Certification**	**Date:** 04/14/2009	**Flow/Load-Reduction Priority:** High
Location:	Franklin, Kingwood, Delaware, and Raritan Townships, Hunterdon County	Watershed-wide remediation strategy	**Implementation Potential:** Moderate
Remediation Type:	Agricultural Stormwater Controls Education and Implementation		**Municipal Priority:** High

Issues and Concerns:
Although agricultural field erosion in the Lockatong and Wickecheoke watersheds is minimal for the existing crop production, sheet flow leaving farm fields becomes concentrated along the perimeter and causes the perimeter drainage ravines to become unstable and erode. In addition, fields next to roads concentrate the runoff flow into roadside drains, increasing erosion. Livestock with access to the streams introduce large quantities of sediment, nutrients, and bacteria.

Existing Condition Based on Field Evaluation:
Large volumes of sediment have eroded from stormwater drainage channels along the perimeter of agricultural crop and livestock fields. Livestock have unconstrained egress to the streams at locations in both watersheds for drinking water and wading. Most often, livestock excrement is directly deposited into the stream.

Proposed Solutions:
The New Jersey River-Friendly Farms program, administered by the North Jersey Resource Conservation and Development Council (NJRC&DC), helps to protect water resources by promoting good farm management practices. This program would be introduced to those farms that may be contributing large volumes of runoff flow and/or have livestock access to the streams, to educate and promote the protection of stream water quality and flow while maintaining productive farmland.

Anticipated Benefits:
The erosion from stream channels was estimated by the NRCS to contribute up to 12,300 tons of sediment per year for the combined watersheds. Approximately 10 percent of this load (1,230 tons/year) could be originating from erosion along the perimeter of the fields and livestock-access areas. The associated in-stream annual total phosphorus load could potentially approach 6.8 tons/year. Education gained from certification will provide conservation options for the farmers for stream corridor and stormwater controls. Once certified, signage placed along the road frontage to the farm would promote conservation to other farmers and residents. The program may be adopted by municipal Environmental Commissions to provide additional resources for agricultural- conservation education. **Figures G1 and G2** show locations of potential candidates for this program based on field observations in the Lockatong and Wickecheoke watersheds, respectively.

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Major Implementation Issues: Farmers must be contacted and agree to adopt the management measures for certification. Although the NJRC&DC River-Friendly Farms Program currently targets the Raritan River basin, it could be expanded to provide certification to farms in the Lockatong and Wickecheoke Creek watershed areas.		
Possible Funding Sources: EPA 319(h) through NJDEP, NJRC&DC, NJWSA, EQIP, Private		
Partners/Stakeholders: Delaware, Kingwood, Franklin, and Raritan Townships; Hunterdon County SCD, NJDEP, NJWSA, NJRC&DC		
Task	**Description**	**Estimated Cost[1]**
1	Certification of an initial 16 farms (identified in **Figures G1 and G2**)	$24,000
2	Certification of 30 additional farms	$45,000
3	Outreach	$4,400
	Total Project Cost	**$73,400**

[1] Costs were derived from previous projects by NJWSA and NJRC&DC.

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Figure G1. Potential sites for "River Friendly Farm" certifications in the Lockatong watershed.

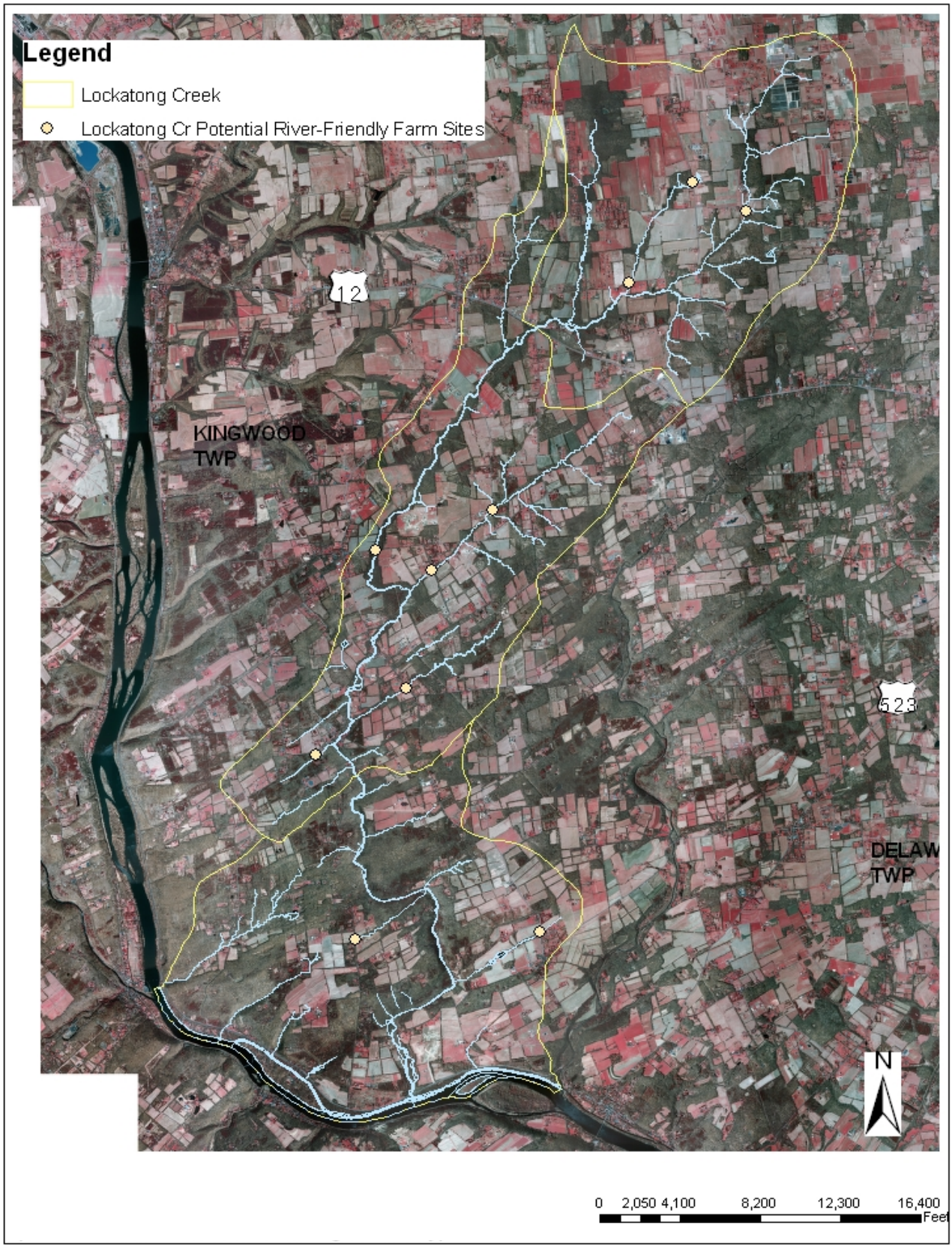

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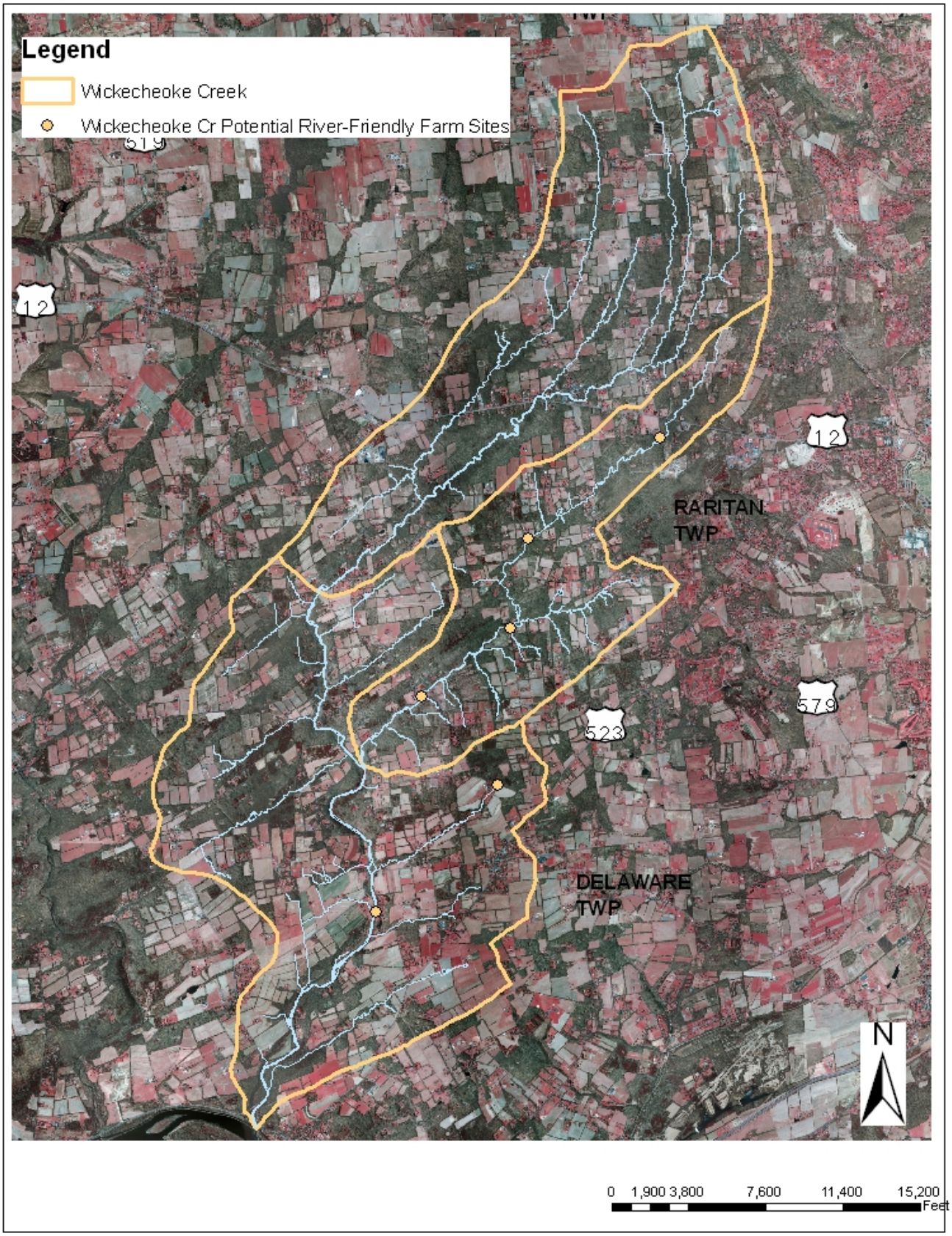
Figure G2. Potential sites for "River Friendly Farm" certifications in the Wickecheoke watershed.



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Project Name:	**Bioretention Applications - Recreational Areas and Private/ Public Lawns**	**Date:** 04/14/2009	**Flow/Load-Reduction Priority:** High
Location:	Kingwood Twp Park, Block 19, Lot 8	Parcel Size: 51.5 acres	**Implementation Potential:** High
Remediation Type:	Bioretention using rain gardens, wetlands, and swales; and streambank revegetation		**Municipal Priority:** High

Issues and Concerns:
Greater runoff flows are created from compacted soils, increased impervious cover, and greater intensity storm events. Soils in the watershed are somewhat poorly drained. Turf and lawn areas become compacted from seasonal maintenance, particularly in the spring when the soil is moist. The soils in athletic fields become compacted from continuous use and maintenance. Over time, the soils lose much of the inherent ability to retain and infiltrate rainwater.

Existing Condition Based on Field Evaluation:
Kingwood Township purchased and designated an open-space area as a community park in 1998. The Park was developed on preserved agricultural lands, some of which had previously been classified as agricultural wetlands. Most of the area was transformed into athletic fields for soccer, baseball, and community events. Large crowds of spectators and recreationists from Kingwood and neighboring municipalities frequent the Park. The original drainage system was part of the agricultural crop production activities. Over time, the use of parking areas, athletic fields, and walking paths has increased soil compaction and subsequently increased the volume and velocity of stormwater runoff. The drainage for the parking lots was piped directly to the Lockatong Creek. None of the Park area was designed for retaining runoff flows, including pesticides and fertilizer used for maintaining the fields. Of the total 51.5 acres, approximately 19 acres can be retrofitted with stormwater controls as a first phase of other potential future retrofits. A narrow and entrenched, grassed stormwater swale borders the northern edge of the athletic fields, draining into a forested wetland next to the Lockatong Creek. The increased runoff has severely eroded the swales, and formed deep conveyance ditches through the forested wetland at the western edge of the Park.

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Proposed Solutions:
Core aeration of entire athletic field complex according to accepted athletic field protocols developed by land grant universities. Retrofit of Kingwood Park (athletic fields) for wetland/rain-garden stormwater controls to eliminate sediment loading to the stream (**Figure H1**). Streambank revegetation would be performed on both sides of the channel to restabilize the streambanks (**Figure H2**). Wider, crescent-shaped, bioretention swales with check-dams would be installed along the northern edge of the Park. Rain gardens would have shallow water depths, one foot or less, and consist of excavation and berming in appropriate areas to retain stormwater runoff for less than 72 hours. Additional information for the design of rain gardens is presented in: *Rain Garden Manual for New Jersey*, The Native Plant Society of New Jersey, Office of Continuing Professional Education, Cook College, April 2005. All project areas will be landscaped with appropriate native vegetation. The bioretention gardens will be done in a manner that is intended to encourage homeowners and corporations to mimic these techniques on their own lawns in different scales. The orientation and size of bioretention systems will be based on site evaluations during the planning and design tasks. Educational materials, via signage and brochures, will be available for people attending athletic and other social events at the site.

Anticipated Benefits:
Stormwater will be retained from approximately 19 acres of the parcel, and from adjoining lands upgradient. Potential annual runoff from this section of the parcel is estimated at 6.7 million gallons. A 20-foot wide bioretention swale, with check-dams, along the northern edge of the Park could retain approximately 69 percent of the runoff volume, or 25 percent of the volume from the entire parcel. An area of 50’ by 200’ for bioretention (a selection of rain gardens), at a maximum depth of 1 foot, should retain the remaining stormwater runoff from up to the 1.25 inch storm and the associated water quality constituents. Using a Commercial land use for annual TP and TSS loading estimates from the *NJSW BMP Manual, Appendix C, Sample Municipal Stormwater Management Plan*, a reduction of up to 90 percent TSS and 60 percent TP can be achieved, or 23.9 lb/year TP and 1.7 tons/yr TSS. Up to 90 tons/yr of sediment load that is currently being eroded from the existing drainage channels would also be reduced. The sediment and flow reductions will increase proportionately as this technique is applied to other public Conservation Lands throughout these watersheds and ultimately throughout the State. This technique could also be adapted to private and commercial lawns (as rain gardens and grassed swales) having the typical condition of smoothed, compacted, high maintenance turf.

Major Implementation Issues:
The project will require approval by Kingwood Township and New Jersey Green Acres. There may be occasional opposition to the increased maintenance at the site, since uneven microtopography could mean that field mowing and maintenance may become more labor intensive. Some may object to the more natural appearance and wetter conditions compared to the existing close-mowed turfgrass in the western section of the Park.

Possible Funding Sources: EPA 319(h) through NJDEP, NJWSA, NRCS, USGS, Kingwood Township

Partners/Stakeholders: Kingwood Township, NJDEP, NRCS, USGS, Hunterdon County SCD, NJWSA

Task	Description	Estimated Cost[1]

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1	Prepare and present concept plan to Kingwood Township officials			$5,000
2	Site topographic survey and soils testing			$9,000
3	Pre-application meeting with Hunterdon County SCD and municipal officials. Preparation of design plans and permits.			$15,000
4	Preparation of Stormwater BMP Maintenance Plan (NJDEP requirement)			$2,000
5	**Installation of BMP retrofits**			
	Activity	**Unit Cost**	**Quantity**	
	Equipment mobilization/erosion control	$35/foot	1,200	$42,000
	Installation of project/sponsor sign	$4,000	1	$4,000
Option A	Construction of bioretention swale/check dams	$6.5/foot^2	16,000	$104,000
	Bioretention swale vegetation management/planting	$2,500	3	$7,500
	Construction of rain garden(s)	$5.5/foot^2	10,000	$55,000
	Rain garden vegetation management/planting	$2,500	2	$5,000
	Streambank revegetation	$2,500	2	$5,000
	Closeout/Contingency	20%		$44,500
			Total Construction Cost	$267,000
			Total Project Cost	**$298,000**
			Annual O&M Cost	$2,000
Option B[2]	Construction of rain garden(s)	$5.5/foot^2	10,000	$55,000
	Rain garden vegetation management/planting	$2,500	2	$5,000
	Streambank revegetation	$2,500	2	$5,000
	Closeout/Contingency	20%		$22,200
			Total Construction Cost	$133,200
			Total Project Cost	**$164,200**
			Annual O&M Cost	$2,000

[1] Costs were estimated based on designs by Omni Environmental, Inc. for various BMPs proposed in the *Mulhockaway Creek Stormwater Management and Watershed Restoration Plan* (NJWSA, 2007). Municipal DPW or NJWSA could supply heavy equipment at no cost. Municipal staff and residents could provide volunteer services for plantings. NRCS will seek matching funds.

[2] If general repairs (some widening and check-dams) to the existing bioretention swales are possible, a complete retrofit may not be necessary.

Figure H1. Kingwood Township Block 19, Lot 8 (Township Park – Athletic Fields). Potential site for stormwater runoff remediation.

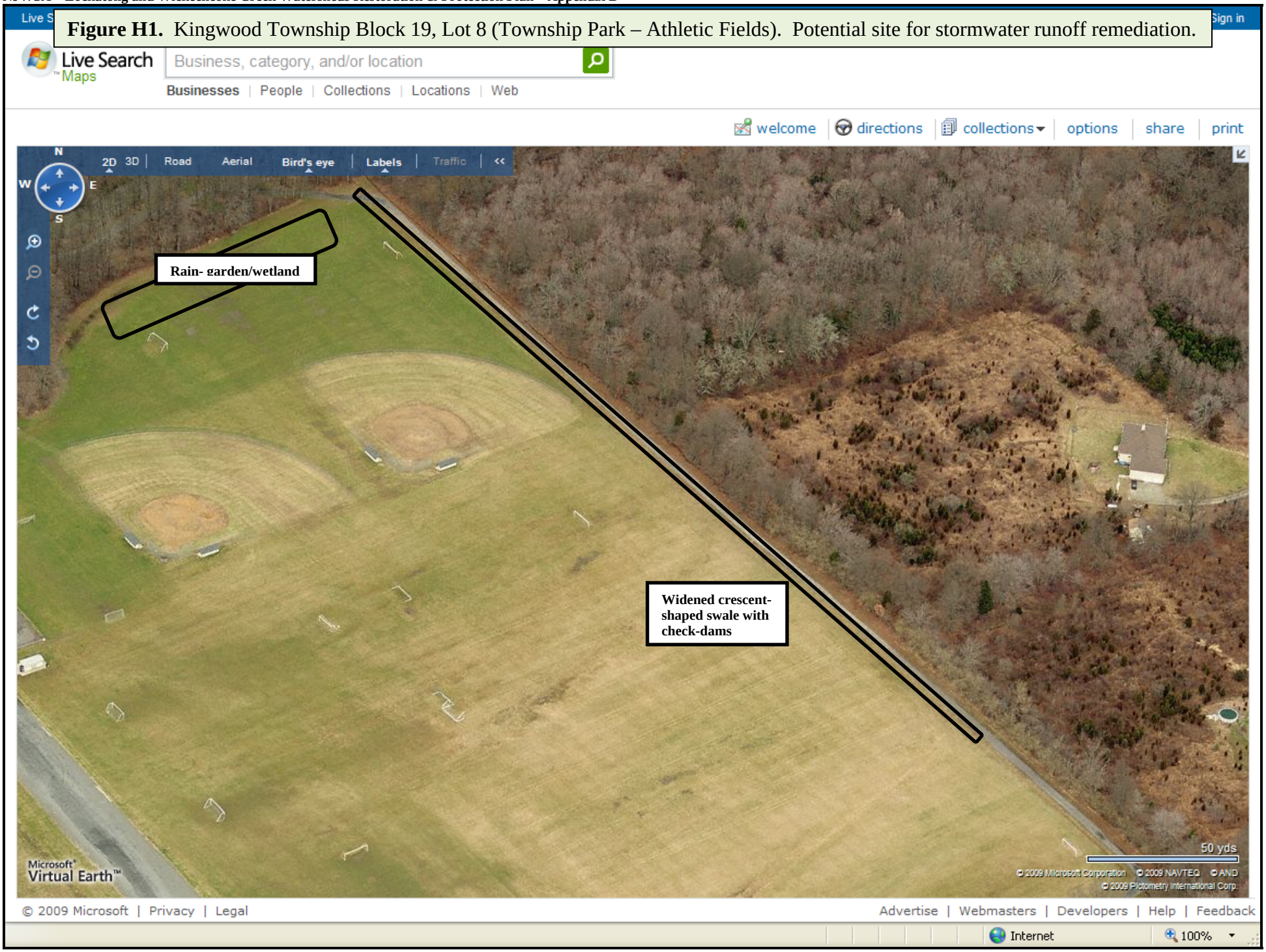

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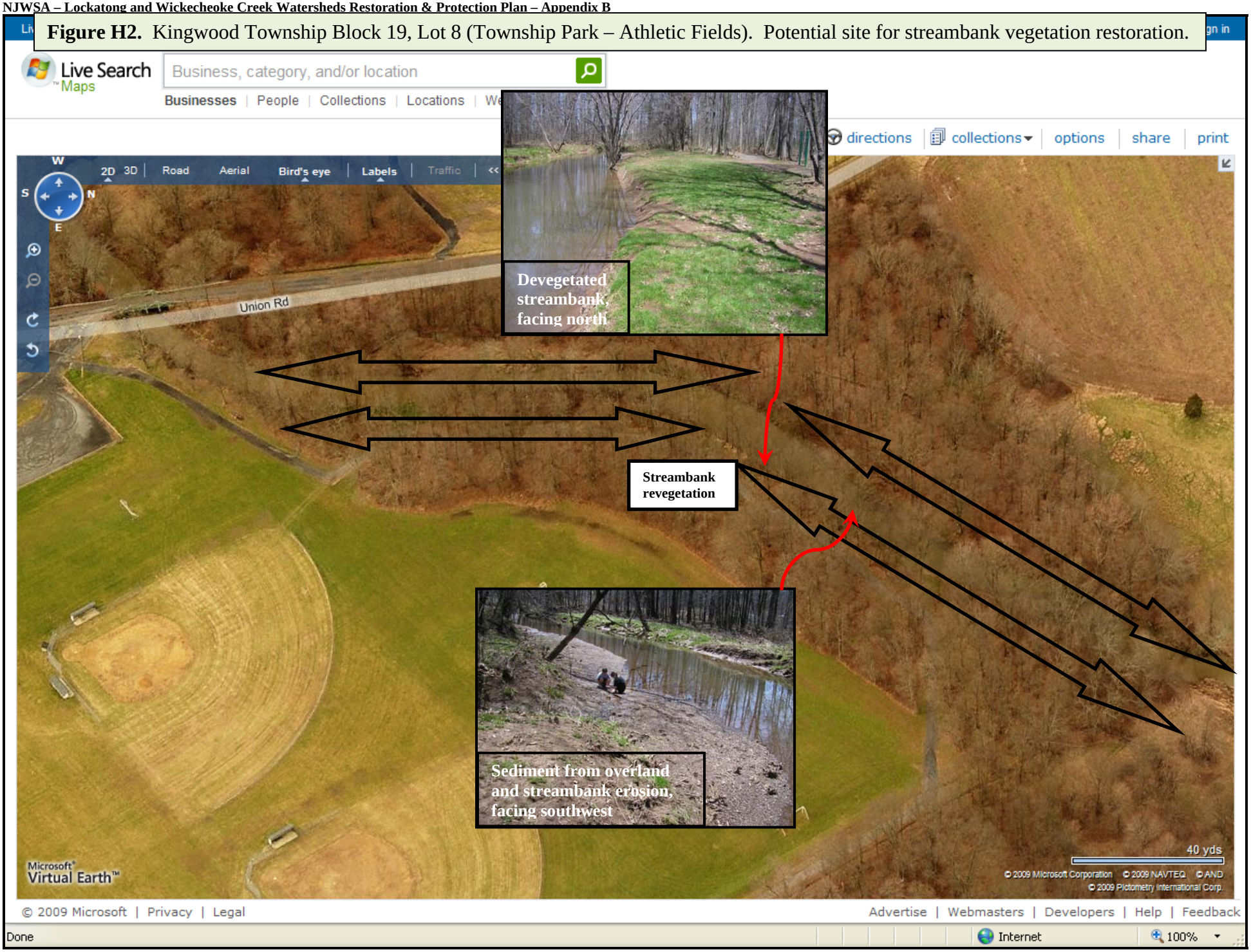
Figure H2. Kingwood Township Block 19, Lot 8 (Township Park – Athletic Fields). Potential site for streambank vegetation restoration.



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Project Name:	**Delaware Township Municipal-Garage Retrofit**	**Date:** 04/14/2009	**Flow/Load-Reduction Priority:** High
Location:	Delaware Twp, Block 34, Lot 12.0003	Parcel Size: 6.5 acres	**Implementation Potential:** High
Remediation Type:	Bioretention swales and check dams		**Municipal Priority:** High

Issues and Concerns:
Vehicular traffic, in combination with sand, gravel, and soil storage piles creates sediment-laden runoff during storm events. Runoff carries sediments containing pollution constituents from the automobiles, such as metals, asbestos, battery acid, and other solutes. Rose Brook, a C1 tributary to the Wickecheoke Creek flows along the northern end of the property.

Existing Condition Based on Field Evaluation:
The site is 6.5 acres, with approximately 80 percent impervious: paved and buildings. School buses, police vehicles, and some heavy equipment are based at this location. Storage piles of sand, gravel and soil are located at the northern end of the property, abutting Rose Brook. Runoff during storms exits the northern end and flows directly into Rose Brook. Dirt tracks are visible throughout the parking lot from vehicle traffic. There exists a perimeter woodland buffer of approximately 50 feet where a vegetative swale may be installed.

Proposed Solutions:
A vegetated bioretention swale would be constructed along the down-gradient perimeter to collect runoff from the site and provide solids and nutrient removal, as well as reduction of the flow volume through evapotranspiration and infiltration (**Figure I1**). Shallow, stone check-dams could be located near the center of the swale length to further slow the flow velocity and provide additional retention volume up-gradient from the dam. The design will be dependent on the width of the perimeter buffer, soil depth and depth to ground water, and topography. Design and maintenance criteria are presented in *New Jersey Stormwater Best Management Practices Manual, Chapter 9.1, Bioretention Systems.* Using an average depth of 1 foot, an area of approximately 22,000 ft^2 could retain the site runoff and eliminate approximately 165,000 gallons of stormwater (93 percent) per 1.25 inch rain event through evapotranspiration and infiltration. Sand filters would be installed to remove metals, hydrocarbons, and other toxic materials, pending results of preliminary soil and water quality analyses. The filters must have a maintenance plan and be protected by easement, deed restriction, ordinance, or other legal measures to prevent neglect, alteration, and removal. Design and maintenance criteria are presented in *New Jersey Stormwater Best Management Practices Manual, Chapter 9.9, Standard for Sand Filters*. Stocked soil, gravel, etc. would be housed in bins or shelters to reduce direct contact with precipitation and runoff.

Anticipated Benefits:
Although the NJDEP BMP Design Manual does not provide pollutant loading values for parking lots or storage of construction materials, the design can assume similar loading rates to those of commercial areas. Commercial areas generate approximately 2.1 lbs/acre/year total phosphorus (TP) and 200 lbs/acre/year total suspended solids (TSS). Vegetative swales, preceeding a sand filter, will retain up to 98 percent of TSS and up to 60 and 35 percent of TP and total nitrogen (TN), respectively. The remediation strategy would retain runoff from the 1.25 inch rain event while reducing erodible flow velocities.

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Major Implementation Issues:
Success of this remediation project would require the Delaware Township Department of Public Works, and/or a qualified contractor, to construct the retrofit and maintain any sand filters that may be installed, according to the manufacturer's recommended maintenance program. Installation of swales and filters must be performed within the existing footprint of disturbance, since Rose Brook is a C1 stream.

Possible Funding Sources: EPA 319(h) through NJDEP, NJ Environmental Infrastructure Financing Program, Delaware Township

Partners/Stakeholders: Delaware Township DPW and officials, NJDEP

Task	Description			Estimated Cost[1]
1	Prepare and present concept plan to Delaware Township officials			$5,000
2	Site topographic survey and soils testing			$5,000
3	Pre-application meeting with Hunterdon County SCD and municipal officials. Preparation of design plans and permits.			$10,000
4	Preparation of Stormwater BMP Maintenance Plan (NJDEP requirement)			$2,000
5	**Installation of BMP retrofits**			
	Activity	**Unit Cost**	**Quantity**	
	Equipment mobilization/erosion control	$35/foot	800	$28,000
	Construction of bioretention swales/check dams	$6.5/foot[2]	22,000	$143,000
	Vegetative Planting	$2,500	4	$10,000
	Sand Filter Installation[2]	$8/foot[2]	2,700	$21,600
	Closeout and Contingency	20%		$40,500
			Total Construction Cost	$243,100
			Total Project Cost	**$265,100**
			Annual O&M Cost	$1,000

[1] Except for the installation costs for the sand filter system, costs were estimated based on similar designs by Omni Environmental, Inc. for various BMPs proposed in the *Mulhockaway Creek Stormwater Management and Watershed Restoration Plan* (NJWSA, 2007).
[2] Size estimated from *NJ Stormwater Best Management Practices Manual, Chapter 9.9, Standard for Sand Filters*.

Figure I1. Delaware Township Block 34, Lot 120003. Potential remediation for municipal garage facility.

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Project Name:	**Vehicle Maintenance and Storage Retrofit**	**Date:** 04/14/2009	**Flow/Load-Reduction Priority:** Moderate
Location:	Delaware Twp, Block 18, Lot 1	Parcel Size: 1.8 acres	**Implementation Potential:** May be cost restricted (private)
Remediation Type:	Bioretention swales/check-dams and sand filter		**Municipal Priority:** Lower

Issues and Concerns:
Vehicles contain pollution constituents such as metals, asbestos, and hydrocarbons. The site is located approximately 800 feet from the mainstem Wickecheoke Creek, a C1 stream.

Existing Condition Based on Field Evaluation:
The site is 1.8 acres, with approximately 80 percent impervious: paved and structures. School buses, trucks, cars, and other vehicles are on site. Runoff during storms exits the southwest corner and flows approximately 800 feet overland and into the Wickecheoke Creek. There exists a perimeter woodland buffer of approximately 20 feet where a vegetative swale may be installed.

Proposed Solutions:
A vegetated bioretention swale would be constructed along the down-gradient perimeter to collect runoff from the site and provide solids and nutrient removal, as well as reduction of the flow volume through evapotranspiration and infiltration (**Figure J1**). Design and maintenance criteria are presented in *New Jersey Stormwater Best Management Practices Manual, Chapter 9.1, Bioretention Systems.* A shallow gravel check-dam would be located near the center of the swale length to further slow the flow velocity and provide additional retention volume up-gradient from the dam. The design will be dependent on the width of the perimeter buffer, soil depth and depth to ground water, and topography. Using an average depth of 1 foot, an area of approximately 6,550 ft^2 could retain the site runoff and eliminate approximately 48,900 gallons of stormwater per 1.25 inch rain event through evapotranspiration and infiltration. Sand filters would be installed to remove metals, hydrocarbons, and other toxic materials, pending results of preliminary soil and water quality analyses. The filters must have a maintenance plan and be protected by easement, deed restriction, ordinance, or other legal measures to prevent neglect, alteration, and removal. Design and maintenance criteria are presented in *New Jersey Stormwater Best Management Practices Manual, Chapter 9.9, Standard for Sand Filters*.

Anticipated Benefits:
Although the NJDEP BMP Design Manual does not provide pollutant loading values for parking lots or storage of vehicles, the design can assume similar loading rates to those of commercial areas. Commercial areas generate approximately 2.1 lbs/acre/year total phosphorus (TP) and 200 lbs/acre/year total suspended solids (TSS). Vegetative swales, preceeding a sand filter, will retain up to 98 percent of TSS and up to 60 and 35 percent of TP and total nitrogen (TN), respectively. The remediation strategy should retain runoff from the 1.25 inch rain event while reducing erodible flow velocities.

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Major Implementation Issues:
Success of this remediation project would require landowner approval of the remediation strategy and maintenance program. If a wooded perimeter buffer is not available, sand filters (or other water purification measures) may need to be installed in the paved area. A qualified contractor would be selected to construct the retrofit and maintain any stormwater purification filters that are installed according to the manufacturer's recommended maintenance program.

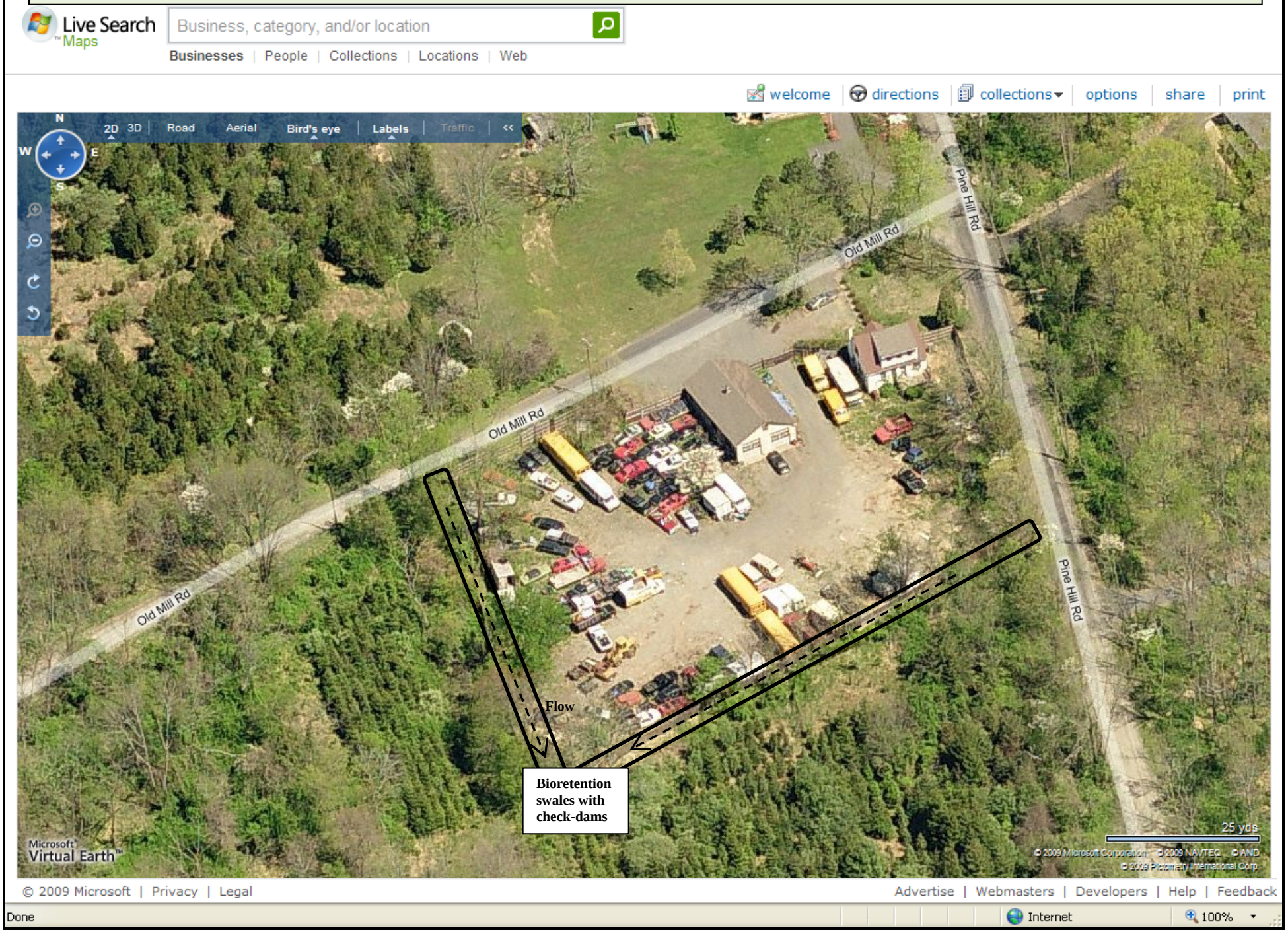
Possible Funding Sources: EPA 319(h) through NJDEP, Private

Partners/Stakeholders: Delaware Township, Hunterdon County SCD, NJDEP

Task	Description			Estimated Cost[1]
1	Prepare and present concept plan to Delaware Township officials			$5,000
2	Site topographic survey and soils testing			$5,000
3	Pre-application meeting with Hunterdon County SCD and municipal officials. Preparation of design plans and permits.			$15,000
4	Preparation of Stormwater BMP Maintenance Plan (NJDEP requirement)			$2,000
5	**Installation of BMP retrofits**			
	Activity	**Unit Cost**	**Quantity**	
	Equipment mobilization/erosion control[2]	$35/foot	500	$17,500
	Construction of bioretention swales/check dams	$6.5/foot[2]	6,550	$42,600
	Vegetative Planting	$2,500	2	$5,000
	Sand Filter Installation[3]	$8/foot[2]	725	$5,800
	Closeout and Contingency	20%		$14,200
			Total Construction Cost	$85,100
			Total Project Cost	**$112,100**
			Annual O&M Cost	$1,000

[1] With an exception for the installation costs for the sand filter system, costs were estimated based on similar designs by Omni Environmental, Inc. for various BMPs proposed in the *Mulhockaway Creek Stormwater Management and Watershed Restoration Plan* (NJWSA, 2007).
[2] Municipal DPW could provide heavy equipment.
[3] Size estimated from *NJ Stormwater Best Management Practices Manual, Chapter 9.9, Standard for Sand Filters*.

Figure J1. Delaware Township Block 18, Lot 1 (Pine Hill and Old Mill Road intersection). Potential remediation site for stormwater runoff.



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Project Name:	**Sergeantsville Firehouse Parking-Lot and Municipal Park Retrofits**	**Date:** 04/14/2009	**Flow/Load-Reduction Priority:** Moderate
Location:	Delaware Twp, Block 36, Lots 24 and 14.11	Parcel Size: 3.1 acres	**Implementation Potential:** High
Remediation Type:	Rain Garden, and Bioretention swale with check-dam		**Municipal Priority:** High

Issues and Concerns:
Stormwater runoff from the firehouse parking lot and the municipal park is routed to roadside drainage along Stockton-Flemington Road (County Route 523), supplementing urban and roadway drainage to Rose Brook, a C1 tributary to Wickecheoke Creek. Since the parking lot is not in continuous use, some of the runoff contaminants may be sediment and nutrients from adjoining residential properties, including the park.

Existing Condition Based on Field Evaluation:
The site is 3.1 acres, with approximately 50 percent impervious: paved parking lot and buildings. Runoff during storms exits the western end of the firehouse property and flows along Route 523 to Rose Brook. There exists a grassed area along the northern edge where a vegetative swale and shallow basin may be installed.

Proposed Solutions:
Two bioretention systems would be constructed: one along the western edge of the park and another along the northern edge of the parking lot to collect runoff and provide solids and nutrient removal, as well as reduction of the flow volume through evapotranspiration and infiltration (**Figure K1**). A shallow, gravel check-dam would be located near the center of the parking lot swale length to further slow the flow velocity and provide additional retention volume up-gradient from the dam. The designs will be dependent on the available area along the western edge of the park and along the northern perimeter of the parking lot, soil depth and depth to ground water, and topography. Design and maintenance criteria are presented in *New Jersey Stormwater Best Management Practices Manual, Chapter 9.1, Bioretention Systems.* Additional information for the design of rain gardens is presented in: *Rain Garden Manual for New Jersey*, The Native Plant Society of New Jersey, Office of Continuing Professional Education, Cook College, April 2005. Using an average depth of 1 foot to facilitate evapotranspiration, an area of approximately 9,000 ft^2 could retain the site runoff and eliminate approximately 66,700 gallons of water per 1.25 inch rain event through evapotranspiration and infiltration. Sand filters would be installed to remove metals, hydrocarbons, and other toxic materials, pending results of preliminary soil and water quality analyses from the parking lot. The filters must have a maintenance plan and be protected by easement, deed restriction, ordinance, or other legal measures to prevent neglect, alteration, and removal. Design and maintenance criteria are presented in *New Jersey Stormwater Best Management Practices Manual, Chapter 9.9, Standard for Sand Filters*. Rain barrels attached to the downspouts of the firehouse would provide additional stormwater retention, up to 75 gallons per barrel (*Combined Sewer Overflow Rooftop Type Analysis and Rain Barrel Demonstration Project*, Department of Environmental Programs Metropolitan Washington Council of Governments, December 2001).

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Anticipated Benefits:
Total phosphorus and total suspended solids loadings for medium to high density residential land cover is 1.4 and 140 lb/acre/year, respectively, according to the NJSW BMP Manual. Although the BMP Manual does not provide pollutant loading values for parking lots, the design can assume similar loading rates to those of commercial areas. Commercial areas generate approximately 2.1 lbs/acre/year total phosphorus (TP) and 200 lbs/acre/year total suspended solids (TSS). A rain garden, vegetative swale and basin, preceding a sand filter, will retain up to 98 percent of TSS and up to 60 and 35 percent of TP and total nitrogen (TN), respectively. The remediation strategy should retain runoff from the 1.25 inch rain event, ultimately reducing runoff flow and the associated increase in scour velocity as the flow reaches Rose Brook.

Major Implementation Issues:
Implementation of this remediation project requires Delaware Township and the Sergeantsville Fire Company to approve the retrofits. A qualified contractor, with possible assistance from the Sergeantsville Department of Public Works, would be required to construct the retrofit and maintain any sand filters that are installed according to the manufacturer's recommended maintenance program.

Possible Funding Sources: EPA 319(h) through NJDEP, NJ Environmental Infrastructure Financing Program, Borough of Sergeantsville, Fire Company dues and contributions, service-area municipalities

Partners/Stakeholders: Sergeantsville Fire Company members, municipal officials, NJDEP

Task	Description			Estimated Cost[1]
1	Prepare and present concept plan to Fire Company and municipal officials			$5,000
2	Site topographic survey and soils testing			$5,000
3	Pre-application meeting with Hunterdon SCD, Fire Company officials, and municipal officials. Preparation of design plans and permits.			$10,000
4	Preparation of Stormwater BMP Maintenance Plan (NJDEP requirement)			$2,000
5	**Installation of BMP retrofits**			
	Activity	**Unit Cost**	**Quantity**	
	Equipment mobilization/erosion control[2]	$35/foot	350	$12,250
	Rain-barrel installation	$200	5	$1,000
	Construction of rain garden	$5.50/ foot[2]	7,000	$38,500
	Vegetative Planting of rain garden	$2,500	1	$2,500
	Construction of bioretention swale/check dam	$8/foot[2]	2,000	$16,000
	Vegetative Planting of swale	$2,500	1	$2,500
	Sand Filter Installation[3]	$8/foot[2]	725	$5,800
	Closeout and Contingency	20%		$15,700
			Total Construction Cost	$94,250
			Total Project Cost	**$116,250**
			Annual O&M Cost	$1,500

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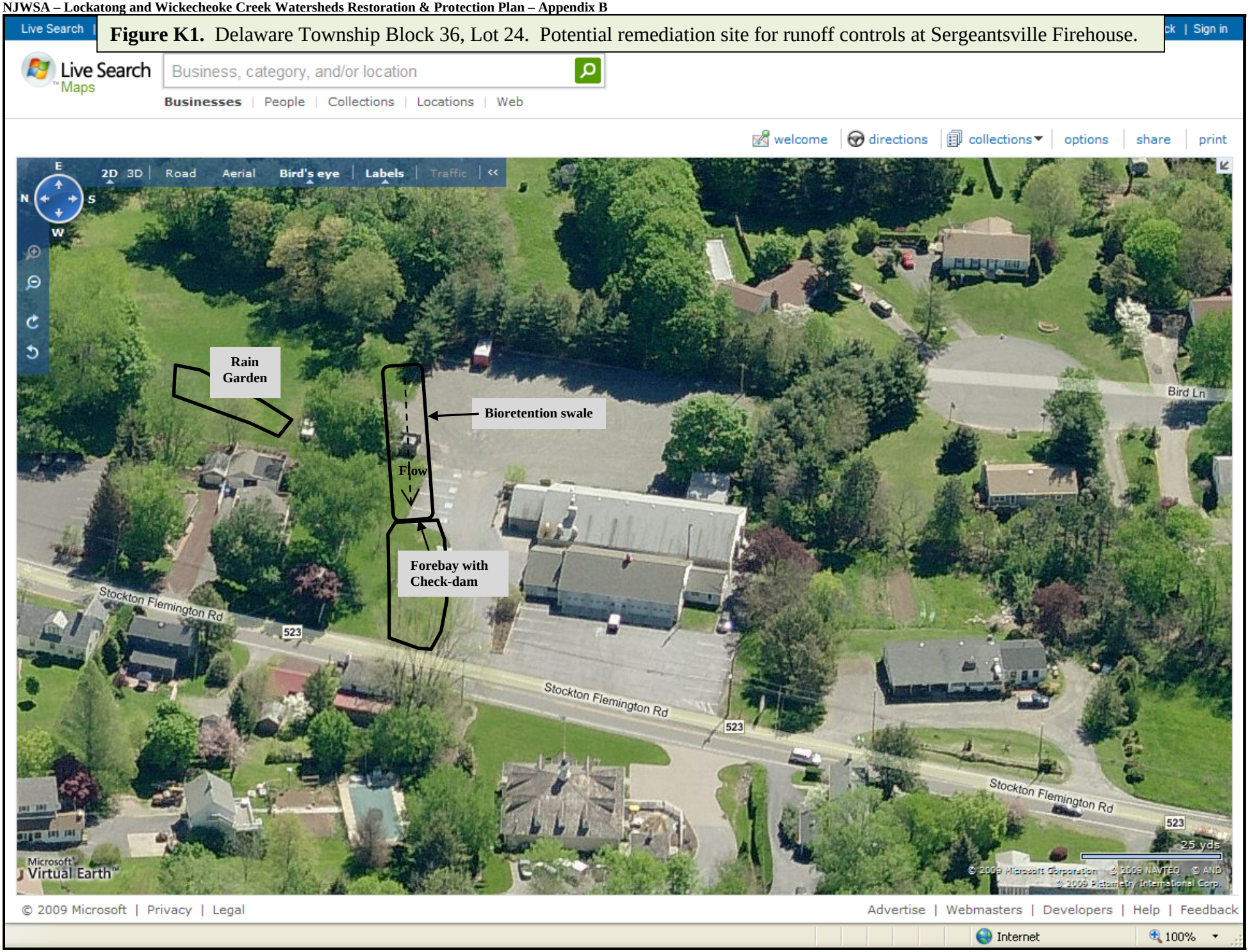
[1] Except for the installation costs for the sand filter system, costs were derived from similar designs by Omni Environmental, Inc. for various BMPs proposed in the *Mulhockaway Creek Stormwater Management and Watershed Restoration Plan* (NJWSA, 2007).
[2] Municipal DPW could provide heavy equipment.
[3] Size estimated from *NJ Stormwater Best Management Practices Manual, Chapter 9.9, Standard for Sand Filters*.

Figure K1. Delaware Township Block 36, Lot 24. Potential remediation site for runoff controls at Sergeantsville Firehouse.



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Other interests by Delaware Township for remediation projects include:

- Road-bank stabilization, via reseeding, along the west side of County Route 519, approximately 0.5 mile north of Stockton.

- Disconnection of roadway drainage along County Route 604, approximately 0.5 mile west of the covered bridge. Increased drainage has apparently increased erosion of a tributary to Wickecheoke Creek.

- Mowing of the roadway right-of-way along County Route 604, between Sergeantsville and the covered bridge has frequently exposed soil from "bottoming out" that is prone to erosion. Mowers should use caution to prevent the exposure of soil.

- Roadway drainage ditches are normally cleaned by backhoes and/or road-graders that deepen and expand the ditches creating destabilized banks from vertical angles and loss of vegetation. Road maintenance crews should retrofit drainage ditches to stabilize the channels and reduce erosion.

- Eliminate roadway widening and install bioretention swales along County Route 523, approximately 0.5 mile south of Sergeantsville, to reduce stormwater runoff.

- Implement care during roadway snow plowing to prevent the removal of roadside vegetation.

- Delaware Township emphasizes the need for options in roadway maintenance for reducing erosion from mowing, devegetation, and destabilized drainage channels.

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Lockatong and Wickecheoke Creek Water Quality and Flow Monitoring Project 2006 Through 2007

Prepared as part of a 319(h) grant for the Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Project
Contract: RP05-082

New Jersey Water Supply Authority
Watershed Protection Programs Unit

June 2009

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INTRODUCTION

The New Jersey Water Supply Authority (NJWSA) conducted a scientific water quality and flow monitoring project on the Lockatong and Wickecheoke Creeks to isolate and quantify contaminant loadings as part of the development of a Watershed Remediation and Protection Plan. The Watershed Plan will guide municipal and inter-governmental efforts to ensure long-term protection of these watersheds that provide source water, via the Delaware and Raritan Canal System, that supplements the water supply of approximately 1.5 million New Jersey residents. The watersheds are situated in Hunterdon County, New Jersey and provide approximately 60 percent of the direct drainage to the Delaware and Raritan Canal, downstream of the intake from the Delaware River.

Two Total Maximum Daily Load (TMDL) reports developed by the New Jersey Department of Environmental Protection (NJDEP or DEP), one for fecal coliform and one for total phosphorus, were also supported by the monitoring efforts of this project. This effort was partially funded by a New Jersey Department of Environmental Protection (NJDEP) 319(h) grant; and supplemented by funding and in-kind services of the New Jersey Water Supply Authority (NJWSA); and through contractual and in-kind services of the Natural Resources Conservation Service (NRCS), US Department of Agriculture.

The water quality monitoring was conducted in two phases: the first phase was performed on mainstem sites and at the mouth of the larger tributaries; the second phase focused on further isolating sub-watershed areas that were determined in Phase 1 to be contributing to either water quality and/or quantity impacts. Phase 1 monitoring occurred from August through December 2006 with 6 sampling events, and Phase 2 monitoring was conducted from March through July 2007 with 11 sampling events, including sediment and additional bacteria sample collections. A total of 16 ambient and one sediment sampling events were performed in each watershed. A Quality Assurance Project Plan (QAPP), approved by the NJDEP Office of Quality Assurance, provided guidance throughout the project. The QAPP and digital database of water quality and flow analyses is attached as a separate document. The location of monitoring sites selected for Phase 1 and Phase 2 are presented in **Figures 1 and 2**, respectively. **Tables in Appendix A** describe the site locations.

Project Goal:
Protection, and enhancement where practicable, of the quality and quantity of source waters to the Delaware and Raritan Canal System

Project Objectives:
Results from this project will be used to: 1) isolate and identify sources/causes of water quality degradation; 2) identify areas contributing baseflow to the mainstem during low-flow conditions, and quantify the contributing flows; 3) quantify pollutant loadings from sub-watershed areas; 4) quantify pollutant mass reductions that will satisfy Surface Water Quality Standards in stream reaches exceeding water quality standards; and 5) develop

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water quality and flow targets for defining "existing" water quality and "measurable change" for long-term protection of these C1 streams. All of the results will become integral parts of the "Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Plan."

WATERSHED CHARACTERISTICS

The Lockatong and Wickecheoke Creek Watersheds are characterized by a mostly rural landscape, consisting primarily of agriculture, forest, and wetlands. The drainage areas of the Lockatong and Wickecheoke Watersheds are 23.3 and 26.6 square miles, respectively. The Lockatong and Wickecheoke watersheds are each composed of three HUC14 drainage areas: 02040105200010 (above Rt 12), 02040105200020 (Milltown to Rt 12), and 02040105200030 (below Milltown, includes Upper Delaware River) for the Lockatong; and 02040105200040 (above Locktown), 02040105200050 (Plum Brook), and 02040105200060 (below Locktown) for the Wickecheoke. Areas of each HUC 14 are illustrated in **Figure 3**. The actual drainage area of two of the watersheds differs from the HUC 14s since some of the area within the HUC 14s, near the mouth of the streams, includes drainage outside of these watersheds. Much of the soil is classified as either hydric or as having a seasonal high water table within two feet of the land surface. Except for two sections of the Wickecheoke watershed (Village of Rosemont and a small portion of Delaware Township), the potable water supply is obtained from private on-site wells. Sewage is treated on-site, via septic systems, except for the same small section of Delaware Township that is serviced by a public well is also serviced by the Delaware Township Municipal Utility Authority wastewater treatment facility. This facility discharges to Rose Brook, a tributary to Wickecheoke Creek. According to the TMDL for total phosphorus, the permitted discharge at this facility is 0.065 MGD (million gallons per day), or approximately 0.1 cfs (cubic feet per second), with an average monthly total phosphorus limit of 1.0 mg/l (milligrams per liter, also referred to as parts per million). In addition to the size of each sub-watershed, land use data from the NJDEP 2002 Land-Use and Land-Cover information is presented for the sub-watersheds in **Tables 1 and 2** for the Lockatong and Wickecheoke Creeks, respectively. Pie charts showing the percentage of land use types in each watershed are presented in **Figures 4 and 5**.

Shallow bedrock, having only secondary porosity (fractures) is widespread throughout the watersheds. In addition to the shallow bedrock, thin soil depths and seasonal high ground water levels create problems throughout these watersheds for locating suitable sites for septic systems, particularly in the lower two-thirds of each watershed. The size, spacing, and orientation of water-bearing fractures within the aquifer presents water supply problems to many well users during the summertime and early fall when recharge is minimal, or non-existent, and water use is maximum. Although fractures near the land surface can provide recharge to the aquifer, they can also provide a fast conveyance for surface and septic contaminants to enter nearby well-water supplies. Much of the Lockatong and Wickecheoke hydrogeography is oriented with the northwest to southeast bedrock strike direction, possibly along fractures, as shown in **Figure 6**. The Lockatong and Wickecheoke Watershed Characterization Report (NJ Water Supply Authority, June

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2007) provides more information on existing surface and ground water, and land-use conditions.

Topography of the watersheds creates a significant elevation change in the streams from 100 feet near the confluence of the Delaware River, at monitoring site L1, to 550 feet at site L9b in the headwaters for the Lockatong; and from 90 feet at monitoring site W1, near the Delaware River confluence, to an elevation of 570 feet at site W9b in the headwaters of the Wickecheoke. **Figure 7** shows the topography of the study area. **Figures 8** and **9**, and **Table 3** provide information regarding the elevation of the sampling sites.

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Figure 1. Monitoring-site locations during Phase I.

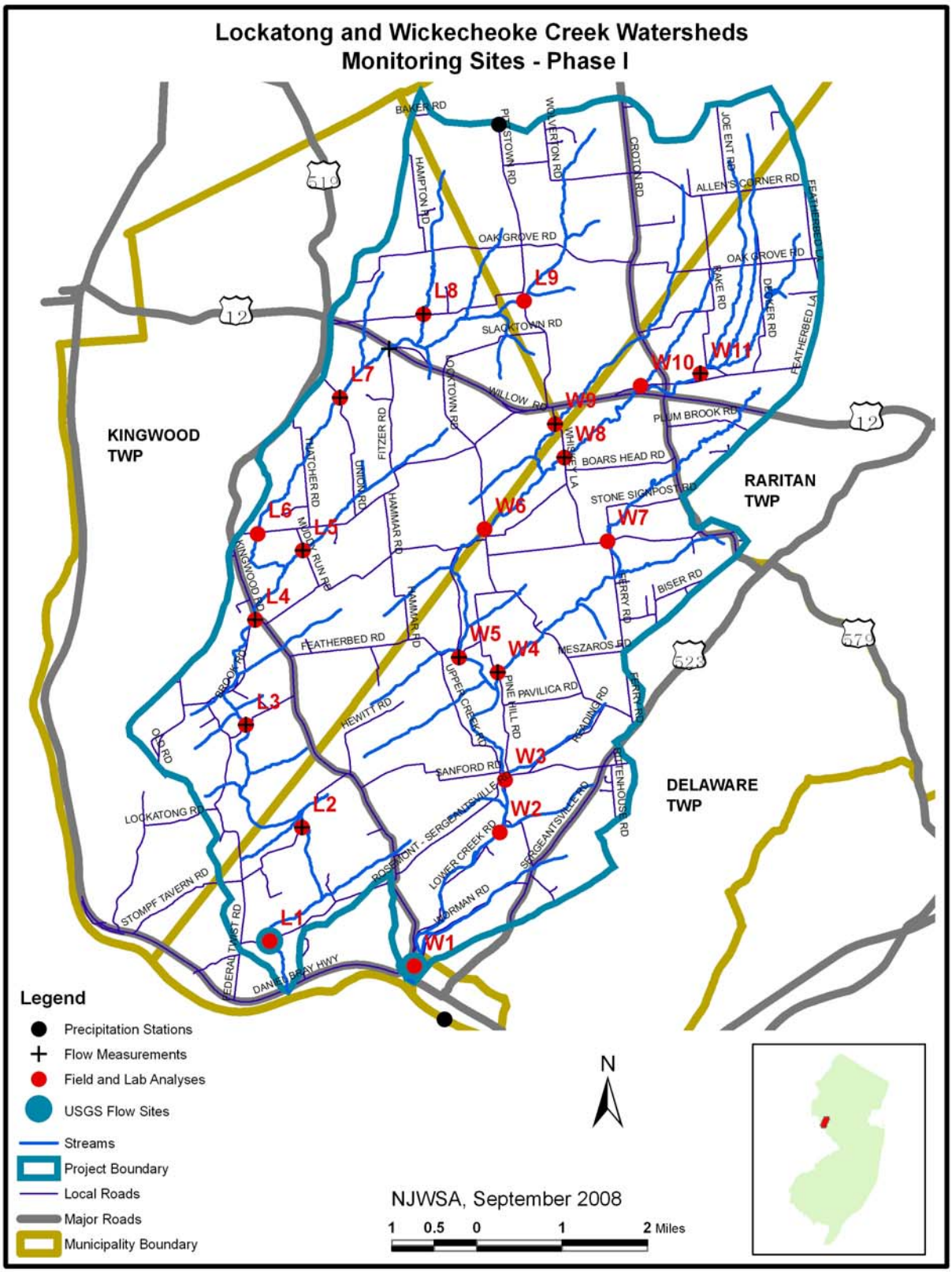

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Figure 2. Monitoring-site locations during Phase II.

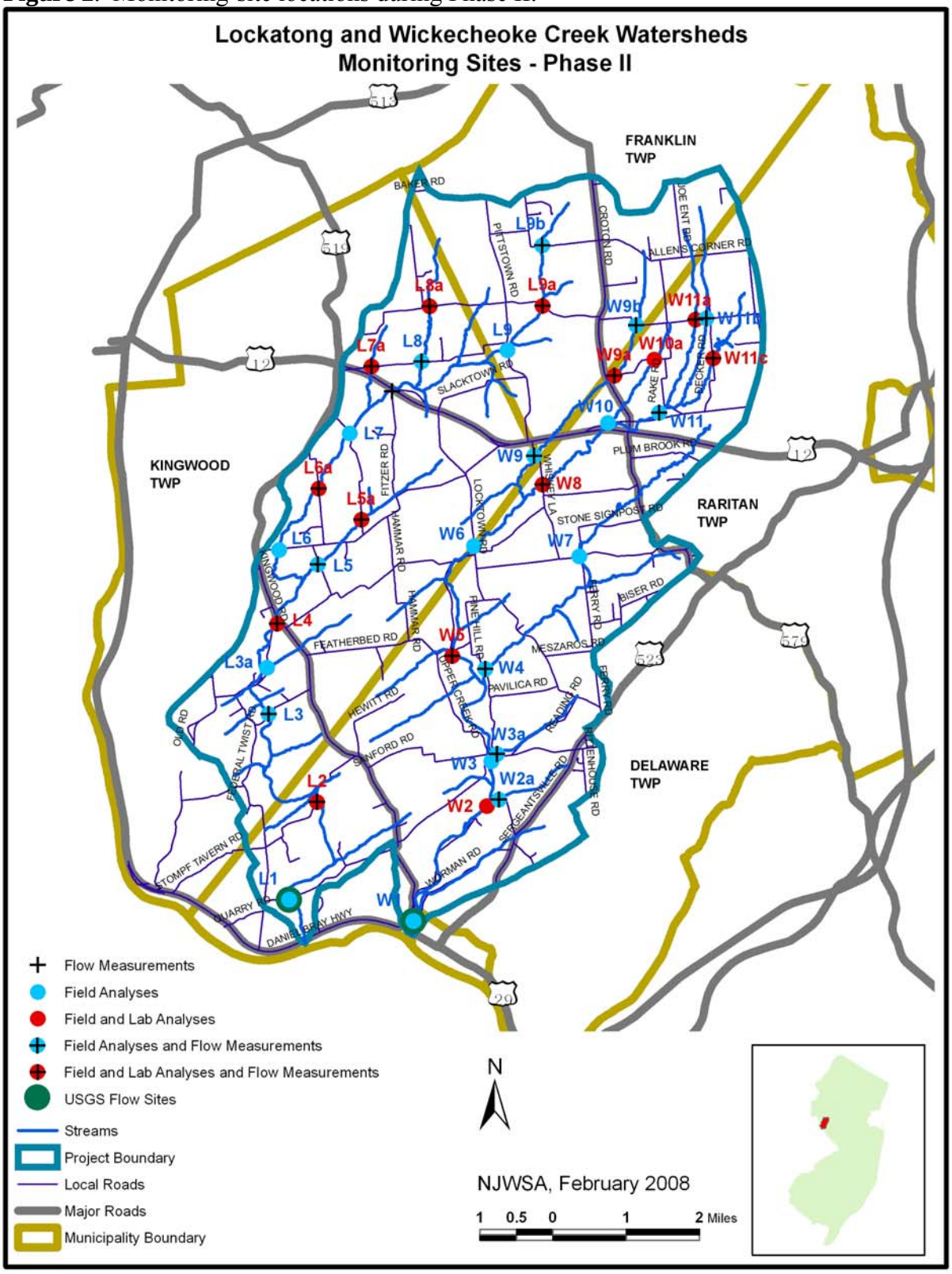

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Figure 3. HUC 14 sub-watersheds in the study area.

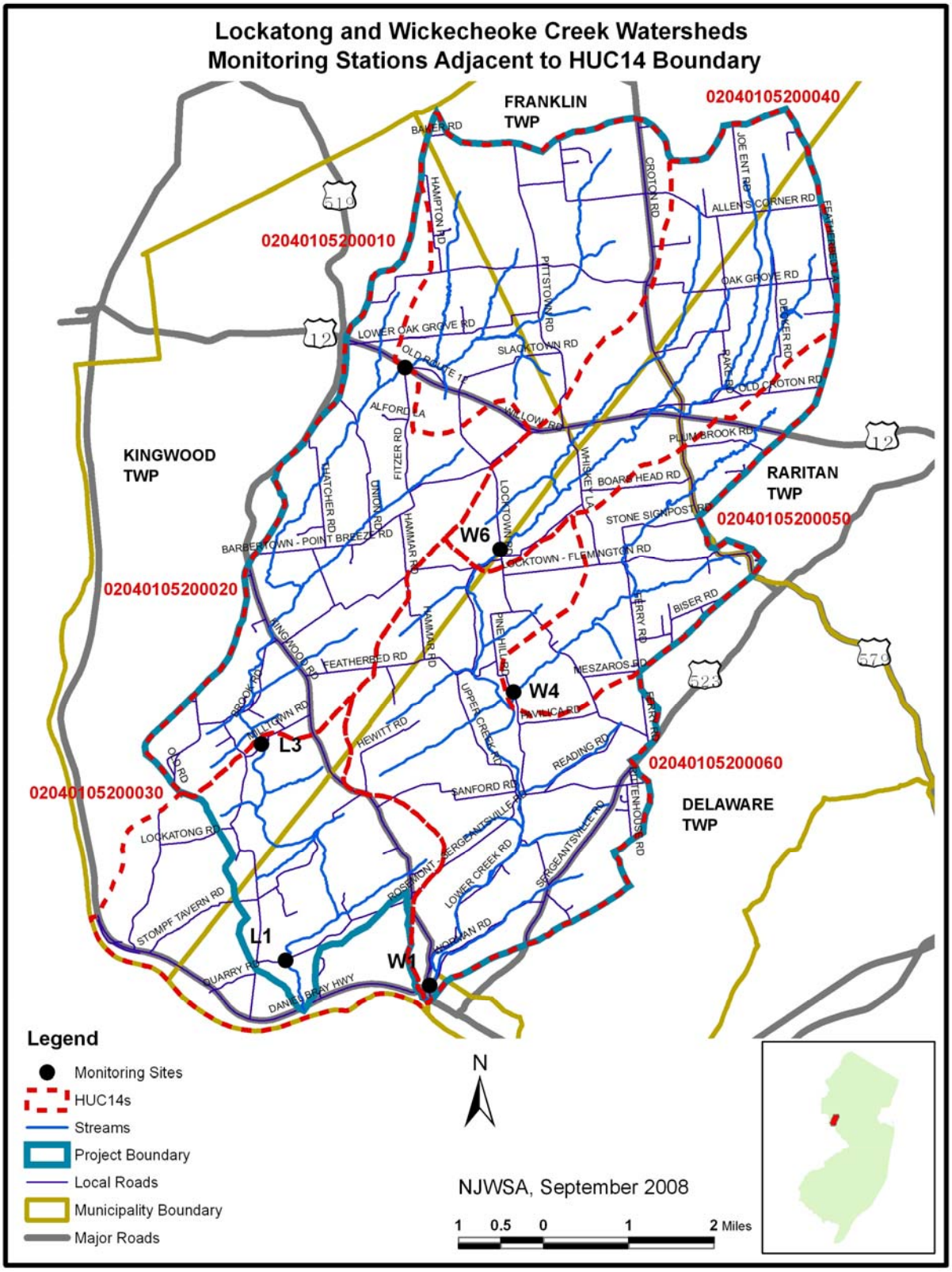

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Table 1. Lockatong Creek – Sub-Watershed Size and Land Use using 2002 State Land Use/Land Cover data.

Lockatong Watershed Sites	Total Drainage Area (Mile^2)	Sub-Watershed Area (Acre)	Acreage/Percent of 2002 Land Use Types Per Sub-Watershed											
			Agricultural		Barren Land		Forest		Urban		Water		Wetlands	
			Acre	%	Acre	%	Acre	%	Acre	%	Acre	%	Acre	%
L0*	23.3	231.3	81.5	35.25	2.1	0.89	105.5	45.61	31.9	13.81	5.6	2.42	4.7	34.40
L1	22.9	1,310.5	450.8	34.40	-----	-----	600.6	45.83	161.8	12.34	16.7	1.28	80.6	6.15
L2	20.9	1,822.2	473.7	25.99	-----	-----	1,056.7	57.99	153.4	8.42	15.4	0.85	123.1	6.76
L3	18.0	1,249.3	360.6	28.87	1.3	0.10	476.7	38.15	162.7	13.02	13.8	1.10	234.2	18.75
L3a	1.2	733.4	206.8	28.19	-----	-----	209.3	28.54	79.1	10.79	-----	-----	238.2	32.48
L4	14.9	601.4	212.6	35.36	1.3	0.22	91.7	15.25	101.2	16.83	11.5	1.92	183.0	30.42
L5	2.7	544.4	201.8	37.07	3.0	0.55	87.2	16.02	63.4	11.64	-----	-----	189.0	34.71
L5F	2.2	241.4	83.4	34.55	-----	-----	33.4	13.82	18.7	7.76	-----	-----	105.9	43.88
L5a	1.9	1,191.4	472.0	39.62	2.6	0.22	212.2	17.81	140.5	11.79	-----	-----	364.1	30.56
L6	11.3	406.3	152.5	37.53	24.2	5.95	90.0	22.14	44.6	10.98	7.0	1.72	88.1	21.68
L6a	10.6	409.7	129.3	31.56	-----	-----	58.8	14.36	53.1	12.96	4.5	1.09	164.0	40.04
L7	10.0	574.8	188.0	32.71	-----	-----	98.7	17.18	110.0	19.14	3.8	0.66	174.3	30.32
Rt 12	8.5	2,232.3	1,201.3	53.81	9.4	0.42	375.4	16.82	240.6	10.78	10.2	0.46	395.3	17.71
L7a	0.6	371.8	160.3	43.10	-----	-----	103.3	27.78	39.8	10.69	1.2	0.33	67.3	18.10
L8	1.9	245.2	114.5	46.72	-----	-----	45.0	18.35	63.5	25.88	2.0	0.82	20.2	8.22
L8a	1.6	991.8	564.7	56.94	-----	-----	187.6	18.92	108.8	10.97	2.4	0.24	128.4	12.94
L9	3.1	685.7	270.1	39.39	-----	-----	264.8	38.62	58.2	8.48	2.1	0.31	90.5	13.20
L9a	2.2	793.6	449.0	56.57	-----	-----	129.4	16.31	123.9	15.61	-----	-----	91.4	11.52
L9b	0.8	502.4	351.2	69.90	-----	-----	40.3	8.01	88.2	17.56	1.8	0.35	21.0	4.19

* Mouth of Lockatong Creek.

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Table 2. Wickecheoke Creek – Sub-Watershed Size and Land Use using 2002 State Land Use/Land Cover data.

Lockatong Watershed Sites	Total Drainage Area (Mile^2)	Sub-Watershed Area (Acre)	Acreage/Percent of 2002 Land Use Types Per Sub-Watershed											
			Agricultural		Barren Land		Forest		Urban		Water		Wetlands	
			Acre	%	Acre	%	Acre	%	Acre	%	Acre	%	Acre	%
W0*	26.62	22.8	-----	-----	-----	-----	14.4	63.31	6.4	28.25	1.9	8.43	0.003	0.01
W1	26.58	1,695.9	972.0	57.32	-----	-----	456.8	26.93	206.0	12.15	18.9	1.11	42.2	2.49
W2	23.9	808.4	529.7	65.52	-----	-----	147.2	18.21	87.5	10.82	5.5	0.68	38.6	4.77
W2a	1.0	638.1	371.2	58.17	-----	-----	86.4	13.53	159.5	25.00	-----	-----	21.0	3.29
W3	21.7	1,548.4	570.6	36.85	4.5	0.29	667.4	43.10	164.4	10.62	18.1	1.17	123.5	7.97
W3a	0.7	455.8	196.5	43.11	-----	-----	183.7	40.30	57.7	12.66	-----	-----	17.9	3.93
W4	5.3	1,996.1	580.1	29.06	0.3	0.01	857.0	42.93	284.0	14.23	7.0	0.35	267.7	13.41
W5	15.4	2,411.5	725.5	30.08	4.6	0.19	971.9	40.30	187.3	7.77	12.5	0.52	509.7	21.13
W6	11.7	936.5	285.9	30.53	5.1	0.54	205.6	21.95	92.1	9.84	15.0	1.60	332.8	35.53
W7	2.2	1,384.9	348.8	25.19	2.6	0.19	572.8	41.36	171.5	12.39	-----	-----	289.0	20.87
W8	5.8	782.2	193.8	24.78	-----	-----	238.4	30.47	91.5	11.69	12.1	1.55	246.4	31.50
W9	2.2	688.6	187.1	27.16	-----	-----	201.9	29.32	64.5	9.36	1.4	0.21	233.8	33.95
W9a	1.2	318.8	146.6	45.99	-----	-----	48.2	15.14	30.9	9.68	-----	-----	93.1	29.20
W9b	0.7	422.2	161.0	38.14	-----	-----	162.6	38.51	48.5	11.48	-----	-----	50.1	11.87
W10	1.0	285.4	98.2	34.42	-----	-----	75.7	26.53	18.7	6.54	0.7	0.25	92.0	32.25
W10a	0.6	353.6	181.4	51.30	-----	-----	85.5	24.19	48.8	13.80	-----	-----	37.9	10.71
W11	3.6	529.2	119.4	22.56	2.9	0.54	121.4	22.93	51.2	9.67	0.5	0.09	233.9	44.20
W11a	0.6	385.6	158.7	41.17	-----	-----	102.9	26.69	38.6	10.02	-----	-----	85.3	22.12
W11b	1.1	729.5	427.7	58.63	0.3	0.04	150.6	20.65	64.6	8.86	0.9	0.12	85.4	11.71
W11c	1.0	640.8	156.0	24.35	9.1	1.42	155.5	24.27	69.8	10.89	0.9	0.15	249.4	38.92

* Mouth of Wickecheoke Creek.

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Figure 4. Percentage of land use types in the Wickecheoke Creek watershed from the 2002 DEP land use/cover information.

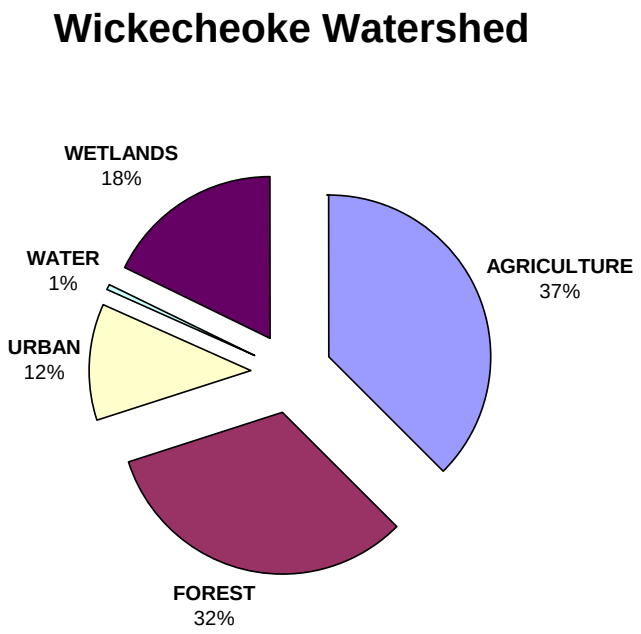

Figure 5. Percentage of land use types in the Lockatong Creek watershed from the 2002 DEP land use/cover information.

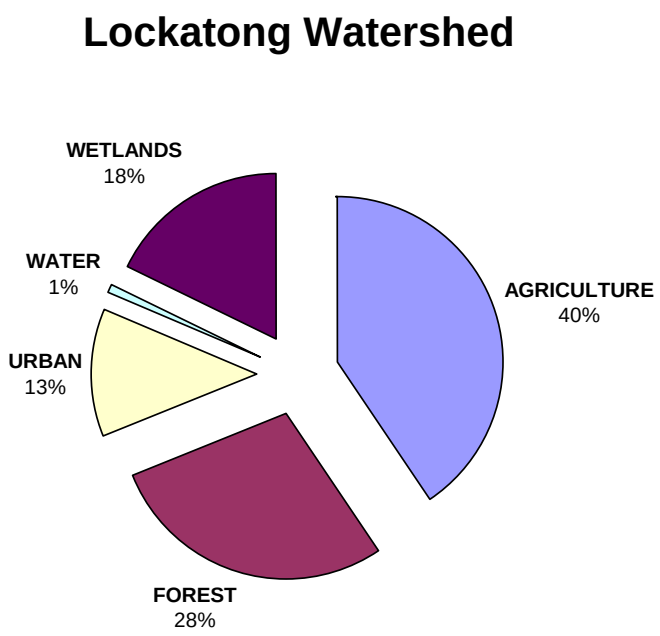

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Figure 6. Geology of the study area.

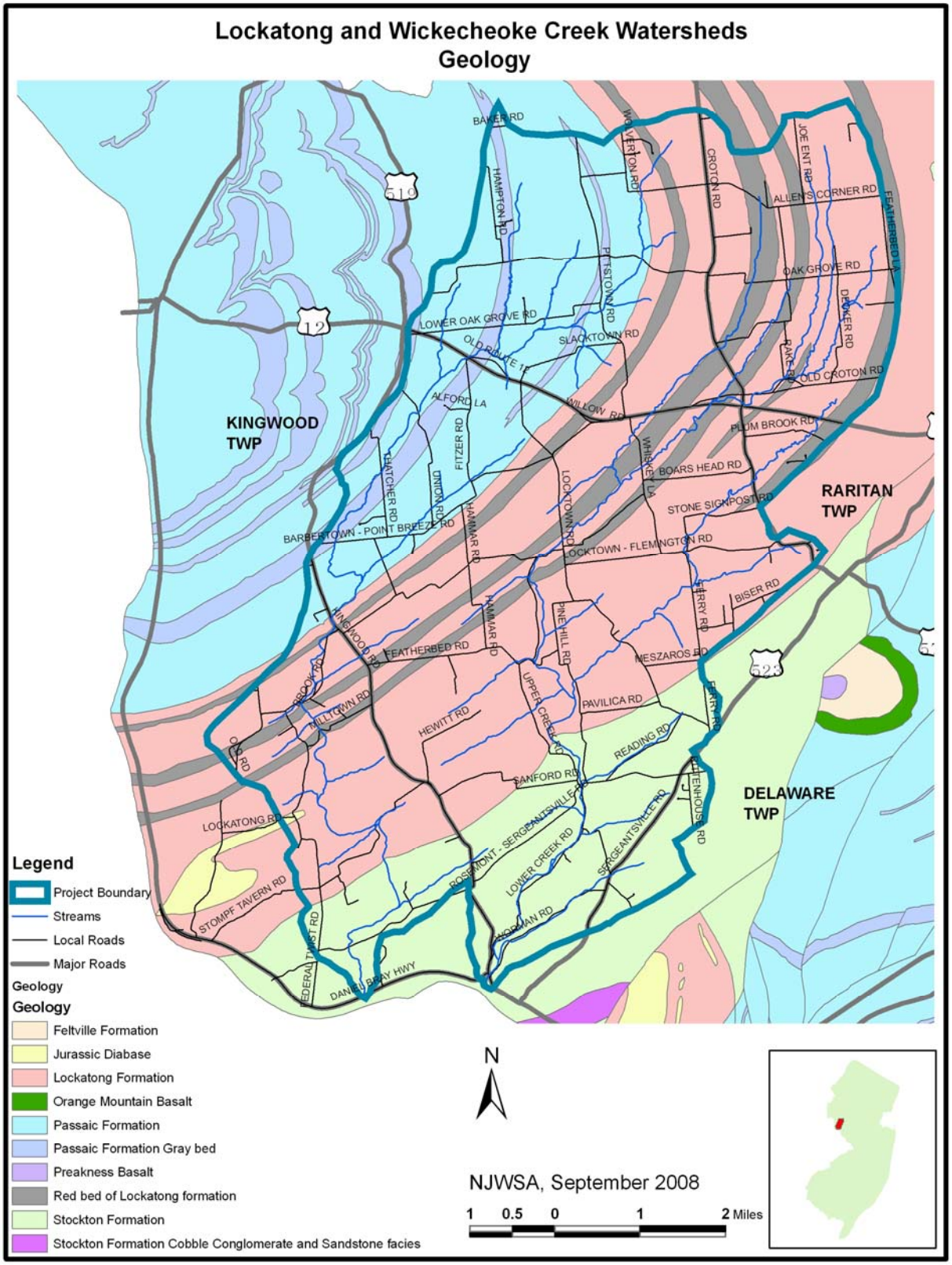

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Figure 7. Topography of the study area.

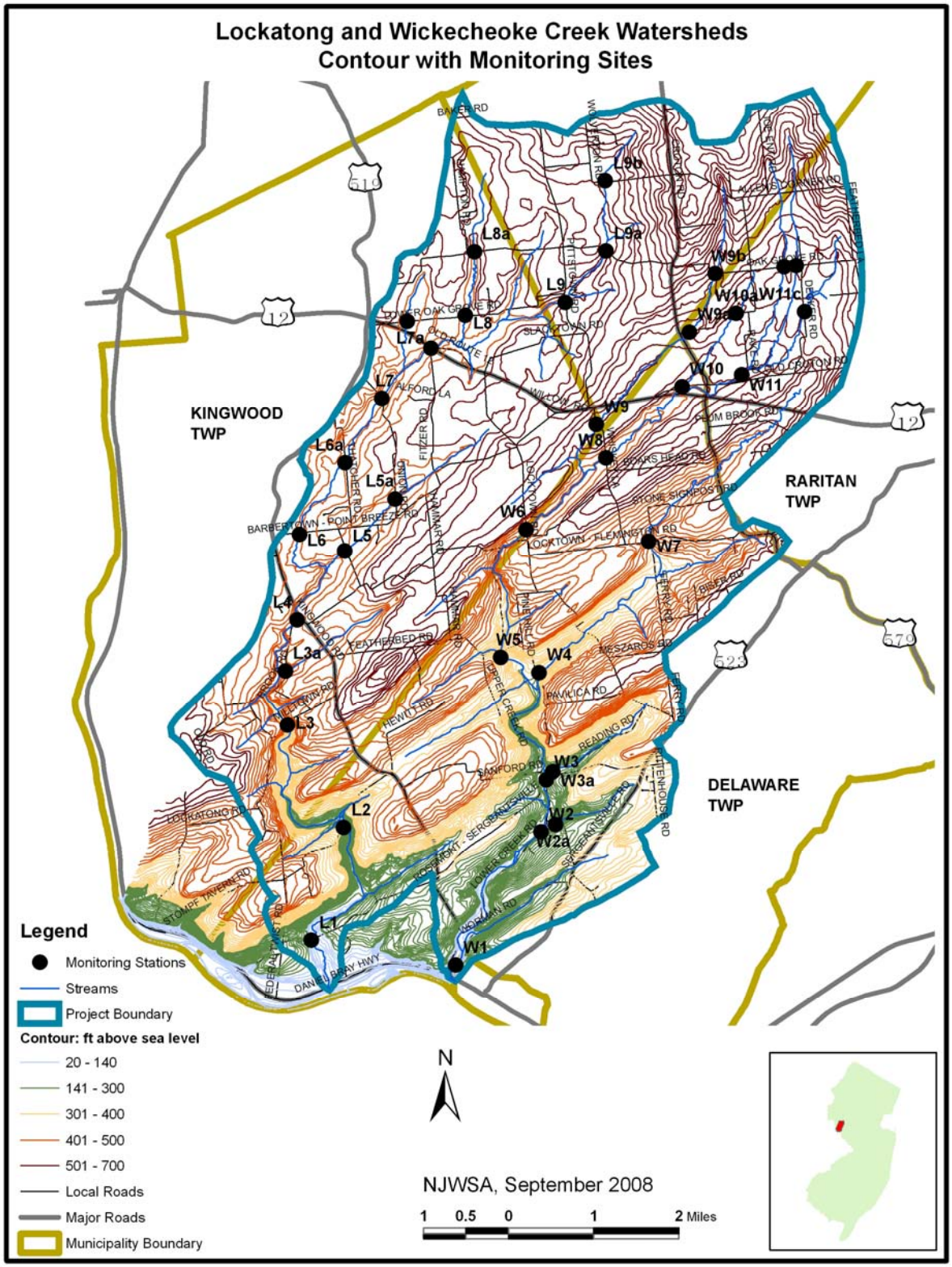

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Figure 8. Elevation of sampling sites within the Lockatong Creek watershed.

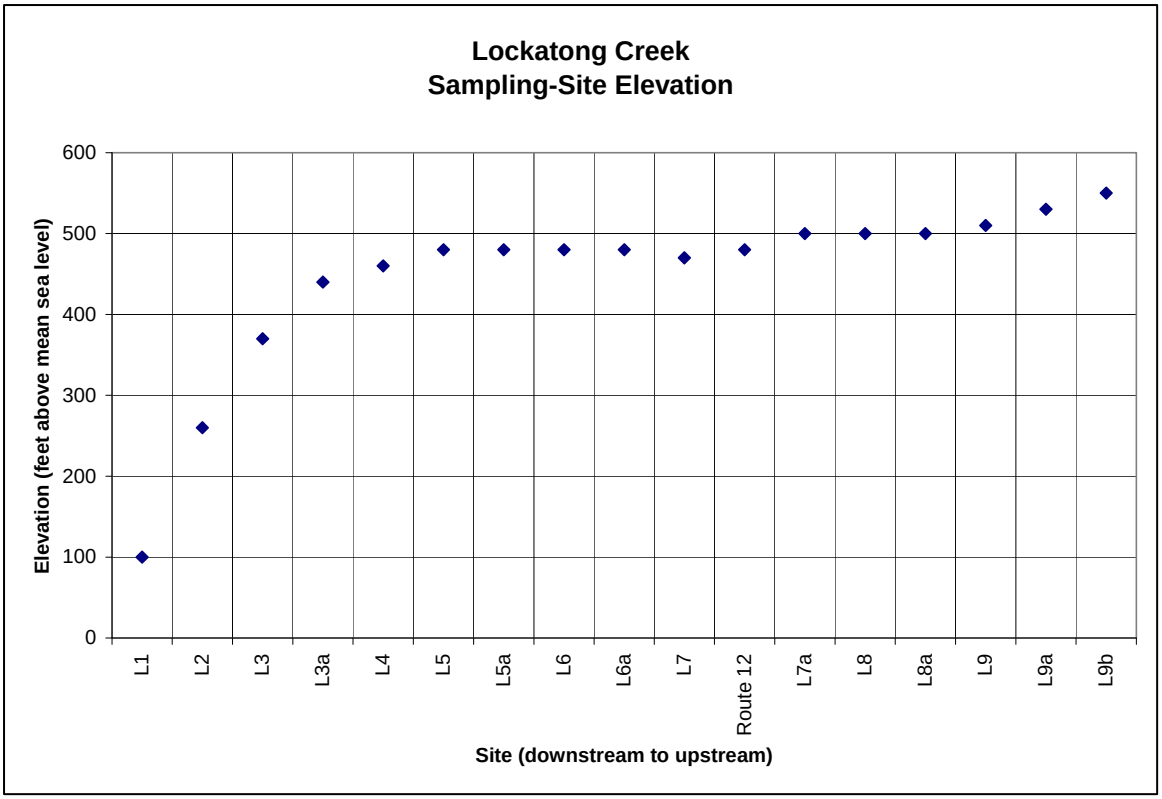

Figure 9. Elevation of sampling sites within the Wickecheoke Creek watershed.

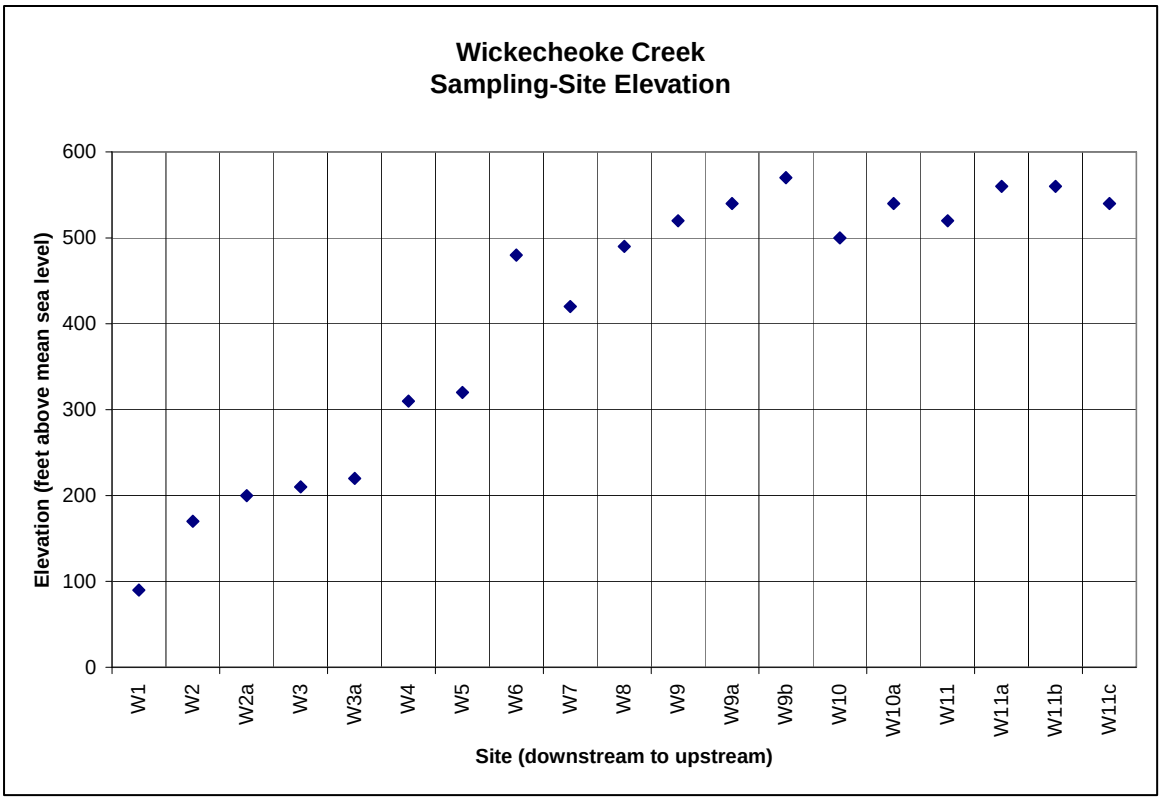

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Table 3. Coordinates and elevation of sampling sites, and distances between sites.

Station	Latitude	Longitude	Elevation (feet above mean sea level)	Distance between Stations	
				To Station	Distance (mile)
Lockatong Creek					
L1	40º 24' 57.57"N	75º 1' 4.71"W	100	Mouth	0.20
L2	40º 26' 7.05"N	75º 0' 39.44"W	260	L1	1.85
L3	40º 27' 9.63"N	75º 1' 24.83"W	370	L2	2.32
L3a	40º 27' 42.71"N	75º 1' 26.72"W	440	L3	0.83
L4	40º 28' 13.91"N	75º 1' 17.69"W	460	L3a	0.92
L5	40º 28' 56.43"N	75º 0' 39.77"W	480	L4	1.08
L5a	40º 29' 28.5"N	74º 59' 59.61"W	480	L5	0.87
L6	40º 29' 6.49"N	75º 1' 16.18"W	480	L5	0.53
L6a	40º 29' 50.42"N	75º 0' 39.74"W	480	L6	1.00
L7	40º 30' 30.01"N	75º 0' 10.83"W	470	L6a	0.97
Route 12	40º 31' 1.03"N	74º 59' 31.53"W	480	L7	0.85
L7a	40º 31' 17.6"N	74º 59' 50.77"W	500	L7	1.05
L8	40º 31' 21.4"N	74º 59' 4.24"W	500	Rt 12	0.84
L8a	40º 32' 0.79"N	74º 58' 57.08"W	500	L8	0.94
L9	40º 31' 29.76"N	74º 57' 43.93"W	510	Rt 12	1.99
L9a	40º 32' 1.57"N	74º 57' 11.37"W	530	L9	0.81
L9b	40º 32' 44.53"N	74º 57' 12.35"W	550	L9a	0.87
Wickecheoke Creek					
W1	40º 24' 42.74"N	74º 59' 9.02"W	90	Mouth	0.72
W2	40º 26' 4.94"N	74º 58' 1.01"W	170	W1	2.40
W2a	40º 26' 9.5"N	74º 57' 49.62"W	200	W2	0.04
W3	40º 26' 36.97"N	74º 57' 57.11"W	210	W2	0.66
W3a	40º 26' 41.93"N	74º 57' 51.91"W	220	W3	0.15
W4	40º 27' 42.62"N	74º 58' 3.4"W	310	W3	1.69
W5	40º 27' 51.7"N	74º 58' 34.24"W	320	W3	2.17
W6	40º 29' 10.19"N	74º 58' 14.53"W	480	W5	1.86
W7	40º 29' 3.28"N	74º 56' 35.99"W	420	W4	2.51
W8	40º 29' 54.25"N	74º 57' 10.76"W	490	W6	1.45
W9	40º 30' 14.66"N	74º 57' 18.55"W	520	W6	1.85
W9a	40º 31' 11.85"N	74º 56' 4.17"W	540	W9	1.68
W9b	40º 31' 47.93"N	74º 55' 43.9"W	570	W9a	0.83
W10	40º 30' 38.29"N	74º 56' 9.83"W	500	W8	1.50
W10a	40º 31' 23.57"N	74º 55' 26.8"W	540	W10	1.18
W11	40º 30' 45.77"N	74º 55' 22.05"W	520	W8	2.48
W11a	40º 31' 52.29"N	74º 54' 48.6"W	560	W11	1.50
W11b	40º 31' 53.02"N	74º 54' 38.72"W	560	W11	1.74
W11c	40º 31' 24.64"N	74º 54' 31.88"W	540	W11	1.32

MONITORING

Site Selection

Monitoring sites were selected based on three main criteria: accessibility; land use and cover; and safety for the field staff. All monitoring sites, except W2, were at bridge crossings to provide an accessible and safe structure for sample collections during both

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low and higher flows. Sampling at site W2 during higher flows was performed using a collection container attached to a pole as described in the QAPP. During lower flows most samples were collected by wading into the stream, facing upstream, and sampling in an undisturbed, mid-channel location that best represented the transect water quality. All sample-collection and analytical procedures were described in the study QAPP, that was approved by the NJDEP Office of Quality Assurance.

Ambient Water Quality

Phase 1 monitoring sites, located in **Figure 1**, were selected based on five major criteria: 1) site accessibility (public access) and safe conditions for the monitoring crew; 2) drainage area size; 3) prominent land-use(s) within each sub-watershed; 4) known potential contamination sources: and 5) the time necessary to complete a sampling event while not exceeding the 6-hour holding time for bacteria samples. Water quality parameters were selected based on land use, and to facilitate the identification of potential contaminant sources for the NJDEP Total Maximum Daily Load (TMDL) studies. The majority of the landscape is agriculture, forests, and wetlands with rural homes and roads dispersed throughout. Although forests and wetlands make up almost 50 percent of the land use, agricultural and residential land uses cover nearly the same acreage and contribute large volumes of stormwater flow containing loadings of nutrients, solids, and bacteria at levels exceeding the surface water quality standards. These loads can adversely affect human, aquatic organism, and livestock health, and increase the level of treatment required for potable water suppliers downstream of the contaminant source(s).

Including flow, the following water quality parameters were monitored during Phase 1 of the study: water and air temperature, pH, conductivity, ammonia, nitrite, nitrate, total Kjeldahl nitrogen (TKN), total phosphorus, boron, fecal coliform, total suspended solids (TSS), and turbidity.

Monitoring locations for Phase 2, as shown in **Figure 2,** were selected by 1) ranking the water quality data from 2006, based on the number of exceedences of the Surface Water Quality Standards and by determining the overall range and average of each water quality constituent; and 2) through observations of the sub-watershed areas that contribute flow during low flow conditions. **Table 4** presents the ranking of individual sites per parameter and overall scores for the 2006 data. Four mainstem sites and two tributaries in the Lockatong watershed ranked high (lower is better). One mainstem and two tributary sites ranked high in the Wickecheoke watershed. The higher rankings warranted additional monitoring at these specific locations. Several other sites having consistent baseflows were also monitored since many of the original sites were dry during low-flow sampling. Three mainstem sites sampled in Phase 1 were selected from each watershed as reference sites and monitored in Phase 2 for the entire suite of parameters. All other mainstem sites were monitored for pH, temperature, and specific conductivity. During the Phase 2 monitoring, all of the parameters analyzed in Phase 1, except nitrite, were continued at selected sites with the addition of Escherichia Coliform (E. Coli, or E. coliform) that was added in response to a change in the DEP Surface Water Quality Standards for fresh-water pathogen indicators. Nitrite was eliminated

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since every sample analyzed during Phase 1 was below the laboratory's 0.02 mg/l method detection limit.

The water quality parameters that were monitored during this study were selected based on their association with the following anthropogenic and natural conditions within the Lockatong and Wickecheoke watersheds.

Point-source loadings

The Delaware Township MUA is the only permitted wastewater treatment plant (WWTP) discharge, located on a tributary to the Wickecheoke Creek (locally known as Rose Brook). A site on this tributary (L2a), near the confluence with the mainstem, was sampled for all of the parameters listed above. All of these parameters are by-products of

Table 4. Stressor rankings* from 2006 monitoring results for Lockatong and Wickecheoke Creeks mainstem and selected tributaries.

Site	Fecal	Boron	Nitrate	Ammonia	TKN	TP	TSS	Turbidity	H2O Temp	pH	Spec Cond	Total # Major Stressors
Lockatong - Mainstem Sites												
L9												10
L7												5
L6												9
L4												8
L3												8
L2												3
L1												2
Lockatong - Tributary Sites												
L8												8
L5 Muddy Run												10
Wickecheoke - Mainstem Sites												
W11												5
W8												10
W6												5
W5												4
W3												0
W2												4
W1												1
Wickecheoke - Tributary Sites												
W10												6
W9												8
W7 Plum Brook												5
W4 Plum Brook												2
W3a Cold Run												2
W2a Rose Brook												8

* Matrix of rankings - worst 3 sites from 2006 data collections for each parameter. Ties create additional selections.
Level of impact - Red = 2 points (location of 1st and 2nd greatest impacts), Grey = 1 point (location of 3rd greatest impact)

the bacterial and chemical decomposition of human wastes. Properly maintained and fully-functional WWTPs discharge these components at levels within their permitted limits. Malfunctioning, or mechanical bypass of treatment systems will convey elevated concentrations of these parameters in the effluent.

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Non-Point Source Loadings

Septic Systems

Malfunctioning septic systems can be traced with fecal coliform, E. coliform, nitrite, nitrate, and boron analyses. Leachate loadings can be conveyed to receiving waterways during both storm-induced flows and baseflows, with higher concentrations usually occurring during the lower flows (less dilution). Fecal coliform and E. Coli can originate from human and animal feces, and can also be present naturally in ponded stream reaches having a silty/mucky anoxic bottom material.

Nitrate and boron are very conservative and do not normally become attached to soil particles. Therefore, both of these will be present at stream locations where septic-system problems are encountered. Besides septic leachate, nitrate can also enter a stream from agricultural and natural sources. Livestock and wildlife manure, leaf litter, and detritus all produce nitrate. Boron is more indicative of septic discharge, since laundry whiteners are the primary, or in many instances the sole source of this element. However, boron may also be present in agricultural waste sites since it has historically been applied alone, or in combination with other pesticides, to orchards and agricultural areas. Many of the associated pesticides used in conjunction with boron are toxic.

Agricultural/Residential

Both livestock and crop farming can add nutrients, solids, organics, and bacteria to surface and ground water. Application of fertilizers for lawn maintenance can also introduce high levels of nutrients to these water systems. According to documentation for the Fecal Tool portion of the EPA Bacterial Indicator Tool (BIT) model (EPA, 2000), dairy and beef cow feces can contribute, on average, approximately 100 billion fecal bacteria per animal per day to the landscape. On average, hogs and sheep waste contributes approximately 11 billion fecal bacteria per animal per day. Sheep and cattle were observed in the stream at 2 locations during the study. All of the sampling sites had agricultural activities occurring next to the stream channel either at, or just upstream of the sampling locations. Total phosphorus, nitrite, nitrate, ammonia, TKN, TSS, fecal coliform and E. coliform bacteria, and turbidity are good indicators for identifying and quantifying these loading sources.

Wildlife and Domestic Animals

Bacteria, nutrients, organics, and solids are contributed to streams and ground water directly and during storm runoff from wildlife and domestic animal wastes. Next to dairy and beef cow feces, geese excrement, on average, can contribute approximately 50 billion fecal bacteria per animal per day, followed closely by bacteria levels of duck and dog wastes (EPA, 2000). These contaminant sources can contribute total phosphorus, nitrite, nitrate, ammonia, TKN, TSS, fecal coliform and E. coliform bacteria, and turbidity to the waterways. Deer and ducks were observed in and near several sampling sites. Very few geese were observed at any of the sampling locations during the study.

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Road Runoff and Roadside Drainage

There are several gravel and dirt roads within the project watersheds, and both unlined and armored drainage ditches bordering both unpaved and paved roads. Runoff from roads occurs quickly, carrying sediment and other road debris into either the drainage ravines along the roads or directly into adjacent streams. When roads are on steep slopes, runoff from the surface is quickly concentrated and fast, deeply scouring drainage ravines and carrying large volumes of sediments into the receiving stream. Sediments conveyed from steep roads and ravines contain a mixture of sediment sizes, ranging from fine silt to boulders. Runoff flows carrying this material enhances the scouring and erosion of the roadways and the conveyance channels. Turbidity and TSS, and possibly TKN and total phosphorus will provide the best indication of rill and gully erosion.

Channel Degradation – All Terrain Vehicles

Within the past five years there has been an obvious increase in the recreational use of All Terrain Vehicles (ATV). The off-road use of these vehicles has had an increasingly detrimental effect to the streams through the entering and use of the stream channels as driving routes. Locations upstream and downstream of sites L6a and L7 show the heaviest use of ATVs. The large tires easily track sediment into the channel and cover and destroy aquatic habitat while adding nutrients and solids to the water. Oil, gasoline, and metals from the vehicles can further degrade the water quality.

Internal stream loadings

Stream channels displaying incised/undercut and eroding banks, and scouring and deposition of the channel substrate, can contribute large loads of sediments and nutrients during higher flows. Sediments contain bacteria, nutrients, and solids. Deposits of sediments can be resuspended during storm flows, putting these loads back into the water column. Pooled reaches usually contain a larger supply of deposited sediments. Of the water quality parameters being measured in this project, TKN, TSS, total phosphorus, and turbidity will provide the best indication of suspended sediments. Nitrite+nitrate, fecal coliform, and E. Coli may also prove to be good secondary indicators.

Since each of the parameters could be associated with more than one potential contamination source, groups of indicator parameters were selected to facilitate the identification of the major source(s) within the watersheds.

Resuspended Sediment and Sediment Sampling

Soils of the watersheds consist of fine-grained clays and silts, in addition to gravel, boulders, and bedrock. When deposited on the stream bottom, through runoff and channel erosion, the fine-grained materials create an ideal habitat for bacterial colonization, and provide a concentrated source of nutrients and solids. As flows increase, scouring velocity increases proportionally, eventually resuspending the fine

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sediments into the water column. Consequently, concentrations of bacteria, solids, and nutrients sampled during the higher-flow events can increase substantially from internal loading sources. More detail is presented in the Water Quality section of the Monitoring Results.

Stream Flow

The US Geological Survey (USGS) was contracted to install and maintain a continuous flow-monitoring station near the mouth of each stream. The Lockatong station, located near the bridge on Raven Rock – Rosemont Road, began operation in November 2005 and the Wickecheoke station, located just upstream of the route 29 bridge, became operational in March 2006. Both monitors remain active at the writing of this report.

In addition to the USGS flow-monitoring sites, the NJWSA developed stage-discharge relationships at 12 water quality monitoring sites along Lockatong Creek, and at 13 water quality monitoring sites along the Wickecheoke Creek. The supplemental flow monitoring sites were developed to provide representative flow estimates for the shallow and fractured bedrock that underlies both watersheds. While the Lockatong Creek receives most of its low-flow water supply from the northern headwater tributaries, most of the Wickecheoke Creek low-flow source water originates from springs along tributaries located within the southern 25 percent of the watershed.

The development of stage-discharge relationships at most of the water quality sampling locations provided an expedient way to estimate the flow during sample collections by measuring the distance between a datum on the bridge and the water surface. This distance was then used in the stage-discharge association equation (rating) to determine the stream flow. Each sampling site had a unique stage-discharge association based on the stream-channel configuration where the stage was measured. In most cases, the relationship between flow and water elevation changed (slope of regression) as the magnitude of flow changed. Lower flows traverse the non-uniform substrates along the channel bottom, traveling through the voids between rocks and debris. This presents a larger increase in water elevation per increase in flow. As flow increases, the voids fill quickly until the substrate is completely covered, elevating the water surface faster than the increase in flow. Once most of the stream bottom is inundated, the unit increases in stage represent a larger increase in flow since the influence by the substrate is minimized. This ratio will continue to change as the flow increases and the water level reaches the steeper stream banks, after which the ratio will again change as increasing flow begins to overflow the banks. Most of the supplemental flow measurements for this study were performed during lower flows. The stage-discharge relationship for the Lockatong Creek at site L4 (route 519 bridge) is shown in **Figure 10**. Stage-measurement location descriptions and discharge relationships for the supplemental flow monitoring sites are presented in **Appendix B**. Flow was measured when present in the channels. All of the headwater tributaries in the Wickecheoke watershed went dry during the summertime, limiting the number of flow measurements. Several tributaries within the Lockatong watershed also went dry during the summertime.

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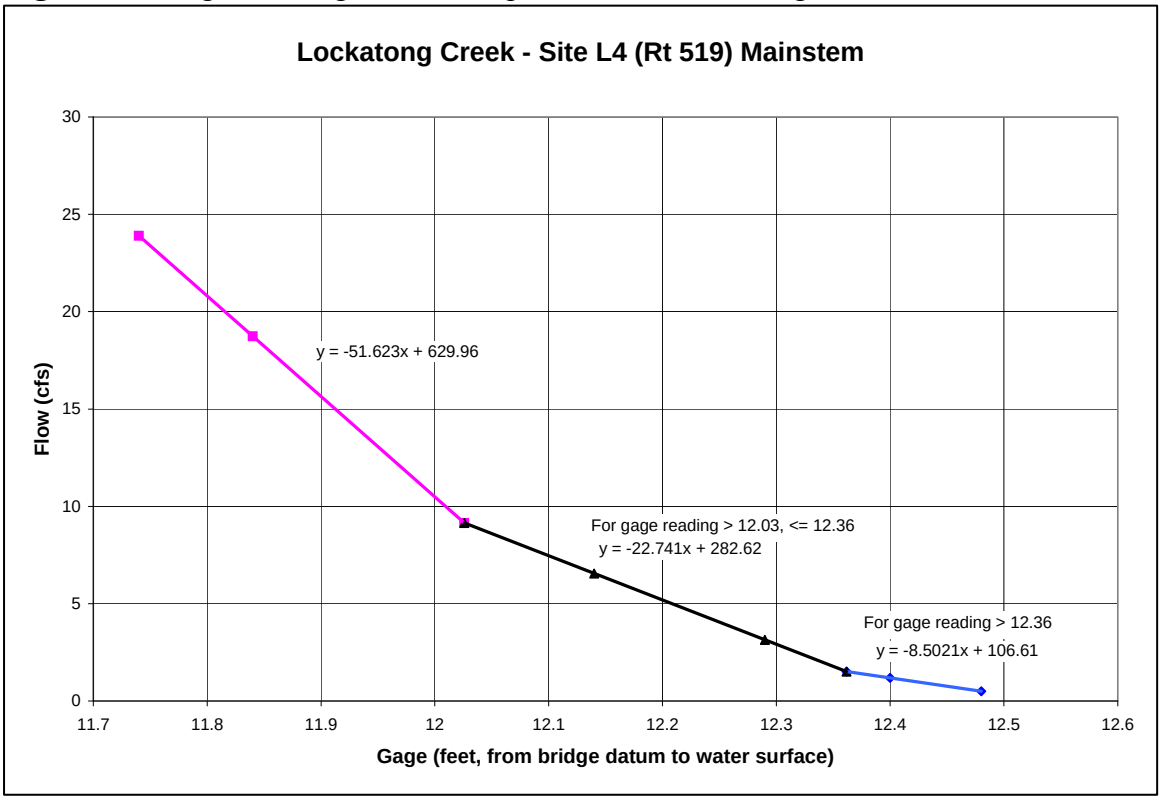
Figure 10. Stage-discharge relationship for the L4 monitoring site.



Data from individual flow measurements for calibrating the stage-discharge relationships are presented in **Appendix C**.

During more intense flows, the USGS flow-monitoring data were extrapolated, using "drainage-area weighting" (i.e., flow rate proportional to the size of the drainage area), to the upstream monitoring stations. As each supplemental flow-monitoring station was calibrated, additional flow, representing the local geologic and precipitation conditions, became available for use in extrapolating or interpolating flows at other nearby sampling sites. Extrapolation of the USGS flows using drainage area weighting was achieved by using the following equation:

$Q_{Ex} = (Q_{USGS} \div DA_{USGS}) \times DA_{Ex}$,

where:

Q_{Ex} = estimated (extrapolated) flow for an upstream site;
Q_{USGS} = flow at the USGS flow-monitoring station;
DA_{USGS} = drainage area at the USGS flow-monitoring station; and
DA_{Ex} = drainage area of the upstream flow-extrapolation site.

After establishing a calibrated stage-discharge association at a supplemental flow-measurement site, flow estimates could be interpolated to other monitoring sites that were

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situated between the USGS and the newly established flow-measurement stations using the following technique:

$$Q_{In} = Q_{USGS} - [(Q_{USGS} - Q_{CAL}) \div (DA_{USGS} - DA_{CAL}) \times (DA_{USGS} - DA_{In})]$$

where:

Q_{In} = estimated (interpolated) flow for an uncalibrated site located between the USGS and newly calibrated site;
Q_{USGS} = flow at the USGS flow-monitoring station;
Q_{CAL} = flow at the newly calibrated flow-monitoring site;
DA_{USGS} = drainage area at the USGS flow-monitoring station;
DA_{CAL} = drainage area of the newly calibrated flow-monitoring site; and
DA_{In} = drainage area of the uncalibrated site.

MONITORING RESULTS

Flow

Up to six flow measurements were performed at each of 27 stage-discharge sites for calibrating the relationship between flow and water surface elevation. At sites exhibiting intermittent flows, calibration measurements were conducted whenever possible. Both the Lockatong and Wickecheoke creeks were very flashy, stormwater runoff flows were conveyed to the stream and routed through the stream channel network very quickly. Most storm runoff flows passed through the USGS flow monitoring stations, located near the mouth of each stream, within 2 days with durations of peak flow normally lasting 1 to 3.5 hours. The combination of fractured bedrock, localized precipitation events, and flashy runoff hydrographs presented site-specific flow conditions that required a dispersed flow-monitoring network. During low flows, many subbasins did not contribute inflow to the creeks. The origin of baseflow for the Lockatong was mostly in the northeast headwater streams while most of the Wickecheoke baseflow originated from spring-fed tributaries in the southern portion of the watershed. The USGS continuous flow monitoring stations provided very reliable flow information during the greater flows associated with spring and fall baseflows and those from frontal storms. The continuous monitors also provided critical baseline and weighted-flow estimates during the development of the selected stage-discharge associations at sites throughout the watersheds. Drainage-area weighted flow from the USGS stations frequently could not be used to predict flows at other locations due to the spatial natural flow variability as presented in **Figures 11 and 12** for the Lockatong and Wickecheoke Creeks, respectively.

The Rutgers Agricultural Research Farm (Pittstown Road) precipitation station and the USGS precipitation monitor at the Stockton bridge were used to compare the relative differences in precipitation between the headwaters and the lower watershed areas. Locations of these rain monitoring stations are shown in **Figure 1**. Along with flow conditions during the sampling events, daily precipitation totals for each sampling

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Figure 11. Fluctuations in flow estimates, using drainage-area weighting versus measured flows, from natural variation in precipitation and runoff in the Lockatong Creek watershed.

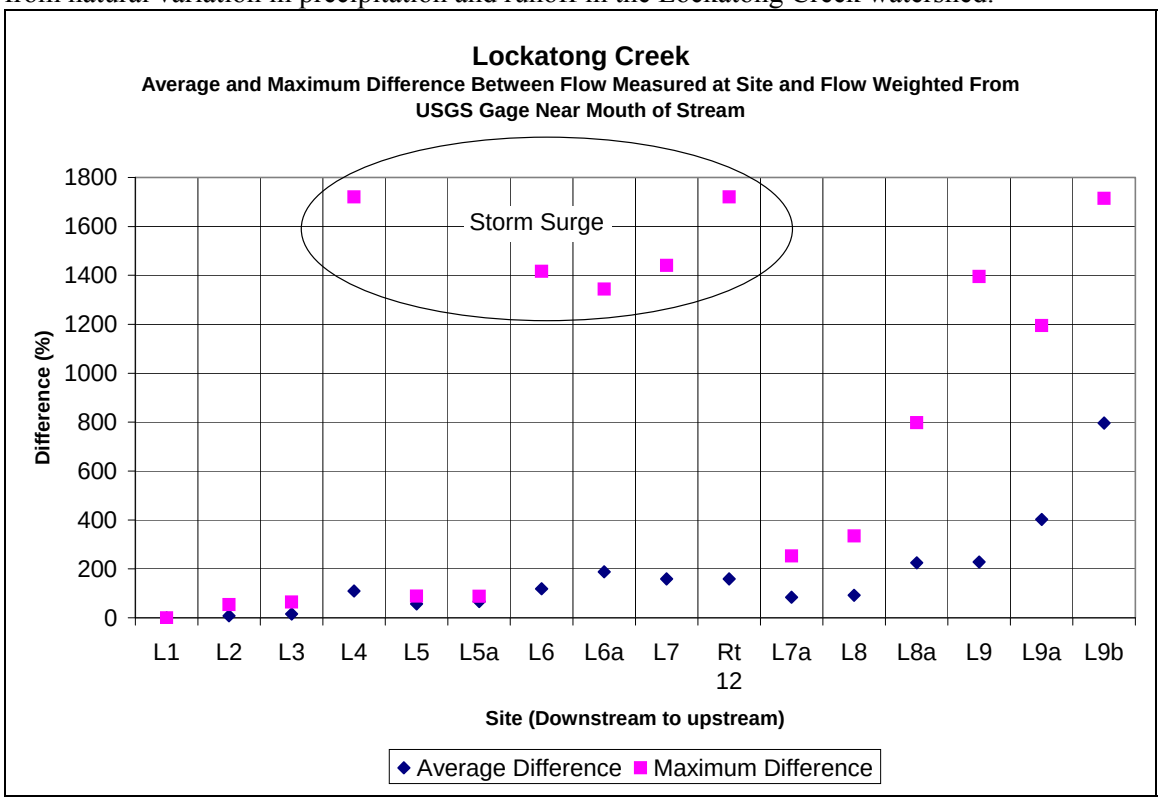
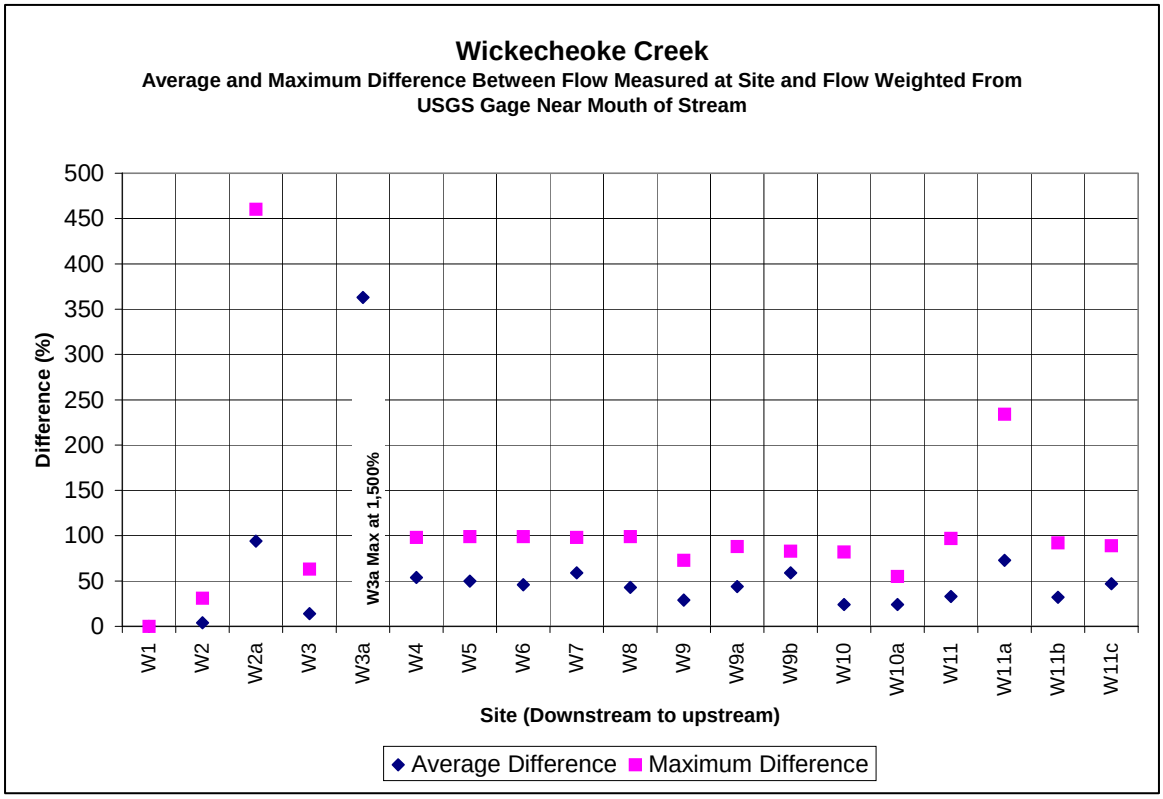


Figure 12. Fluctuations in flow estimates, using drainage-area weighting versus measured flows, from natural variation in precipitation and runoff in the Wickecheoke Creek watershed.



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event are also presented in **Appendix D.** There is approximately 470 feet elevation difference between these two sites that can have a substantial influence on the amount and location of localized rainfall.

A very localized precipitation event occurred on July 21, 2006 in the Rose Brook watershed (1 square mile drainage to sampling site W2a), a tributary to the Wickecheoke Creek. Local residents reported that nearly 6 inches of rain fell over 24 hours, flooding yards, roads, and bridges. The shear velocity of this flow severely damaged sections of the stream channel and eroded the upstream wingwalls and road deck of the bridge on Lower Creek Road. During this event, the Rutgers Snyder Research Farm recorded 0.19 inches and the USGS precipitation monitor at the Stockton bridge recorded 2.52 inches, indicating that while only a small area was affected by the storm, it presented a large contribution to the mainstem flow and loadings.

Low-flow is known herein to be equal to, or less than, 10 cubic feet per second (cfs) as measured at sites L1 and W1. Data collected by the Delaware River Basin Commission (DRBC) at these same sites from 2000 through 2003 (Limbeck, Smith, and Kratzer, 2004) indicated that non-point source pollutant loadings began to increase excessively at flows greater than 10cfs. **Figures 13** and **14** illustrate the amount of flow, referenced to drainage-area size, being supplied from each of the sub-watershed areas during the low-flow conditions.

Figure 13. Average low-flow per drainage area for the Lockatong Creek monitoring sites.

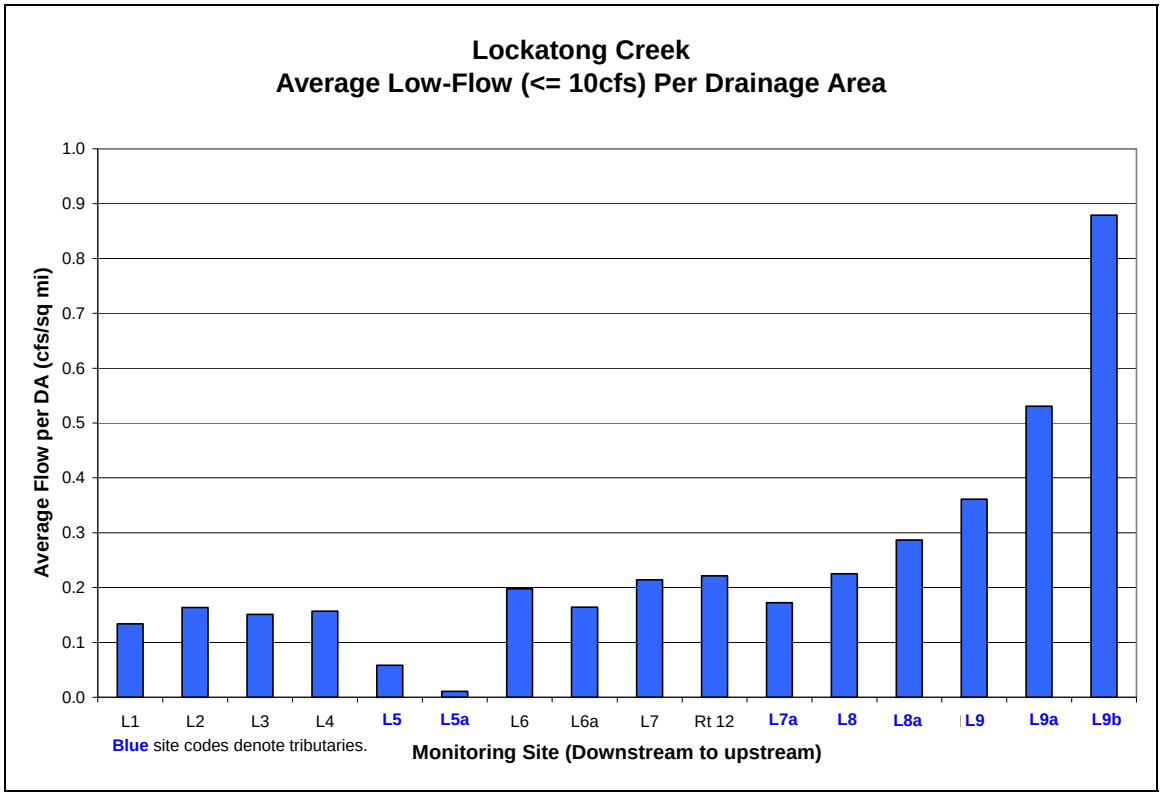

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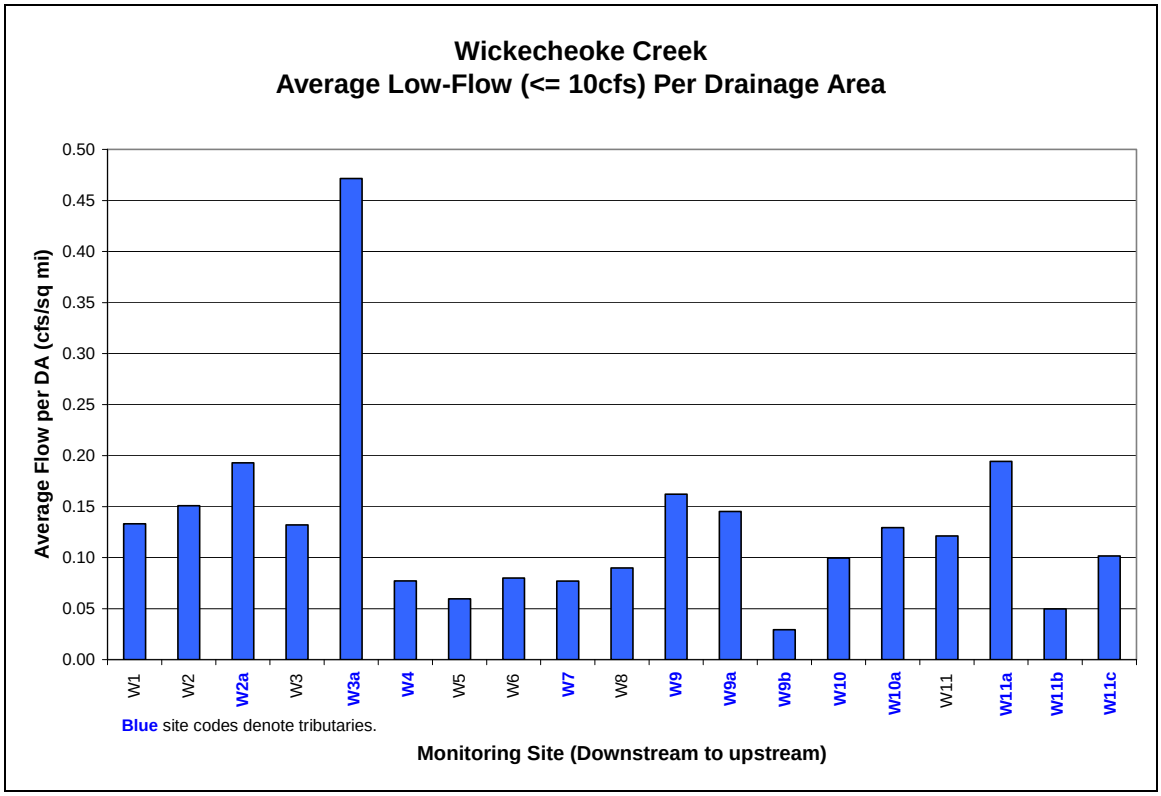
Figure 14. Average low-flow per drainage area for the Wickecheoke Creek monitoring sites.



Stream flow was either measured or estimated at each water quality monitoring site. When both flow and concentration are known during the same time of sampling, a pollutant loading can be derived (analogous to determining the amount of chocolate powder in the chocolate milk). Loadings were calculated for applicable analytes, using concentrations and associated flows for each sample in the following equation:

$L = Q \times C \times 5.39$,

where:

L = estimated loading as mass per unit time (e.g., pound per day, lb/day);
Q = stream flow as volume per unit time (e.g., cubic feet per second, ft^3/second or cfs);
C = pollutant concentration as mass per unit volume (e.g., milligrams per liter, mg/l); and
5.39 = a unit conversion to obtain lb/day from cfs and mg/l.

Loading estimates represent the mass of the pollution constituent that was suspended or dissolved in the stream and storm-runoff, flow. Comparison of the loads to a range of flows can provide a good indication of the source of the contamination, i.e., loadings increasing with higher flows may present non-point source pollution, while stable loadings during the lower flows, that intercept the y-axis above the origin may represent a point-source discharge. The USGS uses this association to estimate annual loadings, and

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the NJDEP uses total phosphorus loading versus stream flow as the technical basis for Total Maximum Daily Load (TMDL) to estimate the necessary percent reduction of total phosphorus load over the sampled range of flows to comply with the Surface Water Quality Standard.

Non-gaseous, water quality constituents that are expressed as a concentration, or mass per unit volume (e.g., mg/l), can be transformed to loadings using this equation. Other parameters, such as specific conductivity (units of micro-mhos per centimeter, µmho/cm), can be expressed as a flow-weighted (normalized) measure by multiplying by the associated flow (e.g., µmho/cm x cfs).

Water Quality

All monitoring activities conducted during this study were guided by a Quality Assurance Program Plan (QAPP) that was reviewed by the Program Committee and approved by the NJ Department of Environmental Protection, Office of Quality Assurance.

The flow and water quality of a stream segment is usually characteristic of the local geology, land-use, and anthropogenic activities. The range of flows, measured at the USGS continuous flow monitoring stations, over which sampling occurred during the project, were from 0.45 to 106 cfs and 0.79 to 151 cfs for the Lockatong and Wickecheoke Creeks, respectively. These flows represented 4.3 to 93.9 flow duration (percentile) for the Lockatong Creek and 0.9 to 95.4 flow duration for the Wickecheoke Creek. Annual and monthly flow durations (percent of time flow is equal to or less than a given value) from November 2005 and March 2006, through October 2008, are presented in **Table 5** for the Lockatong and Wickecheoke Creek USGS stations, respectively. Annual flow percentiles nearly duplicate the same magnitude of flow between the two streams, but monthly percentiles show a dramatic difference in flows between the streams. During this project, several locations along both streams occasionally exhibited inconsistencies in flow and water quality when compared to data from other sites throughout the watersheds. As previously defined in the Flow section, low-flow monitoring events were referenced to stream flows less than, or equal to 10 cfs, as measured at the USGS continuous flow monitoring stations for each stream. Several flow and contaminant-loading factors may have had a direct influence on some of the water quality results, including:

- Localized precipitation events;
- Localized stormwater runoff;
- Spring thawing of soils;
- Seasonal decomposition of leaves and other organic detritus along and in the streams;
- Relocation of sampling site; and
- Wastewater discharge violations.

Some of the stream "higher-flow" sampling events, defined as flows greater than 10 cfs at the USGS continuous flow-monitoring station, actually had flow less than 10 cfs during the time of sampling, but were combined with the higher-flow dataset since there

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Table 5. Lockatong and Wickecheoke Creek flow durations (percentiles) for 30-minute flow intervals at USGS flow-monitoring stations.

Lockatong - 30-Minute Flow Interval											
	Percentile										
	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%
All data	0.52	1.03	2.05	3.50	5.66	8.59	12.51	17.80	28.54	58.12	131.23
January	6.76	7.78	10.72	15.26	19.01	23.27	29.25	35.22	50.74	100.63	245.01
February	2.58	2.77	3.86	8.72	13.57	17.71	23.27	30.66	45.20	87.57	170.33
March	4.90	5.57	7.32	9.93	13.12	15.84	20.06	29.26	41.05	98.72	259.55
April	4.90	5.66	7.50	9.59	11.12	13.30	16.21	20.88	31.85	77.30	185.57
May	2.91	3.17	4.00	5.57	6.52	8.30	9.55	11.49	16.73	30.00	59.40
June	1.76	1.90	2.21	2.72	3.30	3.93	5.57	8.62	16.21	58.01	122.30
July	1.03	1.14	1.37	1.49	1.76	2.37	3.63	5.48	8.59	16.42	28.33
August	0.05	0.32	0.52	0.68	0.87	0.98	1.14	1.49	2.21	3.50	5.48
September	0.13	0.27	0.45	0.52	1.03	1.74	2.77	4.15	5.78	11.17	35.52
October	0.05	0.32	1.37	1.76	1.90	2.54	5.18	8.99	17.02	44.97	139.85
November	2.72	3.30	4.15	4.90	10.10	14.69	17.80	25.23	35.52	85.40	232.60
December	7.45	8.59	10.04	12.61	16.42	19.69	27.23	36.47	55.97	115.70	218.84
Wickecheoke - 30-Minute Flow Interval											
	Percentile										
	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	95%
All data	0.93	1.13	1.92	3.59	5.97	8.81	12.50	18.54	30.11	60.59	135.90
January	8.05	9.35	11.47	14.33	17.20	20.50	26.76	32.26	41.31	69.91	134.79
February	3.11	3.34	3.71	5.80	8.55	19.49	28.07	36.16	51.10	91.85	170.71
March	7.23	8.04	11.46	15.92	19.00	24.32	30.82	42.22	56.89	151.96	334.85
April	6.36	6.95	9.35	12.15	13.24	15.52	19.00	23.22	36.16	80.24	194.19
May	3.84	4.40	5.46	6.95	8.55	9.92	11.81	14.33	20.50	38.68	72.76
June	2.00	2.18	2.67	3.23	3.84	4.82	6.22	9.83	22.08	86.74	422.64
July	1.13	1.24	1.36	1.49	1.63	2.09	4.79	8.04	12.50	18.56	37.07
August	0.79	0.79	0.93	1.03	1.08	1.30	2.00	2.67	4.20	5.97	8.04
September	0.75	0.79	0.84	0.89	0.98	1.30	2.78	4.72	6.72	13.24	35.41
October	1.08	1.08	1.24	1.56	1.85	2.78	5.46	9.20	18.56	47.03	141.96
November	2.47	2.67	3.23	5.30	12.50	16.34	22.08	30.82	40.42	85.00	210.21
December	8.05	8.81	10.21	12.50	16.77	23.18	30.82	43.14	64.47	127.89	248.11

was precipitation occurring and stormwater runoff at many sites throughout the watershed as water quality samples were being collected. The March 1, 2007 sampling on Lockatong Creek was influenced by organic, nutrient, bacteria, and solids loadings from thawing soils. October 2006 sampling events on both streams were influenced by the influx of organic material from leaf and aquatic plant decomposition. The bridge over the Lockatong Creek on Union Road (site L7) was removed and replaced during April and May 2007. This site was relocated one mile downstream, initiating sampling at the new site L6a. Sites W6, W5, W3, W2, and W1 were influenced by an unauthorized discharge at the Magnesium Electron Incorporated company, just upstream of W6, prior to the sampling event on December 20, 2006.

Originally, Microbial Source Tracking (MST) techniques were proposed to further isolate the source (human or type of animal(s)) of bacterial contamination. During the initial phase of this study, the MST techniques were still undergoing evaluation for their application and robustness to track specific sources. Therefore, boron and nitrate were included in this study to further identify potential sewage loads from septic-system leachate and/or direct discharges into the stream from illicit sewer piping at undisclosed locations, possibly originating from some of the older homes. Boron is a conservative chemical (does not get readily bound to soils) that is used as a laundry whitener. Nitrate is also a conservative compound that, in association with fecal bacteria, can indicate the

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presence of sewage. The combination of fecal bacteria, boron, and nitrate provided a good group of indicators for identifying potential pathogen inputs from either human or animal wastes. Other fecal contamination indicators, not used during this project, include optical brighteners and caffeine.

Spatial Relationships

Appendix E shows the influence of lower and higher flows on average loadings and concentrations, at each monitoring site, for total phosphorus, nitrate, TKN, boron, fecal and Escherichia coliform bacteria, TSS, and turbidity. Due to temporal and flow variations between sampling events, some of the spatial comparisons may not adequately represent average conditions for water quality at specific sampling sites. Lower-flow averages used a minimum of 4 data, and higher-flow values (more limited) used a minimum of 2 data. Whenever possible, spatial comparisons should be based on the selected site plus upstream and downstream site conditions for proper interpretation.

Lockatong Creek

The Lockatong Creek monitoring results revealed the following water quality characteristics, as presented for each monitoring site or groups of sites. **Appendix F** contains graphics illustrating the sub-basins that had the highest loading and/or concentration for each water quality constituent.

Sites L1 thru L4 had elevated levels of TP, nitrate, TKN, boron (higher flows), and TSS. Approximately 31 percent of the land along this stream segment is agriculture, with the majority of the land use (41 percent) as forest. Land slope in this stream segment is steeper than in the rest of the watershed, creating a greater potential for non-point source pollution loadings during rain events. During low flows, the source of the increased phosphorus, nitrogen, and solids may be attributed to resuspension of sediments from livestock access and/or recreational uses. Septic malfunctions may be occurring at locations near the stream channel since boron levels increase during the higher flows. In addition to cobble and boulders being swept into the Delaware and Raritan Canal as "bed-load," suspended sediment conveyed into the Canal from the Lockatong Creek accounts for approximately 1,090 tons per year.

Although site L5 had low loadings of nutrients and solids, the concentrations resulting from very low flows were high, including fecal coliform. Turbidity was elevated at this location due to stormwater runoff from the Kingwood Terrace development. The discharge from the development site occurred frequently over 3 months. Thirty-nine percent of the drainage to this site is agriculture, mostly as horse and crop farms.

Average loadings and concentrations for sites L6 thru L7 showed contributions of phosphorus, nitrogen, boron (higher flows), bacteria, and solids during both low and higher flows. This section of the watershed has nearly the same areas of agriculture and wetland uses, 33 and 30 percent, respectively. Drainage from Kingwood Park enters just upstream and downstream of site L7. The stream channel has been loaded with sediment

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from the drainage of the athletic fields, creating a mound of sediment in half the channel width approximately 1 to 2 feet high and nearly 200 feet long. Drainage from the athletic fields can contain fertilizers and pesticides, as well as sediment.

Site L8 had elevated levels of phosphorus, most of which was originating upstream near site L8a. Boron was extremely elevated, at concentrations and loadings uncommon for agricultural applications or natural conditions (Reiser, 2006 and Grande, 2006). More information on this is presented in the Additional Water Quality Impacts section.

Site L8a had higher levels of phosphorus, nitrogen, bacteria, solids, and turbidity than site L8. Just upstream of site L8a are two constructed ponds that may contain carp and other animals that could be resuspending bottom sediments. The stream water at this sampling site was cloudy nearly every site visit. Drainage from agricultural areas enters the stream approximately a half mile upstream. Approximately 57 percent of the drainage area is agriculture.

Monitoring sites L9 thru L9b consistently presented elevated levels of nutrients, bacteria, and solids during the study. Approximately 54 percent of the land use in this area of the watershed is agriculture. Large greenhouse operations exist just upstream from site L9b. These sites provided the largest flow contribution per watershed area to the Lockatong Creek. During lower baseflows, this tributary contributed up to 82 percent of the total flow throughout the entire stream reach.

Wickecheoke Creek

The Wickecheoke Creek monitoring results revealed the following water quality characteristics, as presented for each monitoring site or groups of sites. **Appendix G** contains graphics illustrating the sub-basins that had the highest loading and/or concentration for each water quality constituent.

Sites W1 thru W3 exhibited elevated nutrients and solids levels, and somewhat elevated bacteria levels (higher flows). During higher flows, boron was also much higher at these sites. Fifty-two percent of the land use in this segment of the watershed is agriculture. Failing septic or illicit sewage discharge(s) may be elevating the phosphorus, boron, and nitrate levels. Pine Hill Road has the steepest grade of the public roads in the watersheds. Stormwater runoff from the roadway and the associated erosion from the roadside drainage ravines, and the additional stream-bank erosion from the soil scouring at the discharge outfalls, increases solids and nutrients at the sampling sites, W3 is the first sampling site downstream of this roadway. In addition to cobble and boulders being swept into the Delaware and Raritan Canal as “bed-load,” suspended sediment conveyed into the Canal from Wickecheoke Creek accounts for approximately 1,394 tons per year.

Site W2a (Rose Brook) receives the discharge from the Delaware Township Municipal Utility Authority’s wastewater treatment facility. Total phosphorus, nitrate, and boron were higher at this site. Frequently, a chlorine odor was present at this site during sampling. Extreme stormwater runoff events have recently become more frequent,

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destabilizing nearly the entire channel. Increased runoff from roadways and additional stormwater being conveyed into this watershed from developments in neighboring watersheds has increased the destabilizaton of the channel.

Bacteria, phosphorus, and nitrate levels were commonly higher at site W3a (Cold Run). Approximately 43 percent of this sub-watershed area is agriculture, with more than 12 percent urban. Much of the Wickecheoke flow, up to 44 percent during the lower baseflows, originates from springs in this watershed. Therefore, ground water quality from this sub-basin can be reflected in the mainstem Wickecheoke Creek, particularly during the lower flows. The low-flow data indicate that there may be higher levels of nitrate flowing out of the ground water springs. Other sources of nitrate, bacteria, and phosphorus could be originating from septic systems on older farmsteads and homes, and/or livestock manure.

Site W3 was located at the covered bridge on Rosemont-Ringoes Road. There have been historical sightings of the state "threatened" long-tailed salamandor in this segment of the Wickecheoke Creek. The water quality data collected at this site showed extensive increases in nutrient, coliform bacteria, boron, and suspended solids loadings during all stream flows. Turbidity was also somewhat elevated throughout all flows. Relatively, loadings from site W3a were minimally influencing the loadings of the entire sub-watershed on the mainstem. The sudden surge in loadings may be the result of contamination originating in the local vicinity of Rosemont-Ringoes Road. The seemingly localized increase in loadings during lower flow directs attention to an increased possibility of illicit sewage discharge(s) and septic leachate, and/or anthropogenic disturbance of the stream channel. Agricultural activities make up approximately 37 percent of the land use in this portion of the watershed, possibly adding to the total loadings. Stormwater runoff and erosion from Pine Hill Road and the roadside drains consistently carries large sediment loads, and the associated nutrients, metals, and solids, into Plum Brook and Wickecheoke Creek, increasing these loadings during rain events.

Sites W4 and W7 are located near the mouth and approximately mid way in the Plum Brook tributary to the Wickecheoke Creek, respectively. Site W4 had greater loadings of nutrients and solids than W7, but due to the dilution ratio, site W7 had consistently higher concentrations. Average turbidity was also higher at W7 along with fecal coliform levels that were increased substantially during higher flows. Except for turbidity, the loadings at W7 were near background conditions. Phosphorus, boron, and fecal coliform were at increased levels over background during higher flows at site W4. The increase of phosphorus, boron, and fecal coliform during higher flows suggests the possibility of malfunctioning septic systems that could leak into the stream only when the soils are saturated. These systems may have been installed further back from the stream channel, but may be underlined with clay or other less-permeable materials.

Site W5 is located just downstream of a series of waterfalls. There is a change in elevation of 160 feet in approximately 1.8 miles of stream length, or a slope of 1.6 percent. This is the steepest change in elevation between any two consecutive monitoring

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stations. Although the water quickly cascades over each of the waterfalls, the pooled areas between the falls are large with very slow water velocities, deeper pool areas at the base of each fall. The slower flows, combined with shallower depths downstream of the scour pools, promotes the growth of both submergent and emergent aquatic plants. The plants take in nutrients during the day and the slower velocities allow the deposition of suspended sediments. The fall-pool regime acts as a natural filter during lower flows. This site is heavily influenced by the increased loadings at site W6 for total phosphorus, nitrate, TKN, boron, and bacteria. A breach in a settling basin wall at the Magnesium Electron Incorporated facility on December 17, 2006 (see Additional Water Quality Impacts section) substantially elevated the TSS and turbidity levels that were recorded at sites W6 and W5 on December 20, 2006. Another source of TSS and turbidity may have been the result of a breached and draining farm pond that discharged into a tributary that confluences the Wickecheoke Creek about ½ mile upstream of W5.

Site W6 experienced increased levels of nutrients, boron, fecal bacteria, solids, and turbidity during low and higher flows. The MEI discharge on December 17, 2006 (see Additional Water Quality Impacts section) created substantial increases in TSS and turbidity during the December 20, 2006 sampling run. The increased levels of sewage indicators may warrant additional monitoring for septic-system leachate and/or illicit sewage discharge(s) into the stream, downstream and upstream of the MEI facility. Geese were consistently observed on a pond near the entrance to the facility, possibly a source of additional pollutant loads.

Sites W8 (mainstem) and W9 (tributary), located on Whiskey Lane, have eroded stream banks, contributing fine and coarse substrates to the channel. Except for nitrate, the levels of nutrients, suspended solids, turbidity, and boron were consistently greater at site W8. Site W9 had mostly background levels of all water quality constituents during low flows. Total phosphorus, organic nitrogen, boron, and bacteria increased substantially during higher flows, and suspended solids were somewhat elevated. Agricultural activity and the possibility of leachate from septic systems or direct sewage discharge are possible loading sources. Neither of these sites was sampled when there was no flow, occurring during several site visits.

All of the sites north of route 12 had somewhat elevated levels of total phosphorus and organic nitrogen during higher flows. Two sites, W11 (Wickecheoke Creek at Rake Road) and W10 (tributary on Old Croton Road), had increased phosphorus loadings, and concentrations exceeding the Surface Water Quality Standards during higher flows. Although nitrate was near background levels, these same sites had higher levels of boron, coliform bacteria, suspended solids, and turbidity, indicating the possibility of illicit sewage discharge(s), septic system malfunction(s), and/or fish and wildlife disturbing the sediments of in-line ponds. In addition to in-line ponds, elevated levels of suspended sediment and turbidity can result from stream egress by livestock and wildlife. Since the channel substrates in this area of the Wickecheoke watershed are mostly larger cobbles and rock, with some sand, channel substrate disturbances by wildlife should not substantially increase suspended solids or turbidity. Nearly 40 percent of the land use is agriculture, with approximately 10 percent as urban. Therefore, fertilizers and/or manure

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may be other sources of nutrient and bacterial contamination. During the summer, this portion of the Wickecheoke watershed was frequently dry, indicating a lower aquifer level in this region. Further ground water studies should be conducted to quantify the available water supply.

Integration of Water Quality Data

Sites L1 and W1 were located near the mouth of the Lockatong and Wickecheoke Creeks, respectively. Data collected by the NJWSA from each site were combined with the associated water quality and flow data that were collected from May through September, 2000 through 2003, as part of the Delaware River Basin Commission's (DRBC) Lower Delaware Monitoring Program (Limbeck, Smith, and Kratzer, 2004). Water quality samples were collected under similar flow regimes during both the DRBC and the NJWSA monitoring programs.

No temporal trending was evident at either site W1 of Wickecheoke Creek or site L1 of Lockatong Creek for any of the following parameters: nitrate, TKN, total phosphorus, TSS, pH, or specific conductivity. A slight association existed between specific conductivity and chloride concentration at both of these sites as illustrated in **Figure 15**. It appears there is a source of chloride that, together with other ions, is directly influencing the specific conductivity level. Chlorides are indicators of leachate from septic systems due to normal waste treatment, as well as water softener brine discharge, laundry detergents, roadway deicing materials, and/or from deeper sources of the ground water supply. More specific tracking of this source was beyond the scope of this project.

Resuspended Sediment and Sediment Sampling

The NJWSA collected "kick sediment" samples to determine the effect of sediment resuspension on ambient water quality concentrations. Samples were collected from four sites along the Wickecheoke Creek and three sites along the Lockatong Creek during low-flow conditions in May and July 2007. The sampling events were scheduled to determine whether the results would be influenced by seasonal water temperatures. The USGS simultaneously collected sediment samples during one of the resuspension sampling events. Total phosphorus (TP), TSS, TKN, nitrate, boron, fecal coliform, and E. Coli were analyzed from ambient and resuspended samples, and total phosphorus was analyzed from sediment samples. Results of all sampling techniques are presented in **Table 6**.

- Total Phosphorus -

Associations existed between the average mass of total phosphorus and sediment. Ambient samples had an average mass ratio of approximately 0.01 TP to 1 of dry sediment, while resuspended and ambient TP and solids had an average ratio of approximately 0.001 to 1. The consistent difference in ratios may be due to particle size. The size of ambient suspended solids should be smaller than the samples derived from resuspended or settled solids. Therefore, although the amount of phosphorus adhering

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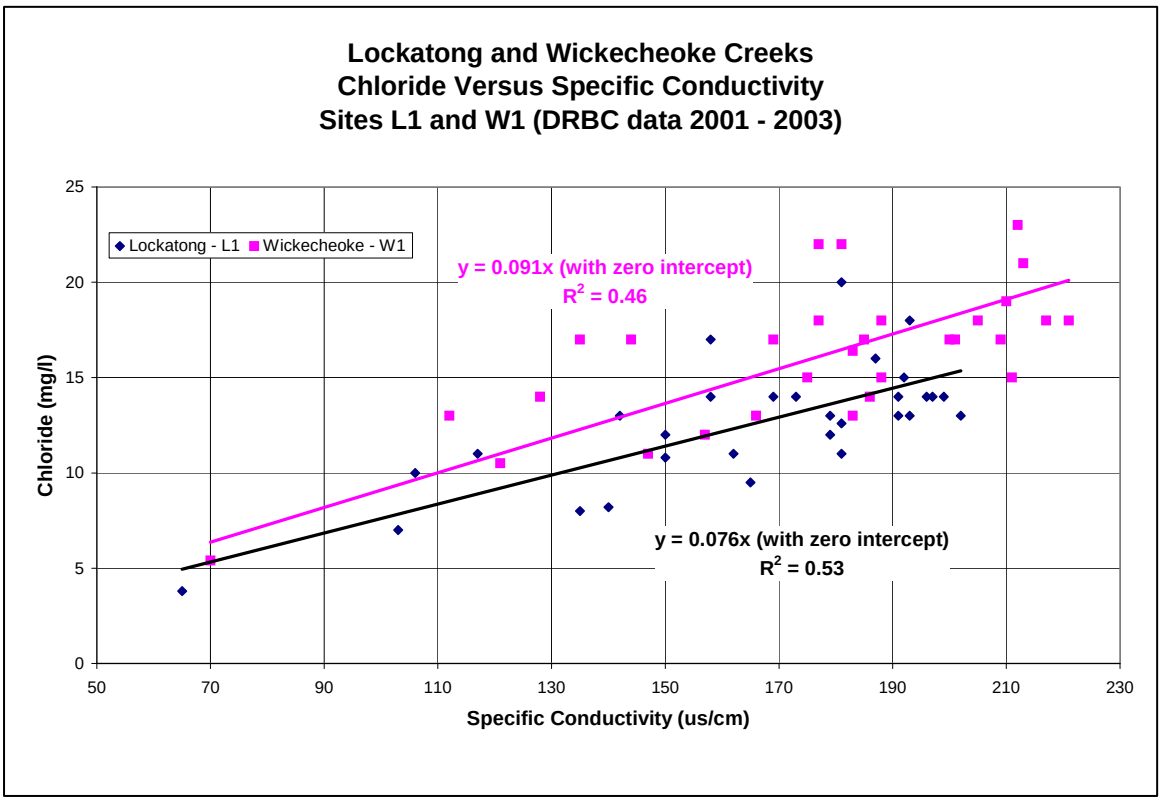
(adsorbed) to the sediment particle may be the same for each sample, the sediment particle mass could be greater for the settled solids, creating a smaller TP:Sediment ratio. This ratio could be used as a surrogate to predict TP concentrations from either

Figure 15. Association between chloride and specific conductivity for water quality data collected by the DRBC near the mouth of the Lockatong and Wickecheoke Creeks.



suspended, resuspended, or ambient sediment mass. Water column (ambient) concentrations of TP during storm flow events were nearly equivalent to the TP concentrations measured from the resuspended-sediment samples collected at the same site. The lowest TP concentration from the resuspended sediment was 0.258 mg/l. Resuspended-sediment concentrations were consistently greater than the ambient levels by nearly an order of magnitude. July concentrations were somewhat higher than those from May, indicating the possibility of increased residential lawn care or additional wildlife activity in the streams and in-line ponds, resuspending sediment. Illustrations comparing seasonality and results of ambient and resuspended sediment analyses are presented in **Appendix F**.

- TSS and TKN -

Total suspended solids (TSS) and total Kjeldahl nitrogen (TKN) showed similar relationships for seasonality, media type, and stream. No distinct differences were noted between the ambient May and July data. However, the resuspended-sediment sample data presented greater concentrations of TSS and TKN during the July samplings,

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possibly due to lower flows that would promote additional particulate settling. Consequently, there also existed a large difference between the ambient and resuspended-sediment concentrations of both TSS and TKN, with the TSS sediment concentrations an order of magnitude greater than the ambient, and most of the sediment TKN concentrations were nearly double those of the ambient samples.

- Nitrate and Boron -

Nitrate and boron were both more concentrated in the Lockatong Creek compared to the Wickecheoke Creek. Boron was elevated at all mainstem sites downstream of an identified loading source in the headwaters of Lockatong Creek, located just upstream of site L8. No July samples were analyzed for nitrate, therefore, seasonality was not determined for this parameter. There was no apparent difference for nitrate between the ambient and resuspended-sediment samples. Boron levels were elevated in both ambient and resuspended-sediment samples during the July samplings, but were nearly equivalent for both media, indicating the increased concentration was not associated with increased settling at lower flows. Further analysis for boron as an agricultural pesticide or other activity that could be supplying additional boron during the lower flows was beyond the scope of this project.

- Coliform Bacteria -

Approximately 39 percent of the land use within the combined watersheds is agriculture, with nearly 12 percent of the land use as urban. The Environmental Protection Agency BIT model provides estimates of fecal coliform loads per agricultural practice. Cattle contribute the largest loads of bacteria followed by hogs, sheep, and geese. Ducks, dogs, and wildlife also contribute large loads of bacteria. Residential and other urban areas are just behind wildlife for bacteria load contributions. According to the Anderson classification code for land use groups, all residential areas are grouped into the "Urban" category.

Other than land-based sources of coliform bacteria, stream-channel sediments can also harbor a large concentration of these organisms. Other studies, including "Middle Delaware Scenic Rivers Monitoring Program," Delaware River Basin Commission; and ***Resuspension of Sediment-Associated Escherichia coli in a Natural Stream***, Rob C. Jamieson et al., Journal of Environmental Quality, 2005, have shown that fine-grained stream sediments can provide optimum conditions for colonizing and sustaining fecal bacteria.

The NJ Water Supply Authority compared ambient water column and suspended sediment samples at several stream sites to determine the extent that fine sediments in the stream channel could provide a source of coliform bacteria loading during higher flow events. Background samples were collected without disturbing the sediment, and suspended sediment samples were collected after disturbing the top layer of the sediment. Suspended sediment concentrations of fecal coliform showed levels ranging from 67 to 450 percent of the water column concentration during May, and from 129 to 916 percent

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of the water column concentration during July. Escherichia coliform (E. Coli) levels differed between water column and resuspended sediment in the range of 33 to 280 percent during May, and from 89 to 875 percent during July. Results from this study supported the published literature regarding the direct association of substrate size and water temperature on the density of coliform bacteria in stream sediments. Samples collected in stream channels with finer sediments and during periods of warmer water temperatures yielded greater concentrations of coliform bacteria. Water temperature ranged from 14° to 17^oC and from 21° to 27^oC during the May and July samplings, respectively. The results indicated that the ratio of E. Coli to fecal coliform may be influenced by seasonal competition between the species. The ratio may have an application for use as an indicator of the relative distance (lag time) downstream from a source of coliform contamination, depending on the die-off rate of each group of bacteria. Further study is required to confirm the use of the E. Coliform to fecal coliform ratio for determining proximity of a contamination source to the sampling site.

Additional Water Quality Impacts

In addition to land use and hydrological affects to water quality, some unanticipated sources of water quality degradation were observed during the monitoring program, as described in the following sections.

- Industrial Discharge -

On December 17, 2006, the sidewall of an inactive settling basin at Magnesium Electron Incorporated (MEI) was breached, releasing a large amount of sediment containing concentrated arsenic, lead, zirconium, and other constituents. On December 22, 2006 ambient water quality samples were collected from the stream and settling pond by the NJ Department of Environmental Protection (NJDEP or DEP). Several analyses of the basin (Pond 7) water presented elevated concentrations of contaminants: sulfate, chloride, chemical oxygen demand (COD), total dissolved solids (TDS), and total suspended solids (TSS). Sulfate levels were elevated in the Pond water, and in combination with manganese acts as a laxative, commonly known as Epson Salt. Manganese was not analyzed. Chloride was somewhat elevated at 42 mg/l. The ambient background concentration is usually below 25 mg/l in the Wickecheoke Creek (DRBC, 2004). COD is a measure of the oxygen consumed as chemicals in the water become oxidized. A ratio of approximately 40 to 80 percent of the COD is equivalent to a 5-day biochemical oxygen demand (BOD_5). The COD concentration was 46 mg/l which is equivalent to approximately 18 to 36 mg/l BOD_5. This level of BOD can create a substantial oxygen deficit downstream of the discharge. In-stream dissolved oxygen concentrations were not measured. The normal ambient background concentration for BOD_5 is usually less than 3 mg/l. The ambient water quality standard for TDS is 500 mg/l. Results from Pond 7 showed 528 mg/l TDS, just above the standard limit. TSS was extremely elevated at 620 mg/l, exceeding the ambient stream water quality standard of 40 mg/l. These results were obtained from samples collected by DEP approximately 5 days following the initial discharge. Sediment samples collected at MEI during November 2006 were analyzed as units of milligrams of analyte per kilogram of dry sediment. The results indicate that

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resuspension of the sediments into the stream flow could create regulatory exceedences of lead and arsenic concentrations.

The NJWSA sampled the Wickecheoke Creek on December 20, 2006 as part of the scheduled sampling program. Concentrations of the following constituents were relatively greater just downstream of the discharge site: fecal coliform, boron, total phosphorus, total suspended solids, and turbidity.

The following photographs show the discoloration of water in the Wickecheoke Creek downstream of the discharge on December 20 and 21, 2006. No photographs are available for December 19, but the observed water color was a very cloudy dark brown, from just downstream of the discharge to sampling site L5.

Wickecheoke Creek at site W5 on December 20, 2006.

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Wickecheoke Creek at Lower Creek Road bridge (between sites W1 and W2), December 21, 2006.

Table 6. Results of simultaneous sampling for ambient, resuspended sediment, and sediment analyses.

			Ambient Samples							
Date	Site	Sediment TP (mg/kg)	TP (mg/l)	TSS (mg/l)	TKN (mg/l)	NO3 (mg/l)	NH3 (mg/l)	Fecal (colonies/100ml)	E.Coli (colonies/100ml)	Boron (mg/l)
5/22/2007	W8		0.017	2.00	0.55	0.10	0.05	40	60	0.0115
5/22/2007	W11a		0.028	12.00	0.54	0.10	0.05	40	50	0.0127
5/22/2007	W11c		0.031	2.67	0.56	0.12	0.05	30	30	0.0115
7/26/2007	W6	1400	0.025	2.00	0.71		0.05	30	20	0.0233
7/26/2007	W8	1500	0.028	4.00	0.62		0.05	90	40	0.0230
5/23/2007	L4		0.023	2.00	0.88	1.97	0.05	110	170	0.0652
5/23/2007	L6a		0.023	3.30	0.84	2.52	0.05	120	100	0.0702
5/23/2007	L8a		0.074	9.30	0.66	2.40	0.05	60	10	0.0141
7/26/2007	L4	990	0.029	3.00	0.97		0.05	120	90	0.0940
7/26/2007	L6a	660	0.075	3.30	0.80		0.06	380	270	0.1140
		Sediment	Resuspended Sediment Samples							
Date	Site	TP	TP	TSS	TKN	NO3	NH3	Fecal	E.Coli	Boron
5/22/2007	W8		0.323	134	1.60	0.10	0.05	40	60	0.0146
5/22/2007	W11a		0.499	624	0.57	0.10	0.05	180	140	0.0142
5/22/2007	W11c		0.323	576	1.97	0.13	0.06	20	10	0.0123
7/26/2007	W6		0.314	686	1.92		0.06	80	40	0.0227
7/26/2007	W8		0.581	710	2.88		0.10	410	350	0.0204
5/23/2007	L4		0.268	150	1.96	2.08	0.05	190	80	0.0756
5/23/2007	L6a		0.258	171	1.67	2.50	0.08	180	160	0.0672
5/23/2007	L8a		0.392	766	1.78	2.30	0.07	130	10	0.0164
7/26/2007	L4		0.437	192	2.13		0.07	1100	80	0.0859
7/26/2007	L6a		0.486	754	2.97		0.06	490	390	0.1020

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- Soil Thawing -

Both the Lockatong and Wickecheoke Creeks were completely frozen from December 2006 through the beginning of March 2007. The first water quality samples collected in 2007 were during the onset of a spring thaw for the Lockatong Creek, March 1, 2007. The observed water color was a slight yellowish-white and organic odors were present at nearly every sampling site. Nutrient and bacteria levels were very elevated from what appeared to be the thawing and release of decomposed organic materials in the subsoils. Data collected during this sampling event therefore represented natural conditions during the spring thaw. After the thaw, Wickecheoke Creek was sampled on March 13, 2007. No coloration or odor was evident at any sampling site and the nutrient and bacteria levels reflected usual background conditions.

- Hydrologic Variations -

Several sampling events were performed during rain storms that increased flows locally. This created inconsistent spatial results for flows and the related water quality loads that only reflected higher flows in areas with stormwater runoff. A localized storm in the Rose Brook watershed occurred on July 21, 2006, affecting the water quality at sampling sites on and downstream of this area along the mainstem of the Wickecheoke Creek. During Wickecheoke sampling events on September 15, 2006 and June 20, 2007, runoff flow from precipitation occurred in the headwaters, not affecting the water quality in the downstream baseflows. Similar conditions occurred in the Lockatong headwaters on July 5, 2007, when a very localized storm created a large surge wave of runoff that was traveling through the mid watershed sampling sites during the sampling event, creating uncertainty for the headwaters sites whether the samples represented storm or baseflow conditions. Due to the uncertainty, these samples were all grouped into the storm-runoff data.

- Concentrated Boron – Source Identification -

Boron concentrations were consistently greater at sampling site L8, a headwater tributary to the Lockatong Creek. Concentrations at levels greater than expected for natural background conditions were identified in the flow from a small spring, originating from a small residential wetland, approximately 150 feet upstream from Lower Oak Grove Road. Staff from the USGS and the Rutgers Snyder Research Farm agreed that the concentrations coming from the spring were not indicative of natural levels or agricultural applications of the element as a pesticide. Natural levels of boron throughout the watersheds were generally in the range from 0.005 to 0.02 micrograms per liter (ug/l). The spring was emitting concentrations in the range of 0.112 to 0.741 ug/l. The downstream effect of this high boron load is shown in **Figure 16**. The load remains very stable as it is carried downstream, showing some slight increases and decreases from either inherent analyticial capabilities or from some deposition and resuspension. The concentration appears to only be influenced by the increases in flow. Specific conductivity showed a good relationship with boron concentrations as illustrated in

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Figure 17. This allowed specific conductivity to be used as a surrogate to track the boron source. Boron has historically been used alone or in combination with other pesticides on agricultural crop lands and orchards, mainly as an herbicide. Boron is also toxic to ants and beetles and has been used as an insecticide. Laundry detergents and whiteners, such as Borax, can supply boron to septic systems. Since this element is relatively conservative, not readily adhering to soil particles, the intent of this project was to use it as a tracer for septic leachate. There is no ambient or drinking water standard for boron. Plants require a limited amount of boron for survival, but at concentrations exceeding this limit the boron becomes toxic to most plants. Pesticide monitoring was not part of this project but should be performed at the spring site to determine if the site was originally used for disposal of pesticides and possibly other associated chemicals.

Figure 16. Boron concentration and load at Lockatong Creek sites upstream and downstream of the source at L8.

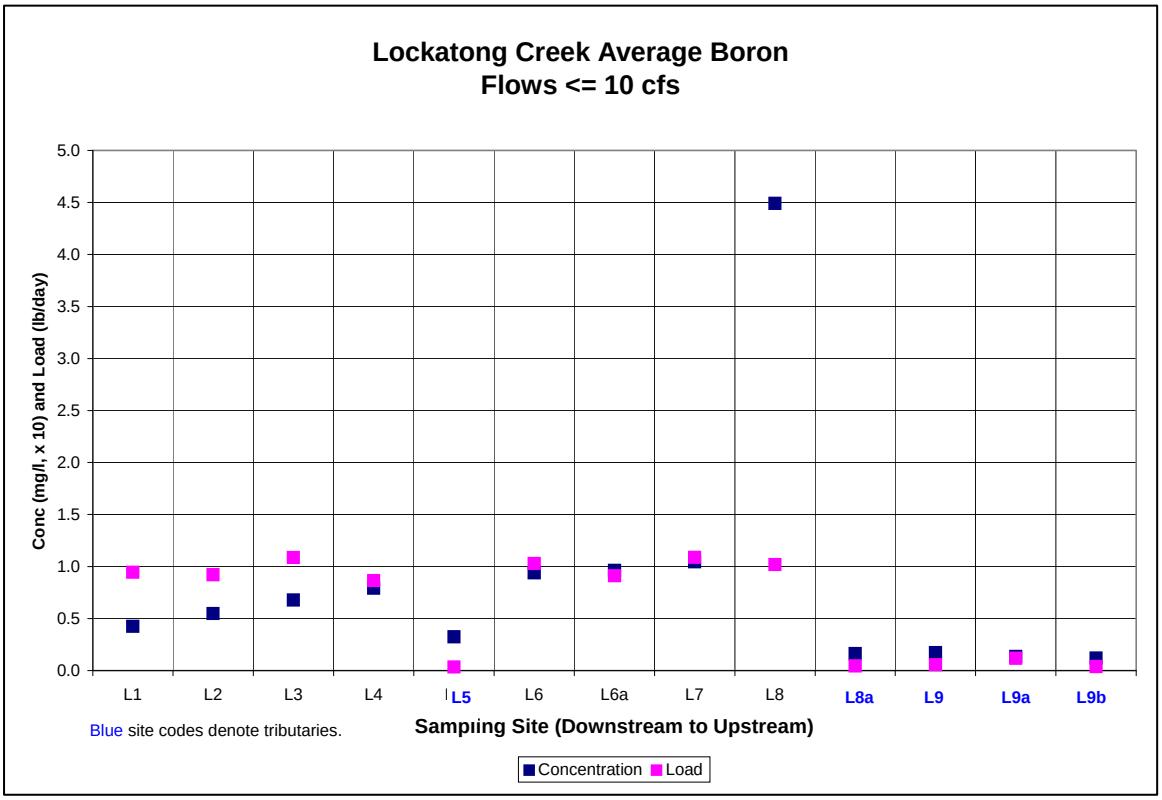

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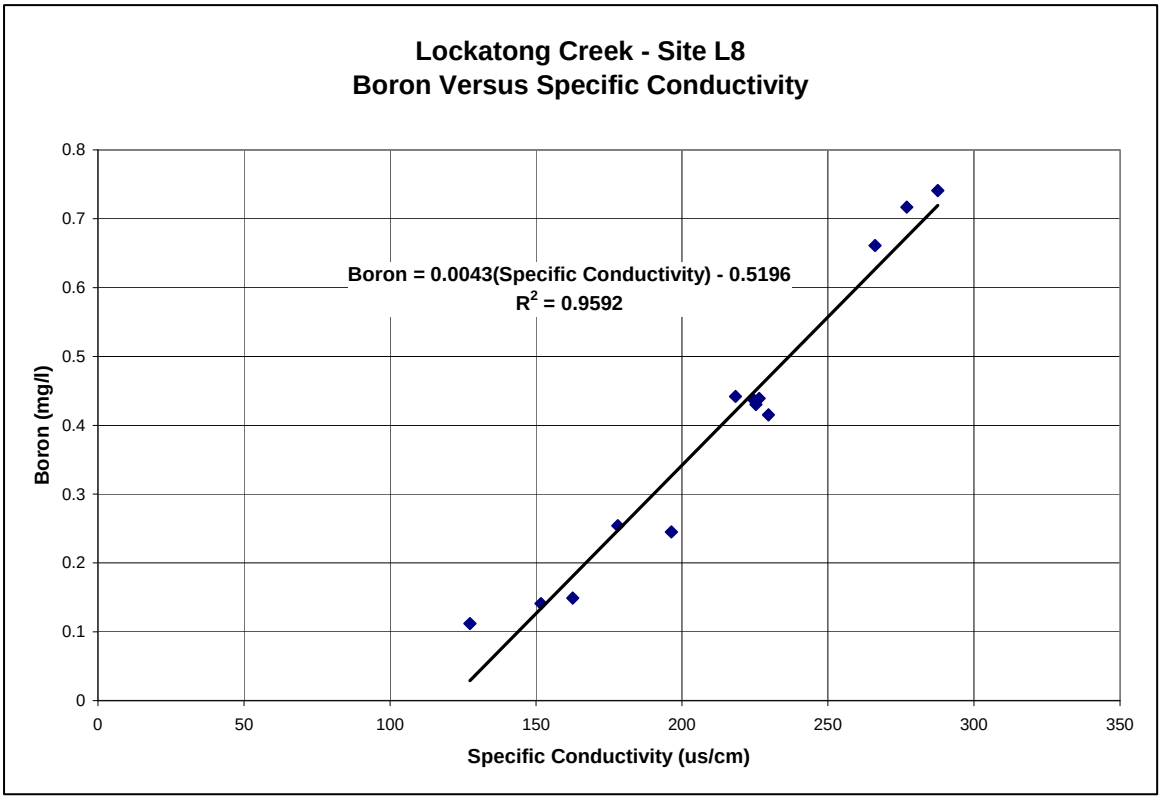
Figure 17. Statistical association between boron and specific conductivity at site L8.



STREAM VISUAL-ASSESSMENTS

Visual assessments of stream channel and aquatic habitat conditions were conducted at 22 sites in the Lockatong watershed and at 25 locations in the Wickecheoke watershed. The assessment protocol are based on qualitative measurements that were developed by the US Department of Agriculture, Natural Resources Conservation Service: ***Stream Visual Assessment Protocol (SVAP)***, National Water and Climate Center, Technical Note 99-1, December 1998. The same field personnel assessed all of the sites for this study to assure consistency among site rankings. Fifteen assessment indicators were used to score a site based on site observations (Hale and Petti, 2008), including:

1. Channel condition: Natural vs. altered channel (e.g. channelization; installation of riprap, dikes or levies; or downcutting or incision).
2. Hydrologic alteration: Connectivity to the floodplain (e.g., structures or channel incision that limit the stream's access to the floodplain).
3. Riparian zone: Stream's buffer area (e.g., a perfect score requires natural vegetation to extend at least two active channel widths on each side of the stream. A lower score, for instance a 5, is given when natural vegetation extends only half the active channel width on each side of the stream).
4. Bank stability: Bank condition (banks are either level with the floodplain and stable or are higher and eroding; banks have exposed roots or slope failures present with the reach).

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5. Water appearance: Water clarity (clear with visible bottom or cloudy/murky).
6. Nutrient enrichment: Presence of algae and/or aquatic macrophytes (A stream with a diverse plant community and clear water scores a 10; a stream with greenish water and an overabundance of algae and/or macrophytes scores a 3).
7. Barriers to fish movement: Withdrawals, culverts, dams or diversions both up and downstream of the reach.
8. Instream fish cover: Available cover types for fish habitat (e.g., woody debris, riffles, pools, and cobble).
9. Pools: Abundance and depth of pools within the reach.
10. Invertebrate habitat: Number of cover types available as habitat.
11. Canopy cover: Coldwater versus warmwater fisheries. The project area is considered a coldwater fishery, thus a reach that is well shaded would score high, whereas a reach that is minimally shaded would score low.
12. Manure Presence: Evidence of livestock in or near the stream; it was not scored for any of the project sites.
13. Salinity: Non-applicable for the project watershed.
14. Riffle embeddedness: Embeddedness of cobble or gravel in sediment.
15. Macroinvertebrates observed: Type and diversity of species present. A site with a good diversity of pollution intolerant species received a score of 15, while a site dominated by more pollution tolerant organisms might receive a 6.

It should be noted that several of the SVAPs were performed during the fall and winter months, which are not ideal months for the observation of macroinvertebrates.

Each assessment element was rated with a score from 1 to 10, except for Macroinvertebrates and Manure Presence that were scored from 1 to 15, and 1 to 5, respectively (Hale and Petti, 2008). Conditions were worst at 1 and best at 10. A stream reach length equivalent to 12 times the channel width was determined for each assessment location, in proximity to public access areas. Any assessment element that was not applicable to a particular site was not scored. Salinity was determined to be not applicable. Manure presence was not identified at the assessment sites, although it may be present at locations not visible from the assessment areas. The scores for each element were summed and divided by the total number of elements assessed obtain the SVAP score. The assessments provided further verification of the extent of channel erosion and its affects on the substrate conditions. The following maps (**Figures 18 and 19**) and **Tables** in **Appendix G** summarize the SVAP results at selected sites for the Lockatong and Wickecheoke watersheds, respectively.

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Figure 18. Selected Stream Visual Assessment locations in the Lockatong watershed.

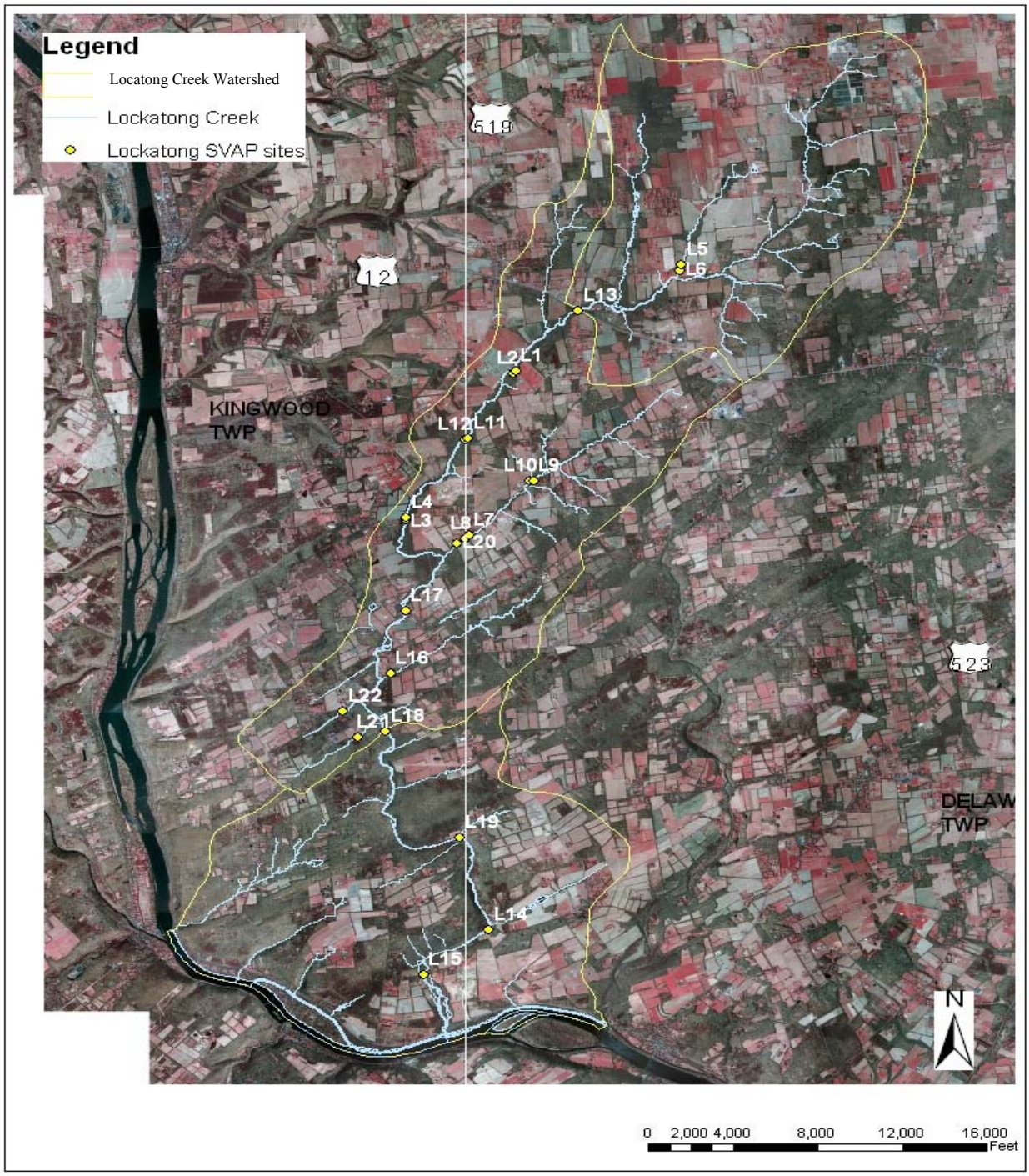

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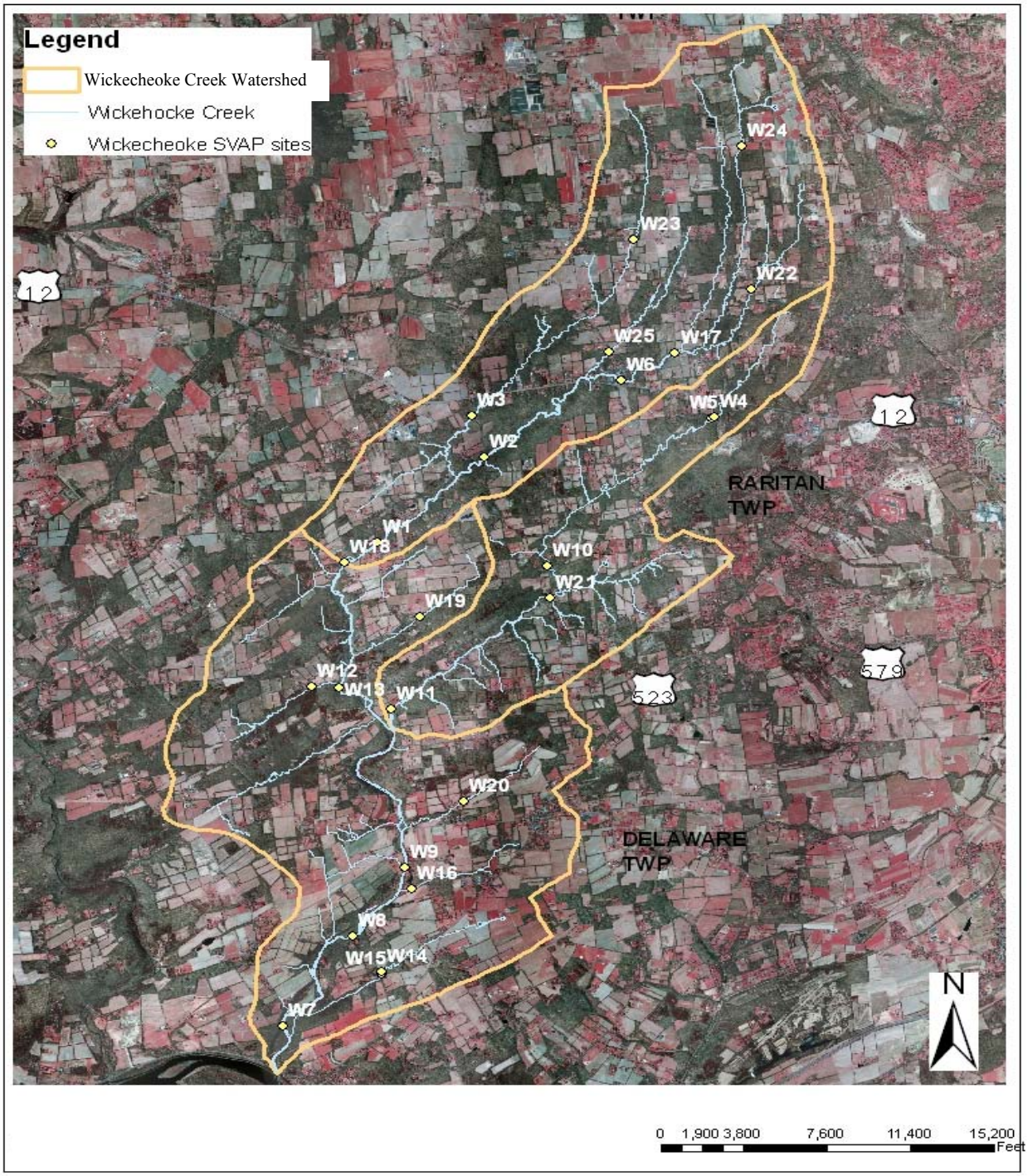
Figure 19. Selected Stream Visual Assessment locations in the Wickecheoke watershed.



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REGULATORY COMPLIANCE

The 2004 Integrated List presented the need to establish TMDLs for total phosphorus, fecal coliform, and temperature. As part of this monitoring program, the data included each of these parameters. However, instantaneous measurements of water temperature were recorded during each sampling event, whereas water quality monitoring protocol developed by the NJDEP during this study requires continuous monitoring for water temperature and pH. Therefore, the data collected during this study can only be used as a reference for additional monitoring needs.

The NJDEP Surface Water Quality Standards specify that ambient water quality must comply with the limits presented in **Table 7**. Stream classifications for the Lockatong Creek are FW2-NT(C1) from the headwaters to Idell Bridge, and FW2-TM(C1) from Idell Bridge to the confluence with the Delaware River. The Wickecheoke Creek is classified as FW2-NT(C1) from the headwaters to the confluence of Plum Brook, and FW2-TM(C1) from the confluence with Plum Brook to the confluence with the Delaware River.

Surface water classifications are defined in the NJDEP Surface Water Quality Standards. FW2 is a general surface water classification applied to surface waters that are not designated as FW1. FW1 is the surface water classification applied to those surface waters that can not be subjected to any wastewater discharges or increases in runoff from anthropogenic (human) activities. NT means the surface water body is not designated for trout production or trout maintenance. The TM, or trout maintenance, classification is applied to sections of streams that are stocked with trout, but do not have a native trout population. Category one (C1) is applied to those surface waters designated in N.J.A.C. 7:9B-1.15(c through h) for protection by antidegradation policies (N.J.A.C. 7:9B-1.5(d)) to disallow measureable changes to water quality.

Table 7. Surface Water Quality Regulations applicable to the study streams.

Water Quality Parameter	Applicable Stream Category*	Regulatory Limit(s)[1]	Sampling Criteria
Fecal Coliform	FW2	Geometric Average ≤ 200 cfu/100 ml, and ≤ 10 % shall not exceed 400 cfu/100 ml	5 samples in 30 days
Escherichia Coliform (E. Coli.)	FW2	Geometric Average ≤ 126 cfu/100 ml, and None shall exceed 235 cfu/100 ml	5 samples in 30 days
Total Suspended Solids (TSS)	FW2-TM FW2-NT	≤ 25 mg/l ≤ 40 mg/l	
Turbidity	FW2-TM FW2-NT	≤ 15 NTU ≤ 50 NTU	30-day average Shall not exceed

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Water Quality Parameter	Applicable Stream Category*	Regulatory Limit(s)[1]	Sampling Criteria
pH	FW2	6.5 to 8.5 Standard Units	Shall not exceed
Total Phosphorus	FW2	≤ 0.1 mg/l	Shall not exceed
Water Temperature	FW2-TM FW2-NT	≤ 20 °C (68 °F) ≤ 27.8 °C (82 °F)	Seasonal Average (May – Sept)

[1] Definitions for the abbreviations are: cfu/100 ml = colony forming unit per milliliter; mg/l = milligram per liter; NTU = Nephelometric Turbidity Unit; °C = degree Centigrade (or Celcius); and °F = degree Fahrenheit.

Table 8 shows the geometric average of fecal coliform and E. Coli, and the number of exceendences of the water quality standards for total phosphorus, total suspended solids, and turbidity. Although subsurface interflow can occur following the cessation of surface flow, samples that were collected when the stream channel was ponded, but not flowing, were not used to determine loading reductions. Wickecheoke sites W8 and W10 each had a sample collected during interflow conditions that was not included in the analyses.

TMDL SUPPORT

Total phosphorus and coliform bacteria sampling were targeted as both contamination indicators/quantifiers and support for the TMDLs. Average values were derived from data collected from March through December. Lower flow averages were determined from 4 or more total phosphorus values per site, while higher flow averages were determined from 2 or more values per site. There were less higher flow data available to determine averages at as many sites as the low-flow data.

Total Phosphorus

During lower flows (USGS flow-monitoring station ≤ 10 cfs) the Lockatong Creek had greater concentrations of average total phosphorus in the headwater tributaries, L8 and L9 subreaches, relative to the other sites. The concentration range for these tributaries was 0.06 to 0.09 mg/l. The mid and lower watershed sites were less than 0.045 mg/l. The greatest average loading was 0.8 lb/day at site L1. Greater flows at this site diluted the loadings to less than 0.045 mg/l. All other sites had average loadings less than 0.45 lb/day. Higher flows (> 10 cfs) created the greatest average concentration of 0.28 mg/l in subreach L9. Sites L2, L4, and L8 were the only monitoring locations with average concentrations less than 0.1 mg/l. Average loadings increased in a downstream direction, from approximately 7 lbs/day in the headwaters to nearly 48 lb/day at site L1. Illustrations for average total phosphorus concentrations and loadings at each site, during lower and higher flows are presented in **Appendix E**.

The Wickecheoke Creek had fairly constant average total phosphorus concentrations throughout the watershed during flows less than or equal to 10 cfs, ranging from 0.035 to 0.075 mg/l, except for site L2a that had an average concentration of 0.12 mg/l. Most

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average loadings were less than 0.24 lb/day, with greater loadings at sites W1, W2, and W3 ranging from 1.0 to 1.3 lb/day. During greater flow events that exceeded 10 cfs, the range of average concentration was from 0.03 to 0.29 mg/l. Most headwater loadings were below 7.5 lb/day. Average loadings became more elevated in the mid to lower watershed areas, with W1 having an average load of 93 lb/day. Due to available dilution, the average concentration at site W1, compared to the other monitoring sites, was relatively low at 0.13 mg/l.

Five of the six total phosphorus results at site W2a (Rose Brook) have exceeded the ambient 0.1 mg/l water quality standard, ranging from 0.094 to 0.225 mg/l. During low-flow conditions, site W2a also presented elevated concentrations of nitrate and boron compared to the other monitoring sites in the Wickecheoke watershed. The elevated average concentrations of these three indicators reflect the anthropogenic source of the loadings (e.g., the Delaware Township Municipal Utility Authority). The permitted maximum total phosphorus discharge at the time of the total phosphorus TMDL was 1.0 mg/l at 0.1 cfs, or 0.54 lb/day (197 lb/yr).

As part of this study, percent load reductions were calculated for the total phosphorus TMDL as represented by combining all samples in each HUC 14. **Figures 20 through 22** show the loading reductions required to achieve a concentration of 0.1 mg/l total phosphorus at the outlet of the 3 HUC 14 sub-basins in the Lockatong Creek watershed, using the Flow-Integrated Reduction of Exceedences (FIRE) method (Kratzer, 2005). This method is used to determine total phosphorus TMDLs by the NJDEP for estimating the load capacity of streams to attain the Surface Water Quality Standard.

On-site and watershed-wide stormwater controls, in addition to the elimination of livestock access to the riparian corridor, and reduction of fertilizer loads, will reduce the associated ambient phosphorus, nitrogen, and bacteria concentrations. Increased management of fertilizer and pesticide applications on agricultural fields, athletic fields, public parks, and on commercial and residential lawns, should greatly reduce loadings in tributary subreaches L9, L8, L7a, W11, W9, and W3a. Mainstem sites that should benefit from increased management of fertilizer and pesticides include L1, L6a, L7, W1, W2, and W3.

Table 8. Regulatory Compliance/Non-Compliance.

Sampling Site	Bacteria #/100ml				Total Phosphorus (mg/l)		Total Suspended Solids (mg/l)		Turbidity (NTU)	
	Fecal Coliform		E. Coliform							
	Geo Avg 5 in 30 days	Geo Avg all data[1]	Geo Avg 5 in 30 days	Geo Avg all data	No. of Exceedences	Max. Conc.	No. of Exceedences	Max. Conc.	30-day Avg [2]	Max.
L1	-------	98	-------	-------	1/6	0.163	0/6	15.2	6.9	19.8
L2	40	55	38	33	2/14	0.336 (ice melt)	1/14	27.6	12.5	36.7
L3	-------	178	-------	-------	1/6	0.155	0/6	19.6	8.9	25.5
L4	398	214	263	141	2/15	0.259 (ice melt)	0/15	27.6	13.5	37.4
L5	-------	269	-------	-------	1/6	0.189	0/5	16.0	6.1	23.6
L5a	-------	251	-------	162	0/4	0.077	0/4	7.3	-------	20.0
L6	-------	219	-------	-------	1/6	0.217	0/6	23.2	14.3	38.6
L6a	363	200	372	151	0/8	0.075	0/8	5.0	5.3	6.0
L7	-------	162	-------	-------	2/7	0.177	0/7	18.8	11.0	28.8
L7a	-------	174	-------	269	1/3	0.126 (ice melt)	0/3	17.0	-------	31.0
L8	-------	117	-------	-------	1/9	0.117	0/10	8.0	7.0	9.0
L8a	692	209	602	151	3/8	0.122	0/8	10.7	10.2	15.0
L9	-------	95	-------	-------	3/10	0.471	0/7	14.4	11.0	30.7
L9a	501	200	479	138	2/9	0.375	0/8	5.5	2.2	5.4
L9b	-------	363	-------	302	2/6	0.482	0/5	6.7	4.0	9.4
W1	-------	219	-------	-------	1/6	0.187	0/6	14.5	11.2	22.5
W2	98	78	48	28	1/14	0.172	0/14	12.8	11.2	22.3
W2a	-------	288	-------	-------	5/6	0.225	0/6	2.8	-------	12.3
W3	-------	158	-------	-------	1/6	0.185	0/6	13.2	12.2	23.9
W3a	155	263	174	174	1/7	0.186	0/7	6.8	1.0	11.5
W4	112	186	48	48	2/9	0.134	0/9	5.2	7.9	13.7
W5	18	36	18	13	2/14	0.219	0/14	14.8	15.2	98.7
W6	-------	257	-------	-------	4/8	0.271	0/8	16.0	18.2	47.4
W7	-------	204	-------	-------	2/7	0.117	0/7	13.3	11.2	23.6
W8	371	219	324	129	3/15	0.363	2/15	317.0	145.0	530.0
W9	-------	347	-------	-------	1/5	0.198	0/5	37.7	17.1	31.4
W9a	316	182	295	126	0/7	0.061	0/7	5.0	6.4	11.0
W9b	-------	-------	-------	-------	0/2	0.019	-------	-------	-------	-------
W10	-------	372	-------	-------	3/6	0.263	0/5	14.0	14.7	22.4
W10a	-------	83	-------	37	2/5	0.178	0/5	8.0	11.0	15.0
W11	-------	209	-------	-------	2/5	0.346	1/5	55.2	38.0	86.5
W11a	-------	93	-------	100	0/6	0.082	0/6	13.7	9.5	18.0

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Sampling Site	Bacteria #/100ml				Total Phosphorus (mg/l)		Total Suspended Solids (mg/l)		Turbidity (NTU)	
	Fecal Coliform		E. Coliform							
	Geo Avg 5 in 30 days	Geo Avg all data[1]	Geo Avg 5 in 30 days	Geo Avg all data	No. of Exceedences	Max. Conc.	No. of Exceedences	Max. Conc.	30-day Avg [2]	Max.
W11b	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
W11c	-------	71	-------	55	0/6	0.064	0/6	9.0	6.7	8.1

Note: Red highlighting represents water quality exceedences and yellow highlighting represents values approaching water quality standards limits.
[1] Geometric average bacteria analyses were performed at sites having a minimum of four data.
[2] Minimum of 3 samples collected within a 30-day period.

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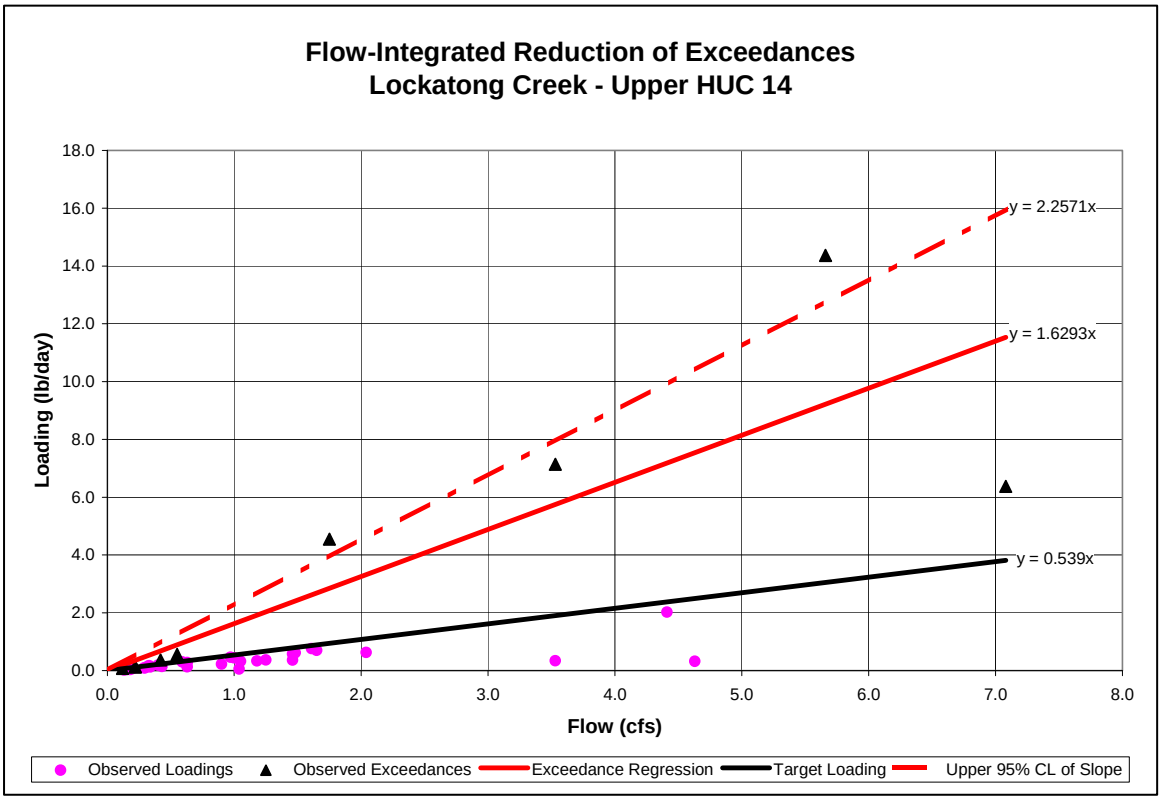
Figure 20. Upper Lockatong Creek load-reduction assessment for total phosphorus exceedences of 0.1 mg/l.



Results from Regression Analysis		
Target Loading Slope	=	0.5390
Exceedance Regression Slope	=	1.6293
Upper 95% Confidence Limit of Exceedance Slope	=	2.2571
Percent of Existing Loadings		
Overall Percent Loading Reduction	=	76.12%
Margin of Safety	=	27.81%

"Results from Regression Analysis" as shown above are the slopes of the regression lines for the "Target Loading Slope," "Exceedance Regression Slope," and the "Upper 95% Confidence Limit of Exceedance Slope." The difference between the Upper 95% CL slope and the Target slope equals the "Overall Percent Loading Reduction." The "Margin of Safety" equals the difference between the Upper 95% CL slope and the Exceedance slope.

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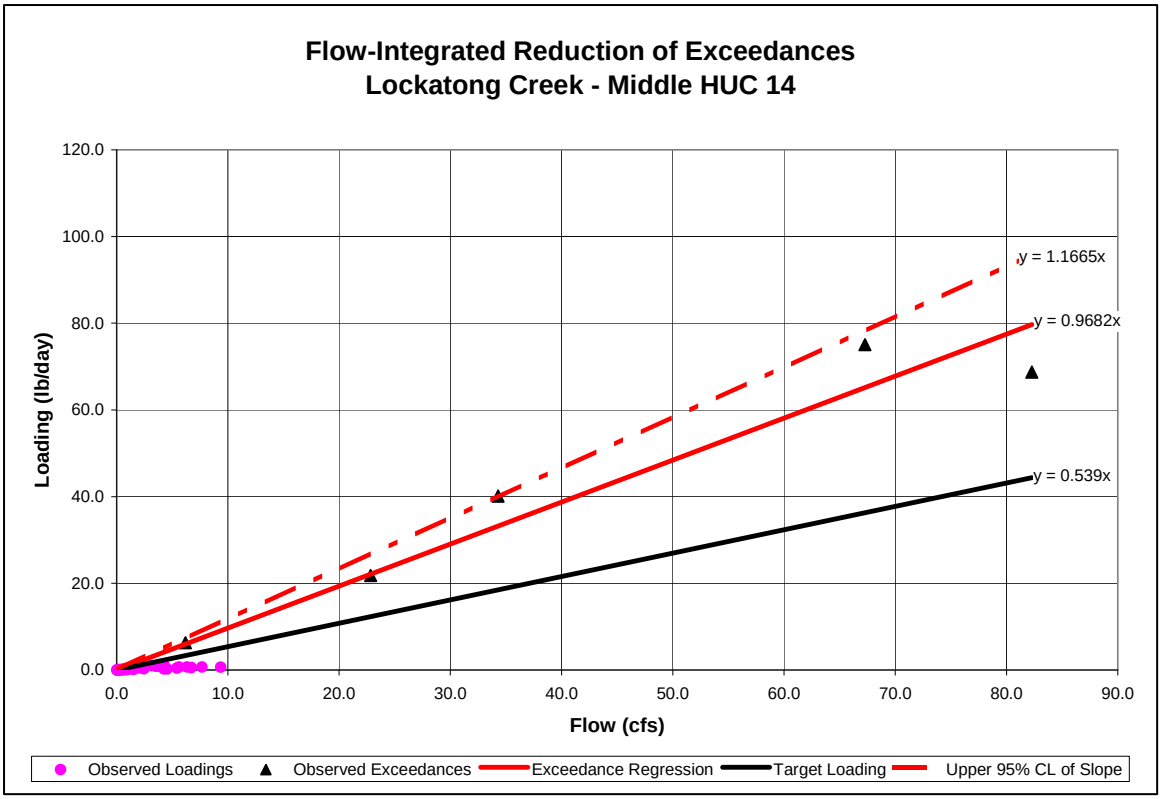
Figure 21. Middle Lockatong Creek load-reduction assessment for total phosphorus exceedences of 0.1 mg/l.



Results from Regression Analysis		
Target Loading Slope	=	0.5390
Exceedance Regression Slope	=	0.9682
Upper 95% Confidence Limit of Exceedance Slope	=	1.1665
Percent of Existing Loadings		
Overall Percent Loading Reduction	=	53.79%
Margin of Safety	=	16.99%

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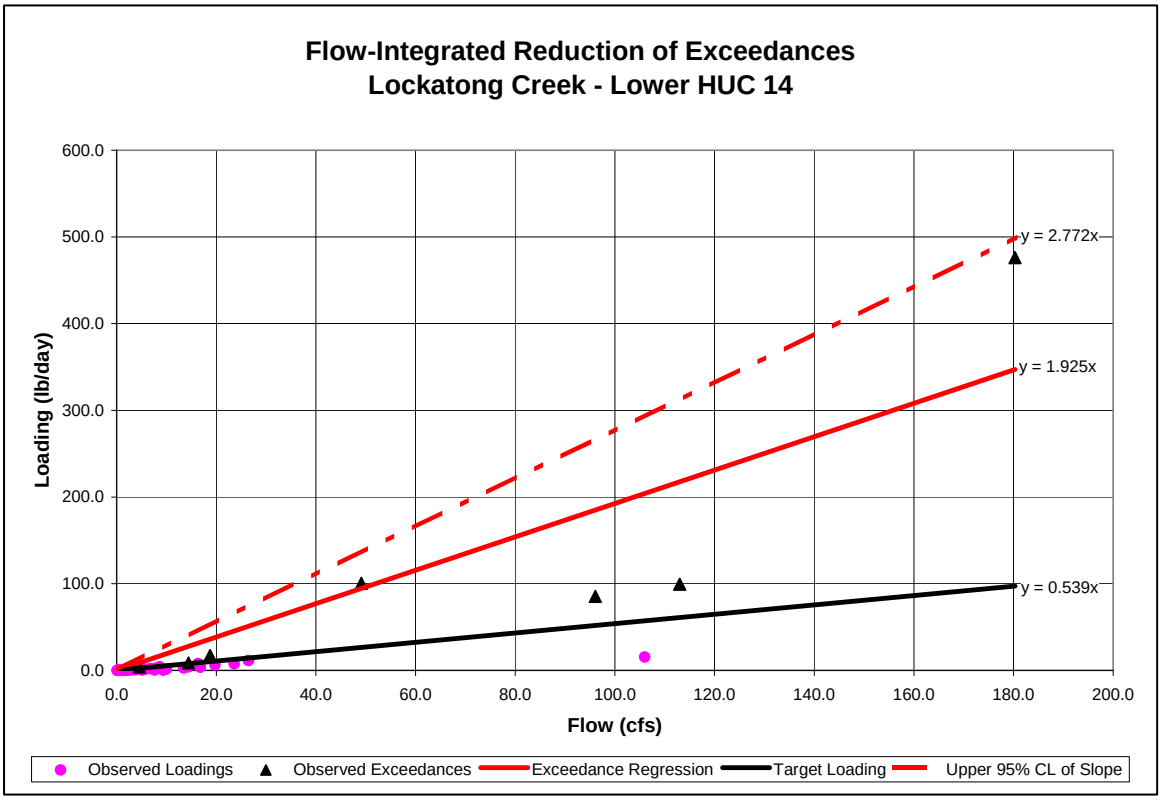
Figure 22. Lower Lockatong Creek load-reduction assessment for total phosphorus exceedences of 0.1 mg/l.



Results from Regression Analysis		
Target Loading Slope	=	0.5390
Exceedance Regression Slope	=	1.9250
Upper 95% Confidence Limit of Exceedance Slope	=	2.7720
Percent of Existing Loadings		
Overall Percent Loading Reduction	=	80.56%
Margin of Safety	=	30.56%

Load reductions implemented in the upper and middle HUC 14s should also reduce the more downstream loadings, unless there are localized loading sources. The total phosphorus loads for Lockatong Creek illustrate that the upper HUC 14 had a maximum loading of approximately 14 lb/day, followed by the middle and lower HUC 14s that had maximum loadings of approximately 75 and 470 lb/day, respectively. Therefore, the data indicate more dispersed localized loading sources throughout this watershed.

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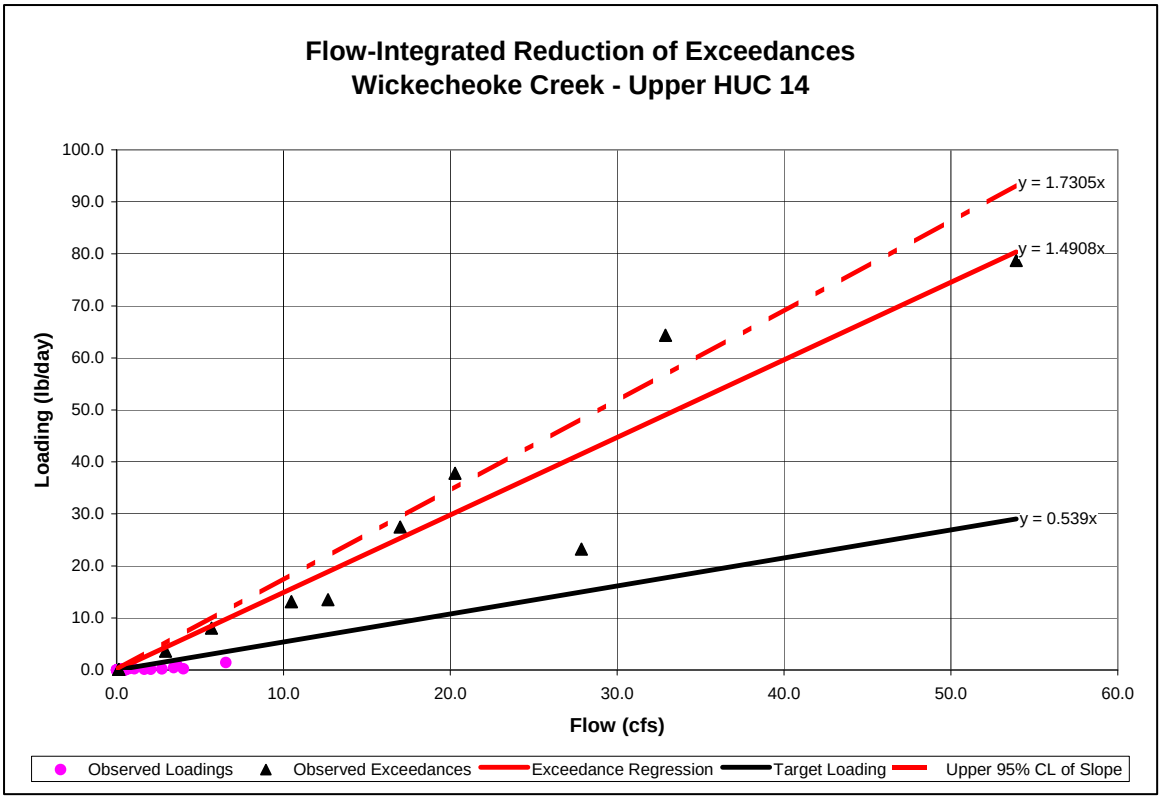
Figures 23 through 25 show reductions in total phosphorus loading required at the outlet of the 3 HUC 14 sub-basins in the Wickecheoke Creek watershed, to attain a concentration of 0.1 mg/l.

Figure 23. Upper Wickecheoke Creek load-reduction assessment for total phosphorus exceedences of 0.1 mg/l.



Results from Regression Analysis		
Target Loading Slope	=	0.5390
Exceedance Regression Slope	=	1.4908
Upper 95% Confidence Limit of Exceedance Slope	=	1.7305
Percent of Existing Loadings		
Overall Percent Loading Reduction	=	68.85%
Margin of Safety	=	13.85%

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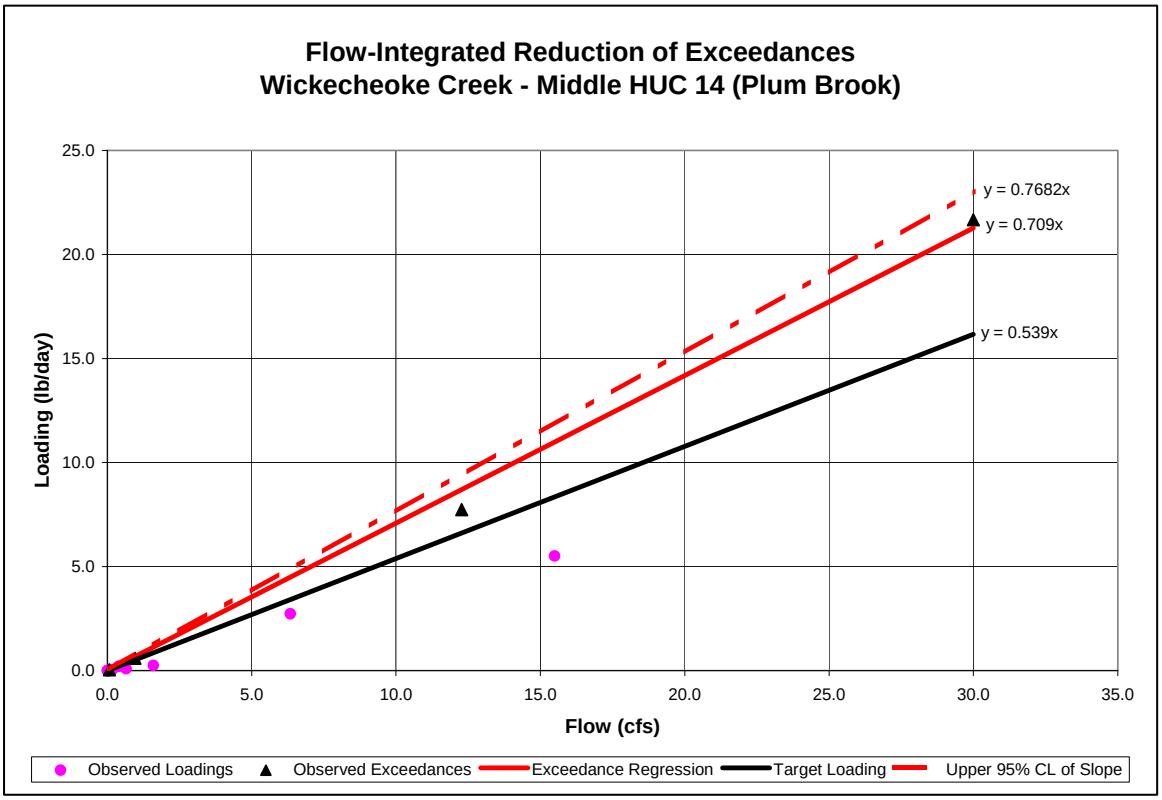
Figure 24. Middle Wickecheoke Creek (Plum Brook) load-reduction assessment for total phosphorus exceedences of 0.1 mg/l.



Results from Regression Analysis		
Target Loading Slope	=	0.5390
Exceedance Regression Slope	=	0.7090
Upper 95% Confidence Limit of Exceedance Slope	=	0.7682
Percent of Existing Loadings		
Overall Percent Loading Reduction	=	29.84%
Margin of Safety	=	7.71%

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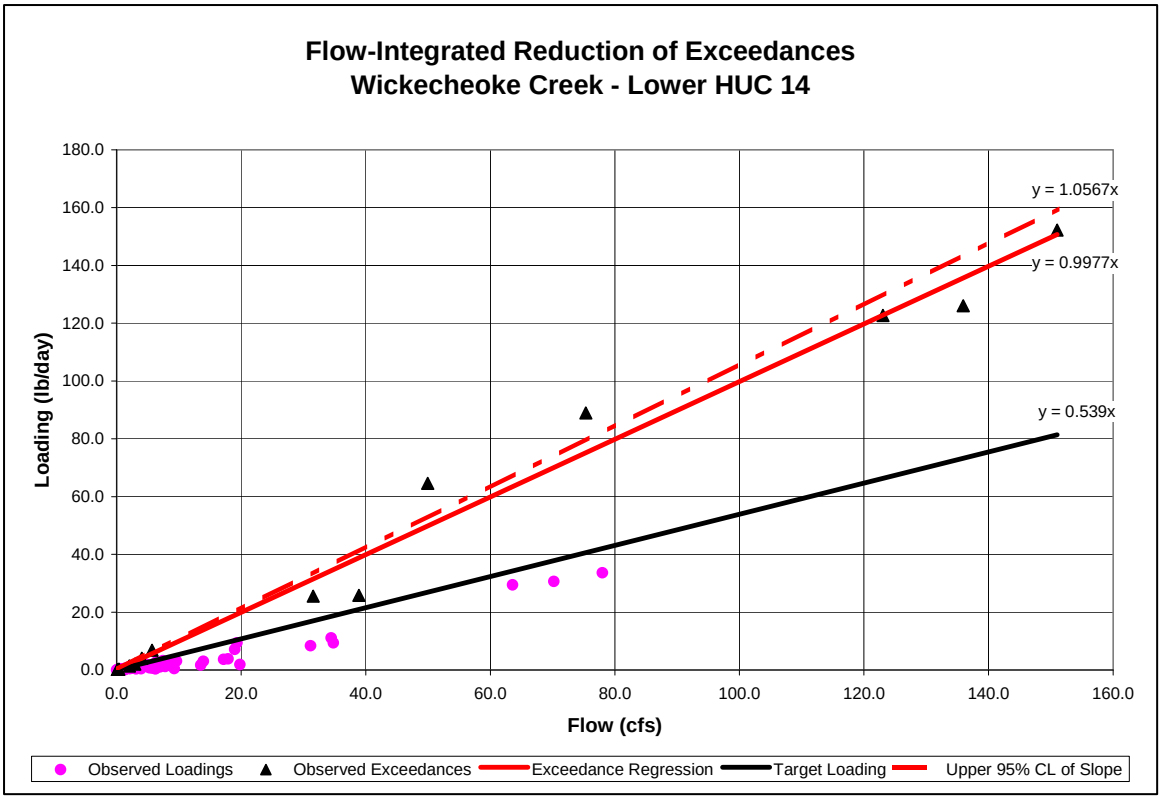
Figure 25. Lower Wickecheoke Creek load-reduction assessment for total phosphorus exceedences of 0.1 mg/l.



Results from Regression Analysis		
Target Loading Slope	=	0.5390
Exceedance Regression Slope	=	0.9977
Upper 95% Confidence Limit of Exceedance Slope	=	1.0567
Percent of Existing Loadings		
Overall Percent Loading Reduction	=	48.99%
Margin of Safety	=	5.58%

The Wickecheoke Creek loadings of total phosphorus show maximums of 80, 20, and 150 lb/day within the upper, middle, and lower HUC 14s, respectively. A load reduction of 69 percent in the upper HUC 14, combined with a 30 percent reduction in the middle HUC 14, should lessen the lower HUC 14 maximum total phosphorus loading by approximately 61 lb/day, or a remaining load of 89 lb/day. An approximate 9 lb/day would have to be eliminated from the lower HUC 14 to meet the surface water quality regulation of 0.1 mg/l. Other combinations of reductions can also be developed to meet the regulatory criteria.

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Coliform Bacteria

Fecal coliform and E. Coli are used as indicators for locating possible sources of pathogens. These bacteria groups consist of various strains of bacteria that can be associated with either human or animal origin. A TMDL for fecal coliform was developed for the Wickecheoke Creek in 2005. E. Coli was introduced as a State Surface Water Quality Standard in the beginning of 2007, replacing the fecal coliform standard. Both bacteria types were analyzed to determine any variability in the test results between the groups. The groups usually presented higher densities of fecal bacteria in relation to the E. Coli group as would be expected. There were however, occasional shifts between the dominant groups. These shifts may indicate the presence of a localized source, since the die-off (decay) rates of the two groups are different. Ultraviolet radiation from sunlight and water temperature affect individual strains of bacteria differently. The ratio of bacteria densities (E. Coli/fecal) may provide an indication of the distance to a source, whether in close proximity to the sampling location or further upstream. Bacteria can thrive in fine-grained sediments, increasing water column bacterial densities during higher flows from the resuspension of sediments. Inoculation of bacteria into the sediments from upland sources should be considered as an internal loading source. Both of the streams had fine-grained sediments at several locations in the watersheds. Further investigation for determining the use of a bacteria ratio for source location was beyond the scope of this project.

Nitrate and boron were analyzed in conjunction with fecal and E. coliform bacteria to facilitate the association of elevated bacteria levels to the source(s) of contamination. Nitrate is produced during the decomposition of fecal matter and boron is used as a laundry whitener. These chemicals are very conservative, not adhering to soil particles, and therefore become concentrated at locations of septic leachate. However, a loading of boron in the headwaters of Lockatong Creek interfered with the identification of soure(s) in this watershed during lower flows. During higher flows the identified boron load had less of an effect. Increased concentrations and loadings were prevalent in reaches suspect of human contamination. As an indicator group, bacteria, boron, and nitrate provided a good indication of contaminant source(s) during both low and higher flows. Microbial Source Tracking (MST) techniques were originally proposed for this project to further isolate the source (human or type of animal(s)) of bacterial contamination. During the initial phase of this study, the MST techniques were still undergoing evaluation for their application and robustness to track specific sources. Therefore, boron and nitrate were included in this study to further identify potential sewage loads from septic-system leachate and/or direct discharges into the stream from illicit sewer piping at undisclosed locations, possibly originating from some of the older homes.

In addition to decreasing the amount of nutrients and solids, BMPs implemented for these sources, will also decrease the amount of pathogens potentially entering the streams. Controls for phosphorus alone should provide the necessary decrease in coliform bacteria as required by the fecal coliform TMDL for the Wickechoeke Creek. Potential sources of elevated bacteria levels include: livestock access to the stream; manure in close proximity to the streams or spread as fertilizer on fields adjacent to the streams; illicit sewage

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discharges; malfunctioning septic systems; observed geese habitat; and internal sources of bacteria colonization in the stream sediments that can be resuspended during higher flows. All of these sources also contribute total phosphorus loadings.

APPLICABLE ANTIDEGRADATION CRITERIA

Ambient water quality data can present a good relationship between flow and concentration, although flow can many times bias concentrations through the creation of a greater dilution ratio (flow to pollutant loading ratio). Concentration alone may show no change during higher-flow storm events when enhanced runoff is actually causing increased stream channel and upland erosion. Since concentration is dependent on the ratio of pollutant load to flow, contamination can be diluted as the flow increases, thus reducing concentration levels at higher flows. However, as flows are reduced, water quality concentrations usually increase proportionally since concentration is directly proportional to the amount of flow (dilution) and constituent loading in the stream flow. At very low flows, present during the summer season, concentrations are very sensitive to small increases in pollution loadings and may increase dramatically as the flows approach zero, even though loadings remain constant or even decrease somewhat.

Commonly, lower flows are targeted as critical protection conditions, since lower flows provide minimal dilution capacity, promote higher water temperatures and greater biological activity, and increase the potential threat of ammonia and metals toxicity. Therefore, to adequately protect existing water quality, the lower-flow regime must be targeted for water quality standards. Another flow target for assessing changes to water quality may be an intermediate level (i.e., median May through September flow) during the low-flow season that reflects the water quality associated with stormwater runoff and possible stream-channel instability.

One strategy for developing numerical criteria for water quality is to relate loadings over the entire flow regime that existed during each sampling, as shown in **Figure 26.** This illustrates the use of a ln-ln loading versus flow relationship (Kratzer, 2008) for total phosphorus at a “target” low flow for establishing water quality based regulations during critical low-flow conditions. At the illustrated hypothetical flow target of 5 cfs, the associated total phosphorus concentration is 0.1 mg/l, equivalent to the Surface Water Quality Standard. If the loadings in the Lower Lockatong HUC 14 are reduced by 80.6 percent, as estimated by the FIRE method (Regulatory Compliance section), the equivalent total phosphorus concentration at 5 cfs would be reduced to 0.02 mg/l.

Concentration versus flow can provide a good correlation at low flows, but does not support the estimated y-intercept as the flows approach zero. At zero flow, concentration should approach or equal zero (hypothetically, during dry stream conditions). However, concentration levels usually become exponentially elevated, from lack of dilution, just before flow reaches zero. This leads to uncertainty as to where the regression line intersects the y-axis for low-flow estimates that closely approximate, but do not equal, zero. Transforming the concentration values to loading values resolves the intercept

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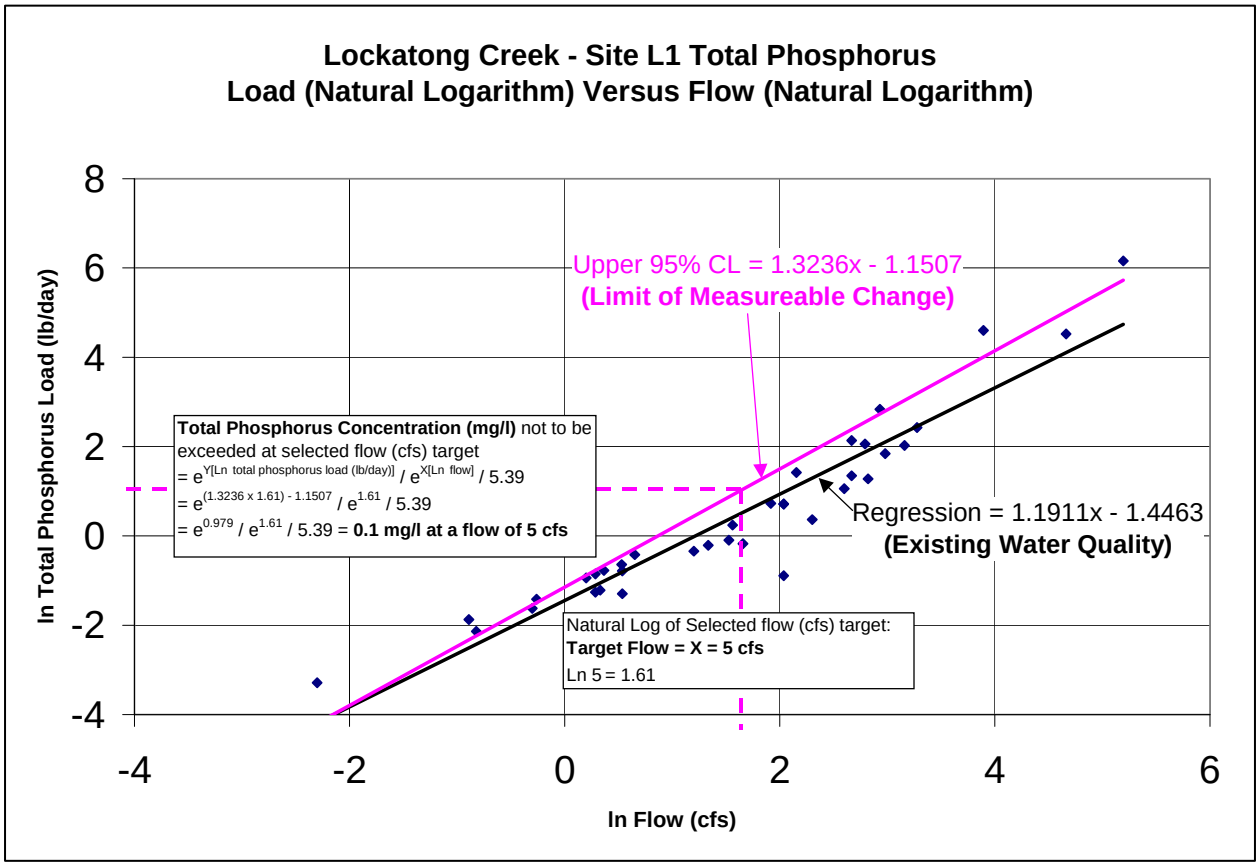
problem, since loading (or flux, mass per unit time) approaches zero at low flows and equals zero at zero flow.

Figure 26. Example of linear regression water quality protection criteria for Lockatong Creek (site L1) total phosphorus data. A ln-ln regression of loading versus flow analysis and an upper 95 percent confidence limit about the slope are illustrated to define "existing water quality" and "measureable change." A hypothetical flow target of 5 cfs was used in the example.



Linear regression provides a good definition of the relationship between loading and flow, over the range of flows present during sampling events. Richards (1999), Kratzer (2005), and several US Geological Survey authors have used similar models to predict pollutant sources, annual loads, TMDL reductions, and water quality trends. This relationship can be used as a measure of "existing" water quality, as a water quality protection strategy, and as an estimate of total loading for the time of sampling.

In **Figure 26**, the use of a natural log-log relationship is used to allow the use of parametric statistics on skewed water quality data and flow data distributions. This provides a linear regression line that approaches, but does not intercept zero. Since loading is not an issue at zero flow, the logarithmic relationship provides a good model. If constant point-source loadings are present, the unadjusted loading versus flow relationship will intersect the y-axis at a value above zero. In this case, each loading value should have the constant loading subtracted prior to development of the regression

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model. The model will then reflect non-point source stream-channel and upland erosion, as well as septic system leachate and livestock activity near, or in, the stream.

The confidence interval about the regression slope provides a high level of sensitivity for changes in water quality. Statistically, an intercept of zero cannot be disqualified if it is included in the confidence interval of the y-intercept. Therefore, for most non-point loadings, the load versus flow regression intercept will approach or be equal to zero and the focus will be on the slope of the regression line.

Following construction of the loading versus flow regression relationship, 1 or more target flows are established to define the water quality target(s). Target flows equal to the average 7 consecutive-day, 10 percent flow probability ($_7Q_{10}$), or selected flow percentiles (i.e., 10, 25, 50, 75, 90), should be used to establish the target (measureable change) concentrations. The combination of a low- and higher-flow target would provide a reference for changes in both point and non-point loadings. **Table 9** shows the establishment of "measureable change" load and concentration targets, using the regression analysis in **Figure 26**. Point source loadings present obvious increased concentrations at lower flows and somewhat elevated concentrations at higher flows when compared to background concentrations. Non-point loadings may reflect increased concentrations at a higher flow since the leading edge and peak of runoff hydrographs from storm events usually contain a greater loading of contaminants.

Table 9. Development of "measureable change" target loads and concentrations (upper 95 percent confidence limit) using regression equation from **Figure 24**.

Target Flow (cfs)	Existing Load (lb/day)	Existing Concentration (mg/l)	Target Load (lb/day)	Target Concentration (mg/l)
1	0.2	0.04	0.3	0.06
5	1.6	0.06	2.7	0.10
20	8.3	0.08	16	0.15
50	25	0.09	56	0.21

Table 9 shows target loads greater than 2.7 lb/day at a flow of 5 cfs to exceed the regulatory limit of 0.1 mg/l. In combination with the loading reductions from the total phosphorus TMDL, the "existing" water quality and "measureable change" targets will be reduced to limits achieving the surface water quality standards. The loads used in the regression equations will need to be adjusted based on the percent loading reduction required by the TMDL, prior to determining the target loads and concentrations.

All target loads must be allocated on a watershed basis (not by project), using the associated HUC 14 or all upstream drainage areas, for long-term water quality protection. The difference between the target load and existing load for each selected flow target is the load available for watershed-wide allocation (e.g., 1.1 lb/day (2.7 – 1.6) can be allocated at 5 cfs).

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A minimum of 20 data should be collected over the range of stream flows to adequately represent the associated loading versus flow relationship. More data (up to 30) may be needed to better represent the relationship if flows and/or water quality is more varied, presenting a wider grouping of data. The loading values should represent the range of wet- and dry-weather flows, and should be compared statistically to the associated flow data. Samples collected in April may be valid if flows are not outside the normal flow regime (up to 80 percent probability, or greater than 20 percent flow duration). Also, March and October sampling may be biased from natural releases of organics and nutrients during soil thawing, and leaf and aquatic plant decomposition, respectively. Outliers should be omitted prior to the regression modeling. A selected confidence interval about the regression slope (most often 95 percent is used) will define the boundary of "existing water quality." Values outside of this limit should be considered regulatory exceedences and cause for new or refined reduction strategies.

DISCUSSION AND RECOMMENDATIONS

Results of this study and pollution loading estimates from the NRCS models emphasize the need to reduce stormwater runoff and increase ground water recharge as the most critical watershed management issues. Stream-channel destabilization from increased stormwater flows, and loss of baseflow during dry-weather conditions have the most dramatic effect on sediment and nutrient loadings and loss of aquatic habitat, respectively. Contaminant loadings will be reduced, and ground water recharge increased, as runoff flows are suppressed. Currently, in addition to bed-load, approximately 2,484 tons of suspended sediment is conveyed into the Delaware and Raritan Canal each year, with an associated total phosphorus load of approximately 13.7 tons/year. Stream channel and agriculture erosion account for more than 15,000 tons of sediment transported into the Canal each year, representing approximately 83 tons/year of total phosphorus.

Techniques for capturing runoff on private lots and the suspended contaminant loadings include: rain gardens and subsurface down-gradient stormwater storage/infiltration per lot; shallow catchment depressions (micro-topography) on private and public lands to facilitate evapo-transpiration and recharge; and elimination of residential and agricultural drainage to roadside drainage ravines. More extensive modifications to existing conditions include: retrofitting preserved open space lands with micro-topography; BMP options to increase efficiency of stormwater controls for local soil and geologic conditions; roadside drainage retrofits for suppressing runoff and erosion; and restrictions addressing All Terrain Vehicles (ATVs) for accessing and disturbing riparian corridors. More details on restoration techniques are presented in the ***Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Plan.***

The following recommendations, based on water quality and quantity monitoring results, should be expediently implemented to ensure long-term protection of the surface and ground water resources.

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1. Installation of stormwater controls for roadside drainage, and existing and newly preserved lands, especially on fields undergoing succession from previous agricultural crop production. There are thousands of acres watershed-wide that would be potential candidates for this remediation technique.

2. Further investigation is warranted for those sections of the Lockatong and Wickecheoke Creeks that have indicated possible contamination from illicit sewage discharge(s) and/or malfunctioning septic systems. Additional assessments should be performed by the Hunterdon County Health Department or the Hunterdon County Soil Conservation District to determine the possible source(s) of elevated nutrient and bacteria concentrations along stream segments presenting these contaminants. Caffeine and optical brighteners (fluorometric technique) could be included for tracking sewage. Other microbial source tracking techniques should also be considered for fecal indicators as verification studies are completed.

3. A GIS layer depicting the locations of septic systems and wells is critical to determine what sites may have a greater potential for surface and ground water contamination. All new or modified septic systems and wells should have a mandatory requirement for GPS locations (using the appropriate State coordinates) on the applications.

4. Site-specific water quality targets for antidegradation should be developed to assess proposed land use changes, and point and non-point pollutant impacts on existing water quality.

5. Hydrogeologic studies to determine the interactions between the surface and ground water, including the location of ground water recharge areas and flow direction, and the capacity of the potable water supply for additional uses (build-out planning) should be implemented throughout the watersheds. This is essential to protect the flow conditions in the streams for esthetics, recreation, and critical habitat for protected animal and plant species, and to protect the quality and quantity of the potable water source.

6. Further investigation is warranted to determine the history and chemical constituents associated with the boron loading that is located at sampling site L8, approximately 150-200 feet upstream of Lower Oak Grove Road. The potential association of boron with other pesticides should be determined. Communications with technical staff at the USGS and the Rutgers Snyder Research Farm support the unlikeliness that these loads are natural or related to normal agricultural applications.

7. Signage, municipal ordinances, or State regulations should be implemented to deter ATV traffic from in or near the stream channel. As with other vehicles, education and training could be required for certifying each driver.

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8. Additional research is required to determine the potential use of an E. Coli/fecal coliform ratio as an indicator of the source location.

9. Further assessment of the Delaware Township Municipal Utility Authority wastewater treatment facility discharge should be conducted to determine possible use impairments to Rose Brook that is a C1 tributary to Wickecheoke Creek.

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Appendix A

Monitoring Site Locations and Sampling Inventory

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Lockatong and Wickecheoke Creek monitoring site locations and notable site characteristics.

Monitoring Site	Location	Characteristics	Major Land Use*/Percent
Lockatong Creek			
L1	Raven Rock-Rosemont Road bridge	Near confluence with Delaware River. USGS flow-monitoring station. TP and temperature exceedences	F/45
L2	Strimples Mill Road bridge	Site of operational saw mill on E. side of stream, pile of sawdust on stream bank. Automobiles and parts on W. side of stream. TP, temperature, and pH exceedences.	F/58
L3	Milltown Road bridge	Just downstream of stone-walled dam with pond. TP, temperature, and pH exceedences.	F/38
L3a	Tributary, at Brook Road bridge	Lowest pH, most readings lower than 6.5. Site only monitored with hand meter.	WL/32
L4	Route 519 bridge	At change in gradient and shallow depth to bedrock. TP and pH exceedences.	A/35
L5	Muddy Run tributary, at Muddy Run Road bridge	Wide, deeper channel slowly flowing into shallow channel through agricultural field. TP exceedences, was often turbid.	A/37
L5F	Muddy Run tributary, at Barbertown-Point Breeze Road bridge	Flow-measurement site, was often turbid from construction activity. Often had an oily sheen on surface.	WL/44
L5a	Muddy Run tributary, at Union Road bridge	Somewhat higher conductivity, was often turbid from construction activity.	A/40
L6	Barbertown-Point Breeze Road bridge	Very slow, shallow flow. TP and pH exceedences. Higher nitrate load.	A/38
L6a	Thatcher Road bridge	Large adjoining wetlands. PH exceedences.	WL/40
L7	Union Road bridge	Kingwood Township Park. TP and pH exceedences. Higher nitrate load.	A/33
Rt 12	Route 12 bridge	Flow-measurement site, often turbid.	A/54
L7a	Tributary at Lower Oak Grove Road culvert	Relatively narrow channel, often dry. TP exceedences.	A/43
L8	Lower Oak Grove Road culvert	TP and pH exceedences. Very high boron concentration. Somewhat higher conductivity. Often had an oily sheen on surface.	A/47
L8a	Oak Grove Road culvert	TP exceedences. Often very turbid.	A/57
L9	Pittstown Road culvert, S. channel	TP and pH exceedences. High nitrate load and concentration. Split channel, N. channel had highest conductivity.	A/39
L9a	Oak Grove Road culvert	Fecal, E. Coli, TP, and pH exceedences. Second to highest nitrate concentration.	A/57
L9b	Old Franklin School Road culvert	Highest nitrate and TP concentrations. TP, fecal, and E. Coli exceedences.	A/70
Wickecheoke Creek			
W1	Rt 29 bridge	Near confluence with Delaware River. USGS flow-monitoring station. TP, temperature, and pH exceedences.	A/57
W2	Approximately 2/3 miles downstream of W3, 200 feet downstream of W2a	TP, temperature, and pH exceedences.	A/66
W2a	Rose Brook tributary, at Lower Creek Road culvert	TP, temperature, and pH exceedences. Higher TP concentrations and specific conductivity. Receiving stream for Del. Twp. MUA discharge.	A/58, MUA discharge

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Monitoring Site	Location	Characteristics	Major Land Use*/Percent
W3	Rosemont-Sergeantsville Road bridge (covered bridge)	TP, temperature, and pH exceedences.	F/43
W3a	Cold Run tributary, at Pine Hill Road culvert	TP and temperature exceedences.	A/43
W4	Plum Brook tributary, at Pine Hill Road bridge	TP and temperature exceedences.	F/43
W5	Old Mill Road bridge	TP exceedences. Just downstream of waterfalls.	F/40
W6	Locktown Road bridge	Approximately 2 miles downstream of MEI. TP exceedences. Somewhat higher specific conductivity.	WL/36
W7	Plum Brook tributary, at Locktown-Flemington Road culvert	Usually sustains a slight trickle during low flows. Somewhat higher specific conductivity.	F/41
W8	Whiskey Lane bridge	TP exceedences.	WL/32
W9	Tributary at Whiskey Lane bridge	TP exceedences. Somewhat higher specific conductivity.	WL/34
W9a	Tributary at Goose Island Road culvert	Lower TP concentrations and specific conductivity. Excessive sediment deposition.	A/46
W9b	Tributary at Oak Grove Road culvert	Low-pH exceedences. Lower specific conductivity.	A&F/38
W10	Tributary at Old Croton Road culvert	Extreme TP exceedences. High specific conductivity, lower pH.	A/34
W10a	2 tributaries at Goose Island Road culverts	Lowest flow supplied by pond outflow. Highest specific conductivity and higher pH, and TP exceedences from Eastern channel. Low specific conductivity from Western channel, usually dry.	W10aW – A/80 W10aE – A/45
W11	Rake Road bridge	Just downstream of W11a confluence. Highest TP exceedences.	WL/44
W11a	Tributary at Oak Grove Road culvert		A/41
W11b	Tributary at Oak Grove Road culvert	Usually dry. Low-pH exceedence.	A/59
W11c	Tributary at Decker Road culvert	Somewhat higher specific conductivity. Slow ponded flow.	WL/39

* Land use, A = Agricultural, F = Forest, and WL = Wetlands.

Water quality monitoring inventory for each monitoring site.

Site	Type and Number of Analyses Performed								
	Flow[1]	AI[2]	Bact[3]	Nutrients[4]	Boron	Turb	TSS	Resuspend[5]	Sediment[6]
Lockatong Creek									
L1	USGS	✓ (20)	F (6)	✓ (6)	6	6	6		
L2	G (17)	✓ (17)	F (16) E (10)	NO2 (6) NO3 (10) NH3 (8) TKN (8) TP (14)	14	14	14		
L3	G (18)	✓ (18)	F (6)	✓ (6)	6	6	6		

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Site	Type and Number of Analyses Performed								
	Flow[1]	**AI[2]**	**Bact[3]**	**Nutrients[4]**	**Boron**	**Turb**	**TSS**	**Resuspend[5]**	**Sediment[6]**
L3a		✓ (7)							
L4	G (19)	✓ (19)	F (17) E (11)	NO2 (6) NO3 (11) NH3 (10) TKN (10) TP (15)	15	15	15	2	1
L5	G (18)	✓ (18)	F (6)	✓ (6)	6	6	5		
L5a	G (10)	✓ (10)	✓ (5)	No NO2 NO3 (2) NH3 (2) TKN (2) TP (4)	4	4	4		
L6		✓ (16)	F (6)	✓ (6)	6	6	6		
L6a	G (10)	✓ (11)	✓ (10)	No NO2 NO3 (4) NH3 (3) TKN (3) TP (8)	8	8	8	2	1
L7	G (7)	✓ (17)	F (7) E (1)	✓ (7) NO2 (6)	7	7	7		
Rt 12	G (28)								
L7a	G (10)	✓ (5)	✓ (4)	No NO2 NO3 (2) NH3 (2) TKN (2) TP (3)	3	3	3		
L8	G (19)	✓ (19)	F (8) E (2)	NO2 (6) NO3 (9) NH3 (6) TKN (6) TP (9)	13	10	10		
L8a	G (12)	✓ (12)	✓ (10)	No NO2 NO3 (6) NH3 (3) TKN (3) TP (8)	9	8	8	1	
L9		✓ (17)	F (7) E (1)	NO2 (6) NO3 (10) NH3 (6) TKN (6) TP (10)	7	7	7		
L9a	G (11)	✓ (11)	✓ (10)	No NO2 NO3 (6) NH3 (2) TKN (2) TP (9)	8	8	8		
L9b	G (9)	✓ (9)	✓ (6)	NO3 (4) TP (6)	5	5	5		
Wickecheoke Creek									
W1	USGS	✓ (19)	F (5)	✓ (6)	6	6	6		

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Site	Type and Number of Analyses Performed								
	Flow[1]	**AI[2]**	**Bact[3]**	**Nutrients[4]**	**Boron**	**Turb**	**TSS**	**Resuspend[5]**	**Sediment[6]**
W2		✓ (18)	F (15) E (10)	NO2 (6) NO3 (10) NH3 (8) TKN (7) TP (14)	13	14	14		
W2a	G (11)	✓ (17)	F (5) E (2)	NO2 (4) NO3 (6) NH3 (5) TKN (4) TP (6)	6	6	6		
W3	G (19)	✓ (19)	F (5)	✓ (6)	6	6	6		
W3a	G (11)	✓ (15)	F (8) E (5)	NO2 (4) NO3 (7) NH3 (5) TKN (4) TP (7)	6	7	7		
W4	G (18)	✓ (18)	F (10) E (5)	NO2 (6) NO3 (9) NH3 (7) TKN (6) TP (9)	8	9	9		
W5	G (17)	✓ (19)	F (15) E (10)	NO2 (6) NO3 (9) NH3 (8) TKN (7) TP (14)	13	14	14		
W6		✓ (19)	F (7) E (2)	NO2 (6) NO3 (7) NH3 (7) TKN (7) TP (8)	8	8	8	1	1
W7		✓ (17)	F (6) E (1)	NO2 (6) NO3 (7) NH3 (6) TKN (6) TP (7)	6	7	7		
W8	G (18)	✓ (18)	F (16) E (11)	NO2 (6) NO3 (10) NH3 (9) TKN (9) TP (15)	14	15	15	2	1
W9	G (20)	✓ (18)	F (5)	✓ (5)	5	5	5		
W9a	G (10)	✓ (10)	✓ (9)	NO3 (2) NH3 (1) TKN (1) TP (7)	6	7	7		
W9b	G (9)	✓ (8)	✓ (2)	NO3 (1) TP (2)	2	1	1		
W10		✓ (15)	F (5)	✓ (5) TP (6)	5	5	5		

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Site	Type and Number of Analyses Performed								
	Flow[1]	**AI[2]**	**Bact[3]**	**Nutrients[4]**	**Boron**	**Turb**	**TSS**	**Resuspend[5]**	**Sediment[6]**
W10a		✓ (5)	✓ (6)	✓ (1) No NO2 TP (5)	5	5	5		
W11	G (20)	✓ (16)	F (5)	✓ (5)	5	5	5		
W11a	G (10)	✓ (9)	✓ (7)	NO3 (3) NH3 (2) TKN (2) TP (6)	6	6	6		
W11b	G (10)	✓ (9)							
W11c	G (10)	✓ (9)	✓ (7)	NO3 (3) NH3 (2) TKN (2) TP (6)	6	6	6	1	

Note: Number in parentheses is the number of analyses. Bact = bacteria and Turb = turbidity. A "✓" indicates that all parameters for the group were analyzed.

[1] Flow = Continuous monitoring by USGS or stage-discharge (gage, G) relationship

[2] AI = Analyze Immediately = Conductivity, air and water temperature, and pH.

[3] Bact = Both fecal coliform (F) and E. Coli (E), or individual if noted as such.

[4] Nutrients = Combination of total phosphorus (TP), nitrite (NO2), nitrate (NO3), ammonia (NH3), and TKN, or individual if noted as such.

[5] Resuspend = Ambient samples analyzed for TP, bacteria, dissolved oxygen, AI, NO3, TKN, NH3, turbidity (T), and TSS following the resuspension (kicking) of sediments.

[6] Sediment = Sediment sampling and analyses for TP (performed by USGS).

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Appendix B

Stage-Measurement Location Descriptions And Stage-Discharge Relationships For Supplemental Flow-Measurement Stations

Stage-Measurement locations

Site	Description
Lockatong Creek and tributaries	
L2	Downstream edge of bridge, measurement taken straight down between horizontal bars
L3	Downstream edge of bridge, etch on railing near mid channel
L4	Upstream edge of rt 519 bridge, 9' from left side of bridge, etched "Y" on railing
L5 (WQ)	Downstream edge of Muddy Run Road bridge, 3rd vertical support from right, sketched line, measure at vertical of lower bevel
L5 (flow)	Upstream edge of Barbertown-Pt Breeze Road bridge, 4th vertical support from right edge of railing, measure from top edge
L5a	Upstream edge of bridge, approx. 18.3' from right, series of etches on top rail
L6a	Upstream edge of bridge, top-center of 2nd vertical concrete support from right side of railing
Rt 12	Downstream edge of bridge, 16' from left edge of concrete parapet, measure from left corner of solid concrete support post
L7a	Downstream edge of bridge, bolt hole, 1.75' to left of diagonally-striped sign, measure from top of vertical
L8	Upstream edge of Lower Oak Grove Road bridge, measure from top of metal plate on side of bridge, near left edge of channel
L8a	Downstream edge of bridge, 3.4' from left edge of bridge, etched horizontal line
L9a	Downstream edge of bridge, 2.5' left of 2nd vertical support from right, etched mark, measure straight down from top of vertical bevel
L9b	Downstream edge of bridge, near mid channel, black marker line on railing
Wickecheoke Creek and tributaries	
W2a	Upstream edge of bridge, approx. 1' to right of 2nd vertical support from right, horizontal line on the vertical edge
W3	USGS nail with washer near right side of bridge on downstream side, measure from top of nail head
W3a	Upstream edge of brige, approx. 7.4' to the left of the diagonally-striped sign (facing US), line etched in stone
W4	Upstream edge of bridge, 45.5' from right edge of bridge at 8th vertical support, etch on top of "I" support
W5	Downstream edge of bridge, etch in middle of railing at intersection of supports forming an "X", measure from edge of railing
W8	Upstream edge of Whiskey Lane bridge, 18' from left abutment at 7th vertical railing support from right
W9	Upstream edge of Whiskey Lane bridge "K173", center vertical railing support, etched bevel, measure from top of vertical at bevel
W9a	Downstream edge of bridge, at right edge of bridge number "Q162" plate, vertical edge of bevel
W9b	Downstream edge of bridge, approx. 1' to right of center vertical, etched mark
W11	Downstream railing of bridge, 16.3' from left abutment, measure between horiz rail and bridge, etched "Y"
W11a	Downstream edge of bridbe, approx. 2.2' left of the first vertical support, etched mark
W11b	Downstream edge of bridge, center of right-most number "9" in "1929"
W11c	Downstream edge of bridge, 1.3' left of 2nd vertical support from right, existing etch mark
Note: All left/right directions are oriented facing downstream	

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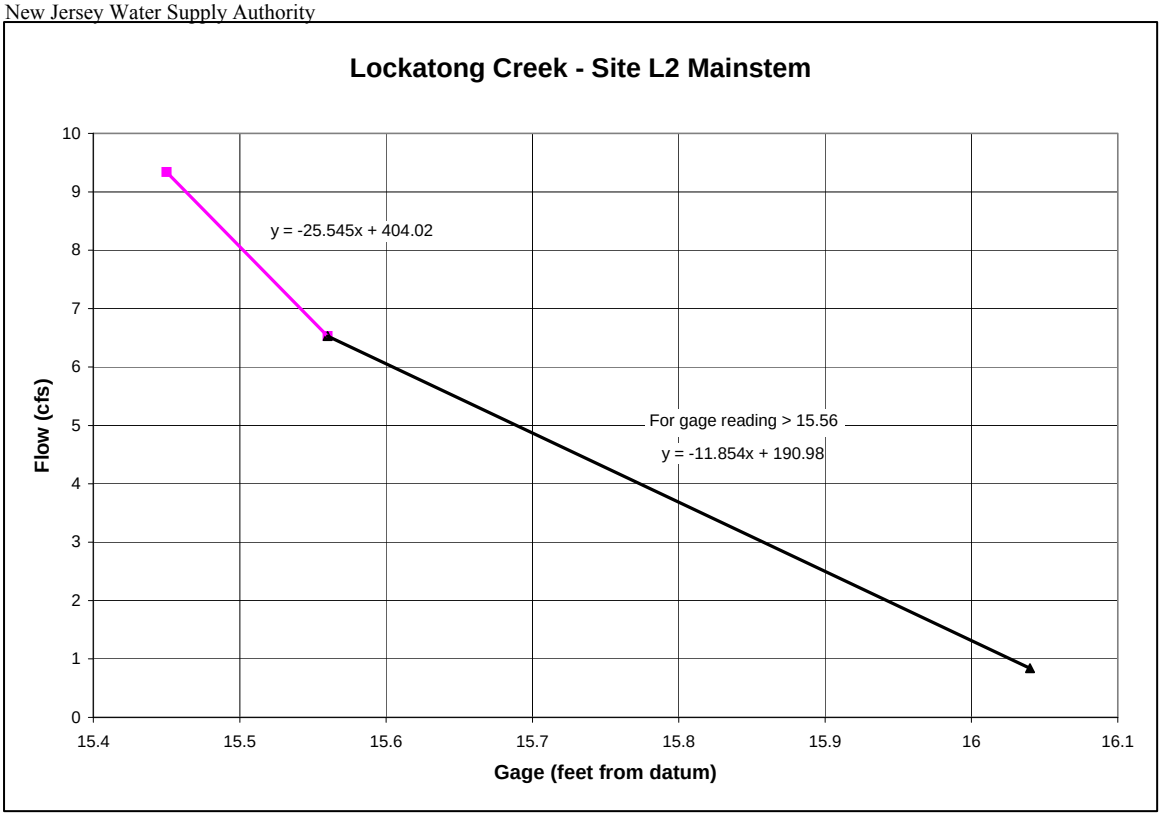

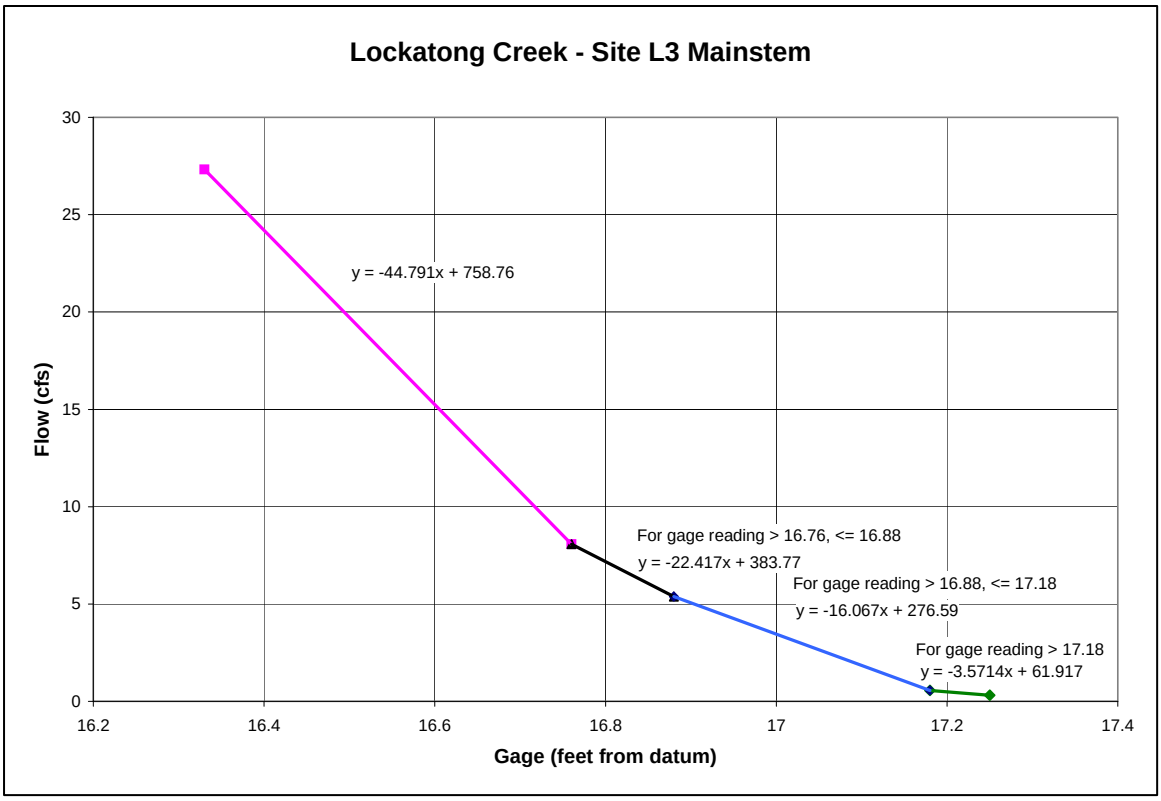

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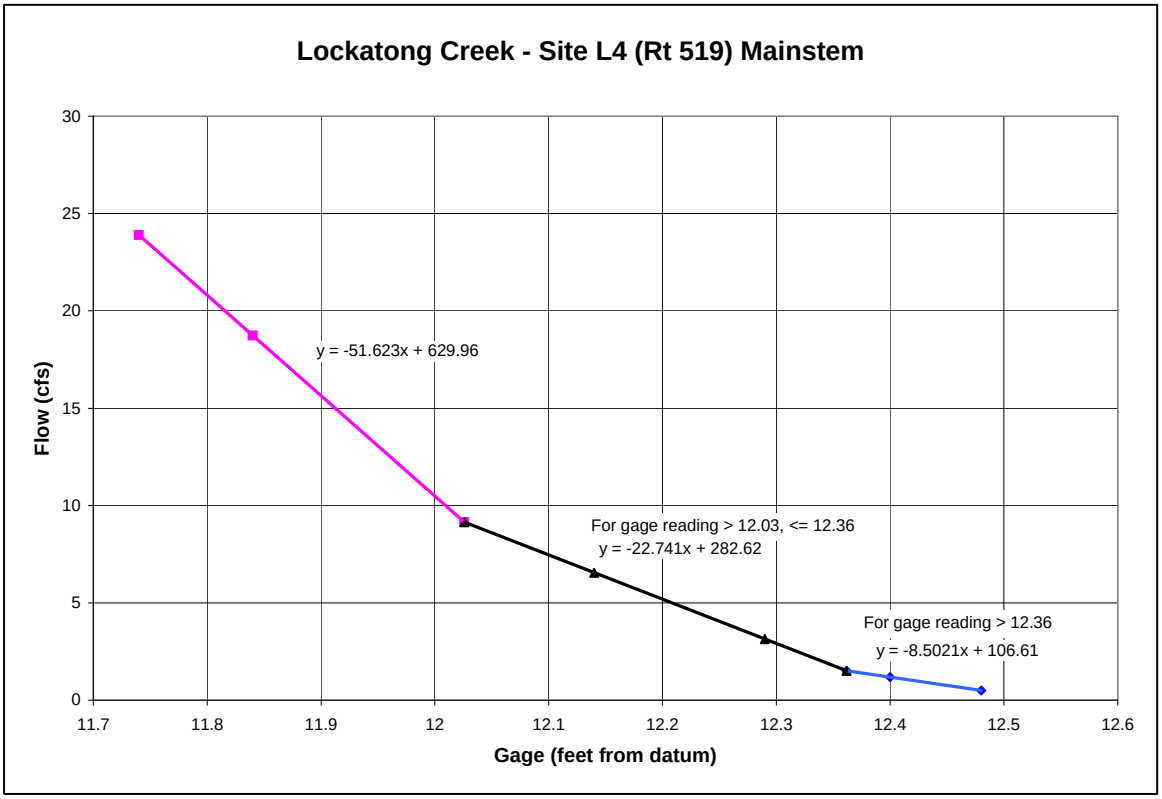

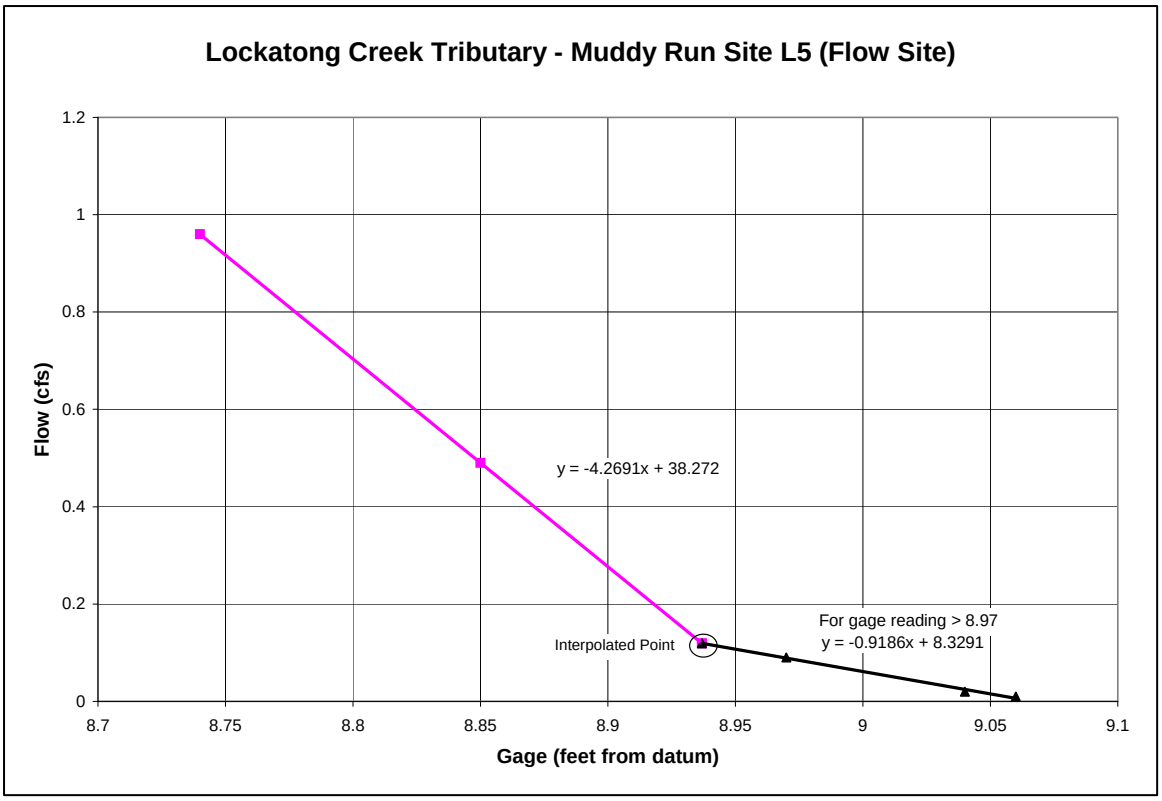

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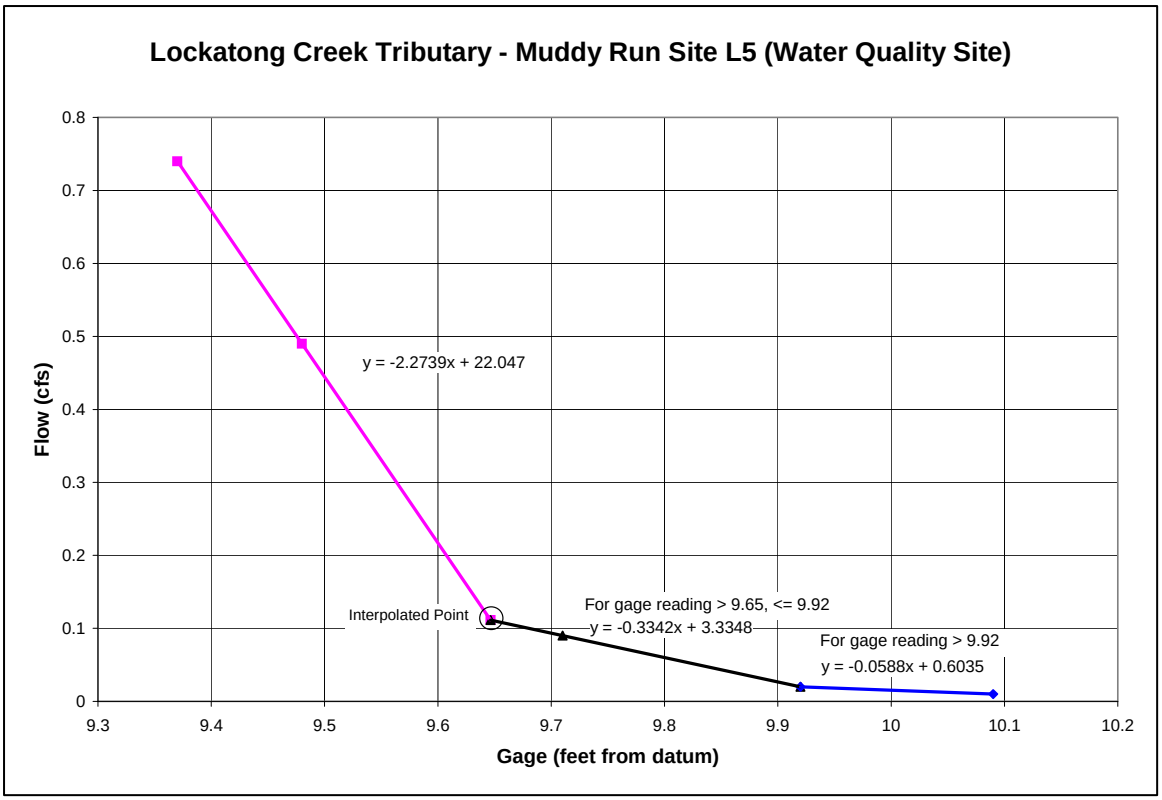

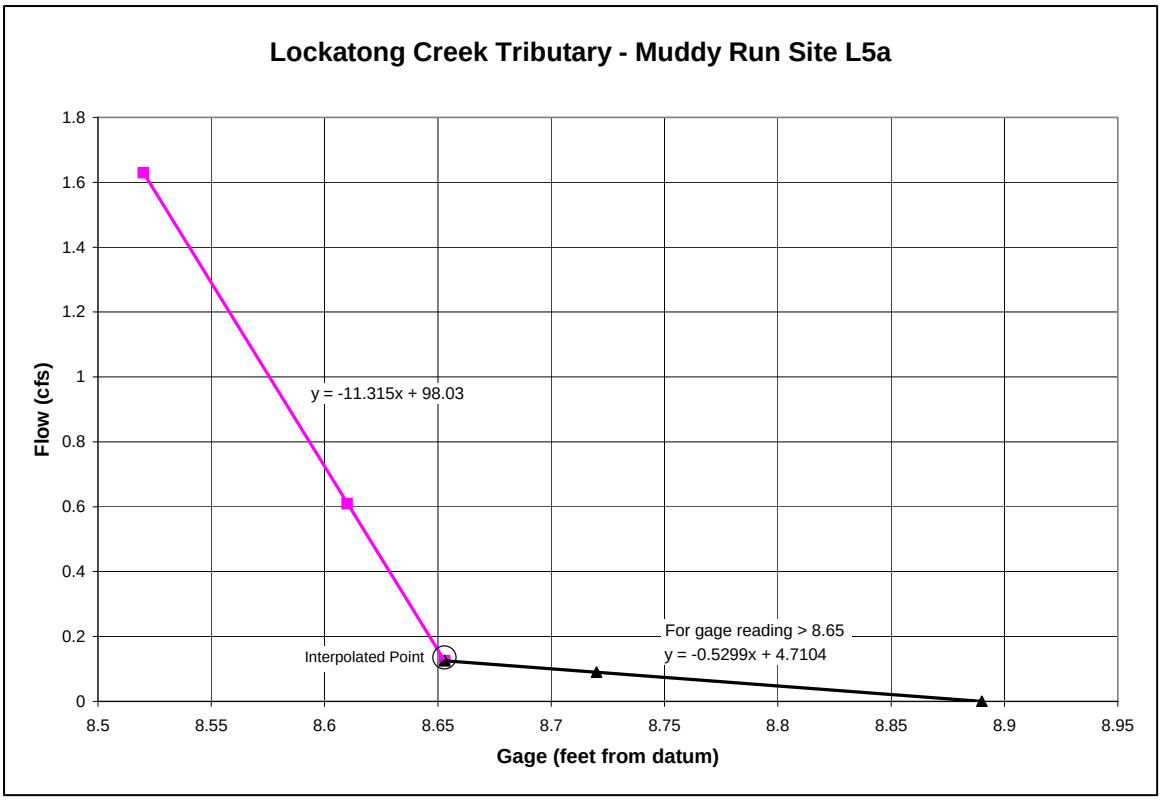

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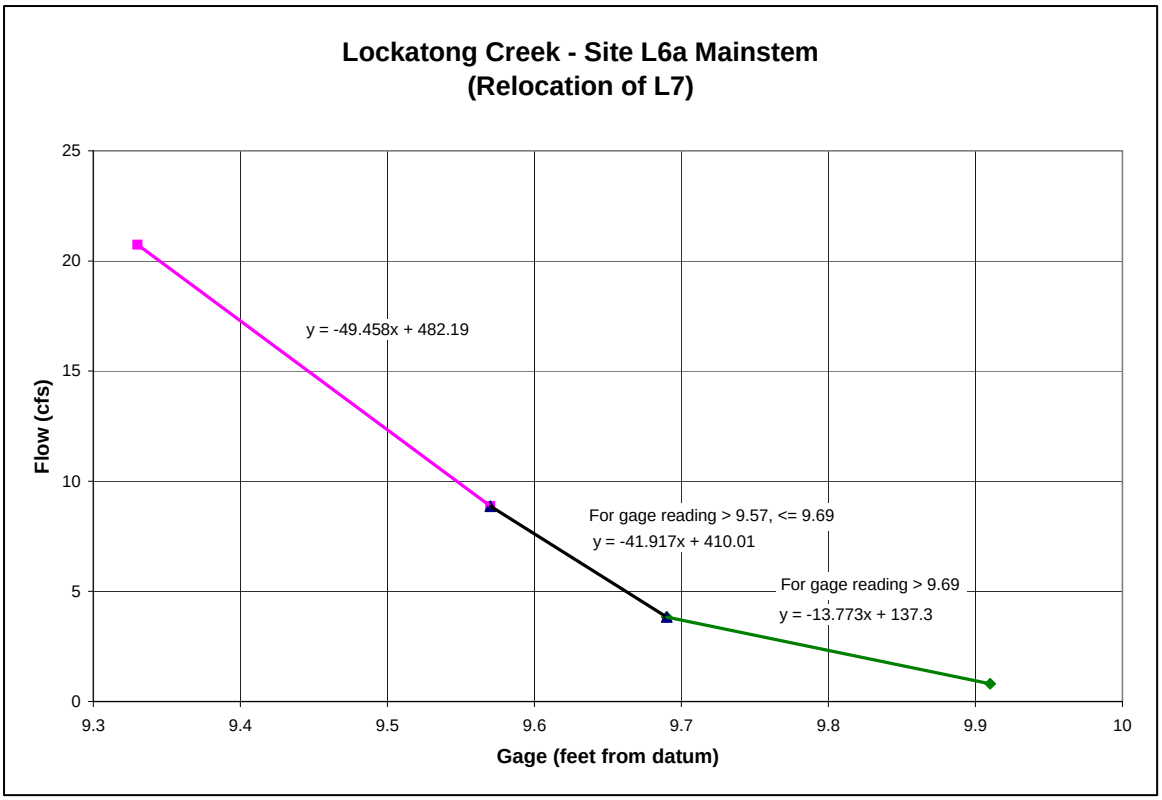

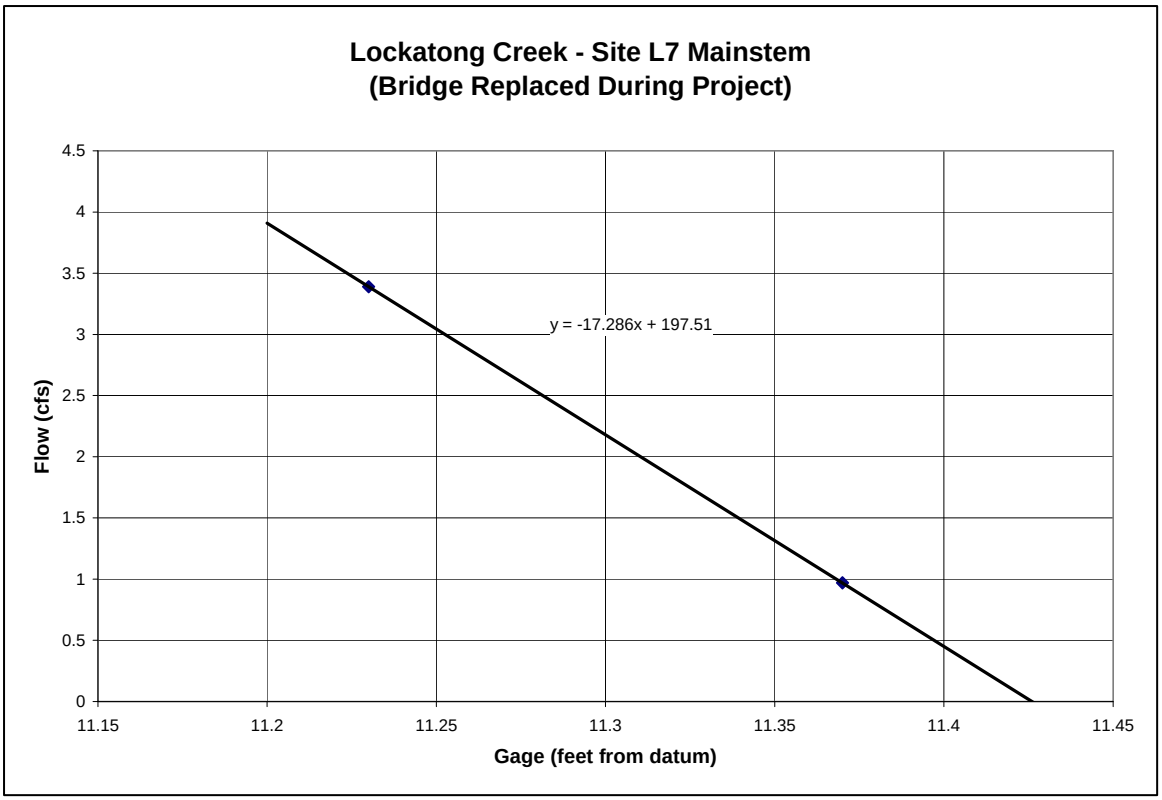

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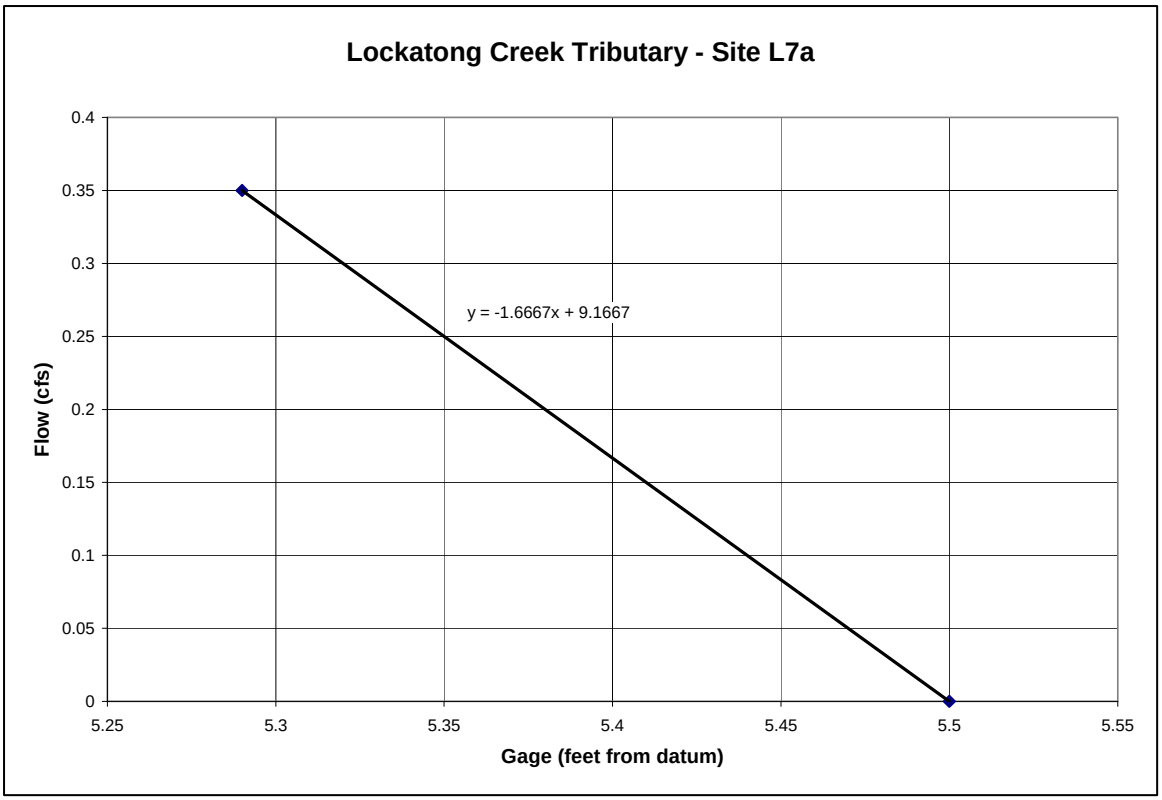

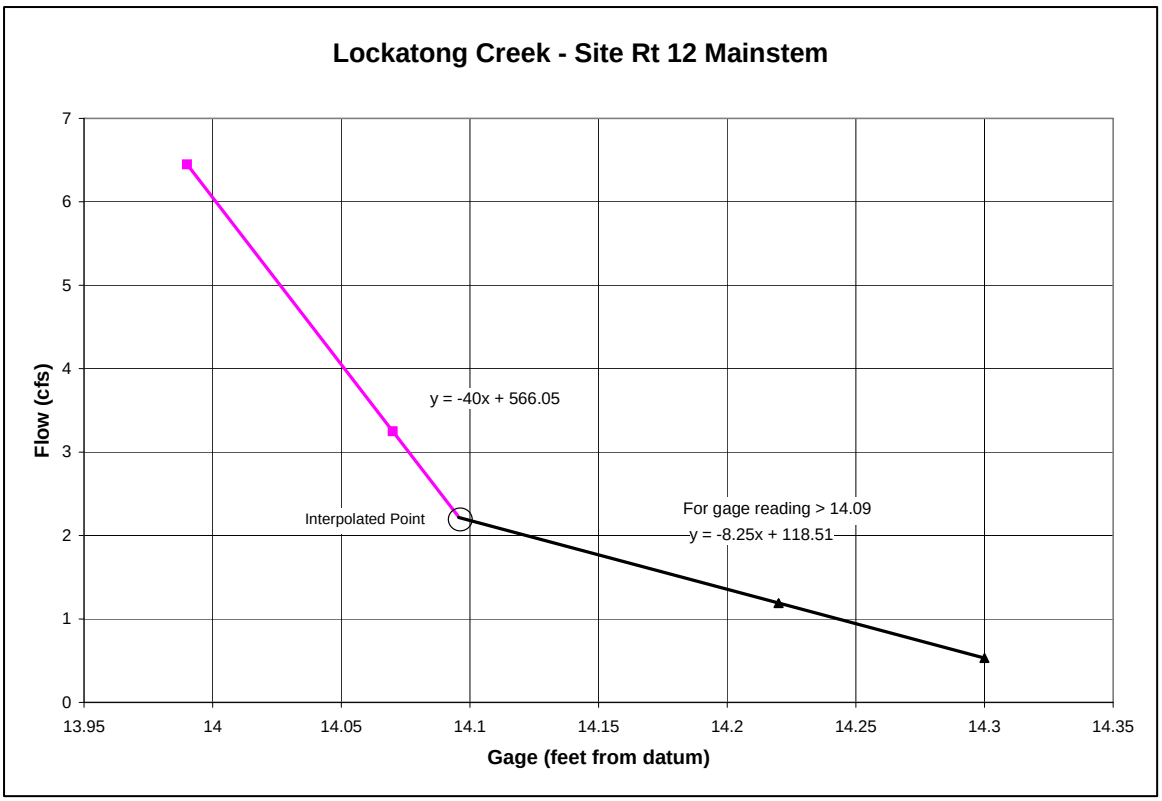

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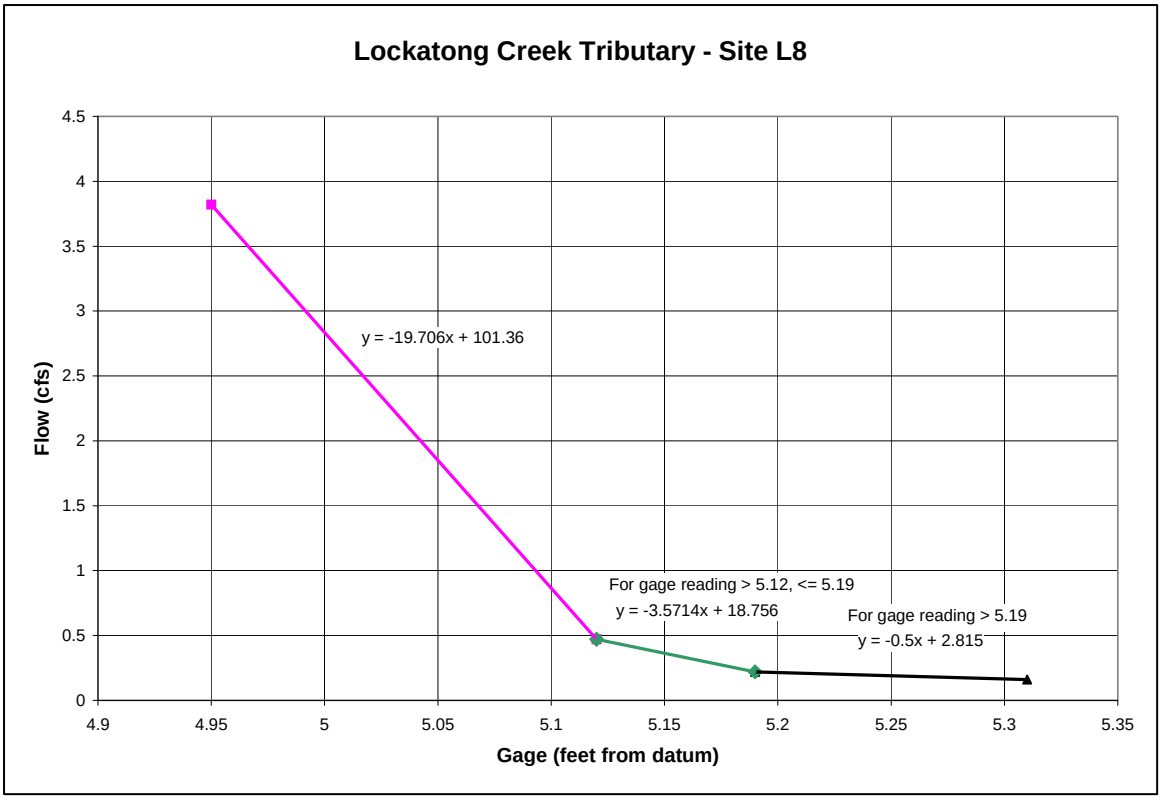

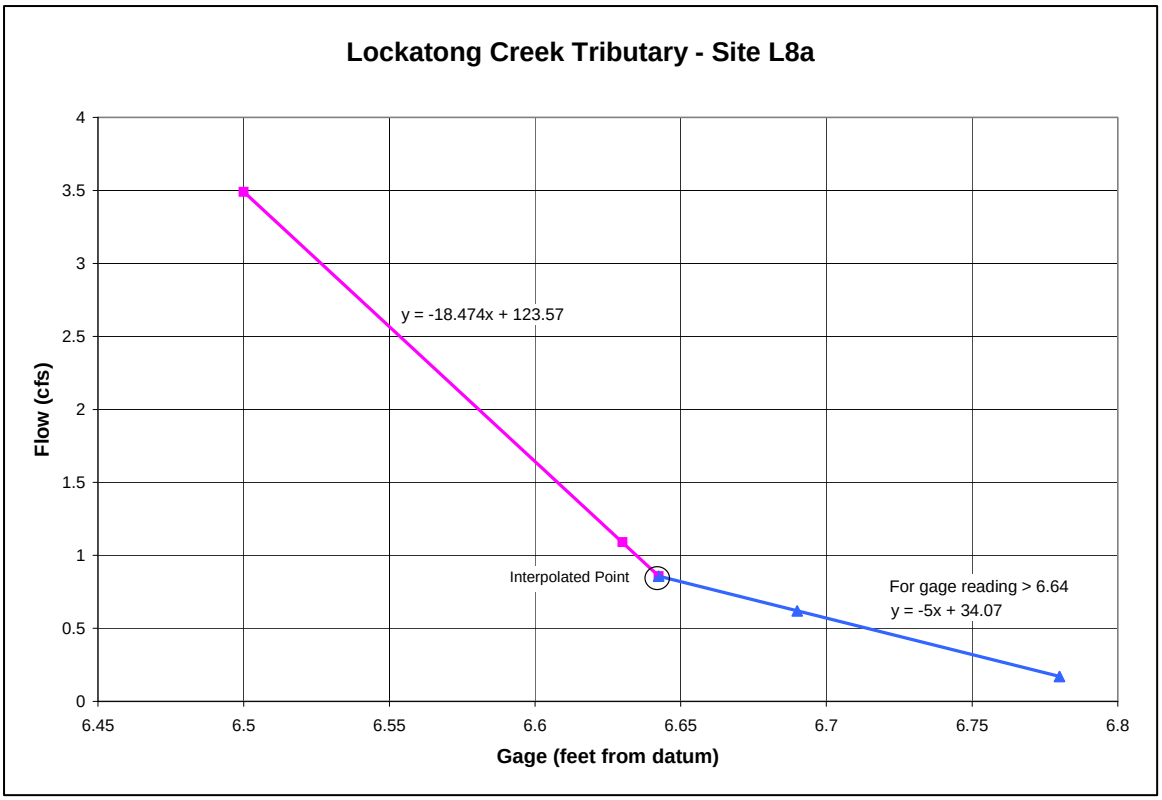

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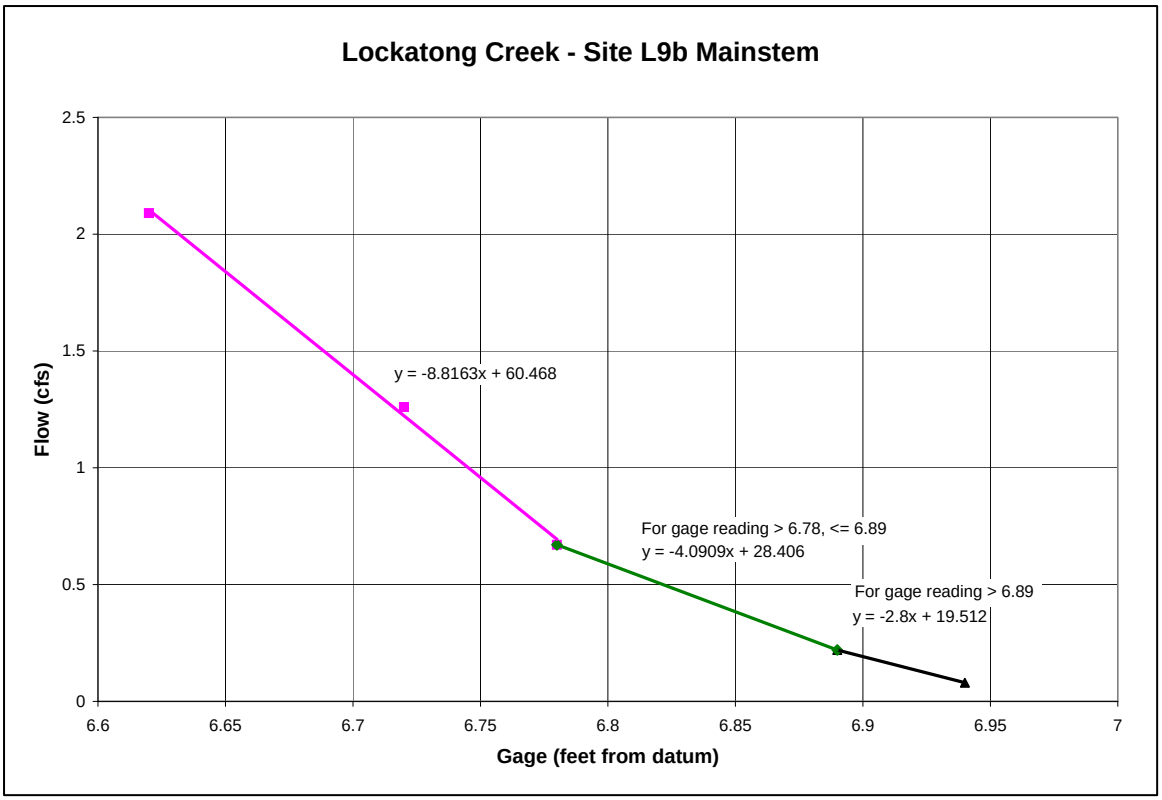

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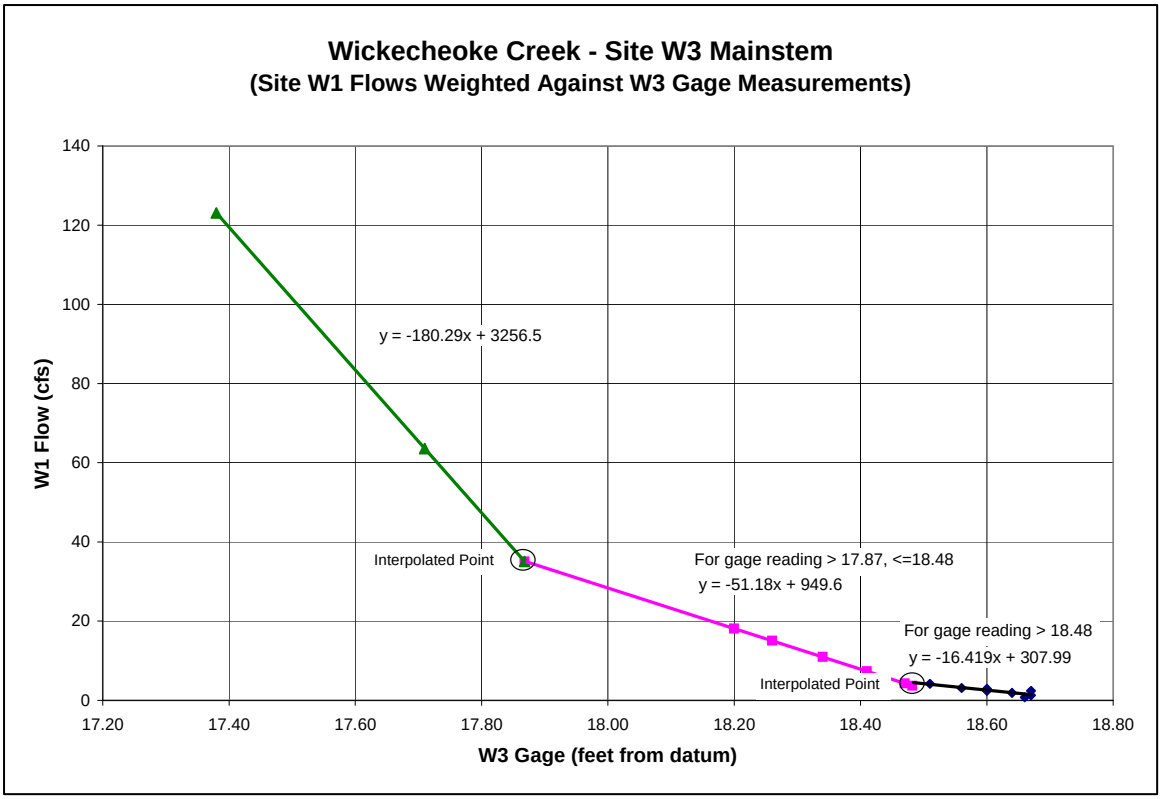

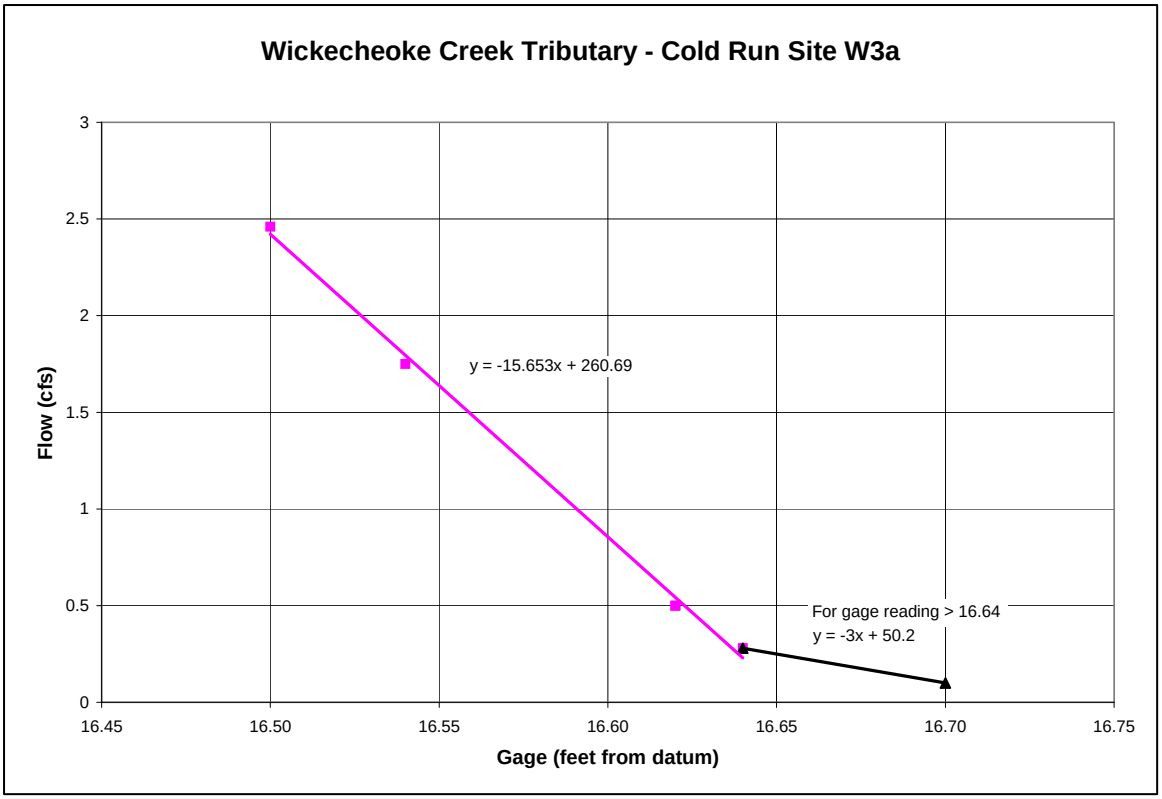

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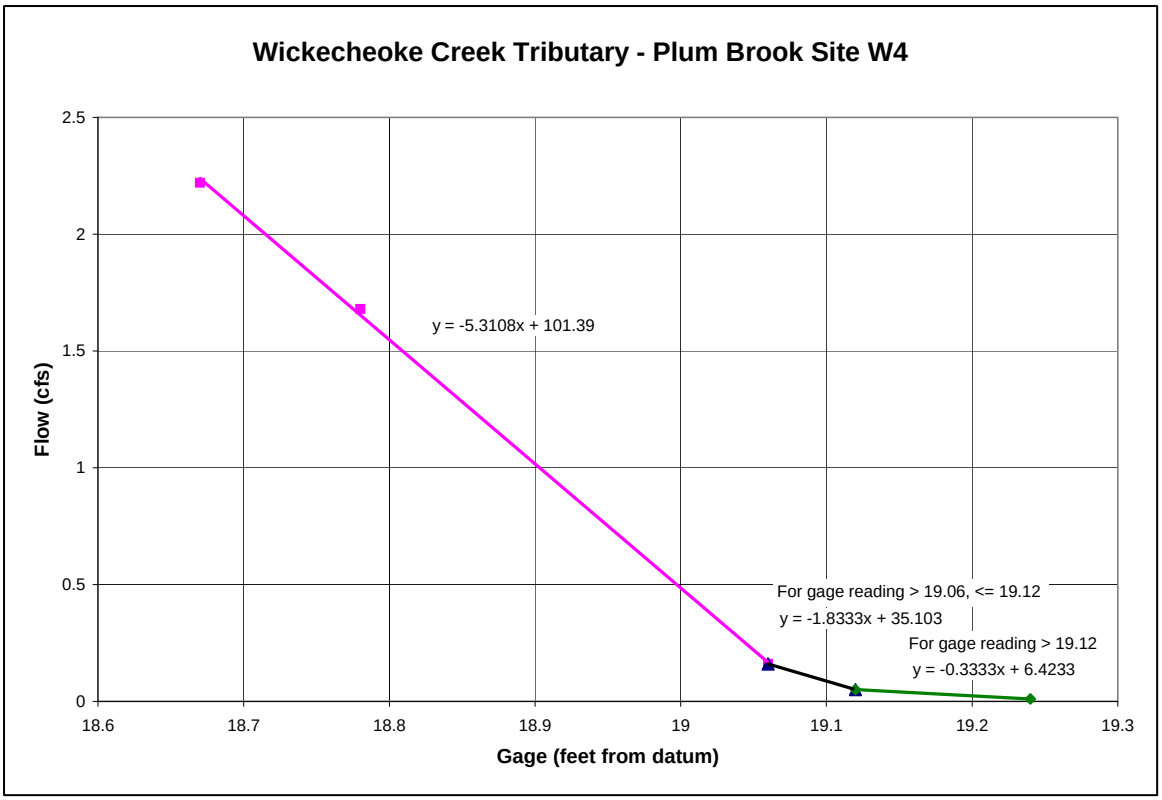

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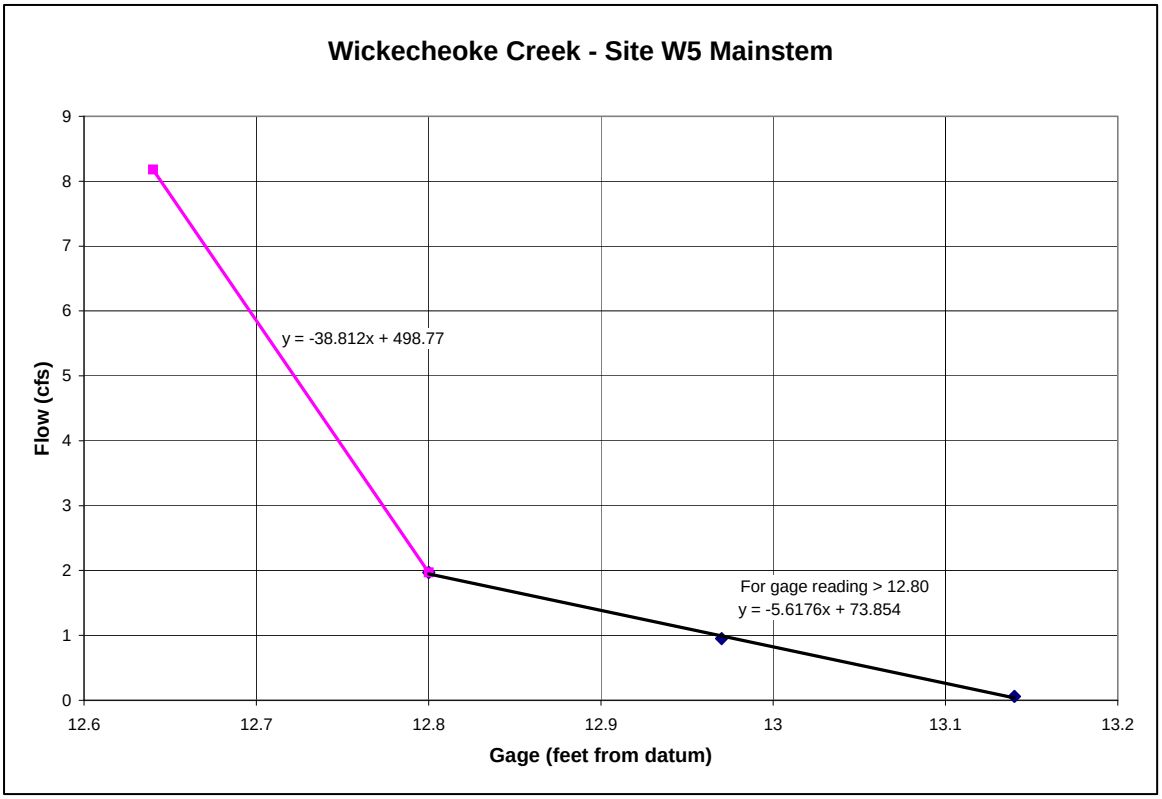

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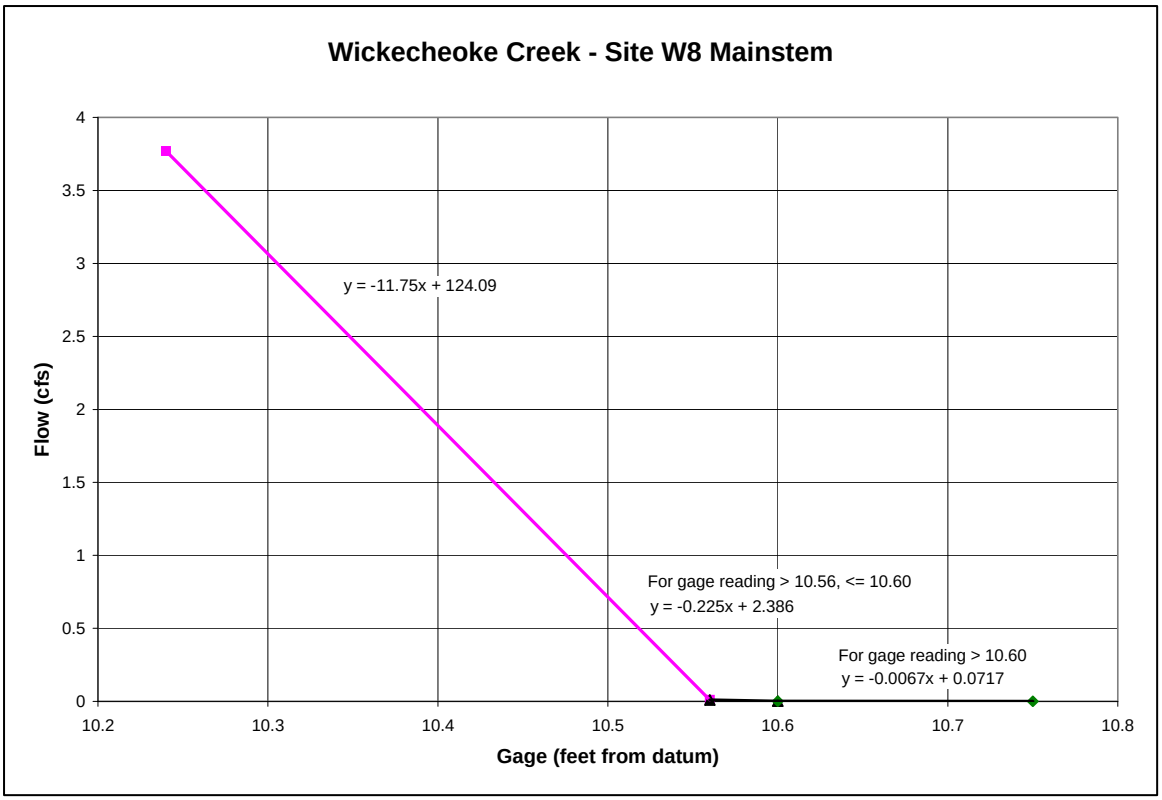

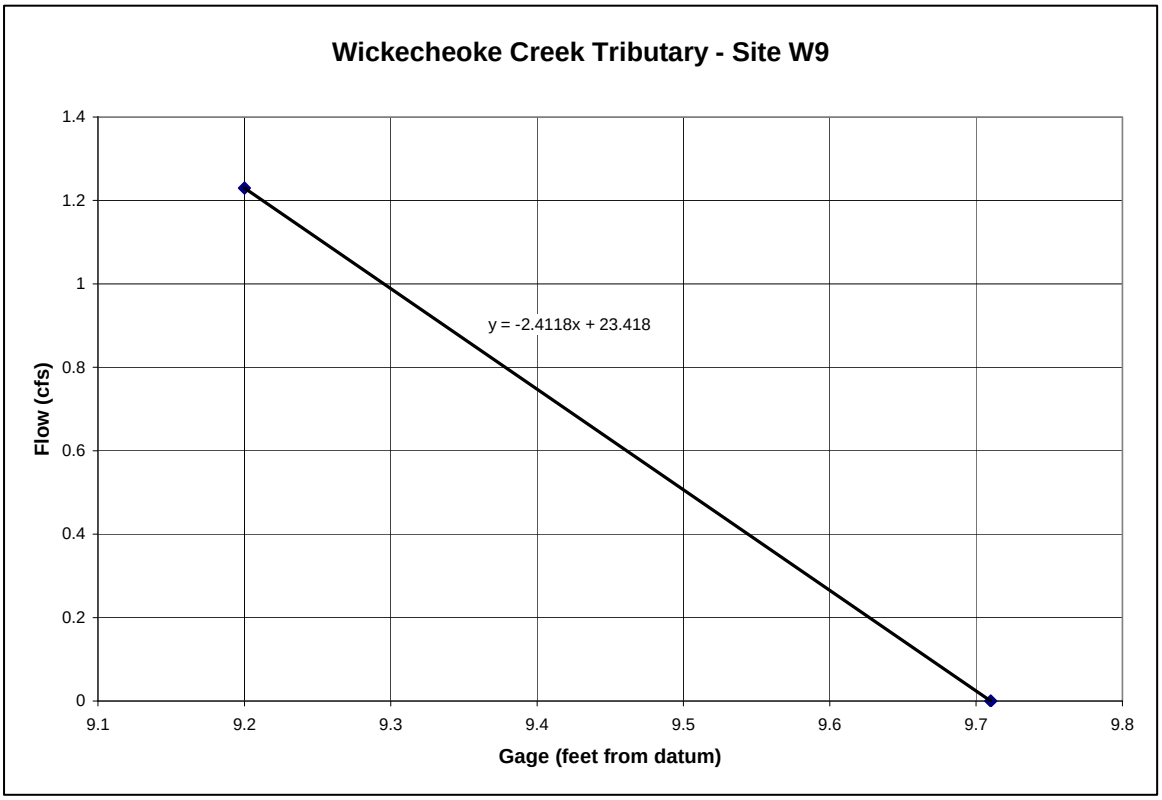

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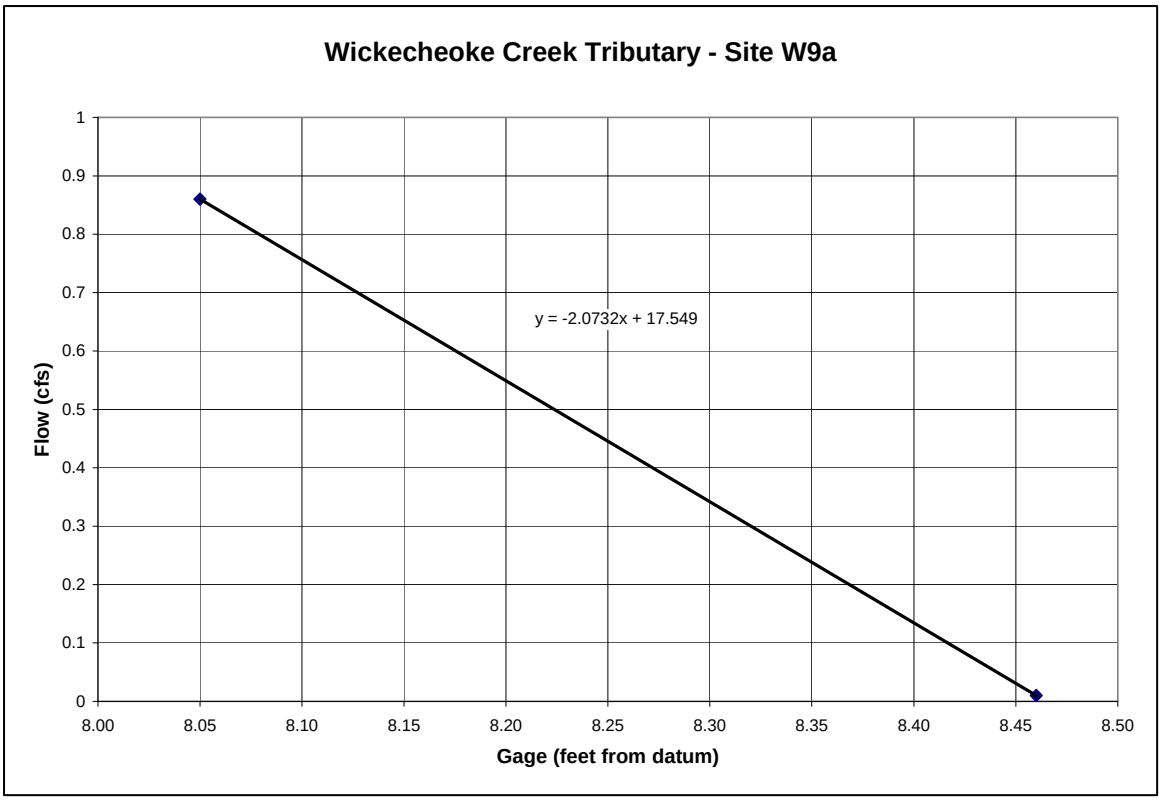

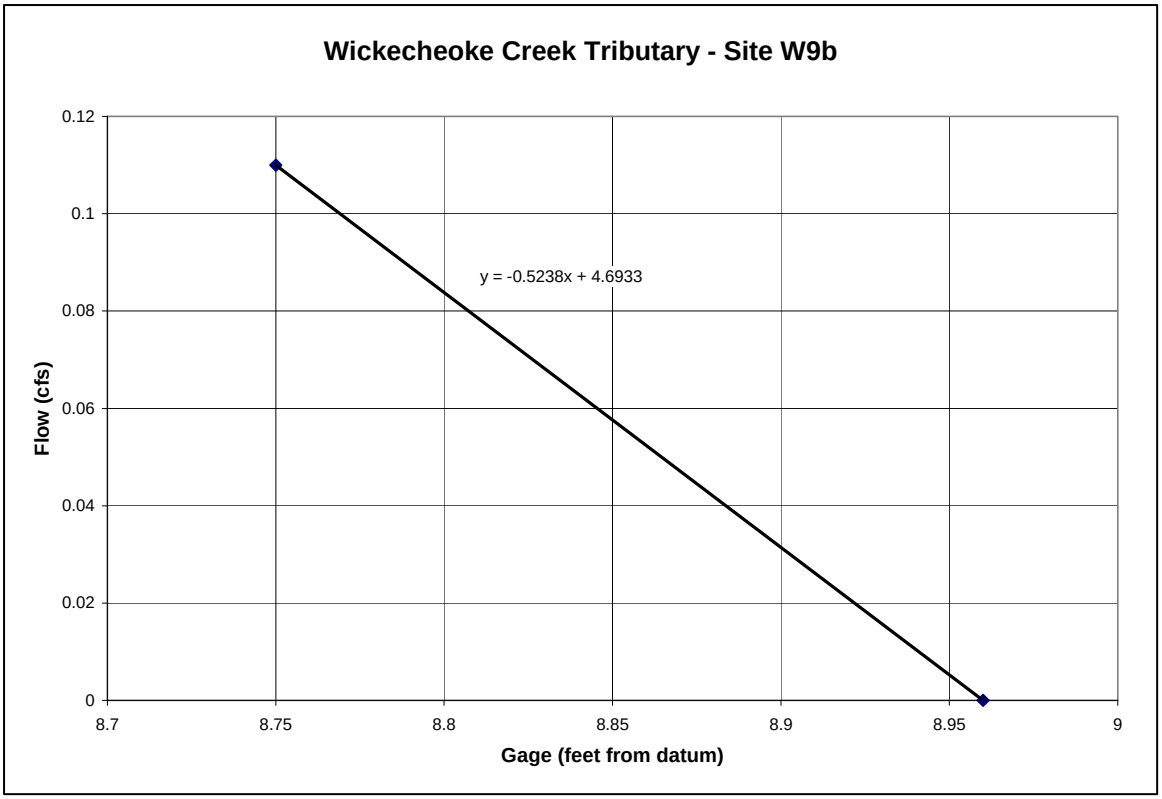

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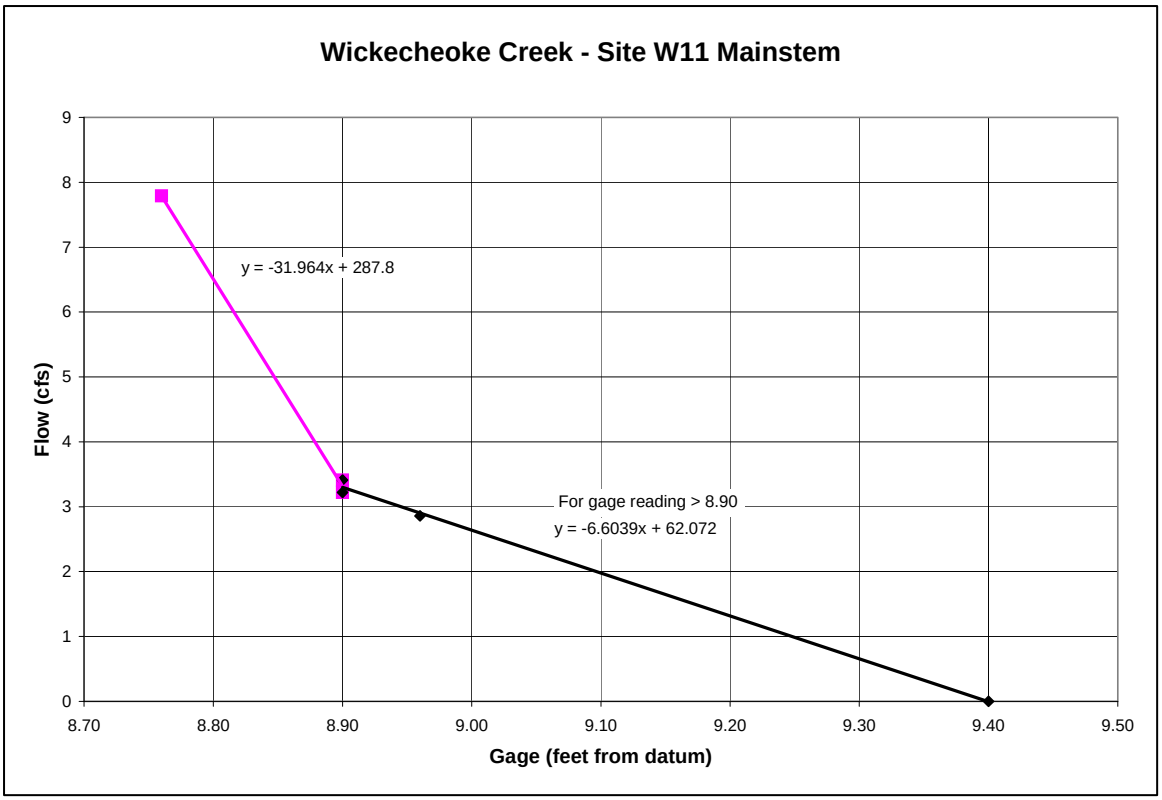

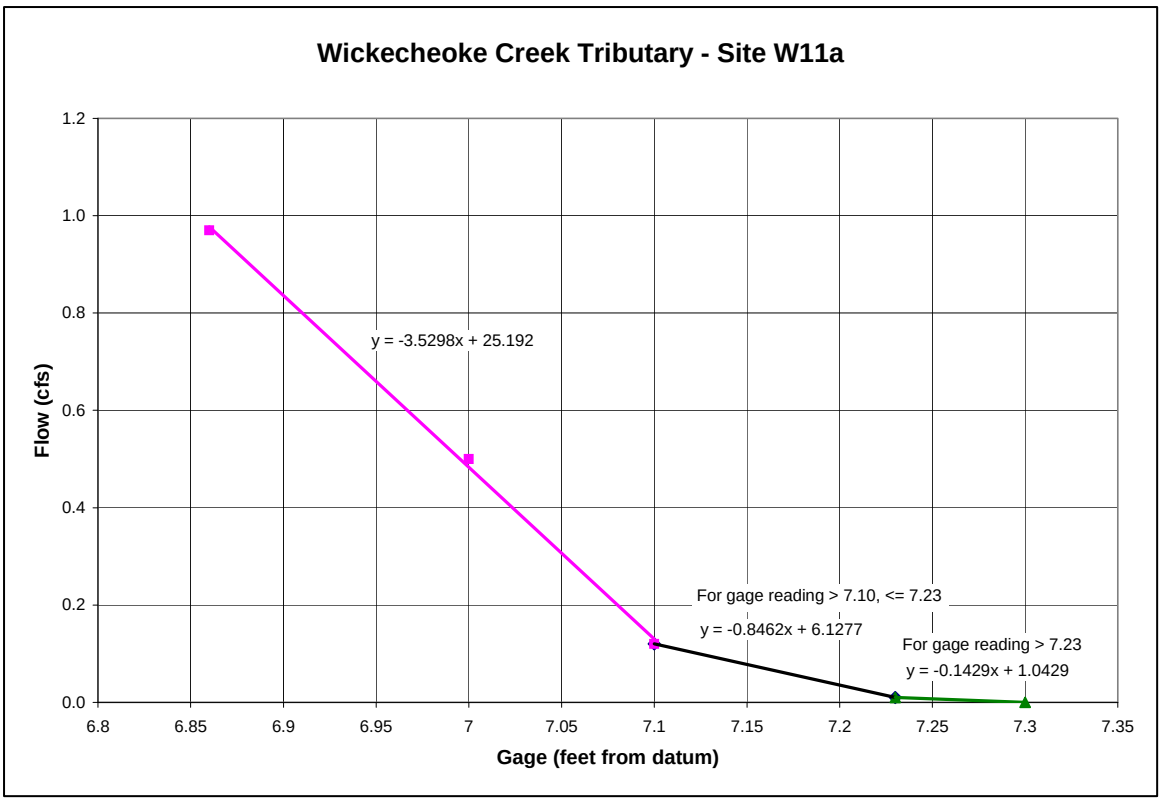

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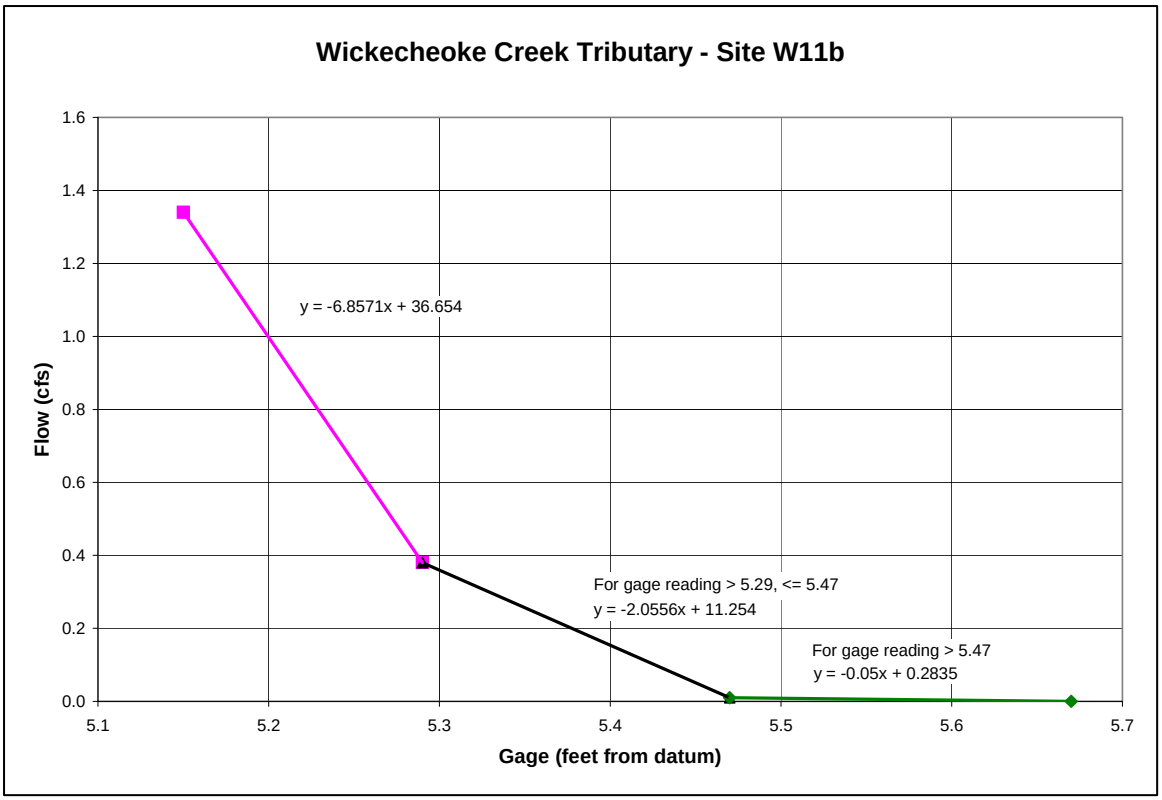

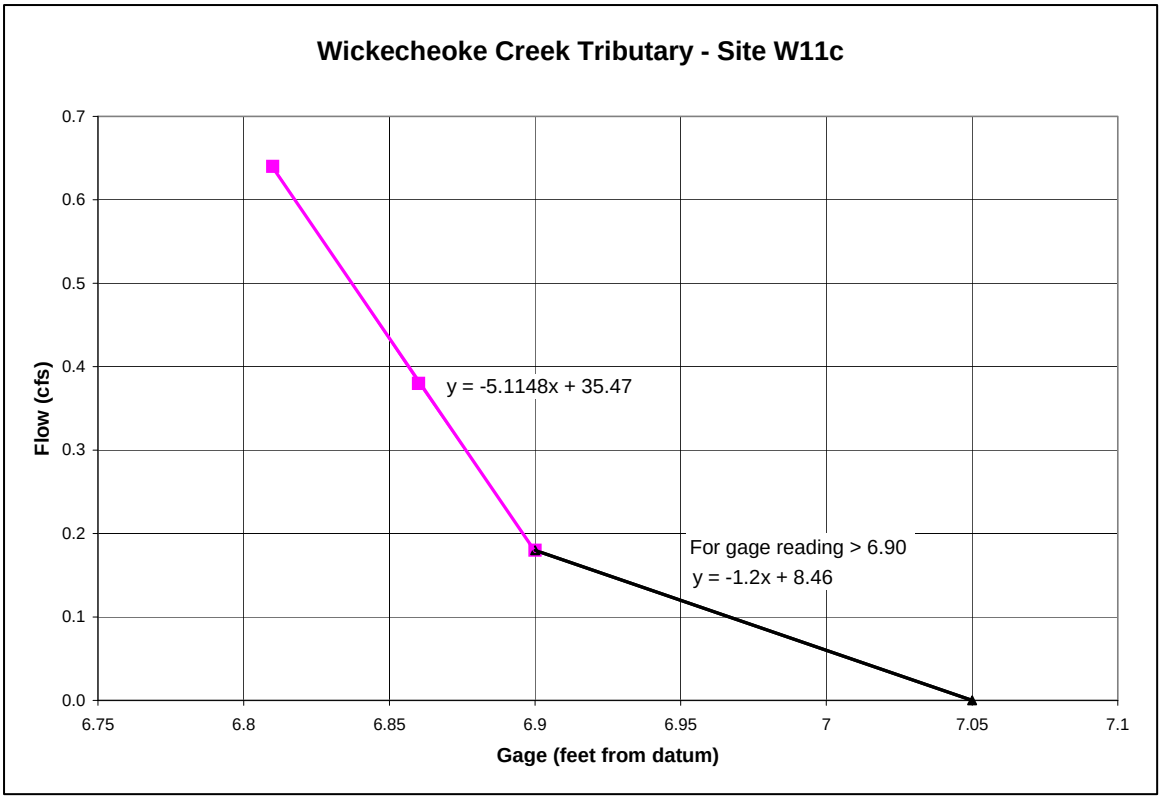

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Appendix C

Flow-Measurement Data For Supplemental Flow Stations

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Flow Measurement Summary

Lockatong Creek and Tributaries

Location	Date	Begin	End	Total Time	Gage	Avg Depth (ft)	Flow Width (ft)	X-Sect Area (ft^2)	Avg Vel (fps)	Flow (cfs)
L1	9/19/2007	12:20	12:45	0:25	19.98	0.30	2.60	0.79	0.57	0.45
L2	7/28/2006	7:09	8:09	1:00	15.56	1.11	15.20	16.68	0.39	6.53
L2	8/17/2006	13:00	14:12	1:12	16.04	0.68	8.40	5.13	0.16	0.84
L2	9/6/2006	15:19	16:16	0:57	15.45	1.07	21.00	22.38	0.42	9.34
L3	4/19/2007	14:29	15:42	1:13	16.33	0.84	36.40	32.40	0.84	27.33
L3	7/20/2007	14:38	15:19	0:41	17.18	0.39	7.70	3.09	0.18	0.56
L3	7/28/2006	8:23	9:44	1:21	16.88	0.61	17.70	11.68	0.46	5.38
L3	8/7/2007	10:00	11:06	1:06	17.25	0.16	6.70	1.19	0.26	0.31
L3	9/6/2006	14:03	15:10	1:07	16.76	0.61	20.10	11.22	0.72	8.07
L4	4/19/2007	12:40	14:16	1:36	11.74	0.84	42.40	30.43	0.79	23.90
L4	6/30/2006	9:55	12:18	2:23	11.84	0.76	40.80	30.36	0.62	18.74
L4	7/19/2006	9:20	10:48	1:28	12.29	0.42	38.00	15.63	0.20	3.14
L4	8/7/2006	16:00	16:55	0:55	12.40	0.20	17.00	3.45	0.34	1.18
L4	8/7/2007	11:10	12:09	0:59	12.48	0.20	10.60	2.14	0.23	0.50
L4	9/6/2006	11:21	13:00	1:39	12.14	0.39	46.20	16.96	0.39	6.55
L5	6/30/2006	14:00	14:45	0:45	8.74	0.17	11.50	1.90	0.50	0.96
L5	7/19/2006	11:59	12:32	0:33	8.97	0.16	1.40	0.24	0.35	0.09
L5	8/7/2006	15:10	15:34	0:24	9.04	0.20	0.75	0.08	0.33	0.02
L5	9/6/2006	9:25	10:57	1:32	8.70	0.19	9.90	1.95	0.38	0.74
L5	3/27/2008	9:00	9:58	0:58	8.85	0.15	5.70	0.87	0.57	0.49
L5a	3/29/2007	15:00	15:30	0:30	8.61	0.16	7.70	1.35	0.45	0.61
L5a	4/19/2007	10:46	11:19	0:33	8.52	0.27	8.20	2.54	0.64	1.63
L5a	4/23/2008	11:35	12:00	0:25	8.72	0.09	2.30	0.23	0.41	0.09
L6a	3/29/2007	14:03	14:50	0:47	9.57	0.45	25.40	12.33	0.72	8.87
L6a	4/19/2007	8:50	10:36	1:46	9.33	0.54	35.50	20.85	0.99	20.74
L6a	7/20/2007	13:36	14:20	0:44	9.91	0.16	10.60	1.86	0.44	0.81
L6a	11/23/2007	10:37	11:41	1:04	9.69	0.26	26.60	7.63	0.50	3.84
L7	7/28/2006	10:33	11:51	1:18	11.23	0.35	15.80	5.66	0.60	3.39
L7	9/13/2006	15:40	16:20	0:40	11.37	0.16	12.20	2.03	0.48	0.97
Rt 12	7/19/2006	7:50	8:51	1:01	14.07	0.54	11.20	6.61	0.49	3.25
Rt 12	8/7/2006	14:10	14:57	0:47	14.22	0.41	10.15	4.30	0.28	1.19
Rt 12	8/7/2007	14:45	15:10	0:25	14.30	0.33	9.00	3.04	0.18	0.53
Rt 12	11/30/2007	11:20	12:28	1:08	13.99	0.45	15.90	8.34	0.77	6.45
L7a	3/29/2007	11:00	11:26	0:26	5.29	0.32	2.60	0.89	0.39	0.35
L8	7/28/2006	12:56	13:35	0:39	5.12	0.27	6.50	2.02	0.24	0.47
L8	8/7/2006	12:54	13:38	0:44	5.20	0.23	2.50	0.60	0.37	0.22
L8	4/18/2007	9:35	10:30	0:55	4.95	0.46	13.30	6.47	0.59	3.82
L8	7/20/2007	9:39	10:06	0:27	5.31	0.25	4.80	1.25	0.13	0.16
L8a	3/29/2007	9:20	10:18	0:58	6.63	0.69	8.60	6.69	0.16	1.09
L8a	4/18/2007	10:46	11:27	0:41	6.50	0.61	10.40	6.59	0.53	3.49
L8a	7/20/2007	9:00	9:22	0:22	6.78	0.40	2.00	0.99	0.17	0.17
L8a	4/23/2008	8:27	9:20	0:53	6.69	0.37	5.10	1.90	0.33	0.62
L9a	3/29/2007	11:53	12:43	0:50	5.50	0.40	12.80	5.57	0.69	3.87
L9a	4/18/2007	11:38	12:21	0:43	5.33	0.56	15.50	8.89	1.16	10.34
L9a	7/20/2007	11:21	11:45	0:24	5.71	0.18	7.40	1.51	0.19	0.29
L9bE	7/20/2007	10:41	11:09	0:28	6.88	0.28	5.90	1.75	0.13	0.22
L9bE	9/19/2007	9:40	10:05	0:25	6.94	0.14	3.00	0.43	0.19	0.08
L9bE	11/23/2007	13:24	13:53	0:29	6.78	0.38	6.70	2.70	0.25	0.67
L9bE	11/30/2007	13:41	14:16	0:35	6.72	0.46	6.90	3.33	0.38	1.26
L9bE	3/28/2008	8:45	9:20	0:35	6.62	0.39	7.50	3.29	0.64	2.09

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Flow Measurement Summary

Wickecheoke Creek and Tributaries

Location	Date	Begin	End	Total Time	Gage	Avg Depth (ft)	Flow Width (ft)	X-Sect Area (ft^2)	Avg Vel (fps)	Flow (cfs)
W1	9/19/2007	13:30	14:00	0:30	18.54	0.30	4.30	1.28	0.45	0.57
W2a	3/28/2007	12:40	13:24	0:44	11.01	0.27	9.40	2.63	0.79	2.08
W2a	8/7/2007	13:10	13:35	0:25	11.10	0.24	2.70	0.70	0.22	0.15
W2a	9/19/2007	14:10	14:29	0:19	11.23	0.17	2.30	0.42	0.16	0.06
W2a	3/27/2008	13:25	13:54	0:29	10.79	0.31	8.00	2.56	0.55	1.42
W3a	3/28/2007	13:32	14:15	0:43	16.50	0.25	8.80	2.34	1.05	2.46
W3a	8/7/2007	13:45	14:12	0:27	16.64	0.18	3.10	0.74	0.38	0.28
W3a	10/29/2007	12:46	13:34	0:48	16.62	0.24	4.00	1.03	0.49	0.50
W3a	3/27/2008	14:00	14:46	0:46	16.54	0.36	10.80	4.06	0.43	1.75
W4	7/19/2006	14:10	14:56	0:46	19.06	0.24	2.20	0.65	0.25	0.16
W4	8/7/2006	8:21	9:26	1:05	19.12	0.23	2.35	0.39	0.12	0.05
W4	10/29/2007	13:54	14:55	1:01	18.78	0.37	11.20	5.32	0.31	1.68
W4	3/27/2008	11:12	12:07	0:55	18.67	0.42	9.40	4.32	0.51	2.22
W5	7/7/2006	13:55	15:04	1:09	12.64	0.66	13.40	8.74	0.94	8.18
W5	7/19/2006	15:08	15:56	0:48	12.97	0.31	7.70	2.39	0.40	0.95
W5	8/7/2006	9:43	10:25	0:42	13.14	0.18	5.65	0.51	0.12	0.06
W5	4/23/2008	13:25	14:43	1:18	12.80	0.50	9.60	7.52	0.26	1.97
W8	7/7/2006	10:04	10:55	0:51	10.24	0.44	19.00	8.46	0.45	3.77
W8	8/7/2006	11:13	11:35	0:22	10.60	0.05	0.40	0.01	0.14	0.001
W9	7/7/2006	12:26	13:15	0:49	9.20	0.39	9.30	3.62	0.34	1.23
W9a	3/28/2007	14:45	15:10	0:25	8.05	0.18	5.60	1.10	0.78	0.86
W9b	11/23/2007	14:05	14:27	0:22	8.75	0.16	2.70	0.53	0.21	0.11
W11	7/7/2006	8:00	8:50	0:50	8.96	0.46	17.60	8.67	0.33	2.86
W11	10/30/2006	15:00	16:21	1:21	8.90	0.44	17.80	9.82	0.33	3.22
W11	3/28/2007	15:19	16:02	0:43	8.90	0.49	16.20	8.21	0.42	3.41
W11	4/18/2007	13:38	14:28	0:50	8.76	0.66	18.80	13.78	0.57	7.79
W11a	3/28/2007	10:58	11:29	0:31	7.00	0.23	4.60	1.48	0.34	0.50
W11a	4/18/2007	14:35	15:04	0:29	6.86	0.59	6.00	3.68	0.26	0.97
W11a	4/23/2008	9:56	10:32	0:36	7.10	0.25	4.00	1.08	0.12	0.12
W11b	3/28/2007	9:17	10:01	0:44	5.15	0.30	12.10	3.80	0.35	1.34
W11b	11/23/2007	15:04	15:37	0:33	5.29	0.21	7.60	1.74	0.22	0.38
W11b	4/23/2008	10:36	11:19	0:43	5.38	0.30	7.90	2.44	0.12	0.29
W11c	3/28/2007	10:10	10:41	0:31	6.81	0.15	9.70	1.45	0.44	0.64
W11c	3/28/2008	10:19	10:58	0:39	6.86	0.22	4.70	1.13	0.34	0.38
W11c	4/17/2008	11:43	12:51	1:08	6.90	0.17	4.60	0.81	0.22	0.18

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Appendix D

Stream Flow Conditions During Sampling Events And Total Amount of Precipitation 2 Days Prior To and During Sample Collection

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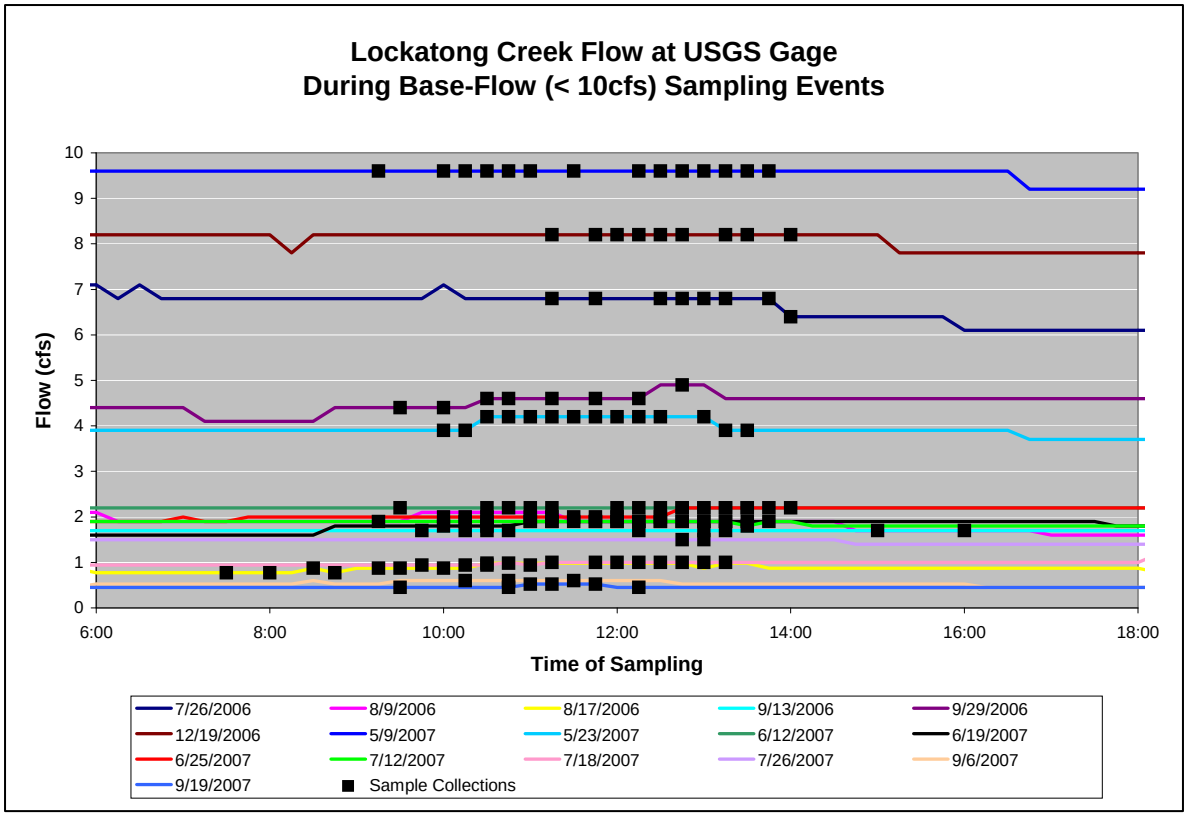
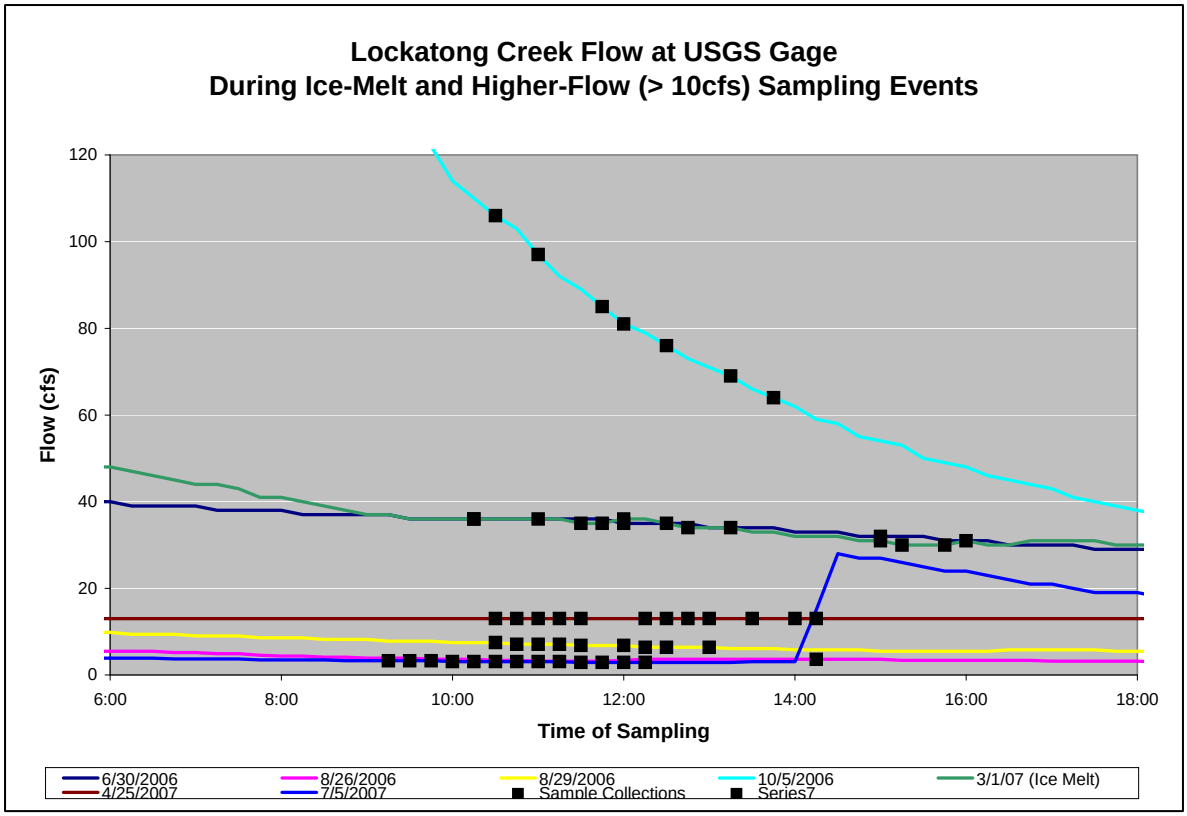
Lockatong Creek sampling events during baseflow and higher flow





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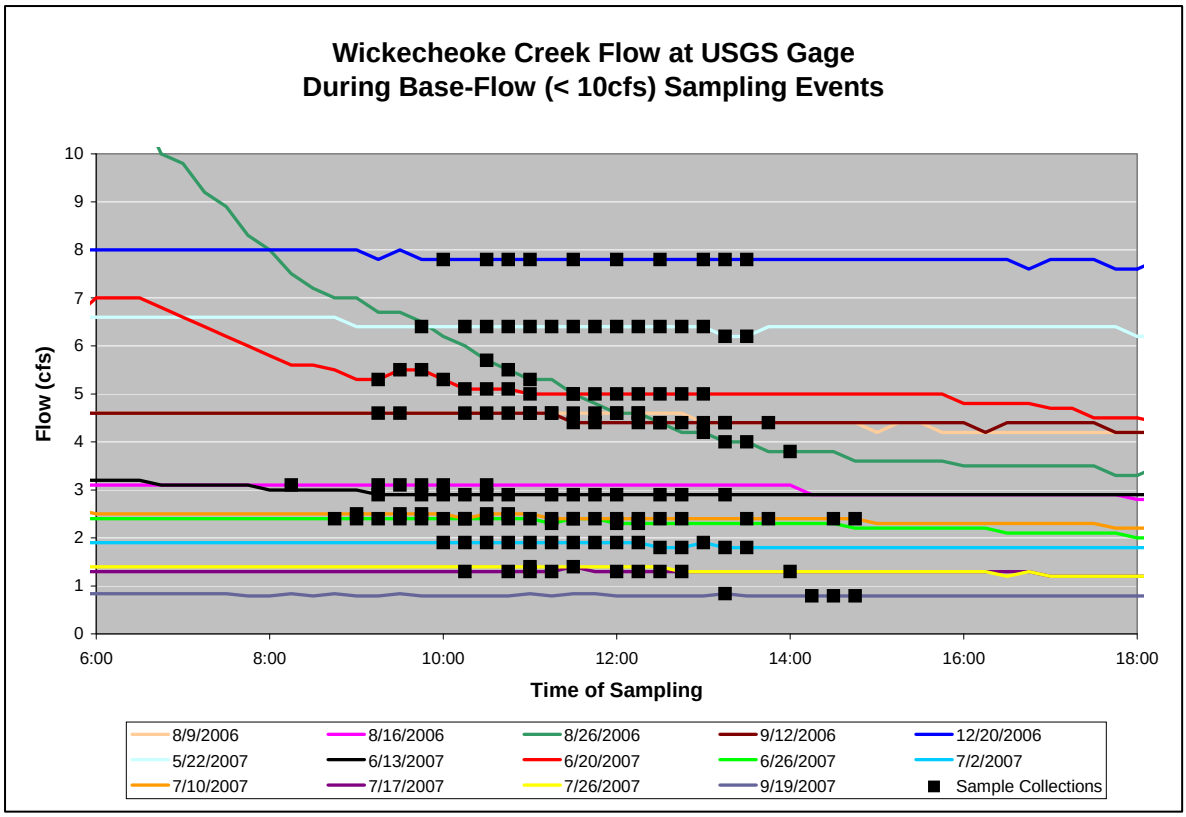
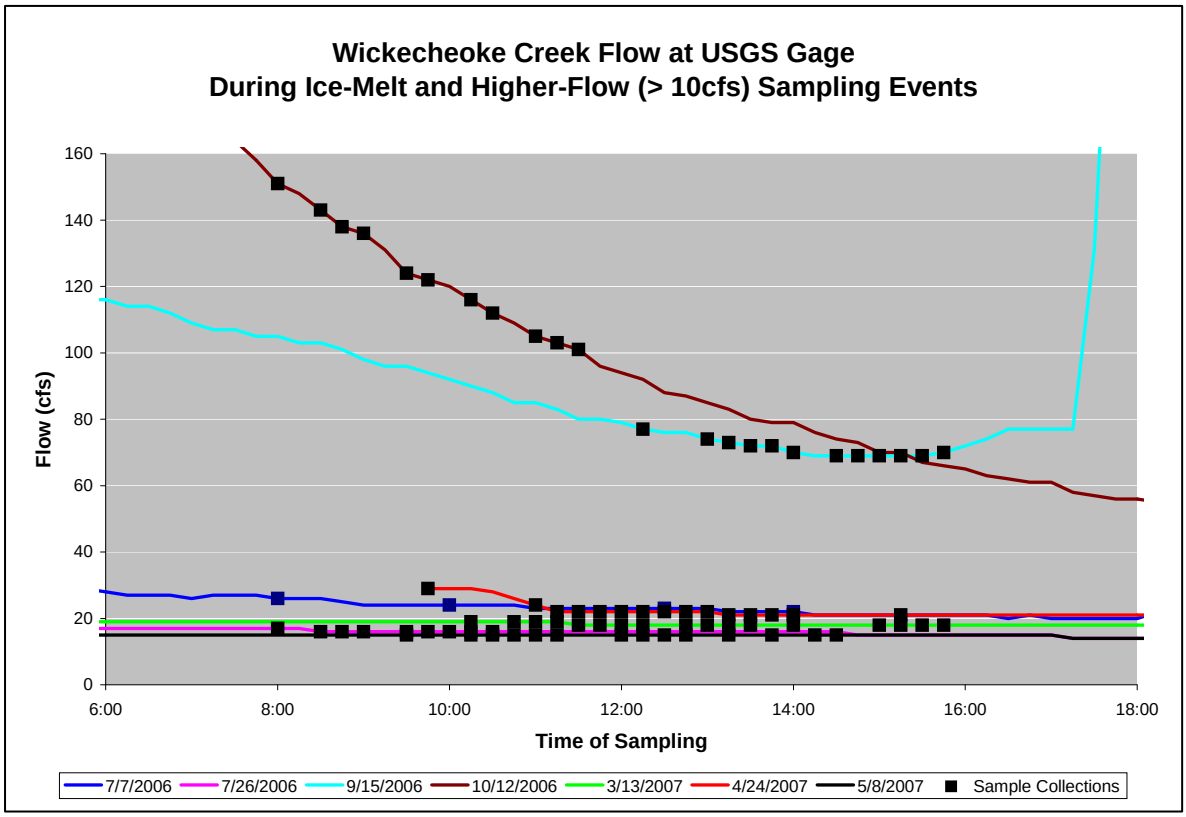
Wickecheoke Creek sampling events during baseflow and higher flow





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Total precipitation within 72 hours prior to each water quality sampling event.

Water Quality Sampling Date	Total Precipitation (inch)	
	Rutgers Snyder Research Farm (Pittstown Road)	USGS monitor at Stockton, NJ (Bridge Street)
6/30/06	5.69	3.20
7/7/06	2.41	0.72
7/26/06	0.00	0.00
8/9/06	0.22	0.04
8/16/06	0.12	0.00
8/17/06	0.12	0.00
8/26/06	0.01	1.00
8/29/06	0.01	1.48
9/12/06	0.00	0.00
9/13/06	0.00	0.00
9/15/06	2.66	0.96
9/29/06	0.67	0.36
10/5/06	0.75	0.96
10/12/06	1.50	0.92
12/19/06	0.00	0.00
12/20/06	0.00	0.00
3/1/07	0.16	0.01
3/13/07	0.07	0.01
4/24/07	0.00	0.00
4/25/07	0.34	0.01
5/8/07	0.00	Not Available
5/9/07	0.00	Not Available
5/22/07	0.02	Not Available
5/23/07	0.00	Not Available
6/12/07	1.16	Not Available
6/13/07	1.15	Not Available
6/19/07	0.30	Not Available
6/20/07	1.22	Not Available
6/25/07	0.02	Not Available
6/26/07	0.02	Not Available
7/2/07	0.00	Not Available
7/5/07	1.75	2.11
7/10/07	0.04	0.00
7/12/07	0.14	0.01
7/17/07	0.00	0.00
7/18/07	0.09	0.38
7/26/07	0.00	0.00
9/6/07	0.00	0.01
9/19/07	0.00	0.58

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Appendix E

Site-Specific Affects of Stream Flow On Water Quality Loadings and Concentrations

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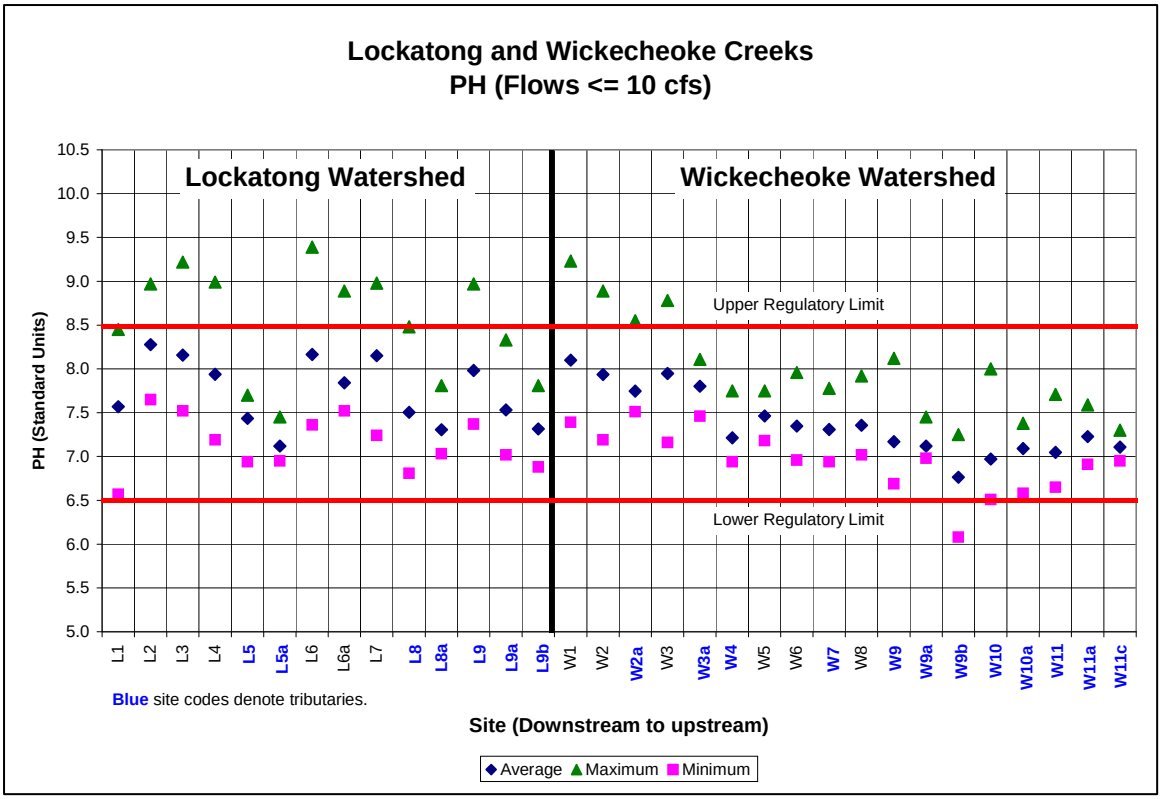
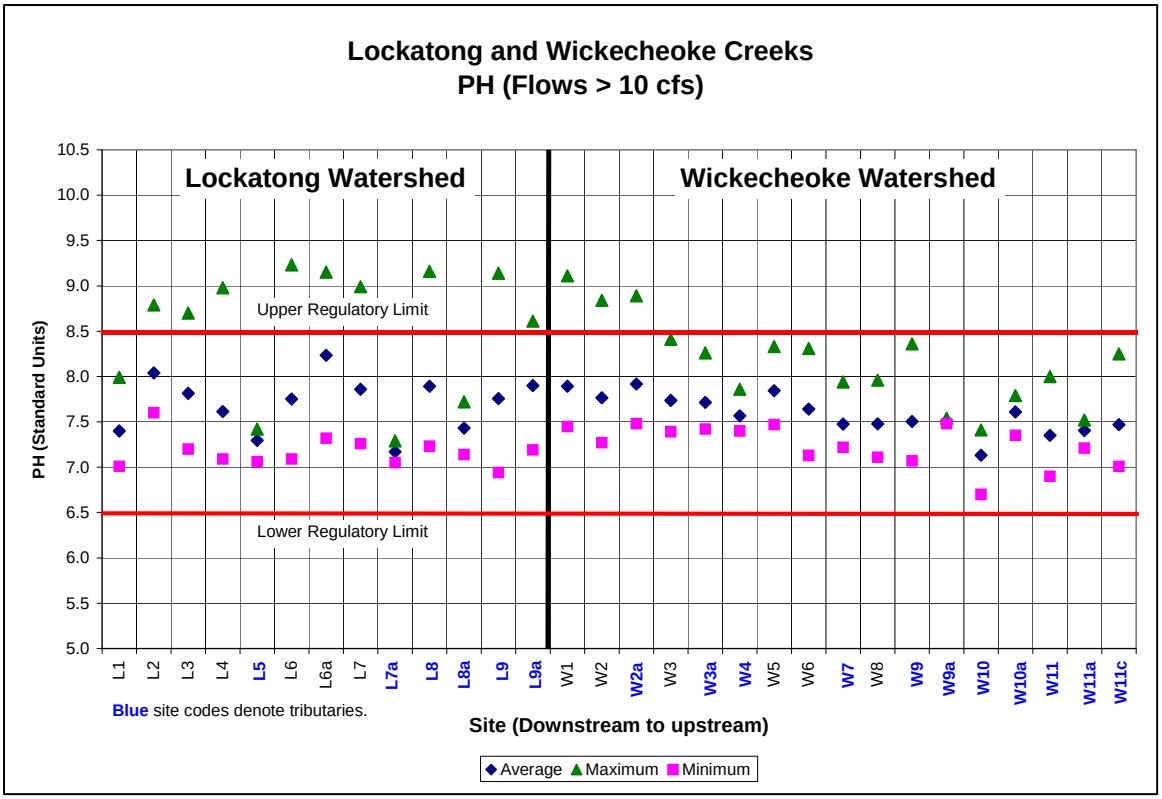
PH





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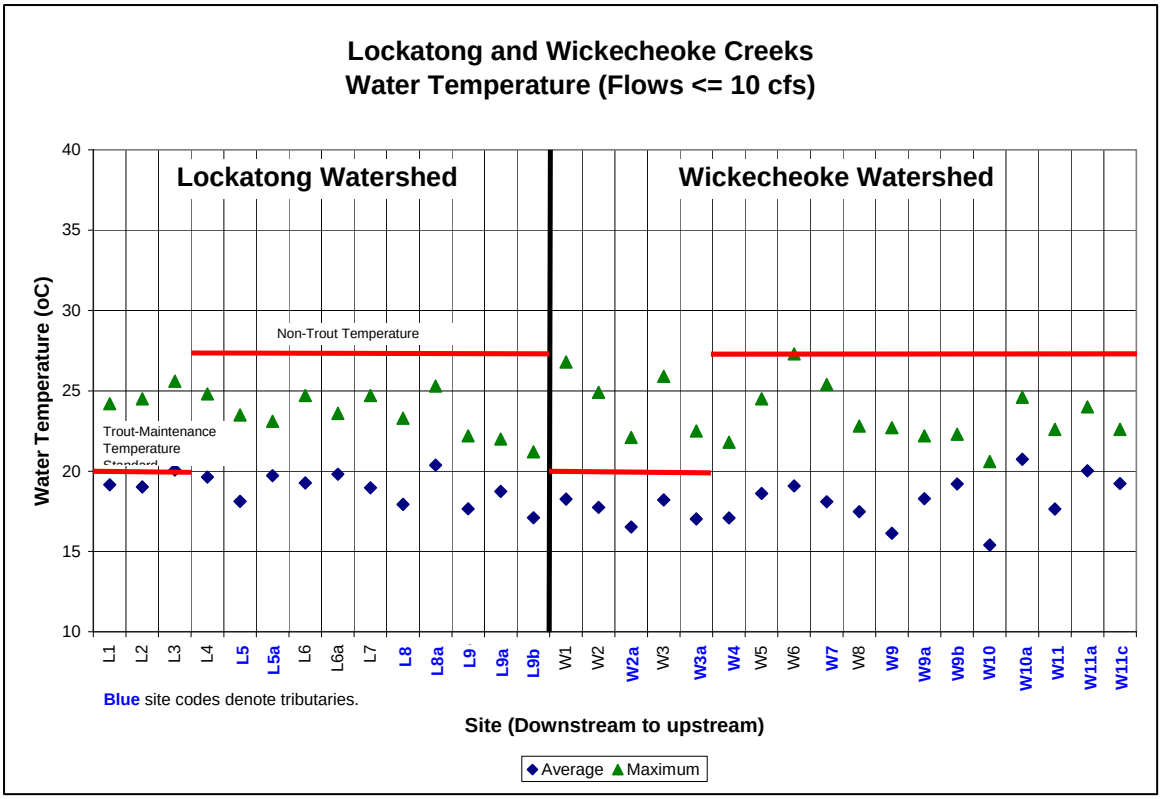
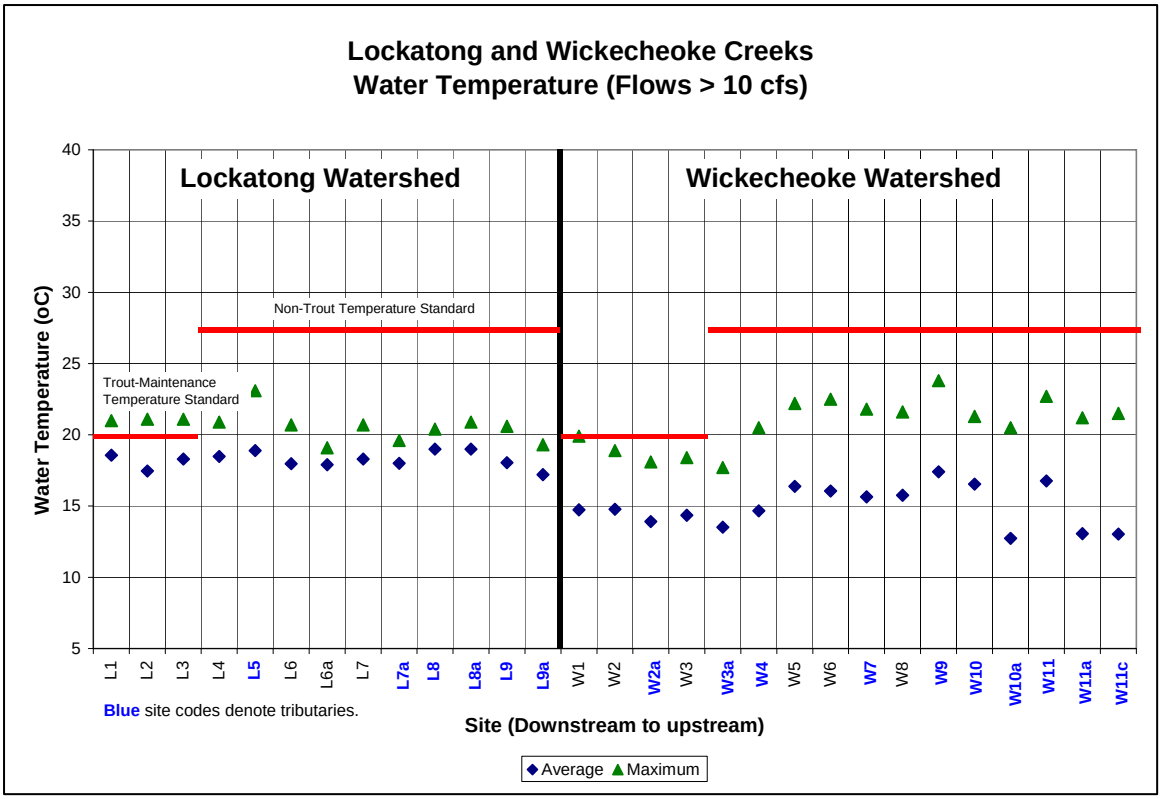
Water Temperature





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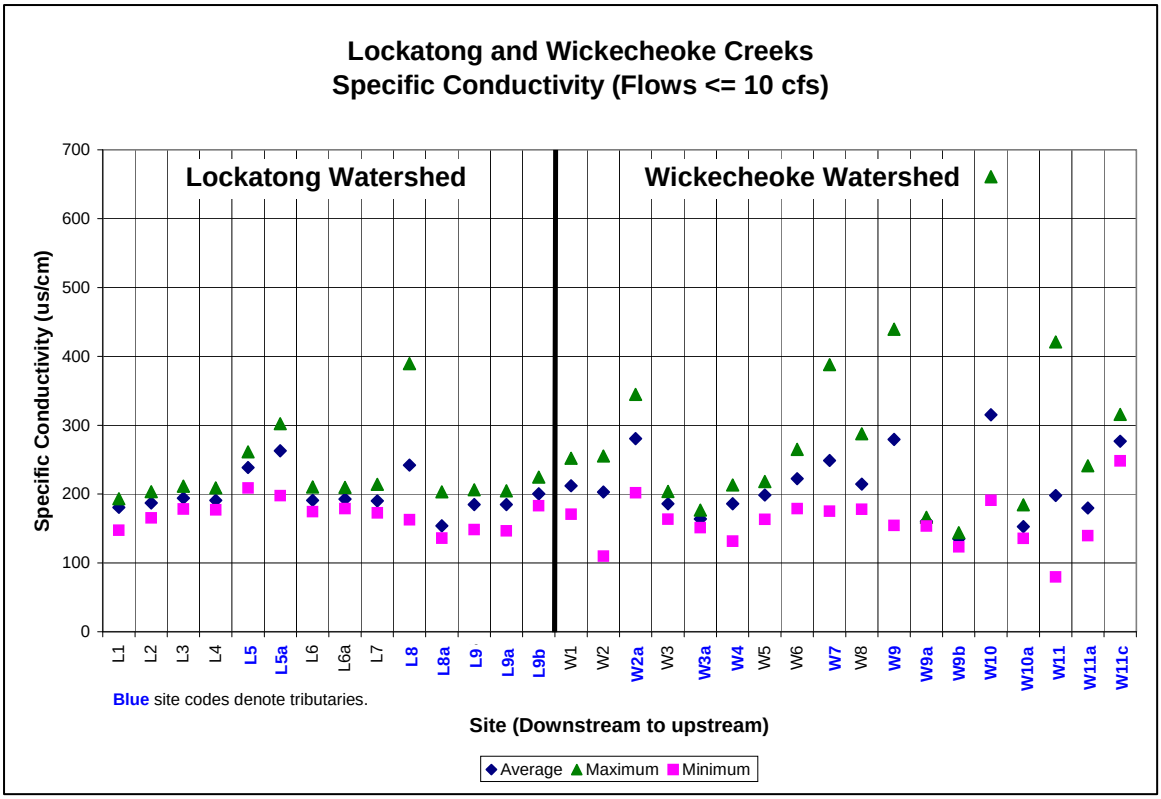
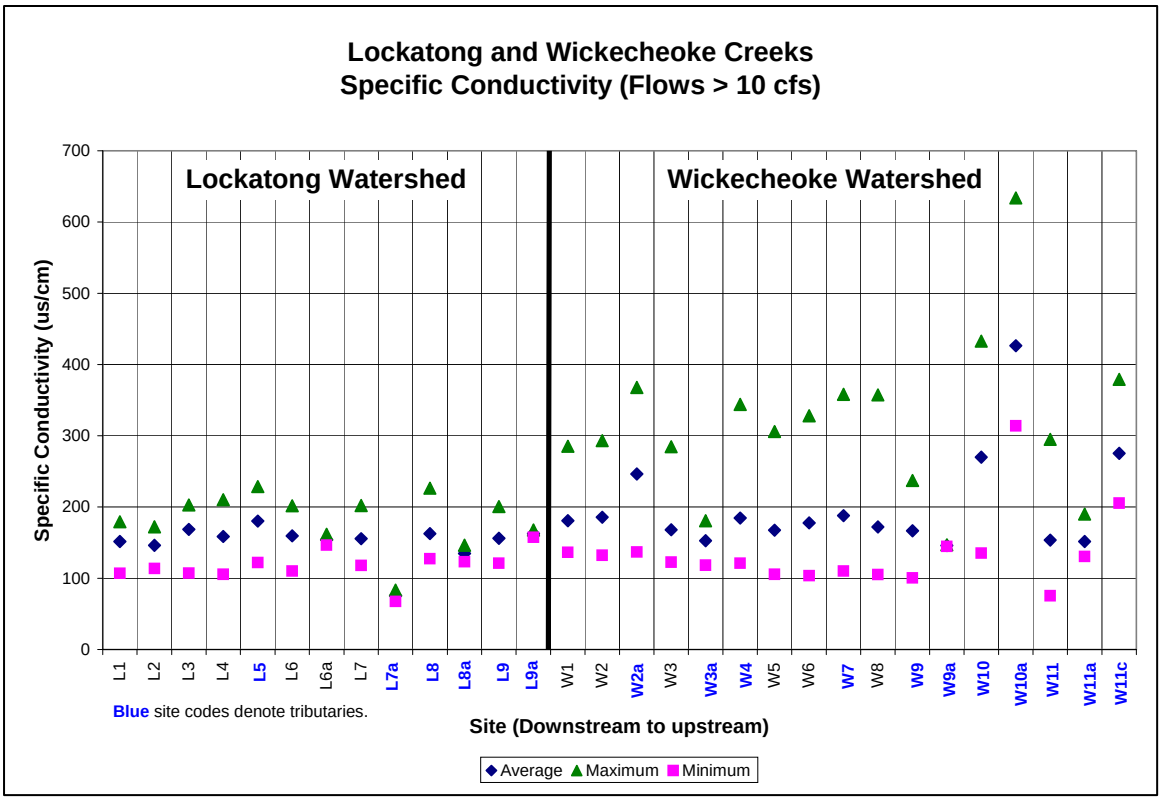
Specific Conductivity





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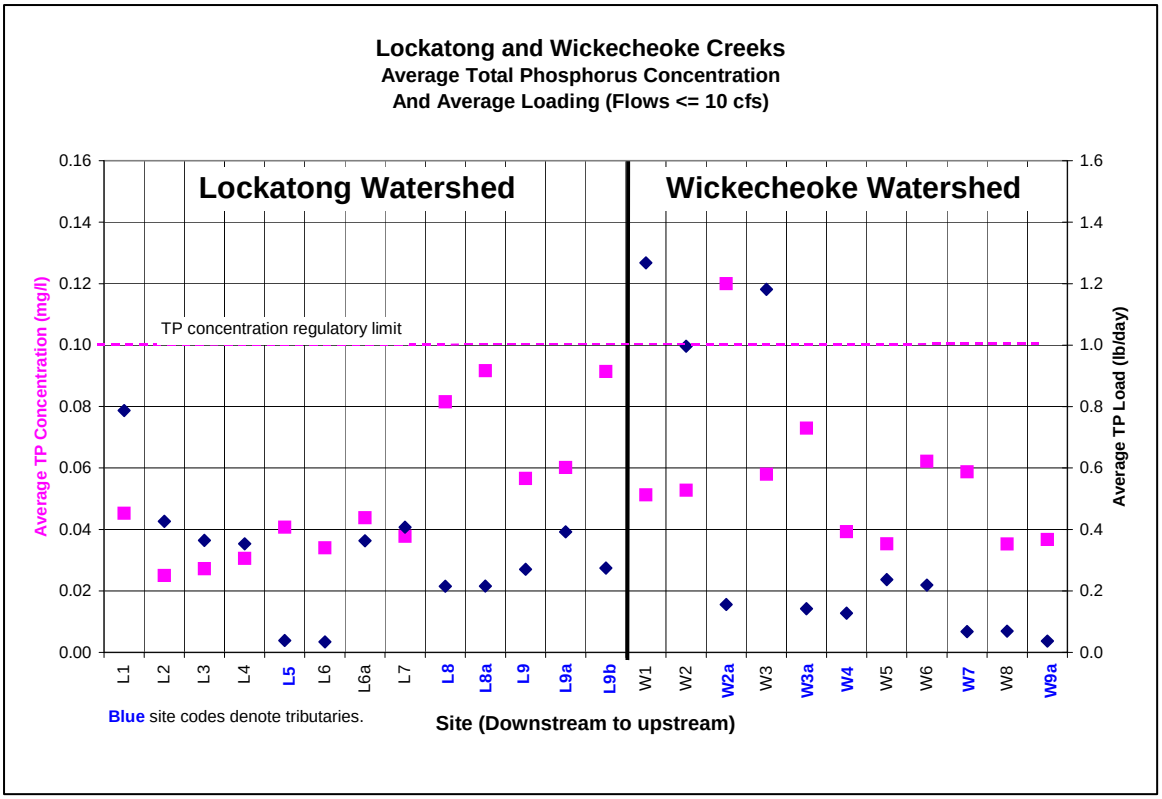
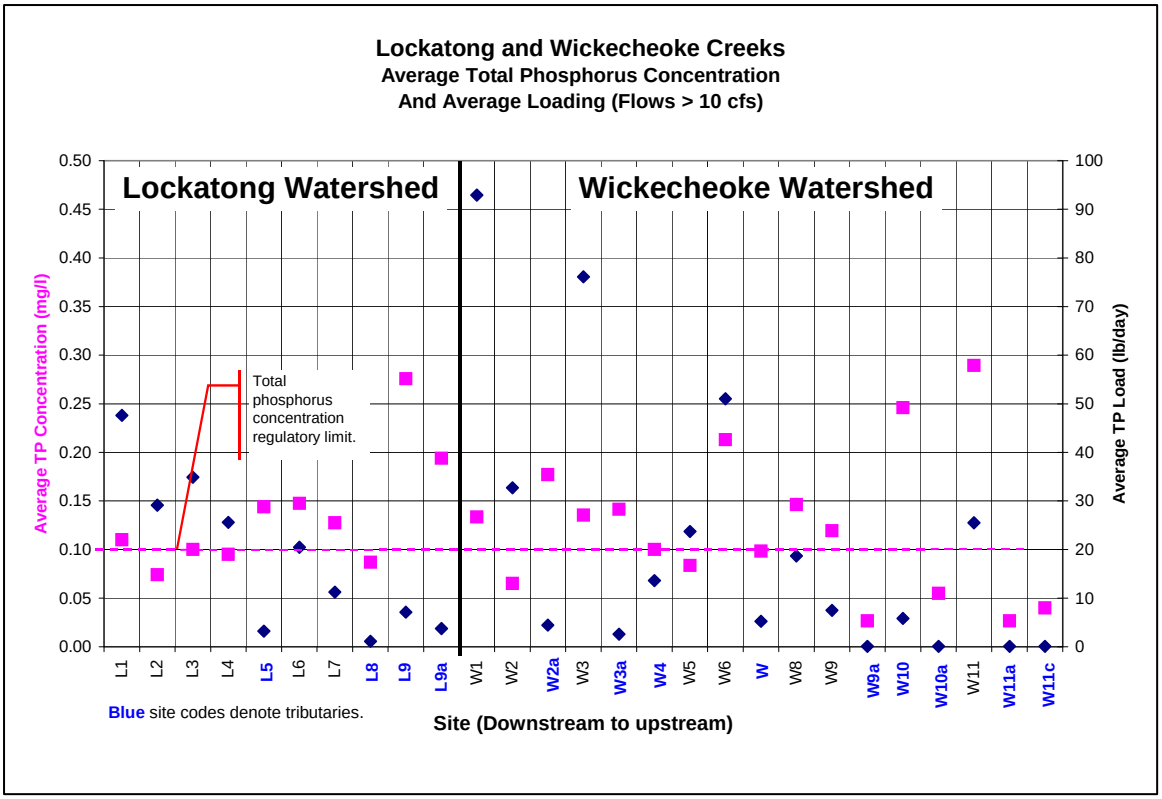
Total Phosphorus





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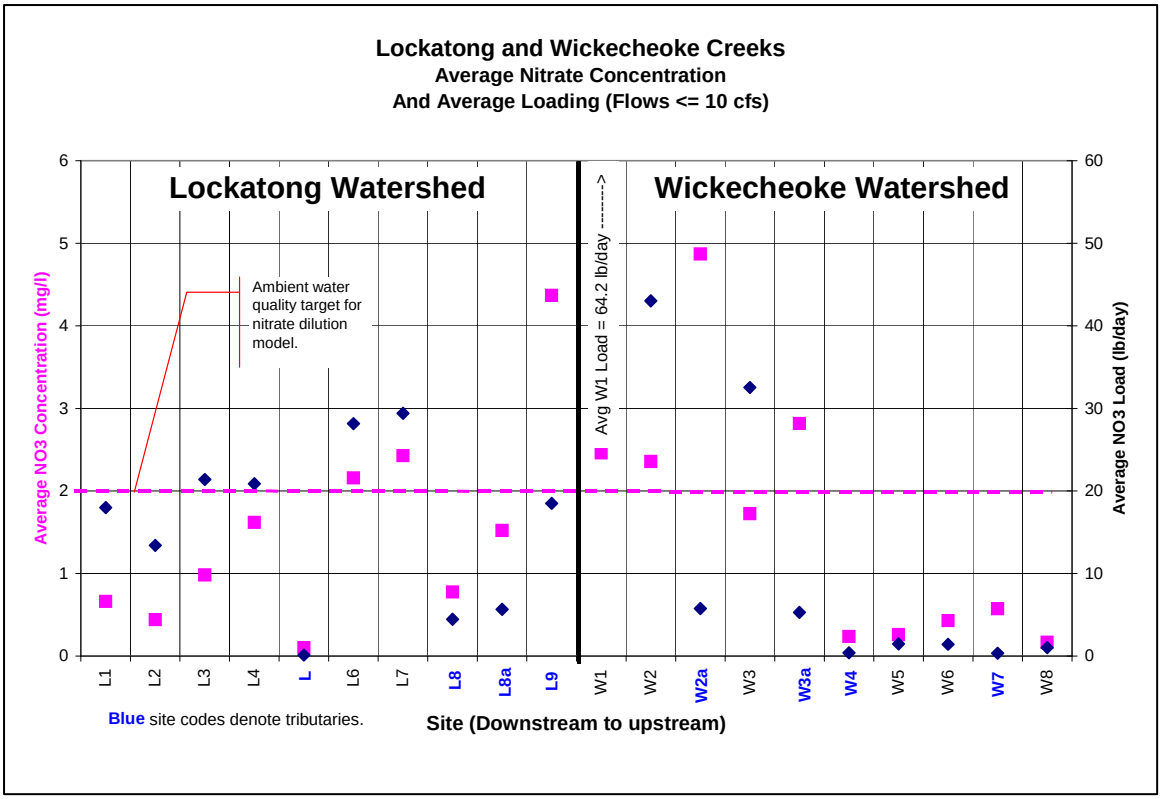
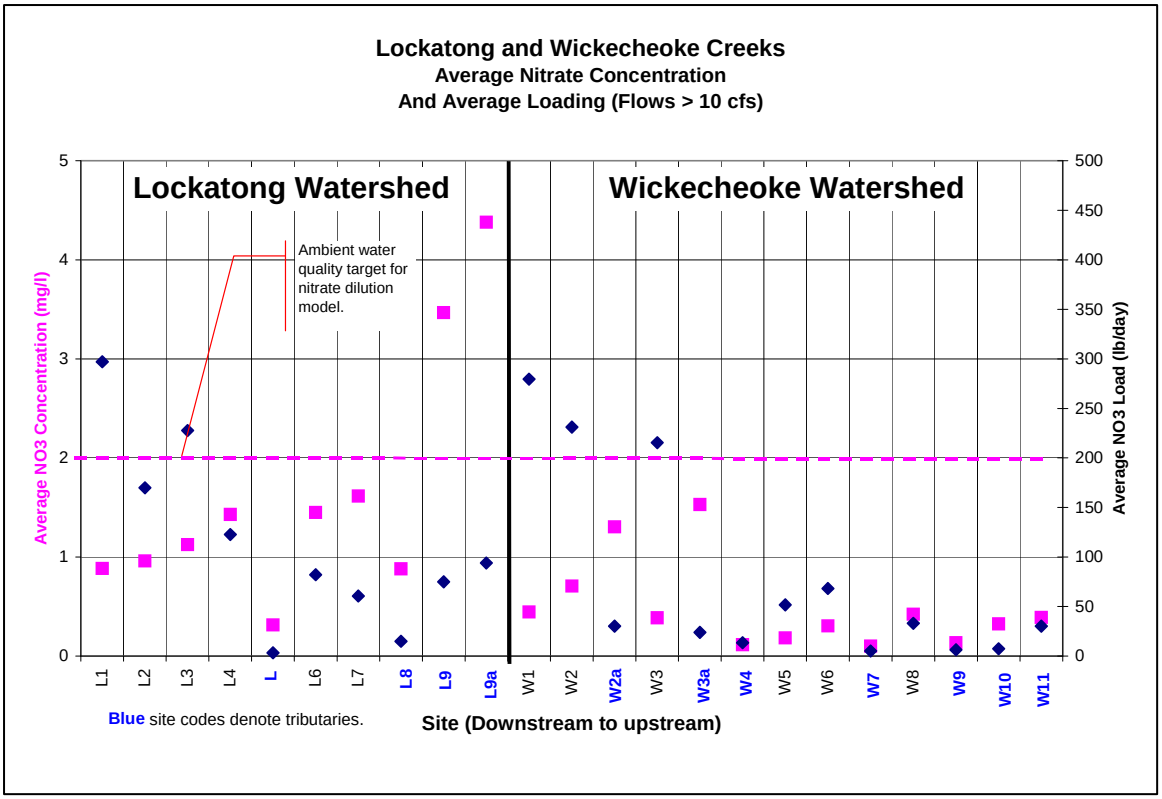
Nitrate (NO_3 as N)





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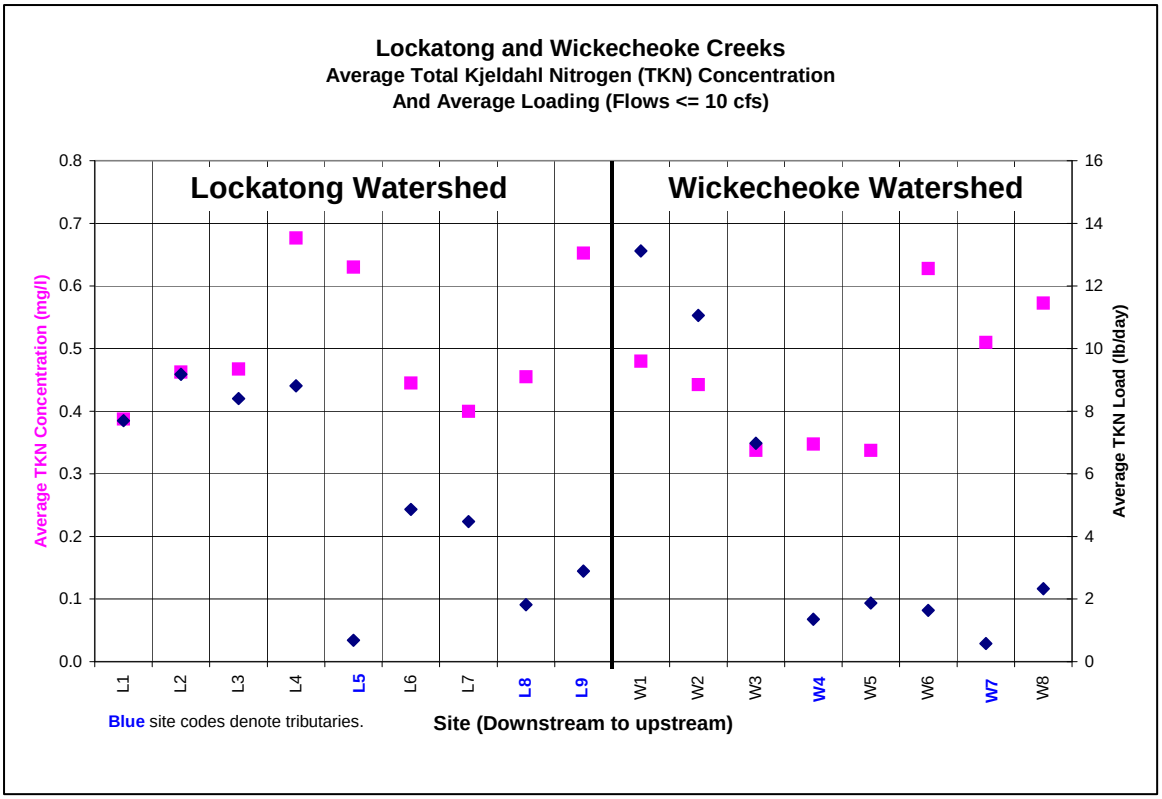
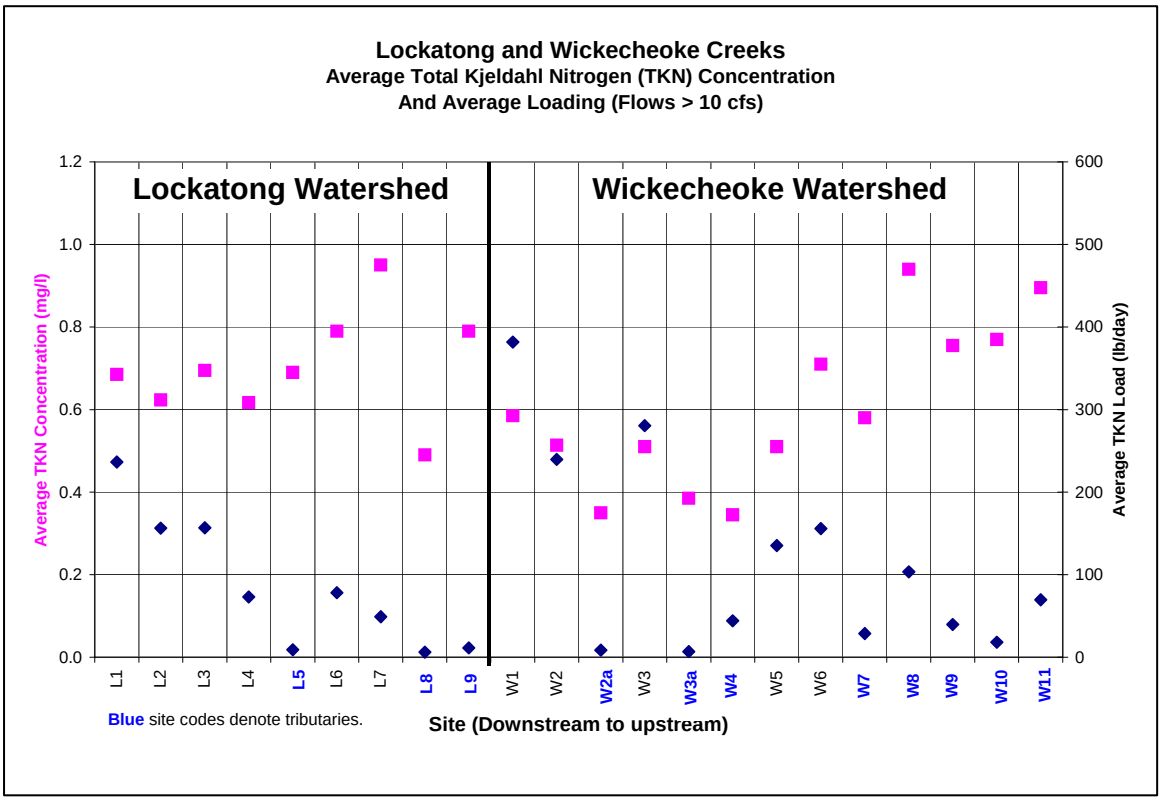
Total Kjeldahl Nitrogen (TKN)





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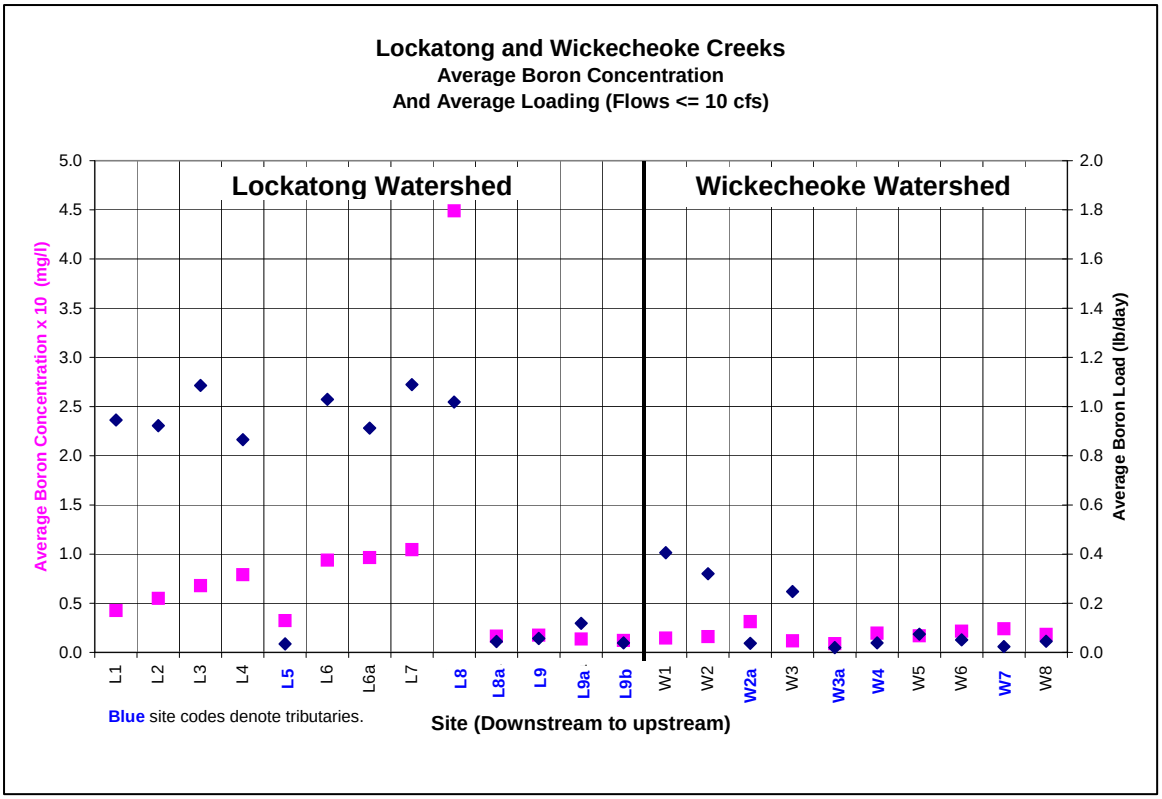
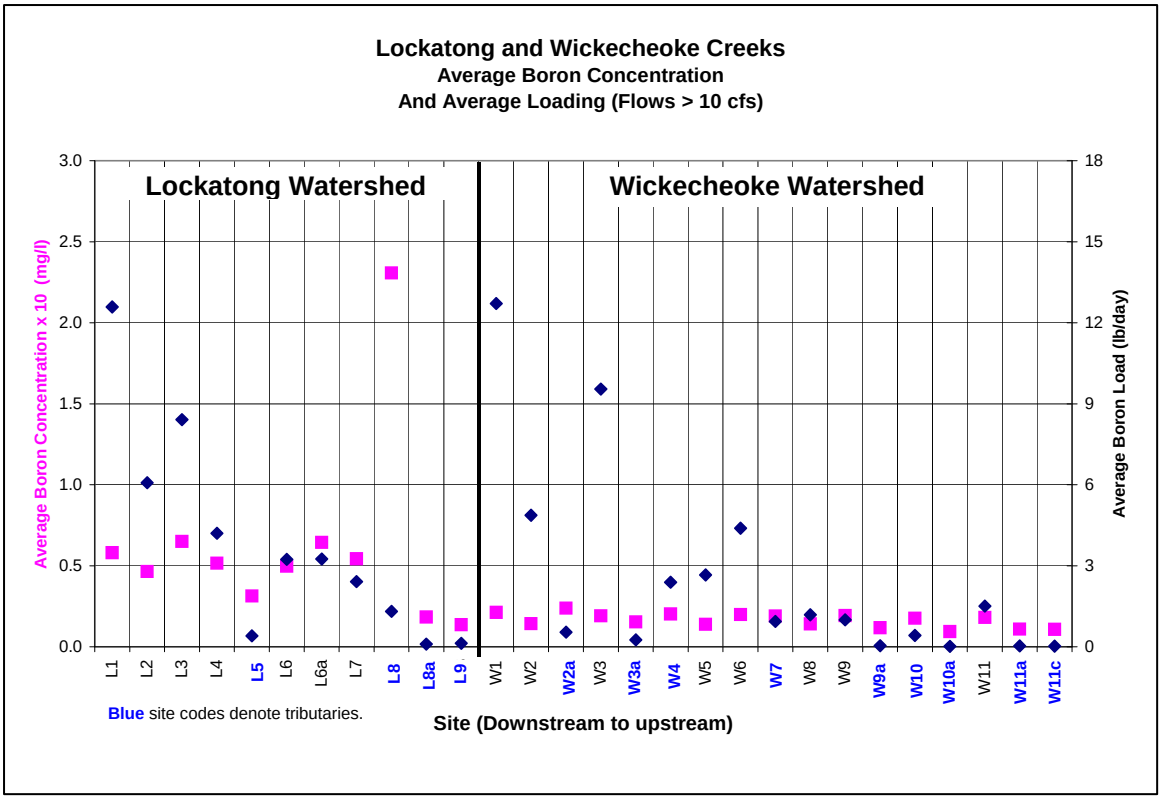
Boron





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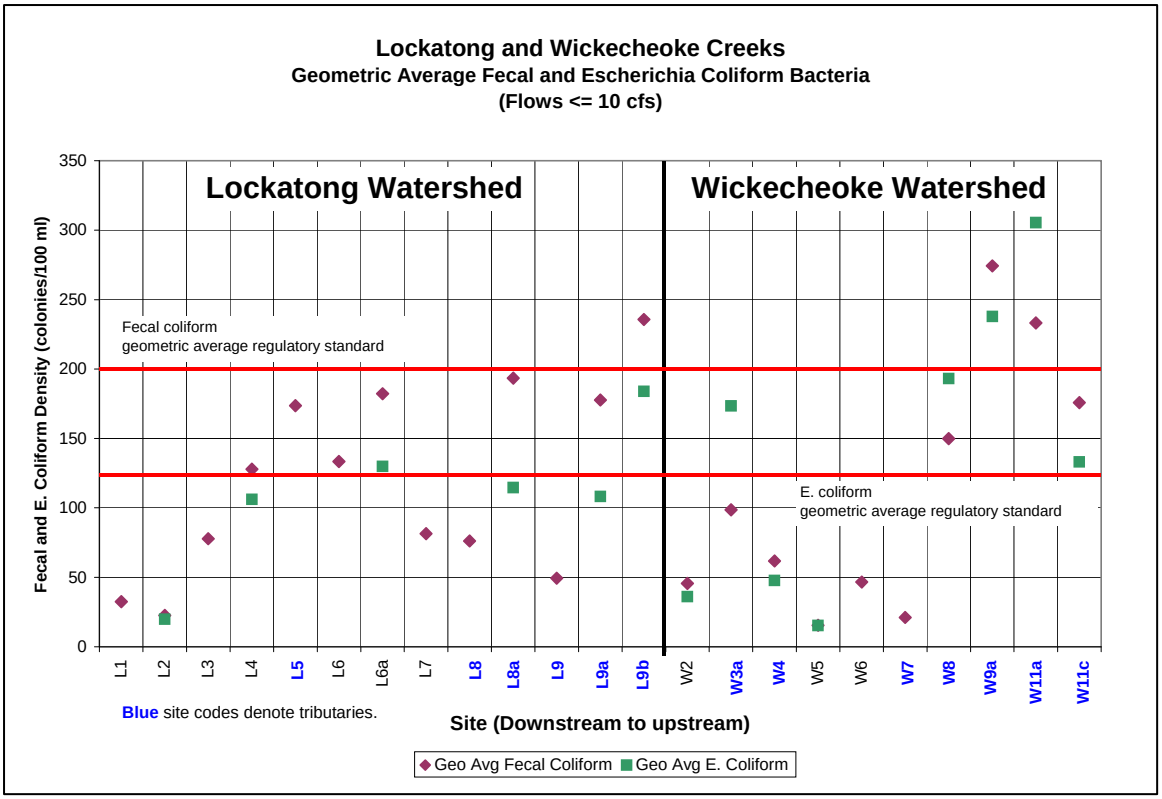
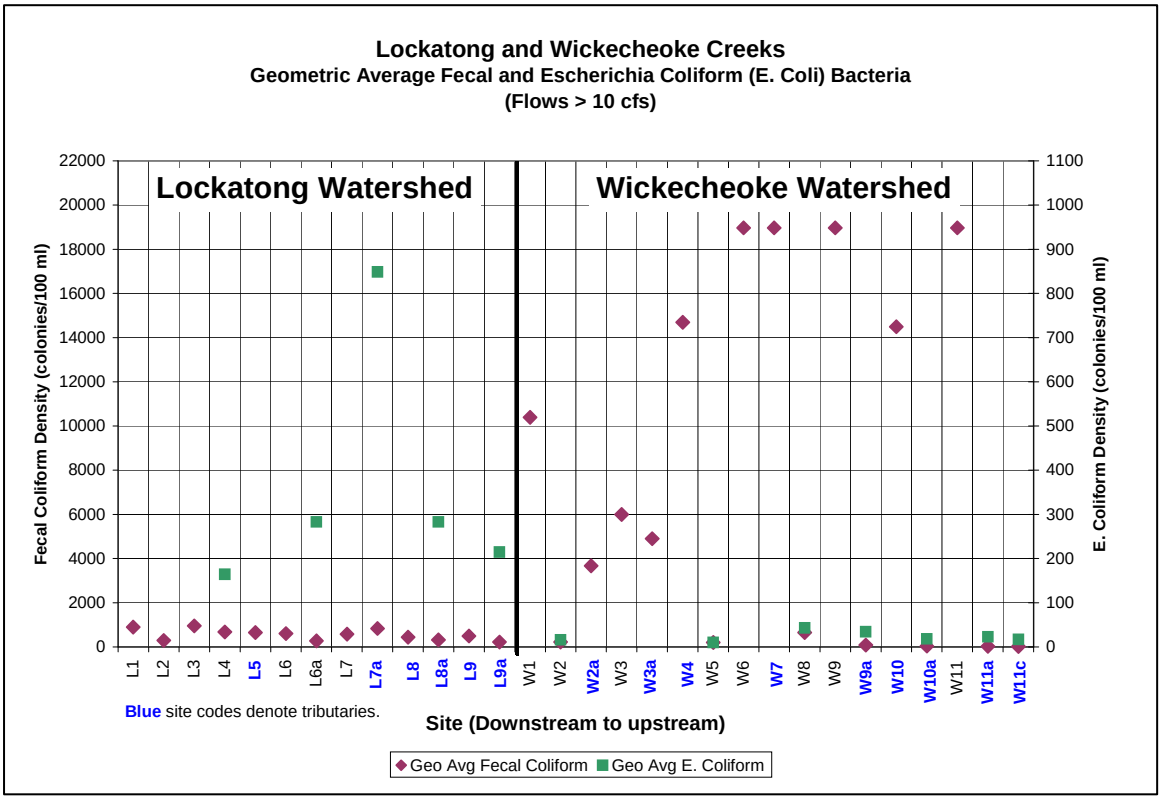
Fecal and Escherichia Coliform (E. Coli, or E. Coliform) Bacteria





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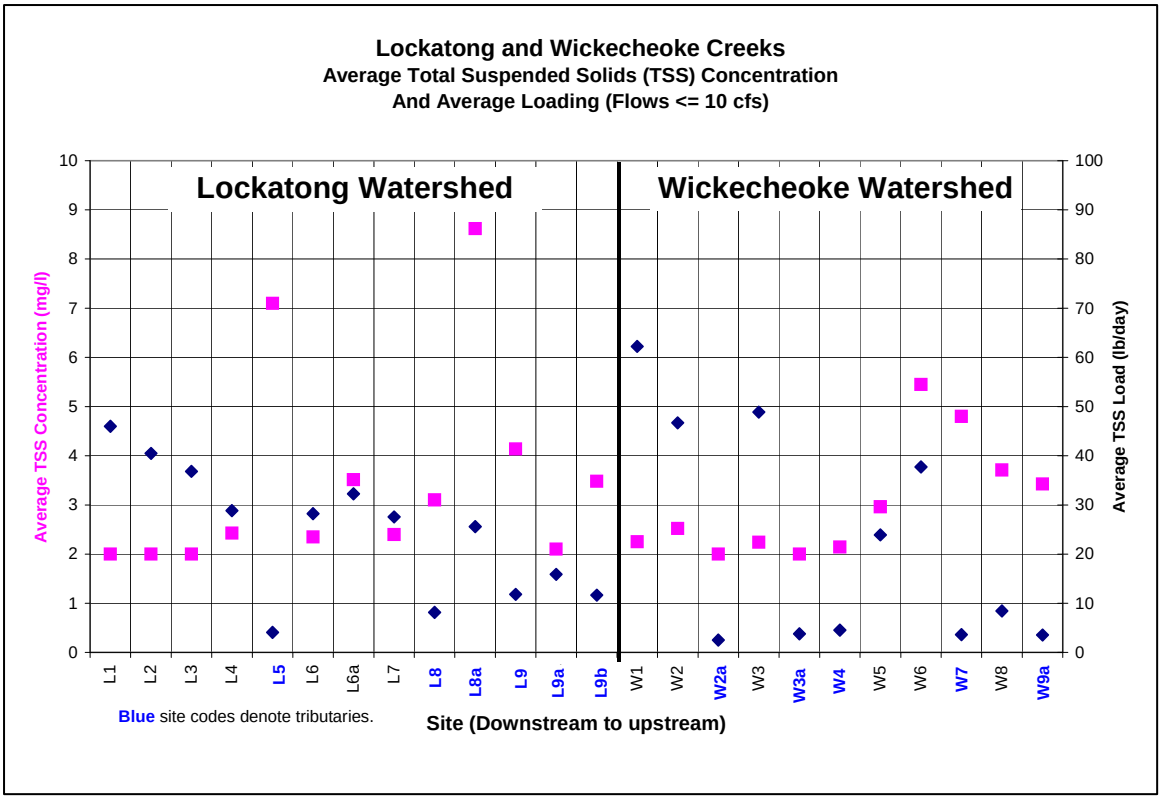
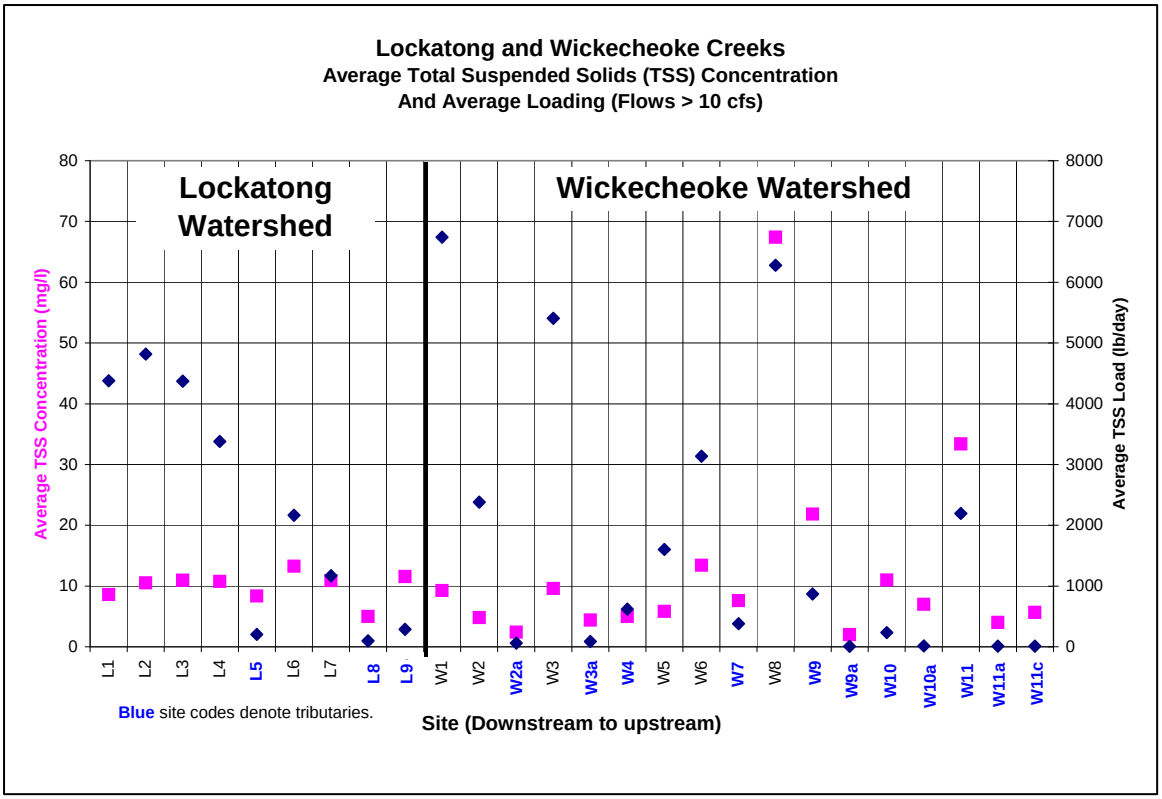
Total Suspended Solids (TSS)





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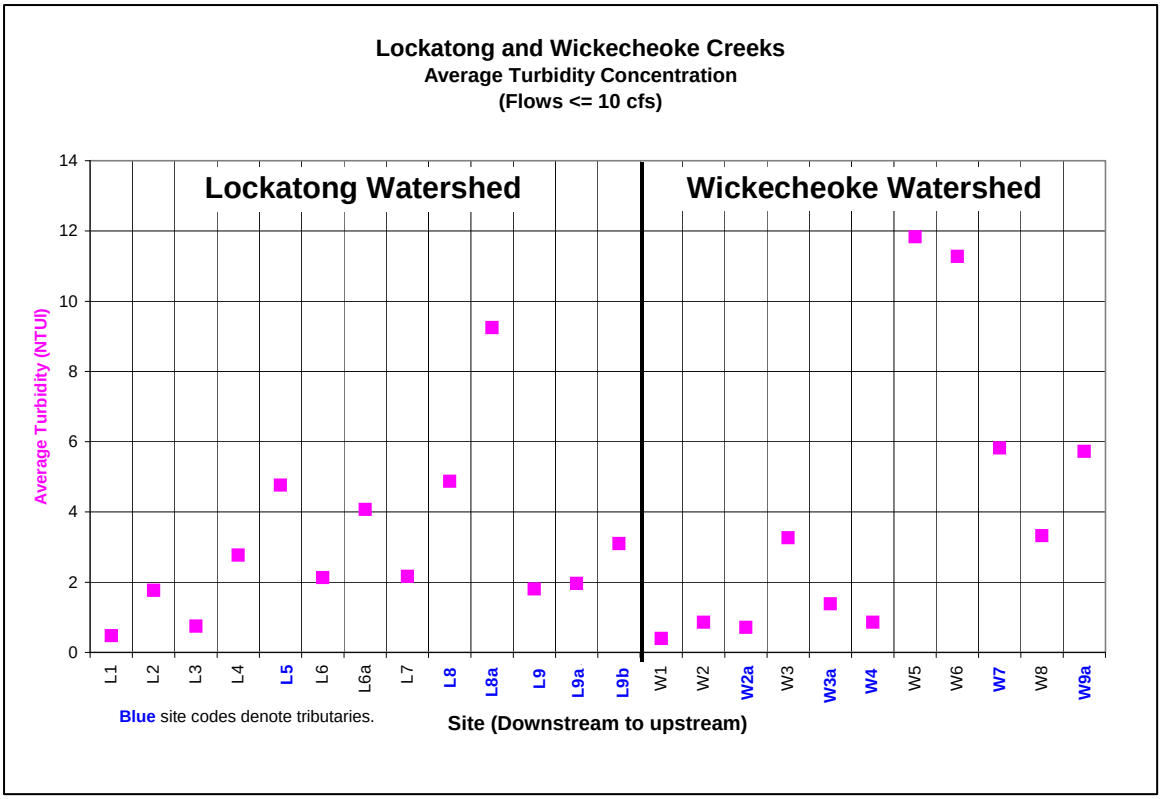
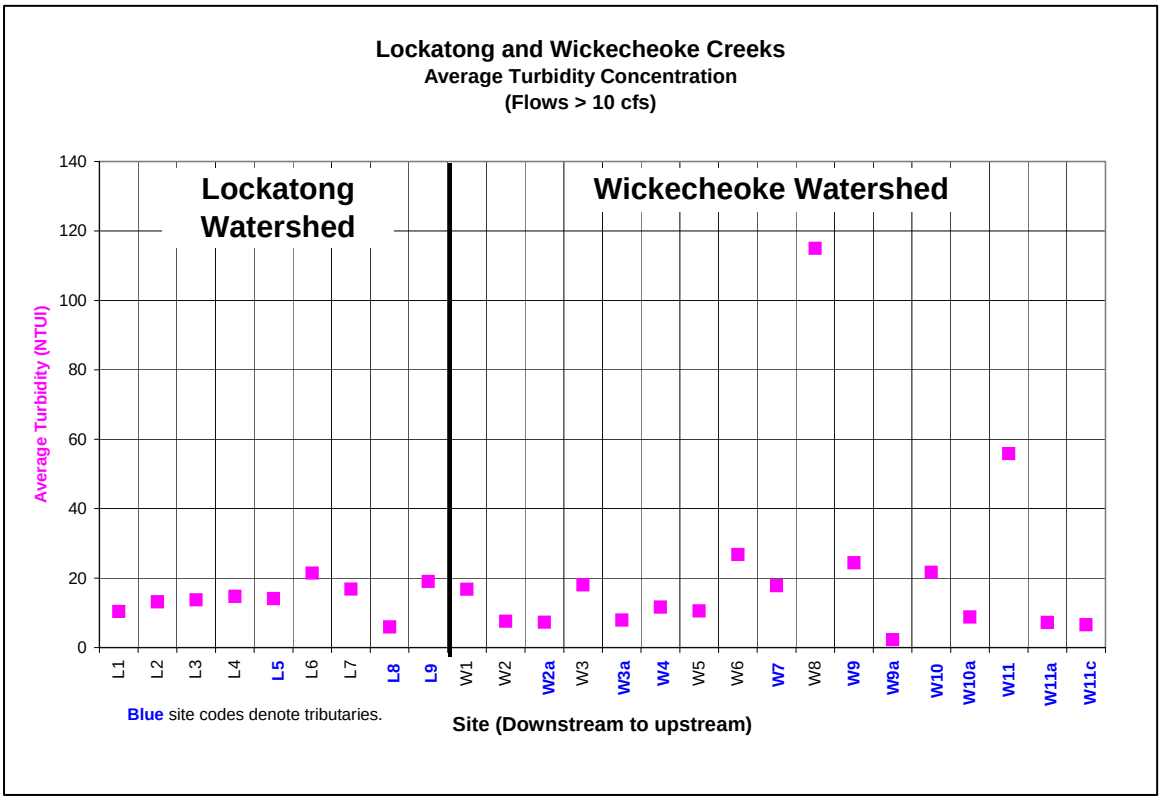
Turbidity





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Appendix F

Comparison of Results From Simultaneous Collections of Ambient, Resuspended Sediment, and Sediment Samples

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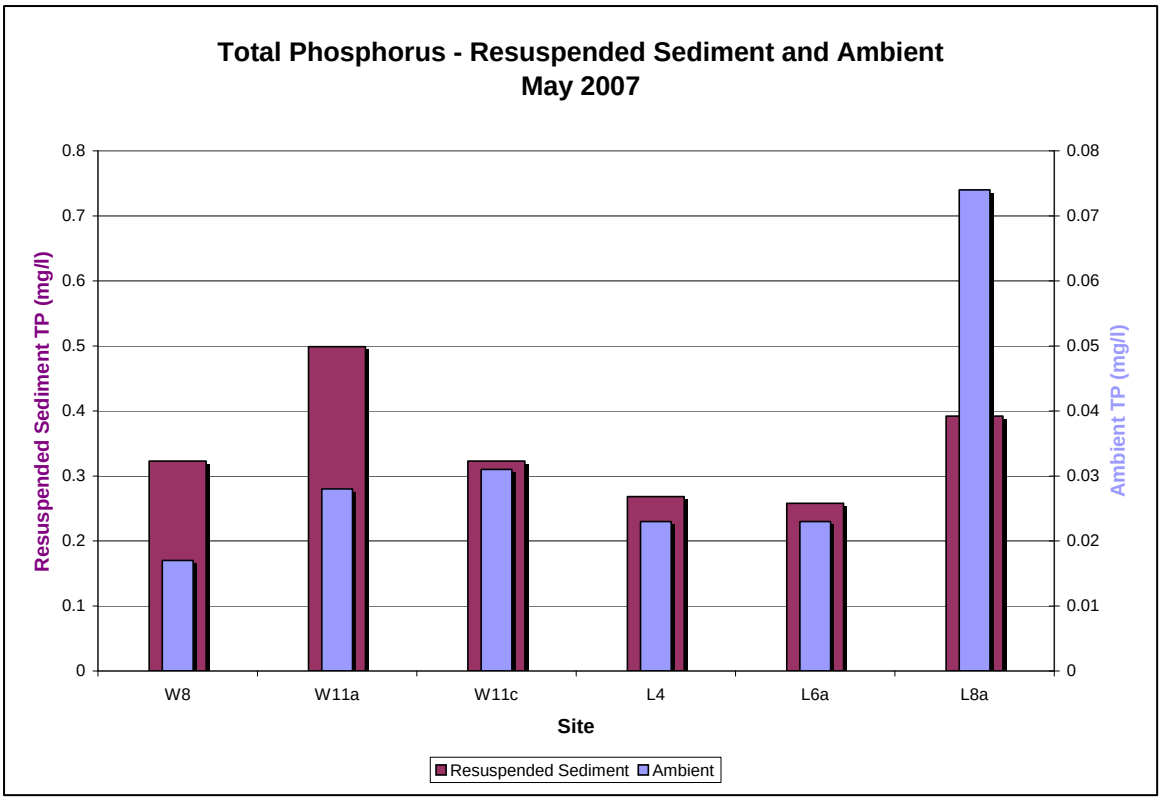

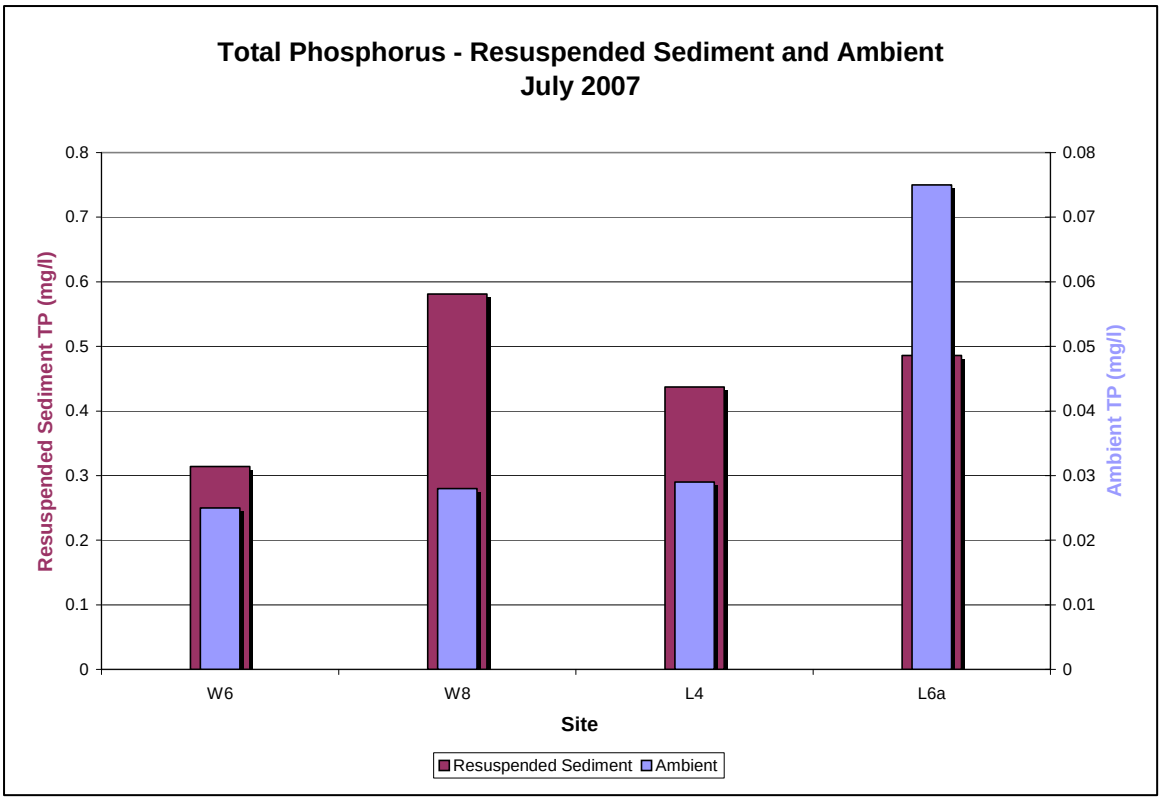

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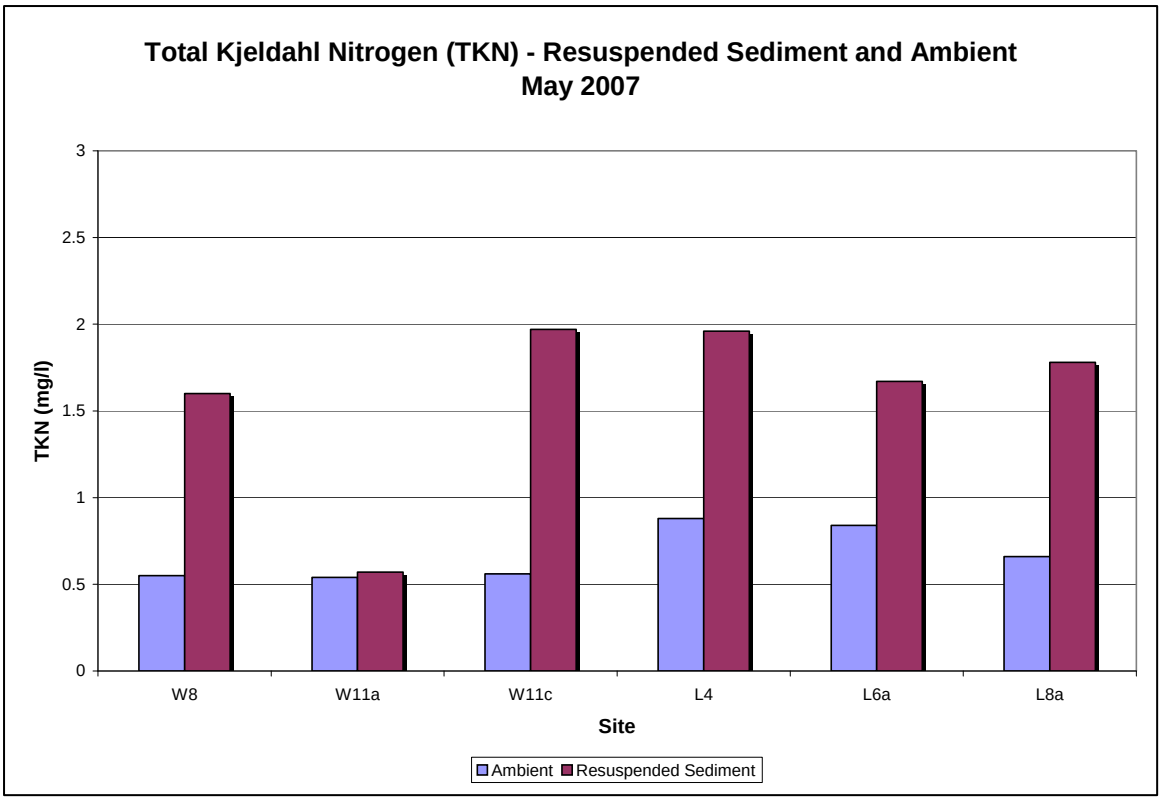

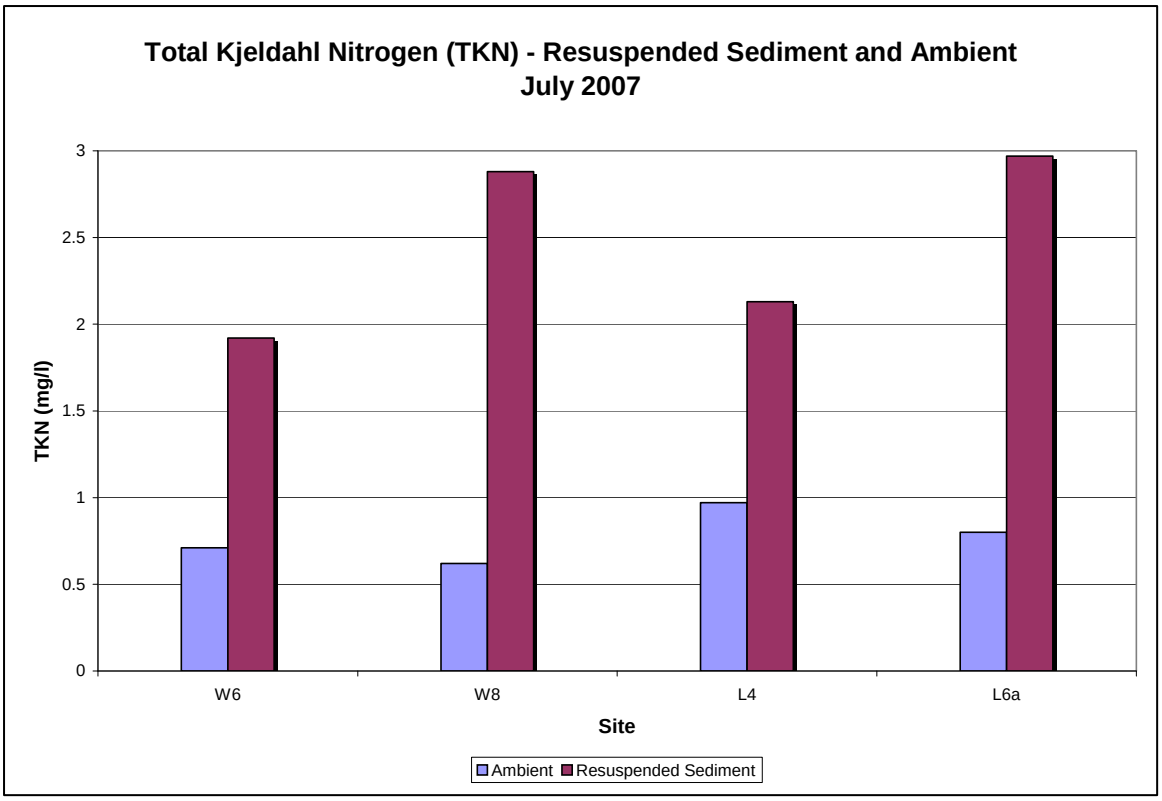

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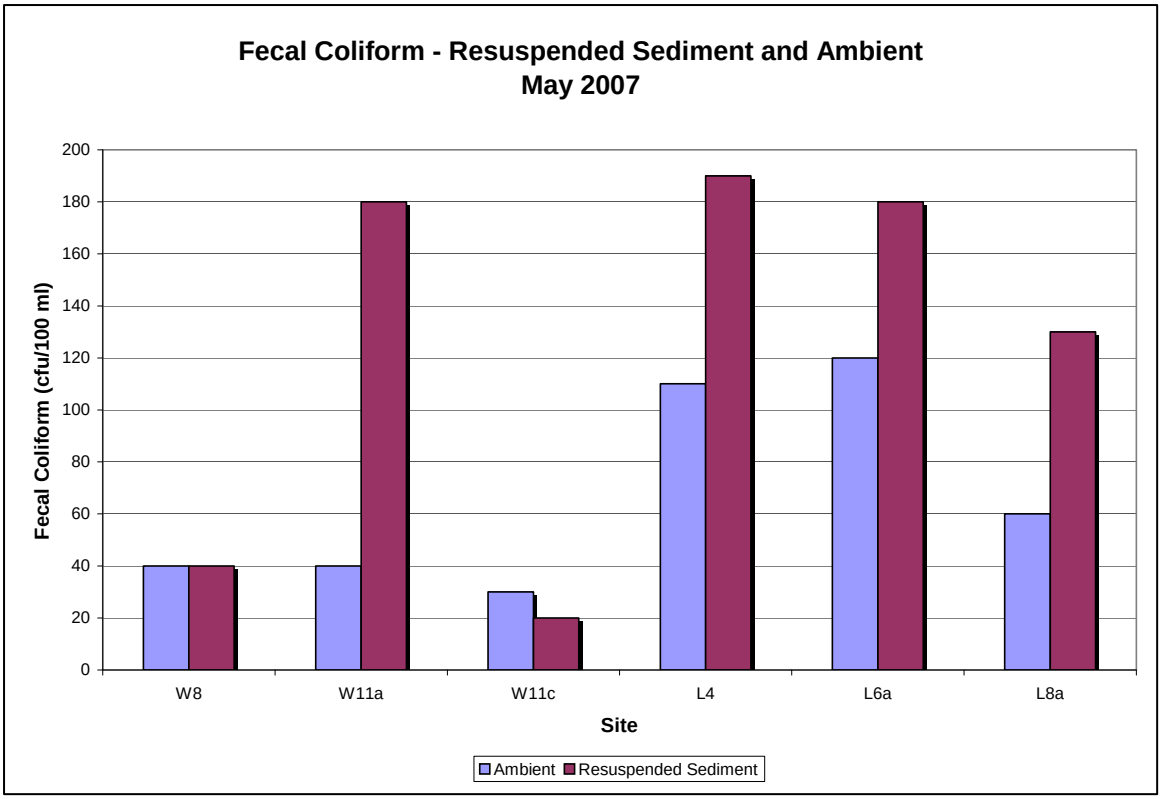

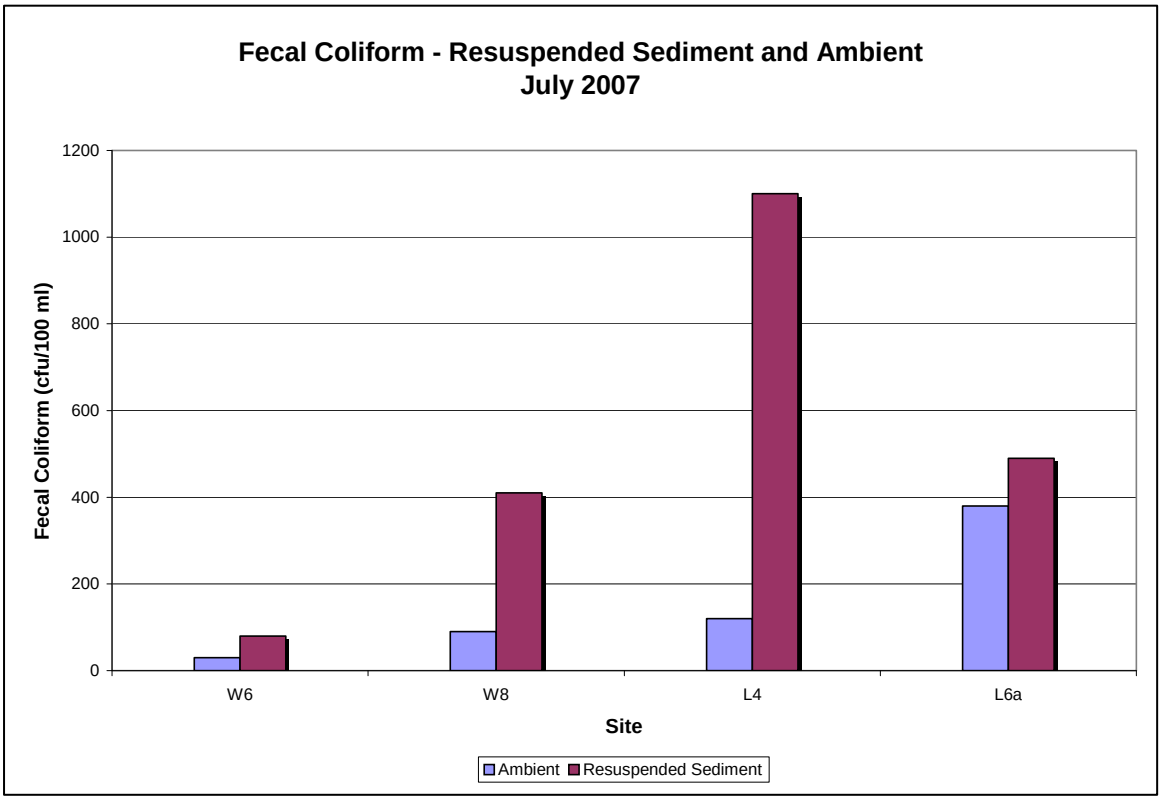

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Appendix G

Results of Stream Visual Assessments

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Visual Assessment Scores For Sites Within the Lockatong Creek Watershed

Water Quality Site	**L7**	**L7**	**L6**	**L6**			**L5**
SVAP #	**L-1**	**L-2**	**L-3**	**L-4**	**L-5**	**L-6**	**L-7**
Stream	**Mainstem**	**Mainstem**	**Mainstem**	**Mainstem**	**Tributary**	**Mainstem**	**Muddy Run**
Location	US Side Union Road, Kingwood Park	DS of Union Road	DS of Barbertown -Point Breeze Road	US of Barbertown-Point Breeze Road	US of Lower Oak Grove Rd	DS of Lower Oak Grove Rd	US of Muddy Run Rd
Assessment Elements/Scores:							
Channel condition	8	8	8	8	8	9	7
Hydrologic alteration	7	7	8	8	8	7	7
Riparian zone	7	8	8	9	8	1	8
Bank stability	6	6	8	9	7	7	6
Water appearance	9	8	8	9	8	8	8
Nutrient enrichment	7	7	7	6	8	7	8
Barriers to fish movement	10	10	10	10	10	10	10
Instream fish cover	3	7	7	5	6	na	6
Pools	1	6	6	5	8	na	6
Invertebrate habitat	5	10	10	7	10	na	8
Canopy cover (if applicable)	8	7	8	7	7	2	6
Manure presence (if applicable)	na	na	na	na	na	na	na
Salinity (if applicable)	na	na	na	na	na	na	na
Riffle embeddedness (if applicable)	7	8	8	7	8	na	7
Macroinvertebrates observed (optional)	10	na	10	na	na	na	na
Overall Score (Total divided by number scored) Poor = <6.0; Fair = 6.1 - 7.4; Good = 7.5 - 8.9; Excellent = >9.0	**6.8**	**7.1**	**8.2**	**7.5**	**8.0**	**6.4**	**7.3**

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Water Quality Site	**L5**	**L5a**	**L5a**	**L6a**	**L6a**	**Rt 12**	
SVAP #	**L-8**	**L-9**	**L-10**	**L-11**	**L-12**	**L-13**	**L-14**
Stream	**Muddy Run**	**Muddy Run**	**Muddy Run**	**Mainstem**	**Mainstem**	**Flow**	**Mainstem**
Location	DS of Muddy Run Road	US of Union Road	DS of Union Road	US of Thatcher Road	DS of Thatcher Road	DS of Fitzer/Old Rt 12	Wescott Preserve
Assessment Elements/Scores:							
Channel condition	8	8	8	6	8	8	8
Hydrologic alteration	8	8	8	7	8	7	7
Riparian zone	1	8	6.5	8	9	9	7
Bank stability	8	7	7	5	6	6	7
Water appearance	7	8	9	8	10	9	9
Nutrient enrichment	5	8	9	na	9	7	6
Barriers to fish movement	10	10	10	10	10	10	3
Instream fish cover	6	7	8	8	7	5	6
Pools	7	6	6	7	5	6	8
Invertebrate habitat	7	7	10	9	9	8	7
Canopy cover (if applicable)	1	9	8	8	9	9	8
Manure presence (if applicable)	na	na	na	na	na	na	na
Salinity (if applicable)	na	na	na	na	na	na	na
Riffle embeddedness (if applicable)	5	8	8	na	8	7	8
Macroinvertebrates observed (optional)	6	9	na	13	na	7	12
Overall Score (Total divided by number scored) Poor = <6.0; Fair = 6.1 - 7.4; Good = 7.5 - 8.9; Excellent = >9.0	**6.1**	**7.9**	**8.1**	**8.1**	**8.2**	**7.5**	**7.4**

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Water Quality Site	**L1**		**L4**	**L3**	**L2**			
SVAP #	**L-15**	**L-16**	**L-17**	**L-18**	**L-19**	**L-20**	**L-21**	**L-22**
Stream	**Mainstem**	**Tributary**	**Mainstem**	**Mainstem**	**Mainstem**	**Muddy Run**	**Tributary**	**Tributary**
Location	US Raven Rock Road	US of Byram-Kingwood Road	US of Route 519	DS of Milltown Road	DS of Strimples Mill Road	DS of Reach 2 @ 85	DS of Federal Twist Rd	US of Federal Twist Rd
Assessment Elements/Scores:								
Channel condition	8	8	8	8	8	7	8	8
Hydrologic alteration	9	8	7	9	8	6	9	8
Riparian zone	8	9	7	9	9	9	9	8
Bank stability	8	7	6	9	8	5	8.5	7.5
Water appearance	9	7	6	7.5	8	7	9	8
Nutrient enrichment	8	7	7	8	8	8	7.5	7
Barriers to fish movement	3	10	10	3	3	10	10	10
Instream fish cover	7	8	8	8	7	8	7	6
Pools	7	8	6	6	8	8	6	6
Invertebrate habitat	8	9	9	9	8	8	9	8
Canopy cover (if applicable)	8	8	9	8	7	8	8	8
Manure presence (if applicable)	na	na	na	na	na	na	na	na
Salinity (if applicable)	na	na	na	na	na	na	na	na
Riffle embeddedness (if applicable)	8	8	8	8	8	7	9	8
Macroinvertebrates observed (optional)	8	6	11	7	11	9	11	11
Overall Score (Total divided by number scored) Poor = <6.0; Fair = 6.1 - 7.4; Good = 7.5 - 8.9; Excellent = >9.0	**7.6**	**7.9**	**7.8**	**7.7**	**7.8**	**7.7**	**8.5**	**8.0**

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Visual Assessment Scores For Sites Within the Wickecheoke Creek Watershed

Monitoring Site Code		**W8**	**W9**					
SVAP #	**W-1**	**W-2**	**W-3**	**W-4**	**W-5**	**W-6**	**W-7**	**W-8**
Stream	**Mainstem**	**Mainstem**	**Tributary**	**Plum Brook**	**Plum Brook**	**Mainstem**	**Mainstem**	**Mainstem**
Location	US of Locktown-Sergeantsville Road	US of Whiskey Lane	Whiskey Lane	US of Plum Brook Road	DS of Plum Brook Road	US of Rt 579 btwn Rt 12 & Old Croton	Lower Creek Rd, most DS	Lower Creek Road
Assessment Elements/Scores:								
Channel condition	8	8	8	8	8	8	6	6
Hydrologic alteration	8	6	8	7	8.5	8	7	5
Riparian zone	9	9	9	7	9	7	5	5
Bank stability	7	6	7	6	8.5	8	5	5
Water appearance	9	8	8	4	8	5	9	9
Nutrient enrichment	8	7	8	4	9	6	9	9
Barriers to fish movement	10	10	7	10	10	10	10	3
Instream fish cover	5	7	7	8	9	7	6	6
Pools	6	na	6	6	7.5	6	6	6
Invertebrate habitat	9	9	9	9	9	9	8	7
Canopy cover (if applicable)	8	8	9	9	9	7	na	na
Manure presence (if applicable)	na	na	na	na	na	na	na	na
Salinity (if applicable)	na	na	na	na	na	na	na	na
Riffle embeddedness (if applicable)	8	na	8	4	7	7	9	8
Macroinvertebrates observed (optional)	10	10	10	9	na	7	9	na
Overall Score (Total divided by number scored) Poor = <6.0; Fair = 6.1 - 7.4; Good = 7.5 - 8.9; Excellent = >9.0	**7.5**	**8.0**	**8.0**	**7.0**	**8.5**	**7.3**	**7.4**	**6.3**

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Monitoring Site Code		**W7**	**W4**		**W5**			
SVAP #	**W-9**	**W-10**	**W-11**	**W-12**	**W-13**	**W-14**	**W-15**	**W-16**
Tributary/mainstem	**Mainstem**	**Plum Brook**	**Plum Brook**	**Tributary**	**Mainstem**	**Tributary**	**Tributary**	**Tributary**
Location	Lower Creek Road	Lower Creek Road	DS of Pine Hill Road	DS of Featherbed Lane	US of Old Mill Road	US of Worman Road	DS of Worman Road	DS of Covered Bridge Road
Assessment Elements/Scores:								
Channel condition	6	7	9	9	9	8	8	5
Hydrologic alteration	7	8.5	9	8	9	8	8	6
Riparian zone	4	6	9	5	8	5	7	2
Bank stability	6	6	9	9	9	6	7	6
Water appearance	9	7	9	8	8	7	7	9
Nutrient enrichment	9	6	6	7	7	8	8	9
Barriers to fish movement	3	10	10	3	3	10	10	3
Instream fish cover	6	8	7	5	5	6	6	6
Pools	6	8	8	na	na	6	6	5
Invertebrate habitat	7	8	8	7	7	8	8	7
Canopy cover (if applicable)	5	8	9	8	8	6	8	3
Manure presence (if applicable)	na	na	na	na	na	na	na	na
Salinity (if applicable)	na	na	na	na	na	na	na	na
Riffle embeddedness (if applicable)	8	8	8	na	na	7	8	8
Macroinvertebrates observed (optional)	na	9	11	na	na	na	13	10.5
Overall Score (Total divided by number scored) Poor = <6.0; Fair = 6.1 - 7.4; Good = 7.5 - 8.9; Excellent = >9.0	**6.3**	**7.7**	**8.6**	**6.9**	**7.3**	**7.1**	**8.0**	**6.1**

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Monitoring Site Code	**W11**					**W11c**	**W9b**		
SVAP #	**W-17**	**W-18**	**W-19**	**W-20**	**W-21**	**W-22**	**W-23**	**W-24**	**W-25**
Tributary/mainstem	**Mainstem**	**Mainstem**	**Trib**	**Trib**	**Trib**	**Trib**	**Trib**	**Trib**	**Trib**
Location	DS of Rake Road/Sam Levine Road	DS of Locktown School Road	US of Locktown Sergeantsville Road	Reading Road	DS of Ferry Road	DS of Decker Road	US of Oak Grove Road	DS of Allen's Corner Road	DS Route 579
Assessment Elements/Scores:									
Channel condition	8.5	9	9	8	9	7.5	9	8.5	7
Hydrologic alteration	7	9	9	8	8	6	8.5	8	7
Riparian zone	8.5	9	8	2	8	7.5	9	8	8
Bank stability	8	9	9	8	9	7	8.5	8.5	6
Water appearance	9	9	8	8	9	9	9	8	6
Nutrient enrichment	7	7	7	7	8	5	9	6	7
Barriers to fish movement	10	10	10	10	10	10	10	10	10
Instream fish cover	7	6	8	8	8	7	9	7.5	7
Pools	7	6	7	6	7	5	9	7.5	7
Invertebrate habitat	8.5	7	8	8	8	9	9	8.5	9
Canopy cover (if applicable)	9	8	8	3	9	9	9	7	8.5
Manure presence (if applicable)	na	na	na	na	na	na	na	na	na
Salinity (if applicable)	na	na	na	na	na	na	na	na	na
Riffle embeddedness (if applicable)	8	8	7	7	8	5	8	8	7
Macroinvertebrates observed (optional)	10	5	10	na	10	11	9.5	11	12
Overall Score (Total divided by number scored) Poor = <6.0; Fair = 6.1 - 7.4; Good = 7.5 - 8.9; Excellent = >9.0	**8.3**	**7.8**	**8.3**	**6.9**	**8.5**	**7.5**	**9.0**	**8.2**	**7.8**

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Document Content(s)

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Lockatong Creek

Stream Visual Assessment Results and Restoration Plan

New Jersey Water Supply Authority

Final Report: September 2008

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Introduction

In 2005, the New Jersey Water Supply Authority (NJWSA) received a Section 319(h) Nonpoint Source Grant from the New Jersey Department of Environmental Protection (NJDEP) to develop a watershed restoration plan for the Lockatong Creek and Wickecheoke Creek watersheds. As part of that project, NJWSA performed stream visual assessments within the two watersheds to gain an overall assessment of stream health.

Stream Visual Assessment Protocol (SVAP)

NJWSA used the United States Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS) Stream Visual Assessment Protocol (SVAP) to gather baseline data for this project. The SVAP is used to score a site based on a set of 15 indicators, including:

- Channel condition: Natural vs. altered channel (e.g. channelization; installation of riprap, dikes or levies; or downcutting or incision).
- Hydrologic alteration: Connectivity to the floodplain (e.g., structures or channel incision that limit the stream's access to the floodplain).
- Riparian zone: Stream's buffer area (e.g., a perfect score requires natural vegetation to extend at least two active channel widths on each side of the stream. A lower score, for instance a 5, is given when natural vegetation extends only half the active channel width on each side of the stream).
- Bank stability: Bank condition (banks are either level with the floodplain and stable or are higher and eroding; banks have exposed roots or slope failures present with the reach).
- Water appearance: Water clarity (clear with visible bottom or cloudy/murky).
- Nutrient enrichment: Presence of algae and/or aquatic macrophytes (A stream with a diverse plant community and clear water scores a 10; a stream with greenish water and an overabundance of algae and/or macrophytes scores a 3).
- Barriers to fish movement: Withdrawals, culverts, dams or diversions both up and downstream of the reach. This was particularly important in the project area, as the dam for Spruce Run Reservoir is within approximately three miles of many of the sites.
- Instream fish cover: Available cover types for fish habitat (e.g., woody debris, riffles, pools, and cobble).
- Pools: Abundance and depth of pools within the reach.
- Invertebrate habitat: Number of cover types available as habitat.
- Canopy cover: Coldwater versus warmwater fisheries. The project area is considered a coldwater fishery, thus a reach that is well shaded would score high, whereas a reach that is minimally shaded would score low.
- Manure presence: Evidence of livestock in or near the stream; it was not scored for any of the project sites.
- Salinity: Non-applicable for the project watershed.
- Riffle embeddedness: Embeddedness of cobble or gravel in sediment.
- Macroinvertebrates observed: Type and diversity of species present. A site with a good diversity of pollution intolerant species received a score of 15, while a site dominated by more pollution tolerant organisms might receive a 6. It should be noted that several of the SVAPs were performed during the fall and winter months, which are not ideal months for the observation of macroinvertebrates.

Once the team chose a segment for assessment, the active channel width was measured. A reach that was 12 times the active channel width was then scored from one to 10 (one to 15 for Macroinvertebrates observed and one to five for Manure presence) based on the 15 parameters described above; any parameter that was not applicable to a particular site was not scored. In the project watershed, salinity was determined to be not applicable; manure presence was not identified and thus not scored at any sites. The scores for each parameter were summed and divided by the total number of parameters scored to yield the SVAP score.

The SVAP relies heavily on relative comparison of sites, rather than a rigorous quantitative analysis; it is a screening assessment tool rather than a site-specific monitoring protocol, and therefore is subjective. Each parameter is scored based on the assessor's observations of a particular reach. For this reason, NJWSA ensured consistency of assessors among all of the sites. Two staff members formed the core assessment team; additional team members included other NJWSA staff and the NJDEP Americorps Watershed Ambassador for the Lower Raritan Watershed Management Area.

The SVAP provided a great deal of useful information regarding Lockatong Creek. The shortfall of the protocol is that it fails to provide a mechanism for identifying the cause of identified problems.

Preliminary Visual Assessments
The Raritan Basin Watershed Alliance Road Crossing Protocol, developed by NJWSA, was utilized to collect information on each road crossing within the watershed. The information collected included land use, type of crossing, suitability for stream assessment (with respect to channel size, accessibility and safety) and the need for riparian buffer restoration. Photographs were taken at each crossing.

From that list, NJWSA selected a subset of sites for stream assessment to perform an overall assessment of stream health in the watershed.

Summary of Results
The 22 SVAP locations were chosen based on the preliminary visual assessments, land use patterns (e.g. weirs, development, agriculture), tributary patterns and accessibility. The objective was to collect enough information to assess overall stream health and to identify potential restoration sites. Stream assessment activities conducted by the assessment team identified areas of impaired streams throughout the watershed.

Observed impairments included:
- Destabilization and erosion of stream banks due to high flows;
- Disconnection of the stream from the flood plain due to downcutting of the stream channel;
- Inadequate riparian zones and loss of riparian zones;
- Inadequate instream habitat; and
- Elevated nutrient inputs.

Overall scores ranged from 6.1 (Fair) to 8.5 (Good). No sites scored in the 'Excellent' range. The parameters ranged from a low of 1 in the riparian zone category (at two sites) to a high of 10 in the barriers to fish movement, water appearance and invertebrate habitat categories and scores of 9 in several other categories.

Detailed Stream Visual Assessment Results

Figure 1 shows the 22 SVAP locations; the data are summarized in Table 1. It should be noted that when the range of scores for each site is discussed, barriers to fish movement and macroinvertebrates observed were not taken into account. The barriers to fish movement score is generally high (10), unless an obvious barrier was identified. The macroinvertebrates observed parameter is scored on a 0-15 scale, and was not scored for all sites.

SVAP L-5

SVAP # L-5 (8/good) is located on a tributary to the main stem just upstream of Lower Oak Grove Road. The scores for this site were mostly 8 to 10, although a 6 was given for instream fish cover.

The riparian buffer on each bank is minimal, approximately 10 to 25 feet wide and of poor quality. The reach was identified as a good site for **riparian buffer restoration**. The stream banks were two to three feet high, giving the stream access to the floodplain during storm flows. The substrate was dominated by large shale, and some fine sediment was observed. The channel was sinuous with deep pools and in-stream cover for fish and macroinvertebrates, although few riffles were observed. A small weir was observed in this reach, constructed of rock and geotextile. The weir backed up water slightly; fewer riffles were observed upstream of the weir than downstream. Land use in the vicinity of the reach consisted of residential property and large fields.

SVAP L-6

SVAP # L-6 (6.4/fair) is located on a small tributary just downstream of SVAP #L-5 and Lower Oak Grove Road, between the bridge and the confluence with the mainstem of Lockatong Creek. The assessment was performed from the road, as the reach was fenced. The scores for this reach ranged from a 1 for the riparian zone and a 2 for canopy cover to a 9 for channel condition.

The riparian buffer on each side was grass to the top of the banks with a sparse overstory of mature trees and no understory. The stream banks were approximately two feet high and the stream had good floodplain access. Good meanders were

observed. Livestock appeared to have access to the stream, although none were observed at the time of the assessment. The land use on the left bank was residential, and on the right bank was residential and agriculture. The reach was identified as a good site for **riparian buffer restoration** and the **River-Friendly Farm program**.

SVAP L-13

SVAP # L-13 (7.5/good) is located on the Lockatong Creek mainstem downstream of the Route 12 bridge. The scores at this site ranged from a 5 for instream fish cover to a 9 for several parameters.

The riparian corridor was forested on both sides of the channel, with moderate coverage by invasive species, particularly multi-flora rose. The stream banks were two to four feet high, allowing access to the floodplain during large storm events (three to five year events). Erosion was observed along both banks. The dominant substrate observed was gravel, with some larger material. Algae and sediment covered a majority of the substrate. The channel was relatively straight with little change in the velocity regime until the end of the survey reach, where meanders and riffles were observed. The land use in the vicinity of this reach was primarily forest.

SVAP L-1

SVAP #L-1 (6.8/fair) is located in Kingwood Park on the upstream side of Union Road on the main stem of Lockatong. The scores for this reach ranged from a 1 for pools and a 3 for instream fish cover to a 9 for water appearance.

The riparian corridor was forested with some disturbance from public access on the park side. The banks were one to three feet in height and some areas of erosion were observed. Access to the floodplain was moderate. The dominant substrate observed was gravel; very little fine sediment or sand was observed. The channel lacked sinuosity and riffle pool morphology. Exposed roots on the banks and mid-channel bar formation were indicative of active widening and deposition in the reach. The land use in the vicinity of this reach was forest and park land.

SVAP L-2

SVAP # L-2 (7.1/fair) is located downstream of Union Road and SVAP #L-1. The scores for this reach ranged from a 6 for bank stability and pools to a 10 for invertebrate habitat.

The riparian corridor was mainly forested with some open areas associated with residential and agricultural land use. The stream banks were approximately one foot high on the left bank and up to three feet high on the right, giving the stream good access to its floodplain during flow events. Some evidence of erosion existed on the outside of bends.

The substrate was dominated by cobble, as opposed to the gravel substrate observed upstream of the Union Road bridge. The surrounding land use consisted of forest and residential / agricultural fields.

SVAP L-11

SVAP # L-11 (8.1/good) is located on the upstream side of Thatcher Road on the mainstem of Lockatong Creek. The scores for this reach ranged from a 5 for bank stability to a 9 for invertebrate habitat.

The reach was mainly forested with one residential property. The riparian buffer was adequate, although a fair amount of invasive species such as multi-flora rose was present. The banks were two to four feet high, allowing access to the floodplain during larger storm events.

There were areas of active erosion along both banks from high flow events. The substrate composition was dominated by gravel, and some mid-channel bars were present. The reach had a meandering pattern with a riffle and glide sequence, and some pools. The land use in the vicinity of this reach was primarily forest.

SVAP L-12

SVAP # L-12 (8.2/good) is located downstream of Thatcher Road and SVAP #L-11. The scores for this reach ranged from a 5 for pools and a 6 for bank stability to 9 for several parameters.

The riparian corridor was forested with minimal invasive species present in the understory. The banks were two to four feet high, allowing access to the floodplain during larger storm events. There was active erosion along both banks. The substrate was dominated by gravel.

A tributary on the right bank at the end of the reach was an active sediment source. Several abandoned vehicles were observed along the tributary. The channel was mainly shallow with some riffles and an absence of pools. The land use near this reach included forest.

SVAP L-4

SVAP #L-4 (7.5/Good) is located on the mainstem of the Lockatong, upstream of Barbertown-Point Breeze Road. The scores for this reach ranged from 5 for instream fish cover and pools to 9 for riparian zone, bank stability and water appearance.

The riparian corridor was primarily forested. The banks were approximately two to four feet high, but were in good condition, well vegetated and gently sloped. The channel was relatively straight, but did not appear to have been altered. The reach contained little in-stream habitat diversity, lacking a good pool/riffle structure. Some algae was observed in the channel.

The land uses near this reach include forest and agriculture, which did not appear to be negatively impacting the stream. The nearby agricultural properties could be targeted for the **River-Friendly Farm** program.

SVAP L-3

SVAP # L-3 (8.2/good) is located on the mainstem of the Lockatong, downstream of Barbertown-Point Breeze Road and SVAP L-4.

This reach had good access to the floodplain, and the banks were in average condition, although some exposed tree roots were observed. Exposed roots can be an indicator of erosive flows and channel movement. Some sediment deposition was observed on the inside of slight bends. No significant erosion of the banks was observed. Good riffle and some average pools were observed within the reach. As observed at SVAP #L-3, the reach was relatively straight, but did not appear to have been altered. The channel narrowed significantly approximately 150 feet below the Barbertown-Point Breeze Road bridge.

The land uses near this reach included forest, a small amount of residential and agriculture. None of these land uses appeared to be negatively impacting the reach.

SVAP L-09

SVAP #L-09 (7.9/Good) is located on a tributary known as Muddy Run, which enters the mainstem Lockatong east of Route 519, between SVAP #L-3 and SVAP #L-17. SVAP #L-09, located upstream of Union Road, was the most upstream of the five assessments performed on Muddy Run. The scores for this reach ranged from a 6 for pools to a 9 for canopy cover.

The banks in this reach were one to three feet in height with some undercutting. The stream had good floodplain access on at least one bank in all areas of the reach. Some erosion of the banks was observed. There was a bankfull bench formed by point bars on some bends. The bench contained some vegetation, but also appeared to be submerged at times. The riparian corridor was forested and contained some invasive species, including multiflora rose, and the understory was sparse. The sinuosity of this reach was considered good. Land use within the vicinity of the reach was primarily forest and one residential property.

SVAP L-10

SVAP #L-10 (8.1/Good) is located on Muddy Run, downstream of Union Road. Two tributaries entered this reach of Muddy Run, one on the left bank approximately 150 feet downstream of Union Road and the second also on the left bank farther downstream. The first tributary was undercut and incised, while the second appeared to be in good condition. The scores for this reach ranged from a 6 for pools and a 6.5 for riparian zone to a 9 for water appearance and nutrient enrichment.

The reach exhibited banks of one to three feet with average flood plain access. The riparian corridor was primarily forested on the left bank, and some areas on the right bank were forested. The area adjacent to the agricultural property on the right bank was a potential **riparian buffer improvement site**.

The land use in the vicinity of this reach included forest, agriculture and residential. The agricultural use on the right bank included houses, barns, a meadow area and pasture containing horses. A fence was present along the stream, there was no apparent animal access to the stream and no apparent manure impact to the stream. The property could be targeted for the **River-Friendly Farm** program.

SVAP L-07

SVAP #L-07 (7.3/Fair) was located on the upstream side of Muddy Run Road on Muddy Run. The scores for this reach ranged from 6 for several parameters, including bank stability, to 8 for other parameters.

The banks in this reach were three to four feet in height with some erosion. The stream's floodplain access was poor. This reach was relatively straight, and the dominant substrate was mixed, including cobble, shale and a small amount of sand. The sinuosity improved farther upstream. A few good riffles were observed, but the majority of the reach was flat water. The riparian corridor was adequate within the reach; upstream of the reach, a residential yard was a recommended **riparian buffer improvement site**. A drain was also observed from beneath the yard, and was likely yard drainage. A road ditch was present on the left bank, and created a scour hole where it entered the stream. The land use in the vicinity of this reach was primarily forested, with a few residential properties.

SVAP L-08

SVAP #L-08 (6.1/Fair) is located downstream of Muddy Run Road on Muddy Run. The scores for this reach ranged from a 1 for riparian zone to 8 for channel condition, hydrologic alteration and bank stability.

The banks in this reach were low and not well defined. The edges were marshy. Good floodplain access existed in this reach. The dominant substrate was gravel and fine sediment. This reach was fairly straight, with minimal fish or macroinvertebrate habitat. The land use in this reach included an agricultural field on the left bank, that appeared to be mowed, and a pasture containing horses on the right bank. The horses did not have access to the stream, and there was no direct evidence of manure runoff into the reach. Approximately 30 to 40 feet of mowed grass existed between the pasture fence and the stream.

This site is a candidate for **riparian buffer improvement** and for the **River-Friendly Farm** program. Due to the plant communities present, the improvement could be as simple as establishing no-mow corridors. Agricultural best management practices should be considered for the adjacent property. The riparian zone and canopy cover scores were the primary reasons for the very low SVAP score of this reach.

SVAP L-20

SVAP #L-20 (7.7/Good) is located downstream of Muddy Run Road, on Muddy Run. This reach is downstream of SVAP #L-08 and continues to the confluence of Muddy Run with the mainstem Lockatong Creek. The scores for this reach ranged from 5 for bank stability to 9 for riparian zone.

This reach exhibited banks much higher than those observed upstream, adjacent to Muddy Run Road at SVAP #L-08. The floodplain access was poor in this reach. The banks were eroded in several areas. The sinuosity in this reach was considered good. The dominant substrate was gravel and larger shale; there were areas of fine sediment deposition. Average riffles were observed, and some point bars had formed. The reach was overwidened, due to the excessive quantity and velocity of water moving through the reach. There was also evidence of ATV traffic through the stream channel.

Land use in the vicinity of this reach was primarily forest; the reach is downstream of an

agricultural property (see SVAP #L-08). The use of ATVs in the stream should be addressed. The reach could be considered for **structural bank stabilization**, such as reconnection with the floodplain, if the cause of the stream incision is addressed. Without addressing the cause of the incision, any structural stabilization will fail.

SVAP L-17

SVAP #L-17 (7.8/Good) was located on the upstream side of Route 519, slightly west of Byram-Kingwood Road. The stream flows quite close to Route 519 in the more downstream portion of the reach. The scores for this reach ranged from 6 for pools, water appearance and nutrient enrichment to 9 for invertebrate habitat and canopy cover.

The banks were one to four feet in height, and the stream's access to the floodplain was better in the downstream part of the reach. Slight to moderate bank erosion was observed, but not at a level that was considered a problem. This reach was relatively straight, movement is constrained by the nearby road. The water was slightly murky; significant rain fell a few days prior to the SVAP. The channel bed exhibited a great deal of topographic variation. A few good riffles were observed, but the spacing in between the riffles was very long. A few average pools were also observed. Some deposits of sand, perhaps from road runoff, were observed. A tributary was observed on the left bank near the downstream end of the reach and a drainage swale from the road was observed mid-reach (right bank).

The land uses near this reach include forest, roadway, agriculture and residential; with the exception of the road, none appeared to be negatively impacting the reach.

SVAP L-16

SVAP #L-16 (7.9/Good) is located on a small tributary to Lockatong Creek, upstream of Byram-Kingwood Road. This tributary enters the left bank of the mainstem, west of Route 519. The scores for this reach ranged from 7 for bank stability, water appearance and nutrient enrichment to 9 for riparian zone and invertebrate habitat. Despite the high quality riparian habitat, the site received a very low score for observed macroinvertebrates.

The riparian corridor was primarily forested, including a forest stewardship area on the left bank. Some fields were observed set back from the stream somewhat. The right bank near the road crossing is a potential target for **riparian buffer improvement**. The banks varied in height from less than one foot to three feet. The stream had access to the floodplain on at least one side of the channel in all areas. It appeared that the stream overtops the bank occasionally, but there is room for water to dissipate energy and sediment. The dominant substrate was cobble and larger material, with some bedrock. The reach contained a few good meanders, and the sinuosity through the reach was average. Many downed trees were observed, along with some areas of erosion.

The stream appears to experience high flows, which could account for the low macroinvertebrate score. Some fine sediment deposition was observed, primarily on point bars and in meanders. The rocks were somewhat slimy and green, indicating potential nutrient enrichment. The water was slightly murky, but heavy rain fell the day prior to the assessment, which also could contribute to the low macroinvertebrate score. Road ditches were present on both banks. This reach looks ‘messy’ or problematic in the photographs, but the assessment indicated that it was actually in reasonable condition.

SVAP L-22

SVAP #L-22 (8.0/Good) is located on a small tributary that enters the right bank of the mainstem Lockatong Creek west of Route 519. The SVAP site was located upstream of Federal Twist Road. This tributary had less flow than some other areas that were assessed, the assessors anticipated that this reach is dry much of the year. The scores for this reach ranged from 6 for instream fish cover and pools to 8 for several parameters.

The banks were mostly low, with a few higher points. The stream had good floodplain access. The reach contained decent riffles, but no significant pools were observed. One area of severe erosion was observed. It appeared as if lawn debris was dumped in a drainage swale or headcut on the left bank. The riparian corridor was primarily forested; there is an area upstream of the reach where a residential yard is relatively close to the stream. Ditches were observed on both banks of the stream at the road crossing; these ditches were sources of sediment to the stream. Some rip rap was placed on the left bank at the road crossing.

The land use in the vicinity of this reach included forest and residential. An agricultural property was present downstream where livestock potentially had access to the stream. That property should be targeted for the **River-Friendly Farm** program.

SVAP L-21

SVAP #L-21 (8.5/Good) is located on a small tributary that enters the right bank of the mainstem Lockatong Creek west of Route 519, downstream of the #L-22 tributary. This site was located downstream of Federal Twist Road.

The banks were relatively low in this reach and the stream had good access to the floodplain. The channel did not contain much water, the reach likely goes dry for much of the year. The reach contained good meanders and riffles and adequate pools. The assessed reach contained a fair amount of algae, but this was not present downstream of the assessed reach. Water appears to move quickly through this reach during storm events. Some trees have fallen in the stream and some areas were undercut. The dominant substrate in this reach was shale, with some fine sediment deposits.

The land use adjacent to this reach included forest, field and one residential property. The landowner planted many new trees on the right bank and was planting on the left bank in April

2008. This reach could be a target for **riparian buffer improvement** to complement what the landowner has already accomplished. A large amount of multi-flora rose was observed in the riparian corridor.

SVAP L-18

SVAP #L-18 (7.7/Good) is located downstream of Milltown Road on the mainstem of the Lockatong. The scores for this reach ranged from a 6 for pools to 9 for several parameters.

The riparian corridor was forested on both sides of this reach. The left bank was somewhat high, but the right bank was low with good floodplain access. Although the channel was not very sinuous, water was moving within the channel in a meandering pattern. The dominant substrate was cobble and boulder. A pond was present upstream of Milltown Road, and is at a much higher elevation than the stream channel. It is likely that the channel incised when the pond was built; the road and dam act as a boundary feature for the incision. The stream had a moderate gradient with good riffles and few pools. The channel appeared to be stable.

The channel split after the end of the assessed reach; a large island that appeared to have been in existence for many years was between the channels, which rejoined downstream of the island. The right channel appeared to be the main channel. Two rocky swales were present on the island, and water appeared to flow over the island at higher flows. The highest point of the island was approximately four to six feet above the bed of the stream channel.

The land use in the vicinity of the reach was primarily forested. A state wildlife management area was present on the right bank. Milltown Road was present on the right bank, but was an adequate distance from the stream.

SVAP L-19

SVAP #L-19 (7.8/Good) is located downstream of Strimples Mill Road on the mainstem of the Lockatong. The scores for this reach ranged from 7 for instream fish cover and canopy cover to 9 for riparian zone.

The left bank contained a steep, natural slope, the right bank was one to three feet in height. The riparian buffer was forested on each side of the stream. Although this reach exhibited good riffles and pools, it was not very sinuous. The water was slightly murky, but was clear in still areas. Significant rain fell a few days prior to the assessment. The channel was slightly incised, as evidenced by exposed tree roots above the water elevation. The banks were very rocky and in good condition, with no erosion observed. The rocks had a slight coat of fine sediment. A drainage swale was present on the left bank near the downstream end of the reach.

Although the riparian corridor of the assessed reach consisted of forest, upstream of Strimples Mill Road the land use included an old saw mill, an autobody shop/junkyard and pasture containing a few sheep. Peacocks were also observed near the reach.

SVAP L-14

SVAP #L-14 (7.4/Fair) is adjacent to the Wescott Preserve, adjacent to Raven Rock Road. The Preserve is owned by Hunterdon County. The scores for this reach ranged from 6 for nutrient enrichment and instream fish cover to 9 for water appearance.

The riparian corridor was primarily forested, with one residential property present in the upstream portion of the reach. This reach was very rocky, the channel bed was bedrock in some areas. The left bank by the Wescott Preserve was a very high, bedrock cliff. The right bank in this area was approximately seven feet in height. The banks were lower upstream and downstream where the bedrock cliff was not a boundary condition and the stream can move. Despite the high banks, the stream appeared to be in a stable condition. Good riffles and some deep pools were observed, and the sinuosity was average. Rocky point bars were observed. Many exposed tree roots were observed, but the banks were protected from erosion by rocks.

Several small drainages and overland flow originated in the Wescott Preserve and a tributary (mapped) entered the left bank mid-reach. The water was clear, but the rocks were slimy and green. The residential area on the left bank in the upstream section of the reach should be targeted for a **riparian buffer improvement** effort, as lawn area was present adjacent to the stream.

SVAP L-15

SVAP #L-15 (7.6/Fair) is located upstream of Raven Rock-Rosemont Road. The scores for this reach ranged from 7 for instream fish cover and pools to 9 for riparian zone and water appearance.

The banks were higher nearer to the road crossing, but were mostly low with moderate floodplain access. The stream had access to floodplain areas on at least one bank throughout the reach. The stream had room to move within the floodplain. Prominent rock point bars were observed, and some sand deposition was present on the bars. Good riffles and a few good pools were observed. There were some fallen trees in the reach, and the banks were undercut in some areas, more prominently toward the road crossing. The reach exhibited good sinuosity and was very rocky. The land use in the vicinity of this reach included forest, semi-wild preserve and one residential property. The residential property contained lawn area near the stream, which could be targeted for a **riparian buffer improvement** project.

Recommendations

As detailed in Figure 2 and Table 2, 40 sites were identified for riparian buffer restoration, nine properties were recommended for the River-Friendly Farm program, and one site was recommended for structural stabilization. The recommendations were developed based on the road crossing inventory, stream visual assessments and review of aerial photographs.

Riparian buffer restoration includes forest and herbaceous plantings. A cost estimate was prepared for each recommended site. For riparian buffer restoration cost estimates, the target buffer was 20 feet on each side of the stream. Approximately 62,300 linear feet of riparian buffer restoration was recommended, for a total of 30 acres of riparian buffer restoration. In some areas, the actual buffer that can be achieved may be less than 20 feet, in other areas it will be much greater. The estimated cost per acre for materials was $3,000, plus staff time for an estimated total cost of $113,000. Each site can be implemented independently of the others; however, cost savings will be achieved when multiple sites are completed in a single season due to the benefit of ordering plant materials in bulk. For each site, NJWSA recommends developing a planting plan prior to restoration. Potential funding sources include the Section 319(h) Nonpoint Source grant program, various programs led by the Natural Resources Conservation Service (NRCS, e.g. Conservation Reserve Enhancement Program, Conservation Reserve Program, Wildlife Habitat Incentives Program) and other similar programs.

Nine sites were recommended for the River-Friendly Farm program, based on the SVAP and road crossing inventory (Table 3 and Figure 3). There are many additional agricultural properties in the watershed; however NJWSA estimated that an additional 15 farms, for a total of 24 participants within the watershed, is a feasible target.

This program is administered by North Jersey Resource Conservation & Development Council (RC&D), the Raritan Watershed Agricultural Committee and NJWSA. The program is currently implemented throughout much of Hunterdon County, although the target areas are the Mulhockaway Creek Watershed, Spruce Run Watershed, South Branch Raritan Watershed and Neshanic River Watershed. An agricultural outreach specialist from North Jersey RC&D performs a review of the farm's management activities, in particular soil loss management, nutrient management, pest management, riparian buffer management and irrigation water management. If the farm meets the criteria, it is certified River-Friendly. If the farm does not meet the criteria, the agricultural outreach specialist works with the farmer and with a conservation planner from NRCS to develop a conservation plan so that the farm can meet the River-Friendly criteria and to identify potential cost-share programs. The estimated cost to implement the River-Friendly Farm program in the Lockatong Watershed is $38,200 (Table 4), assuming extension of the existing program to this watershed. This estimate does not include implementation of conservation practices that may be needed for the farms to meet the River-Friendly criteria.

Structural stabilization was recommended at one site on Muddy Run Road (SVAP #L-20). This reach exhibited poor floodplain access, eroded banks and overwidening. Structural stabilization could include installation of structures such as vanes, J-hooks or barbs constructed of rock or

wood. Depending on the extent of the restoration needed, such projects may cost from $25,000 to $500,000 for construction.

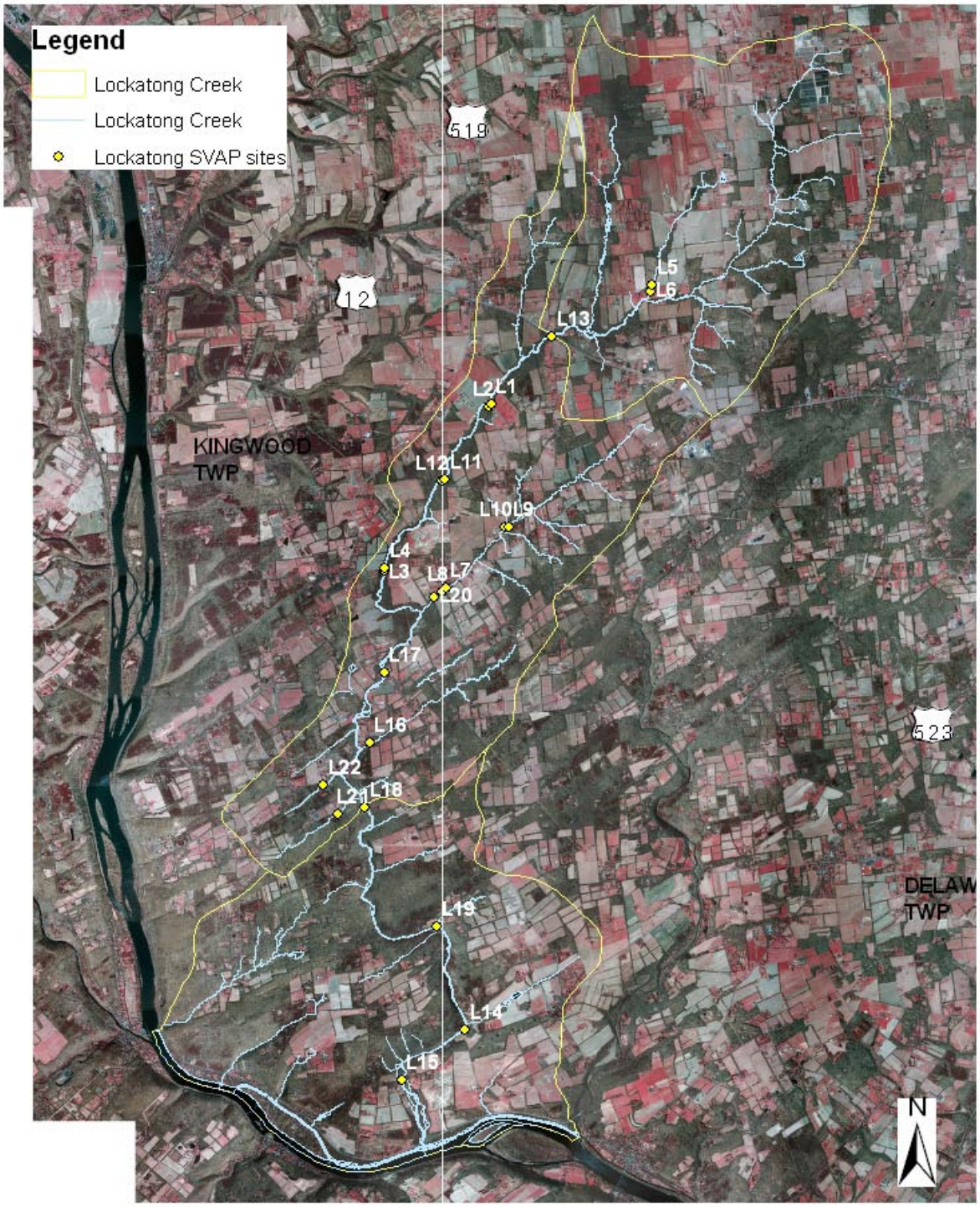

Figure 1.
Lockatong Creek Stream Visual Assessment (SVAP) Sites

0 2,000 4,000 8,000 12,000 16,000 Feet

Table 1. Lockatong Creek Stream Visual Assessment Scores							
SVAP #	**L-1**	**L-2**	**L-3**	**L-4**	**L-5**	**L-6**	**L-7**
Location	US Side Union Road, Kingwood Park	DS of Union Road	Barbertown-Point Breeze Road			DS	
Assessment Scores:							
Channel condition	8	8	8	8	8	9	7
Hydrologic alteration	7	7	8	8	8	7	7
Riparian zone	7	8	8	9	8	1	8
Bank stability	6	6	8	9	7	7	6
Water appearance	9	8	8	9	8	8	8
Nutrient enrichment	7	7	7	6	8	7	8
Barriers to fish movement	10	10	10	10	10	10	10
Instream fish cover	3	7	7	5	6	na	6
Pools	1	6	6	5	8	na	6
Invertebrate habitat	5	10	10	7	10	na	8
Canopy cover (if applicable)	8	7	8	7	7	2	6
Manure presence (if applicable)	na	na	na	na	na	na	na
Salinity (if applicable)	na	na	na	na	na	na	na
Riffle embeddedness (if applicable)	7	8	8	7	8	na	7
Macroinvertebrates observed (optional)	10	na	10	na	na	na	na
Overall Score (Total divided by number scored) Poor = <6.0; Fair = 6.1 - 7.4; Good = 7.5 - 8.9; Excellent = >9.0	**6.8**	**7.1**	**8.2**	**7.5**	**8.0**	**6.4**	**7.3**

Table 1. Lockatong Creek Stream Visual Assessment Scores (continued)							
SVAP #	**L-8**	**L-9**	**L-10**	**L-11**	**L-12**	**L-13**	**L-14**
Location	DS of Muddy Run Road	US of Union Road	Ds of Union Road	US of Thatcher Road	DS of Thatcher Road	DS of Fitzer/Old Rt 12	Wescott Preserve
Assessment Scores:							
Channel condition	8	8	8	6	8	8	8
Hydrologic alteration	8	8	8	7	8	7	7
Riparian zone	1	8	6.5	8	9	9	7
Bank stability	8	7	7	5	6	6	7
Water appearance	7	8	9	8	10	9	9
Nutrient enrichment	5	8	9	na	9	7	6
Barriers to fish movement	10	10	10	10	10	10	3
Instream fish cover	6	7	8	8	7	5	6
Pools	7	6	6	7	5	6	8
Invertebrate habitat	7	7	10	9	9	8	7
Canopy cover (if applicable)	1	9	8	8	9	9	8
Manure presence (if applicable)	na	na	na	na	na	na	na
Salinity (if applicable)	na	na	na	na	na	na	na
Riffle embeddedness (if applicable)	5	8	8	na	8	7	8
Macroinvertebrates observed (optional)	6	9	na	13	na	7	12
Overall Score (Total divided by number scored) Poor = <6.0; Fair = 6.1 - 7.4; Good = 7.5 - 8.9; Excellent = >9.0	**6.1**	**7.9**	**8.1**	**8.1**	**8.2**	**7.5**	**7.4**

Table 1. Lockatong Creek Stream Visual Assessment Scores (continued)								
SVAP #	**L-15**	**L-16**	**L-17**	**L-18**	**L-19**	**L-20**	**L-21**	**L-22**
Location	US Raven Rock Road	US Byram-Kingwood Road	US Route 519	DS Milltown Road	DS Strimples Mill Road	DS Reach 2 @ 85	DS	US
Assessment Scores:								
Channel condition	8	8	8	8	8	7	8	8
Hydrologic alteration	9	8	7	9	8	6	9	8
Riparian zone	8	9	7	9	9	9	9	8
Bank stability	8	7	6	9	8	5	8.5	7.5
Water appearance	9	7	6	7.5	8	7	9	8
Nutrient enrichment	8	7	7	8	8	8	7.5	7
Barriers to fish movement	3	10	10	3	3	10	10	10
Instream fish cover	7	8	8	8	7	8	7	6
Pools	7	8	6	6	8	8	6	6
Invertebrate habitat	8	9	9	9	8	8	9	8
Canopy cover (if applicable)	8	8	9	8	7	8	8	8
Manure presence (if applicable)	na	na	na	na	na	na	na	na
Salinity (if applicable)	na	na	na	na	na	na	na	na
Riffle embeddedness (if applicable)	8	8	8	8	8	7	9	8
Macroinvertebrates observed (optional)	8	6	11	7	11	9	11	11
Overall Score (Total divided by number scored) Poor = <6.0; Fair = 6.1 - 7.4; Good = 7.5 - 8.9; Excellent = >9.0	**7.6**	**7.9**	**7.8**	**7.7**	**7.8**	**7.7**	**8.5**	**8.0**

Table 2.
Lockatong Creek Recommended Riparian Buffer Restoration Sites

					Buffer Restoration Location					
Stream	**Site Crossing ID**	**SVAP #**	**Nearest Road**	**Municipality**	**US RB**	**US LB**	**DS RB**	**DS LB**	**Length/ description (for each designated location)**	**Estimated Buffer Cost**
Lockatong	1002		Old Franklin School Rd	Franklin Twp	x	x			650	$2,300
Lockatong	1003		Oak Grove Rd	Franklin Twp	x	x	x	x	1000	$6,100
Lockatong	1004		Oak Grove Rd	Franklin Twp	x	x	x	x	600	$3,800
Lockatong	1006		Old Franklin School Rd	Franklin Twp	x	x	x	x	850	$5,600
Lockatong	1010		Old Franklin School Rd	Franklin Twp	x	x			950	$3,200
Lockatong	1011		Old Franklin School Rd	Franklin Twp	x	x			850	$3,000
Lockatong	1012		Old Franklin School Rd	Franklin Twp	x	x	x		1500	$7,000
Lockatong	1016		Kingwood Stockton Rd	Delaware Twp	x				1500	$400
Lockatong	1021		Barbertown Point Breeze Rd	Kingwood Twp			x	x	400	$1,700
Lockatong	1025		Kingwood Stockton Rd	Delaware Twp	x	x	x	x	1000	$6,100
Canal	1026		Daniel Brae Hwy	Delaware Twp	x	x			650	$2,300
Lockatong	1040		Union Rd	Kingwood Twp	x		x		400	$1,700
Lockatong	1041		Union Rd	Delaware Twp	x		x		750	$2,600
Lockatong	1045		Slacktown Rd	Kingwood Twp		x		x	1000	$3,700
Muddy Run	1000		Locktown Rd	Kingwood Twp	x	x	x	x	750	$5,000
Muddy Run	1017		Barbertown-Point Breeze Rd	Kingwood Twp	x	x	x	x	1800	$11,000
Muddy Run	1037		Barbertown Point Breeze Rd	Kingwood Twp	x	x		x	400	$2,300
Lockatong	1038		Thatcher Rd	Kingwood Twp		x		x	450	$1,700
Muddy Run	1039		Locktown Rd	Kingwood Twp	x		x		550	$2,000
Lockatong	195	SVAP L-14	Worman Road	Delaware Twp			x		350	$1,000
Muddy Run		SVAP L-20	Muddy Run Road	Kingwood Twp						
Lockatong	Lock104		Pittstown Rd	Franklin Twp		x		x	250	$1,400

Lockatong	Lock106		Lower Oak Grove Rd	Kingwood Twp	x	x	x	x	900	$6,000
Muddy Run	Lock441		Stanbury La	Kingwood Twp	x	x	x	x	450	$3,500
Lockatong	Lock480		Old Franklin School Rd	Franklin Twp	x	x	x	x	400	$2,800
Lockatong	Lock481		Old Franklin School Rd	Franklin Twp	x		x	x	450	$2,600
Muddy Run	Lock494		Locktown Rd	Kingwood Twp	x	x	x	x	550	$3,700
Lockatong	Lock497		Hampton Rd	Kingwood Twp			x	x	600	$2,300
Muddy Run	Lock498		Hammar Rd	Kingwood Twp		x			200	$700
Muddy Run	Lock499		Hammar Rd	Kingwood Twp			x	x	350	$1,400
Muddy Run	Lock5		Barbertown-Point Breeze Rd	Kingwood Twp			x	x	200	$1,000
Lockatong	Lock73		Pittstown Rd	Franklin Twp			x		100	$400
Lockatong	Lock74		Pittstown Rd	Franklin Twp	x	x			1000	$3,700
Lockatong	Lock75		Oak Grove Rd	Franklin Twp			x	x	800	$2,800
Lockatong	Lock76	SVAP L-05 SVAP L-06	Lower Oak Grove Rd	Kingwood Twp			x	x	450	$1,700
Lockatong	Lock79		12	Kingwood Twp			x		200	$700
Lockatong	Lock84	SVAP L-03 SVAP L-04	Barbertown-Point Breeze Rd	Kingwood Twp						na
Muddy Run	Lock85	SVAP L-07 SVAP L-08	Muddy Run Rd	Kingwood Twp	x	x	400			$1,700
Muddy Run	Lock86	SVAP L-09 SVAP L-10	Union Rd	Kingwood Twp			x		200	$700
Lockatong	Lock88		Kingwood Rd	Kingwood Twp						na
Lockatong	Lock89	SVAP L-22	Federal Twist Rd	Kingwood Twp						na
Lockatong	Lock90	SVAP L-21	Federal Twist Rd	Kingwood Twp				x	350	$1,000
Lockatong	Lock92	SVAP L-15	Raven Rock-RosemontRd	Delaware Twp		x			300	$1,000
Lockatong	Lock93		Kingwood-Stockton Rd	Delaware Twp						na
Lockatong	Lock96		Federal Twist Rd	Delaware Twp						na
Lockatong	Lock98	SVAP L-16	Byram - Kingwood Rd	Kingwood Twp	x		x		200	$1,000

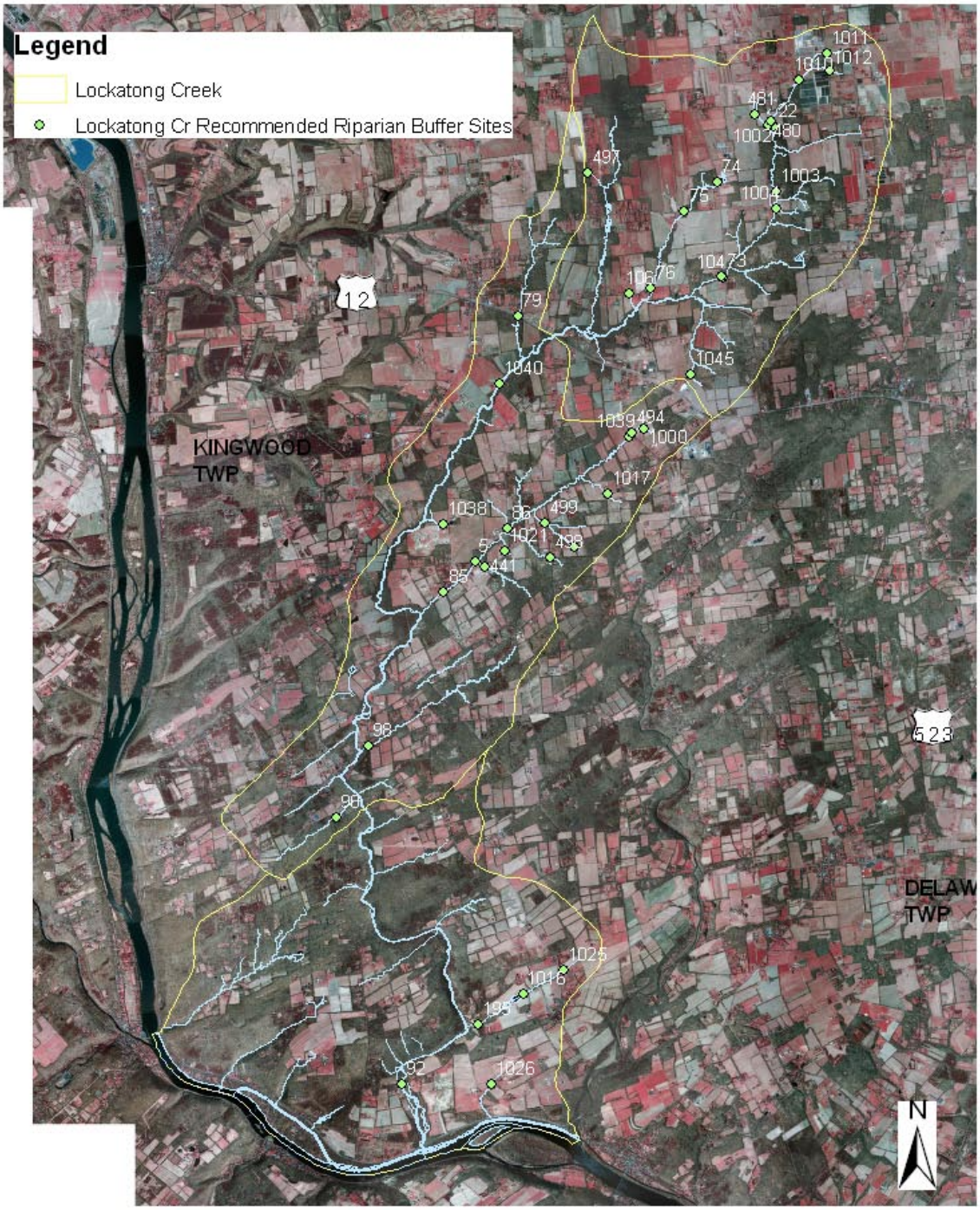

Figure 2.
Lockatong Creek Potential Riparian Buffer Sites

0 2,050 4,100 8,200 12,300 16,400 Feet

Table 3. Lockatong Creek Potential River-Friendly Farm Locations (based on SVAP and Road Crossing Inventory)					
Stream	**Site Crossing ID**	**SVAP #**	**Nearest Road**	**Municipality**	**Estimated Cost River-Friendly Farm**
Lockatong	Lock74		Pittstown Rd	Franklin Twp	$1500
Lockatong	Lock76	SVAP L-05 SVAP L-06	Lower Oak Grove Rd	Kingwood Twp	$1500
Lockatong	Lock84	SVAP L-03 SVAP L-04	Barbertown-Point Breeze Rd	Kingwood Twp	$1500
Muddy Run	Lock 85	SVAP L-07 SVAP L-08	Muddy Run Road	Kingwood Twp.	$1500
Muddy Run	Lock86	SVAP L-09 SVAP L-10	Union Rd	Kingwood Twp	$1500
Lockatong	Lock88		Kingwood Rd	Kingwood Twp	$1500
Lockatong	Lock89	SVAP L-22	Federal Twist Rd	Kingwood Twp	$1500
Lockatong	Lock93		Kingwood-Stockton Rd	Delaware Twp	$1500
Lockatong	Lock96		Federal Twist Rd	Delaware Twp	$1500

Table 4. Lockatong Creek River-Friendly Farm Project Estimated Budget		
Farms Identified through SVAP/Road Crossing	9 farms	$13,500
Additional Farms	Estimate 15 additional farms entering the program	$22,500
Outreach		$2200
Total		$38,200

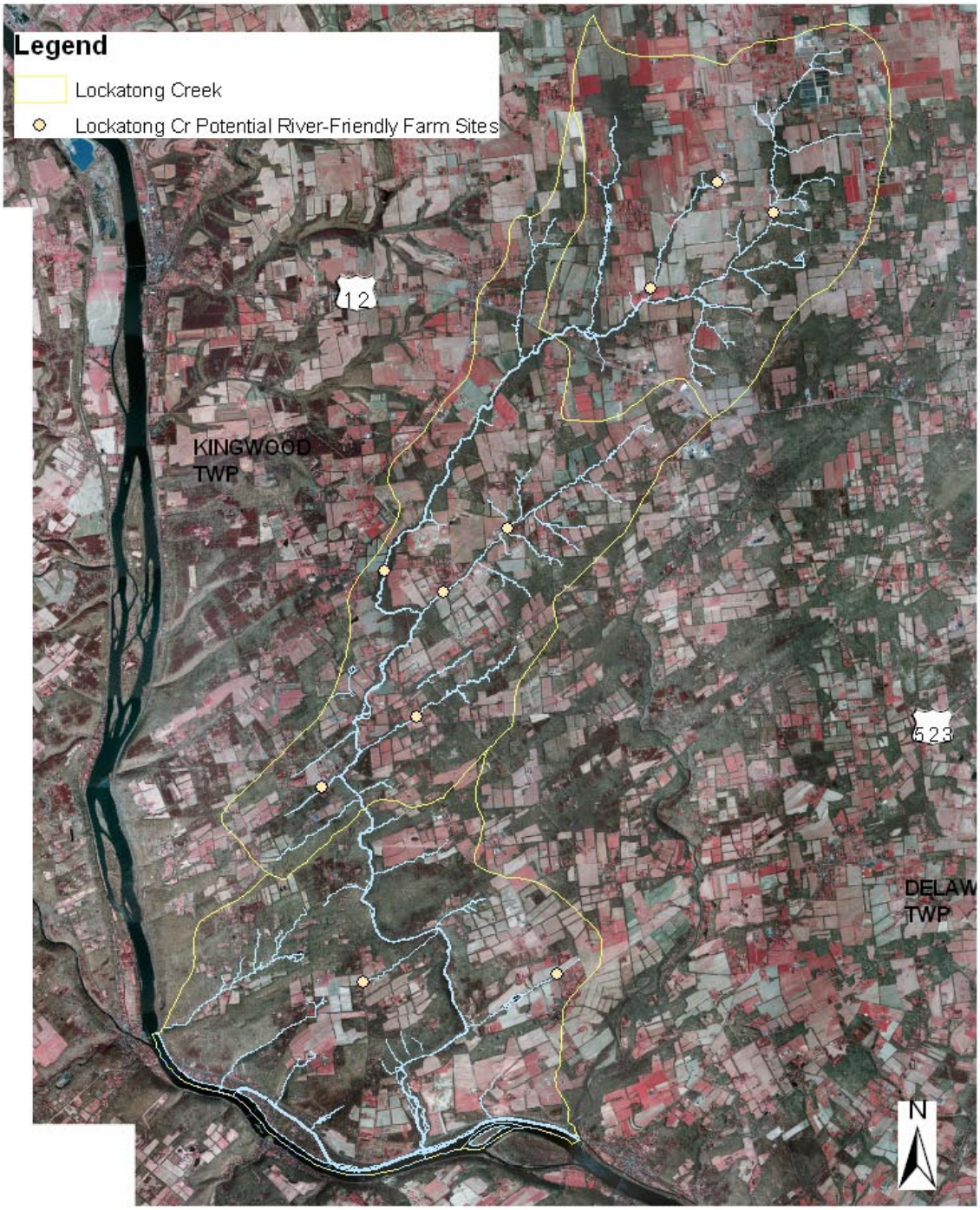

Figure 3.
Lockatong Creek Potential River-Friendly Farm Sites
(based on SVAP & Road Crossing Inventory)

0 2,050 4,100 8,200 12,300 16,400 Feet

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Document Content(s)

Lockatong Vis Assess.PDF.....1-29

Wickecheoke Creek

Stream Visual Assessment Results and Restoration Plan

New Jersey Water Supply Authority

Final Report: September 2008

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Introduction

In 2005, the New Jersey Water Supply Authority (NJWSA) received a Section 319(h) Nonpoint Source Grant from the New Jersey Department of Environmental Protection (NJDEP) to develop a watershed restoration plan for the Lockatong Creek and Wickecheoke Creek watersheds. As part of that project, NJWSA performed stream visual assessments within the two watersheds to gain an overall assessment of stream health.

Stream Visual Assessment Protocol (SVAP)

NJWSA used the United States Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS) Stream Visual Assessment Protocol (SVAP) to gather baseline data for this project. The SVAP is used to score a site based on a set of 15 indicators, including:

- Channel condition: Natural vs. altered channel (e.g. channelization; installation of riprap, dikes or levies; or downcutting or incision).
- Hydrologic alteration: Connectivity to the floodplain (e.g., structures or channel incision that limit the stream's access to the floodplain).
- Riparian zone: Stream's buffer area (e.g., a perfect score requires natural vegetation to extend at least two active channel widths on each side of the stream. A lower score, for instance a 5, is given when natural vegetation extends only half the active channel width on each side of the stream).
- Bank stability: Bank condition (banks are either level with the floodplain and stable or are higher and eroding; banks have exposed roots or slope failures present with the reach).
- Water appearance: Water clarity (clear with visible bottom or cloudy/murky).
- Nutrient enrichment: Presence of algae and/or aquatic macrophytes (A stream with a diverse plant community and clear water scores a 10; a stream with greenish water and an overabundance of algae and/or macrophytes scores a 3).
- Barriers to fish movement: Withdrawals, culverts, dams or diversions both up and downstream of the reach.
- Instream fish cover: Available cover types for fish habitat (e.g., woody debris, riffles, pools, and cobble).
- Pools: Abundance and depth of pools within the reach.
- Invertebrate habitat: Number of cover types available as habitat.
- Canopy cover: Coldwater versus warmwater fisheries. The project area is considered a coldwater fishery, thus a reach that is well shaded would score high, whereas a reach that is minimally shaded would score low.
- Manure presence: Evidence of livestock in or near the stream; it was not scored for any of the project sites.
- Salinity: Non-applicable for the project watershed.
- Riffle embeddedness: Embeddedness of cobble or gravel in sediment.
- Macroinvertebrates observed: Type and diversity of species present. A site with a good diversity of pollution intolerant species received a score of 15, while a site dominated by more pollution tolerant organisms might receive a 6. It should be noted that several of the SVAPs were performed during the fall and winter months, which are not ideal months for the observation of macroinvertebrates.

Once the team chose a segment for assessment, the active channel width was measured. A reach that was 12 times the active channel width was then scored from one to 10 (one to 15 for Macroinvertebrates observed and one to five for Manure presence) based on the 15 parameters described above; any parameter that was not applicable to a particular site was not scored. In the project watershed, salinity was determined to be not applicable; manure presence was not identified and thus not scored at any sites. The scores for each parameter were summed and divided by the total number of parameters scored to yield the SVAP score.

The SVAP relies heavily on relative comparison of sites, rather than a rigorous quantitative analysis; it is a screening assessment tool rather than a site-specific monitoring protocol, and therefore is subjective. Each parameter is scored based on the assessor's observations of a particular reach. For this reason, NJWSA ensured consistency of assessors among all of the sites. Two staff members formed the core assessment team. Additional team members included other NJWSA staff and the NJDEP Americorps Watershed Ambassador for the Lower Raritan Watershed Management Area.

The SVAP provided a great deal of useful information regarding Wickecheoke Creek. The shortfall of the protocol is that it fails to provide a mechanism for identifying the cause of identified problems.

Preliminary Visual Assessments

The Raritan Basin Watershed Alliance Road Crossing Protocol, developed by NJWSA, was utilized to collect information on each road crossing within the watershed. The information collected included land use, type of crossing, suitability for stream assessment (with respect to channel size, accessibility and safety) and the need for riparian buffer restoration. Photographs were taken at each crossing.

From that list, NJWSA selected a subset of sites for stream assessment to perform an overall assessment of stream health in the watershed.

Summary of Results

The 25 SVAP locations were chosen based on the preliminary visual assessments, land use patterns (e.g. weirs, development, agriculture), tributary patterns and accessibility. The objective was to collect enough information to assess overall stream health and to identify potential restoration sites. Stream assessment activities conducted by the assessment team identified areas of impaired stream systems throughout the watershed. Observed impairments included:

- Destabilization and erosion of stream banks due to high flows;
- Disconnection of the stream from the flood plain due to downcutting of the stream channel;
- Inadequate riparian zones and loss of riparian zones;
- Inadequate instream habitat; and
- Elevated nutrient inputs.

Overall scores ranged from 6.1 (Fair) to 9.0 (Excellent). The scores for each parameter varied widely, from a low of two in the riparian zone category to a high of ten for barriers to fish movement and nine in several other categories.

Detailed Stream Visual Assessment Results

Figure 1 shows the 25 SVAP locations; the data are summarized in Table 1. Note that when scoring ranges are discussed for individual sites, the Barriers to Fish Movement parameter is not considered, as it is more a watershed parameter than an individual reach parameter. In addition, the Macroinvertebrates Observed score is not considered, as it is a different scale than the other parameters. Where the score for these parameters is important to the assessment of a particular reach, they are discussed in more detail.

SVAP W-24

SVAP #W-24 (8.2/Good) is located downstream of Allen's Corner Road on a small tributary that drains to the mainstem of Wickecheoke Creek. This tributary is in the most northern portion of the watershed, and is considered a headwaters tributary to the Wickecheoke. The scores for this reach ranged from a 6 for nutrient enrichment to 8.5s for channel condition, bank stability and invertebrate habitat.

This reach was very narrow, with banks that were one to three feet in height. The stream's floodplain access was average. A minor amount of erosion was observed, along with some undercut banks. This reach was very sinuous, and contained some deep pools, but there were few riffles in the reach. The dominant substrate was a combination of gravel and cobble with some fine sediment deposition, particularly just downstream of the road crossing. The riparian corridor was well vegetated, however, a great deal of the vegetation was invasive species such as multiflora rose. Some algae was observed within the reach. A large culvert was present on the left bank by the road crossing. The property surrounding the reach was owned by the New Jersey Conservation Foundation and was primarily forested.

SVAP W-22

SVAP #W-22 (7.5/Good) is located on another small headwaters tributary to Wickecheoke Creek, downstream of Decker Road. The assessment scores ranged from a 5 for nutrient enrichment, pools and riffle embeddedness to 9 for invertebrate habitat, canopy cover and water appearance.

The banks were two to four feet in height and exhibited a fair amount of erosion. This reach had a very 'messy' appearance, with many downed trees and sediment deposits. Some debris (cinder blocks, sink) were observed within the reach. This reach was widening somewhat. The dominant substrate was a combination of

rock and cobble, with some bedrock and significant sediment deposits, particularly in the riffles. There were few riffles and pools observed in the reach. Significant algae and plant growth was observed, much more than would be expected in April. A road drain was present on the left bank by the road crossing. The land use on the left bank was forest. The right bank contained a driveway and a field; the assessors could not tell if the field was cultivated or mown grass. Upstream of Decker Road, the land use was forest and agriculture (chickens and goats).

SVAP W-17

SVAP #W-17 (8.3/Good) is located at the intersection of Rake Road and Sam Levine Road, just downstream of the bridge. This reach is just downstream of the intersection of three headwaters tributaries, and is considered the true beginning of the mainstem Wickecheoke Creek. The assessment scores ranged from 7 for hydrologic alteration, nutrient enrichment, instream fish cover and pools, to 9 for canopy cover and water appearance.

The banks were one to three feet in this reach, and erosion was only observed in a few small areas. The banks each had good vegetative cover. In the more upstream portion of this reach, there were some good meanders formed by stone point bars and a very good pool. More downstream, the stream widened somewhat, and had flatter water. The more downstream portion did not have point bars, and was not as sinuous as the more upstream portion of the reach. Downstream of the assessed reach, the stream regained some sinuosity and some point bars had formed. The dominant substrate in the assessed reach was cobble and large rock. Significant fine sediment deposits and some gravel were observed in the downstream portion of the reach. Algae and moss were observed on rocks within the stream channel. The riparian corridor was forested on both banks of this reach The road was present on the left bank approximately 30 to 50 feet from the stream.

SVAP W-06

SVAP #W-06 (7.3/Fair) is located on the upstream side of Route 579 (Easton Trenton Turnpike. The assessment scores ranged from 5 for water appearance to 9 for invertebrate habitat.

The banks were mostly low in this reach, approximately one to two feet, with good floodplain access. This reach narrowed upstream of the road crossing, from more than 20 feet to 15-20 feet in width. The mid- to downstream portion of the reach had low banks and a wetland bench, with a less defined channel. The channel was more defined in the

upstream portion of the reach. Average riffles and some pools were observed. The more downstream portion of the reach was relatively murky, and a great deal of algae was present. Some debris was observed adjacent to the stream on the left bank near the upstream end of the reach; the debris included concrete, tires and wood. A very faint septic smell was detected in the more downstream portion of the reach; no visible pipes or discharges were observed. The dominant substrate in this reach was sand, gravel, cobble and large rocks. The land use in the vicinity of the reach included forest, residential and commercial. The left bank by the residential property was identified as a potential **riparian buffer improvement** site.

SVAP W-25

SVAP #W-25 (7.8/Good) is located downstream of Route 579, on a tributary to the mainstem Wickecheoke Creek. This tributary enters the mainstem downstream of SVAP #W-06. The assessment scores ranged from 6 for bank stability and water appearance to 9 for invertebrate habitat.

This reach had banks that were two to three feet in height, and did not have good floodplain access. A few trees were down in the stream. The reach appeared 'messy', but scored relatively well. Some erosion of the banks was observed, but not anything that was considered a problem by the assessor. The sinuosity was average. Fine sediment deposits were observed, and the stream was a little bit murky. The land use within the reach was forested. Downstream of the assessed reach there were residential properties and more open areas. Past the end of the assessed reach, there was a second channel, which may have been an overflow channel or an abandoned channel.

SVAP W-02

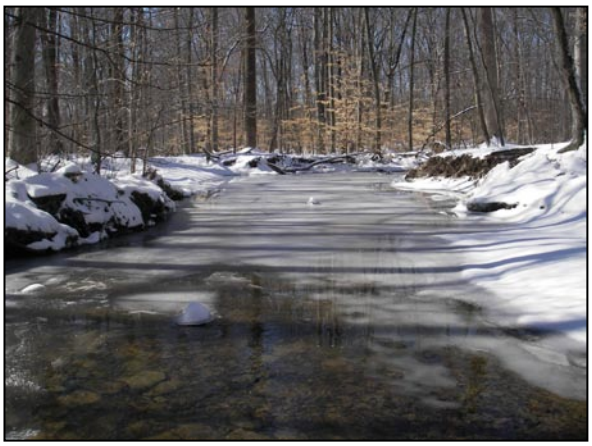
SVAP #W-02 (8.0/Good) is located on the mainstem of the Wickecheoke Creek, upstream of Whiskey Lane. The assessment scores ranged from 6 for hydrologic alteration and bank stability to 9 for riparian zone and invertebrate habitat.

The banks were two to four feet in this reach, and approached five feet in some areas. The stream did not have floodplain access in this reach, and did not have good sinuosity. Some erosion and undercutting of the banks were observed. Rock and sediment deposits were observed mid-channel, and fine sediment deposits were present. Algae were observed on the rocks. The land use within the reach consisted of forest.

SVAP W-23

SVAP #W-23 (9.0/Excellent) is located on a headwaters tributary to the mainstem of the Wickecheoke, upstream of Oak Grove Road. This was the best-scored site in the Wickecheoke Creek set of SVAPs. The assessment scores were all 8 and above.

The banks were mostly low within the assessed reach, with a few higher spots that were one to three feet in height. The stream had good floodplain access. The channel was a bit widened, probably because of high flows, but the stream has deposited sediment and rock to form benches and point bars. The reach had good meanders, and the thalweg was meandering within the channel. There was some erosion, primarily in the outsides of bends, where it would be expected. The dominant substrate consisted of gravel, cobble and shale, with some fine sediment deposits. The reach contained average riffles and some average pools. There were large point bars within the stream, and it appeared that the stream was moving large amounts of sediment during higher flow events. The riparian corridor was forested on each side. Farther from the stream, there was a cultivated field on the left bank and a residential property on the right bank.



SVAP W-03

SVAP #W-03 (8.0/Good) is located downstream of SVAP #W-23, on a headwaters tributary to the mainstem of the Wickecheoke, upstream of Whiskey Lane. The assessment scores ranged from 6 for pools to 9 for canopy cover, invertebrate habitat and riparian zone.

The banks were one to three feet throughout this reach, and the stream had average floodplain access. Point bars were forming meanders within the channel, and the channel itself had a few good meanders. A large swale entered the stream on the right bank near the upstream end of the reach; the banks were eroded just below the swale. A meander and log jam were present upstream of the swale, and good meanders were present above the log jam. The banks were also lower upstream of the log jam. The stream appeared to flow over the left bank during high flows at the log jam. Some algae were observed on the rocks within the reach. The land use in the vicinity of this reach was primarily forest.

SVAP W-01

SVAP #W-1 (7.5/Good) is located on the mainstem of Wickecheoke Creek, upstream of Locktown-Sergeantsville Road. The assessment scores ranged from a 5 for instream fish cover to 9 for riparian zone and invertebrate habitat.

The banks were one to three feet in height through this reach, and the stream's floodplain access was adequate. Some areas of erosion were observed, but considered to moderate. The dominant substrate in this reach was large shale and bedrock; some gravel and cobble were observed in the upstream portion of the reach. This reach primarily contained flat water, with only a few riffles in the upstream portion of the reach. A few side channels entered the stream just upstream of the bridge. A W-weir type structure was present approximately mid-way through the reach. This structure could be natural, or it might have been constructed. An outcrop was built into the stream at the upstream end of the reach; a clay pipe entered the stream from beneath the outcrop. The land use in the vicinity of the reach was forest, residential and some lawn area. The left bank was identified as a good candidate for a **riparian buffer improvement** project.

SVAP W-18

SVAP #W-18 (7.8/Good) is located on the mainstem Wickecheoke Creek, downstream of Locktown-School Road, adjacent to Wickecheoke Road. The assessment scores ranged from 6 for pools to 9 for several parameters.

The stream had good access to the floodplain in this reach; the banks were relatively low. The left bank was slightly higher than the right bank, but it was protected by bedrock. The banks were in good condition, no erosion was observed. The dominant substrate in this reach was bedrock and large rocks. The channel had average sinuosity, and water flow had good sinuosity in and around the large rocks. Some fine sediment was observed in between the rocks, which were somewhat slimy. Very little leaf pack was observed in the stream. Any leaf pack and large woody debris was probably washed through the system in a large storm event approximately two weeks prior to the assessment. A road ditch was present on the right bank on the upstream side of the crossing and on the left bank on the downstream side of the crossing. The ditch on the right bank contained approximately a large amount of gravel and sand. The stream may have historically been redirected to go straight beneath the road crossing, but it has meandered to the right bank. The land use in the vicinity of this reach was forest, the road and one residential property on the

right bank, and then an agricultural property and forest on the left bank. The canopy cover and shading of this reach was inadequate, in part due to the width of the stream channel.

SVAP W-19

SVAP #W-19 (8.3/Good) is located on a tributary to the mainstem Wickecheoke, upstream of Locktown-Sergeantsville Road. This tributary enters the left bank of the mainstem, upstream of SVAP #W-13. The assessment scores ranged from 7 for pools to 9 for several parameters.

The banks in this reach were one to two feet in height, with better than average floodplain access. There was evidence that the stream flows out of its banks on a regular basis. Minimal erosion was observed, although the banks were undercut in a few areas. The stream had good meanders within this reach. The area just upstream of the road crossing was more impacted (higher banks, erosion, sand deposits) than the area farther upstream. The dominant substrate was gravel and cobble, with some sand and fine sediment deposits. The land use in the vicinity of this reach was primarily forested. The right bank, beyond the forest, contained a field and agricultural property.

SVAP W-12

SVAP #W-12 (6.9/Fair) is located on a tributary to the mainstem of Wickecheoke Creek. This tributary enters the mainstem just upstream of SVAP #W-13. The assessment scores ranged from a 3 for barriers to fish movement and 5 for riparian zone and instream fish cover to 9 for hydrologic alteration and bank stability. The reach was on the downstream side of Featherbed Road.

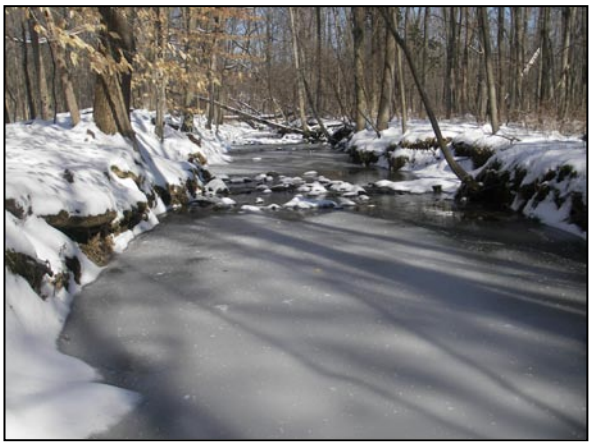
The riparian corridor on the left bank included a small amount of forest, then agricultural field/meadow and a few houses. The right bank contained sparse forest, then the road and then more forest. Featherbed Road runs very close to the stream. The dominant substrate in this reach was bedrock. Upstream of Featherbed Road, the stream was well connected to the floodplain and was not incised. Immediately downstream of the road crossing, the stream channel dropped approximately ten feet. It appeared that the channel downstream of Featherbed Road had incised in the past and that the bedrock was a boundary condition that prevented the incision from continuing upstream. The channel was stable at the time of the assessment; the downcutting was not active. Slightly outside the channel, there were naturally steep slopes, so there was a very small floodplain. The stream was iced over at the time of the assessment. The banks in this reach were in good condition; no

erosion was observed. The banks contained a great deal of bedrock. This reach was a higher gradient than many of the other reaches that were assessed. The reach exhibited good sinuosity and contained good riffle/pool sequences.

SVAP W-13

SVAP #W-13 (8.0/Good) is located on the mainstem of the Wickecheoke, upstream of Old Mill Road. The assessment scores ranged from 3 for barriers to fish movement and 5 for instream fish cover to 9 for channel condition and bank stability.

The banks in this reach were low on the right bank, with good floodplain access and evidence of overflow. The left bank contained a steep, natural slope, permitting less floodplain access than on the right bank. This reach was bedrock dominated, and was not very sinuous. It was, however, stable, and appeared to have adequate riffle/pool morphology. The reach was mostly iced over at the time of the assessment. An approximately three foot change in gradient was present approximately 75 feet upstream of the road crossing. Bedrock formed a limiting condition. A tributary entered the right bank of the stream slightly upstream of the crossing. There were some undercut trees within the reach, but the banks were not undercut or eroded.



SVAP W-04

SVAP #W-4 (7.0/Fair) is located at the headwaters of Plum Brook, a tributary to the mainstem of the Wickecheoke. The assessment reach was located on the upstream side of Plum Brook Road. The assessment scores ranged from 4 for water appearance and nutrient enrichment to 9 for invertebrate habitat and canopy cover.

The land use in the vicinity of the reach included forest and a residential property. That property included some lawn area, which could be a potential buffer project location. Beyond the forested area on the right bank, an agricultural property was present, and included horses, paddocks and pastures. The banks in this reach were primarily one to three feet, and the stream had poor floodplain access. The banks were somewhat higher in the upstream portion of the reach. The dominant substrate in this reach was large rocks, with some smaller gravel and fine sediments. The downstream portion of the reach was deep with a large amount of rock, but no riffles. The more upstream portion of the reach was more natural, and was shallower with some riffles. There was rock on both banks; a rock retaining wall by the residential property was falling into the stream. A great deal of algae and macrophytes was observed, which was

surprising considering the time of year (January). The overabundance of these plants indicates high nutrient inputs to the reach. A large amount of fine sediment was observed in the reach; several pools were filled in with sediment. Two pipes were observed entering the stream from the residential property. A ditch was present on the right bank by the road crossing and a small tributary entered the stream's left bank in the upper portion of the reach.

SVAP W-05

SVAP #W-5 (8.5/Good) is located downstream of Plum Brook Road, on Plum Brook. The assessment scores ranged from 7 for riffle embeddedness to 8.5 and 9 for several parameters.

The primary land use in the riparian corridor was forest; one residential property was present. The banks in this reach were mostly low and the stream had good floodplain access. The dominant substrate in this reach was sand and small gravel. This reach had good sinuosity, although it was somewhat straight near the road crossing. This reach had a good riffle/pool sequence, as opposed to the upstream reach (SVAP #W-4), which did not. This reach was also much shallower and exhibited much less fine sediment and algae than the upstream reach. The banks were in good condition, with the exception of one outer bend that exhibited some erosion. It appeared that the road crossing backed up water at high flow, causing sediment to settle on the upstream side of the road crossing. The riparian corridor was in relatively good condition; fewer invasive species were observed compared to the more upstream reach.

SVAP W-10

SVAP #W-10 (7/7/Good) is located to the east of Ferry Road, downstream of Locktown-Flemington Road, on Plum Brook. The reach began approximately 50 feet downstream of the road crossing. The assessment scores ranged from 6 for riparian zone and bank stability to 8.5 for hydrologic alteration.

The riparian corridor on the left bank was forested. The right bank contained Ferry Road, then forest and a few residential properties. In the upstream portion of the reach, the banks were high on the left bank, up to eight feet. The right bank was lower, permitting floodplain access for the stream. In the downstream portion of the reach, the banks were lower and the stream had floodplain access. The stream had good riffle/pool sequences. The pools were not very deep, but they were frequent. The upstream portion of the reach was messy, with eroded meander bends, high banks, overhanging and

undercut banks and many downed trees. The downstream portion of the reach exhibited banks in better condition and the stream appeared to have recovered from the impact of the road crossing. The dominant substrate in this reach was large rocks; smaller gravel was observed in between the rocks. A large amount of rock was observed on the floodplain, indicating that the stream exits its banks frequently and is likely adjusting within the floodplain.

SVAP W-21

SVAP #W-21 (8.5/Good) is located on Plum Brook, a tributary to the mainstem Wickecheoke Creek. The assessment site is located downstream of Ferry Road. The assessment scores in this reach ranged from 7 for pools to 9 for several parameters.

The stream widened downstream of the crossing, narrowed somewhat, then widened again. The banks were somewhat high in some areas, up to two to four feet, while in others areas the banks were one to three feet. The stream's access to the floodplain was average. The banks were in good condition and were not eroded through most of the reach. The dominant substrate in this reach was cobble and gravel, with some larger material. There were large areas of fine sediment and sand deposits. The reach was somewhat straight, with only a few good meanders; however, the streamflow meandered within the channel. The area surrounding the reach was primarily forested. A ditch entered the stream on the right bank by the crossing, and a few smaller tributaries entered Plum Brook upstream of the crossing.

SVAP W-11

SVAP #W-11 (8/6/Good) is located downstream of Pine Hill Road on Plum Brook, a tributary to the mainstem of the Wickecheoke. The assessment scores ranged from 7 for instream fish cover to 9 for several parameters.

This riparian corridor was forested; New Jersey Conservation Foundation owns the surrounding property. The banks were low in this reach and the stream had good floodplain access. A floodplain bench was present in some areas. The dominant substrate was bedrock, cobble and gravel. Algae was observed on some rocks, but there were no fine sediment deposits and no gravel deposits from roadside ditches. The left bank contained a steep, forested slope. A few areas of erosion were observed on the banks, but none were considered a problem. Good pools and riffles were observed. A drainage swale was present from near the bridge to approximately 100 feet downstream, parallel to the stream channel.

SVAP W-20

SVAP #W-20 (6.9/Fair) is located on a tributary to the mainstem of the Wickecheoke that runs along Reading Road and enters the mainstem near the intersection of Lower Creek Road and Rosemont-Ringoes Road. The assessment was performed about mid-way up the tributary, near #13 Reading Road. The assessment scores ranged from a 2 for riparian zone and 3 for canopy cover to 8 for several parameters.

The left bank, adjacent to Reading Road, was high, while the right bank provided adequate floodplain access for the stream. Reading Road was very close to the stream's left bank. This reach was relatively straight, but contained good riffles and some small pools. There were fine sediment deposits in the reach. A drainage swale entered the right bank of the reach from the agricultural property. A ditch on the far side of the road led to an infall on the stream's left bank. The stream travelled through a large box culvert for the residential driveway. The land use in the vicinity of the reach was forested, residential and agricultural. The right bank, which sloped down from a residential/agricultural property and contained lawn, should be targeted for **riparian buffer improvement.**

SVAP W-09

SVAP #W-9 (6.3/Fair) is located adjacent to Lower Creek Road, on the mainstem of Wickecheoke Creek. The assessment scores ranged from 3 for barriers to fish movement and 4 for riparian zone to 9 for water appearance and nutrient enrichment.

The land use within the riparian corridor on the left bank consisted of Lower Creek Road, beyond which there were residential properties and some forest. The right bank contained an agricultural property with horses and cattle; the pasture ended approximately ten feet from the stream. That property should be included as a target for **riparian buffer improvements.** The left bank was somewhat high through this reach; the right bank had average floodplain access. The dominant substrate within the reach was bedrock and large rocks. The stream channel was relatively straight, but water meandered within the channel. A long stretch of the left bank was armored with gabions to protect Lower Creek Road. Willow stakes were installed at the top of the bank. Point bars had formed on the right bank. No large woody debris was present in this reach; there are not many immediate sources on the banks and it is likely swept through the reach in high flows.

SVAP W-16

SVAP #W-16 (6.6/Fair) is located on a tributary to the mainstem of the Wickecheoke Creek that enters the mainstem along Lower Creek Road, near the intersection of Covered Bridge Road. The assessment site was on the downstream side of Covered Bridge Road. The assessment scores ranged from 2 for riparian zone to 9 for water appearance and nutrient enrichment.

The banks were relatively high in this reach, ranging from two to four feet. The stream did not have good floodplain access within this reach. This tributary is higher gradient than some of the other reaches that were assessed. The reach was relatively straight, and had a few good riffles but very few pools. The right bank in the upper portion of the reach contained a stone bulkhead. Residential properties on each bank had lawn to the top of bank; this site is a good target for **riparian buffer improvement**. Exposed roots were observed within the reach, but the bank was relatively shaly, which prevented erosion. The dominant substrate was cobble and large rock. Two PVC pipes were present underneath the lawn in the left bank near the downstream end of the reach. A 12-inch corrugated metal pipe discharged stormwater into the tributary from the left bank at Covered Bridge Road.

SVAP W-08

SVAP #W-8 (6.3/Fair) is located on the mainstem of the Wickecheoke, adjacent to Lower Creek Road. The assessment scores ranged from 3 for barriers to fish movement to 9 for nutrient enrichment and water appearance; the scores were generally low.

The banks were two to four feet high in this reach, preventing floodplain access for the stream. Lower Creek Road restricted the movement of the stream in this reach. The bank was armored with gabions in one area to protect the road. The banks were very eroded by high flows. Minimal sediment deposition was observed during the assessment, likely due to the high flows that this reach experiences. The channel was very wide, approximately 60 feet, but the streamflow moved around within the channel. A long point bar that extended approximately 100 feet was observed in the upstream portion of the reach. The land use within the riparian corridor was primarily forested, with a few residential properties. New Jersey Conservation Foundation owned a large portion of the land surrounding this reach.

SVAP W-07

SVAP #W-7 (7.4/Fair) is located on the Maisntem of the Wickecheoke. It was the most downstream assessment that was performed. The assessment scores ranged from 5 for riparian zone and bank stability to 9 for water appearance and nutrient enrichment.

The banks were one to four feet in this reach; the stream did not have good floodplain access. The channel was relatively straight, but the stream meandered within the channel. Good riffles were observed within the reach, but no good pools were observed. A few small pools were associated with large boulders. No large woody debris or fine sediment deposition were observed, likely due to the high flows through this reach. A tributary/drainage swale was present on the left bank at the upstream portion of the reach. A scour pool was observed at the end of the tributary where it entered the mainstem. The scour pool was downcutting and moving a great deal of sediment. Both the right bank and left bank of the mainstem were eroded due to high flows. Much of the stream channel is not shaded due to the width of the stream. The left bank near the residential properties should be a target for **riparian buffer improvement**.

SVAP W-14

SVAP #W-14 (7.1/Fair) is located on a tributary to the mainstem Wickecheoke along Worman Road. The reach was located upstream of Worman Road. The assessment scores ranged from 5 for riparian zone to 8 for several parameters.

The left bank was very high within the reach and received a great deal of impact from high flows, as exhibited by the erosion of the banks. The right bank was lower and provided average floodplain access for the stream. This reach flows very close to Worman Road, but contained some good meanders and one good pool. The stream was murky, but there was rain the day prior to the assessment. Algae were observed on the rocks. The land use in the vicinity of this reach included forest, a few residential properties and Worman Road.

SVAP W-15

SVAP #W-15 (8.0/Good) is located on a tributary to the mainstem Wickecheoke along Worman Road. This reach was located downstream of Worman Road and SVAP #W-14. The assessment scores ranged from 6 for instream fish cover and pools to 8 for several parameters.

This reach was quite straight, but it was also a short reach. Erosion was observed on the right bank, but a boundary limiting condition of bedrock existed there. The left bank was one to two feet in height and provided average floodplain access for the stream. The dominant substrate was cobble and boulder. Fine sediment deposits were also observed. A great deal of gravel, apparently deposited from Worman Road, was also observed in the stream. The right bank contained a steep, natural bank that was forested. The left bank contained a very narrow forested strip, then Worman Road and then additional forest. A residential property, located downstream of the next crossing and this reach, was a potential target for a small area of **riparian buffer improvement**.

Recommendations

As detailed in Figure 2 and Table 2, 48 sites were identified for riparian buffer restoration, seven sites were recommended for River-Friendly Farm, one site was recommended for roadside ditch mitigation and 1 one was recommended for floodplain reconnection. The recommendations were developed based on the road crossing inventory, stream visual assessments and review of aerial photographs.

Riparian buffer restoration includes forest and herbaceous plantings. For riparian buffer restoration cost estimates, the target buffer was 20 feet on each side of the stream. Approximately 94,000 linear feet of riparian buffer restoration was recommended, for a total of 43 acres of riparian buffer restoration. In some areas, the actual buffer that can be achieved may be less than 20 feet, in other areas it will be much greater. The estimated cost per acre for materials was $3,000, in addition to staff time for an estimated cost of $158,000. Each site can be implemented independently of the others; however, cost savings will be achieved when multiple sites are completed in a single season due to the benefit of ordering plant materials in bulk. For each site, NJWSA recommends developing a planting plan prior to restoration. Potential funding sources include the Section 319(h) Nonpoint Source grant program, various programs led by the Natural Resources Conservation Service (NRCS, e.g. Conservation Reserve Enhancement Program, Conservation Reserve Program, Wildlife Habitat Incentives Program) and other similar programs.

Seven sites were recommended for the River-Friendly Farm program, based on the SVAP and road crossing reconnaissance (Table 3 and Figure 3). There are many additional agricultural properties in the watershed; however NJWSA estimated that an additional 15 farms, for a total of 22 participants within the watershed, is a feasible target.

This program is administered by North Jersey Resource Conservation & Development Council (RC&D), the Raritan Watershed Agricultural Committee and NJWSA. The program is currently implemented throughout much of Hunterdon County, although the target areas are the Mulhockaway Creek Watershed, Spruce Run Watershed, South Branch Raritan Watershed and Neshanic River Watershed. An agricultural outreach specialist from North Jersey RC&D performs a review of the farm's management activities, in particular soil loss management, nutrient management, pest management, riparian buffer management and irrigation water management. If the farm meets the criteria, it is certified River-Friendly. If the farm does not meet the criteria, the agricultural outreach specialist works with the farmer and with a conservation planner from NRCS to develop a conservation plan so that the farm can meet the River-Friendly criteria and to identify potential cost-share programs. The estimated cost to implement the River-Friendly Farm program in the Wickecheoke Watershed is $35,200 (Table 4), assuming extension of the existing program to this watershed. This estimate does not include implementation of conservation practices that may be needed for the farms to meet the River-Friendly criteria.

One site was specifically recommended for roadside ditch mitigation. This is a problem that was observed throughout the watershed and is addressed in the watershed restoration plan.

One site was recommended for floodplain reconnection. It should be noted that floodplain reconnection will not succeed unless the causes of the stream channel incision (e.g. high flows) are addressed. Without further surveys, a cost estimate for this project is very difficult, but it could cost up to $800,000 or more.

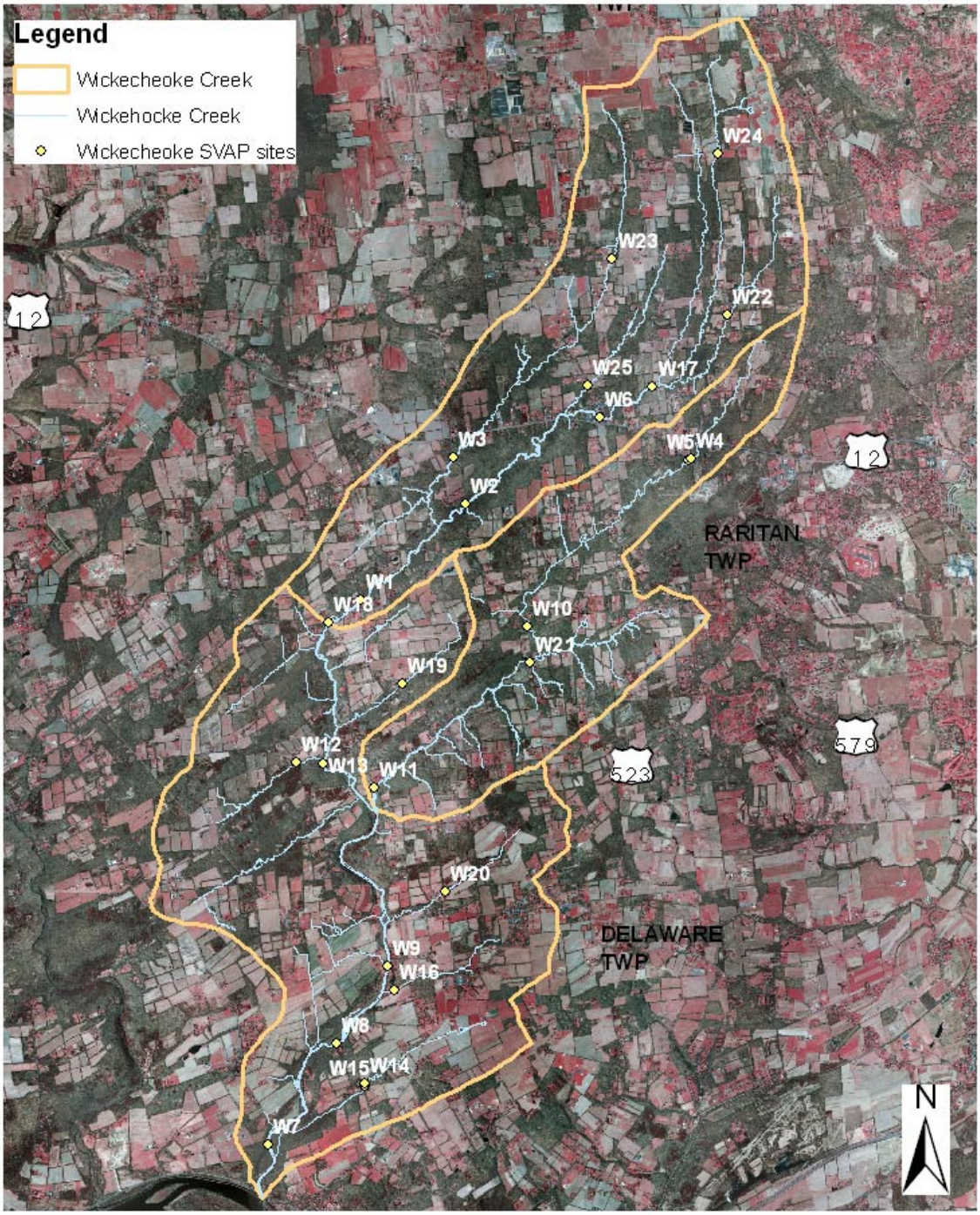


Figure 1.
Wickecheoke Creek Stream Visual Assessment (SVAP) Sites

0 1,900 3,800 7,600 11,400 15,200 Feet

Table 1. Wickecheoke Creek Stream Visual Assessment Results								
SVAP #	**W-1**	**W-2**	**W-3**	**W-4**	**W-5**	**W-6**	**W-7**	**W-8**
Tributary/mainstem								
Location	US side Locktown-Sergeantsville Road	US Side Whiskey Lane	Whiskey Lane	US Plum Brook Road	DS Plum Brook Road	US Rt 579 b/w Rt 12 & Old Croton	Lower Creek Rd, most DS	Lower Creek Road
Assessment Scores:								
Channel condition	8	8	8	8	8	8	6	6
Hydrologic alteration	8	6	8	7	8.5	8	7	5
Riparian zone	9	9	9	7	9	7	5	5
Bank stability	7	6	7	6	8.5	8	5	5
Water appearance	9	8	8	4	8	5	9	9
Nutrient enrichment	8	7	8	4	9	6	9	9
Barriers to fish movement	10	10	7	10	10	10	10	3
Instream fish cover	5	7	7	8	9	7	6	6
Pools	6	na	6	6	7.5	6	6	6
Invertebrate habitat	9	9	9	9	9	9	8	7
Canopy cover (if applicable)	8	8	9	9	9	7	na	na
Manure presence (if applicable)	na	na	na	na	na	na	na	na
Salinity (if applicable)	na	na	na	na	na	na	na	na
Riffle embeddedness (if applicable)	8	na	8	4	7	7	9	8
Macroinvertebrates observed (optional)	10	10	10	9	na	7	9	na
Overall Score (Total divided by number scored) Poor = <6.0; Fair = 6.1 - 7.4; Good = 7.5 - 8.9; Excellent = >9.0	**7.5**	**8.0**	**8.0**	**7.0**	**8.5**	**7.3**	**7.4**	**6.3**

Table 1. **Wickecheoke Creek Stream Visual Assessment Results** (continued)								
SVAP #	**W-9**	**W-10**	**W-11**	**W-12**	**W-13**	**W-14**	**W-15**	**W-16**
Location	Lower Creek Road	Lower Creek Road	DS Pine Hill Rd	DS Featherbed Lane	US Old Mill Road	Worman Road	DS Worman Road	DS Covered Bridge Road
Assessment Scores:								
Channel condition	6	7	9	9	9	8	8	5
Hydrologic alteration	7	8.5	9	8	9	8	8	6
Riparian zone	4	6	9	5	8	5	7	2
Bank stability	6	6	9	9	9	6	7	6
Water appearance	9	7	9	8	8	7	7	9
Nutrient enrichment	9	6	6	7	7	8	8	9
Barriers to fish movement	3	10	10	3	3	10	10	3
Instream fish cover	6	8	7	5	5	6	6	6
Pools	6	8	8	na	na	6	6	5
Invertebrate habitat	7	8	8	7	7	8	8	7
Canopy cover (if applicable)	5	8	9	8	8	6	8	3
Manure presence (if applicable)	na	na	na	na	na	na	na	na
Salinity (if applicable)	na	na	na	na	na	na	na	na
Riffle embeddedness (if applicable)	8	8	8	na	na	7	8	8
Macroinvertebrates observed (optional)	na	9	11	na	na	na	13	10.5
Overall Score (Total divided by number scored) **Poor = <6.0; Fair = 6.1 - 7.4; Good = 7.5 - 8.9; Excellent = >9.0**	**6.3**	**7.7**	**8.6**	**6.9**	**7.3**	**7.1**	**8.0**	**6.1**

Table 1.
Wickecheoke Creek Stream Visual Assessment Results (continued)

SVAP #	**W-17**	**W-18**	**W-19**	**W-20**	**W-21**	**W-22**	**W-23**	**W-24**	**W-25**
Location	DS Rake Road/Sam Levine	DS Locktown School Rd	US Locktown Sergeantsville Rd	Reading Road	DS Ferry Rd	DS Decker Road	US Oak Grove Rd	DS Allen's Corner Rd	DS Route 579
Assessment Scores:									
Channel condition	8.5	9	9	8	9	7.5	9	8.5	7
Hydrologic alteration	7	9	9	8	8	6	8.5	8	7
Riparian zone	8.5	9	8	2	8	7.5	9	8	8
Bank stability	8	9	9	8	9	7	8.5	8.5	6
Water appearance	9	9	8	8	9	9	9	8	6
Nutrient enrichment	7	7	7	7	8	5	9	6	7
Barriers to fish movement	10	10	10	10	10	10	10	10	10
Instream fish cover	7	6	8	8	8	7	9	7.5	7
Pools	7	6	7	6	7	5	9	7.5	7
Invertebrate habitat	8.5	7	8	8	8	9	9	8.5	9
Canopy cover (if applicable)	9	8	8	3	9	9	9	7	8.5
Manure presence (if applicable)	na	na	na	na	na	na	na	na	na
Salinity (if applicable)	na	na	na	na	na	na	na	na	na
Riffle embeddedness (if applicable)	8	8	7	7	8	5	8	8	7
Macroinvertebrates observed (optional)	10	5	10	na	10	11	9.5	11	12
Overall Score (Total divided by number scored) Poor = <6.0; Fair = 6.1 - 7.4; Good = 7.5 - 8.9; Excellent = >9.0	**8.3**	**7.8**	**8.3**	**6.9**	**8.5**	**7.5**	**9.0**	**8.2**	**7.8**

Table 2. Wickecheoke Creek Recommended Riparian Buffer Restoration Locations										
					Buffer Restoration Location					
Stream	**Site Crossing ID**	**SVAP #**	**Nearest Road**	**Municipality**	**US RB**	**US LB**	**DS RB**	**DS LB**	**Estimated Buffer Length (for each designated location)**	**Estimated Buffer Cost**
Plum Brook	1005		Ferry Rd	Delaware Twp		x	x	x	1100	$5,200
Plum Brook	1013		Old Croton Rd	Raritan Twp	x	x		x	1500	$7,200
Wickecheoke	1001		Locktown Rd	Kingwood Twp	x	x	x	x	1500	$9,400
Wickecheoke	1007		Allen's Corner Rd	Franklin Twp	x				1500	$2,600
Wickecheoke	1009		Goose Island Rd	Franklin Twp	x	x			1500	$5,000
Wickecheoke	1015		Allen's Corner Rd	Raritan Twp	x	x			650	$2,300
Wickecheoke	1018		Rosemont-Sergeantsville Rd	Delaware Twp	x	x	x	x	2200	$13,100
Wickecheoke	1019		Sergeantsville Rd	Delaware Twp	x	x	x	x	1700	$10,300
Wickecheoke	1020		Sergeantsville Rd	Delaware Twp	x	x			750	$2,600
Wickecheoke	1023		Hammar Rd	Kingwood Twp	x	x	x		800	$3,800
Wickecheoke	1024		Sanford Rd	Delaware Twp		x		x	550	$2,000
Wickecheoke	1027		Rosemont Sergeantsville Rd	Delaware Twp	x	x	x	x	2000	$12,000
Wickecheoke	1028		Rosemont Sergeantsville Rd	Delaware Twp	x	x	x	x	1250	$8,000
Wickecheoke	1029		Rosemont Sergeantsville Rd	Delaware Twp	x	x	x	x	1000	$6,100
Wickecheoke	1030		Upper Creek Rd	Delaware Twp	x		x		600	$2,300
Wickecheoke	1033		Covered Bridge Rd	Delaware Twp			x		675	$1,600
wickecheoke	1034		Locktown Flemington Rd	Delaware Twp	x	x		x	500	$2,600
Wickecheoke	1042		Goose Island Rd	Raritan Twp				x	200	$700
Wickecheoke	1043		Goose Island Rd	Raritan Twp		x			1100	$2,000
Wickecheoke	1044		Goose Island Rd	Raritan Twp	x	x	x	x	500	$3,700
Wickecheoke	1014		Rake Road	Raritan Twp	x	x	x		1200	$6,000

Wickecheoke	Wick20		Allen's Corner Rd	Franklin Twp	x	x			1000	$3,700
Wickecheoke	Wick22		Old Franklin School Rd	Franklin Twp	x	x			800	$2,800
Wickecheoke	Wick30	SVAP W-06	Croton Rd	Raritan Twp		x			200	$700
Wickecheoke	Wick31	SVAP W-01	Locktown Rd	Delaware Twp		x			200	$700
Wickecheoke	Wick32	SVAP W-02	Whiskey La	Delaware Twp						
Plum Brook	Wick35	SVAP W-04 SVAP W-05	Plum Brook Rd	Raritan Twp		x			100	$400
Plum Brook	Wick36		Easton-Trenton Turnpike	Raritan Twp	x	x			200	$1,000
Plum Brook	Wick39	SVAP W-21	Ferry Rd	Delaware Twp			x		150	$700
Plum Brook	Wick41		private	Delaware Twp	x	x	x	x	600	$3,800
Plum Brook	Wick42		Locktown - Sergeantsville Rd	Delaware Twp			x	x	400	$1,700
Wickecheoke	Wick43	SVAP W-19	Locktown - Sergeantsville Rd	Delaware Twp				x	150	$700
Wickecheoke	Wick44		Locktown - Sergeantsville Rd	Delaware Twp			x	x	1000	$3,700
Wickecheoke	Wick452		Old Croton Rd	Raritan Twp			x		150	$700
Plum Brook	Wick454		Old Croton Rd	Raritan Twp				x	350	$1,000
Wickecheoke	Wick456		Oak Grove Rd	Raritan Twp	x			x	675	$2,600
Wickecheoke	Wick46	SVAP W-16	Covered Bridge Rd	Delaware Twp		x		x	300	$1,400
Wickecheoke	Wick461		12W	Raritan Twp	x				150	$700
Wickecheoke	Wick463		Sanford Rd	Delaware Twp						
Wickecheoke	Wick468		Sanford Rd	Delaware Twp			x		650	$1,400
Wickecheoke	Wick47		Sergeantsville Rd	Delaware Twp	x	x	x	x	1400	$8,700
Wickecheoke	Wick471	SVAP W-07	Lower Creek Rd	Delaware Twp		x			600	$1,400
Wickecheoke	Wick472		Lower Creek Rd	Delaware Twp	x	x			450	$1,700
Plum Brook	Wick473		Locktown - Sergeantsville Rd	Delaware Twp			x		100	$400
Wickecheoke	Wick483		Joe Ent Rd	Franklin Twp	x	x	x	x	550	$3,700
Wickecheoke	Wick484		Allen's Corner Rd	Franklin Twp	x				150	$700
Wickecheoke	Wick55		Rosemont-Sergeantsville Rd	Delaware Twp		x	x		400	$1,700
Wickecheoke	Wick56	SVAP W-09	Lower Creek Rd	Delaware Twp	x		x		800	$2,800
Wickecheoke	Wick64		Locktown Rd	Kingwood Twp	x	x	x	x	200	$1,700

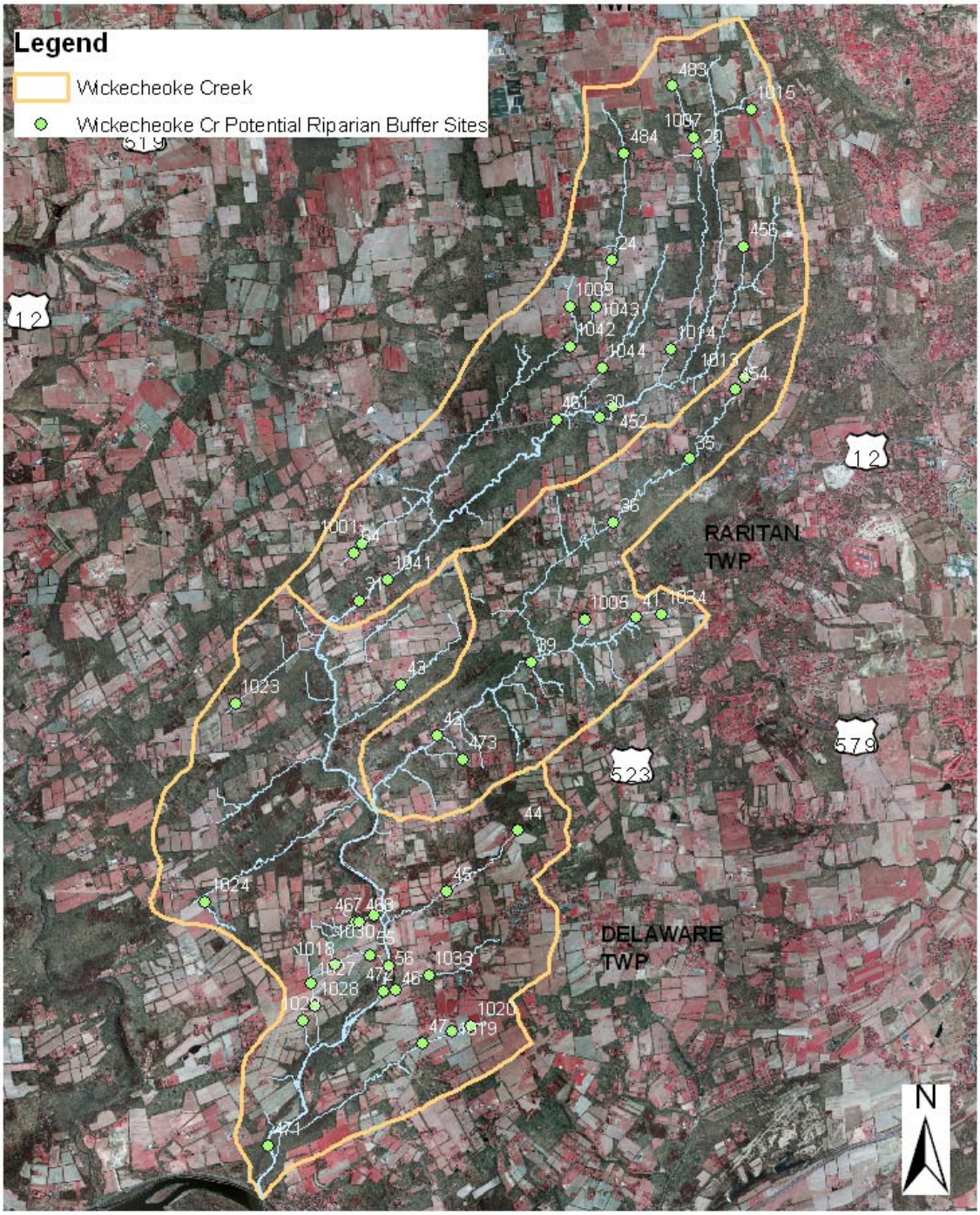


Figure 2.
Wickecheoke Creek Potential Riparian Buffer Sites

0 1,900 3,800 7,600 11,400 15,200 Feet

Table 3. Wickecheoke Creek Potential River-Friendly Farm Locations (based on SVAP and Road Crossing Inventory)					
Stream	**Site Crossing ID**	**SVAP #**	**Nearest Road**	**Municipality**	**Estimated Cost River-Friendly Farm**
Wickecheoke	Wick23		Oak Grove Rd	Franklin Twp	$1500
Plum Brook	Wick35	SVAP W-04 SVAP W-05	Plum Brook Rd	Raritan Twp	$1500
Plum Brook	Wick37		Stone Signpost Rd	Delaware Twp	$1500
Plum Brook	Wick39	SVAP W-21	Ferry Rd	Delaware Twp	$1500
Plum Brook	Wick42		Locktown - Sergeantsville Rd	Delaware Twp	$1500
Wickecheoke	Wick44		Locktown - Sergeantsville Rd	Delaware Twp	$1500
Wickecheoke	Wick56	SVAP W-09	Lower Creek Rd	Delaware Twp	$1500

Table 4. Wickecheoke Creek River-Friendly Farm Project Estimated Budget		
Farms Identified through SVAP/Road Crossing	7 farms	$10,500
Additional Farms	Estimate 15 additional farms entering the program	$22,500
Outreach		$2200
Total		$35,200

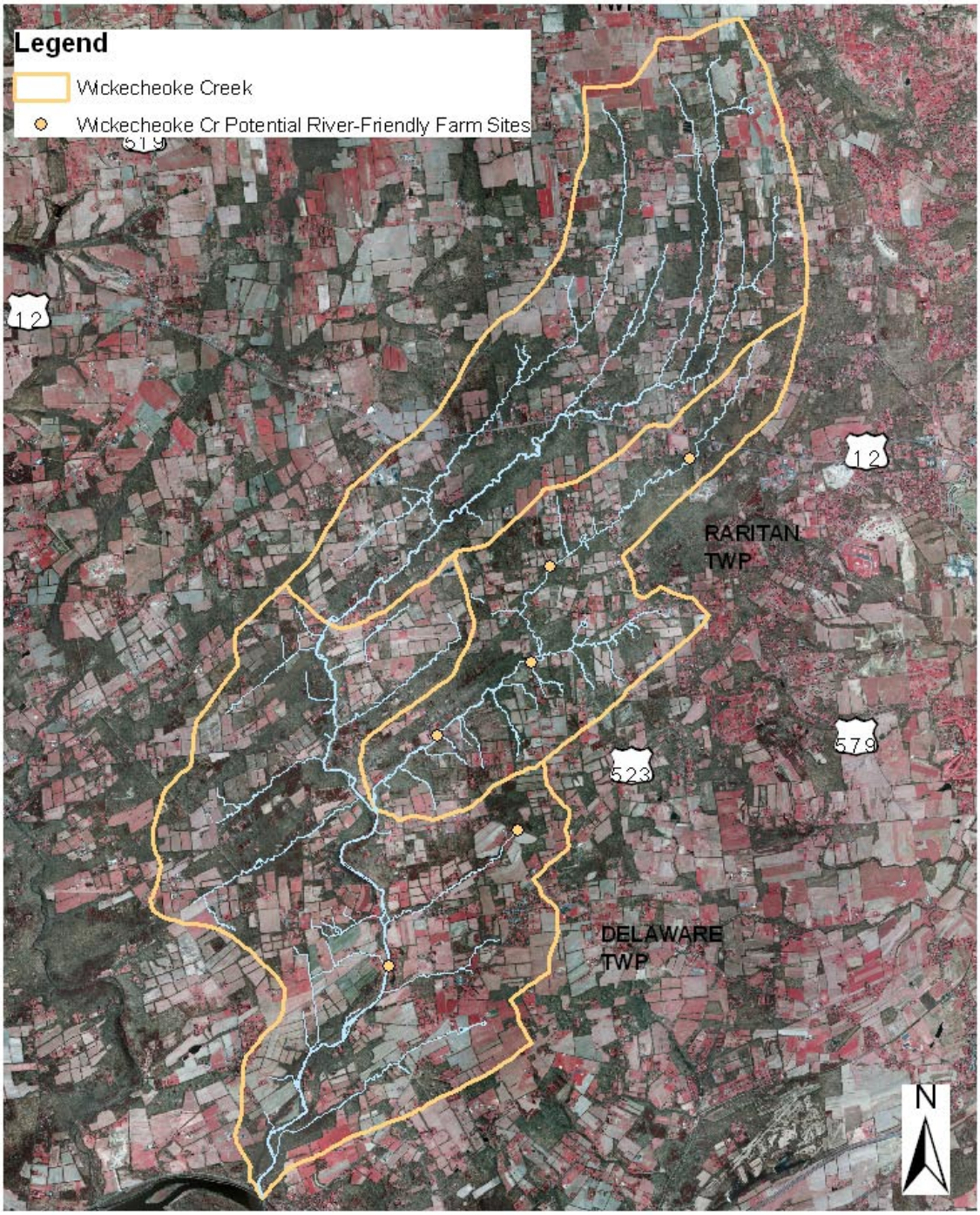


Figure 3.
Wickecheoke Creek Potential River-Friendly Farm Sites

0 1,900 3,800 7,600 11,400 15,200 Feet

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Document Content(s)

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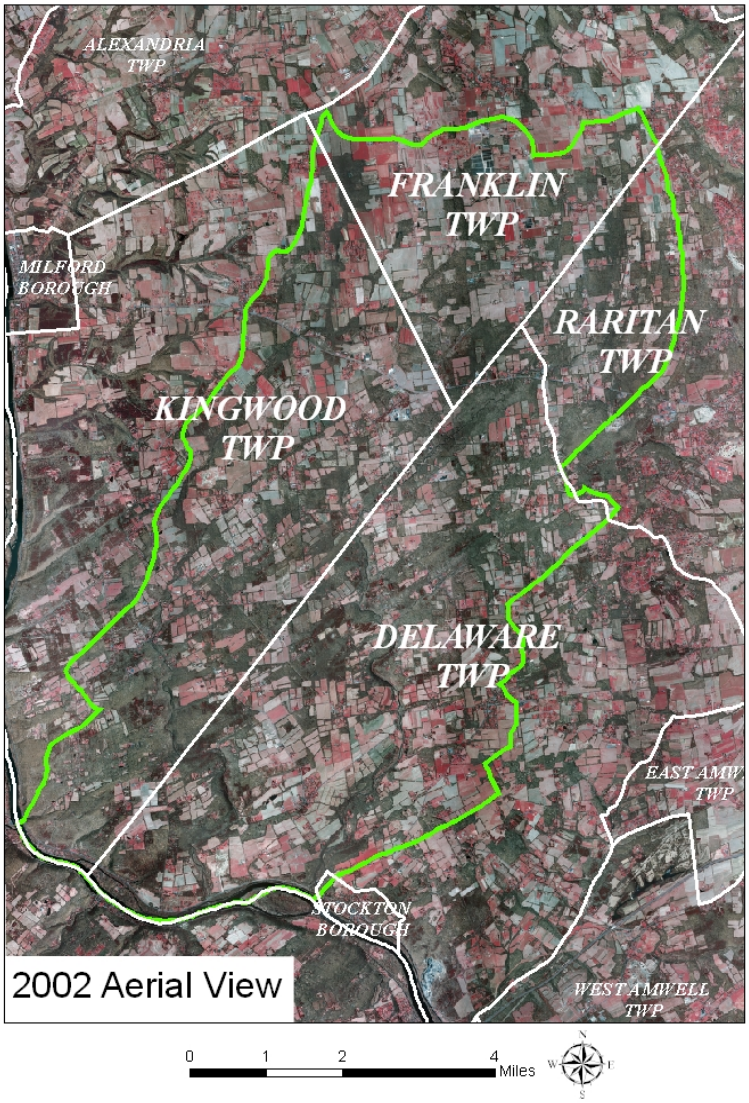
An Assessment of Municipal Plans, Policies and Regulations Effecting Water Quality in the Lockatong and Wickecheoke Creek Watersheds

and

Resource Toolkit Prepared for Delaware Township, Franklin Township, Kingwood Township, and Raritan Township
Hunterdon County, New Jersey

Lockatong and Wickecheoke Creek Watersheds



New Jersey Water Supply Authority
Draft: November, 2008

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This Document was Prepared as part of a 319(h) grant for the Lockatong and Wickecheoke Watershed Restoration and Protection Project under Contract RP05-082. Author: Robert A. O'Neil, AICP, PP (LI#33LI00429400), Principal Watershed Protection Specialist, New Jersey Water Supply Authority.

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An Assessment of Municipal Plans, Policies and Regulations Effecting Water Quality in the Lockatong and Wickecheoke Watersheds

Introduction

The purpose of this section of the report is to assess the plans, policies and regulations used by Delaware Township, Franklin Township, Kingwood Township and Raritan Township which effect the water quality of the Lockatong and Wickecheoke Watersheds. The assessment is followed by a discussion of the water resource protection value of local municipal efforts (literature review). Finally, a series of recommendations, tailored to each community, are offered to improve water quality throughout the watersheds. Sample ordinances are provided as a reference tool.

Two Total Maximum Daily Load (TMDL) reports have been developed by the New Jersey Department of Environmental Protection (NJDEP or DEP), one for fecal coliform and one for total phosphorus. Water quality monitoring conducted by the NJWSA confirmed these impairments. In addition, recent state regulations on stormwater, floodplains and wastewater require action by local governments to protect water resources.

There are a number of fundamental community based elements which serve to protect water quality:

- A Master Plan which articulates Water Resource Goals and Objectives,
- A current GIS-based Natural or Environmental Resource Inventory (NRI or ERI),
- A Water Budget and Build-out Analysis,
- A Wastewater Management Plan,
- A Stormwater Management Plan,
- An active Environmental Commission and Planning Board, and
- Implementing Ordinances[1] including:
    - Steep Slopes Protection
    - Riparian Corridors Protection
    - Woodlands Protection
    - Wellhead Protection and Well Testing
    - Septic System Management
    - Soil Erosion and Sediment Control
    - Floodplain Management
    - Wetlands Protection
    - Nutrient Management
    - Pet Waste Control
    - Litter Control
    - Improper Waste Disposal Control
    - Wildlife Feeding
    - Illicit Connections
    - Water Conservation

[1] Many of these Ordinances are required by various state regulations including N.J.A.C. 7:13, N.J.A.C. 7:15, and N.J.A.C. 7:18.

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- Development Density and Limitations to Impervious Cover.[2]

Assessment of the Study Area Communities

A review of the various plans, policies and practices of each community, as they relate to water quality in general and fecal coliform and total phosphorus in particular, has been undertaken. Recommendations are offered which are intended to strengthen municipal efforts to protect water resources and provide a strategy for meeting surface water quality standards as well as the State's Water Quality Management Planning rule.

Presented below is a composite "score card"[3] resulting from the assessment exercise. The analysis was conducted in the Spring of 2008 and it is recognized that each of the municipalities have on-going planning activities which result in continuous updates to their ordinances. None-the-less, this "snap-shot in time" provides a reference to measure progress and the graphic summary has been found to be a useful visual tool.

There were 31 categories of water resource protection evaluated for each community. Each category was assigned points ranging from 0 (no existing provisions) to 3 (very good provisions). The scoring is somewhat subjective but every effort was made to assign points consistently and fairly.

Each community had particular strengths:

- Delaware Township was found to have an excellent Master Plan, ERI, Riparian Protection and Well Testing Ordinance,
- Franklin Township had particularly good water resource goals expressed in their Master Plan, is the only community with a Water Conservation Policy, and had the best Soil Erosion Control regulations of the four communities,
- Kingwood was found to have and outstanding ERI and Well Testing Ordinance and an active Environmental Commission which maintains a very informative web-site,
- Raritan Township had the most up-to-date and comprehensive collection of Plans, Policies and Ordinances. Raritan is the only Tier A (Stormwater) community in the study area. Accordingly, it is the only community that has passed Ordinances on Pet Waste, Litter Control, Improper Disposal of Waste, Wildlife Feeding, Yard Waste Collection, and Illicit Connections.

Under existing conditions, Raritan Township scored 43 out of a possible 62 points, followed by Delaware and Franklin Townships with 22 out of 62, and Kingwood Township which scored 16 out of 62. None of the communities had conducted a build-out analysis as part of their Master Plan, nor had they adopted Nutrient Management regulations.

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[2] The Center for Watershed Protection has observed that stream degradation can be seen at 10% impervious surface (see: Hhttp://www.cwp.org/Resource_Library/Center_Docs/IC/Impacts_IC_Aq_Systems.pdfH).
The present impervious surface area of the Lockatong and Wickecheoke watersheds is 2.01%, yet stream degradation associated with stormwater volume is evident. Soil conditions, shallow depth-to-bedrock, and other factors which limit infiltration and storativity warrant a lower threshold of total impervious cover.
[3] Based on the Ten Towns Great Swamp Watershed Management Committee Model
Hhttp://www.tentowns.org/10t/home.htmH

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Lockatong and Wickecheoke Watershed Study
Municipal Water Resource Protection Assessment Summary

Key	No Provisions	Could be Improved	Very Good
	0 points	1 point	2 points

	Delaware Township	Franklin Township	Kingwood Township	Raritan Township
Master Plan (General)				
Water Resource Goals				
Resource Protection Element				
Water Resources Element				
Water Budget				
Build-Out Analysis				
Wastewater Management Plan				
Stormwater Management Plan				
Environmental Resource Inventory				
Environmental Commission				
Ordinances / Regulations (General)				
Steep Slopes				
Riparian Corridors				
Woodlands/Trees				
Wellhead Protection				
Well Testing				
Septic Management				
Soil Erosion and Sedimentation Control				
Floodplains				
Wetlands				
Nutrient Management - Farm				
Nutrient Management - Lawn				
Impervious Surface Ratios				
Pet Waste Ordinance				
Litter Control Ordinance				
Improper Disposal of Waste Ordinance				
Wildlife Feeding Ordinance				
Containerized Yard Waste Ordinance				
Yard Waste Collection Program				
Illicit Connection Ordinance				
Water Conservation				
31 categories - 62 point maximum	22 of 62 = 36%	22 of 62 = 36%	16 of 62 = 26%	43 of 62 = 69%

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Water Resource Protection through Municipal Action

(A Literature Review)

The Water Resource Protection Value of a Municipal Master Plan

General. The municipal master plan can be the vehicle for organizing a planning process to protect natural resources. In fact, the purposes of the MLUL clearly state that the master plan should protect the environment and conserve open space. First, a municipality should develop a land use plan that uses the natural/environmental resource inventory as a base and takes into account the capacity of the natural infrastructure, i.e. what the land, water and air will support. The master plan can map the environmentally critical areas that should be preserved and explain why these particular lands are important. It should also identify suitable areas for growth where development will have little or no impact on environmentally critical areas.

Including strong natural resource preservation planning in the master plan offers the municipality many benefits. A master plan with clear objectives and comprehensive elements will help keep various interest groups and successive administrations of local government "on the same page." This will lead to a more consistent, cohesive and defensible approach to protecting critical environmental areas.
(see: http://www.anjec.org/pdfs/SG_MasterPlan.pdf, p. 2)

Resource Protection Element. The resource protection element of a master plan, also referred to as a conservation plan "...provides an environmental framework for the master plan. Using the natural/environmental resource inventory as a base, it should describe the municipality's natural resources, their value and benefits to the health, safety and general welfare of the community. It should also analyze the impact of other master plan elements on the preservation and use of the municipality's natural resources and environmental quality.

Including an open space/greenway plan, either as part of the conservation plan or as a separate element, has a number of benefits. As a master plan element, an open space/greenway plan receives official recognition and support and will be regularly updated as part of the six-year master plan reexamination cycle required by the MLUL.

Many municipalities have passed open space taxes to establish funds for land acquisition. Having an open space plan in the master plan will legitimize targeting properties for purchase with municipal open space funds. It can also help in obtaining state funding for acquisition.

NJ's two major land preservation programs require specific local plans to qualify for special incentive grants. To take advantage of the NJ Green Acres Planning Incentive Grant Program, a municipality must have an Open Space and Recreation Plan (OSRP) that meets Green Acre's specifications. The OSRP can be an independent document, or the planning board can adopt it as an element of the master plan. For municipalities interested in farmland preservation, the State Agriculture Development Committee requires a Farmland Preservation Element in the master plan. Both delineate where open space currently exists and clearly set forth a community's vision and justifications for future open space and

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farmland needs. The Farmland Preservation Element should be consistent with the data and recommendations of the Conservation Element."
(see: http://www.anjec.org/pdfs/SG_MasterPlan.pdf, p. 5)

The Water Resource Protection Value of a Local Environmental Resource Inventory

"The Environmental Resource Inventory (ERI), also called a Natural Resource Inventory (NRI), or Index of Natural Resources, is a compilation of text and visual information about the natural resource characteristics and environmental features of an area.

An ERI is an unbiased report of integrated data. It provides baseline documentation for measuring and evaluating resource protection issues. The ERI is an objective index and description of features and their functions, rather than an interpretation or recommendation. Identifying significant environmental resources is the first step in their protection and preservation.

The ERI is an important tool for environmental commissions, open space committees, planning boards and zoning boards of adjustment. The planning board should adopt the ERI as part of the municipal master plan, either as an appendix or as part of a master plan conservation element. As part of the master plan, the ERI can provide the foundation and documentation for the development of resource protection ordinances and resource-based land use planning.

The ERI is a dynamic document, not cast in concrete. The commission should add to, revise and refine it as members gain knowledge and more data become available. The ERI is a notebook of the accumulated information about an area."
(see: http://www.anjec.org/pdfs/EnvironmentalResource04.pdf)

"Comprehensive ERI's are a necessary, sound and defensible foundation for capacity analyses and planning decisions. For instance, the ERI for a community which relies on a combination of surface and ground water supplies, should contain the location information on critical slopes and aquifer recharge areas, natural factors which affect sediment control, water quality and water supply. With this information, [*in addition to a hydrogeological study of the local ground water supply and flow network*] local officials can determine the capacity for recharge for local water supplies, project the amount of water use to be expected over time, and determine the natural system capacity for sustainability. Changes could be made to land use and development ordinances to minimize effects on water quality and promote sustainable resource use, using the ERI to justify and support the changes."
(see: http://www.nj.gov/dca/osg/plan/stateplan/goals_resources.shtml)

The Function of a Local Environmental Commission

"The value of the state's natural resources and systems as capital assets is often overlooked. In response to the increasing stress placed on New Jersey's resource base, the New Jersey Legislature adopted legislation in 1968 which allows the creation of environmental

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commissions as nonelective, advisory arms of local government (N.J.S.A. 40:56A). Environmental Commissions are authorized to index or inventory natural resources and open spaces and prepare plans for their protection and use."
(see: http://www.nj.gov/dca/osg/plan/stateplan/goals_resources.shtml)

"As advisors to the planning board and other municipal agencies, environmental commissions are local environmental advocates representing the public and its long-term interest.

Environmental commissions:

- advise municipal planning boards and zoning boards of adjustment about the impacts of proposals for development on such issues as flooding and runoff, open space needs, water and air quality, plant and animal habitat and waste disposal; advocate planned open space preservation at the municipal level; investigate environmental problems and offer solutions;
- research and propose ordinances on a variety of topics, such as tree removal, stormwater management, open space preservation and pesticides;
- educate and inform residents, including school children on ways to help protect the environment;
- interact with neighboring commissions, watershed agencies and other organizations to tackle regional and statewide problems;
- help monitor and explain to other local officials and citizens the state and federal programs and regulations intended to combat problems with toxics, solid waste disposal, unhealthy air, contaminated water and wetlands protection."
  (see: http://www.anjec.org/pdfs/MunicipalEnvCommRes.pdf)

The Function and Value of a Water Budget and Build-out Analysis

Preparing a water budget and build-out analysis is essential for a community to understand its growth potential and limitations. Like the Environmental Resource Inventory, they should be undertaken as background studies, which support the goals and objectives of a Master Plan.

"Water budget" is a term for the quantification of precipitation, runoff, recharge, storage, evaporation, transpiration and human uses of water within a watershed. A water budget is used to understand how water arrives, is retained and flows through and leaves a watershed, and is valuable in understanding how human activities modify the natural flow of water. Precipitation is the sole natural source of water in a watershed. Of the total precipitation, some evaporates from the land or water surfaces of the Basin or transpires from vegetation (the two are usually combined in the single term "evapotranspiration"), and the remainder either infiltrates to become ground water or runs off the land surface to be surface water during storm and snowmelt periods. Shallower ground water can eventually become stream flow, contributing to the flow of streams during both wet and dry periods. Human activities within the Basin may add to or subtract from infiltration, evapotranspiration and runoff. (see: http://www.raritanbasin.org/Reports/WaterBudgetReport.pdf)

A build-out analysis tries to answer the question, what will your community look like when all the available vacant land has been built on? Recent studies predict that New Jersey may reach this situation as soon as 2030. We will be the first state in the nation to do so.

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A build-out analysis can help residents understand what their municipality, or a section of it such as a highway corridor, will look like if built to the capacity allowed in current zoning. The analysis can also include environmental, social and economic impacts of full development and evaluate whether the current zoning will achieve the goals of the master plan. An economic analysis can forecast future tax revenues and liabilities to finance new infrastructure for the expanded community, including schools, water and wastewater treatment plants, recreational facilities, roadways and services.

A build-out can help identify changes needed in local master plans, zoning ordinances and development regulations. A build-out will not address the capacity of the natural or infrastructure systems, because it is based on zoning that may not recognize the capacity of these systems. (For example, the zoning may allow half-acre lots around lakes without consideration of the potential for eutrophication of the lake from non-point source pollution.)

Once the build-out is completed, planners can use Capacity Analysis to assess whether existing resources are sufficient to serve the potential new development. The second half of this article will cover capacity analysis.

While build-out studies are useful, they generally cannot predict when full development will occur. This depends on many pressures, such as the economy, which are generally outside the municipality's control. (see: http://www.anjec.org/pdfs/SG_Planning.pdf)

The Water Resource Protection Value of Critical Environmental Features

Steep Slopes. The ridgelines and ravines of the Lockatong and Wickecheoke study area a valued resource in western Hunterdon County. They provide an aesthetic quality that helps define the region. They also serve as wildlife habitat and stream buffers. "Disturbance of areas containing steep slopes can trigger erosion and sedimentation, resulting in the loss of topsoil. It can also result in the disturbance of habitats, degradation of surface water quality, silting of wetlands, and alteration of drainage patterns. These processes, when severe, can also result in land slumping and landslides that can damage both developed property and ecosystems. The identification and classification of steep slopes is important in order to effectively manage critical natural resources..." (Highlands Final Draft Regional Master Plan, p. 31)

Riparian Corridors. **"**Research has shown that a vegetated area immediately adjacent to a watercourse provides a variety of significant functions and values. As stated by the United States Army Corps of Engineers in a rule proposal (Federal Register Volume 64 No. 139 Page 39274, July 21, 1999) that would allow the Army Corps to require vegetated buffers adjacent to certain water areas, which was later adopted (Federal Register Volume 65 No. 47 March 9, 2000), vegetated buffers along waters serve to:

1. Reduce adverse effects to water quality by removing nutrients and pollutants from surface runoff;
2. Reduce concentrations of nutrients and pollutants in subsurface water that flows into streams and other open waters;
3. Moderate storm flows to streams, which reduces downstream flooding and degradation of aquatic habitat;

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4. Stabilize soil (through plant roots), which reduces erosion in the vicinity of the open water body;
5. Provide shade to the water body, which moderates water temperature changes and provides a more stable aquatic habitat for fish and other aquatic organisms;
6. Provide detritus, which is a food source for many aquatic organisms;
7. Provide large woody debris from riparian zones, which furnishes cover and habitat for aquatic organisms and may cause the formation of pools in the stream channel;
8. Provide habitat to a wide variety of aquatic and terrestrial species;
9. Trap sediments, thereby reducing degradation of the substrate that provides habitat for fish and other aquatic organisms (for example, some fish species depend upon gravel stream beds for spawning habitats); and
10. Provide corridors for movement and dispersal of many species of wildlife. In addition, vegetated buffers next to streams provide flood storage capacity and groundwater recharge functions."

(see: http://www.njflood.org/docs/web_rule_8_31_06.pdf, pp. 6-7)

"The destruction of riparian areas and the removal of riparian vegetation for urbanization, agriculture and development projects can result in the deterioration of aquatic ecosystems and contribute to the impairment of healthy streams and waterways. Stream channels with impaired riparian zones or those entirely without riparian areas do not receive protection from negative influences such as polluted surface water runoff or stream bank erosion. Riparian areas that have been damaged or replaced by impervious surfaces do not provide any benefits to the stream channel or its existing biota. The condition of vegetation along streams is a major component in determining the integrity of riparian ecosystems. Riparian areas facilitate the removal of excess nutrients and sediment from surface water runoff. They shade streams to optimize light and temperature conditions for aquatic plants and animals. According to the Maryland Department of Natural Resources Forest Service, streamside riparian areas have been found to improve the quality of water resources by removing harmful pollutants in stormwater runoff and increase the biological diversity and productivity of stream communities." (see: SURFACE WATER AND RIPARIAN AREAS OF THE RARITAN RIVER BASIN A Technical Report for the Raritan Basin Watershed Management Project @ http://www.raritanbasin.org/Reports/SurfaceWaterRiparian/SurfaceWaterRiparian_0902.pdf)

Woodlands/Trees**. "**Trees - especially contiguous woodlands - serve critical public and environmental needs, including stormwater management, erosion control, groundwater recharge and threatened and endangered species habitat. They reduce noise pollution, filter water, conserve energy and provide aesthetic value. Trees and woodlands can be a financial benefit to communities, landowners and builders alike, creating a win-win situation for everyone." (see: http://www.co.hunterdon.nj.us/planning/addressingsprawl.htm)

Wetlands**.** Wetlands (both freshwater and saltwater), estuaries/tidal bays, and forests are by far the most valuable ecosystems in New Jersey's portfolio, accounting for over 90% of the estimated total value of ecosystem services. (Examples of ecosystem services ("ecoservices") include temporary storage of flood waters by wetlands, long-term storage of climate-altering greenhouse gases in forests, dilution and assimilation of wastes by rivers, and numerous others. All of these services provide economic value to human beings.) (see: http://www.nj.gov/dep/dsr/naturalcap/nat-cap-2.pdf)

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Accordingly, the State of New Jersey has established a strict regulatory process by which wetlands are protected. N.J.S.A. 13:9B-2 notes: "The Legislature finds and declares that freshwater wetlands protect and preserve drinking water supplies by serving to purify surface water and groundwater resources; that freshwater wetlands provide a natural means of flood and storm damage protection, and thereby prevent the loss of life and property through the absorption and storage of water during high runoff periods and the reduction of flood crests; that freshwater wetlands serve as a transition zone between dry land and water courses, thereby retarding soil erosion; that freshwater wetlands provide essential breeding, spawning, nesting, and wintering habitats for a major portion of the State's fish and wildlife, including migrating birds, endangered species, and commercially and recreationally important wildlife; and that freshwater wetlands maintain a critical baseflow to surface waters through the gradual release of stored flood waters and groundwater, particularly during drought periods."

Recommendations

The findings of the Total Maximum Daily Load (TMDL) reports developed by the New Jersey Department of Environmental Protection for fecal coliform and total phosphorus were confirmed by the water quality sampling conducted by the New Jersey Water Supply Authority. During the course of the study the state adopted or amended rules regulating Water Quality Management Planning (N.J.A.C. 7:15), Stormwater Management (N.J.A.C. 7:8), and Flood Hazard Area Control (N.J.A.C. 7:13) (appendix 1). In an effort to improve water quality and in order to meet the various state regulatory mandates, municipal action is warranted. Recommendations are offered to meet the specific needs of each community. Sample ordinances are provided in Appendix 2.

Delaware Township:

- Prepare a build-out analysis in conformance with the Water Quality Management Planning Rules at N.J.A.C.7:15. (Appendix 3 p.435)
- Prepare a Wastewater Management Plan in conformance with the Water Quality Management Planning Rules at N.J.A.C.7:15. (Appendix 1C p.203)
- Revise the existing Steep Slope Provisions of the Land Use Code in conformance with the Water Quality Management Rules Planning at N.J.A.C.7:15. (Appendix 2A p.285)
- Prepare a Woodlands Protection Ordinance. (Appendix 2C p.305)
- Prepare a Wellhead Protection Ordinance. (Appendix 2D p.333)
- Prepare a Septic Management Plan and implementing ordinance in conformance with the Water Quality Management Planning Rules at N.J.A.C. 7:15. (Appendix 2F p.375)
- Prepare a Soil Erosion and Sediment Control Ordinance to regulate activities not under the jurisdiction of the County Soil Conservation District. (Appendix 2Q p.427)
- Revise the existing Floodplain Provisions of the Land Use Code in conformance with the Water Quality Management Planning Rules at N.J.A.C. 7:15(Appendix 1C p.203) and Flood Hazard Control Act Rules at N.J.A.C. 7:13. (Appendix 1B p.49)
- Prepare a Wetlands Protection Ordinance. (Appendix 2R p.431)
- Prepare a Nutrient Management Plan and adopt a Fertilizer Management Ordinance. (Appendix 2G p.391)
- Prepare a Pet Waste Ordinance. (Appendix 2H p.395)
- Prepare a Litter Control Ordinance. (Appendix 2I p.397)
- Prepare an Improper Disposal of Waste Ordinance. (Appendix 2J p.399)
- Prepare a Wildlife Feeding Ordinance. (Appendix 2K p.401)

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- Prepare a Containerized Yard Waste Ordinance. (Appendix 2L p.403)
- Prepare a Yard Waste Collection Ordinance. (Appendix 2M p.405)
- Prepare and Illicit Connection Ordinance. (Appendix 2N p.407)
- Prepare a Water Conservation Ordinance. (Appendix 2O p.409)
- Reduce permitted impervious surface areas to 5% in areas zoned agricultural, rural or low density residential.
- Conduct on-going Outreach and Education programs through the Environmental Commission to inform local residents of the value of water resource protection. Engage local schools to participate in activities that are protective of water resources.

Franklin Township:

- Prepare a build-out analysis in conformance with the Water Quality Management Planning Rules at N.J.A.C. 7:15. (Appendix 3 p.435)
- Prepare a Wastewater Management Plan in conformance with the Water Quality Management Planning Rules at N.J.A.C. 7:15. (Appendix 1C p.203)
- Revise the existing Steep Slope Provisions of the Land Use Code in conformance with the Water Quality Management Planning Rules at N.J.A.C. 7:15. (Appendix 2A p.285)
- Revise the existing Riparian Corridor Provisions of the Land Use Code in conformance with the Water Quality Management Planning Rules at N.J.A.C. 7:15. (Appendix 2B p.289)
- Prepare a Wellhead Protection Ordinance. (Appendix 2D p.333)
- Prepare a Septic Management Plan and implementing ordinance in conformance with the Water Quality Management Planning Rules at N.J.A.C. 7:15. (Appendix 2F p.375)
- Prepare a Soil Erosion and Sediment Control Ordinance to regulate activities not under the jurisdiction of the County Soil Conservation District. (Appendix 2Q p.427)
- Revise the existing Floodplain Provisions of the Land Use Code in conformance with the Water Quality Management Planning Rules at N.J.A.C. 7:15 and Flood Hazard Control Act Rules at N.J.A.C. 7:13. (Appendix 2P p.411)
- Prepare a Nutrient Management Plan and adopt a Fertilizer Management Ordinance. (Appendix 2G p.391)
- Prepare a Pet Waste Ordinance. (Appendix 2H p.395)
- Prepare a Litter Control Ordinance. (Appendix 2I p.397)
- Prepare an Improper Disposal of Waste Ordinance. (Appendix 2J p.399)
- Prepare a Wildlife Feeding Ordinance. (Appendix 2K p.401)
- Prepare a Containerized Yard Waste Ordinance. (Appendix 2L p.403)
- Prepare a Yard Waste Collection Ordinance. (Appendix 2M p.405)
- Prepare and Illicit Connection Ordinance. (Appendix 2N p.407)
- Revaluate the Township's Water Conservation Regulations. (Appendix 2O p.409)
- Reduce permitted impervious surface areas to 5% in areas zoned agricultural, rural or low density residential.
- Conduct on-going Outreach and Education programs through the Environmental Commission to inform local residents of the value of water resource protection. Engage local schools to participate in activities that are protective of water resources.

Kingwood Township:

- Update the Township Master Plan to include Water Resource Goals and Objectives, a Resource Protection Element, a Water Resources Element, a Water Budget and a Build-out Analysis (Appendix 3 p.435).
- Revise the existing Steep Slope Provisions of the Land Use Code in conformance with the Water Quality Management Planning Rules at N.J.A.C. 7:15. (Appendix 2A p.285)

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- Prepare a Riparian Corridor Ordinance in conformance with the Water Quality Management Planning Rules at N.J.A.C. 7:15. (Appendix 2B p.289)
- Prepare a Woodlands Protection Ordinance. (Appendix 2C p.305)
- Prepare a Wellhead Protection Ordinance. (Appendix 2D p.333)
- Prepare a Septic Management Plan and implementing ordinance in conformance with the Water Quality Management Planning Rules at N.J.A.C. 7:15. (Appendix 2F p.375)
- Prepare a Soil Erosion and Sediment Control Ordinance to regulate activities not under the jurisdiction of the County Soil Conservation District. (Appendix 2Q p.427)
- Revise the existing Floodplain Provisions of the Land Use Code in conformance with the Water Quality Management Planning Rules at N.J.A.C. 7:15 and Flood Hazard Control Act Rules at N.J.A.C. 7:13. (Appendix 2P p.411)
- Prepare a Wetlands Protection Ordinance. (Appendix 2R p.431)
- Prepare a Nutrient Management Plan and adopt a Fertilizer Management Ordinance. (Appendix 2G p.391)
- Prepare a Pet Waste Ordinance. (Appendix 2H p.395)
- Prepare a Litter Control Ordinance. (Appendix 2I p.397)
- Prepare an Improper Disposal of Waste Ordinance. (Appendix 2J p.399)
- Prepare a Wildlife Feeding Ordinance. (Appendix 2K p.401)
- Prepare a Containerized Yard Waste Ordinance. (Appendix 2L p.403)
- Prepare a Yard Waste Collection Ordinance. (Appendix 2M p.405)
- Prepare and Illicit Connection Ordinance. (Appendix 2N p.407)
- Prepare a Water Conservation Ordinance. (Appendix 2O p.409)
- Reduce permitted impervious surface areas to 5% in areas zoned agricultural, rural or low density residential.
- Conduct on-going Outreach and Education programs through the Environmental Commission to inform local residents of the value of water resource protection. Engage local schools to participate in activities that are protective of water resources.

Raritan Township:

- Prepare a build-out analysis in conformance with the Water Quality Management Planning Rules at N.J.A.C. 7:15. (Appendix 3 p.435)
- Prepare a Nutrient Management Plan and adopt a Fertilizer Management Ordinance.
- Prepare a Containerized Yard Waste Ordinance. (Appendix 2G p.391)
- Prepare a Water Conservation Ordinance. (Appendix 2O p.409)
- Reduce permitted impervious surface areas to 5% in areas zoned agricultural, rural or low density residential.
- Conduct on-going Outreach and Education programs through the Environmental Commission to inform local residents of the value of water resource protection. Engage local schools to participate in activities that are protective of water resources.

By taking the recommended steps each municipality can expect to improve their “score card” significantly. There were 31 categories of water resource protection reviewed for each community. Kingwood Township can expect to improve from 16 to 59 points out of the possible 62 (95%) , Delaware Township can expect to improve from 22 to 59 points (95%), Franklin Township can expect to improve from 22 to 52 points (84%), and Raritan Township can expect to improve from 43 to 54 points out of a possible 62 (87%).

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Lockatong and Wickecheoke Watershed Study
Municipal Water Resource Protection Assessment Summary
Existing Provisions

Key	No Provisions	Could be Improved	Very Good
	0 points	1 point	2 points

	Delaware Township	Franklin Township	Kingwood Township	Raritan Township
Master Plan (General)				
Water Resource Goals				
Resource Protection Element				
Water Resources Element				
Water Budget				
Build-Out Analysis				
Wastewater Management Plan				
Stormwater Management Plan				
Environmental Resource Inventory				
Environmental Commission				
Ordinances / Regulations (General)				
Steep Slopes				
Riparian Corridors				
Woodlands/Trees				
Wellhead Protection				
Well Testing				
Septic Management				
Soil Erosion and Sedimentation Control				
Floodplains				
Wetlands				
Nutrient Management - Farm				
Nutrient Management - Lawn				
Impervious Surface Ratios				
Pet Waste Ordinance				
Litter Control Ordinance				
Improper Disposal of Waste Ordinance				
Wildlife Feeding Ordinance				
Containerized Yard Waste Ordinance				
Yard Waste Collection Program				
Illicit Connection Ordinance				
Water Conservation				
31 categories - 62 point maximum	22 of 62 = 36%	22 of 62 = 36%	16 of 62 = 26%	43 of 62 = 69%

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Lockatong and Wickecheoke Watershed Study
Municipal Water Resource Protection Assessment Summary
Upon Implementation of Recommendations

Key	No Provisions	Could be Improved	Very Good
	0 points	1 point	2 points

	Delaware Township	Franklin Township	Kingwood Township	Raritan Township
Master Plan (General)				
Water Resource Goals				
Resource Protection Element				
Water Resources Element				
Water Budget				
Build-Out Analysis				
Wastewater Management Plan				
Stormwater Management Plan				
Environmental Resource Inventory				
Environmental Commission				
Ordinances / Regulations (General)				
Steep Slopes				
Riparian Corridors				
Woodlands/Trees				
Wellhead Protection				
Well Testing				
Septic Management				
Soil Erosion and Sedimentation Control				
Floodplains				
Wetlands				
Nutrient Management - Farm				
Nutrient Management - Lawn				
Impervious Surface Ratios				
Pet Waste Ordinance				
Litter Control Ordinance				
Improper Disposal of Waste Ordinance				
Wildlife Feeding Ordinance				
Containerized Yard Waste Ordinance				
Yard Waste Collection Program				
Illicit Connection Ordinance				
Water Conservation				
31 categories - 62 point maximum	59 of 62 = 95%	52 of 62 = 84%	59 of 62 = 95%	54 of 62 = 87%

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Appendix 1

Select State Regulations

Stormwater Management (N.J.A.C. 7:8).....Appendix 1A
Flood Hazard Area Control (N.J.A.C. 7:13).....Appendix 1B
Water Quality Management Planning (N.J.A.C. 7:15).....Appendix 1C

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Appendix 1A

N.J.A.C. 7:8
STORMWATER MANAGEMENT

THIS IS A COURTESY COPY OF THIS RULE ADOPTION. THE OFFICIAL VERSION WILL BE PUBLISHED IN THE FEBRUARY 2, 2004 NEW JERSEY REGISTER. SHOULD THERE BE ANY DISCREPANCIES BETWEEN THIS TEXT AND THE OFFICIAL VERSION OF THE ADOPTION, THE OFFICIAL VERSION WILL GOVERN.

SUBCHAPTER 1. GENERAL PROVISIONS

7:8-1.1 Scope and purpose

(a) This chapter establishes general requirements for stormwater management plans and stormwater control ordinances, as well as content requirements and procedures for the adoption and implementation of regional stormwater management plans and municipal stormwater management plans under the Municipal Land Use Law N.J.S.A. 40:55D-1 et seq.; the Water Quality Planning Act, N.J.S.A. 58:11A-1 et seq.: the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq.; and the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq.; and implementing rules.

(b) This chapter establishes design and performance standards for stormwater management measures required by rules pursuant to the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq.; the Coastal Area Facility Review Act, N.J.S.A. 13:19-1 et seq.; the Wetlands Act of 1970, N.J.S.A. 13:9A-1 et seq.; the Waterfront Development Law, N.J.S.A. 12:5-3; the Freshwater Wetlands Protection Act, N.J.S.A. 13:9B-1 et seq.; and the Dam Safety Act, N.J.S.A. 58:4-1 et seq.

(c) This chapter establishes safety standards for stormwater management basins pursuant to N.J.S.A. 40:55D-95.1.

7:8-1.2 Definitions

The following words and terms, when used in this chapter, shall have the following meanings unless the context clearly indicates otherwise.

"CAFRA Planning Map" means 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.

"CAFRA Centers, Cores or Nodes" means those areas within boundaries accepted by the Department pursuant to N.J.A.C. 7:8E-5B.

"Compaction" means the increase in soil bulk density.

"Core" means a pedestrian-oriented area of commercial and civic uses serving the surrounding municipality, generally including housing and access to public transportation.

"County review agency" means an agency designated by the County Board of Chosen Freeholders to review municipal stormwater management plans and implementing

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ordinance(s). The county review agency may either be:

1. A county planning agency; or
2. A county water resources 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" means the Department of Environmental Protection.
"Designated Center" means a State Development and Redevelopment Plan Center as designated by the State Planning Commission such as urban, regional, town, village, or hamlet.
"Design engineer" means 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.
"Development" means 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, 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 on agricultural land, development means: any activity that requires a State permit; any activity reviewed by the County Agricultural Boards (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" means a geographic area within which stormwater runoff, sediments, or dissolved materials drain to a particular receiving waterbody or to a particular point along a receiving waterbody.
"Environmentally constrained area" means the following areas where the physical alteration of the land is in some way restricted, either through regulation, easement, deed restriction or ownership such as: wetlands, floodplains, threatened and endangered species sites or designated habitats, and parks and preserves. 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.
"Environmentally critical area" means an area or feature which is of significant environmental value, including but not limited to: stream corridors; natural heritage priority sites; habitats 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.
"Empowerment Neighborhoods" means neighborhoods 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.
"Erosion" means the detachment and movement of soil or rock fragments by water, wind, ice or gravity.
"Impervious surface" means a surface that has been covered with a layer of material so that it is highly resistant to infiltration by water.

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"Infiltration" is the process by which water seeps into the soil from precipitation.
"Lead planning agency" means one or more public entities having stormwater management planning authority designated by the regional stormwater management planning committee pursuant to N.J.A.C. 7:8-3.2, that serves as the primary representative of the committee.
"Major development" means any "development" that provides for ultimately disturbing one or more acres of land or increasing impervious surface by one-quarter 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. Projects undertaken by any government agency which otherwise meet the definition of "major development" but which do not require approval under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq., are also considered "major development."
"Municipality" means any city, borough, town, township, or village.
"Node" means an area designated by the State Planning Commission concentrating facilities and activities which are not organized in a compact form.
"Nutrient" means a chemical element or compound, such as nitrogen or phosphorus, which is essential to and promotes the development of organisms.
"Person" means any individual, corporation, company, partnership, firm, association, political subdivision of this State and any state, interstate or Federal agency.
"Pollutant" means 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" means the amount of water from precipitation that infiltrates into the ground and is not evapotranspired.
"Sediment" means 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" means the lot or lots upon which a major development is to occur or has occurred.
"Soil" means all unconsolidated mineral and organic material of any origin.
"State Development and Redevelopment Plan Metropolitan Planning Area (PA1)" means 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" is defined as 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" means 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 storm sewers or other sewage or drainage facilities or conveyed by snow removal equipment.

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“Stormwater runoff" means water flow on the surface of the ground or in storm sewers, resulting from precipitation.
"Stormwater management basin" means 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" means 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 nonstormwater discharges into stormwater conveyances.
"Stormwater management planning agency" means a public body authorized by legislation to prepare stormwater management plans.
“Stormwater management planning area” means the geographic area for which a stormwater management planning agency is authorized to prepare stormwater management plans, or a specific portion of that area identified in a stormwater management plan prepared by that agency.
"Tidal Flood Hazard Area" means 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" means a neighborhood given priority access to State resources through the New Jersey Redevelopment Authority.
“Urban Enterprise Zones” means a zone designated by the New Jersey Urban Enterprise Zone Authority pursuant to the New Jersey Urban Enterprise Zones Act, N.J.S.A. 52:27H-60 et seq.
"Urban Redevelopment Area" is defined as previously developed portions of areas:

1. Delineated on the State Plan Policy Map (SPPM) as the Metropolitan Planning Area (PA1), Designated Centers, Cores or Nodes;
2. Designated as CAFRA Centers, Cores or Nodes;
3. Designated as Urban Enterprise Zones; and
4. Designated as Urban Coordinating Council Empowerment Neighborhoods.

“Waters of the State” means the ocean and its estuaries, all springs, streams, wetlands, 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.
"Wetlands" or "wetland” means an area that is inundated or saturated by surface water or ground water 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.

7:8-1.3 Program information

Questions or submissions regarding this chapter should be directed to the Division of Watershed Management, New Jersey Department of Environmental Protection, P.O. Box 418, Trenton, New Jersey 08625.

7:8-1.4 Severability

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If the provisions of any section, subsection, paragraph, or clause of this chapter shall be judged invalid by a court of competent jurisdiction, such order or judgment shall not affect or invalidate the remainder of any section, subsection, paragraph, or clause of this chapter.

7:8-1.5 Relationship to other regulatory programs
(a) Nothing in this chapter shall be construed as preventing the Department or other agencies or entities from imposing additional or more stringent stormwater management requirements necessary to implement the purposes of any enabling legislation including those measures necessary to achieve the Surface Water Quality Standards at N.J.A.C. 7:9B.
(b) If a stormwater management measure is used as a soil erosion or sediment control measure, the Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 et seq., shall also apply.
(c) These stormwater requirements are the Department's standards referenced by the stormwater management provisions of the Residential Site Improvement Standards at

N.J.A.C 5:21-7.
7:8-1.6 Applicability to Major Development
(a) Except as provided in (b) below, all major development shall comply with the requirements of this chapter.
(b) The following major development shall be subject to the stormwater management requirements in effect on February 1, 2004, copies of which are available from the Department at the address specified in N.J.A.C. 7:8-1.3:

1. Major development which does not require any of the Department permits listed in (c) below and which has received one of the following approvals pursuant to the Municipal Land Use Law (N.J.S.A. 40:55D-1 et seq.) prior to February 2, 2004:
    i. Preliminary or final site plan approval;
    ii. Final municipal building or construction permit;
    iii. Minor subdivision approval where no subsequent site plan approval is required;
    iv. Final subdivision approval where no subsequent site plan approval is required; or
    v. Preliminary subdivision approval where no subsequent site plan approval is required;
2. Major development which has received one of the approvals pursuant to the Municipal Land Use Law (N.J.S.A. 40:55D-1 et seq.) in (1) above prior to February 2, 2004 and has secured at least one of the applicable permits listed in (c) below from the Department by February 2, 2004, and provided that the permit included a stormwater management review component.
3. Major development undertaken by any government agency, which does not require approval under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq., provided the project has secured at least one of the applicable Department permits listed in (c) below prior to February 2, 2004, and provided that the permit included a stormwater management review component.

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(c) For the purposes of this section, the term "permit" shall include transition area waivers under the Freshwater Wetlands Protection Act. In order to qualify under (b)2 or 3 above, the major development must have obtained at least one Department permit granted under the following statutes and, provided that the permit included a stormwater management review component, prior to February 2, 2004:

1. Flood Hazard Area Control Act, N.J.S.A. 58-16A-50 et seq.;
2. Freshwater Wetlands Protection Act, N.J.S.A. 13:9B-1 et seq.;
3. Coastal Area Facility Review Act, N.J.S.A. 13:19-1 et seq.;
4. Waterfront and Harbor Facilities Act, N.J.S.A. 12:5-3;

(d) An exemption provided by (b) above shall expire with the expiration, termination or other loss of duration or effect of either of the qualifying local approval or Department permit, whichever comes first. The expiration of local approvals under (b)1 above shall be governed by local ordinance. In the event there are multiple qualifying Department permits under (c) above, the expiration date is governed by that permit which expires last provided that the permit is still in effect. Once the exemption expires, the major development shall be subject to all requirements of this chapter upon reapplication for that permit and all subsequent permits or local approval(s) under the Municipal Land Use Law.

(e) An exemption under (b) above is limited to the land area and the scope of the project addressed by the qualifying approval(s) and permit(s). Exemptions under this section shall be deemed void if revisions are made to the qualifying approval or permit in (b) above, including approvals under the Municipal Land Use Law, unless upon application, the Department determines that each revision would have a de minims impact on water resources. In making this determination, the Department shall consider the extent of any impacts on water resources resulting from the revision, including, but not limited to:

1) increases in stormwater generated;
2) increases in impervious surface;
3) increases in stormwater pollutant loading;
4) changes in land use;
5) new encroachments in special water resource protection areas; and,
6) changes in vegetative cover.

(f) In case of conflict with the Coastal Permit Program Rules at N.J.A.C. 7:7-4.4(a)4, the requirements of this chapter shall supersede.

SUBCHAPTER 2. GENERAL REQUIREMENTS FOR STORMWATER MANAGEMENT PLANNING

7:8-2.1 Scope

This subchapter provides general principles applicable to all stormwater management plans and stormwater control ordinances, including the goals of stormwater management planning, the process for identification of stormwater management planning agencies, and stormwater management plan requirements.

7:8-2.2 Goals of stormwater management planning

(a) All stormwater management plans and stormwater control ordinances shall be designed to:

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1. Reduce flood damage, including damage to life and property;
2. Minimize, to the extent practical, any increase in stormwater runoff from any new development;
3. Reduce soil erosion from any development or construction project;
4. Assure the adequacy of existing and proposed culverts and bridges, and other instream structures;
5. Maintain groundwater recharge;
6. Prevent, to the greatest extent feasible, an increase in nonpoint pollution;
7. Maintain the integrity of stream channels for their biological functions, as well as for drainage;
8. Minimize pollutants in stormwater runoff from new and existing development in order to restore, enhance and maintain the chemical, physical, and biological integrity of the waters of the State, to protect public health, to safeguard fish and aquatic life and scenic and ecological values, and to enhance the domestic, municipal, recreational, industrial and other uses of water; and
9. Protect public safety through the proper design and operation of stormwater management basins.

7:8-2.3 Stormwater management planning agencies
(a) The following entities may be stormwater management planning agencies provided they are authorized under their enabling legislation to prepare stormwater management plans:

1. A municipality;
2. A county;
3. A county water resources agency or association;
4. A designated planning agency under N.J.A.C. 7:15;
5. A Soil Conservation District, in coordination with the State Soil Conservation Committee;
6. The Delaware River Basin Commission;
7. The Pinelands Commission;
8. The Delaware and Raritan Canal Commission;
9. The New Jersey Meadowlands Commission;
10. The Department; or
11. Other regional, State or interstate agencies.

7:8-2.4 Stormwater management plan requirements
(a) A stormwater management plan shall include structural and nonstructural stormwater management strategies necessary to meet the stormwater management goals of this chapter.
(b) A regional stormwater management plan shall comply with the requirements of this subchapter and N.J.A.C 7:8-3.
(c) A municipal stormwater management plan shall comply with the requirements of this subchapter and N.J.A.C 7:8-4.
(d) A stormwater management plan shall incorporate the safety standards for stormwater management basins at N.J.A.C. 7:8-6.
(e) In developing a stormwater management plan and identifying appropriate stormwater

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management measures thereunder, each stormwater management planning agency shall consider the physical characteristics and ecological resources of the stormwater management planning area.
(f) A stormwater management plan and any stormwater management ordinance shall be coordinated with any other stormwater management plans related to the same river basin or drainage area.

7:8-2.5 Exemptions
A municipality or other entity conducting stormwater management planning under this chapter may petition the Department at the address provided at N.J.A.C. 7:8-1.3 for an exemption to the requirements of this chapter by submitting documentation to demonstrate that, if granted, the exemption will not result in an increase in flood damage, water pollution, including threats to the biological integrity, or constitute a threat to the public safety.

SUBCHAPTER 3. REGIONAL STORMWATER MANAGEMENT PLANNING

7:8-3.1 Scope
(a) This subchapter describes stormwater management planning and implementation at the regional level, including plan elements; planning process; characterization; development of drainage area-specific objectives and standards; selection of stormwater management measures; strategy for implementing the measures and evaluating the effectiveness of the regional stormwater management plan; plan review, adoption, amendment or revision; and implementation and periodic evaluation of the plan.
(b) A regional stormwater management plan shall address stormwater-related water quality, ground water recharge and/or water quantity impacts of new and existing land uses in a regional stormwater management planning area. A regional stormwater management planning area shall consist of one or more continuous drainage areas. For example, a drainage area could be an area defined by a hydrologic unit code 14 (HUC14) as defined by the United States Geological Survey.

7:8-3.2 Regional stormwater management planning committee and lead planning agency
(a) A regional stormwater management planning committee (the committee) shall be established for the purposes of creating a regional stormwater management plan.
(b) A person or entity seeking to establish a regional stormwater management committee shall solicit participation from municipalities, interstate agencies, regional agencies, counties, designated planning agencies under N.J.A.C. 7:15, Soil Conservation Districts, regional environmental commissions, Pinelands Commission, mosquito control and extermination commissions, public water supply and wastewater treatment utilities and agencies, lake associations, watershed associations, the watershed management planning area public advisory committee, environmental organizations, businesses, the Department and other appropriate State and Federal agencies and, members of the general public in the drainage area(s) to be addressed by the proposed plan. The solicitation for members of the general public to be part of the regional stormwater management planning committee can be performed through notices in local paper.
(c) The regional stormwater management planning committee shall designate a lead

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planning agency, which shall be recognized as the primary contact for the committee. The regional stormwater management planning committee, through the lead planning agency, shall:

1. Prepare the regional stormwater management plan;
2. Coordinate the regional stormwater management planning process with any applicable watershed management area planning process;
3. Provide opportunities for public participation throughout the regional stormwater management planning process; and
4. Perform other activities appropriate to facilitate the regional stormwater management planning process, including mediation, public information, providing technical assistance, and seeking and providing grants or other financial assistance, as available, to municipalities and/or local or regional agencies pursuant to N.J.S.A. 40:55D-99 or other applicable authority.

(d) A request for recognition as a regional stormwater management planning committee shall be submitted to the Department at the address listed in N.J.A.C. 7:8-1.3 by the lead planning agency, and include the following information:

1. A draft work plan and schedule for completing a regional stormwater management plan;
2. A copy of the mailing list used to solicit participation, including the entities identified in (b) above;
3. A copy of the letter of invitation to participate in the committee;
4. A copy of each response to the letter of invitation; and
5. In cases where no response from a public entity to the letter of invitation is received within 60 days, the group shall send a follow-up request by certified mail, return receipt requested, and submit proof of such follow-up.

(e) The Department shall respond in writing within 45 days of the receipt of a complete request for recognition as a regional stormwater management planning committee. The Department shall either approve the application, request additional information or deny the request for recognition. Denials will include a justification for the decision.
The Department shall base approval or denial on the information submitted in the draft work plan and schedule for plan completion, completion of the requirements to involve and notify impacted parties, and whether there are other competing or overlapping requests for recognition for the same regional stormwater management planning area.

7:8-3.3 Regional stormwater management plan and elements

(a) A regional stormwater management plan shall incorporate, at a minimum, the following elements:

1. Identification of the lead planning agency and a description of the structure and members of the committee;
2. A statement of authority to develop and implement a stormwater management plan from public entities, as appropriate, represented on the regional stormwater management planning committee.
3. A characterization and assessment of the regional stormwater management planning area prepared in accordance with N.J.A.C. 7:8-3.4;
4. A statement of drainage area-specific water quality, groundwater recharge, and water quantity objectives established under N.J.A.C. 7:8-3.5;

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5. The drainage area-specific stormwater-related water quality, groundwater recharge and water quantity design and performance standards established under N.J.A.C. 7:8-3.6;
6. The stormwater management measures selected in accordance with N.J.A.C. 7:8-3.7 and a summary of the rationale for the selection of each measure;
7. A description of the strategy for implementing the selected stormwater management measures for the regional stormwater management planning area and for evaluating the effectiveness of the regional stormwater management plan in accordance with N.J.A.C. 7:8-3.8, including a long-term monitoring program; and
8. To the extent elements of the plan do not represent the consensus of the committee, the plan shall identify and provide a discussion of the majority and minority positions.

(b) The regional stormwater management plan may also include:
1. Innovative stormwater measures and strategies such as nonpoint source pollutant trading, mitigation strategies, or special protection measures; and
2. A stream corridor protection plan to address protection of areas adjacent to waterbodies. For waterbodies subject to N.J.A.C. 7:8-5.5(h), the plan shall provide, at a minimum, protections equivalent to those provided at N.J.A.C. 7:8-5.5(h) and demonstrate that the functional value and overall condition of the special water resource protection area will be maintained or enhanced.

7:8-3.4 Characterization and assessment of the regional stormwater management planning area

(a) The regional stormwater management plan shall include a characterization and assessment that addresses the following components, unless the committee determines that a component is not appropriate for the regional stormwater management planning area and provides a rationale for not including the component:
1. Maps showing the following information. Maps developed on a Geographical Information System shall meet the Digital Data standards in N.J.A.C. 7:1D unless a rationale for a different format is provided.
i. The regional stormwater management planning area boundary;
ii. Existing land uses;
iii. Projected land uses assuming full development under existing zoning;
iv. Soil mapping units based on the detailed soil maps in County Soil Surveys published by the U.S. Department of Agriculture or, in areas for which County Soil Surveys are not available, on information obtained from Soil Conservation Districts;
v. Topography based on the U.S. Geological Survey Topographic Map, 7.5 minute quadrangle series, or other sources of information depicting topography in similar or greater detail;
vi. Water bodies based on detailed map sheets in County Soil Surveys published by the U.S. Department of Agriculture; the U.S. Geological Survey Topographic Map, 7.5 minute quadrangle series; or other sources of information depicting water bodies in similar or greater detail;
vii. Coastal wetlands based on maps prepared by the Department under the Wetlands Act of 1970, N.J.S.A. 13:9A-1 et seq., and freshwater wetlands

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based on maps prepared by the Department under the Freshwater Wetlands Protection Act, N.J.S.A. 13:9B-1 et seq.;

viii. Flood hazard areas based on delineations made by the Department under the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq. For a water body for which the Department has not delineated the flood hazard area, a map of the flood hazard area prepared in accordance with N.J.A.C. 7:13 is acceptable;

ix. Groundwater recharge areas and well head protection areas based on maps prepared by the Department or ordinances of an affected municipality;

x. Environmentally constrained areas and environmentally critical areas;

xi. River areas designated under the New Jersey Wild and Scenic Rivers Act, N.J.S.A. 13:8-45 et seq., or the Federal Wild and Scenic Rivers Act, 16 U.S.C. §§1278 et seq.;

xii. For each waterbody in the regional stormwater management planning area, identification of the waterbody or waterbody segment, the drainage area, and the classification of the waterbody pursuant to N.J.A.C. 7:9B-1.15;

xiii. Each waterbody designated as a water quality limited surface water pursuant to N.J.A.C. 7:15-6;

xiv. Man-made stormwater conveyance, storage and discharge systems, including municipal separate storm sewer outfall pipes and the drainage areas as appropriate for these outfall structures; and

xv. Source water areas of potable public surface water supply intakes and public water supply reservoirs available on the Departments webpage at www.nj.gov/dep/swap/;

2. A map showing jurisdictional boundaries within the regional stormwater management planning area of municipal, county, and other agencies with responsibility for implementing stormwater management;

3. Identification of the physical characteristics of the regional stormwater management planning area pertinent to stormwater management, such as slopes, swales and impoundment areas as necessary for completing the analysis in N.J.A.C. 7:8-3.4(a)4;

4. A water quality, groundwater recharge and water quantity hydrologic and hydraulic model or analysis of the regional stormwater management planning area which addresses existing land uses and projected land uses assuming full development under existing zoning and taking into account permanently preserved lands;

5. An identification and evaluation of existing municipal, county, State, Federal, and other stormwater-related groundwater recharge, water quality and water quantity regulations and programs shall be conducted, including, where applicable, programs to develop total maximum daily loads (TMDLs) in accordance with N.J.A.C. 7:15-7; and

6. A summary of information that has been identified as useful for purposes of stormwater management planning but that is not available for technical, financial, or other reasons.

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(b) The Department encourages the use of existing information to the extent that it is available to minimize the cost of data acquisition, such as information available on the Department's Geographical Information System web site (www.state.nj.us/dep/gis) or as developed through a watershed planning process.
(c) The characterization and assessment shall include information on locations and activities outside the regional stormwater management planning area that drain into the planning area (for example, stormwater originating in an adjacent drainage area that is transferred to the stormwater management planning area).
(d) Using the modeling or other information obtained under (a) through (c) above, the stormwater-related water quality impacts of existing land uses and projected land uses assuming full development under existing zoning shall be identified and ranked in accordance with the following process:

1. Inventory existing and potential stormwater-related pollutant sources and stormwater related pollutants in the regional stormwater management planning area.
    i. Stormwater-related pollutant sources include, for example, urban and suburban development, roads, storm sewers, agriculture, mining, and waterfront development.
    ii. Stormwater-related pollutants include, for example, nutrients, pathogens, hydrocarbons, metals, pesticides, sediments, and suspended solids;
2. For surface water bodies and/or segments thereof and aquifers and/or portions thereof in the regional stormwater management planning area, identify and describe the existing or designated uses that are or may be adversely affected by stormwater-related pollutants, and to the extent feasible, identify the source(s) of the pollutant. The use of the report and list prepared by the Department to comply with Federal Clean Water Act, Section 303(d) and 305(b) (33 USC §§1313(d) and 1315(b)) and underlying data, including biological assessments, is encouraged; and
3. Identify and rank the most significant existing and potential stormwater-related pollutants and, for each pollutant, identify and rank the sources.

(e) Using the modeling or other information obtained under (a) through (c) above for stormwater-related water quantity impacts and stormwater-related groundwater recharge impacts of existing and projected land uses assuming full development under existing zoning, the most significant existing and potential stormwater-related water quantity problems, including flooding, erosion, mosquitoes, base-flow reduction, ground water depletion, and associated ecosystem impacts, shall be identified and described. The problems shall be ranked based on consideration of threat to public health, safety, and welfare as evidenced by history of or potential for flood damage; risk of loss of or damage to water supplies; and risk of damage to the biological integrity of water bodies.

7:8-3.5 Drainage area-specific water quality, groundwater recharge and water quantity objectives
(a) The regional stormwater management plan shall identify drainage area-specific water quality, groundwater recharge and water quantity objectives that are consistent with the goals of stormwater management planning at N.J.A.C. 7:8-2.3, and address each of the

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stormwater-related pollutant sources and pollutants ranked under N.J.A.C. 7:8-3.4(d) and the water quantity and groundwater recharge problems ranked under N.J.A.C. 7:8-3.4(e). The objectives shall address the elimination, reduction, or minimization of stormwaterrelated
impacts associated with new and existing land uses. The objectives developed for the regional stormwater management plan may take into consideration environmental, social, and economic factors.
(b) Notwithstanding (a) above, the drainage area -specific objectives for major development shall provide, at a minimum, the protection that would be achieved through the application of N.J.A.C. 7:8-5, Design and Performance Standards for Stormwater Management Measures.
(c) If a TMDL has been established pursuant to N.J.A.C. 7:15 for a waterbody or waterbody segment in the regional stormwater management planning area, drainage areaspecific
objectives shall incorporate the loading reductions established in the TMDL for stormwater sources of pollution. In addition, if a waterbody or waterbody segment in the regional stormwater management planning area is on the Department's list prepared to comply with Federal Clean Water Act, Section 303(d) (33 USC §§1313(d)) for one or more designated uses by stormwater runoff, then drainage area objectives shall be included that address the pollutants or pollution for which the waterbody is threatened or impaired.

7:8-3.6 Drainage area-specific design and performance standards
(a) The regional stormwater management plan shall identify drainage area-specific design and performance standards in order to meet the drainage area-specific water quality, groundwater recharge and water quantity objectives identified under N.J.A.C. 7:8-3.5.
(b) Drainage area-specific design and performance standards may include performance standards for control of stormwater quantity, erosion, groundwater recharge and stormwater quality, as well as design standards for particular structural and nonstructural stormwater management strategies.
(c) The design and performance standards for stormwater management measures for major development described in N.J.A.C. 7:8-5 shall be incorporated into the regional stormwater management plan. Alternative drainage area-specific design and performance standards may be developed provided the alternative standard is at least as protective as would be achieved under N.J.A.C. 7:8-5 when considered on a regional stormwater management planning area basis.
(d) For structural stormwater management measures, drainage area-specific design and performance standards shall conform to the general standards at N.J.A.C. 7:8-5.7.
(e) Drainage area-specific design and performance standards do not have to be uniform throughout a drainage area provided the drainage area, when considered in its entirety, satisfies N.J.A.C. 7:8-5.

7:8-3.7 Selection of stormwater management measures
(a) The regional stormwater management plan shall identify stormwater management measures necessary to achieve the drainage area-specific water quality, groundwater recharge and water quantity objectives developed in accordance with N.J.A.C. 7:8-3.5,

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and design and performance standards developed in accordance with N.J.A.C. 7:8-3.6.
(b) Stormwater management measures in the following categories shall be considered and selected, as appropriate:

1. Stormwater management measures for new land uses;
2. Stormwater management measures for existing land uses, including, for example, retrofit measures for the modification of existing structural stormwater management measures or other structures affecting stormwater runoff; elimination of illicit or illegal discharges; prevention or minimization of the exposure of pollutants to stormwater; and control of floatables;
3. Stormwater management measures that enhance, protect, and/or preserve land or water areas possessing characteristics or features that provide for flood control, maintenance or improvement of water quality, or conservation of natural resources (for example, land use controls, local and regional open space plans and taxes, buffer zones, redirecting, recharging or minimizing stormwater discharges, pretreatment and/or end-of-pipe treatment); and
4. Public education programs that address stormwater quantity and quality.

(c) A written rationale shall be provided for each selected stormwater management measure, including an analysis of feasibility, benefits and costs, estimated percent pollutant load reduction and anticipated performance longevity;
(d) Each selected stormwater management measure shall include, as appropriate, a program for preventative and corrective maintenance, including a long-term implementation schedule and identification of the entity responsible for implementation and maintenance.

7:8-3.8 Strategy for implementing and evaluating effectiveness of stormwater management measures
(a) The regional stormwater management plan shall include a strategy for implementing the stormwater management measures. The lead planning agency or another entity designated by the committee shall be responsible for coordination and tracking of the implementation of the regional stormwater management plan, including the long-term monitoring program.
(b) The implementation strategy shall:

1. Identify agencies and/or entities necessary to implement the measures and conduct the long-term monitoring program;
2. Identify the respective measures and/or monitoring each agency and/or entity will implement and the enabling mechanisms by which the measures will be implemented, including, for example, new or amended municipal ordinances or interagency agreements;
3. Establish a schedule for the implementation of the measures based on priority, including specific milestones for all mechanisms identified under (b)2 above;
4. Provide an estimate of short term and long term implementation costs to be incurred; and
5. Identify existing and potential private, local, State, and Federal funding sources to implement the regional stormwater management plan.

(c) The implementation strategy shall include a long-term monitoring program that will provide information about land use, water quality, water quantity, groundwater resources

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and riparian and aquatic habitat condition, as appropriate. Information for the monitoring program may include data obtained through watershed management, local, county, State, interstate, and/or Federal monitoring programs, including volunteer monitoring programs.
(d) The implementation strategy shall include a procedure for evaluating and then updating as necessary, at least every five years, the effectiveness of the implemented measures in achieving the objectives and design and performance standards established in the regional stormwater management plan.

7:8-3.9 Regional stormwater management plan review, adoption, and amendment and/or revision
(a) Upon completion of a regional stormwater management plan, the lead planning agency shall submit the plan to the Department and, if applicable, to the designated water quality management planning agency as an amendment to the areawide water quality management plan(s) in accordance with the Water Quality Management Planning Rules at N.J.A.C. 7:15.
(b) In reviewing a regional stormwater management plan submitted under (a) above, the Department shall determine whether the plan conforms to the requirements of this chapter. The Department will disapprove, return for additional information or proceed with a proposed amendment in accordance with N.J.A.C. 7:15-3.4(g).
(c) Modifications to an adopted regional stormwater management plan shall be processed as an amendment or revision in accordance with N.J.A.C. 7:15-3.4(b)5 or 3.5(b)5, as applicable.

7:8-3.10 Implementation of adopted regional stormwater management plan
(a) Once the regional stormwater management plan has been adopted pursuant to N.J.A.C. 7:8-3.9, implementation responsibilities are as follows:

1. The Department will use the adopted regional stormwater management plan as the basis for reviewing the stormwater management aspects of projects or activities regulated pursuant to Coastal Permit Program rules, N.J.A.C. 7:7; the Freshwater Wetland Protection Act rules, N.J.A.C. 7:7A; the Coastal Zone Management rules, N.J.A.C. 7:7E; the Flood Hazard Area Control Act rules, N.J.A.C. 7:13; the New Jersey Pollutant Discharge Elimination System rules, N.J.A.C 7:14A; and the Dam Safety Standards, N.J.A.C. 7:20. The requirements of this chapter are considered to be the minimum stormwater standards. Additional requirements may be imposed as necessary under the respective programs.
2. Each municipality in the regional stormwater management planning area shall incorporate the applicable provisions of the regional stormwater management plan into a new or amended municipal stormwater management plan and ordinances.
3. In accordance with the Residential Site Improvement Standards at N.J.A.C. 5:21-7, if a stormwater management plan for the region has been approved by the Department, stormwater management systems must conform with that plan.
4. The Department shall not issue a permit for a project or activity that conflicts with an Areawide Water Quality Management Plan pursuant to N.J.A.C. 7:15-3.1.

SUBCHAPTER 4. MUNICIPAL STORMWATER MANAGEMENT PLANNING

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7:8-4.1 Scope
This subchapter describes stormwater management planning and implementation at the municipal level, including plan elements, county review and technical assistance, the schedule for adoption of the plan and ordinances, and variance or exemption from design and performance standards for stormwater management measures.

7:8-4.2 Municipal stormwater management plan and elements
(a) A municipal stormwater management plan shall address stormwater-related water quality, groundwater recharge and water quantity impacts of major development, and may also address stormwater-related water quality, water quantity and groundwater recharge impacts of existing land uses. For purposes of this subchapter, major development is limited to projects that ultimately disturb one or more acres of land.
(b) A municipal stormwater management plan and stormwater control ordinance(s) shall conform with applicable regional stormwater management plan(s).
(c) A municipal stormwater management plan shall, at a minimum:

1. Describe how the municipal stormwater management plan will achieve the goals of stormwater management planning set forth at N.J.A.C. 7:8-2.3;
2. Include maps showing water bodies based on Soil Surveys published by the U.S. Department of Agriculture; the U.S. Geological Survey Topographic Map, 7.5 minute quadrangle series; or other sources of information depicting water bodies in similar or greater detail;
3. Map groundwater recharge areas and well head protection areas based on maps prepared by the Department under N.J.S.A. 58:11A-13 or a municipal ordinance;
4. Describe how the municipal stormwater management plan incorporates design and performance standards in N.J.A.C.7: 8-5 or alternative design and performance standards adopted as a part of a regional stormwater management plan or water quality management plan;
5. Describe how adequate long-term operation as well as preventative and corrective maintenance (including replacement) of the selected stormwater management measures will be ensured;
6. Describe how the plan will ensure compliance with Safety Standards for Stormwater Management Basins at N.J.A.C. 7:8-6;
7. Describe how the municipal stormwater management plan is coordinated with the appropriate Soil Conservation District and any other stormwater management plans, including any adopted regional stormwater management plan, prepared by any stormwater management planning agency related to the river basins or drainage areas to which the plans and/or ordinances apply;
8. Evaluate the extent to which the municipality's entire master plan (including the land use plan element), official map and development regulations (including the zoning ordinance) implement the principles expressed in N.J.A.C. 7:8-5.3(b). This evaluation shall also be included (with updating as appropriate) in the reexamination report adopted under N.J.S.A. 40:55D-89;
9. Include a map of the municipality showing:
    i. Projected land uses assuming full development under existing zoning, and

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ii. The hydrologic unit code 14 (HUC14) drainage areas as defined by the United States Geological Survey; and an estimate, for each HUC14 drainage area, of the total acreage in the municipality of impervious surface and associated future nonpoint source pollutant load assuming full build out of the projected land uses.

10. At the option of the municipality, document that it has a combined total of less than one square mile of vacant or agricultural lands rather than provide the information required in (c)8 and 9 above. Agricultural lands may be excluded if the development rights to these lands have been permanently purchased or restricted by covenant, easement or deed. Vacant or agricultural lands in environmentally constrained areas may be excluded if the documentation also includes an overlay map of these areas at the same scale as the map under (c)10i below.

i. Documentation shall include an existing land use map at an appropriate scale to display the land uses of each parcel within the municipality. Such a map shall display the following land uses: residential (which may be divided into single family, two-to-four family, and other multi-family), commercial, industrial, agricultural, parkland, other public uses, semipublic uses, and vacant land;

11. In order to grant a variance or exemption from the design and performance standards in N.J.A.C. 7:8-5, include a mitigation plan that identifies what measures are necessary to offset the deficit created by granting the variance or exemption. The mitigation plan shall ensure that mitigation is completed within the drainage area and for the performance standard for which the variance or exemption was granted;

12. Include a copy of the recommended implementing stormwater control ordinance(s) requiring stormwater management measures, and

13. The municipal stormwater management plan may also include a stream corridor protection plan to address protection of areas adjacent to waterbodies. For waterbodies subject to N.J.A.C. 7:8-5.5(h), the plan shall provide, at a minimum, protections equivalent to those provided at N.J.A.C. 7:8-5.5(h) and be approved by the Department.

7:8-4.3 Schedule for adoption of municipal stormwater management plan and ordinances

(a) A municipality shall adopt a municipal stormwater management plan as an integral part of its master plan and official map in accordance with the schedule in (a)1 or 2 below, whichever is sooner. The requirements in N.J.A.C. 7:8-4.2(c)8 and 9 are not operative until February 2, 2006.

1. By the deadline established in a New Jersey Pollutant Discharge Elimination System permit obtained by the municipality for a municipal separate storm sewer system under N.J.A.C. 7:14A; or

2. By the next reexamination of the master plan under N.J.S.A. 40:55D-89, if a grant for 90 percent of the costs for the preparation of the municipal stormwater management plan has been made available to a municipality by the Department;

(b) Within one year after the municipality adopts the municipal stormwater management plan, the municipality shall adopt stormwater control ordinance(s) to implement the

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adopted plan and shall submit the adopted municipal stormwater management plan and ordinance(s) to the county review agency for approval. The adopted municipal stormwater management plan and ordinance(s) shall not take effect without approval by the county review agency.
(c) The municipality shall amend the municipal stormwater management plan and stormwater control ordinance(s) as necessary and submit the amended plan and amended ordinance(s) to the county review agency for approval.
(d) The municipality shall reexamine the municipal stormwater management plan at each reexamination of the municipality's master plan in accordance with N.J.S.A. 40:55D-89.
(e) Within one year of the adoption of a regional stormwater management plan as an amendment to the Areawide Water Quality Management Plan, or an amendment thereto, each municipality within the regional stormwater management planning area shall amend their respective municipal stormwater management plans and stormwater control ordinance(s) to implement the regional stormwater management plan.

7:8-4.4 County review process
(a) A municipality shall submit a copy of the adopted stormwater management plan and stormwater control ordinance(s) to the county review agency and the Department.
(b) In reviewing the adopted municipal stormwater management plan and ordinance(s), the county review agency shall consider whether the plan and ordinance(s) conform with the requirements of this chapter.
(c) In accordance with N.J.S.A. 40:55D-97, it is the county review agency's responsibility to review and approve, conditionally approve (specifying the necessary amendments to the plan and ordinance(s)) or disapprove the adopted municipal stormwater management plan and ordinance(s) within 60 calendar days of receipt of the plan and ordinance(s). If the county review agency does not approve, conditionally approve, or disapprove the plan or ordinance(s) within 60 calendar days, the plan and ordinance(s) shall be deemed approved. The county review agency shall issue a written decision to the municipality, with a copy to the Department.
(d) A municipal stormwater management plan and ordinance(s) approved under (c) above shall take effect immediately. A municipal stormwater management plan and ordinance(s) conditionally approved under (c) above shall take effect upon adoption by the municipality of the amendments specified by the county review agency.
(e) Within 30 days of the effective date of the municipal stormwater management plan and ordinance(s) under (d) above, the municipality shall place the plan and ordinance(s) on its website and notify the Department, the Soil Conservation District and State Soil Conservation Committee, or:

1. Submit a copy of the approved municipal stormwater management plan and ordinance(s) to the Department; and
2. Provide notice of such approval to the Soil Conservation District and the State Soil Conservation Committee and, upon request, submit a copy of the approved plan and ordinance(s).

7:8-4.5 Reservation of rights
The Department reserves the right to review stormwater management plans and ordinances for compliance with this subchapter and make recommendations to correct

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any deficiencies.

7:8-4.6 Variance or exemption from the design and performance standards for stormwater management measures
A municipality may grant a variance or exemption from the design and performance standards for stormwater management measures set forth in its approved municipal stormwater management plan and stormwater control ordinance(s), provided the municipal plan includes a mitigation plan in accordance with N.J.A.C. 7:8-4.2(c)11 and the municipality submits a written report to the county review agency and the Department describing the variance or exemption and the required mitigation.

SUBCHAPTER 5 DESIGN AND PERFORMANCE STANDARDS FOR STORMWATER MANAGEMENT MEASURES

7:8-5.1 Scope
(a) This subchapter establishes design and performance standards for stormwater management measures for major development intended to minimize the adverse impact of stormwater runoff on water quality and water quantity and loss of groundwater recharge in receiving water bodies.
(b) The standards specified in this subchapter do not apply to major development if alternative design and performance standards that are at least as protective as would be achieved through this subchapter when considered on a regional stormwater management area basis are applicable under a regional stormwater management plan adopted in accordance with this chapter or a water quality management plan adopted in accordance with N.J.A.C. 7:15.

7:8-5.2 Stormwater management measures for major development
(a) Stormwater management measures for major development shall be developed to meet the erosion control, groundwater recharge, stormwater runoff quantity, and stormwater runoff quality standards at N.J.A.C. 7:8-5.4 and 5.5. To the maximum extent practicable, these standards shall be met by incorporating nonstructural stormwater management strategies at N.J.A.C. 7:8-5.3 into the design. If these measures alone are not sufficient to meet these standards, structural stormwater management measures at N.J.A.C. 7:8-5.7 necessary to meet these standards shall be incorporated into the design.
(b) The development shall incorporate a maintenance plan under N.J.A.C. 7:8-5.8 for the stormwater management measures.
(c) Stormwater management measures shall avoid adverse impacts of concentrated flow on habitat for threatened and endangered species as documented in the Department's 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).
(d) The following linear development projects are exempt from the groundwater recharge, stormwater runoff quantity, and stormwater runoff quality requirements at N.J.A.C. 7:8-5.4 and 5.5:

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

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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.

(e) A waiver from strict compliance from the groundwater recharge, stormwater runoff quantity, and stormwater runoff quality requirements at N.J.A.C. 7:8-5.4 and 5.5 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 alternatives analysis, that through the use of nonstructural and structural stormwater management strategies and measures, the option selected complies with the requirements of N.J.A.C. 7:8-5.4 and 5.5 to the maximum extent practicable;
3. The applicant demonstrates that, in order to meet the requirements at N.J.A.C. 7:8-5.4 and 5.5 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 (e)3 above within the upstream drainage area of the receiving stream, that would provide additional opportunities to mitigate for requirements of N.J.A.C. 7:8-5.4 and 5.5 that were not achievable on-site.

7:8-5.3 Nonstructural stormwater management strategies

(a) To the maximum extent practicable, the standards in N.J.A.C. 7:8-5.4 and 5.5 shall be met by incorporating nonstructural stormwater management strategies at N.J.A.C. 7:8-5.3 into the design. The persons submitting an application for review shall identify the nonstructural strategies 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 strategies identified in (b) below into the design of a particular project, the applicant shall identify the strategy and provide a basis for the contention.

(b) Nonstructural stormwater management strategies incorporated into site design shall:

1. Protect areas that provide water quality benefits or areas particularly susceptible to erosion and sediment loss;
2. Minimize impervious surfaces and break up or disconnect the flow of runoff over impervious surfaces;
3. Maximize the protection of natural drainage features and vegetation;
4. Minimize the decrease in the "time of concentration" from pre-construction to postconstruction. "Time of Concentration" is defined as the time it takes for runoff to travel from the hydraulically most distant point of the drainage area to the point of interest within a watershed;
5. Minimize land disturbance including clearing and grading;
6. Minimize soil compaction;

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7. Provide low-maintenance landscaping that encourages retention and planting of native vegetation and minimizes the use of lawns, fertilizers and pesticides;
8. Provide vegetated open-channel conveyance systems discharging into and through stable vegetated areas; and
9. 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. These source controls include, but are not limited to:
i. Site design features that help to prevent accumulation of trash and debris in drainage systems;
ii. Site design features that help to prevent discharge of trash and debris from drainage systems;
iii. Site design features that help to prevent and/or contain spills or other harmful accumulations of pollutants at industrial or commercial developments; and
iv. 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.

(c) Any land area used as a non structural stormwater management measure to meet the performance standards in N.J.A.C. 7:8-5.4 and 5.5 shall be dedicated to a government agency, subjected to a conservation restriction filed with the County Clerk's office, or subject to Department approved or equivalent restriction that ensures that measure or an equivalent stormwater management measure approved by the reviewing agency is maintained in perpetuity.
(d) Guidance for nonstructural stormwater management strategies is available in the New Jersey Stormwater Best Management Practices Manual available from the Department through the address listed at N.J.A.C. 7:8-1.3.

7:8-5.4 Erosion control, groundwater recharge and runoff quantity standards
(a) This section 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.
1. 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.
2. The minimum design and performance standards for groundwater recharge are as follows:
i. The design engineer shall, using the assumptions and factors for stormwater runoff and groundwater recharge calculations at N.J.A.C. 7:8-5.6, either:
(1) Demonstrate through hydrologic and hydraulic analysis that the site and its stormwater management measures maintain 100 percent of the average annual preconstruction groundwater recharge volume for the site; or

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(2) Demonstrate through hydrologic and hydraulic analysis that the increase of stormwater runoff volume from pre-construction to post-construction for the two-year storm is infiltrated.

ii. This groundwater recharge requirement does not apply to projects within the "urban redevelopment area," or to projects subject to iii below.

iii.The following types of stormwater shall not be recharged:

(1) 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

(2) 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.

iv. 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 downgradient of the groundwater recharge area.

3. In order to control stormwater runoff quantity impacts, the design engineer shall, using the assumptions and factors for stormwater runoff calculations at N.J.A.C. 7:8-5.6, complete one of the following:

i. Demonstrate through hydrologic and hydraulic analysis that for stormwater leaving the site, post-construction runoff hydrographs for the two, 10, and 100-year storm events do not exceed, at any point in time, the pre-construction runoff hydrographs for the same storm events;

ii. Demonstrate through hydrologic and hydraulic analysis that there is no increase, as compared to the pre-construction condition, in the peak runoff rates of stormwater leaving the site for the two, 10, and 100-year storm

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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;

iii. Design stormwater management measures so that the post-construction peak runoff rates for the two, 10 and 100-year storm events are 50, 75 and 80 percent, respectively, of the pre-construction 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; or

iv. In tidal flood hazard areas, stormwater runoff quantity analysis in accordance with i, ii, and iii above shall only be applied if the increased volume of stormwater runoff could increase flood damages below the point of discharge.

(b) Any application for a new agricultural development that meets the definition of major development at N.J.A.C. 7:8-1.2 shall be submitted to the 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 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 manufacture of agriculturally related products.

7:8-5.5 Stormwater runoff quality standards

Stormwater management measures shall be designed to reduce the post-construction load of total suspended solids (TSS) in stormwater runoff generated from the water quality design storm by 80 percent 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 one-quarter 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 Pollutant 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 below. The calculation of the volume of runoff may take into account the implementation of non-structural and structural stormwater management measures.

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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		

(b) 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 N.J.A.C. 7:8-1.3 or found on the Department's website at www.njstormwater.org. The BMP manual and other sources of technical guidance are listed in N.J.A.C. 7:8-5.9(a). 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. Where the Department is not 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 address at N.J.A.C. 7:8-1.3.

(c) If more than one BMP in series is necessary to achieve the required 80 percent TSS reduction for a site, the applicant shall utilize the following formula to calculate TSS reduction:

$$R = A + B - (A \times B)/100$$

Where

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

A = the TSS percent removal rate applicable to the first BMP

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

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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 N.J.A.C. 7:8-5.7(d)
Sand Filter	80
Vegetative Filter Strip	60-80
Wet Pond	50-90

(d) If there is more than one onsite drainage area, the 80 percent 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.

(e) 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 N.J.A.C. 7:8-5.4 and 5.5.

(f) Additional information and examples are contained in the New Jersey Stormwater Best Management Practices Manual, which may be obtained from the address identified in N.J.A.C. 7:8-1.3.

(g) 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.

(h) 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 HUC 14 drainage. 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:

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

i. 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 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.

ii. Encroachment within the designated special water resource protection area under (h)1i above shall only be allowed where previous development or disturbance has occurred (for example, active agricultural use, parking

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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 subparagraph shall be subject to review and approval by the Department.

2. All stormwater shall be discharged outside of but may 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. (See N.J.A.C. 2:90-1.3).

3. 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., (see N.J.A.C. 2:90-1.3), 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:

i. Stabilization measures shall not be placed within 150 feet of the waterway;

ii. Stormwater associated with discharges allowed by this paragraph shall achieve a 95 percent TSS post construction removal rate;

iii. Temperature shall be addressed to ensure no impact on receiving waterway;

iv. 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;

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

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

4. 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 this subsection has been approved by the Department, 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 this subsection shall maintain or enhance the current functional value and overall condition of the special water resource protection area as defined above in (h)1i. In no case shall a stream corridor protection plan allow reduction of the Special

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Water Resource Protection Area to less than 150 feet as measured perpendicular to the waterway subject to this subsection.

5. This subsection 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.

7:8-5.6 Calculation of stormwater runoff and groundwater recharge

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

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

i. The USDA Natural Resources Conservation Service (NRCS) methodology, including the NRCS Runoff Equation and Dimensionless Unit Hydrograph, as described in Section 4, National Engineering Handbook (NEH-4), dated July 2002, incorporated herein by reference as amended and supplemented. This methodology is additionally described in Technical Release 55 - Urban Hydrology for Small Watersheds (TR-55), dated June 1986, incorporated herein by reference as amended and supplemented. Information regarding the methodology is available from the Natural Resources Conservation Service website at http://www.wcc.nrcs.usda.gov/water/quality/common/neh630/4content.html or at Natural Resources Conservation Service, 220 Davidson Avenue, Somerset, New Jersey 08873; (732) 537-6040; or

ii. The Rational Method for peak flow and the Modified Rational Method for hydrograph computations. The rational and modified rational methods are described in "Appendix A-9 Modified Rational Method" in the Standards for Soil Erosion and Sediment Control in New Jersey, July 1999. This document is available from the State Soil Conservation Committee or any of the Soil Conservation Districts listed at N.J.A.C. 2:90-1.3(a)4. The location, address, and telephone number or each Soil Conservation District is available from the State Soil Conservation Committee, P.O. Box 330, Trenton, NJ 08625, 609-292-5540.

2. For the purpose of calculating runoff coefficients and groundwater recharge, there is a presumption that the pre-construction 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 N.J.A.C. 7:8-5.6(a)1i and the Rational and Modified Rational Methods at N.J.A.C. 7:8-5.6(a)1i. 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.)

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3. In computing pre-construction 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 pre-construction 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 or 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 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 New Jersey Geological Survey website at http://www.state.nj.us/dep/njgs/, or at New Jersey Geological Survey, 29 Arctic Parkway, P.O. Box 427, Trenton, NJ 08625-0427; (609) 984-6587.

7:8-5.7 Standards for structural stormwater management measures

(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. The parallel bars at the outlet structure shall be spaced no greater than one-third the width of the diameter of the orifice or one-third the width of the weir, with a minimum spacing between bars of one-inch and a maximum spacing between bars of six inches. For outlets with a width or diameter less than three inches, the parallel bars shall be spaced one inch apart. In addition, the design of trash racks must comply with the requirements of N.J.A.C. 7:8-6.2(a).

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.

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4. At the intake to the outlet from the stormwater management basin, the orifice size shall be a minimum of two and one-half inches in diameter.
5. Stormwater management basins shall be designed to meet the minimum safety standards for stormwater management basins at N.J.A.C. 7:8-6.

(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, ground water recharge and water quality design and performance standards established by this subchapter.
(c) Manufactured treatment devices may be used to meet the requirements of this subchapter, provided the pollutant removal rates are verified by the New Jersey Corporation for Advanced Technology and certified by the Department.

7:8-5.8 Maintenance requirements
(a) The design engineer shall prepare a maintenance plan for the stormwater management measures incorporated into the design of a major development.
(b) The maintenance plan shall contain specific preventative maintenance tasks and schedules; cost estimates, including estimated cost of sediment, debris, or trash removal; and the name, address, and telephone number of the person or persons responsible for preventative and corrective maintenance (including replacement). 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.
(c)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.
(d) If the person responsible for maintenance identified under (b) above is not a public agency, the maintenance plan and any future revisions based on (h) below shall be recorded upon the deed of record for each property on which the maintenance described in the maintenance plan must be undertaken.
(e) 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.
(f) The person responsible for maintenance identified under (b) 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.
(g) The person responsible for maintenance identified under (b) above shall evaluate the effectiveness of the maintenance plan at least once per year and adjust the plan and the

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deed as needed.
(h) The person responsible for maintenance identified under (b) 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 (f) and (g) above.
(i) 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.

7:8-5.9 Sources for technical guidance
(a) Technical guidance for stormwater management measures can be found in the documents listed at (a)1 and 2 below, which are available from Maps and Publications, 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, 2002 as amended. Information is provided on stormwater management measures such as:
    i. Bioretention systems;
    ii. Constructed stormwater wetlands;
    iii. Dry wells;
    iv. Extended detention basins;
    v. Infiltration structures;
    vi. Manufactured treatment devices;
    vii. Pervious paving;
    viii. Sand filters;
    ix. Vegetative filter strip, and
    x. Wet pond.
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.

SUBCHAPTER 6. SAFETY STANDARDS FOR STORMWATER MANAGEMENT BASINS

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7:8-6.1 Scope
(a) This subchapter sets forth requirements to protect public safety through the proper design and operation of stormwater management basins. This subchapter applies to any new stormwater management basin.
(b) The provisions of this subchapter are not intended to 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 N.J.A.C. 7:8-6.2(a), (b) and (c)1 for trash racks, overflow grates, and escape provisions at outlet structures.

7:8-6.2 Requirements for trash racks, overflow grates and escape provisions
(a) 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:

1. The trash rack shall have parallel bars, with no greater than six-inch spacing between the bars;
2. The trash rack shall be designed so as not to adversely affect the hydraulic performance of the outlet pipe or structure;
3. 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; and
4. The trash rack shall be constructed of rigid, durable, and corrosion resistant material and designed to withstand a perpendicular live loading of 300 lbs./ft sq.

(b) An overflow grate is designed to prevent obstruction of the overflow structure. If an outlet structure has an overflow grate, the grate shall comply with the following requirements:

1. The overflow grate shall be secured to the outlet structure but removable for emergencies and maintenance;
2. The overflow grate spacing shall be no greater than two inches across the smallest dimension; and
3. The overflow grate shall be constructed of rigid, durable, and corrosion resistant material and designed to withstand a perpendicular live loading of 300 lbs./ft sq.

(c) Stormwater management basins shall include escape provisions as follows:

1. If a stormwater management basin has an outlet structure, escape provisions shall be incorporated in or on the structure. Escape provisions include the installation of permanent ladders, steps, rungs, or other features that provide easily accessible means of egress from stormwater management basins. With the prior approval of the reviewing agency pursuant to N.J.A.C. 7:8-6.3(a), a free-standing outlet structure may be exempted from this requirement;
2. Safety ledges shall be constructed on the slopes of all new stormwater management basins having a permanent pool of water deeper than two and one-half feet. Safety ledges shall be comprised of two steps. Each step shall be four to six feet in width. One step shall be located approximately two and one-half feet

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below the permanent water surface, and the second step shall be located one to one and one-half feet above the permanent water surface. See N.J.A.C. 7:8-6 Appendix A for an illustration of safety ledges in a stormwater management basin; and

3. 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.

7:8-6.3 Variance or exemption from safety standards

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.

Appendix A: Illustration of safety ledges in a new stormwater management basin. Depicted is an elevational view. [*not shown*]

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Appendix 1B

Flood Hazard Area Control Act Rules

N.J.A.C. 7:13
November 5, 2007

NOTE: THIS IS A COURTESY COPY OF THIS RULE. THE OFFICIAL VERSION IS PUBLISHED IN THE NOVEMBER 5, 2007, NEW JERSEY REGISTER. SHOULD THERE BE ANY DISCREPANCIES BETWEEN THIS TEXT AND THE OFFICIAL VERSION, THE OFFICIAL VERSION WILL GOVERN.

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SUBCHAPTER 1. GENERAL PROVISIONS

7:13-1.1 Purpose and scope

(a) This chapter sets forth requirements governing human disturbance to the land and vegetation in the following areas:

1. The flood hazard area of a regulated water, as described at N.J.A.C. 7:13-3; and
2. The riparian zone of a regulated water, as described at N.J.A.C. 7:13-4.

(b) This chapter implements the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq.; and, in addition, relevant aspects of the New Jersey Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq.; the Water Quality Planning Act, N.J.S.A. 58:11A-1 et seq.; the Highlands Water Protection and Planning Act, N.J.S.A. 13:20-1 et seq.; the Ninety-Day Construction Permits Law, N.J.S.A. 13:1D-29 et seq.; and N.J.S.A. 13:1D-1 et seq.

(c) The purpose of this chapter is to minimize damage to life and property from flooding caused by development within fluvial and tidal flood hazard areas, to preserve the quality of surface waters, and to protect the wildlife and vegetation that exist within and depend upon such areas for sustenance and habitat.

1. Unless properly controlled, development within flood hazard areas increases the intensity and frequency of flooding by reducing flood storage, increasing stormwater runoff and obstructing the movement of floodwaters. Damage also occurs from fallen structures, unsecured materials and other debris carried by floodwaters. Furthermore, improperly built structures are subject to flood damage and threaten the health, safety and welfare of those who use them. Increased flooding results in increased risk of loss of life and property damage.
2. Healthy vegetation adjacent to surface waters is essential for maintaining bank stability and water quality. The indiscriminate disturbance of such vegetation destabilizes the banks of channels and other surface waters, which leads to increased erosion and sedimentation that exacerbates the intensity and frequency of flooding. The loss of vegetation adjacent to surface waters also reduces filtration of stormwater runoff and thus degrades the quality of these waters. Such impacts adversely affect the health and habitat of fish and wildlife that depend upon clean surface waters and therefore disrupt the ecological balance that is necessary for life. Humans are ultimately affected by this imbalance, since clean water is essential for all life.

(d) Except where authority has been delegated to a county governing body under N.J.A.C. 7:13- 1.4, the Department shall be the agency that implements this chapter.

(e) Activities regulated under this chapter may also be subject to other Federal, State and/or local rules, plans and ordinances. Authorization to undertake a regulated activity under this chapter does not indicate that the activity also meets the requirements of any other rule, plan or ordinance. It is the applicant's responsibility to obtain all necessary approvals for a proposed project.

(f) Information and forms relating to this chapter can be obtained from:

Street address (for meetings and hand delivery of material):

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State of New Jersey
Department of Environmental Protection
Division of Land Use Regulation
501 East State Street
Station Plaza 5, 2nd Floor
Trenton, New Jersey 08609
Postal address:
State of New Jersey
Department of Environmental Protection
Division of Land Use Regulation
P.O. Box 439
Trenton, New Jersey 08625-0439
Telephone: (609) 292-0060
Fax: (609) 777-3656
Website: www.nj.gov/dep/landuse/

(g) USGS quad maps and Flood Hazard Area Technical Manuals can be obtained from the Department's Office of Maps and Publications at the address below. The Flood Hazard Area Technical Manual can also be downloaded from the website listed in (f) above.

State of New Jersey
Department of Environmental Protection
Office of Maps and Publications
428 East State Street
P.O. Box 438
Trenton, New Jersey 08625-0438
Telephone: (609) 777-1039
Fax: (609) 292-3285

7:13-1.2 Definitions

The following words and terms, when used in this chapter, have the following meanings unless the context clearly indicates otherwise:

"Acid producing soils" means soils that contain geologic deposits of iron sulfide minerals (pyrite or marcasite) which, when exposed to oxygen from the air or from surface waters, oxidize to produce sulfuric acid. Acid producing soils, upon excavation, generally have a pH of 4.0 or lower. After exposure to oxygen, these soils generally have a pH of 3.0 or lower. Information regarding the location of acid producing soils in New Jersey can be obtained from local Soil Conservation District offices.

"Actively farmed" means currently and continually in use for cultivation, grazing or other agricultural purposes, provided such activities are recognized as agricultural by the USDA. An area that lies fallow as part of a conventional rotational cycle that does not exceed five years is considered to be actively farmed. Farms that have been abandoned for more than five years are not actively farmed.

"Anadromous water" means a water that supports anadromous fish, as identified by the Department’s Division of Fish and Wildlife. Anadromous fish travel between salt water and fresh water or upstream to spawn, and N.J.A.C. 7:13-10.5(b) indicates how to determine which waters support anadromous fishery resources.

"Applicability determination" is the Department's official statement of whether an activity

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requires permit under this chapter, as described at N.J.A.C. 7:13-5.1.
"Aquatic habitat enhancement device" means a device placed within and/or adjacent to a channel to enhance aquatic habitat, typically consisting of boulders, brush, deflectors, felled shoreline trees, low-flow channel structures, mud sills, rubble reefs, spawning/nursery structures and/or tire structures.
"Architect" means a professional architect who is licensed to practice in New Jersey.
"Bank" means the inclined side of a channel, an excavated or impounded area or a topographic depression, which confines and/or conducts water.
"Bed" means the floor of a channel over which water flows continuously or intermittently. Bed also means the floor of an excavated or impounded area or of a topographic depression that confines and/or conducts water.
"Building" means a structure with walls and a roof, which is designed, constructed and/or intended for storage, shelter or occupation. A building that is intended for regular human occupation is considered a habitable building.
"Category One water" means a water designated as such in the Department's Surface Water Quality Standards at N.J.A.C. 7:9B.
"Central Passaic Basin" means the regulated area along the following waters:

1. Beaver Dam Brook, downstream of Jacksonville Road in Montville Township, Morris County;
2. Black Brook in Florham Park Borough, East Hanover Township and Hanover Township, Morris County;
3. Dead River, downstream of Liberty Corner Road in Bernards Township, Somerset County;
4. East Ditch, downstream of Jacksonville Road in Pequannock Township, Morris County;
5. Harrison Brook, downstream of Lake Road in Bernards Township, Somerset County;
6. Passaic River, between U.S. Route 202 in Bernards Township, Somerset County, and Harding Township, Morris County, and Beatties Dam in Little Falls Township, Passaic County;
7. Pequannock River, downstream of Paterson-Hamburg Turnpike in Riverdale Borough, Morris County, and Pompton Lakes Borough, Passaic County;
8. Pompton River;
9. Ramapo River, downstream of the Pompton Lake dam in Pompton Lakes Borough, Passaic County;
10. Rockaway River, downstream of the Boonton Reservoir dam in Boonton Town and Parsippany-Troy Hills Township, Morris County;
11. Wanaque River, downstream of Paterson-Hamburg Turnpike in Pompton Lakes Borough, Passaic County;
12. West Ditch, downstream of Jacksonville Road in Lincoln Park Borough, Morris County; and
13. Whippany River, downstream of State Route 10 in East Hanover and Hanover Townships, Morris County;

"Channel" means a linear topographic depression that continuously or intermittently confines and/or conducts surface water, not including transient erosional gullies and other ephemeral features that temporarily form after heavy rainfall. A channel can be naturally

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occurring or can be of human origin through excavation or construction. A channel includes both bed and banks.

"Channel modification" means the reconfiguration or reconstruction of all or part of a channel, such as by straightening, relocating, lining or excavating the channel, or by enclosing the channel within a structure such as a pipe or culvert. The removal of accumulated sediment and debris in accordance with N.J.A.C. 7:13-8.3, 8.4(c)2 or 11.15 is not a channel modification.

"Commissioner" means the Commissioner of the Department of Environmental Protection.

"Crawl space" means an enclosed area beneath a building's lowest finished floor, in which the vertical distance between the floor of the enclosed area and the building's lowest finished floor is no more than six feet.

"Dam" means a structure defined as such in the Department's Dam Safety Standards at N.J.A.C. 7:20.

"Department" means the New Jersey Department of Environmental Protection.

"Department delineation" means the flood profiles, flood elevations and/or detailed mapping of the flood hazard area and/or floodway, promulgated by the Department. Appendix 2 of this chapter, incorporated herein by reference, lists the Department delineated waters of New Jersey.

"Documented habitat for threatened or endangered species" means an area for which:

1. There is recorded evidence of past use by a threatened or endangered species of flora or fauna for breeding, resting or feeding. Evidence of past use by a species can include, but is not limited to, sightings of the species or of its sign (for example, skin, scat, shell, track, nest, herbarium records, etc.), as well as identification of its call; and
2. The Department makes the finding that the area remains suitable for use by the specific documented threatened or endangered species during the normal period(s) the species would use the habitat.

"Drainage area" means a geographic area within which water, sediments and dissolved materials drain to a particular receiving waterbody or to a particular point along a receiving waterbody.

"Drawing" means a graphic depiction of land, vegetation, water, structures, and other physical features on paper, such as a blueprint, construction plan, cross-section, topographic map, architectural rendering or other similar illustration, which is submitted to the Department to describe an existing or proposed activity or condition.

"Dry flood-proofing" means a modification to a building designed to eliminate or reduce potential flood damage to the building and its contents by preventing floodwaters from entering the building up to a certain elevation.

"Emergency permit" means an authorization to undertake a regulated activity, which is issued by the Department when certain conditions exist that warrant immediate action to protect the environment and/or public health, safety and welfare, as described at N.J.A.C. 7:13-12.

"Engineer" means a professional engineer who is licensed to practice in New Jersey.

"Erosion" means the detachment and movement of soil or rock fragments by water, wind, ice and/or gravity.

"Excavation" means removal or recovery of soil, minerals, mineral substances or organic substances other than vegetation, from the land surface or beneath the land surface, whether the

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land surface is exposed or submerged. Excavation does not include the movement of material due to erosion.

"FEMA" means the United States Federal Emergency Management Agency.

"FEMA flood insurance study" means a document providing various information regarding the potential for a water to flood, published by FEMA for certain waters in certain municipalities. A FEMA study can include flood profiles, floodway maps, flow rates and other information related to flooding along the water covered by the FEMA study. Requests for copies of the available FEMA flood insurance studies or flood profiles, as well as any questions regarding their use, derivation or modification, should be directed to FEMA at (800) 358-9616.

"FEMA flood profile" means a graphic depiction of the 100-year water surface elevation of a given water, published by FEMA as part of a FEMA flood insurance study. FEMA flood profiles are not included in all FEMA flood insurance studies.

"FEMA floodway map" means a map showing the limits of the floodway for a given water, published by FEMA as part of a FEMA flood insurance study. FEMA floodway maps are not included in all FEMA flood insurance studies.

"FEMA flow rate" means the calculated peak rate at which floodwaters would flow in a given water during a 100-year flood, published by FEMA as part of a FEMA flood insurance study. FEMA flow rates are not included in all FEMA flood insurance studies.

"Fill" means to deposit or place material on the surface of the ground and/or under water. "Fill" also means the material being deposited or placed. Fill includes, but is not limited to, concrete, earth, pavement, rock, sand, soil, structures or any stored material such as building material, construction equipment, landscaping material, piles of soil, stone or wood, trash, vegetation in planters and/or root balls, and vehicles. Fill does not include vegetation rooted in the ground, whether naturally occurring or planted.

"Flood control project" means a structural or topographic modification to a channel, flood hazard area and/or riparian zone, performed for the public benefit and undertaken by a public entity, which is designed primarily to reduce flood elevations, reduce the risk of damage from flooding and/or protect an area from flooding or flood damage.

"Flood fringe" means the portion of the flood hazard area that is outside the floodway.

"Flood hazard area" means land, and the space above that land, which lies below the flood hazard area design flood elevation. Structures, fill and vegetation that are situated on land that lies below the flood hazard area design flood elevation are described as being "in" or "within" the flood hazard area. The inner portion of the flood hazard area is called the floodway and the outer portion of the flood hazard area is called the flood fringe. Figures A and B at N.J.A.C. 7:13-2.3 illustrate these areas as well as the riparian zone along a typical water. The flood hazard area on a particular site is determined using the methods set forth at N.J.A.C. 7:13-3. There are two types of flood hazard areas:

1. Tidal flood hazard area, in which the flood hazard area design flood elevation is governed by tidal flooding from the Atlantic Ocean. Flooding in a tidal flood hazard area may be contributed to or influenced by stormwater runoff from inland areas, but the depth of flooding generated by the tidal rise and fall of the Atlantic Ocean is greater than flooding from any fluvial sources; and
2. Fluvial flood hazard area, in which the flood hazard area design flood elevation is governed by stormwater runoff. Flooding in a fluvial flood hazard area may be contributed to or influenced by elevated water levels generated by the tidal rise and

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fall of the Atlantic Ocean, but the depth of flooding generated by stormwater runoff is greater than flooding from the Atlantic Ocean.

"Flood hazard area design flood" means a flood equal to the 100-year flood plus an additional amount of water in fluvial areas to account for possible future increases in flows due to development or other factors. This additional amount of water also provides a factor of safety in cases when the 100-year flood is exceeded. N.J.A.C. 7:13-3 describes the various methods of determining the flood hazard area design flood for a particular water as well as the additional amount of water to be added in various situations.

"Flood hazard area design flood elevation" means the peak water surface elevation that will occur in a water during the flood hazard area design flood.

"Flood Hazard Area Technical Manual" means the version of the Department publication entitled "Flood Hazard Area Technical Manual" in effect at the time an application is submitted. The manual can be obtained from the Department at the address listed at N.J.A.C. 7:13-1.1(g). The manual includes a copy of this chapter, various application checklists and other information helpful for understanding the requirements of this chapter and the application review process.

"Floodway" means land, and the space above that land, which lies within the inner portion of the flood hazard area, and which is mathematically determined to be required to carry and discharge floodwaters resulting from the 100-year flood under certain conditions. The floodway always includes the channel and often includes land adjacent to the channel. The floodway is normally characterized by faster and deeper flows than the flood fringe, which is the portion of the flood hazard area outside the floodway.

"Freshwater wetlands" means an area defined as such under the Freshwater Wetlands Protection Act rules at N.J.A.C. 7:7A-1.4.

"General permit" means a flood hazard area permit to undertake a regulated activity for which the terms and conditions are established in a rule promulgated under this chapter at N.J.A.C. 7:13-8, and for which a person must submit an application for authorization.

"Grace period" means the period of time afforded under the Grace Period Law, N.J.S.A. 13:1D-125 et seq., for a person to correct a minor violation in order to avoid imposition of a penalty that would otherwise be applicable for such violation.

"Grading" means the movement of soil or other material on the surface of the ground by humans resulting in a change in topography.

"Habitable building" means a building that is intended for regular human occupation. Examples of a habitable building include a private residence or public building as defined below; a commercial building such as a retail store, restaurant, office building or gymnasium; an appurtenant structure that is regularly occupied, such as a garage, barn or workshop; and any other building that is regularly occupied, such as a house of worship, community center or meeting hall. Examples of a non-habitable building include a bus stop shelter, utility building, storage shed, self-storage unit or an individual shelter for animals such as a doghouse.

"Hazardous substance" means material defined as such in the Spill Compensation and Control Act, N.J.S.A. 58:10-23.11.

"Hazardous waste facility" means a facility that is licensed by the State to receive, store and/or process hazardous substances, and which is operating in accordance with all applicable Federal, State and local laws.

"Highlands Preservation Area" means that geographic portion of the State described in the Highlands Water Protection and Planning Act at N.J.S.A. 13:20-7(b)1.

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"Hydraulic capacity" means the ability of a channel, flood hazard area or structure to conduct water. Hydraulic capacity is a function of cross-sectional area, hydraulic friction, shape, skew, slope and the presence or absence of obstructions.
"Impervious surface" means a surface that is covered with a layer of material so that it is highly resistant to infiltration by water. Examples of an impervious surface include asphalt, brick, buildings, concrete, metal and most structures. In some instances, the Department will also consider densely packed gravel or stone roadways and parking areas to be impervious for the purposes of this chapter.
"Individual permit" means a flood hazard area permit to undertake a regulated activity issued by the Department after submittal of an application, and after the Department conducts a project-specific review under the applicable requirements at N.J.A.C. 7:13-9, 10 and 11.
"Invert" means the lowest point in a given cross-section of a channel, as well as the lowest point on the inside of a pipe, culvert or any other structure with an opening such as a flood vent.
"Jacking" means the placement of an underground utility line beneath a channel by means of horizontally pushing, drilling or otherwise forcing through the earth below the channel in such a way that the channel is not disturbed.
"Land surveyor" means a professional land surveyor who is licensed to practice in New Jersey.
"Lawfully existing" means an existing fill, structure and/or use, which meets all Federal, State and local laws, and which is not in violation of this chapter because it was established:

1. Prior to January 31, 1980; or
2. On or after January 31, 1980, in accordance with the requirements of this chapter as it existed at the time the fill, structure and/or use was established.

"Low dam" means an artificial dike, levee or other barrier, which is constructed for the purpose of impounding water on a permanent or temporary basis, but which does not raise the water surface elevation enough to meet the definition of a dam.
"Low-flow aquatic passage" means the ability of aquatic species to travel upstream and downstream in a waterway without impediment during low-flow conditions in a channel. Natural channel beds often possess small rivulets that serve to provide aquatic passage in this way during low-flow conditions, which can occur during dry periods of the year. Bridges, culverts and other manmade structures may also be designed to provide low-flow aquatic passage by inclusion of a linear depression throughout the bottom of the structure in the direction of flow, which collects water during low-flow conditions and allows aquatic species to pass through the structure without impediment.
"Lowest floor" means the lowest floor of a building, including a basement or any other area that can be occupied by humans, except for a crawl space, garage or other enclosed area that meets the requirements at N.J.A.C. 7:13-11.5(m), (n) or (o), respectively.
"Method 1" or the "Department delineation method" means the method of determining the flood hazard area design flood elevation and floodway limit from State adopted delineations, as described at N.J.A.C. 7:13-3.3.
"Method 2" or the "FEMA tidal method" means the method of determining the tidal flood hazard area design flood elevation and floodway limit from FEMA Flood Insurance Studies, as described at N.J.A.C. 7:13-3.4(d).
"Method 3" or the "FEMA fluvial method" means the method of determining the fluvial flood hazard area design flood elevation and floodway limit from FEMA Flood Insurance

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Studies, as described at N.J.A.C. 7:13-3.4(e).
"Method 4" or the "FEMA hydraulic method" means the method of determining the flood hazard area design flood elevation and floodway limit by calculation using flow rate data from FEMA Flood Insurance Studies, as described at N.J.A.C. 7:13-3.4(f).
"Method 5" or the "approximation method" means the method of determining the flood hazard area design flood elevation from the charts in chapter Appendix 1, incorporated herein by reference, as described at N.J.A.C. 7:13-3.5.
"Method 6" or the "calculation method" means the method of determining the flood hazard area design flood elevation and floodway limit by calculation using flow rates provided by an applicant for a verification under this chapter, as described at N.J.A.C. 7:13-3.6.
"NGVD" means the national geodetic vertical datum of 1929, which is the reference datum for all surveying, topography and elevations described in this chapter.
"Non-trout water" means a water that is defined as such in the Department's Surface Water Quality Standards at N.J.A.C. 7:9B. A non-trout water is a water that is not trout production, trout maintenance or trout stocked.
"NRCS" means the United States Department of Agriculture Natural Resource Conservation Service.
"Obstruction" means material placed and/or situated in a flood hazard area that can impede or change the direction of the flow of water, either by itself or by catching or collecting debris carried by such water.
"100-year flood" in fluvial areas means a flood that has a one percent probability of being equaled or exceeded within a one-year period for a given geographic location and/or watershed. In tidal areas, a "100-year flood" means a flood caused by a tidal surge in the Atlantic Ocean, which has a one percent probability of being equaled or exceeded within a one-year period.
"Permit-by-rule" means a flood hazard area permit to undertake a regulated activity for which the terms and conditions are established in a rule promulgated under this chapter at N.J.A.C. 7:13-7 and that is effective without prior written approval from the Department, provided all requirements established for that activity in the applicable permit-by-rule are satisfied.
"Person" means an individual, corporation, corporate officer, partnership, association, the Federal government, the State, a municipality, a commission or political subdivision of the State or any interstate body.
"Private residence" means a one or two-family dwelling.
"Private roadway" means a roadway for use by vehicles, including a driveway or access road, which is not a public roadway as defined in this section.
"Public building" means a habitable building that serves as one or more of the following:

1. An assisted living facility or nursing home;
2. A day care center;
3. A dormitory;
4. A hospital or medical clinic;
5. A jail or detention facility;
6. A police station, fire station or emergency response center;
7. A public shelter;
8. A residential rental unit of three or more units, such as an apartment, hotel or motel;

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9. A school or college; and

10. Any other building designed for a public use that is similar to 1 through 9 above.

"Public roadway" means a roadway for use by vehicles, including a driveway or access road, which is constructed for public use and is maintained by the Federal, State, county or municipal government.

"Reconstruct" means to patch, mend, replace, rebuild and/or restore a lawfully existing structure to a usable condition after decay or damage has occurred, in which greater than 50 percent of the structure is replaced and/or the size, shape or location of the structure is altered. For habitable buildings, the percentage of replacement shall be determined by comparing the cost of the reconstruction to the replacement value of the building. For all other structures, the percentage of replacement shall be determined by comparing the area of the structure being reconstructed to the total area of the structure.

"Regulated activity" means an activity that is regulated under this chapter as described at N.J.A.C. 7:13-2.4. Some regulated activities, when performed in a certain manner or to a specified degree, are permitted-by-rule at N.J.A.C. 7:13-7. All regulated activities which are not permitted-by-rule require a general permit under N.J.A.C. 7:13-8, an individual permit under N.J.A.C. 7:13-9, 10 and 11, an emergency permit under N.J.A.C. 7:13-12, or a coastal permit under N.J.A.C. 7:7 and N.J.A.C. 7:7E, prior to commencement.

"Regulated area" means the flood hazard area and riparian zone along a regulated water, as described at N.J.A.C. 7:13-2.3.

"Regulated water" means a water subject to this chapter as described at N.J.A.C. 7:13-2.2.

"Repair" means to patch, mend, replace, rebuild and/or restore a lawfully existing structure to a usable condition after decay or damage has occurred, in which no more than 50 percent of the structure is replaced and the size, shape or location of the structure is not altered. For habitable buildings, the percentage of replacement shall be determined by comparing the cost of the repair to the replacement value of the building. For all other structures, the percentage of replacement shall be determined by comparing the area of the structure being reconstructed to the total area of the structure.

"Revision" means a document issued by the Department to revise a valid, previously issued verification, general permit authorization, individual permit or Department delineation as described at N.J.A.C. 7:13-13.

"Riparian zone" means the land and vegetation within and adjacent to a regulated water as described at N.J.A.C. 7:13-4.1 and illustrated at N.J.A.C. 7:13-2.3.

"Sediment" means solid material, mineral or organic, that is in suspension, is being transported or has been moved from its site of origin by air, water, ice or gravity as a product of erosion.

"Site" means the area within the legal boundary of the property, properties or right-of-way upon which any action under this chapter is requested, proposed, occurring or has occurred, plus any contiguous land owned or controlled by the same person(s). The legal boundary of a property is set forth in the deed(s) of the property. The legal boundary of a right-of-way is set forth in the document creating the right-of-way.

"Soil bioengineering" means the method of stabilizing eroded banks using vegetation, and sometimes in conjunction with other natural materials, as described at section 650.1601(d)(2) of Chapter 16 in the USDA Natural Resource Conservation Service Engineering Field Handbook, published December 1996, incorporated herein by reference. Copies of the Engineering Field Handbook can be obtained from local NRCS offices.

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"Soil Conservation District" means a division of the New Jersey Department of Agriculture (NJDA), authorized under N.J.S.A. 4:24-1 et seq. Each Soil Conservation District administers NJDA programs for one or more counties. Soil Conservation Districts are overseen by the New Jersey State Soil Conservation Committee in the NJDA, which promulgates the Standards for Soil Erosion and Sediment Control in New Jersey at N.J.A.C. 2:90.
"Solid waste" means any garbage, refuse, sludge or any other material defined as solid waste in the Solid Waste Rules at N.J.A.C. 7:26-1.6.
"Solid waste facility" means a facility that is licensed by the State to receive, store and/or process solid waste.
"Stormwater" means 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 storm sewers or other sewage or drainage facilities.
"Stormwater management basin" means an impoundment created by constructing an embankment, excavating a pit and/or erecting or placing a structure, for the purpose of managing stormwater runoff. A stormwater management basin can be designed to be normally dry (as in a detention or infiltration basin), retain a permanent pool of water (as in a retention basin or wet pond), and/or be planted mainly with vegetation suitable for freshwater wetlands (as in most constructed stormwater wetlands).
"Stormwater runoff" means water flow on the surface of the ground or in storm sewers, resulting from precipitation.
"Structure" means any assemblage of material by humans, including, but not limited to, a berm, bridge, bulkhead, building, cable, causeway, culvert, dam, dike, embankment, fence, jetty, levee, pavement, piling, pipe, post, railroad, retaining wall, roadway, stormwater management basin, tower, utility pole or wire. Vegetation is not a structure. Soil bioengineering material that includes vegetation as well as other material is a structure.
"Suitably anchored" means secured to resist flotation, collapse and displacement due to floodwaters. A structure shall be considered to be suitably anchored if the structure is erected in accordance with the requirements for flood-resistant construction in the International Building Code, incorporated herein by reference. Copies of the International Building Code can be obtained at the following address:

International Code Council, Inc.
4051 West Flossmoor Road
Country Club Hills, Illinois 60477
Telephone: (888) 422-7233

"Temporary" means a regulated activity that occupies, persists and/or occurs on a site for no more than six months. For example, a fill or structure is temporary if, within six months of its placement, the fill or structure is removed from the site, all disturbed regulated areas are restored to their original topography, and all necessary measures are implemented to ensure that the original vegetative cover onsite is restored to its previous (or an improved) condition.
"Threatened or endangered species" means a species identified pursuant to the Endangered and Nongame Species Conservation Act, N.J.S.A. 23:2A-1 et seq., the Endangered Species Act of 1973, 16 U.S.C. § § 1531 et seq. or the Endangered Plant Species List, N.J.A.C. 7:5C-5.1, and any subsequent amendments thereto.
"Tree" means a woody plant which is five inches or greater in diameter at a height of 4.5 feet above the ground.
"Trout maintenance water" means a section of water designated as trout maintenance in the

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Department's Surface Water Quality Standards at N.J.A.C. 7:9B.
"Trout production water" means a section of water identified as trout production in the Department's Surface Water Quality Standards at N.J.A.C. 7:9B.
"Trout stocked water" means a section of water stocked with trout by the Department's Division of Fish and Wildlife and listed in N.J.A.C. 7:25-6.
"Unsecured material" means the following:

1. A structure that is not suitably anchored; and
2. Material placed on the surface of the ground, which would likely become buoyant, mobile or lifted by water during a flood, or otherwise be transported offsite by floodwaters. Examples include building material, construction equipment, landscaping material, patio furniture, piles of soil, stone or wood, trash, vegetation in planters or root balls, and vehicles.

"USDA" means the United States Department of Agriculture.
"USGS quad map" means a topographic quadrangle map issued by the United States Geologic Survey (USGS), 7.5 minute series, drawn at a scale of 1:24,000, available from the Department at the address listed in N.J.A.C. 7:13-1.1(g).
"Utility line" means a pipe, cable, line or wire for the transport or transmission of gases, liquids, electrical energy or communications. This term includes a pole or tower required to support a utility line, but does not include a tower that only transmits or receives electromagnetic waves through the air, such as for radio, television or telephone transmission.
"Verification" means a document issued by the Department under N.J.A.C. 7:13-6, which establishes the flood hazard area design flood elevation, flood hazard area limit, floodway limit, and/or riparian zone limit on a site.
"Water" means a collection of water on the surface of the ground, including, but not limited to, a bay, brook, creek, ditch, lake, pond, reservoir, river or stream. A water also includes the path or depression through which the water flows or is confined. A water that is piped, relocated or otherwise modified remains a water. A storm sewer is not a water unless it was constructed to replace or divert a previously existing water.
"Water control structure" means a structure within or adjacent to a water, which intentionally or coincidentally alters the hydraulic capacity, design flood elevation, flood hazard area limit and/or floodway limit of the water. Examples of a water control structure include a bridge, culvert, dam, embankment, ford (if above grade), retaining wall and weir.
"Water surface elevation" means the elevation of the surface of a water, measured in feet NGVD, and determined either by special calculation or gauge. For the purposes of determining compliance with a requirement of this chapter, a water surface elevation is rounded to the nearest 0.1 feet.

7:13-1.3 Types of permits and approvals

(a) This chapter establishes procedures and requirements for the following permits and approvals:

1. An applicability determination, in accordance with N.J.A.C. 7:13-5;
2. A verification, in accordance with N.J.A.C. 7:13-6;
3. A permit-by-rule, in accordance with N.J.A.C. 7:13-7;
4. A general permit, in accordance with N.J.A.C. 7:13-8;
5. An individual permit, in accordance with N.J.A.C. 7:13-9, 10 and 11;
6. An emergency permit, in accordance with N.J.A.C. 7:13-12;

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7. A revision of a verification, general permit authorization, individual permit or Department delineation, in accordance with N.J.A.C. 7:13-13; and

8. A transfer of an approval to another person, in accordance with N.J.A.C. 7:13-14.1.

(b) Only the following persons or entities may qualify to obtain or operate under the permits and approvals listed at (a) above:

1. The owner(s) of the site on which the regulated activity is proposed or conducted. If the regulated activity is proposed or conducted within a right-of-way or easement, the Department shall be provided written consent for the regulated activity from the owner(s) of the right-of-way or easement;

2. An agent that has been designated by the owner(s) of the site on which the regulated activity is proposed or conducted to obtain or operate under a permit or approval on behalf of the owner(s); or

3. A public entity that is proposing work within an existing or proposed right-of-way or easement, which is owned or controlled by that entity or which will be appropriated by that entity under the power of eminent domain.

(c) The Department shall review an application for a permit or approval listed in (a) above according to this chapter in effect on the day that a complete application is received by the Department. Any amendments to this chapter that are promulgated after the receipt of a complete application (as described by the application requirements for each type of permit or approval under this chapter) shall not affect the Department's review of that application, unless otherwise agreed to in writing by both the Department and the applicant.

(d) A person submitting an application under this chapter shall, to the extent that the person is aware, notify the Department of all facts relevant to the review of the application including, but not limited to, the presence of regulated areas and of threatened or endangered species onsite, history of flooding and previous flood damages onsite and the location of easements and other encumbrance on the property. Failure to provide all necessary information of which the applicant, its consultants, engineers, surveyors or agents is aware may result in the denial of an application or the suspension or termination of an approval, and may subject the applicant, its consultants, engineers, surveyors or agents to enforcement action under action pursuant to N.J.A.C. 7:13-19 for submittal of false information.

(e) No Department decision made under this chapter shall obligate the Department to approve or deny any future application under this or any other Department program or rule.

7:13-1.4 Delegation of authority

(a) Except as specified in (e) below, the Department may delegate authority to take action under this chapter to a county governing body. A county governing body seeking to assume all or a portion of the Department's authority under this chapter shall do the following:

1. Retain employees with professional training and education capable of properly administering the permitting program established by this chapter; and

2. Submit to the Department a written request for delegation that includes the following:

i. A description of the aspects of the Department's authority that the county governing body seeks to assume;

ii. An agreement to uphold the requirements of this chapter;

iii. A written statement by the county governing body agreeing to apply for and accept delegation of authority, pursuant to N.J.S.A. 58:16A-55.6, and agreeing

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to adopt, in the event the request is approved, an ordinance or resolution enabling the body to carry out the delegation. A copy of the proposed ordinance or resolution shall also be provided; and

iv. A detailed description of the personnel, the physical resources and the source and amount of funding the county governing body shall use to fulfill the obligations it seeks to assume.

(b) Within 60 calendar days of receipt of a request by a county governing body in accordance with (a)2 above, the Department shall:

1. Delegate all or a portion of the authority sought by the county governing body. Such delegation may include conditions to ensure compliance with this chapter, and may be for a specified period of time, as the Department deems appropriate; or

2. Deny the request for delegation and provide the reasons why the Department has determined such delegation is not appropriate.

(c) A county governing body that has assumed delegation shall permanently retain, and make available for Department review, a copy of all documents, plans, maps, memoranda and notes necessary to document that it has discharged its delegated duties for each application it processes. The Department shall review these records at least biannually. The Department can at any time terminate delegation if it determines that the county governing body has failed to properly administer the authority delegated to it, or has failed to maintain the necessary documentation.

(d) A county governing body that has assumed delegation shall not charge fees greater than those provided at N.J.A.C. 7:13-17.

(e) The Department shall not delegate authority to approve any of the following:

1. An application under this chapter by a State agency;

2. An application under this chapter by the county governing body itself; and

3. An application under this chapter for an individual permit that involves a hardship exception pursuant to N.J.A.C. 7:13-9.8.

7:13-1.5 Creation of a county water resources association

(a) A county governing body can create, by ordinance or resolution, a county water resources association, the purpose of which shall be to:

1. Establish county flood control and water management programs, and coordinate these with State and Federal programs;

2. Advise the county governing body on issues related to flood control and water management; and

3. Undertake other duties concerning flood control and water management that the county governing body delegates to the association by ordinance or resolution.

(b) The county governing body shall appoint the members of the county water resources association. Appointed members may include the chief administrative officer or executive of a county planning agency, office of the county engineer, county utility authority, county health department, county mosquito commission, local Soil Conservation District, county parks agency and any other person with relevant experience or training.

7:13-1.6 Liberal construction

This chapter shall be liberally construed to enable the Department to fulfill its statutory obligations. The Commissioner can amend, repeal or rescind this chapter or any part thereof in

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accordance with the Administrative Procedure Act, N.J.S.A. 52:14B-1 et seq.

7:13-1.7 Severability
If any section, subsection, provision, clause or portion of these rules or the application thereof to any person or circumstance is judged unconstitutional or invalid by a court of competent jurisdiction, the remainder of these rules and their application to persons and circumstances other than those to which they have been held invalid shall not be affected thereby.

SUBCHAPTER 2. EXTENT OF REGULATORY AUTHORITY

7:13-2.1 Permit requirement
(a) No person shall engage in a regulated activity in a regulated area without a flood hazard area permit as required by this chapter, or a coastal permit as required by N.J.A.C. 7:7 and 7:7E, as set forth in (b) and (c) below. Initiation of a regulated activity in a regulated area without a flood hazard area or coastal permit as set forth at (b) below (except as provided in (c) below) shall be considered a violation of this chapter and shall subject the party or parties responsible for the regulated activity to enforcement action, as set forth at N.J.A.C. 7:13-19. Regulated areas are set forth at N.J.A.C. 7:13-2.3 and regulated activities are set forth at N.J.A.C. 7:13-2.4.
(b) Except as provided in (c) or (e) below, a person undertaking any regulated activity in a regulated area shall do so only in accordance with one of the following:

1. A permit-by-rule, pursuant to N.J.A.C. 7:13-7;
2. An authorization under a general permit, pursuant to N.J.A.C. 7:13-8;
3. An individual permit, pursuant to N.J.A.C. 7:13-9, 10 and 11;
4. An emergency permit, pursuant to N.J.A.C. 7:13-12; or
5. A CAFRA or waterfront development permit, pursuant to N.J.A.C. 7:7 and N.J.A.C. 7:7E, provided:
    i. The CAFRA or waterfront development permit was declared by the Department as complete for final review on or after November 5, 2007; and
    ii. If activities are proposed in a fluvial flood hazard area, the applicant meets one of the four conditions at N.J.A.C. 7:13-9.6(a) regarding the need for a verification of the flood hazard area and/or floodway onsite.

(c) Undertaking a regulated activity in a regulated area does not require an approval listed at (b) above in the cases listed below. For the purpose of this subsection, each distinct construction activity in a project, such as each building, road or utility crossing, is considered a distinct regulated activity.

1. The regulated activity is part of a project for which all elements that were subject to the Flood Hazard Area Control rules in effect prior to November 5, 2007, have been approved under a permit issued pursuant to those rules, provided:
    i. The regulated activity is specifically approved under the permit, or was not subject to the requirements of this chapter prior to November 5, 2007;
    ii. The application for the permit was received by the Department and was complete for review prior to November 5, 2007; and
    iii. The permit is valid when the regulated activity is undertaken;
2. The regulated activity is part of a project for which all elements in a tidal flood hazard area that were subject to N.J.A.C. 7:7 and N.J.A.C. 7:7E in effect prior to

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November 5, 2007, have been approved under a valid CAFRA or waterfront development permit, provided:

i. The regulated activity is specifically approved under the permit, or was not subject to the requirements of N.J.A.C. 7:7 and N.J.A.C. 7:7E prior to November 5, 2007;

ii. The application for the permit was received by the Department and was declared complete for final review prior to November 5, 2007; and

iii. The permit is valid when the regulated activity is undertaken;

3. The regulated activity is part of a project that was subject to neither the requirements of this chapter, nor N.J.A.C. 7:7 and N.J.A.C. 7:7E, prior to November 5, 2007, and both of the following apply:

i. The regulated activity is located within the Hackensack Meadowlands District; and

ii. The regulated activity is authorized under a valid zoning certificate issued by the New Jersey Meadowlands Commission prior to November 5, 2007, pursuant to N.J.A.C. 19:4-4.2; or

4. The regulated activity is part of a project that was subject to neither the requirements of this chapter, nor N.J.A.C. 7:7 and N.J.A.C. 7:7E, prior to November 5, 2007, and one of the following applies:

i. The regulated activity is authorized under a valid municipal approval, issued prior to the November 5, 2007, which enables commencement of construction of the regulated activity on a specific lot and/or easement; or

ii. The regulated activity does not require an approval identified in (c)4i above, and one or more of the following construction activities were completed onsite prior to November 5, 2007:

(1) The foundation for at least one building or structure;

(2) All of the subsurface improvements for a roadway; or

(3) The installation of all of the bedding materials for a utility line.

(d) If a regulated activity is approved under a qualifying approval listed at (c) above, and the regulated activity is subsequently revised by the issuing entity, the original approval continues to satisfy the requirements of (c) above provided the Department determines that the revision will not result in one or more of the following:

1. An increase in the area of vegetation disturbed in a riparian zone;

2. An increase in flood storage displacement in a flood hazard area;

3. For regulated activities under a qualifying approval under (c)1 or 2 above, additional regulated activities within a regulated area that have not been previously reviewed by the Department under N.J.A.C. 7:7, 7:7E and/or this chapter, as applicable; and/or

4. A change in land use and/or an alteration of the basic purpose and intent of the project, such as converting a residential development into a commercial development.

(e) If railroad activities proposed in a flood hazard area or riparian zone are exempt from State regulation under Federal law, no permit shall be required under this chapter for that activity. However, the railroad shall provide the Department with the application material normally required for the proposed activity at least 90 calendar days prior to the railroad commencing the activity. For emergency activities, the information described at N.J.A.C. 7:13-12.1(c) shall be provided to the Department via telephone and/or fax, as listed at N.J.A.C. 7:13-1.1(f), as

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soon as possible after the emergency is discovered, and in no event later than the day the activity is authorized or commences, whichever occurs first.

7:13-2.2 Regulated waters

(a) All waters in New Jersey are regulated under this chapter except for the following:

1. Any manmade canal;
2. In accordance with N.J.S.A. 58:16A-60, any coastal wetland regulated under the Wetlands Act of 1970 (N.J.S.A. 13:9A-1 et seq.); and
3. Any segment of water that has a drainage area of less than 50 acres, provided one or more of the following applies:
   - i. The water has no discernible channel;
   - ii. The water is confined within a lawfully existing, manmade conveyance structure or drainage feature, such as a pipe, culvert, ditch, channel or basin (not including any water that historically possessed a naturally-occurring, discernible channel, which has been piped, culverted, ditched or similarly modified); and/or
   - iii. The water is not connected to a regulated water by a channel or pipe, such as an isolated pond or depression that has no outlet.

7:13-2.3 Regulated areas

(a) For each regulated water, as described at N.J.A.C. 7:13-2.2, the Department identifies and regulates the water and the area surrounding it in two different ways, resulting in the regulated areas described at (a)1 and 2 below:

1. A flood hazard area exists along every regulated water that has a drainage area of 50 acres or more. If a regulated water has a drainage area of less than 50 acres, the water does not have a flood hazard area that is regulated under this chapter. The flood hazard area is comprised of a flood fringe and a floodway, except for the Atlantic Ocean and other non-linear tidal waters such as bays and inlets, which do not have a floodway. Therefore, the entire flood hazard area along these tidal waters is considered to be a flood fringe for the purposes of this chapter. The methods for determining the limits of the flood fringe and floodway are described at N.J.A.C. 7:13-3; and
2. A riparian zone exists along every regulated water, except there is no riparian zone along the Atlantic Ocean nor along any manmade lagoon, stormwater management basin, or oceanfront barrier island, spit or peninsula. The regulated water itself is also part of the riparian zone. The methods for determining the limits of the riparian zone are described at N.J.A.C. 7:13-4.1.

(b) The flood hazard area and riparian zone described at (a)1 and 2 above generally overlap. Figures A and B below (not drawn to scale) illustrate a typical water and each of these regulated areas. This chapter sets forth the specific requirements applicable to activities in each regulated area.

FIGURE A: [*Omitted*]
FIGURE B: [*Omitted*]

7:13-2.4 Regulated activities

(a) Any action that includes or results in one or more of the following constitutes a regulated activity under this chapter if undertaken in a regulated area, as described at N.J.A.C. 7:13-2.3:

1. The alteration of topography through excavation, grading and/or placement of fill;

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2. The clearing, cutting and/or removal of vegetation in a riparian zone;
3. The creation of impervious surface;
4. The storage of unsecured material;
5. The construction, reconstruction and/or enlargement of a structure; and
6. The conversion of a building into a private residence or a public building.

SUBCHAPTER 3. DETERMINING THE FLOOD HAZARD AREA AND FLOODWAY

7:13-3.1 General provisions for determining the flood hazard area and floodway along a regulated water

(a) This subchapter provides six methods for determining the flood hazard area and floodway along a regulated water as follows:

1. Method 1 (Department delineation method) as described at N.J.A.C. 7:13-3.3;
2. Method 2 (FEMA tidal method) as described at N.J.A.C. 7:13-3.4(d);
3. Method 3 (FEMA fluvial method) as described at N.J.A.C. 7:13-3.4(e);
4. Method 4 (FEMA hydraulic method) as described at N.J.A.C. 7:13-3.4(f);
5. Method 5 (approximation method) as described at N.J.A.C. 7:13-3.5; and
6. Method 6 (calculation method) as described at N.J.A.C. 7:13-3.6.

(b) The flood hazard area is the land, and the space above that land, which lies below the flood hazard area design flood elevation, as defined at N.J.A.C. 7:13-1.2. The six methods described in (a) above provide the flood hazard area design flood elevation, from which the flood hazard area limit on a site is determined. In some cases, the limits of the floodway can also be determined using these methods.

(c) In most cases, the Department shall issue an individual permit under this chapter only if the applicant has determined the flood hazard area and floodway limits on the site, and has received a verification for these limits from the Department pursuant to N.J.A.C. 7:13-6.1. However, under certain conditions as set forth at N.J.A.C. 7:13-9.6, the flood hazard area and/or floodway limits need not be verified in order for the Department to be able to determine whether a regulated activity complies with this chapter. Furthermore, a verification is not required prior to obtaining a general permit authorization under this chapter, except for certain cases as noted under general permits 5, 6 and 7 at N.J.A.C. 7:13-8.7, 8.8 and 8.9, respectively.

(d) The flood hazard area and floodway described in this subchapter may differ from areas identified as a "flood hazard area," "flood zone," "floodplain" or "floodway" by another public entity such as FEMA or a local government. The methods listed at (a) above are specifically designed and intended for determining compliance with the construction standards and requirements of this chapter.

7:13-3.2 Selecting a method for determining the flood hazard area and floodway along a regulated water

(a) This section establishes the methods by which the flood hazard area and floodway shall be determined along a regulated water. The flowchart at the end of this section illustrates the correct use of this process. The Flood Hazard Area Technical Manual, available from the Department at the address listed at N.J.A.C. 7:13-1.1(g), also provides further guidance on how to perform calculations for those methods that require calculations.

(b) There are a number of factors that influence the selection of a method for determining the

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flood hazard area and floodway. These factors include the existence of a Department delineation or FEMA flood insurance study, whether the applicant proposes a regulated activity in the flood hazard area and what type of project is proposed. Furthermore, each method has certain limitations on its usefulness and availability as described in this subchapter. Applicants are encouraged to carefully review the entire subchapter before selecting a method.

(c) The flood hazard area and floodway limits along a regulated water shall be determined as follows:

1. If a Department delineation exists for a regulated water, an applicant shall use Method 1 as described at N.J.A.C. 7:13-3.3. Appendix 2 of this chapter lists the Department delineated waters of New Jersey.

2. If no Department delineation exists for a regulated water, an applicant may:

i. Determine the flood hazard area and/or floodway from FEMA mapping, if such mapping exists for the section of regulated water in question, using Methods 2, 3 or 4 as described at N.J.A.C. 7:13-3.4(d), (e) and (f), respectively;

ii. Determine the approximate limit of the flood hazard area using Method 5 as described at N.J.A.C. 7:13-3.5 if no FEMA mapping is exists for the section of regulated water in question; or

iii. Determine the flood hazard area and/or floodway by calculation using Method 6 as described at N.J.A.C. 7:13-3.6.

(d) The flood hazard area and floodway shall be determined using only one method for each regulated water on a site, except in the following cases:

1. If a Department delineation or FEMA flood insurance study terminates within a site, the flood hazard area on the remainder of the site may be delineated using another applicable method described in this subchapter; and

2. If Method 3 is used to delineate the flood hazard area but no FEMA floodway map exists for the section of regulated water in question, and determining the floodway is necessary to demonstrate compliance with the requirements of this chapter, the applicant shall use Method 4 to calculate the floodway.

FLOW CHART FOR DETERMINING THE FLOOD HAZARD AREA ON A SITE1
[***Flow Chart Omitted***]

7:13-3.3 Flood hazard area and floodway based on a Department delineation (Method 1)

(a) This section sets forth the procedure for determining a flood hazard area design flood elevation and floodway limit from a Department delineation. Appendix 2 of this chapter lists the Department delineated waters of New Jersey. Requests for copies of a Department delineation, including flood profiles and maps, as well as any questions regarding the use, derivation or modification of these delineations, should be directed to the Department's Office of Floodplain Management at the following address:

State of New Jersey
Department of Environmental Protection
Bureau of Dam Safety and Flood Control
P.O. Box 419
Trenton, New Jersey 08625-0419
Telephone: (609) 984-0859

(b) The following apply if a Department delineation has been promulgated under this chapter

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for a regulated water:

1. The flood hazard area design flood elevation is that which is shown on the flood profile adopted as part of the Department delineation; and
2. The floodway limit is that which is shown on the flood maps adopted as part of the Department delineation.

(c) An applicant seeking to modify a Department delineation shall submit an application for a revision as provided at N.J.A.C. 7:13-13.4.
(d) If an applicant proposes construction in a Department delineated floodway, and must prepare hydraulic calculations to demonstrate that the construction meets the requirements of this chapter, the applicant shall base the calculations on the original data used by the Department to determine the delineation. Such data is available from the Department at the address listed in (a) above.

7:13-3.4 Flood hazard area and floodway based on a FEMA flood insurance study (Methods 2 through 4)

(a) This section sets forth the procedure for determining a flood hazard area design flood elevation and floodway limit from a FEMA flood insurance study where no Department delineation exists. Requests for copies of the available FEMA flood insurance studies or flood profiles, as well as any questions regarding their use, derivation or modification, should be directed to FEMA at (800) 358-9616.
(b) The methods set forth in this section for determining the flood hazard area and floodway along a regulated water may be used only if the following requirements are satisfied:

1. No Department delineation exists for the section of regulated water in question; and
2. A FEMA flood insurance study exists for the section of regulated water in question, which meets the following:
   i. The FEMA flood insurance study includes the information needed for the Method that is being used. For example, Methods 2 and 3 below require that the FEMA study includes the regulated water's 100-year flood elevation, and Method 4 below requires that the FEMA study includes the regulated water's 100-year flow rate;
   ii. The flood insurance study used is dated January 31, 1980, or later; and
   iii. The flood insurance study used is the most recent study published by FEMA for that municipality.

(c) There are three methods by which a FEMA flood insurance study may be used to determine the flood hazard area and floodway limit along a regulated water as follows:

1. Method 2 (FEMA tidal method), set forth at (d) below, which applies to a tidal flood hazard area for which a FEMA flood profile exists for the section of regulated water in question. If the FEMA flood insurance study does not provide a 100-year flood elevation, it is not possible to use this method;
2. Method 3 (FEMA fluvial method), set forth at (e) below, which applies to a fluvial flood hazard area for which a FEMA flood profile exists for the section of regulated water in question. If the FEMA flood insurance study does not provide a 100-year flood elevation, it is not possible to use this method; and
3. Method 4 (FEMA hydraulic method), set forth at (f) below. This method may be used only if the following requirements are satisfied:

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i. The FEMA flood insurance study provides a 100-year flow rate for the regulated water. In most tidal flood hazard areas a large area is inundated due to flooding from the Atlantic Ocean, and therefore FEMA does not provide a 100-year flow rate for the regulated water itself. In such a case, it is not possible to use this method; and

ii. The applicant proposes a regulated activity in the flood hazard area and applies for an individual permit under this chapter, for which the Department requires hydraulic calculations comparing pre-construction and post-construction water surface elevations within the regulated water, in order to demonstrate that the regulated activity complies with this chapter. Examples of activities that require such an analysis are detailed at N.J.A.C. 7:13-11.1(f), 11.1(g), 11.7(c) and 11.7(d).

(d) Under Method 2 (FEMA tidal method):

1. The flood hazard area design flood elevation shall be equal to the FEMA 100-year flood elevation; and

2. The floodway limit shall be determined as follows:

i. If a FEMA floodway map exists for the section of regulated water in question, the floodway limit shall be equal to the floodway limit shown on the FEMA floodway map; or

ii. If no FEMA floodway map exists for the section of regulated water in question, the floodway limit shall be equal to the limits of the channel. The Atlantic Ocean and other non-linear tidal waters such as bays and inlets do not have a floodway.

(e) Under Method 3 (FEMA fluvial method):

1. The flood hazard area design flood elevation shall be equal to one foot above the FEMA 100-year flood elevation; and

2. The floodway limit shall be determined as follows:

i. If a FEMA floodway map exists for the section of regulated water in question, the floodway limit shall be equal to the floodway limit shown on the FEMA floodway map; or

ii. If no FEMA floodway map exists for the section of regulated water in question, the floodway limit cannot be determined using this method. The applicant shall instead calculate the floodway limit using Method 4 as described in (f) below. In such a case, applicants are encouraged to first contact the Department to discuss whether it is necessary to determine the floodway limit on a site for a given project.

(f) Under Method 4 (FEMA hydraulic method):

1. The flood hazard area design flood elevation and floodway limit shall be based on a standard step backwater analysis and determined as follows:

i. For a tidal flood hazard area, a hydraulic analysis shall be performed to determine the flood hazard area design flood elevation using the 100-year flow rate reported by FEMA for the regulated water (see (c)3i above);

ii. For a fluvial flood hazard area, a hydraulic analysis shall be performed to determine the flood hazard area design flood elevation using 125 percent of the 100-year flow rate reported by FEMA for the regulated water; and

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iii. A hydraulic analysis shall be performed to determine the floodway limit using the 100-year flow rate reported by FEMA for the regulated water, assuming a maximum rise of 0.2 feet in the 100-year flood elevation. The floodway limits shall be calculated assuming equal conveyance reduction, unless the applicant demonstrates (prior to the submission of an application for a verification to the Department) that due to the topography of the area, the proximity of structures to the channel and/or other physical characteristics of the watershed or flood hazard area, use of another method will more optimally calculate the floodway limits at a given location.

7:13-3.5 Flood hazard area determined by approximation (Method 5)

(a) This section sets forth the procedure for approximating a flood hazard area design flood elevation using the method described in chapter Appendix 1. This method does not provide a floodway limit. Therefore, the Department shall issue an individual permit for a regulated activity within an approximated flood hazard area only if the project meets the requirements at N.J.A.C. 7:13-9.7.

(b) The flood hazard area design flood elevation for a regulated water can be approximated under Method 5, provided the following requirements are satisfied:

1. Method 1 (Department delineation method) set forth at N.J.A.C. 7:13-3.3 cannot be used because no Department delineation exists for the section of regulated water in question;
2. Methods 2 through 4 (FEMA fluvial, FEMA tidal and FEMA hydraulic methods) set forth at N.J.A.C. 7:13-3.4 cannot be used because no qualifying FEMA flood insurance study exists for the section of regulated water in question; and
3. The drainage area of the water at the project site does not exceed 30 square miles.

(c) An applicant may elect to establish the approximate flood hazard area limit at an elevation higher than that which is provided by Method 5 in order to match an existing topographic feature onsite, such as the top of an embankment, or to run concurrent with a verified freshwater wetland or transition area line.

(d) Method 5 is intended to be conservative and may in some cases overestimate the actual limits of flooding onsite to ensure that public health, safety and welfare is adequately protected in absence of a Department delineation or FEMA flood insurance study. Note that an applicant may use Method 6 under N.J.A.C. 7:13-3.6 to determine the flood hazard area and floodway along any regulated water for which no Department delineation exists.

(e) If the Department determines that using Method 5 to approximate a flood hazard area will significantly underestimate the depth of flooding on a particular site due to an unusual hydrologic or hydraulic condition within the drainage area, or due to a unique feature on or near the site, the Department shall not approve a general permit authorization or an individual permit for any regulated activity in the approximated flood hazard area if such approval is determined to constitute a threat to public safety. Should the applicant choose to apply for a permit in such a case, the flood hazard area limit shall first be calculated according to Method 6, as described at N.J.A.C. 7:13-3.6.

7:13-3.6 Flood hazard area and floodway determined by calculation (Method 6)

(a) This section sets forth the procedure for determining a flood hazard area design flood elevation and floodway limit via hydrologic and hydraulic calculations. An applicant may use

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Method 6 to determine the flood hazard area and floodway along any regulated water for which no Department delineation exists. If a Department delineation does exist on a site, the applicant shall use Method 1 as set forth at N.J.A.C. 7:13-3.3.

(b) If the following conditions exist, Method 6 is the only method by which an applicant may determine the flood hazard area and floodway along a regulated water:

1. Method 1 (Department delineation method) set forth at N.J.A.C. 7:13-3.3 cannot be used because no Department delineation exists for the section of regulated water in question;
2. Methods 2 through 4 (FEMA fluvial, FEMA tidal and FEMA hydraulic methods) set forth at N.J.A.C. 7:13-3.4 cannot be used because no qualifying FEMA flood insurance study exists for the section of regulated water in question; and
3. Method 5 (approximation method) set forth at N.J.A.C. 7:13-3.5 cannot be used for one of the following reasons:
    i. The requirements for using the approximate method at N.J.A.C. 7:13-3.5(b) are not satisfied;
    ii. The Department determines that the approximate method will significantly underestimate the depth of flooding on the site in question, pursuant to N.J.A.C. 7:13-3.5(e); or
    iii. The applicant is proposing a regulated activity for which the requirements at N.J.A.C. 7:13-9.7 are not satisfied.

(c) Under Method 6, the flood hazard area design flood elevation and floodway limit shall be based on a standard step backwater analysis and determined as follows:

1. A hydrologic analysis shall be performed to determine the peak flow rate for the 100-year flood for the regulated water. The hydrologic analysis shall assume existing development conditions in the drainage area, as of the date of the application to the Department;
2. For a tidal flood hazard area, a hydraulic analysis shall be performed to determine the flood hazard area design flood elevation using the 100-year flow rate determined under (c)1 above;
3. For a fluvial flood hazard area, a hydraulic analysis shall be performed to determine the flood hazard area design flood elevation using 125 percent of the 100-year flow rate determined under (c)1 above; and
4. A hydraulic analysis shall be performed to determine the floodway limit using the 100-year flow rate determined under (c)1 above, assuming a maximum rise of 0.2 feet in the100-year flood elevation. The floodway limits shall be calculated assuming equal conveyance reduction, unless the applicant demonstrates (prior to the submission of an application for a verification to the Department) that due to the topography of the area, the proximity of structures to the channel and/or other physical characteristics of the watershed or flood hazard area, use of another method will more optimally calculate the floodway limits at a given location.

SUBCHAPTER 4. DETERMINING THE RIPARIAN ZONE

7:13-4.1 The riparian zone

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(a) A riparian zone exists along every regulated water, except there is no riparian zone along the Atlantic Ocean nor along any manmade lagoon, stormwater management basin, or oceanfront barrier island, spit or peninsula.

(b) The riparian zone includes the land and vegetation within each regulated water described in (a) above, as well as the land and vegetation within a certain distance of each regulated water as described in (c) below. The portion of the riparian zone that lies outside of a regulated water is measured landward from the top of bank. If a discernible bank is not present along a regulated water, the portion of the riparian zone outside the regulated water is measured landward as follows:

1. Along a linear fluvial or tidal water, such as a stream, the riparian zone is measured landward of the feature's centerline;
2. Along a non-linear fluvial water, such as a lake or pond, the riparian zone is measured landward of the normal water surface limit;
3. Along a non-linear tidal water, such as a bay or inlet, the riparian zone is measured landward of the mean high water; and
4. Along an amorphously-shaped feature, such as a wetland complex, through which a regulated water flows but which lacks a discernible channel, the riparian zone is measured landward of the feature's centerline.

(c) The width of the riparian zone along each regulated water described in (a) above is as follows:

1. The riparian zone is 300 feet wide along both sides of any Category One water, and all upstream tributaries situated within the same HUC-14 watershed;
2. The riparian zone is 150 feet wide along both sides of the following waters not identified in (c)1 above:
    i. Any trout production water and all upstream waters (including tributaries);
    ii. Any trout maintenance water and all upstream waters (including tributaries) within one linear mile as measured along the length of the regulated water;
    iii. Any segment of a water flowing through an area that contains documented habitat for a threatened or endangered species of plant or animal, which is critically dependent on the regulated water for survival, and all upstream waters (including tributaries) within one linear mile as measured along the length of the regulated water; and
    iv. Any segment of a water flowing through an area that contains acid producing soils; and
3. The riparian zone is 50 feet wide along both sides of all waters not identified in (c)1 or 2 above.

(d) The riparian zones established by this chapter are separate from and in addition to any other similar zones or buffers established to protect surface waters. For example, the Stormwater Management rules at N.J.A.C. 7:8 and the Highlands Water Protection and Planning Act rules at N.J.A.C. 7:38 establish 300-foot Special Water Resource Protection Areas and buffers, respectively, along certain waters. Furthermore, the Freshwater Wetlands Protection Act rules at N.J.A.C. 7:7A establish 50-foot and 150-foot transition areas along freshwater wetlands and other features that are also regulated under this chapter. Compliance with the riparian zone requirements of this chapter does not constitute compliance with the requirements imposed under any other Federal, State or local statute, regulation or ordinance.

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SUBCHAPTER 5. APPLICABILITY DETERMINATIONS

7:13-5.1 General provisions for applicability determinations

(a) A flood hazard area applicability determination is the Department's statement of whether an activity is regulated and, therefore, requires a permit under this chapter.

(b) An applicability determination is optional. However, if it is unclear whether a particular activity is regulated, the Department encourages applicants to obtain an applicability determination prior to commencing work since unauthorized regulated activities may result in enforcement action pursuant to N.J.A.C. 7:13-19.

(c) An application for an applicability determination shall contain the following:

1. One copy of an application report, as described at N.J.A.C. 7:13-15.3; and
2. One set of drawings, signed and sealed by a engineer, land surveyor or architect, as appropriate, detailing the proposed activities. If fill or grading is proposed, the drawing shall show existing and proposed topography unless the Department determines that topography is not necessary to determine compliance with this chapter. All topography shall reference NGVD, or include the appropriate conversion factor to NGVD, unless the applicant demonstrates that such reference is not necessary.

(d) After reviewing an application for an applicability determination, the Department shall:

1. Notify the applicant that the application did not include all the material required at (c) above and request the missing information. The Department may cancel the request for an applicability determination if the missing information is not provided within 60 calendar days. Otherwise, when the requested material is received, the Department shall take one of the actions in (d)2 below; or
2. Inform the applicant in writing that:
   - i. The Department is unable to determine whether this chapter applies to the proposed activities because the limit of the flood hazard area and/or riparian zone onsite cannot be determined without additional information. Therefore, the Department shall not issue an applicability determination until the applicant obtains a verification under N.J.A.C. 7:13-6;
   - ii. This chapter does not apply to the proposed activity and no permit is required pursuant to N.J.A.C. 7:13-2.1, provided the chapter is not amended to establish stricter standards or conditions; or
   - iii. This chapter does apply to the proposed activities and the regulated activities must be conducted in accordance with a permit pursuant to N.J.A.C. 7:13-2.1. The Department will also inform the applicant whether the proposed activities qualify for a permit-by-rule or whether an application for a general permit authorization or individual permit is necessary, provided the application contains sufficient detail regarding the proposed activities for the Department to make such a determination.

(e) Workload permitting, the Department shall make a final decision on an application for an applicability determination within 30 calendar days of receiving a complete application.

(f) Except as provided in (g) below, an applicability determination is valid for five years from its issuance date and shall not be extended. However, an applicant may request a new applicability determination to replace an expired one by submitting an application under (c) above. An applicability determination may also be transferred upon the sale of a property to which it applies to a new owner pursuant to N.J.A.C. 7:13-14.1.

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(g) If the Department determines under (d)2ii above that this chapter does not apply to a proposed activity, and this chapter is subsequently amended to put in place stricter standards or conditions such that the proposed activity becomes regulated, or else the Department amends the flood hazard area or riparian zone onsite such that the proposed activity now lies within one of these regulated areas, the applicability determination shall become void and the applicant shall obtain a permit pursuant to N.J.A.C. 7:13-2.1 prior to commencing the regulated activities onsite.

SUBCHAPTER 6. VERIFICATIONS

7:13-6.1 General provisions for verifications

(a) A verification is a document containing the Department's approval of the flood hazard area design flood elevation on a site, includes either a flood hazard area limit or an indication that the entire site is in a flood hazard area, and may also include a floodway limit and/or a riparian zone limit, if applicable.

(b) The flood hazard area design flood elevation, flood hazard area and/or floodway limits on a site shall be determined in accordance with the procedures outlined in N.J.A.C. 7:13-3. The riparian zone limits on a site shall be determined in accordance with N.J.A.C. 7:13-4.

(c) An application for a verification shall include the following:

1. Three copies of an application report, as described at N.J.A.C. 7:13-15.3. If a hydrologic and/or hydraulic model is submitted with the application, the photographs required in the application report shall depict any water control structures, as well as a representative sampling of the locations of any cross-sections, which are referenced by the models;
2. One copy of an engineering report, as described at N.J.A.C. 7:13-15.4, which includes all necessary supporting calculations, maps and other documentation and a description of which delineation method under N.J.A.C. 7:13-3 was used;
3. Documentation that the applicable public notice requirements of N.J.A.C. 7:13-16 have been met;
4. The appropriate application fee required at N.J.A.C. 7:13-17; and
5. Six sets of drawings, signed and sealed by an engineer, land surveyor or architect, as appropriate, which include the following:
    i. Topography that references NGVD, or includes the appropriate conversion factor to NGVD, unless the applicant demonstrates that such reference is not necessary;
    ii. The limit of the flood hazard area under existing conditions on the site. If the entire site is in a flood hazard area, the drawings shall include a note to this effect, as well as the elevation(s) of the flood hazard area design flood on the site;
    iii. The limit of any floodway under existing conditions on the site, if the applicant seeks verification of the floodway limits. If the entire site is in a floodway, the drawings shall include a note to this effect;
    iv. A metes and bounds description of any flood hazard area limit and floodway limit under existing conditions onsite. If the verification is submitted concurrently with a permit application that proposes to affect one or both of

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these limits, the drawings shall also include a metes and bounds description of the proposed flood hazard area and/or floodway limits;
v. The following statement: "NOTE: All or a portion of this site lies in a flood hazard area. Certain activities in flood hazard areas are regulated by the New Jersey Department of Environmental Protection and some activities may be prohibited on this site or may first require a permit. Contact the Division of Land Use Regulation at (609) 292-0060 for more information prior to any construction onsite.";
vi. A note indicating which method described at N.J.A.C. 7:13-3 was used to determine the limit of the flood hazard area and/or floodway;
vii. The limit of any riparian zone onsite as described at N.J.A.C. 7:13-4.1; and
viii. An indication of the location of any cross-section and water control structure referenced in the engineering report as well as a graphic depiction of each cross section.

(d) The Department shall review an application for a verification according to the same procedure established for individual permit applications at N.J.A.C. 7:13-9.3.
(e) A verification is valid for five years from its issuance date, unless the verification is issued concurrently with a ten-year individual permit under N.J.A.C. 7:13-9.4(b), in which case the verification is valid for ten years from its issuance date. A verification shall not be extended. However, a verification can be reissued automatically with the issuance of a permit for a regulated activity at that site pursuant to (f) below and can be transferred at the time of sale of a property to which the verification applies to a new owner pursuant to N.J.A.C. 7:13-14.1.
(f) If the Department issues a verification for a site, and within five years issues a general permit authorization or an individual permit for a regulated activity that references or relies upon the verification at that site, the Department shall automatically reissue the verification upon approval of the permit or authorization so that the verification and permit or authorization have the same expiration date. This automatic reissuance shall occur only once per verification and there is no fee for this reissuance. The reissued verification shall reflect any alterations to the flood hazard area design flood elevation, flood hazard area limit and/or floodway limit that will result from the regulated activities authorized under the individual permit or general permit authorization. All pre-construction and post-construction elevations and limits shall be demarcated on drawings approved under the verification.
(g) Within 90 calendar days after the Department issues a verification on a privately owned lot, or on a publicly owned lot other than a right-of-way, the applicant shall submit the following information to the clerk of each county in which the site is located, and shall send proof to the Department that this information is recorded on the deed of each lot referenced in the verification. Failure to have this information recorded in the deed of each lot and/or to submit proof of recording to the Department constitutes a violation of this chapter and may result in suspension or termination of the verification and/or subject the applicant to enforcement action pursuant to N.J.A.C. 7:13-19:

1. The Department file number for the verification;
2. The approval and expiration dates of the verification;
3. A metes and bounds description of any flood hazard area limit and/or floodway limit approved under the verification;
4. The flood hazard area design flood elevation, or range of elevations if variable, approved under the verification; and

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5. The following statement: "The State of New Jersey has determined that all or a portion of this lot lies in a flood hazard area. Certain activities in flood hazard areas are regulated by the New Jersey Department of Environmental Protection and some activities may be prohibited on this site or may first require a permit. Contact the Division of Land Use Regulation at (609) 292-0060 for more information prior to any construction onsite."

SUBCHAPTER 7. PERMITS-BY-RULE

7:13-7.1 General provisions for permits-by-rule

(a) This subchapter establishes permits-by-rule for certain regulated activities. Each permit-by-rule specifically describes the regulated activity authorized, including the size and type of regulated activity and in some cases where in the flood hazard area and riparian zone the regulated activity may be conducted. The Department may, by rulemaking in accordance with the Administrative Procedure Act, rescind or modify an existing permit-by-rule, or establish new ones. The flood hazard area permits-by-rule are set forth at N.J.A.C. 7:13-7.2, and are summarized, for informational purposes only, in Table A below.

(b) The following requirements apply to every permit-by-rule at N.J.A.C. 7:13-7.2:

1. Each limit or condition of a particular permit-by-rule shall be satisfied without requiring a review of detailed engineering calculations; and
2. All structures shall be suitably anchored.

(c) A regulated activity that meets the requirements of a permit-by-rule may be conducted without prior Department approval. However, if it is unclear whether a particular activity meets a permit-by-rule, the Department encourages applicants to obtain an applicability determination under N.J.A.C. 7:13-5.1 prior to commencing work, since unauthorized regulated activities may result in enforcement action pursuant to N.J.A.C. 7:13-19. Furthermore, a person may wish to obtain an applicability determination in order to demonstrate to a local government that a proposed activity meets a permit-by-rule.

(d) A person intending to undertake a regulated activity under any of the eight permits-by-rule at N.J.A.C. 7:13-7.2(a) shall, at least 14 days prior to initiating the activity, provide written notification to the Department (via letter, electronic mail, fax or in person) as follows:

1. The notification shall include:
   - i. The property owner's name and contact information;
   - ii. The contractor's name (if applicable) and contact information;
   - iii. The street address and lot, block, municipality and county for the site at which the regulated activity will be conducted;
   - iv. Which permit-by-rule applies to the activity;
   - v. The proposed start and end date for the activity; and
   - vi. A brief description of the activity.
2. The notification shall be submitted to:

   Attn: Permit-By-Rule Notification
   New Jersey Department of Environmental Protection
   Bureau of Coastal and Land Use Compliance and Enforcement
   P.O. Box 422
   401 East State Street
   Trenton, New Jersey 08625-0422
   Fax: (609) 633-6798

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Electronic mail: floodhazard-pbrnotice@dep.state.nj.us
Website: http://nj.gov/dep/enforcement/lu.html

(e) Prior to undertaking a regulated activity that fails to comply with any limit, condition or requirement of a permit-by-rule in this subchapter, the applicant must first obtain a general permit authorization (pursuant to N.J.A.C. 7:13-8), an individual permit (pursuant to N.J.A.C. 7:13-9, 10 and 11), an emergency permit (pursuant to N.J.A.C. 7:13-12) or a CAFRA or waterfront development permit (pursuant to N.J.A.C. 7:7 and 7:7E) for the regulated activity. Furthermore, a person may undertake a regulated activity under a permit-by-rule only up to any given limit specified by the permit-by-rule. For example, the placement of no more than five cubic yards of fill under the permit-by-rule at N.J.A.C. 7:13-7.2(b)3 means either the one-time placement of five cubic yards of fill or multiple placements of fill over time that cumulatively do not exceed five cubic yards. A person may also concurrently undertake activities under two or more permits-by-rule provided all activities meet the requirements of this subchapter. For example, a person could elevate a building under the permit-by-rule at N.J.A.C. 7:13-7.2(a)3, construct an addition to the building under the permit-by-rule at N.J.A.C. 7:13-7.2(a)4, and build a fence around the building under the permit-by-rule at N.J.A.C. 7:13-7.2(b)5, without requiring another approval under this chapter, provided each activity meets the descriptions of each applicable permit-by-rule.

Table A
SUMMARY OF PERMITS-BY-RULE
This Table is for informational purposes only. See N.J.A.C. 7:13-7.2(a) through (f) for specific applicable limits and requirements for each permit-by-rule

(a) Activities that require 14-day prior notice to the Department
1. Reconstructing a lawfully existing structure outside a floodway
2. Constructing in a disturbed riparian zone or at or below grade in a flood hazard area
3. Elevating a building above the flood hazard area design flood elevation
4. Constructing an addition to a building of no more than 300 square feet outside a floodway
5. Removing a major obstruction from a regulated water with machinery
6. Constructing a boat launching ramp of no more than 1,000 square feet
7. Constructing an aquatic habitat enhancement device
8. Constructing a USGS-approved flow gauge or weir
(b) General construction and maintenance activities
1. Conducting normal property maintenance in a riparian zone
2. Removing a lawfully existing structure outside a floodway
3. Placing no more than 5 cubic yards of fill material outside a floodway
4. Repairing a lawfully existing structure
5. Constructing a fence
6. Construction in a tidal flood fringe that does not need a coastal permit
7. Constructing an addition above a building outside a floodway
8. Constructing a non-habitable building of no more than 150 square feet outside a floodway
9. Constructing an open structure with a roof outside a floodway (e.g., car port, patio, pole barn)
10. Constructing an aboveground recreational structure (e.g., bleacher, picnic table, backstop)
11. Constructing an aboveground swimming pool outside a floodway
12. Constructing an in-ground swimming pool
13. Constructing an open deck attached to a building

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14. Constructing an open dock of no more than 1,000 square feet on an impounded water
15. Placing an aboveground fuel tank of no more than 2,000 gallons outside a floodway
16. Placing an underground fuel tank
17. Filling an abandoned raceway
18. Maintaining a manmade canal that passes through a regulated area

(c) Activities associated with utilities
1. Placing a utility pole
2. Placing an open-frame utility tower outside a floodway
3. Jacking an underground utility line beneath a water
4. Placing an underground utility line beneath existing pavement
5. Attaching a utility line to the downstream face of a roadway that crosses a water
6. Placing an underground utility line in a flood hazard area outside a riparian zone
(d) Activities associated with roadways and parking areas
1. Repaving a roadway or parking area outside a floodway
2. Placing an open guardrail along a public roadway
3. Removing sediment by hand adjacent to a bridge, culvert or outfall along a public roadway
4. Reconstructing a bridge superstructure above a flood hazard area
(e) Activities associated with the storage of unsecured material
1. Temporary storage of construction material outside a floodway
2. Incidental storage of material associated with a residence
3. Incidental storage of material associated with a non-residence
4. Operating an existing business that stores and distributes material
5. Operating an existing hazardous waste facility
6. Operating an existing solid waste facility
(f) Agricultural activities
1. Continuing ongoing agricultural activities that result in no fill
2. Commencing new agricultural activities that result in no fill
3. Undertaking soil conservation practices outside a floodway
4. Constructing an agricultural building of no more than 1,000 square feet outside a floodway

7:13-7.2 Permits-by-rule

(a) The permits-by-rule at (a)1 through 8 below apply to the specified construction and maintenance activities listed therein. Pursuant to N.J.A.C. 7:13-7.1(d), prior written notice to the Department is required for each of these permits-by-rule.

1. The reconstruction of a lawfully existing structure outside a floodway, provided:
   - i. The structure is not a habitable building;
   - ii. The structure is not a retaining wall that extends four feet or more above the ground;
   - iii. The reconstructed structure lies within the footprint of the existing structure and is not enlarged;

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iv. The reconstruction is not a major development, as defined at N.J.A.C. 7:8-1.2, and is, therefore, not subject to the requirements of the Stormwater Management rules at N.J.A.C. 7:8;
v. No vegetation is cleared, cut or removed in a riparian zone, except for vegetation within 20 feet of the structure if such disturbance is necessary to facilitate its reconstruction; and
vi. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;

2. Any construction activity, provided:
i. If the activity is located in a flood hazard area, all construction is situated at or below grade and the existing ground elevation is not raised (such as for the construction of a bicycle path, driveway, fishing or hunting area, garden, lawn, nature preserve, outdoor recreation area, park, parking area, picnic ground, playground, playing field, roadway, sidewalk or trail);
ii. No disturbance related to the regulated activity is located within 25 feet of any top of bank or edge of water;
iii. The construction activity is not a major development, as defined at N.J.A.C. 7:8-1.2, and is therefore not subject to the requirements of the Stormwater Management rules at N.J.A.C. 7:8;
iv. No vegetation is cleared, cut or removed in a riparian zone, except where previous development or disturbance has occurred (such as an area maintained as a lawn or garden or an abandoned parking area that has partially revegetated); and
v. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;

3. The elevation of a lawfully existing building outside a floodway, in order to reduce flood damage potential, provided:
i. The building to be elevated is not relocated;
ii. The lowest finished floor of the building is raised to at least one foot above the flood hazard area design flood elevation;
iii. The area below the lowest finished floor of the building is not used for habitation and remains open to floodwaters, in accordance with N.J.A.C. 7:13-11.5(l);
iv. No vegetation is cleared, cut or removed in a riparian zone, except for vegetation within 20 feet of the building if such disturbance is necessary to facilitate its elevation; and
v. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;

4. The construction of an addition that is connected to a lawfully existing building outside a floodway, provided:
i. The addition has a footprint of no more than 300 square feet;
ii. No disturbance related to the regulated activity is located within 25 feet of any top of bank or edge of water;

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iii. No part of the addition extends into a floodway;
iv. No vegetation is cleared, cut or removed in a riparian zone, except for vegetation within 20 feet of the addition if such disturbance is necessary to facilitate its construction; and
v. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;

5. The use of machinery to remove a major obstruction from a regulated water that cannot be removed by hand, such as a fallen tree, abandoned vehicle, furniture and other large debris, provided:
i. No trees are disturbed in the riparian zone to provide access to the channel and/or obstruction;
ii. The machinery is situated outside the regulated water where possible;
iii. The timing restrictions set forth at N.J.A.C. 7:13-10.5(d) are observed; and
iv. No fill material or accumulated sediment is removed from the regulated water;

6. The construction of a boat launching ramp, provided:
i. The ramp has a footprint of no more than 2,000 square feet;
ii. The ramp is constructed at or below grade;
iii. The timing restrictions set forth at N.J.A.C. 7:13-10.5(d) are observed;
iv. No more than 2,000 square feet of vegetation, including permanent and temporary disturbance, is cleared, cut or removed in a riparian zone; and
v. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;

7. The construction of an aquatic habitat enhancement device provided:
i. The device is approved by the Department's Division of Fish and Wildlife, Bureau of Freshwater Fisheries;
ii. The device will not cause erosion in the regulated water;
iii. The device will not cause any rise in the flood hazard area design flood elevation outside the regulated water;
iv. The device will not cause any existing building to be subject to increased flooding during any flood event up to and including the flood hazard area design flood;
v. The timing restrictions set forth at N.J.A.C. 7:13-10.5(d) are observed;
vi. No more than 2,000 square feet of vegetation, including permanent and temporary disturbance, is cleared, cut or removed in a riparian zone; and
vii. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity; and

8. The construction of a gauge, weir or other device to measure the depth, velocity and/or rate of flow in a regulated water provided:
i. The device is approved by the United States Geological Survey;
ii. The device will not cause erosion in the regulated water;
iii. The device will not cause any rise in the flood hazard area design flood elevation outside the regulated water;

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iv. The device will not cause any existing building to be subject to increased flooding during any flood event up to and including the flood hazard area design flood;
v. The timing restrictions set forth at N.J.A.C. 7:13-10.5(d) are observed;
vi. No more than 2,000 square feet of vegetation, including permanent and temporary disturbance, is cleared, cut or removed in a riparian zone; and
vii. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity.

(b) The permits-by-rule at (b)1 through 18 below apply to the specified construction and maintenance activities listed therein.

1. The disturbance of vegetation in a riparian zone for normal property maintenance.
   i. Normal property maintenance means an activity necessary to maintain a lawfully existing structure, lawn and/or garden and includes:
      (1) Pruning;
      (2) Selective tree cutting;
      (3) Planting indigenous, non-invasive vegetation;
      (4) Maintaining a field, lawn, park and/or easement that was lawfully established prior to October 2, 2006, and that has been maintained (such as through periodic mowing) since that date;
      (5) The removal of trash, debris and dead vegetation by hand; and
      (6) Maintaining a garden that was lawfully established prior to October 2, 2006.
   ii. Normal property maintenance does not include any activity that would result in any clearing, cutting or removal of vegetation not described in (b)1i above, such as:
      (1) Mowing an area that was not lawfully mowed prior to October 2, 2006, or which was lawfully mowed prior to this date but has since been allowed to revert to its natural vegetative state;
      (2) Removing vegetation to create a new lawn, garden, field or park;
      (3) Burning vegetation;
      (4) Applying herbicide;
      (5) Grading and other changes in topography; and
      (6) Constructing structures, or placing fill or impervious surfaces;
2. The removal of any lawfully existing structure outside a floodway, provided:
   i. The structure is disposed of outside of any regulated area and in accordance with all applicable Federal, State and local laws;
   ii. All disturbed regulated areas are properly stabilized;
   iii. No vegetation is cleared, cut or removed in a riparian zone, except for vegetation within 20 feet of the structure if such disturbance is necessary to facilitate its removal; and
   iv. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity, except where the removed material is to be replaced by new fill or a structure.
   (Note that any replacement fill or structure is subject to the requirements of this

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chapter and may require a permit.);

3. The placement of no more than five cubic yards of fill outside a floodway, provided:
   i. No fill is placed within 25 feet of any top of bank or edge of water;
   ii. The fill is not a structure. For example, five cubic yards of stone, topsoil, wood chips or other landscaping material can be placed under this permit-by-rule but the construction of a building that displaces five cubic yards of flood storage volume cannot;
   iii. No vegetation is cleared, cut or removed in a riparian zone, except where previous development or disturbance has occurred (such as an area maintained as a lawn or garden or an abandoned parking area that has partially revegetated); and
   iv. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;
4. The repair of a lawfully existing structure, provided:
   i. The timing restrictions set forth at N.J.A.C. 7:13-10.5(d) are observed if the structure is located in a regulated water;
   ii. No vegetation is cleared, cut or removed in a riparian zone, except where previous development or disturbance has occurred (such as an area maintained as a lawn or garden or an abandoned parking area that has partially revegetated); and
   iii. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;
5. The construction of a fence, provided:
   i. No disturbance related to the regulated activity is located within 25 feet of any top of bank or edge of water;
   ii. No vegetation is cleared, cut or removed in a riparian zone, except where previous development or disturbance has occurred (such as an area maintained as a lawn or garden or an abandoned parking area that has partially revegetated);
   iii. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity; and
   iv. One of the following conditions is satisfied:
      (1) The fence is located outside a floodway; or
      (2) The fence is located in a floodway and has sufficiently large openings so as not to catch debris during a flood and thereby obstruct floodwaters, such as a barbed-wire, split-rail or strand fence. A fence with little or no open area, such as a chain link, lattice or picket fence, does not meet this requirement;
6. Any construction activity in a tidal flood hazard area that is not regulated under N.J.A.C. 7:7 and 7:7E, provided:
   i. The existing ground elevation is not raised in any floodway;
   ii. No aboveground structure is placed in a floodway;
   iii. No habitable building is constructed;

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iv. No disturbance related to the regulated activity is located within 25 feet of any top of bank or edge of water;
v. The construction activity is not a major development, as defined at N.J.A.C. 7:8-1.2, and is therefore not subject to the requirements of the Stormwater Management rules at N.J.A.C. 7:8;
vi. No vegetation is cleared, cut or removed in a riparian zone, except where previous development or disturbance has occurred (such as an area maintained as a lawn or garden or an abandoned parking area that has partially revegetated); and vii. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;

7. The construction of an addition above a lawfully existing building outside a floodway, provided:
i. The addition is completely supported by the existing building;
ii. The lowest finished floor of the addition is constructed at least one foot above the flood hazard area design flood elevation;
iii. No part of the addition extends into a floodway;
iv. No vegetation is cleared, cut or removed in a riparian zone, except for vegetation within 20 feet of the building if such disturbance is necessary to facilitate the construction of the addition; and
v. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;

8. The construction of a non-habitable building outside a floodway, such as a shed, animal shelter or storage area, provided:
i. The building has a footprint of no more than 150 square feet;
ii. No disturbance related to the regulated activity is located within 25 feet of any top of bank or edge of water;
iii. No vegetation is cleared, cut or removed in a riparian zone, except where previous development or disturbance has occurred (such as an area maintained as a lawn or garden or an abandoned parking area that has partially revegetated); and
iv. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;

9. The construction of an open structure with a roof outside a floodway, such as a car port, covered patio or pole barn, provided:
i. The structure is not enclosed with walls on any side below the flood hazard area design flood elevation;
ii. No disturbance related to the regulated activity is located within 25 feet of any top of bank or edge of water;
iii. The roof is supported solely by poles or is cantilevered from an adjoining structure;
iv. No fill is placed in the flood hazard area except for any poles necessary to support the roof;

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v. No vegetation is cleared, cut or removed in a riparian zone, except where previous development or disturbance has occurred (such as an area maintained as a lawn or garden or an abandoned parking area that has partially revegetated); and

vi. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;

10. The construction of an aboveground recreational structure (such as a backstop, bleacher, picnic table or playground equipment), provided:

i. The structure is not a building;

ii. No obstruction to flow is placed in a floodway;

iii. The existing ground elevation is not raised;

iv. No disturbance related to the regulated activity is located within 25 feet of any top of bank or edge of water;

v. No vegetation is cleared, cut or removed in a riparian zone, except where previous development or disturbance has occurred (such as an area maintained as a lawn or garden or an abandoned parking area that has partially revegetated); and

vi. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;

11. The construction of an aboveground swimming pool outside a floodway associated with residential use, provided:

i. The swimming pool does not displace more than 100 cubic yards of flood storage volume (see N.J.A.C. 7:13-10.4);

ii. No disturbance related to the regulated activity is located within 25 feet of any top of bank or edge of water;

iii. No vegetation is cleared, cut or removed in a riparian zone, except where previous development or disturbance has occurred (such as an area maintained as a lawn or garden or an abandoned parking area that has partially revegetated); and

iv. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;

12. The construction of an in-ground swimming pool associated with residential use, provided:

i. The pool lies completely at or below existing grade;

ii. If the pool is located in a floodway, and the construction of a safety fence around the pool is required by local ordinances, the size and height of the fence is minimized and the fence is as open as possible to allow the passage of floodwaters;

iii. Any material excavated to construct the pool is removed from the flood hazard area;

iv. No disturbance related to the regulated activity is located within 25 feet of any top of bank or edge of water;

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v. No vegetation is cleared, cut or removed in a riparian zone, except where previous development or disturbance has occurred (such as an area maintained as a lawn or garden or an abandoned parking area that has partially revegetated); and

vi. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;

13. The construction of a deck that is connected to a lawfully existing building, provided:

i. The deck is not enclosed with walls either above or below its floor, except for protective or decorative fencing, banisters or latticework that allow floodwaters to pass freely;

ii. No disturbance related to the regulated activity is located within 25 feet of any top of bank or edge of water;

iii. No vegetation is cleared, cut or removed in a riparian zone, except where previous development or disturbance has occurred (such as an area maintained as a lawn or garden or an abandoned parking area that has partially revegetated); and

iv. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;

14. The construction of a dock along an impounded water, such as a lake, pond or reservoir, provided:

i. The dock is built on pilings and remains open underneath to allow floodwaters to pass freely;

ii. The dock covers no more than 1,000 square feet including all decking and pilings;

iii. The impounded water has a surface area of one acre or more;

iv. The dock does not extend more than 20 percent across the width of the impounded water;

v. No more than 1,000 square feet of vegetation, including permanent and temporary disturbance, is cleared, cut or removed in a riparian zone; and

vi. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;

15. The construction of an aboveground fuel tank of no more than 2,000 gallons outside a floodway, within or adjacent to the building it serves, provided:

i. The tank is designed to remain watertight during a flood;

ii. No disturbance related to the regulated activity is located within 25 feet of any top of bank or edge of water;

iii. No vegetation is cleared, cut or removed in a riparian zone, except where previous development or disturbance has occurred (such as an area maintained as a lawn or garden or an abandoned parking area that has partially revegetated); and

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iv. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;

16. The construction of an underground fuel tank within or adjacent to the building it serves, provided:

i. The tank is designed to remain watertight during a flood;

ii. No disturbance related to the regulated activity is located within 25 feet of any top of bank or edge of water;

iii. No vegetation is cleared, cut or removed in a riparian zone, except where previous development or disturbance has occurred (such as an area maintained as a lawn or garden or an abandoned parking area that has partially revegetated); and

iv. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;

17. The filling of an abandoned raceway adjacent to a regulated water, provided:

i. The raceway is a manmade conveyance structure that was created to divert water from a channel for the purpose of providing hydrology or hydraulic power before returning the water to the channel;

ii. The raceway is currently blocked at one or both ends so that water from the channel is not able to flow through the raceway under normal flow conditions;

iii. The raceway does not supply hydrology to an otherwise isolated freshwater wetlands complex;

iv. The raceway is filled up to, but not above, the surrounding topography and the entire disturbed area is properly graded so as not to interfere with overland drainage; and

v. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity; and

18. The repair, maintenance or dredging of the channel and/or embankments of a manmade canal, which passes through a regulated area, provided:

i. A public entity having jurisdiction over the canal determines that the proposed regulated activity is necessary for the proper operation of the canal;

ii. No fill or dredged spoils are placed in the flood hazard area;

iii. No trees are cleared, cut or removed in a riparian zone; and

iv. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity

(c) The permits-by-rule at (c)1 through 6 below apply to the specified activities associated with utility lines listed therein.

1. The placement of one or more utility poles (which are not open-frame towers as described in (c)2 below) for utility lines, provided:

i. No disturbance related to the regulated activity is located within 25 feet of any top of bank or edge of water;

ii. All wires or cables connected to the utility poles are situated at least one foot above the flood hazard area design flood elevation;

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iii. No trees are cleared, cut or removed in a riparian zone; and
iv. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;

2. The placement of one or more open-frame towers outside a floodway to support a utility line, provided:
i. Each tower's footing is constructed at or below grade;
ii. No disturbance related to the regulated activity is located within 25 feet of any top of bank or edge of water;
iii. All wires or cables connected to the towers are situated at least one foot above the flood hazard area design flood elevation;
iv. No trees are cleared, cut or removed in a riparian zone; and
v. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;

3. The placement of an underground utility line beneath a regulated water through directional drilling or "jacking," provided:
i. The regulated water is not disturbed in any way;
ii. No trees are cleared, cut or removed in a riparian zone;
iii. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;
iv. All disturbed areas in the flood hazard area are restored to their original topography upon completion of the regulated activity;
v. If the line is jacked or drilled beneath a bridge or culvert, all work is accomplished without displacing or damaging the bridge or culvert;
vi. If the line is jacked or drilled beneath an open channel, the top of the line is placed at least four feet below the channel invert and remains nominally horizontal at this depth at least 10 feet beyond the top of each bank;
vii. The line is sealed to ensure that there will be no leakage or discharge in a regulated area;
viii. No manhole is constructed within 10 feet of any top of bank or edge of water (unless situated within a paved surface);
ix. The top of any manhole in a floodway is flush with the ground;
x. The top of any manhole in a flood fringe is flush with the ground where possible; and
xi. Any manhole along a sanitary sewer has a watertight cover in the flood hazard area;

4. The placement of an underground utility line beneath existing pavement within a regulated area (such as under an existing parking lot in the flood hazard area or under an existing roadway that crosses a regulated water), provided:
i. The regulated water is not disturbed in any way;
ii. No vegetation is cleared, cut or removed in a riparian zone;
iii. All disturbed areas in the flood hazard area are restored to their original topography upon completion of the regulated activity;

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iv. If the line is placed under a roadway, either above or below a culvert or within a bridge, all work is accomplished without displacing or damaging the bridge or culvert;
v. If the line is placed under a roadway, either above or below a culvert, the line is encased within a larger steel pipe, or is placed with at least one foot vertical clearance above or below the culvert;
vi. The line is sealed to ensure that there will be no leakage or discharge in a regulated area;
vii. No manhole is constructed within 10 feet of any top of bank or edge of water (unless situated within a paved surface);
viii. The top of any manhole in a floodway is flush with the ground;
ix. The top of any manhole in a flood fringe is flush with the ground where possible; and
x. Any manhole along a sanitary sewer has a watertight cover in the flood hazard area;

5. The attachment of a utility line to a lawfully existing roadway that crosses a regulated water, provided:

i. The regulated water is not disturbed in any way;
ii. No more than 1,000 square feet of vegetation, including permanent and temporary disturbance, is cleared, cut or removed in a riparian zone, and all such vegetation lies within an existing right-of-way that is periodically mowed and/or cleared:
iii. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;
iv. All disturbed areas in the flood hazard area are restored to their original topography upon completion of the regulated activity;
v. The line is firmly attached to the roadway's bridge or culvert so that no part of the line, its encasement or any attachment device extends above the roadway profile or across the bridge or culvert opening;
vi. Where possible, the line is situated at least one foot above the flood hazard area design flood elevation;
vii. If a predominant direction of flow in the regulated water is discernible, the line is attached to the downstream face of the roadway crossing;
viii. All work is accomplished without displacing or damaging any bridge or culvert in any way;
ix. The line is sealed to ensure that there will be no leakage or discharge in a regulated area;
x. No manhole is constructed within 10 feet of any top of bank or edge of water (unless situated within a paved surface);
xi. The top of any manhole in a floodway is flush with the ground;
xii. The top of any manhole in a flood fringe is flush with the ground where possible; and
xiii. Any manhole along a sanitary sewer has a watertight cover in the flood hazard area; and

6. The placement of an underground utility line in a flood hazard area outside a riparian

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zone, provided:

i. All disturbed areas in the flood hazard area are restored to their original topography upon completion of the regulated activity;

ii. The line is sealed to ensure that there will be no leakage or discharge in a regulated area;

iii. The top of any manhole in a floodway is flush with the ground;

iv. The top of any manhole in a flood fringe is flush with the ground where possible; and

v. Any manhole along a sanitary sewer has a watertight cover in the flood hazard area.

(d) The permits-by-rule at (d)1 through 4 below apply to the specified activities associated with roadways and parking areas listed therein.

1. The repaving and/or resurfacing of a lawfully existing paved roadway or paved parking area outside a floodway, provided:

i. The surface of the existing roadway or parking area is raised by no more than three inches. Multiple repaving and/or resurfacing is permissible provided the cumulative impact of the activity does not result in raising the pavement by more than three inches;

ii. The existing roadway is not expanded; and

iii. No vegetation is cleared, cut or removed in a riparian zone;

2. The construction of a guardrail along a public roadway approved by a public entity, provided:

i. No trees are cleared, cut or removed in a riparian zone; and

ii. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;

3. The removal of accumulated sediment and/or debris from a regulated water, within and/or immediately adjacent to a lawfully existing bridge, culvert or stormwater discharge pipe along a public roadway and/or on public property, provided:

i. All work is performed by hand, such as by shovels, hoses, hydraulic pumps and other similar equipment. No backhoes or other heavy machinery shall be used in the regulated water;

ii. The sediment and debris removal is necessary to maintain positive flow through the structure;

iii. The sediment and debris removal is limited to within 100 feet of the structure;

iv. All work is performed under the supervision of the public entity that is responsible for maintaining the roadway and/or public property;

v. Vegetation outside the regulated water is not disturbed;

vi. No trees are cleared, cut or removed in a riparian zone;

vii. The timing restrictions set forth at N.J.A.C. 7:13-10.5(d) are observed;

viii. Excavation consists solely of accumulated sediment and does not alter the natural bed and banks of the channel; and

ix. The material removed is disposed of outside of any regulated area and in accordance with all applicable Federal, State and local laws; and

4. The reconstruction of all or part of a lawfully existing bridge superstructure over a

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regulated water, provided the reconstructed portion lies above the flood hazard area design flood elevation. The reconstruction need not be in-kind.

(e) The permits-by-rule at (e)1 through 6 below apply to the specified activities associated with the storage of secured and/or unsecured material listed therein.

1. The temporary storage of unsecured material outside a floodway, which is necessary for a lawful construction activity, provided:

i. No hazardous substances are stored;

ii. No storage is located within 25 feet of any top of bank or edge of water;

iii. No vegetation is cleared, cut or removed in a riparian zone, except where previous development or disturbance has occurred (such as an area maintained as a lawn or garden or an abandoned parking area that has partially revegetated); and

iv. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity;

2. The storage in a regulated area of unsecured material incidental to the use or maintenance of a lawfully existing private residence (such as lawn and garden equipment and materials, shelters for animals, trash receptacles, toys, vehicles and wood piles), provided:

i. No hazardous substances are stored;

ii. The unsecured material is of an amount and nature typical for a residence. For example, this permit-by-rule does not authorize the storage of construction debris, roll-off containers, an inordinate number of vehicles or machinery or large piles of refuse;

iii. No unsecured material is located within a floodway unless the material was lawfully situated there prior to October 2, 2006;

iv. No unsecured material is located within 25 feet of any top of bank or edge of water unless the material was lawfully situated there prior to October 2, 2006; and

v. No vegetation is cleared, cut or removed in a riparian zone, except where previous development or disturbance has occurred (such as an area maintained as a lawn or garden or an abandoned parking area that has partially revegetated);

3. The storage in a regulated area of unsecured material incidental to the use or maintenance of a lawfully existing business or other non-residential facility (such as dumpsters, vehicles and equipment), provided:

i. No hazardous substances are stored unless:

(1) The storage of hazardous substances is essential to the operation of the business or facility;

(2) The hazardous substances are isolated from potential contact with floodwaters; and

(3) The hazardous substances are stored in accordance with all Federal, State and local laws;

ii. The unsecured material is of an amount and nature typical for the subject business or non-residential facility. For example, this permit-by-rule does not authorize the storage of construction debris, roll-off containers, an inordinate number of vehicles or machinery or large piles of refuse;

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iii. No unsecured material is located within a floodway unless the material was lawfully situated there prior to October 2, 2006;
iv. No unsecured material is located within 25 feet of any top of bank or edge of water unless the material was lawfully situated there prior to October 2, 2006; and
v. No vegetation is cleared, cut or removed in a riparian zone, except where previous development or disturbance has occurred (such as an area maintained as a lawn or garden or an abandoned parking area that has partially revegetated);

4. The storage in a regulated area of unsecured material that is necessary for the operation of a lawfully existing business or other non-residential facility, the primary function of which is to store and distribute material (such as a gravel pit, junk yard, landscaping business, lumber yard or vehicle dealership, rental facility or impoundment area), provided:
i. No hazardous substances are stored unless;
(1) The storage of hazardous substances is essential to the operation of the business or facility;
(2) The hazardous substances are isolated from potential contact with floodwaters; and
(3) The hazardous substances are stored in accordance with all Federal, State and local laws;
ii. The business or facility was established prior to October 2, 2006;
iii. The business or facility has been in continuous operation since October 2, 2006; and
iv. The size of the business or facility and the peak volume of material stored in the flood hazard area have not increased since October 2, 2006. Any increase in size or peak volume requires that an individual permit be obtained pursuant to N.J.A.C. 7:13-11.16;

5. The placement, storage or processing of hazardous waste at a lawfully existing hazardous waste facility located in a regulated area, provided:
i. The facility was established prior to October 2, 2006;
ii. The facility has been in continuous operation since October 2, 2006;
iii. The facility is operating in compliance with all Federal, State and local requirements; and
iv. The size of the facility and the peak volume of hazardous waste in the flood hazard area have not increased since October 2, 2006. Any increase in size or peak volume requires that an individual permit be obtained pursuant to N.J.A.C. 7:13-11.17; and

6. The placement, storage or processing of solid waste at a lawfully existing solid waste facility (such as a composting facility, landfill or recycling center), located in a regulated area, provided:
i. The facility was established prior to October 2, 2006;
ii. The facility has been in continuous operation since October 2, 2006;
iii. The facility is operating in compliance with all Federal, State and local requirements; and

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iv. The size of the facility and the peak volume of solid waste in the flood hazard area have not increased since October 2, 2006. Any increase in size or peak volume requires an individual permit pursuant to N.J.A.C. 7:13-11.18.

(f) The permits-by-rule at (f)1 through 4 below apply to the specified agricultural activities listed therein.

1. The continuation of lawfully existing agricultural activities (such as grazing, harvesting, horticulture, irrigation, planting, tilling, viticulture and watering, as well as forestry under an approved forestry management plan that does not allow clear cutting), provided:

i. The activities are undertaken on land that has been actively farmed since October 2, 2006; and

ii. The activities do not result in the displacement of flood storage volume or the construction of an aboveground structure;

2. The commencement of new agricultural activities (such as grazing, harvesting, horticulture, irrigation, planting, tilling, viticulture and watering, as well as forestry under an approved forestry management plan that does not allow clear cutting) on land that is not actively farmed provided:

i. The activities do not result in the displacement of flood storage volume or the construction of an aboveground structure; and

ii. No vegetation is cleared, cut or removed in a riparian zone, except where previous development or disturbance has occurred (such as an area maintained as a lawn or garden or an abandoned parking area that has partially revegetated);

3. The continuation or commencement of soil conservation practices outside a floodway, such as terracing, subsurface tile drainage or construction of a diversion, a grassed swale or an excavated pond, provided:

i. The activities are undertaken on land that has been actively farmed since October 2, 2006;

ii. The activities are approved in writing by the local Soil Conservation District or the USDA Natural Resource Conservation Service, as appropriate;

iii. No disturbance related to the regulated activity is located within 25 feet of any top of bank or edge of water;

iv. No vegetation is cleared, cut or removed in a riparian zone, except where previous development or disturbance has occurred (such as an area maintained as a lawn or garden or an abandoned parking area that has partially revegetated); and

v. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity; and

4. The construction of a building with no foundation outside a floodway, provided:

i. The building is located on land that has been actively farmed since October 2, 2006;

ii. The building has a footprint of no more than 1,000 square feet;

iii. The building is designed for agricultural use. Examples of such buildings include a plastic covered greenhouse, a roadside farm stand and a tool shed placed on an existing farm field;

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iv. No disturbance related to the regulated activity is located within 25 feet of any top of bank or edge of water;
v. No vegetation is cleared, cut or removed in a riparian zone, except where previous development or disturbance has occurred (such as an area maintained as a lawn or garden or an abandoned parking area that has partially revegetated); and
vi. All vegetated areas temporarily disturbed within the riparian zone are replanted with indigenous, non-invasive species upon completion of the regulated activity.

SUBCHAPTER 8. GENERAL PERMITS

7:13-8.1 Standards applicable to all general permits

(a) This subchapter establishes general permits for certain regulated activities. Each general permit describes the regulated activity authorized, including the size and type of regulated activity and in some cases where in the flood hazard area or riparian zone the regulated activity may be conducted. The Department may, by rulemaking in accordance with the Administrative Procedure Act, N.J.S.A. 52:14B-1 et seq., rescind or modify an existing general permit or establish new ones. The flood hazard general permits established in this subchapter are set forth as follows:

Table B
SUMMARY OF GENERAL PERMITS
This Table is for informational purposes only. See N.J.A.C. 7:13-8.3 through 8.12 for specific applicable limits and requirements for each general permit

Permit	Description	Citation
1	Channel cleaning by a public entity under the Stream Cleaning Act	8.3
2A	Agricultural: Soil erosion control, bank stabilization or bank restoration	8.4(c)1
2B	Agricultural: Channel cleaning	8.4(c)2
2C	Agricultural: Constructing a roadway across a water	8.4(c)3
2D	Agricultural: Filling a manmade water for freshwater wetlands restoration	8.4(c)4
2E	Agricultural: Creating a ford across a water to manage livestock	8.4(c)5
2F	Agricultural: Constructing a fence across or along a water to manage livestock	8.4(c)6
2G	Agricultural: Constructing a pump or water intake along a water for livestock	8.4(c)7
3	Bridge or culvert scour protection by a public entity	8.5
4	Stormwater maintenance by a public entity	8.6
5	Relocating a building to reduce flood damage	8.7
6	Reconstructing a damaged or destroyed residence	8.8
7	Residential construction in a tidal flood hazard area	8.9
8	Utility line across or along a water draining less than 50 acres	8.10
9	Roadway or footbridge across a water draining less than 50 acres	8.11
10	Stormwater outfall along a water draining less than 50 acres	8.12

(b) A regulated activity shall be authorized under a general permit only if the Department determines that the following requirements are satisfied:

1. The regulated activity is not undertaken in the channel or riparian zone of a regulated

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water with fishery resources during a restricted time period as described at N.J.A.C. 7:13-10.5(d), unless otherwise approved by the Department's Division of Fish and Wildlife;

2. The regulated activity does not adversely affect low-flow aquatic passage within any regulated water;

3. The regulated activity will not adversely affect a threatened or endangered species, or a documented habitat for a threatened or endangered species;

4. All structures are suitably anchored;

5. The regulated activity is performed in accordance with the Standards for Soil Erosion and Sediment Control in New Jersey at N.J.A.C. 2:90;

6. Prior to undertaking the regulated activity, all necessary approvals are obtained from the local Soil Conservation District in cases where the district has jurisdiction over the project;

7. The regulated activity does not require review for compliance with the Stormwater Management rules at N.J.A.C. 7:8 because:

i. The overall project with which the general permit activity is associated is not a major development, as defined at N.J.A.C. 7:8-1.2; or

ii. The Department has already determined through the approval of a CAFRA, Waterfront Development or Freshwater Wetlands Protection Act permit that the overall project with which the general permit activity is associated complies with the Stormwater Management rules at N.J.A.C. 7:8;

8. If the regulated activity is proposed in a regulated area known or suspected to contain acid producing soils, a plan is established and implemented to minimize the adverse effects of exposing these soils as described at N.J.A.C. 7:13-10.7; and

9. The regulated activity complies with the specific requirements of the applicable general permit(s) set forth in this subchapter.

(c) Except for general permit 1, the application and review procedures for which are described at N.J.A.C. 7:13-8.3, an application for a general permit shall be submitted to the Department to the address listed in N.J.A.C. 7:13-1.1(f), and shall include the following:

1. One completed certification (available from the Department's website at www.nj.gov/dep/landuse), signed and sealed by an engineer, which lists each requirement of (b) above, as well as each requirement for the particular general permit under which authorization is sought and explains how each requirement is met;

2. Six sets of drawings, signed and sealed by an engineer, land surveyor or architect, as appropriate, which detail the proposed activities, including existing and proposed topography if fill or grading is proposed. All topography shall reference NGVD, or include the appropriate conversion factor to NGVD, unless the applicant demonstrates that such reference is not necessary. The limit of any riparian zone onsite shall also be shown, as well as any areas where riparian zone vegetation will be cleared, cut or removed;

3. Three copies of an application report, as described at N.J.A.C. 7:13-15.3; and

4. An application fee of $ 500.00 in accordance with N.J.A.C. 7:13-17.1, except for general permit 6, which requires no application fee.

(d) Within 20 working days following the receipt of an application for an authorization under a general permit, the Department shall:

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1. Determine that all necessary information required by this chapter for a complete general permit application has been provided, and declare the application complete for review;
2. Determine that all necessary information required by this chapter for a complete general permit application has not been provided, or that one or more submitted items are deficient, and request in writing that the applicant submit the missing material and/or address any deficiencies within a reasonable time period. The Department may cancel the application if the requested information is not provided within 60 calendar days. The Department shall subsequently declare the application complete for review within 20 working days of receiving the requested information; or
3. If the Department does not take action under (d)1 or 2 above within 20 working days, the general permit application shall automatically be deemed complete for review. In such a case, the Department may to request additional information, which is necessary to bring the application into compliance with the requirements of this chapter during the review of the application.

(e) Within 45 calendar days after receiving a complete application for an authorization under a general permit, the Department shall:

1. Determine that the application meets the requirements of this chapter and approve the general permit authorization in writing; or
2. Determine that the application does not meet the requirements of this chapter and deny the general permit authorization in writing.

(f) If the Department fails to take written action on an application in accordance with (e) above, the general permit application shall automatically be deemed to be approved. This default approval is subject to any applicable conditions set forth in this chapter for the activities covered by the application for general permit authorization. Furthermore, default approval under this section shall not prevent the Department from taking enforcement action pursuant to N.J.A.C. 7:13-19 for any activity undertaken in violation of this chapter.

(g) An authorization to perform a regulated activity under a general permit is subject to the conditions listed at N.J.A.C. 7:13-8.2.

(h) Multiple or repeated activities proposed to be undertaken on a site that would individually qualify for authorization under a general permit shall require an individual permit if the cumulative impacts exceed any limit contained in the applicable general permit.

(i) Except as provided in (j) below, a general permit authorization is valid for five years from its issuance date and shall not be extended. However, a new general permit authorization to replace an expired one may be requested by submitting an application under this section. A general permit can also be transferred with the sale of a property to a new owner pursuant to N.J.A.C. 7:13-14.1.

(j) If the rule in this subchapter establishing a particular general permit is repealed, then any person with a valid authorization issued under such general permit shall immediately cease any authorized activities and apply for an individual permit in accordance with N.J.A.C. 7:13-9, 10 and 11. If the rule in this subchapter establishing a particular general permit is amended to put in place stricter standards or conditions, then any person with a valid authorization issued under the original general permit shall immediately cease any authorized activities under the authorization and either apply for authorization under the amended general permit in accordance with this subchapter or else apply for an individual permit in accordance with N.J.A.C. 7:13-9, 10 and 11.

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(k) A verification of the flood hazard area design flood elevation, floodway limits and/or riparian zone limits, pursuant to N.J.A.C. 7:13-6, is not required prior to obtaining a general permit authorization under this chapter, except for certain cases as noted under general permits 5, 6 and 7 at N.J.A.C. 7:13-8.7, 8.8 and 8.9, respectively. However, pursuant to Table F at N.J.A.C. 7:13-17.1, the $500.00 fee for a verification based on methods 1, 2, 3 and 5 (at N.J.A.C. 7:13- 3.3, 3.4(d), 3.4(e) and 3.5, respectively) does not apply if the verification application is submitted concurrently with an application for any general permit authorization for which verification of the flood hazard area is required to determine compliance with the general permit.

7:13-8.2 General permit conditions

(a) The standard conditions that apply to all general permit authorizations are described in (b) below. Site-specific conditions are described in (c) through (e) below. If a permittee undertakes any regulated activity approved under a general permit authorization, such action shall constitute the permittee's acceptance of the general permit authorization in its entirety and the permittee's agreement to abide by the general permit authorization and all applicable conditions.

(b) The following conditions apply to all general permit authorizations issued under this chapter:

1. Duty to comply: The permittee, its contractors and subcontractors shall comply with all conditions of the permit authorization, supporting documents and approved drawings. Any noncompliance with a permit authorization constitutes a violation of this chapter, and is grounds for enforcement action pursuant to N.J.A.C. 7:13-19, as well as suspension and/or termination of the permit authorization.
2. Duty to reapply: If the permittee wishes to continue an activity covered by the permit after the expiration date of the permit authorization, the permittee must apply for and obtain a new permit authorization.
3. Duty to halt or reduce activity: It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of the permit authorization.
4. Duty to minimize environmental impacts: The permittee shall take all reasonable steps to prevent, minimize or correct any adverse impact on the environment resulting from activities conducted pursuant to the permit, or from noncompliance with the permit authorization.
5. Proper operation and maintenance: The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used to achieve compliance with the permit authorization. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. The operation of back-up or auxiliary facilities or similar systems is only required when necessary to achieve compliance with the permit authorization. The permittee must also properly execute any approved mitigation compensation and/or restoration proposal designed to mitigate losses caused by the permitted activity. The permittee shall maintain the authorized work areas in good condition and in accordance with the permit authorization.

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6. Proper oversight: The permittee shall ensure that all approved activities are undertaken using the best management practices available under the supervision and direction of an engineer at all points necessary to ensure compliance with all permit conditions.
7. Proper site maintenance: While the regulated activities are being undertaken, neither the permittee nor its agents shall cause or permit any unreasonable interference with the free flow of a regulated water by placing or dumping any materials, equipment, debris or structures within or adjacent to the channel. Upon completion or abandonment of the work, the permittee and/or its agents shall remove and dispose of in a lawful manner all excess materials, debris, equipment, silt fences and other temporary soil erosion and sediment control devices from all regulated areas.
8. Permit actions: A permit authorization can be revised, suspended or terminated for cause. The filing of a request by the permittee for a revision, or a notification of planned changes or anticipated noncompliance does not stay any condition of a permit authorization.
9. Property rights: A permit authorization does not convey any property rights or any exclusive privilege.
10. Duty to provide information: A copy of the general permit authorization and other authorizing documents including all approved plans and drawings shall be maintained at the authorized site at all times and made available to Department representatives or their designated agents immediately upon request. The permittee shall also furnish to the Department within a reasonable time any information that the Department requests to determine compliance with a permit authorization or to determine whether cause exists for suspension or termination of a permit authorization. The permittee shall also furnish to the Department, upon request, copies of records required to be kept by the permit authorization.
11. Inspection and entry: The permittee shall allow an authorized representative of the Department, at reasonable times and upon the presentation of credentials, to:

i. Enter upon the permittee's premises where a regulated activity is located or conducted, or where records must be kept under the conditions of the permit authorization;
ii. Have access to and copy any records that must be kept under the conditions of the permit authorization; and
iii. Inspect any facilities, equipment, practices or operations regulated or required under the permit authorization. Failure to allow reasonable access under this section shall be considered a violation of this chapter and subject the permittee to enforcement pursuant to N.J.A.C. 7:13-19.

12. Reporting requirements: The permittee shall provide reports to the Department as follows:

i. Planned changes: The permittee shall give notice to the Department prior to any planned physical alterations or additions to the permitted project or activity;
ii. Transfers: The permit authorization is not transferable to any person unless the transfer is approved by the Department, pursuant to N.J.A.C. 7:13-14.1;
iii. Noncompliance: The permittee shall immediately report to the Department by telephone at (877) 927-6337 any noncompliance that may endanger health or the environment. The permittee shall report all other noncompliance to the

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Division of Land Use Regulation by telephone at (609) 292-0060 within two business days of the time the permittee becomes aware of the noncompliance, and in writing within five business days of the time the permittee becomes aware of the noncompliance.

The written notice shall include: a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and, if the noncompliance has not been corrected, the anticipated length of time it is expected to continue; and steps taken or planned to reduce, eliminate and prevent recurrence of the noncompliance. Such notice shall not, however, serve as a defense to enforcement action if the project is found to be in violation of this chapter; and

iv. Other information: Where the permittee becomes aware that it failed to submit any relevant facts in an application, or submitted incorrect information in an application or in any report to the Department, it shall promptly submit such facts or information.

(c) In addition to the conditions that apply to all general permit authorizations under (b) above, the Department shall establish conditions in a general permit, as required on a case-by-case basis, to assure compliance with all applicable requirements of this chapter and its enabling statutes.

(d) The Department may include in a general permit authorization a condition requiring a preconstruction meeting on the site of permitted activities. Any such condition shall specify how many days prior to construction the permittee must notify the Department so that the preconstruction meeting can be scheduled.

(e) All conditions of a general permit authorization shall be incorporated either expressly or by reference. If incorporated by reference, a specific citation to the applicable rules or regulations or requirements shall be included in the general permit authorization.

7:13-8.3 General permit 1 for channel cleaning under the Stream Cleaning Act

(a) General permit 1 authorizes a county, municipality or a designated agency thereof to desnag a channel and/or remove accumulated sediment, debris and garbage which are obstructing flow in a channel. This section implements the provisions of the "Stream Cleaning Act" in the Flood Hazard Area Control Act at N.J.S.A. 58:16A-67.

(b) The receipt of a freshwater wetlands general permit 26 authorization, issued pursuant to N.J.A.C. 7:7A-5.26, which authorizes stream cleaning, clearing or desnagging by local governments, shall constitute authorization to conduct activities qualifying for a general permit 1 authorization under this chapter without further application or approval under this chapter. However, the receipt of a general permit 1 authorization under this section shall not relieve an applicant from the need to obtain a freshwater wetlands general permit 26 authorization, since the freshwater wetlands general permit has notice requirements that must be satisfied pursuant to N.J.A.C. 7:7A-10.

(c) Except where the applicant has obtained a freshwater wetlands general permit 26 authorization as described in (b) above, applicants for a general permit 1 authorization must follow the application requirements and procedures at (f) through (j) below. There is no application fee for general permit 1 authorization.

(d) In addition to satisfying the requirements applicable to all general permits at N.J.A.C. 7:13-8.1(b), to qualify for general permit 1 authorization, a channel cleaning, clearing or desnagging

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project shall satisfy all of the following requirements:

1. The project's sole purpose is to remove obstructions to flow or desnag a channel;
2. The project is necessary and in the public interest;
3. The project consists solely of either:
   i. The removal of accumulated silt, sediment, debris and/or garbage from a channel with a natural bed. This general permit does not authorize removal of material below the natural bed of the channel; or
   ii. The removal of any accumulated material from a channel previously lined with concrete or similar artificial material;
4. The project does not disturb the channel bank or the riparian zone, unless such disturbance is unavoidable, necessary to gain access to the channel and minimized;
5. The project does not alter the natural banks of the channel. This general permit does not authorize the straightening or realignment of a channel. Straightening or realignment constitutes channel modification and requires an individual permit pursuant to N.J.A.C. 7:13-10.1(c);
6. The project is conducted from only one bank where possible;
7. The use of heavy equipment in the channel is avoided;
8. Vegetation and tree canopy on the more southerly or westerly bank is preserved in order to shade the channel; and
9. If the project involves sediment removal from a channel with a natural bed, the following requirements are satisfied:
   i. The channel reach is less than 500 feet in length;
   ii. The channel bed does not exceed 15 feet in average width;
   iii. The channel has a documented history of severe flooding that has resulted or can result in property damage, therefore necessitating the proposed cleaning, clearing or desnagging;
   iv. The channel is not classified as a Pinelands water or Category One water under the Department's Surface Water Quality Standards at N.J.A.C. 7:9B; and
   v. The channel is not a documented habitat for threatened or endangered species.

(e) All materials, including dredged material, removed from a channel during activities authorized under this general permit shall be disposed of outside of any regulated area and also any freshwater wetlands, transition areas and State open waters, as those terms are defined in the Department's Freshwater Wetlands Protection Act rules at N.J.A.C. 7:7A-1.4, unless the applicant demonstrates that this would cause more environmental harm or flooding risk than disposing of the material in these areas. For example, if removal of dredged material requires construction of a long temporary roadway through a very wet area to enable trucks to transport the dredged material offsite, this might cause more environmental harm than using a large blower to spread the dredged material thinly over a large area.

(f) An application for authorization under this general permit shall be submitted to the Department by mail at the address listed in N.J.A.C. 7:13-1.1(f), and shall include the following (photocopies of maps and documents are acceptable):

1. Three sets of drawings, signed and sealed by a engineer or land surveyor, as appropriate, that clearly depict the segments of channel to be cleaned;
2. Three copies of an application report, as described at N.J.A.C. 7:13-15.3. The narrative

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required in the application report shall include the following:

i. A description of the proposed cleaning methods and disposal locations for all dredged material; and

ii. The classification, under the Department's Surface Water Quality Standards, N.J.A.C. 7:9B, of the affected portion of the channel; and

3. One completed certification (available from the Department's website at www.nj.gov/dep/landuse) that meets the following requirements:

i. The certification is signed and sealed by the county or municipal engineer, or an engineer who is employed by the local Soil Conservation District; and

ii. The certification lists each requirement in (d) above that applies to the project, and states how the requirement has been or will be satisfied.

(g) Within 15 calendar days following the receipt of an application submitted under (f) above for a project that does not involve sediment removal, the Department shall:

1. Notify the applicant that the application did not include the information required at (f) above, or that supplemental information is needed to determine if the activity complies with the general permit, and request the additional information. The Department may cancel the request for a general permit if the requested information is not provided within 60 calendar days. When the requested information is received, the Department shall, within 15 calendar days after receiving the information, take one of the actions in (g)2 or 3 below;

2. Notify the applicant in writing that the project does not qualify for authorization under this general permit, pursuant to (j) below; or

3. Approve the general permit authorization.

(h) Within 60 calendar days following the receipt of an application submitted under (f) above for a project that does involve sediment removal, the Department shall:

1. Notify the applicant that the application did not include information required at (f) above, or that supplemental information is needed to determine if the activity complies with the general permit, and request the additional information. The Department may cancel the request for a general permit if the requested information is not provided within 60 calendar days. When the requested information is received, the Department shall, within 60 calendar days after receiving the information, take one of the actions in (h)2 or 3 below;

2. Notify the applicant in writing that the project does not qualify for authorization under this general permit, pursuant to (j) below; or

3. Approve the general permit authorization.

(i) If the Department fails to take written action on an application in accordance with (g) or (h) above, the general permit application shall automatically be deemed to be approved. This default approval is subject to any applicable conditions set forth in this chapter for the activities covered by the application. Furthermore, default approval under this section shall not prevent the Department from taking enforcement action pursuant to N.J.A.C. 7:13-19 for any activity undertaken in violation of this chapter.

(j) If the Department notifies the applicant under (g)2 or (h)2 above that a channel cleaning, clearing or desnagging project is not authorized under this general permit, the Department shall provide the applicant with the technical reasons for the decision. If the Department's technical reasons are based upon an inability to determine the location of the natural channel bed, the Department shall, at the request of the applicant, assist in identifying the natural channel bed.

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(k) Within 15 calendar days after the completion of a project under this general permit that involves the removal of sediment, the permittee shall submit to the Department a written notice that the project has been completed. The notice shall contain one completed certification (available from the Department's website www.nj.gov/dep/landuse) that satisfies the following requirements:

1. The certification is signed and sealed by the county or municipal engineer, or an engineer who is employed by the local Soil Conservation District; and
2. The certification states each requirement in (d) above that applies to the project, and states how the requirement has been satisfied.

7:13-8.4 General permits 2A through 2G for agricultural activities designed by the NRCS

(a) This section sets forth general permits for seven agricultural activities in a regulated area. In addition to satisfying the requirements applicable to all general permits at N.J.A.C. 7:13-8.1(b), to qualify for a general permit under this section, an activity shall satisfy the requirements applicable to the specific general permit and shall:

1. Occur on land that is actively farmed;
2. Be solely intended for agricultural purposes; and
3. Be approved by and performed under the supervision of the USDA Natural Resource Conservation Service and/or local soil conservation district, as appropriate.

(b) Applications for a general permit authorization under this section are subject to the application requirements and procedures at N.J.A.C. 7:13-8.1(c) through (e).

(c) Regulated activities satisfying (a) above shall qualify for authorization under one of the following general permits provided the conditions applicable to that general permit are satisfied:

1. General permit 2A: A soil erosion control, bank stabilization or bank restoration project, provided:
    - i. The project is accomplished by re-sloping the eroded bank and planting vegetation where possible. Where these techniques alone will not stabilize erosion, or where more than 2,000 square feet of trees would be cleared, cut or removed using such methods, soil bioengineering, shall be used;
    - ii. Disturbance to vegetation within the riparian zone is minimized;
    - iii. The cross-sectional area of the channel is not significantly altered;
    - iv. The activity will not obstruct flow in the channel or floodway; and
    - v. All cleared, cut or removed vegetation in the riparian zone is replanted with indigenous, non-invasive vegetation, except where the removed vegetation has been replaced by non-vegetative stabilizing material;
2. General permit 2B: The removal of accumulated silt, sediment, debris and/or garbage from a regulated water, provided:
    - i. Excavation does not extend below the natural bed or alter the natural banks. This general permit does not authorize the straightening or realignment of a channel. Straightening or realignment constitutes channel modification and requires an individual permit pursuant to N.J.A.C. 7:13-10.1(c);
    - ii. The project does not disturb the channel bank or the riparian zone, unless such disturbance is unavoidable, necessary to gain access to the channel and minimized;
    - iii. The project is conducted from only one bank where possible;

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iv. All heavy machinery necessary for the conduct of the project is situated outside the channel. Heavy machinery may reach into the channel to dredge, but cannot be driven into or operated within the channel;
v. Vegetation and tree canopy on the more southerly or westerly bank is preserved in order to shade the channel;
vi. All proposed access points to the water are described in writing and with color photographs;
vii. All disturbed areas in the riparian zone are replanted with indigenous, non-invasive vegetation upon completion of the project;
viii. All removed sediment is disposed of in accordance with all applicable Federal, State and local laws. If the removed sediment is to remain in the flood hazard area, it is spread evenly at least 25 feet from any top of bank or edge of water and, if in a floodway, no more than three inches deep; and
ix. The placement of the removed sediment does not interfere with the positive overland drainage of the receiving area;

3. General permit 2C: The construction of a roadway across a regulated water, provided:
i. Construction in the channel is minimized and unset or raw cement is not allowed to come into contact with water in the channel during construction;
ii. If the crossing is accomplished with a culvert, the culvert is stabilized with headwalls that have footings which extend at least three feet below grade, and which will prevent the culvert from displacement during the flood hazard area design flood;
iii. If the crossing is accomplished with a bridge, the bridge is constructed with abutments that have footings which extend at least three feet below grade, and which will prevent the bridge from displacement during the flood hazard area design flood;
iv. The proposed roadway surface and all embankments are designed to remain stable during the flood hazard area design flood;
v. The perpendicular path of disturbance through the riparian zone is no more than 25 feet in width; and
vi. It is clear to the Department from a visual inspection of submitted drawings that the proposed roadway crossing will not increase flooding offsite;

4. General permit 2D: The filling of a manmade regulated water for the purpose of freshwater wetlands restoration, provided:
i. The regulated water originates onsite; and
ii. The filling of the regulated water will not adversely affect overland drainage on adjoining properties;

5. General permit 2E: The creation of a ford for livestock to cross a regulated water, provided:
i. Livestock currently cross the regulated water on a regular basis;
ii. The creation of a stable ford will reduce ongoing damage to the channel caused by the existing access to the channel by livestock;
iii. No trees are cleared, cut or removed in a riparian zone;
iv. The ford is situated at or below the existing channel bed so that the ford will not obstruct flow;

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vii. The perpendicular path of disturbance through the riparian zone is no more than 20 feet in width; and

v. The ford is designed to remain stable during the flood hazard area design flood;

6. General permit 2F: The construction of a fence along and/or across a regulated water to limit or manage livestock access to a channel, or to prevent livestock or other animals from accessing certain agricultural areas, provided:

i. No trees are cleared, cut or removed in a riparian zone;

ii. The fence is placed parallel to the channel where possible;

iii. If the fence crosses a channel and/or is located in a floodway, it has sufficiently large openings so as not to catch debris during a flood and thereby obstruct floodwaters, such as a barbed-wire, split-rail or strand fence. A fence with little or no open area, such as a chain link, lattice or picket fence, is not permitted across a channel or in a floodway; and

iv. The fence will not impede bank-full flow in the channel; and

7. General permit 2G: The construction of a pump and/or water intake structure in or along a regulated water, in order to provide water for livestock outside the channel (and thereby limit livestock access to the channel), provided:

i. No trees are cleared, cut or removed in a riparian zone;

ii. Fill within the flood hazard area is minimized; and

iii. The pump or structure will not impede bank-full flow in the channel.

7:13-8.5 General permit 3 for bridge or culvert scour protection by a public entity

(a) This section sets forth a general permit that authorizes a public entity to place rip-rap and other stabilization material within or along one or more regulated waters to replace material that has eroded away, in order to prevent the scouring of an existing bridge or culvert along a public roadway. The application requirements and review procedures for this general permit authorization are set forth at N.J.A.C. 7:13-8.1(c) through (e).

(b) In addition to satisfying the requirements applicable to all general permits at N.J.A.C. 7:13-8.1(b), a scour protection activity is eligible for authorization under general permit 3 only if:

1. It is approved by and performed under the supervision of a public entity;

2. It is necessary for the maintenance and/or protection of an existing bridge or culvert along a public roadway;

3. The stabilizing material placed in the channel is in the same location as the material that has eroded away since the bridge or culvert was originally constructed. This stabilizing material can be placed within any open void area that has been created by previous scour in the channel, and/or can replace any unconsolidated material in the channel, such as silt or sediment, which has subsequently been deposited in any such void area;

4. The amount of stabilizing material placed in the channel is no greater than necessary to replace the material that has eroded away (and which may have subsequently been replaced by unconsolidated material) since the bridge or culvert was originally constructed;

5. The stabilizing material consists of, or is covered by, indigenous substrate where possible;

6. The stabilizing material does not obstruct flow in the channel or floodway;

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7. The project does not disturb the channel bank or the riparian zone, unless such disturbance is unavoidable, necessary to gain access to the channel and minimized. If access to the channel results in topographic changes to the bank, such as ruts from trucks or other machinery, the grade of the bank shall be restored to its pre-construction topography where possible;
8. All cleared, cut or removed vegetation in the riparian zone is replanted with indigenous, non-invasive vegetation, except where the removed vegetation has been replaced by the stabilizing material;
9. Every effort is made to perform the activity from only one bank; and
10. Vegetation and canopy on the more southerly or westerly bank is preserved for shading of the water where possible.

7:13-8.6 General permit 4 for stormwater maintenance by a public entity

(a) This section sets forth a general permit that authorizes the maintenance, repair and replacement of lawfully existing stormwater management structures and conveyance features by a public entity, in cases where such activities are regulated under this chapter. This general permit does not authorize any new stormwater discharges or the expansion of an existing stormwater management or collection system. The application requirements and review procedures for this general permit authorization are set forth at N.J.A.C. 7:13-8.1(c) through (e).

(b) In addition to satisfying the requirements applicable to all general permits at N.J.A.C. 7:13-8.1(b), a maintenance and repair activity is eligible for authorization under general permit 4 only if:

1. It is approved by and performed under the supervision of a public entity;
2. It occurs within and is necessary for the maintenance of a lawfully existing, manmade conveyance structure or drainage feature, such as a pipe, culvert, ditch, channel or basin, not including natural channels that were previously modified;
3. It involves one or more of the following:
    i. The removal of accumulated sediment, debris or nuisance vegetation;
    ii. The stabilization of an eroded structure; and/or
    iii. The reconstruction, repair and/or in-kind replacement of any:
        (1) Culvert along a manmade channel;
        (2) Stormwater pipe, manhole, inlet, catch basin;
        (3) Headwall, discharge structure or associated conduit outlet protection; and/or
        (4) Tidegate, levee or pump station along a water that is separated from tidal influence by these structures;
4. Disturbance to vegetation in the riparian zone is minimized; and
5. All temporarily cleared, cut or removed vegetation in the riparian zone is replanted with indigenous, non-invasive vegetation.

7:13-8.7 General permit 5 for the relocation of a building to reduce flood damage

(a) This section sets forth a general permit that authorizes the relocation of a lawfully existing building to another location on the same site in order to reduce flood damage potential. The application requirements and review procedures for this general permit authorization are set forth at N.J.A.C. 7:13-8.1(c) through (e).

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(b) In addition to satisfying the requirements applicable to all general permits at N.J.A.C. 7:13-8.1(b), the relocation of a lawfully existing building is eligible for authorization under general permit 5 only if:

1. Where possible, the building is moved further from the regulated water and to higher ground on the same site;
2. The building is not enlarged (except for an addition that meets a permit-by-rule at N.J.A.C. 7:13-7.2);
3. The building is not located in a floodway (either before or after relocation);
4. The lowest finished floor of the building is raised to at least one foot above the flood hazard area design flood elevation;
5. The area below the lowest finished floor of the building is not used for habitation and remains open to floodwaters, in accordance with N.J.A.C. 7:13-11.5(l);
6. The proposed location of the building is situated outside the riparian zone if a suitable location exists on the same site. Otherwise, the removal of trees within the riparian zone shall be minimized to accommodate the new building location; and
7. No vegetation is cleared, cut or removed in a riparian zone, except for vegetation within 20 feet of the existing and/or proposed building if such disturbance is necessary to facilitate its relocation. In such a case, all temporarily disturbed areas shall be replanted with indigenous, non-invasive vegetation upon completion of the project, including the area where the relocated building originally existed.

(c) The flood hazard area design flood elevation and floodway limits must be known in order to determine compliance with this general permit authorization. If the flood hazard area design flood elevation and/or floodway limits can be determined using Methods 1, 2 or 3 (at N.J.A.C. 7:13-3.3, 3.4(d) and 3.4(e), respectively), then a verification pursuant to N.J.A.C. 7:13-6.1 does not need to be obtained prior to obtaining authorization under this general permit authorization. However, if the flood hazard area design flood elevation and/or floodway limits are determined using Methods 4, 5 or 6 (at N.J.A.C. 7:13-3.4(f), 3.5 and 3.6, respectively), then a verification pursuant to N.J.A.C. 7:13-6.1 must be obtained from the Department prior to, or concurrent with, obtaining authorization under this general permit.

7:13-8.8 General permit 6 for the reconstruction of a damaged or destroyed residence

(a) This section sets forth a general permit that authorizes the reconstruction of a lawfully existing private residence that has been damaged or destroyed by fire, flood or other natural disaster. The application requirements and review procedures for this general permit authorization are set forth at N.J.A.C. 7:13-8.1(c) through (e).

(b) In addition to satisfying the requirements applicable to all general permits at N.J.A.C. 7:13-8.1(b), the reconstruction of a lawfully existing private residence is eligible for authorization under general permit 6 only if:

1. The residence has been damaged or destroyed by fire, flood or other natural disaster within one year prior to application to the Department under this general permit authorization;
2. The new residence is constructed within the footprint of the residence that was damaged or destroyed or is moved further from the regulated water to higher ground onsite;
3. The residence is not enlarged (except for an addition that meets a permit-by-rule at N.J.A.C. 7:13-7.2);

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4. The residence is not located in a floodway (either before or after reconstruction);
5. The lowest finished floor of the new residence is constructed at least one foot above the flood hazard area design flood elevation;
6. The area below the lowest finished floor of the residence is not used for habitation and remains open to floodwaters, in accordance with N.J.A.C. 7:13-11.5(l);
7. If the residence is to be moved, it is situated outside the riparian zone if a suitable location exists on the same site. Otherwise the removal of trees within the riparian zone shall be minimized to accommodate the new building location; and
8. No vegetation is cleared, cut or removed in a riparian zone, except for vegetation within 20 feet of the existing and/or proposed residence if such disturbance is necessary to facilitate its reconstruction. In such a case all temporarily disturbed areas shall be replanted with indigenous, non-invasive vegetation upon completion of the project including, if the residence is relocated, the area where the residence originally existed.

(c) The flood hazard area design flood elevation and floodway limits must be known in order to determine compliance with this general permit authorization. If the flood hazard area design flood elevation and/or floodway limits can be determined using Methods 1, 2 or 3 (at N.J.A.C. 7:13-3.3, 3.4(d) and 3.4(e), respectively), then a verification pursuant to N.J.A.C. 7:13-6.1 does not need to be obtained prior to obtaining authorization under this general permit. However, if the flood hazard area design flood elevation and/or floodway limits are determined using Methods 4, 5 or 6 (at N.J.A.C. 7:13-3.4(f), 3.5 and 3.6, respectively), then a verification pursuant to N.J.A.C. 7:13-6.1 must be obtained from the Department prior to, or concurrent with, obtaining authorization under this general permit.

7:13-8.9 General permit 7 for residential construction in a tidal flood hazard area

(a) This section sets forth a general permit to construct the following residential buildings in a tidal flood hazard area:

1. One new private residence, which is not being constructed as part of a larger residential subdivision;
2. An addition to a private residence; and/or
3. A building appurtenant to a private residence, such as a garage, barn or shed.

(b) The application requirements and review procedures for this general permit are set forth at N.J.A.C. 7:13-8.1(c) through (e). The construction of certain types of residential additions and appurtenant structures may occur pursuant to a permit-by-rule in accordance with N.J.A.C. 7:13-7.2(a) and (b). Activities covered by a permit-by-rule do not require a general permit authorization under this section.

(c) In addition to satisfying the requirements applicable to all general permits at N.J.A.C. 7:13-8.1(b), a private residence, addition or appurtenant structure is eligible for authorization under general permit 7 only if:

1. It is located in a tidal flood hazard area;
2. It does not require a CAFRA or waterfront development permit under N.J.A.C. 7:7 and 7:7E;
3. It meets the requirements for disturbance in the riparian zone at N.J.A.C. 7:13-10.2, including any justification that may be required for the activity and any limitations on the area of vegetation that can be cleared, cut or removed in the riparian zone; and
4. It meets the applicable requirements for a building at N.J.A.C. 7:13-11.5.

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(d) The flood hazard area design flood elevation and floodway limits must be known in order to determine compliance with this general permit. If the flood hazard area design flood elevation and/or floodway limits can be determined using Methods 1, 2 or 3 (at N.J.A.C. 7:13-3.3, 3.4(d) and 3.4(e), respectively), then a verification pursuant to N.J.A.C. 7:13-6.1 does not need to be obtained prior to obtaining authorization under this general permit. However, if the flood hazard area design flood elevation and/or floodway limits are determined using Methods 4, 5 or 6 (at N.J.A.C. 7:13-3.4(f), 3.5 and 3.6, respectively), then a verification pursuant to N.J.A.C. 7:13-6.1 must be obtained from the Department prior to, or concurrent with, obtaining authorization under this general permit.

7:13-8.10 General permit 8 for a utility line across or along a water with a drainage area of less than 50 acres

(a) This section sets forth a general permit to construct a utility line across or along a regulated water that has a drainage area of less than 50 acres. The application requirements and review procedures for this general permit authorization are set forth at N.J.A.C. 7:13-8.1(c) through (e).

(b) In addition to satisfying the requirements applicable to all general permits at N.J.A.C. 7:13-8.1(b), a utility crossing is eligible for authorization under general permit 8 only if:

1. It is located across or along a regulated water that has a drainage area of less than 50 acres;
2. It is not located in the flood hazard area or riparian zone of another regulated water that has a drainage area of 50 acres or greater;
3. It is authorized under a valid freshwater wetlands general permit 2 or 21, pursuant to N.J.A.C. 7:7A-5.2 or 5.21, respectively;
4. It meets the requirements for disturbance in the riparian zone at N.J.A.C. 7:13-10.2, including any justification that may be required for the activity and any limitations on the area of vegetation that can be cleared, cut or removed in the riparian zone; and
5. It meets the requirements at N.J.A.C. 7:13-11.9 for the construction of a utility line.

7:13-8.11 General permit 9 for a roadway or footbridge across a water with a drainage area of less than 50 acres

(a) This section sets forth a general permit to construct a roadway or footbridge across a regulated water that has a drainage area of less than 50 acres. The application requirements and review procedures for this general permit are set forth at N.J.A.C. 7:13-8.1(c) through (e).

(b) In addition to satisfying the requirements applicable to all general permits at N.J.A.C. 7:13-8.1(b), a roadway or footbridge is eligible for authorization under general permit 9 only if:

1. It crosses a regulated water that has a drainage area of less than 50 acres;
2. It is not located in the flood hazard area or riparian zone of another regulated water that has a drainage area of 50 acres or greater;
3. It is authorized under a valid freshwater wetlands general permit 10A or 10B, pursuant to N.J.A.C. 7:7A-5.10A or 5.10B, respectively;
4. It meets the requirements for disturbance in the riparian zone at N.J.A.C. 7:13-10.2, including any justification that may be required for the activity and any limitations on the area of vegetation that can be cleared, cut or removed in the riparian zone; and
5. It meets the requirements at N.J.A.C. 7:13-11.7(e) through (l) for the protection of aquatic habitat and the maintenance of low-flow aquatic passage.

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7:13-8.12 General permit 10 for a stormwater outfall along a water with a drainage area of less than 50 acres

(a) This section sets forth a general permit to construct a stormwater outfall structure along a regulated water that has a drainage area of less than 50 acres. The application requirements and review procedures for this general permit authorization are set forth at N.J.A.C. 7:13-8.1(c) through (e).

(b) In addition to satisfying the requirements applicable to all general permits at N.J.A.C. 7:13-8.1(b), a stormwater outfall structure is eligible for authorization under general permit 10 only if:

1. It is located along a regulated water that has a drainage area of less than 50 acres;
2. It is not located in the flood hazard area or riparian zone of another regulated water that has a drainage area of 50 acres or greater;
3. It is authorized under a valid freshwater wetlands general permit 11, pursuant to N.J.A.C. 7:7A-5.11;
4. It meets the requirements for disturbance in the riparian zone at N.J.A.C. 7:13-10.2, including any justification that may be required for the activity and any limitations on the area of vegetation that can be cleared, cut or removed in the riparian zone; and
5. It meets the requirements at N.J.A.C. 7:13-11.10 for the construction of a stormwater outfall structure.

SUBCHAPTER 9. INDIVIDUAL PERMITS

7:13-9.1 General provisions for individual permits

(a) This subchapter sets forth application and review procedures for an individual permit. Design and construction standards for activities that require an individual permit are set forth in this chapter as follows:

1. Standards associated with the location of a project in a particular regulated area, such as a channel or floodway, or the location of the project in relation to certain natural resources, are set forth at N.J.A.C. 7:13-10; and
2. Standards associated with a particular regulated activity, such as the construction of a building or roadway, are set forth at N.J.A.C. 7:13-11.

(b) A regulated activity that requires an individual permit is typically subject to multiple requirements that are set forth throughout N.J.A.C. 7:13-10 and 11 as described in (a) above. The applicant shall evaluate each regulated activity according to its location, nature and potential impacts in order to determine which design and construction standards will apply to the applicant's particular project.

7:13-9.2 Application requirements for an individual permit

(a) An application for an individual permit shall include information on all planned activities that are reasonably related to the proposed project. In general, the level of detail and documentation required for an application shall correspond to the size and likely impact of the proposed project, its proximity to a channel and/or riparian zone, and its potential to adversely affect flooding and the environment. The Department shall, upon request, provide an applicant with guidance regarding the appropriate level of detail for a particular application.

(b) An application for an individual permit shall include the following:

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1. One copy of the appropriate checklist for the proposed activities, completed as directed by its instructions. Checklists summarize the requirements of this chapter and ask various questions about the project in order to guide the applicant through the permitting process and ensure that the correct material is submitted with each application. For example, checklists ask how the applicant determined the flood hazard area and floodway limits onsite, whether construction is proposed in a floodway or flood fringe, and how much impervious surface is proposed, all in order to alert the applicant as to whether hydrologic, hydraulic, flood storage and/or stormwater management calculations are required as part of the permit application. Checklists also ask the applicant to identify all regulated activities proposed onsite to ensure that public notice is provided where necessary and to help the applicant determine the correct application review fee. Checklists do not set forth application requirements in addition to those listed in this chapter. Checklists are provided at www.nj.gov/dep/landuse or can be obtained from the Department at the address listed in N.J.A.C. 7:13-1.1(f);
2. Three copies of an application report, as described at N.J.A.C. 7:13-15.3. The photographs required in the application report shall show any sections of channel or riparian zone that will be disturbed by the project;
3. One copy of an engineering report, as described at N.J.A.C. 7:13-15.4, if the Department must review detailed engineering calculations in order to determine whether the proposed activity complies with this chapter;
4. Three copies of an environmental report, as described at N.J.A.C. 7:13-15.5, except that no environmental report is required if a project consists solely of the following activities:
    i. The construction of one private residence, which is not being constructed as part of a larger residential subdivision; and/or
    ii. The construction of a building appurtenant to a private residence, such as a garage, barn or shed;
5. Documentation that the applicable public notice requirements of N.J.A.C. 7:13-16 have been met;
6. The application fee required under N.J.A.C. 7:13-17; and
7. Six sets of drawings, signed and sealed by a engineer, land surveyor or architect, as appropriate, which contain the following information:
    i. All proposed regulated activities (including the size, location and all construction details for each regulated activity);
    ii. The limit of any riparian zone onsite;
    iii. Existing and proposed topography if fill or grading is proposed, unless the Department determines that topography is not necessary to determine compliance with this chapter. All topography shall reference NGVD, or include the appropriate conversion factor to NGVD, unless the applicant demonstrates that such reference is not necessary;
    iv. The limit of the flood hazard area and floodway onsite if present. If proposed fill, construction and/or grading will affect these limits, then both existing and proposed flood hazard area and floodway limits shall be included on all drawings;
    v. Details of proposed soil erosion and sediment control measures;

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vi. If construction is proposed in a regulated water, the drawings shall also include the following:

(1) A thorough explanation of the proposed method of construction;

(2) A timetable for the construction; and

(3) All proposed trenching, diversionary channels and temporary piping of the regulated water; and

vii. If construction is proposed in a riparian zone, the drawings shall also include the following:

(1) All locations where vegetation will be cleared, cut or removed; and

(2) Details of any replanting pursuant to N.J.A.C. 7:13-10.2.

(c) An application that proposes activities in a regulated area known or suspected to contain acid producing soils shall include the following:

1. A comprehensive evaluation of the potential environmental risks caused by exposure of the acid producing soils; and

2. A plan to minimize any such risks.

(d) An application that proposes the use of fill credits to balance fill on a site in the Central Passaic Basin, as described at N.J.A.C. 7:13-10.4(s) and (t), shall include documentation that the fill credits have been purchased by the applicant prior to the submittal of the application.

(e) An application that proposes to construct a dry flood-proofed building shall include the following material, signed and sealed by an architect or engineer:

1. Drawings that clearly show the proposed dry flood-proofing measures;

2. Calculations that demonstrate that the structure meets the requirements for flood resistance at N.J.A.C. 7:13-11.4(b); and

3. A dry flood-proofing certification, listing each applicable dry flood-proofing requirement at N.J.A.C. 7:13-11.5(q), and stating how the building meets each requirement.

(f) An application proposing an activity that adversely impacts a property not owned by the applicant, as described at N.J.A.C. 7:13-11.1(f), shall include documentation demonstrating that one or more of the following applies to each adversely impacted property:

1. The applicant is a public entity that intends to appropriate the adversely impacted property through its power of eminent domain;

2. The applicant has entered into a contract to purchase the adversely impacted property;

3. The applicant has obtained an easement that encompasses the entire area that will be adversely impacted by the proposed activity, which specifically allows the applicant to undertake the proposed activity; and/or

4. The applicant has obtained written permission from the owners of the adversely impacted property. Written permission shall include the following:

i. An explanation of the nature and purpose of the project;

ii. An estimate of the length of time regulated activities will occur;

iii. An estimate of the extent to which the adversely impacted property will be affected by flooding or stormwater discharges and the frequency at which these impacts are expected to occur; and

iv. The notarized signature of all owners of the adversely impacted property.

(g) The Department shall accept for review an application for an individual permit for an

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activity subject to the Department's Water Quality Management Planning rules at N.J.A.C. 7:15 only if the activity is consistent with N.J.A.C. 7:15 and the applicable Water Quality Management Plan adopted under the Water Quality Management Planning Act, N.J.S.A. 58:11A-1 et seq.

(h) The Department shall accept for review an application for an individual permit for an activity located in an area under the jurisdiction of the Pinelands Commission, as defined at N.J.S.A. 13:18A-11, only if the applicant has first received a Certificate of Filing, a Notice of Filing, a Certificate of Compliance or a Resolution of Approval from the Pinelands Commission for the proposed activity, as appropriate. For more information, contact the Pinelands Commission at (609) 894-7300 or through its website at www.state.nj.us/pinelands.

7:13-9.3 Application review procedures for a verification or individual permit

(a) This section sets forth the Department's application review process for verifications and individual permits with the following exceptions:

1. Pursuant to the Construction Permits Law at N.J.S.A. 13:1D-29 et seq., the default approval provisions at (e) through (h) below do not apply to an application for an individual permit for an electric generating facility or for a petroleum processing or storage facility, including a liquefied natural gas facility, with a storage capacity of over 50,000 barrels; and

2. Pursuant to the Highlands Water Protection and Planning Act at N.J.S.A. 13:20-1 et seq., this section does not apply to a regulated activity associated with a Major Highlands Development, the application requirements and review procedures for which are found in the Highlands Water Protection and Planning Act rules at N.J.A.C. 7:38.

(b) Within 20 working days following the receipt of an application for a verification or individual permit, the Department shall:

1. Determine that all necessary information required by this chapter for a complete application has been provided, and declare the application complete for review;

2. Determine that all necessary information required by this chapter for a complete application has not been provided, or that one or more submitted items are deficient, and request in writing that the applicant submit the missing material and/or address any deficiencies within a reasonable time period. The Department may cancel the application if the requested information is not provided within 60 calendar days. The Department shall subsequently declare the application complete for review within 20 working days of receiving the requested information; or

3. If the Department does not take action under (b)1 or 2 above within 20 working days, the application shall be deemed complete for review. In such a case, the Department may request additional information, which is necessary to bring the application into compliance with the requirements of this chapter during the review of the application.

(c) Upon written request of the applicant, the Department shall cancel an application and fully refund the submitted application fee provided:

1. The request to cancel the application is received within 20 working days of the submittal of the application and the Department has not already approved or denied the application; or

2. The request to cancel the application is received within 60 calendar days of the submittal of an application that remains incomplete under (b)2 above.

(d) If the Department determines during the review of a complete application under (b) above

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that the application does not meet the requirements of this chapter, the Department can request additional information and/or changes to the project in order to bring the project into compliance, provided such changes are possible within the remaining application review period described in (e) below.

(e) Within 90 calendar days following the receipt of a complete application under (b) above, the Department shall:

1. Determine that the application meets the requirements of this chapter and approve the application in writing;
2. Determine that the application does not meet the requirements of this chapter and extend the review period by 30 calendar days in writing, if agreed to by the applicant as described in (f) below; or
3. Determine that the application does not meet the requirements of this chapter and deny the application in writing.

(f) The 90-day review period in (e) above can be extended one time by 30 calendar days by mutual consent of the applicant and the Department. An applicant requesting an extension shall make this request in writing during the 90-day review period (prior to the approval or denial of the project) and shall direct the request to the project manager (or his or her supervisor) assigned to review the application. The Department shall not extend the 90-day review period by less than or greater than 30 calendar days. An applicant cannot waive the right for a timely review (as provided under this section and the Ninety-Day Construction Permits Law, N.J.S.A. 13:1D-29 et seq.) and thereby avoid or indefinitely extend the Department's 90-day review period for the application.

(g) If a 30-day extension has been granted under (f) above, the Department shall, within this 30-day period:

1. Determine that the application meets the requirements of this chapter and approve the application in writing; or
2. Determine that the application does not meet the requirements of this chapter and deny the application in writing.

(h) If the Department fails to take action on an application in accordance with (e) or (g) above, the application shall automatically be deemed to be approved. This default approval is subject to any applicable conditions set forth in this chapter for the activities covered by the application. Furthermore, default approval under this section shall not prevent the Department from taking enforcement action pursuant to N.J.A.C. 7:13-19 for any activity undertaken in violation of this chapter.

(i) An applicant can request withdrawal of an application in writing at any time during the Department's review of the application. In response to a request to withdraw an application, the Department shall:

1. Agree to the withdrawal in writing; or
2. Not agree to the withdrawal and either approve or deny the application in accordance with (e) or (g) above.

(j) If an application is denied or withdrawn under (e), (g) or (i) above, any application fee that was paid to the Department shall be credited toward the application fee for one new application, provided the following requirements are satisfied:

1. The denied or withdrawn application did not include a request for a hardship exception pursuant to N.J.A.C. 7:13-9.8;
2. The new application is submitted within one year of denial or withdrawal;

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3. The new application is submitted by the same applicant;
4. The new application is submitted for the same site; and
5. The new application is submitted for the same project, except for changes necessary to meet the requirements for approval or other minor adjustments that do not require a complete re-review of the project.

(k) The Department shall list in the DEP Bulletin, published in accordance with N.J.S.A. 13:1D-34, all complete applications received, the review status of these applications, and all decisions made on these applications. The DEP Bulletin can be viewed or downloaded from the Department's web site at www.state.nj.us/dep.

(l) The Department may issue or deny an application for a verification or an individual permit without a public hearing. However, the Department shall hold a public hearing in either of the following cases:

1. There is a significant degree of public interest in the application, as manifested by written requests for a hearing from at least 10 persons at different addresses. In considering the degree of public interest, the Department shall take into account whether the issues raised in the hearing requests are relevant to the application's review; or
2. The Department determines that the public interest would be best served by holding a hearing due to an unusual situation or condition on site, or due to a high potential for adverse impacts to flooding and/or the environment.

7:13-9.4 Duration of an individual permit

(a) Except as provided in (b) below, an individual permit is valid for five years from its issuance date and shall not be extended. However, the Department can transfer an individual permit with the sale of a property to a new owner pursuant to N.J.A.C. 7:13-14.1.

(b) An individual permit for a public roadway, railroad or flood control project is valid for 10 years from its issuance date, provided the applicant is a public entity and the applicant demonstrates that the size and scope of the project is likely to prevent the completion of all regulated activities within a five-year period.

(c) All regulated activities shall cease upon expiration of an individual permit. Regulated activities cannot resume unless the applicant applies for and obtains a new individual permit from the Department. In such cases, the Department shall issue a new individual permit only as follows:

1. If no regulated activities have occurred onsite prior to the expiration of the original individual permit, a new individual permit shall be issued only if the project is revised where necessary to comply with the requirements of this chapter in effect when the new application is submitted; and
2. If some regulated activities have occurred onsite prior to the expiration of the original individual permit, a new individual permit shall be issued only if the project is revised where feasible to comply with the requirements of this chapter in effect when the new application is submitted. In determining the feasibility of compliance with the current requirements of this chapter, the Department shall consider the amount of construction that was completed onsite prior to the permit expiration, as well as whether continuing construction as originally approved would constitute an adverse impact on flooding or the environment.

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7:13-9.5 Individual permit conditions

(a) The Department places certain conditions on an individual permit to ensure that the approved project complies with this chapter. Standard conditions that apply to all individual permits are described in (b) below and the application of additional site-specific conditions are described in (c) through (e) below. If a permittee does not agree with a condition on an individual permit, the permittee is entitled to appeal the individual permit as described at N.J.A.C. 7:13-18.1. However, if a permittee undertakes any regulated activity approved under an individual permit, such action shall constitute the permittee's acceptance of the individual permit in its entirety and the permittee's agreement to abide by the individual permit and all conditions listed therein.

(b) The following conditions apply to all individual permits issued under this chapter:

1. Duty to comply: The permittee, its contractors and subcontractors shall comply with all conditions of the permit, supporting documents and approved drawings. Any noncompliance with a permit constitutes a violation of this chapter, and is grounds for enforcement action pursuant to N.J.A.C. 7:13-19, as well as suspension and/or termination of the permit

2. Duty to reapply: If the permittee wishes to continue an activity covered by the permit after the expiration date of the permit, the permittee must apply for and obtain a new permit.

3. Duty to halt or reduce activity: It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of the permit.

4. Duty to minimize environmental impacts: The permittee shall take all reasonable steps to prevent, minimize or correct any adverse impact on the environment resulting from activities conducted pursuant to the permit, or from noncompliance with the permit.

5. Proper operation and maintenance: The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used to achieve compliance with the permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. The operation of back-up or auxiliary facilities or similar systems is only required when necessary to achieve compliance with the permit. The permittee must also properly execute any approved mitigation compensation and/or restoration proposal designed to mitigate losses caused by the permitted activity. The permittee shall maintain the authorized work areas in good condition and in accordance with the permit.

6. Proper oversight: The permittee shall ensure that all approved activities are undertaken using the best management practices available under the supervision and direction of an engineer at all points necessary to ensure compliance with all permit conditions.

7. Proper site maintenance: While the regulated activities are being undertaken, neither the permittee nor its agents shall cause or permit any unreasonable interference with the free flow of a regulated water by placing or dumping any materials, equipment, debris or structures within or adjacent to the channel. Upon completion or abandonment of the work, the permittee and/or its agents shall remove and dispose of in a lawful manner all

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excess materials, debris, equipment, silt fences and other temporary soil erosion and sediment control devices from all regulated areas.
8. Permit actions: A permit can be revised, suspended or terminated for cause. The filing of a request by the permittee for a revision, or a notification of planned changes or anticipated noncompliance does not stay any condition of a permit.
9. Property rights: A permit does not convey any property rights of any sort, or any exclusive privilege.
10. Duty to provide information: A copy of the general permit and other authorizing documents including all approved plans and drawings shall be maintained at the authorized site at all times and made available to Department representatives or their designated agents immediately upon request. The permittee shall also furnish to the Department within a reasonable time any information that the Department requests to determine compliance with a permit or to determine whether cause exists for suspension or termination of a permit. The permittee shall also furnish to the Department, upon request, copies of records required to be kept by the permit.
11. Inspection and entry: The permittee shall allow an authorized representative of the Department, at reasonable times and upon the presentation of credentials, to:

i. Enter upon the permittee's premises where a regulated activity is located or conducted, or where records must be kept under the conditions of the permit;
ii. Have access to and copy any records that must be kept under the conditions of the permit; and
iii. Inspect any facilities, equipment, practices or operations regulated or required under the permit. Failure to allow reasonable access under this section shall be considered a violation of this chapter and subject the permittee to enforcement action pursuant to N.J.A.C. 7:13-19.

12. Reporting requirements: The permittee shall provide reports to the Department as follows:

i. Planned changes: The permittee shall give notice to the Department prior to any planned physical alterations or additions to the permitted project or activity;
ii. Transfers: The permit is not transferable to any person unless the transfer is approved by the Department, pursuant to N.J.A.C. 7:13-14.1;
iii. Noncompliance: The permittee shall immediately report to the Department by telephone at (877) 927-6337 any noncompliance that may endanger health or the environment. The permittee shall report all other noncompliance to the Division of Land Use Regulation by telephone at (609) 292-0060 within two business days of the time the permittee becomes aware of the noncompliance, and in writing within five business days of the time the permittee becomes aware of the noncompliance. The written notice shall include: a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and, if the noncompliance has not been corrected, the anticipated length of time it is expected to continue; and steps taken or planned to reduce, eliminate and prevent recurrence of the noncompliance. Such notice shall not, however, serve as a defense to enforcement action if the project is found to be in violation of this chapter; and iv. Other information: Where the permittee becomes aware that it failed to submit any relevant facts in an

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application, or submitted incorrect information in an application or in any report to the Department, it shall promptly submit such facts or information.

(c) In addition to the conditions that apply to all individual permits under (b) above, the Department shall establish conditions in an individual permit, as required on a case-by-case basis, to assure compliance with all applicable requirements of this chapter and its enabling statutes.

(d) The Department may in some cases include in an individual permit a condition requiring a pre-construction meeting on the site of permitted activities. Such a condition shall specify how many days prior to construction the permittee must notify the Department so that the preconstruction meeting can be scheduled.

(e) All conditions of an individual permit shall be incorporated either expressly or by reference. If incorporated by reference, a specific citation to the applicable rules or regulations or requirements shall be included in the individual permit.

7:13-9.6 Cases where a verification is required prior to obtaining an individual permit

(a) Except as provided at (b) and (c) below, the Department shall issue an individual permit for a regulated activity only if the flood hazard area design flood elevation and floodway limit are known and verified pursuant to N.J.A.C. 7:13-6.1. An applicant for an individual permit shall therefore demonstrate that:

1. The applicant possesses a valid verification of the flood hazard area design flood elevation, and also the floodway limit if present, for the project area;
2. The applicant has applied for a verification of the flood hazard area design flood elevation, and also the floodway limit if present, for the project area, and the Department approves the verification either prior to or concurrent with the issuance of the individual permit;
3. The project meets the conditions of either (b)1 or 2 below, in which case no verification is required in order to obtain an individual permit; or
4. The project meets the conditions of (c) below, in which case a verification of only the flood hazard area design flood elevation is required either prior to or concurrent with the issuance of an individual permit.

(b) A verification is not required prior to the issuance of an individual permit in either of the following cases:

1. No fill and no aboveground structure is proposed onsite; or
2. Fill and/or an aboveground structure is proposed and it is clear to the Department from a visual inspection of submitted drawings that:
   i. No habitable building, railroad, roadway or parking area is proposed, which requires knowledge of the flood hazard area design flood elevation to determine compliance with this chapter;
   ii. The proposed fill and/or structure is either located outside a floodway or will not obstruct flow in a floodway; and
   iii. The flood storage displacement requirements of N.J.A.C. 7:13-10.4 are satisfied.

(c) Verification of the floodway limit is not required prior to the issuance of an individual permit for the construction a habitable building, railroad, roadway or parking area provided it is clear to the Department from a visual inspection of submitted drawings that:

1. The proposed fill and/or structure is either located outside a floodway or will not

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obstruct flow in a floodway; and

2. The flood storage displacement requirements of N.J.A.C. 7:13-10.4 are satisfied.

7:13-9.7 Cases where an individual permit can be issued in an approximated flood hazard area

(a) The Department shall issue an individual permit for a regulated activity in a flood hazard area approximated under Method 5 at N.J.A.C. 7:13-3.5, only if the flood hazard area is verified under N.J.A.C. 7:13-6, and only in either of the following cases:

1. No fill or aboveground structure is proposed in the flood hazard area; or

2. Fill and/or an aboveground structure is proposed in the flood hazard area, and it is clear to the Department from a visual inspection of submitted drawings that the following requirements are satisfied:

i. If a habitable building is proposed, it is located outside a floodway;

ii. If fill or any structure other than a habitable building is proposed, it is either located outside a floodway or will not obstruct flow in a floodway; and

iii. The flood storage displacement requirements of N.J.A.C. 7:13-10.4 are satisfied.

7:13-9.8 Hardship exception for an individual permit

(a) The Department shall issue an individual permit for an activity that does not comply with one or more of the requirements at N.J.A.C. 7:13-10 and 11 only if all of the requirements of (b) below are satisfied and, additionally, one or more of the following requirements are satisfied:

1. The Department determines that there is no feasible and prudent alternative to the proposed project, including not pursuing the project, which would avoid or substantially reduce the anticipated adverse effects of the project, and that granting the hardship exception would not compromise the reasonable requirements of public health, safety and welfare, or the environment;

2. The Department determines that the cost of compliance with the requirements of this chapter is unreasonably high in relation to the environmental benefits that would be achieved by compliance; and/or

3. The Department and applicant agree to one or more alternative requirements that, in the judgment of the Department, provide equal or better protection to public health, safety and welfare and the environment.

(b) To obtain an individual permit based on a hardship exception, the applicant shall demonstrate to the Department that the following requirements are satisfied:

1. Due to an extraordinary situation of the applicant or site condition, compliance with this chapter would result in an exceptional and/or undue hardship for the applicant;

2. The proposed activities will not adversely affect the use of contiguous or nearby property;

3. The proposed activities will not pose a threat to the environment, or to public health, safety and welfare; and

4. The hardship was not created by any action or inaction of the applicant or its agents.

(c) To obtain an individual permit based on a hardship exception, the applicant shall submit an application pursuant to N.J.A.C. 7:13-9.2 and shall include the following additional information as applicable:

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1. A description of any potential impacts of the proposed project upon the environment;
2. If the hardship exception request relates to the access requirements of N.J.A.C. 7:13-11.6, proposed access routes to and from the property during a flood;
3. If the hardship exception request relates to any potential impacts from or to flooding, the projected height, velocity and duration of the floodwaters expected at the site during the flood hazard area design flood, as well as evidence that the project will not adversely affect the hydraulic capacity of any water so as to cause or increase flooding upstream and/or downstream of the proposed project;
4. If the hardship exception request is based on economic grounds, detailed financial documentation to support the request;
5. A description of the existing development in the area and any potential impacts of the proposed regulated activities on that development; and
6. Any additional information that the Department determines is reasonable and necessary to evaluate whether the hardship exception request meets the requirements of this section.

(d) The Department shall review an application for an individual permit based on a hardship exception in accordance with the procedures for an individual permit at N.J.A.C. 7:13-9.3. The denial of an individual permit based on a hardship exception shall be without prejudice. However, any future reapplication for an individual permit based on a hardship exception that has been denied or withdrawn shall be accompanied by a new application fee.
(e) A delegated agency shall not issue an individual permit based on a hardship exception.

SUBCHAPTER 10. INDIVIDUAL PERMIT REQUIREMENTS WITHIN VARIOUS REGULATED AREAS

7:13-10.1 Requirements for a regulated activity in a channel

(a) This section sets forth specific design and construction standards that apply to any regulated activity proposed in a channel.
(b) The Department shall issue an individual permit for a regulated activity in a channel only if the following requirements are satisfied:

1. The basic purpose of the project cannot be accomplished without the disturbance to the channel;
2. Disturbance to the channel is eliminated where possible; where not possible to eliminate, disturbance is minimized through methods including relocating the project and/or reducing the size or scope of the project;
3. All roadway, railroad, pedestrian, utility and other crossings are constructed as nearly perpendicular to the channel as possible;
4. All disturbed sections of the channel are properly stabilized, with special attention given to changes in slope, channel width and hydraulic capacity;
5. If stabilization measures such as rip-rap or scour holes are proposed in the channel, the applicant demonstrates that such measures are necessary to stabilize the channel and/or to withstand scour along a bridge or culvert, and cannot be avoided through alternative designs, such as construction of deeper abutment footings or a larger bridge opening. Any rip-rap shall be embedded in the channel bed in such a way as to provide low-flow aquatic passage and withstand velocities associated with bank-full flows;

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6. No mining of the channel is proposed. This does not preclude the incidental use or sale of material removed as a result of lake dredging, channel cleaning or other regulated activities authorized by the Department and performed for purposes other than mining;
7. All temporarily disturbed sections of the channel are restored to pre-construction conditions. Characteristics that shall be replicated include channel shape, width and meandering, ratio of shallow areas to deep areas, anticipated flow rate and velocity and substrate type;
8. Aquatic habitat is preserved where possible; and
9. Aquatic habitat is enhanced where preservation is not possible, such as through the placement of habitat enhancement devices, replacement of vegetation removed during construction, creation of tree canopy along the channel where no canopy exists and/or enhancement of existing tree canopy along the channel.

(c) The Department shall issue an individual permit for a channel modification only if the applicant demonstrates that, in addition to meeting the requirements of (b) above, the channel modification meets at least one of the following requirements:

1. The channel modification is necessary to improve the ecological health of the regulated water and its riparian zone, or to control existing flooding or erosion which poses an immediate threat to life, property or a lawfully existing structure; or
2. The channel modification is necessary for the construction of a bridge or culvert, and the following requirements are satisfied:
    i. The disturbance to the channel is minimized;
    ii. A bridge is constructed rather than a culvert, where feasible;
    iii. The length of channel covered by a bridge or enclosed in a culvert is the minimum feasible; and
    iv. No more than 200 linear feet of channel (including the bridge or culvert) is disturbed.

(d) The Department shall allow the use of construction equipment to perform regulated activities in a channel (whether situated in a channel, reaching into a channel or driven across a channel) only if, in addition to meeting the requirements of (b) above, the following requirements are satisfied:

1. There is no feasible alternative that will result in less environmental damage;
2. The bed is firm, the approaches are stable and the proposed construction activities will not cause or exacerbate bank erosion;
3. Contact with flowing water is minimized where possible through the use of temporary bridges, culverts, coffer dams and/or sediment control devices, which are removed after completion of the project;
4. Fording the channel is avoided;
5. Where unavoidable, fording is made as nearly perpendicular to the channel as possible; and
6. Adequate precautions are taken to prevent sediment, petroleum products and other pollutants from entering the channel.

(e) A person shall not drive or operate a vehicle across a channel except in the following cases:

1. It is necessary to operate construction equipment in or across a channel as described in (d) above as part of a temporary construction activity;

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2. An emergency vehicle must access a site that has no other feasible means of entry. This does not include repeated visits to the same site by delivery trucks; or
3. The vehicle is driven across a lawfully existing and stable ford that was either constructed prior to October 2, 2006, or which is constructed on agricultural lands under general permit 2E at N.J.A.C. 7:13-8.4(c)5.

7:13-10.2 Requirements for a regulated activity in a riparian zone

(a) This section sets forth specific design and construction standards that apply to any regulated activity proposed in a riparian zone. The width of the riparian zone is set forth at N.J.A.C. 7:13- 4.1.

(b) The riparian zones established by this chapter are separate from and in addition to any other similar zones or buffers established to protect surface waters. For example, the Stormwater Management rules at N.J.A.C. 7:8 and the Highlands Water Protection and Planning Act rules at N.J.A.C. 7:38 establish 300-foot Special Water Resource Protection Areas and buffers, respectively, along certain waters. Furthermore, the Freshwater Wetlands Protection Act rules at N.J.A.C. 7:7A establish 50-foot and 150-foot transition areas along freshwater wetlands and other features that are also regulated under this chapter. Compliance with the riparian zone requirements of this chapter does not constitute compliance with the requirements imposed under any other Federal, State or local statute, regulation or ordinance.

(c) As used in this section, the total area of vegetation disturbed in a riparian zone shall include the following:

1. The area of any vegetation within the limit of disturbance shown on submitted drawings;
2. The area under the canopy of any trees to be cleared, cut or removed; and
3. All other areas from which any vegetation is to be temporarily or permanently cleared, cut or removed.

(d) The following table sets forth limits on the area of vegetation that can be disturbed for various regulated activities, provided the requirements for each activity as described in (e) through (r) below are satisfied, and provided the applicant demonstrates the following:

1. The basic purpose of the project cannot be accomplished onsite without disturbing vegetation in the riparian zone;
2. Disturbance to the riparian zone is eliminated where possible; where not possible to eliminate, disturbance is minimized through methods including relocating the project, reducing the size or scope of the project and/or situating the project in portions of the riparian zone where previous development or disturbance has occurred;
3. All temporarily cleared, cut or removed vegetation within a riparian zone is replanted with indigenous, non-invasive vegetation upon completion of the project in accordance with (u) below; and
4. All additional restrictions for the specific proposed activity described elsewhere in this chapter are satisfied. For example, while (o) below sets limits on disturbance to the riparian zone resulting from a flood control project, N.J.A.C. 7:13-11.12 includes further specific requirements to ensure that disturbance to the channel and riparian zone is avoided or minimized for such projects.

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Table C
MAXIMUM ALLOWABLE DISTURBANCE TO RIPARIAN ZONE VEGETATION

Proposed Regulated Activity		See Paragraph Below for Further Detail	Maximum Area of Vegetation Disturbance Based on the Width of the Riparian Zone		
			50-foot Riparian Zone	150-foot Riparian Zone	300-foot Riparian Zone
• Railroad or public roadway					
New	Crossing a water	(e)	5,000 ft^2	15,000 ft^2	30,000 ft^2
	Not crossing a water		2,000 ft^2	6,000 ft^2	12,000 ft^2
Reconstructed	Crossing a water	(f)	2,500 ft^2	7,500 ft^2	15,000 ft^2
	Not crossing a water		1,000 ft^2	3,000 ft^2	6,000 ft^2
• Private roadway that serves as a driveway to one private residence					
New	Crossing a water	(g)	1,500 ft^2	4,500 ft^2	9,000 ft^2
	Not crossing a water		600 ft^2	1,800 ft^2	3,600 ft^2
Reconstructed	Crossing a water	(h)	750 ft^2	2,250 ft^2	4,500 ft^2
	Not crossing a water		300 ft^2	900 ft^2	1,800 ft^2
• All other private roadways					
New	Crossing a water	(g)	3,000 ft^2	9,000 ft^2	18,000 ft^2
	Not crossing a water		1,200 ft^2	3,600 ft^2	7,200 ft^2
Reconstructed	Crossing a water	(h)	1,500 ft^2	4,500 ft^2	9,000 ft^2
	Not crossing a water		600 ft^2	1,800 ft^2	3,600 ft^2
• Bank stabilization or channel restoration					
Accomplished with vegetation alone		(i)	No limit if disturbance is justified		
Other permanent disturbance			2,000 ft^2	2,000 ft^2	2,000 ft^2
Other temporary disturbance			1,000 ft^2	3,000 ft^2	6,000 ft^2
• Stormwater discharge (including pipe and conduit outlet protection)					
Permanent disturbance		(j)	1,000 ft^2	1,000 ft^2	1,000 ft^2
Temporary disturbance			1,000 ft^2	3,000 ft^2	6,000 ft^2
• Utility line (temporary disturbance only)					
Crossing a water		(k)	2,000 ft^2	6,000 ft^2	12,000 ft^2
Not crossing a water		(l)	800 ft^2	2,400 ft^2	4,800 ft^2
• Other projects					
Private residence		(m)	2,500 ft^2	5,000 ft^2	5,000 ft^2
Addition, garage, barn or shed		(n)	1,000 ft^2	2,000 ft^2	2,000 ft^2
Flood control project		(o)	3,000 ft^2	9,000 ft^2	18,000 ft^2
Public access way or public access area		(p)	No limit if disturbance is justified		
Water dependent development		(q)	No limit if disturbance is justified		
All other regulated activities		(r)	1,000 ft^2	3,000 ft^2	6,000 ft^2

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(e) The Department shall issue an individual permit for the construction of a new railroad or public roadway, which results in clearing, cutting and/or removing vegetation in a riparian zone, only if the following requirements are satisfied:

1. The total area of vegetation cleared, cut and/or removed within the riparian zone does not exceed the limits set forth in Table C above;
2. The width of the railroad or public roadway is minimized;
3. Any crossing of a regulated water is designed and constructed as nearly perpendicular to the channel as possible; and
4. If the project impacts a 150-foot or 300-foot riparian zone, the applicant demonstrates that there is a compelling public need to construct the new railroad or public roadway, which cannot be satisfied without impacting the riparian zone. This demonstration shall include an analysis of alternate routes and other alternative projects that would avoid impacting the riparian zone.

(f) The Department shall issue an individual permit for the expansion or improvement of a lawfully existing railroad or public roadway, which results in clearing, cutting and/or removing vegetation in a riparian zone, only if the following requirements are satisfied:

1. The total area of vegetation cleared, cut and/or removed within the riparian zone does not exceed the limits set forth in Table C above, unless the applicant demonstrates that public safety cannot be adequately ensured without exceeding these limits. In such a case, the applicant shall provide 2:1 compensation for all cleared, cut and removed vegetation in excess of the limit set forth in Table C in a manner described at (t) below;
2. The width of the railroad or public roadway is minimized; and
3. If the project impacts a 150-foot or 300-foot riparian zone, the applicant demonstrates that there is a compelling public need to expand or improve the railroad or public roadway, which cannot be satisfied without impacting the riparian zone. This demonstration shall include an analysis of alternate routes and other alternative projects that would avoid impacting the riparian zone.

(g) The Department shall issue an individual permit for the construction of a new private roadway, which results in clearing, cutting and/or removing vegetation in a riparian zone, only if the following requirements are satisfied:

1. The total area of vegetation cleared, cut and/or removed within the riparian zone does not exceed the limits set forth in Table C above;
2. The width of the roadway is minimized;
3. Any crossing of a regulated water is designed and constructed as nearly perpendicular to the channel as possible;
4. The roadway accesses a lot that did not receive preliminary or final subdivision approval after October 2, 2006;
5. If the roadway does not cross a regulated water, but impacts a 150-foot or 300-foot riparian zone, the applicant demonstrates that there is no other means of constructing a roadway to access the developable area onsite, which would reduce or eliminate the impact to the riparian zone; and
6. If the roadway crosses a regulated water that has a 150-foot or 300-foot riparian zone, the applicant demonstrates that there is developable land onsite that cannot feasibly be accessed without crossing the water, including accessing the site through neighboring properties.

(h) The Department shall issue an individual permit for the expansion or improvement of an

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existing private roadway, which results in clearing, cutting and/or removing vegetation in a riparian zone, only if the following requirements are satisfied:

1. The total area of vegetation cleared, cut and/or removed within the riparian zone does not exceed the limits set forth in Table C above;
2. The width of the roadway is minimized; and
3. If the expansion or improvement impacts a 150-foot or 300-foot riparian zone, the applicant demonstrates the proposed reconstruction is necessary for the continued safe access to the site.

(i) The Department shall issue an individual permit to restore to a stable condition a bank or channel, which has become eroded, unstable and/or ecologically degraded, which results in clearing, cutting and/or removing vegetation in a riparian zone, only if the following requirements are satisfied:

1. If the bank or channel is restored and revegetated as described at N.J.A.C. 7:13-11.14(c)2, and the applicant demonstrates the project is necessary pursuant to N.J.A.C. 7:13-11.14(b), the area of vegetation cleared, cut and/or removed within the riparian zone is minimized;
2. If the bank or channel is restored by any means other than that which is described in (i)1 above, the total area of vegetation permanently cleared, cut and/or removed within the riparian zone does not exceed the limits set forth in Table C above, unless the applicant demonstrates that the bank or channel cannot be adequately stabilized or restored without exceeding these limits. In such a case, the applicant shall provide 2:1 compensation for all areas permanently cleared of vegetation in excess of the limit set forth in Table C in a manner described at (t) below; and
3. The total area of vegetation temporarily cleared, cut and/or removed within the riparian zone in order to provide access to perform the stabilization or restoration does not exceed the limits for temporary disturbance set forth in Table C above, and all such disturbed areas are replanted with indigenous, non-invasive vegetation.

(j) The Department shall issue an individual permit to construct a stormwater discharge (including the stormwater pipe leading to the discharge), which results in clearing, cutting and/or
removing vegetation in a riparian zone, only if the following requirements are satisfied:

1. The total area of vegetation cleared, cut and/or removed within the riparian zone does not exceed the limits set forth in Table C above; and
2. No portion of the stormwater discharge, including any associated conduit outlet protection and/or conveyance swale, is placed within a 150-foot or 300-foot riparian zone, except in the following cases (note that new discharges along Category One waters and certain upstream tributaries are restricted in certain cases under the Stormwater Management rules at N.J.A.C. 7:8-5.5(h)):
    - i. The reconstruction of an existing stormwater discharge provided:
        - (1) The reconstruction is necessary to ameliorate erosion and/or flooding; and
        - (2) The volume, rate and quality of stormwater being discharged is not altered. Compliance with this requirement shall be determined in accordance with the standards of the Department's Stormwater Management rules at N.J.A.C. 7:8;
    - ii. The construction of a new stormwater discharge along an existing roadway

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provided:

(1) The discharge is necessary to ameliorate erosion and/or flooding; and

(2) There is no feasible alternative means of constructing the discharge outside the riparian zone due to topography, soil type, vegetative cover and/or location of the roadway or other existing structures;

iii. The construction of a new stormwater discharge associated with the construction of a new roadway provided:

(1) There is no feasible alternative location or alignment for either the new roadway or the new discharge, which would eliminate the need to construct a discharge in the riparian zone;

(2) In the case of a public roadway, the applicant demonstrates that there is a compelling public need to construct the new roadway and the new discharge, which cannot be satisfied without impacting the riparian zone. This demonstration shall include an analysis of alternate routes for the new roadway and other alternative projects that would avoid impacting the riparian zone; and

(3) In the case of a private roadway, the applicant demonstrates that there is developable land onsite that cannot feasibly be accessed without constructing a new roadway and/or discharge that impacts the riparian zone, including accessing the site through neighboring properties; and

iv. The construction or reconstruction of any stormwater discharge not described in (j)2i, ii or iii above, which is located in a Special Water Resource Protection Area pursuant to N.J.A.C. 7:8-5.5(h), provided the requirements at N.J.A.C. 7:8-5.5(h)3 are met.

(k) The Department shall issue an individual permit to construct a utility line, which crosses a regulated water and results in clearing, cutting and/or removing vegetation in a riparian zone, only if the following requirements are satisfied:

1. The total area of vegetation cleared, cut and/or removed within the riparian zone does not exceed the limits set forth in Table C above, unless the applicant demonstrates that:

i. The construction of an open trench through the riparian zone is necessary to install the utility line; and

ii. The width of the trench required to safely install the utility line necessitates that disturbance to vegetation in the riparian zone exceeds the limits set forth in Table C, as described at N.J.A.C. 7:13-11.9(b)4; and

2. The applicant demonstrates, pursuant to N.J.A.C. 7:13-11.9(b)1 through 4, that disturbance in the riparian zone is unavoidable.

(l) The Department shall issue an individual permit to construct a utility line, which does not cross a regulated water but which results in clearing, cutting and/or removing vegetation in a riparian zone, only if the following requirements are satisfied:

1. The total area of vegetation cleared, cut and/or removed within the riparian zone does not exceed the limits set forth in Table C above;

2. The applicant demonstrates that it is not feasible to construct the line either outside the riparian zone completely, or otherwise in such a way that no vegetation in the riparian zone is disturbed; and

3. The line is placed at least 25 feet from any top of bank or edge of water.

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(m) The Department shall issue an individual permit for the construction of a new private residence, which results in clearing, cutting and/or removing vegetation in a riparian zone, only if the following requirements are satisfied:

1. The total area of vegetation cleared, cut and/or removed within the riparian zone does not exceed the limits set forth in Table C above;
2. The private residence is being constructed on a lot that did not receive preliminary or final subdivision approval after October 2, 2006;
3. The private residence is not being constructed as part of a larger residential subdivision; and
4. The applicant demonstrates the following:
    i. There is no other reasonable use for the site under the applicable zoning for the property, which would reduce or eliminate the impact to the riparian zone;
    ii. There is no other feasible location onsite to construct a private residence, which would reduce or eliminate the impact to the riparian zone; and
    iii. All disturbance within the riparian zone is located at least 25 feet from any top of bank or edge of water and as far from the regulated water as possible, unless the private residence is constructed adjacent to a manmade tidal water in cases where such waters possess a riparian zone.

(n) The Department shall issue an individual permit for the construction of an addition to an existing building, or the construction of a building appurtenant to an existing building, such as a garage, barn or shed, which results in clearing, cutting and/or removing vegetation in a riparian zone, only if the following requirements are satisfied:

1. The total area of vegetation cleared, cut and/or removed within the riparian zone does not exceed the limits set forth in Table C above; and
2. The applicant demonstrates the following:
    i. There is no other feasible location onsite to construct the addition or building, which would reduce or eliminate the impact to the riparian zone; and
    ii. All disturbance within the riparian zone is located at least 25 feet from any top of bank or edge of water and as far from the regulated water as possible, unless the addition or building is constructed adjacent to a manmade tidal water in cases where such waters possess a riparian zone.

(o) The Department shall issue an individual permit for the construction of a flood control project, which results in clearing, cutting and/or removing vegetation in a riparian zone, only if the total area of vegetation cleared, cut and/or removed within the riparian zone does not exceed the limits set forth in Table C above, unless the applicant demonstrates that public safety cannot be adequately ensured without exceeding these limits. In such a case, the applicant shall provide 2:1 compensation for all cleared, cut and removed vegetation in excess of the limit set forth in Table C in a manner described at (t) below.

(p) The Department shall issue an individual permit for the construction of a public accessway or public access area along a tidal water, which results in clearing, cutting, and/or removing vegetation in a riparian zone, only if the following requirements are met:

1. The public accessway or public access area is designed in accordance with the public access to the waterfront rule, N.J.A.C. 7:7E-8.11, in which case such construction need not comply with (d)1 and 2 above;
2. No building is constructed within 25 feet of any top of bank or edge of water; and

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3. For any proposed parking area, the applicant demonstrates that there is no other feasible location onsite to construct the parking area, which would reduce or eliminate the impact to the riparian zone;

(q) The Department shall issue an individual permit for the construction of a water dependent development along a tidal water, which results in clearing, cutting, and/or removing vegetation in a riparian zone, only if the following requirements are met:

1. The development is designed in accordance with the Coastal Zone Management rules,
N.J.A.C. 7:7E, and meets the definition of water dependent at N.J.A.C. 7:7E-1.8;
2. No building is constructed within 25 feet of any top of bank or edge of water; and
3. For any proposed development, the applicant demonstrates that there is no other feasible location onsite to construct the development, which would reduce or eliminate the impact to the riparian zone.

(r) The Department shall issue an individual permit for a regulated activity not listed in (e) through (q) above, which results in clearing, cutting and/or removing vegetation in a riparian zone, only if the following requirements are satisfied:

1. The total area of vegetation cleared, cut and/or removed within the riparian zone does not exceed the limits set forth in Table C above;
2. No building is constructed within 25 feet of any top of bank or edge of water;
3. The applicant demonstrates the following:
   i. There is no other reasonable means of accomplishing the project, which would reduce or eliminate the impact to the riparian zone;
   ii. There is no other feasible location onsite to undertake the project, which would reduce or eliminate the impact to the riparian zone; and
   iii. All disturbance within the riparian zone is located as far from the regulated water as possible; and
4. The applicant provides 2:1 compensation for all cleared, cut and removed vegetation in the riparian zone in a manner described at (t) below.

(s) If the Department determines that requiring an applicant to meet a limit of disturbance set forth in Table C above constitutes a hardship under N.J.A.C. 7:13-9.8, and the Department subsequently grants an individual permit for an activity that exceeds that limit, the applicant shall provide 2:1 compensation for all cleared, cut and removed vegetation in excess of that limit set forth in Table C in a manner described at (t) below.

(t) The 2:1 compensation required under (f)1, (i)2, (o), (r)4 and (s) above shall be accomplished as follows:

1. In the case of (f)1, (i)2, (o) and (s) above, at least twice the area of all cleared, cut and removed vegetation in excess of the limit in Table C above shall be replanted;
2. In the case of (r)4 above, at least twice the area of all cleared, cut and removed vegetation shall be replanted;
3. The area selected for 2:1 compensation is deed restricted against future development that would remove the vegetation being planted; and
4. All replanting of vegetation shall be accomplished as described in (u) below and in one or both of the following ways. (Replanting vegetation that was removed in violation of this chapter does not constitute compensation under this section):
   i. The applicant shall remove lawfully existing structures and/or impervious surfaces in the riparian zone, and replant the area with vegetation; and/or

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ii. The applicant shall plant new trees in the riparian zone in an area that is substantially devoid of trees at the time of application because the trees were removed due to previous, lawful development.

(u) All replanting of riparian zone vegetation required under this section shall meet the following requirements:

1. All replanting shall be located in the riparian zone of the same regulated water as the cleared, cut or removed vegetation;
2. All replanting shall be located as close in proximity to the cleared, cut or removed vegetation as possible;
3. All replanting shall consist of indigenous, non-invasive vegetation;
4. The replanted vegetation shall be of equal or greater density as the cleared, cut or removed vegetation;
5. The applicant shall monitor and maintain the replanted vegetation for at least three growing seasons to ensure proper establishment and survival; and
6. The location, nature, area and schedule for replanted vegetation shall be shown on drawings submitted with the application for the individual permit which necessitates the replanting. No replanting required under this section shall commence without the prior approval of the Department.

(v) In cases where an applicant proposes to redevelop a site within 25 feet of any top of bank or edge of water, all existing impervious surface within 25 feet of the top of bank or edge of water shall be removed and the riparian zone in this area shall be adequately stabilized and replanted with indigenous, non-invasive vegetation, except in the following cases:

1. The applicant demonstrates that removing the existing impervious surface and/or preventing the replacement of the existing impervious surface within 25 feet of the top of bank or edge of water would likely threaten public safety, exacerbate flooding or erosion and/or cause an undue economic hardship upon the applicant. In such a case, the riparian zone within 25 feet of the top of bank or edge of water shall be restored, stabilized and/or replanted to the extent feasible; and/or
2. The applicant proposes to construct a public walkway within 25 feet of the top of bank or edge of water, provided the walkway is constructed of permeable material where feasible, and provided the remainder of the area within 25 feet of the top of bank or edge of water is restored, stabilized and replanted with indigenous, non-invasive vegetation.

7:13-10.3 Requirements for a regulated activity in a floodway

(a) This section sets forth specific design and construction standards that apply to any regulated activity proposed in a floodway.

(b) Except as provided in (c) below, the Department shall not issue an individual permit for the following activities:

1. The placement of any aboveground structure in or above a floodway;
2. Any regulated activity that would result in the placement of fill in a floodway;
3. Any regulated activity that would raise the ground elevation in a floodway; or
4. Any regulated activity that would obstruct the passage of floodwaters in a floodway.

(c) Notwithstanding (b) above, the Department shall issue an individual permit for the following regulated activities in a floodway, provided all other requirements of this chapter are satisfied for each activity:

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1. The construction of a building on a pier in the Hudson River, provided the requirements of the Coastal Zone Management rules at N.J.A.C. 7:7E-3.48 are satisfied;
2. The reconstruction of a lawfully existing building, in accordance with N.J.A.C. 7:13-11.5(e);
3. The construction of an addition to a lawfully existing building, in accordance with N.J.A.C. 7:13-11.5(f);
4. The construction of a water control structure, such as a bridge, culvert, footbridge, dam or flood control project, in accordance with N.J.A.C. 7:13-11.7, 11.8, 11.11 and 11.12, respectively;
5. The construction of a stormwater outfall structure, in accordance with N.J.A.C. 7:13-11.10;
6. The restoration and/or stabilization of a bank or channel, in accordance with N.J.A.C. 7:13-11.14, which requires the placement of fill, provided:
   i. The placement of the fill is necessary to protect nearby structures or trees from undermining or failure, or to restore or improve the ecological health or habitat value of a regulated water, and not simply to reclaim land that has been lost due to erosion; and
   ii. The cross-sectional area of the channel open to flow will not be reduced to less than the pre-eroded condition of the channel;
7. The placement of dredged material adjacent to the water from which the material was removed, in accordance with N.J.A.C. 7:13-11.15(f);
8. The placement of fill in an isolated shallow depression or other area that does not contribute to the hydraulic capacity of the floodway; and
9. The placement of fill in a portion of a manmade impoundment of water, such as a pond or lake, provided:
   i. An equal or greater amount of excavation is performed elsewhere in the same pond or lake at similar elevations as the proposed fill;
   ii. The applicant demonstrates that the fill will not obstruct flood flows;
   iii. The fill will extend no further than 20 percent of the width of the water, measured perpendicularly across the water from the shoreline along which the fill is being placed; and
   iv. The applicant demonstrates that placing the fill will not cause adverse environmental impacts.

7:13-10.4 Requirements for a regulated activity in a flood fringe

(a) This section sets forth specific design and construction standards that apply to any regulated activity proposed in a flood fringe.

(b) This section provides standards for the volume of material that may be placed aboveground in a flood fringe as well as other activities that would reduce the flood storage volume on a site. When material is placed aboveground in a flood fringe, it will occupy a space that would otherwise be filled with floodwaters during a flood, and, thus, will reduce the flood storage volume on the site. Construction also reduces the flood storage volume by preventing floodwaters from entering a space that it would otherwise occupy, such as the space inside a building or stormwater management basin, or behind an embankment. For example, although the space within a building may be empty, the building's walls might prevent floodwaters from

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entering that space. Since the entire space within the walls has been rendered inaccessible to floodwaters, the entire space, though empty, displaces flood storage volume. The Department also recognizes that some structures, such as garages, sheds and other buildings that are not dry flood-proofed are not likely to prevent the entry of floodwaters, and, therefore, the space within the walls of such a structure may not actually displace flood storage volume.

(c) The Department shall issue an individual permit for a regulated activity (or combination of regulated activities) in a flood fringe only if one of the following is satisfied:

1. The regulated activity is not subject to the flood storage volume displacement limits of this section, in accordance with (d) below;
2. The regulated activity will displace no flood storage volume onsite, as calculated for both the volume between the flood hazard area design flood and the 10-year flood, and the volume between the 10-year flood and the ground, in accordance with (e) below; or
3. The regulated activity will displace no more than 20 percent of the flood storage volume onsite, as calculated for both the volume between the flood hazard area design flood and the 10-year flood, and the volume between the 10-year flood and the ground, and all flood storage displacement onsite will be compensated offsite as follows:
    i. If the regulated activity is located within the Central Passaic Basin, the requirements at (g) below shall be met;
    ii. If the regulated activity is a Major Highlands Development, as defined at N.J.A.C. 7:38-1.4, the requirements at (h) below shall be met; or
    iii. If the regulated activity is not located within the Central Passaic Basin and is not a Major Highlands Development, the requirements at (i) below shall be met.

(d) The following regulated activities (or combination of regulated activities) are not subject to the flood storage volume displacement limits of this section, provided the activity is not associated with a Major Highlands Development:

1. Any activity located in a tidal flood hazard area;
2. Any activity that displaces no more than five cubic yards of flood storage volume;
3. The reconstruction of a lawfully existing railroad or public roadway, including any improvement or enlargement, provided flood storage volume displacement is minimized;
4. The construction or improvement of a driveway across a regulated water provided:
    i. The driveway serves only one private residence, which is not being constructed as part of a larger residential subdivision;
    ii. In the case of the construction of a new driveway, the applicant demonstrates that there is developable land onsite that cannot feasibly be accessed without crossing the water, including accessing the site through neighboring properties; and
    iii. Any flood storage volume displacement resulting from the driveway is minimized;
5. The construction of one private residence provided:
    i. The residence is not being constructed as part of a larger residential subdivision;
    ii. Any enclosed area beneath the flood hazard area design flood elevation meets the requirements of N.J.A.C. 7:13-11.5(l); and
    iii. Except for the construction of a driveway across a regulated water, which meets the

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requirements of (d)4 above, the site is not graded to accommodate the construction of the residence in such a way that flood storage volume would be displaced;

6. The construction of a flood control project, provided flood storage volume displacement is minimized; and

7. The depositing of sediment removed from a channel, which meets the requirements of N.J.A.C. 7:13-11.15(f).

(e) The following shall apply to any regulated activity that is designed to displace no flood storage volume in accordance with (c)2 above:

1. The existing flood storage volume onsite (VE) is the volume of floodwater that is able to occupy the flood fringe onsite before the proposed regulated activity is undertaken. To determine the existing flood storage volume, calculate the volume of space within the flood fringe between the flood elevation and the ground surface as it exists on the date of application to the Department, and subtract the volume occupied by any structures that lawfully exist as of that date.

2. The proposed flood storage volume onsite (VP) is the volume of floodwater that will be able to occupy the flood fringe onsite once all proposed construction, excavation, filling and grading is completed. To determine the proposed flood storage volume, calculate the volume of space within the flood fringe between the flood elevation and the proposed ground surface, and subtract the volume occupied by any structures that will lawfully exist once all proposed construction is completed.

3. The proposed flood storage volume onsite (VP) shall be greater than or equal to the existing flood storage volume onsite (VE), for both the volume between the flood hazard area design flood and the 10-year flood, and the volume between the 10-year flood and the ground. Certain considerations should be made in calculating both (VP) and (VE), as set forth in (j) below. Additional flood storage volume can also be created onsite to compensate for proposed flood storage displacement in accordance with (m) below.

(f) Table D below sets forth the percentage of flood storage volume that a regulated activity (or combination of activities) can lawfully displace in various geographic areas of New Jersey. As described in further detail in this section below, a project cannot displace more than 20 percent of the flood storage volume that originally existed onsite, and all proposed displacement onsite must ultimately be compensated offsite. Table D indicates the dates from which the original and proposed flood storage volumes should be calculated for different geographic areas. Flood storage calculations shall be performed for both the volume between the flood hazard area design flood and the 10-year flood, and the volume between the 10-year flood and the ground, as described at (j) below, to show that the 20-percent and zero-percent limitations are met for both of these areas.

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Table D
ALLOWABLE PERCENTAGES OF FLOOD STORAGE VOLUME DISPLACEMENT
(Which shall be met for both the volume between the flood hazard area design flood and the 10-year flood, and the volume between the 10-year flood and the ground)

Geographic Area	Maximum onsite percentage of flood storage volume that a project can lawfully displace (PONSITE)	Maximum total percentage of flood storage volume that a project can lawfully displace including all offsite credits (PTOTAL)
Central Passaic Basin	20% of flood storage that existed onsite on March 25, 1977	0% of flood storage that existed onsite on March 25, 1977
Highlands Preservation Area*	20% of flood storage that existed onsite on January 31, 1980	0% of flood storage that existed onsite on August 10, 2004
Remainder of State	20% of flood storage that existed onsite on January 31, 1980	0% of flood storage that existed onsite on November 5, 2007

*If associated with Major Highlands Development, as defined at N.J.A.C. 7:38-1.4.

(g) The following shall apply to any project located within the Central Passaic Basin that does not meet the requirements of (d) or (e) above:

1. The onsite percentage of flood storage volume that a project displaces shall be determined as follows:

i. Calculate the base flood storage volume onsite on March 25, 1977, (V1977) according to (j) and (k) below;

ii. Calculate the proposed flood storage volume onsite (VP) according to (j) and (l) below; and

iii. Calculate the percentage of flood storage volume displaced onsite (PONSITE) as follows:

$$PONSITE = (V1977 - VP)/ V1977$$

2. The total percentage of flood storage volume that a project displaces, including any offsite compensation, shall be determined as follows:

i. Calculate any offsite compensation (VC) according to (o) below; and

ii. Calculate the total percentage of flood storage volume displaced (PTOTAL) as follows:

$$PTOTAL = (V1977 - VP - VC)/ V1977$$

(h) The following shall apply to any Major Highlands Development within the Highlands Preservation Area that does not meet the requirements of (d) or (e) above:

1. The onsite percentage of flood storage volume that a project displaces shall be determined as follows:

i. Calculate the base flood storage volume onsite on January 31, 1980, (V1980) according to (j) and (k) below;

ii. Calculate the proposed flood storage volume onsite (VP) according to (j) an (l) below; and

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iii. Calculate the percentage of flood storage volume displaced onsite (PONSITE) as follows:

PONSITE = (V1980 - VP)/ V1980

2. The total percentage of flood storage volume that a project displaces, including any offsite compensation, shall be determined as follows:

i. Calculate the base flood storage volume onsite on August 10, 2004, (V2004) according to (j) and (k) below;

ii. Calculate any offsite compensation (VC) according to (o) below; and

iii. Calculate the total percentage of flood storage volume displaced (PTOTAL) as follows:

PTOTAL = (V2004 - VP - VC)/ V2004

(i) The following shall apply to any project located outside the Central Passaic Basin (except for Major Highlands Development as described at (h) above) that does not meet the requirements of (d) or (e) above:

1. The onsite percentage of flood storage volume that a project displaces shall be determined as follows:

i. Calculate the base flood storage volume onsite on January 31, 1980, (V1980) according to (j) and (k) below;

ii. Calculate the proposed flood storage volume onsite (VP) according to (j) and (l) below; and

iii. Calculate the percentage of flood storage volume displaced onsite (PONSITE) as follows:

PONSITE = (V1980 - VP)/ V1980

2. The total percentage of flood storage volume that a project displaces, including any offsite compensation, shall be determined as follows:

i. Calculate the base flood storage volume onsite on November 5, 2007, (V2007) according to (j) and (k) below;

ii. Calculate any offsite compensation (VC) according to (o) below; and

iii. Calculate the total percentage of flood storage volume displaced (PTOTAL) as follows:

PTOTAL = (V2007 - VP - VC)/ V2007

(j) The following factors shall be considered when calculating flood storage volumes under this section:

1. The flood storage displacement limits in this section apply to both the volume between the flood hazard area design flood and the 10-year flood, and the volume between the 10-year flood and the ground. As such, applicants must demonstrate that a proposed project meets these limits for both floods unless the entire project lies above the 10-year flood elevation.

2. Flood storage displacement proposed above the 10-year flood elevation onsite must be compensated for by the creation of flood storage above the 10-year flood elevation. Similarly, flood storage displacement proposed below the 10-year flood elevation onsite must be compensated for by the creation of flood storage below the 10-year flood elevation. This applies whether the compensation occurs onsite, as described at (m) below, or offsite, as described at (o) below.

3. In cases where the 10-year flood elevation is not provided on State or Federal flood

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maps, calculations can instead be performed using a flood depth halfway between the flood hazard area design flood elevation and the lowest ground elevation within the flood fringe onsite. For example, at a given cross-section through a site, if the flood hazard area design flood elevation is 90.0 feet NGVD and the lowest ground elevation within the flood fringe is 80.0 feet NGVD, flood storage calculations can be performed at that cross-section using a flood elevation of 85.0 feet NGVD at that location, if the 10-year flood elevation is unknown. Furthermore, this halfway depth must be determined separately for each cross-section in the flood fringe, and at close intervals throughout the site in order to provide an accurate estimate of the upper and lower flood storage volumes. An illustration of how to properly calculate these volumes is provided in the Flood Hazard Area Technical Manual.

4. The volume inside a stormwater management basin or other impoundment is considered displaced flood storage volume. For instance, when calculating the flood storage volume onsite during the 10-year flood, the volume below the 10-year water surface elevation in the basin is considered displaced flood storage volume.

5. The volume behind a dike, levy or similar barrier that prevents the free flow of water is considered displaced flood storage volume.

6. The volume inside a building that prevents floodwaters from entering is considered displaced flood storage volume.

7. The construction of a channel modification, or the reconstruction of a water control structure such as a bridge or culvert, can result in lower flood elevations at some point along the water. In such a case, the volume in the flood fringe between the existing and proposed flood elevations is considered displaced flood storage volume.

(k) The base flood storage volume onsite (V1977, V1980, V2004 and/or V2007) is the volume of floodwater that was able to occupy the flood fringe onsite on the appropriate date shown in Table D depending on the geographic location of the project. To determine the base flood storage volume, calculate the volume of space within the flood fringe between the flood elevation and the ground surface as it existed on the appropriate date in Table D, and subtract the volume occupied by any structures that lawfully existed on that date.

(l) The proposed flood storage volume onsite (VP) is the volume of floodwater that will be able to occupy the flood fringe onsite once all proposed construction, excavation, filling and grading is completed. To determine the proposed flood storage volume, calculate the volume of space within the flood fringe between the flood elevation and the proposed ground surface, and subtract the volume occupied by any structures that will lawfully exist once all proposed construction is completed.

(m) Additional flood storage volume may be created onsite to compensate for proposed flood storage displacement only on land that meets the requirements of (n) below and in the following ways:

1. Removing material that has been previously lawfully placed within the flood fringe, such as fill or structures, and properly disposing the material outside a flood hazard area, as described in (q) below; and/or

2. Excavating material from below the surface of the ground and properly disposing the material outside a flood hazard area, as described in (r) below.

(n) Flood storage volume may be created onsite to compensate for regulated activities that displace flood storage as described in (m) above provided the onsite compensation:

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1. Is created within or adjacent to the flood hazard area of the same water as the proposed flood storage displacement, or a tributary to the same water as the proposed flood storage displacement, provided the tributary lies upstream of the site or the flood hazard area of both waters connect onsite;
2. Is not created in a floodway;
3. Is not created within the following areas, unless the area where the compensation will be created has been subject to previous, lawful disturbance:
    i. Within a riparian zone, pursuant to N.J.A.C. 7:13-4.1 and 10.2;
    ii. Within 300 feet of a Highlands open water, if the project is a major Highlands development as defined in the Highlands Water Protection and Planning Act rules at N.J.A.C. 7:38-1.4; and/or
    iii. Within a Special Water Resource Protection Area, if the project is a major development as defined in the Stormwater Management rules at N.J.A.C. 7:8-1.2; and
4. Would not have other significant adverse environmental consequences; the proposed compensation shall not merely substitute the adverse effects of the proposed activities with adverse impacts upon threatened or endangered species, aquatic biota, fishery resources or Highlands resource areas.

(o) Offsite compensation (VC) is additional flood storage volume created offsite to compensate for proposed flood storage displacement onsite. Offsite compensation can only be created on land that meets the requirements of (p) below, and only in the following ways:
1. Removing material that has been previously lawfully placed within the flood fringe, such as fill or structures, and properly disposing the material outside a flood hazard area, as described in (q) below;
2. Excavating material from below the surface of the ground and properly disposing the material outside a flood hazard area, as described in (r) below; and/or
3. Purchasing fill credits, where available, if the project is located in the Central Passaic Basin, as described in (s) and (t) below.

(p) Flood storage volume can be created offsite to compensate for regulated activities that displace flood storage as described in (o) above provided the offsite compensation:
1. Is created within or adjacent to the flood hazard area of the same water as the proposed flood storage displacement, or a tributary to the same water as the proposed flood storage displacement, provided the tributary lies upstream of the site or the flood hazard area of both waters connect onsite;
2. Is not separated from the proposed flood storage displacement by a water control structure, such as a bridge, culvert or dam, unless the applicant demonstrates that the water control structure causes no significant change in the flood hazard area design flood elevation;
3. Is situated within the same HUC-14 watershed as the proposed flood storage displacement;
4. Is not created in a floodway;
5. Is not created within the following areas, unless the area where the compensation will be created has been subject to previous, lawful disturbance:
    i. Within a riparian zone, pursuant to N.J.A.C. 7:13-4.1 and 10.2;

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ii. Within 300 feet of a Highlands open water, if the project is a major Highlands development as defined in the Highlands Water Protection and Planning Act rules at N.J.A.C. 7:38-1.4; and/or

iii. Within a Special Water Resource Protection Area, if the project is a major development as defined in the Stormwater Management rules at N.J.A.C. 7:8-1.2;

6. Would not have other significant adverse environmental consequences; the proposed compensation shall not merely substitute the adverse effects of the proposed activities with adverse impacts upon threatened or endangered species, aquatic biota, fishery resources or Highlands resource areas;

7. Is agreed to in writing by the owners of the land on which the offsite compensation is proposed; and

8. Is proposed on land which, subsequent to the creation of the offsite compensation, is deed restricted against future flood storage volume displacement. The modified deed shall be filed with the local county clerk, a copy of which shall be provided to the Department within 90 calendar days of the issuance of the individual permit.

(q) For the purposes of (m)1 and (o)1 above, flood storage volume can be created by removing material previously placed within the flood fringe, such as fill or structures, provided:

1. The material to be removed was not placed in violation of this chapter;

2. The material to be removed is not associated with an activity permitted-by-rule under N.J.A.C. 7:13-7;

3. The area disturbed by the removal of the material is properly graded so that floodwaters can freely enter and exit;

4. The material to be removed is properly disposed of outside of any regulated area; and

5. The removal of the material is approved under an individual permit and is completed concurrent with or prior to the commencement of the activities for which the compensation is intended.

(r) For the purposes of (m)2 and (o)2 above, flood storage volume can be created by excavating material from below the surface of the ground, provided:

1. The excavation is located in a flood fringe, or is located adjacent and connected to a flood hazard area so that floodwaters can enter the excavated area;

2. The excavation is located below the flood hazard area design flood elevation;

3. The excavation is located above the seasonal high water table;

4. The excavation is located above the normal water surface elevation of the nearest regulated water;

5. The area disturbed by the excavation is properly graded so that floodwaters can freely enter and exit;

6. The excavated material is properly disposed of outside of any regulated area; and

7. The excavation is approved under an individual permit and is completed concurrent with or prior to the commencement of the activities for which the compensation is intended.

(s) For the purposes of (o)3 above, offsite compensation in the Central Passaic Basin can be accomplished in certain cases described in (t) below through the purchase of fill credits. A fill credit is a unit of flood storage volume that has been created in the Central Passaic Basin by excavation and/or removal of fill, and which can be sold to a permittee to compensate for proposed fill elsewhere in the Central Passaic Basin. The Department has previously permitted

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several facilities to create fill credits. However, the Department shall no longer accept new applications to allow a person or facility to create additional fill credits in this manner. In order for fill credits to be valid under this section, an application to create the fill credits must have been received by the Department prior to October 2, 2006, and the fill credits, once approved, must be lawfully created by the applicant prior to October 2, 2011. Once all approved fill credits have been purchased, offsite compensation in the Central Passaic Basin will no longer be possible through fill credits.

(t) For the purposes of (o)3 above, offsite compensation in the Central Passaic Basin can be made through the purchase of fill credits, as described in (s) above, provided the following requirements are satisfied:

1. The fill credits are purchased from a person or facility that has been authorized by the Department to create and sell fill credits in accordance with (s) above;
2. The flood storage volume on which the fill credits are based was created prior to the submittal of the application for the activities for which compensation is required;
3. The Department approves the use of the particular fill credits for the particular activity; and
4. The applicant provides the Department with adequate documentation of the purchase of the fill credits.

(u) If the percentage of flood storage volume displacement on a site already exceeds a limit at Table D above due to activities that were previously undertaken in accordance with this chapter, the Department shall issue an individual permit for a new regulated activity on the site only if an equal amount of flood storage volume is created to compensate onsite for any displaced flood storage volume that would result from the new regulated activity, in accordance with (e) above. Compensatory flood storage volume shall not be created offsite in such a case, and shall only be created onsite, as described in (m) above. The volume of fill in excess of the limits in Table D does not need to be removed from the site.

(v) If the percentage of flood storage volume displacement on a site already exceeds a limit at Table D above due to activities that were previously undertaken in violation of this chapter, the Department shall issue an individual permit for a new regulated activity on the site only if the following requirements are satisfied:

1. The applicant either obtains an individual permit for the activities undertaken in violation of this chapter, or else removes from the flood hazard area any fill or structure that was placed in violation of this chapter;
2. All displaced flood storage volume in excess of the limit in Table D is restored onsite; and
3. An equal amount of flood storage volume is created to compensate onsite for any displaced flood storage volume that would result from the new regulated activity, in accordance with (e) above. Compensatory flood storage volume shall not be created offsite in such a case, and shall only be created onsite, as described in (m) above.

(w) If the Department issues or has issued an individual permit for a regulated activity that displaces flood storage volume on a site, and that activity was subject to a flood storage displacement limit at the time the permit was issued, subsequent subdivision of that site shall not increase the total amount of flood storage volume that can be displaced on the site under future applications. Instead, the following shall apply:

1. Flood storage volume can be displaced within a portion of the subdivided site only to the extent that the total flood storage volume displaced within the entire subdivided site

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does not exceed the flood storage displacement limits of this section;
2. If the subdivided site involves multiple lots owned (or to be owned) by different persons, any remaining allowable flood storage volume shall be divided equally among all lots in the flood fringe, unless the owners of all lots in the flood fringe otherwise agree in writing; and
3. The volume of flood storage displacement permissible on each lot shall be described in any individual permit issued for the site as well as in the deed of record for each affected property. The modified deed shall be filed with the applicable county clerk, a copy of which shall be provided to the Department within 90 calendar days of the issuance of the individual permit.

7:13-10.5 Requirements for a regulated activity in or along a water with fishery resources
(a) This section sets forth specific design and construction standards that apply to any regulated activity proposed in the channel and/or riparian zone of a regulated water containing fishery resources. Further standards for the construction of a bridge or culvert in or along waters with fishery resources are described at N.J.A.C. 7:13-11.7.
(b) The waters identified by the Department as containing fishery resources are listed in the Department's Surface Water Quality Standards at N.J.A.C. 7:9B, and are further supplemented by the following reports as updated, which are included here by reference. Copies of these reports are included in the Flood Hazard Area Technical Manual, available from the Department at the address listed at N.J.A.C. 7:13-1.1(g):
1. "Classification of New Jersey Waters as Related to Their Suitability for Trout";
2. "List of Waters Stocked with Trout by the New Jersey Division of Fish and Wildlife"; and
3. "Locations of Anadromous American Shad and River Herring During Their Spawning Period in New Jersey's Freshwaters Including Known Migratory Impediments and Fish Ladders."
(c) The Department shall issue an individual permit for a regulated activity in the channel and/or riparian zone of a regulated water containing fishery resources only if the following requirements are satisfied:
1. Except as provided in (e) below, the activity meets the timing restrictions of (d) below;
2. Unset or raw cement is not allowed to come into contact with water in the channel during construction;
3. No logs or boulders that provide fish habitat are removed from the channel, unless the Department determines that such removal is necessary to accomplish the project; and
4. Low-flow aquatic passage is maintained in the channel throughout the entire area of disturbance during and after the performance of the regulated activity. In order to provide low-flow aquatic passage, the depth of flow in the modified channel during low-flow conditions must be equal to or greater than pre-project conditions. Where feasible, the applicant shall also provide low-flow aquatic passage in areas that do not currently contain low-flow aquatic passage.
(d) Except as provided at (e) below, certain activities are prohibited during times when fish are breeding or are especially sensitive to disturbance. The following activities are prohibited during the restricted periods listed in Table E below:

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1. Any construction, excavation, filling or grading in the channel; and
2. Any construction, excavation, filling or grading in the riparian zone, unless the applicant demonstrates that appropriate soil erosion and sediment control measures are in place which will prevent sediment from reaching the channel. All proposed measures shall meet the Standards for Soil Erosion and Sediment Control in New Jersey at N.J.A.C. 2:90.

Table E
RESTRICTED TIME PERIODS FOR WATERS WITH FISHERY RESOURCES

Water and classification	Time period (inclusive) during which activities are prohibited
1. Trout Waters	
• All trout production waters except rainbow trout	September 15 through March 15
• Rainbow trout production waters	February 1 through April 30
• Trout stocked waters • Trout maintenance waters • Any water located within 1 mile upstream of a trout stocked or a trout maintenance water	March 15 through June 15
2. Non-Trout Waters	
• Waters that support general game fish	May 1 through June 30
• Waters that support pickerel	Ice out through April 30
• Waters that support walleye	March 1 through May 30
3. Anadromous Waters	
• All unimpeded tidal waters open to the Atlantic Ocean or any coastal bay • All waters identified as anadromous migratory pathways	April 1 through June 30
• Delaware River upstream of U.S. Route 202	April 1 through June 30 and September 1 through November 30
• Delaware River between U.S. Route 202 and Interstate 276 (Pennsylvania Turnpike Bridge)	March 1 through June 30
• Delaware River between Interstate 276 (Pennsylvania Turnpike Bridge) and Interstate 295 (Delaware Memorial Bridge) • Tidal portions of Raccoon, Rancocas Creek, Crosswicks Creeks and Cooper River	March 1 through June 30 and September 1 through November 30
• All unimpeded tidal waters open to the Delaware River downstream of Interstate 295 (Delaware Memorial Bridge) • Tidal portions of the Maurice River, Cohansey River and Salem River	March 1 through June 30 and October 1 through November 30

(e) An applicant may request that the Department reduce, extend or otherwise modify a timing restriction listed in Table E. The Department shall grant such a request if one or more of the

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following requirements is satisfied:

1. The applicant demonstrates that the adverse impacts to fishery resources will be less if a regulated activity occurs during the restricted time period rather than during an unrestricted time period;
2. A regulated activity is subject to more than one restricted time period, the combined effect of which would limit the regulated activity to fewer than 183 calendar days per year. In such a case, the Department shall allow the regulated activity to occur for up to 183 calendar days, provided the applicant demonstrates that additional measures shall be taken to reduce adverse impacts to fishery resources to a level acceptable to the Department. Note that the 183-day period during which the Department determines that activities may occur need not be consecutive. For example, the Department may determine that restricting activities for three months in the spring and three months in the fall best protects fishery resources in a particular case;
3. The Department determines that observance of a timing restriction for the reconstruction of a public road crossing would cause increased risks or excessive delays to school buses or vans, and the applicant demonstrates that additional measures shall be taken to reduce adverse impacts to fishery resources to an acceptable level; or
4. The Department determines that, due to the nature of the project or an unusual circumstance onsite, the timing restriction must be modified in order to prevent a substantial adverse impact to the fishery resource or to the environment.

(f) The Delaware River Basin Commission (DRBC) may impose timing restrictions in addition to those listed in Table E above on certain activities in waters under DRBC jurisdiction. Contact the U.S. Fish and Wildlife Service's River Basin Coordinator through the DRBC at (609) 883-9500 for information on these additional timing restrictions.

7:13-10.6 Requirements for a regulated activity in a documented habitat for threatened or endangered species

(a) This section sets forth specific design and construction standards that apply to any regulated activity proposed in a documented habitat for a threatened or endangered species.

(b) For the purposes of this chapter, the Department identifies present and/or documented habitat for most threatened or endangered wildlife species using the Landscape Project method, which focuses on habitat areas required to support local populations of threatened and endangered wildlife species. This method is further described in the Flood Hazard Area Technical Manual, available from the Department at the address listed at N.J.A.C. 7:13-1.1(g). The report entitled New Jersey's Landscape Project provides additional information on mapping methodology and is available at the website www.nj.gov/dep/fgw/ensphome.htm or by contacting the address given below. The Department's Landscape Maps may be updated periodically and may be obtained via file download from www.nj.gov/dep/fgw/ensphome.htm or through the Interactive I-map NJ website: www.state.nj.us/dep/gis/imapnj/imapnj.htm or by writing to the Division of Fish and Wildlife, Endangered and Nongame Species Program at:

The Landscape Project
State of New Jersey Department of Environmental Protection
Division of Fish and Wildlife Endangered and Nongame Species Program
P.O. Box 400
Trenton, NJ 08625-0400

(c) For endangered or threatened plant species and for those wildlife species for which a

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landscape model in the Landscape Project has not been developed (models do not exist for certain aquatic species), the Department shall rely on the New Jersey Natural Heritage Database for site-specific information. To determine which animal species are not included in the Landscape Project, see Appendix IV of the New Jersey Landscape Mapping Project, Version 2.0 report, available at www.nj.gov/dep/fgw/ensphome.htm. Information regarding the Natural Heritage Program Database is available at: www.nj.gov/dep/parksandforests/natural/heritage/.

(d) The Department shall issue an individual permit for a regulated activity only if the activity will not adversely affect either of the following:

1. A threatened or endangered species; or
2. A documented habitat for a threatened or endangered species.

(e) The Department shall require a survey and/or a habitat assessment for threatened or endangered species as part of an environmental report, as described at N.J.A.C. 7:13-15.5(c), for an individual permit for any regulated activity which is likely to do either of the following:

1. Disturb an area known to contain a threatened or endangered species; or
2. Disturb any habitat that could support a threatened or endangered species.

(f) Persons seeking information pertaining to threatened or endangered species sightings on or near a particular site can contact: State of New Jersey Department of Environmental Protection, Natural Heritage Program P.O. Box 404 Trenton, New Jersey 08625 Telephone: (609) 984-1339 Website: www.nj.gov/dep/parksandforests/natural/heritage/

(g) The Department shall restrict a regulated activity during times of year when a threatened or endangered species is especially sensitive to disturbance, such as during mating or migratory periods. The Department shall not limit the regulated activity to fewer than 183 calendar days per year under this section. Note that the 183-day period during which the Department determines that activities may occur need not be consecutive. For example, the Department may determine that restricting activities for three months in the spring and three months in the fall best protects a threatened or endangered species in a particular case.

7:13-10.7 Requirements for a regulated activity in an area with acid producing soils

(a) This section sets forth specific design and construction standards that apply to any regulated activity proposed in an area containing acid producing soils.

(b) The Department shall issue an individual permit for an activity in a regulated area known or suspected to contain acid producing soils only if the applicant submits for Department approval a plan to minimize the adverse effects of exposing acid producing soils. The plan shall, at a minimum, address how the applicant will meet the following requirements:

1. Exposure of acid producing soils to air and/or water shall be minimized;
2. All exposed areas with acid producing soils shall be promptly stabilized to prevent such soils from washing into the water;
3. Any acid that is generated or exposed shall be properly neutralized;
4. The area shall be treated to ensure that post-exposure oxidation rates do not exceed preexposure oxidation rates;
5. Acid producing soils shall be disposed of properly and shall not be mixed into or spread over non-acid producing soils; and
6. Any acid producing soils remaining after construction shall be covered with lime and a layer of non-acid producing soil sufficient to facilitate the growth of vegetation.

(c) The following steps shall be taken if acid producing soils are unexpectedly exposed in a

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regulated area:

1. Soil disturbance shall cease immediately;
2. The soils that have been disturbed shall be quickly stabilized so as to prevent acid producing soils from washing into any nearby water;
3. Any uncovered acid producing soil shall be immediately isolated from any flowing water;
4. The Department shall be contacted immediately for further guidance;
5. The plan required in (b) above shall be prepared and submitted to the Department; and
6. Soil disturbance shall not resume until the Department has approved the plan.

(d) The Flood Hazard Area Technical Manual, available at the Department at the address listed at N.J.A.C. 7:13-1.1(g), provides further information to assist in preparation of the plan required in (b) and (c) above.

SUBCHAPTER 11. INDIVIDUAL PERMIT REQUIREMENTS FOR VARIOUS REGULATED ACTIVITIES

7:13-11.1 Requirements that apply to all regulated activities

(a) This section sets forth design and construction standards that apply to any regulated activity proposed in any regulated area.

(b) The Department shall issue an individual permit for a regulated activity only if it determines that the regulated activity is not likely to cause significant and adverse effects on the following:

1. Water quality;
2. Aquatic biota;
3. Water supply;
4. Flooding;
5. Drainage;
6. Channel stability;
7. Threatened and endangered species or their current or documented historic habitats;
8. Navigation;
9. Energy production; and
10. Fishery resources.

(c) A permittee shall obtain all necessary approvals from the local Soil Conservation District or its designee prior to commencing any activity approved in an individual permit issued under this chapter.

(d) A permittee shall obtain all necessary approvals from the USDA Natural Resource Conservation Service or its designee prior to commencing any activity designed or overseen by the NRCS, which is approved in an individual permit issued under this chapter.

(e) If neither the Soil Conservation District nor the USDA Natural Resource Conservation Service has jurisdiction over an activity approved in an individual permit issued under this chapter, the permittee shall commence the activity only if the following soil erosion and sediment control standards, as specified in the Standards for Soil Erosion and Sediment Control in New Jersey at N.J.A.C. 2:90, are implemented:

1. Sediment control measures shall be installed around the proposed construction sufficient to prevent sediment from entering any riparian zone or channel outside the

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construction area;
2. If construction is proposed in a channel, sediment control measures, such as coffer dams, shall be installed around the activity sufficient to prevent flowing water from coming in contact with construction for the duration of the project where feasible;
3. All slopes shall be graded and stabilized to prevent post-construction erosion; and
4. Permanent, indigenous, non-invasive vegetation shall be established on all exposed soils immediately following construction. The applicant shall monitor and maintain all such vegetation for at least three growing seasons to ensure proper establishment and survival.

(f) The Department shall issue an individual permit for a regulated activity that adversely impacts a property not owned by an applicant only if the applicant demonstrates that one or more of the requirements at N.J.A.C. 7:13-9.2(f) are satisfied for each adversely impacted property. A regulated activity shall be considered to adversely impact a property not owned by an applicant if the activity meets any of the following requirements (for the purpose of determining compliance with (f)3, 4 and 5 below, calculations shall be rounded to the nearest 0.1 feet):

1. The regulated activity is situated, in whole or in part, on property that is not owned by the applicant;
2. A stormwater discharge is directed overland onto property that is not owned by the applicant and the Department determines that the discharge will significantly increase overland flow on the property not owned by the applicant;
3. The regulated activity will cause a building situated on property not owned by the applicant to be subject to increased frequency or depth of flooding during any flood event up to and including the flood hazard area design flood;
4. The applicant owns (or has development rights on) both sides of a regulated water, and the regulated activity will cause the flood hazard area design flood elevation to increase by more than 0.2 feet on any property not owned by the applicant; and/or
5. The applicant owns (or has development rights) on only one side of a regulated water, and the regulated activity will cause the flood hazard area design flood elevation to increase by more than 0.1 feet on any property not owned by the applicant.

(g) If a project results in a significant change in the cross-sectional area and/or hydraulic capacity of a channel or floodway, the Department shall presume that the project has the potential to adversely impact a property not owned by the applicant, as described at (f) above. In such a case, the Department shall require the applicant to provide hydrologic and/or hydraulic calculations that identify the properties that would be adversely impacted, or which demonstrate that such impacts will not in fact occur. Examples of projects that may require such an analysis include a channel modification, flood control project, the construction or removal of a water control structure and the placement of a significant volume of fill in a floodway.

7:13-11.2 Requirements for stormwater management

(a) This section sets forth stormwater management requirements and specific design and construction standards that apply to any major development, as defined at N.J.A.C. 7:8-1.2, which requires an individual permit under this chapter.

(b) The Department shall issue an individual permit for a regulated activity associated with a

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major development only if the requirements of the Stormwater Management rules at N.J.A.C. 7:8 are satisfied.

(c) The Department shall issue an individual permit for a stormwater management basin located within or discharging within a flood hazard area only if the following requirements are satisfied:

1. The basin is designed and constructed to function properly during both flood and nonflood conditions;
2. The effects of flooding and tailwater conditions on any proposed discharge are accounted for in the stormwater management calculations for the proposed basin. Tailwater conditions refer to situations where the discharge pipe will be submerged during a flood in such a way that floodwaters prevent the basin from draining properly. The effects of flooding and tailwater conditions are of particular concern in the following cases:
    i. The basin will be overtopped and flooded during the flood hazard area design flood, because it is not feasible to construct the emergency spillway in accordance with (c)3 below;
    ii. The drainage area of the basin is similar in size to the drainage area of the water receiving the proposed discharge;
    iii. The basin reaches its maximum storage volume during or near the time flooding peaks within the water receiving the proposed discharge; and/or
    iv. The elevation of the lowest discharge orifice or weir in the basin lies below the flood hazard area design flood elevation;
3. If a basin is proposed within the flood hazard area, the emergency spillway shall be constructed above the flood hazard area design flood elevation where feasible, in order to prevent floodwaters from overtopping the berm and flooding the basin; and
4. If the elevation of the lowest discharge orifice or weir in the basin lies below the flood hazard area design flood elevation, the discharge pipe shall be equipped with mechanical devices where appropriate to prevent floodwater from backing up the pipe into the basin.

7:13-11.3 Requirements for excavation, fill and grading activities

(a) This section sets forth specific design and construction standards that apply to any excavation, fill and/or grading proposed in any regulated area.

(b) The Department shall issue an individual permit for excavation, fill and/or grading only if the following requirements are satisfied:

1. The overland flow of stormwater is not impeded and floodwaters can freely enter and exit the disturbed area, unless the area is graded to impound water for a stormwater management structure that meets the requirements of the Stormwater Management rules at N.J.A.C. 7:8;
2. Any slope of greater than 50 percent (a ratio of two horizontal to one vertical) is stabilized using soil bioengineering, retaining walls, rip-rap or other appropriate slope protection;
3. The excavation, fill and/or grading does not endanger the integrity of any existing structure; and
4. All excavated material is disposed of lawfully.

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7:13-11.4 Requirements for a structure

(a) This section sets forth specific design and construction standards that apply to any structure proposed in any regulated area.

(b) The Department shall issue an individual permit to construct or reconstruct a structure only if the entire structure is designed and constructed to be suitably anchored in order to:

1. Resist impact from water and debris during the flood hazard area design flood;
2. Resist uplift, flotation, collapse and displacement due to hydrostatic and hydrodynamic forces resulting from the flood hazard area design flood;
3. Resist overturning and sliding pressure, as well as pressure from the freeze/thaw cycle of the soil; and
4. If the structure is located in or adjacent to a channel, resist undermining caused by channel erosion.

7:13-11.5 Requirements for a building

(a) This section sets forth specific design and construction standards that apply to any building proposed in the areas listed in (b) below. Subsection (c) below establishes standards that apply to all buildings, and subsections (d) through (q) below provide additional standards for various types of buildings.

(b) The requirements in this section apply to a building that is constructed or reconstructed in the following areas:

1. A flood hazard area; and
2. An area that was previously situated in a flood hazard area, but which was filled, raised or otherwise removed from the flood hazard area after January 31, 1980, whether in accordance with or in violation of this chapter, except in the following cases:
    - i. A Department delineation is available for the site, and the Department approves a revision of its delineation that removes the area in question from the flood hazard area; or
    - ii. No Department delineation is available for the site, but FEMA issues a Letter of Map Amendment that removes the area in question from the 100-year flood plain.

(c) The Department shall issue an individual permit to construct or reconstruct a building of any kind only if the following requirements are satisfied:

1. Any new building is located at least 25 feet from any top of bank or edge of water;
2. If an existing building located near any top of bank or edge of water is to be expanded, the expanded portion is located at least 25 feet from the top of bank or edge of water, where possible;
3. If an existing building located near any top of bank or edge of water is to be reconstructed, the new building shall be relocated at least 25 feet from the top of bank or edge of water, where possible;
4. Any exterior wall being constructed or reconstructed is designed to resist hydrostatic and hydrodynamic pressure caused by flooding up to the flood hazard area design flood elevation; and
5. All applicable requirements contained in (d) through (q) below are satisfied.

(d) The Department shall not issue an individual permit for the construction of a new building in a floodway, except for the construction of a building on a pier in the Hudson River satisfying the requirements of N.J.A.C. 7:7E-3.48.

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(e) The Department shall issue an individual permit for the reconstruction of a lawfully existing building in a floodway only if the following requirements are satisfied:

1. The building has not been unoccupied for more than five years prior to the date of application to the Department to reconstruct;
2. The reconstruction shall not convert a non-residential use to a residential use; and
3. All construction takes place within the same footprint as the original building.

(f) The Department shall issue an individual permit for the construction of an addition to a lawfully existing building in a floodway only if the following requirements are satisfied:

1. The building has not been unoccupied for more than five years prior to the date of application to the Department to construct the addition;
2. The addition does not result in any further obstruction to the flow of floodwaters; and
3. The existing building, in combination with the addition, is modified to withstand the hydrodynamic and hydrostatic forces due to flooding up to the flood hazard area design flood elevation.

(g) The Department shall issue an individual permit to construct or reconstruct a private residence only if the lowest floor of the building meets the elevation requirements at (k) below.

(h) The Department shall issue an individual permit to construct or reconstruct a public building
only if the following requirements are satisfied:

1. The lowest floor of the building meets the elevation requirements at (k) below;
2. For a new building in a fluvial flood hazard area, the applicant demonstrates that the building is served by at least one roadway, the travel surface of which is constructed at least one foot above the flood hazard area design flood elevation; and
3. For a new building in a tidal flood hazard area, or for any reconstructed building, the applicant demonstrates that the building is served by at least one roadway, the travel surface of which is constructed at least one foot above the flood hazard area design flood elevation, where feasible.

(i) The Department shall issue an individual permit to construct or reconstruct a habitable building that is neither a private residence nor a public building, only if one of the following requirements is satisfied:

1. The lowest floor of the building meets the elevation requirements at (k) below; or
2. The applicant does the following:
    i. Demonstrates that it is not feasible to meet the elevation requirements at (k) below;
    ii. Constructs the lowest floor of the building as close to one foot above the flood hazard area design flood elevation as feasible; and
    iii. Certifies that the building will be constructed in accordance with the dry floodproofing requirements at (q) below.

(j) The Department shall issue an individual permit for the conversion of a building into a private residence or public building only if the following requirements are satisfied:

1. The lowest floor of the building meets the elevation requirements at (k) below; and
2. For a public building, the applicant demonstrates that the building is served by at least one roadway, the travel surface of which is constructed at least one foot above the flood hazard area design flood elevation, where feasible.

(k) The elevation requirements for a building listed at (g) through (j) above are as follows:

1. For a new building, the lowest floor shall be constructed at least one foot above the

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flood hazard area design flood elevation;

2. For the reconstruction of a building that has been damaged by fire, flooding or other natural disaster, the lowest floor shall be constructed at least one foot above the flood hazard area design flood elevation, unless the applicant demonstrates that it is not feasible to do so. In such a case, the lowest floor shall be constructed as close to this elevation as feasible;

3. For the reconstruction of a building not covered in (k)2 above, such as the voluntary razing a building and constructing a new one in its place, the lowest floor shall be constructed at least one foot above the flood hazard area design flood elevation; and

4. For the enlargement of a building, such as the construction of an addition, the lowest floor of the new portion of the building shall be constructed at least one foot above the flood hazard area design flood elevation. The original building does not need to be elevated unless the original building was constructed in violation of this chapter. The Department shall not issue a permit to enlarge a building that was constructed in violation of this chapter unless the applicant first does the following:

i. Receives a permit under this chapter to legalize the existing building; and

ii. Performs any modifications to the existing building that the Department determines are necessary to bring the building into compliance with the requirements of this chapter.

(l) The Department shall issue an individual permit for a habitable building with an enclosed area beneath the flood hazard area design flood elevation only if the enclosed area meets one of the following requirements:

1. The enclosed area is a crawl space that meets the requirements of (m) below;

2. The enclosed area is a garage that meets the requirements of (n) below; or

3. The enclosed area is open to floodwaters as described at (o) below.

(m) The Department shall issue an individual permit for a habitable building with a crawl space below the flood hazard area design flood elevation as described at (l)1 above only if the Department determines that the crawl space meets the following requirements:

1. The floor elevation of the crawl space is at or above the adjoining exterior grade along at least one entire exterior wall;

2. In order to prevent habitation of the crawl space, the vertical distance from the crawl space floor to the finished elevation of the first floor of the building is six feet or less. If this distance is greater than six feet, the area beneath the finished first floor is not considered a crawl space;

3. Two or more permanent flood vents that meet the requirements of (p) below are constructed in the outer walls of the crawl space; and

4. The deed of the property is modified to state that habitation of the crawl space is prohibited. The modified deed shall be filed with the local county clerk, a copy of which shall be provided to the Department within 90 calendar days of the issuance of the individual permit.

(n) The Department shall issue an individual permit for a garage with a floor below the flood

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hazard area design flood elevation as described at (l)2 above, whether attached to or below a private residence or freestanding, only if the garage meets the following requirements:

1. The floor elevation of the garage is at or above the adjoining exterior grade along at least one entire exterior wall;
2. The garage serves only one private residence, which is not being constructed as part of a larger residential subdivision;
3. The garage has a footprint of no more than 625 square feet;
4. Two or more permanent flood vents that meet the requirements of (p) below are constructed in the outer walls of the garage; and
5. The deed of the property is modified to disclose (n)5i through iv below. The modified deed shall be filed with the local county clerk, a copy of which shall be provided to the Department within 90 calendar days of the issuance of the individual permit:
    - i. That habitation of the garage is prohibited;
    - ii. That the garage and driveway are likely to be inundated by floodwaters, which may result in damage and/or inconvenience;
    - iii. The minimum frequency storm at which the garage and driveway will be inundated; and
    - iv. The depth of flooding during the flood hazard area design flood.

(o) The Department shall issue an individual permit for a habitable building with an enclosed area below the flood hazard area design flood elevation, which is not a crawl space or garage as described at (m) and (n) above, respectively, only if the enclosed area meets the following requirements:

1. The floor elevation of the enclosed area is at or above the adjoining exterior grade along at least one entire exterior wall;
2. At least 25 percent of the surface area of the outer wall of the enclosed area is left permanently open so that floodwaters can freely enter the building to balance hydrostatic pressure during a flood;
3. At least one permanent opening in the outer wall extends down to the floor elevation of the enclosed area; and
4. The deed of the property is modified to state that habitation of the enclosed area is prohibited. The modified deed shall be filed with the local county clerk, a copy of which shall be provided to the Department within 90 calendar days of the issuance of the individual permit.

(p) A flood vent constructed in the outer wall of a building shall meet the following requirements (unless otherwise required under the New Jersey Uniform Construction Code at N.J.A.C. 5:23):

1. The invert of each flood vent shall be no more than 12 inches above the adjoining exterior grade;
2. The invert of at least half of the flood vents shall be no more than 12 inches above the floor of the building;
3. The combined effective open area of the flood vents shall be at least one square inch per square foot of the area of the footprint of the building, unless a smaller FEMA-approved device with an equivalent effective area is utilized; and

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4. The flood vents shall not be blocked at any time, but shall permanently remain open so that floodwaters can freely enter the building to balance hydrostatic pressure during a flood.

(q) A building that is to be dry flood-proofed to meet a requirement of this chapter shall be designed and constructed to be waterproof up to the flood hazard area design flood elevation so that floodwaters cannot enter the structure during a flood. Specifically, the building's foundation, floor slab and walls shall be designed to resist hydrostatic pressure up to the flood hazard area design flood elevation. In addition, any exterior wall opening below the flood hazard area design flood elevation, such as a door or window, shall be equipped with waterproof seals and/or panels and shall also be designed to resist hydrostatic pressure up to the flood hazard area design flood elevation. An application for an individual permit for a dry flood-proofed building shall include the information listed at N.J.A.C. 7:13-9.2(e).

7:13-11.6 Requirements for a railroad, roadway or parking area

(a) This section sets forth specific design and construction standards that apply to any railroad, roadway or parking area proposed in a flood hazard area.

(b) The Department shall issue an individual permit to construct or reconstruct a railroad or public roadway only if one of the following requirements is satisfied:

1. The travel surface of the railroad or public roadway is constructed at least one foot above the flood hazard area design flood elevation; or

2. The applicant demonstrates that it is not feasible to construct the travel surface of the proposed railroad or public roadway at least one foot above the flood hazard area design flood elevation pursuant to (g) below, and instead constructs the travel surface as close to this elevation as feasible.

(c) The Department shall issue an individual permit to construct or reconstruct a driveway that only serves one private residence, which is not being constructed as part of a larger residential subdivision, only if one of the following requirements is satisfied:

1. The travel surface of the driveway is constructed at least one foot above the flood hazard area design flood elevation; or

2. The applicant does the following:

i. Demonstrates that it is not feasible to construct the travel surface of the proposed driveway at least one foot above the flood hazard area design flood elevation pursuant to (g) below, and instead constructs the travel surface as close to this elevation as feasible; and

ii. Modifies the deed of the property to disclose (c)2ii(1) through (3) below. The modified deed shall be filed with the local county clerk, a copy of which shall be provided to the Department within 90 calendar days of the issuance of the individual permit.

(1) That the driveway is likely to be inundated by floodwaters, which may result in damage and/or inconvenience;

(2) The minimum frequency storm at which the driveway will be inundated; and

(3) The depth of flooding during the flood hazard area design flood.

(d) The Department shall issue an individual permit to construct or reconstruct a private roadway that serves a public building only if one of the following requirements is satisfied:

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1. The travel surface of the private roadway is constructed at least one foot above the flood hazard area design flood elevation;
2. For a new private roadway in a fluvial flood hazard area, the applicant demonstrates that the public building is already served by one or more roadways having a travel surface at least one foot above the flood hazard area design flood elevation, which is of adequate size and capacity to serve the public building, and instead constructs the travel surface of the roadway as close to this elevation as feasible; or
3. For a new private roadway in a tidal flood hazard area, or for any reconstructed private roadway that currently lies below the flood hazard area design flood elevation, the applicant demonstrates that it is not feasible to construct the travel surface of the roadway at least one foot above the flood hazard area design flood elevation pursuant to (g) below, and instead constructs the travel surface of the roadway as close to this elevation as feasible.

(e) The Department shall issue an individual permit to construct or reconstruct a parking area that serves a public building only if one of the following requirements is satisfied:

1. The travel surface of the parking area is constructed at least one foot above the flood hazard area design flood elevation; or
2. The applicant demonstrates that it is not feasible to construct the travel surface of the parking area at least one foot above the flood hazard area design flood elevation pursuant to (g) below, and instead constructs the travel surface of the parking area as close to this elevation as feasible.

(f) The Department shall issue an individual permit to construct or reconstruct a private roadway and/or parking area that serves a building, or group of buildings, not covered by (c), (d) or (e) above, such as a commercial business, house of worship, office complex, shopping center or residential subdivision of two or more private residences, only if one of the following requirements is satisfied:

1. The travel surface of each proposed private roadway and parking area that serve the building or group of buildings is constructed at least one foot above the flood hazard area design flood elevation;
2. The applicant demonstrates the following:
   i. Each building or group of buildings is already served by one or more roadways having a travel surface at least one foot above the flood hazard area design flood elevation, which is of adequate size and capacity to serve the building or group of buildings;
   ii. The travel surface of each proposed roadway is constructed as close to one foot above the flood hazard area design flood elevation as feasible; and
   iii. The travel surface of each proposed parking area is constructed at least one foot above the flood hazard area design flood elevation; or
3. The applicant demonstrates the following:
   i. It is not feasible to construct the travel surface of each private roadway and parking area at least one foot above the flood hazard area design flood elevation pursuant to (g) below;
   ii. The travel surface of each private roadway and parking area is constructed as close to one foot above the flood hazard area design flood elevation as feasible;
   iii. Every effort has been taken to provide some parking areas or sections of roadway in the overall development that are situated at least one foot above the

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flood hazard area design flood elevation so that vehicles can be moved to higher ground during a flood;

iv. No extraordinary risk is posed to any person using each private roadway or parking area that is constructed at an elevation less than one foot above the flood hazard area design flood elevation; and

v. An adequate number of permanent signs are posted in prominent locations indicating which private roadways and parking areas are subject to flooding in the following cases:

(1) The roadway and/or parking area serves a residential subdivision of two or more private residences; or

(2) The parking area has 10 spaces or more.

(g) An applicant seeking to demonstrate that it is not feasible to construct the travel surface of a railroad, roadway or parking area at least one foot above the flood hazard area design flood elevation, as is required for various activities in this section, shall prove that strict compliance with this requirement would result in one or more of the following:

1. Prohibitively high construction costs;

2. Construction costs that are disproportionately high compared with any benefit that would be obtained by strict compliance;

3. A design that necessitates excessive volumes of fill that exceed the flood storage displacement limits at N.J.A.C. 7:13-10.4, for which flood storage cannot feasibly be created in compensation either onsite or offsite; and/or

4. A design that causes unavoidable and adverse impacts to the environment (such as to the channel, riparian zone or fishery resources), or which would cause unavoidable and significant increases in the flood hazard area design flood elevation.

7:13-11.7 Requirements for a bridge or culvert

(a) This section sets forth specific design and construction standards that apply to any bridge or culvert proposed in any regulated area.

(b) The Department shall issue an individual permit to construct or reconstruct a bridge or culvert only if the following requirements are satisfied:

1. The bridge or culvert, and all embankments, are designed to remain stable, scour resistant and resistant to displacement and/or damage during any flood event up to and including the flood hazard area design flood. At a minimum, each bridge shall have stable abutments, each culvert shall have stable headwalls, and each abutment and headwall shall have footings that extend no less than three feet below the invert of the channel; and

2. The bridge or culvert, and its associated roadway, are designed to minimize flooding and adverse impacts to channel stability and fishery resources. To help achieve this goal, the bridge or culvert opening shall match or exceed the dimensions of the existing channel where feasible, so that the size and shape of the natural channel is preserved through the structure. If additional flood conveyance is required, parallel culverts can be placed alongside the primary structure to carry flows that exceed the banks. Examples
of acceptable designs are provided in the Flood Hazard Area Technical Manual, available from the Department at the address listed at N.J.A.C. 7:13-1.1(g).

(c) The Department shall issue an individual permit to construct a new bridge or culvert only if

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the following requirements are satisfied (for the purpose of determining compliance with this subsection, calculations shall be rounded to the nearest 0.1 feet):

1. The new structure does not cause any offsite building, railroad, roadway or parking area to be subject to increased frequency or depth of flooding during any flood event up to and including the flood hazard area design flood; and
2. The new structure does not cause an increase of more than 0.2 feet in the flood hazard area design flood elevation offsite.

(d) The Department shall issue an individual permit to reconstruct an existing bridge or culvert only if the following requirements are satisfied (for the purpose of determining compliance with this subsection, calculations shall be rounded to the nearest 0.1 feet):

1. The reconstructed structure does not cause any offsite building, railroad, roadway or parking area to be subject to increased frequency or depth of flooding during any flood event up to and including the flood hazard area design flood;
2. The reconstructed structure does not cause an increase of more than 0.2 feet in the flood hazard area design flood elevation offsite within 500 feet of the structure; and
3. The reconstructed structure does not cause any increase in the flood hazard area design flood elevation offsite more than 500 feet from the structure.

(e) Subsections (f) through (m) below set forth standards for the protection of aquatic habitat and the maintenance of low-flow aquatic passage associated with the construction of a bridge or culvert. Examples of various designs described in this section are depicted in the Flood Hazard Area Technical Manual, available from the Department at the address listed at N.J.A.C. 7:13-1.1(g). For the purposes of this section, regulated waters are divided into three classes as follows:

1. Class A waters, which include the following:
   i. Category One waters;
   ii. Trout production waters;
   iii. Trout maintenance waters;
   iv. Trout stocked waters;
   v. Anadromous waters;
   vi. Waters supporting cool and warmwater gamefish; and
   vii. Waters supporting aquatic threatened and/or endangered species;
2. Class B waters, which include the following:
   i. Waters supporting non-game cool and warmwater fish;
   ii. Waters identified by the Department's Division of Fish and Wildlife as supporting aquatic biota, which are not otherwise listed as Class A in (e)1 above; and
   iii. Waters that have been altered and/or degraded by lining, ditching, channel modification or other human activity, but which the Department determines can be restored and/or enhanced to support viable aquatic resources such as described in this paragraph; and
3. Class C waters, which include the following:
   i. Waters that do not contain fishery resources;
   ii. Waters that are wholly manmade (not naturally occurring waters that have been altered by human activity); and
   iii. All other waters not otherwise included in Class A and Class B in (e)1 and 2 above.

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(f) The Department shall issue an individual permit to construct or reconstruct a bridge or culvert in or across a Class A water that has a channel width of five feet or more as follows:

1. The channel shall be completely spanned with one bridge, arch culvert or three-sided culvert as described in (i) below.
2. If spanning under (i) below is not feasible due to prohibitively high construction costs, unstable substrate, adverse impacts to flooding and/or an irregular channel configuration, and the applicant meets the waiver requirements at (m) below, the channel shall be spanned with a smaller structure and adjoining side-relief culverts shall be constructed as described in (j) below.
3. If spanning the channel with side-relief culverts under (j) below is not feasible due to prohibitively high construction costs, unstable substrate, adverse impacts to flooding and/or an irregular channel configuration, one circular or elliptical culvert, or a system of culverts, shall be constructed as described in (k) below.
4. If constructing culverts under (k) below is not feasible due to hydraulic or structural design constraints, the applicant can construct a circular, elliptical or box culvert as described in (l) below.

(g) The Department shall issue an individual permit to construct or reconstruct a bridge or culvert in or across a Class B water, or a Class A water that has a channel width of less than five feet, as follows:

1. The channel shall be completely spanned with one bridge, arch culvert or three-sided culvert as described in (i) below.
2. If spanning under (i) below is not feasible due to prohibitively high construction costs, unstable substrate, adverse impacts to flooding and/or an irregular channel configuration, the channel shall be spanned with a smaller structure and adjoining side relief culverts shall be constructed as described in (j) below.
3. If spanning the channel with side-relief culverts under (j) below is not feasible due to prohibitively high construction costs, unstable substrate, adverse impacts to flooding and/or an irregular channel configuration, and the applicant meets the waiver requirements at (m) below, one circular or elliptical culvert, or a system of culverts, shall be constructed as described in (k) below.
4. If constructing culverts under (k) below is not feasible due to hydraulic or structural design constraints, the applicant can construct a circular, elliptical or box culvert as described in (l) below.

(h) The Department shall issue an individual permit to construct or reconstruct a bridge or culvert in or across a Class C water as follows:

1. The channel shall be completely spanned with one bridge, arch culvert or three-sided culvert as described in (i) below.
2. If spanning under (i) below is not feasible due to prohibitively high construction costs, unstable substrate, adverse impacts to flooding and/or an irregular channel configuration, the channel shall be spanned with a smaller structure and adjoining side relief culverts shall be constructed as described in (j) below.
3. If spanning the channel with side-relief culverts under (j) below is not feasible due to prohibitively high construction costs, unstable substrate, adverse impacts to flooding and/or an irregular channel configuration, one circular or elliptical culvert, or a system of culverts, shall be constructed as described in (k) below.
4. If constructing culverts under (k) below is not feasible due to hydraulic or structural

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design constraints, the applicant can construct a circular, elliptical or box culvert as described in (l) below.

(i) Spanning a channel under (f)1, (g)1 and (h)1 above shall be accomplished as follows:

1. The span shall be adequately sized to pass the flood hazard area design flood without a significant increase in the velocity of water in the channel;
2. A stable, natural, earthen channel with low-flow aquatic passage shall be provided throughout the structure; and
3. No armoring shall be placed under or across the channel bed, unless such armoring is necessary to prevent scour along the proposed abutments or footings. In such a case, the armoring shall be buried beneath at least two feet of native substrate where feasible.

(j) Spanning a channel with adjoining side-relief culverts under (f)2, (g)2 and (h)2 above shall be accomplished as follows:

1. The span shall consist of a bridge, arch culvert or three-sided culvert that is sized to match the width and cross-sectional area of the channel so as to convey bank-full flow without a significant increase in the velocity of water in the channel;
2. A stable, natural, earthen channel with low-flow aquatic passage shall be provided throughout the structure;
3. Additional culverts shall be constructed outside the channel, and parallel to the span, as needed to convey flood events that exceed the channel's capacity, up to and including the flood hazard area design flood; and
4. No armoring shall be placed under or across the channel bed, unless such armoring is necessary to prevent scour along the proposed abutments or footings. In such a case, the armoring shall be buried beneath at least two feet of native substrate where feasible.

(k) One circular or elliptical culvert, or a system of parallel circular and/or elliptical culverts, under (f)3, (g)3 and (h)3 shall be constructed as follows:

1. Where possible, one culvert shall be constructed, which is adequately sized so to pass the flood hazard area design flood without a significant increase in the velocity of water in the channel;
2. If construction under (k)1 above is not feasible, one culvert shall be sized to match the width and cross-sectional area of the channel, so as to convey bank-full flow without a significant increase in velocity, and additional culverts shall be constructed outside the channel, and parallel to the span, as needed to convey flood events that exceed the channel's capacity, up to and including the flood hazard area design flood;
3. The invert of the in-channel culvert shall be installed at least two feet below the invert of the natural channel where feasible;
4. The in-channel culvert shall be filled with native substrate up to the invert of the natural channel, in order to create a contiguous flow-path through the culvert that meets and matches the bottom inverts, cross-sections and profile of the channel beyond the culvert; and
5. The applicant shall demonstrate that the native substrate placed within the in-channel culvert will remain stable under expected storm flow conditions.

(l) A circular, elliptical or box culvert under (f)4, (g)4 and (h)4 shall be constructed as follows:

1. Where feasible:
    i. The invert of the culvert shall be installed at least two feet below the invert of the natural channel where feasible;
    ii. The culvert shall be filled with native substrate up to the invert of the natural

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channel, in order to create a contiguous flow-path through the culvert that meets and matches the bottom inverts, cross-sections and profile of the channel beyond the culvert; and

iii. The applicant shall demonstrate that the native substrate placed within the culvert will remain stable under expected storm flow conditions; and

2. If a culvert cannot be constructed as described at (k)1 above due to unstable substrate or other physical constraints, the culvert shall be constructed to incorporate an artificial low-flow treatment such as a V-notch, key-notch or concave floor (see the Flood Hazard Area Technical Manual, available from the Department at the address listed at N.J.A.C. 7:13-1.1(g), for various examples).

(m) A waiver from the requirements of (f)1 and (g)2 above shall be granted provided:

1. The applicant clearly demonstrates that compliance with (f)1 or (g)2 is not possible or feasible, and/or that the cost of compliance greatly outweighs the environmental benefit that would be achieved. For the purposes of this subsection, the cost of compliance refers not only to economic cost to the applicant but also real or potential adverse impacts to the environment, flooding or public safety;

2. The applicant, if a public entity, demonstrates that:

i. There is a public need to cross the regulated water; and

ii. There is no other feasible means of constructing a bridge or culvert, which would reduce or eliminate adverse impacts to aquatic resources, flooding and public safety; and

3. The applicant, if a private entity, demonstrates that:

i. There is developable land onsite that cannot feasibly be accessed without crossing the regulated water, including accessing the site through neighboring properties; and

ii. There is no other feasible means of constructing a bridge or culvert to access the developable area onsite, which would reduce or eliminate adverse impacts to aquatic resources, flooding and public safety.

7:13-11.8 Requirements for a footbridge

(a) This section sets forth specific design and construction standards that apply to any footbridge proposed in any regulated area.

(b) The Department shall issue an individual permit to construct or reconstruct a footbridge only if the following requirements are satisfied (examples of various designs described in this section are depicted in the Flood Hazard Area Technical Manual, available from the Department at the address listed at N.J.A.C. 7:13-1.1(g)):

1. The structure is used exclusively to carry pedestrians, livestock and/or light vehicles such as bicycles, golf carts or lawn tractors over a regulated water;

2. The travel width is no more than 10 feet. If the travel width is more than six feet, bollards or similar devices shall be installed to prevent automobiles and other larger vehicles from utilizing the footbridge;

3. The structure completely spans the water so that no footings, piers or abutments are placed in the water or its channel;

4. All footings, piers and abutments proposed within 10 feet of the top of bank or edge of water extend at least three feet below the channel invert;

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5. All footings, piers and abutments proposed more than 10 feet beyond the top of bank or edge of water extend at least three feet below grade;
6. No approach ramp or other part of the footbridge obstructs flow in a floodway;
7. If the footbridge provides access to a public building, its travel surface is constructed at least one foot above the flood hazard area design flood elevation where feasible, or as close to this elevation as feasible; and
8. The footbridge is designed to pass floodwaters in one of the following ways:
i. The low chord of the footbridge is set above the flood hazard area design flood elevation; or
ii. Open handrails are used instead of a solid parapet, and the vertical distance between the low chord and the top of the footbridge deck, including any curbing, is no more than eight inches.

(c) A structure that meets the requirements of (b) above is not subject to the requirements for a bridge or culvert at N.J.A.C. 7:13-11.7. Any footbridge or other similar crossing that does not comply with the requirements of (b) above is subject to the requirements at N.J.A.C. 7:13-11.7 for bridges and culverts instead of the requirements of this section.

7:13-11.9 Requirements for a utility line

(a) This section sets forth specific design and construction standards that apply to any utility line proposed in any regulated area.
(b) The Department shall issue an individual permit to construct or reconstruct a utility line across or under a channel or water only if the following requirements are satisfied, as applicable:
1. The applicant demonstrates that it is not feasible to directionally drill or "jack" the proposed utility line under the channel or water, as permitted-by-rule at N.J.A.C. 7:13-7.2(c)3;
2. The applicant demonstrates that it is not feasible to construct the utility line within a roadway that already crosses the channel or water, as permitted-by-rule at N.J.A.C. 7:13-7.2(c)4;
3. The applicant demonstrates that it is not feasible to attach the utility line to a bridge that already crosses the channel or water, as permitted-by-rule at N.J.A.C. 7:13-7.2(c)5;
4. The excavation of an open trench across a channel or water resulting in contact with flowing water is avoided. If the excavation of an open trench is unavoidable, the following requirements shall be met;
i. Any trench in a channel, water or riparian zone, is no more than 20 feet wide, unless the applicant demonstrates that such a width is not feasible and a wider trench is necessary for safe construction;
ii. The normal flow of the channel or water is piped or diverted around the open trench during construction where possible so that sediment cannot enter the regulated water; and
iii. The trench is backfilled to the pre-excavation ground elevation using native substrate upon completion of the crossing;
5. All disturbed areas in the flood hazard area are restored to pre-construction topography;
6. A utility line that conveys a gas or liquid is protected in one of the following ways:

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i. It is covered by at least four feet of stable material consisting of native substrate in the channel or water;
ii. It is encased in six inches of concrete and covered by at least three feet of stable material consisting of native substrate in the channel or water;
iii. It is encased within a steel sleeve, or protected above by a 0.25-inch thick stainless steel plate, and covered by at least three feet of stable material consisting of native substrate in the channel or water; or
iv. If the applicant demonstrates that it is not feasible to provide at least three feet of coverage beneath the channel or water, and that there is no feasible alternative location for crossing the channel or water where at least three feet of coverage is provided, the utility line is either:
(1) Covered by as much stable material consisting of native substrate in the channel or water as feasible, and encased within a steel sleeve; or
(2) Covered by as much stable material consisting of native substrate in the channel or water as feasible, protected above by a 0.25-inch thick stainless steel plate, and encased with six inches of concrete around the sides and bottom;

7. A utility line that does not convey a gas or liquid is covered by at least three feet of stable material consisting of native substrate in the channel or water where feasible;
8. The utility line is sealed to ensure that there will be no leakage or discharge in a regulated area; and
9. The following requirements are satisfied for each utility line that crosses a channel or water, unless the applicant demonstrates that one or more of these requirements is not feasible or that another configuration would pose less risk to life, property and the environment:
i. Each utility line is placed nominally horizontal under the entire channel or water, and remains so beyond each bank for a distance equal to twice the height of the bank, or 10 feet, whichever is greater. If there is no discernible bank, the utility line shall remain nominally horizontal for at least 10 feet beyond the normal edge of water;
ii. The inclined portion of each utility line approaching the channel or water has a slope no greater than 50 percent (a ratio of two horizontal to one vertical); and
iii. Encasement extends under the entire channel or water and 10 feet beyond each top of bank. If there is no discernible bank, the utility line shall be encased for at least 10 feet beyond the normal edge of water.

(c) The Department shall issue an individual permit to construct or reconstruct a utility line above a channel or floodway, which is not attached to a roadway or railroad crossing, or which is attached to such a crossing but does not meet the permit-by-rule at N.J.A.C. 7:13-7.2(c)5, only if the following requirements are satisfied:
1. The applicant demonstrates that it is not feasible to attach the utility line to a bridge that already crosses the channel or water, as permitted-by-rule at N.J.A.C. 7:13-7.2(c)5;
2. The utility line does not create any obstruction to the flow of floodwaters;
3. The utility line is suitably anchored and protected from damage by impact from floating debris;
4. The utility line is sealed to ensure that there will be no leakage or discharge in a regulated area; and

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5. The utility line is placed at least one foot above the flood hazard area design flood elevation.

(d) The Department shall issue an individual permit to construct or reconstruct a manhole associated with a utility line in a regulated area only if the following requirements are satisfied:

1. The manhole is constructed at least 10 feet from any top of bank or edge of water (unless situated within a paved surface);
2. The manhole has a watertight cover if constructed along a sanitary sewer line;
3. The top of a manhole in a floodway is flush with the ground; and
4. The top of a manhole in a flood fringe is flush with the ground, where possible.

(e) The Department shall issue an individual permit for the placement of a cable directly on the bed of a channel or water only if the following requirements are satisfied:

1. The channel or water is large enough in both width and depth that the cable will not interfere with the normal flow of the channel or water; and
2. The cable is laid with enough slack so that it can be easily moved.

(f) The Department shall issue an individual permit that allows, over the five-year term of the permit, the necessary and periodic maintenance, repair or replacement of any section of a lawfully existing above or below ground utility line in a regulated area only if the following requirements are satisfied:

1. The applicant submits an application for an individual permit which, in addition to the normal application requirements, includes the following:
   i. The exact location of the utility line network that is the subject of the application, identified on USGS quad maps; and
   ii. Details of the types of maintenance, repair and/or replacement activities that can be expected to occur during the five-year period, including typical drawings of any anticipated repairs and a construction sequence;
2. The applicant agrees to provide public notice pursuant to N.J.A.C. 7:13-16.3(d) at least five working days before performing any repair or replacement;
3. The applicant agrees to replant all disturbed areas in the riparian zone with indigenous, non-invasive vegetation after each repair or replacement;
4. The applicant agrees to restore all disturbed areas in the flood hazard area to preconstruction topography after each repair or replacement; and
5. The applicant agrees to submit a report to the Department each January which includes the following:
   i. A description of each repair or replacement that occurred during the previous calendar year;
   ii. Color photographs of each regulated area before and after each repair or replacement; and
   iii. The fee for each repair or replacement, as provided at N.J.A.C. 7:13-17.

7:13-11.10 Requirements for a stormwater outfall structure

(a) This section sets forth specific design and construction standards that apply to any stormwater outfall structure proposed in any regulated area.

(b) The Department shall issue an individual permit to construct or reconstruct a stormwater outfall structure only if the following requirements are satisfied (examples of acceptable designs are provided in the Flood Hazard Area Technical Manual, available from the Department at the address listed at N.J.A.C. 7:13-1.1(g)):

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1. The structure is built with a concrete headwall or flared-end section with footings that extend no less than three feet below grade;
2. The structure does not obstruct flow in a channel or floodway;
3. The structure includes adequate conduit outlet protection where required by the Standards for Soil Erosion and Sediment Control in New Jersey at N.J.A.C. 2:90;
4. If the structure includes a rip-rap apron, a three feet deep by three feet wide rip-rap toe wall is constructed at the end of the apron; and
5. The structure does not interfere with the normal flow of the channel or threaten to change the dimensions or location of the channel. For example, a large discharge of stormwater into a small channel, or a discharge situated at a significant angle to the normal flow in a channel, may cause the channel to move over time, interfere with the direction of flow and/or cause increased erosion or deposition of sediment within the channel.

7:13-11.11 Requirements for a dam or a low dam

(a) This section sets forth specific design and construction standards that apply to any dam or low dam proposed in any regulated area.

(b) Activities performed in association with the construction of a dam or low dam, such as a channel modification, the excavation of a stormwater management basin or the creation of a stormwater collection and discharge system, shall be reviewed in accordance with the appropriate requirements for those activities under this chapter. This section applies only to the construction of the dam or low dam itself.

(c) The construction of a dam in a regulated area is subject to the requirements of this chapter only if the dam is part of a stormwater management basin that is located in a regulated area, or which discharges in a regulated area. Any dam that is constructed for another purpose is not subject to the requirements of this chapter, but is subject to the Dam Safety Standards at N.J.A.C. 7:20. Certain classes of dams require a permit from the Department's Dam Safety Section, which can be reached at (609) 984-0859 for further information. The requirements for removing a dam that is subject to this chapter are found at N.J.A.C. 7:13-11.19.

(d) The Department shall issue an individual permit to construct a dam or a low dam in a regulated area only if the following requirements are satisfied:

1. The dam or low dam does not increase offsite flooding in accordance with N.J.A.C. 7:13-11.1(f);
2. The dam or low dam is not located in a channel unless the applicant demonstrates that there is no feasible alternative that would cause less adverse impact to the environment; and
3. The dam or low dam is not located in a water with fishery resources, as described at N.J.A.C. 7:13-10.5, unless the dam or low dam includes a fish ladder or other mechanism that permits fish to pass the structure in either direction.

7:13-11.12 Requirements for a flood control project

(a) This section sets forth specific design and construction standards that apply to any flood control project proposed in any regulated area.

(b) The Department shall issue an individual permit for a flood control project only if the applicant is a public entity, and the applicant provides a detailed analysis of the existing flooding problem that is to be mitigated. At minimum, this analysis shall include the following:

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1. The frequency and intensity of flooding;
2. The number of homes, businesses and other facilities historically affected by flooding;
3. A cost-benefit analysis for the proposed flood control project, which includes a comparison of any adverse environmental impacts that may be caused by the project with the benefits for flood relief for each investigated alternative;
4. A discussion regarding which storms the flood control project is designed to mitigate and why these storms were selected;
5. If the flood control project is not designed to alleviate flooding for the 100-year flood and/or the flood hazard area design flood, a demonstration as to why this is not feasible and/or possible; and
6. All hydrologic and hydraulic calculations necessary to demonstrate the need for and viability of the project.

(c) The Department shall issue an individual permit for a flood control project that results in disturbance to a channel and/or riparian zone only if the requirements of (b) above are satisfied and provided the applicant demonstrates that there is no feasible alternative project located outside the channel and riparian zone that would satisfactorily reduce flooding. At minimum, this analysis shall include the following:

1. A demonstration that the flooding problem cannot feasibly be solved through any of the following:
    i. Raising, relocating and/or removing the flood prone structures;
    ii. Replacing, removing or altering existing water control structures that are contributing to the flooding, such as dams or inadequately-sized bridges or culverts; and
    iii. Improving the hydraulic capacity of existing water control structures, such as removing accumulated sediment and debris from bridges and culverts, or eliminating bends, inlets and blockages in culverts;
2. A demonstration that the flooding problem cannot feasibly be solved by reducing the volume and/or flow rate of floodwaters in the channel through either of the following:
    i. Constructing regional stormwater management basins upstream of the flooding; and
    ii. Redirecting excess flows into pipes or artificial channels to bypass the affected areas; and
3. A demonstration that the following steps have been taken to ensure that the flooding problem will not reoccur after the flood control project has been constructed:
    i. Analysis of local stormwater management ordinances within the drainage area and modification, where necessary, or the ordinances to ensure that flows within the channel will not increase over time; and
    ii. Development of a regional plan to preserve the existing flood storage within the drainage area.

(d) The Department shall issue an individual permit for the lining or piping of a channel as part of a flood control project only if the project meets the requirements at (b) and (c) above, and provided the applicant demonstrates the following:

1. There is no feasible alternative project that would satisfactorily reduce the flooding, which would avoid lining or piping the channel;
2. Lining or piping the channel is necessary to protect public health, safety and welfare;

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and
3. Adequate mitigation for all lost vegetation and aquatic biota will occur.

7:13-11.13 Requirements for a retaining wall or bulkhead
(a) This section sets forth specific design and construction standards that apply to any retaining wall or bulkhead proposed in any regulated area.
(b) The Department shall issue an individual permit to construct or reconstruct a retaining wall or bulkhead that is at least four feet in height in a fluvial flood hazard area only if the following requirements are satisfied:
1. The retaining wall or bulkhead is designed with stable footings that extend at least 3 feet below grade, unless the applicant demonstrates that such a footing is not possible to construct or necessary for stability;
2. The applicant provides a stability analysis, signed and sealed by an engineer, which demonstrates that the retaining wall or bulkhead is designed to withstand displacement, overturning and failure due to undermining and/or pressure from soil, water and frost; and
3. If located in a channel, the wall is designed to be resistant to erosion as well as the possibility of a shifting bed and/or bank over time.
(c) The Department shall issue an individual permit to construct or reconstruct a retaining wall or bulkhead that is at least four feet in height in a tidal flood hazard area only if an engineer certifies that the retaining wall or bulkhead is designed to withstand displacement, overturning and failure due to undermining and/or pressure from soil, water and frost.
(d) The Department shall issue an individual permit to construct or reconstruct a retaining wall or bulkhead that is less than four feet in height only if the wall is designed with stable footings and, if located in a channel, the wall is designed to be resistant to erosion as well as the possibility of a shifting bed and/or bank over time.

7:13-11.14 Requirements for bank stabilization and channel restoration
(a) This section sets forth specific design and construction standards that apply to any bank stabilization or channel restoration project proposed in any regulated area.
(b) The Department shall issue an individual permit to restore to a stable condition a bank or channel, which has become eroded, unstable and/or ecologically degraded, only if the applicant provides a detailed analysis of the specific problem that is to be corrected. At minimum, this analysis shall include the following:
1. A complete description of the existing problem onsite including:
i. A history of the site and the drainage area, including any previous attempts to restore the bank or channel; and
ii. The likely causes of any erosion, instability or ecological degradation;
2. A demonstration of why the selected stabilization or restoration methods (as described at (c) below) are the most suitable for the site. At minimum, this demonstration should include and discuss the following (see Flood Hazard Area Technical Manual, available from the Department at the address listed at N.J.A.C. 7:13-1.1(g), for examples):
i. The location of any headcut in the channel if present. A headcut is a sudden change in elevation in the stream bed, which usually occurs at the leading edge

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of a forming gully, and is indicative of erosive forces that are likely to continue to wash away the natural channel;

ii. Any upstream or downstream stressors that may have contributed to and/or exacerbated any erosion, instability or ecological degradation, which should be addressed as part of the project;

iii. How future development in the drainage area could impact the bank and/or channel and the proposed stabilization and/or restoration;

iv. The anticipated lifetime of the proposed stabilization or restoration; and

3. A maintenance and monitoring plan to ensure the success of the proposed stabilization or restoration, which includes:

i. An action plan in case of future failure of the project; and

ii. A plan to reduce the likelihood of future erosion, instability and ecological degradation onsite.

(c) The Department shall issue an individual permit to restore to a stable condition a bank or channel, which has become eroded, unstable and/or ecologically degraded, only if the project is accomplished as follows:

1. The project is designed by an individual with experience in fluvial geomorphology (and soil bioengineering if used on site), as evidenced by documentation supplied with the individual permit application;

2. Where possible, a localized eroded bank or destabilized channel is restored solely by cutting back the bank to a stable slope and planting with vegetation suitable for stabilization. Generally a slope of no greater than 50 percent (a ratio of two horizontal to one vertical) is recommended to stabilize an eroded bank;

3. If cutting the bank and planting vegetation as described in (c)2 above cannot adequately restore the channel and/or fully prevent erosion due to excessive channel velocity, or if cutting the bank would destroy vegetation in excess of that which is allowed at N.J.A.C. 7:13-10.2(i), soil bioengineering is used to stabilize the eroded bank and/or restore the channel. In designing soil bioengineering installations, the existing soil characteristics, the bank and/or channel's physical structure and the hydrologic conditions on site shall be considered;

4. The Department shall issue an individual permit for bank stabilization or channel restoration that is not accomplished solely using vegetation or soil bioengineering, as described in (c)2 and (c)3above, respectively, only if the applicant demonstrates that, given the velocity and configuration of the adjacent channel and/or other conditions of the site, vegetation and/or soil bioengineering alone are not adequate to stabilize the bank and/or restore the channel; and

5. The Department shall issue an individual permit for the lining or piping of a channel in order to stabilize erosion only if the applicant demonstrates the following:

i. There is no feasible alternative project that would satisfactorily reduce the erosion, which would avoid lining or piping the channel;

ii. Lining or piping the channel is necessary to protect public health, safety and welfare; and

iii. Adequate mitigation for all lost vegetation and aquatic biota will occur.

(d). In cases where nuisance flooding is a related issue, flood capacity outside the regulated

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water shall be increased by terracing the overbank areas where appropriate, so that the channel is not forced to convey excessive flows (see the Flood Hazard Area Technical Manual, available from the Department at the address listed at N.J.A.C. 7:13-1.1(g), for examples).

7:13-11.15 Requirements for sediment and debris removal from a water

(a) This section sets forth specific standards that apply to any proposed sediment and debris removal from a regulated water.

(b) This section does not apply to the removal of sediment and/or debris by a county or municipality in accordance with general permit 1 at N.J.A.C. 7:13-8.3, or the removal of sediment and/or debris conducted for agricultural purposes in accordance with general permit 2B at N.J.A.C. 7:13-8.4(c)2. In addition, the removal of trash and obstructions from a channel are permitted-by-rule under certain circumstance pursuant to N.J.A.C. 7:13-7.2(a)5 and (d)3.

(c) Except as provided in (d) below, the Department shall issue an individual permit for the removal of sediment and debris from a channel only if the following requirements are satisfied:

1. The applicant demonstrates the following:
   i. That there is a flooding problem, mosquito control problem or other threat to public health, safety or welfare that cannot otherwise be remedied without removing the sediment and/or debris from the water; and
   ii. That removing the sediment and/or debris will remedy the problem identified in (c)1i above;
2. The material to be removed from the water consists solely of accumulated silt, sediment and debris. Removal of material beyond or below the natural channel constitutes a channel modification and is subject to the requirements at N.J.A.C. 7:13-10.1(c);
3. In order to minimize the downstream transport of sediment during dredging, all areas being dredged are isolated from flowing water where possible. Means of isolation include erecting temporary berms or sheet-piles around the areas being dredged and pumping the normal channel flow around the work area, or, if channel flow is low, by blocking off sections of the channel being dredged and allowing the sediment to settle;
4. The applicant properly disposes of all material removed from the channel. Removed sediment can be disposed of in a regulated area provided the requirements at (f) below are satisfied. All removed trash and debris shall be disposed of in accordance with all applicable Federal, State and local laws outside any flood hazard area or riparian zone;
5. The project does not disturb the channel bank or the riparian zone, unless such disturbance is unavoidable, necessary to gain access to the channel and minimized;
6. The project is conducted from only one bank where possible;
7. The use of heavy equipment in the channel is avoided;
8. Vegetation and tree canopy on the more southerly or westerly bank is preserved in order to shade the channel;
9. All access points to the water are described in writing and with color photographs; and
10. All disturbed areas in the riparian zone are replanted with indigenous, non-invasive vegetation upon completion of the project.

(d) The Department shall issue an individual permit for the removal of sediment and debris from a channel, which does not meet one or more of the requirements at (c) above, only if the

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following requirements are satisfied:

1. The applicant is a public entity;
2. The project is intended solely for mosquito control;
3. The applicant demonstrates that the mosquito control problem cannot be solved by any other feasible methods;
4. The applicant submits an individual, site-specific proposal to the Administrator of the State Office of Mosquito Control Coordination, and said office determines that the project is necessary to control a documented mosquito problem;
5. The applicant explains in its public notice that the project does not meet the normal requirements under this chapter for sediment removal and that the applicant is seeking an exception for mosquito control purposes;
6. The applicant convenes a public hearing to discuss the project in cases of significant public interest; and
7. The applicant demonstrates that all adverse environmental impacts are minimized.

(e) The Department shall issue an individual permit for the removal of sediment and debris from an impounded water, such as a lake, pond or reservoir, only if the following requirements are satisfied:

1. In order to minimize the transport of sediment during dredging, all areas being dredged are isolated from flowing water where possible. Means of isolation include erecting temporary berms or sheet-piles around the areas being dredged, lowering the water level if controlled by a dam, plugging the downstream discharge of the water and pumping the incoming water around the impoundment;
2. The applicant obtains a lake lowering permit from the Department's Division of Fish and Wildlife, where necessary;
3. The applicant obtains any necessary approvals the Department's Dam Safety Section;
4. Machinery access to the water is restricted in order to minimize disturbance to the riparian zone;
5. The applicant properly disposes of all material removed from the impounded water. Removed sediment can be disposed of in a regulated area provided the requirements at (f) below are satisfied. All removed trash and debris shall be disposed of in accordance with all applicable Federal, State and local laws outside any flood hazard area or riparian zone; and
6. If dredging expands the area or depth of the impounded water beyond its original dimensions, the applicant demonstrates that such expansion will not adversely affect flooding, any structure or freshwater wetlands adjacent to the water, the seasonal high water table or any dam or low dam that may exist.

(f) The Department shall issue an individual permit to deposit sediment that has been removed from a regulated water, only if the following requirements are satisfied:

1. The applicant demonstrates that the transport of the sediment out of the regulated area is not economically or physically feasible, and/or would cause greater environmental damage than depositing the sediment within the regulated area;
2. The sediment is disposed of in accordance with all applicable Federal, State and local laws;
3. The sediment is deposited at least 25 feet from any top of bank or edge of water;
4. The placement of the sediment does not interfere with the positive overland drainage of the receiving area;

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5. Sediment deposited in a floodway is placed no more than three inches deep; and
6. Sediment deposited is placed on land that lies below both the seasonal high water table and the normal water surface elevation of the nearest regulated water, unless the applicant demonstrates that the sediment cannot feasibly be deposited on such land.

(g) The Department shall issue an individual permit that allows an applicant to repeatedly remove sediment and debris from a regulated water during the term of the permit, only if the applicant does the following:

1. Demonstrates that there is no feasible means of preventing the accumulation of sediment and debris over time, which would therefore avoid the need for repeated cleanings;
2. Demonstrates that repeated cleanings are necessary to properly maintain existing bridges or culverts along the water, and/or to alleviate local flooding;
3. Demonstrates that repeated cleanings will not adversely impact fishery resources in the water;
4. Agrees to notify the Department in writing no less than 10 calendar days prior to each proposed sediment removal activity; and
5. Agrees to submit a report to the Department within 30 calendar days of the completion of each sediment removal activity. This report shall include color photographs of the work area and shall describe how the sediment removal was accomplished, where the dredged material was deposited and to what extent disturbed vegetation in the riparian zone was restored.

7:13-11.16 Requirements for the storage of unsecured material

(a) This section sets forth specific standards that apply to any proposed storage of unsecured material in any regulated area.

(b) This section governs the storage of unsecured material not addressed by the following:

1. The permits-by-rule at N.J.A.C. 7:13-7.2(e)1 through 4, which cover the storage of unsecured materials for construction activities, and for certain ongoing residential and commercial uses; and
2. The requirements at N.J.A.C. 7:13-11.17 and 11.18, which cover the placement of hazardous substances and solid waste in a regulated area, respectively, whether secured or unsecured.

(c) The Department shall not issue an individual permit for the storage of unsecured material in a floodway.

(d) The Department shall issue an individual permit for the storage of unsecured material in a regulated area outside a floodway only if the following requirements are satisfied:

1. No vegetation is cleared, cut or removed in a riparian zone;
2. The unsecured material is stored as part of a business or facility, the primary function of which is to store and distribute material, such as a bus or truck depot, car dealership or rental facility, gravel pit, junk yard, landscaping business, lumber yard or vehicle impoundment area;
3. The applicant demonstrates that the unsecured material cannot feasibly be stored outside the flood hazard area and riparian zone onsite;
4. The unsecured material to be stored is isolated from floodwaters by berms, or will be situated in a specially designed containment area onsite, so that, in the event of a flood, the stored material will not be transported off the site by floodwaters;

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5. The applicant discloses the maximum volume of unsecured material that will be stored in the flood fringe and includes this volume in calculating the maximum flood storage volume displacement on the site pursuant to N.J.A.C. 7:13-10.4; and
6. The Department determines that the storage of unsecured material in a flood hazard area and riparian zone will not pose a threat to the environment or to public health, safety or welfare.

7:13-11.17 Requirements for the placement, storage or processing of hazardous substances

(a) This section sets forth specific design and construction standards that apply to any proposed placement, storage or processing of hazardous substances in any regulated area.
(b) A hazardous waste facility established on or before October 2, 2006, may be eligible to place, store or process hazardous substances under the permit-by-rule at N.J.A.C. 7:13-7.2(e)5, provided the size or capacity of the facility is not increased. In addition, the placement of a fuel tank is permitted-by-rule under certain conditions pursuant to N.J.A.C. 7:13-7.2(b)15 and 16. All other placement, storage or processing of hazardous substances is subject to this section.
(c) The Department shall not issue an individual permit for the placement, storage or processing of hazardous substances in a floodway.
(d) The Department shall issue an individual permit for the placement, storage or processing of hazardous substances in a regulated area outside a floodway only if the following requirements are satisfied:

1. No vegetation is cleared, cut or removed in a riparian zone;
2. The placement, storage or processing of hazardous substances is part of an increase in the size or capacity of a lawfully existing hazardous waste facility established on or before October 2, 2006. The individual permit application shall include copies of all relevant State permits, licenses and authorizations in order to demonstrate that the facility is operating lawfully;
3. The applicant demonstrates that the hazardous substances cannot feasibly be placed, stored or processed outside the flood hazard area and riparian zone onsite;
4. The hazardous substances to be placed, stored or processed is isolated from floodwaters by berms, or will be situated in a specially designed containment area onsite, so that in the event of a flood, the hazardous substances will not be transported off the site by floodwaters;
5. The applicant discloses the maximum volume of hazardous substances to be placed, stored or processed in the flood fringe and includes this volume in calculating the maximum flood storage displacement volume on the site pursuant to N.J.A.C. 7:13-10.4; and
6. The Department determines that the placement, storage or processing of hazardous substances in the flood hazard area and riparian zone will not pose a threat to the environment or to public health, safety or welfare.

7:13-11.18 Requirements for the placement, storage or processing of solid waste

(a) This section sets forth specific standards that apply to any proposed placement, storage or processing of solid waste in any regulated area.
(b) A solid waste facility established on or before October 2, 2006, may be eligible to continue

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to place, store or process solid waste under the permit-by-rule at N.J.A.C. 7:13-7.2(e)6, provided the size or capacity of the facility is not increased. All other placement storage or processing of solid waste is subject to this section.
(c) The Department shall not issue an individual permit for the placement, storage or processing of solid waste in a floodway.
(d) The Department shall issue an individual permit for the placement, storage or processing of solid waste in a regulated area outside a floodway only if the following requirements are satisfied:

1. No vegetation is cleared, cut or removed in a riparian zone;
2. The placement, storage or processing of solid waste is part of an increase in the size or capacity of a lawfully existing solid waste facility established on or before October 2, 2006. The individual permit application shall include copies of all relevant State permits, licenses and authorizations in order to demonstrate that the facility is operating lawfully;
3. The applicant demonstrates that the solid waste cannot feasibly be placed, stored or processed outside the flood hazard area and riparian zone onsite;
4. The solid waste to be placed, stored or processed is isolated from floodwaters by berms, or will be situated in a specially designed containment area onsite, so that in the event of a flood, the solid waste will not be transported off the site by floodwaters;
5. The applicant discloses the maximum volume of solid waste to be placed, stored or processed in the flood fringe for the purpose of calculating the maximum flood storage displacement on the site pursuant to N.J.A.C. 7:13-10.4; and
6. The Department determines that the placement, storage or processing of solid waste in the flood hazard area and riparian zone will not pose a threat to the environment or to public health, safety or welfare.

7:13-11.19 Requirements for the removal of existing fill or an existing structure
(a) This section sets forth specific standards that apply to any proposed removal of existing fill or an existing structure in any regulated area.
(b) The removal of existing fill or an existing structure is subject to the requirements of this section only as follows:

1. The fill or structure to be removed lies in a floodway; or
2. The fill or structure to be removed lies in a regulated area outside a floodway, but does not qualify for the permit-by-rule at N.J.A.C. 7:13-7.2(b)2.

(c) The Department shall issue an individual permit for the removal of existing fill or an existing structure as described in (b) above only if the following requirements are satisfied:

1. All disturbed regulated areas are properly stabilized;
2. If the removed fill or structure lies in a floodway, the applicant demonstrates through a hydraulic analysis that the removal will not adversely impact a property not owned by the applicant, pursuant to N.J.A.C. 7:13-11.1(f) and (g), unless it is clear to the Department that the proposed removal poses no threat to offsite properties;
3. Any removed fill is disposed of in accordance with all applicable Federal, State and local laws;
4. Any removed structure is disposed of outside of any regulated area and in accordance with all applicable Federal, State and local laws; and

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5. No vegetation is cleared, cut or removed in a riparian zone, unless the following apply:

i. Vegetation in the riparian zone must be cleared, cut or removed in order to access the fill or structure;

ii. The area of disturbance within the riparian zone is minimized; and

iii. All vegetation cleared, cut or removed in the riparian zone is replanted with indigenous, non-invasive species, except where the removed material is to be replaced by a new structure. (Any replacement fill or structure is subject to the requirements of this chapter.)

SUBCHAPTER 12. EMERGENCY PERMITS

7:13-12.1 Requirements for issuing an emergency permit

(a) An emergency permit is an authorization to undertake a regulated activity that the Department will issue when conditions warrant immediate action to protect the environment and/or public health, safety and welfare.

(b) The Department shall approve an emergency permit only if the following requirements are satisfied:

1. Severe environmental degradation will occur if an emergency permit is not issued and/or there is an immediate and extraordinary risk to property or the public health, safety and welfare; and

2. There is a high probability that the environmental degradation or impact to property or the public health, safety and welfare will occur before a flood hazard area individual permit or general permit authorization could be obtained under the otherwise applicable requirements of this chapter.

(c) An applicant for an emergency permit shall provide the Department with the following by telephone, and in addition by fax, electronic mail or letter, if possible:

1. The nature of the emergency;

2. The cause of the emergency;

3. The date and time at which the applicant learned of the emergency;

4. The nature and extent of the proposed regulated activities;

5. The date by which the applicant expects to begin the proposed regulated activities;

6. The date by which the applicant expects to complete the proposed regulated activities;

7. The precise location of the proposed regulated activities, including lot, block, municipality and county;

8. The identity of the owner of the site where the regulated activities are proposed;

9. A demonstration that the property owner has given permission for the regulated activities to be performed or, in the case of a public entity intending to undertake regulated activities on private property through power of eminent domain, a written statement of the public entity's intent; and

10. If notice to the Department is also made by fax, electronic mail or letter, photographs of the area in question and a drawing of the proposed emergency activities, where feasible.

(d) If the Department determines that the requirements of (b) and (c) above are satisfied, the

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Director of the Division of Land Use Regulation, or the Director's designee, shall provide verbal approval of the necessary activities. This verbal approval shall be followed within five working days by a written confirmation of the emergency permit from the Department.
(e) No public notice or fee is required for an emergency permit. However, either an individual permit (which requires public notice and an application fee) or a general permit authorization (which requires an application fee, except for general permits 1 and 6) must be obtained after an emergency permit is issued under N.J.A.C. 7:13-12.2.

7:13-12.2 Procedures after an emergency permit is issued
(a) The permittee shall commence the approved emergency activities within 30 calendar days after the Department's verbal approval of the emergency permit, unless extended in accordance with (d) below. If the emergency activities are not commenced within 30 calendar days of the Department's verbal approval, the emergency permit is void.
(b) Once commenced, all regulated activities authorized under the emergency permit shall be completed, and the emergency permit shall expire, within 60 calendar days of the Department's verbal approval, unless extended in accordance with (d) below. If the regulated activities authorized under the emergency permit are not completed by this expiration date, these regulated
activities shall cease until an individual permit, general permit authorization or another emergency permit is obtained from the Department for the regulated activities.
(c) The permittee shall submit to the Department a complete application for an individual permit or a general permit authorization for the completed activities within 90 calendar days of the Department's verbal approval of the emergency permit, unless extended in accordance with (d) below. The application shall include the following:

1. A demonstration that the regulated activities comply with this chapter; and
2. "As-built" drawings, signed and sealed by a engineer, land surveyor or architect, as appropriate, showing the regulated activities that were conducted under the emergency permit.

(d) The Department shall extend the 30-day, 60-day and/or 90-day periods established in (a), (b) and (c) above if the applicant demonstrates that the specified requirements cannot feasibly be satisfied within these allotted time frames.
(e) Any activity performed under an emergency permit shall meet all requirements that apply to that activity under this chapter to the fullest extent possible. Upon review of the permit application and associated as-built drawings required in (c) above, the Department shall require modification, restoration and/or stabilization measures as necessary to ensure compliance with this chapter.

SUBCHAPTER 13. REVISION OF AN APPROVAL

7:13-13.1 Revision of a verification
(a) This section applies to the revision of a flood hazard area design flood elevation, flood hazard area limit, floodway limit, riparian zone limit and/or other related feature on an approved drawing after a verification has been issued. A verification must be valid in order to be revised. A revision shall not extend the term of a verification.
(b) The Department shall, in response to an applicant's request, revise an entire verification or any portion of a verification, provided the requirements of this section are satisfied.

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(c) There are two types of verification revisions, as follows:

1. A minor revision of a verification is a change in the flood hazard area design flood elevation, flood hazard area limit, floodway limit, riparian zone limit and/or other related feature, which does not require the Department to review detailed engineering calculations in order to determine that the revision is accurate. Any type of verification under N.J.A.C. 7:13-6 can be the subject of a minor revision. Examples of a minor revision include the following, provided no review of calculations is required:

i. Correcting a drafting error;

ii. Improving topographical data;

iii. Revising a previously approved riparian zone limit or metes and bounds description of the flood hazard area limit and/or floodway limit to more closely match their actual location;

iv. Deletion or addition of structures that were previously unmapped or mapped in error (unless said structure would alter the original hydraulic modeling); and

v. Adding notes, labels or other clarifying information required by the Department or another governing body; and

2. A major revision of a verification is a change in the flood hazard area design flood elevation, flood hazard area limit, floodway limit and/or other related feature, which requires the Department to review detailed engineering calculations in order to determine that the revision is accurate. Only a verification based on Method 4 (pursuant to N.J.A.C. 7:13-3.4) or Method 6 (pursuant to N.J.A.C. 7:13-3.6) can be the subject of a major revision. Examples of a major revision include:

i. Correcting the floodway limit;

ii. Improving the hydrologic modeling upon which the verification is based, resulting in a new peak flow rate; and

iii. Improving the hydraulic modeling upon which the verification is based, such as adding cross-sections, revising, improving or correcting topography, or altering data for a water control structure, resulting in a new water surface profile.

(d) The Department shall not revise a verification if the Department determines that the proposed revision constitutes a substantial change in the approved flood hazard area design flood elevation, flood hazard area limit and/or floodway limit. In such a case, the applicant shall submit an application for a new verification and the Department shall review the proposed redelineation as if it were a new project. Examples of a substantial change include:

1. The redelineation of all or most of the verified flood hazard area and/or floodway limit based on new hydrologic and hydraulic calculations; and

2. The addition of any previously unverified sections of a regulated water as described in (e) below.

(e) The Department shall revise a verification only for the section of water approved under the verification that the applicant seeks to revise. The Department shall not issue a revision that adds
a new section of water to the verification.

(f) An application for a minor revision of a verification shall include the following:

1. The application fee required under N.J.A.C. 7:13-17;

2. One LURP application form completed as described at N.J.A.C. 7:13-15.1(f);

3. One copy of the verification that is the subject of the revision application;

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4. One set of the originally approved drawings (if available);
5. A detailed written description of the proposed revisions to the flood hazard area design flood elevation, flood hazard area limit, floodway limit, riparian zone limit and/or other related feature; and
6. Six sets of revised drawings, signed and sealed by a engineer, land surveyor or architect, as appropriate, prepared in accordance with the application requirements for a verification at N.J.A.C. 7:13-6.1(c). For each revised flood hazard area design flood elevation, flood hazard area limit, floodway limit, riparian zone limit and/or other related feature, the applicant shall submit both the originally approved drawings showing the approved elevation, limits and/or features and new drawings showing the revised elevation, limits and/or features.

(g) An application for a major revision of a verification shall include the following:
1. All material listed in (f) above;
2. All supporting hydrologic and hydraulic calculations, which are necessary to demonstrate that the proposed revision meets the requirements of this chapter;
3. A narrative that explains the submitted calculations and describes why each particular calculation or methodology was used; and
4. All maps, references and other supporting materials that were used to prepare the submitted calculations.

(h) After reviewing an application for a revision of a verification, the Department shall:
1. Notify the applicant that the application did not include all the material required at (f) or (g) above, or that supplemental information is needed to determine if the application complies with this chapter, and request the missing information. The Department may cancel the application if the requested information is not provided within 60 calendar days. When the requested material is received, the Department shall take one of the actions in (h)2 or 3 below;
2. Notify the applicant in writing that the application does not meet the requirements of this section, deny the application, and provide the technical reasons for this decision; or
3. Determine that the application meets the requirements of this section and approve the revision in writing.

(i) Workload permitting, the Department shall make a final decision on an application for a revision of a verification within 60 calendar days of receiving a complete application.

(j) Within 90 calendar days after the Department revises a verification on a privately owned lot, or on a publicly owned lot other than a right-of-way, the applicant shall submit the following information to the clerk of each county in which the site is located, and shall send proof to the Department that this information is recorded on the deed of each lot referenced in the verification. Failure to have this information recorded in the deed of each lot and/or to submit proof of recording to the Department constitutes a violation of this chapter and may result in suspension or termination of the verification and/or subject the applicant to enforcement action under N.J.A.C. 7:13-19:
1. The Department file number for the verification;
2. The approval and expiration dates of the verification;
3. A metes and bounds description of each flood hazard area limit and/or floodway limit approved under the verification;
4. The flood hazard area design flood elevation, or range of elevations if variable, approved under the verification; and

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5. The following statement: "The State of New Jersey has determined that all or a portion of this lot lies in a flood hazard area. Certain activities in flood hazard areas are regulated by the New Jersey Department of Environmental Protection and some activities may be prohibited on this site or may first require a permit. Contact the Division of Land Use Regulation at (609) 292-0060 for more information prior to any construction onsite."

7:13-13.2 Revision of a general permit

(a) This section applies to proposed changes to a regulated activity after the Department issues a general permit. A general permit must be valid in order to be revised. A revision shall not extend the term of a general permit.

(b) The Department shall only issue a minor revision to a general permit. A minor revision is a change in a project element that does not require the Department to review detailed engineering calculations in order to determine whether the revised project element complies with this chapter, whereas a major revision involves the review of calculations, which does not apply to general permits under this chapter. Examples of a minor revision include the following, provided no review of calculations is required:

1. Correcting a drafting error;
2. Improving topographical data;
3. Adding notes, labels or other clarifying information required by the Department or another governing body;
4. Adjusting the size, shape or location of a proposed structure or activity; and/or
5. Reducing the level of proposed development on site, such as deleting a proposed structure or activity, or reducing its footprint.

(c) The Department shall not issue a revision of a general permit if the Department determines that the proposed revision constitutes a substantial redesign of the project or will increase the environmental impact of the project. In such a case, the applicant shall submit an application for a new general permit and the Department shall review the proposed redesign as if it were a new project. Examples of a substantial redesign include:

1. Any change to the basic purpose or scope of a project;
2. Any increase in the amount of disturbance within the riparian zone; and
3. The addition of any previously unapproved project element.

(d) An application for a revision of a general permit shall include the following:

1. The application fee required under N.J.A.C. 7:13-17;
2. One LURP application form completed as described at N.J.A.C. 7:13-15.1(f);
3. One copy of the general permit that is the subject of the revision application;
4. One set of the originally approved drawings (if available);
5. One completed certification (available from the Department's website at www.nj.gov/dep/landuse), signed and sealed by an engineer, which lists each requirement of N.J.A.C. 7:13-8.1(b), as well as each requirement for the particular general permit being modified. The certification shall explain, as necessary, how each requirement for the particular general permit is met, as well as any changes that are being proposed to the project which necessitates the request to revise the general permit; and
6. Six sets of drawings, signed and sealed by an engineer, land surveyor or architect, as appropriate, which detail the proposed activities and show the project elements to be

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revised, including existing and proposed topography if fill or grading is proposed. All topography shall reference NGVD, or include the appropriate conversion factor to NGVD, unless the applicant demonstrates that such reference is not necessary. The limit of any riparian zone onsite shall also be shown, as well as any areas where riparian zone vegetation will be cleared, cut or removed.

(e) After reviewing an application for a revision of a general permit, the Department shall:

1. Notify the applicant that the application did not include all the material required at (d) above, or that supplemental information is needed to determine if the application complies with this chapter, and request the missing information. The Department may cancel the application if the requested information is not provided within 60 calendar days. When the requested material is received, the Department shall take one of the actions in (e)2 or 3 below;

2. Notify the applicant in writing that the application does not meet the requirements of this section, deny the application, and provide the technical reasons for this decision; or

3. Determine that the application meets the requirements of this section and approve the revision in writing.

(f) Workload permitting, the Department shall make a final decision on an application for a revision of a general permit authorization within 30 calendar days of receiving a complete application.

7:13-13.3 Revision of an individual permit

(a) This section applies to proposed changes to a regulated activity after the Department issues an individual permit. An individual permit must be valid in order to be revised. A revision shall not extend the term of an individual permit.

(b) The Department shall, in response to an applicant's request, revise an entire individual permit or any project element approved under an individual permit, provided the requirements of this section are satisfied.

(c) There are two types of individual permit revisions, as follows:

1. A minor revision of an individual permit is a change in a project element that does not require the Department to review detailed engineering calculations in order to determine whether the revised project element complies with this chapter. Examples of a minor revision include the following, provided no review of calculations is required:

i. Correcting a drafting error;

ii. Improving topographical data;

iii. Adding notes, labels or other clarifying information required by the Department or another governing body;

iv. Adjusting the size, shape or location of a proposed structure or activity; and

v. Reducing the level of proposed development on site, such as deleting a proposed structure or activity, or reducing its footprint.

2. A major revision of an individual permit is a change in a project element that requires the Department to review detailed engineering calculations in order to determine whether the revised project element complies with this chapter. A project element that does not require calculations in order to receive an individual permit, such as a footbridge or utility line, instead qualifies for a minor revision under (c)1 above. Examples of a major revision include the following:

i. Adjusting the proposed flood storage displacement volume on site, thereby

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requiring re-review of cut and fill calculations;
ii. Adjusting the size, shape or location of a proposed water control structure, thereby requiring a re-review of hydraulic calculations; and
iii. Adjusting a characteristic of a proposed stormwater management system, thereby requiring a re-review of hydrologic and/or hydraulic calculations.

(d) The Department shall not issue a revision of an individual permit if the Department determines that the proposed revision constitutes a substantial redesign of the project or will increase the environmental impact of the project. In such a case, the applicant shall submit an application for a new individual permit and the Department shall review the proposed redesign as if it were a new project. Examples of a substantial redesign include:

1. Any change to the basic purpose or scope of a project, such as a change from the construction of a hospital to the construction of an apartment complex;
2. Any expansion of activity beyond that which was described in the public notice made for the individual permit application;
3. Any substantial redesign of the project or its stormwater management system, which would require a new hydrologic analysis of the site;
4. Any increase in the amount of disturbance within the riparian zone; and
5. The addition of any previously unapproved project element.

(e) An application for a minor revision of an individual permit shall include the following:

1. The application fee required under N.J.A.C. 7:13-17;
2. One LURP application form completed as described at N.J.A.C. 7:13-15.1(f);
3. One copy of the individual permit that is the subject of the revision application;
4. One set of the originally approved drawings (if available);
5. A detailed written description of the proposed revisions; and
6. Six sets of drawings, signed and sealed by an engineer, land surveyor or architect, as appropriate, which detail the proposed activities and show the project elements to be revised, including existing and proposed topography if fill or grading is proposed. All topography shall reference NGVD, or include the appropriate conversion factor to NGVD, unless the applicant demonstrates that such reference is not necessary. The limit of any riparian zone onsite shall also be shown, as well as any areas where riparian zone vegetation will be cleared, cut or removed.

(f) An application for a major revision of an individual permit shall include the following:

1. All material listed in (e) above;
2. All supporting hydrologic, hydraulic, flood storage volume, stormwater and structural calculations, which are necessary to demonstrate that the proposed project meets the requirements of this chapter;
3. A narrative that explains the submitted calculations and describes why each particular calculation or methodology was used; and
4. All maps, references and other supporting materials that were used to prepare the submitted calculations.

(g) After reviewing an application for a revision of an individual permit, the Department shall:

1. Notify the applicant that the application did not include all the material required at (e) or (f) above, or that supplemental information is needed to determine if the application complies with this chapter, and request the missing information. The Department may cancel the application if the requested information is not provided

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within 60 calendar days. When the requested material is received, the Department shall take one of the actions in (g)2 or 3 below;

2. Notify the applicant in writing that the application does not meet the requirements of this section, deny the application, and provide the technical reasons for this decision; or

3. Determine that the application meets the requirements of this section and approve the revision in writing.

(h) Workload permitting, the Department shall make a final decision on an application for a revision of an individual permit within 60 calendar days of receiving a complete application.

7:13-13.4 Revision of a Department delineation by application

(a) This section applies to the revision of a flood hazard area design flood elevation, flood hazard area limit, floodway limit and/or other related feature on a flood hazard area delineation that has been promulgated by the Department. Appendix 2 of this chapter lists the Department delineated waters of New Jersey.

(b) There are two types of delineation revisions, as follows:

1. A minor revision of a delineation is a change in the flood hazard area design flood elevation, flood hazard area limit, floodway limit and/or other related feature, which does not require the Department to review detailed engineering calculations in order to determine that the revision is accurate. Examples of a minor revision include the following, provided no review of calculations is required:

i. Correcting a drafting error;

ii. Improving topographical data;

iii. Deletion or addition of structures that were previously unmapped or mapped in error (unless said structure would alter the original hydraulic modeling); and

iv. Adding notes, labels or other clarifying information required by the Department or another governing body; and

2. A major revision of a delineation is a change in the flood hazard area design flood elevation, flood hazard area limit, floodway limit and/or other related feature, which requires the Department to review detailed engineering calculations in order to determine that the revision is accurate. Examples of a major revision include:

i. Correcting the floodway limit;

ii. Improving the hydrologic modeling upon which the delineation is based, resulting in a new peak flow rate; and

iii. Improving the hydraulic modeling upon which the delineation is based, such as adding cross-sections, revising, improving or correcting topography, or altering data for a water control structure, resulting in a new water surface profile.

(c) The Department shall issue a revision of a delineation only for a section of water already promulgated by the Department. The Department shall not add or remove a section of delineated water from Appendix 2 under this section.

(d) An application for a minor revision of a Department delineation shall include the following:

1. The application fee required under N.J.A.C. 7:13-17;

2. One LURP application form completed as described at N.J.A.C. 7:13-15.1(f);

3. One copy of the Department delineation that is the subject of the revision application;

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4. A detailed written description of the proposed revisions to the flood hazard area design flood elevation, flood hazard area limit, floodway limit and/or other related feature; and

5. Three copies of revised drawings, signed and sealed by a engineer or land surveyor, as appropriate, depicting the existing and the revised flood hazard area design flood elevations, flood hazard area limits, floodway limits and/or other related features. These drawings shall be of the same scale as the Department delineation that is the subject of the revision, unless otherwise requested by the Department.

(e) After reviewing an application for a minor delineation revision, the Department shall:

1. Notify the applicant that the application did not include all the material required at (d) above, or that supplemental information is needed to determine if the application complies with this chapter, and request the missing information. The Department may cancel the application if the requested information is not provided within 60 calendar days. When the requested material is received, the Department shall take one of the actions in (e)2 or 3 below;

2. Notify the applicant in writing that the application does not meet the requirements of this chapter, deny the application, and provide the technical reasons for this decision; or

3. Determine that the revision is accurate and necessary, in which case the Department shall revise the delineation as necessary and provide the applicant and the affected municipalities with a copy of the revised flood hazard area and/or floodway maps.

(f) Workload permitting, the Department shall make a final decision on an application for a minor delineation revision within 60 calendar days of receiving a complete application.

(g) An application for a major revision of a Department delineation shall include the following:

1. All material listed in (d) above;

2. All supporting hydrologic and hydraulic calculations, which are necessary to demonstrate that the proposed revision meets the requirements of this chapter. The Flood Hazard Area Technical Manual, available from the Department at the address listed at N.J.A.C. 7:13-1.1(g), provides guidance in how to perform the calculations required for various delineation revisions;

3. A narrative that explains the submitted calculations and describes why each particular calculation or methodology was used; and

4. All maps, references and other supporting materials that were used to prepare the submitted calculations.

(h) After reviewing an application for a major delineation revision, the Department shall:

1. Notify the applicant that the application did not include all the material required at (g) above, or that supplemental information is needed to determine if the application complies with this chapter, and request the missing information. The Department may cancel the application if the requested information is not provided within 60 calendar days. When the requested material is received, the Department shall take one of the actions in (h)2 or 3 below;

2. Notify the applicant that the application does not meet the requirements of this section, deny the application, and provide the technical reasons for this decision; or

3. Determine that the revision is accurate and necessary and proceed with the revision according to (i) below.

(i) If the Department determines that a major delineation revision is accurate and necessary, the Department shall proceed with the revision as follows:

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1. The Department shall publish notice of its intent to revise the delineation in the New Jersey Register, as well as in the official newspaper of each affected municipality (or in a newspaper of general circulation in each affected municipality if there is no official newspaper) and in one newspaper of regional circulation (relative to the location of the project). This notice shall include:
   i. The location of the delineation to be revised;
   ii. The reason the Department intends to revise the delineation;
   iii. An invitation for interested parties to submit written comments and to attend a public hearing to be held in one or more of the affected municipalities; and
   iv. The mailing address and telephone number of a contact person within the Department who is able to discuss the proposed revision.
2. During the public hearing, the Department shall:
   i. Explain the proposed revision, including any impacts the Department expects from revising the delineation; and
   ii. Collect public comments.
3. Upon consideration of the available information and public comments, if the Department concludes that revising the delineation is in the best interest of public health, safety and welfare, the Department shall:
   i. Revise the delineation as the Department deems necessary;
   ii. Publish a description of the revision in the New Jersey Register, including a response to any public comments;
   iii. Publish a public notice describing the revision in the official newspaper of each affected municipality (or in a newspaper of general circulation in each affected municipality if there is no official newspaper) as well as in one newspaper of regional circulation (relative to the location of the project); and
   iv. Provide the applicant and affected municipalities with a copy of the revised flood hazard area and/or floodway map (except in cases where the Department initiates the revision pursuant to N.J.A.C. 7:13-13.5).

(j) Workload permitting, the Department shall make a final decision on an application for a major delineation revision within 180 calendar days of receiving a complete application.

7:13-13.5 Revision or suspension of a Department delineation by the Department

(a) If the Department determines, independent of an application pursuant to N.J.A.C. 7:13-13.4,
that an existing Department delineation as listed in Appendix 2 underestimates the extent of the floodway and/or flood hazard area, and that it is in the best interest of public health, safety and welfare to revise a delineation, the Department shall do one of the following:

1. If the Department has sufficient topographic, hydrologic and hydraulic data to adequately revise the delineation, the Department shall initiate a revision as follows:
   i. For a minor delineation revision as described at N.J.A.C. 7:13-13.4(b)1, the Department shall revise the delineation as necessary; or
   ii. For a major delineation revision as described at N.J.A.C. 7:13-13.4(b)2, the Department shall follow the procedure described at N.J.A.C. 7:13-13.4(i); or
2. If the Department does not have sufficient topographic, hydrologic and hydraulic data to adequately revise the delineation, or if the Department determines that a serious threat to public health, safety and welfare will exist if an existing delineation is allowed

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to remain in place, the Department shall initiate an emergency suspension of the delineation for a one-year period pursuant to (b) below. The purpose of this suspension is to allow the Department adequate time to acquire data necessary to accurately revise the delineation.

(b) To initiate an emergency one-year suspension of a delineation as described in (a)2 above, the Department shall:

1. Publish notice of its intent to suspend the delineation in the New Jersey Register, as well as in the official newspaper of each affected municipality (or in a newspaper of general circulation in each affected municipality if there is no official newspaper) and in one newspaper of regional circulation (relative to the location of the project). This notice shall include:

i. The location of the delineation to be suspended;

ii. The reason the Department is suspending the delineation;

iii. An invitation for interested parties to submit written comments regarding the suspension and subsequent need for amendment of the suspended delineation; and

iv. The mailing address and telephone number of a contact person within the Department who is able to discuss the suspension.

2. The Department shall consider the portion of the delineation described in the notice to be suspended for a one-year period beginning with the publication date of the notice in the New Jersey Register.

3. The Department shall, within one year of the suspension date:

i. Revise the delineation in accordance with (a)1 above;

ii. Reinstate the delineation without revision, and explain why the delineation was found to be acceptable after suspension; or

iii. Take no action, in which case the delineation shall be automatically reinstated.

(c) During the suspended period described in (b)2 above, any application made under this chapter shall not reference the flood hazard area and/or floodway of the suspended delineation. Applicants must instead rely on another delineation method to determine the extent of the flood hazard area and/or floodway as provided at N.J.A.C. 7:13-3. Furthermore, the Department shall review all valid verifications, general permits and individual permits issued for the flood hazard area of the suspended delineation and will suspend or terminate such approvals where necessary to protect public safety, in accordance with N.J.A.C. 7:13-14.

(d) The Department shall issue a revision of a delineation only for a section of water already promulgated by the Department. The Department shall add or remove a section of delineated water from Appendix 2 only through an amendment to this chapter.

(e) If the Department approves an individual permit under this chapter for an activity which alters the flood hazard area design flood elevation, flood hazard area limit and/or floodway limit along a Department delineated water, such as the construction of a flood control project, or the construction, modification or removal of a bridge or culvert, the Department shall automatically revise the delineation as necessary after the construction is completed. No public notice or hearing is necessary to revise a Department delineation in such a case.

SUBCHAPTER 14. TRANSFER, SUSPENSION AND TERMINATION OF AN APPROVAL

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7:13-14.1 Transfer of an approval

(a) An approval authorized under this chapter (see N.J.A.C. 7:13-1.3) can be transferred to another person, provided:

1. The approval is valid;
2. The approval is not an emergency permit or an individual permit based on a hardship exception;
3. The approval is transferred to a person who currently owns the site or who is under contract to purchase the site that is the subject of the approval. A transfer to a contract purchaser shall become valid only upon the actual transfer of the site to the new owner; and 4. The Department determines that the transfer will not alter a basic condition upon which the original approval was granted or otherwise circumvent a requirement of this chapter as described in (b) below.

(b) The Department shall not transfer an approval if doing so would alter a basic condition or premise upon which the original approval was granted or would otherwise circumvent a requirement of this chapter. For example, an existing lot may be shaped in such a way that the owner must construct a road across a channel in order to access the rear portion of the lot in order to construct a house. In some cases, the Department would, during the review of an individual permit application, consider whether there is another means of accessing the site that would reduce the amount of disturbance to the channel, or which would avoid crossing the channel altogether, such as crossing through a neighboring property. If the owner of a lot demonstrates that there is no feasible means of accessing the rear portion of the lot without crossing the channel, the Department would authorize a road crossing provided all other requirements of this chapter are met. However, if the owner of the lot first obtains an individual permit for such a road crossing, and then sells the lot to an adjacent land owner who already has a roadway across the channel, the basic premise upon which the individual permit was granted no longer exists. Therefore, the Department would not approve the transfer of the approval to the new owner in such a case.

(c) If the Department approves a regulated activity under a general permit authorization or an individual permit that is not based on a hardship exception, and the subject property is subsequently sold to a new owner, the new owner must obtain a transfer of said approval before commencing or continuing any work authorized under the approval. Should the new owner engage in a regulated activity without the prior transfer of the approval, the approval shall be void and the new owner shall be in violation of this chapter and subject to enforcement action pursuant to N.J.A.C. 7:13-19.

(d) An applicant seeking to transfer an approval to a new owner (or contract purchaser) shall submit the following to the Department:

1. The application fee for a transfer as described at N.J.A.C. 7:13-17; and
2. A written request to transfer the approval, which includes the following:
    - i. The notarized signature of each original owner of the site, or any legal designee thereof;
    - ii. The name and address of each new owner (or contract purchaser) of the site;
    - iii. A list of any adjacent property already owned by the new owner(s); and
    - iv. The date the property will be or has been transferred to the new owner(s).

(e) Workload permitting, the Department shall make a final decision on an application to transfer an approval within 30 calendar days of receiving a complete application.

(f) A person receiving a transferred approval shall comply with all conditions of the transferred

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approval.

7:13-14.2 Suspension of an approval

(a) The following are causes for the Department to suspend an approval authorized under this chapter:

1. The permittee has not complied with a condition of the approval;
2. The permittee has undertaken activities onsite that are in violation of this chapter;
3. The permittee has misrepresented or failed to fully disclose all relevant facts pertaining to the approval;
4. The approval was based on false or inaccurate information; or
5. The approval has caused significant flooding or unanticipated adverse environmental impacts which have become apparent during the performance of the regulated activities. Examples of unanticipated adverse environmental impacts include excessive erosion, destabilization or undue migration of the channel, and destruction of biota, habitat or vegetation not authorized by the permit.

(b) If the Department determines that cause exists to suspend an approval for a reason listed at (a) above, the Department shall provide written notice of suspension by certified mail to the permittee. This notice shall:

1. State the reasons the Department is suspending the approval;
2. Order the permittee to immediately cease all regulated activities onsite; and
3. Notify the permittee of the right to make a request, within 10 calendar days of receipt of the notice, for a meeting with the Department.

(c) Within 30 calendar days after receipt of a notice of suspension under (b) above, the permittee shall submit a plan to the Department proposing to remedy the reasons for the suspension as stated in the notice. Such a plan shall be implemented immediately upon approval by the Department and shall propose to remedy all noncompliance and unanticipated impacts within 60 calendar days of approval.

(d) Within 15 calendar days after the Department receives a complete remediation plan under (c) above, the Department shall:

1. Approve the remediation plan with conditions where necessary, and reinstate the approval with revisions where necessary to achieve compliance with this chapter; or
2. Determine that the remediation plan is inadequate to achieve compliance and notify the applicant of intent to terminate the approval pursuant to N.J.A.C. 7:13-14.3(b).

(e) Nothing in this section shall prevent the Department from taking enforcement action pursuant to N.J.A.C. 7:13-19.

7:13-14.3 Termination of an approval

(a) The following are causes for the Department to terminate an approval which has been suspended under N.J.A.C. 7:13-14.2:

1. The permittee has not ceased all regulated activities pursuant to N.J.A.C. 7:13-14.2(b)2;
2. The permittee has not submitted a remediation plan pursuant to N.J.A.C. 7:13-14.2(c);
3. The Department has determined that the remediation plan submitted pursuant to N.J.A.C. 7:13-14.2(c) is inadequate to achieve compliance; or
4. The permittee fails to remedy non-compliance with a condition of the approval.

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(b) If the Department determines that cause exists to terminate an approval for a reason listed at (a) above, the Department shall provide written notice of intent to terminate the approval by certified mail to the permittee. The permittee shall cease all regulated activities immediately upon receiving the notice. Within 10 calendar days after receiving the notice, the permittee shall:

1. Submit a plan to the Department proposing to remedy the causes for the termination as stated in the notice; or
2. Request an adjudicatory hearing under N.J.A.C. 7:13-18.

(c) If the permittee has not taken one of the actions required at (b) above within 10 calendar days after receiving the Department's notice, the approval shall automatically terminate and the permittee shall remedy any violations of this chapter and/or unanticipated adverse impacts to flooding or the environment caused by the project, and shall restore the site to its pre-activity condition where feasible. Once the impacts or violations are remedied, the Department may reinstate the permit or require the applicant to apply for a new permit.
(d) Nothing in this section shall prevent the Department from taking enforcement action pursuant to N.J.A.C. 7:13-19.

SUBCHAPTER 15. APPLICATION REQUIREMENTS

7:13-15.1 General provisions

(a) For each approval being sought under this chapter, the applicant shall provide all information necessary for the Department to determine if the requirements of this chapter are satisfied. The application requirements for each type of approval are detailed in the sections pertaining to each approval under this chapter. However, the Department also provides application checklists, which include guidance and detail in order to assist applicants through the review and approval process. For example, the application checklist may recommend that the document to be folded or prepared in a certain manner to facilitate processing. To minimize application processing time, an applicant should carefully review the application checklist and verify that the application includes all required information. Checklists are provided at www.nj.gov/dep/landuse or can be obtained from the Department at the address listed in N.J.A.C. 7:13-1.1(f).
(b) If a proposed project requires more than one approval from the Division of Land Use Regulation, the Department encourages, but does not require, the applicant to submit one consolidated application for all the approvals. For example, an applicant wishing to construct a private residence can use one application to simultaneously apply for both an individual permit under this chapter and a freshwater wetlands permit under N.J.A.C. 7:7A. If an application requests more than one approval, the combined application shall comply with the application requirements of each permit program. A reduction in fees is also applied to joint applications as described at N.J.A.C. 7:13-17.1(e).
(c) An applicant is encouraged to keep copies of the data used to complete an application, the information submitted to the Department during the application review process, and all permits, approvals and Department-approved drawings for at least 10 years after the Department issues a decision.
(d) All calculations submitted under this chapter shall be performed at the applicant's expense and shall be signed and sealed by an engineer. The Flood Hazard Area Technical Manual, available from the Department at the address listed at N.J.A.C. 7:13-1.1(g), provides examples

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and guidance for performing the calculations that are included in this chapter. For example, while the calculations required for determining the volume of flood storage that a project displaces are found at N.J.A.C. 7:13-10.4, the Flood Hazard Area Technical Manual provides samples of the different formats in which these calculations are often performed, as well as recommendations and guidance designed to facilitate their execution.

(e) All drawings submitted under this chapter shall be signed and sealed by an engineering, surveyor or architect as appropriate, unless the following apply, in which case the applicant can prepare his or her own drawings:

1. The applicant solely proposes one or more of the following activities on his or her own property:

i. The construction of a private residence, which is not being constructed as part of a larger residential subdivision; and/or

ii. The construction of a building appurtenant to a private residence, such as a garage, barn or shed; and

2. No topography or calculations are necessary to demonstrate compliance with the requirements of this chapter.

(f) All LURP application forms submitted under this chapter shall be completed as directed by the form for the type of application being requested. The LURP form requires basic information regarding the applicant and the proposed activities, such as the name and address of the applicant and any designated agents, the specific location of the project, the types of applications being requested and a brief description of the activities being proposed. Where signatures are required on the form, original signatures shall be provided. The form also requires State plane coordinates for the approximate center of the site, except as provided at (f)1 and 2 below. The accuracy of the State plane coordinates shall be within 50 feet of the actual center point of the site. For assistance in determining the State plane coordinates for a site contact the Department's Geographic Information (GIS) Office at (609) 777-0672.

1. State plane coordinates are not required if a project consists solely of the following activities:

i. The construction of a private residence, which is not being constructed as part of a larger residential subdivision; and/or

ii. The construction of a building appurtenant to a private residence, such as a garage, barn or shed.

2. State plane coordinates shall be provided for linear projects such as railroads, roadways and utility lines as follows:

i. For a linear project of one-half mile or more in length, the State plane coordinates shall include the coordinates for the end points of the project and the coordinates for points located at 1,000 foot intervals along the entire length of the project; and

ii. For a linear project of less than one-half mile in length, the State plane coordinates shall include the coordinates for the end points of the project.

7:13-15.2 Pre-application conference

(a) A pre-application conference is a meeting between the Department and a prospective applicant to discuss the applicant's project. An applicant may request a pre-application conference for any project. A pre-application conference is highly recommended for large and/or complicated projects as it enables the Department to inform an applicant of the

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application procedures and standards that will apply to the project. There is no fee for a pre-application conference.
(b) A pre-application conference can be requested by telephone, electronic mail or by writing to the address listed at N.J.A.C. 7:13-1.1(f). Such a request shall be directed to the engineering supervisor or review engineer responsible for the county wherein the project is located and shall include a description of the project.
(c) Prior to scheduling a pre-application conference, the Department shall require the applicant to submit a set of drawings depicting the proposed development and an application report, as described at N.J.A.C. 7:13-15.3, if the Department determines that such information is necessary to properly advise the applicant regarding the proposed project and application procedures. The information contained in an application report enables the Department to be better prepared for a pre-application conference, which often saves the applicant and the Department both time and effort.
(d) At a pre-application conference, Department staff will discuss various requirements of this chapter as they relate to a project and may offer guidance to assist the applicant. However, no discussion or guidance offered at a pre-application conference shall compel the Department to approve or deny an application.
(e) If a project requires approvals from multiple Department programs, the applicant is advised to contact the Office of Pollution Prevention and Right to Know at (609) 292-3600 before filing an application under this chapter. The Office of Pollution Prevention and Permit Coordination can help the applicant coordinate the various applications.
(f) If an applicant has reason to believe that construction is proposed in freshwater wetlands or transition areas, the Department encourages the applicant to obtain a freshwater wetlands letter of interpretation under the Freshwater Wetlands Protection Act rules at N.J.A.C. 7:7A-8 prior to the pre-application conference.
(g) Workload permitting, the Department shall hold a pre-application conference within three weeks of receiving a request that complies with this section. The Department is not obligated to hold a pre-application conference with a prospective applicant if the Department determines that the questions raised can be adequately addressed by telephone.

7:13-15.3 Application report
(a) An application report required under this chapter shall include the following (photocopies of maps and documents are acceptable, except for the LURP application form, which must include original signatures):

1. A complete written description of the project and all proposed activities;
2. One original LURP application form, completed as described at N.J.A.C. 7:13-15.1(f);
3. One copy of a USGS quad map with the site clearly outlined to scale;
4. One copy of a municipal tax map with the site clearly outlined to scale;
5. One copy of a Department flood hazard area map or FEMA flood insurance rate map with the site clearly outlined to scale, if such mapping exists;
6. One copy of each previous approval received from the Department concerning the site, if such approvals exist; and
7. One set of color photographs depicting the entire project area, mounted on 8 1/2-inch by 11-inch paper and accompanied by a map showing the location and direction from which each photograph was taken. Copies of photographs are acceptable provided they

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are color copies. Black and white copies of photographs are not acceptable.

7:13-15.4 Engineering report

(a) An engineering report required under this chapter shall include the following, as applicable:

1. The signature and seal of an engineer;
2. The name, mailing address and telephone number of the engineer, as well as any other person designated by the engineer to answer questions about the report;
3. All supporting hydrologic, hydraulic, flood storage volume, stormwater and structural calculations, which are necessary to demonstrate that the proposed application meets the requirements of this chapter;
4. A narrative that explains the submitted calculations and describes why each particular calculation or methodology was used;
5. All maps, references and other supporting materials that were used to prepare the submitted calculations;
6. In the case of a verification application, all flood maps, drainage area maps and other material used to determine the flood hazard area and/or floodway limits;
7. In the case of an individual permit application, the total area of impervious surface proposed and the total land area that will be disturbed; and
8. In the case of an individual permit application for which stormwater management is required pursuant to N.J.A.C. 7:13-11.2, the following information where applicable:
    i. An explanation of how nonstructural stormwater management strategies have been maximized on site, as required at N.J.A.C. 7:8-5.3;
    ii. A demonstration of how the project meets the groundwater recharge standards at N.J.A.C. 7:8-5.4(a)2;
    iii. A table which compares existing and proposed stormwater discharges for the two-year, 10-year and 100-year storm in order to demonstrate compliance with the runoff quantity standards at N.J.A.C. 7:8-5.4(a)3; and
    iv. An explanation of how the project meets the water quality standards at N.J.A.C. 7:8-5.5.

7:13-15.5 Environmental report

(a) An environmental report required under this chapter shall include the following, as applicable:

1. A narrative that describes the proposed design and the construction techniques that will be used;
2. Maps (such as freshwater wetlands maps and USDA soil surveys) which provide an environmental inventory of the site; and
3. An analysis of any potential adverse impacts to the following resources and a detailed description of how potential adverse impacts shall be minimized. This analysis shall include all temporary and permanent adverse impacts of each proposed activity, whether onsite or offsite, as follows:
    i. Channels: compliance with the requirements of N.J.A.C. 7:13-10.1, as well as any anticipated effects on the size, shape and characteristics of existing channels, including low-flow aquatic passage, shall be addressed;
    ii. Riparian zones: compliance with the requirements of N.J.A.C. 7:13-10.2 shall be addressed;

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iii. Fishery resources: compliance with the requirements of N.J.A.C. 7:13-10.5 shall be addressed.
iv. Threatened or endangered species: if a survey for threatened or endangered species is required under N.J.A.C. 7:13-10.6(e), it shall meet the requirements of (c) below; and
v. Regulated waters: the effects on water quality due to stormwater runoff, exposure of acid producing soils, and potential for erosion and turbidity shall be addressed.

(b) If it is determined that a proposed project is likely to cause an adverse impact to any resource listed in (a)3 above, the environmental report shall include the following material, in addition to the information required at (a) above:

1. A justification for the project, including an explanation of why the proposed structures and their locations are the most appropriate for the site and how the proposed design minimizes environmental damage;
2. An analysis of alternatives to the proposed activity, including the no-build alternative;
3. A description of all measures to be taken to reduce temporary and permanent detrimental impacts to each resource listed at (a)3 above, whether onsite or offsite; and
4. A plan to mitigate the effects of all unavoidable adverse impacts.

(c) If the Department requires a survey for threatened or endangered species under N.J.A.C. 7:13-10.6(e), the survey shall be performed by a person with education and experience in wildlife biology, zoology and/or botany, as appropriate, and shall include the following:

1. The name, mailing address and qualifications of all persons participating in the survey;
2. The acreage of the surveyed area;
3. A USGS quad map with the surveyed area for each habitat outlined;
4. A description of each habitat and cover type onsite including vegetation, hydrology, soils and natural communities. These habitats shall be assessed for suitability and compatibility to the life history of the species being investigated. If no threatened or endangered species are observed, a discussion of the site's suitability for such species shall be provided;
5. The date and time of the investigation (including total number of hours spent by each individual for species observation);
6. The number of observers present on the site at any one time, including their location on the site relative to one another;
7. Site conditions during the survey, such as precipitation, temperature, wind speed and direction, artificial or natural noise, and nearest onsite or offsite human activity or development; and
8. If the survey reveals the presence or evidence of a threatened or endangered species, detailed information regarding each sighting, including:

i. Whether the subject was sighted directly or identified by call, track, scat, remains or other indirect evidence of presence;
ii. The date(s) and time(s) of each such sighting or discovery of evidence;
iii. The relative age and condition of any indirect evidence observed and its location on the property;
iv. A description of the techniques and methodologies employed by the observer

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during the site investigation;
v. If an animal species is observed directly, the number of each species observed, likely age, observed activity, gender, location on or near the site, and proximity to the observer at each sighting; and
vi. If a plant species is observed directly, the number of each species observed and its location on or near the site.

SUBCHAPTER 16. PUBLIC NOTICE OF APPLICATIONS

7:13-16.1 General requirements for public notice of applications

(a) This subchapter sets forth the requirements for providing public notice of an application for a verification and/or an application for an individual permit. Public notice is not required for an application for an applicability determination, permit-by-rule, general permit, emergency permit or the revision or transfer of an approval.
(b) A person seeking a verification and/or an individual permit shall provide public notice of the application to the persons specified in this subchapter. The public notice shall be provided no more than 30 calendar days prior to the submittal of the application.
(c) If a person provides public notice for an application, and the Department determines that the application is incomplete, the following shall apply:

1. If the applicant submits the material requested by the Department to render the application complete within 90 calendar days of the date that the public notice was provided for the application, and the Department determines that the revised application is substantially the same as the original application, the Department shall consider the original public notice to be valid.
2. If the applicant submits the material requested by the Department more than 90 calendar days after the date that the public notice was provided, or if the Department determines that the revised application is substantially different from the original application, the applicant must provide a new public notice of the application.

(d) If a person concurrently applies for a verification and an individual permit, the joint application shall meet the public notice requirements for both a verification application under N.J.A.C. 7:13-16.2 and an individual permit application under N.J.A.C. 7:13-16.3.
(e) Except in cases where newspaper notice is allowed pursuant to N.J.A.C. 7:13-16.2(a)3, 16.3(c) and 16.3(d), the public notice required at N.J.A.C. 7:13-16.2 and 16.3 shall be provided by certified mail (return receipts requested) and shall be documented pursuant to N.J.A.C. 7:13-16.4.

7:13-16.2 Public notice requirements for an application for a verification

(a) An applicant for a verification based on Methods 4, 5 or 6, as provided at N.J.A.C. 7:13-3.4 and 3.5, shall provide public notice via certified mail, in the manner described at N.J.A.C. 7:13-16.6, as follows:

1. Three copies to the municipal clerk in each municipality in which the site is located;
2. One copy to the county clerk in each county in which the site is located; and
3. One copy to each owner of property located within 200 feet of the property boundary of the site. If a property within 200 feet of the property boundary of the site is located outside the flood hazard area, newspaper notice pursuant to N.J.A.C. 7:13-16.5 can be provided for that property instead of certified mail notice.

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7:13-16.3 Public notice requirements for an application for an individual permit

(a) Except as provided in (b), (c) and (d) below, an applicant for an individual permit shall provide public notice via certified mail, in the manner described at N.J.A.C. 7:13-16.6, to the following:

1. Three copies to the municipal clerk in each municipality in which the site is located;
2. Three copies to the municipal clerk in any municipality located within one mile of the site;
3. One copy to the county clerk in each county in which the site is located;
4. One copy to the local Soil Conservation District if the project will disturb at least 5,000 square feet of land; and
5. One copy to each owner of property located within 200 feet of the property boundary of the site, except as provided in (c) below.

(b) Public notice does not need to be provided under (a) above if the project consists solely of the following activities:

1. The construction of a private residence, which is not being constructed as part of a larger residential subdivision; and/or
2. The construction of a building appurtenant to a private residence, such as a garage, barn or shed.

(c) Public notice to the owner of a property located within 200 feet of the property boundary of a site under (a)5 above may be satisfied via newspaper notice pursuant to N.J.A.C. 7:13-16.5 instead of via certified mail in the following circumstances:

1. To any property that is located outside the flood hazard area and at least 500 feet from all proposed regulated activities onsite; and
2. If the application is solely for a linear project of one-half mile or more in length, to any property that is located more than 200 feet from any aboveground structure that is part of the project. Examples of aboveground structures include pumping stations, treatment plants, power substations and elevated roadways or railroads, but not telephone poles or similar utility line support structures.

(d) An application for an individual permit for utility line maintenance, repair or replacement pursuant to N.J.A.C. 7:13-11.9(f) is not subject to the public notice requirements of (a) above. Instead, the applicant shall provide public notice of the individual permit application and of each repair and replacement as follows:

1. At the time the application is submitted to the Department, the applicant shall provide newspaper notice that meets the requirements at N.J.A.C. 7:13-16.5;
2. At least five working days before performing any repair or replacement, the applicant shall provide a written description of each proposed activity (including the method and duration of construction and the location of each proposed activity on a USGS quad map) to the following:
    - i. The Department, either at the address listed at N.J.A.C. 7:13-1.1(f) or by fax or electronic mail if prearranged with the Department;
    - ii. The municipal clerk for each municipality in which the work is located, via certified mail;
    - iii. The municipal engineer for each municipality in which the work is located, via certified mail; and
    - iv. The owners of each property on which the applicant will perform the work, via certified mail.

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7:13-16.4 Documenting public notice of an application

(a) For applications that require public notice under this subchapter, the following shall be submitted to the Department to demonstrate that public notice was provided:

1. The original certified U.S. Postal Service receipt for each public notice that was mailed, mounted on 8 1/2-inch by 11-inch paper. All certified mail shall be sent with return receipts requested. An applicant shall submit either the white postal receipt or the green return receipt card with an application. However, the green cards, if not sent with the application, shall be sent collectively to the Department once they are received from the post office by the applicant;
2. A list of the persons to whom public notice was mailed, as follows:
   i. A certified list of all property owners within 200 feet of the site (including name, mailing address, lot and block) prepared by the municipal government for each municipality in which the project is located; and
   ii. The mailing address of each public entity notified; and
3. A copy of any newspaper notice provided under N.J.A.C. 7:13-16.5.

7:13-16.5 Newspaper notice

(a) Newspaper notice required for an application under this chapter shall consist of either a legal notice or a display add (at the applicant's discretion) published in the official newspaper of the municipality (or in a newspaper of general circulation in the municipality if there is no official newspaper) as well as in one newspaper of regional circulation (relative to the location of the project). The newspaper notice shall include:

1. The mailing address and telephone number of the Department, as listed at N.J.A.C. 7:13-1.1(f);
2. The name and mailing address of the applicant;
3. The type of approval sought from the Department and a description of any proposed activities on site; and
4. The location of the site, including a street address, the name of any regulated water within or adjacent to the site, and a list of each lot, block, municipality and county involved in the project.

7:13-16.6 Contents of public notice of an application

(a) Except for the newspaper notice provided under N.J.A.C. 7:13-16.5, public notice required under this subchapter shall include the following:

1. A copy of the completed LURP application form that was submitted to the Department for the application;
2. A cover letter as follows:
   i. For an application for a verification, the letter set forth at (c) below;
   ii. For an application for an individual permit, the letter set forth at (d) below; and
   iii. For a joint verification and individual permit application, the letter set forth at (e) below; and
3. If an application includes a request for a hardship exception under N.J.A.C. 7:13-9.8, the letter required under (a)2 above shall also include the following:
   i. A statement that a hardship exception is being requested;
   ii. The nature of the hardship; and

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iii. The citation and subject matter of each requirement in this chapter for which the hardship exception is being requested.

(b) Where public notice is required under this subchapter to be sent to a municipal or county clerk, the applicant shall send three copies of the public notice, accompanied by a letter requesting that the clerk keep one copy for public inspection, and distribute one copy of the public notice to the planning board and one copy to the environmental commission if any.

(c) The letter required in (a)2 above for an application for a verification shall state:

This letter is to notify you that an application for a flood hazard area verification will be submitted to the State of New Jersey Department of Environmental Protection (Department) for the site described on the attached application form. The Department regulates construction within flood hazard areas and riparian zones adjacent to certain waters. This application is a request for the Department to verify the extent of these areas on the subject property. A flood hazard area verification does not approve any construction. A separate application must be made to the Department if regulated activities are proposed within these areas. If you have any comments or questions regarding this application, please write to the Department at the following address and include a copy of the first page of the attached application form.

Attn: Engineering Supervisor for (the county or counties where the property that is the subject of the application is located)
State of New Jersey Department of Environmental Protection
Division of Land Use Regulation
P.O. Box 439
Trenton, New Jersey 08625-0439

Your comments must be sent within 15 calendar days of your receipt of this letter to ensure that the Department will be able to consider your concerns during its review of this application. You can submit comments after this date but the Department may not be able to address your concerns. You can also contact the Department by telephone at (609) 292-0060 and can obtain general information about the flood hazard area program at the following website: www.nj.gov/dep/landuse.

(d) The letter required in (a)2 above for an application for an individual permit shall state:

This letter is to notify you that an application for a flood hazard area permit will be submitted to the State of New Jersey Department of Environmental Protection (Department) for the project described on the attached application form. A flood hazard area permit is required for this project because some or all of the work is proposed in a flood hazard area or in a riparian zone. If you have any comments or questions regarding this application, please write to the Department at the following address and include a copy of the first page of the attached application form:

Attn: Engineering Supervisor for (the county or counties where the property that is the subject of the application is located)
State of New Jersey Department of Environmental Protection
Division of Land Use Regulation
P.O. Box 439
Trenton, New Jersey 08625-0439

Your comments must be sent within 15 calendar days of your receipt of this letter to ensure that the Department will be able to consider your concerns during its review of this application. You can submit comments after this date but the Department may not be able to

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address your concerns. You can also contact the Department by telephone at (609) 292-0060 and can obtain general information about the flood hazard area program at the following website: www.nj.gov/dep/landuse.

(e) The letter required in (a)2 above for a joint verification and individual permit application shall state:

> This letter is to notify you that an application for a flood hazard area verification will be submitted to the State of New Jersey Department of Environmental Protection (Department) for the property described on the attached application form. The Department regulates construction within flood hazard areas and riparian zones adjacent to certain waters. This application is a request for the Department to verify the extent of these areas on the subject property. In addition, an application for a flood hazard area permit will also be submitted to the Department for the project described on the attached application form. A flood hazard area permit is required for this project because some or all of the work is proposed in a flood hazard area or in a riparian zone. If you have any comments or questions regarding this application, please write to the Department at the following address and include a copy of the first page of the attached application form:
>
> > Attn: Engineering Supervisor for (the county or counties where the property that is the subject of the application is located)
> > State of New Jersey Department of Environmental Protection
> > Division of Land Use Regulation
> > P.O. Box 439
> > Trenton, New Jersey 08625-0439

Your comments must be sent within 15 calendar days of your receipt of this letter to ensure that the Department will be able to consider your concerns during its review of this application. You can submit comments after this date but the Department may not be able to address your concerns. You can also contact the Department by telephone at (609) 292-0060 and can obtain general information about the flood hazard area program at the following website: www.nj.gov/dep/landuse.

SUBCHAPTER 17. APPLICATION FEES

7:13-17.1 Application fees

(a) At Table F below, this subchapter sets forth the fees for an application for the following:

1. A verification, pursuant to N.J.A.C. 7:13-6;
2. An authorization under a general permit, pursuant to N.J.A.C. 7:13-8, except for general permits 1 and 6, which have no application fee;
3. An individual permit, pursuant to N.J.A.C. 7:13-9, 10 and 11;
4. A revision of an approval, pursuant to N.J.A.C. 7:13-13; and
5. A transfer of an approval, pursuant to N.J.A.C. 7:13-14.

(b) There is no application fee for the following:

1. An applicability determination, pursuant to N.J.A.C. 7:13-5;
2. A permit-by-rule, pursuant to N.J.A.C. 7:13-7;
3. An authorization under general permit 1, pursuant to N.J.A.C. 7:13-8.3
4. An authorization under general permit 6, pursuant to N.J.A.C. 7:13-8.8; and
5. An emergency permit, pursuant to N.J.A.C. 7:13-12.

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(c) The total application fee for a given project is calculated by summing the following:

1. The appropriate fee for each project element to be covered by any individual permit;
2. The appropriate fee for any verification; and
3. The appropriate fee for any general permit authorization, revision or transfer for which an application is submitted.

(d) All application fees shall be paid by money order, check (personal, bank, certified or attorney) or government purchase order. Fees shall be made payable to the "Treasurer, State of New Jersey".

(e) If a project requires approval under this chapter, and also requires any CAFRA, waterfront development, coastal wetlands and/or freshwater wetlands approvals issued under the respective rules for these regulatory programs, the application fee for the project shall be calculated as follows:

1. The total application fee for each regulatory program's approvals shall be calculated separately. For example, if a project requires a flood hazard area permit, a flood hazard area verification and three freshwater wetlands approvals, the total fee for all flood hazard area approvals shall be computed separately from the total fee for all freshwater wetlands approvals; and
2. The application fee for the project shall be the sum of the following, provided all applications are submitted to the Department simultaneously:
   i. The highest total application fee among the regulatory programs calculated under (e)1 above; and
   ii. Seventy-five percent of the total application fee for each additional regulatory program calculated under (e)1 above.

(f) Any fee required under this chapter that is subject to N.J.A.C. 7:1L, Payment Schedule for Permit Application Fees, shall be payable in installments in accordance with N.J.A.C. 7:1L.

(g) For the purpose of determining the application fee for the review of a linear project, such as a verification of a flood hazard area limit or an individual permit for a bank stabilization project where a review of calculations is necessary, the length of the feature shall be measured along the centerline of the channel. Along regulated waters where no channel is discernible, the length of the channel (for calculating fees under this section) shall be determined by measuring the approximate centerline of the regulated water.

Table F
APPLICATION FEES

Verification (N.J.A.C. 7:13-6)

Type of Verification	Fee
Method 1 (Department delineation method)	$500.00
Method 2 (FEMA tidal method)	$500.00
Method 3 (FEMA fluvial method)	$500.00
Method 4 (FEMA hydraulic method)	$3,000 plus $300.00 per each 100 linear feet of channel (or portion thereof)
Method 5 (Approximate method)	$500.00
Method 6 (Calculation method)	$3,000 plus $300.00 per each 100 linear feet of channel (or portion thereof)

Note: The $500.00 fee for methods 1, 2, 3 and 5 above does not apply if the verification application is submitted concurrently with either of the following:

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1. An application for any general permit authorization for which verification of the flood hazard area is required to determine compliance with the general permit; or
2. An individual permit application solely for the construction of one private residence (which is not being constructed as part of a larger residential subdivision), the construction of a residential addition and/or the construction of a building appurtenant to a private residence, such as a garage, barn or shed.

General Permit Authorization (N.J.A.C. 7:13-8)

Type of General Permit	Fee
General permits 1 and 6	No fee
General permits 2A, 2B, 2C, 2D, 2E, 2F, 2G, 3, 4, 5, 7, 8, 9 and 10	$500.00

Individual permit (N.J.A.C. 7:13-9 through 11)

Project Element	Qualifier	Fee
Bank stabilization, reestablishment, or protection	Review of hydrologic and/or hydraulic calculations necessary	$3,000 plus $300.00 per each 100-foot segment of channel (or portion thereof)
	Review of hydrologic and/or hydraulic calculations not necessary	$1,000
Bridge, culvert, footbridge, low dam or other water control structure (including up to 200 feet of channel modification if necessary for the placement of the water control structure)	Review of hydrologic and/or hydraulic calculations necessary (except as noted below)	$4,000
	Review of hydrologic and/or hydraulic calculations necessary for a bridge or culvert that provides access to one private residence (which is not being constructed as part of a larger residential subdivision)	$2,000
	Review of hydrologic and/or hydraulic calculations not necessary	$1,000
Channel modification	Review of hydrologic and/or hydraulic calculations necessary	$3,000 plus $300.00 per each 100-foot segment of channel (or portion thereof)
	Review of hydrologic and/or hydraulic calculations not necessary	$1,000
Excavation, fill and/or grading	Review of net fill calculations necessary (except as noted below)	$4,000
	Review of net fill calculations not necessary and project consists solely of excavation, fill and/or grading	$1,000
	Review of net fill calculations necessary and project consists solely of one private residence that is not being constructed as part of a larger residential subdivision (including any appurtenant structure such as a garage, barn or shed)	No fee
	Review of net fill calculations necessary for a bridge or culvert where review of hydrologic and/or hydraulic calculations is also necessary	No fee
Hardship exception	Request associated with one private residence that is not being constructed as part of a larger residential subdivision (including any appurtenant structure such as a garage, barn or shed)	No fee
	All other requests	$4,000

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Private residence	One private residence that is not being constructed as part of a larger residential subdivision (including any appurtenant structure such as a garage, barn or shed)	$1,000
	Addition and/or new appurtenant structure to an existing private residence, such as a garage, barn or shed	$1,000
Retaining wall	Extending 4 feet or more above ground	$4,000
	Extending less than 4 feet above ground	$1,000
Sediment removal from a channel	Each sediment removal project	$1,000 plus $100.00 per each 100-foot segment of channel (or portion thereof) not to exceed $4,000
Stormwater discharge structure	Each stormwater discharge structure (including any conduit outlet protection and/or conveyance channel)	$1,000
Utility line	Each crossing	$1,000
Any other activity	Each project element	$1,000

Additional Fee if permit is for a Major Development pursuant to N.J.A.C. 7:8-1.2

Qualifier	Area of Impact	Fee
Base fee for any major development	Any size project	$2,000
Additional fee for the review of groundwater recharge calculations (pursuant to N.J.A.C. 7:8-5.4(a)2) per area of land disturbed by the project	Up to 3 acres	$500
	More than 3 acres and up to 10 acres	$1,000
	More than 10 acres and up to 100 acres	$2,000
	More than 100 acres	$4,000
Additional fee for the review of runoff quantity calculations (pursuant to N.J.A.C. 7:8-5.4(a)3) per area of land disturbed by the project	Up to 3 acres	$500
	More than 3 acres and up to 10 acres	$1,000
	More than 10 acres and up to 100 acres	$2,000
	More than 100 acres	$4,000
Additional fee for the review of water quality calculations (pursuant to N.J.A.C. 7:8-5.5) per area of impervious surface under review	Up to 1 acre	$500
	More than 1 acre and up to 3 acres	$1,000
	More than 3 acres and up to 10 acres	$2,000
	More than 10 acres	$4,000
Additional fee if any vegetation is removed within a Special Water Resource Protection Area (pursuant to N.J.A.C. 7:8-5.5(h))	Any size project	$2,000

Revision of a verification, general permit authorization or individual permit (N.J.A.C. 7:13-13.1 through 13.3)

Qualifier	Fee
Each major revision	Fifty percent of the original permit application fee for each project element to be revised
Each minor revision	$200.00 per element to be revised

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Revision of a Department delineation (N.J.A.C. 7:13-13.4)

Qualifier	Fee
Each major revision	$3,000 plus $300.00 per each 100-foot segment of channel (or portion thereof) to be re-delineated
Each minor revision	$200.00

Transfer an approval (N.J.A.C. 7:13-14.1)

Qualifier	Fee
Transfer of an applicability determination or permit-by-rule	No fee
Transfer of any other approval	$200.00

(h) The Department shall annually adjust the fees in this subchapter. The Department shall calculate a fee adjustment factor annually, and multiply each fee by that fee adjustment factor. The Department shall calculate the fee adjustment factor by taking the following steps:

1. Project the total amount of money required to fund the program in the coming year. This projection shall be based upon the following data:
   i. The number and type of Department staff required to perform each activity for which fees are charged;
   ii. The total salaries of those staff members;
   iii. The cost of fringe benefits for those staff members, calculated as a percentage of salaries, which percentage is set by the New Jersey Department of the Treasury based upon costs associated with pensions, health benefits, workers' compensation, disability benefits, unused sick leave, and the employer's share of FICA;
   iv. Indirect costs attributable to those staff members. "Indirect costs" means costs incurred for a common or joint purpose, benefiting more than one cost objective, and not readily assignable to the cost objective specifically benefited without effort disproportionate to the results achieved. Indirect costs shall be calculated at the rate negotiated annually between the Department and the United States Environmental Protection Agency, multiplied by the total of salaries and fringe benefits;
   v. Operating expenses (including, without limitation, expenses for postage, telephone, travel, supplies and data system management) attributable to those staff members; and
   vi. The budgeted annual cost of legal services rendered by the Department of Law and Public Safety, Division of Law, in connection with the program.
2. Project the total amount to be available from sources other than fees, such as State appropriations or Federal grants;
3. Subtract the amount in (h)2 above from the amount in (h)1 above. The remainder is the fee revenue necessary for the coming year;
4. Divide the fee revenue necessary for the coming year by the fee revenue which was necessary for the current year;
5. Divide the volume of applications the Department received in the current year by the

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volume it expects to receive in the coming year. In projecting the expected volume of applications, the Department shall consider the following factors:

i. The volume of applications received in previous years;

ii. Based on (h)5i above, any trends toward an increasing or decreasing volume of applications;

iii. Information indicating a trend toward increasing or decreasing construction activity in various areas of the State; and

iv. Other data concerning economic trends reasonably likely to influence the volume of applications; and

6. Multiply the number provided in (h)5 above by the number provided in (h)4 above. This result is the fee adjustment factor.

(i) Each year, the Department shall prepare an Annual Flood Hazard Area Control Act Fee Schedule Report. Promptly after completing the report, the Department shall publish in the New Jersey Register a notice of opportunity for public input setting forth the adjusted fees. The notice shall state that the report is available and direct interested persons to contact the Department for a copy of the report and to provide comments within 45 calendar days of the notice date. The Department shall promptly provide a copy to each person requesting a copy. The Department will evaluate the comments submitted and publish in the New Jersey Register its findings and the final adjusted fees with their operative dates in a notice of administrative change.

(j) The Department will not make the adjustment of fees provided in (h) above or prepare the report described in (i) above for any one-year period ending June 30, if in that period the Department proposes or promulgates amendments to any fees for applications under this chapter.

SUBCHAPTER 18. REQUESTS FOR ADJUDICATORY HEARINGS

7:13-18.1 Requests for adjudicatory hearings

(a) Subject to the limitations of (j) below, a person may request an adjudicatory hearing to contest a decision on any of the following actions:

1. An application for a verification;
2. An application for authorization to act under a general permit; or
3. An application for an individual permit.

(b) To contest a decision listed at (a) above, a person shall submit a hearing request within 30 calendar days after public notice of the decision is published in the DEP Bulletin. If a person submits the hearing request after this time, the Department shall deny the request.

(c) A request for an adjudicatory hearing shall:

1. Be in writing on a hearing request form available from the Department at the address in N.J.A.C. 7:13-1.1(f) and shall set forth:

i. The name, address and daytime telephone number of the person requesting the hearing;

ii. When the request is submitted by someone other than the applicant, evidence that a copy of the hearing request has been mailed to the applicant;

iii. A copy of the Department notice or decision for which a hearing is being requested;

iv. The Department file number or project number on the notice or decision;

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v. A statement requesting a hearing;
vi. A specific admission, denial or explanation of each fact appearing in the Department notice or decision or a statement that the person is without knowledge thereof; and
vii. A concise statement of the facts or principles of law asserted to constitute any factual or legal defense; and

2. Be submitted to the Department as follows:
i. Submit the original request to: Office of Legal Affairs Attention: Adjudicatory Hearing Requests Department of Environmental Protection P.O. Box 402401 East State Street Trenton, New Jersey 08625-0402
ii. Submit a copy of the request to: Division of Land Use Regulation Attention: Director Department of Environmental Protection P.O. Box 439501 East State Street, Trenton, New Jersey 08625-0439

(d) As part of a request for an adjudicatory hearing, a person may request that the Department determine whether the matter for which the adjudicatory hearing is requested is suitable for mediation by the Department's Office of Dispute Resolution. The Department shall promptly notify the requester of its determination. If the Department determines the matter is suitable for mediation, the Department shall also notify the requester of the procedures and schedule for mediation.

(e) In some cases, a hearing request may result in a stay of operation of a general permit or individual permit being appealed, as follows:

1. If a permittee requests a hearing to appeal any portion of its permit, the hearing request shall automatically stay operation of the permit, unless the permittee shows good cause in writing why the permit should continue in effect while being contested. All permitted activities shall stop upon the date the hearing request is submitted, and shall not be started again until the matter is resolved, unless the Department grants an exception in writing; and

2. If a person other than the permittee requests a hearing on a permit, the requester may include with the hearing request a request for a stay of the permit. The Department shall stay operation of the permit only upon its determination that good cause exists. If a stay is imposed, all permitted activities shall stop upon the date the stay is imposed, and shall not be started again until the matter is resolved, unless the Department grants an exception in writing.

(f) The Department shall notify the requester if the request for a hearing is granted and, if denied, the reasons why. If a hearing request is granted, the Department shall refer the matter to the Office of Administrative Law for an adjudicatory hearing in accordance with the Administrative Procedure Act, N.J.S.A. 52:14B-1 et seq., and the Uniform Administrative Procedure Rules, N.J.A.C. 1:1.

(g) If the Department and the person seeking a hearing agree to settle a matter for which a hearing request has been submitted under this section, and the settlement will result in Department approval of a regulated activity, notice of the settlement shall be provided as follows:

1. The person who requested the hearing shall send by certified mail a "notice of intent to settle" the matter, using the notice form available from the Department at the address in N.J.A.C. 7:13-1.1(f), to the following persons:

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i. Each person provided public notice of the application for the permit or approval which is the subject of the appeal; and
ii. Each person who commented on the application;

2. The Department shall publish in the DEP Bulletin the notice of intent to settle, and shall accept comments on the public notice for at least 30 calendar days;

3. After the 30-day comment period provided for in (g)2 above, the person who requested the hearing shall send by certified mail a "notice of settlement" using the notice form available from the Department at the address in N.J.A.C. 7:13-1.1(f), to the following persons:

i. Each person provided a notice of intent to settle under (g)1 above; and
ii. Each person who commented on the notice of intent to settle within the 30-day comment period provided under (g)2 above; and

4. If the Department thereafter determines that no good cause exists for the Department to decline the proposed settlement or to significantly modify it, the Department shall publish a notice of the final settlement in the DEP Bulletin.

(h) At the conclusion of any adjudicatory hearing in the Office of Administrative Law, the administrative law judge will submit an initial decision to the Commissioner. The Commissioner shall issue a final decision affirming, rejecting or modifying the initial decision, in accordance with the Administrative Procedure Act, N.J.S.A. 52:14B-1 et seq., and the Uniform Administrative Procedure Rules, N.J.A.C. 1:1.

(i) The Commissioner's decision under (h) above shall be considered final agency action for the purposes of the Administrative Procedure Act, and shall be subject only to judicial review in the Appellate Division of the Superior Court, as provided in the Rules of Court.

(j) Nothing in this section shall be construed to provide a right to an adjudicatory hearing in contravention of the Administrative Procedure Act, N.J.S.A. 52:14B-3.1 through 3.3.

SUBCHAPTER 19. ENFORCEMENT

7:13-19.1 Penalties

(a) Pursuant to N.J.S.A. 58:16A-63, and subject to the grace period provisions applicable in accordance with N.J.A.C. 7:13-19.2, the Department may seek, in a court of competent jurisdiction, a civil penalty and/or injunctive relief for any violation of the Flood Hazard Area Control Act and/or this chapter, as follows:

1. Any person who knowingly violates any provision of the Act or this chapter shall be subject to a penalty of not more than $ 2,500 for each offense; and

2. Any person who otherwise violates any provision of the Act or this chapter shall be subject to a penalty of not more than $ 1,500 for each offense.

(b) If a violation is of a continuing nature, each day that the violation continues constitutes an additional, separate and distinct offense. A violation is of a continuing nature as long as the adverse impact of the violation continues. For example, if a violation involves placement of fill in a floodway, each day that the fill remains in the floodway is an additional, separate and distinct offense, because the increased flood hazard caused by the fill continues each day that the fill is present. In such a case, the Department may seek a separate penalty for each day that the fill remains in the floodway.

7:13-19.2 Grace period applicability; procedures

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(a) Each violation identified in Table G at (f) below by an "M" in the Type of Violation column, for which the conditions of (d)1 through 6 below are satisfied, is a minor violation and is subject to a 30-day grace period as described at (e) below.
(b) Each violation identified in Table G at (f) below by an "NM" in the Type of Violation column is a non-minor violation and is not subject to a grace period.
(c) If a violation is not listed in Table G at (f) below, the designation of the violation as minor or non-minor is determined as follows:

1. If the violation is not listed in Table G at (f) below but is comparable to a violation designated as "M" in Table G and the violation meets all of the criteria of (d)1 through 6 below, then the violation is minor. The minor violation shall be subject to a grace period of 30 calendar days as described at (e) below.
2. If the violation is not listed in Table G at (f) below and is not comparable to a violation listed in Table G but the violation meets all of the criteria at (d)1 through 9 below, then the violation is minor. The minor violation shall be subject to a grace period of 30 calendar days as described at (e) below.
3. If the violation is not listed in Table G at (f) below but is comparable to a violation designated as "NM" in Table G, then the violation is a non-minor violation and is not subject to a grace period.
4. If the violation is not listed in Table G at (f) below and is not comparable to a violation listed in Table G, and the violation does not meet all of the criteria at (d)1 through 9below, the violation is non-minor and is not subject to a grace period.
5. Comparability of a violation to a violation in Table G at (f) below is based on the nature of the violation(s) (for example recordkeeping, accuracy of information provided to the Department, amount and type of impacts to the protected resources). A violation shall not be considered comparable to any violation designated as "M" in Table G unless the violation also meets the criteria at (d)7 through 9 below.

(d) The Department shall provide a grace period of 30 calendar days for any violation identified as minor under this section, provided the following conditions are met:

1. The violation is not the result of the purposeful, knowing, reckless or criminally negligent conduct of the person responsible for the violation;
2. The activity or condition constituting the violation has existed for less than 12 months prior to the date of discovery by the Department or a local government agency;
3. In the case of a violation that involves a permit, the person responsible for the violation has not been identified in a previous enforcement action by the Department or a local government agency as responsible for a violation of the same requirement of the same permit within the preceding 12-month period;
4. In the case of a violation that does not involve a permit, the person responsible for the violation has not been identified in a previous enforcement action by the Department or a local government agency as responsible for the same or a substantially similar violation at the same facility within the preceding 12-month period;
5. In the case of a violation of the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq. or any rule or regulation promulgated thereunder, or permit issued pursuant thereto, the person responsible for the violation has not been identified in a previous enforcement action by the Department or a local government agency as responsible for the same or a substantially similar violation at the same site or any other site within the preceding 12-month period;

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6. In the case of any violation, the person responsible for the violation has not been identified by the Department or a local government agency as responsible for the same or substantially similar violations at any time that reasonably indicate a pattern of illegal conduct and not isolated incidents on the part of the person responsible;
7. The violation poses minimal risk to the public health, safety and natural resources;
8. The violation does not materially and substantially undermine or impair the goals of the regulatory program; and
9. The activity or condition constituting the violation is capable of being corrected and compliance achieved within the time prescribed by the Department.

(e) For a violation determined to be minor under (a) or (c) above, the following provisions apply:

1. The Department shall issue a notice of violation to the person responsible for the minor violation that:
   i. Identifies the condition or activity that constitutes the violation and the specific regulatory provision or other requirement violated; and
   ii. Specifies that a penalty may be imposed unless the minor violation is corrected and compliance is achieved within the specified grace period of 30 calendar days.
2. If the person responsible for the minor violation corrects that violation and demonstrates, in accordance with (e)3 below, that compliance has been achieved within the specified grace period, the Department shall not impose a penalty for the violation.
3. In response to a notice of violation, the person responsible for the minor violation shall submit to the Department, before the end of the specified grace period, written information, signed and certified to be true by the responsible person or his or her designee, detailing the corrective action taken or how compliance was achieved.
4. If the person responsible for the minor violation seeks additional time beyond the specified grace period to achieve compliance, the person shall request an extension of the specified grace period in writing no later than one week before the expiration of the specified grace period. The request shall include the anticipated time needed to achieve compliance, the specific cause or causes of the delay, and any measures taken or to be taken to minimize the time needed to achieve compliance. The request shall be signed and certified to be true by the responsible party or their designee. The Department may, in its discretion, approve in writing an extension which shall not exceed 90 calendar days, to accommodate the anticipated delay in achieving compliance. In exercising its discretion to approve a request for an extension, the Department may consider the following:
   i. Whether the violator has taken reasonable measures to achieve compliance in a timely manner;
   ii. Whether the delay has been caused by circumstances beyond the control of the violator;
   iii. Whether the delay will pose a risk to the public health, safety and natural resources; and
   iv. Whether the delay will materially or substantially undermine or impair the goals of the regulatory program.
5. If the person responsible for the minor violation fails to demonstrate to the Department that the violation has been corrected and compliance achieved within the

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specified grace period, or within any approved extension, the Department may, in accordance with the provisions of this chapter, impose a penalty that is retroactive to the date on which the notice of violation under (e)1 above was issued.

6. The person responsible for a minor violation shall not request more than one extension of a grace period specified in a notice of violation.

(f) The designations of violations of the Flood Hazard Area Control Act and this chapter as minor (M) and non-minor (NM) are set forth in Table G below. The violation descriptions are provided for informational purposes only. In the event that there is a conflict between a violation description in Table G and the rule to which the violation description corresponds, the rule shall govern.

Table G
MINOR AND NON-MINOR VIOLATIONS

Rule Citation	Violation Description	Type of Violation
N.J.A.C. 7:13-1.3(d)	Failure of an applicant, or any consultant, engineer, surveyor or agent employed by an applicant, to provide all necessary information to the Department which is relevant to an application. Submittal of false information by the applicant, its consultants and/or agents.	NM
N.J.A.C. 7:13-1.4(a)2ii	Failure of a delegated county governing body to uphold the requirements of this chapter	NM
N.J.A.C. 7:13-1.4(c)	Failure of a delegated county governing body to permanently retain a copy of all required documents that document that it has discharged its delegated duties	NM
N.J.A.C. 7:13-2.1(a)	Initiating a regulated activity in a regulated area not in conformance with a permit-by-rule, general permit authorization, individual permit, emergency permit or appropriate CAFRA or waterfront development permit.	NM
N.J.A.C. 7:13-6.1(g)	Failure of an applicant to record the metes and bounds description of a verified flood hazard area and/or floodway limit on the property deed within 90 calendar days of issuance of the verification	NM
N.J.A.C. 7:13-6.1(g)	Failure of an applicant to submit proof to the Department of recording of the metes and bounds description of the verified flood hazard area and/or floodway limit on the property deed within 90 calendar days of issuance of the verification	M
N.J.A.C. 7:13-8.2	Failure to comply with all conditions of a general permit except as indicated directly below	NM
N.J.A.C. 7:13-8	Failure to submit to the Department any documentation required by a general permit	M
N.J.A.C. 7:13-9.5	Failure to comply with all conditions of an individual permit except as indicated directly below	NM
N.J.A.C. 7:13-9	Failure to submit to the Department any documentation required by an individual permit	M
N.J.A.C. 7:13-12.2	Commencement of activities authorized under an emergency permit later than 30 calendar days after verbal approval; failure to complete commenced activities within 60 calendar days after verbal approval; failure to file a complete permit application and "as built" drawings for completed activities within 90 calendar days after verbal approval; and failure to modify the activities to comply with the requirements of this chapter where directed to do so by the Department.	NM
N.J.A.C. 7:13-13	Failure of an applicant to record a revised verification	NM
N.J.A.C. 7:13-13	Failure of an applicant to provide proof that a revised verification has been properly recorded	M
N.J.A.C. 7:13-16.1(c)	Failure of an applicant to comply with notice requirements	NM

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APPENDIX 1: [*Omitted from this text...Please refer to DEP rule at AN.J.A.C 17:13*]

APPENDIX 2: [*Omitted from this text...Please refer to DEP rule at AN.J.A.C 17:13*]

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Appendix 1C

N.J.A.C. 7:15
WATER QUALITY MANAGEMENT PLANNING RULE

THIS IS A COURTESY COPY OF THIS RULE. ALL OF THE DEPARTMENT'S RULES ARE COMPILED IN TITLE 7 OF THE NEW JERSEY ADMINISTRATIVE CODE.

Statutory authority: N.J.S.A. 13:1D-1 et seq., 13:19-1 et seq., 13:20-1 et seq., 23:2A-1 et seq., 40:55D-93 through 99, 58:1A-1 et seq., 58:10A-1 et seq., 58:11A-1 et seq., 58:11-23 et seq., 58:16A-50 et seq., and 58:29-1 et seq.
Date last amended: July 7, 2008
For regulatory history and effective dates see the New Jersey Administrative Code

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SUBCHAPTER 1. GENERAL PROVISIONS

7:15-1.1 Scope

(a) This chapter establishes water quality management policies and procedures pursuant to the Water Quality Planning Act, N.J.S.A. 58:11A-1 et seq., the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq., the Department's enabling legislation, N.J.S.A. 13:1D-1 et seq., the Watershed Protection and Management Act of 1997, N.J.S.A. 58:29-1 et seq., the Coastal Area Facility Review Act, N.J.S.A. 13:19-1 et seq., the Highlands Water Protection and Planning Act,
N.J.S.A. 13:20-1 et seq., the Endangered and Nongame Species Conservation Act, N.J.S.A. 23:2A-1 et seq., the Stormwater Management Act, N.J.S.A. 40:55D-93 through 99, the Water Supply Management Act, N.J.S.A 58:1A-1 et seq., the Realty Improvement Sewerage and Facilities Act, N.J.S.A. 58:11-23 et seq., and the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq. Specifically, this chapter establishes policies and procedures concerning the following subjects:

1. The content of the continuing planning process ("CPP") and its relationship to this chapter and the Statewide Water Quality Management ("WQM") Plan;
2. The relationship between the Statewide, areawide, and county water quality management (WQM) plans and this chapter;
3. The role of the Department and designated planning agencies in WQM planning activities;
4. The review of projects and activities for consistency with WQM plans and this chapter, including the issuing of consistency determinations for specified kinds of projects;
5. The preparation, adoption, amendment, revision, and certification of WQM plans;
6. The adoption of other Department rules, priority systems and project priority lists, sludge management plans, regional stormwater management plans, effluent limitations, wastewater management plans, 201 Facilities Plans, and other documents in WQM Plans;
7. Coordination of WQM planning with Coastal Zone, Hackensack Meadowlands, Highlands and Pinelands programs and municipal zoning;
8. Mechanisms to resolve conflicts among State agencies, designated planning agencies,
applicants, and other parties affected by this chapter;
9. Selected aspects of wastewater management, including treatment works deemed to be
consistent with WQM plans and this chapter; WQM Plan amendment requirements for treatment works not identified in WQM plans; construction of individual subsurface sewage disposal systems and other small domestic treatment works in future sewer service areas; and eligibility for financial assistance.
10. The procedures for WQM plan amendments and revisions, and the withdrawal of wastewater service areas where wastewater management plans are not current in accordance with
this chapter;
11. The assignment of the duty to prepare and update wastewater management plans to

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county boards of chosen freeholders and the establishment of alternative assignments of such wastewater management plan responsibility to municipalities;
12. The required contents of wastewater management plans, and schedules and procedures for their submission, adoption, and updating;
13. The process for identifying water bodies on the List of Water Quality Limited Segments and establishing total maximum daily loads;
14. Designation of appropriate wastewater service areas in consideration of environmentally sensitive areas; and
15. The application and approval process for grants as authorized by the Watershed Protection and Management Act of 1997, N.J.S.A. 58:29-1 et seq.

7:15-1.2 Construction
This chapter shall be liberally construed to permit the Department to discharge its statutory functions, and to effectuate the provisions of the Water Quality Planning Act, N.J.S.A. 58:11A-1 et seq., the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq., the Department's enabling legislation, N.J.S.A. 13:1D-9**,** the Watershed Protection and Management Act of 1997, N.J.S.A. 58:29-1 et seq., the Coastal Area Facility Review Act, N.J.S.A. 13:19-1 et seq., the Highlands Water Protection and Planning Act, N.J.S.A. 13:20-1 et seq., the Endangered and Nongame Species Conservation Act, N.J.S.A. 23:2A-1 et seq., the Stormwater Management Act, N.J.S.A. 40:55D-93 through 99, the Water Supply Management Act, N.J.S.A 58:1A-1 et seq., the Realty Improvement Sewerage and Facilities Act, N.J.S.A. 58:11-23 et seq., and the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq., the Statewide WQM Plan, and the areawide WQM plans.

7:15-1.3 Purpose
(a) The purpose of this chapter is to:
1. Implement the Water Quality Planning Act, N.J.S.A. 58:11A-1 et seq., the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq., the Department's enabling legislation, N.J.S.A. 13:1D-9, the Watershed Protection and Management Act of 1997, N.J.S.A. 58:29-1 et seq., the Coastal Area Facility Review Act, N.J.S.A. 13:19-1 et seq., the Highlands Water Protection and Planning Act, N.J.S.A. 13:20-1 et seq., the Endangered and Nongame Species Conservation Act, N.J.S.A. 23:2A-1 et seq., the Stormwater Management Act, N.J.S.A. 40:55D-93 through 99, the Water Supply Management Act, N.J.S.A 58:1A-1 et seq., the Realty Improvement Sewerage and Facilities Act, N.J.S.A. 58:11-23 et seq., and the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq.;
2. Establish policies, procedures and standards which, wherever attainable, help to restore, enhance and maintain the chemical, physical and biological integrity of the waters of the State, including ground waters, and the public trust therein, to protect public health, to safeguard fish and aquatic life and scenic and ecological values, and to enhance the domestic, municipal, recreational, industrial and other uses of water;
3. Prevent, control, and abate water pollution;
4. Conserve the natural resources of the State, promote environmental protection, and prevent the pollution of the environment of the State;
5. Encourage, direct, supervise and aid areawide WQM planning;
6. Integrate and unify the Statewide and areawide WQM planning processes, and provide

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for continuing WQM planning;
7. Ensure that projects and activities affecting water quality are developed and conducted in a manner consistent with this chapter and adopted WQM Plans;
8. Coordinate and integrate WQM plans with related Federal, State, regional and local comprehensive land use, functional and other relevant planning activities, programs and policies;
9. Develop and implement water quality programs in concert with other social and economic objectives;
10. Provide opportunities for public participation in the WQM planning process;
11. Prepare, administer, and supervise Statewide, regional and local plans and programs concerning conservation and environmental protection, including plans and programs concerning sewerage facilities;
12. Encourage, direct and aid in coordinating State, regional and local plans and programs concerning conservation and environmental protection, including plans and programs concerning sewerage facilities, in accordance with a unified Statewide plan formulated, approved and supervised by the Department;
13. Supervise sanitary engineering facilities within the State; and
14. Encourage the development of comprehensive regional wastewater management planning that serves the needs of the regional community and that conforms to the adopted areawide WQM plan applicable to that region.

7:15-1.4 Severability
If any section, subsection, provision, clause, or portion of this chapter is adjudged unconstitutional or invalid by a court of competent jurisdiction, the remainder of this chapter shall not be affected thereby and shall remain in full force and effect.

7:15-1.5 Definitions
The following words and terms, as used in this chapter, shall have the following meanings, unless the context clearly indicates otherwise.
"Acid producing soils" means soils that contain geologic deposits of iron sulfide minerals (pyrite and marcasite) which, when exposed to oxygen from the air or from surface waters, oxidize to produce sulfuric acid. Acid producing soils, upon excavation, generally have a pH of 4.0 or lower. After exposure to oxygen, these soils generally have a pH of 3.0 or lower. Information regarding the location of acid producing soils in New Jersey can be obtained from local Soil Conservation District offices.
"Actual flow" means the volume of sewage and other wastes which a DTW or industrial treatment works receives. Actual flow shall be determined by the arithmetic average of the metered daily volumes of waste received at a DTW or industrial treatment works for the preceding period of three consecutive calendar months. Where peak flows have been determined
by the Department to be seasonal in nature, the seasonal peak flow period shall be used in determining actual flow.
"Adoption" means the adoption by the Department of Statewide WQM Plans or amendments or revisions thereof and the adoption by the Governor or his or her designee of areawide plans or amendments or revisions thereof pursuant to this chapter.
"Amendments" means changes to the Statewide and areawide WQM plans that may be

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proposed and adopted under N.J.A.C. 7:15-3.4.
"Applicant" means any person, corporation, government body or other legal entity which applies for an approval pursuant to this chapter.
"Areawide plan" or "areawide WQM plan" means the areawide WQM plan authorized in Section 5 of the Water Quality Planning Act (N.J.S.A. 58:11A-1 et seq.), and Sections 208 and 303 of the Clean Water Act, 33 U.S.C. § 1251 et seq.
"Authority" means a sewerage authority as defined in N.J.S.A. 40:14A-3(5), or a municipal authority as defined in N.J.S.A. 40:14B-3(5).
"Best Management Practices (BMPs)" means:

1. Schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the State; or
2. Methods, measures, or practices selected by an agency to meet its nonpoint source control needs. BMPs also include treatment requirements, operating procedures, and techniques to control site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage. BMPs include, but are not limited to, structural and nonstructural controls and operation and maintenance procedures. BMPs can be applied before, during, and after pollution-producing activities to reduce or eliminate the introduction of pollutants into receiving waters. "BPU-regulated sewer or water utilities" means sewer utilities or water utilities regulated by the Board of Public Utilities under N.J.S.A. 48:1-1 et seq. and N.J.A.C. 14:9.

"Category One waters" or "C1 waters" means waters designated as "C1 waters" in the Surface Water Quality Standards, N.J.A.C. 7:9B.
"Category Two waters" or "C2 waters" means waters designated as "C2 waters" in the Surface Water Quality Standards, N.J.A.C. 7:9B.
"Clean Water Act" means the "Federal Water Pollution Control Act", 33 U.S.C. §§ 1251 et seq., also known as the "Federal Act" including all subsequent supplements and amendments.
"Combined sewer overflow" or "CSO" means the excess flow from the combined sewer system which is not conveyed to the domestic treatment works for treatment, but transmitted by pipe or other channel directly to waters of the State.
"Combined sewer system" means a sewer system that is designed to carry sanitary sewage at all times and that also is designed to collect and transport stormwater from streets and other sources, thus serving a combined purpose.
"Commissioner" means the Commissioner of the New Jersey Department of Environmental Protection or his or her designee.
"Committed flow" means the sum of the actual flow plus the sum of all flows which are anticipated from connections which have been approved but are not yet in operation. The flow to be anticipated from any such connections shall be that flow approved by the Department.
"Composite zoning" means a compilation of various similarly zoned areas into a single representative zoning designation. Under composite zoning, residential zones that would allow a similar density of units would be consolidated into a single zone with an intermediate density of units that represents a weighted average of similar zones.
"Conservation restriction" means a restriction, easement, covenant, or condition, in any deed, will or other instrument, other than a lease, executed by or on behalf of the owner of the land, appropriate to retaining land or water areas predominantly in their natural state, scenic or open or wooded condition, or for the conservation of soil or wildlife, or for the outdoor

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recreation or park use, or for public access to tidal waterways and their shores, or as suitable habitat for fish and wildlife, or for preservation of continuing agricultural uses, to forbid or limit any or all of the following:

1. Construction or placing of buildings, roads, signs, billboards or other advertising, or other structures on or above ground;
2. Dumping or placing of soil or other substance or material as landfill, or dumping or placing of trash, waste or unsightly or offensive materials;
3. Removal or destruction of trees, shrubs or other vegetation;
4. Excavation, dredging or removal of loam, peat, gravel, soil, rock or other mineral substance;
5. Surface use except for purposes permitting the land or water area to remain predominantly in its natural condition;
6. Activities detrimental to drainage, flood control, water conservation, erosion control or soil conservation, or fish and wildlife habitat preservation; or
7. Other acts or uses detrimental to the retention of land or water areas according to the purposes of this chapter.

"Consistency determination" means the written statement by the Department under N.J.A.C. 7:15-3.2, as to whether a project or activity listed in N.J.A.C. 7:15-3.1(b) is consistent with, inconsistent with, or not addressed by, adopted WQM Plans and this chapter.

"Continuing planning process" or "CPP" means the Statewide planning process conducted by the Department of Environmental Protection as authorized in Section 7 of the Water Quality Planning Act (N.J.S.A. 58:11A-7).

"County utilities authority" means any public body created by a county governing body pursuant to N.J.S.A. 40:14B-4a, or any sewerage authority or county sewer authority reorganized as a county utilities authority pursuant to N.J.S.A. 40:14B-6b.

"County water quality management plan" or "County WQM plan" means a county plan prepared by a county planning board pursuant to Section 5 of the Water Quality Planning Act (N.J.S.A. 58:11A-5).

"Department" means the New Jersey Department of Environmental Protection.

"Designated area" means an area designated by the Governor as an areawide WQM planning area pursuant to Section 4 of the Water Quality Planning Act (N.J.S.A. 58:11A-4).

"Designated management agency" means an agency designated in an adopted WQM plan to implement one or more of the policies, objectives, and recommendations of that plan.

"Designated planning agency" means an agency designated by the Governor to conduct areawide WQM planning pursuant to Section 4 of the Water Quality Planning Act (N.J.S.A. 58:11A-4).

"Designated use" means those surface water or ground water uses, both existing and potential, that have been established by the Department under the Surface Water Quality Standards, N. J. A. C. 7:9B, for the waters of the State.

"Development" means 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 other structure, or of any mining, landfill, excavation, roads, sewers and other infrastructure and any use or change in the use of any building or other structure, or land or extension of use of land. Phased development shall be considered as a single project.

"District" means either any or all of the following, depending on the context: the district of a sewerage authority as defined in N.J.S.A. 40:14A-3(6), or the district of a municipal

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authority as defined in N.J.S.A. 40:14B-3(6), or the Passaic Valley Sewerage District as defined at N.J.S.A. 58:14-1.

"Disturbance" means the placement of impervious surface, the exposure or movement of soil or bedrock, or the clearing, cutting, or removing of vegetation.

"Domestic treatment works" or "DTW" means a publicly or privately owned treatment works and shall include a treatment works processing domestic wastes together with any ground water, surface water, storm water or industrial process wastewater that may be present.

"DTW" means "domestic treatment works".

"Dwelling unit" means any building or portion of a building, permanent or temporary in nature, used or proposed to be used as a residence either seasonally or throughout the year.

"DWM" means the Division of Watershed Management, or its successor, in the Department of Environmental Protection.

"Effluent limitation" means any restriction on quantities, quality, discharge rates and concentration of chemical, physical, thermal, biological, radiological, and other constituents of pollutants established by permit, or imposed as an interim enforcement limit pursuant to an administrative order, including an administrative consent order.

"Emergency activities" means activities that are necessary to be performed in response to sudden or unexpected occurrences or conditions, in order to prevent loss of life, personal injury, severe property damage, or severe environmental damage.

"Endangered species" means species of wildlife included on the list of endangered species promulgated pursuant to the Endangered and Nongame Species Conservation Act, N.J.S.A. 23:2A-13 et seq., at N. J. A. C. 7:25 – 4.13, and any species or subspecies of wildlife appearing on any Federal endangered species list pursuant to the Endangered Species Act of 1973, 16 U.S.C. §§ 1531 et seq.

"Environmentally sensitive areas" means those areas identified in a Statewide or areawide WQM plan as land areas possessing characteristics or features which are important to the maintenance or improvement of water quality, or to the conservation of the natural resources of the State. Environmentally sensitive areas include, but are not limited to, areas mapped as endangered or threatened wildlife species habitat on the Department's Landscape Maps of Habitat for Endangered, Threatened or Other Priority Species, Natural Heritage Priority Sites, wetlands and riparian zones.

"Equivalent dwelling unit" means the standard residential unit upon which the nitrate dilution model is based, which is a single family home with three bedrooms and three residents, or its equivalent in terms of flow generated or pounds of nitrate generated. The standard residential unit is assumed to generate 500 gallons per day of wastewater or 30 pounds per year of nitrate. The equivalency measure of 500 gallons per day is to be used for systems that do not have effluent limits established through a NJPDES permit. The equivalency measure of 30 pounds per year of nitrate is to be used for systems that have effluent limits for nitrate established through a NJPDES permit.

"Governmental entity" means a Federal, state, county or municipal government or school district whose jurisdiction is partially or entirely within New Jersey.

"Head of tide" means the point on a tidal watercourse at which measurement of the water surface vertical movement at Mean High Water becomes no longer practical. All points seaward of the head of tide on a tidal watercourse are tidal.

"Highlands Council" means the Highlands Water Protection and Planning Council established by N.J.S.A. 13:20-4.

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"Highlands planning area" means that portion of the Highlands Region not included within the Highlands preservation area.
"Highlands preservation area" means that portion of the Highlands Region so designated by N.J.S.A 13:20-7b.
"Highlands Region" means that region so designated by N.J.S.A. 13:20-7.
"HUC 11" or "hydrologic unit code 11" means an area within which water drains to a particular receiving surface water body, also known as a watershed, which is identified by an 11-digit hydrologic unit boundary designation, delineated within New Jersey by the United States Geological Survey.
"HUC 14" or "hydrologic unit code 14" means an area within which water drains to a particular receiving surface water body, also known as a subwatershed, which is identified by a 14-digit hydrologic unit boundary designation, delineated within New Jersey by the United States Geological Survey.
"Impervious surface" means any structure, surface, or improvement that reduces or prevents absorption of stormwater into land, and includes porous paving, paver blocks, gravel, crushed stone, decks, patios, elevated structures, and other similar structures, surfaces, or improvements.
"Individual subsurface sewage disposal system" means a system for the disposal of sanitary sewage into the ground, which is designed and constructed to treat sanitary sewage in a manner that will retain most of the settleable solids in a septic tank and discharge the liquid effluent to a disposal field.
"Industrial/commercial" means any project or activity engaged in manufacturing, production or sales of services or products.
"Industrial treatment works" means an industrial treatment works as defined at N.J.A.C. 7:14A.
"Infill area" means a lot or lots existing on July 7, 2008 situated between two lots improved as of July 7, 2008 where the total amount of wastewater to be generated by all potential new development allowed by existing zoning at the time of application between the two previously improved lots is 2,000 gallons per day or less, as calculated in accordance with N.J.A.C. 7:14A-23.3. When calculating flow from lots zoned for single family residential development, 300 gallons per day per unit shall be utilized.
"Integrated Water Quality Monitoring and Assessment Report" means the biennial report prepared by the Department, pursuant to Section 305(b) of the Clean Water Act, 33 U.S.C. §1315(b), which inventories and assesses the quality of the waters of the State and includes the List of Water Quality Limited Segments required under Section 303(d) of the Clean Water Act, 33 U.S.C. 1313(d).
"Interim connection", "interim construction" or "interim expansion" means interim connection, construction or expansion of wastewater facilities as described in N.J.A.C. 7:15-4.2(a)4.
"Intermittent stream" means surface water drainage channels with definite bed and banks in which there is not a permanent flow of water.
"Joint meeting" means a joint meeting as defined in N.J.S.A. 40:63-69.
"Lake, pond or reservoir" means any impoundment, whether naturally occurring or created in whole or in part by the building of structures for the retention of surface water, excluding sedimentation control, wastewater management and storm water management basins.

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Lakes, ponds and reservoirs are characterized by a long-term or permanent downgradient restriction of surface water flow from the impoundment and areas of quiescent water within the body of the impoundment. Lakes, ponds and reservoirs are frequently characterized by greater water depths within the impoundment than either the upgradient or downgradient surface water flow and by shallow water lateral edges containing emergent or submerged plant species. For regulatory purposes, the upgradient boundary of a lake, pond or reservoir shall be considered to be the point at which areas of greater depth and relatively quiescent water can be differentiated from the upgradient surface water input into the impoundment under average flow conditions.
"Landscape Maps of Habitat for Endangered, Threatened and Other Priority Wildlife" or "Landscape Maps" means the Department's maps delineating areas used by or necessary for endangered and threatened species and other priority wildlife to sustain themselves successfully. The maps depict areas of contiguous habitat types (forest, grassland, forested wetland, emergent wetland and beach/dune) that are ranked based upon intersection with documented occurrences of endangered, threatened and priority wildlife species. Mapped habitat areas are classified based upon the status of the wildlife species whose presence is documented. Rank 5 is assigned to areas containing one or more documented occurrences of at least one wildlife species listed as endangered or threatened on the Federal list of endangered and threatened species. Rank 4 is assigned to areas with one or more documented occurrences of at least one State endangered species. Rank 3 is assigned to areas containing one or more documented occurrences of at least one State threatened species. Rank 2 is assigned to areas containing one or more documented occurrences of at least one non-listed State priority wildlife species. The maps also delineate, as Rank 1, habitat areas that meet habitat-specific suitability requirements, such as minimum area criteria for endangered, threatened and priority wildlife species, but that do not intersect with any documented occurrences of such species.
"Lead planning agency" means one or more public entities having stormwater management planning authority designated by the regional stormwater management planning committee pursuant to N.J.A.C. 7:8-3.2, that serves as the primary representative of the committee.
"Linear development" means land uses such as roads, drives, railroads, sewerage and stormwater management pipes, gas and water pipelines, electric, telephone and other transmission lines and the rights-of-way therefor, the basic function of which is to connect two points. Linear development shall not mean residential, commercial, office, or industrial buildings, improvements within a development such as utility lines or pipes, or internal circulation roads.
"Load allocation" means the portion of a receiving water's total maximum daily load for a specific pollutant that is allocated to existing or future nonpoint sources of pollution.
"Municipal authority" means a municipal authority as defined in the Municipal and County Utilities Authorities Law at N.J.S.A. 40:14B-3(5), and shall include a municipal utilities authority created by one or more municipalities and a county utilities authority created by a county.
"Municipal government" means a city, town, borough, village, township or other municipal government created by State law, which has an elected governing body, a chief executive, and municipal public officials including a municipal clerk, tax assessor, and tax collector.
"Natural Heritage Priority Sites" mean areas identified on the Department's graphic

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information systems (GIS) coverage compiled from the Natural Heritage Database. The Natural Heritage Database is the manual and computerized file maintained by the Department at http://www.nj.gov/dep/parksandforests/natural/heritage/index.html that includes continuously updated information on the location and status of rare plant and animal species and ecological communities in New Jersey.

"NJPDES" means the New Jersey Pollutant Discharge Elimination System established in N.J.A.C. 7:14A.

"NJPDES discharge permit" means a permit issued by the Department under N.J.A.C. 7:14A for a discharge to surface water or a discharge to ground water.

"Non-designated area" means an area not designated by the Governor as an areawide WQM planning area pursuant to Section 4 of the Water Quality Planning Act (N.J.S.A. 58:11A- 4).

"Nonpoint source" means:

1. Any man-made or man-induced activity, factor, or condition, other than a point source, from which pollutants are or may be discharged;
2. Any man-made or man-induced activity, factor, or condition, other than a point source, that may temporarily or permanently change any chemical, physical, biological, or radiological characteristic of waters of the State from what was or is the natural, pristine condition of such waters, or that may increase the degree of such change; or
3. Any activity, factor, or condition, other than a point source, that contributes or may contribute to water pollution.

"Passaic Valley Sewerage Commissioners" means the body described by that name under N.J.S.A. 58:14-2.

"Passaic Valley Sewerage District" means the sewerage district now or hereafter described by that name under N.J.S.A. 58:14-1 et seq.

"Permitted flow" means maximum allowable flow (usually in million gallons per day, or other appropriate unit of flow such as gallons per day) for a treatment works as stated in the facility's NJPDES permit or TWA, whichever is less.

"Planning flow" means that daily flow which is estimated or anticipated to be contributed by wastewater generating facilities for their wastewater service area. Planning flow is based upon projected flow criteria values used in computing the projected flow to wastewater conveyance and treatment facilities contained in N.J.A.C. 7:14A-23.3 or N.J.A.C. 7:9A-7.4, as applicable for the type of wastewater facilities being proposed.

"Point source" means any discernible, confined and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft, from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture.

"Process wastewater" means 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. This definition includes the terms commercial wastewater and industrial wastewater as used in 40 CFR Part 503.

"Public advisory committee" or "PAC" means a representative committee of interests formed for the purpose of advising the Department on policy and other relevant issues in the

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development and implementation of a watershed management area plan or TMDL.
"Public water supply" means a water supply providing piped water to the public for human consumption, if such system has at least 15 service connections or regularly serves at least 25 individuals.
"Purveyor" or "water purveyor" means any person who owns or operates a public water supply.
"Reclaimed water for beneficial reuse" or "RWBR" means water that meets restricted access or public access reuse requirements specified in a NJPDES permit that authorizes that water to be directly reused for non-potable applications in place of potable water, diverted surface water, or diverted ground water. The NJPDES permit shall specify a method of disposal (for example, discharge to surface water) of that water if these requirements are not met.
"Redevelopment" means the construction of structures or improvements on areas which previously contained structures or other improvements.
"Regional authority" means any sewerage authority created by the governing bodies of two or more municipalities pursuant to N.J.S.A. 40:14A-4(c), or any municipal authority created by the governing bodies of two or more municipalities pursuant to N.J.S.A. 40:14B-5.
"Restricted access reclaimed water for beneficial reuse" means the classification of reclaimed water where the possibility of exposure to the general population is minimal and/or worker exposure is controlled. This classification of water shall require at least secondary treatment and/or compliance with effluent limitation established in a NJPDES permit. Examples of "restricted access reclaimed water for beneficial reuse" are sewer jetting, street cleaning, dust control or irrigation of restricted access locations at treatment works facilities. "Restricted access reclaimed water for beneficial reuse" does not include irrigation of public places.
"Revisions" means changes to WQM plans under N.J.A.C. 7:15-3.5 that are necessary for one or more of the purposes set forth at N.J.A.C. 7:15-3.5(b).
"Riparian zone" means the land and vegetation within and directly adjacent to all surface waters including, but not limited to, lakes, ponds, reservoirs, perennial and intermittent streams, up to and including their point of origin, such as seeps and springs, as shown the Department's GIS hydrography coverages. There is no riparian zone along the Atlantic Ocean nor along any manmade lagoon or oceanfront barrier island, spit or peninsula.
The portion of the riparian zone that lies outside of a surface water is measured landward from the top of bank. If a discernible bank is not present along a surface water, the portion of the riparian zone outside the surface water is measured landward as follows:

1. Along a linear fluvial or tidal water, such as a stream or swale, the riparian zone is measured landward of the feature's centerline;
2. Along a non-linear fluvial water, such as a lake or pond, the riparian zone is measured
landward of the normal water surface limit;
3. Along a non-linear tidal water, such as a bay or inlet, the riparian zone is measured landward of the mean high water line; and
4. Along an amorphously-shaped feature, such as a wetland complex, through which a water flows but which lacks a definable channel, the riparian zone is measured landward of the feature's centerline.

"Sewage" means any wastes, including wastes from humans, households, commercial

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establishments, industries, and stormwater runoff, that are discharged to or otherwise enter a domestic treatment works.
"Sewerage agency" means the Passaic Valley Sewerage Commissioners, a sewerage authority, a municipal authority or a joint meeting.
"Sewerage authority" means a sewerage authority created pursuant to the Sewerage Authorities Law, N.J.S.A. 40:14A-1 et seq.
"Sewer service area" means the land area identified in an areawide WQM plan from which wastewater generated is designated to flow to a domestic treatment works or industrial treatment works. A distinct sewer service area is established for each domestic treatment works and industrial treatment works.
"Significant modification" means a significant alteration, expansion or other change that may reasonably be expected to affect the quantity of flow treated or the quality of the effluent discharged to the waters of the State or to a publicly owned treatment works.
"Site-specific pollution control plan" means a plan that details necessary structures or measures designed to control one or more specified pollutants or sources of pollution from a site.
"State" means the State of New Jersey.
"Statewide Water Quality Management Plan" or "Statewide WQM Plan" (formerly known as the Statewide Water Quality Management Program Plan) means the plan that, together with this chapter, directs and coordinates water quality planning and implementation activities for the entire State, and contains the written provisions of the CPP pursuant to Section 7 of the Water Quality Planning Act (N.J.S.A. 58:11A-7).
"Steep slope" means any slope equal to or greater than 20 percent as measured over any minimum run of 10 feet. Steep slopes are determined based on contour intervals of two feet or less.
"Stormwater" means 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 sewage or drainage facilities, or is conveyed by snow removal equipment.
"Stormwater runoff" means water flow on the surface of the ground or in storm sewers, resulting from precipitation.
"Subwatershed" means a portion of an identified watershed containing all the lands from which water, sediments and dissolved materials drain to a particular receiving surface water body or to a particular point along a receiving surface water body.
"Suitable habitat" means habitat featuring ecological characteristics that may provide for the breeding, feeding, resting or sheltering of any threatened and/or endangered animal species. Ecological characteristics may include, but are not limited to, seasonal wetland or dry land, roost sites, nesting grounds, spawning sites, feeding sites, vegetative community size, age, structure, or diversity; waterway or pond water quality, size, or substrate; and soil types or hydrologic characteristics.
"Surface water quality standards" means the rules at N.J.A.C. 7:9B which set forth, for the surface waters of the State, designated uses, use classifications and water quality criteria, and the Department's policies concerning these uses, classifications and criteria.
"Threatened species" means species designated as "threatened" on the list defining the status of indigenous nongame wildlife species of New Jersey, promulgated pursuant to the Endangered and Nongame Species Conservation Act, N.J.S.A. 23:2A-1 et seq., at N.J.A.C. 7:25 – 4.17.

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"Tidal watercourse" means a watercourse that is distinguished by periodic rise and fall of the water surface resulting from the gravitational interaction of the earth, the moon, and the sun.
"Total maximum daily load" or "TMDL" means a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards or a different target where the water quality is better than the water quality standard. It is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources and includes a margin of safety and consideration of seasonal variations.
"Treatment works" means treatment works as defined at N.J.A.C. 7:14A.
"Treatment works approval" means an approval issued pursuant to N.J.S.A. 58:10A-6b and N.J.A.C. 7:14A.
"Trout maintenance waters" or "TM waters" means waters designated as TM waters in the Surface Water Quality Standards, N.J.A.C. 7:9B.
"Trout production waters" or "TP waters" means waters designated as TP waters in the Surface Water Quality Standards, N.J.A.C. 7:9B.
"201 Facilities Plans" means the plans for wastewater facilities prepared pursuant to Section 201 of the Clean Water Act, 33 U.S.C. §§ 1251 et seq.
"201 Facilities Planning agencies" means those agencies which are responsible for conducting 201 facilities planning, pursuant to Section 201 of the Clean Water Act, 33 U.S.C. §§ 1251 et seq.
"209 Basin Plans" means water resources plans adopted pursuant to Section 209 of the Clean Water Act, 33 U.S.C. §§ 1251 et seq.
"Undeveloped and underdeveloped areas" means areas that are either unimproved or contain existing improvements but could be further developed in a manner that would create additional wastewater flow without the need to obtain a variance, according to existing zoning.
"Upgrade" means a modification of a domestic or industrial treatment works to improve the quality of effluent discharged to surface water or ground water. The term "upgrade" does not include the construction or modification of any wastewater facilities that will allow an increased discharge, in terms of increased quantity of wastewater, loadings, sewer service area or collection system.
"Urbanized municipalities" means those where 90 percent of the municipality's developable land area appears as "Urban Lands" as designated in the New Jersey Department of Environmental Protection's 1995/97 and 2002 Land Use/Land Cover geographical information systems database as amended and updated, available as a digital data download from the Department at www.state.nj.us/dep/gis , based on Level I of the Anderson Classification System (Anderson et al, 1976, modified by the New Jersey Department of Environmental Protection, 1999).
"USEPA" means the United States Environmental Protection Agency.
"USGS quadrangle map" means any of the set of topographic maps published by the United States Geological Survey at 1:24,000 scale and known as "quadrangles" or "quads".
"Wasteload allocation" or "WLA" means the portion of a receiving water's total maximum daily load for a specific pollutant that is allocated to one of its existing or future point sources or categories of point sources of pollution. Wasteload allocations constitute a type of water quality based effluent limitation.
"Wastewater" means residential, commercial, industrial, or agricultural liquid waste, sewage, septage, stormwater runoff, or any combination thereof, or other residue discharged or

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collected into wastewater facilities. Wastewater shall not include stormwater runoff conveyed by a separate storm sewer system.

"Wastewater facilities" means facilities that include, but are not limited to, any equipment, plants, structures, machinery, apparatus, or land that shall be an integral part of a treatment process or used for the ultimate disposal of residues resulting from such treatment, or any combination thereof, acquired, used, constructed or operated for the storage, collection, reduction, recycling, reclamation, disposal, separation or other treatment of wastewater, wastewater sludges, septage or industrial wastes. Wastewater facilities also include, but not limited to, pumping and ventilating stations, treatment systems, plants and works, connections, extensions, outfall sewers, combined sewer overflows, intercepting sewers, trunklines, sewage collection systems, individual subsurface sewage disposal systems and other equipment, personal property and appurtenances necessary thereto.

"Wastewater management agency" means a governmental entity or sewerage agency designated in an areawide WQM Plan to plan, construct, or operate domestic treatment works.

"Wastewater management plan" or "WMP" means a written and graphic description of existing and future wastewater-related jurisdictions, wastewater service areas, and selected environmental features and treatment works.

"Wastewater management plan area" or "WMP area" means the geographic area for which a governmental unit has "wastewater management plan responsibility" as defined in N.J.A.C. 7:15-5.3(b).

"Wastewater management plan update" or "WMP update" means the periodic readoption of a wastewater management plan, with modifications as necessary from the preexisting plan to meet the requirements of this chapter, for an entire WMP area.

"Wastewater management planning agency" means a governmental unit that has "wastewater management plan responsibility" as defined in N.J.A.C. 7:15-5.3(b).

"Wastewater service area" means a sewer service area, a general service area approved for wastewater facilities with planning flows of less than 20,000 gallons per day (gpd) which discharge to ground water and general service area for wastewater facilities with planning flows of less than 2,000 gallons per day (gpd) which discharge to ground water.

"Water quality based effluent limitations" means effluent limitations established so that the quality of the waters receiving a discharge will meet the Surface Water Quality Standards, N.J.A.C. 7:9B, after the introduction of the effluent.

"Water quality limited segment" means any waterbody segment which does not meet or is not expected to meet one or more of the Surface Water Quality Standards, N.J.A.C. 7:9B, applicable to the waterbody after implementation of technology-based or more stringent effluent limitations or pollution control requirements. A water quality limited segment requires development of a TMDL(s).

"Water quality management plans" or "WQM plans" means the plans prepared pursuant to Sections 208 and 303 of the Clean Water Act, 33 U.S.C. §§ 1251 et seq., and the Water Quality Planning Act, N.J.S.A. 58:11A-1 et seq., including the Statewide, areawide, and county WQM Plans.

"Watershed" means a geographic area containing all the lands from which water, sediments and dissolved materials drain to a particular receiving surface water body or to a particular point along a receiving surface water body.

"Watershed management activity" means activities or projects undertaken by a watershed management group to improve the condition or prevent further degradation of a watershed, and

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may include, but need not be limited to, public meetings to discuss and exchange information on watershed issues, the establishment and operation of a stakeholders advisory group or groups or watershed associations dedicated to preserving and protecting a watershed, the monitoring, water quality modeling or assessment of the condition of a watershed, the development of policy goals to reduce the amount of pollutants discharged into a watershed, the development of projects designed to enhance or restore a watershed, the development, in consultation with the department, of a watershed management strategy, or the reassessment of a watershed to determine whether the policy goals or the objectives of a watershed management area plan or watershed management strategy have been attained.
"Watershed Management Area" or "WMA" means a regional area established by the Department that is comprised of multiple watersheds and subwatersheds. WMA delineations are available from the Department and on the DWM web page.
"Watershed Management Area Plan" or "WMA plan" means the plan developed and adopted by the Department, in consultation with the PAC, to protect and improve New Jersey's water and water-related resources by identifying actions to maintain, restore and enhance existing water quality, water quantity and ecosystem health, wherever attainable, within a watershed management area.
"Watershed management group" means a group recognized by the Department pursuant to N.J.A.C. 7:15-9.3(b) as the entity representing various interests within one or more watersheds or subwatersheds located in a watershed management area and whose purpose is to improve the condition or prevent further degradation of a watershed or watersheds.
"Watershed management strategy" means a plan developed by a WMG, in consultation with the PAC and the Department, to improve the condition of one or more watersheds or reassess a watershed to determine whether the policy goals or the objectives of the watershed management area plan or watershed management strategy have been attained.
"Wetlands" means those areas defined as wetlands under any of the following statutes and implementing rules as applicable:

1. New Jersey Coastal Wetlands Act, N.J.S.A. 13:9A-1 et seq., at N.J.S.A. 13:9A-2;
2. New Jersey Freshwater Wetlands Protection Act, N.J.S.A. 13:9B-1 et seq., at N.J.S.A. 13:9B-3, and N.J.A.C. 7:7A-1.4;
3. Coastal Area Facility Review Act, N.J.S.A. 13:19-1 et seq., at N.J.S.A. 13:19-4, and N.J.A.C. 7:7E-3.25; and
4. Pinelands Protection Act, N.J.S.A. 13:18-1 et seq., at N.J.S.A. 13:18A-3 and 13:18A-11, and N.J.A.C. 7:50-3.1, 6.3, 6.4 and 6.5.

"WMP" means wastewater management plan.
"Work programs and plans" means those documents that detail the specific work activities proposed as part of a water quality management program.
"WQM plan" means water quality management plan.

7:15-1.6 Program forms and information; Internet web site

(a) Forms or other information related to this chapter may be obtained from the Division of Watershed Management as follows:

1. Through the Division of Watershed Management website at www.state.nj.us/dep/watershedmgt; or
2. By contacting the Division of Watershed Management at: New Jersey Department of

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Environmental Protection, Division of Watershed Management, PO Box 418, Trenton, New Jersey 08625, (609) 984-0058.

(b) Applications and correspondence shall be submitted to the address in (a)2 above, except that courier and hand deliveries shall be delivered to: New Jersey Department of Environmental Protection, Division of Watershed Management, 401 East State Street, 7th Floor West Wing, Trenton, New Jersey 08625.

(c) Applications or other materials sent or delivered to a Department address other than those in (a) and (b) shall not be deemed to have been received for the purposes of calculating application review deadlines or other time periods under this chapter, until the application is actually received by the Division of Watershed Management, unless the application is being submitted directly to a permit program for a consistency determination under N.J.A.C. 7:15-3.2.

(d) Other Department sources of information referred to in this chapter are available on the Department of Environmental Protection's website at www.state.nj.us/dep or from the Office
of Maps and Publications, located at 428 State Street, Trenton, New Jersey 08625, (609) 777-1038.

7:15-1.7 Conservation restriction form and recording requirements

(a) A conservation restriction required at N.J.A.C. 7:15-3.5(b)4x shall be recorded in the chain of title for all properties affected by the restriction.

(b) A conservation restriction shall:

1. Be in the appropriate form and terms as specified and approved by the Department as protecting all environmental features in accordance with the definition of "conservation restriction" in this chapter and with the New Jersey Conservation Restriction and Historic Preservation Restriction Act, N.J.S.A. 13:8B-1 et seq. Conservation restrictions may include preservation of continuing agricultural uses pursuant to N.J.A.C. 7:15-3.5(b)4x(3);
2. Be recorded in accordance with the New Jersey Recording Act, N.J.S.A. 46:15-1.1 et seq., and
3. Run with the property and be binding upon the property owner and the successors in interest in the property or in any part thereof.

(c) The Department shall not grant any approval under this chapter until the applicant has provided to the Department proof that a conservation restriction complying with this section has been recorded in the office of the clerk of the county or the registrar of deeds and mortgages of the county in which the project or activity is located.

SUBCHAPTER 2. PLANNING REQUIREMENTS

7:15-2.1 Continuing planning process (CPP)

(a) The Department shall conduct a continuing planning process (CPP) whose written provisions shall be contained, directly or by reference, in the Statewide WQM Plan and this chapter. In conducting the CPP, the Department shall:

1. Integrate and unify the Statewide and areawide water quality management planning processes;
2. Encourage, direct, supervise and aid areawide water quality management planning;

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3. Coordinate and integrate WQM plans with related Federal, State, regional and local comprehensive land use, functional and other relevant planning activities, programs and policies;
4. Identify aspects of the CPP that have been delegated to other State, Federal, interstate,
or local agencies;
5. Provide opportunities for meaningful public participation in the water quality management planning process;
6. Conduct a Statewide assessment of water quality. The Integrated Water Quality Monitoring and Assessment Report shall be the principal water quality assessment component of the Statewide WQM Plan;
7. Establish water quality goals and water quality standards for the waters of the State; and
8. Develop a Statewide implementation strategy to achieve the water quality standards and objectives and meet the requirements of Section 303(e) of the Clean Water Act (33 U.S.C. §§ 1251 et seq.), which shall include, but not be limited to:
   i. The determination of effluent limitations and schedules of compliance at least as stringent as those required by the Clean Water Act (33 U.S.C. §§ 1251 et seq.);
   ii. The identification of water quality limited segments;
   iii. The determination of total maximum daily loads, wasteload allocations, and load allocations for pollutants;
   iv. The incorporation of areawide and county WQM plans, applicable 209 Basin Plans, 201 Facilities Plans, and wastewater management plans;
   v. The amendment and revision of WQM plans, including schedules for such amendment and revision;
   vi. An inventory and ranking of needs, in order of priority, for the construction of
   wastewater facilities;
   vii. The determination of priorities for the issuance of discharge permits;
   viii. Methods for controlling all residual wastes from any water treatment processing; and
   ix. Adequate authority for intergovernmental cooperation in water quality management activities.

(b) In order to accomplish one or more of the requirements of (a) above, the CPP may also include or otherwise address, but not be limited to, one or more of the following:
1. Identification of existing or potential surface or ground water pollution problems, caused by point or nonpoint sources;
2. Evaluation of programs for water pollution control based upon factors that may include, but not be limited to, technical feasibility; cost- effectiveness; public acceptability; economic, social, or environmental impact; or legal, institutional, managerial or financial capability;
3. Technical measures, regulatory programs, or non-regulatory programs for point or nonpoint source water pollution control, protecting water resources, protecting environmentally sensitive areas, or other water quality related issues;
4. Designation of management agencies to implement one or more provisions of WQM

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plans; and
5. Other measures necessary to implement WQM plans.

7:15-2.2 Relationship between the Statewide, areawide and county Water Quality Management Plans

(a) The Statewide WQM Plan and this chapter contain the written provisions of the CPP. The Statewide WQM Plan and this chapter direct and coordinate water quality management planning and implementation activities for the entire State and serve as a guide for areawide planning. The Statewide Water Quality Management Plan adopted by the Commissioner on December 5, 1985 and all subsequent amendments and revisions thereto are hereby incorporated by reference into this chapter. This chapter is included within the Statewide WQM Plan.

1. The Statewide Water Quality Management Plan may be inspected at the Division of Watershed Management, Department of Environmental Protection, 401 East State Street,
Trenton, New Jersey, or the Office of Administrative Law, Quakerbridge Plaza, Building 9, Trenton, New Jersey.

(b) The areawide WQM Plan is the basis by which the Department and the designated planning agencies conduct selected water quality management planning activities for a particular "area" or section of the State which has either designated or non-designated area status.

(c) If any elements of any areawide WQM plan conflict with any component of the Statewide WQM Plan identified under N.J.A.C. 7:15-3.1(e) or with this chapter, such elements shall be of no legal effect and shall be superseded by this chapter and the Statewide WQM Plan to the extent that such conflict exists.

(d) All WQM plans shall be consistent with State statutes and rules and to the extent they are not consistent shall have no legal force and effect.

(e) Every county planning board may conduct a county-wide water quality management planning process and prepare a county WQM plan.

1. County WQM plans shall not be in conflict with the Statewide WQM Plan, appropriate areawide WQM plans, or this chapter. If any elements of any county WQM plan conflict with the Statewide WQM Plan, appropriate areawide WQM plans, or this chapter, such elements shall be superseded by the Statewide WQM Plan, areawide WQM plans, or this chapter to the extent that such conflict exists.
2. Each county planning board that prepares or changes a county WQM plan shall transmit a copy of that plan or change to the DWM, and to any designated planning agency whose designated area includes part or all of the subject geographic area.
3. Consistency of projects and activities with county WQM plans shall be required under N.J.A.C. 7:15-3.1 or 3.2, only to the extent that county WQM plans or components thereof are adopted into areawide WQM plans pursuant to N.J.A.C. 7:15-3.4 or 3.5.

7:15-2.3 Role of the Department

(a) The Department shall:

1. Conduct a CPP and prepare a Statewide WQM Plan;
2. Prepare areawide WQM plans for non-designated areas:

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3. Revise and amend the Statewide WQM Plan as necessary;
4. Coordinate and direct the activities of designated planning agencies;
5. Review and approve areawide work programs;
6. To the maximum extent feasible, act as a resource for designated planning agencies, county planning boards, and county boards of chosen freeholders, providing them with technical assistance, and information on best management practices and pollution control technologies;
7. Require the preparation and updating of wastewater management plans, and provide for their review and adoption into areawide WQM plans;
8. Establish and administer policies, procedures, standards, criteria, and rules for water quality and wastewater management issues;
9. Identify water quality limited segments;
10. Establish total maximum daily loads, wasteload allocations, load allocations, and water quality based effluent limitations;
11. Prepare an Integrated Water Quality Monitoring and Assessment Report, and other reports required from the State under the Clean Water Act, 33 U.S.C. §§ 1251 et seq.;
12. Perform consistency determination reviews, and otherwise ensure that projects and activities affecting water quality do not conflict with WQM plans or this chapter;
13. Delegate aspects and responsibilities of the CPP to other State, Federal, interstate, county or local agencies, and also withdraw or transfer such delegations as necessary; and
14. Make recommendations to the Governor regarding designation of planning agencies and planning areas under N.J.S.A. 58:11A-4.

7:15-2.4 Role of designated planning agencies

(a) The designated planning agencies shall:

1. Prepare, revise, and amend the areawide WQM plans for their designated areas;
2. Fulfill all responsibilities assigned to them under this chapter, the Statewide WQM Plan, the areawide WQM plan, their charter, any grant agreement, approved work program, and any agreement with the State;
3. Carry out other responsibilities as agreed with or assigned by the Department under N.J.A.C. 7:15-2.3; and
4. Ensure that the areawide WQM plan shall not be in conflict with any component of this chapter or the Statewide WQM Plan and shall not otherwise conflict with State statutes or duly promulgated rules.

(b) The Department and the designated planning agencies shall coordinate their work in shared river basins or sub-basins, and shall refer any conflicts concerning such coordination to the Commissioner for his mediation.

(c) If a previously designated area becomes a non- designated area as a result of action by the Governor, the Department shall conduct areawide water quality management planning for
that area.

SUBCHAPTER 3. PLAN ASSESSMENT, AMENDMENT AND ADOPTION

7:15-3.1 Water quality management plan consistency requirements

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(a) All projects and activities affecting water quality shall be developed and conducted in a manner that does not conflict with this chapter or adopted WQM plans. The Commissioner shall not undertake, nor shall he or she authorize through the issuance of a permit, any project or activity that conflicts with applicable sections of an adopted WQM plan or with this chapter. For purposes of N.J.A.C. 7:15-3.1 and 3.2, "permit" includes permits, approvals, certifications, and similar actions. The Department shall conduct the consistency determination review or other consistency review for a Department permit concurrently with the Department's review of the permit application. The Department shall not issue the permit if the Department finds the project or activity to be inconsistent with a WQM plan or this chapter.

(b) The Department shall not grant permits for the following projects and activities before a formal consistency determination review under N.J.A.C. 7:15-3.2 has been completed:

1. New surface water or ground water discharges, or existing surface or ground water discharges proposing significant modifications, as well as expansions and upgrades, that require individual NJPDES discharge permits under the Pollutant Discharge Elimination System rules, N.J.A.C. 7:14A, and the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq.;

2. Treatment works that require treatment works approvals under the Pollutant Discharge
Elimination System rules, N.J.A.C. 7:14A-22, and the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq.;

3. Actions under the Coastal Permit Program rules, N.J.A.C. 7:7, that require:

i. Individual permits; or

ii. Authorizations under the coastal general permits at N.J.A.C. 7:7-7.5, 7.8, 7.13, 7.16, and 7.26;

4. Actions under the Freshwater Wetlands Protection Act rules, N.J.A.C. 7:7A, that require:

i. Individual freshwater wetland permits;

ii. Individual open water fill permits;

iii. Authorizations under the general permits at N.J.A.C. 7:7A-5.2, 5.2A, 5.6, 5.7, 5.10A, 5.10B, 5.10C, 5.11 and 5.11A; or

iv. Transition area waivers for the following:

(1) Hardship transition area waivers under N.J.A.C. 7:7A-6.5;

(2) Transition area waivers for activities authorized under the general permits at N.J.A.C. 7:7A-5.2, 5.2A, 5.6, 5.10A, 5.10B, 5.10C, 5.11 and 5.11A;

(3) Special activity transition area waivers under N.J.A.C. 7:7A-6.3, except special activity transition area redevelopment waivers for redevelopment under N.J.A.C. 7:7A-6.3(f);

(4) Transition area averaging plan waivers under N.J.A.C. 7:7A-6.2; and

(5) Matrix type width reduction transition area waivers under N.J.A.C. 7:7A-6.4;

5. Construction of the following new solid waste facilities, other than hazardous waste facilities and minor expansions of solid waste facilities, regulated by N.J.A.C. 7:26:

i. New sanitary landfills other than vertical expansions;

ii. New solid waste composting or co- composting facilities over one acre, but excluding

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leaf composting facilities;

iii. New resource recovery facilities and new solid waste materials recovery facilities; and

iv. New solid waste incinerators and thermal destruction facilities;

6. Sanitary landfill closures where leachate collection and control is required under N.J.A.C. 7:26;

7. Construction of new hazardous waste facilities regulated by N.J.A.C. 7:26;

8. Any major Highlands development in the Highlands preservation area that requires a Highlands Applicability and Water Quality Management Plan Consistency Determination pursuant to N.J.A.C. 7:38-2.4;

9. Construction of 50 or more realty improvements requiring a Department certification under the Realty Improvement Sewerage and Facilities Act, N.J.S.A. 58:11-23 et seq.;

10. Adoption or amendment of environmental health ordinances to control water pollution under the County Environmental Health Act, N.J.S.A. 26:3A2-21 et seq.;

11. Actions that require water supply system certifications for new, altered or replacement nonpublic or public noncommunity water systems that expand capacity or extend service to a new area issued pursuant to the Safe Drinking Water Act rules, N.J.A.C. 7:10-12, where the Department is the administrative authority;

12. Actions that require water supply system construction or operation permits for new or modified public community water systems that expand capacity or extend service to a new area issued pursuant to the Safe Drinking Water Act rules, N.J.A.C. 7:10-11;

13. Actions that require well construction permits issued pursuant to the Well Construction and Maintenance; Sealing of Abandoned Wells rules, N.J.A.C. 7:9D, for the following well categories:

i. All category 1 potable water supply wells as identified at N.J.A.C. 7:9D-2.1(a)1;

ii. Category 2 non-potable water supply wells, specifically, irrigation, test, industrial and open loop geothermal wells, as identified at N.J.A.C. 7:9D-2.1(a)2; and

iii. Category 4 special use wells, specifically, closed-loop geothermal wells, as identified at N.J.A.C. 7:9D-2.1(a)4;

14. Actions that require new water usage certifications, or the renewals of water usage certifications if an increase in water withdrawal for a new or different use is proposed as part of the renewal, pursuant to the Agricultural, Aquacultural, and Horticultural Water Usage Certification rules, N.J.A.C. 7:20A;

15. Actions that involve diversions of surface or ground waters that require water supply allocation permits pursuant to the Water Supply Allocation rules, N.J.A.C. 7:19, except for activities requiring a temporary dewatering permit, short term water use or dewatering permit by-rule under N.J.A.C. 7:19-2.17;

16. Actions that require a Department-issued permit under the Flood Hazard Area Control Act Rules, N.J.A.C. 7:13, except for:

i. Bank stabilization projects that use only vegetation and/or soil-bioengineering as described at section 650.1601(d)(2) of Chapter 16 of the USDA Natural Resource Conservation Service (NRCS) Engineering Field Handbook, published December 1996, incorporated herein by reference. Copies of the NRCS Engineering Field Handbook can be obtained from USDANRCS,

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220 Davidson Ave., 4th Floor, Somerset, NJ 08873-4115 (telephone (732) 537-6040); and

ii. Permits-by-rule under N.J.A.C. 7:13-7;

17. Actions within the Hackensack Meadowlands District (see N.J.S.A. 13:17-4), that require water quality certifications pursuant to N.J.S.A. 58:10A-5.b and Section 401 of the Clean Water Act (33 U.S.C. §§1251 et seq.); and

18. Actions that require permits under the Dam Safety Standards, N.J.A.C. 7:20, for construction of Class I through III dams that are not covered by a permit-by-rule pursuant to N.J.A.C. 7:20-1.3.

(c) Projects and activities not listed in (b) above do not require a formal consistency determination review under N.J.A.C. 7:15-3.2, but shall not conflict with any applicable WQM plans.

(d) At the request of any person who intends to apply for a Department permit, the Department shall informally discuss with such person the consistency of such person's proposed project or activity with WQM plans and this chapter. Information provided by the Department in such discussions is for guidance only, and is not binding on the Department.

(e) The only components of the Statewide WQM Plan that shall be used in performing consistency determination reviews and other consistency reviews are those components of the Statewide WQM Plan specified or adopted under this chapter.

(f) Interested parties may comment on the consistency of Department permits with WQM plans and this chapter through the appropriate draft or final permit public review and comment process. Such comments shall be taken into consideration prior to the issuance of a final permit.

(g) At the request of any applicant whose proposed project or activity has been found by the Department to be inconsistent with a WQM plan or this chapter, the Department may informally discuss with that applicant the possible actions which that applicant might take to attempt to resolve the conflict. Such actions may include revising the project or activity to conform with the WQM plan and this chapter, seeking an amendment to the WQM plan under N.J.A.C. 7:15-3.4, seeking a revision to the WQM plan under N.J.A.C. 7:15-3.5, or appealing the Department's finding under N.J.A.C. 7:15- 3.9(a) or (g). The applicant may take such actions without regard to the existence or absence of a discussion or a request for a discussion under this subsection. Information provided by the Department in such discussions is for guidance only, and is not binding on the Department or the designated planning agencies. If the project or activity is in a designated area, the Department shall invite the designated planning agency to participate in the discussion.

7:15-3.2 Procedures for consistency determination reviews

(a) Except for applications for projects or activities in the Highlands preservation area, which are addressed in (d) below, a complete application for a consistency determination review shall, where applicable, include, but not be limited to, all of the information in 1 through 13 below. If the consistency determination is being requested as part of a permit application, information contained in that application need not be duplicated.

1. The name and address of the applicant;

2. The address of the location of the project or activity;

3. The lot and block numbers for the entire site where the proposed project or activity will occur;

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4. The municipality and county names where the proposed project or activity will occur;
5. The total land area in acreage of the entire site of the proposed project or activity;
6. If there is an adopted applicable wastewater management plan, a certification by the applicant that the proposal was part of the zoning approval, without variance, upon which the wastewater management plan was based;
7. The approximate boundaries of the project or activity site clearly delineated on a USGS quadrangle map, including the title-name of the quad, or geographic information systems (GIS) coverage and the State Plane coordinates in NAD 1983 for a point at the center of the site. The accuracy of these coordinates should be within 50 feet of the actual point. For linear projects, the applicant shall provide State plane coordinates for the endpoints of those projects that are 1,999 feet or less, and, for those projects that are 2,000 feet or longer, the endpoints as well as additional coordinates at each 1,000-foot interval. For assistance in determining the State Plane coordinates for a site, see the i-Map webpage at nj.gov/dep/gis/depsplash.htm;
8. A description of the type of proposed development or activity including the number of dwelling units if residential, or the proposed square footage if commercial, institutional or industrial;
9. A description of the proposed method of wastewater treatment. Indicate if the project or activity will be served by an individual subsurface sewage disposal system or identify the existing or anticipated domestic or industrial treatment works proposed to be used. If a new domestic or industrial treatment works is proposed, include the proposed owner and operator of the domestic or industrial treatment works and the proposed location of the domestic or industrial treatment works and the discharge location;
10. A description of the proposed water supply. Indicate if the project or activity will be served by an individual well, public community well, non-public community well or identify the existing or anticipated water service area including name of purveyor. If a new water service area is proposed, include the proposed water purveyor and the proposed location and type of water supply;
11. A folded site plan showing all of the following:
    i. All proposed site improvements;
    ii. A Department-verified wetlands delineation, if one exists;
    iii. Waterbodies within 300 feet of the proposed project; and
    iv. All steep slopes;
12. If an applicant intends to demonstrate that its project or activity site was not withdrawn from a wastewater service area because it is infill development pursuant to N.J.A.C. 7:15-8.1(b)1, the applicant shall include documentation regarding the following:
    i. Proof there is a lawfully existing public sewer line in the right-of-way adjoining the project or activity site lot or lots such that a connection can be made without crossing any property lines other than that of the lot to be served and where such connection does not require the extension of a collection system;
    ii. Proof the sewer lines existed on the date that wastewater service area was withdrawn; and

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iii. Proof that the total flow projection from the lot or lots between the previously connected properties does not exceed 2,000 gallons per day; and

13. If an applicant intends to demonstrate that its project or activity is part of a residential development or subdivision of fewer than six dwelling units pursuant to N.J.A.C. 7:15-8.1(c)2, the applicant shall include documentation regarding previous development and development on contiguous parcels or property in accordance with N.J.A.C. 7:15-8.1(c)2, including, but not limited to, the size of the lot and the date the lot was created.

(b) Based upon potential negative water quality impacts of the project, the Department may require the applicant for a consistency determination to also include in its application information on potential water quality impacts and a site specific pollution control plan. In most cases, the Department intends that requirements for such inclusion shall be established through amendments to areawide WQM plans. Any areawide WQM plan that establishes such requirements shall specify the categories of projects that are subject to the requirements, the pollutants or sources of pollution that shall be addressed, and the geographic region in which the requirements apply, if that region is less than the entire designated area or non-designated area.

(c) Except for applications for projects or activities in the Highlands preservation area, which are addressed in (d) below, the Department shall perform consistency determination reviews in accordance with the following procedures:

1. Upon receipt of a complete application for consistency determination review or a complete permit application, the Department shall review the appropriate WQM plan and this chapter to determine whether the project or activity is consistent with the written provisions of the plan and this chapter. This review shall include, but not be limited to, the following plan components where applicable:

i. Population forecasts;

ii. Wastewater flow projections;

iii. Available capacity at DTW or industrial treatment works;

iv. Identification of appropriate DTW or industrial treatment works;

v. Identification of appropriate wastewater service area;

vi. Identification of appropriate project management agency;

vii. Use of Best Management Practices for pollution control in accordance with the Stormwater Management rules, N.J.A.C. 7:8;

viii. Identification of areas suitable or unsuitable for development with consideration of riparian zones and steep slopes;

ix. Other water quality based policies, goals, objectives, or recommendations;

x. 201 Facilities Plan grant conditions;

xi. Total maximum daily load conditions or limitations; and

xii. Water supply availability.

2. The Department shall complete this review within 90 days of receipt of a complete application for consistency determination review or within the timeframe as established in the rules for the applicable permit(s).

3. Upon completion of the review, the Department shall, except as provided in (c)4 below, issue a consistency determination. This determination shall state that the project or activity is either consistent with, inconsistent with, or not addressed by, the WQM plan and this chapter.

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i. A project or activity shall be determined to be consistent if it is in accordance with the written provisions of the WQM plan and this chapter.
ii. If the WQM plans and this chapter do not contain provisions precluding a project or activity, then this shall be interpreted to mean that the project or activity is not addressed. A finding of "not addressed" is equivalent in effect to a finding of consistent.
iii. A finding of inconsistent means that the project or activity is in conflict with the written provisions of a WQM plan or this chapter.

4. If the Department finds that a project or activity is consistent or not addressed, then the Department may issue a statement of this finding to the applicant or may issue the permit without issuing a written consistency determination.
5. Except as provided in (c)6 below, all Department findings made for Department permits under (c)4 above shall be valid only for the permit application for which the consistency determination review was sought.
6. If a project or activity requires two or more Department permits, and if the Department makes a finding under (c)4 above for one of those permits, that finding shall be valid for the remaining Department permits unless:
i. The project or activity has become inconsistent, because of an amendment made to the WQM plan or this chapter after the initial finding; or
ii. The Department denies a permit in response to comments received under N.J.A.C. 7:15-3.1(f).
7. If the Department finds a project or activity to be inconsistent, then the Department shall notify the applicant in writing of the reasons for this finding. The applicant may request an informal discussion of the conflict under N.J.A.C. 7:15-3.1(g).

(d) For projects or activities in the Highlands preservation area, a complete application for a consistency determination review shall include all relevant information identified pursuant to N.J.A.C. 7:38-9.2 and 9.3. The Department shall perform consistency determination reviews for projects and activities in the Highlands preservation area in accordance with N.J.A.C. 7:38-11.2, 11.3 and 11.7.

7:15-3.3 (Reserved)

7:15-3.4 Water quality management plan amendment procedures

(a) The Department and the designated planning agencies shall propose amendments to the Statewide and areawide WQM Plans whenever such amendments are necessary or desirable. Amendments may be proposed for various reasons, such as to implement or comply with applicable State or Federal law; respond to new circumstances; improve the economic, social, or environmental impact of WQM plans; or resolve issues disclosed through the consistency review procedure.

(b) Procedures for amendment of the Statewide WQM Plan are as follows:
1. Water quality related provisions in present and future rules adopted by the Department shall be considered to be part of the Statewide WQM Plan. Such provisions may not be adopted, amended, or repealed through the WQM plan amendment process under (b)6 below.
2. Priority systems, intended use plans and project priority lists for wastewater facilities that are developed by the Department and accepted by the United States Environmental

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Protection Agency (USEPA) pursuant to USEPA regulations, or that otherwise are developed by the Department under N.J.A.C. 7:22, shall be considered to be part of the Statewide WQM Plan. Such priority systems and project priority lists shall be adopted or revised in accordance with USEPA regulations and N.J.A.C. 7:22, as appropriate, and shall not be adopted or revised through the WQM plan amendment process under (b)6 below.

3. Statewide Sludge Management Plans, District Sludge Management Plans and sludge management rules that are promulgated or approved by the Department pursuant to N.J.S.A. 13:1E-1 et seq. shall be considered to be part of the Statewide WQM Plan. Such plans and rules shall be promulgated, revised, updated or approved in accordance with N.J.S.A. 13:1E-1 et seq., and shall not be promulgated, revised, updated, or approved through the WQM plan amendment process under (b)6 below.

4. Lists of water quality limited segments, and schedules for TMDL development, which are developed by the Department under N.J.A.C. 7:15-6, shall be adopted as amendments to the Statewide WQM Plan. TMDLs developed in accordance with N.J.A.C. 7:15-6.3 shall be adopted as amendments to the relevant areawide WQM plan(s). However, such lists, and TMDLs shall be adopted or revised in accordance with N.J.A.C. 7:15-6 and shall not be adopted or revised through the WQM plan amendment process under (b)6 below.

5. A regional stormwater management plan prepared in accordance with N.J.A.C. 7:8-3 shall be submitted only by a lead planning agency as a proposed amendment to the applicable areawide WQM plan. In addition, the following changes to an adopted regional stormwater management plan shall be processed as amendments to applicable areawide WQM Plans under this section:

i. The addition, deletion or modification to any of the drainage area-specific water quality, groundwater recharge or water quantity objectives identified under N.J.A.C. 7:8-3.5;

ii. The addition, deletion or modification to any drainage area-specific design or performance standard developed under N.J.A.C. 7:8-3.6;

iii. Any modification to a regional stormwater management plan that the Department or designated planning agency determines is likely to have a significant environmental, social, or economic impact; or

iv Any modification that the applicant requests be processed as an amendment.

6. Components of the Statewide WQM Plan other than (b)1 through 5 above may be amended by using the procedure specified in (g) below, except that the Commissioner shall render the final decision identified in (g)9 below.

(c) Areawide WQM plans for designated areas may be amended by designated planning agencies pursuant to their approved plan amendment procedures. The Department may amend the areawide WQM plan for any non designated area, pursuant to the procedures under (g) below. Amendments or provisions thereof for any areawide WQM plan whose specific purpose or effect is to address projects or activities covered by (i) below, or that are either proposed, constructed, operated or conducted by the State or Federal government, or that are regulated by the Solid Waste Management Act (N.J.S.A. 13:1E-1 et seq.), shall be processed only by the Department, regardless of whether the areawide WQM plan is for a designated area or a nondesignated area. By the mutual consent of the Department and the designated planning

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agency, the Department may also process all other amendments to an areawide WQM plan for a designated area.

(d) Plan amendment procedures developed by the designated planning agencies shall be consistent with this section and approved by the Department. Such procedures shall include, but need not be limited to, provisions that:

1. Allow any interested person to submit to the designated planning agency written, documented petitions to amend the areawide WQM plan;
2. Provide for review by the Department of all proposed amendments prior to public notice;
3. Allow the Department to identify governmental entities, sewerage agencies, and BPU regulated sewer or water utilities that shall be requested to issue written statements of consent for proposed amendments, such parties being in addition to any governmental entities, sewerage agencies, and BPU-regulated sewer or water utilities identified by the designated planning agency;
4. Provide for publication of public notice of proposed amendments in the New Jersey Register and in a newspaper of general circulation in the designated area; and
5. Provide for adequate public comment periods and opportunities for public hearings before the designated planning agency decides whether to approve an amendment.

(e) Designated planning agency plan amendment procedures approved by the Department prior to July 7, 2008 shall remain in full force and effect, unless or until modified by the designated planning agency and approved by the Department under this section. Where a designated planning agency does not have its own plan amendment procedure or where a designated planning agency is de-designated, the Department's plan amendment procedure in (g) below shall be used.

(f) Within 15 days of approving an amendment, a designated planning agency shall submit to the DWM a copy of the amendment, together with background information for that amendment. WQM plan amendments approved by designated planning agencies are valid only upon the subsequent adoption of such amendments by the Governor or his or her designee.

(g) The Department procedure for amendment of areawide WQM plans is as follows:

1. For amendments which are the Department's responsibility under (c) above, any interested person may petition the Department to amend the areawide WQM plan, or the Department may propose to amend the areawide WQM plan on the Department's own initiative. Applications for amendments shall be submitted to the Division of Watershed Management, Department of Environmental Protection, PO Box 418, 401 East State Street, 7th Floor, Trenton, New Jersey 08625-0029.
2. Except for applications for plan amendments for projects or activities in the Highlands preservation area, which are addressed in (j) below, applications for amendments shall include, but need not be limited to, a description of the proposed amendment, including documentation substantiating the need for the amendment, and other documentation as determined by the Department to be necessary to determine compliance with the criteria established at N.J.A.C. 7:15-5.24 and 5.25. Within 90 days of receiving an amendment application, the Department shall review the application and shall either:
    i. Disapprove the amendment application, and return it to the applicant; or
    ii. Return the amendment application to the applicant for additional information or other necessary changes. If the applicant then submits a revised amendment

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application, the Department shall, within 90 days of receiving the revised amendment application, review such application and render a decision under (g)2i above, this subparagraph, or (g)2iii below; or

iii. Decide to proceed further with the amendment application.

3. The Department shall notify the applicant and the applicable designated planning agency, if any, in writing of its decision under (g)2 above. If the Department's decision is to proceed further with the amendment application under (g)2iii above, then this notification shall include the public notice that shall be given for the proposed amendment. If the proposed amendment is a regional stormwater management plan, the Department shall also notify the Department of Community Affairs, the Department of Transportation, and the Department of Agriculture. The applicant shall request written statements of consent under (g)4 below, and shall give public notice by publication in a newspaper of general circulation at the applicant's expense. The Department shall maintain a list identifying the newspaper that shall be used for this purpose in each planning area. The public notice shall also be published in the New Jersey Register. In cases where such Department decisions include a requirement for a non-adversarial public hearing, the public notice shall provide at least 30 days notice of the hearing.

4. Requirements concerning written statements of consent for plan amendments are as follows:

i. As part of each notification of a decision under (g)2iii above, the Department may identify a list of governmental entities, sewerage agencies, and BPU-regulated sewer and water utilities that may be affected by, or otherwise have a substantial interest in, approval of the proposed amendment, and that shall be asked to issue written statements of consent for the proposed amendment. Within 15 days of receiving such notification, the applicant shall submit by certified mail (return receipt requested) a copy of the proposed amendment to these parties, with a request that they issue written statements of consent for the proposed amendment within 60 days of their receipt of the request.

ii. A written statement of consent shall include a statement that the party concurs with, or does not object to, the proposed amendment. Tentative, preliminary, or conditional statements shall not be considered to be statements of consent. A statement of consent by a governmental unit shall be in the form of a resolution by that unit's governing body. If the party objects in writing to the proposed amendment, the party shall state all reasons for objection in writing.

iii. The applicant shall promptly forward to the DWM a copy of all written statements of consent and other written comments received, and a copy of all requests for consent (with return receipts) sent to parties that did not provide written statements of consent or other written comments within 60 days of their receipt of such requests.

iv. Where a party identified under (g)4i above denies a request for a written statement of consent or does not issue a written statement of consent, the reasons therefor, if known on the basis of reasonably reliable information, shall be considered in making decisions under (g)8 and 9 below.

5. When the Department proposes to amend the areawide plan on its own initiative, the

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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 under (g)3 and 4 above. The public notice shall also be published in the New Jersey Register.

6. Interested persons, including, but not limited to, those from whom written statements of consent are requested under (g)4i or 5 above, may submit written comments to the DWM within 30 days of the date of the public notice. Interested persons may request that the public comment period be extended up to 30 additional days, and such extensions may be granted to the extent they appear necessary. Requests for such extensions shall be submitted in writing to the DWM within 30 days of the date of the public notice.

7. Interested persons may also request that the Department hold a non-adversarial public hearing; such requests shall be submitted in writing to the DWM within 30 days of the date of the public notice. If there is significant interest, as determined by the Department, in holding a public hearing, then a public hearing will be held. A public notice providing at least 30 days notice of the hearing will be published in the New Jersey Register and in one newspaper of general circulation, and will be mailed to the applicable designated planning agency, if any, and to each party who was requested to issue a written statement of consent for the amendment. The public comment period will be extended until 15 days after the hearing. Except when the Department proposes to amend areawide WQM plans on its own initiative, the applicant shall, at the applicant's expense, mail the public notice, provide for publication of the public notice in one newspaper, secure a court stenographer, and provide three copies of a verbatim transcript of the hearing to the DWM.

8. If any data, information or arguments submitted during the public comment period or in response to a request for written statement of consent appear to raise substantial new questions concerning a proposed plan amendment, the Department may:

i. Reopen or extend the public comment period for no more than 30 additional days to give interested persons an opportunity to comment on the information or arguments submitted;

ii. Disapprove the proposed amendment and, where applicable, return it to the applicant;

iii. Return the amendment request to the applicant for necessary, substantial changes. If the applicant then submits a revised amendment request, the Department shall review such request in the same manner as a revised amendment request submitted under (g)2ii above; or

iv. Prepare a new proposed plan amendment, appropriately modified, for proposal under this section.

9. Except where the Department has already disapproved or returned the proposed amendment under (g)8 above, the Governor or his or her designee shall render a final decision on the amendment. Wastewater management plans and wastewater management plan updates shall not be approved unless documentation has been submitted to the Department demonstrating that municipal ordinances required under N.J.A.C. 7:15-5.25 have been adopted and conform to the requirements of this chapter. The Governor or his or her designee shall either:

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i. Adopt the amendment as proposed;
ii. Adopt the proposed amendment with minor changes that do not effectively destroy the value of the public notice; or
iii. Disapprove the proposed amendment and, where applicable, return it to the applicant.

10. The Department shall provide written notification of the decision of the Governor or his or her designee to the applicant where applicable. Notice of the final decision shall also be published in the New Jersey Register.

11. The Department shall retain the administrative record for WQM Plan amendments for the following periods of time:

i. For each amendment adopted under (g)9 above, a period of not less than three years from the effective date of the amendment.
ii. For each proposed amendment disapproved or returned under (g)2, 8, or 9 above, a period of not less than one year from the date of disapproval or return.

(h) (Reserved)

(i) Effluent limitations, including, but not limited to, water quality based effluent limitations, and schedules of compliance established as NJPDES permit conditions under N.J.A.C. 7:14A-13 shall be considered to be part of the areawide WQM plans. NJPDES permit conditions shall be modified only through the procedures specified in the Department's New Jersey Pollutant Discharge Elimination System rules (N.J.A.C. 7:14A), in accordance with applicable Department rules, and shall not be modified through the WQM plan amendment process under (c) or (g) above. This subsection, however, shall not preclude the adoption of effluent limitations or schedules of compliance in areawide WQM plans under (g) above, prior to the establishment of such effluent limitations or compliance schedules as new or revised NJPDES permit conditions.

(j) Applications for plan amendments for projects located in the Highlands preservation area that require a Highlands Preservation Area Approval shall be governed by the application filing and related procedures set forth in the Highlands Water Protection and Planning Act rules at N.J.A.C. 7:38-11.6. If the Department determines to proceed with the amendment application, then the amendment shall be processed in accordance with (g)3 through 11 above.

(k) Water quality management planning related documentation in 201 Facilities Plans approved by the Department and USEPA after May 31, 1975 shall constitute amendments to areawide WQM plans. This documentation may include, but is not limited to: selected facilities alternative, future design capacity and flows, treatment levels, sewer service areas, septage management areas, sludge and septage management and disposal plans, environmental constraints mapping, identification of management agencies, and grant conditions. Itemized abstracts of the appropriate documentation shall be available at the Division of Watershed Management. Water quality management planning related documentation in 201 Facilities Plans completed on or prior to May 31, 1975 may be adopted into areawide WQM plans on a case-by-case basis under (c) or (g) above.

(l) In preparing amendments to areawide WQM plans where a sewer connection ban is in effect under N.J.A.C. 7:14A-22.17 on a DTW or a wastewater management plan is not in compliance with the schedule at N.J.A.C. 7:15-5.23, the Department will not consider the alteration of the sewer service area for that DTW through an amendment of the WQM plan unless it is part of a WMP.

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7:15-3.5 Water quality management plan review, revision, and certification

(a) The Department and the designated planning agencies shall periodically review Statewide and areawide WQM Plans in order to propose appropriate amendments under N.J.A.C. 7:15-3.4, and to prepare appropriate revisions under this section.

(b) An application for a revision shall be submitted in writing to the Department in accordance with (d) below. The Department and the designated planning agencies shall prepare revisions to Statewide and areawide WQM Plans under this section whenever such revisions are necessary to:

1. Correct, clarify, or update erroneous, unclear, or outdated statements in Statewide and areawide WQM Plans regarding:

i. Development and wastewater treatment facilities existing at the time of the most recently adopted areawide WQM plan or amendment affecting the site; or

ii. Proposed projects, provided that all other Department approvals were received, in full compliance with applicable regulations, at the time of the most recently adopted areawide WQM plan or amendment affecting the site;

2. Transfer or assign wastewater management plan responsibility under N.J.A.C. 7:15-5.13;

3. Revise schedules for submission of wastewater management plans under N.J.A.C. 7:15-5.23(f);

4. Provide for the following substantive changes in Statewide and areawide WQM Plans where the Department determines, based on its assessment that the project for which the revision is proposed complies with the environmental standards established at N.J.A.C. 7:15-5.24 and 5.25, as applicable, that no significant individual or cumulative impacts will occur to environmentally sensitive areas or other natural resources (such as water supplies) due to the proposed revision (individually or in combination with past revisions in the area), that the changes are consistent with N.J.A.C. 7:15-3.6, 3.7, and 3.10 and that certain directly affected municipal and county agencies and other interests as identified by the Department have been provided an opportunity to review and comment on the proposed revision:

i. Any increase in flow (including both increased loadings and no increased loadings) from industrial treatment works where no change in wastewater service area or discharge type (for example, discharge to surface water or ground water) is proposed, the discharge is not to an impaired waterbody segment for which a TMDL has been proposed or adopted under N.J.A.C. 7:15-6.3 and where the applicant demonstrates there is adequate water supply in accordance with the most recent New Jersey State Water Supply Plan for the proposed additional flow. If the discharge is to an impaired waterbody and the discharge contains any of the parameters that are the basis for the impaired listing, the expansion may be allowed if the expansion is consistent with the WLAs set forth in an adopted TMDL developed for the affected waterbody for the listed parameters in the discharge. The Department may process such revisions prior to or simultaneously with a NJPDES permit for the same change in flow;

ii. The transfer of sewer service area from one domestic treatment works to another, provided that all affected wastewater management plans are current in accordance with the schedule at N.J.A.C. 7:15-5.23, the approved sewer service

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areas in the areawide WQM plan are currently contiguous in the area to be transferred, neither domestic treatment works is subject to a sewer connection ban, the proposed revision includes only areas currently designated for sewer service, both the sending and receiving wastewater management planning agencies concur with the proposed revision, and no new or expanded treatment works other than sewer line extensions is proposed as part of the revision;

iii. Any increase of 8,000 gpd or less in planning flow to an on-site discharge to ground water for an existing public school or public institution, using the same general type of treatment works (for example, direct discharge to ground water, spray irrigation);

iv. Any change in the estimated planning flow (see N.J.A.C. 7:15-5.16(b)8) or permitted flow (see N.J.A.C. 7:15-5.16(b)9) of less than 8,000 gallons per day to an existing NJPDES regulated discharge to ground water, provided (b)4v below is satisfied unless the sewer service area is not changing and the same general type of treatment works is proposed;

v. Expansion of a future sewer service area to contiguous lots, where the expansion involves less than 100 acres, contributes less than 8,000 gallons per day of additional wastewater flow, and does not create a significantly new pattern of sewered development such that a significant potential or incentive is created for additional revisions or amendments to open new areas to sewered development. A revision under this subparagraph shall be processed only if the applicant demonstrates that the receiving domestic treatment works has sufficient capacity under the projected build-out to serve the proposed development in addition to its existing approved sewer service area, and any affected wastewater management plan is current in accordance with the schedule at N.J.A.C. 7:15-5.23;

vi. The utilization of individual subsurface sewage disposal systems where the project for which the revision is requested involves less than 100 acres and generates less than 8,000 gallons per day of wastewater flow (or a total of fewer than 23 residential dwelling units), only where the WMP is not in compliance with the schedule at N.J.A.C. 7:15-5.23 and the applicant demonstrates that the project for which the revision is proposed meets the nitrate planning standard at N.J.A.C. 7:15-5.25(h)2;

vii. The utilization of a RWBR project to reduce either existing or proposed wastewater discharges to surface waters below the head of tide or ground water discharges located within HUC 14 drainage areas which are wholly below the head of tide;

viii. The utilization of a RWBR project to reduce existing wastewater discharges to surface waters above the head of tide or ground water discharges located within HUC 14 drainage areas any part of which is above the head of tide, provided the following are met:

(1) The utilization of RWBR will not increase or create an exceedance of the water availability in any HUC 11 in accordance with the assessment of water availability identified in the New Jersey State Water Supply Plan; and

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(2) The utilization of RWBR does not cause an adverse effect on any downstream designated use, including without limitation, water supply, sewage treatment plant discharges, or aquatic life support;

ix. Connection of an existing structure with a malfunctioning subsurface sewage disposal system that is not currently within an approved sewer service area to an identified sewage treatment plant, provided the applicant demonstrates that it is not feasible to repair or replace the malfunctioning subsurface sewage disposal system under N.J.A.C. 7:9A-3.4 and the property where the existing structure is located is contiguous to the existing sewer line; or

x. The utilization of individual subsurface sewage disposal systems or a NJPDES regulated discharge to ground water for a clustered residential development, where the applicant ensures that a minimum of 70 percent of the property is permanently restricted from development, subject to a conservation restriction prepared in accordance with N.J.A.C. 7:15-1.7, and provided that the following conditions are met:

(1) Where individual subsurface sewage disposal systems will be utilized, the density necessary to achieve the 2.0 mg/L nitrate planning standard in N.J.A.C. 7:15-5.25(e) and (h)2 is met for the overall project site and the ground water quality criteria of 10 mg/L is met at the edge of the developed portion of the clustered residential development;

(2) Except to account for unique site conditions, the development shall be located to maximize continuity of the preserved area and in areas that do not contain Natural Heritage Priority Sites or habitat patches identified as Rank 3, 4, or 5 on the Department's Landscape Maps of Habitat for Endangered, Threatened and Other Priority Wildlife; and

(3) Existing agricultural land uses allowed to continue on the restricted portion are required to implement Best Management Practices by implementing the findings of a Conservation Plan developed by the Natural Resources Conservation Service; or

5. Provide for any modification in an adopted regional stormwater management plan that does not require an amendment under N.J.A.C. 7:15-3.4(b)5.

(c) The documents that are automatically adopted into the Statewide or areawide WQM Plans under N.J.A.C. 7:15-3.4(b)1 through 4, and 7:15-3.4(i) shall not be revised under this section.

(d) An application for a revision under (b)4 above shall include a detailed basis for the revision, including any documentation supporting the assertion that the project or activity qualifies as a revision, all applicable information listed in N.J.A.C. 7:15-3.2(a) and other documentation as determined by the Department to be necessary to determine compliance with the criteria established at N.J.A.C. 7:15-5.24 and 5.25. The Department will notify the applicant of any additional information it needs to determine if the proposal qualifies as a revision. If the Department is unable to determine that a proposed project or activity qualifies to be processed as a revision based on information in the revision application or submitted by the applicant after notification, the Department will review the proposal as a potential amendment pursuant to N.J.A.C. 7:15-3.4. Once the Department determines that a project or activity qualifies as a revision, the Department shall provide a copy of the proposed revision to

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the agencies identified in N.J.A.C. 7:15-5.22 and provide 21 days for these entities to comment on the proposed revision.

(e) The procedure for revision of Statewide and areawide WQM plans is as follows:

1. The Governor or his or her designee shall adopt revisions to areawide WQM plans and the Commissioner shall adopt revisions to the Statewide WQM Plan. Such revisions shall take effect immediately, unless the adoption notice specifies otherwise.
2. The Department shall, on an annual basis, make publicly available a list of adopted revisions to WQM plans. Under N.J.A.C. 7:15-3.4, interested persons may submit petitions to amend WQM plans to repeal or modify such revisions.

(f) Designated planning agencies shall revise areawide WQM Plans in accordance with procedures established by such agencies and approved by the Department. All revisions to areawide WQM plans are valid only upon their adoption by the Governor or his or her designee.

(g) The Governor or his or her designee shall certify adopted WQM Plans in accordance with United States Environmental Protection Agency regulations.

7:15-3.6 Coordination with Coastal Zone and Hackensack Meadowlands programs

(a) In accordance with N.J.A.C. 7:7E-1.2(h), the Department's Rules on Coastal Zone Management, including, but not limited to, provisions concerning the New Jersey Meadowlands Commission at N.J.A.C. 7:7E-3.45, shall provide the basic policy direction for WQM planning in the New Jersey Coastal Zone defined at N.J.A.C. 7:7E-1.2(b), including, but not limited to, the Hackensack Meadowlands District described in N.J.S.A. 13:17-4.

(b) In accordance with N.J.A.C. 7:15-3.4(b)1, the water quality related provisions of N.J.A.C. 7:7E, including but not limited to N.J.A.C. 7:7E-8.4, are part of the Statewide WQM Plan.

(c) Under N.J.A.C. 7:7E-8.4 and Section 307(f) of the Coastal Zone Management Act, 33 U.S.C. §§ 1451 et seq., the Department's Coastal Management Program incorporates by reference all requirements established by or pursuant to the Clean Water Act, 33 U.S.C. §§ 1251 et seq., including all requirements contained in this chapter and in WQM plans.

(d) For WQM plan amendments relating to the Hackensack Meadowlands District, the consultation requirement in N.J.S.A. 13:17-9(c) shall be met as follows:

1. For amendments processed under N.J.A.C. 7:15-3.4(b)5, (b)6 or (c), the New Jersey Meadowlands Commission shall be requested to issue written statements of consent for such amendments under N.J.A.C. 7:15-3.4(g)3 and 4 or N.J.A.C. 7:15-3.4(d)3, as appropriate.
2. For other amendments to WQM plans under N.J.A.C. 7:15-3.4(b)1 through (b)4, (i), or (k) that automatically incorporate into Statewide or areawide WQM Plans any Department or USEPA actions taken through rulemaking or other proceedings the consultation requirement in N.J.S.A. 13:17-9(c) shall be addressed, as necessary, through those proceedings and shall not be independently addressed under this section.

7:15-3.7 Coordination with Pinelands program

(a) In accordance with N.J.S.A. 13:18A-8, 16 U.S.C. § 471i(f), and the "Water Resources Planning" element (page 221) of the "Surface and Groundwater Resources Program" contained in Chapter Seven of the Comprehensive Management Plan adopted by the Pinelands Commission on November 21, 1980, comments shall be sought from the Pinelands Commission on proposed WQM plan amendments pertaining to the Pinelands Area defined at

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N.J.S.A. 13:18A-11 or the Pinelands National Reserve defined at 16 U.S.C. § 471i(c), to ensure that such amendments are consistent with the intent and programs of the Pinelands Protection Act, N.J.S.A. 13:18A-1 et seq., and section 502 of the National Parks and Recreation Act of 1978, 16 U.S.C. § 471i.
(b) The Department shall seek comments from the Pinelands Commission on proposed WQM plan amendments and revisions pertaining to the Pinelands Area and Pinelands National Reserve before making the decision required by N.J.A.C. 7:15-3.4(g)2 or 7:15-3.5(e), as appropriate.
(c) For other amendments to WQM plans under N.J.A.C. 7:15-3.4(b)1 through (b)4, (i), or (k) that automatically incorporate into Statewide or areawide WQM Plans any Department or USEPA actions taken through rulemaking or other proceedings, any need to seek comments from the Pinelands Commission shall be addressed, as necessary, through those proceedings and shall not be independently addressed under this section.

7:15-3.8 Validity of site specific water quality management plan amendments and revisions
(a) No WQM plan amendment or revision hereafter adopted by the Governor or his or her designee is valid unless adopted in substantial compliance with this chapter.
(b) Proposed site specific WQM plan amendments for which notice has been filed for publication or published in the New Jersey Register pursuant to N.J.A.C. 7:15-3.4(g)3 or 3.4(g)5 as of July 7, 2008 shall be subject to the rules in effect on July 6, 2008. Where the Department disapproves or returns the proposed amendment pursuant to N.J.A.C. 7:15-3.4(g)8, and the applicant submits a new or modified site specific plan amendment, the new or modified proposed plan amendment shall be subject to the rules in effect at the time of the subsequent submittal.
(c) Proposed WQM plan revisions that have been submitted to the Department but not adopted pursuant to N.J.A.C. 7:15-3.5(e)1 as of July 6, 2008 shall be subject to the rules in effect
as of July 7, 2008.
(d) Site specific amendments and revisions adopted prior to July 7, 2008 shall be valid for six years from the date of adoption or until the sewer service or wastewater service area is revoked under N.J.A.C. 7:15-8.1, whichever is later.
(e) Site specific amendments or revisions adopted after July 7, 2008 shall be valid for six years from the date of adoption, unless a wastewater management plan updated in accordance with N.J.A.C. 7:15-5.23 includes the site specific amendments or revision.

7:15-3.9 Appeals of Department decisions
(a) Except as provided in (g) below, within 30 calendar days from receipt by the applicant of a written notification from the Department of the decision of the Department made pursuant to N.J.A.C. 7:15-3.1 or 3.2, 3.4(g)2i or ii or 3.4(g)8ii through iv, the applicant may request an adjudicatory hearing to contest the Department decision by submitting a written request to the Department, addressed to the Office of Legal Affairs, ATTENTION:

Adjudicatory Hearing Requests,
Department of Environmental Protection,
PO Box 402, 401 East
State Street, 4th Floor,

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Trenton, New Jersey 08625-0402.
A copy of the request shall be submitted to
Division of Watershed Management,
Department of Environmental Protection, P.O.
Box 418, 401 East State Street, 7th Floor,
Trenton, N.J. 08625.
The request shall include the following information:

1. The name, address, and telephone number of the applicant and its authorized representative if any;
2. The applicant's factual position on each question alleged to be at issue, its relevance to the Department's decision, specific reference to contested factors as well as suggested revised or alternative provisions;
3. Information supporting the applicant's factual position and copies of other written documents relied upon to support the request for a hearing;
4. An estimate of the time required for the hearing (in days and/or hours); and
5. A request, if necessary, for a barrier-free hearing location for disabled persons.

(b) A hearing request not received within 30 days after receipt by the applicant of a written notification from the Department of the decision of the Department, shall be denied.
(c) During the pendency of the review and hearing on a Department decision made pursuant to this chapter, the challenged Department decision shall remain in full force and effect, unless a stay is granted by the Department upon formal request by the applicant.
(d) If the appellant fails to include all the information required by (a) above, the Department may deny the hearing request.
(e) If it grants the request for a hearing, the Department shall file the request for a hearing with the Office of Administrative Law. The hearing shall be held before an administrative law judge and in accordance with the Administrative Procedure Act, N.J.S.A. 52:14B-1 et seq., and the Uniform Administrative Procedure Rules, N.J.A.C. 1:1. If the subject of the hearing is a proposed amendment to the areawide WQM plan for a designated area, the Department shall provide notice of the hearing to the designated planning agency for that area.
(f) Appeals of decisions made by designated planning agencies under this subchapter shall be made to a court of competent jurisdiction.
(g) An appeal of a consistency determination shall be made in accordance with the statutes and rules that govern the permit that is the subject of the decision. Such an appeal shall not be governed by (a) through (e) above.
(h) If the subject of a Department decision identified under (a) above is a proposed amendment to the areawide WQM plan for a designated area, the designated planning agency for that area may request an adjudicatory hearing to contest the Department decision, regardless of whether or not the applicant requests such a hearing. Such requests shall be governed by (a) through (e) above, and the designated planning agency shall be treated in the same manner as an "applicant" for purposes of those subsections.
(i) An appeal to contest any WQM plan amendment or revision on the ground of noncompliance with the procedural requirements of this chapter shall be commenced within one year from the adoption date of the plan amendment or revision.

7:15-3.10 Coordination with Highlands Council
(a) In accordance with the Highlands Water Protection and Planning Act (Highlands

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Act), N.J.S.A. 13:20-1 et seq., and the Highlands Water Protection and Planning Act Rules, N.J.A.C. 7:38, the Department shall seek comments from the Highlands Council on proposed WQM plan amendments and revisions pertaining to the Highlands Region as defined at N.J.S.A. 13:20-7, before making the decision required by N.J.A.C. 7:15-3.4(g)2 or 7:15-3.5(e), as appropriate.
(b) For amendments to WQM plans under N.J.A.C. 7:15-3.4(b)1 through (b)4, (i), or (k) that automatically incorporate into Statewide or areawide WQM Plans any Department or USEPA actions taken through rulemaking or other proceedings, any need to seek comments from the Highlands Council shall be addressed, as necessary, through those proceedings and shall not be independently addressed under this section.

SUBCHAPTER 4. WATER QUALITY AND WASTEWATER MANAGEMENT POLICIES AND PROCEDURES

7:15-4.1 (Reserved)

7:15-4.2 Projects and activities deemed to be consistent with WQM plans and this chapter
(a) The following treatment works are deemed to be consistent with WQM plans and this chapter:

1. Upgrades of domestic or industrial treatment works, including upgrades accomplished through construction of new treatment works at the same location, that do not exceed existing flows and do not exceed flows identified in areawide WQM plans. However, where levels of treatment are specified in areawide WQM Plans, upgrades that are not designed to achieve such treatment levels shall be deemed to be consistent only if such upgrades are in accordance with approved compliance schedules that provide for the future achievement of such treatment levels, and that are included in NJPDES discharge permits, court orders, or Department enforcement documents such as administrative orders or administrative consent orders.
2. Treatment works whose sole purpose is to abate an existing pollution problem, if such treatment works are required by the Department or USEPA.
3. Removal or remedial actions performed or required by the Department or by Federal agencies or by their agents, under the Spill Compensation and Control Act, N.J.S.A. 58:10-23.11 et seq., or the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986, 42 U.S.C. §§ 9601 et seq., or other statutes authorizing Department or Federal removal or remedial actions for hazardous substances.
4. Interim construction or interim expansion of, or interim connection with, domestic or industrial treatment works that are required by law to be abandoned or incorporated at a definite time into other treatment works:
    i. That are under construction;
    ii. For which contracts have been awarded for construction; or
    iii. Whose construction is required by court order or Department order, or by a consent agreement to which the Department is a party.
5. Improvements to conveyance systems necessary to comply with the combined sewer overflows (CSOs) policy at N.J.A.C. 7:14A-11.12. This provision does not apply to wastewater facility expansions or upgrades.

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(b) The initial performance of emergency activities, including, but not limited to, emergency activities allowed by emergency permits issued pursuant to N.J.A.C. 7:14A-6.14, is deemed to be consistent with the WQM plans and this chapter. The Department may require the results of an emergency activity to be removed or modified after such initial performance, in order to obtain conformance with a WQM plan or this chapter.
(c) Restricted access reclaimed water for beneficial reuse activities for sewer jetting, street cleaning, dust control, and irrigation of restricted access locations at treatment works facilities are deemed to be consistent with the WQM plans and this chapter.

7:15-4.3 Treatment works not identified in Water Quality Management Plans
(a) Except as provided in N.J.A.C. 7:15-4.2 or 4.4, the following treatment works are considered to be inconsistent with the areawide WQM plan, and shall require an amendment or revision to that plan to be eligible for treatment works approvals, NJPDES discharge permits, or
financial assistance under the Clean Water Act, U.S.C. §§ 1251 et seq., or under N.J.A.C. 7:22:

1. New domestic or industrial treatment works, or expansions of existing domestic or industrial treatment works, if such new treatment works or expansions are not identified in the existing areawide WQM plan, are not sewers, pumping stations, or significant indirect users (SIU) as defined in N.J.A.C. 7:14A-1.2 and would:
    i. Directly discharge to surface waters, or onto the land surface (for example, spray irrigation or overland flow facilities); or
    ii. Have a design capacity of greater than 2,000 gallons per day.
2. New DTW that would conflict with or be outside of future sewer service areas depicted in the areawide WQM plan.

(b) The provisions of (a) above apply whether treatment works approvals are sought for both construction and operation, or for construction only, of treatment works.
(c) This section does not apply to the following treatment works:

1. Activities identified under N.J.A.C. 7:14A-22.4 as not requiring treatment works approval;
2. Treatment works components that handle sludge only;
3. Industrial treatment works that do not handle process wastewater or sanitary sewage except that these discharges shall comply with any wasteload allocation established in an
adopted TMDL;
4. A permanent holding tank that complies with N.J.A.C. 7:14A-22.13(c); or
5. Discharges to ground water of non-contact cooling water or discharges to ground water of filter backwash water from potable water treatment plants.

7:15-4.4 Individual subsurface sewage disposal systems and other small domestic treatment works in sewer service areas
(a) Subject to the provisions of (b) and (c) below and of N.J.A.C. 7:15-5.19, depiction of future sewer service areas in wastewater management plans or elsewhere in areawide WQM plans shall not be construed to prohibit the lawful construction in such areas of the following DTW:

1. Individual subsurface sewage disposal systems for individual residences pursuant to

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N.J.A.C. 7:9A, provided that the cumulative amount of wastewater to be generated by the project or activity does not exceed 2,000 gallons per day or five dwelling units; or

2. Other DTW that would have a design capacity of 2,000 gallons per day or less, and use either subsurface sewage disposal systems or other sewage disposal systems that would not directly discharge to surface water or onto the land surface.

(b) DTW identified in (a) above shall be constructed in depicted sewer service areas only if legally enforceable guarantees at the local government level are provided before such construction that the depicted sewer service will be used when it becomes available, and that any discharge to ground water will then be discontinued.

(c) DTW that are identified in a(2) above and that require treatment works approval shall not be constructed in the depicted sewer service area of a DTW on which a sewer connection ban is in effect under N.J.A.C. 7:14A-22.17, unless such construction would, even in the absence of the sewer connection ban, be cost-effective, environmentally sound, and feasible from the engineering standpoint.

SUBCHAPTER 5. WASTEWATER MANAGEMENT PLANNING REQUIREMENTS

7:15-5.1 Wastewater management plan requirement for water quality management plan amendments and revisions

(a) The Department will reject an application for an amendment or revision under N.J.A.C. 7:15-3.4(c) or (g) in areas where a wastewater management plan has not been adopted in accordance with the schedule established at N.J.A.C. 7:15-5.23, except as provided below:

1. The revision meets the requirements of N.J.A.C. 7:15-3.5(b)1 through 3, 4i, 4iii through iv, or 4vi through x; or

2. The specific purpose or effect of the amendment is to address projects or activities that are either proposed, constructed, operated or conducted by the State or Federal government, or that are regulated by the Solid Waste Management Act, N.J.S.A. 13:1E-1 et seq.

(b) The Governor or his or her designee shall adopt an amendment or revision only if the amendment or revision complies with this chapter.

7:15-5.2 Validity of previously adopted or submitted wastewater management plans

(a) Wastewater service area designations in wastewater management plans that are in compliance with the schedule established at N.J.A.C. 7:15-5.23 as of July 7, 2008 shall remain in effect for a period of six years from the date of WMP adoption or until July 7, 2009, whichever is later.

(b) Proposed wastewater management plans that have been filed with the Department as of July 7, 2008 shall be subject to the rules in effect on July 6, 2008 unless the Department disapproves or returns the proposed amendment pursuant to N.J.A.C. 7:15-3.4(g)2 or (g)8. If adopted, the wastewater service area designations shall remain in effect for a period of six years.

(c) Wastewater service area designations in wastewater management plans that are not in compliance with the schedule established at N.J.A.C. 7:15-5.23 or the sewer service area designations in the portions of areawide Water Quality Management plans where no wastewater management plan was ever prepared as of July 7, 2008 shall remain in effect until April 7, 2009.

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(d) If a wastewater management plan is submitted by April 7, 2009, the wastewater service area designations in the wastewater management plan and the sewer service area designations in portions of areawide Water Quality Management plans where no wastewater management plan was ever prepared shall remain in effect until the submitted WMP or WMP update is either:

1. Disapproved or returned by the Department pursuant to N.J.A.C. 7:15-3.4(g)2 or (g)8; or
2. Adopted as a new wastewater management plan in accordance with this chapter.

(e) If the wastewater management planning agency does not submit a WMP or WMP update for a wastewater management plan that is not in compliance with the schedule established at N.J.A.C. 7:15-5.23 by April 9, 2009, or if the Department disapproves or returns the wastewater management plan, the Department shall withdraw the wastewater service area pursuant to N.J.A.C. 7:15-8.1.

(f) General wastewater service area designations for wastewater facilities with planning flows less than 20,000 gallons per day which discharge to ground water shall not be established or reestablished as part of a new or updated WMP.

7:15-5.3 Wastewater management planning agencies, wastewater management plan areas and wastewater management plan responsibility: general statement

(a) A "wastewater management planning agency" (WMP agency) is a governmental unit that has "wastewater management plan responsibility" as defined in (b) below. A "wastewater management plan area" (WMP area) is the geographic area for which a wastewater management planning agency has "wastewater management planning responsibility."

(b) N.J.A.C. 7:15-5.4, 5.6 and 5.8 identify entities that have either "wastewater management plan responsibility" (WMP responsibility) for the wastewater management plan areas specified in those sections, unless alternative assignments of wastewater management plan responsibility are established under N.J.A.C. 7:15-5.13, or that have the responsibility to prepare and submit required elements of a wastewater management plan to the wastewater management planning agency. "Wastewater management plan responsibility" means the duty to:

1. Prepare, submit, and periodically update a wastewater management plan for the wastewater management plan area;
2. Provide comments on proposed amendments to wastewater management plans under N.J.A.C. 7:15- 3.4; and
3. Provide comments on proposed revisions to wastewater management plans under N.J.A.C. 7:15-3.5.

(c) Wastewater management plans shall be prepared, submitted, and periodically updated only by the wastewater management planning agencies for the corresponding wastewater management plan areas. Such wastewater management planning agencies shall submit wastewater management plans as requests to amend areawide WQM plans in accordance with the procedures specified in N.J.A.C. 7:15-3.4, and in accordance with the schedule specified in N.J.A.C. 7:15-5.23. A wastewater management planning agency may meet its responsibility to prepare and submit wastewater management plans by submitting wastewater management plans prepared by another party on behalf of that wastewater management planning agency.

(d) N.J.A.C. 7:15-5.4 and 5.13 apply notwithstanding any statements about wastewater planning responsibility contained in management agency designations or WQM Plans, or

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amendments thereto, issued or adopted before July 7, 2008.
(e) The identification under this subchapter of wastewater management plan areas and assignments of wastewater management plan responsibility does not, by itself, establish or change the designations of 201facilities planning areas or 201 facilities planning agencies. Such designations may be established or modified only by specific provisions for that purpose in amendments to areawide WQM plans under N.J.A.C.7:15-3.4, including but not limited to provisions in wastewater management plans under N.J.A.C. 7:15-5.18(i). The identification of wastewater management plan areas under this subchapter does not establish or change the designation of "planning areas" as defined in N.J.A.C. 7:22-10.1.
(f) Except as identified in N.J.A.C. 7:15-5.2(a) through (d), wastewater management plans and amendments thereto are valid only upon their adoption by the Governor or his or her designee as amendments to areawide WQM plans under N.J.A.C. 7:15-3.4.
(g) Wastewater management planning agencies may submit wastewater management plans that cover only a portion of their wastewater management planning area provided that the submitted wastewater management plan(s) addresses an entire municipality or municipalities.

7:15-5.4 Responsibility of County Boards of Chosen Freeholders
A county board of chosen freeholders shall have wastewater management plan responsibility for a wastewater management plan area consisting of all of its county except as provided in N.J.A.C. 7:15-5.13.

7:15-5.5 (Reserved)

7:15-5.6 Responsibility of sewerage authorities and municipal authorities
(a) The Passaic Valley Sewerage Commissioners (PVSC), joint meetings, county utilities authorities, and every sewerage authority and every municipal authority that performs sewerage related functions in at least part of its district shall provide, upon the request of the WMP agency, the following sewerage-related information regarding its district or wastewater service area to the wastewater management planning agency or agencies responsible for a wastewater management
plan area in which it lies partially or wholly within:

1. The name and NJPDES discharge permit number of any DTW owned or operated by the entities in (a) above;
2. The existing permitted flow of each named DTW in million gallons per day;
3. The actual wastewater flow, by municipality, for each municipality within the sewer service area of each named DTW in million gallons per day;
4. The capacity allocation to each municipality within the sewer service area of each named DTW in million gallons per day;
5. A description of the legal or financial arrangement concerning the capacity allocation in (a)4 above;
6. Identification of committed flow not presently connected to each named DTW in million gallons per day for each municipality within the sewer service area;
7. Any information relevant to a future DTW expansion demonstrated to be needed in accordance with N.J.A.C. 7:15-5.25(d), including, but not limited to, stream studies or effluent characteristics;
8. Identification of any wasteload allocations in a total maximum daily load assigned to

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any named DTW and a proposed schedule to meet any non-compliance with the wasteload allocation;

9. Maps, prepared in accordance with the requirements at N.J.A.C. 7:15-5.20, showing the name, NJPDES discharge permit number, and the existing collection and conveyance systems of any named DTW; and

10. Any other information needed to satisfy the requirements of N.J.A.C. 7:15-5.16.

(b) Except as provided in (c) below, a municipal authority performs "sewerage-related functions" if it:

1. Owns, leases, constructs, operates, or maintains sewerage facilities, or is a party to a contract providing for or relating to sewerage facilities;

2. Regulates the construction or use of sewerage facilities;

3. Is a permittee or co-permittee under N.J.A.C. 7:14A for a DTW, or has applied to be such a permittee or co-permittee;

4. Seeks WQM plan amendments for sewerage facilities;

5. Receives or seeks to receive Federal or State financial assistance for sewerage facilities; or

6. Is required by statute, rule, contract, court order, Department order, consent agreement, or other legal obligation to perform any of the activities listed in (b)1 through 5 above.

(c) The activities listed in (b)1 through 6 above shall not be considered "sewerage related functions" if such activities are:

1. Performed solely to carry out the municipal authority's water supply, solid waste, chemical or hazardous waste, or hydroelectric power functions; or

2. Pertain solely to sewage that arises on property owned or leased by the municipal authority, and that is conveyed to sewerage facilities not owned, leased, operated, or maintained by the municipal authority.

(d) The Department may, at any time, send a letter to any municipal authority, requesting that authority to declare in writing whether or not that authority performs any of the sewerage related functions listed under (b) and (c) above. If that authority does not make such a declaration within 90 calendar days of receipt of the letter, the Department shall, in the absence of information to the contrary, presume that the authority performs sewerage-related functions.

(e) Where one or more entity has responsibility for an area within one or more wastewater management planning areas, each entity shall provide all necessary sewerage-related information in accordance with (a) above regarding their district to each wastewater management planning agency responsible for wastewater management planning within the entity's district.

(f) For purposes of (e) above, "overlap" exists when the district of one authority is partially or completely within, or identical to, the district of one or more other authorities.

7:15-5.7 (Reserved)

7:15-5.8 Responsibility of municipalities

(a) Upon the request of the WMP agency, every municipality shall provide the following information to the wastewater management planning agency:

1. Ordinances as required to demonstrate compliance with N.J.A.C. 7:15-5.25(f)3iii, (g)1, (g)3 or (g)6;

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2. A map, prepared in accordance with the requirements at N.J.A.C. 7:15-5.20, identifying any public water supply service areas;
3. Where applicable, a septic management plan in accordance with N.J.A.C. 7:15-5.25(e)3;
4. In addition to (a)1 through 3 above, for urbanized municipalities provide:
   i. Population projections; and
   ii. Employment projections;
5. In addition to (a)1 through 3 above, for municipalities not subject to (a)4 above provide:
   i. The current zoning map and associated ordinances; and
   ii. A modified zoning map and associated ordinances as revised to demonstrate compliance with N.J.A.C. 7:15-5.25, as applicable.

7:15-5.9 (Reserved)

7:15-5.10 (Reserved)

7:15-5.11 (Reserved)

7:15-5.12 (Reserved)

7:15-5.13 Alternative assignment of wastewater management plan responsibility
(a) Alternative assignments of wastewater management plan responsibility, different from the assignment set forth in N.J.A.C. 7:15-5.4, shall be made and subsequently changed as revisions to WQM plans under N.J.A.C. 7:15-3.5.
(b) The Department may assign wastewater management plan responsibility to a municipality, if the municipality requests such responsibility and provided that the county WMP agency has not submitted or stipulates it does not intend to submit a WMP. As part of the application, municipalities requesting wastewater management plan responsibility must certify that the information it was required to submit at N.J.A.C. 7:15-5.8 was submitted to the county. Requests for municipal wastewater management plan responsibility shall be made by the municipality as part of an application for a revision to an areawide WQM plan or plans under N.J.A.C. 7:15-3.5. A municipality that becomes the wastewater management planning agency for itself through alternate assignment of wastewater management plan responsibility may submit a wastewater management plan directly to the Department.
(c) Where a wastewater management plan chapter has not been submitted or adopted for a municipality in accordance with the provisions at N.J.A.C. 7:15-5.2 or the schedule established at N.J.A.C. 7:15-5.23, wastewater service area designations within that municipality shall be withdrawn in accordance with N.J.A.C. 7:15-8.1.

7:15-5.14 Wastewater management plan partition by municipality
(a) A county-wide wastewater management plan shall include an independent chapter for each municipality in the county. Each chapter shall address the entire municipality.
(b) Each chapter within a county-wide wastewater management plan may be adopted, returned or disapproved under N.J.A.C. 7:15-3.4(g)2 and 8 independent of other chapters.
(c) Where a wastewater management plan chapter has not been adopted for a

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municipality in accordance with the provisions at N.J.A.C. 7:15-5.2 or the schedule established at N.J.A.C. 7:15-5.23, wastewater service area designations within that municipality shall be withdrawn in accordance with N.J.A.C. 7:15-8.1.

7:15-5.15 Contents of wastewater management plans; general statement

(a) Each wastewater management plan shall consist of written and electronic descriptions and maps of existing and future wastewater-related jurisdictions and wastewater service areas, public water supply service area served by each purveyor, and of selected environmental features. A wastewater management plan shall also include written and electronic descriptions and maps of specified categories of existing and future treatment works, if such treatment works presently exist or are necessary to meet anticipated wastewater management needs. More specific requirements for these written and electronic descriptions and maps are set forth in N.J.A.C. 7:15-5.16 through 5.20, 5.24 and 5.25 and 7:15-8.

(b) In accordance with N.J.A.C. 7:15-5.16 through 5.20 and 5.25 and 7:15-8, each wastewater management plan shall address all types of DTW and all methods of domestic wastewater disposal, including, but not limited to, individual subsurface sewage disposal systems, discharges to surface water and discharges to ground water to the extent that such DTW and methods of domestic wastewater disposal presently exist or are necessary to meet anticipated wastewater management needs. In accordance with N.J.A.C. 7:15-5.16 through 5.20 and 5.25 and 7:15-8, each wastewater management plan shall provide information about specified categories of industrial treatment works.

7:15-5.16 Existing jurisdictions, wastewater service areas, and treatment works

(a) Each wastewater management plan shall include maps of existing wastewater jurisdictions, existing wastewater service areas, and any existing treatment works in the categories specified in (a)3 or 5 below. These maps shall depict the following information:

1. The existing boundaries of the wastewater management plan area;
2. The boundaries, within the wastewater management plan area, of the following:
   - i. Any existing districts, franchise areas, and water or sewer service areas of any public utilities; and
   - ii. Any areas within the Hackensack Meadowlands District defined at N.J.S.A. 13:17-4, the Pinelands Area defined at N.J.S.A. 13:18A-11, the Pinelands National Reserve defined at 16 U.S.C. § 471i(c), the Highlands preservation area, the Highlands planning area defined at N.J.S.A. 13:20-3, or the "coastal area" described in N.J.S.A. 13:19-4.
3. The location, within or outside the wastewater management plan area, of each existing treatment works, if any, that is not a sewer or a pumping station, but that receives wastewater that arises within or is conveyed into or through the wastewater management plan area, if such treatment works is:
   - i. A DTW that directly discharges to surface waters, or onto the land surface (for example, spray irrigation or overland flow facilities);
   - ii. A DTW that has a design capacity of greater than 2,000 gallons per day, and stores or disposes of sewage by any means; or
   - iii. An industrial treatment works that requires a NJPDES discharge permit and that handles process waste water or sanitary sewage.

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4. The location of each existing discharge to surface or ground water from each treatment works mapped within the wastewater management plan area under (a)3 above, and the location of any overflow discharges of sewage within the wastewater management plan area;
5. The location of each existing pumping station and major interceptor and trunk sewer, if any, within the wastewater management plan area;
6. The present sewer service area, within or outside the wastewater management plan area, for each:
    i. DTW mapped within the wastewater management plan area under (a)3 above, distinguishing the separate area served by each DTW; and
    ii. Industrial treatment works that is mapped within the wastewater management plan area under (a)3 above including property other than the property on which the industrial treatment works is located, distinguishing the separate area served by each industrial treatment works.
7. The present sewer service area, within the wastewater management plan area, for each:
    i. DTW mapped outside the wastewater management plan area under (a)3 above, distinguishing the separate area served by each DTW; and
    ii. Industrial treatment works that is mapped outside the wastewater management plan area under (a)3 above including property other than the property on which the industrial treatment works is located, distinguishing the separate area served by each industrial treatment works; and
8. Any areas within the wastewater management plan area that, as regards DTW, are presently served only by either or both of the following:
    i. Individual subsurface sewage disposal systems for individual residences; or
    ii. Other DTW that have a design capacity of less than 2,000 gallons per day, use either subsurface sewage disposal systems or other sewage disposal systems that have no direct discharge to surface water or onto the land surface.

(b) Each wastewater management plan shall provide the following information, in narrative, outline, or tabular form, for each existing treatment works or each existing DTW, as appropriate, mapped within the wastewater management plan area under (a)3 above:
1. Name and owner of the treatment works;
2. Name of any other governmental unit or corporation, if any, responsible for operating the DTW;
3. Location of the treatment works within municipality, county, and WQM planning area, and within any district;
4. NJPDES discharge permit number, if any, for any discharges from the treatment works;
5. Name of NJPDES permittee and any co-permittee under N.J.A.C. 7:14A for any discharges from the DTW;
6. Name and classification, under N.J.A.C. 7:9B and 7:9C, of any surface and ground waters receiving any discharges from the treatment works;
7. Estimate of existing residential population served by the treatment works within and outside the wastewater management plan area, disaggregated by municipality and including any major seasonal fluctuations;
8. Actual flow of wastewater received by the treatment works, in millions of gallons per

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day (MGD), expressed as total flow, as estimated flow arising within and outside the wastewater management plan area, and as estimated flow, disaggregated by municipality and attributed to each of the following sources: residential, commercial, industrial, and infiltration/inflow; and 9. Existing permitted flow of the DTW.

(c) Each wastewater management plan shall include the following information, in narrative, outline, or tabular form, for each existing treatment works mapped outside the wastewater management plan area under (a)3 above:

1. Name and owner of the treatment works;
2. Estimate of existing residential population served by the treatment works within the wastewater management plan area, disaggregated by municipality and including any major seasonal fluctuations; and
3. Estimated average flow of wastewater conveyed to the treatment works from the wastewater management plan area, in millions of gallons per day, disaggregated by municipality and expressed as total flow and as estimated flow attributed to each of the following sources: residential, commercial, industrial, and infiltration/inflow.

(d) For a particular treatment works, the Department may waive the disaggregation of flow by municipality or land use under (b)8 and (c)3 above, if it is demonstrated to the satisfaction of the Department that such disaggregation would require data not readily available for that treatment works.

(e) Each wastewater management plan shall state whether or not there are combined sewers in the wastewater management plan area.

(f) For purposes of (a), (b) and (c) above, “existing” or “present” means permitted and/or constructed at the time the particular wastewater management plan is being prepared or updated, as the case may be.

7:15-5.17 Mapping features requirements

(a) Each wastewater management plan shall include mapping of each of the following features in the wastewater management plan area, and in any additional wastewater service area identified in that wastewater management plan under N.J.A.C. 7:15-5.18(c)4, 5.24, or 5.25:

1. Coastal wetlands that have been mapped by the Department under the Wetlands Act of 1970, N.J.S.A. 13:9A-1 et seq.;
2. Other freshwater and estuarine wetlands, based on maps prepared by the Department under the Freshwater Wetlands Protection Act, N.J.S.A. 13:9B-25c;
3. Flood prone areas, based on the following information sources in order of preference:
    i. Delineations of flood hazard areas made by the Department under the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq., where such delineations exist;
    ii. Delineations of flood hazard areas by the Federal Emergency Management Agency under the National Flood Insurance Program, 42 U.S.C. §§ 4001-4128;
4. Public open space and recreation areas that include at least 10 acres of undeveloped land, including:
    i. National recreation areas, wildlife refuges, and historical parks administered by the United States Department of the Interior;

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ii. State and interstate parks, forests, wildlife management areas, natural areas, and recreation areas administered by the Department or the Palisades Interstate Park Commission; and
iii. County and municipal parks, reservations, preserves, and other conservation or
recreation areas;
5. River areas designated under the New Jersey Wild and Scenic Rivers Act, N.J.S.A. 13:8-45 et seq., or the Federal Wild and Scenic Rivers Act, 16 U.S.C. §§ 1278 et seq.;
6. Category One waters, trout production waters, and trout maintenance waters designated in the Department's Surface Water Quality Standards, N.J.A.C. 7:9B, based on the Department's maps of such waters; and
7. Surface waters, as mapped on the Department's graphic information systems (GIS) hydrography coverage;
8. Suitable habitat for endangered and threatened species as identified on the Department's Landscape Maps of Habitat for Endangered, Threatened and Other Priority Wildlife as Rank 3, 4 and 5;
9. Natural Heritage Priority Sites;
10. Riparian zones;
11. Steep slopes, if available;
12. Current composite or municipal zoning;
13. Municipal parcel mapping, if available;
14. All undeveloped and underdeveloped property, which could support additional or new sewage generating development, under current zoning;
15. All existing water service areas as defined at N.J.A.C. 7:10-11.5(c)6; and
16. All areas where sanitary or combined sewer collection and conveyance systems exist.

7:15-5.18 Future wastewater jurisdictions, wastewater service areas, and domestic treatment works

(a) In accordance with the provisions of this section, N.J.A.C. 7:15-5.24 and 5.25, each wastewater management plan shall include a description of wastewater service areas and DTW necessary to meet anticipated wastewater management needs over a 20-year period for urbanized municipalities or at build-out for all other municipalities. The description shall include:

1. Cost-effective, environmentally sound wastewater management, including regional management where appropriate; and
2. Examination of specific wastewater management alternatives as part of the preparation of the wastewater management plan in accordance with N.J.A.C. 7:15-5.25. The Department shall require such examination to include analysis of critical economic, social, environmental, or institutional factors pertaining to such alternatives.

(b) Except for urbanized municipalities, subject to the requirements, qualifications, and exceptions listed in (b)3 through 6 below, wastewater service areas and DTW shall be identified in such a manner as to provide adequate wastewater service for:

1. Land uses allowed in zoning ordinances that have been adopted and are in effect under N.J.S.A. 40:55D-62; or
2. The wastewater management plan shall identify relevant zoning ordinances on which

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the wastewater management plan is based specifying the type, density, and intensity of land use allowed in each district.

3. If, for particular locations, a zoning variance under article 9 of the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq., allows land development that would generate more wastewater than would the development allowed in the zoning ordinance, then for some or all of those locations the wastewater management plan may be based on the zoning variance rather than on the zoning ordinance.

4. If, for particular locations, preliminary or final subdivision or site plan approvals under article 6 of the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq., have allowed land development that would generate more wastewater than would the development allowed in the zoning ordinance, then for those locations the wastewater management plan shall be based on such approvals rather than on the zoning ordinance.

5. Wastewater management plans relating to the New Jersey Coastal Zone, the Hackensack Meadowlands District, the Pinelands Area, or the Pinelands National Reserve are subject to the requirements of N.J.A.C. 7:15-3.6 or 3.7, as appropriate. Wastewater management plans relating to the Highlands Region are subject to the requirements of N.J.A.C. 7:15-3.10.

6. The proposed wastewater management plan may be inconsistent with zoning ordinances for compelling reasons, provided that the wastewater management plan specifically identifies such inconsistencies and sets forth such reasons with adequate documentation.

(c) Each wastewater management plan shall include maps of future wastewater service areas, and of specified categories of future DTW, that are necessary to meet anticipated wastewater management needs at the end of the 20-year period for urbanized municipalities, or at build-out for all other municipalities. These maps shall depict the following:

1. The location, within or outside the wastewater management plan area, of each existing, expanded, or new DTW, if any, that would not be a sewer or a pumping station, but that would receive sewage that would arise within or be conveyed into or through the wastewater management plan area, if such DTW would require a NJPDES discharge permit and:

i. Directly discharge to surface waters, or onto the land surface (for example, spray irrigation or overland flow facilities); or

ii. Have a design capacity of greater than 2,000 gallons per day, and store or dispose of sewage by any means;

2. The location of each discharge to surface or ground water from each DTW mapped within the wastewater management plan area under (c)1 above;

3. The location of each existing, expanded, or new pumping station and major interceptor and trunk sewer, if any, that would convey sewage within the wastewater management plan area;

4. The sewer service area, within or outside the wastewater management plan area, for each DTW mapped within the wastewater management plan area under (c)1 above, distinguishing the separate area to be served by each DTW;

5. The sewer service area, within the wastewater management plan area, for each DTW mapped outside the wastewater management plan area under (c)1 above, distinguishing the separate area to be served by each DTW; and

6. The area, if any, within the wastewater management plan area that would be served

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only by either or both of the following:

i. Individual subsurface sewage disposal systems for individual residences; or

ii. Other DTW that would have a design capacity of 2,000 gallons per day or less, and use either individual subsurface sewage disposal systems or other sewage disposal systems that would have no direct discharge to surface water or onto the land surface.

(d) For each DTW mapped within the wastewater management plan area under (c)1 above, each wastewater management plan shall further identify the future DTW that are necessary to meet wastewater management needs by providing, in narrative, outline, or tabular form, the following information applicable to such DTW at the end of the 20-year period for urbanized municipalities, or at build-out for all other municipalities:

1. Owner and, where known, name of the DTW;
2. Name of any other governmental unit or corporation, if any, to be responsible for operating the DTW;
3. Location of the DTW within municipality, county, and WQM planning area, and within any existing district;
4. Where known, NJPDES permit number for any discharges from the DTW;
5. Name of present or proposed NJPDES permittee and any co-permittee for any discharges from the DTW;
6. Name and present classification, under N.J.A.C. 7:9B and 7:9C, of any surface and ground waters that would receive any discharges from the DTW;
7. Estimate of residential population to be served by the DTW within and outside the wastewater management plan area, disaggregated by municipality and including any major seasonal fluctuations; and
8. Estimated average planning flow of wastewater in accordance with N.J.A.C. 7:15-5.25(d) to be received by the DTW, in millions of gallons per day, disaggregated by municipality and expressed as total flow, as flow arising within and outside the wastewater management plan area, and as flow attributed to each of the following sources: residential, commercial, and industrial.

(e) For each DTW mapped outside the wastewater management plan area under (c)1 above, each wastewater management plan shall further identify the future DTW that are necessary to meet wastewater management needs by providing, in narrative, outline, or tabular form, the following information applicable to such DTW at the end of the 20-year period for urbanized municipalities, or at build-out for all other municipalities, and at the end of any shorter or longer period identified under (a) above:

1. Owner and, where known, name of the DTW;
2. Estimate of residential population to be served by the DTW within the wastewater management plan area, disaggregated by municipality and including any major seasonal fluctuations; and
3. Estimated average planning flow of wastewater in accordance with N.J.A.C. 7:15-5.25(d) to be conveyed to the DTW from the wastewater management plan area, in millions of gallons per day, disaggregated by municipality and expressed as total flow and as flow attributed to each of the following sources: residential, commercial and industrial.

(f) The wastewater management plan shall document the basis for the estimated planning flows attributed to residential, commercial, and industrial sources under (d)8 and (e)3 above.

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Where actual, accurate gauging is available for a sewer system already in existence, such gauging shall be used in preparing these flow estimates, with an allowance for future changes in wastewater flow. There shall be a reasonable relationship between these flow estimates and wastewater service areas identified under (c)4 and 5 above. There shall be a reasonable relationship, consistent with (b) above, between these wastewater service areas and residential population estimates under (d)7 and (e)2 above. The average domestic flow from new development, exclusive of industrial flows, shall be calculated utilizing the projected flow criteria found at N.J.A.C. 7:14A-23.3 or 7:9A-7.4, as applicable, for the type of wastewater facilities proposed. Wastewater flows shall be expressed as a 30-day average flow from DTW that discharge to surface water and as a daily maximum flow from DTW that discharge to ground water. In instances where future specific residential dwelling types are unknown, the residential flow calculation may be computed using 75 gallons per capita per day. No additional provisions for inflow and infiltration shall be made as the above flows include allowances for inflow and infiltration.

(g) Unless expressly stated otherwise in the wastewater management plan, disaggregations of estimated flows by municipality and land use under (d)8and (e)3 above shall serve only to document the basis for estimates of total flow under those paragraphs, and shall not constitute legally enforceable flow allocations to those municipalities or land uses.

(h) If the Department has waived under N.J.A.C. 7:15-5.16(d) the disaggregation by municipality or land use of existing flow to a DTW, then the disaggregation of estimated flow by municipality or land use under (d)8and (e)3 above shall be limited to disaggregation of future changes in wastewater flow to that DTW.

(i) A wastewater management plan may identify specific changes to assignments of wastewater management plan responsibility under N.J.A.C. 7:15-5.9,or specific changes to 201 facilities planning responsibilities. Such changes shall take effect upon adoption of the wastewater management plan under N.J.A.C. 7:15-3.4. A wastewater management plan may suggest the establishment, modification, or elimination of districts or franchise areas under N.J.S.A. 40:14A-1et seq., 40:14B-1 et seq., 58:14-1 et seq., or 48:1-1et seq., but such districts or franchise areas shall be established, modified or eliminated only in the manner provided by law. Inclusion of such suggestions in an adopted wastewater management plan does not, by itself, accomplish such establishment, modification, or elimination.

7:15-5.19 Individual subsurface sewage disposal systems and other small domestic treatment works in sewer service areas

(a) In sewer service areas depicted under N.J.A.C.7:15-5.18(c)4 or 5, a wastewater management plan may require the construction of DTW identified in N.J.A.C.7:15-4.4(a)1 or 2 to be accompanied by construction of collection system sewers that would be used when the depicted sewer service becomes available. This requirement shall exist only if it is specifically stated in the wastewater management plan.

(b) A wastewater management plan shall require that individual subsurface sewage disposal systems for individual residences can be constructed in depicted sewer service areas only if legally enforceable guarantees at the local government level are provided before such construction that use of such systems will be discontinued when the depicted sewer service becomes available.

(c) A wastewater management plan shall not apply requirements under (a) or (b) above to individual subsurface sewage disposal systems that do not require certifications from the

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Department under N.J.S.A.58:11-25.1 or individual permits from the Department under N.J.A.C. 7:14A, unless that wastewater management plan includes adequate arrangements for enforcement of such requirements by one or more substate governmental units.
(d) Estimated wastewater flows under N.J.A.C. 7:15-5.18(d)8 and (e)3 shall include flows that would be received when use of DTW identified in N.J.A.C. 7:15-4.4(a)1 and 2 is discontinued when depicted sewer service becomes available.

7:15-5.20 Specifications for text and graphics
(a) Wastewater management plans should be concise, using the minimum feasible narrative and mapping. All pages, tables, and figures in wastewater management plans shall be legible and numbered. The text of wastewater management plans, wastewater management plan updates, WQM plan amendments and revisions shall be submitted in hard copy and in an electronic format that is compatible with the Department's software capabilities. Information regarding the Department's software capabilities may be obtained by contacting the Department at New Jersey Department of Environmental Protection, Division of Watershed Management, P.O. Box 418, Trenton, New Jersey 08625, (609) 984-6888. The applicant shall submit a minimum of five hard copies to the Department and, if the Department determines that more are needed based on the particulars of the proposal, the Department will notify the applicant.
(b) All maps in wastewater management plans, wastewater management plan updates, and WQM plan amendments and revisions shall be prepared and submitted in hard copy in a format which is consistent with the Department's mapping standards at N.J.A.C. 7:1D Appendix
A and shall be in New Jersey State Plane Feet using the North American Datum of 1983 (NAD83), use 1:24,000 scale United States Geological Survey quadrangle maps as a base and shall meet "United States National Map Accuracy Standards," incorporated herein by reference as amended or updated, for that scale. The United States National Map Accuracy Standards were issued by the U.S. Bureau of the Budget, Revised June 17, 1947, and can be obtained at http://rockyweb.cr.usgs.gov/nmpstds/nmas.html. Other maps at other scales may be provided as supplements. Mapping information for wastewater management plans shall also be submitted in digital form compatible with the mapping standards at N.J.A.C. 7:1D Appendix A. The digital maps shall be accurate, at a minimum, to a scale of 1:12,000. The Department recommends that the creation of new digital mapping information for wastewater management plans be prepared in a format that conforms to the "New Jersey Department of Environmental Protection Geographic Information System Mapping and Digital Data Standards" guidance document, as amended or updated. Guidance related to the mapping and digital data standards is available at the Department's website at http://www.state.nj.us/dep/gis. Each wastewater management plan shall include the following main maps in hard copy and in digital form, except digital maps in (b)3 below already generated by the Department in GIS do not have to submitted to the Department:

1. A map depicting the existing boundaries of the wastewater management plan area and the existing treatment works and wastewater service areas identified under N.J.A.C. 7:15- 5.16(a)3 through 8;
2. A map depicting future DTW and wastewater service areas identified at the end of the 20-year period for urbanized municipalities, or at build-out for all other municipalities, under N.J.A.C. 7:15-5.18(c)1 through 5. Wherever feasible, the

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boundaries of future wastewater service areas shall coincide with recognizable geographic, political or environmental features depicted in Department GIS coverages used for the wastewater management plan. The existing boundaries of the wastewater management plan area shall also be depicted on any map under this paragraph; and

3. One or more maps depicting the existing boundaries of the wastewater management plan area, and the features identified under N.J.A.C. 7:15-5.17. This map shall also state that development in areas mapped as wetlands, flood prone areas, suitable habitat for endangered and threatened species as identified on the Department's Landscape Maps of Habitat for Endangered, Threatened and Other Priority Wildlife as Rank 3, 4 and 5, Natural Heritage Priority Sites, riparian zones, steep slopes, or designated river areas may be subject to special regulation under Federal or State statutes or rules, and that interested persons should check with the Department for the latest information. Depiction of environmental features shall be for general information purposes only, and shall not be construed to define the legal geographic jurisdiction of such statutes or rules.

(c) Any other mapping required by N.J.A.C. 7:15-5.16 through 5.18, 5.24 and 5.25 may be included on one or more of the main maps listed in (b) above if the information is legible, or on other 1:24,000 scale maps.

7:15-5.21 (Reserved)

7:15-5.22 Consultation and consent for wastewater management plans

(a) Every wastewater management planning agency that prepares a wastewater management plan or wastewater management plan update, and every governmental unit or other person that prepares an amendment to a wastewater management plan, shall, during such preparation, notify and seek comments from and offer to confer with:

1. All governmental units that have regulatory or planning jurisdiction over wastewater, water supply, or land use in that wastewater management plan area, or in any additional sewer service area identified or being considered for identification under N.J.A.C. 7:15-5.16(a)6, 5.18(c)4, 5.24 or 5.25. Such governmental units shall include, but not be limited to: designated planning agencies, wastewater management planning agencies, county planning boards, municipal governing bodies and planning boards, sewerage authorities, municipal authorities, joint meetings, the Passaic Valley Sewerage Commissioners, the New Jersey Meadowlands Commission, water purveyors, the Pinelands Commission, the Highlands Council, and the Delaware River Basin Commission, as appropriate.

2. All governmental units and public utilities, and all vendors of wastewater treatment systems or services under the "New Jersey Wastewater Treatment Privatization Act", N.J.S.A. 58:27-1 et seq., that:

i. Own, lease, operate, or maintain DTW that receive wastewater that arises within, or that is conveyed into or through, that wastewater management plan area, or in any additional sewer service area identified or being considered for identification under N.J.A.C. 7:15-5.16(a)6, [or] 5.18(c)4, 5.24 or 5.25;

ii. Are parties to contracts for such DTW;

iii. Are permittees or co-permittees under N.J.A.C. 7:14A for such DTW; or

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iv. Are projected in a draft or previously adopted wastewater management plan for that wastewater management plan area to perform activities listed in (a)2 i, ii or iii above.

3. The criteria in (a)2 i through iv above are exclusive of collection facilities for sewage that arises only on nonresidential property owned or leased by the governmental unit, public utility, or vendor.

(b) Under N.J.A.C. 7:15-3.4(d)3 and (g)4, written statements of consent for wastewater management plans shall generally be requested from, at a minimum, the governing bodies of each of the governmental entities and sewerage agencies that are required to be notified under (a) above.

(c) Wastewater management plans relating to the New Jersey Coastal Zone, the Hackensack Meadowlands District, the Pinelands Area, or the Pinelands National Reserve are also subject to the requirements of N.J.A.C. 7:15-3.6, 3.7 or 3.10 as appropriate.

7:15-5.23 Schedule for submission of wastewater management plans

(a) Each wastewater management planning agency shall prepare and submit a wastewater management plan update every six years from the date of last adoption unless an alternate schedule is established pursuant to (e) or (f) below as a request to revise the applicable areawide WQM plan under N.J.A.C. 7:15-3.5. Where no wastewater management plan has ever been adopted or a wastewater management plan has been adopted prior to July 7, 2002, the wastewater management plan is not current and is not in compliance with this section.

(b) If a wastewater management plan in compliance with the schedule in (a) above is not in place on July 7, 2008, the WMP agency shall submit a WMP or WMP update by April 7, 2009. If a municipality accepts wastewater management plan responsibility through alternative assignment under N.J.A.C. 7:15-5.13, the municipality shall submit a wastewater management plan by July 7, 2009 or in accordance with the schedule established in (e) below.

(c) If the wastewater management planning agency fails to comply with the schedule in (a) or (b) above or an alternative schedule established under (e) or (f) below, the general service areas for wastewater facilities with planning flows of less than 20,000 gallons per day which discharge to ground water, the general service area for wastewater facilities with planning flows of less than 2,000 gallons per day which discharge to ground water, and sewer service areas shall be withdrawn in accordance with N.J.A.C. 7:15-8.1.

(d) Each municipal wastewater management plan chapter established through alternative assignment of WMP responsibility under N.J.A.C. 7:15-5.13 and adopted in accordance with the schedule established at (e) or (f) below shall be current for a period of six years unless the WMP chapter becomes part of a county-wide WMP. Where a municipal WMP chapter is incorporated into a county-wide WMP, the municipal WMP chapter shall assume the same six-year WMP update schedule as the county-wide WMP in accordance with the schedule at (a) above.

(e) Each WQM plan revision that makes or changes alternative assignments of wastewater management plan responsibility under N.J.A.C. 7:15-5.13 shall include a schedule for submission of the corresponding wastewater management plan.

(f) Alternative schedules for submission of wastewater management plans, different from those set forth under (a) through (e) above, shall be established and subsequently changed only if such alternative schedules or changes thereto are adopted as revisions to WQM plans.

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Reasons that may justify the establishment or changing of alternative schedules include, but are not limited to:

1. Coordination of wastewater management plans with the preparation of municipal or county master plans under N.J.S.A. 40:55D-28 or N.J.S.A. 40:27- 2, or with reexaminations under N.J.S.A. 40:55D-89;
2. Coordination between adjacent wastewater management plan areas;
3. The need for additional time to perform specific examinations required under N.J.A.C.
7:15-5.18(a)2 or 5.25(a) through (g);
4. Coordination of wastewater management plans with the schedules of the NJPDES programs or of financial assistance programs under N.J.A.C. 7:22; and
5. The need to stagger the submission of wastewater management plans so that the Department can better manage its corresponding workload under N.J.A.C. 7:15-3.4.

(g) The Department may at any time request a wastewater management planning agency to submit written reports on the progress that such agency is making in meeting its wastewater management plan responsibility. Such agency shall submit such reports to the DWM within 30 calendar days of receiving such requests.

(h) Each wastewater management plan that updates one or more already existing wastewater management plan shall comply with N.J.A.C. 7:15-5.20 and include:

1. Updated maps and descriptions of the then existing wastewater jurisdictions, wastewater service areas, and facilities under N.J.A.C. 7:15-5.16;
2. Updated maps of features under N.J.A.C. 7:15-5.17;
3. Updated maps and descriptions of future wastewater jurisdictions, wastewater service areas, and facilities under N.J.A.C. 7:15-5.18, with due regard to changes in factors discussed in that section, such as adoption of new or amended zoning ordinances; and
4. A demonstration of compliance with the criteria at N.J.A.C. 7:15-5.24 and 5.25(a) through (g).

(i) A wastewater management planning agency may submit a wastewater management plan at any time prior to the period when such submission is required under (a) through (f) above. The establishment of an alternative schedule under (f) above is not required for such early submission.

7:15-5.24 Delineation of sewer service areas

(a) Sewer service may only be provided to areas that are not identified as environmentally sensitive areas at (b) below, coastal planning areas listed at (c) below, or special restricted areas at (d) below, except as provided at (e) through (h) below. Nothing in this section shall preclude the wastewater management planning agency from excluding additional areas from sewer service based on local planning objectives, the lack of wastewater treatment capacity or other environmental concerns, including, but not limited to, source water protection.

(b) Environmentally sensitive areas shall be defined based on a composite geographic information systems (GIS) analysis, as any contiguous area of 25 acres or larger consisting of any of the following features alone or in combination:

1. Areas mapped as endangered or threatened wildlife species habitat on the

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Department's Landscape Maps of Habitat for Endangered, Threatened or Other Priority Species. The data are available as a download at the Department's webpage http://www.nj.gov/dep/gis/listall.html titled "Landscape Project Data";

2. Areas mapped as Natural Heritage Priority Sites, excluding those lands within the boundaries of these sites mapped in the "Urban Lands" layer extracted from the Department's 1995/97 and 2002 Land Use/Land Cover geographical information systems database as amended and updated. Both the Natural Heritage Priority Site data and the Urban Lands data are available as a digital data download at the Department's webpage http://www.nj.gov/dep/gis/listall.html titled "Natural Heritage Priority Sites";

3. Special water resource protection areas along a Category One waters and their tributaries established under the Stormwater Management rules, N.J.A.C. 7:8. Surface waters that are designated Category One are listed in the Surface Water Quality Standards at N.J.A.C. 7:9B. These waters can be determined using the download available on the Department's webpage at http://www.nj.gov/dep/gis/listall.html titled "Surface Water Quality Standards"; and

4. Wetlands as mapped pursuant to N.J.S.A. 13:9A-1 and 13:9B-25. This data is available as a download on the Department's webpage http://www.nj.gov/dep/gis/listall.html titled "Wetlands."

(c) The following coastal planning areas identified on the CAFRA Planning Map, available at http://www.nj.gov/dep/gis/listall/cafralayers.html shall not be identified as sewer service areas:

1. Coastal Fringe Planning Areas;
2. Coastal Rural Planning Areas; or
3. Coastal Environmentally Sensitive Planning Areas.

(d) The following special restricted areas shall be excluded from the extension of new sewer service either through sewer service area mapping where local mapped information exists delineating these areas, or through narrative description in a wastewater management plan where a reliable mapping source does not exist:

1. Environmentally sensitive areas in which Federal 201 grant limitations prohibit the extension of sewer service;
2. Beaches as defined at N.J.A.C. 7:7E-3.22;
3. Coastal high hazard areas as defined at N.J.A.C. 7:7E-3.18; and
4. Dunes as defined at N.J.A.C. 7:7E-3.16.

(e) The applicant for a Water Quality Management plan amendment, including wastewater management plans, wastewater management plan updates or site specific amendments may rebut the presumption that the environmental data identified in (b) above is correct by providing the following information:

1. All of the information required at N.J.A.C. 7:15-5.26 for a habitat suitability determination that demonstrates that an area is not suitable habitat for endangered or threatened species;
2. A Letter of Interpretation issued by the Department pursuant to N.J.A.C. 7:7A-8 to demonstrate that an area is not wetlands; or
3. Any other information that demonstrates that the Department's GIS coverage is inaccurate at a particular location.

(f) Any area identified in (d) above may be added to the sewer service area upon

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submission of the information listed at (f)1 and 2 below. Where areas identified in (d) above are excluded in the mapping of sewer service areas, a formal amendment or revision to the wastewater management plan and areawide WQM plan under N.J.A.C. 7:15-3.4 or 3.5, as appropriate, shall be required. Where the areas are excluded by narrative criteria only, the submission of the information listed in (f)1 and 2 below shall be sufficient to make the project consistent with the areawide WQM plan for the particular criteria addressed:

1. A mapping revision or grant condition waiver issued by the U. S. Environmental Protection Agency for a project or site that would otherwise be subject to a 201 grant condition prohibiting the extension of sewers into environmentally sensitive areas; or
2. A CAFRA permit issued by the Department for a specific site and use approved under the Rules on Coastal Zone Management, N.J.A.C. 7:7E.

(g) Sewer service areas may include environmentally sensitive areas listed at (b) above provided:

1. The environmentally sensitive area is included either to allow infill development, or to remove undulations in the sewer service area boundary as necessary to create a linear boundary that relates to recognizable geographic features as allowed by N.J.A.C. 7:15-5.20(b)2; and
2. The Department determines that the environmentally sensitive areas included in the sewer service area are not critical to a population of endangered or threatened species, the loss of which would decrease the likelihood of the survival or recovery of the species in the State.

(h) Sewer service areas may include environmentally sensitive areas listed at (b) above provided it is designed to accommodate center based development and is an element of an endorsed plan approved by the State Planning Commission where:

1. The Department determines that the environmentally sensitive areas included in the sewer service area are not critical to a population of endangered or threatened species, the loss of which would decrease the likelihood of the survival or recovery of the species in the State;
2. The Department has determined that the endorsed plan adequately addresses the protection of environmentally sensitive areas located outside of the designated sewer service area; and
3. The wastewater management planning agency has identified an adequate wastewater management alternative in accordance with N.J.A.C. 7:15-5.25(a) through (c).

7:15-5.25 Evaluation criteria for wastewater management plans and amendments

(a) The Department will only adopt a wastewater management plan, wastewater management plan update or wastewater management plan amendment if the applicant demonstrates compliance with the requirements in this section for existing and future wastewater treatment needs, water supply demands, and nonpoint sources of pollution. The Department will only process a revision under N.J.A.C. 7:15-3.5(b)4 if the Department determines, based on its assessment of the revision proposal, that it complies with the requirements in this section. The standards set forth in this section represent the minimum standards for approval of a wastewater management plan, wastewater management plan update or wastewater management plan amendment. WMP planning agencies or municipalities may incorporate more protective standards.

(b) Except as provided for a site specific amendment in (h) below, an application for

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approval of a wastewater management plan or wastewater management plan update shall include environmental analyses or assessments and meet the standards set forth in (c) through (g) below.

(c) An environmental build-out analysis shall be developed for each existing and proposed wastewater service area, except for those portions of sewer service areas that are located in urbanized municipalities. The build-out analysis shall be developed on a HUC 11 basis. Each HUC 11 shall be further disaggregated by municipality. Development shall also be broken down between areas within and outside of public water supply service areas. These delineations and associated analyses shall be based on the mapping and narrative requirements in N.J.A.C. 7:15-5.16 through 5.18 and 5.20 and shall be prepared in accordance with the following:

1. In areas not currently connected to sewers that are in an existing or proposed sewer service area, identify the development that is currently existing and intended to be connected to sewers, as well as the future development that can occur under existing zoning in undeveloped areas and is expected to connect to sewers, after removing wetlands and riparian zones. At the option of each municipality, other areas may be removed if they are not expected to connect to sewers, including, but not limited to, permanently preserved agricultural lands or public open space. Identify the development to be connected to sewers by acres and type, including number of residential units and measures of nonresidential development in terms used to calculate wastewater flow at N.J.A.C. 7:14A-23.3;

2. For undeveloped and underdeveloped areas outside of sewer service areas, identify the number of dwelling units that can occur consistent with the analysis at (e) below, without removing wetlands and riparian zones; and

3. The information required in (c)1 and 2 above must be presented in tables and maps sufficient to demonstrate compliance with analyses of wastewater and water supply in (d) through (f) below.

(d) The existing and future wastewater treatment needs of each sewer service area and the specific treatment alternatives proposed to meet these needs shall be identified and evaluated in conformance with the following:

1. For areas identified to be served by existing or proposed expanded or new domestic or industrial treatment works that require a NJPDES permit, the applicant shall identify the existing wastewater generated and future wastewater generation potential within each existing or proposed new or expanded sewer service area as follows:

i. Determine the existing flows attributed to portions of the sewer service area that are connected to the facility based on the monthly average over the most recent 12 months, or the peak monthly average flow for treatment facilities that experience a seasonal peak resulting from transient populations, as reported in the Discharge Monitoring Reports required pursuant to N.J.A.C. 7:14A-6.8 for the facility;

ii. For urbanized municipalities, estimate future wastewater flows by multiplying the incremental population increase projected within a 20-year planning horizon from the date of WMP preparation, developed using the municipal master plan or other governmental or academic source, by a value of 75 gallons per capita per day and adding any known new nonresidential flows

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including from, without limitation, expanded or redeveloped industries, landfill leachate or septage; and

iii. For municipalities not subject to ii above, estimate future wastewater flows from existing development that is not currently connected and future development using information developed in the environmental build-out in (c) above, and flow projections from N.J.A.C. 7:14A-23.3, and adding any known new non-residential flows including from, without limitation, new or expanded industries that do not conform to the categories at N.J.A.C. 7:14A-23.3, landfill leachate or septage;

2. Potential wastewater generation from each sewer service area shall not exceed the permitted capacity for each facility. Where the sewer service area encompasses more than one municipality, the potential wastewater generated in each municipality shall be compared to the amount of capacity allocated to that municipality. Where potential wastewater generation from any contributing municipality calculated in accordance with (d)1 above exceeds the flow allocated to that contributing municipality or if the total wastewater generation potential exceeds the permitted flow for each domestic or industrial treatment works, the WMP agency and/or affected municipalities shall either:

i. Reduce the sewer service area;

ii. Change zoning to reduce the wastewater generation potential in the sewer service area;

iii. Identify new or expanded domestic or industrial treatment works sufficient to address the difference between the permitted flow and wastewater generation potential calculated in accordance with (d)1 above; or

iv. Submit a plan, including a commitment by the owner of the affected facilities to implement the plan and approved by the Department, to eliminate excessive infiltration and inflow sufficient to accommodate the increase in wastewater flow;

3. For each proposed new or expanded domestic or industrial treatment works with discharge to surface water, the applicant shall perform an antidegradation analysis in accordance with the antidegradation policies in the Surface Water Quality Standards at N.J.A.C. 7:9B-1.5(d). The applicant shall propose a wastewater treatment and disposal alternative only as consistent with the following hierarchy:

i. The applicant shall evaluate the feasibility of reclaiming wastewater for beneficial reuse by conducting a study in accordance with the Department's "Technical Manual for Reclaimed Water for Beneficial Reuse," as amended or supplemented, incorporated herein by reference. The Technical Manual for Reclaimed Water for Beneficial Reuse is available to be viewed or downloaded at http://www.state.nj.us/dep/dwq/techman.htm. RWBR shall be implemented to the extent determined to be feasible;

ii. Expansions of existing permitted domestic or industrial treatment works facilities shall maintain the current pollutant load, after compliance with any wasteload allocations imposed through an adopted total maximum daily load wasteload allocation, by increasing flow and improving the quality of treatment at the treatment works;

iii. To the extent that load increases cannot be avoided in accordance with (d)3ii above, new or expanded domestic or industrial treatment works shall achieve no

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measurable change in water quality in the receiving stream by adhering to water quality based effluent limits calculated based on a stream study approved by the Department or limits needed to comply with adopted total maximum daily load wasteload allocations;

iv. Where a new or expanded domestic or industrial treatment works discharging to Category Two waters will result in a measurable change in receiving water quality based on the stream study in (d)3iii above, the applicant shall make the demonstrations at N.J.A.C. 7:9B-1.9 to justify the proposed lowering of existing water quality; and

v. Where the demonstrations in (d)3i through iv cannot be made, the Department will not approve the proposed new or expanded domestic or industrial treatment works and the sewer service area must be adjusted such that wastewater generation potential does not exceed the permitted capacity;

4. For areas to be served by a proposed new or expanded domestic or industrial treatment works with a discharge to ground water that will require a NJPDES permit, the applicant shall demonstrate compliance with Ground Water Quality Standards, N.J.A.C. 7:9C, through the permitting process and, for domestic treatment works, shall demonstrate consistency with the number of equivalent dwelling units, using the flow or mass basis as applicable, allowable based on the nitrate planning standard as determined at (e) below;

5. Where new or expanded domestic or industrial treatment works are proposed, demonstrate that water supply commensurate with the new or expanded capacity is available from a source that is consistent with water availability identified in the most current New Jersey State Water Supply Plan; and

6. For areas within the Highlands preservation area, the applicant shall additionally demonstrate that proposed wastewater facilities are consistent with the requirements as set forth in the Highlands Water Protection and Planning Act Rules, N.J.A.C. 7:38.

(e) For areas not covered by (d) above, the future wastewater treatment needs of the entire remaining wastewater management planning area shall be evaluated in conformance with the following:

1. Except as provided in (e)2 below, in areas proposed to be served by individual subsurface sewage disposal systems discharging 2,000 gallons per day or less to ground water, the applicant shall determine the development density that can be accommodated in undeveloped and underdeveloped areas that will result in attainment of 2.0 mg/L nitrate in the ground water on a HUC 11 basis, as follows:

i. Determine the number of acres per equivalent dwelling unit using either:

(1) "A Recharge-Based Nitrate-Dilution Model for New Jersey v5.1" developed by the New Jersey Geological Survey incorporated herein by reference, as amended and supplemented, available at www.state.nj.us/dep/watershedmgt/rules.htm; or

(2) A simplified model using HUC 11 recharge values called "A Recharge-Based HUC11-Scale Nitrate-Carrying-Capacity Planning Tool for New Jersey, MS Excel Workbook, v1.0," incorporated by reference, as amended and supplemented available at http://www.nj.gov/dep/watershedmgt/rules.htm;

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ii. Determine the number of undeveloped and underdeveloped acres in each municipality or portion thereof in each HUC 11 and divide the number of acres by the number of acres per unit calculated in (e)1i above to determine the number of additional allowable equivalent dwelling units;

iii. Apply existing zoning to all undeveloped and underdeveloped areas to determine the number of equivalent dwelling units for comparison to (e)1ii above. For nonresidential areas, convert the proposed development type to equivalent dwelling units by dividing the flow projected to be generated in accordance with N.J.A.C. 7:9A-7.4 by 500 gallons per day;

iv. If the wastewater management planning entity determines that the number of additional equivalent dwelling units calculated in (e)1iii above exceeds the allowable number of additional equivalent dwelling units in (e)1ii above then the plan shall include an adjustment to the zoning in order to achieve consistency between zoning and the allowable number of additional equivalent dwelling units at build-out in the undeveloped and underdeveloped areas; and

v. The allowable number of additional equivalent dwelling units may be distributed within the HUC 11 at the discretion of the municipality(ies) provided that the total number of additional equivalent dwelling units in the HUC 11 does not exceed the allowable number calculated in (e)1ii above;

2. In the Highlands preservation area, the applicant shall demonstrate that proposed wastewater facilities are consistent with the requirements as set forth in the Highlands Water Protection and Planning Act Rules, N.J.A.C. 7:38; and

3. Demonstrate that areas to be served by individual subsurface sewage disposal systems are subject to a mandatory maintenance program, such as an ordinance, which ensures that all individual subsurface sewage disposal systems are functioning properly. This shall include requirements for periodic pump out and maintenance, as needed.

(f) The Department will only adopt a WMP, WMP update or WMP amendment if water supply needs associated with the environmental build-out are demonstrated to be met with existing, new or expanded water supplies that do not conflict with the most current New Jersey State Water Supply Plan, regional water supply plans, or TMDLs adopted as WQM plan amendments including, but not limited to, any limitations on withdrawals due to ecological and saltwater intrusion concerns. The following information and analyses are required to be submitted by the WMP agency to allow a determination by the Department:

1. For each public water supply service area and for the area outside public water supply service areas, provide the following for each municipality, disaggregated by wastewater service area and on a HUC 11 basis:

i. An estimate of the amount of future water supply demand determined utilizing information developed under the environmental build-out analysis at (c) above and N.J.A.C. 7:10-11.5(f) or, in urbanized municipalities, assuming the equivalent of the wastewater generation of the incremental population increase; and

2. Where the Department determines that there is insufficient existing water supply available to provide for the needs identified in (f)1 above based on existing water allocation permits and the available water supply established in the most recent New Jersey State Water Supply Plan, regional water supply plans or adopted TMDLs, the

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WMP agency must identify measures to ensure an adequate water supply, including one or more of the following:

i. Obtaining additional water supply through reuse as identified in accordance with the Department's "Technical Manual for Reclaimed Water for Beneficial Reuse" as amended or supplemented, incorporated herein by reference. The Technical Manual for Reclaimed Water for Beneficial Reuse is available to be viewed or downloaded at http://www.state.nj.us/dep/dwq/techman.htm;

ii. Obtaining water from a source with available capacity consistent with the most current version of the New Jersey State Water Supply Plan and consistent with the findings of any applicable regional water supply plan or an applicable Total Maximum Daily Load where one has been adopted;

iii. Adopting water conservation ordinances to reduce demand to match available supply; or

iv. Reducing the amount of water demand by reducing the amount or altering the type of planned future development.

(g) An assessment of nonpoint source pollution impacts of planned future development shall be conducted and it shall be demonstrated that the environmental standards for stormwater, riparian zones, and steep slopes established in this section, as well as measures identified in adopted TMDLs or watershed restoration plans, shall be met.

1. Ground water recharge shall be maintained and stormwater runoff quantity and quality shall be controlled in accordance with the requirements of the Stormwater Management rules, N.J.A.C. 7:8. Compliance with this standard shall be demonstrated by submission of an adopted stormwater management plan and an ordinance that conforms with the requirements of N.J.A.C. 7:8.

2. Riparian zones adjacent to all waters as described below in this paragraph shall be protected from avoidable disturbance:

i. The riparian zone is 300 feet wide along both sides of any Category One water, and all upstream tributaries situated within the same HUC 14 watershed;

ii. The riparian zone is 150 feet wide along both sides of the following waters not identified in (g)2i above:

(1) Any trout production water and all upstream waters (including tributaries);

(2) Any trout maintenance water and all upstream waters (including tributaries) within one linear mile as measured along the length of the regulated water;

(3) Any segment of a water flowing through an area that contains documented habitat for a threatened or endangered species of plant or animal, which is critically dependent on the regulated water for survival, and all upstream waters (including tributaries) within one linear mile as measured along the length of the regulated water; and

(4) Any segment of a water flowing through an area that contains acid producing soils; and

iii. A riparian zone 50 feet wide shall be maintained along both sides of all waters not subject to (g)2i or ii above.

3. Compliance with the riparian zone standard shall be demonstrated by submission of

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copies of municipal ordinances that prevent new disturbance for projects or activities except as provided in (g)3i and ii below:

i. Redevelopment within the limits of existing impervious surfaces; and

ii. New disturbance in the riparian zone necessary to protect public health, safety or welfare; to provide an environmental benefit; to prevent extraordinary hardship on the property owner peculiar to the property; or to prevent extraordinary hardship, provided the hardship was not created by the property owner, that would not permit a minimum economically viable use of the property based upon reasonable investment.

4. Compliance with the riparian zone requirements of this chapter does not constitute compliance with the riparian zone or buffer requirements imposed under any other Federal, State or local statute, regulation or ordinance.

5. Adjustments to the riparian zones established by this subsection are allowed to the extent they comply with the Stormwater Management rules, N.J.A.C. 7:8, the Flood Hazard Area Control Act rules, N.J.A.C. 7:13, the Highlands Water Protection and Planning Act Rules, N.J.A.C. 7:38, and the Coastal Zone Management rules, N.J.A.C. 7:7E.

6. Steep slopes shall be protected from avoidable disturbance in accordance with this section. Compliance with this standard shall be demonstrated by submission of copies of municipal ordinances that prevent new disturbance for projects or activities except as provided in (f)6i and ii below:

i. Redevelopment within the limits of existing impervious surfaces; and

ii. New disturbance necessary to protect public health, safety or welfare; to provide an environmental benefit; to prevent extraordinary hardship on the property owner peculiar to the property; or to prevent extraordinary hardship, provided the hardship was not created by the property owner, that would not permit a minimum economically viable use of the property based upon reasonable investment.

7. A WMP, WMP update or WQM plan amendment shall include additional measures as
specified in an adopted TMDL or watershed restoration plan.

(h) Site specific wastewater management plan amendments shall not create a significantly new pattern of sewered development such that a significant potential or incentive is created for additional revisions or amendments to open new areas to sewered development. Site specific wastewater management plan amendments and revisions at N.J.A.C. 7:15-3.5(b)4 shall comply with the environmental standards of (d), (e), (f) and (g) above except as provided in (h)1 through 6 below:

1. Instead of performing the calculation at (d)1 above for the entire sewer service area, the calculation required at (d)1 above shall be performed for the proposed project or activity. Where a project or activity is proposed to be included within an existing sewer service area, the planning flow shall be compared to the wastewater generation potential previously calculated for the sewer service area and the permitted capacity of the receiving wastewater treatment facility. If the project or activity will cause the wastewater generation potential of the expanded sewer service area to exceed the permitted capacity of the receiving wastewater treatment facility, or if the project or activity is proposed to be served by a new wastewater treatment facility, then the

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analyses at (d)2 through (d)4 above apply;

2. Instead of the analyses at (d)4 and (e)1 and 2 above, the following apply:

i. For projects utilizing discharge to ground water that are allowed to proceed in accordance with this chapter where a wastewater management plan is not in compliance with the schedule at N.J.A.C. 7:15-23, demonstrate that the wastewater generated by the project or activity can be discharged in conformance with the nitrate planning standard of 2.0 mg/L, considering dilution available on the project site, using one of the methods in (h)2i(1) through (3) below, as appropriate to the type of development:

(1) For residential development, "A Recharge-Based Nitrate-Dilution Model for New Jersey v5.1" developed by the New Jersey Geological Survey, incorporated herein by reference, as amended and supplemented available at www.state.nj.us/dep/watershedmgt/rules.htm;

(2) For nonresidential development, "A Recharge-Based Nitrate-Dilution Model for Small Commercial Establishments in New Jersey, v1.1" developed by the New Jersey Geological Survey, incorporated herein by reference, as amended and supplemented available at www.state.nj.us/dep/watershedmgt/rules.htm; or

(3) An alternative analytical method approved by the Department that is designed to assess the impacts of nitrate discharged from individual subsurface sewage disposal systems;

ii. For projects utilizing discharge to ground water where a wastewater management plan is in compliance with the schedule at N.J.A.C. 7:15-23, demonstrate that the discharge of wastewater generated by the project or activity is consistent with attaining the nitrate planning standard within the HUC 11, taking into account the demonstration in the approved WMP;

3. Instead of providing the information at (f)1 above for the entire wastewater management planning area, the information required at (f)1 above shall be provided for the proposed project or activity. The water supply need for the proposed project or activity shall be compared to water availability as established in the most recent New Jersey State Water Supply Plan, regional water supply plans or adopted TMDLs, and in consideration of other needs within the HUC 11, where the WMP is in conformance with the schedule at N.J.A.C. 7:15-5.23. If the project or activity would cause an exceedance of the established water availability, either alone or in combination with the other water supply need identified in a WMP in conformance with the schedule, then the analyses at (f)3 above apply;

4. Instead of the stormwater management requirements at (g)1 above provide:

i. Proof that the project or activity is exempt from the requirements of N.J.A.C. 7:8;

ii. Site specific stormwater design documentation to demonstrate the project or activity is in compliance with the requirements of N.J.A.C. 7:8; or

iii. Proof of a municipal waiver or variance for the proposed project or activity in accordance with N.J.A.C. 7:8 through a municipal mitigation plan;

5. Instead of the riparian zone protection requirements at (g)2 above, demonstrate compliance with one of the following:

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i. The proposed project or activity is not in the riparian zone established at (g)2 above;
ii. The proposed disturbance in a riparian zone is for a linear development with no feasible alternative route. If the riparian zone is associated with Category One waters, the linear development must also meet the requirements of N.J.A.C. 7:8-5;
iii. The proposed disturbance of a riparian zone is in accordance with a stream corridor restoration or stream bank stabilization plan or project approved by the Department;
iv. The proposed disturbance of a riparian zone is necessary to provide for public pedestrian access or water dependent recreation that meets the requirements of the Freshwater Wetlands Protection Act rules, N.J.A.C. 7:7A, the Flood Hazard Area Control rules, N.J.A.C. 7:13, or the Coastal Zone Management rules, N.J.A.C. 7:7E;
v. The proposed disturbance of a riparian zone is required for the remediation of hazardous substances performed with Department or Federal oversight pursuant to the Spill Compensation and Control Act, N.J.S.A. 58:10-23.11a et seq. or the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. §§ 9601 et seq.;
vi. The proposed disturbance is for redevelopment that does not exceed the limits of existing impervious surfaces; or
vii. The proposed disturbance would prevent extraordinary hardship on the property owner peculiar to the property; or prevent extraordinary hardship, provided the hardship was not created by the property owner, that would not permit a minimum economically viable use of the property based upon reasonable investment; and/or

6. In lieu of the requirements at (g)6 above, demonstrate through site plans depicting proposed development and topography that new disturbance is not located in areas with a steep slope, except as provided in (g)6i and ii above.

7:15-5.26 Habitat Suitability Determination

(a) Where an area is excluded from a sewer service area in accordance with N.J.A.C. 7:15-5.24 on the basis that it is within habitat patch of Rank 3, 4 or 5 on the Department's Landscape Maps of Habitat for Endangered, Threatened and Other Priority Wildlife, an applicant may seek a Habitat Suitability Determination from the Department if it wishes to rebut the presumption that a habitat patch of Rank 3, 4 or 5 on the Department's Landscape Maps of Habitat for Endangered, Threatened and Other Priority Wildlife is accurate.

(b) An application for a Habitat Suitability Determination shall include:

1. A letter from the Department's Natural Heritage Program issued within six months of the date of application, stating if any threatened or endangered animals listed in the Natural Heritage database exist on or near the site. Information and forms relating to the Natural Heritage Program may be found on the Division of Parks and Forestry web page at www.nj.gov/dep/parksandforests/natural/heritage or obtained from the Office of Natural Lands Management, Natural Heritage Program at:

Division of Parks and Forestry
New Jersey Department of Environmental Protection

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P.O. Box 404
Trenton, New Jersey 08625-0404
Phone: (609) 984-1339
Fax: (609) 984-1427

2. A description of the habitat requirements for each species identified in the Natural Heritage Program letter, including citations to appropriate literature and studies;

3. Three copies of a description of the parcel, including, but not limited to:

i. Vegetation, elevation, slope and aspect, and a description of any important topographic features such as cliffs, bluffs and sinkholes on or within 0.25 miles of the boundary of the site;

ii. The geology of the site as described in the most current USGS bedrock geologic maps, a description of bedrock and surficial deposits, and the location and description of any important geologic features such as talus and caves within 0.25 miles from the boundary of the site;

iii. The soil types on the site as most currently classified and mapped by the U.S. Department of Agriculture (U.S.D.A.) Natural Resources Conservation Service and the location and description of any important soil features present within 0.25 miles of the boundary of the site;

iv. The location and a description of all hydrologic features on the site such as rivers, streams, lakes, ponds, springs, seeps, vernal pools and waterfalls, as well as those located within 0.25 miles from the boundary of the site;

v. The location and a description of all evidence of natural or man-made disturbance both on the site and within 0.25 miles from the boundary of the site;

vi. The location and a description of all upland, wetland, and aquatic ecological vegetative communities on the site, based on quantitative data collected during the optimal time(s) of the year using appropriate, scientifically accepted terms of description and analysis techniques. Guidance with regard to appropriate classification systems and techniques may be found in Guidelines for Describing Associations and Alliances of the U.S. National Vegetation Classification by Jennings et al. (2003), The Ecological Society of America – Vegetation Classification Panel, available at: www.esa.org/vegweb/NVC_guidelines_v3.pdf; Ecological Systems of the United States: A Working Classification of U.S. Terrestrial System by Comer et al. (2003), NatureServe, available at: www.natureserve.org/library/usEcologicalsystems.pdf; and Classification of Vegetation Communities of New Jersey: Second Iteration by Breden etal. (2001), Association for Biodiversity Information and New Jersey Natural Heritage Program, available at: http://njedl.rutgers.edu/njdlib, Record ID#1980. For each ecological community identified on the site, the evaluation shall include physiognomy, species composition with a list of the most abundant plant species by strata (canopy tree, subcanopy tree, shrub, vine, herbaceous, bryophyte), a description of successional stage, slope degrees and aspect, geologic substrate (as indicated in the most recent USGS bedrock geologic maps), soil texture and pH (as indicated in the most recent Soil Survey and

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verified by field sampling), depth to water table (as indicated in the most recent Soil Surveys), and hydrologic influences;

vii. A map showing the location and composition of ecological communities on the site and the location of important topographical, geological and hydrological features identified in (b)3iv above;

viii. The results of threatened or endangered animal species surveys for the purpose of supplementing scientific data regarding the suitability of a particular habitat for a particular species that were conducted in consultation with the Department and in accordance with all Federal and State laws and regulations, including for each species surveyed: the survey method, the surveyor's name(s), dates and times surveys were performed, number of samples, and number of replications;

ix. The names, addresses and professional qualifications of all persons who performed habitat evaluations, and/or species surveys relied upon to support the application for the Habitat Suitability Determination;

x. A copy of any other relevant animal survey or report to which the applicant or their agent has access; and

xi. Any other information relevant to assessing the suitability of habitat on the site for any threatened or endangered animal species.

(c) In making a Habitat Suitability Determination, the Department shall consider as suitable habitat any site that, based on the best available scientific information, provides all of the components necessary to sustain any threatened or endangered animal species, including, but not limited to, nesting or breeding areas, foraging or feeding areas, resting or roosting areas, hibernacula or denning areas , migratory and/or movement pathways, areas necessary for lifecycle completion, or any site that is a part of a larger habitat area that provides all of the components necessary to sustain the threatened or endangered animal species in question. The determination shall be based upon evaluation of the following:

i. The information provided by the applicant under (b) above;

ii. Information available to the Department identifying which, if any, threatened or endangered animal species may have suitable habitat on the site. Such information includes, but is not limited to, the Landscape Maps, Natural Heritage Database, records of documented species occurrences and public comment;

iii. Scientific information related to the life history characteristics and habitat needs of the species;

iv. The results of any animal species surveys done in consultation with the Department and in accordance with the survey procedures at N.J.A.C. 7:7E-3C.4(a) and (b); and

v. The extent to which the site contains the characteristics of suitable habitat for each threatened and endangered animal species, including onsite and adjacent vegetation structure and composition, soil characteristics, wetland characteristics and hydrologic conditions, surrounding land use and disturbance levels, and any other factor that may affect the habitat suitability for any threatened or endangered animal species that are identified as part of on-site inspection(s).

(d) Based on the information provided in (b) above and the Department's analysis at (c) above, the Department will:

1. Issue a letter finding that the parcel is not suitable habitat;
2. Issue a letter finding that the parcel is suitable habitat; or

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3. Notify the applicant that seasonal conditions do not permit an accurate assessment of habitat, explain the seasonal conditions involved, and give the applicant the option of either accepting a finding that the site constitutes suitable habitat for that species, or waiting until the Department can determine the suitability of habitat.

SUBCHAPTER 6. WATER QUALITY LIMITED SEGMENTS LISTS AND TOTAL MAXIMUM DAILY LOADS

7:15-6.1 Scope and purpose
This subchapter sets forth the processes for identifying and listing water quality limited segments, setting the priorities and schedule for development of total maximum daily loads (TMDLs) to address impairments in water quality limited segments, and for developing TMDLs and plans to implement TMDLs.

7:15-6.2 Listing of water quality limited segments
(a) The Department shall develop lists of water quality limited segments in accordance with the Federal requirements at 40 CFR 130.7(b), incorporated herein by reference; Federal information or guidance concerning the Clean Water Act Section 303(d), 305(b) and 314 Integrated Reporting and Listing Decisions; the USEPA guidance document titled Information Concerning 2008 Clean Water Act Sections 303(d), 305(b) and 314 Integrated Reporting and Listing Decisions – Diane Regas – October 12, 2006 (available at http://www.epa.gov/owow/tmdl/policy.html) incorporated herein by reference, as amended and supplemented; and pursuant to the process set forth in (b) through (g) below.
(b) The Department has developed and shall, from time to time, revise a document known as the Integrated Water Quality Monitoring and Assessment Methods document in accordance with 40 CFR 130.7(b)6 that sets forth assessment methods used to develop the List of Water Quality Limited Segments required by Section 303(d) of the Federal Clean Water Act (33 U.S.C. §1313(d)).
(c) The Department shall publish a notice in the New Jersey Register and on its website http://www.state.nj.us/dep/wms/bwqsa/generalinfo.html to solicit water quality data to be considered in the development of the List of Water Quality Limited Segments.
(d) The Integrated Water Quality Monitoring and Assessment Methods document describes:

1. The quality assurance requirements for data used to evaluate water quality and support
of designated uses;
2. The methods used to evaluate water quality data, assess water quality standards attainment and identifying water quality limited segments; and
3. The basis for assigning the priority for development of TMDLs for the waterbody and pollutant combinations identified on the List of Water Quality Limited Segments, also known as the 303(d) list.

(e) The Department shall publish a notice in the New Jersey Register and on its website to provide the public with the opportunity to provide comment on revisions to the Integrated Water Quality Monitoring and Assessment Methods Document prior to applying the revised assessment methods in developing the next List of Water Quality Limited Segments in (f) below.

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(f) The Department shall revise, on a biennial basis, the List of Water Quality Limited Segments in accordance with the Integrated Water Quality Monitoring and Assessment Methods in effect at that time. The list shall indicate those water quality limited segments that are scheduled for the development of TMDLs while the list is in effect.
(g) The Department shall propose the List of Water Quality Limited Segments as an amendment to the Statewide Water Quality Management Plan, provide an opportunity for public comment and adopt the amendment in accordance with N.J.A.C. 7:15-6.4.

7:15-6.3 Total maximum daily loads

(a) Pursuant to the process set forth in (b) and (c) below, the Department shall develop total maximum daily loads (TMDLs) for water quality limited segments in accordance with:

1. The Federal requirements at 40 CFR 130.7(c) and (e), incorporated herein by reference, including all future amendments and supplements; and
2. The following USEPA guidance documents, incorporated herein by reference, including all future amendments and supplements, available at www.nj.gov/dep/watershedmgt/tmdl.htm:
   i. USEPA. 2002. EPA Review of 2002 Section 303(d) Lists and Guidelines for Reviewing TMDLs under Existing Regulations issues in 1992. Office of Wetlands, Oceans and Watersheds Memorandum from: C.H. Sutfin, dated October 2002;
   ii. USEPA. 2002. Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs. Office of Wetlands, Oceans and Watersheds Memorandum from: R.H. Wayland, III, dated November 22, 2002; and
   iii. USEPA. 2006. Establishing TMDL "Daily" Loads in Light of the Decision by the U.S. Court of Appeals for the D.C. Circuit in *Friends of the Earth, Inc. v. EPA, et al.*, No.05-5015, (April 25, 2006) and Implications for NPDES Permits. Office of Water Memorandum from: B. H. Grumbles, dated November 15, 2006.

(b) A TMDL document shall include the following components:

1. An identification of segment(s), pollutant(s) of concern, pollutant sources and the priority for the subject TMDL as identified in the 303(d) list;
2. A description of applicable water quality standards and the water quality target(s) selected for the pollutant(s) of concern;
3. Identification of critical conditions considering seasonal variation;
4. The loading capacity of the segment with respect to the pollutant(s) of concern under the identified critical conditions and identification of the means used to relate actual and predicted water quality to pollutant loads;
5. Allocation of the loading capacity among the following:
   i. Load allocations for nonpoint sources of pollutant load;
   ii. Wasteload allocations for point sources of pollutant load;
   iii. A margin of safety required to included the overall load reductions required to account for uncertainties in the data used in the analysis, the model or other tool use to link water quality and pollutant loads, or the effectiveness of controls available to reduce pollutant loads; and
   iv. An optional reserve capacity to allow for future growth;

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6. An implementation plan that shall include the strategies designed to achieve attainment of the Surface Water Quality Standards or other more stringent target, a proposed schedule for implementation, and the methods to measure the effectiveness of the strategies; and
7. A summary of the opportunities provided and outcomes of public participation in the development of the TMDL.

(c) In addition to the public participation opportunities identified at N.J.A.C. 7:15-6.4, the Department may provide opportunities for public participation in the TMDL development process, based upon anticipated interest, which may include the following:

1. The Department may hold one or more informational meetings, at any point during the development of a TMDL and solicit comments on the components of the TMDL; and
2. The Department may inform or consult with the public through web postings or electronic communication with groups or individuals that have an interest in the affected watershed, regarding components of the TMDL.

7:15-6.4 Amendment procedures

(a) The Department shall propose an amendment to the Statewide Water Quality Management Plan for a revised List of Water Quality Limited Segments or to the applicable areawide Water Quality Management plan(s) for a TMDL document(s) as follows:

1. The Department shall publish a notice of proposed amendment to the Statewide or applicable areawide WQM Plan in the New Jersey Register, on the Department's website at www.state.nj.us/dep and in a newspaper(s) of general circulation in the affected area(s). The public notice shall specify the means to access the subject document electronically or by hard copy and the procedure for submitting comments. The Department may determine to hold a nonadversarial public hearing in anticipation of sufficient public interest. If so, the location, time and place of the hearing will be identified in the notice. A minimum comment period of 30 days will be provided. If a public hearing is to be held, at least 30 days notice of the hearing will be provided and the comment period will remain open until 15 days after the public hearing;
2. The Department may alternatively determine to hold a nonadversarial public hearing in response to expression of sufficient public interest, as defined under N.J.A.C. 7:1D-5.2, received within 30 days of the publication of the notice in (a)1 above. If the Department determines to hold a nonadversarial public hearing in response to a request, notice of the public hearing shall be provided on the Department's website at www.state.nj.us/dep and in a newspaper(s) of general circulation in the affected area. The Department shall additionally provide notice of the public hearing to those requesting the hearing. The Department shall provide a 30-day notice period prior to the public hearing and a 15-day public comment period after the hearing;
3. At the conclusion of the public comment period, the Department will make any appropriate revisions to the document(s) and for TMDLs, prepare a response document to the comments. The Department shall either:
    i. Establish the List of Water Quality Limited Segments or the TMDL as proposed;
    ii. Establish all or portions of the List of Water Quality Limited Segments or the TMDL with changes which do not effectively destroy the value of the public

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notice regarding the proposed List of Water Quality Limited Segments or TMDL, as applicable; or

iii. Re-propose in accordance with (a)1 above, all or portions of the List of Water Quality Limited Segments or the TMDL with substantive changes; and

4. The Department shall submit the established List of Water Quality Limited Segments or the established TMDL, including the response to comments received, to the USEPA for approval.

(b) Upon receipt of a response from USEPA, the Department shall:

1. Amend the document in accordance with USEPA comments and repropose the amendment if USEPA requests substantive changes that effectively destroy the value of the original public notice; or

2. Adopt the document(s) as an amendment to the Statewide Water Quality Management Plan or areawide Water Quality Management plan(s), as applicable, by placing a notice in the New Jersey Register and the Department's website at www.state.nj.us/dep/wms/bwqsa for the List of Water Quality Limited Segments and www.nj.gov/dep/watershedmgt/tmdl.htm for TMDLs. This step constitutes final agency action.

SUBCHAPTER 8. WITHDRAWAL AND REDESIGNATION OF WASTEWATER SERVICE AREAS

7:15-8.1 Withdrawal of wastewater service area designations

(a) Except as provided in (b) and (d) below, wastewater service area designations shall be withdrawn in areas which fail to adopt and maintain a wastewater management plan in accordance with the requirements of N.J.A.C. 7:15-5.2(b), 5.13 and 5.23. Withdrawal of wastewater service area designations under this subsection shall not impact areas where sewers are physically installed and wastewater generating structures are lawfully connected to the collection and treatment system at the time of withdrawal.

(b) Wastewater service area designations for the following are not withdrawn under (a) above:

1. Projects involving the lateral connection of an infill area to an existing public sewer line, where sanitary or combined sewer infrastructure lawfully exists in the right-of-way adjoining the lot or lots such that a connection can be made without crossing any property lines other than that of the lot to be served and where such connection does not require the extension of a collection system. The sewer line, lots, and improvements on the lots must exist on the date that wastewater service area was withdrawn;

2. Except as provided in (d) below, projects that have received, prior to the effective date of the wastewater service area withdrawal, both a local preliminary or final site plan approval or subdivision approval where subsequent site plan approval is not required under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq., (MLUL) or a municipal construction permit; and a Department TWA or NJPDES permit, if one is required, until such time as one of those qualifying approvals expires;

3. Projects that have received a site specific WQM plan amendment or revision adopted prior to the date of wastewater service area withdrawal remain valid for a period of six years from the date of adoption of the amendment or revision; and

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4. Projects that require an industrial treatment works that does not handle process wastewater or sanitary sewage.

(c) Areas for which wastewater service area designations are withdrawn under this section are re-designated as ground water general wastewater service area designation for planning flows of 2,000 gallons per day or less. The following wastewater facilities with discharges to ground water are deemed to be consistent with this new designation:

1. Wastewater facilities serving non-residential development that discharge to ground water with a daily maximum planning flow of 2,000 gallons per day or less when calculated in accordance with the expected volume of sanitary sewage criteria at the Standards for Individual Subsurface Sewage Disposal Systems, N.J.A.C. 7:9A-7.4; or

2. Individual or other subsurface sewage disposal systems serving residential development or subdivisions resulting in a total of fewer than six dwelling units.

i. For the purpose of determining the total number of dwelling units, previous development shall be taken into account. Previous development includes development constructed after the effective date of the wastewater service area withdrawal. Previous development to be taken into account in determining if the development qualifies includes:

(1) The construction of any residential development on contiguous parcels of property, regardless of present ownership, where there is a proposed sharing of infrastructure constructed to serve those parcels including, but not limited to, roads, utility lines, drainage systems, open spaces or septic drainage fields;

(2) The construction of any residential development on contiguous parcels of property which were under common ownership on or after the effective date of the wastewater service area withdrawal, regardless of present ownership, or on parcels created by subdivision or resubdivision of land which occurred after the effective date of the wastewater service area withdrawal;

(3) The construction of any residential development on contiguous parcels of property after the effective date of the wastewater service area withdrawal where there is some shared pecuniary, possessory or other substantial common interest by one or more individuals in the units; and

(4) The addition of one or more dwelling units where such addition, when combined with the dwelling units constructed prior to the effective date of the wastewater service area withdrawal, results in a total of six or more dwelling units;

3. Wastewater facilities with a discharge to ground water including individual and other subsurface sewage disposal systems, associated with a development for which one of the following applies:

i. Projects that have a valid approval issued by the Department, as of the effective date of the wastewater service area withdrawal, for construction of 50 or more realty improvements issued pursuant to the Realty Improvement Sewerage and Facilities Act, N.J.S.A. 58:11-23 et seq.;

ii. Except as provided in (d) below, projects that have received, prior to the effective date of the wastewater service area withdrawal both a local preliminary or final site plan approval or subdivision approval where

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subsequent site plan approval is not required under the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq. or a municipal construction permit and a permit to construct or alter issued by the administrative authority under N.J.A.C. 7:9A-3.5 until such time as one of those qualifying approvals expires; and

4. Repair or minor expansions of existing wastewater facilities with a discharge to ground water provided the total wastewater generated is 2,000 gallons per day or less.

(d) For a public school, in lieu of the MLUL approvals in (b)2 or (c)3ii above, a facility that provides evidence of compliance with statutory provisions of the Municipal Land Use Law at N.J.S.A. 40:55D-1 et seq. in the form of a planning board response dated prior to the effective date of the wastewater service area withdrawal or expiration of the 45-day courtesy comment period that municipal planning boards are allotted to provide recommendations to the school board and Department of Education prior to the effective date of the wastewater service area withdrawal.

SUBCHAPTER 9. WATERSHED MANAGEMENT GRANTS

7:15-9.1 Scope and purpose

(a) The purpose of this subchapter is to set forth the rules governing grants from the Watershed Management Fund to assist watershed management groups in the funding of watershed management activities in accordance with the Watershed Protection and Management Act of 1997, N.J.S.A. 58:29-1 et seq. This subchapter establishes policies and procedures for the award and distribution of Watershed Management Fund monies.

7:15-9.2 Project Priority System and Project Priority Award List

(a) Each year the Department shall develop a Project Priority System that establishes the project category priorities for watershed management grants for that year.

(b) The Department shall publish a notice of availability of watershed management grants in the New Jersey Register, identifying the Project Priority System, application requirements, and deadline for submittal of applications. This notice shall additionally be posted on the Division of Watershed Management's web site (www.state.nj.us/dep/watershedmgt).

(c) Unless otherwise specified in the notice of availability, the Department shall, in general, give priority to the following watershed management activities:

1. The initial establishment of watershed associations and/or stakeholder groups to support watershed management planning activities;
2. Watershed management activities identified as a priority action in a adopted Watershed Management Area (WMA) Plan;
3. Watershed management activities identified by a PAC as a priority action prior to adoption of a WMA Plan;
4. Watershed management activities that are designed to address documented water resource problems or issues of particular concern in a subwatershed, watershed or watershed management area, as indicated in the Statewide Water Quality Inventory Report prepared by the Department pursuant to Section 305(b) of the Federal Clean Water Act (33 U.S.C. §1315(b)), or a characterization and assessment of water quality and water quantity report prepared by or for the Department, or other Department-approved sources of assessment;

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5. Watershed management activities conducted in partnership with other watershed management groups or other entities or interests other than those participating in the applicant's watershed management group;
6. Monitoring and/or modeling activities designed to support the development, implementation and assessment of TMDLs for waterbodies listed on the most recently approved Water Quality Limited Segments (WQLS) List;
7. Watershed management activities to be conducted for an entire watershed management area or areas; and
8. Development of watershed or subwatershed management strategies. (d) Each year, the Department shall develop a Project Priority Award List for projects determined to be eligible for funding based on the Project Priority System. The list shall be submitted to the Legislature for consideration and approval in accordance with N.J.A.C. 7:15-9.5.

7:15-9.3 Pre-application procedures

(a) The Department encourages potential grant applicants to consult with the Department and the applicable PAC(s) prior to application submission in order to facilitate preparation and evaluation of the grant application. Inquiries to the Department may relate to procedural or substantive matters and may range from informal telephone advice to pre-arranged meetings.
(b) Watershed management grants shall only be issued to watershed management groups recognized in accordance with the following:

1. A watershed management group is a group recognized by the Department as the entity representing various interests within one or more watersheds or subwatersheds located in a watershed management area and whose purpose is to improve the condition or prevent further degradation of a watershed or watersheds.
2. The activities of a watershed management group may include:
   i. Holding public meetings to discuss and exchange information on watershed issues;
   ii. Establishing and operating a stakeholder's advisory group or groups or watershed associations dedicated to preserving and protecting a watershed;
   iii. Engaging in water quality and quantity monitoring, water quality modeling or assessment of the condition of a watershed;
   iv. Developing policy goals to reduce the amount of pollutants discharged into a watershed;
   v. Developing projects designed to enhance or restore a watershed; or
   vi. Developing, in consultation with the Department and the PAC established for the WMA, a watershed management strategy, or the reassessment of a watershed to determine whether the policies, goals or the objectives of a WMA plan or a watershed management strategy have been attained. The watershed management strategy addresses one or more watersheds or subwatersheds and is developed by the watershed management group, whereas the WMA plan addresses the watershed management area, which consists of more than one watershed, and is developed by the Department.
3. At a minimum, the following entities and individuals shall be invited to participate in a watershed management group:

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i. The mayor or equivalent government official, or such official's designee, for each municipal government located partially or entirely within the watershed or watersheds represented by the watershed management group;
ii. The county board of freeholders, or the freeholders' designee, for each county located partially or entirely within the watershed or watersheds represented by the watershed management group;
iii. A representative of water purveyors;
iv. A representative of wastewater utilities or authorities;
v. A representative of the business community;
vi. A representative of the development community;
vii. A representative of the agricultural community, if appropriate;
viii. A representative of the applicable Soil Conservation District(s);
ix. A representative of the academic community;
x. A representative of the environmental community;
xi. A representative of the general public; and
xii. An official of any regional planning agency (including regional planning boards established pursuant to N.J.S.A. 40:55D-77 et seq.) that has been created for all or part of the watershed or watersheds to be represented by the watershed management group, as applicable.

4. A request for recognition as a watershed management group shall be submitted to the Department with a copy to the applicable PAC(s), and include the following information:

i. A copy of the mailing list used to establish the watershed management group, including the entities identified in (b)3 above;
ii. A copy of the letter of invitation to participate in the watershed management group;
iii. A copy of the responses from those officials or representatives agreeing to participate;
iv. A copy of the responses from those officials or representatives declining to participate; and
v. In cases where no response to the letter of invitation was received within 60 days, the group shall send a follow-up request by certified mail, return receipt requested, and submit proof of such follow-up.

5. The Department shall respond in writing within 45 days of the receipt of a complete request for recognition as a watershed management group.

6. To qualify for funding under this chapter, a watershed management group shall make an application to the Department for recognition, identify a government entity, 501(c)3 corporation or other corporate entity that will serve as the fiscal agent for the watershed management group and provide a statement of agreement from that entity to serve as the fiscal agent for the watershed management group. The fiscal agent shall be responsible for all financial interactions with the Department.

7. All meetings of a watershed management group shall be open to the public with prior notification in a newspaper of general circulation that covers area of the group.

(c) Potential grant applicants are encouraged to obtain recognition as a watershed management group at least 60 days prior to the submittal of grant applications.

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7:15-9.4 Application procedures for grants for watershed management activities

(a) Any recognized watershed management group may submit an application to the Department for a watershed management grant.

(b) The watershed management group should submit an application pertaining to watershed management activities for which the watershed management group has a high probability of success. Factors for consideration include the extent to which available resources (personnel and fiscal) are sufficient for complete and successful implementation of the activities and achievement of the stated objectives.

(c) The applicant shall submit the information identified in the notice of availability published annually by the Department, in accordance with N.J.A.C. 7:15-9.2. In order to be considered for a grant, the information shall be submitted by the application deadline specified in the notice of availability.

(d) Grant applications shall provide, at a minimum, the following information, as specified in the notice of availability:

1. Proof that the applicant has been recognized as a watershed management group in accordance with N.J.A.C. 7:15-9.3(b);
2. A description of the watershed or watersheds in which the activity is to be conducted, including a map as appropriate;
3. A scope of work that includes an executive summary, a description of the proposed watershed management activities, environmental objectives and measures (as appropriate), a budget, and a schedule for completion;
4. A description of how the proposed activities correspond to and will achieve the goals and objectives of this chapter and conformance with the priorities defined in the annual Project Priority System or N.J.A.C. 7:15-9.2;
5. A description of any proposed environmental monitoring, including evaluation criteria, environmental indicators, and an approved quality assurance/quality control plan, as applicable;
6. Identification of the source and availability of any additional supplementary funds, in the form of cash, in-kind services or both, to be used with this grant to implement the proposed watershed management activity;
7. Identification of all personnel and consultant(s) who will be performing the activity and a description of their experience and expertise in the proposed watershed management activity; and
8. Evidence that the PAC(s) of the watershed management areas within which the proposal is located were provided an opportunity to comment on the proposal, including a copy of the PAC's response; and
9. Any additional information as specified in the notice of availability.

(e) If a grant is awarded, a grant agreement shall be executed between the Department and the watershed management group. The watershed management group is responsible for all performance reports, expenditure reports, deliverables and all other requirements specified in the executed grant agreement.

(f) A watershed management group may contract for services for all or part of the grant to another person or entity to perform a watershed management activity(ies) in accordance with Department procedures and forms provided in the grant agreement, subject to the following conditions:

1. The watershed management group shall not enter into any contract with any person

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debarred, suspended or disqualified from Department contracting pursuant N.J.A.C. 7:1-5 for any services within the scope of work;

2. If the watershed management group distributes a grant to a person who has a NJPDES permit to discharge pollutants into the waters of the State pursuant to N.J.A.C. 7:14A, the distribution shall be conditioned upon the NJPDES permittee providing a match of one dollar for every dollar distributed to the NJPDES permittee. The match may be made either as a monetary payment or as an in-kind contribution; and

3. The use any of the grant monies for the purpose of complying with a NJPDES permit is prohibited.

(g) All grant applications, grant agreements and any supporting documentation are public records.

(h) Unless otherwise specified in the notice of availability, applications for watershed management grants shall be submitted to:

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

7:15-9.5 Project priority award process

(a) The Department shall submit the Project Priority Award List of recommended watershed management grant projects developed under N.J.A.C. 7:15-9.2 to the Legislature for consideration and approval.

(b) The Department shall publish a notice in the DEP Bulletin and on the Division of Watershed Management web site (www.state.nj.us/dep/watershedmgt) of those projects recommended to the Legislature for approval in the Project Priority Award List.

(c) For all watershed management grant applications included on the Project Priority Award List and approved by the Legislature, the Department shall transmit to the applicant for execution a grant agreement specifying the terms and conditions of the grant, including the scope of work, the approved budget, and the schedule for completion. The applicant shall execute the grant agreement in the manner specified by the Department and shall return the grant agreement to the Department within 60 days, unless the applicant has requested and received from the Department an extension of the 60-day period. If the grant agreement is not returned by the deadline, the Department reserves the right to award the grant monies to the next highest ranked eligible project.

(d) Funds under a watershed management grant shall be released only after a grant agreement has been executed by both the applicant and the Department.

(e) The budget in the grant agreement shall specify the items eligible for funding under this subchapter, which may include, for example:

1. Costs of materials, supplies and reproduction for reports, policy recommendations, draft ordinances, publications, maps, diagrams and other similar documents;

2. Project implementation costs, including costs for travel, materials, tools, and disposal costs for debris;

3. Equipment purchases such as computers and global position satellite units may be eligible for grant funding. However, upon completion of the grant commitments, these

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purchases are subject to the Department's procedures for the disposition of equipment purchased with State funds;
4. Contractual costs for services necessary to implement the grant;
5. Costs of acquisition of real property, including administrative costs, where such property must be acquired as a site for the construction or implementation of nonstructural stormwater management, nonpoint source pollution controls or best management practices, including but not limited to, real property to be used for buffers or to protect aquifer recharge areas; and
6. The acquisition of land, as a means of avoiding new pollutant inputs or water body degradation, may be made eligible, if included in the notice of availability, but shall have a lower priority for watershed management grants than implementation projects that mitigate current stresses or prevent future stresses to water and water-related resources in ways other than land acquisition.

(f) The following items are not eligible for funding under this subchapter:
1. Building construction or other kinds of real property improvements;
2. Bonus payments, charges for contingency reserves, deficits or overdrafts, costs of discounts not taken and interest expenses;
3. Costs of services, materials or equipment obtained under any other State or Federal grant or loan program;
4. Costs of fund raising and lobbying;
5. Work performed at the direction of a county or municipal government which has not been awarded in compliance with the Local Public Contracts Law, N.J.S.A. 40A:1-1 et seq.;
6. Costs associated with the compliance with permit conditions or enforcement orders; and
7. Any additional item(s) specified by the Department in the notice of availability and the grant agreement as not eligible for funding.

7:15-9.6 Administration and performance of grants

(a) The Department shall release funds to the grant recipient in accordance with the terms of the grant agreement. Upon execution of the grant agreement, up to 60 percent of the grant award may be released. If the grant agreement is for a multiple-year project, up to 60 percent of the funds budgeted for each year may be released at the beginning of each contract year.

(b) After the initial release of funds, any subsequent release of State funds is conditioned upon the submittal of properly documented expenditure reports and final deliverables.

(c) As the grant recipient, the watershed management group has sole responsibility for the administration and success of the grant project, including any work performed on behalf of the grant recipient for accomplishing grant objectives. Watershed management groups are encouraged to seek the advice and opinion of the Department on problems that may arise; however, such advice shall not shift the responsibility for final decisions from the recipient to the Department. The watershed management group shall be solely responsible for the use of the grant funds awarded pursuant to this subchapter in conformance with applicable State requirements to achieve grant and program objectives and to ensure the most efficient use of public funds.

(d) The grant recipient shall supply performance reports to the Department within the

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time period specified in the grant agreement.
(e) The grant recipient shall supply expenditure reports to the Department within the time period specified in the grant agreement.

7:15-9.7 Project changes: amendment of grant agreement
(a) The grant recipient shall promptly notify the Department in writing (certified mail, return receipt requested) of any event or proposed change which may require an amendment of the grant agreement, including the following:

1. A significant change in budgeting cost or in scope of work;
2. A significant change in the scheduled project completion date;
3. A significant changed conditions at the project site;
4. A change in the schedule in the time for performance of the project or any major phase thereof;
5. A change in personnel responsible for grant and subsequent project implementation; and
6. A change in approved technical plans or specifications for the project.

(b) If the Department determines that a formal amendment is necessary, it shall notify the grant recipient and a formal amendment to the grant agreement shall be prepared and executed.
(c) If the Department determines that the project change does not require an amendment of the grant agreement under (a) and (b) above, the Department shall notify the grant recipient in writing.

7:15-9.8 Noncompliance
(a) If the grant recipient does not comply with the terms and conditions of the grant agreement, the Department may:

1. Issue written notice identifying the deficiency (for example, failure to submit timely performance reports) and directing the grant recipient to correct the deficiency;
2. Meet with the grant recipient to review the terms and conditions of the grant agreement and amend the grant as necessary;
3. Demand reimbursement of any advance payment(s) and/or withhold scheduled payments under the grant agreement;
4. Rescind the grant agreement by issuance of a notice of termination of grant award; or
5. Award the grant to another watershed management group to perform the previously approved scope of work.

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Appendix 2

Sample Ordinances

The following ordinances are offered as samples only and their use here is not meant as an endorsement. Individual towns should tailor any ordinance to meet the goals and objectives of the municipality. Each ordinance should be drafted under the guidance of the Municipal Attorney and where appropriate, in consultation with local Boards, Commissions or Committees as well as professional staff.

Steep Slopes Protection.....Appendix 2A
Riparian Corridors Protection.....Appendix 2B
Woodlands Protection.....Appendix 2C
Wellhead Protection.....Appendix 2D
Well Testing.....Appendix 2E
Septic System Management.....Appendix 2F
Fertilizer Management.....Appendix 2G
Pet Waste Control.....Appendix 2H
Litter Control.....Appendix 2I
Improper Waste Disposal Control.....Appendix 2J
Wildlife Feeding.....Appendix 2K
Containerized Yard Waste.....Appendix 2L
Yard Waste Control.....Appendix 2M
Illicit Connections.....Appendix 2N
Water Conservation.....Appendix 2O
Flood Hazard Control.....Appendix 2P
Soil Erosion Control.....Appendix 2Q
Wetlands Protection.....Appendix 2R

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Appendix 2A

STEEP SLOPE MODEL ORDINANCE

(see: http://www.nj.gov/dep/watershedmgt/DOCS/WQMP/steep_slope_model_ordinance062408.pdf)
Contact NJDEP Division of Watershed Management, Phone: (609) 984-0058

[The requirements set forth in this Model Ordinance are consistent with those found in the State of New Jersey's Water Quality Management Planning rule (N.J.A.C. 7:15).]

I. PURPOSE

The purpose of this ordinance is to regulate the intensity of use in areas of steeply sloping terrain in order to limit soil loss, erosion, excessive stormwater runoff, the degradation of surface water and to maintain the natural topography and drainage patterns of land.

II. BACKGROUND

Disturbance of steep slopes results in accelerated erosion processes from stormwater runoff and the subsequent sedimentation of waterbodies with the associated degradation of water quality and loss of aquatic life support. Related effects include soil loss, changes in natural topography and drainage patterns, increased flooding potential, further fragmentation of forest and habitat areas, and compromised aesthetic values. It has become widely recognized that disturbance of steep slopes should be restricted or prevented based on the impact disturbance of steep slopes can have on water quality and quantity, and the environmental integrity of landscapes.

III. APPLICABILITY

This ordinance shall be applicable to new development or land disturbance on a steep slope within *[insert municipality]*.

IV. DEFINITIONS

"Disturbance" means the placement of impervious surface, the exposure or movement of soil or bedrock, or the clearing, cutting, or removing of vegetation.

"Impervious surface" means any structure, surface, or improvement that reduces or prevents absorption of stormwater into land, and includes porous paving, paver blocks, gravel, crushed stone, decks, patios, elevated structures, and other similar structures, surfaces, or improvements.

"Redevelopment" means the construction of structures or improvements on areas which previously contained structures or other improvements.

"Steep Slopes" means any slope equal to or greater than 20 percent as measured over any minimum run of 10 feet. Steep slopes are determined based on contour intervals of two feet or less.

V. DESIGNATION OF AREAS

The percent of slope (rise in feet per horizontal distance) shall be established by measurement of distance perpendicular to the contour of the slope. The percent of slope shall be calculated for each two-foot contour interval. For example, any location on the site where there is a one-foot rise over a 10-foot horizontal run constitutes a 10 percent

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slope; a 1.5 foot rise over a 10-foot horizontal run constitutes a 15 percent slope; a two-foot rise over a 10-foot horizontal run constitutes a 20 percent slope.

VI. STEEP SLOPE LIMITS

For steep slopes any disturbance shall be prohibited except as provided below:

1. Redevelopment within the limits of existing impervious surfaces; and
2. New disturbance necessary to protect public health, safety or welfare, such as necessary linear development with no feasible alternative; to provide an environmental benefit, such as remediation of a contaminated site; to prevent extraordinary hardship on the property owner peculiar to the property; or to prevent extraordinary hardship, provided the hardship was not created by the property owner, that would not permit a minimum economically viable use of the property based upon reasonable investment. For example, redevelopment, within the footprint of existing impervious cover should be allowed to support efforts to revitalize development that has fallen into disrepair.

The applicant shall demonstrate through site plans depicting proposed development and topography that new disturbance is not located in areas with a 20 percent or greater slope.

[Municipalities may include additional restrictions for 20 percent slopes or include restrictions for lesser slopes, at their discretion, as long as the minimum requirements above are met.]

[The municipality may wish to include a section stating minimum requirements needed in a site plan and/or the approval process.]

VII. CONFLICTS AND SEVERABILITY

A. Conflicts: All other ordinances, parts of ordinances, or other local requirements that are inconsistent or in conflict with this ordinance are hereby superseded to the extent of any inconsistency or conflict, and the provisions of this ordinance apply.

B. Severability:

1. Interpretation: This Ordinance shall be so construed as not to conflict with any provision of New Jersey or Federal law.
2. Notwithstanding that any provision of this Ordinance is held to be invalid or unconstitutional by a court of competent jurisdiction, all remaining provisions of the Ordinance shall continue to be of full force and effect.
3. The provisions of this Ordinance shall be cumulative with, and not in substitution for, all other applicable zoning, planning and land use regulations.

VIII. ENFORCEMENT, VIOLATION AND PENALTIES

A prompt investigation shall be made by the appropriate personnel of *[municipality]*, of any person or entity believed to be in violation hereof. If, upon inspection, a condition which is in violation of this Ordinance is discovered, a civil action in the Special Part of the Superior Court, or in the Superior Court, if the primary relief sought is injunctive or if

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penalties may exceed the jurisdictional limit of the Special Civil Part, by the filing and serving of appropriate process. Nothing in this Ordinance shall be construed to preclude the right of *[municipality]*, pursuant to N.J.S.A 26:3A2-25, to initiate legal proceedings hereunder in Municipal Court. The violation of any section or subsection of this Ordinance shall constitute a separate and distinct offense independent of the violation of any other section or subsection, or of any order issued pursuant to this Ordinance. Each day a violation continues shall be considered a separate offense.

[The municipality should include a section on penalties that apply in the event of noncompliance.]

IX. EFFECTIVE DATE

This Ordinance shall take effect upon final adoption and publication in accordance with the law on *[date]*.

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Appendix 2B

RIPARIAN ZONE MODEL ORDINANCE

(see: http://www.nj.gov/dep/watershedmgt/DOCS/WQMP/riparian_model_ordinance.pdf)
Contact NJDEP Division of Watershed Management, Phone: (609) 984-0058

(This Model Ordinance is modified from the original version prepared by the Passaic River Coalition by the New Jersey Department of Environmental Protection, Division of Watershed Management) July 7, 2008

I. Intent and Purpose
II. Statutory Authority
III. Definitions
IV. Establishment of Riparian Zones
V. Uses Permitted in Riparian Zones
VI. Performance Standards for Riparian Zones
VII. Nonconforming Structures and Uses in Riparian Zones
VIII. Uses Prohibited in Riparian Zones
IX. Activities Permitted in Riparian Zones in the Case of No Reasonable or Prudent Alternative or Extreme Hardship
X. Riparian Zone Management Plan
XI. Boundary Interpretation, Appeals Procedures, Inspections, Conflicts, Severability
XII. Enforcement
XIII. Effective Date

[The requirements set forth in this Model Ordinance are consistent with those found in the State of New Jersey's Stormwater Management rules, N.J.A.C. 7:8, the Flood Hazard Area Control Act rules, N.J.A.C. 7:13 and the Water Quality Management Planning rules, N.J.A.C. 7:15.]

I. INTENT AND PURPOSE

The governing body of *[municipality]* finds that riparian lands adjacent to streams, lakes, or other surface water bodies that are adequately vegetated provide an important environmental protection and water resource management benefit. It is necessary to protect and maintain the beneficial character of riparian areas by implementing specifications for the establishment, protection, and maintenance of vegetation along the surface water bodies within the jurisdiction of *[municipality]*, consistent with the interest of landowners in making reasonable economic use of parcels of land that include such designated areas. The purpose of this Ordinance is to designate riparian zones, and to provide for land use regulation therein in order to protect the streams, lakes, and other surface water bodies of *[municipality]*; to protect the water quality of watercourses, reservoirs, lakes, and other significant water resources within *[municipality]*; to protect the riparian and aquatic ecosystems of *[municipality]*; to provide for the environmentally sound use of the land resources of *[municipality*], and to complement existing state, regional, county, and municipal stream corridor protection and management regulations and initiatives.

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The specific purposes and intent of this Ordinance are to:

A. Restore and maintain the chemical, physical, and biological integrity of the water resources of *[municipality]*;

B. Prevent excessive nutrients, sediment, and organic matter, as well as biocides and other pollutants, from reaching surface waters by optimizing opportunities for filtration, deposition, absorption, adsorption, plant uptake, biodegradation, and denitrification, which occur when stormwater runoff is conveyed through vegetated buffers as stable, distributed flow prior to reaching receiving waters;

C. Provide for shading of the aquatic environment so as to moderate temperatures, retain more dissolved oxygen, and support a healthy assemblage of aquatic flora and fauna;

D. Provide for the availability of natural organic matter (leaves and twigs) and large woody debris (trees and limbs) that provide food and habitat for aquatic organisms (insects, amphibians, crustaceans, and small fish), which are essential to maintain the food chain;

E. Increase stream bank stability and maintain natural fluvial geomorphology of the stream system, thereby reducing stream bank erosion and sedimentation and protecting habitat for aquatic organisms;

F. Maintain base flows in streams and moisture in wetlands;

G. Control downstream flooding; and

H. Conserve the natural features important to land and water resources, e.g., headwater areas, ground water recharge zones, floodways, floodplains, springs, streams, wetlands, woodlands, and prime wildlife habitats.

II. STATUTORY AUTHORITY

The municipality of *[municipality]* is empowered to regulate land uses under the provisions of the New Jersey Municipal Land Use Law, N.J.S.A 40:55D-1 *et seq.*, which authorizes each municipality to plan and regulate land use in order to protect public health, safety and welfare by protecting and maintaining native vegetation in riparian areas. *[Municipality]* is also empowered to adopt and implement this Ordinance under provisions provided by the following legislative authorities of the State of New Jersey:

A. Water Pollution Control Act, N.J.S.A. 58:10A-1 *et seq.*

B. Water Quality Planning Act, N.J.S.A. 58:11A-1 *et seq.*

C. Spill Compensation and Control Act, N.J.S.A. 58:10-23 *et seq.*

D. Soil Erosion and Sediment Control Act, N.J.S.A. 4:24-39 *et seq.*

E. Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 *et seq.*

III. DEFINITIONS

Acid producing soils means soils that contain geologic deposits of iron sulfide minerals (pyrite and marcasite) which, when exposed to oxygen from the air or from surface waters, oxidize to produce sulfuric acid. Acid producing soils, upon excavation, generally have a pH of 4.0 or lower. After exposure to oxygen, these soils generally have a pH of 3.0 or lower. Information regarding the location of acid producing soils in New Jersey can be obtained from local Soil Conservation District offices.

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Administrative authority means the Planning Board or Board of Adjustment or Construction Office with all of the powers delegated, assigned, or assumed by them according to statute or ordinance.

Applicant means a person, corporation, government body or other legal entity applying to the Planning Board, Board of Adjustment or the Construction Office proposing to engage in an activity that is regulated by the provisions of this ordinance, and that would be located in whole or in part within a regulated Riparian Zone.

Category One waters or C1 waters shall have the meaning ascribed to this term by the Surface Water Quality Standards, N.J.A.C. 7:9B, for purposes of implementing the antidegradation policies set forth in those standards, for protection from measurable changes in water quality characteristics because of their clarity, color, scenic setting, and other characteristics of aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, or exceptional fisheries resources.

Category Two waters or C2 waters means those waters not designated as Outstanding Natural Resource waters or Category One waters in the Surface Water Quality Standards, N.J.A.C. 7:9B, for purposes of implementing the antidegradation policies set forth in those standards.

Floodway shall have the meaning ascribed to this term by the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq., and regulations promulgated there under published at N.J.A.C. 7:13 et seq., and any supplementary or successor legislation and regulations from time to time enacted or promulgated.

Intermittent Stream means a surface water body with definite bed and banks in which there is not a permanent flow of water and shown on the New Jersey Department of Environmental Protection Geographic Information System (GIS) hydrography coverages or, in the case of a Special Water Resource Protection Area (SWRPA) pursuant to the Stormwater Management rules at N.J.A.C. 7:8-5.5(h), C1 waters as shown on the USGS quadrangle map or in the County Soil Surveys.

Lake, pond, or reservoir means any surface water body shown on the New Jersey Department of Environmental Protection Geographic Information System (GIS) hydrography coverages or, in the case of a Special Water Resource Protection Area (SWRPA) pursuant to the Stormwater Management rules at N.J.A.C. 7:8-5.5(h), C1 waters as shown on the USGS quadrangle map or in the County Soil Surveys; that is an impoundment, whether naturally occurring or created in whole or in part by the building of structures for the retention of surface water. This excludes sedimentation control and stormwater retention/detention basins and ponds designed for treatment of wastewater.

Perennial stream means a surface water body that flows continuously throughout the year in most years and shown on the New Jersey Department of Environmental Protection Geographic Information System (GIS) hydrography coverages or, in the case of a Special Water Resource Protection Area (SWRPA) pursuant to the Stormwater Management rules at N.J.A.C. 7:8-5.5(h), C1 waters as shown on the USGS quadrangle map or in the County Soil Surveys.

Riparian zone means the land and vegetation within and directly adjacent to all surface water bodies including, but not limited to lakes, ponds, reservoirs, perennial and intermittent streams, up to and including their point of origin, such as seeps and springs, as shown on the New Jersey Department of Environmental Protection's GIS hydrography

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coverages or, in the case of a Special Water Resource Protection Area (SWRPA) pursuant to the Stormwater Management rules at N.J.A.C. 7:8-5.5(h), C1 waters as shown on the USGS quadrangle map or in the County Soil Surveys. There is no riparian zone along the Atlantic Ocean nor along any manmade lagoon or oceanfront barrier island, spit or peninsula.

Riparian Zone Management Plan means a plan approved by the Engineer of *[municipality]*. The plan shall be prepared by a landscape architect, professional engineer or other qualified professional, and shall evaluate the effects of any proposed activity/uses on any riparian zone. The plan shall identify existing conditions, all proposed activities, and all proposed management techniques, including any measures necessary to offset disturbances to any affected riparian zone.

Special Water Resource Protection Area or SWRPA means a 300 foot area provided on each side of a surface water body designated as a C1 water or tributary to a C1 water that is a perennial stream, intermittent stream, lake, pond, or reservoir, as defined herein and shown on the USGS quadrangle map or in the County Soil Surveys within the associated HUC 14 drainage, pursuant to the Stormwater Management rules at N.J.A.C. 7:8-5.5(h).

Surface water body(ies) means any perennial stream, intermittent stream, lake, pond, or reservoir, as defined herein. In addition, any regulated water under the Flood Hazard Area Control Act rules at N.J.A.C. 7:13-2.2, or State open waters identified in a Letter of Interpretation issued under the Freshwater Wetlands Protection Act Rules at N.J.A.C. 7:7A-3 by the New Jersey Department of Environmental Protection Division of Land Use Regulation shall also be considered surface water bodies.

Threatened or endangered species means a species identified pursuant to the Endangered and Nongame Species Conservation Act, N.J.S.A. 23:2A-1 et seq., the Endangered Species Act of 1973, 16 U.S.C. §§1531 et seq. or the Endangered Plant Species List, N.J.A.C. 7:5C-5.1, and any subsequent amendments thereto.

Trout maintenance water means a section of water designated as trout maintenance in the New Jersey Department of Environmental Protection's Surface Water Quality Standards at N.J.A.C. 7:9B.

Trout production water means a section of water identified as trout production in the New Jersey Department of Environmental Protection's Surface Water Quality Standards at N.J.A.C. 7:9B.

IV. ESTABLISHMENT OF RIPARIAN ZONES

A. Riparian zones adjacent to all surface water bodies shall be protected from avoidable disturbance and shall be delineated as follows:

1. The riparian zone shall be 300 feet wide along both sides of any Category One water (C1 water), and all upstream tributaries situated within the same HUC 14 watershed. This includes Special Water Resource Protection Area's or SWRPA's as defined herein and shown on the USGS quadrangle map or in the County Soil Surveys within the associated HUC 14 drainage, pursuant to the Stormwater Management rules at N.J.A.C. 7:8-5.5(h).
2. The riparian zone shall be 150 feet wide along both sides of the following waters not designated as C1 waters:

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a. Any trout production water and all upstream waters (including tributaries);
b. Any trout maintenance water and all upstream waters (including tributaries) within one linear mile as measured along the length of the surface water body;
c. Any segment of a water flowing through an area that contains documented habitat for a threatened or endangered species of plant or animal, which is critically dependent on the surface water body for survival, and all upstream waters (including tributaries) within one linear mile as measured along the length of the surface water body; and
d. Any segment of a surface water body flowing through an area that contains acid producing soils.

3. For all other surface water bodies, a riparian zone of 50 feet wide shall be maintained along both sides of the water.

B. The portion of the riparian zone that lies outside of a surface water body is measured landward from the top of bank. If a discernible bank is not present along a surface water body, the portion of the riparian zone outside the surface water body is measured landward as follows:

1. Along a linear fluvial or tidal water, such as a stream or swale, the riparian zone is measured landward of the feature's centerline;
2. Along a non-linear fluvial water, such as a lake or pond, the riparian zone is measured landward of the normal water surface limit;
3. Along a non-linear tidal water, such as a bay or inlet, the riparian zone is measured landward of the mean high water line; and
4. Along an amorphously-shaped feature such as a wetland complex, through which water flows but which lacks a definable channel, the riparian zone is measured landward of the feature's centerline.

Where slopes (in excess of 15 percent) are located within the designated widths, theriparian zone shall be extended to include the entire distance of this sloped area to a maximum of 300 feet.

[Municipalities have the ability to include a series of options, as long as the minimum requirements are met. If an existing municipal ordinance includes more stringent buffer requirements, or if the municipality wished to propose more stringent requirements, then the more stringent requirements should be applied.]

For areas adjacent to surface water bodies for which the floodway has been delineated per the Flood Hazard Area Control Act rules at N.J.A.C. 7:13-3 or the State's adopted floodway delineations, the riparian zone shall cover the entire floodway area, or the area described in Section IV.A.1. or IV.A.2. above, whichever area has the greatest extent. Requests for alterations to the adopted delineations can be provided to the New Jersey Department of Environmental Protection for consideration if site specific information is available.

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C. A riparian zone is an overlay to the existing zoning districts. The provisions of the underlying district shall remain in full force except where the provisions of the riparian zone differ from the provisions of the underlying district, in which case the provision that is more restrictive shall apply. These provisions apply to land disturbances resulting from or related to any activity or use requiring application for any of the following permits or approvals:

- Building permit
- Zoning variance
- Special exception
- Conditional use
- Subdivision/land development approval

D. A map of the riparian zones of the entire municipality of *[municipality]*, including all land and water areas within its boundaries, which designates surface water bodies, is included as part of this Ordinance, and is appended as Figure *[municipality to insert Figure # here]*. Maps of the municipality on which these designations have been overlain shall be on file and maintained by the offices of the Clerk of *[municipality]*. This map conforms to all applicable laws, rules and regulations applicable to the creation, modification and promulgation of zoning maps.

E. It shall be the duty of the Engineer of [municipality], every second year after the adoption of this Ordinance, to propose modifications to the map delineating riparian zones required by any naturally occurring or permitted change in the location of a defining feature of a surface water body occurring after the initial adoption of the riparian zone map, to record all modifications to the riparian zone map required by decisions or appeals under Section XI., and by changes made by the New Jersey Department of Environmental Protection in surface water classifications or floodway delineations.

F. The applicant or designated representative shall be responsible for the initial determination of the presence of a riparian zone on a site, and for identifying the area on any plan submitted to the *[municipality]* in conjunction with an application for a construction permit, subdivision, land development, or other improvement that requires plan submissions or permits. This initial determination shall be subject to review and approval by the municipal engineer, governing body, or its appointed representative, and, where required, by the New Jersey Department of Environmental Protection.

G. The municipal Master Plan provides the legal basis for zoning and land use regulation at the local level. The technical foundation for local riparian zones in this municipality should be incorporated into the Master Plan. A technical report on the need for riparian zones in *[municipality]* may be adopted as part of the Master Plan, N.J.S.A 40:55D-28b(11). The technical report should include the following information: a statement setting forth the rationale and need to protect riparian zones; and reference to the methods used to designate and delineate riparian zones.

H. Exemptions

Instead of the riparian zone protection requirements above, the applicant must demonstrate compliance with one of the following:

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1. The proposed project or activity is not in the riparian zone established at section IV.A. above;
2. The proposed disturbance in a riparian zone is for a linear development with no feasible alternative route. If the riparian zone is associated with Category One waters, the linear development must also meet the requirements for Special Water Resource Protection Areas under the Stormwater Management rules at N.J.A.C. 7:8-5.5(h);
3. The proposed disturbance in a riparian zone is in accordance with a stream corridor restoration or stream bank stabilization plan or project approved by the New Jersey Department of Environmental Protection;
4. The proposed disturbance of a riparian zone is necessary to provide for public pedestrian access or water dependent recreation that meets the requirements of the Freshwater Wetlands Protection Act rules, N.J.A.C. 7:7A, the Flood Hazard Area Control Act rules, N.J.A.C. 7:13, or the Coastal Zone Management rules, N.J.A.C. 7:7E;
5. The proposed disturbance of a riparian zone is required for the remediation of hazardous substances performed with New Jersey Department of Environmental Protection or Federal oversight pursuant to the Spill Compensation and Control Act, N.J.S.A. 58:10-23.11a et seq. or the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. §§9601 et seq.;
6. The proposed disturbance is for redevelopment that does not exceed the limits of existing impervious surfaces;
7. The proposed disturbance would prevent extraordinary hardship on the property owner peculiar to the property; or prevent extraordinary hardship, provided the hardship was not created by the property owner, that would not permit a minimum economically viable use of the property based upon reasonable investment; and/or 8. Demonstrate through site plans depicting proposed development and topography that new disturbance is not located in areas with a 20 percent or greater slope, except as allowed under H.6. and H.7. above.

V. USES PERMITTED IN RIPARIAN ZONES

A. For riparian zones in Category One waters (C1 waters), permitted uses are governed by the Stormwater Management rules at N.J.A.C. 7:8-5.5(h) and the Flood Hazard Area Control Act rules, N.J.A.C. 7:13, unless otherwise exempt.
B. Any other riparian zone area shall remain in a natural condition or, if in a disturbed condition, including agricultural activities, at the time of adoption of this ordinance may be restored to a natural condition. There shall be no clearing or cutting of trees and brush, except for removal of dead vegetation and pruning for reasons of public safety or for the replacement of invasive species with indigenous species. There shall be no altering of watercourses, dumping of trash, soil, dirt, fill, vegetative or other debris, regrading or construction. The following uses are permitted either by right or after review and approval by the municipality in riparian zones. No new construction, development, use, activity, encroachment,

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or structure shall take place in a riparian zone, except as specifically authorized in this Section. The following uses shall be permitted within a riparian zone:

1. Open space uses that are primarily passive in character shall be permitted by right to extend into a riparian zone, provided near stream vegetation is preserved. These uses do not require approval by the Zoning Enforcement Officer or compliance with an approved Riparian Zone Management Plan. Such uses include wildlife sanctuaries, nature preserves, forest preserves, fishing areas, game farms, fish hatcheries and fishing reserves, operated for the protection and propagation of wildlife, but excluding structures. Such uses also include passive recreation areas of public and private parklands, including unpaved hiking, bicycle and bridle trails, provided that said trail have been stabilized with pervious materials.
2. Fences, for which a permit has been issued by the Construction Code Office, to the extent required by applicable law, rule or regulation.
3. Crossings by farm vehicles and livestock, recreational trails, roads, railroads, storm water lines, sanitary sewer lines, water lines and public utility transmission lines, provided that the land disturbance is the minimum required to accomplish the permitted use, subject to approval by the Zoning Enforcement Officer, provided that any applicable State permits are acquired, and provided that any disturbance is offset by buffer improvements in compliance with an approved Riparian Zone Management Plan and that the area of the crossing is stabilized against significant erosion due to its use as a crossing.
4. Stream bank stabilization or riparian reforestation, which conform to the guidelines of an approved Riparian Zone Management Plan, or wetlands mitigation projects that have been approved by the New Jersey Department of Environmental Protection, subject to approval by the Zoning Enforcement Officer and subject to compliance with an approved Riparian Zone Management Plan.

VI. PERFORMANCE STANDARDS FOR RIPARIAN ZONES

A. All encroachments proposed into riparian zones in C1 waters shall comply with the requirements of the Stormwater Management rule at N.J.A.C. 7:8-5.5(h) and the Flood Hazard Area Control Act rules, N.J.A.C. 7:13, and shall be subject to review and approval by the New Jersey Department of Environmental Protection, unless exempt.

B. For all other riparian zones, the following conditions shall apply:

1. All new major and minor subdivisions and site plans shall be designed to provide sufficient areas outside of the riparian zone to accommodate primary structures, any normal accessory uses appurtenant thereto, as well as all planned lawn areas.
2. Portions of lots within the riparian zone must be permanently restricted by deed or conservation easement held by *[municipality]*, its agent**,** or another public or private land conservation organization which has the ability to provide adequate protection to prevent adverse impacts within the riparian zone. A complete copy of the recorded conservation

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restriction that clearly identifies the deed book and pages where it has been recorded in the office of the clerk of the applicable county or the registrar of deeds and mortgages of the applicable county must be submitted to the municipality. The applicant shall not commence with the project or activity prior to making this submittal and receiving actual approval of the plan modification and receipt of any applicable permits from the New Jersey Department of Environmental Protection. The recorded conservation restriction shall be in the form approved by the municipality and shall run with the land and be binding upon the property owner and the successors in interest in the property or in any part thereof. The conservation restriction may include language reserving the right to make *de minimus* changes to accommodate necessary regulatory approvals upon the written consent of the municipality, provided such changes are otherwise consistent with the purpose and intent of the conservation restriction. The recorded conservation restriction shall, at a minimum, include:

a. A written narrative of the authorized regulated activity, date of issuance, and date of expiration, and the conservation restriction that, in addition, includes all of the prohibitions set forth at N.J.S.A. 13:8B-2b(1) through (7);

b. Survey plans for the property as a whole and, where applicable, for any additional properties subject to the conservation restrictions. Such survey plans shall be submitted on the surveyor's letterhead, signed and sealed by the surveyor, and shall include metes and bounds descriptions of the property, the site, and the areas subject to the conservation restriction in New Jersey State Plane Coordinates, North American Datum 1983, and shall depict the boundaries of the site and all areas subject to the conservation restriction as marked with flags or stakes onsite. All such survey plans shall be submitted on paper and in digital CAD or GIS file on a media and format defined by the municipality. The flags or stakes shall be numbered and identified on the survey plan; and

c. A copy or copies of deeds for the property as a whole that indicate the deed book and pages where it has been recorded in the office of the clerk of the applicable county or the registrar of deeds and mortgages of the applicable county.

3. Any lands proposed for development which include all or a portion of a riparian zone shall as a condition of any major subdivision or major site plan approval, provide for the vegetation or revegetation of any portions of the riparian zone which are not vegetated at the time of the application or which were disturbed by prior land uses, including for agricultural use. Said vegetation plan shall utilize native and non-invasive tree and plant species to the maximum extent practicable in accordance with an approved Riparian Zone Management Plan, described in Section X.

4. For building lots which exist as of the date of adoption of this ordinance, but for which a building permit or a preliminary site plan

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approval has not been obtained or is no longer valid, the required minimum front, side, and rear setbacks may extend into the riparian zone, provided that a deed restriction and/or conservation easement is applied which prohibits clearing or construction in the riparian zone.

5. All stormwater shall be discharged outside of but may flow through a riparian zone 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.* (see N.J.A.C. 2:90-1.3.)

6. If stormwater discharged outside of and flowing through a riparian zone cannot comply with the Standard for Off-Site Stability cited in Section VI.5, then the proposed stabilization measures must meet the requirements of the Flood Hazard Area Control Act rules at N.J.A.C. 7:13-10.2 et seq., and have an approved flood hazard area permit.

VII. NONCONFORMING STRUCTURES AND USES IN RIPARIAN ZONES

Nonconforming structures and uses of land within the riparian zone are subject to the following requirements:

A. Legally existing but nonconforming structures or uses may be continued.

B. Any proposed enlargement or expansion of the building footprint within the riparian zone of a C1 water shall comply with the standards in the Stormwater Management rules at N.J.A.C. 7:8-5.5(h) and the Flood Hazard Area Control Act rules, N.J.A.C. 7:13.

C. For all other riparian zones:

1. Encroachment within the riparian zone shall only be allowed where previous development or disturbance has occurred and shall be in conformance with the Stormwater Management rules, N.J.A.C. 7:8, and the Flood Hazard Area Control Act rules, N.J.A.C. 7:13.

2. Existing impervious cover shall not be increased within the riparian zone as a result of encroachments where previous development or disturbances have occurred.

3. Discontinued nonconforming uses may be resumed any time within one year from such discontinuance but not thereafter when showing clear indications of abandonment. No change or resumption shall be permitted that is more detrimental to the riparian zone, as measured against the intent and purpose under Section I., than the existing or former nonconforming use. This one-year time frame shall not apply to agricultural uses that are following prescribed Best Management Practices for crop rotation. However, resumption of agricultural uses must be strictly confined to the extent of disturbance existing at the time of adoption of this ordinance.

VIII. USES PROHIBITED IN RIPARIAN ZONES

A. Any use within a riparian zone of a C1 water shall comply with the standards in the Stormwater Management rules at N.J.A.C. 7:8-5.5(h) and the Flood Hazard Area Control Act rules, N.J.A.C. 7:13.

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B. For other riparian zones, any use or activity not specifically authorized in Section V. or Section VII. shall be prohibited within the riparian zone. By way of example, the following activities and facilities are prohibited:

1. Removal or clear-cutting of trees and other vegetation or soil disturbance such as grading, except for selective vegetation removal for the purpose of stream or riparian area stabilization or restoration projects that require vegetation removal or grading prior to implementation.
2. Storage of any hazardous or noxious materials.
3. Use of fertilizers, pesticides, herbicides, and/or other chemicals in excess of prescribed industry standards or the recommendations of the Soil Conservation District.
4. Roads or driveways, except where permitted in compliance with Section V.
5. Motor or wheeled vehicle traffic in any area, except as permitted by this Ordinance.
6. Parking lots.
7. Any type of permanent structure, except structures needed for a use permitted by Section V.
8. New subsurface sewage disposal system areas. The expansion and replacement of existing subsurface sewage disposal system areas for existing uses is permitted.
9. Residential grounds or lawns, except as otherwise permitted pursuant to this Ordinance.

IX. ACTIVITIES PERMITTED IN RIPARIAN ZONES IN THE CASE OF NO REASONABLE OR PRUDENT ALTERNATIVE OR EXTREME HARDSHIP

A. For riparian zones in C1 waters, requests for exemptions must be authorized by the New Jersey Department of Environmental Protection, as per the Stormwater Management rules at N.J.A.C. 7:8-5.5(h) and the Flood Hazard Area Control Act rules, N.J.A.C. 7:13.

B. For other riparian zones, hardship variances may be granted by the Zoning Board of Adjustment in cases of a preexisting lot (existing at the time of adoption of this ordinance) when there is insufficient room outside the riparian zone for uses permitted by the underlying zoning and there is no other reasonable or prudent alternative to placement in the riparian zone, including obtaining variances from setback or other requirements that would allow conformance with the riparian zone requirements, and provided the following demonstrations are made:

1. An applicant shall be deemed to have established the existence of an extreme economic hardship, if the subject property is not capable of yielding a reasonable economic return if its present use is continued or if it is developed in accordance with provisions of this ordinance and that this inability to yield a reasonable economic return results from unique circumstances peculiar to the subject property which:
    a. Do not apply to or affect other property in the immediate vicinity;

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b. Relate to or arise out of the characteristics of the subject property because of the particular physical surroundings, shape or topographical conditions of the property involved, rather than the personal situations of the applicant; and are not the result of any action or inaction by the applicant or the owner or his predecessors in title.

c. The necessity of acquiring additional land to locate development outside the riparian zone shall not be considered an economic hardship unless the applicant can demonstrate that there is no adjacent land that is reasonably available or could be obtained, utilized, expanded or managed in order to fulfill the basic purpose of the proposed activity.

2. An applicant shall be deemed to have established compelling public need if the applicant demonstrates, based on specific facts that one of the following applies:

a. The proposed project will serve an essential public health or safety need;

b. The proposed use is required to serve an existing public health or safety need; or

c. There is no alternative available to meet the established public health or safety need.

3. A variance can only be granted if it is shown that the activity is in conformance with all applicable local, state, and federal regulations, including but not limited to the Stormwater Management rules, N.J.A.C. 7:8, and the Flood Hazard Area Control Act rules, N.J.A.C. 7:13,and that the exception granted is the minimum relief necessary to relieve the hardship.

C. If such an exception is granted, the applicant shall rehabilitate an environmentally degraded riparian zone area within or adjacent to the same site, and at least equivalent in size to the riparian zone reduction permitted, or, if not possible, rehabilitate or expand a riparian zone area at least equivalent in size within a nearby site and, if available, within the same watershed. Rehabilitation shall include reforestation, stream bank stabilization and removal of debris, in accordance with a Riparian Zone Management Plan, as described in Section X below.

[The municipality may require a financial contribution be made to an Open Space or Municipal Stormwater Management Plan mitigation plan fund in exchange for this requirement.]

X. RIPARIAN ZONE MANAGEMENT PLAN

A. Within any riparian zone, no construction, development, use, activity, or encroachment shall be permitted unless the effects of such development are accompanied by preparation, approval, and implementation of a Riparian Zone Management Plan.

B. The landowner, applicant, or developer shall submit to *[municipal contact],* or its appointed representative, a Riparian Zone Management Plan prepared by an

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environmental professional, professional engineer or other qualified professional which fully evaluates the effects of any proposed uses on the riparian zone. The Riparian Zone Management Plan shall identify the existing conditions including:

1. Existing vegetation;
2. Field delineated surface water bodies;
3. Field delineated wetlands;
4. The 100-year floodplain;
5. Flood Hazard Areas, including floodway and flood fringe areas, as delineated by the New Jersey Department of Environmental Protection;
6. Soil classifications as found on Soil Surveys;
7. Existing subdrainage areas of site with HUC (Hydrologic Unit Code) 14 designations;
8. Slopes in each subdrainage area segmented into sections of slopes less than 15 %; above 15 % but less than 20%; and steep slopes greater than 20%. The proposed plan shall describe all proposed uses/activities, and fully evaluate the effects of all proposed uses/activities in a riparian zone, and all proposed management techniques, including proposed vegetation and any other measures necessary to offset disturbances to the riparian zone. A discussion of activities proposed as well as management techniques proposed to offset disturbances and/or enhance the site to improve the riparian zone's ability to function effectively as a riparian zone shall also be included with the Riparian Zone Management Plan submittal to *[municipality]*.

C. The Plan shall be reviewed and must be approved by the Engineer of *[municipality]*, in consultation with the Environmental Commission, as part of the subdivision and land development process.

D. The Riparian Zone Management Plan must include management provisions in narrative and/or graphic form specifying:

1. The manner in which the area within the riparian zone will be owned and by whom it will be managed and maintained.
2. The conservation and/or land management techniques and practices that will be used to conserve and protect the riparian zone, as applicable.
3. The professional and personnel resources that are expected to be necessary, in order to maintain and manage the riparian zone.
4. A revegetation plan, if applicable, that includes: three (3) layers of vegetation, including herbaceous plants that serve as ground cover, understory shrubs, and trees that when fully mature, will form an overhead canopy. Vegetation selected must be native, non-invasive species, and consistent with the soil, slope and moisture conditions of the site. The revegetation plan shall be prepared by a qualified environmental professional, landscape architect, or professional engineer, and shall be subject to the approval of the Engineer of *[municipality]*, in consultation with the Environmental Commission. Dominant vegetation in the Riparian Zone Management Plan shall consist of plant species that are suited to the riparian zone environment. The Engineer of *[municipality]* may require species suitability to be verified by qualified experts from the Soil

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Conservation District, Natural Resources Conservation Service, New Jersey Department of Environmental Protection, US Fish and Wildlife Service and/or State or Federal forest agencies.

E. A Riparian Zone Management Plan is not required where the riparian zone is not being disturbed and conservation easements/deed restrictions are applied to ensure there will be no future clearing or disturbance of the riparian zone.

F. Performance of the Riparian Zone Management Plan shall be guaranteed for [*municipality to insert length of time. Minimum of two years suggested.*] by a surety, such as a bond, cash or letter of credit, which shall be provided to the *[municipality]* prior to the *[municipality]* issuing any permits or approving any uses relating to the applicable use or activity.

XI. BOUNDARY INTERPRETATION, APPEALS PROCEDURES, INSPECTIONS, CONFLICTS, SEVERABILITY

A. When a landowner or applicant disputes the boundaries of a riparian zone, or the defined bank-full flow or level, the landowner or applicant shall submit evidence to *[municipal contact]* that describes the riparian zone, presents the landowner or applicant's proposed riparian zone delineation, and presents all justification for the proposed boundary change, including but not limited to, a verification issued under the Flood Hazard Area Control Act rules at N.J.A.C. 7:13-6, or an approval from the New Jersey Department of Environmental Protection to encroach within the Special Water Resource Protection Area (SWRPA) of a C1 water pursuant to the Stormwater Management rules at N.J.A.C. 7:8-5.5(h)1ii.

B. Within 45 days of a complete submission of Section XI.A above, the Engineer of *[municipality]*, or appointed representative, shall evaluate all material submitted and shall make a written determination, a copy of which shall be submitted to *[municipal contact]* and the landowner or applicant. Failure to act within the 45-day period shall not be interpreted to be an approval of the proposed boundary change.

C. Any party aggrieved by any such determination or other decision or determination under Section XI.B. may appeal to the *[municipal contact]* under the provisions of this ordinance. The party contesting the location of the riparian zone boundary shall have the burden of proof in case of any such appeal.

D. Any party aggrieved by any determination or decision of the *[municipal contact]* under this Ordinance may appeal to the *[governing body]* of *[municipality]*. The party contesting the determination or decision shall have the burden of proof in case of any such appeal.

E. Inspections:

1. Lands within or adjacent to an identified riparian zone shall be inspected by *[municipal representative]* when:

a. A subdivision or land development plan is submitted;

b. A building permit is requested;

c. A change or resumption of a nonconforming use is proposed;

d. A discontinued nonconforming use is resumed more than a year later, as described in Section VII.

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2. The riparian zone may also be inspected periodically by representatives from *[municipality]* if excessive or potentially problematic erosion is present, other problems are discovered, or at any time when the presence of an unauthorized activity or structure is brought to the attention of municipal officials or when the downstream surface waters are indicating reduction in quality.

[Inspections are meant to be conducted on an as-needed basis, should the township feel that a problem exists. All inspections should be in accordance with local, state and federal requirements for property owner notification and permission.] [The township is not expected to conduct monitoring, but rather, is being given the ability to react to changes in water quality that are brought to light by either the Department or another reputable data collector.]

F. Conflicts: All other ordinances, parts of ordinances, or other local requirements that are inconsistent or in conflict with this ordinance are hereby superseded to the extent of any inconsistency or conflict, and the provisions of this ordinance apply.

G. Severability:

1. Interpretation: This Ordinance shall be so construed as not to conflict with any provision of New Jersey or Federal law.
2. Notwithstanding that any provision of this Ordinance is held to be invalid or unconstitutional by a court of competent jurisdiction, all remaining provisions of the Ordinance shall continue to be of full force and effect.
3. The provisions of this Ordinance shall be cumulative with, and not in substitution for, all other applicable zoning, planning and land use regulations.

XII. ENFORCEMENT

A prompt investigation shall be made by the appropriate personnel of *[municipality]*, of any person or entity believed to be in violation hereof. If, upon inspection, a condition which is in violation of this Ordinance is discovered, a civil action in the Special Part of the Superior Court, or in the Superior Court, if the primary relief sought is injunctive or if penalties may exceed the jurisdictional limit of the Special Civil Part, by the filing and serving of appropriate process.

Nothing in this Ordinance shall be construed to preclude the right of *[municipality]*, pursuant to N.J.S.A 26:3A2-25, to initiate legal proceedings hereunder in Municipal Court. The violation of any section or subsection of this Ordinance shall constitute a separate and distinct offense independent of the violation of any other section or subsection, or of any order issued pursuant to this Ordinance. Each day a violation continues shall be considered a separate offense.

[The municipality should include a discussion of compliance and enforcement actions taken in the event of non-compliance.]

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XIII. EFFECTIVE DATE

This Ordinance shall take effect upon final adoption and publication in accordance with the law on *[date]*.

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Appendix 2C

Woodlands Protection Model Ordinance

http://www.co.hunterdon.nj.us/planning/ordinances/toolbox/Environmental_Toolbox-Woodlands.pdf

Prepared by the Hunterdon County Tool Box

Contact the Hunterdon County Planning Board, Phone: (908) 788-1490

PREREQUISITES

1. The municipal Master Plan should be amended to identify existing woodlands within the municipality and prioritize them (as "Priority Woodlands") in terms of their types and relative values. This will require the municipality to determine and balance the often competing goals of woodlands retention and retention of agricultural lands. Potential publicly owned lands suitable for woodlands mitigation plantings should also be identified in the Master Plan.

2. The municipal Zoning Ordinance should accommodate the preservation of woodlands by establishing uses and densities/intensities and development alternatives that permit development to occur without necessitating the destruction of prioritized woodlands. In some zones (such as commercial and industrial zones) it may not be possible to achieve both land use goals and woodland conservation goals. The Master Plan should anticipate this and establish guidelines for addressing the conflict or recommend appropriate zoning changes. The municipality should decide whether this Ordinance will be applicable to all developments or only to "major developments" as defined by the municipality.

3. Municipality will also need to adopt a separate Tree/Woodland Protection Ordinance as a regular police power ordinance to cover tree removal on properties that are not the subject of a development application.

4. Municipality may wish to adopt a separate ordinance establishing the position and responsibilities of the Woodlands Advisor who will advise the municipal agencies reviewing site plans and subdivisions and who would also be charged with enforcing any separate Tree/Woodland Protection Ordinance, overseeing construction activities, monitoring the implementation of mitigation plans and policing conservation easements.

5. The checklist requirements for complete applications will need to include the information described in Sections IV and V of the attached Ordinance. Please note that many of the requirements of Section IV are already required by the municipality as part of the submission requirements for an Environmental Impact Statement. If so, the requirements of Section IV should be used to amend and supplement the existing EIS requirements so that the additional data needed for woodlands preservation are provided.

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6. The municipality has the responsibility for enforcing the terms of any conservation easements relating to woodlands preservation. The municipality must be willing to accept this responsibility and develop a plan for executing it.

7. A Reference List of technical resources should be appended to both the Master Plan and the Zoning Ordinance. A suggested Reference List of technical resources to be included is attached to the back of this Ordinance.
8. The municipal fee schedule should be amended to include fees for optional pre-application meetings with and site inspections by the Woodlands Advisor. It is anticipated that escrow fees, paid by the applicant at the time of the submission of a formal site plan or subdivision application, will cover all services performed by the Woodlands Advisor thereafter.

WOODLANDS RETENTION ORDINANCE
AN ORDINANCE ESTABLISHING REQUIREMENTS AND PROCEDURES FOR THE RETENTION AND PROTECTION OF TREES AND WOODLANDS IN THE DEVELOPMENT OF LAND

I. Purpose

The purpose of this Ordinance is to promote the intent of the municipal Master Plan and the purposes of the Municipal Land Use Law (set forth at N.J.S. 40:55D-2) by protecting critical environmental resources, including air quality, water quality, soil cover, animal and plant habitat and viewsheds, that are negatively affected by the removal of woodlands. Retention of woodlands helps to control the velocity and amount of stormwater runoff, thereby reducing flooding; filters sediments and pollutants before they reach streams; promotes groundwater recharge; stabilizes the soil and reduces soil erosion; improves air quality by filtering pollutants from the air; preserves viewsheds; offers a stable habitat for associated plant species and for animal wildlife; and provides shade and windbreaks that help moderate the effects of climate conditions. Protection of woodlands along a stream corridor is essential to the maintenance of stream biota, and protection of woodlands on steep slopes is essential to soil stabilization. The retention of woodlands is essential to the scenic quality of a community and helps to preserve the diversity of native plant life and animal species. The protection of woodlands is consistent with New Jersey's Stormwater Management Rules and Best Management Practices. The protection of woodlands also has an intrinsic value. Once removed or mismanaged, the restoration or replacement of woodlands can be a lengthy, delicate, complex and expensive process. The time, difficulties and costs inherent in this process render existing woodlands tantamount to a non-renewable resource in a community.

The purpose section of this Ordinance establishes the legal basis for adopting the Ordinance by tying it to the health, safety and welfare of the community. The purpose section can draw from the municipality's master plan, restating specific environmental, health and aesthetic benefits of woodlands that relate to health, safety and welfare.

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II. Definitions

A. Caliper - The diameter of a balled and burlapped or bare root nursery stock tree trunk taken 6 inches above the ground for trees up to 4 inches in diameter and taken 12 inches above the ground for trees larger than 4 inches in diameter.

B. Critical Root Zone - The region measured outward from the trunk of a tree to and beyond the dripline to include the entire area within which the tree's feeder roots are located, as determined by probing of the soil around the tree to a depth of 18 inches by a qualified tree care professional.

C. Diameter at Breast Height (dbh) - The measurement of the diameter of the trunk of a tree planted in the ground taken 4.5 feet from the ground level on the uphill side of the tree.

D. Determination of Inapplicability - A determination by the Municipal Agency or its designee that the criteria of Section III.C. herein have been satisfied and that the applicant is thereby relieved of all other submission requirements and procedures of this Ordinance.

E. Dripline - A vertical line extending from the outermost edge of the tree canopy or shrub branch to the ground beneath.

F. Forest - A biological community dominated by trees having an average canopy height greater than 20 feet and other woody plants covering a land area of at least 10,000 square feet (.23 acres) and generally characterized by a tree density of 100 or more trees per acre with at least 50 percent of such trees having a dbh of two (2) inches or greater. A forest may have been cut (but not cleared) in conjunction with an approved forestry management plan or may be intact. An orchard or a tree nursery is not a forest. The term “woodland” is used interchangeably with the term “forest” in this Ordinance.

G. Forest Stand - A contiguous grouping of trees growing on a site that are sufficiently uniform in ageclass distribution, composition and structure and are of sufficiently uniform quality to be a distinguishable unit.

H. Forest Stewardship Management Plan - A plan prepared for qualifying property owners participating in the federally funded Forest Stewardship Program. The Management Plan and Program are intended to encourage management of private forests for their non-commodity benefits, such as wildlife, recreation, aesthetics and water quality, in addition to or in lieu of their traditional commodities such as timber and wood products. Forest stewardship promotes long-term active management while emphasizing consideration of all resources and benefits associated with forests.

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I. Municipal Agency - The Planning Board, Zoning Board of Adjustment or Land Use Board of the municipality having jurisdiction to review and approve an application for development pursuant to N.J.S.A. 40:55D-1, *et seq*.
J. Specimen Tree - A tree in good health of unusual or exceptional form, size, age or shape for its species and/or occupying a significant position within the landscape. A Specimen Tree would necessarily include, but not by way of limitation, any tree included on the "Big Tree List" of the New Jersey Bureau of Forestry, Community Forestry Program; any endangered species of tree; or any tree that has been identified or would qualify as a "heritage tree" having significant historical or cultural value to the community.

K. Woodlands Advisor - An expert qualified in woodlands management and forestry retained by the Municipal Agency for the purposes of offering advice and recommendations concerning the implementation of this Ordinance. The Woodlands Advisor should be a New Jersey Approved Forester, New Jersey Certified Landscape Architect or New Jersey Certified Tree Expert.

Definitions of terms that specifically relate to the Woodland Retention and Preservation Ordinance can be listed separately within the Woodland Retention and Preservation Ordinance or included under general definitions found in the municipality's land development regulations. Alternatively, they can be restated in both places. If they are included in more than one section of the municipality's land development regulations, definitions must be consistent.

All technical terms should be adopted from reliable sources (see references provided in Appendix A for sources from which definitions in this model ordinance were derived). The term "caliper" is used in the nursery industry to define the size class of a tree when purchasing nursery stock for landscaping purposes. The term "Diameter at Breast Height" or "dbh" is used when classifying trees in a forest.

The definition of "Specimen Tree" is intentionally left broad. Each municipality is encouraged to develop a comprehensive list and associated map of known Specimen Trees within the municipality and/or a set of guidelines for determining that a tree qualifies as a Specimen Tree. This information should be included in the municipal Master Plan and should be developed in consultation with the Woodlands Advisor and other municipal agencies; the "Big Tree List" of the New Jersey Bureau of Forestry, Community Forestry Program; lists of endangered tree species; lists of "heritage trees" (trees having historic or cultural value within the community); and consideration of the extraordinary characteristics of particular trees, such as their size relative to other members of the same species or their significant placement within the landscape.

The municipality should adopt a separate ordinance establishing the position of a "Woodlands Advisor." This individual may advise the municipal reviewing agencies not only as per the provisions of this Ordinance, but also regarding: 1) any separate police power Tree/Woodland Protection Ordinance; 2) overseeing the implementation of this Ordinance during construction activities; 3) monitoring implementation of mitigation plans; and 4) policing woodland conservation easements.

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III. Applicability

A. The regulations set forth herein shall apply to any tract of land that is the subject of an application for site plan or subdivision approval.

B. The removal of trees on a lot or tract of land that is not the subject of an application for site plan or subdivision approval shall be governed by the regulations of Chapter ___, Tree Protection Ordinance.

C. An applicant, after submitting the information required in Section IV.B.1. of this Ordinance to the Municipal Agency, may thereafter request a determination of inapplicability by the Municipal Agency if all of the following apply:

1. If the application proposes no encroachment into forested areas;
2. If the application proposes no removal of specimen trees; and
3. If the Woodlands Advisor concurs that conditions 1. and 2. above exist.

A determination of inapplicability shall relieve the applicant of all other submission requirements and procedures of this Ordinance.

In the event an applicant proposes the development of only a portion of a tract, the balance of which is proposed to remain in agricultural use or agricultural woodland management use, a determination of inapplicability shall be rendered with respect to the portion of the tract that is proposed to remain in agricultural use or agricultural woodland management use.

D. It is strongly recommended that each prospective applicant schedule a pre-application meeting with the Woodlands Advisor prior to submitting a formal application for development to the Municipal Agency for the purpose of evaluating the impact of this Ordinance on the plans for development. The fees for such pre-application meeting are set forth in Article _____ of the municipal Code.

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The Model Woodland Retention and Preservation Ordinance applies to all subdivisions and site plans including major and minor, residential and nonresidential. Each municipality must determine how broadly it chooses the Ordinance to apply. Ideally, each municipality should also adopt a Tree/Forest Removal Ordinance as part of the municipality's police power regulations to address tree/forest removal on properties not subject to a subdivision or site plan application. This ensures forest conservation not only at the time a property is being developed, but also in a variety of other situations. These may include routine tree removal activities by landowners for septic system replacement, construction of a deck or other accessory structures, or other land disturbance activities that do not constitute a subdivision or site plan but potentially affect tree/woodland resources.

Please note that the municipal fee schedule should be amended to include fees for development reviews conducted by the Woodlands Advisor.

IV. Environmental Resource Inventory

A. Each application for site plan or subdivision approval shall be accompanied by an environmental resource inventory documenting the existing natural features on the site. The purpose of the environmental resource inventory is to permit the Municipal Agency to evaluate the importance of the existing woodlands to the preservation of high priority natural resources and ecosystems. The environmental resource inventory shall be prepared by one or more qualified professionals such as an engineer, forester, ecologist or landscape architect and shall be site specific. The environmental resource inventory requirements set forth herein may be submitted as part of the environmental resource inventory required for the development application as a whole.

B. The inventory shall consist of a natural resource inventory map, an aerial photograph and a report.

1. The natural resource inventory map shall show the following on the tract and within 500' of the tract boundary at a scale of 1" = 100' or larger and at the same scale as the rest of the site plan or subdivision submission:

a. Topography at two-foot contour intervals;

b. A critical slope analysis showing areas of steep slope in each of the following ranges: >12%-15%, >15%-20%, >20%-25% and >25%, as well as areas of highly erodible soils on slopes of 12% or less and on slopes of >12%-15% (based on the Natural Resources Conservation Service, Soil Survey data);

c. State-designated Forested Natural Heritage Priority Sites;

d. Woodlands identified in the New Jersey Landscape Project as either Forests or Forested Wetlands that create a habitat having a ranking of 3, 4 or 5 for rare, threatened or endangered species;

e. Intermittent and perennial streams, lakes, and other water bodies;

f. 100-year floodplains;

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g. Wetlands, with legend, and required wetlands transition areas and vernal pools;
h. Required stream corridor buffers;
i. Soils with a legend showing soil names and characteristics, including the limitations and potential for forest growth and the types of native forest species typically associated with each soil type, based on the Natural Resources Conservation Service, Soil Survey;
j. Areas of groundwater recharge equal to or greater than the median groundwater recharge rate for the municipality as a whole, based upon the New Jersey Geological Survey or municipally-approved alternate data source, if available;
k. Locations of sinkholes, disappearing streams and other features associated with the presence of carbonate rock and any other unusual geological features of the tract;
l. Aerial extent of forest and tree cover which shall encompass the outside perimeter of the canopy of individual trees;
m. Forest stand data: the forested portions of the property shall be divided into separate forest stands for the purpose of describing the different forested areas of the tract as required in Sections 3.a. and b. below; stands smaller than five (5) acres shall be fully described; stands of five (5) acres or larger shall be sampled, and the stand shall be statistically described based on the sample data; *(See Technical Appendix for Forest Stand and Sample Data Sheet)*
n. Locations, species and sizes of all specimen trees and of all individual trees that are not located in a delineated forest stand; and
o. Existing man-made structures.

2. The most current and readily available aerial photograph of the tract and the area within 1000 feet thereof at a scale of 1" = 400' or larger and preferably at the same scale as the natural resource inventory map.
3. The natural resource inventory report shall include the following:
a. A description of each forest stand on the site including, for each stand, the dominant and codominant species, understory vegetation, range of sizes in diameter at breast height (dbh), the health and condition of the trees in the stand, and the extent and nature of invasive species within the stand; and
b. Copies of the sampling point data sheets and summaries.

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The elements of an Environmental Resource Inventory (ERI) outlined in Section IV.B.1. are meant to supplement the ERI requirements that may already be contained in a municipality's land development regulations. Items IV.B.1.d., l., m. and n. are specifically required for the implementation of this Ordinance and may not already be included among the submission requirements the municipality has in place.

The qualifications of the professional(s) preparing the various components of the ERI should be carefully scrutinized by the Municipal Agency. Experts qualified to undertake items IV.B.1.d., l., m. and n. and to prepare the natural resource inventory report include: New Jersey Approved Foresters, New Jersey Certified Landscape Architects and New Jersey Certified Tree Experts.

Item 1.d., New Jersey Landscape Project, spearheaded by the New Jersey DEP Endangered and Nongame Species Program, is a project to protect New Jersey's biological diversity by mapping and maintaining critical habitats of rare wildlife populations. Upland forests and forested wetlands are two such critical ecosystems that have been mapped statewide. The rankings of 3, 4, and 5 refer to habitats of state-listed threatened species, state-listed endangered species and federally-listed threatened or endangered species respectively. This information is available at http://www.nj.gov/dep/fgw/ensp/landscape/download.htm

Note that all information required to be submitted under Sections IV and V of this Ordinance should also be included in the municipal site plan and subdivision checklist requirements for determining the completeness of an application.

V. Woodland Retention and Preservation Plan

A. A woodland retention and preservation plan shall be submitted for approval. The plan shall include a report articulating how the requirements of Section VI of this Ordinance will be met by the proposed woodland retention and preservation plan; how the proposed development will affect the existing natural resources on the tract; the quantity of existing woodlands, and of individual trees not located within a designated forest stand, that will be removed and that will be retained; and what specific techniques will be used to protect woodlands and individual trees during the construction process.

B. The woodland retention and preservation plan shall be prepared using the information requested in Section IV of this Ordinance and shall be certified by a New Jersey Approved Forester, A New Jersey Certified Landscape Architect or a New Jersey Certified Tree Expert.

C. The woodland retention and preservation plan shall include all of the information provided on the natural resource inventory map as well as:

1. Proposed topography as shown on the proposed grading plan;
2. Surveyed locations of the following:

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a. All individual trees 6" dbh or larger that are not located in a delineated forest stand but are nevertheless proposed to be retained and are located within the proposed areas of disturbance; and
b. If a forest stand or portion thereof is proposed to be retained, all individual trees 6" dbh or greater located within the first 25 feet of such area, measured toward the interior of the woodland from its proposed perimeter.

3. Cultural features, historic sites, and critical viewsheds as identified and/or mapped in the Township Master Plan;
4. Existing man-made structures to be removed and to remain;
5. All proposed development including buildings, roads, driveways, utilities and other improvements;
6. A table listing the tract area in square feet; the square footage of existing and proposed woodlands located within the tract, classified according to the priority categories listed in Section VI.A. of this Ordinance; and the percentage of the net tract area covered by existing and proposed woodlands, classified according to the priority categories listed in Section VI.A. of this Ordinance;
7. A clear, graphic indication of the woodland preservation areas on the site;
8. A clear, graphic indication of the proposed limit of disturbance line, "tree save" fencing and other proposed tree protection measures;
9. Locations of proposed soil stockpile areas; and
10. A clear written and graphic indication of all proposed methods to be employed in protecting existing trees that are proposed to be retained but lie within the limits of disturbance during construction.
11. Existing preservation/conservation easements on the tract.

The Woodland Retention and Preservation Plan is critical. It is in this Plan that the applicant assesses the impact of proposed activities on the site's natural features and the proposed means of addressing these impacts. The requirements under Subsection A are especially important. Although the Municipality's Woodlands Advisor will be able to assess the impact of proposed activities on the site's trees/woodlands according to the mapped information and supportive technical materials that are submitted by the applicant, the report requirement under Subsection A integrates the information from Sections IV, V and VI into a cohesive package that can be reviewed and understood by the Municipal Agency.

Subsection C.2. requires certain trees 6" or greater that are targeted for preservation to be surveyed as part of the inventory process. The purpose for doing this is to evaluate the impacts of the proposed site design on individual trees and to ensure proper protection measures are utilized during the construction process to protect these trees. For example, tree roots that extend into the proposed area of disturbance can be harmed by soil compaction unless proper measures are taken to avoid this.

VI. Woodland Retention Requirements

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A. The intent of this Ordinance is to retain rather than to replace existing woodlands. To that end, development shall be designed to maximize the area of existing woodlands to be retained. If woodlands are to be disturbed or removed, the applicant shall design the development in such a way as to avoid or minimize removal of priority woodlands, which shall consist of woodlands in any of the following priority categories:

1. Any woodlands prioritized in the municipal Master Plan;
2. Any woodlands within required stream corridor buffers, wetlands, wetland transition areas or floodplains;
3. Woodlands on slopes of 15% or more or woodlands located in highly erodible soils on slopes of less than 15%, with the steepest slopes having the highest priority;
4. Woodlands associated with a critical groundwater recharge area, defined as having a recharge rate greater than or equal to the median recharge rate for the municipality as a whole.
5. Woodlands associated with a critical viewshed identified in the municipal Master Plan;
6. Woodlands identified in the New Jersey Landscape Project as either Forests or Forested Wetlands that create a habitat having a ranking of 3, 4 or 5 for rare, threatened or endangered species;
7. Woodlands that are connected to a larger woodlands corridor extending beyond the tract boundaries; and
8. Woodlands and hedgerows that provide visual screening, are associated with an historic site or line a rural roadway.

Not more than ten (10) percent of priority woodlands existing on the site prior to its development shall be removed or otherwise disturbed for development. Any removal of priority woodlands shall require mitigation, irrespective of the exemptions set forth in Sections VI.D. and E. below.

B. All woodland areas designated for retention shall be protected by a Conservation Easement in accordance with Section VIII of this Ordinance. *(See also Technical Appendix for model Conservation Easement)*

C. To the extent that the use of the clustering or lot averaging techniques permitted in the applicable zoning district will maximize the retention of woodlands in the development of the tract, such techniques shall be used.

D. Subject to the provisions of Section VI.A. above, if the application is for a subdivision, a portion of the woodlands existing on the tract prior to development may be permitted to be removed for development as follows:

1. Up to 10 percent of the woodlands existing on the tract prior to development may be removed for the construction of necessary public and private streets, public utilities and common or public stormwater management facilities; and
2. Reasonable and necessary removal of woodlands shall also be permitted on each new residential lot within the subdivision provided that such removal shall not exceed the following:

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a. To allow the construction of a dwelling, with an average of up to 30 feet of clearance around the dwelling, and permitted accessory building(s);
b. To allow a driveway with up to 5 feet of clearance on each side of the driveway;
c. To allow a septic bed with up to 20 feet of clearance around the perimeter of the septic bed; and
d. To allow underground utility lines with a maximum corridor width of 20 feet.

3. All improvements on new residential lots shall be located so as to retain any specimen tree or any other desirable healthy individual tree as identified by the Woodlands Advisor. Improvements must also be located and designed to minimize forest removal and fragmentation.
4. The above criteria for permitted removal of woodlands on new residential lots shall not result in the removal of woodlands on any lot in excess of the following:

Acreage of Lot (1)	Maximum Area of Woodlands Removed (2)
1	20,000 sq. ft.
2	30,000 sq. ft.
3	40,000 sq. ft.
4	50,000 sq. ft.
5 acres and over	60,000 sq. ft.

Notes: (1) For lots with a lot area less than or between these size ranges, interpolation shall be used.
(2) Or an area equal to twice the impervious surface coverage permitted in the zone, whichever is less.

E. Subject to the provisions of Section VI.A. above, if the application is for site plan approval, up to ____ percent (*to be determined by the municipality based upon appropriate zoning and the characteristics of the district*) of the woodlands existing on the lot prior to development may be removed for development, provided, however, that all improvements shall be located so as to retain any specimen tree or any other desirable healthy individual tree as identified by the Woodlands Advisor.

For developments involving both site plan and subdivision approval, the requirements of Sections VI.D. shall apply to the development of the tract as a whole and to the development of any new residential lots within the development, and the requirements of this Section VI.E. shall apply only to the development of any nonresidential lots within the development.

F. If the approval of the application and of any permits issued pursuant to such approval will result in the removal of more woodlands than the limits set forth in Sections VI.D. and E. above, or will result in the removal of any priority woodlands identified in Section VI.A. above, mitigation shall be required on an acre for acre basis to the extent of such excess removal or removal of priority woodlands. Mitigation shall be undertaken in accordance with Section VII of this Ordinance. Prior to approving a plan for mitigation, the Municipal Agency shall first determine that the proposed design cannot reasonably be

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modified to reduce woodlands removal or to locate improvements outside of priority woodlands.

G. The following procedures and requirements for the protection of the woodlands and individual trees to be retained shall be adhered to in the construction phase of the development:

1. During construction, no permanent or temporary material, including soil, shall be placed or deposited within the critical root zone or within six (6) feet, whichever is greater, of any tree to be retained or of the trees at the perimeter of any forest stand to be retained. Such area shall be protected by orange blazed fencing placed outside of such area during construction, and the fencing shall be inspected and approved by the Woodlands Advisor prior to the start of any site disturbance. Permanent monuments and signs, if required by the municipality for the demarcation of conservation easements, must be installed prior to the start of construction.
2. Where necessary, pursuant to an approved grading plan, to fill or remove soil within an area that encompasses either the critical root zone or the area within six (6) feet, whichever is greater, of any individual tree to be retained in the area of disturbance or of the trees within the perimeter of any forest stand to be retained, the existing grade around each such tree shall be maintained to the extent of the critical root zone or six (6) feet, whichever is greater, by a tree well and extension tiles (in the case of fill) or by a retaining wall (in the case of a cut).
3. No chemicals shall be disposed of and no concrete trucks shall be rinsed within the critical root zone of any tree or of the trees at the perimeter of any forest stand to be retained.
4. During construction, individual trees to be retained and trees located at the perimeter of a forest stand to be retained shall be maintained in accordance with a maintenance schedule and plan under the direction of the Woodlands Advisor.
5. If equipment must temporarily invade the critical root zone of any individual tree to be retained or of any tree(s) located at the perimeter of a forest stand to be retained, the Woodlands Advisor shall approve and inspect the installation of required critical root zone protection measures within the path of such equipment, shall inspect the invasion of the critical root zone and shall thereafter inspect the removal of all temporary protective measures and the replacement of the protective fencing.
6. If the approved plan calls for the installation of any pavement or utilities within the critical root zone of any individual tree to be retained or of any tree(s) located at the perimeter of any forest stand to be retained, special techniques for such installation shall be employed to minimize the impact on the critical root zone(s), and such installation shall be directed, inspected and monitored by the Woodlands Advisor.

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This Ordinance addresses the protection of existing woodland resources only. There are other types of ordinances that are designed not only to minimize impacts to existing forests on site but also to plant new forests (afforestation) where they are absent or where they once existed (reforestation). One example of this approach is Ordinance # 103.53, Natural and Cultural Resource Conservation of Washington Township, Mercer County, NJ. An advantage of the latter approach is that it discourages landowners from deforesting their properties prior to making a subdivision or site plan application. Another advantage is that it fosters reforestation or afforestation of areas where woodland resources would provide a public health, safety and welfare benefit such as enhanced ground water recharge, water quality protection, etc. However, afforestation and reforestation requirements can result in significant financial impacts on property owners. Therefore, municipalities should carefully weigh the costs and benefits of such requirements before proceeding.

In order for a Woodland Retention and Preservation Ordinance to be effective in protecting existing woodland resources, the municipal zoning regulations must work in concert with this objective. Specifically, they

According to Sections VI.A.1.-A.3. of this Ordinance, no more than 10% of priority woodlands may be cleared and any such clearing requires mitigation on an acre-for-acre basis.

Section VI.D. establishes the design standards for improvements that necessitate forest removal. Only the minimum necessary forest removal is permitted according to the criteria spelled out in Sections VI.D.1. and 2., providing said clearing results in removal no greater than that set forth in Section VI.D.4. These criteria and thresholds were established based on an examination of several residential subdivision plats and discussions with municipal and county engineers. The thresholds established under Section IV.D.4. were tested on lots of varying sizes and found to be reasonable. Each municipality should carefully review said standards, however, and adjust them as needed to fit its own unique complexion.

Section VI.D.3. ensures that Specimen Trees and other noteworthy trees not within a forest stand are protected as well. Many local ordinances specify that trees of a certain size be protected. This Ordinance does not specify a minimum size. Health, form, size relative to other members of the same species, age, shape or position within the landscape are generally more important to the desirability of maintaining a given tree than size alone. Thus, the Ordinance directs the municipal Woodlands Advisor to work with the applicant to identify and protect Specimen Trees and any other trees that the Advisor deems desirable based on species, health, size and any other relevant factors.

Subsection E. above applies primarily to nonresidential developments. Each municipality must determine the appropriate threshold for maximum forest removal in its nonresidential zones based on its own zoning requirements, extent of existing forest cover, priority forest resources, and local forest protection objectives.

7. In the event any of the foregoing procedures and requirements for construction are violated, the Municipal Engineer or Construction Official shall issue a stop work order until the violation is remedied.

VII. Woodlands Mitigation

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A. If mitigation is required, a woodlands mitigation plan shall be presented which shall consist of one or more of the following alternative approaches (in descending order of desirability):

1. Mitigation planting on-site.
2. Mitigation planting off-site on public land (including County or State land) or on other land designated in or meeting the requirements identified in the municipal Master Plan that is, to the extent practicable, located within the same subwatershed as the woodlands being removed.
3. Mitigation planting off-site on privately-owned land to be permanently deed-restricted for that purpose that is, to the extent practicable, located within the same subwatershed as the woodlands being removed.

B. Requirements for mitigation planting on and off-site:

1. Landscaping in accordance with an approved landscaping plan may be credited as mitigation if the landscaped area has a width of 35 feet or more in all directions and equals or exceeds 2,500 square feet in area and if the quantity of plantings per each 2,500 square foot area is at least 7 trees and 20 shrubs.
2. A woodlands mitigation planting plan that is not part of the approved landscaping plan shall be reviewed and approved by the Municipal Agency based on the recommendations of the Woodlands Advisor. All of the following shall ordinarily be planted on each acre of woodlands mitigation area:
    a. 35 trees per acre at a 2" caliper size; and
    b. 70 trees per acre at a 1" caliper size; and
    c. 100 trees per acre installed as whips (5' to 6' in height); and
    d. 40 woody shrubs per acre, to be located at the edges of the planting area; and
    e. A native grass mix shall be seeded over the entire planting area.

    A diversity of native species shall be planted in each of the above categories. The species selection shall be informed by the information collected in the natural resource inventory required at Section IV of this Ordinance and shall be subject to the approval of the Woodlands Advisor, who shall also inspect and approve all planting materials upon delivery to the site and prior to and following their installation.
3. The applicant's Landscape Architect or New Jersey Certified Tree Expert or New Jersey Approved Forester shall prepare the cost estimate for the woodlands mitigation planting plan. Such estimate shall be separate and apart from the estimate pertaining to the approved landscaping plan. The cost of the woodlands mitigation planting plan shall include all materials, installation costs and continuing costs associated with the implementation of the maintenance plan. The cost estimate for the woodlands mitigation planting plan shall be reviewed and approved by the Woodlands Advisor and shall thereafter be transmitted to the municipal engineer for inclusion in the cost estimate for the performance guarantee for the entire project.
4. Prior to the release of any portion of the performance guarantee covering the woodlands mitigation planting plan, the Woodlands Advisor shall inspect the

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plantings and shall make a recommendation to the municipal engineer as to whether the plantings have been installed in accordance with the approved woodlands mitigation planting plan. The applicant shall post a maintenance guarantee following the inspection and approval or acceptance by the municipality of the installation of the plantings included in the woodlands mitigation planting plan. The amount and timing of the maintenance guarantee shall be in accordance with N.J.S. 40:55D-53.

5. Prior to the release of the maintenance guarantee or portion thereof covering the woodlands mitigation area, the Woodlands Advisor shall inspect the mitigation area. The maintenance guarantee shall not be released unless the following conditions have been met:

a. Survival of 100% of the trees installed at 2" caliper size and 100% of the woody shrubs;

b. Survival of 85% of trees installed at 1" caliper size;

c. Survival of 75% of trees installed as whips;

d. All surviving plant material shall be found to be in good health and free of diseases and pests; and

e. There shall be no evidence of exotic and invasive plant material.

6. To ensure the survival rates and conditions in paragraph 3. above, a maintenance plan shall be submitted to the Woodlands Advisor for approval prior to the grant of final approval by the Municipal Agency. The maintenance plan shall include, but not by way of limitation, the following: plans and schedules for weeding, watering and deer protection (including fencing or tree shelters). For individual trees, the maintenance plan may also be required to include mulching, fertilizing, and treatments for pests and diseases. The Woodlands Advisor shall inspect the premises periodically following the installation of the woodlands mitigation planting to ensure that the maintenance plan is being implemented and to recommend additional maintenance requirements, if necessary, to ensure the health and survival of the woodlands mitigation area.

7. A preservation/conservation easement shall be placed on the woodlands mitigation area. The preservation/conservation easement shall allow for continued maintenance of the woodlands mitigation area by the owner via the removal of hazardous or diseased trees or tree limbs, removal of exotic and invasive planting species, erection of protective fencing, and the installation by hand of new plantings intended to replace dead trees or supplement existing growth, but only with the approval of the Woodlands Advisor.

C. Information to be provided for mitigation planting on and off-site:

1. A table and description of soil preparation methods, species, sizes and spacing to be utilized for the new plantings;

2. A binding two-year maintenance and management agreement that details how the area(s) designated for new plantings will be maintained to ensure satisfactory establishment of the new woodland including:

a. Regular watering;

b. Regular removal of invasive plant species;

c. Protection from deer grazing; and

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d. Contact name and phone number for party responsible for maintenance.

3. A mitigation table identifying the percent of the tract area in woodlands that is proposed to be cleared as a result of the proposed development; the number of acres of existing woodlands to be cleared; the applicable replacement requirements; and the number of acres of mitigation plantings proposed.

Section VII of this Ordinance establishes the criteria and procedures for replanting forests (mitigation) when required. The first priority is to plant forests on the same site where forest cover was removed in excess of the maximums established in Sections VI.D. and E. If mitigation cannot occur on site due to site constraints or other limitations, then the next priority is to plant off-site on public lands or on other lands either designated for this purpose in the municipal master plan or satisfying the criteria outlined in the municipal master plan for mitigation planting.

This Section also provides that the applicant post performance and maintenance guarantees and establishes the requirements for the condition of the mitigation plantings upon completion of the two year maintenance period. This two-year period is the maximum permitted by the Municipal Land Use Law. Municipalities will need to develop maintenance strategies that will cover the time beyond this two-year period, to ensure the long-term health and survival of mitigation plantings.

In addition, this Section requires that conservation easements be placed on retained woodlands or on woodlands mitigation areas to ensure their long-term protection. Section VI.G.1. had suggested that the municipality mandate the placement of monuments and signs demarcating such protected areas prior to construction. Monuments and/or signs are also a means of notifying landowners of the existence of conservation easements with special requirements that must be adhered to, even on private property.

VIII. Conservation Easement

A. A conservation easement shall be placed on any portion(s) of a lot or tract on which woodlands are proposed to be retained and on any areas designated for woodlands mitigation. The conservation easement shall be shown on the filed plat, if applicable; shall be referenced by legal description in the deed to the lot or tract; and shall be filed with the County Recording Officer. Monuments and signs shall be placed to demarcate the conservation easement as required by the Municipal Agency.

B. The conservation easement shall identify those activities and improvements that are specifically permitted (for example, walking paths, fences and play structures), the maximum sizes of, or areas to be covered by, permitted improvements and those activities and improvements that are specifically prohibited within the affected area.

C. The conservation easement shall include the following limitations:

1. No tree with a diameter greater than six (6) inches dbh or more than thirty (30) feet in height may be cut down, removed or destroyed within the conservation easement area without cause and without the prior written consent of the Woodlands Advisor. Diseased or hazardous trees or tree limbs may be removed to

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prevent personal injury or property damage provided notice is served upon the Woodlands Advisor at least ten (10) days prior to such removal. Where an emergency situation renders the giving of notice impracticable, the tree or limb may be removed without prior notice, but a notarized statement from the owner of the underlying title giving the reasons for such removal shall be submitted to the Woodlands Advisor within seven (7) days thereof, along with appropriate documentation of the reasons in the form of photographs, corroborative letters or other evidence.

2. Understory plant materials, including, but not limited to, brush, shrubs, saplings, seedlings, undergrowth and vines may not be cut down, removed or destroyed within the conservation easement area except to control exotic or invasive species, and then only with the prior written consent of the Woodlands Advisor.

3. Fences may be erected within or around the conservation easement area if approved by the municipal agency initially or, thereafter, with the prior written consent of the Woodlands Advisor, if the approved deer control measures have proven to be ineffective.

4. New plantings may be installed within the conservation easement area if needed to supplement existing vegetation or to replace dead trees or other vegetation, provided such plantings are characteristic of native growth and with the prior written consent of the Woodlands Advisor.

D. The following activities shall be specifically prohibited within the conservation easement area once it has been legally established:

1. Construction, excavation, grading or the erection of retaining walls, buildings or other structures, roads, driveways, fences or utilities.
2. Any grading or other activities that would or might impair soil or slope stability or alter drainage patterns on or off the site.
3. Commercial timber cutting or harvesting of vegetative products for commercial purposes.
4. Maintenance or grazing of livestock.
5. Excavation, grading, dredging or removal of topsoil, sand, gravel, loam, rock or other materials.
6. Dumping or composting of soil, grass clippings, garden waste, household waste, sawdust, ashes, trash, construction materials or other debris of any kind.
7. Operation of any mechanical equipment of any kind, including recreational vehicles such as ATVs and snowmobiles, except as needed to undertake approved activities identified herein or in the conservation easement itself.

E. The conservation easement may provide for a municipally approved forest stewardship program that may also be used to satisfy the requirements for a Forest Stewardship Plan to be approved by the State Forester.

F. The conservation easement language shall specifically provide for the right of the municipality through any of its officers or agents to enter and inspect the conservation easement area to determine that the terms of the conservation easement are being adhered

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to and that necessary maintenance is being undertaken. The municipality shall have the right, and the conservation easement shall so state, to issue citations for any violations of the terms of the conservation easement or of this Ordinance or of the development application approval pursuant to which the conservation easement was established.

The Technical Appendix provides model language for conservation easements placed on woodlands. A conservation easement is a legal covenant restricting the use of land and/or natural features of the land that is described in the property deed and shown on a filed plat. In this case, the restrictions stipulated in the conservation easement ensure proper long term protection, maintenance and health of the woodlands. The conservation easement is held by a third party – typically a land trust or government entity. This party is responsible for the enforcement of any restrictions stipulated in the easement. Land held in a conservation easement may still be able to be used by the land owner, subject to the restrictions in the easement.

XI. Fees, Violations and Penalties

A. Fees:

1. The fees charged for inspections undertaken and other services provided by the Woodlands Advisor shall be established by the municipal governing body by ordinance at the time of the appointment of the Woodlands Advisor. Such fees may, from time to time, be amended by ordinance.
2. All charges made against escrow accounts for the services of the Woodlands Advisor shall be in accordance with N.J.S. 40:55D-53.2.

B. Violations and Penalties:

1. Any violation of the provisions of this Ordinance shall be punishable by a fine not exceeding $1,000.00 or by imprisonment or community service not exceeding 90 days, or both, for each separate offense.
2. Each day on which a duly noticed violation is continued or remains unremedied while work is progressing shall constitute a separate offense, punishable as set forth herein.
3. Upon notification by the municipality or its agent of the existence of a violation, the violation shall be immediately remedied. If a violation cannot be remedied immediately, the municipality or its agent may issue a “Stop Work Order” until the violation is remedied. If a violation causes irreversible damage to a tree or woodland slated for retention, the municipality or its agent shall issue a “Stop Work Order” and the developer shall be required to submit a new preliminary and final plan to the municipal agency for its approval before resuming work.
4. The Municipal Agency shall reserve the right to revoke or withdraw any approval granted for subdivision or site plan upon notice to the applicant and public hearing, in the event that there is any deviation from, or alteration of, the approved woodlands retention and preservation plan, unless prior written approval for such deviation or authorization has been obtained from the Municipal Agency. Minor deviations and field changes may be authorized solely by the Woodlands

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Advisor in writing and only after consultation with the Chairman of the applicable Municipal Agency to determine if the proposed minor deviations and field changes deviate from the intent of the original approval with respect to the woodlands retention and preservation plan. If it is determined by this consultation that the changes proposed are not minor, the matter must be referred to the full Board, and no changes may be effected until such Board gives its approval.

5. Each of the terms and conditions of any approval relating to woodlands retention and preservation are material elements of the development approval based upon the submission of the application in its entirety, and the non-compliance with any term or condition by the applicant or its successors or assigns shall be deemed a material default subjecting the applicant to revocation of such approval. The request to change any single condition, since all conditions are integrally related, shall open the entire application to the applicable Municipal Agency for reconsideration, possible re-approval, and new terms and conditions in addition to those terms and conditions contained in the original approval.

The ability to impose penalties and issue Stop Work Orders is needed to address those situations in which the provisions of this Ordinance are found to have been violated.

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TECHNICAL APPENDIX

SAMPLE WOODLANDS CONSERVATION EASEMENT

THIS INDENTURE dated _____ between _____ residing at _____ hereinafter referred to as GRANTOR, and _____, a municipal corporation of the State of New Jersey, having its principal office at _____ in _____, New Jersey, hereinafter referred to as GRANTEE,

WITNESSETH:

WHEREAS, Grantor, in order to comply with the applicable provisions of the Woodlands Retention Ordinance of Grantee (and for no money paid by Grantee), does by these presents grant and convey to the Grantee a conservation easement over premises in _____, County of Hunterdon and State of New Jersey, as more particularly described and set forth in Schedule "A" annexed hereto, and hereinafter referred to as THE PROPERTY. Within the conservation easement, the following terms and conditions shall apply:

1. No tree with a diameter greater than six (6) inches dbh or more than thirty (30) feet in height may be cut down, removed or destroyed on The Property except for selective cutting and thinning required for woodlands management in connection with a forest stewardship or woodlands management plan to be approved by the Grantee, which plan may also be used to satisfy the requirements for a Forest Stewardship Plan to be approved by the State Forester. Notwithstanding the foregoing, diseased or hazardous trees or tree limbs may be removed to prevent personal injury or property damage provided notice shall be served upon the Grantee at least ten (10) days prior to such removal. Where an emergency situation renders the giving of notice impracticable, the tree or limb may be removed without prior notice, but a notarized statement from the owner of the underlying title giving the reasons for such removal shall be submitted to the Grantee within seven (7) days thereof, along with appropriate documentation of the reasons in the form of photographs, corroborative letters or other evidence.
2. Understory plant materials, including, but not limited to, brush, shrubs, saplings, seedlings, undergrowth and vines shall not be cut down, removed or destroyed within The Property, except as needed to control exotic or invasive species in connection with a forest stewardship or woodlands management plan to be approved by the Grantee, which plan may also be used to satisfy the requirements for a Forest Stewardship Plan to be approved by the State Forester.
3. Fences for deer control may be erected within or around The Property, if approved as part of the woodlands maintenance plan or with the consent of the Grantee if previously approved deer control measures have proven to be ineffective.
4. New plantings may be installed within The Property if needed to supplement existing vegetation or to replace dead trees or other vegetation, provided such

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plantings are characteristic of native growth and have been approved by the Grantee.

5. The following activities shall be specifically prohibited within The Property:

a. Construction, excavation, grading or the erection of retaining walls, buildings or other structures, roads, driveways or utilities.

b. Any grading or other activities that would or might impair soil or slope stability or alter drainage patterns on or off the site.

c. Commercial timber cutting or harvesting of vegetative products from The Property for commercial purposes.

d. Maintenance or grazing of livestock.

e. Excavation, grading, dredging or removal of topsoil, sand, gravel, loam, rock or other minerals from The Property.

f. Dumping or composting of soil, grass clippings, garden waste, household waste, sawdust, ashes, trash, construction materials or other debris of any kind on The Property.

g. The operation of any mechanical equipment of any kind, including recreational vehicles such as ATVs and snowmobiles, except as needed to undertake approved activities identified in this conservation easement.

6. Although the conservation easement granted and intended to be granted hereby has been created for the benefit of the general public through the retention and maintenance of existing woodlands or the protection of a woodlands mitigation area, nothing herein contained shall be construed to convey to the public any right of access to or use of The Property, and Grantor, his heirs, successors and assigns shall, subject to paragraph 7 hereof, retain the exclusive right of access to and use of The Property.

7. The municipally-approved forest stewardship program/woodlands management plan for The Property shall be as follows: (*to be filled in for the particular site after consultation with the Woodlands Advisor*.)

8. Grantee and its agents shall be permitted limited access to enter upon The Property at all reasonable times for the purpose of inspection in order to assure compliance with the terms and conditions herein contained. In the event of non-compliance with the terms hereof, the Grantee shall have the right to enter the premises and fulfill the obligations imposed herein and charge the reasonable cost thereof to the Grantor or to issue citations for any violations of the terms and conditions of this conservation easement or of the development application approval or ordinance pursuant to which this conservation easement has been established.

9. Nothing herein contained shall be deemed to restrict the right of Grantor to maintain all trails and strictures existing upon The Property on the date hereof.

10. Grantee may at any time transfer and assign the easement and interest created hereby to any succeeding public corporation or entity.

11. It is understood that this instrument imposes no obligation on the Grantor and no restrictions on the use of The Property except as specifically set forth herein and nothing herein contained shall be construed to interfere with the right of the Grantor, its heirs, successors and assigns and their licensees and any party

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claiming rights under them to utilize The Property in such manner as they or any of them may deem desirable, subject to the terms and conditions hereof.

12. This instrument shall be binding upon the Grantor, its heirs, successors and assigns and upon the Grantee, its successors and assigns.

IN WITNESS WHEREOF Grantor and Grantee have duly executed this instrument as of the date first above written.

_____	_____
For Grantor	For Grantee

Attested by: _____

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Site Plan Review - The Right Questions To Ask

1. Do plans include a tree stand delineation identifying one or more tree stands (groups of similar trees) by species and locating "specimen" trees?

2. Do plans include a tree survey identifying trees that will be impacted by construction and describing their existing size, species, health and overall condition?

3. Do soil erosion and sediment control plans and grading plans indicate tree save areas? Do soil erosion and sediment control plans and grading plans complement or conflict with tree save areas?

4. Is protective fencing delineated around tree save areas?

5. Is protective fencing placed around the tree using either the dripline method (at the dripline for broad-canopied trees and up to 1.5 times the dripline for narrow-canopied trees) or the critical root zone method?

6. Do plans include proposed measures to protect and/or enhance tree save areas as needed (e.g. management of invasive species, wind protection, planting of new species to increase species diversity within protected tree stands)?

7. Do plans include language prohibiting grading, trenching or equipment storage within designated tree save areas?

8. Do plans require erection of tree protection fencing prior to any clearing, demolition, grubbing, grading or construction on site?

9. Do plans require that protective fencing remain in place until all construction is complete?

10. Do soil erosion and sediment control plans show installation of silt fences sufficient to keep excess soil away from roots of trees to be saved?

11. Where root loss will affect trees in tree save areas, are adequate measures indicated on the plans to properly prune roots and trees and otherwise minimize damage to trees?

12. Where temporary construction roads must pass over root areas of trees to be retained, are adequate measures proposed to minimize soil compaction? (e.g., a temporary road bed of 6 inches of mulch or gravel)?

13. Are methods indicated in plans for remedying unintended damage to trees in tree save areas?

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14. Where cuts or fills affect roots of trees in tree save areas, are appropriate stabilizing measures indicated on plans (e.g. retaining walls, tree wells)?

15. Where barriers are not possible to keep vehicular or foot traffic away from tree roots, do plans indicate protective methods to be employed (e.g., spreading several inches of wood chips; pumping concrete through conveyor pipes instead of driving trucks over root systems; bridging root areas with plates of steel)?

16. Are underground utilities proposed to be installed by tunneling rather than trenching to avoid damaging tree roots?

17. As a general rule of thumb, are all of the existing trees that are proposed to be saved at least 5 feet from any proposed new structure?

18. How will the forested area(s) to be retained be cared for?

19. What are the stewardship needs of the retained forested area(s) and of any proposed mitigation area(s)?

20. How will the health and vigor of the retained forested area(s) be sustained?

21. How will the health and vigor of any proposed mitigation area(s) be assured?

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FOREST STAND SAMPLE DATA SHEET

NAME OF DEVELOPMENT Woodlands Stand Descriptions					
Map Key	Size (Acres)	Species	Size Range in DBH	Condition (1)	Priority (2)
A					
B					
C					
D					

NAME OF DEVELOPMENT Specimen Trees				
Map Key	Species	DBH	Condition (1)	Comments(3)
001				
002				
003				
004				
005				
006				
007				
008				
009				
010				
011				
012				
013				
014				
015				
016				
017				
018				
019				
020				
021				
022				
023				
024				
025				
026				
027				
028				
029				
030				

NOTES: (1) Rank as "Good", "Fair", "Poor" "or "Dead".
(2) Priorities refer to those set forth in the Woodlands Retention Ordinance and the municipal Master Plan.
(3) Expand upon description of condition; indicate if remediation of a poor or fair condition is possible/advisable.

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How to Hire a Woodlands Advisor for your Community

Communities adopting the model Woodlands Retention Ordinance developed through the Hunterdon County Woodlands Toolbox Advisory Committee will need to employ a "Woodlands Advisor" to provide advice and recommendations concerning the implementation of the ordinance on behalf of the municipality. The ordinance defines a "Woodlands Advisor" as an expert qualified in woodlands management and forestry.

Woodlands Advisors must have technical expertise to:

• Complete forest stand assessments describing forest complex groupings, dominant and co-dominant species, range of size in diameter breast height (dbh), health and condition, and extent and nature of invasive species, all in accordance with approved statistical point sampling techniques as well as visual observations and descriptions.

• Assess forest health issues including: insect and disease identification and control, invasive species impacts and deer impacts on forest health and regeneration. Knowledge of appropriate remedies to improve or address forest health issues is necessary.

• Prepare and review reforestation plans (woodlands mitigation plans) and assess such plans when submitted for consideration by a municipal agency for: compatibility with onsite forest characteristics; invasive species management; elimination, mitigation and/or best management of grade changes (cuts and fills planned for the site); wind protection at edges of cleared areas; and soils, drainage and soil erodibility conditions.

• Design and direct the installation of tree protection measures such as tree wells, tree shelters and tree protection fencing.

• Identify critical root zones and undertake and direct the implementation of techniques to minimize and mitigate root loss and damage, including root pruning, tunneling and placement of root barrier materials, soil compaction mitigation and temporary root protection best management practices.

• Undertake and advise as to proper arboricultural practices and standards for tree care.

Qualified Woodlands Advisors must hold a license or be duly accredited in at least one of the following fields:

State of New Jersey Approved Foresters: To be included on the list, an approved forester must have graduated from a four year college or university accredited by the Society of American Foresters with a major course in Forest

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Management or have completed the Cook College-Rutgers University Forest Management option within the Natural Resource Management curriculum or have a graduate degree that the DEP determines to be equivalent to the aforementioned major course work in Forest Management; must have two years of experience in the preparation of woodland management plans or the implementation of forestry practices for the protection, development, marketing and utilization for forest land resources; and must abide by the Society of American Forester's Code of Ethics. The Society of American Foresters (SAF) is the national scientific and educational organization representing the forestry profession.

Landscape Architects: Landscape architects in New Jersey are licensed professionals. Landscape architecture encompasses the analysis, planning, design, management and stewardship of the natural and built environments. Most landscape architects maintain a membership in the American Society of Landscape Architects, a national professional association representing landscape architects.

New Jersey Certified Tree Experts: New Jersey Certified Tree Experts (CTE's) are experts in arboricultural practices and tree care. Many CTE's maintain membership in The International Society of Arboriculture (ISA), a scientific and educational organization serving tree care professionals.

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REFERENCE LIST

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Carter, Marybeth H., ASLA, AICP, Building Greener Communities, Planning for Woodland Conservation, North Jersey Resource Conservation and Development Council and Hunterdon County Planning Board, June, 2003.

Duerksen, Christopher J., with Suzanne Richman, Tree Conservation Ordinances, *Planning Advisory Service Report Number 446*, American Planning Association, Chicago, Illinois, and Scenic America, Washington, D.C., August, 1993.

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Kuser, John E., editor, Handbook of Urban and Community Forestry in the Northeast, Cook College, Rutgers University, Kluwer Academic/Plenum Publishers, New York, New York, 2000.

Matheny, Nelda, and James R. Clark, Trees and Development, A Technical Guide to Preservation of Trees During Land Development, International Society of Arboriculture, Champaign, Illinois, 1998.

Miller, Robert W., Urban Forestry: Planning and Managing Urban Greenspaces, Prentice-Hall, Inc., A Division of Simon & Schuster, Englewood Cliffs, New Jersey, 1988.

New Jersey Big Tree Program,
www.nj.gov/dep/parksandforests/forest/community/bigtree.html
Identifies and catalogues by species New Jersey's largest individual trees.

New Jersey Forest Stewardship Program,
www.nj.gov/dep/parksandforests/forest/stw_inc_prog.html
Federally funded program promoting the management of privately owned forests for environmental benefits through technical and financial assistance to landowners.

Snyder, David, and Sylvan R. Kaufman, An Overview of NonIndigenous Plant Species in New Jersey, New Jersey Department of Environmental Protection, Division of Parks and Forestry, Office of Natural Lands Management, Natural Heritage Program, Trenton, New Jersey, 2004.

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Appendix 2D

MODEL MUNICIPAL WELLHEAD PROTECTION ORDINANCE

http://www.passaicriver.org/ordinance.html

Prepared by Passaic Valley Ground Water Protection Committee 2003

Contact: The Passaic River Coalition, Phone: (908) 222-0357

CONTENTS

Section I. Statement of Findings
Section II. Purpose
Section III. Statutory Authority
Section IV. Definitions
Section V. Establishment of Well Head Protection Areas and Maps
Section VI. Regulation of Well Head Protection Areas for Public Community Wells
Section VII. Potential Pollutant Sources Listed
Section VIII. Best Management Practice Performance Standard
Section IX. Operations and Contingency Plan
Section X. Enforcement
Section XI. Severability
Section XII. Effective Date

Appendix A. New Jersey Department of Environmental Protection Delineations of Well Head Protection Areas around Public Community Water Supply Wells

SECTION I. STATEMENT OF FINDINGS

The governing body of [municipality] finds that:

A. The ground water underlying this municipality is a major source of existing and future water supplies, including drinking water. The ground water underlying this municipality lies within the Buried Valley Aquifer Systems of the Central Passaic River Basin, which are designated as a "sole source" aquifer under Section 1424(e) of the federal Safe Drinking Water Act of 1974.

B. The ground water aquifers are integrally connected with, are recharged by, and flow into the surface waters, lakes and streams, which also constitute a major source of water for drinking, commercial and industrial needs.

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C. Accidental spills and discharges of toxic and hazardous materials may threaten the quality of these ground water supplies and related water sources.
D. Contaminated water from any source is a detriment to the health, welfare and comfort of the residents of this municipality, and other users of these water resources.
E. Spills or discharges of hazardous substances or hazardous wastes may contaminate or pollute water. As a preventive measure, the proximity of such materials to sources of water supplies, such as public community wells, should be restricted so that there will be sufficient time to find and clean up such spills or discharges before water supplies become contaminated.

SECTION II. PURPOSE

The purpose of this Ordinance is to protect the public health, safety and welfare through the protection of the ground water resources underlying the municipality to ensure a supply of safe and healthful drinking water for the present and future generations of local residents, employees and the general public in this municipality, as well as users of these water supplies outside this municipality. Areas of land surrounding each public community well, known as Well Head Protection Areas (WHPAs), from which contaminants may move through the ground to be withdrawn in water taken from the well, have been delineated. Through regulation of land use, physical facilities and other activities within these areas, the potential for ground water contamination can be reduced. The purpose of the regulations contained in this ordinance is to prevent the migration of potential pollutants from areas within a WHPA into ground water that is withdrawn from a public community well.

SECTION III. STATUTORY AUTHORITY

The municipality of [municipality] is empowered to regulate these activities under the provisions of the New Jersey Municipal Land Use Law, N.J.S.A 40:55D-1 *et seq.*, which authorizes each municipality to plan and regulate land use to secure a safe and adequate drinking water supply for its residents. The Board of Health of this municipality has autonomous power granted by the State Legislature to develop this Ordinance to protect public health, safety and welfare, as set forth in the New Jersey Local Boards of Health Law, N.J.S.A. 26:3-1 *et seq.,* and the New Jersey County Environmental Health Act, N.J.S.A. 26:3A2-21 *et seq.*

SECTION IV. DEFINITIONS

Administrative Authority-- The Planning Board or Board of Adjustment and the Board of Health, acting jointly and in consultation, with all of the powers delegated, assigned, or assumed by them according to statute or ordinance.

Applicant-- Person applying to the Board of Health, Planning Board, Board of Adjustment or the Construction Office proposing to engage in an activity that is regulated by the provisions of this ordinance, and that would be located within a regulated Well Head Protection Area.

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Aquifer-- A formation, group of formations, or part of a formation that contains sufficient saturated permeable rock, sand, or gravel which is capable of storing and transmitting usable quantities of water to wells and springs.

Best Management Practices (BMP) -- These are performance or design standards established to minimize the risk of contaminating ground water or surface waters while managing the use, manufacture, handling or storage of hazardous substances or hazardous wastes.

Contamination-- The presence of any harmful or deleterious substances in the water supply.

Development-- The carrying out of any construction, reconstruction, alteration of surface or structure or change of land use or intensity of use.

Discharge-- Any intentional or unintentional action or omission, unless pursuant to and in compliance with the conditions of a valid and effective Federal or State Permit, resulting in the releasing, spilling, pumping, pouring, emitting, emptying or dumping of a hazardous substance into the waters or lands of the State or into waters outside the jurisdiction of the State when damage may result to the lands, waters or natural resources within the jurisdiction of the State.

Ground Water-- Water contained in interconnected pores of a saturated zone in the ground, also known as well water. A saturated zone is a volume of ground in which the voids in the rock or soil are filled with water at a pressure greater than atmospheric.

Hazardous Substance-- Any substance designated under 40 CFR 116 pursuant to Section 311 of the Federal Act, the Spill Compensation and Control Act, N.J.S.A. 58:10-23.ll *et seq*., or Section 4 of the State Act. Substances listed include petroleum, petroleum products, pesticides, solvents and other substances.

Hazardous Waste-- Any solid waste that is defined or identified as a hazardous waste pursuant to the Solid Waste Management Act, N.J.S.A. 13:1E *et seq*., N.J.A.C. 7:26-8, or 40 CFR Part 261.

Maximum Contaminant Level-- Maximum permissible level of a contaminant in water which is delivered to any user of a Public Community Water System.

NJDEP-- New Jersey Department of Environmental Protection.

Person-- Any individual, public or private corporation, company, partnership, firm, association, owner or operator, political subdivision of this State, and any state, Federal or interstate agency or an agent or employee thereof.

Polluted Water-- In the content of drinking water, water is polluted when a pollutant is present in excess of a maximum contaminant level or bacteriological limit established by law or regulation.

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Potential Pollutant Source (PPS)-- Activity or land use which may be a source of a pollutant that has the potential to move into ground water withdrawn from a well. For the purposes of this ordinance Potential Pollutant Sources are defined in Section VII.

PPS-- Potential Pollutant Source

Public Community Well-- A public water supply well which serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

SIC-- Standard Industrial Classification.

Sole Source Aquifer-- Any drinking water aquifer upon which more than 50% of a population group depends and for which there is no practicable or affordable alternate water supply, as certified by the United States Environmental Protection Agency.

Time of Travel (TOT)-- The average time that a volume of water will take to travel in the saturated zone from a given point to a pumping well.

Tier 1 Well Head Protection Area-- That area of land within a WHPA from which ground water may enter the well within 2 years. (See maps referenced under Section V.)

Tier 2 Well Head Protection Area-- That area of land within a WHPA from which ground water may enter the well within 5 years. (See maps referenced under Section V.)

Tier 3 Well Head Protection Area-- That area of land within a WHPA from which ground water may enter the well within 12 years. (See maps referenced under Section V.)

Well Head-- The well borehole and appurtenant equipment.
Well Head Protection Area (WHPA)-- An area described in plan view around a well, from which ground water flows to the well and ground water pollution, if it occurs, may pose a significant threat to the quality of water withdrawn from the well.

WHPA-- Well Head Protection Area.

SECTION V. ESTABLISHMENT OF WELL HEAD PROTECTION AREAS AND MAPS

A. Well Head Protection Area Maps:

1) The delineations of Well Head Protection Areas for public community wells, which were published by the New Jersey Geological Survey of the New Jersey Department of Environmental Protection, are incorporated herein and made

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a part of this Ordinance. They are designated as follows: New Jersey Well Head Protection Areas, Edition 2, Geospatial Data Presentation, New Jersey Digital Data Series, DGS02-2, dated 18 June 2002. A description of these data, which has been excerpted from these materials, is appended as Appendix B. A map of the Well Head Protection Areas located within [municipality] is included as part of this Ordinance, is appended as Figure [?], and is adopted as of [date]. Maps of the municipality on which these delineations have been overlain shall be on file and maintained by the offices of the Clerk of [municipality], and of the Board of Health of [municipality].

2) Well Head Protection Areas, as shown on the maps described in Section V.A(1), shall be considered to be superimposed over any other established zoning district. Land in a Well Head Protection Area may be used for any purpose permitted in the underlying district, subject to the additional restriction presented herein.

B. Assignment of Restriction within Well Head Protection Areas:
Properties located wholly or partially within a Well Head Protection Area shall be governed by the restrictions applicable to the Well Head Protection Area.

C. Inclusion of Well Head Protection Area Zoning into Master Plan:
The municipal Master Plan provides the legal basis for zoning and land use regulation at the local level. The technical foundation for local well head protection in this municipality should be incorporated into the Master Plan. A technical report on the need for well head protection in [municipality] may be adopted as part of the Master Plan (N.J.S.A 40:55D-28b(11)). The technical report should include the following information:

1) A statement setting forth the rationale and need to protect the public water supply through a program of well head protection for public community wells.

2) Reference to the method used to delineate the Well Head Protection Areas (WHPAs) according to the "tiered" level of protection for public community wells based upon the time of travel (TOT) of ground water, as developed by the New Jersey Geological Survey.

SECTION VI. REGULATION OF WELL HEAD PROTECTION AREAS FOR PUBLIC COMMUNITY WELLS

A. The Administrative Authority for administering the provisions of this Ordinance shall be the Planning Board or Board of Adjustment and the Board of Health of [municipality] acting jointly and in consultation.

B. Any applicant for a permit requesting a change in land use or activity, which is subject to review under the provisions of the Municipal Land Use Law and other pertinent regulations of [municipality], [code references], and which is located within a

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delineated WHPA, as defined in Section V, that involves a Potential Pollutant Source (PPS), as defined in Section VII, shall comply with the requirements of this ordinance.

C. Any applicant for a permit requesting a change in land use or activity, which is subject to the requirements of this ordinance, shall file an Operations and Contingency Plan, as required by Section IX, with the Administrative Authority. No permit that allows a change in land use or activity, which is subject to the requirements of this ordinance, shall be granted unless an Operations and Contingency Plan for the proposed change has been approved by the Administrative Authority. Any plan approved by the Administrative Authority shall be kept on file in the office of the [office] of [municipality], and shall be available to the public for inspection.

D. Any change in land use or activity that introduces a Major or Minor Potential Pollutant Source (PPS), as defined in Section VII, shall be prohibited within a Tier 1 WHPA.

E. Any change in land use or activity that introduces a Major PPS, as defined in Section VII, shall be prohibited within a Tier 2 WHPA.

F. Any change in land use or activity that involves any PPS, as defined in Section VII, within any WHPA, that is not prohibited pursuant to Section VI.D. or VI.E., shall comply with the Best Management Practice Standards, as defined in Section IX.

G. This Ordinance is supplementary to other laws and Ordinances in this municipality. Where this Ordinance or any portion thereof imposes a greater restriction than is imposed by other regulations, the provisions of this Ordinance shall supersede. These Rules and Regulations shall in no way effect the limitations or requirements applicable in the underlying municipal land use and zoning districts.

SECTION VII. POTENTIAL POLLUTANT SOURCES LISTED

The following are Major and Minor Potential Pollutant Sources (PPS) subject to the requirements of this Ordinance. This listing is consistent with the New Jersey Safe Drinking Water Act, N.J.A.C. 7:10-11.7 through 12.12.

A. Major PPSs include:

1) Permanent storage or disposal of hazardous wastes, industrial or municipal sludge or radioactive materials, including solid waste landfills.
2) Collection and transfer facilities for hazardous wastes, solid wastes that contain hazardous materials, and radioactive materials.
3) Any use or activity requiring the underground storage of a hazardous substance or waste in excess of an aggregate total of 50 gallons.
4) Underground fuel and chemical storage and oil tanks regulated by NJDEP under provisions of the Underground Storage of Hazardous Substances Act (N.J.S.A. 58:10A-21 et seq.).
5) Above-ground storage facility for a hazardous substance or waste with a cumulative capacity greater than 2,000 gallons.

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6) Any industrial treatment facility lagoon.
7) Any facility with a SIC Code number included under the New Jersey Safe Drinking Water Act Regulations at N.J.A.C 7:10A-1.14, Table II(N), with a toxicity number of II or greater. (See Appendix A.)
8) Automotive service center (repair & maintenance).
9) Landfill.
10) Dry cleaning facility.
11) Road salt storage facility.
12) Cemetery.
13) Highway maintenance yard.
14) Truck, bus, locomotive maintenance yard.
15) Site for storage and maintenance of heavy construction equipment and materials.
16) Site for storage and maintenance of equipment and materials for landscaping.
17) Livestock operation.
18) Quarrying and/or mining facility.
19) Asphalt and/or concrete manufacturing facility.
20) Junkyard/auto recycling and scrap metal facility.
21) Residential or agricultural motor fuel in NJDEP exempted underground storage tanks (i.e., under 1,000 gallons).

B. Minor PPSs include:

1) Underground storage of hazardous substance or waste of less than 50 gallons.
2) Underground heating oil storage tank with a capacity of less than 2,000 gallons.
3) Sewage treatment facility.
4) Sanitary sewer system, including sewer line, manhole, or pump station. (See conditions in Section VII.C.)
5) Industrial waste line. (See conditions in Section VII.C.)
6) Septic leaching field.
7) Facility requiring a ground water discharge permit issued by the NJDEP pursuant to N.J.A.C 7:14A *et seq*.
8) Stormwater retention-recharge basin.
9) Dry well. (See conditions in Section VII.C.)
10) Storm water line. (See conditions in Section VII.C.)
11) Waste oil collection, storage and recycling facility.
12) Agricultural chemical bulk storage and mixing or loading facility including crop dusting facilities.
13) Above-ground storage of hazardous substance or waste in quantities of less than 2,000 gallons.

C. Conditions:

1) Sanitary sewer lines, industrial waste lines and storm water lines may be located no closer than 100 feet to a regulated well, and only if they are

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constructed of watertight construction (that is steel, reinforced concrete, cast iron, PVC or other suitable material).

2) Manhole and/or connections to a sanitary sewer system are prohibited within 100 feet of a regulated well.

3) Dry wells dedicated to roof runoff and serving residential properties or commercial or industrial properties with SIC codes not listed in _____[4]

SECTION VIII. BEST MANAGEMENT PRACTICE PERFORMANCE STANDARD

Any applicant proposing any change in land use or activity that involves any PPS, as defined in Section VII, that would be located either wholly or partially within any WHPA shall comply with and operate in a manner consistent with the following Best Management Practices:

A. All portions or areas of a facility in which hazardous substances or hazardous wastes are stored, processed, manufactured or transferred outdoors, shall be designed so that the discharges of hazardous substances will be prevented from overflowing, draining, or leaching into the ground water or surface waters.

B. Outdoor storage, dispensing, loading, manufacturing or processing areas of hazardous substances or hazardous wastes must be protected from precipitation, stormwater flows or flooding.

C. Wherever hazardous substances are stored, processed, manufactured or transferred outdoors, the design features shall include secondary containment and/or diversionary structures which may include but not be limited to:

1) Containers, dikes, berms or retaining walls sufficiently impermeable to contain spilled hazardous substances, for the duration of a spill event.
2) Curbing.
3) Gutter, culverts and other drainage systems.
4) Weirs, booms and other barriers.
5) Lined diversion ponds, lined lagoons and lined retention basins, holding tanks, sumps, slop tanks and other collecting systems.
6) Drip pans.

D. Secondary containment and/or diversionary systems, structure or equipment must meet the following standards:

1) The system must block all routes by which spilled hazardous substances could be expected to flow, migrate, or escape into the ground water or surface waters.
2) The system must have sufficient capacity to contain or divert the largest probable single discharge that could occur within the containment area, plus an

[4] The model Ordinance is blank at this reference.

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additional capacity to compensate for any anticipated normal accumulation of rainwater.

3) In order to prevent the discharge of hazardous substances into ground water, all components of the system shall be made of or lined with impermeable materials sufficient to contain the substance for the duration of a spill event. Such material or liner must be maintained in an impermeable condition.

4) No manufacturing area, processing area, transfer area, dike storage area, or other storage area, or secondary containment/diversion system appurtenant thereto shall drain into a watercourse, or into a ditch, sewer, pipe or storm drain that leads directly or indirectly into a surface or subsurface disposal area, unless provision has been made to intercept and treat any spilled hazardous substances in an NJDEP approved industrial wastewater treatment or pre-treatment facility, or other NJDEP approved facility.

5) Catchment basins, lagoons and other containment areas that may contain hazardous substances should not be located in a manner that would subject them to flooding by natural waterways.

E. Stormwater shall be managed so as to prevent contamination of ground water, and so as to be in accordance with applicable laws and regulations of the State of New Jersey, and of [municipality].

SECTION IX. OPERATIONS AND CONTINGENCY PLAN

A. Any applicant proposing any change in land use or activity that involves any PPS, as defined in Section VII, that would be located either wholly or partially within any WHPA shall submit an Operations and Contingency Plan to the Administrative Authority. This Operations and Contingency Plan shall inform the Administrative Authority about the following aspects of the proposal:

1) Types of PPS proposed for the site;

2) Types and quantities of hazardous substances or hazardous wastes that may be used or stored on site;

3) Means to be employed to contain or restrict the spillage or migration of hazardous substances or hazardous wastes from the site into ground water;

4) Means to be used to contain or remediate accidental spillage of such materials;

5) Means to notify administrative authority about any accidental spillage of such materials;

6) Demonstration that the proposed use and/or activity would employ, to the maximum extent possible, best management practices as set forth in Section VIII, to protect ground water quality in the WHPA and minimize the risk of potential ground water contamination.

B. The Administrative Authority shall review, and shall approve or reject any Operations and Contingency Plan prior to approving or denying the application for a land use change or activity.

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C. Any Operations and Contingency Plan submitted shall be available for public review and comment.

SECTION X. ENFORCEMENT

A prompt investigation shall be made by the appropriate personnel of the Health Department of [municipality] , of any person or entity believed to be in violation hereof. If, upon inspection, a condition which is in violation of this Ordinance is discovered, a civil action in the Special Part of the Superior Court, or in the Superior Court, if the primary relief sought is injunctive or if penalties may exceed the jurisdictional limit of the Special Civil Part, by the filing and serving of appropriate process. Nothing in this Ordinance shall be construed to preclude a municipality's right, pursuant to N.J.S.A 26:3A-25, to initiate legal proceedings hereunder in Municipal Court. The violation of any section or subsection of this Ordinance shall constitute a separate and distinct offense independent of the violation of any other section or subsection, or of any order issued pursuant to this Ordinance. Each day a violation continues shall be considered a separate offense.

SECTION XI. SEVERABILITY

If any section, sentence, clause or phrase of this Ordinance is held to be invalid or unconstitutional by any court of competent jurisdiction, then said holdings shall in no way affect the validity of the remaining portions of this Ordinance.

SECTION XII. EFFECTIVE DATE

This Ordinance shall take effect upon final adoption and publication in accordance with the law on [date].

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APPENDIX A - NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION (NJ DEP) DELINEATIONS OF WELLHEAD PROTECTION AREAS (WHPAs) AROUND PUBLIC COMMUNITY WATER SUPPLY WELLS

Excerpts from:

New Jersey Geological Survey, New Jersey Department of Environmental Protection,

New Jersey Public Community Water Supply Well Head Protection Areas, Edition 2,

Geospatial Data Presentation, New Jersey Digital Data Series, DGS02-2, dated 18 June 2002.

Description of WHPAs: A Well Head Protection Area (WHPA) is an area calculated around a Public Community Water Supply (PCWS) well in New Jersey that delineates the horizontal extent of groundwater captured by a well pumping at a specific rate over two-, five-, and twelve-year periods of time. The area of capture is defined using line boundaries and polygon areas generated with the ARC/INFO Geographic Information System (GIS). GIS coverages are produced for each PCWS well and for the set of all PCWS wells in a county using the ARC/INFO UNION command on individual coverages. WHPA delineation methods are described in "Guidelines for Delineation of Well Head Protection Areas in New Jersey (http://www.state.nj.us/dep/njgs/whpaguide.pdf). An ARC/INFO point coverage of associated PCWS wells is available as N.J. Geological Survey Digital Geodata Series DGS97-1 (http://www.state.nj.us/dep/njgs/geodata/dgs97-1.htm).

Internet Address: http://www.state.nj.us/dep/njgs/geodata/dgs02-2.htm

NJDEP Data Distribution Agreement:

The Data provided herein are distributed subject to the following conditions and restrictions.

I. Description of Data to be Provided: For all data contained herein, NJDEP makes no representations of any kind, including, but not limited to, the warranties of merchantability or fitness for a particular use, nor are any such warranties to be implied with respect to the digital data layers furnished hereunder. NJDEP assumes no responsibility to maintain them in any manner or form.

II. Terms of Agreement:

1. Digital data received from the NJDEP are to be used solely for internal purposes in the conduct of daily affairs.

2. The data are provided, as is, without warranty of any kind and the user is responsible for understanding the accuracy limitations of all digital data

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layers provided herein, as documented in the accompanying cross-reference files (see Section 1.14 CROSS_REFERENCE). Any reproduction or manipulation of the above data must ensure that the coordinate reference system remains intact.

3. Digital data received from the NJDEP may not be reproduced or redistributed for use by anyone without first obtaining written permission from the NJDEP. This clause is not intended to restrict distribution of printed mapped information produced from the digital data.

4. Any maps, publications, reports, or other documents produced as a result of this project that utilize NJDEP digital data will credit the NJDEP's Geographic Information System (GIS) as the source of the data with the following credit/disclaimer: "This (map/publication/report) was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized."

5. Users shall require any independent contractor, hired to undertake work that will utilize digital data obtained from the NJDEP, to agree not to use, reproduce, or redistribute NJDEP GIS data for any purpose other than the specified contractual work. All copies of NJDEP GIS data utilized by an independent contractor will be required to be returned to the original user at the close of such contractual work. Users hereby agree to abide by the use and reproduction conditions specified above and agree to hold any independent contractor to the same terms. By using data provided herein, the user acknowledges that terms and conditions have been read and that the user is bound by these criteria.

Process Description:

The WHPA delineations were created using the methods outlined in "Guidelines for Delineation of Well Head Protection Areas in New Jersey" available as a download at <http://www.state.nj.us/dep/njgs/whpaguide.pdf>. Coordinate files delineating each WHPA boundary were generated using a custom MS-DOS program on-file at the offices of the N.J. Geological Survey. The MS-DOS coordinate files are formatted as ARC/INFO coverages and contain line attributes specifying each time of travel tier for groundwater to the well. Each coverage was built as both a line and a polygon coverage having both arc and polygon attributes for the three Time of Travel (TOT) tiers. PCWS wells were located using a Global Positioning System (GPS). WHPA delineations are considered to have an accuracy of plus or minus 40 feet in any direction from the mapped location. WHPA delineations for wells completed in the glacial sand and gravel aquifer were clipped to a custom hydrologic boundary. Sand and gravel aquifers occur where deposits are more than 50 feet thick. The hydrologic boundary is generated as a 2000 foot buffer around the polygon representing the contact of the sand and gravel aquifer for those areas where the aquifer is less than 50 feet thick. This distance was selected based

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on an average distance between the 50 and 100 foot thickness contours of the sand and gravel aquifer. The aveage inter contour distance was doubled to provide a conservative estimate of the thickness variation. Therefore, any portion of the WHPA delineation that lies beyond this extent is clipped

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Appendix 2E

MODEL MUNICIPAL WELL TESTING ORDINANCE
Kingwood Township

(see: http://www.kingwoodtownship.com/ktdocuments/KT-well-ordinance-060107.pdf)
Contact: Kingwood Township, (908) 996-4276

BOARD OF HEALTH OF THE
TOWNSHIP OF KINGWOOD
ORDINANCE NO. BOH 2007-01

Please take notice that the following Ordinance was adopted on first reading by the Board of Health of the Township of Kingwood, County of Hunterdon, State of New Jersey at a meeting held on the 23rd day of May, 2007. The Ordinance was then ordered to be published according to law. Notice is hereby given that the said Ordinance will be considered for final passage after a public hearing to be held on the 20th day of June, 2007 at a meeting beginning at 8:00 P.M. at the Municipal Building located on the corner of County Road 519 and Oak Grove Road, Kingwood Township, New Jersey, at which time all interested parties will be heard.

AN ORDINANCE OF THE TOWNSHIP OF KINGWOOD TO AMEND CHAPTER 153, ARTICLE 2 - "NON-PUBLIC WATER SYSTEMS AND WELLS", TO EXPAND THE EXISTING CODE TO INCLUDE AMENDED STANDARDS, AND INCORPORATE NEW PERFORMANCE AND INTERFERENCE TEST REQUIREMENTS.

Section I. The "Code of the Township of Kingwood", *Chapter 153 - Sewage Disposal Systems; Non-Public Water Systems and Wells.* and specifically, *Article 2 - Non-Public Water Systems and Wells* is amended to incorporate modifications and new provisions such that the existing Sections will be replaced in their entirety as follows:

ARTICLE 2 - NON-PUBLIC WATER SYSTEMS AND WELLS

153-20 Purpose and Authority.

1. Basis for Ordinance. Kingwood Township does not utilize a public water supply, public water treatment facility or municipal sewage treatment facility. Kingwood Township residents and businesses rely exclusively upon a high quality supply of ground water from private wells. The quantity and quality of the ground water is susceptible to change, especially in the geologic formations known as Lockatong, Stockton and Diabase, because water exists only in fractures in the bedrock (which can be sparse), because recharge is limited by local soils and geology, because new wells can impact existing wells if they access the same fracture system, and because wells could be subject to contamination if pollution sources, including hazardous waste deposition sites and septic systems, are located in the vicinity of a supply fracture(s). To provide a reliable,

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long-term, dependable yield and high quality of the ground water resource; and to ensure protection of the surface water resources, this ordinance will be used as the basis for decisions regarding potential detrimental impacts associated with proposed new and altered wells, and expanded uses of ground water (e.g., multi-residential, public, commercial, and off-site water supply).

2. Purpose of Ordinance. In order to carry out its delegated duties pursuant to N.J.S.A. 26:3-31 and N.J.S.A. 58:11-23 et seq., the Township of Kingwood adopts this Ordinance for the following purposes: to ensure that new wells constructed, or the increased water withdrawal(s) from an existing well(s), in Kingwood Township are able to provide a reliable, safe, and adequate water supply to support intended uses within the capacity of available ground water resources; to provide safeguards designed to minimize the impact of new development on water availability for existing homes and businesses; to develop a mechanism for funding the rehabilitation or replacement of existing wells rendered unusable by new development or from increased water withdrawal(s) from an existing well(s); to maintain undiminished, high quality stream baseflow, and maintain the antecedent hydrology of streams, wetlands, lakes, and ponds, for the long-term protection of aquatic ecosystems; and to provide for the collection of accurate ground water information.

153-21 Definitions.

1. *ABANDONED WELL*: Any well which is not in use, has been illegally installed or improperly constructed, has been improperly maintained or is damaged, has not been maintained in a condition that ensures that the subsurface or percolation waters of the State are protected from contamination, has been replaced by another well or connection to a public supply, is contaminated, is nonproductive, or no longer serves its intended use pursuant to the State Act.

2. *ABANDONMENT OR DECOMMISSIONING OF A WELL***:** The permanent closure or sealing of a well in accordance with N.J.A.C. 7:9D-3 et seq.

3. *ADMINISTRATIVE AUTHORITY*: The Kingwood Township Board of Health having jurisdiction or the authorized agent (e.g. Hunterdon County Health Department) of the Administrative Authority acting on behalf of the Administrative Authority. The Kingwood Township Planning Board shall be the Administrative Authority with respect to the requirements of this Article pertaining to the review and approval of subdivisions and site plans.

4. *ADVANCE NOTICE OF TEST DATES*: Communications in writing or by telephone with the secretary of the Administrative Authority or with a field witness designated by the Administrative Authority. Messages left on answering machines, or transmitted by facsimile or email are not binding advance notices.

5. *ALTERATION*: Any physical change in a well, including deepening, modification, fracturing, or removal such that there will be a change in size, construction or installation.

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The term alter shall be construed accordingly. Replacement of pumps and installations of adapters shall be considered a repair and not an alteration.

6. *APPROVED*: Accepted by the Administrative Authority as satisfying the requirements of this Article.

7. *AQUIFER***:** A formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield economic quantities of water to wells and springs.

8. *AQUIFER TEST*: A three-part test conducted to obtain background, pumping, and recovery data from a pumping well and observation wells in order to determine aquifer characteristics and assess potential well interference.

9. *AQUIFER TEST PLAN*: A plan specifying the well testing proposed by an applicant and submitted for approval by the Administrative Authority prior to the well construction to satisfy the requirements of this Article.

10. *AUTHORIZED AGENT*: A licensed health officer, professional engineer, sanitary inspector, plumbing inspector or any other qualified person who is delegated to function within specified limits by the Administrative Authority.

11. *AVAILABLE DRAWDOWN*: The distance between static level and fifteen (15) feet above the pump intake level or the first major water bearing fracture.

12. *AVERAGE DAILY DEMAND*: The average amount of water used per day, as specified in N.J.A.C. 7:10-12.6.

13. *BEDROOM*: Any room within a dwelling unit, furnished or unfurnished, which is used to, or which may reasonably be expected to provide sleeping quarters for one or more individuals. The term bedroom shall be considered, in absence of any evidence to the contrary, to include any room on any floor above the lowest floor to have a door providing access directly to the outside and which has no through traffic.

14. *CERTIFICATION OF WELL*: A written statement by the Administrative Authority attesting that the water supply facilities for the proposed realty improvement are in compliance with the Realty Improvement and Facilities Act as revised N.J.S.A. 58:11-23 et seq., N.J.S.A. 48:12A-1 et seq., and the Regulations promulgated under either and the requirements of this Ordinance.

15. *CONSTANT RATE TEST*: A pumping test conducted upon the well so that discharge remains relatively constant with time.

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16. *CONSTRUCT A WELL*: The drilling, building, assembly or installation of a new water supply system or the enlargement of an existing water supply system and the term well construction shall be construed accordingly.

17. *DRAWDOWN*: A decline in the water level in a well measured from the static level during pumping (it is the difference between the static water level prior to pumping and the water level during pumping).

18. *DROUGHT*: The 1965 annual precipitation (equivalent to sixty-six percent (66 %) of the average annual precipitation), or the most recent 50 year return period (lowest 2 percent probability) of annual precipitation, whichever is less. Acceptable precipitation data are daily averages that have been recorded and published by the National Weather Service, National Oceanic and Atmospheric Administration, or other government agencies directed to monitor precipitation. The precipitation data collection site must be within 15 miles of the well-testing site.

19. *FRACTURE TRACE*: The surface representation of a fracture zone as determined from an analysis of aerial photographs in stereo pair.

20. *HYDRAULIC CONDUCTIVITY*: The ease with which water can travel through a porous media. Also referred to as permeability.

21. *HYDROGEOLOGY*: The study of groundwater with particular emphasis given to its chemistry, mode of migration, and relation to the geologic environment.

22. *INTERFERENCE*: The amount of drawdown in a non-pumping well resulting from nearby well pumpage.

23. *INTERFERENCE TEST*: A pumping test conducted to determine the interference effects on one or more selected observation wells, resulting from pumping a subject well.

24. *IRRIGATION SYSTEM*: Equipment including but not limited to pumps, piping, and sprinkler heads used to distribute water to grasses, landscape materials, crops, and other vegetation.

25. *NEW WELL*: A well newly constructed or altered, or an existing well prior to its certification for a new or expanded use.

26. *NITRATE DILUTION MODEL*: The Trela – Douglas method, or a State-adopted successor method, for estimating the amount of recharge required to maintain ground water nitrate nitrogen (NO_3 as N) concentration that will not diminish the quality and safety of potable ground water supplies, and will not degrade the trophic status (health) of adjacent waterways. The NJ Geological Survey recommends levels not to exceed 2.0 mg/l for maintaining good trophic levels. The 1995 hydrogeology report for Kingwood Township by Robert Hordon, PhD, presented a Township-wide average concentration of 0.90 mg/l. Any additional nitrate loading shall not create a predicted or actual total nitrate

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concentration in excess of 5.0 mg/l, provided, however, that if any coupling of the ground and surface water hydrology exists at the site or within 500 feet of the site boundary, then any additional nitrate loading shall not create a predicted or actual total nitrate concentration in excess of 2.0 mg/l. Omission of rational shall constitute a concentration of 2 mg/l for the model.

27. *OBSERVATION WELL*: Any well, which is not the pumping well, utilized to obtain water level measurements, and other associated data, during interference testing.

28. *PEAK-DAY DEMAND*: Equal to twice the Average Daily Demand.

29. *PEAK DEMAND RATE*: The average rate of discharge of water from a well, in gallons per minute (gpm), during peak demand. For residential use, the Peak Demand Rate equals the number of bathrooms (including half-baths) in the residence multiplied by 3 gpm. For non-residential or multi-residence use, minimum water requirements of N.J.A.C. 7:10-12.6 govern.

30. *PEAK DEMAND TEST*: A pumping test conducted upon a well to evaluate its capability to supply peak water-demand needs. The test is conducted at a rate equal to or greater than the Peak Demand Rate to deliver at least the Peak Load. This test has been described in detail by J.L. Hoffman and R. Canace in "Two-Part Pump Test for Evaluating the Water-Supply Capabilities of Domestic Wells" - N.J. Geological Survey Ground Water Report Series No. 1 - 1986.

31. *PEAK DEMAND TIME*: The duration of time, in minutes, during which the peak demand rate is exerted on a well. Peak demand time is computed in the following manner:

$$\text{Peak Demand Time (minutes)} = \frac{\text{Peak Load (gal.)}}{\text{Peak Demand Rate (gpm)}} = \frac{\text{100 gals. x Number of Bedrooms}}{\text{3 gpm x Number of Bathrooms}}$$

32. *PEAK LOAD*: The volume of water, in gallons, required during the occurrence of peak demand. Peak Load is equal to the number of bedrooms in the residence multiplied by one hundred (100) gallons. For non-residential uses, the Peak Load equals one-half of the minimum daily demand volume requirements according to N.J.A.C. 7:10-12.6.

33. *POTABLE WATER*: Any water used or intended to be used for drinking or culinary purposes.

34. *QUALIFIED HYDROGEOLOGICAL CONSULTANT*: An individual who has received a baccalaureate or post-graduate degree in hydrogeology, geohydrology, geology, engineering or soil science and has at least five (5) years of professional work experience in the practice of applying geologic principals to the interpretation of groundwater conditions, especially aquifer testing in fractured bedrock. Applicants

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submitting an aquifer test plan and/or hydrogeologic report shall be required to submit evidence of the credentials of the associated Qualified Hydrogeological Consultant.

35. *REALTY IMPROVEMENT*: Any proposed new residence or other building the useful occupancy of which requires the installation or erection of a water supply system. Each family unit in a proposed multiple dwelling shall be construed to be a separate realty improvement.

36. *REPAIR*: Fix, refurbish or replace one or more components of a water supply system in a manner that will restore and preserve the original location, design, construction and installation of the system, while not increasing water supply capacity.

37. *SPECIFIC CAPACITY*: The rate of discharge of water from the well divided by the drawdown of water level within the well. Specific Capacity should be related to the number of hours pumping prior to measurement of drawdown. Specific capacity will generally decrease with increased time of pumping.

38. *SPECIFIC STORAGE*: The volume of water that a unit volume of aquifer releases from storage for a unit decline in water depth.

39. *STATIC WATER LEVEL*: The water level in the well at rest either before or after pumping when all drilling and pumping effects on the aquifer have dissipated and the well is in equilibrium with atmospheric pressure.

40. *STORAGE COEFFICIENT (STORATIVITY)*: The volume of water an aquifer releases or takes into storage per unit surface area of the aquifer per unit change in head. It equals the product of specific storage and aquifer thickness. Also known as storativity.

41. *TRANSMISSIVITY*: The rate at which water of a prevailing density and viscosity is transmitted through a unit width of an aquifer under a unit hydraulic gradient. Transmissivity equals hydraulic conductivity multiplied by the aquifer thickness.

42. *UNSATURATED ZONE*: The zone between ground surface and the water table. Pore spaces in the unsaturated zone just above the Water Table contain water at pressures less than atmospheric. Also referred to as “zone of aeration” and “vadose zone”.

43. *WATER TABLE*: The surface in an unconfined aquifer or confining bed at which the pore water pressure is equal to atmospheric. It is defined by the levels at which water stands in wells that penetrate the water body just far enough to hold standing water.

44. *WELL* means an artificial excavation that derives water from the interstices of the rocks and soils which it penetrates.

45. *WELL RECOVERY* means the inflow of ground water into a well from the aquifers in which the well is completed (drilled) after a period or episode of drawdown from pumping.

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46. *WELL YIELD* means the rate at which it has been demonstrated that water can be withdrawn from the well during the time of the pump test where the water level does not change more than 0.5 feet (six (6) inches) per hour under a constant pumping rate.

153-22 Incorporation of Additional Codes.

1. In addition to the requirements contained in this Article, existing laws and regulations governing the location, construction, alteration, use and supervision of individual and semi-public water supplies; requiring certain permits and certifications based upon accepted testing procedures; providing for the inspection of such water supplies and the fixing of fees, and prescribing penalties for violations comprised of the following codes, standards and statutes are hereby incorporated herein and made a part hereof by reference:

N.J.S.A. 58:12A-1 et seq. - "Safe Drinking Water Act"
N.J.S.A. 58:11-23 et seq. - "The Realty Improvement Sewage and Facilities Act"
N.J.S.A. 4:1C-1 et seq. - “Right to Farm Act”
N.J.A.C. 7:10 - "Safe Drinking Water Act Regulations"
N.J.A.C. 7:9D - “Well Construction; Maintenance and Sealing of Abandoned Wells”
N.J.A.C. 7:9E - "Private Well Testing Act” Kingwood Township Well Ordinance

2. If any conflict between any part of this Ordinance, or any other applicable code, standard or statute or applicable law arises, the more stringent standard shall apply.

153-23 Well Construction Permit.

1. Prohibition. No person shall locate, construct or alter any water supply system or well within the Township of Kingwood until a permit for the location, construction or alteration of such well has been issued by the Administrative Authority.

2. Application for Well Construction Permit. A State Well Permit is a prerequisite to the issuance of a Kingwood Township Well Construction Permit. Application must be made on forms prescribed by the Administrative Authority titled “Kingwood Township Application for Well Construction Permit.” When a Hydrogeologic Report is required as stated in §153-25, an Aquifer Test Plan (described in §153-29.3) must be submitted to and approved by the Administrative Authority before issuance of a Well Construction Permit. The application must include a copy of the receipt for submission of a well construction permit to the Hunterdon County Department of Health.

3. Map. Scale of 1 inch equals 100 feet, prepared by a certified Professional Engineer or Qualified Hydrogeological Consultant. All applications shall include five (5) copies of a plot plan showing the location measured from at least two property or main structure corners, of all new well(s), all pre-existing well(s), all existing subsurface disposal areas and all soil test points (e.g., percolation test pits) for potential subsurface disposal areas. All identifiable pre-existing wells and existing subsurface disposal areas shall include

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those on adjoining properties that are located within two hundred (200) feet of the subject property. Latitude and longitude for the new and pre-existing wells shall be recorded.

4. Other permits. It is the applicant's responsibility to obtain any other permits needed, such as construction of access roads, sediment control, etc.

5. Transferability. Permits shall not be transferable, except that permits may be transferred to any successor in interest who holds title to the property to which the permit is applicable.

6. Repairs. Repairs shall not require a Well Construction Permit unless the pump is replaced with one of a greater pumping capacity, which is considered an alteration.

153-24 Certification of Well.

1. New water supplies, new water wells or altered water wells constructed in the Township of Kingwood shall not be placed in service, nor shall new dwellings or buildings or additions to existing buildings, which must rely on such supply for water, be used or occupied which must rely on such supply for water, until the Administrative Authority shall have issued a Certificate indicating that the said water supply has been located and constructed in compliance with the terms of the Well Construction Permit, and provides an acceptable potable water supply, as defined by the requirements of this Ordinance. Certification of Well is required before issuance of a Building Permit for any new dwellings or buildings or additions to existing buildings which must rely on a private well for water supply.

2. Application for Certification of Well.

a) Forms. Any such application submitted to the Administrative Authority for approval or certification shall be made on forms prescribed by the Administrative Authority under the title "Application for Certification of Well". Copies of forms required by N.J.A.C. 7:10-1 et seq. and properly executed Forms DWR-138 "Well Record" (issued by NJDEP) and "Kingwood Township Well Testing Report" shall be submitted to the Administrative Authority, with the "Application for Certification of Well." The applicant shall submit five (5) copies of the application and all supporting materials. The Secretary of the Administrative Authority shall forward one copy of the application and all supporting materials to the Township Qualified Hydrogeological Consultant for review.

b) The application must include a copy of the test results necessary to fulfill the requirements of the State well permit.

3. Failure of Wells. A new well which fails any portion of the requirements of this Ordinance shall be considered unacceptable, unless used in series to provide the necessary water supply, and the applicant shall either replace the well or alter the well (i.e., deepen the well to intercept additional fractures, and/or add additional well storage).

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After well replacement or well alteration, the entire test procedure shall be repeated on the new or altered well. If the new or altered well fails the testing procedure, the lot may be classified as unacceptable for development. Wells which fail to gain Certification shall be abandoned and sealed in accordance with the requirements of N.J.S.A. 58:4A-4.1 et seq. and N.J.A.C. 7:9D-3.

153-25 Applicability.

1. Except as stated in Table 1 (*Applicability and Timing for Types of Water Uses*), all provisions of this Ordinance shall apply to all applications to the Administrative Authority for Certification of Well. Advance Notice of Test Dates is required for all pump tests for all new and existing wells.

Table 1: Applicability and Timing for Types of Water Use.

Type of Water Use and Daily Demand Value	**Applicability for Certification of Well**		**Timing of Well Certification**
	153-28 Three-Part Pump Test	**153-29 Aquifer Test & Hydrogeologic Report**	
Existing improved or unimproved residential lot with a proposed daily demand of < 800[1] gallons	YES	N/A	Prior to issuance, renewal or extension of Building Permit
Existing improved or unimproved residential lot with a proposed daily demand of > 800 gallons	N/A	YES	
Residential lot that is part of an approved subdivision with an approved ydrogeological Report	YES	N/A	
Change in Use[2] that requires additional water when the total daily demand will be > 800 gallons, unless the well has been previously certified for the amount of water proposed	N/A	YES	Prior to approval of Change in Use[2]
Subdivision of one (1) lot (excluding the remaining lands)	YES	N/A	Prior to issuance, renewal or extension of Building Permit
Subdivisions of 2 or more lots[3] (excluding the remaining lands)	N/A	YES	
Non-residential or multiple residence uses < 800 gpd	YES	N/A	Prior to preliminary site plan approval
Non-residential or multiple residence uses > 800 gpd	N/A	YES	
Any use > 100,000 gpd	Obtain NJDEP Water Allocation Permit		
Public water systems			

[1] An equivalent of 4 bedrooms (200 gpd/bedroom).

[2] Any new or expanded water use that was not part of the original well certification (i.e., providing an off-site water supply, addition of bedroom(s), and other non-certified water uses), or in addition to the estimated water use (based on N.J.A.C. 7:10-12.6) if no certification was required at the

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time the well was installed. Off-site water supply shall only be conveyed to an adjacent single-family residence.

[3] Unless the total proposed daily demand is ≤ 800 gpd, whereby the Three-Part Pump Test shall be applied to each well.

2. Off-site water use. Conveyance of ground water beyond the outer perimeter of an existing lot, shall only be permitted as an emergency supply of potable water in cases of water supply loss to less than 0.25 gpm for a directly bordering single-family private residence, up to a maximum daily demand of 600 gallons. The additional water use shall be included in the total water demand from the supply well and all provisions of this ordinance shall apply to the combination of the original certified well water supply plus the increased demand at the supply well.

153-26 Physical Construction Requirements.

1. General requirements. All wells constructed within the Township of Kingwood shall conform to the standards for the construction of non-public and non-community wells as promulgated by the New Jersey Department of Environmental Protection; N.J.A.C. 7:9D and 7:10-12.1 et seq., together with the following additional and supplementary requirements:

2. Spacing. No new well shall be located at a distance less than 100 feet from any approved well or subsurface disposal area. New wells shall be located upgradient from subsurface disposal areas.

a) The spacing requirement for wells may be waived for multiple wells (only), on single lots that serve one individual residence, to not less than 50 feet.

3. Due to the potential for the creation of new and/or expanded fractures, a distance of 200 feet (200’), or more, is required between any new or existing well being hydrofractured and any nearby approved wells and subsurface disposal areas. This distance shall be maintained unless the applicant can technically demonstrate, with representation by a certified professional engineer or a Qualified Hydrogeological Consultant, professionally-accepted techniques to the Administrative Authority that would render equal or more protection to nearby approved wells and subsurface disposal areas within a shorter distance, not less than 150 feet.

4. Explosives. The use of explosives for development of any well is prohibited.

5. Pitless Adapter and Casing. Any new well shall be provided with a pitless adapter, with the lateral discharge line installed below the frost level. Casings shall extend twelve inches (12”) above finished grade and be equipped with all brass and bronze pitless adaptor and brass fittings. Non-metallic casing is prohibited. No well casing shall be smaller than six (6”) inches in diameter. Six inch (6”) well casing must weigh a minimum of 19 lbs. per foot (.280 inch pipe thickness). The borehole diameter shall be at least four inches (4”) larger than the outside diameter of the casing. Well casing shall extend to a minimum of fifty feet (50’) and extend at least twenty feet (20’) into competent bedrock.

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6. Electric lines. Electric lines shall be installed and maintained as described in Chapter 3 of the National Electric Code (NEC).

7. Repairs. Any well head that is buried below grade and dug up for repair to the well or pump must have the well casing extended above grade and a pitless adapter installed, if possible.

8. Disinfection. Any well used during test proceedings must be chlorinated at the end of the pump test in accordance with procedures recommended by the Hunterdon County Health Department.

9. Pump placement. Placement of the pump shall not be deeper than ten feet (10') above the bottom of the well, but not less than 20 feet (20') below the depth of the water level as measured at the end of a successful Peak Demand Test.

10. Pump Type. Type and capacity of the pump and equipment (motor, drop pipes, foot valve, cylinder, storage tank, etc.) used shall be selected to meet applicable conditions and the requirements of the property served. All pumps must be lead-free.

11. Storage. All new and/or altered wells shall be equipped with a water storage tank at least forty-two (42) gallons in capacity or greater in accordance with the standards as established in N.J.A.C. 7:10-12.35. The Administrative Authority, in consultation with the Qualified Hydrogeologic Consultant, may require larger capacity storage tanks for dwelling units which have in excess of five bedrooms, wells with a specific capacity of less than 1 gallon per minute per foot of drawdown, or installations other than single family dwelling units at the rate of an additional 20 gallons of storage capacity per bedroom or for each additional daily demand of 200 gallons.

153-27 General Requirements for Three-Part Pump Test and Aquifer Test.

1. Supervision. All well tests shall be conducted under the supervision of a Certified Well Driller, or Certified Pump Installer licensed under the laws of the State of New Jersey, who shall certify the results to the Administrative Authority. All test results shall be recorded on "Kingwood Township Well Testing Report" forms to be issued by the Administrative Authority.

2. Witnessing. The Administrative Authority reserves the right to witness all well tests. A minimum of two working days Advance Notice of Test Dates shall be provided to the Administrative Authority. The Administrative Authority reserves the right to allot testing dates in case of scheduling problems.

3. Precipitation. The pump test or aquifer test shall not be conducted during a precipitation event or events in which total precipitation exceeds or equals 0.5 inches. Precipitation must be recorded with a National Weather Service acceptable rain gauge on site during all phases of testing and measurements for each day must be included in the

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hydrogeologic report. If precipitation occurs during the test, the applicant should provide precipitation amounts and sufficient data to show that the precipitation did not recharge the aquifer during the test and bias the testing results. If precipitation amounts exceeding 0.5-inches are recorded at the Lot in question, the test must be repeated, or technical documentation provided that clearly shows that the precipitation event had no impact on ground water levels throughout 24 hours before, and during the test.

4. Flow meter. Flow rates at the discharge line must be measured with a water flow meter. A valve must also be on the discharge line in order to permit adjustment of the flow rate.

5. Discharge. The discharged water must be channeled away, at a minimum distance of 100 feet, from the wellhead to minimize direct recharge of the well during the test. Any and all permits required by the NJDEP for the discharge of water must be obtained prior to starting the test.

6. Dip tube. All test wells must have a "dip tube" installed in order to allow accurate measurement of the water level during the pump test. The water level must be measured to the nearest tenth of a foot from a fixed point (measurement point); e.g., from the top of the well casing.

7. Evaluation of General Requirements. Failure to adhere to general requirements will invalidate the test results. Pumping tests shall be performed from July through October to adequately account for seasonal effects on aquifer levels and the associated changes to ground water hydraulics (e.g., changes in transmissivity in leaky or semi-confined aquifers and unconfined aquifers as aquifer water levels change).

153-28 Three-Part Pump Test.

1. General Requirements

a) Property Owner Notification. Owners of existing wells on lots located within 300 feet of the property boundary of a proposed new or altered well, as applicable to § 153-25.1 Table 1, shall receive notification of the scheduled well test(s) from the applicant, via certified mail, 4 weeks prior to the well test date. The applicant shall obtain a certified list of all property owners within 300 feet of the property boundary from the Township Tax Assessor.

b) Three-Part Pump Test. The capability of a well to meet the peak demand and the total daily requirements of its user shall be evaluated through a three-part pump test. The three parts are the Peak Demand Test (§ 153-28.2); Constant Rate Test (§ 153-28.3); and Well Recovery Test (§ 153-28.4). The well must pass the Constant Rate and Peak Demand Tests as required for the size of the facility to be supported by the well. The result of the Constant Rate Test shall determine, according to § 153-28.3.c, the maximum size of the proposed residence or non-

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residential facility to be supported by the well. The result of the Well Recovery Test provides additional data about the suitability of the well for extended use.

c) Technique. The three-part pump test must be performed in one continuous operation as specified in § 153-28.2, § 153-28.3, and § 153-28.4. The test well must be at its Static Water Level at the beginning of the test, i.e., the well has to be undisturbed for at least 72 hours before testing. If the test sequence has to be interrupted for technical reasons, the well must be pumped to the drawdown observed just prior to the interruption before the test sequence can be resumed. If more than 24 hours lapse during interruption, the entire test must be rerun.

2. Peak Demand Test

a) Purpose. The Peak Demand Test is a standard drawdown pump test used to determine whether the well can supply the water needed during times of peak water use. The results of the Peak Demand Test must show that well storage plus Well Recharge during Peak Demand Time at least equals the Peak Load required for the facility proposed to be supported by the well.

b) Test Protocol. To perform the Peak Demand Test, the well is pumped at least at the Peak Demand Rate until the Peak Load has been delivered. The duration of pumping equals the Peak Demand Time (see definitions section). The water level shall be measured and recorded, at a frequency of every five (5) minutes during the test.

c) Evaluation of Results. To pass the Peak Demand Test, the well must not be drawn down anytime during the test to a level less than five (5) feet above the pump intake or to a level less than thirty feet (30’) above the bottom of the well, whichever is higher. If the results of the Peak Demand Test are unsatisfactory, the well may be altered or used in conjunction with additional wells, or the design of the proposed facility must be so modified as to lower the Peak Load requirements sufficiently to accommodate the performance of the well.

3. Constant Rate Test

a) Purpose. The Constant Rate Test is used to measure the well yield and to determine whether the recharge from the aquifer is sufficient to replenish the water volume removed from the well during use.

b) Test Protocol. The Constant Rate Test is undertaken in sequence with the Peak Demand Test regardless of whether or not the well passed the Peak Demand Test. The pump discharge rate should be as close as possible to the Peak Demand Rate, but the main objective is to achieve a stable water level while pumping. A constant head condition exists where the water level does not change more than 0.5 feet (six inches (6”)) per hour under a constant pumping rate. The water level

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shall be measured and recorded, at a minimum frequency of every five (5) minutes during the test. The Constant Rate Test is run for a full four (4) hours.

c) Evaluation of Results. If the pumping rate has not varied by more than 0.2 gpm for at least the last hour of the test, the yield shall be determined to be equal to the measured pumping rate. To allow for long-term fluctuations of water availability from the aquifer, caused by variations of precipitation, competition from other ground water users or other factors, the minimum requirements of Table 2 for Constant Rate Test results shall apply to all new or expanded residential or non-residential uses. For non-residential or multi-residence use, minimum water requirements of N.J.A.C. 7:10-12.6 govern, and each 200 gallons per day requirements or fraction thereof shall be considered equivalent to one bedroom for the purpose of the Constant Rate Test. An aquifer contribution of at least 0.5 gpm shall be required for each bedroom equivalent for non-residential use.

Table 2: Minimum Yield Requirements for Wells

Well Yield from Constant Rate Test	**Residential Water Use**
More than 3.0 gpm	Use must not exceed the limits established during pump test
More than 2.0 to 3.0 gpm	Not more than four bedrooms
More than 1.5 to 2.0 gpm	Not more than three bedrooms
1.0 to 1.5 gpm	Not more than two bedrooms
Less than 1.0 gpm	Up to two bedrooms, pending successful demonstration*

Water conservation toilets and shower heads should be installed for all new or renovated plumbing. Well Yield should be considered as a minimum for intended water uses. Residential Water Use does not include provisions for pools, jacuzzis, and other larger water uses.

* Well Yields less than 1.0 gpm shall be considered unusable to support residential use, unless a certified Professional Engineer demonstrates professionally-accepted techniques to the Administrative Authority that would allow for a residential water use of at least 400 gpd (equivalent of 2 bedrooms) without adverse effects to the well, or neighboring wells, based on Drought conditions for the period of July through October.

4. Well Recovery Test

a) Purpose. The Well Recovery Test provides an estimate of ground water inflow to the well, which is referred to as Well Recovery Rate. When used in combination with the above tests, it can assist in evaluating the adequacy of water supply wells to meet water demands.

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b) Test protocol. The water level is recorded at the end of the pumping phase (§ 153-28.3) before turning off the pump. After the pump is turned off, water level recovery begins as the aquifer recharges the well. The water level shall be measured and recorded, at a minimum, every five (5) minutes during the first 30 minutes of the test. The Well Recovery Rate is calculated from these water level measurements, measured in gallons per minute (gpm), using the following equation (for a six (6) inch inside diameter well casing):

$$\text{Well Recovery Rate} = \frac{(\text{well level at time 1 (feet)} - \text{water level at time 2 (feet)}) \times 1.5 \text{ gallons/foot}}{\text{recovery time 1} - \text{recovery time 2 (minutes)}}$$

c) Results. The minimum acceptable well recovery rate for Certification of Well is one half (0.5) gpm averaged over the first 30 minutes of recovery. If the well fails to achieve this, the test shall be repeated to ensure that all steps were undertaken correctly. If it fails a second time, the well should be deepened or re-drilled at a different location. Deepening the well may result in encountering additional water-bearing fractures. Generally, if the well depth exceeds 500 feet, the chances on encountering additional water-bearing fractures are minimal. If a replacement well is drilled and fails to pass this test, it may be possible to use both wells in combination to meet the expected demand if the well-recovery rate of both wells together exceeds 0.5 gpm. A well which fails to achieve this recovery rate due to drawdown of less than 5 feet during the pumping phase shall be deemed acceptable.

153-29 Aquifer Test and Hydrogeologic Report.

1. Purpose. An Aquifer Test is a three-part test conducted to obtain background, pumping, and recovery data from a pumping well and observation wells in order to determine aquifer characteristics and assess potential well interference. The Hydrogeologic Report shall include a review of available information and Aquifer Test results and analyses in order to evaluate whether the aquifer can provide a reliable, safe, and adequate water supply to support intended uses within the capacity of available ground water resources, and to ensure that new wells do not unduly infringe upon the performance of existing wells. Aquifer Tests shall be designed to yield the most accurate information concerning the aquifer and to identify locations most likely to be marginal or problematic. All methodologies used in this analysis and report shall be in conformance with recognized engineering practice for ground water hydraulics.

2. Qualified Hydrogeological Consultant. The Aquifer Test Plan and Hydrogeologic Report shall be prepared by a Qualified Hydrogeological Consultant (as defined in §153-21).

3. Aquifer Test Plan. An Aquifer Test Plan provides details about the proposed field work required for the Aquifer Test and Hydrogeologic Report. An Aquifer Test Plan shall be submitted, together with a Preliminary Hydrogeologic Report, at the times stated in §153-

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25.3 Table 1 “Timing of Well Certification.” The design of the Aquifer Test shall be developed using the applicable guidance from "Guidelines for Preparing Hydrogeologic Reports for Water Allocation Permit Application with an Appendix on Aquifer - Test analysis Procedures" NJGS GSR 29 (1992 or most recent edition) or successor document. The Aquifer Test Plan must include the estimated Daily Demand Value for each proposed well, and the project as a whole; and the location and technical specifications for each proposed test well and observation wells. Review of the Aquifer Test Plan includes submission of such test plan to a Qualified Hydrogeological Consultant representing the Administrative Authority for review and recommendations. Review of the Aquifer Test Plan must be completed by the Qualified Hydrogeological Consultant, and the Plan must be approved, approved with conditions or disapproved, within 45 days of receipt of the Plan. Before the Qualified Hydrogeological Consultant approves any Aquifer Test Plan, the Qualified Hydrogeological Consultant must review the proposed Aquifer Test Plan with the Administrative Authority. The Aquifer Test Plan will be finalized before issuance of a Well Construction Permit and before the Aquifer Test can proceed. Review of results of the Aquifer Test and any individual Three-Part Pump Tests must be completed by the Qualified Hydrogeological Consultant representing the Administrative Authority, and the results must be approved, approved with conditions or disapproved within 60 days of receipt of the well testing data.

4. Selection of Location of Aquifer Test. The Aquifer Test shall be conducted at a location most representative of site geologic conditions.

a) The aquifer test(s) shall be conducted at the location(s) most representative of site geologic conditions and also most effective for evaluating the potential impact(s) to proximate users of the ground water resource to ensure that adequate yield is available throughout the proposed subdivision.

b) If the proposed site is underlain by two or more geologic formations, then an aquifer test will be required for each portion of the site underlain by each formation. The test requirements for each formation will depend on the number of lots and size of units per formation.

c) In the event that the preliminary hydrogeologic evaluation indicates that a surface-water and/or groundwater divide separates the subdivision/site, an aquifer test will be required for each side of the divide, in addition to the requirements of sections a) and b).

5. Observation Wells.

a) The number of observation wells required per Aquifer Test is specified in Table 3. Observation wells may be located such that they can be used as future water-supply wells but they shall be located in such a manner that will yield the most accurate information concerning the aquifer.

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Table 3: Number of Test Wells Required.

Number of Lots	Number of Test Wells*
2	1 pumping well and 1observation well.
3 to 5	2 on-site test wells, for pumping and observation. Minimum of 1, up to 3 off-site existing observation wells.***
6 to 15	4 on-site test wells, for pumping and observation. Minimum of 3, up to 5 off-site existing observation wells.***
16 to 49	6 on-site test wells, for pumping and observation. Minimum of 5, up to 7 off-site existing observation wells.***
≥50**	6 on-site test wells, for pumping and observation. Minimum of 7, up to 10 off-site existing observation wells.***

* Subject to §153-29.6g.

** Proposed water withdrawals of ≥ 100,000 gpd must also be submitted to NJDEP for review and approval.

*** At the discretion of the Qualified Hydrogeological Consultant representing the Administrative Authority.

b) Fracture Trace Analysis. A fracture trace analysis showing the location and orientation of fractures beneath the site must be included with the Aquifer Test Plan. This same analysis with additional information regarding septic system locations must be included in the hydrogeologic report. This fracture trace analysis must be used to identify all observation wells on the site and should be used to identify neighboring property owner wells to be monitored during the test.

c) Location. Observation wells should be completed to similar depths as the pumping well. Observation wells must be located parallel and perpendicular to strike of the primary regional fractures and those intersected by the tested well. Additional observation wells should be located to evaluate potential secondary fractures, and impacts to adjacent and up-gradient properties.

d) Distance between wells. All wells must be located in accordance with the minimum distances required by N.J.A.C. 7:10-12.12. Depending on the total number of observation wells, as specified in §153-29.5a Table 3, one (1) to five (5) observation well(s) shall be located between 100 feet and 500 feet of the pumping well, and three (3) to seven (7) observation well(s) must be located between 500 feet 1,000 feet of the pumping well. Based upon local ground-water hydrology and site specific conditions, the Qualified Hydrogeological Consultant will determine the number of observation wells within the specified distance from the pumping well and may locate up to five (5) observation wells between 1,000 feet and 2,500 feet of the subdivision/site plan boundary.

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e) Geologic Log. The observation wells and pumping well must have a geologic log completed for each well. The geologic log shall describe the depth and types of soils and rocks encountered and the depth and yields of all water-bearing fracture zones. Furthermore, the logs must include static water-level measurements and total yield estimates for each well.

6. Use of Existing Wells as Observation Wells.

a) Property Owner Notification. Owners of existing wells on lots located within 2,500 feet of the subdivision/site plan boundary shall be given an opportunity to have their wells monitored during the aquifer test. The applicant shall obtain a certified list of all property owners within 2,500 feet from the Township Tax Assessor. Such opportunity shall be given by the applicant by notice via certified mail on forms available from the Administrative Authority and shall give the time and place of the aquifer test. The notice shall indicate that such existing well may be monitored if agreed to by the well owner provided the well is readily accessible. Such notice shall indicate that the existing well owner must respond within seven (7) days and the applicant's responsibility is to monitor up to the number specified in Table 3 for off-site observation wells.

b) Response. If the owner of the lot within 2,500 feet of the subdivision/site plan boundaries agrees to have their existing well monitored, they shall notify the applicant by certified mail within seven (7) days of receipt of the certified notice from the applicant. If the applicant receives no response within the time provided, the response shall be deemed to be negative. If more homeowners agree to participate than the required number of observation wells, the selection of wells will be made by the Township's Qualified Hydrogeological Consultant. A return response for notification of the selected well owners, and date and time of the well pump test(s) shall be delivered by the applicant via certified mail to those interested lot owners within 2,500 feet of the subdivision/site plan boundaries. The return response must be received by the homeowner at least four (4) weeks prior to the well test(s).

c) Insurance. The applicant shall provide a certificate of insurance for itself and all contractors utilized and pay all costs associated with the monitoring of any existing residential well.

d) Costs. The costs of extending, restoring or replacing a well included in the Aquifer Test and which is damaged as a result of testing shall be the responsibility of the applicant.

e) Liability. The applicant shall indemnify and hold the Township and its consultants and representatives harmless from any liability and claims for personal injury, including death, and property damage occurring in connection with the performance of these test requirements.

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f) Protection of monitored wells. All reasonable efforts must be made to protect the potability of water from the monitored well. All wells shall be chlorinated (using the Hunterdon County Health Department's recommended procedures) each time they are opened for service or monitoring, unless the owner specifically waives the requirement of chlorination in writing. Bottled water shall be provided by the applicant to the residents utilizing off-site wells selected for inclusion in the Aquifer Test during the monitoring period and while the chlorine is detected above the acceptable limits of chlorine in potable water.

g) Selection of Wells for Monitoring. When property owners within 2,500 feet of the subdivision/site plan boundaries decide to participate and to have their existing wells monitored, it is the applicant's responsibility to monitor up to the number of wells specified in Table 3. However, if any of the property owners requesting monitoring have wells that are supported with public records to have been completed to a depth less than 100 feet, these wells must also be monitored in addition to the requirements for observation wells in Table 3. The observation wells on neighboring properties shall be selected to assess if the drawdown from the pumping well will extend beyond the subdivision/site plan boundary in any direction.

h) Water Use During Aquifer Test. If possible, the pump of each observation well should be electrically disconnected at least three (3) hours before the beginning of the test sequence to permit stabilization of the static water level, and remain disconnected throughout the test sequence. If this is not possible, the well owner shall minimize water use during the test sequence.

7. Preliminary Hydrogeologic Report. The preliminary Hydrogeologic Report shall be submitted with the Aquifer Test Plan at the times stated in §153-25.3 Table 1 "Timing of Well Certification." The following is a minimum outline:

a) Map: Scale of 1 inch equals 100 feet, prepared by a certified Professional Engineer or Qualified Hydrogeological Consultant. The map must show the geology; surface and ground water features (i.e. any known fractures, faults and recharge areas); location(s) of proposed test wells and observation wells; location(s) of proposed water quality monitoring wells; existing wells on lots located within 500 feet of the subdivision/site plan boundary; all septic systems and hazardous waste disposal areas active or abandoned within 500 feet of the boundary; and the location of all soil tests for potential subsurface sewage disposal areas on lots located within 500 feet of the subdivision/site plan boundary.

b) Well Locations: Global Positioning System (GPS) coordinates, using NJ State Plane criteria, of the on-site test and observation wells, and proposed ground water quality monitoring wells must be submitted on a CD in either DBase or Excel format, with the original digital GPS file(s).

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c) Nearby Wells: Documentation of all well drilling results from the records of the Hunterdon County Health Department on lots located within 500 feet of the subdivision/site plan boundary. Well failures within 0.5 (1/2) mile of the subdivision/site plan boundary must be identified.

d) Hydrogeology Description: Include a description of the hydrogeology of the site and its environs including any factors that would influence well yield, location of any known fractures or faults, and recharge characteristics of the local soils and geology. This review shall also include the attitude of formation strike and dip and a fracture trace analysis using aerial photographs showing the location and orientation of fractures beneath the site. Calculate the zone of influence and the zone of capture for the proposed wells.

e) Analysis of Hydrological Impacts: Summarize projections of the hydrological impact (e.g., the projected long-term trend, including seasonality, of the water levels in the available aquifers or other sources of potable water and stream baseflow) that may be caused by the proposed wells. This hydrological analysis shall at a minimum address the impacts of any existing and proposed wastewater disposal systems onto water supplies (including Trela Douglas nitrate dilution modeling); impacts of water supply and wastewater disposal systems on the aquifer, existing wells, and surface waters (e.g. wetlands and stream baseflow for Drought conditions); and impacts of any existing and proposed stormwater management practices onto any existing and proposed water supply and wastewater disposal systems. The analysis shall also include an outline of all measures that may reasonably be employed to minimize any identified adverse impacts.

8. Aquifer Test Protocol.

a) General Requirements.

i. The aquifer test shall consist of at least one constant-rate pumping test conducted at a sufficient rate and duration to be able to determine aquifer characteristics such as transmissivity and storage coefficient. As part of the aquifer test, observation wells (see §153-29.5 and 153-29.6) are to be monitored to determine and evaluate the area and magnitude of drawdown (cone of depression) and aquifer parameters, and predict the effect of long term pumping on existing and future wells.

ii. The aquifer test will be conducted in three phases: the background phase (§153-29.8b), the pumping phase (§153-29.8c), and the recovery phase (§153-29.8d).

iii. The pump must be installed in the pumping well at least 48 hours prior to the start of the background phase. Prior to starting the background phase,

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water levels in the test well and observation wells must be permitted to stabilize for a minimum of three days after all drilling activities are complete.

iv. General Requirements for Three-Part Pump Test and Aquifer Test (§153-27) also apply.

v. If the proposed diversion's effect on nearby wetlands or water bodies is of concern, then these should be monitored.

b) Background Phase. The first phase will involve the collection of background water levels prior to the start of pumping.

i. Prior to Pumping Phase. During the background phase, water levels should be collected at a minimum once per hour for the 24 hour period prior to the start of pumping. It is the applicant's responsibility to collect sufficient data to determine background conditions and to ensure that antecedent influences can be fully characterized. Barometer measurements and additional water-level measurements can be made by the applicant to evaluate the change in water levels resulting from barometric pressure changes and/or influences from off-site pumping.

ii. On the day of the Pumping Phase. Water levels shall be collected from all wells to determine static water levels prior to the start of pumping. Water levels in observation wells on neighboring properties should be allowed to stabilize at or near static water level prior to the start of pumping. For any observation well which has been pumped within the 24 hours preceding the test, at least two depth–to-water measurements, at least 1 hour apart, shall be collected to show that the well has fully recovered prior to the start of pumping.

c) Pumping Phase. The second phase will involve the pumping of water from the well and the monitoring of water-level drawdown in the observation and pumping wells.

i. Calculation of Flow Rate. The flow rate of the Aquifer Test will depend upon the size of the proposed development and expected average and peak daily demands for water. The average daily and average yearly water demand for human consumption within the subdivision or site plan must be determined according to the guidelines in N.J.A.C. 7:10-12.6. Demand calculations must include irrigation systems if proposed and water usage for filling of swimming pools and all other demands. Demand is to be determined based on N.J.A.C. 7:10-12.6. The peak-day demand is twice the average daily demand. For non-residential developments, peak-day demand must include seasonal factors. The minimum pumping rate is calculated by dividing the peak-day demand by 1440 minutes per 24-hour period.

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ii. Duration. The duration of the Aquifer Test will depend upon the size of the proposed development and expected average and peak daily demands for water. The pumping phase will be equal to the greater time duration of the following: 1) the time required to remove a volume of water from the aquifer equal to the peak-day demand; or 2) 8 hours. The pumping phase must simulate peak-day demand and therefore, the pumping phase duration is not to extend more than 24 hours.

iii. Maintaining Constant Flow Rate. When the pump is started the flow rate shall be adjusted immediately to a uniform pumping rate as required for a constant-rate test and in accordance with the approved Aquifer Test Plan. The flow rate shall not vary more than 10 percent throughout the test. If the flow rate fluctuates more than 10 percent, the test shall be deemed invalid and the applicant required to repeat the notification and testing process.

iv. Frequency of Measurements. Water-level measurements during the pumping phase of the test shall be collected in accordance with Table 4. This same schedule shall be followed for the recovery phase of testing upon shut down of the pump in the test well.

Table 4: Maximum Frequency of Water-Level Measurements in Wells During Pumping and Recovery Phases of Aquifer Test

Time Since Pumping Began or Stopped	Test Well	Observation Wells
0 to 5 minutes	0.5 minutes	0.5 minutes
5 to 10 minutes	1 minute	1 minute
10 to 30 minutes	2 minutes	2 minutes
½ to 24 or more hours	5 minutes	5 minutes

v. Mixed Developments. For mixed developments containing both residential and nonresidential properties, each portion will be tested separately. Wells installed for the residential portion must be used as observation wells for the nonresidential testing and wells installed for nonresidential use must be used as observation wells for the residential testing.

vi. Equipment. The pumping rate will be determined by equipping the discharge pipe with an orifice/manometer apparatus and calibrated flow meter to instantaneously measure flow rate and determine total volume pumped from the well. For low-capacity pumping tests (less than 3 gallons per minute), flow can be measured with a calibrated bucket and stop watch.

d) Recovery Phase. The third phase will involve the recovery of water levels in the observation and pumping wells after the pump has been shut down.

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i. Frequency of Measurements. Water-level measurements during the recovery phase of the test shall be collected in accordance with §153-29c.iv Table 4.

ii. Duration. For purposes of evaluating water-level recovery, the recovery phase duration will be equal to the pumping phase duration. For example, if the pumping phase is 8 hours in duration, water levels 8 hours after the pump has been turned off will be compared to the pre-pumping static water level to assess recovery rates and residual drawdown.

9. Water Quality Evaluation.

a) Collection. Ground water samples must be collected during the pumping phase from the pumping well in accordance with the NJDEP Field Procedures Manual.

b) Field Analyses. Field measurements of pH, water temperature, conductivity, and total dissolved solids shall be made with calibrated instruments.

c) Laboratory Analyses. At a minimum, the samples shall be analyzed by a NJDEP-certified laboratory for hardness, Gross Alpha Particle Activity, arsenic, iron, manganese, copper, lead, nitrate, and total and fecal coliform bacteria. The samples shall also be analyzed for volatile organic compounds for which the USEPA or NJDEP has determined maximum contaminant levels using USEPA Method 524.2.

d) Additional Analyses. Based on past historical operations at the site or at nearby properties, the Administrative Authority, may require additional analyses of ground water, such as heavy metals, pesticides, herbicides, or other volatile or semi-volatile organic compounds to assess potential future and current impacts.

10. Final Hydrogeologic Report.

a) After the new wells are drilled and tested, according to the provisions of this Ordinance and the specifications of the approved Aquifer Test Plan, a final Hydrogeologic Report shall be submitted, at the times stated in §153-25.2 Table 1 “Timing of Well Certification.” Guidance is provided by "Guidelines for Preparing Hydrogeologic Reports for Water Allocation Permit Application with an Appendix on Aquifer - Test Analysis Procedures" NJGS GSR 29 (1992 or most recent edition) or successor document.

b) Data: Results of the tests as described in this Ordinance shall be submitted for each new well, on forms prescribed by the Administrative Authority. All data obtained during the aquifer tests shall be provided on CD in Microsoft Word and Excel format. In addition, all water quality sampling data, including copies of the laboratory reports, shall be provided. Tables summarizing the analytical results should be included.

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c) Analyses: The final hydrogeologic report shall provide calculations of important aquifer characteristics such as transmissivity and storage coefficient as detailed in NJDEP GSR 29. The radius of influence for the test as determined from observation wells shall be provided. Determination of coupling between the surface and ground water hydrology on, and within 500 feet of the site boundary shall be provided, if proposed. The impact on adjacent land owners shall be described. The overall assessment of the aquifer test compared to data developed in the preliminary hydrogeologic report shall be detailed, specifically variations in expected response of the aquifer.

11. Evaluation of Results. Based on the available information, as specified by the provisions of this Ordinance, the Administrative Authority can approve, or disapprove the application. If the information indicates that the purpose of this ordinance (§153-20.2) would not be supported, the proposal cannot be approved, unless the applicant can show that any documented concerns can be remedied.

a) Precipitation. A test conducted during a period in which 0.5 inches or more of precipitation is recorded at the site must be repeated.

b) Background Phase. Antecedent water level conditions must be determined by monitoring, and, if necessary, pumping phase and recovery phase data corrected. Insufficient data to assess these influences will require repetition of all three phases of the Aquifer Test.

c) Pumping Phase.

i. If the pumping rate does not exceed the average daily demand by 120 percent or the peak-day demand cannot be pumped within a 24-hour period, the aquifer beneath the site will be deemed insufficient to meet the proposed water use demands, and the applicant must reduce site demands and development units.

ii. If the pumping rate varies by more than 10 percent of the average flow rate, the entire test shall be repeated.

iii. If the pump shuts down during the pumping phase for more than 10 minutes, the entire test must be repeated.

iv. If water levels in the pumping and/or observation wells exceed the measurement capacity of the devices used for measuring changes in water levels and measurements are not recorded with other devices in accordance with the schedule listed in Table 4, the test must be repeated.

v. If the pumping data indicate a change in aquifer transmissivity as a result of fracture dewatering, all analyses of the potential radius of influence and

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impacts to neighbors, streams, and wetlands must be conducted using the lowered aquifer transmissivity. If this lowered transmissivity indicates that the anticipated demand cannot be supported by the aquifer beneath the site, the applicant must reduce the site demand and development units.

d) Recovery Phase. If water-level recovery is less than ninety percent (90%) of full recovery in the pumping well or any observation well(s) at the end of the recovery phase, of the same duration as the pumping phase, the applicant must show, through professionally-accepted standards for aquifer test analytical procedures and calculations, that the well or wells are capable of full recovery. If full recovery cannot be shown or ground water mining/dewatering has occurred, the applicant must reduce the site demand and development units to allow the proper recovery.

e) Observation Wells.

i. If the drawdown is measured or projected to be more than 1 foot at any existing adjacent property well or along the subdivision/site plan boundary, the applicant's hydrogeologist must evaluate long-term potential impacts to adjacent properties based on the actual condition of wells in that zone or along that portion of the subdivision/site plan boundary.

ii. If a drawdown of 5 feet or more is noted in any existing adjacent property well, or is projected at any property boundary, then the aquifer will be deemed to have insufficient transmissivity to support the proposed subdivision/site plan. The applicant must reduce the site demand and development units to ensure that drawdown will not exceed 5 feet at any site boundaries.

f) Impacts to Streams and Wetlands. If drawdown is measured or projected to induce leakage from streams or wetlands such that baseflow in these streams will be reduced or wetlands partially or entirely dewatered, or if ambient water quality would be impacted, then the site demand and development units must be reduced to prevent adverse impacts to streams and wetlands.

g) Water Quality.

i. Results of water quality tests must meet the minimum requirements for potability according to N.J.A.C. 7:10 or the well cannot be certified for use unless the documented concerns can be remedied.

ii. If results of the Trela Douglas nitrate dilution model predict unacceptable nitrate levels in new or existing wells, then the site demand and development units must be reduced. Model simulations must reflect low-recharge summer season and Drought conditions. (Reference: Trela, J.J. and Douglas, L.A., 1978, Soils, septic systems and carrying capacity in the New Jersey Pine

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Barrens: paper presented at the First Annual Pine Barrens Research Conference, Atlantic City, May 22, 1978, 34p.)

iii. A ground water quality monitoring program is required for residential subdivisions with 5 or more lots (initially, or as an aggregate over 10 years), or any residential, public, or non-residential water use of ≥ 1,500 gpd. Subdivisions with 5 to 14 lots, or any residential, public, or non-residential water use from 1,500 gpd to 2,000 gpd, shall install and use a single monitoring well. Monitoring well(s) will be established at a location not more than 200 feet down-gradient from the lowest building site elevation, or in line with the natural path of runoff from the developed area, whichever location best represents an intercept for subsurface transport of pollutants from the developed sites. Selected monitoring site(s) and well depths will be reviewed by the Township Qualified Hydrogeological Consultant. Monitoring wells will be sampled for background water quality as per §153-29.9. Water samples shall be collected and analyzed from these wells by a New Jersey State Certified Laboratory for a period of twelve (12) years. The monitoring program shall be the responsibility of the Applicant's Qualified Hydrogeological Consultant, in coordination with a selected New Jersey State Certified Laboratory, for sample collections, well security and sanitation, and decommissioning of the well(s). During the first year, a sample shall be collected and analyzed for each season (i.e., summer, fall, winter, and spring). Thereafter, samples shall be collected semi-annually, rotating between spring-fall, and summer-winter season collections. Data will be submitted, semi-annually, to the Township Qualified Hydrogeological Consultant, Board of Health, and Planning Board for comparison with the background data to determine if the water quality has changed. An additional water quality monitoring well and sampling program is required for each additional 10 lots or part thereof, or additional residential, public, or non-residential water use of 2,000 gpd or part thereof.

h) Additional Testing. Any test that must be repeated, restarted, or reconducted at a reduced demand, must satisfy all the requirements of this ordinance including but not limited to re-notification of all property owners within 2,500 feet of the site boundary, and resubmission of an Aquifer Test Plan for Administrative Authority approval prior to implementation of the test.

153-30 Documentation

The applicant shall submit 15 copies of the Aquifer Test Plan, Preliminary Hydrogeologic Report, Proof of Property Owner Notification, Final Hydrogeologic Report, and Water Quality Monitoring Results (semi-annually, when applicable) to the Township Administrative Secretary for distribution to the Township's Qualified Hydrogeologic Consultant, Board of Health, and Planning Board.

153-31 Consistency with Prior Ordinances.

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All Ordinances, Codes or parts of the same inconsistent with any of the provisions of this Ordinance and the code established hereunder are repealed to the extent of such inconsistency.

153-32 Hearing Upon Denial of Permit or Certificate.
In case any permit or certification required by this Ordinance is denied by the Administrative Authority, a hearing shall be held thereon before the Administrative Authority within fifteen (15) days after request therefore is made by the applicant, and upon such hearing the Administrative Authority shall affirm, alter or rescind its previous determination and take action accordingly within fifteen (15) days after the date of such hearing.

153-33 Orders to Stop Work.
The Administrative Authority may order all further work in and about any water supply which is being erected or installed in violation of the Code to be stopped forthwith, except such work as shall be necessary to remedy such violation, and, thereafter, the work continued without any violation of any of the provisions of the Code, and after issuance of any such order and the service of a copy thereof upon any person connected with or working in and about the erection or installation of any such water supply or any part thereof, no further work shall be done thereon except as aforesaid.

153-34 Fees.

1. Application for Kingwood Township Well Construction Permit. $200

2. Witnessing of Pump Tests. $500

3. Application for Certification of Well. $100

4. Escrow Deposits For Professional Review of Aquifer Test Plan and Hydrogeologic Report.

a) Residential subdivisions and site plans. An initial escrow deposit of $4,000 for the first lot or dwelling unit and $400 for each proposed additional lot or dwelling unit. These fees do not apply to existing dwelling units.

b) Non-residential site plans. An initial escrow deposit of $4,000 for the first 1,000 gallons of average daily demand and $300 for each additional 1,000 gallons of average daily demand.

5. Escrow For Rehabilitation and Monitoring.

a) Well-water supply. Establishment of an Escrow account for remediating any unforeseen detrimental effects of a proposed development upon existing wells, both interior and exterior to the project boundary, are to be required as a condition of approval of any subdivision or site plan application. A deposit of $3,000 into

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escrow shall be required for each new well. This escrow fee shall not be required if a new well is being drilled to replace an existing failed well. A deposit of $200 into escrow shall be required for every 100 square feet, or portion thereof, of building floor space for which site plan approval is granted. Subdivisions resulting in the creation of only 1 new lot are exempted from the $3,000 escrow requirement. Whenever a resident submits a claim that their well has been rendered unusable by a development, the Qualified Hydrogeological Consultant shall review the applicable facts and circumstances and determine whether the development has rendered the existing well unusable. If the Qualified Hydrogeological Consultant determines that development has rendered the existing well unusable, then the owner of the well so affected shall be entitled to have the cost of rehabilitation or replacement of his well paid from the escrow funds. Escrow shall be held for a duration of twelve (12) years at which time any residual will be returned to the applicant.

b) Water-quality monitoring. Establishment of an Escrow account to fund water quality monitoring shall be required as a condition of any subdivision or site plan approval, pursuant to section §153-11.g.iii. A deposit of $2,800 into escrow shall be required for each new well. A deposit of $150 into escrow shall be required for every 100 square feet, or portion thereof, of building floor space for which site plan approval is granted. Escrow shall be held for a duration of twelve (12) years at which time any residual will be returned to the applicant.

153-35 Retest Procedures.
A licensed well driller, pump installer, Qualified Hydrogeological Consultant, or a professional engineer must be present during retest. The entire procedure must be undertaken, regardless if only one section of the test is failing. The witness fee must be paid for a retest, even though the County Health Department does not charge a duplicate fee.

153-36 Penalties.
Any person or persons, firm or corporation violating any of the provisions of or any order promulgated under this Ordinance and the Code, Statutes and Regulations adopted hereunder, shall, upon conviction thereof, pay a penalty up to Five Hundred Dollars ($500.00). Each day a particular violation continues shall constitute a separate offense and violation.

Section II. Severability.
If the provision of any article, section, subsection, paragraph, subdivision or clause of this Ordinance shall be judged invalid by any Court of competent jurisdiction, such Order or Judgment shall not effect or invalidate the remainder of any such article, section, subsection, paragraph or clause, and, to this end, the provisions of this Ordinance are hereby declared to be severable.

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Appendix 2F

Model Management Ordinance
Individual Onsite Wastewater Treatment Systems

(Systems regulated under N.J.A.C. 7:9A)
Contact: NJDEP Bureau of Nonpoint Pollution Control, Phone (609) 633-7021

Since 1990 the Department [of Environmental Protection] has maintained the regulations which govern the Standards for Individual Subsurface Sewage Disposal Systems at N.J.A.C. 7:9A (Standards). Although these Standards generally guide the regulated community through the process of locating, designing and constructing septic systems, the Standards also address the concepts surrounding the proper operation and maintenance of those systems. However, it is difficult to ensure that these systems are properly operated or maintained without a mechanism to oversee systems after the certification of compliance is issued. This is where management of systems becomes important. The purpose of this Model Management Ordinance is to provide an example to Boards of Health of what could be incorporated into local ordinance to allow them to begin managing systems within their borders.

The model ordinance is comprehensive and should not discourage anyone from taking a step back and ask "What level of management is appropriate for my area?" It is not the intention of the Department to suggest that every town needs to adopt every facet of the model ordinance. This is a dynamic document which can be adopted in whole, in part or in some variation to suit the needs of the jurisdiction.

Some areas have already begun septic management and could use ideas within the model ordinance to expand their program a little or a lot. Areas without a model ordinance could adopt some basic requirements to allow for the use of technology to fix malfunctioning systems in problematic areas. Others still may want to incorporate septic management of all their systems to begin assessing the local situation and allow for access to low interest loan programs to help their citizens repair malfunctioning systems. The Department hopes that this model ordinance can be used to inform communities in New Jersey and promote the possibilities and benefits associated with septic management.

The model ordinance incorporates ideas, format and structure from existing model ordinance documents such as the Pinelands Commission pilot program for nitrate reducing technologies, the Association of New Jersey Environmental Commissions model ordinance for septic maintenance, and the USEPA's voluntary guidelines for decentralized system management. The Department has expanded on those documents and developed this model ordinance to provide a model document which shows many of the conventional thoughts on septic management.

After reading this document, you should feel free to contact the Department to discuss the possibilities for your area. Please contact the Bureau of Nonpoint Pollution Control at

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(609) 633-7021 or at CH199@dep.state.nj.us and we will be happy to address your concerns and questions.

(INSERT NAME OF JURISDICTION) BOARD OF HEALTH
AN ORDINANCE TO AMEND THE CODE OF THE BOARD OF HEALTH OF THE (INSERT NAME OF JURISDICTION) TO CREATE ESTABLISH REQUIREMENTS FOR THE MANAGEMENT OF ONSITE WASTEWATER TREATMENT SYSTEMS.

WHEREAS the Board of Health of the (Name of jurisdiction) desires to implement an onsite wastewater management program in accordance with the guidelines from the United States Environmental Protection Agency and in cooperation with the New Jersey Department of Environmental Protection.

BE IT ORDAINED by the Board of Health of the (INSERT NAME OF JURISDICTION) in the County of (Insert Name of County) and State of New Jersey as follows:

SECTION ONE

A. FINDINGS

It is found and declared that:

1. Residential and non-residential onsite wastewater treatment systems are in use within the (insert name of jurisdiction).
2. Onsite wastewater treatment systems, similar to any other physical structure, require ongoing maintenance and proper operation to ensure proper functionality.
3. When existing onsite wastewater treatment systems have malfunctioned even when the systems have been designed, constructed, and sited in accordance with applicable standards, largely due to lack of proper operation and maintenance. These malfunctions have been shown to adversely affect public health and welfare and the environment. Such systems constitute a potential source of pollution of ground and surface waters, contamination of potable water supplies, foul odors, nuisance problems and other hazards to public health.
4. It is determined to be in the interest of public health and the environment, safety and welfare to establish provisions to regulate the management of such systems to protect the public and environment against system failures and resultant pollution.
5. The licensing provisions contained in this Ordinance are necessary to protect the public health safety and welfare and it is therefore necessary to exceed the provisions contained in N.J.A.C. 7:9A-1 et seq. This is hereby declared to be a "special ordinance" in accordance with N.J.A.C. 7:9A-3.1(b) and shall be forwarded to the New Jersey Department of Environmental Protection within 10 days of adoption.
6. In order to enable the use of onsite system technology that enhances treatment of wastewater, management and maintenance are a necessity.

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7. Economic benefits to all onsite system owners by improving the quality of wastewater management, will extend the serviceable life of onsite systems, preventing or postponing the need for costly repairs or replacements.

B. PURPOSE

In addition to the purposes set forth in N.J.A.C. 7:9A-1.1, it is the purpose of this ordinance:

1. To establish a management program for residential and non-residential onsite wastewater treatment systems in the (insert name of jurisdiction) in order to ensure the proper operation and maintenance of such systems. This ordinance requires all onsite wastewater treatment systems subject to local regulation to be satisfactorily operated, inspected and maintained on a regular basis in order to minimize future malfunctions of such systems.
2. To regulate onsite wastewater treatment systems in (insert name of jurisdiction) to protect public health and welfare and the environment. This includes a means of educating onsite wastewater treatment system owners/operators, as defined herein, in the characteristics of such systems and the proper procedures for altering, operating and maintaining them.
3. To develop a management program to maintain records regarding onsite wastewater treatment systems in the program area.
4. To promote and assure the proper use and maintenance of residential and non-residential onsite wastewater treatment systems.

SECTION TWO

TITLE.

This Ordinance shall be known as the Onsite Wastewater Treatment System Management Ordinance of the (insert name of jurisdiction.)

SECTION THREE

DEFINITIONS.

All definitions given in Subchapter 2 (N.J.A.C. 7:9A-2.1) of the New Jersey Department of Environmental Protection (NJDEP) Standards for the Construction of Individual Onsite wastewater treatment Systems, N.J.A.C, 7:9A-1.1 et seq., and any amendments thereto ("NJDEP Regulations") are hereby incorporated into this article, with the following additions:

ADVANCED WASTEWATER TREATMENT OR DISPOSAL TECHNOLOGY- Any component or system, which is a part of an individual subsurface sewage disposal system, that is employed to reduce levels of pollution or convey pollutants to the subsurface environment that is not addressed or is not designed in strict conformance with the requirements of N.J.A.C. 7:9A.

BOARD OF HEALTH- The Board of Health of the (insert name of jurisdiction)

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EDUCATION PROGRAM- An educational program prepared and administered by the Board of Health regarding the function of onsite wastewater treatment systems and the proper procedures for the operation and maintenance of such systems. The educational program shall be performed in accordance with the minimum requirements of N.J.A.C. 7:9A-3.14.)
ENFORCING OFFICIAL- The (Insert name of officer) of the (insert jurisdiction) or his designee.

LICENSED SEPTIC SLUDGE REMOVAL OPERATOR- Any person, firm or corporation which has been duly examined by the enforcing official and found qualified to pump onsite wastewater treatment systems, and who has been properly registered with all appropriate local, county and state authorities.

MANAGEMENT DISTRICT- (This definition is necessary if the ordinance is to be applied only to a portion of a jurisdiction. The definition must be developed locally and specifically describe the geographic area to be subject to the ordinance.)

NON-RESIDENTIAL- Any realty improvement other than a single family home. Such systems include but are not limited to those systems defined in N.J.A.C. 7:9A-1.8(C)2. Typical examples include but are not limited to: commercial buildings, restaurants, food establishments, commercial/residential mixed uses, and systems servicing multiple units.

ONSITE WASTEWATER TREATMENT SYSTEM- An individual subsurface sewage disposal system as referred to in N.J.A.C. 7:9A. A septic system is one example.

OPERATOR'S LICENSE- A license issued to an applicant pursuant to this ordinance for the operation of an onsite wastewater treatment system.

OWNER/OPERATOR- The person who owns or leases the realty improvement which is served by a residential or non-residential onsite wastewater treatment system and/or the person who uses or operates said system. The owner of the reality and the operator of the system, if different, are jointly and severally liable for the obligations imposed by this ordinance.

PLOT PLAN - A sketch showing the type (if known) and location of the onsite wastewater treatment system servicing the property, as well as the location and type of any on-site water supply. All plots plans shall be drawn to scale and list the dimensions used.

RETAIL FOOD ESTABLISHMENT- Any fixed or mobile restaurant; coffee shop; cafeteria; short order cafe; luncheonette; grill; tearoom; sandwich shop; soda fountain; tavern; bar; cocktail lounge; night club; roadside stand; industrial feeding establishment; private, public, or nonprofit organization, institution, or

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group preparing, storing or serving food; catering kitchen; commissary; box lunch establishment; retail bakery; meat market; delicatessen; grocery store; public food market, or any similar place in which food or drink is prepared for retail sale or service on the premises or elsewhere, and any other retail eating or drinking establishment or operation where food is served, handled or provided for the public with or without charge.

SYSTEM- An individual or non-individual onsite wastewater treatment system, including all of the component parts thereof.

SECTION FOUR

SCOPE, APPLICABILITY AND EXEMPTIONS

SCOPE. The owner and/or occupant of any realty improvement serviced by an onsite wastewater treatment system located in the Management District shall be subject to all of the requirements of this chapter.

APPLICABILITY. No person within the (insert name of jurisdiction) area shall operate a residential or non-residential onsite wastewater treatment system unless such construction, installation, alteration, maintenance or operation is in accordance with all applicable sanitary regulations and this ordinance.

EXEMPTIONS. Any system not in operation for a period of six (6) months or longer shall be exempted from this Ordinance. The Board of Health shall require an owner or operator of a system seeking exemption under this section to submit proof in the form acceptable to the Board to qualify for this exemption.

SECTION FIVE

LICENSE TO OPERATE

A. REQUIREMENT FOR LICENSE: On and after (insert effective date) no owner or occupant of a property in the (insert name of jurisdiction) upon which an individual or non-individual onsite wastewater treatment system is located shall operate or otherwise use a system unless a currently valid license to operate the system has been issued by the Board of Health in accordance with the schedule herein to the owner of the property on which the system is located.

1. The Board of Health or its designee may issue a license to operate and distribute educational information relative to the proper operation and maintenance practices to the owner and occupant of a property upon one or more of the following events:
    a. Issuance of a certificate of compliance for any system using advanced wastewater treatment or disposal technology(ies);
    b. Issuance of a certificate of compliance for a new system;
    c. Issuance of a certificate of compliance for the alteration of a system;
    d. Upon the sale or transfer of a premises;

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e. For all existing individual and non-individual sewerage disposal systems in accordance with the following schedule:

Option 1- Immediate effective date for all/some systems (i.e., within 90 days of the effective date of this ordinance)

Option 2- Deferred effective date for all/some systems (i.e., within 2 years of the effective date of this ordinance)

Option 3- Phased in date for existing systems (i.e., Systems constructed prior to 1990 within 1 year Systems constructed prior to 2000 but after 1990 within 2 years Systems constructed since 2000 within 3 years)

2. All licenses issued pursuant to this section shall be on a form provided by the Board of Health. Once issued, a license shall be transferable upon change of ownership or occupancy of the premises for which the license has been issued. A fee, as provided in section eleven of this ordinance, shall accompany each application for a license or renewal. The initial application for a license shall include a plot plan showing the location of the septic system (both the tank and the disposal area) and of any private water source on the property. The plot plan shall also include the general location, if known, of any wells, and septic systems on adjoining properties.

B. EXPIRATION/RENEWAL. The license to operate shall expire three (3) years after issuance. The Board of Health shall notify the licensee or its designee at least (INSERT REASONABLE TIME) before the license expires and shall be directed to apply for a renewal of the license. The renewal notice shall include educational materials relative to the proper operation and maintenance practice for such systems in accordance with N.J.A.C. 7:9A-3.14.

1. Requirements for Renewal: The Board of Health or its designee shall not renew the license unless the licensee has submitted the following to the Board of Health or its designee:

Submission of a Septic System Inspection Report on a form approved by the Board of Health indicating that the system has been maintained, is not in need of pumping, and is functioning in conformance with the requirements of this chapter. Said form shall be prepared, completed and certified by:

A staff member of the Board of Health;

A licensed professional engineer;

A licensed health officer or sanitarian;

(Insert local option if, any); or

Other person acceptable to the Board of Health.

Any such inspection under this section, shall include but not be limited to the following:

A complete walkover of the septic field;

Measurement of the effluent in inspection ports, (if any);

Pumping of the septic tank(s); and

An inspection of baffles and internal integrity of the tank.

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Any such inspection shall be conducted in accordance with any NJDEP approved protocol, guidance or regulations.

Any system which incorporates advanced wastewater treatment technology must submit verification annually, following the initially required warranty period, that a valid maintenance contract is currently in effect for the subject system.

If the inspection indicates that pumping of the treatment tank or other maintenance, alteration, or repair of the system is necessary, the Board of Health shall issue a notice of pumping, alteration or repair. Following pumping or other maintenance, alteration or repair of the system, the owner /operator shall submit to the Board of Health a completed alteration/pumping report prepared and signed by the person performing the required work.

No person shall test an onsite wastewater treatment system in a manner that will adversely affect the functioning of the system. Hydraulic loading shall not be applied in excess of the design flow capacity. All solids shall have been removed from the septic tank and/or grease trap prior to testing unless the hydraulic loading is applied at a point that will bypass the septic tank and/or grease trap.

2. Renewal Term: Any license shall be renewed for a period of three years. As a condition precedent to a license renewal, the owner/operator shall pay the fee required by section eleven herein.

C. SUSPENSION OF LICENSE: The Board of Health or its designee may suspend or revoke the license to operate in the following circumstances:

1. It has been determined that the system is malfunctioning based upon criteria provided for in N.J.A.C. 7:9A-3.4(a) and the licensee fails to take immediate steps to correct said malfunction as directed by the Board of Health or its designee;
2. The owner or occupant of the premises served by the system violates any provision of this chapter with respect to operation and maintenance of the system; or
3. The owner or occupant of the premises served by the system denies the right of entry to the Board of Health or its designee, or to the New Jersey Department of Environmental Protection (NJDEP), as required in N.J.A.C. 7:9A-3.19, or in any way interferes with the administration or enforcement of this ordinance.
4. Operation of an onsite system under a suspended license shall be subject to penalties under Section 12 of this ordinance.

D. MODIFIED TERM OF LICENSE: The Board of Health may on its own motion, upon notice and opportunity to the property owner or operator for a hearing, or upon application of a property owner or system operator, alter the time period of a license to operate.

The Board of Health may consider the following factors in determining that a more frequent licensing renewal or pumping/inspection schedule may be necessary:

1. Inadequate size of the septic tank or disposal field;

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2. The fact that the existing system may be a cesspool;
3. The age of the system;
4. Past history of malfunction or other non-compliance;
5. Location of the existing system in a flood hazard, wetland area, wetland transition zone or other environmentally sensitive area as defined in (insert reference);
6. Proximity of the system to a well or water body.

SPECIAL LICENSING PROVISIONS FOR RETAIL FOOD HANDLING ESTABLISHMENTS:
The license to operate for a retail food-handling establishment shall expire one year after issuance or one year from the date of the documented inspection, whichever comes first. The owner of said establishment shall have the right to apply to the Board of Health for a longer license renewal period, but in no case shall the license renewal period exceed three years. In considering any such application the Board of Health may consider the establishment's demonstrated compliance history of with management of the system.

SECTION SIX

STANDARDS ON THE USE OF ONSITE WASTEWATER TREATMENT SYSTEMS

A. GENERAL
The onsite wastewater treatment system shall be used only for the disposal of sanitary wastes of the type and origin provided for in the approved engineering design. No permanent or temporary connection shall be made to any source of wastes, waste water or clean water other than those plumbing fixtures which are normally present within the type of facility indicated in the approved engineering design.

Drainage from basement floors, footings or roofs shall not enter the sewage disposal system and shall be diverted away from the area of the disposal field.
As set forth in N.J.S.A. 58:10A-17, no person shall use or introduce or cause any other person to use or introduce into any sewage water disposal system any sewage system cleaner containing any restricted chemical material.

Disposal of materials containing toxic substances into a onsite wastewater treatment system is prohibited. Materials containing toxic substances include, but are not limited to, waste oil (other than cooking oil), oil based or acrylic paints, varnishes, photographic solutions, pesticides, insecticides, paint thinners, organic solvents or degreasers and drain openers.

Inert or non-biodegradable substances should not be disposed of in the onsite wastewater treatment system. Such substances include, but are not limited to, disposable diapers containing plastic, cat box litter, coffee grounds, cigarette filters, sanitary napkins, facial tissues and wet-strength paper towels.

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Large quantities of cooking greases or fats shall not be discharged into systems not equipped with a grease trap designed and constructed as prescribed in N.J.A.C.7:9A-8.1. Major plumbing leaks shall be repaired promptly to prevent hydraulic overloading of the system.

Vehicle traffic and vehicular parking shall be kept away from the aspects of the system, unless the system has been specifically designed to support vehicular traffic. Swimming pools and additional building structures shall be setback according to the requirements of N.J.A.C. 7:9A-4.3.

Water softener backwash and HVAC condensate may be disposed into the onsite system in accordance with N.J.A.C. 7:9A-12.1. OR Although water softener backwash may be disposed into the onsite system in accordance with N.J.A.C. 7:9A-12.1, to reduce hydraulic loading to the system and preserve the serviceability of the system, HVAC condensate and water softener backwash is required to be discharged to a separate seepage pit designed in accordance with N.J.A.C. 7:9A-11.

B. DISPOSAL FIELD MAINTENANCE.

1. The area of the disposal field shall be kept free of encroachments from decks, pools, sprinkler systems, driveways, patios, accessory buildings, additions to the main building and trees or shrubbery whose roots may disrupt the system
2. Grading shall be maintained in a condition that will promote run-off of rainwater away from the system and prevent ponding.
3. All drainage from roofs, footing drains, ditches or swales shall be diverted away from the system.
4. Vegetation shall be maintained to prevent soil erosion.

C. ABANDONED SYSTEMS.
When it is necessary to abandon a system or components of a system, all septic tanks, dosing tanks, seepage pits, dry wells and cesspools which are to be abandoned shall be emptied of wastes and removed or filled completely with sand, gravel, stones or soil material in a manner which is acceptable to the Board of Health or its designee. Except when done as part of or in conjunction with an alteration, a permit must be obtained from the Board of Health prior to abandoning a septic system or component of a septic system.

D. ADDITIONAL INSPECTION AND MAINTENANCE REQUIREMENTS FOR SYSTEMS WITH GREASE TRAPS.

1. Grease traps or other grease removal systems shall be inspected and cleaned out at a frequency adequate to prevent the volume of grease from exceeding the grease retention capacity. Grease shall be removed whenever seventy-five percent (75%) of the grease retention capacity has been reached.

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2. Pumping of grease traps/removal systems shall be performed by a solid waste hauler registered with the NJDEP in accordance with the requirements of N.J.A.C. 7:26-3.1
3. Equipment used in the pumping of grease traps/removal systems shall meet the following requirements:

Mobile tanks shall be securely mounted on trucks or trailers, shall be watertight and provided with a leak-proof cover and shall be vented to permit the escape of gases but not the liquid or solid contents of the tank.

Pumps and hoses shall be maintained and operated in a condition that will prevent the leakage of sewage.

Equipment shall be available to permit accurate measurement of the volume of grease in relation to the grease retention capacity of the grease trap.

Pumping of grease traps shall be conducted in such a manner that the entire contents of the grease trap including both liquids and solids are removed.

Pumping shall be carried out in a manner that will prevent spillage of sewage onto the ground. If any spillage occurs, the solid portion shall be immediately removed and disposed of in a sanitary manner and the area of the spill shall be disinfected using a suitable chlorine-bearing compound.

Grease and other waste materials removed from grease traps shall be disposed of in accordance with the requirements of the Statewide Sludge Management Plan adopted pursuant to N.J.S.A. 13:1E-1 et seq. and N.J.S.A. 7:11A-1 et seq., as well as any other applicable State or local rules, regulations, ordinances or directives.

E. MAINTENANCE OF DOSING TANKS.
Dosing tanks and associated pumps, siphons, switches, alarms, electrical connections and wiring shall be maintained in proper working order.

Any solids that accumulate in the dosing tank shall be removed and disposed of in a sanitary manner.

F. ADVANCED TECHNOLOGY
Advanced wastewater technology, which is alternative to the standard technology allowed by N.J.A.C. 7:9A-1 et seq., may be (is)required by the Board of Health to repair/alter an existing, malfunctioning septic systems in cases where site constraints do not allow for a repaired/altered system that is fully compliant with the requirements of N.J.A.C. 7:9A-1 et seq. {and/or}

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Advanced wastewater technology, which is in addition to the standard technology allowed by N.J.A.C. 7:9A-1 et seq., may be (is) required by the Board of Health for all new systems to provide additional wastewater treatment to sanitary sewage for the further protection of human health and the environment. Any advanced technology must be applied in accordance with N.J.A.C. 7:9A.

Each system which incorporates advanced technology shall incorporate the following conditions:

1. Alternative wastewater treatment systems that are equipped with automatic dialing capability or other automatic notification to the manufacturer, or its agent, in the event of a mechanical malfunction shall be covered by a minimum three-year warranty that can not be cancelable and is renewable. This warranty must include provisions for the manufacturer or its agent to inspect the system at least once a year and undertake any maintenance or repairs determined to be necessary during any such inspection or as a result of observations made at any other time;

2. Alternative wastewater treatment technology which do not include automatic notification capabilities described in paragraph 1., above, shall be covered by a minimum five-year warranty that can not be cancelable and is renewable and which includes provisions for the manufacturer or its agent to inspect the system at least once every three months (quarterly) and undertake any maintenance or repairs determined to be necessary during any such inspection or as a result of observations made at any other time;

3. All alternative wastewater disposal systems shall be covered by a minimum two-year warranty that can not be cancelable which includes provisions for the manufacturer or its agent to inspect the system at least once every six months to ensure the system was properly installed and is functioning properly. The warranty shall also include provisions that include all costs of repairing any problems associated with the inadequate function of the disposal system.

4. Any property served by an onsite wastewater treatment system, which utilizes advanced wastewater treatment and/or disposal technology, shall submit with the appropriate fee, on an annual basis, proof that the renewable warranty has been extended for the proper inspection and maintenance of the advanced technology. Any system that does not renew its warranty shall be deemed a nuisance pursuant to this ordinance, subject to a separate violation for every [day] the maintenance contract is not renewed.

5. The property owner shall provide notification to a purchaser of the property, prior to entering into any contract for real estate transfer, of the presence of and requirements of the advanced technology that exists on the property. This notification shall include a copy of the manufacturer's owner's manual for the

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technology and a copy of the requirements for the system owner listed in this ordinance.

G. ADVANCED GREASE REMOVAL
Food service facilities that experience a malfunction must install advanced grease removal systems as part of the alteration to that system to correct the malfunction. Advanced grease removal systems must be certified by a New Jersey Licensed Professional Engineer to meet the following minimum standards: Total Fats, Oils and Grease (FOG) level of 70 mg/l and a 5-day biochemical oxygen demand (BOD_5) of 140 mg/l prior to discharging to any other standard septic system components, including any passive grease trap. All requirements of D., above, shall be met.

SECTION SEVEN

REMOVAL OF SEPTIC TANK SLUDGE

A. Any person, partnership, firm or corporation who empties, relieves or pumps out all or a portion of an individual or non-individual sewage disposal system within the (insert jurisdiction) shall first apply to the Board of Health to become a licensed septic sludge removal operator. The applicant shall have the following qualifications: (Insert qualifications.) Any such license shall be for a term of (insert time period) and shall be subject to the payment of a fee as provided in section eleven of this ordinance.

B. Prior to emptying, relieving or pumping out all or a portion of any individual or non-individual onsite wastewater treatment system within the (insert name of jurisdiction), the licensed septic sludge removal operator shall obtain a septic sludge removal permit from the Board of Health.

C. The septic sludge removal operator shall complete all information on the septic sludge removal permit and deliver one (1) copy to the property owner and one copy to the Board of Health within 72 hours of the time that the individual or non-individual sewage disposal system is pumped. Failure to deliver said report within the required time frame shall be considered to be a violation of this ordinance.

In addition, to the license required under section a above, the pumping of septic tanks shall be performed by a solid waste hauler registered with the NJDEP in accordance with the requirements of N.J.A.C. 7:26-3(c).

The Board of Health may suspend or refuse to renew the license of any septic sludge removal operator who fails to comply with this ordinance.

Equipment used in the pumping of septic tanks shall meet the following requirements:

1. Mobile tanks shall be securely mounted on trucks or trailers, shall be watertight and provided with a leak-proof cover and shall be vented to permit the escape of gases but not the liquid or solid contents of the tank.

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2. Pumps and hoses shall be maintained and operated in a condition that will prevent the leakage of sewage.
3. Equipment shall be available to permit the accurate measurement of the sludge and scum levels in relation to the bottom of the outlet baffle.
Pumping of septic tanks shall be conducted in such a manner that the entire contents of the septic tank including both liquids and solids are removed.

Pumping shall be carried out in a manner that will prevent spillage of sewage onto the ground.

If any spillage occurs, the solid portion shall be immediately removed and disposed of in a sanitary manner and the area of the spill shall be disinfected using a suitable chlorine-bearing compound.

Septage shall be disposed of at a sewage treatment plant designated in accordance with District and/or State Solid Waste Management Plans pursuant to the Statewide Sludge Management Plan adopted pursuant to N.J.S.A. 13:1E-1 et seq. and N.J.S.A 58:IA-1 et seq.

SECTION EIGHT.

APPEAL TO BOARD OF HEALTH

Any person aggrieved by any decision of a designee of the Board of Health made pursuant to this chapter shall have the right to appeal that decision to the Board of Health. Any aggrieved person seeking a hearing under this section shall make application to the Board in writing within 30 days of the decision to be appealed. The Board of Health shall schedule the matter for a hearing within 45 days thereafter. The hearing shall be conducted at a meeting held pursuant to the Open Public Meetings Act.

SECTION NINE

ENFORCEMENT

A. NUISANCES TO BE CORRECTED.

1. Any on-site sewage disposal system or component thereof that is found to be malfunctioning (as defined in N.J.A.C. 7:9A-2.1 and 3.4) shall constitute a nuisance and shall be repaired, modified or replaced pursuant to an order of the Board of Health or its designee to correct the condition caused by the malfunction. Alterations shall be performed in accordance with N.J.A.C. as adopted and implemented by the Board of Health by virtue of this Code and any amendments thereto.
2. Any onsite wastewater treatment system which has not been operated or maintained in accordance with the provisions required by this ordinance is hereby declared a nuisance.

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3. Any onsite wastewater treatment system which is constructed, installed, altered, operated or maintained in violation of this section, N.J.A.C. 7:9A-1 et seq., any rule or regulation promulgated pursuant to this ordinance or any approval, permit, certificate or license issued pursuant to this ordinance is hereby declared to be a nuisance.
4. In addition the powers provided for in N.J.A.C. 7:9A-1.1 et seq., the Board of Health retains its authority to abate any nuisance in accordance with the provisions of N.J.S.A. 26:3-45 et seq.

B. MALFUNCTIONING ONSITE WASTEWATER TREATMENT SYSTEM: INSPECTIONS OF SYSTEM; REVOCATION OF LICENSE

1. The Board of Health shall have the right to inspect any system that shows evidence of any malfunction. Such evidence may include, but not be limited to, foul odors, leakage to ground surface, or saturated soil/lush vegetation over system. Water and/or soil samples may be taken to confirm the existence of a malfunctioning system.
2. The Board of Health may require that any malfunctioning system be corrected by servicing, replacement or alteration of the system.
3. Until any necessary replacement or alteration of a system has been accomplished, the Board of Health may require pumping and the removal of the entire contents of the septic tank for the system (both liquids and solids) at intervals specified by the Board.
4. No provision to this Ordinance shall be interpreted as precluding the Board of Health from revoking a license issued by the Board for the operation of a system in the event that the Board shall determine that such action is necessary and appropriate for the enforcement of this Ordinance. Any such revocation shall be upon Notice to the owner/operator, with an opportunity to comment or appeal.

SECTION TEN

RIGHT OF ENTRY.

In furtherance of the rights granted to the Board of Health in N.J.S.A. 26:3-45 et seq. and N.J.A.C. 7:9-3.19, the (insert name of enforcing official) or his designee, upon presentation of identification, shall have the right to enter upon property where an individual or non-individual onsite wastewater treatment system is located for the purpose of observation, inspection, monitoring and/or sampling of the on-site sewage disposal system. 'This authority is exercised by virtue of N.J.S.A. 26:3-31 as a necessary and reasonable method of furthering the duties of the Board of Health as enumerated therein.

SECTION ELEVEN

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FEES

(The fees established herein are only a suggestion to approximate the fees necessary to adequately operate a management district. Fees may be adjusted to adequately fund the management program.)

A. An initial license fee of ($100) shall accompany each initial application for system licensure.

B. Upon renewal of each license, a Renewal License fee of ($50) shall accompany the application for license renewal.

C. If a Board of Health Inspection is requested to complete the license renewal, an additional fee of ($350) shall be due at time of license renewal

D. Fees for licensure as a Septic Sludge Removal Operator shall be established at ($250) for each individual requesting licensure in the jurisdiction. Renewal fees shall be established at ($150) per individual requesting renewal of licensure.

E. An administrative fee of ($15) shall be assessed for each Septic Sludge Removal Permit issued by the management district.

F. An administrative filing fee of ($10) shall be included with each alternative technology warranty renewal submitted to the management district.

G. Any fee which is submitted late shall be assessed a $5 late fee for every work day after the fee is due.

SECTION TWELVE

VIOLATIONS AND PENALTIES

A. A person who violates any provision of this article, or any term or condition of any certificate or license issued hereunder, shall be liable for one or more of the following penalties [N.J.S.A. 40:69A-29(b)].

1. A fine of not less than one hundred dollars ($100.00) nor more than ($1,000).
2. A period of community service not to exceed 90 days.

B. Each separate day and each violation of any provision or this article, any term or condition of any certificate or license or any notice or order issued by the Board of Health shall constitute a separate and distinct violation under this ordinance.

C. Nothing in this section shall be construed as limiting the remedies of the Board of Health for violation of this article. The Board of Health may proceed under any other remedy available at law or in equity for any violation of this article or any term or

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condition of any certificate or license issued by the Board or Health or for any failure to comply with any notice or order issued by the Board of Health or its enforcement official under this ordinance.

SECTION THIRTEEN
REPEAL OF INCONSISTENT ORDINANCES.

All ordinances, codes or parts of same inconsistent with any of the provisions of this ordinance are hereby repealed to the extent of such inconsistency

SECTION FOURTEEN

EFFECTIVE DATE.

This ordinance shall take effect thirty (30) days after adoption and publication of a Notice of Adoption in accordance with New Jersey law.

SECTION FIFTEEN

SEVERABILITY.

In the event that any provision of this Ordinance or its application to any person is held invalid for any reason, such invalidity shall not affect any other provision of this Ordinance and to this end, the provisions of this Ordinance are severable.

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Appendix 2G

Fertilizer Application Model Ordinance

(see: http://www.nj.gov/dep/watershedmgt/DOCS/TMDL/Fertilizer%20Application%20Model%20Ordinance.pdf)
Contact NJDEP Division of Watershed Management, Phone: (609) 984-0058

SECTION I. 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.

SECTION II. 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 most 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

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conservation plans developed for the farm by the Natural Resource Conservation Service and approved by the Soil Conservation District Board.

SECTION III. 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 ft 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 P_2O_5, with a guaranteed analysis of greater than zero; except that it shall not be considered to include animal (including human) or 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.

SECTION IV. Prohibited Conduct:

No person may do any of the following:

a) Apply fertilizer when a runoff producing rainfall is occurring or predicted

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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 **[insert season applicable to municipality as identified by the USDA Plant Hardiness Zones. USDA Plant Hardiness Zones mapping can be found in *The Standards for Soil Erosion and Sediment Control in New Jersey, July 1999*. The growing seasons are identified as follows: Zones 5b and 6a (northwestern New Jersey) - March 15 to October 31; Zone 6b (northeastern, central and part of southern New Jersey) – March 1 to November 15; Zones 7a and 7b (Atlantic Coastal area and southwestern New Jersey) – February 1 to November 30. Refer to USDA Plant Hardiness Zone mapping for more information]**.

SECTION V. 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 and 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. re-established or repairing a turf area.
2. Application of phosphorus fertilizer that delivers liquid or granular fertilizer under the soils surface, directly to the feeder roots.
3. Application of phosphorus fertilizer to residential container plantings, flowerbeds, or vegetable gardens.

SECTION VI. Enforcement:
This ordinance shall be enforced by the **[Police Department and/or other Municipal Officials]** of **[insert name of municipality]**.

SECTION VII. Violations and Penalties:
Any person(s) found to be in violation of the provisions of this ordinance shall be subject to a fine not to exceed **[insert amount]**.

SECTION VIII. Severability:

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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 IX. Effective date:
This Ordinance shall be in full force and effect **[insert appropriate language for ordinance adoption in municipality such as: from and after its adoption and any publication as may be required by law]**.
ALL OF WHICH IS ADOPTED this ___day of _____, 2___, by the _____.

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Appendix 2H

Model Ordinance - Pet Waste

(http://www.njstormwater.org/tier_A/pdf/pet waste ordinance.pdf)
Contact: NJDEP's Stormwater Management Program, Phone (609) 633-1441

Ordinance # [ ] - Pet Waste

SECTION I. Purpose:
An ordinance to establish requirements for the proper disposal of pet solid waste in **[insert name of municipality]**, 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:

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The provisions of this Article shall be enforced by the **[Police Department and the Local Board of Health]** of **[insert name of municipality]**.

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 not to exceed **[insert amount]**.

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 _____ day of ____, 200_, by the _____.

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Appendix 2I

Model Ordinance - Litter Control

(see: http://www.state.nj.us/dep/stormwater/tier_A/pdf/litter%20ordinance.pdf)
Contact: NJDEP's Stormwater Management Program, Phone (609) 633-1441

SECTION I. Purpose:
An ordinance to establish requirements to control littering in **[insert name of unicipality]**, 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. 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 and/or other Municipal**

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Officials] of **[insert name of municipality]**.

SECTION V. Penalties:

Any person(s) who is found to be in violation of the provisions of this ordinance shall be subject to a fine not to exceed **[insert amount]**.

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 _____ day of ____, 200_, by the _____.

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Appendix 2J

Model Ordinance - Improper Disposal of Waste

(see: http://www.state.nj.us/dep/stormwater/tier_A/pdf/improper%20disposal%20of%20waste%20ordinance.pdf)
Contact: NJDEP's Stormwater Management Program, Phone (609) 633-1441

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 **[insert name of municipality]**, 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 [insert name of municipality] 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. 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 **[insert name of municipality]** 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)

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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/or other Municipal Officials]** of **[insert name of municipality]**.

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 not to exceed **[insert amount]**.

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 ___day of _____, 200_, by the _____.

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Appendix 2K

Model Ordinance - Wildlife Feeding

(see: http://www.njstormwater.org/tier_A/pdf/wildlife feeding ordinance.pdf)
Contact: NJDEP's Stormwater Management Program, Phone (609) 633-1441

SECTION I. Purpose:
An ordinance to prohibit the feeding of unconfined wildlife in any public park or on any other property owned or operated by **[insert name of municipality]**, 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. 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:

a. No person shall feed, in any public park or on any other property owned or operated by **[insert name of municipality]**, any wildlife, excluding confined wildlife (for example, wildlife confined in zoos, parks or rehabilitation centers, or unconfined wildlife at environmental education centers, or feral cats as part of an approved Trap-Neuter-Release program).

SECTION IV. Enforcement:

a. This ordinance shall be enforced by the **[Police Department and/or other Municipal Officials]** of **[insert name of municipality]**.
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 not to exceed **[insert amount]**.

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

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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 ___ day of ____, 200_, by the _____.

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Appendix 2L

Model Ordinance - Containerized Yard Waste

(see: http://www.state.nj.us/dep/stormwater/tier_A/pdf/containerized%20yard%20waste%20ordinance.pdf)
Contact: NJDEP's Stormwater Management Program, Phone (609) 633-1441

SECTION I. Purpose:
An ordinance to establish requirements for the proper handling of yard waste in **[insert name of municipality]**, 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 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 **[insert appropriate department]**.

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 not to exceed **[insert amount]**.

SECTION VI. Severability:

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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 _____ day of ____, 200_, by the _____.

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Appendix 2M

Model Ordinance - Yard Waste Collection Program

(see: http://www.state.nj.us/dep/stormwater/tier_A/pdf/yard%20waste%20collection%20program%20ordinance.pdf)
Contact: NJDEP's Stormwater Management Program, Phone (609) 633-1441

SECTION I. Purpose:
An ordinance to establish a yard waste collection and disposal program in **[insert name of municipality]**, 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. Yard Waste Collection
Sweeping, raking, blowing or otherwise placing yard waste that is not containerized at the curb or along the street is only allowed during the seven (7) days prior to a scheduled and announced collection, and shall not be placed closer than 10 feet from any storm drain inlet. Placement of such yard waste at the curb or along the street at any other time or in any other manner is a violation of this ordinance. If such placement of yard waste occurs, the party responsible for placement of the 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 **[insert appropriate department]**.

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 not to exceed **[insert amount]**.

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SECTION VI. Severability:
Each section, subsection, sentence, clause and phrase of this Ordinance is declared to be 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 _____ day of ____, 200_, by the _____.

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Appendix 2N

Model Ordinance - Illicit Connection

(see: http://www.njstormwater.org/tier_A/pdf/illicit%20connection%20ordinance.pdf)
Contact: NJDEP's Stormwater Management Program, Phone (609) 633-1441

SECTION I. Purpose:
An ordinance to prohibit illicit connections to the municipal separate storm sewer system(s) operated by the **[insert name of municipality]**, 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 [insert name of municipality], 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 [insert name of municipality] 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."

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

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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 discharge or cause to be discharged through an illicit connection to the municipal separate storm sewer system operated by the **[insert name of municipality]** any domestic sewage, non-contact cooling water, process wastewater, or other industrial waste (other than stormwater).

SECTION IV. Enforcement:
This ordinance shall be enforced by the **[Police Department and/or other Municipal Officials] of [insert name of municipality]**.

SECTION V. Penalties:
Any person(s) who is found to be in violation of the provisions of this ordinance shall be subject to a fine not to exceed **[insert amount]**.

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 ___day of _____, 200_, by the _____.

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Appendix 2O

Sample Water Conservation Ordinance

Randolph Township, Morris County
http://www.randolphnj.org/townhall/ordinances/12_07/
Contact: Randolph Township, Phone (973) 989-7100

Ordinance No. 12-07

Introduced: April 19, 2007
Public Hearing: May 3, 2007
Status: Adopted

An ordinance supplementing Chapter 50, Water and Sewers, of the Revised Ordinances of the Township of Randolph, Morris County, New Jersey, Requiring Water Conservation Measures for All Properties Served by Public Water Systems

WHEREAS, the Township of Randolph is provided a contractual water allocation by the Morris County Municipal Utilities Authority (MCMUA); and
WHEREAS, the amount of water purchased and consumed through the Randolph water system is well within the allocation provided by the MCMUA during the Fall, Winter and Spring months; and
WHEREAS, in the summer months and particularly during periods of drought, the Township of Randolph experiences record high levels of water consumption referred to as spikes in consumption levels; and
WHEREAS, the principal reason for high levels of water use during the summer months is the inefficient and at times wasteful over watering of lawns; and
WHEREAS, the citizens of Randolph recognize that potable water is a valuable resource that must be conserved and consumed with appropriate care; and
WHEREAS, the adoption of a Water Conservation Ordinance is in the interest of the citizens of the Township of Randolph.
NOW, THEREFORE, BE IT ORDAINED by the Governing Body of the Township of Randolph, County of Morris, State of New Jersey as follows:

SECTION ONE. Chapter 50, Water and Sewers, of the Revised Ordinances of the Township of Randolph, Morris County, New Jersey, shall be supplemented to add Section 50-31, Conservation of Water, which shall read as follows:

50-31. Conservation of Water.

(a) From May 1 through September 30 each year, residential lawn watering shall be permitted as follows for properties served by public water:

(1) Watering of properties having even numbered street addresses shall be permitted on the even numbered days of the month.
(2) Watering of properties having odd numbered street addresses shall be permitted on the odd numbered days of the month.
(3) No watering shall be permitted on the 31st day of the month.

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(4) These restrictions shall apply only to properties which receive water provided by the Township of Randolph and the Town of Dover.
(5) Watering on the above dates shall be permitted during the hours from 5 am to 9 am and from 5 pm to 9 pm only.

(b) These limitations shall not apply to:
(1) Newly installed sod or seed for a period of two weeks from notice of installation to the Engineering Department of Randolph Township.

(c) The water use limitations imposed pursuant to this ordinance shall be enforced by local authorized officials, including but not limited to, the health department and/or the police department, all of whom are empowered to write summonses for a violation of the water use limitations.

(d) Violations of this ordinance shall be subject to the penalties set forth below:
(1) First Offense $200
(2) Second Offense $500
(3) Third and subsequent offenses to be determined by the Municipal Judge.

(e) In the event the Township Council declares that a water conservation emergency exists due to a prolonged scarcity of water from any cause, the Township reserves the right upon public notice to restrict certain uses of water above and beyond the limitations contained herein. Said public notice shall be posted in the Township Municipal Building and published at least once in a newspaper circulating within the Township. No person during the existence of a water conservation emergency so duly declared with public notice shall use water in violation of the terms of said water conservation emergency restrictions.

(f) In the event of more stringent water conservation measures imposed by the Morris County Municipal Utilities Authority or an agency or department of the State of New Jersey, every person shall be bound by and must comply with said restrictions.

SECTION TWO. All ordinances of the Township of Randolph which are inconsistent with the provisions of this Ordinance are hereby repealed as to the extent of the inconsistency.

SECTION THREE. If any section, subsection, clause or phrase of this Ordinance is for any reason held to be unconstitutional or invalid by any Court of competent jurisdiction, such decision shall not effect the remaining portion of this Ordinance.

SECTION FOUR. This Ordinance shall take effect immediately upon final passage, approval, and publication as provided by law.
ATTEST

_____
Donna Marie Luciani, Township Clerk
TOWNSHIP OF RANDOLPH

_____
Michael Obremski, Mayor

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Appendix 2P

THE FLOOD DAMAGE PREVENTION ORDINANCE

http://www.nj.gov/dep/floodcontrol/modelord.htm
Contact: NJDEP Bureau of Dam Safety & Flood Control, Phone (609) 984-0859

Section 1.0

STATUTORY AUTHORIZATION, FINDINGS OF FACT, PURPOSE AND OBJECTIVES

1.1 STATUTORY AUTHORIZATION

The Legislature of the State of New Jersey has in N.J.S.A. 40:48-1,et seq., delegated the responsibility to local governmental units to adopt regulations designed to promote public health, safety, and general welfare of its citizenry. Therefore, the [governing body] of (municipality), of New Jersey does ordain as follows:

1.2 FINDINGS OF FACT

[1] The flood hazard areas of [municipality] are subject to periodic inundation which results in loss of life and property, health and safety hazards, disruption of commerce and governmental services, extraordinary public expenditures for flood protection and relief, and impairment of the tax base, all of which adversely affect the public health, safety, and general welfare.

[2] These flood losses are caused by the cumulative effect of obstructions in areas of special flood hazard which increase flood heights and velocities, and when inadequately anchored, damage uses in other areas. Uses that are inadequately floodproofed, elevated or otherwise protected from flood damage also contribute to the flood loss.

1.3 STATEMENT OF PURPOSE

It is the purpose of this ordinance to promote the public health, safety, and general welfare, and to minimize public and private losses due to flood conditions in specific areas by provisions designed:

[1] To protect human life and health;

[2] To minimize expenditure of public money for costly flood control projects;

[3] To minimize the need for rescue and relief efforts associated with flooding and generally undertaken at the expense of the general public;

[4] To minimize prolonged business interruptions;

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[5] To minimize damage to public facilities and utilities such as water and gas mains, electric, telephone and sewer lines, streets, bridges located in areas of special flood hazard;

[6] To help maintain a stable tax base by providing for the second use and development of areas of special flood hazard so as to minimize future flood blight areas;

[7] To insure that potential buyers are notified that property is in an area of special flood hazard; and

[8] To ensure that those who occupy the areas of special flood hazard assume responsibility for their actions.

1.4 METHODS OF REDUCING FLOOD LOSSES

In order to accomplish its purposes, this ordinance includes methods and provisions for:

[1] Restricting or prohibiting uses which are dangerous to health, safety, and property due to water or erosion hazards, or which result in damaging increases in erosion or in flood heights or velocities;

[2] Requiring that uses vulnerable to floods including facilities which serve such uses, be protected against flood damage at the time of initial construction;

[3] Controlling the alteration of natural flood plains, stream channels, and natural protective barriers, which help accommodate or channel flood waters;

[4] Controlling filling, grading, dredging, and other development which may increase flood damage; and,

[5] Preventing or regulating the construction of flood barriers which will unnaturally divert flood waters or which may increase flood hazards in other areas.

Section 2.0

DEFINITIONS

Unless specifically defined below, words or phases used in this ordinance shall be interpreted so as to give them the meaning they have in common usage and to give this ordinance its most reasonable application.

"Appeal" means a request for a review of the [local administrator] 's interpretation of any provision of this ordinance or a request for a variance.

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"Area of shallow flooding" means a designated AO, AH, or VO zone on a community's Digital Flood Insurance Rate Map (DFIRM) with a one percent annual or greater chance of flooding to an average depth of one to three feet where a clearly defined channel does not exist, where the path of flooding is unpredictable and where velocity flow may be evident. Such flooding is characterized by ponding or sheet flow.

"Area of special flood hazard" means the land in the flood plain within a community subject to a one percent or greater chance of flooding in any given year.

"Areas of special flood related erosion hazard" is the land within a community which is most likely to be subject to severe flood related erosion losses. After a detailed evaluation of the special flood related erosion hazard area will be designated a Zone E on the Flood Insurance Rate Map.

"Base flood" means the flood having a one percent chance of being equaled or exceeded in any given year.

"Basement" means any area of the building having its floor subgrade (below ground level) on all sides.

"Breakaway wall" means a wall that is part of the structural support of the building and is intended through its design and construction to collapse under specific lateral loading forces without causing damage to the elevated portion of the building or supporting foundation system.

"Coastal high hazard area" means an area of special flood hazard extending from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storms or seismic sources.

"Development" means any man made change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations, or storage of equipment or materials located within the area of special flood hazard.

"Elevated building" means a non-basement building (i) built in the case of a building in a Area of Special Flood Hazard to have the top of the elevated floor or in the case of a building in a Coastal High Hazard Area to have the bottom of the lowest horizontal structural member of the elevated floor elevated above the ground level by means of piling, columns (posts and piers), or shear walls parallel to the flow of the water, and (ii) adequately anchored so as not to impair the structural integrity of the building during a flood up to the magnitude of the base flood. In an Area of Special Flood Hazard "elevated building" also includes a building elevated by means of fill or solid foundation perimeter walls with openings sufficient to facilitate the unimpeded movement of flood waters. In Areas of Coastal High Hazard "elevated buildings" also includes a building otherwise meeting the definition of "elevated building" even though the lower area is enclosed by means of breakaway walls.

"Erosion" means the process of the gradual wearing away of land masses.

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"Flood or flooding" means a general and temporary condition of partial or complete inundation of normally dry land areas from:

[1] The overflow of inland or tidal waters and/or

[2] The unusual and rapid accumulation or runoff of surface waters from any source.

"Digital Flood Insurance Rate Map" (DFIRM) means the official map on which the Federal Insurance Administration has delineated both the areas of special flood hazards and the risk premium zones applicable to the community.

"Flood Insurance Study" (FIS) means the official report in which the Federal Insurance Administration has provided flood profiles, as well as the Flood Insurance Rate Map(s) and the water surface elevation of the base flood.

"Flood-related erosion" means the collapse or subsidence of land along the shore of a lake or other body of water as a result of undermining caused by waves or currents of water exceeding anticipated cyclical levels or suddenly caused by unusually high water level in a natural body of water, accompanied by a severe storm, or by unanticipated force of nature, such as a flash flood or an abnormal tidal surge, or by some similarly unusual and unforeseeable event which results in flooding.

"Flood-related erosion area" or "flood-related erosion prone area" means a land area adjoining the shore of a lake or other body of water, which due to the composition of the shore line or bank and high water levels or wind-driven currents, is likely to suffer flood-related erosion.

"Flood-related erosion area management" means the operation of an overall program of corrective and preventive measures for reducing flood-related erosion damage, including but not limited to emergency preparedness plans, flood-related erosion control works, and flood plain management regulations.

"Flood plain management regulations" means zoning ordinances, subdivision regulations, building codes, health regulations, special purpose ordinances (such as a flood plain ordinance, grading ordinance and erosion control ordinance) and other applications of police power. The term describes such State or local regulations, in any combination thereof, which provide standards for the purpose of flood damage prevention and reduction.

"Floodway" means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than 0.2 foot.

"Highest adjacent grade" means the highest natural elevation of the ground surface prior to construction next to the proposed walls of a structure.

"Historic Structure" means any structure that is:

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[a] Listed individually in the National Register of Historic Places (a listing maintained by the Department of Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register;

[b] Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined by the Secretary to qualify as a registered historic district;

[c] Individually listed on a State inventory of historic places in States with historic preservation programs which have been approved by the Secretary of the Interior; or

[d] Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either:

(1) By an approved State program as determined by the Secretary of the Interior; or

(2) Directly by the Secretary of the Interior in States without approved programs.

"Lowest Floor" means the lowest floor of the lowest enclosed area [including basement]. An unfinished or flood resistant enclosure, useable solely for the parking of vehicles, building access or storage in an area other than a basement is not considered a buildings lowest floor provided that such enclosure is not built so to render the structure in violation of other applicable non-elevation design requirements.

"Manufactured home" means a structure, transportable in one or more sections, which is built on a permanent chassis and is designed for use with or without a permanent foundation when attached to the required utilities. The term "manufactured home" does not include a "recreation vehicle".

"Manufactured home park or manufactured home subdivision" means a parcel (or contiguous parcels) of land divided into two or more manufactured home lots for rent or sale.

"New construction" means structures for which the start of construction commenced on or after the effective date of a floodplain regulation adopted by a community and includes any subsequent improvements to such structures.

"New manufactured home park or subdivision" means a manufactured home park or subdivision for which the construction of facilities for servicing the lots on which the manufactured homes are to be affixed (including at a minimum, the installation of utilities, the construction of streets, and either final site grading or the pouring of concrete pads) is completed on or after the effective date of the flood plain management regulations adopted by the municipality.

"Recreational vehicle" means a vehicle which is [i] built on a single chassis; [ii] 400 square feet or less when measured at the longest horizontal projections; [iii] designed to be self-propelled or permanently towable by a light duty truck; and [iv] designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel, or seasonal use.

"Start of Construction" for other than new construction or substantial improvements under the Coastal Barrier Resources Act (P.L. No. 97-348) includes substantial improvements and means

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the date the building permit was issued, provided the actual start of construction, repair, reconstruction, rehabilitation, addition, placement, or other improvement was within 180 days of the permit date. The actual start means either the first placement of permanent construction of a structure on a site such as the pouring of a slab or footings, the installation of piles, the construction of columns, or any work beyond the stage of excavation, or the placement of a manufactured home on a foundation.

Permanent construction does not include land preparation, such as clearing, grading and filling nor does it include the installation of streets and/or walkways, nor does it include excavation for a basement, footings or piers, or foundations or the erection of temporary forms, nor does it include the installation on the property of accessory buildings, such as garages or sheds not occupied as dwelling units or not part of the main structure. For a substantial improvement, the actual start of construction means the first alteration of any wall, ceiling, floor, or other structural part of a building, whether or not that alteration affects the external dimensions of the building.

"Structure" means a walled and roofed building, a manufactured home, or a gas or liquid storage tank, that is principally above ground.

"Substantial Damage" means damage of any origin sustained by a structure whereby the cost of restoring the structure to its before damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

"Substantial Improvement" means any reconstruction, rehabilitation, addition, or other improvement of a structure, the cost of which exceeds 50 percent of the market value of the structure before the "start of construction" of the improvement. This term includes structures which have incurred "substantial damage", regardless of the actual repair work performed. The term does not, however, include either:

[1] Any project for improvement of a structure to correct existing violations of State or local health, sanitary or safety code specifications which have been identified by the local code enforcement officer and which are the minimum necessary to assure safe living conditions; or

[2] Any alteration of a "historic structure", provided that the alteration will not preclude the structure's continued designation as a "historic structure".

"Variance" means a grant of relief from the requirements of this ordinance that permits construction in a manner that would otherwise be prohibited by this ordinance.

Section 3.0

GENERAL PROVISIONS

3.1 LANDS TO WHICH THIS ORDINANCE APPLIES

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This ordinance shall apply to all areas of special flood hazards

within the jurisdiction of (local unit), Hudson County, New Jersey.

3.2 BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD

The areas of special flood hazard for the (local unit), Community No. _____, are identified and defined on the following documents prepared by the Federal Emergency Management Agency:

A scientific and engineering report "Flood Insurance Study, Hudson County, New Jersey (all jurisdictions)" dated

(date), 2006.

Flood Insurance Rate Map for Hudson County, New Jersey (all jurisdictions) as shown on Index No. _____and panel(s) (panel (s)), whose effective date is

(date), 2006.

The above documents are hereby adopted and declared to be a part of this ordinance. The Flood Insurance Study and maps are on file
at_____

(Street address)_____.

3.3 PENALTIES FOR NONCOMPLIANCE

No structure or land shall hereafter be constructed, located, extended, converted, or altered without full compliance with the terms of this ordinance and other applicable regulations. Violation of the provisions of this ordinance by failure to comply with any of its requirements (including violations of conditions and safeguards established in connection with conditions) shall constitute a misdemeanor. Any person who violates this ordinance or fails to comply with any of its requirements shall upon conviction thereof be fined not more than or imprisoned for not more than days, or both, for each violation, and in addition shall pay all costs and expenses involved in the case. Nothing herein contained shall prevent the (local municipality)from taking such other lawful action as is necessary to prevent or remedy any violation.

3.4 ABROGATION AND GREATER RESTRICTIONS

This ordinance is not intended to repeal, abrogate, or impair any existing easements, covenants, or deed restrictions. However, where this ordinance and other ordinance,

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easement, covenant, or deed restriction conflict or overlap, whichever imposes the more stringent restrictions shall prevail.

3.5 INTERPRETATION

In the interpretation and application of this ordinance, all provisions shall be:

[1] Considered as minimum requirements;

[2] Liberally construed in favor of the governing body; and,

[3] Deemed neither to limit nor repeal any other powers granted under State statutes.

3.6 WARNING AND DISCLAIMER OF LIABILITY

The degree of flood protection required by this ordinance is considered reasonable for regulatory purposes and is based on scientific and engineering considerations. Larger floods can and will occur on rare occasions. Flood Heights may be increased by man-made or natural causes. This ordinance does not imply that land outside the area of special flood hazards or uses permitted within such areas will be free from flooding or flood damages.

This ordinance shall not create liability on the part of (local unit) , any officer or employee thereof or the Federal Insurance Administration, for any flood damages that result from reliance on

this ordinance or any administrative decision lawfully made thereunder.

Section 4.0

DEVELOPMENT PERMIT

4.1 ESTABLISHMENT OF DEVELOPMENT PERMIT

A Development Permit shall be obtained before construction or development begins within any area of special flood hazard established in Section 3.2. Application for a Development Permit shall be made on forms furnished by the (local administrator) and may include, but not be limited to; plans in duplicate drawn to scale showing the nature, location, dimensions, and elevations of the area in question; existing or proposed structures, fill, storage of materials, drainage facilities; and the location of the foregoing.

Specifically, the following information is required:

[1] Elevation in relation to mean sea level, of the lowest floor (including basement) of all structures;

[2] Elevation in relation to mean sea level to which any structure has been floodproofed.

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[3] Certification by a registered professional engineer or architect that the floodproofing methods for any nonresidential structure meet the floodproofing criteria in Section 5.2-2; and,
[4] Description of the extent to which any watercourse will be altered or relocated as a result of proposed development.

4.2 DESIGNATION OF THE LOCAL ADMINISTRATOR

The (local administrator) is hereby appointed to administer and implement this ordinance by granting or denying development permit applications in accordance with its provisions.

4.3 DUTIES AND RESPONSIBILITIES OF THE

Duties of the (local administrator) shall include, but not be limited to:

4.3-1 PERMIT REVIEW

[1] Review all development permits to determine that the permit requirements of this ordinance have been satisfied.

[2] Review all development permits to determine that all necessary permits have been obtained from those Federal, State or local governmental agencies from which prior approval is required.

[3] Review all development permits to determine if the proposed development is located in the floodway.

[4] Review all development permits in the coastal high hazard area of the area of special flood hazard to determine if the proposed development alters sand dunes so as to increase potential flood damage.

[5] Review plans for walls to be used to enclose space below the base flood level in accordance with Section 5.4-2(4).

4.3-2 USE OF OTHER BASE FLOOD AND FLOODWAY DATA

When base flood elevation and floodway data has not been provided in accordance with Section 3.2, BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD, the (local administrator) shall obtain, review, and reasonably utilize any base flood elevation and floodway data available from a Federal, State or other source, in order to administer Sections 5.2-1, SPECIFIC STANDARDS, Residential Construction, and 5.2-2, SPECIFIC STANDARDS, Nonresidential Construction.

4.3-3 INFORMATION TO BE OBTAINED AND MAINTAINED

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[1] Obtain and record the actual elevation (in relation to mean sea level) of the lowest floor (including basement) of all new or substantially improved structures, and whether or not the structure contains a basement.

[2] For all new or substantially improved floodproofed structures:

[i] verify and record the actual elevation (in relation to mean sea level); and
[ii] maintain the floodproofing certifications required in Section 4.1 (3).

[3] In coastal high hazard areas, certification shall be obtained from a registered professional engineer or architect that the provisions of 5.4-2(1) and 5.4-2(2)(i) and (ii) are met.
[4] Maintain for public inspection all records pertaining to the provisions of this ordinance.

4.3-4 ALTERATION OF WATERCOURSES

[1] Notify adjacent communities and the New Jersey Department of Environmental Protection , Flood Plain Management Section and the Land Use Regulation Program prior to any alteration or relocation of a watercourse, and submit evidence of such notification to the Federal Insurance Administration.

[2] Require that maintenance is provided within the altered or relocated portion of said watercourse so the flood carrying capacity is not diminished.

4.3-5 INTERPRETATION OF FIRM BOUNDARIES

Make interpretations where needed, as to the exact location of the boundaries of the areas of special flood hazards (for example, where there appears to be a conflict between a mapped boundary and actual filed conditions). The person contesting the location of the boundary shall be given a reasonable opportunity to appeal the interpretation as provided in SECTION 4.4.

4.4 VARIANCE PROCEDURE

4.4-1 APPEAL BOARD

[1] The (appeal board) as established by (local unit) shall hear and decide appeals and requests for variances from the requirements of this ordinance.

[2] The (appeal board) shall hear and decide appeals when it is alleged there is an error in any requirement, decision, or determination made by the (local administrator) in the enforcement or administration of this ordinance.

[3] Those aggrieved by the decision of the (appeal board), or any taxpayer, may appeal such decision to the (name of appropriate court), as provided in (stature) .

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[4] In passing upon such applications, the (appeal board), shall consider all technical evaluations, all relevant factors, standards specified in other sections of this ordinance, and:

(i) the danger that materials may be swept onto other lands to the injury of others;
(ii) the danger to life and property due to flooding or erosion damage;
(iii) the susceptibility of the proposed facility and its contents to flood damage and the effect of such damage on the individual owner;
(iv) the importance of the services provided by the proposed facility to the community;
(v) the necessity to the facility of a waterfront location, where applicable;
(vi) the availability of alternative locations for the proposed use which are not subject to flooding or erosion damage;
(vii) the compatibility of the proposed use with existing and anticipated development;
(viii) the relationship of the proposed use to the comprehensive plan and flood plain management program of that area;
(ix) the safety of access to the property in times of flood for ordinary and emergency vehicles;
(x) the expected heights, velocity, duration, rate of rise, and sediment transport of the flood waters and the effects of wave action, if applicable, expected at the site; and,
(xi) the costs of providing governmental services during and after flood conditions, including maintenance and repair of public utilities and facilities such as sewer, gas, electrical, and water systems, and streets and bridges.

[5] Upon consideration of the factors of Section 4.4-1(4) and the purposes of this ordinance, the (appeal board) may attach such conditions to the granting of variances as it deems necessary to further the purposes of this ordinance.

[6] The (local administrator) shall maintain the records of all appeal actions, including technical information, and report any variances to the Federal Insurance Administration upon request.

4.4-2 CONDITIONS FOR VARIANCES

[1] Generally, variances may be issued for new construction and substantial improvements to be erected on a lot of one-half acre or less in size contiguous to and surrounded by lots with existing structures constructed below the base flood level, providing items (i-xi) in SECTION 4.4-1(4) have been fully considered. As the lot size increases beyond the one-half acre, the technical justification required for issuing the variance increases.

[2] Variances may be issued for the repair or rehabilitation of historic structures upon a determination that the proposed repair or rehabilitation will not preclude the

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structure's continued designation as a historic structure and the variance is the minimum necessary to preserve the historic character and design of the structure.

[3] Variances shall not be issued within any designated floodway if any increase in flood levels during the base flood discharge would result.

[4] Variances shall only be issued upon a determination that the variance is the minimum necessary, considering the flood hazard, to afford relief.

[5] Variances shall only be issued upon:

(i) a showing of good and sufficient cause;

(ii) a determination that failure to grant the variance would result in exceptional hardship to the applicant; and,

(iii) a determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public as identified in SECTION 4.4- 1(4), or conflict with existing local laws or ordinances.

[6] Any applicant to whom a variance is granted shall be given written notice that the structure will be permitted to be built with a lowest floor elevation below the base flood elevation and that the cost of flood insurance will be commensurate with the increased risk resulting from the reduced lowest floor elevation.

SECTION 5.0

PROVISIONS FOR FLOOD HAZARD REDUCTION

5.1 GENERAL STANDARDS

In all areas of special flood hazards the following standards are required:

5.1-1 ANCHORING

[1] All new construction and substantial improvements shall be anchored to prevent flotation, collapse, or lateral movement of the structure.

[2] All manufactured homes shall be anchored to resist flotation, collapse or lateral movement. Methods of anchoring may include, but are not to be limited to, use of over-the-top or frame ties to ground anchors. This requirement is in addition to applicable State and local anchoring requirements for resisting wind forces.

5.1-2 CONSTRUCTION MATERIALS AND METHODS

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[1] All new construction and substantial improvements shall be constructed with materials and utility equipment resistant to flood damage.

[2] All new construction and substantial improvements shall be constructed using methods and practices that minimize flood damage.

5.1-3 UTILITIES

[1] All new and replacement water supply systems shall be designed to minimize or eliminate infiltration of flood waters into the system;

[2] New and replacement sanitary sewage systems shall be designed to minimize or eliminate infiltration of flood waters into the systems and discharge from the systems into flood waters;

[3] On-site waste disposal systems shall be located to avoid impairment to them or contamination from them during flooding; and

[4] Electrical, heating, ventilation, plumbing and air-conditioning equipment and other service facilities shall be designed and/or located so as to prevent water from entering or accumulating within the components during conditions of flooding.

5.1-4 SUBDIVISION PROPOSALS

[1] All subdivision proposals shall be consistent with the need to minimize flood damage;

[2] All subdivision proposals shall have public utilities and facilities such as sewer, gas, electrical, and water systems located and constructed to minimize flood damage;

[3] All subdivision proposals shall have adequate drainage provided to reduce exposure to flood damage; and,

[4] Base flood elevation data shall be provided for subdivision proposals and other proposed development which contain at least 50 lots or 5 acres (whichever is less).

5.1-5 ENCLOSURE OPENINGS

All new construction and substantial improvements having fully enclosed areas below the lowest floor that are usable solely for parking of vehicles, building access or storage in an area other than a basement and which are subject to flooding shall be designed to automatically equalize hydrostatic flood forces on exterior walls by allowing for the entry and exit of floodwaters. Designs for meeting this requirement must either be certified by a registered professional engineer or architect or must meet or exceed the following minimum criteria: A minimum of two openings having a total net area of not less than one square inch for every square foot of enclosed area subject to flooding shall be provided.

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The bottom of all openings shall be no higher than one foot above grade. Openings may be equipped with screens, louvers, or other covering or devices provided that they permit the automatic entry and exit of floodwaters.

5.2 SPECIFIC STANDARDS

In all areas of special flood hazards where base flood elevation data have been provided as set forth in Section 3.2, BASIS FOR ESTABLISHING THE AREAS OF SPECIAL FLOOD HAZARD or in SECTION 4.3-2, Use of Other Base Flood Data, the following standards are required:

5.2-1 RESIDENTIAL CONSTRUCTION

[1] In AE zones new construction and substantial improvement of any residential structure shall have the lowest floor, including basement, elevated to or above base flood elevation;

[2] require within any AO zone on the municipality's FIRM that all new construction and substantial improvement of any residential structure shall have the lowest floor, including basement, elevated above the highest adjacent grade at least as high as the depth number specified in feet (at least two feet if no depth number is specified). And, require adequate drainage paths around structures on slopes to guide floodwaters around and away from proposed structures.

New construction and substantial improvement of any residential structure shall have the lowest floor, including basement, elevated to or above base flood elevation.

5.2-2 NONRESIDENTIAL CONSTRUCTION

[1] In AE zones all new Construction and substantial improvement of any commercial, industrial or other nonresidential structure shall either have the lowest floor, including basement, elevated to the level of the base flood elevation; or together with the attendant utilities and sanitary facilities, shall:

[2] require within any AO zone on the municipality's FIRM that all new Construction and substantial improvement of any commercial, industrial or other nonresidential structure shall either have the lowest floor, including basement, elevated above the highest adjacent grade at least as high as the depth number specified in feet (at least two feet if no depth number is specified). And, require adequate drainage paths around structures on slopes to guide floodwaters around and away from proposed structures; or

New Construction and substantial improvement of any commercial, industrial or other nonresidential structure shall either have the lowest floor, including basement, elevated to the level of the base flood elevation; or

[3] be floodproofed so that below the base flood level the structure is watertight with walls substantially impermeable to the passage of water;

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[4] have structural components capable of resisting hydrostatic and hydrodynamic loads and effects of buoyancy; and,

[5] be certified by a registered professional engineer or architect that the design and methods of construction are in accordance with accepted standards of practice for meeting the applicable provisions of this subsection. Such certification shall be provided to the official as set forth in SECTION 4.3-3 (2).

5.2-3 MANUFACTURED HOMES

[1] Manufactured homes shall be anchored in accordance with Section 5.1-1(2).
[2] All manufactured homes to be placed or substantially improved within an area of special flood hazard shall be elevated on a permanent foundation such that the top of the lowest floor is at or above the base flood elevation.

5.3 FLOODWAYS

Located within areas of special flood hazard established in SECTION 3.2 are areas designated as floodways. Since the floodway is an extremely hazardous area due to the velocity of flood waters
which carry debris, potential projectiles, and erosion potential, the following provisions apply:

[1] Prohibit encroachments, including fill, new construction, substantial improvements, and other development unless a technical evaluation demonstrates that encroachment shall not result in any increase in flood levels during the occurrence of the base flood discharge.

[2] If SECTION 5.3(1) is satisfied, all new construction and substantial improvements must comply with SECTION 5.0 PROVISIONS FOR FLOOD HAZARD REDUCTION.

[3] In all areas of special flood hazard in which base flood elevation data has been provided and no floodway has been designated, the cumulative effect of any proposed development, when combined with all other existing and anticipated development, shall not increase the water surface elevation of the base flood more than two-tenths (0.2) of a foot at any point.

5.4 Reserved

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Appendix Q

Model Soil Erosion and Sediment Control Ordinance

This extensive 16-page ordinance addresses one of the most critical and pressing issues facing the Lockatong and Wickecheoke watersheds. Excessive sediment is a known problem impairing biological integrity and water supply treatment.The complete text of this ordinance is available at http://www.tentowns.org/10t/mointro.htm. The model ordinance contains the following sections:

Contact: Great Swamp Watershed Management Committee, Ten Towns Committee, Phone (973) 984-2000

1. Statutory Authorization
Statutory authorization comes from the Soil Erosion and Sediment Control Act, Chapter 251.

2. Title
Soil and Sediment Control Ordinance

3. Purpose
A general statement is provided to protect the public health, safety convenience, general welfare and water quality. The purposes statement also makes the link between construction activities and the potential for environmental damage. A total of eight "specific purposes" are cited, including the protection of land from erosion, protecting water quality and biodiversity of streams, preventing danger to life and property, detaining surface waters, preserving recreational uses of water bodies, reducing public expenditures, conserving taxable value by preserving environmental character and ensuring that adequate inspection and enforcement procedures are followed.

4. Applicability
The ordinance applies to all major subdivisions or site plan applications, or any other project defined in the ordinance. It also applies to the construction of single family and multi-family dwelling units and building additions.

5. Definitions
A total of 55 definitions are provided. Many are standard and will be familiar to municipal officials. Several are of note, however. There is a definition of "watercourse" that includes a broad range of topographic features and also includes the area adjacent to the channel inundated by floodwaters. "Vegetative protection" is also defined and may be unfamiliar to the reader.

6. Land Disturbance Permit Required
A land disturbance permit is required for all projects as defined in the ordinance except those specifically exempted.

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7. Activities Exempt From Permit Requirements
The following exemptions are specified:

- Land disturbance in accordance with a farm conservation plan.
- Planting and harvesting of crops, plants, flowers or shrubs in areas devoted to such use prior to the adoption of this ordinance.
- Road and road shoulder work performed by the municipal Department of Public Works
- Projects exempt from requirements of State law.
- Land disturbance of less than 1000 square feet.

8. Applications for Land Disturbance Permits
A. Jurisdiction: The municipal engineer has jurisdiction over applicants

B. Application Forms
Forms are to be provided by the municipality. Specific minimum requirements are specified.

C. Plan to Accompany Application
Every application shall include a Plan meeting the requirements of sections C. 1 through C.4. A map and written report with specific guidelines must be submitted (C. 1). All stages of the construction process shall be covered from grading through establishment of finished grade and installation of improvements (C.2). Starting and completion dates and exposure time for the entire development sequence must be provided (C.3). The sequence and timing of control measures superimposed on a soils map must be provided (C.4).

D. General Conditions
Extensive general conditions are provided. Several are of particular note: Sections D. 6. a. and b. require that the "smallest practicable area of land shall be disturbed at any one time and duration of this disturbance shall be kept to a minimum" and "whenever feasible, natural vegetation and the natural ground surface shall be retained and protected."

E. Fees to Accompany Application
Specific procedures regarding fees are provided. A separate fee is required unless the application is part of a project governed by the Land Development Ordinance, in which case the fee will be a part of the general review fees charged. An escrow fee is to accompany the application to be used to pay for inspections by the municipal engineer. No application is to be processed unless fees and escrow payments are paid.

9. Action on Applications
Applications are to be reviewed by the planning board and the municipal within a specified time period. Other review procedures are provided, especially governing referral to the County Soil Conservation District, the environmental commission, other qualified

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government agencies or consultants. Detailed provisions governing approvals are provided. Time limitations are specified for the approval process. Referral to the County Soil Conservation District upon approval or by approval by inaction is specified.

10. Issuance of Permits
A performance guarantee is required. The amount of the guarantee shall not exceed 120% of the total cost of the improvements. Other detailed requirements dealing with the performance guarantee are provided. A land disturbance permit shall be issued after an application is approved and a performance guarantee is received.

11. Performance of Work
Strict adherence to the approved Plan is required. The municipal engineer shall inspect all projects for which a permit has been issued and shall be responsible for enforcing the conditions of the permit. A copy of the complete permit application shall be kept on site at all times. Inspections shall be made prior to any construction, intermittently during construction, after completion and at other times when conditions are unsatisfactory. Deviations from the approved plan are to be immediately corrected. Stop work orders may be issued to obtain compliance. The municipal engineer may order minor modifications. A detailed section on inspection fees is provided. Section F governs approval of completion. The municipal engineer issues the approval and no Certificate of Occupancy shall be issued until approval is granted.

12. Maintenance Obligation and Maintenance Guarantee
There is a two-year obligation to maintain all construction and installation work. A maintenance guarantee related on a percentage basis to the total cost of improvements is required. A figure of 15% is suggested.

13. Appeals
Appeals are made to the governing body.

14. Penalties and Injunctive Relief
Failure to comply with the requirement of an approved plan, or to comply with the terms of the ordinance, or the rules of the State Soil Conservation Committee may result in civil action for injunctive relief. The ordinance also specifies the ability to levy fines for non-compliance but specifies no specific amount.

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Appendix R

Model Wetlands Protection Ordinance

The complete text of this ordinance is available at http://www.tentowns.org/10t/mointro.htm.

Contact: Great Swamp Watershed Management Committee, Ten Towns Committee, Phone (973) 984-2000

1. PURPOSE

The purpose of this ordinance is to protect wetlands and wetland transition areas from being destroyed; and to provide provisions by which the municipality shall be informed of the presence of wetlands. Wetlands provide important environmental benefits such as groundwater recharge, filtration and treatment of stormwater runoff, flood attenuation and wildlife habitat.

2. WETLAND SURVEY

A wetland survey shall be performed by a qualified professional on all properties which are the subject of a minor or major subdivision, or major site plan application. The survey shall state whether or not regulated wetlands are present on the site. All wetlands and transition areas identified shall be shown on all plans. The name of the person who performed the wetlands survey shall be shown on the plans. If regulated wetlands are not present on the site, a note shall be added to the plan stating that a wetland survey was performed, who performed the survey, the date the survey was performed and what method was used to perform the survey. In addition, the note shall state that no regulated wetlands were identified during the survey.

3. WETLAND DELINEATION

A wetlands letter of interpretation (LOI) from the NJDEP must be submitted as part of the application for any major subdivision or major site plan application. A minor subdivision application shall not be required to submit a LOI, however, an on-site wetland delineation shall be prepared by a qualified professional. Any wetlands identified as a result of such delineation shall be placed on the minor subdivision plans. If the wetlands present will be impacted by the proposed improvements, a NJDEP approved LOI is required to be submitted with the plans for minor subdivision.

4. PLAN APPROVAL

No minor or major subdivision plan or major site plan submitted will be approved unless a wetland survey has been performed and evidence of such has been provided to the municipality.

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A. **Documentation -** All wetland and transition areas required pursuant to N.J.A.C. 7:7A-1 et seq. (N.J. Freshwater Wetlands Protection Act Rules) shall be clearly shown on all plats or site plans submitted for approval.
B. **Wetland protection standards -** To prevent adverse impacts on delineated wetlands, the following guidelines shall be employed:
    1. A snow fence shall be installed in the area of disturbance outside of the final wetland transition area boundary line prior to the commencement of on-site construction, so as to prevent encroachment into these regulated areas.
    2. A silt fence and/or hay bales shall be installed downstream from disturbance areas adjacent to the State-mandated wetland transition line (or buffer) so as to prevent the transport of silt into the wetland areas.
    3. All final plats or final site plans shall include the wetland line(s) identification number as assigned by NJDEP, pursuant to the Freshwater Wetlands Protection Act.
    4. The applicant shall avoid encroachment into state-regulated wetland areas. All existing on-site vegetation within or adjacent to the wetland areas shall be preserved.
    5. Prior to signing of the final plat or site plan, the applicant shall provide evidence of the filing of any deed restriction required by NJDEP to permit transition area modification.
    6. All wetland boundaries on new sites shall be delineated with a sufficient number of permanent markers to ensure that future encroachment and distinction of wetlands does not occur.

5. PROPERTY INSPECTIONS

The municipality, its agents or employees may make reasonable entry upon lands and waters within the municipality for the purpose of making any investigation, survey or study contemplated by this ordinance.

6. EXEMPTIONS

Land development plans which were approved prior to the adoption date of this ordinance, shall be exempt from these requirements.

7. COMPATIBILITY WITH OTHER PERMIT AND ORDINANCE REQUIREMENTS

Development approvals issued pursuant to this ordinance 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 other applicable codes, rules, acts or ordinances. In their interpretation and application the provisions of this ordinance shall be held to be the minimum requirements for the promotion of the public health, safety and general welfare and the protection of water quality.

8. SEVERABILITY

If the provisions of any part of this ordinance shall be judged invalid by a court of competent jurisdiction, such order of judgement shall not affect or invalidate the remainder of this ordinance.

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Appendix 3

Preparing a Build-Out and Capacity Analysis

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Build-Out and Capacity Analysis

http://www.anjec.org/pdfs/SG_Planning.pdf

Contact: Association of New Jersey Environmental Commission, Phone (973) 539-7547

I. Build-Out

What Is Build-Out?
What will your community look like when all the vacant land has been built on? Recent studies predict that New Jersey may reach this situation as soon as 2030. We will be the first state in the nation to do so.

A build-out analysis can help residents understand what their municipality, or a section of it such as a highway corridor, will look like if built to the capacity allowed in current zoning. The analysis can also include environmental, social and economic impacts of full development and evaluate whether the current zoning will achieve the goals of the master plan. An economic analysis can forecast future tax revenues and liabilities to finance new infrastructure for the expanded community, including schools, water and wastewater treatment plants, recreational facilities, roadways and services.

A build-out can help identify changes needed in local master plans, zoning ordinances and development regulations. A build-out will not address the capacity of the natural or infrastructure systems, because it is based on zoning that may not recognize the capacity of these systems. (For example, the zoning may allow half-acre lots around lakes without consideration of the potential for eutrophication of the lake from non-point source pollution.) Once the build-out is completed, planners can use Capacity Analysis to assess whether existing resources are sufficient to serve the potential new development. The second half of this article will cover capacity analysis.

While build-out studies are useful, they generally cannot predict when full development will occur. This depends on many pressures, such as the economy, which are generally outside the municipality's control.

Starting a Build-Out

1. Determine the study area.
Defining the boundary of the study area is a critical first step. It can be all or part of the municipality, for example, the commercial zone, areas with large undeveloped tracts or a number of brownfields.

2. Gather data
The necessary information is probably at your fingertips. The Environmental or Natural Resource Inventory (ERI or NRI) has baseline natural resource information and local planning and engineering departments have planning and zoning information.

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The county and state are also valuable sources of information.

From the municipality
1. Tax Map showing property sizes and vacant lands
2. Current Zoning Map
3. Existing Land Use Map
4. ERI showing environmentally sensitive areas
5. Open Space Plan showing publicly owned lands, conservation easements, planned greenways, and planned open space
6. Development and subdivision approvals not yet built

From most counties
1. Tax lots in GIS (Geographical Information System) format
2. Open Space Plan showing publicly owned lands

From the State GIS
1. Land use, land cover by watershed
2. Wetlands
3. Streams, lakes, and floodprone areas
4. Aquifers and recharge areas
5. Critical wildlife habitat
6. State Planning Areas
7. Known contaminated sites

All maps should be the same scale to facilitate transfer of data between maps. The computerized mapping program, GIS, can change the scale of the maps and can print multiple copies. If your community does not have access to GIS, manual mapping techniques can still be effective. The key is to adapt to local skills and budgets. The most important task is to complete the build-out sooner than later.

Having high quality data is imperative. The buildout will be only as good as the information collected. Good data are critical to build confidence in the results of the study.

Preparing a Build-Out

1. Gross Land Surface.
Locate and calculate Gross Land Surface – all the land in the region to be studied. Review the existing land use map to identify zones. Focus on areas most likely to attract development – vacant lands and developed areas with a potential for infill or increased densities. Tax maps can help determine a property's acreage and any existing easements.

2. Constrained Lands.
Locate and calculate acreage on the lands with development constraints like • Public ownership,
• Historic sites,

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- Conservation and utility easements,
- Approved development not yet built, and
- Environmentally important lands like wetlands, flood plains, steep slopes, stream corridors, water bodies, soils with limitations (limited percolation or bearing strength), and contaminated sites that are regulated by the state or municipality.

All land should be considered developable unless State laws (e.g. wetlands, floodplains) or municipal ordinances (e.g. steep slopes, stream corridors) restrict their use.

3. Net Useable Land.
Subtract the constrained lands from the gross land surface to obtain the net useable land area for future growth. This should include remaining farmlands, forest and open space not currently deed restricted and developed parcels that could accommodate more intense uses. Transfer the net useable land area to the base map.

4. Total Developable Acreage.
Use the zoning map and applicable ordinances to determine the requirements and limits for each vacant parcel or zone, for example road rights-of-way, septic field requirements, minimum frontage, open space set-asides, and building coverage or floor area ratio requirements (FAR). A community may zone for clustered residential zones with a mandatory open space set aside of 25 percent or place additional limits on number of units or acreage of development. Subtract these zoning controls from the net useable land area to obtain the total developable acreage.

5. Full Build-Out.
For residential zones, divide the total developable acres by the underlying lot-size requirement for each zone to obtain an estimate of potential new units. For commercial zones, if FAR is applicable, multiply the total developable area by the FAR ratio to determine how much commercial floor space is permitted by the zone. Use a figure or tables and bar charts to show the study's results. A phased build-out approach also may show several points in the future, such as 50 percent or 75 percent building coverage.

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Build-Out Example

Total Study Area		2000 acres
Current Zoning	Agriculture, 1-acre Commercial	1500 acres 500 acres
Development Approvals	Agriculture Commercial	250 acres (210 units) 0
State and Local Regulations	Agriculture Commercial	Wetlands and buffers -– 150 acres Steep Slopes — 25 acres Wetlands and buffers — 25 acres Historic sites — 25 acres Easements — 50 acres
Net Usable Land	Agriculture Commercial	1075 acres 400 acres
Zoning Controls	Agriculture Commercial	1 dwelling unit/1 acre Road/Infrastructure ROWs 15% FAR of 25%
Total Developable Land	Agriculture Commercial	914 acres (1075*(1-0.15)) 400 acres
Full Build-Out	Agriculture Commercial	1124 units (914+210) 4.36 million sq. ft. (400*0.25)

Current zoning allows for 1,124 dwelling units and 4.4 million square feet of commercial space on 2,000 acres of fields. Eye opening indeed.

Education and Outreach

To make sure the build-out study's recommendations become reality, it is very important to present the results and offer a written summary at a public forum for local officials and interested citizens, place articles in the local newspaper, public service announcements on cable TV, postings on the community web page.

The support of public officials is key to accomplishing the build-out study's recommendations since they have the power to make the necessary zoning and infrastructure planning decisions. The town may need to adopt more creative development and design techniques to protect natural resources, retain a stable tax

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base, and avoid wall-to-wall subdivisions. The town can also use the study to calculate what additional services the community will need like education, recreation, municipal fire, police, and maintenance services, and infrastructure for drinking, waste, and stormwater systems. A build-out analysis also offers the opportunity to insure that the master plan goals are consistent with the current zoning.

A build-out provides valuable insight of future development potential based on current zoning. Large lot zoning, mandatory clustering, an open space plan, transfer of development rights, and reductions in building lot coverage can change the outcome.
Economic analysis can be a good technique for convincing local officials and citizens that over-development may not pay for itself in the long run. Tables and figures can effectively summarize the results.

Capacity analysis can provide the underlying factual data needed to put large lot zoning or reductions in lot coverage in place.

Stafford (Ocean) Build-Out Case Study

Stafford Township (Ocean) has completed several build-out analyses to address concerns about encroachment of development on environmentally sensitive lands like the Barnegat Bay Estuary. Using the results of two studies since 1990 to put creative conservation zoning and land preservation initiatives in place, Stafford has reduced its estimated build-out population from 66,000 to 49,000 with 14,000 fewer housing units.

The town also used the build-out data to perform an economic analysis to evaluate the breakeven point where additional development will be a tax burden on the community.

For Further Information

- ANJEC Resource Center, resourcecenter@anjec.org, www.anjec.org, 973-539-7547
- *The Environmental Resource Inventory: ERI,* 2003, Association of New Jersey Environmental Commissions
- *Open Space Plan,* 2003, Association of NJ Environmental Commissions
- GIS Data, NJDEP, www.state.nj.us/dep/gis, 609-984-2243; NJ Geological Survey, www.state.nj.us/dep/njgs; NJ Landscape Project, www.njfishandwildlife.com; NJ Geographic Information Network, https://njgin.state.nj.us (use no www)

Note: Environmental commissions and non-profit organizations can apply for GIS software from the NJ Office of GIS by applying on-line at the Resources section of https://njgin.state.nj.us. (use no www)

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II. Next Steps – Carrying Capacity of Natural Systems

Capacity analysis takes the build-out study a step further by analyzing the capacity of the environmental and the infrastructure systems. It looks at questions like these.

- Is there enough water to supply the projected development?
- How will nonpoint source pollution generated by the new development affect local streams and lakes?
- Can existing roads and transit systems handle the increased traffic?

Projected growth should be sustainable; otherwise over-development will destroy existing stable communities. Engineered systems can modify the capacity of a system, but usually result in continued operating costs and/or negative ecological impacts. For example, channelization of urban streams increases flow but reduces water purification. Good planning should include some aspect of capacity analysis so the natural and built systems are not overloaded and a balance is achieved between the developed and natural systems. This section will focus on the capacity of natural systems, although a similar analysis can be performed for infrastructure, such as water and wastewater systems.

In the 1980s the Pinelands Commission used capacity analysis to determine where within the Pinelands it would allow development and what intensity it should be. The Commission used a nitrate dilution model to limit the impact of nitrates, from residential septic systems on groundwater quality. The model assumed no treatment of nitrates in the sandy soils and established an ambient ground water quality of 2 ppm (parts per million) nitrate-nitrogen at the property line as the sustainable limit. Lot sizes could be adjusted to be bigger or smaller than the modeled density number, as long as the overall density within each sub-watershed achieved the 2 ppm nitratenitrogen standard. The Commission used the nitrate dilution study to develop residential zoning. For example, it set zoning in the forested area at one unit per 30 acres.

The State Planning Commission recommends municipalities use capacity analysis as a basis for exploring alternate growth patterns and addressing sustainability. Because GIS and mathematical models have made working with data easier and relatively inexpensive, municipal and regional planners will be using capacity analysis studies more frequently.

Limitations of Mathematical Models
Environmental Commissioners are not expected to be experts in the field of capacity analysis so don't hesitate to ask the professionals about the details of the mathematical model used for the analysis.
1. What are the model's assumptions?
2. What is the boundary of the model (e.g. municipal borders, physiographic region)?
3. Has NJDEP approved the model?
4. What determined the sustainable goal (e.g. nondegradation limits such as background water quality or health-based limits such as drinking water standards)?

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General Approach for Natural Resource Capacity Analysis

Generally, a municipality hires a professional consultant to complete the analysis. Municipal officials, the environmental commission, and interested citizens should work with the professional to tailor the study to local resources.

1. Determine extent of the study area.
Natural resources may encompass different study areas depending on their basic characteristics. For instance, water supply may be limited to a local aquifer of 30 square miles, while air quality issues may encompass the entire state or beyond its borders.

Regional and site-specific capacity analysis studies are feasible. The bottom line is that the community must decide whether to limit the study to municipal borders or specific tracts of land within the town. West Windsor (Mercer) used capacity analysis to determine whether to downzone several tracts of developable land. Another approach is to work with neighboring communities to study the capacity of a regional system.

GIS is an excellent tool for defining the boundaries of the study area because it can display or hide map layers depending on the area of focus.

2. Determine which resources to evaluate.
Capacity analysis can cover a wide range of natural systems, but probably time and money will limit the study's scope.

The natural resources considered will depend on the community's needs. The study may include development impacts on environmentally sensitive lands like critical slopes, forested areas, plant and animal habitat, wetlands, water supply in recharge areas, water quality impacts due to impervious coverage. Each area will have its own issues of concern. In general, understanding the water capacity of a community is critical since the availability of clean drinking water can limit most future development. Although engineered systems can divert water from one watershed to another, in the long run, over-development will deplete regional resources, increase operating costs and probably reduce water quality.

3. Prepare a literature review.
Review recent research to understand different approaches. The Internet provides access to academic institutes and non-profit organizations working on natural resource protection and global sustainability issues. Also consider plans developed by State agencies. For comprehensive planning, it is critical that municipal, regional and state plans are linked. Most State and regional plans can be downloaded from the Internet, obtained at minimum cost from the agency or consulted at a depository library. State agency plans that may be of interest include the following.

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Regional Plans
• *Delaware River Basin Commission Comprehensive Plan,*
www.state.nj.us/drbc; 609-883-9500
• *Hackensack Meadowlands Master Plan*
www.hmdc.state.nj.us; 201-460-1700
• *Pinelands Comprehensive Management Plan,*
www.state.nj.us/pinelands/cmp.htm; 609-894-7300
• *Regional Strategic Transportation Plans* – North Jersey Transportation Planning Organization, www.NJTPA.org for 13 northern counties; 973-639-8400
– Delaware River Valley Planning Commission for Burlington, Camden, Gloucester, Mercer, www.dvrpc.org; 215-592-1800
– South Jersey Transportation Planning Organization 4 southern counties, www.sjtpo.org; 856-794-1941

Statewide Plans
• *NJ State Development and Redevelopment Plan,* www.nj.gov/dca/osg
•*NJ Statewide Water Supply Plan,* www.state.nj.us/
dep/watershedmgt/water_supply_planning.htm
• *NJ Statewide Water Quality Management Plan,* with amendments — incorporates some 13 regional plans — www.state.nj.us/dep/watershedmgt/ water_quality_management_planning.htm
• *Long Range Schools Facilities Master Plans,* www.state.nj.us/njded/facilities and from local school districts
• *2003 SCORP (Statewide Comprehensive Outdoor Recreation Plan),*
www.state.nj.us/dep/greenacres
• *NJ Transportation Capital Program,* www.state.nj.us/
transportation/capital_improvements.html

4. Take it from the drawing board to a full-scale system.
Once you have defined the boundaries of the study area and obtained literature values on capacity and related factors, you need to extrapolate the values from the micro- to the macro-system. To develop these numbers you may need to make assumptions, which should be documented in writing. The extrapolated values can be used in mathematical models to determine the capacity of the system. A professional can select the appropriate mathematical models appropriate. You can look at various scenarios once the mathematical model is set up. For instance, water withdrawal rates can be changed to understand better the water supply needs during peak withdrawal periods, or the impact of conservation techniques. One benefit of a mathematical model is that once the computer program is calibrated you can easily change the variables to study several scenarios.

5. Compare projected capacity versus projected level of growth.
At this point, compare the results of the build-out study with the results of the capacity analysis results. Tables and figures can help link the two studies. Can the capacity of the natural systems and infrastructure sustain the projected level of growth at full build-out?

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If the projected development exceeds the capacity of the natural system then the town should amend the existing zoning code to achieve a reasonable density. For example, Bedminster Township (Somerset) recently downzoned a large area from 3 to 10 acres based on the results of a nitrate dilution model study that showed negative impacts to groundwater at higher densities. Courts have upheld the rezoning based on the merits of the capacity analysis and master plan goals. As part of a master plan re-examination, a number of municipalities are using water demand and nitrate dilution models to re-evaluate the impact of current zoning on the community's hydrogeologic capacity.

Word of Warning

While capacity analysis can quantify a system's remaining resources, it has limits. Outside forces like global warming will impact the hydrological cycle. Also once a system's capacity is known, a natural tendency is to fill the capacity rather than manage the resource wisely. Natural systems do not observe political boundaries (for example, aquifers stretch for miles and cross municipal boundaries), so cooperation by municipalities on regional capacity analysis is essential.

Engineered systems can lessen natural resources depletion, but cannot sustain our society. Capacity analysis can help us better understand the limits of natural resources and change the local land use regulations to correct any imbalance.

Case Study on Capacity Analysis:
Evaluating Impacts from Impervious Coverage

The Connecticut Extension System in cooperation with the University of Connecticut (UCONN) and EPA developed the NEMO (Nonpoint Education for Municipal Officials) program, which maps impervious cover to indicate the impacts of land use practices on water quality. Impervious coverage can increase flooding, reduce aquifer recharge rates, increase non-point source pollution, and reduce aquatic biodiversity. NEMO's mapping exercise shows the direct link between land use decisions and water quality with just two sets of data – impervious cover for existing land cover and impervious cover at build-out. Existing land cover data is readily available on GIS from NJDEP. NEMO uses estimates for different densities developed by the Natural Resources Conservation Service to calculate impervious cover for build-out. This type of capacity analysis is readily transferable to other regions and states, including New Jersey.

Carrying the Torch

Both build-out and capacity analyses are excellent tools for understanding municipal plans. Municipalities will rely upon these techniques more and more in the future as the entire state reaches full build-out. Communities that complete build-out and capacity

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analyses will be closer to understanding limiting factors to development and developing creative techniques to address sustainability in their communities. A core group committed to the benefits of comprehensive planning can coordinate the study and organize public forums to discuss the study's results.

For Further Information

Regional Studies

- Barnegat Bay Build-Out, CRSSA, Rutgers University – www.crssa.rutgers.edu/projects/ runj/buildout.html for an example of build-out analysis
- NJ Highlands Build-Out, Environmental Defense – Jason Patrick, 212-505-2100 ext. 1209 for an example of a build-out analysis
- NJ Pinelands Commission studies on the Mullica watershed – go to Science Office section of www.state.nj.us/pinelands/ 609-894-7300

Tools and Data

- ANJEC Resource Center – www.anjec.org, email to resourcecenter@anjec.org, 973-539-7547
- Center for Watershed Protection – www.cwp.org, 410-461-8323, for scientific information on watersheds
- NJ DEP, *A Model of Residential Carrying Capacity for New Jersey Based on Water Quality* – www.state.nj.us/dep/watershedmgt/ wmp_rule_model.htm, 609-984-0058, for the nitrate model used by NJDEP; other models are also available
- GIS Data – NJDEP, www.state.nj.us/dep/gis/, 609-984-2243; NJ Geological Survey, www.state.nj.us/dep/njgs; NJ Landscape Project, www.njfishandwildlife.com; NJ Geographic Information Network, https://njgin.state.nj.us (use no www)
- NJ Environmental Digital Library – http://njenv. rutgers.edu/njdlib (use no www) for an on-line library of enviromental literature
- *NJ State Development and Redevelopment Plan* – www.nj.gov/dca/osg, 609-292-7156, statewide land use initiatives, development and redevelopment scenarios
- Nonpoint Education for Municipal Officials (NEMO) – for case studies and local information, contact ANJEC, NEMO's NJ representative, at 973-539-7547, or email resourcecenter@anjec.org. NEMO, http://nemo. uconn.edu (use no www), 860-345-4511, offers an approach to capacity analysis
- Regional Planning Partnership, www.planning partners.org, 609-452-1717, GOZ™ model (goal-oriented zoning) in Tools and Services for "capacity-based" plans

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Notes:

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Non-Point Source Pollutant Loading Build-Out Analysis for the Lockatong and Wickecheoke Creek Watersheds

Draft Report -- January 2009

Author: Jen Zhang
Water Quality Statistical Analysis support by Todd Kratzer

This Document was prepared as part of a 319(h) grant for the Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Project under Contract RP05-082.

New Jersey Water Supply Authority

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Introduction of Build-Out Analysis

Lockatong and Wickecheoke, though separate streams, have complementary components of an exceptional watershed area located in a rather remote part of Hunterdon County (**Figure 1**). The Lockatong-Wickecheoke Watersheds encompass approximately 49.9 square miles (31,917 acres). They include portions of Franklin, Delaware, Raritan, and Kingwood Townships, and a small portion of Stockton Borough. Both the Lockatong and Wickecheoke Creek are third order (tributaries are first and second order) streams that flow into the D & R Canal.

Though the watersheds are predominantly rural, recent census data showed a significant population increase during the past thirty years, with Raritan Township increasing the most, 186% since 1970, and Delaware Township growing the slowest at 38%. Because of their underlying geology and steep topography, these watersheds are particularly sensitive to the growing pressure of development and its associated environmental impacts. If growth continues at these rates, the health of these creeks will continue to decline, reflecting the associated impacts.

Therefore, as part of a 319(h) grant for the Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Project, this build-out analysis report was prepared to "illustrate the form and pattern that development can be expected to take under a continuation of current trends and the manner and degree to which this form and pattern are contrary to planning goals" (Build-Out Analysis - Creating Communities of Place, NJ Office of State Planning, 1995).

A build-out analysis maps potential future development across the landscape under specific sets of constraints. The scope and location of future development is identified in this type of analysis, although timing of development is not predicted. Information gained through a build-out analysis can be very useful in long-term planning efforts.

The build-out analysis in this report compared two future development patterns, one was based on current zoning and the other one was based on the Nitrate Dilution Model. A non-point source pollutant-loadings build-out was assessed to help to understand the impacts of future development on the water quality issues in the Watersheds. Build-out scenarios were created based on regulations and environmental constraints. To identify the potential impacts of build-out, impervious surface cover was used as a measure of non-point source water pollution from urban run-off with a comparison of non-point source pollution from forest and agricultural lands using NJDEP approved pollutant-loading Unit Aerial Load (UAL) values. A comparison of measured loadings from fieldwork with estimated loadings from UAL was also analyzed as part of the build-out report.

The goal of this report is to provide insight into the magnitude of future impacts on non-point source pollutant loadings on water quality issues, and help local municipalities and other interested entities determine what measures need to be taken to prevent over-development and depletion of natural resources. Such actions may include changes to

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Master Plan elements, current zoning practices and development regulations. For the purposes of this analysis, a critical use of the build-out loading analysis is the estimation of future pollutant loads and the associated changes in water quality.

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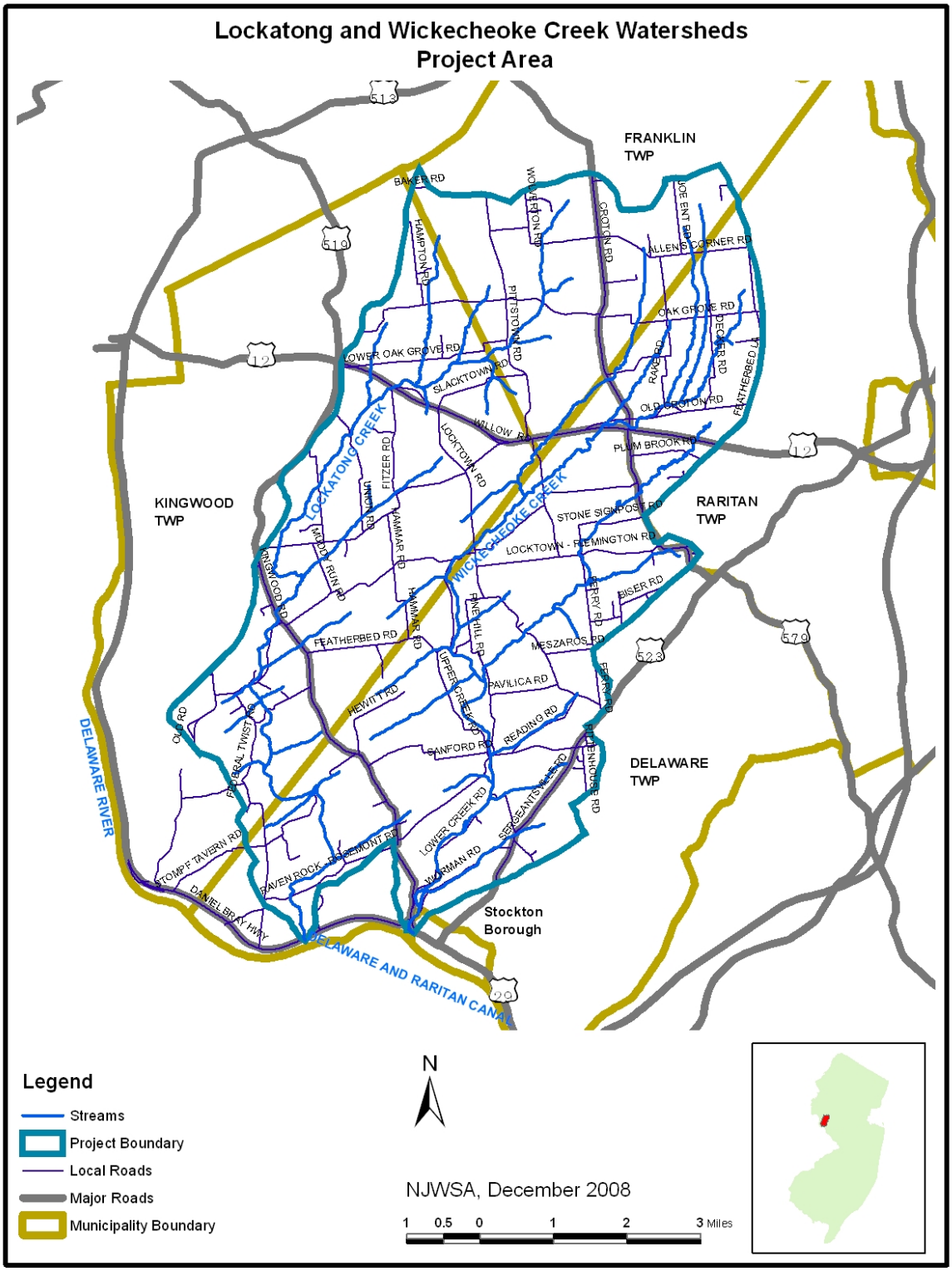
Figure 1: The Lockatong and Wickecheoke Creek Watersheds Project Area



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Study Area

The Lockatong and Wickecheoke Creek watersheds are located within the Central Delaware Watershed Management Area (WMA11), which encompasses a drainage area of approximately 271.9 square miles, running through parts of Hunterdon, Mercer and Monmouth Counties and includes 27 municipalities. Most of the area in the Lockatong and Wickecheoke Creek Watersheds are in the Hunterdon (or Croton) Plateau with its hard argillite bedrock.

The Lockatong Creek is 13 miles long and originates from springs and wetlands near Quakertown in Franklin Township. It drains a 23.3 square mile watershed passing by cliff and rock formations, waterfalls, hemlock groves and historic old mills on its way to the Delaware and Raritan Canal and Delaware River. The Wickecheoke Creek is 14 miles long and originates from wetlands in Franklin and Raritan Townships, and springs in Delaware Township, flowing south through Delaware and Kingwood Townships to the D&R Canal and Delaware River at Prallsville Mills in Stockton. It drains a 26.6 square mile watershed.

These watersheds are still predominantly rural, having areas of agricultural and residential development. The major roads running through the watersheds include: State Highway 12, and County Routes 519, 523 and 579. State Highway 29 runs along the southern border of the watersheds. The upper segments of the streams, including the headwater segments, are designated as FW2-Non Trout status. The lower third (approximately) of the streams are categorized as FW2-Trout Maintenance status. Both streams and all the tributaries are classified as Category 1 status.

The total project area is about 31,960 acres; covering part of five municipalities: Franklin Township, Raritan Township, Kingwood Township, Delaware Township and Stockton Borough. The tables below show the percentage of the Lockatong and Wickecheoke Creek watersheds in each of the five municipalities and the percentage of each municipality covered within the watersheds.

Table 1: Percent of the Lockatong and Wickecheoke Creek Watersheds in each Municipality

Municipality	**Total acres of each Municipality within the Lock-Wick Project Area**	**% of the Lock-Wick Project Area within each Municipality**
Franklin Twp	5,501.3	17.2
Raritan Twp	3,172.3	9.9
Kingwood Twp	10,632.4	33.3
Delaware Twp	12,630.7	39.5
Stockton Boro	24.0	0.1
Total Acres of Lock-Wick Project Area	31,960.7	

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Table 2: Percent of each Municipality within the Watersheds

Municipality	Total acres of each Municipality	Total acres of each Municipality within the Lock-Wick Project Area	% of each Municipality within the Lock-Wick Project Area
Franklin Twp	14,712.5	5,501.3	37.4
Raritan Twp	24,159.2	3,172.3	13.1
Kingwood Twp	22,900.6	10,632.4	46.4
Delaware Twp	23,675.4	12,630.7	53.3
Stockton Boro	383.7	24.0	6.3

A Literature Review of Build-Out Techniques

There are many variations of build-out methodology that can be used; however most are based on the same principles and standards. The build-out methodology used for the Lockatong and Wickecheoke Creek Watersheds was developed by the Watershed Protecton Program Unit office, New Jersey Water Supply Authority, with techniques borrowed and combined from ANJEC and New Jersey Stormwater Best Management Practice Manual. Here is a brief summary of four approaches for build-out analyses.

ANJEC developed a "Smart Growth Kit for Build-Out and Capacity Analysis" (http://www.anjec.org/pdfs/SG_Planning.pdf). This document outlines the basics of creating and completing a build-out analysis in steps and also includes "A Carrying Capacity of Natural Systems".

EPA's "Green Communities Kit" (http://www.epa.gov/greenkit/build_out.htm) includes a "How To Do A Build-Out Analysis" article. This build-out methodology is slightly different, as it provides for a phased approach. Phase One is a visual description of changes, and Phase Two is a quantification of those changes.

The Grant F. Walton Center for Remote Sensing and Spatial Analysis (CRSSA), Rutgers University, developed a methodology for build-out – "Build-out Data for Each Municipality with the New York/New Jersey Highlands Regional Assessment Study Area" (http://crssa.rutgers.edu/projects/highlands/hi_data/popch_metadata.htm). This methodology focuses only on residential capacities, and deals only with municipalities in the New York and New Jersey Highlands Region. Although there are some limitations present in this type of analysis, this method may be timesaving and cost-effective for some municipalities. Because a build-out analysis was completed for each municipality in the Highlands, selected municipalities will be able to take this document and use it immediately in their analysis.

The final methodology included is from the "New Jersey Stormwater Best Management Practices Manual" (http://www.co.hunterdon.nj.us/pdf/stormwater/NJDEP_SAMPLE_SW_PLAN.pdf). This method is very similar to the others, however specific requirements for meeting storm water BMPs are outlined here. This would be a useful way of controlling storm

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water through a build-out analysis and eventual implementation of the recommended courses of action.

Results of hydrogeologic evaluations of the ground water supply should be used as a planning tool for delineating zones of suppressed aquifer recharge and/or water use in excess of the available aquifer supply. Zoning should mandate lot sizes based on areas required to infiltrate precipitation for diluting and maintaining ground water nitrate (from on-site septic systems) at 2 milligrams per liter (mg/l), and to maintain a balance between water use and the available recharge. Critical dry, summertime conditions should be targeted for estimating recharge and water-use rates.

Current Observed and Calculated Pollutant Loadings in Lockatong and Wickecheoke Creek Watersheds

Total phosphorus loadings, total suspended solids, and total nitrogen loadings were compared between those estimated using Unit Aerial Load (UAL) values and those determined from field measurements. USGS 30-minute interval flow data from the Lockatong and Wickecheoke Creek continuous flow-measurement stations were used as the “x” variable for the respective regression equations in Figures 2 thru 7 to determine total phosphorus, total suspended solids, and total nitrogen loadings. Combined data sets, NJWSA and DRBC, were used to construct these relationships at monitoring sites L1 (near mouth of Lockatong Creek) and W1 (near mouth of Wickecheoke Creek).

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Figure 2: Relationship (natural ln-ln) of total phosphorus (TP) load to flow for site L1 on Lockatong Creek

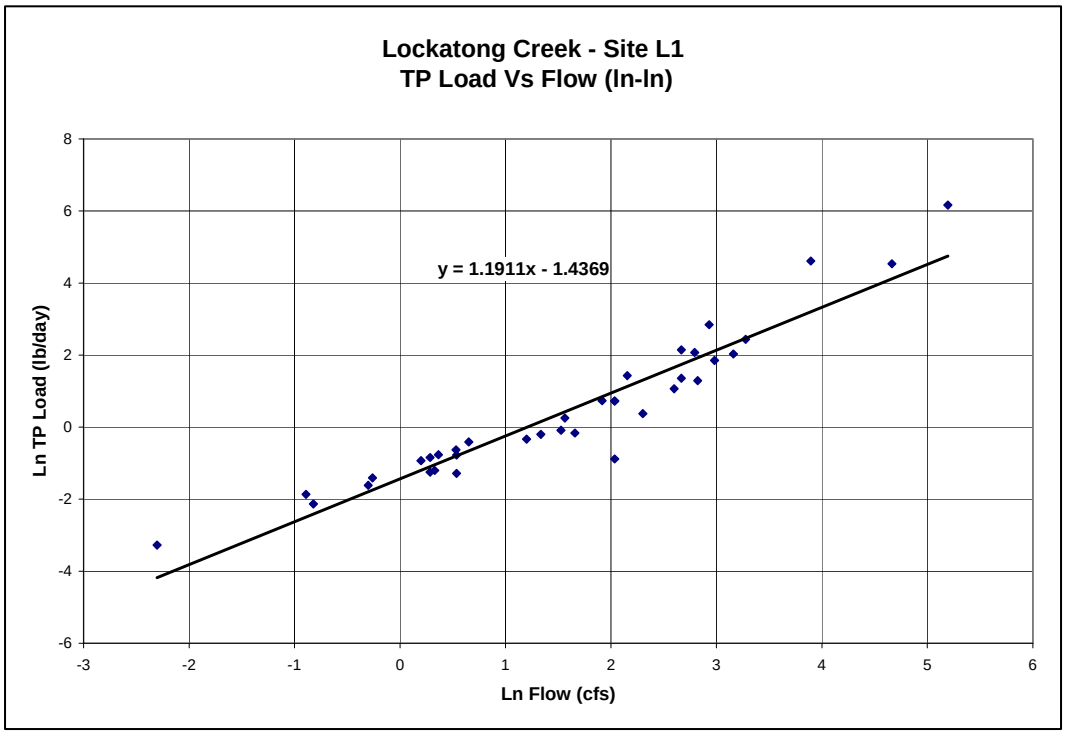

Figure 3: Relationship (natural ln-ln) of total phosphorus load (TP) to flow for site W1 on Wickecheoke Creek

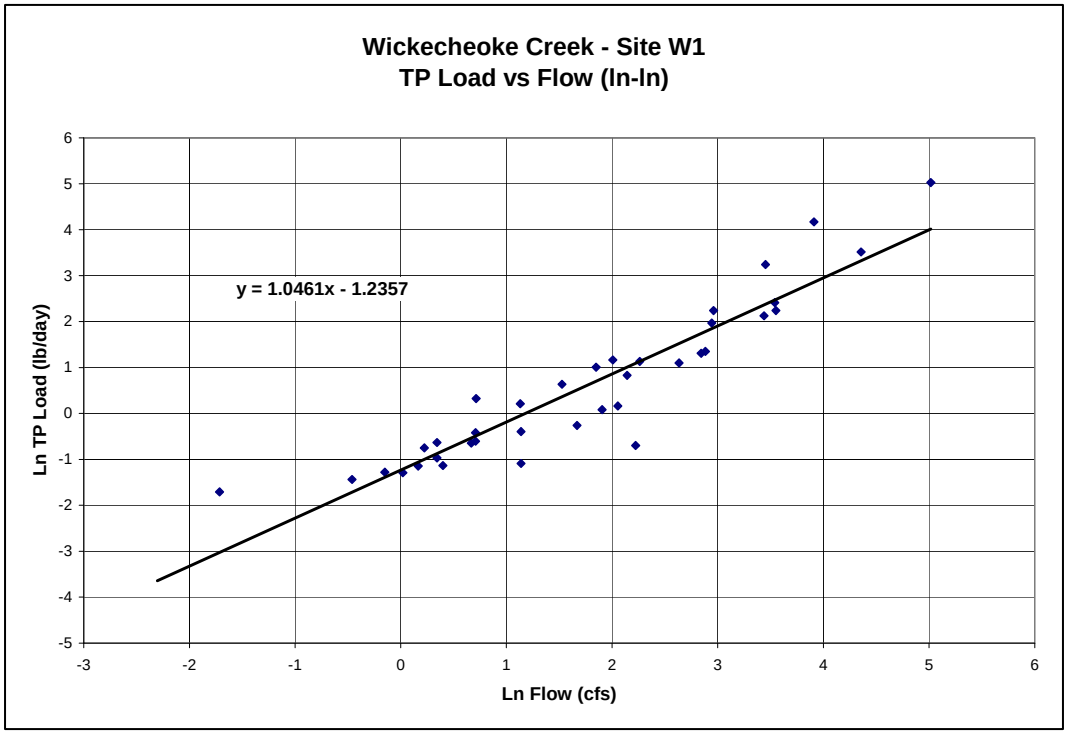

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Figure 4: relationship (natural ln-ln) of total suspended solids (TSS) load to flow for site L1 on Lockatong Creek

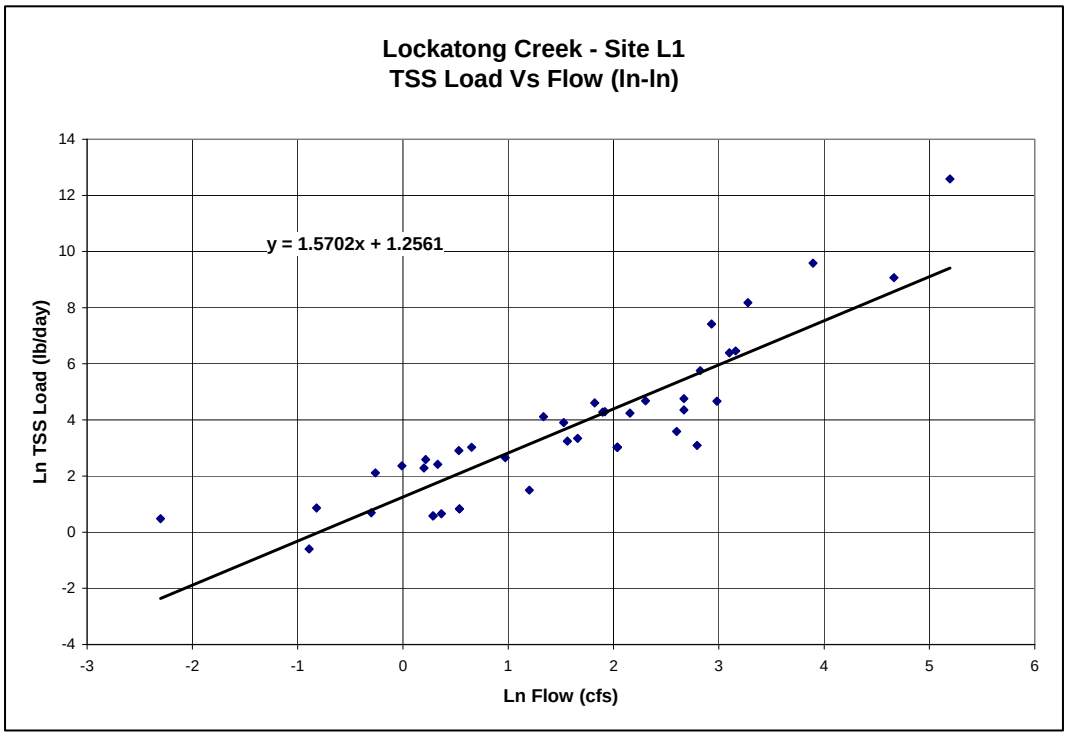

Figure 5: Relationship (natural ln-ln) of total suspended solids (TSS) load to flow for site W1 on Wickecheoke Creek

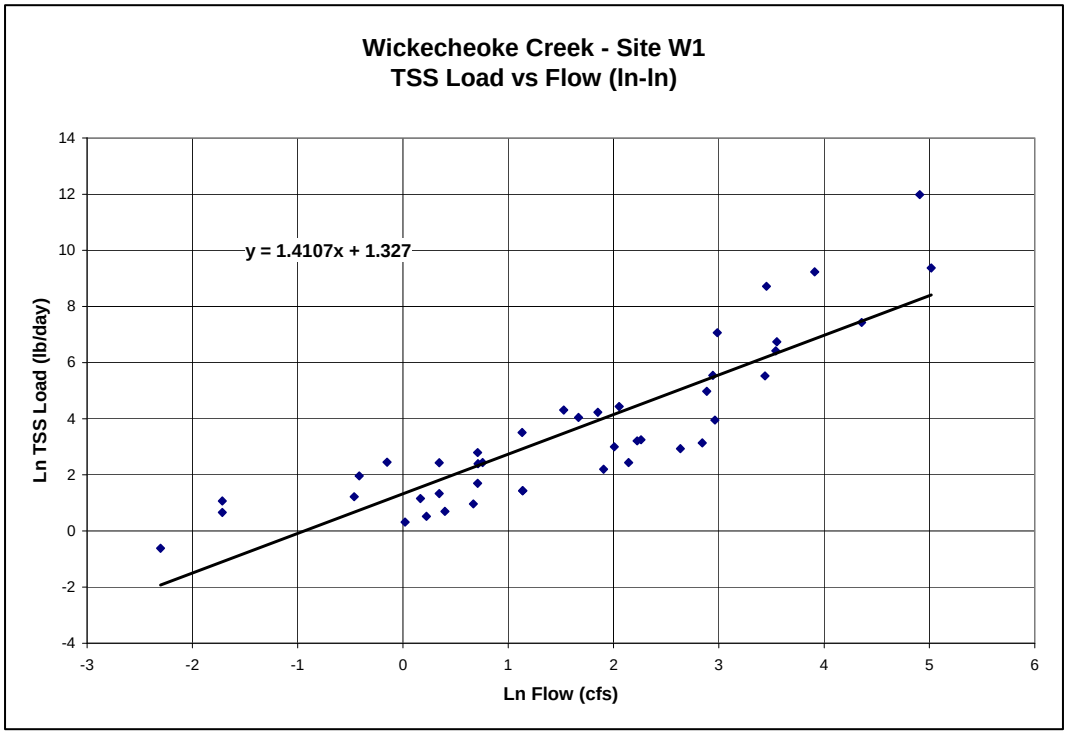

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Figure 6: Relationship (natural ln-ln) of total nitrogen (TN) load to flow for site L1 on Lockatong Creek

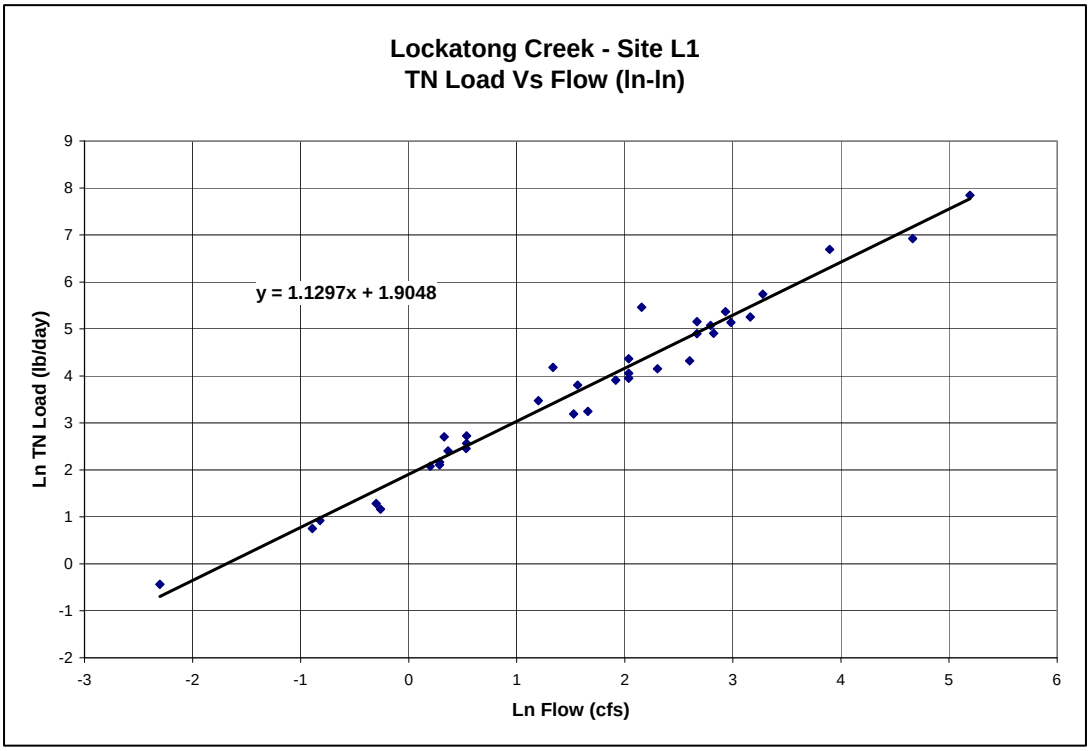
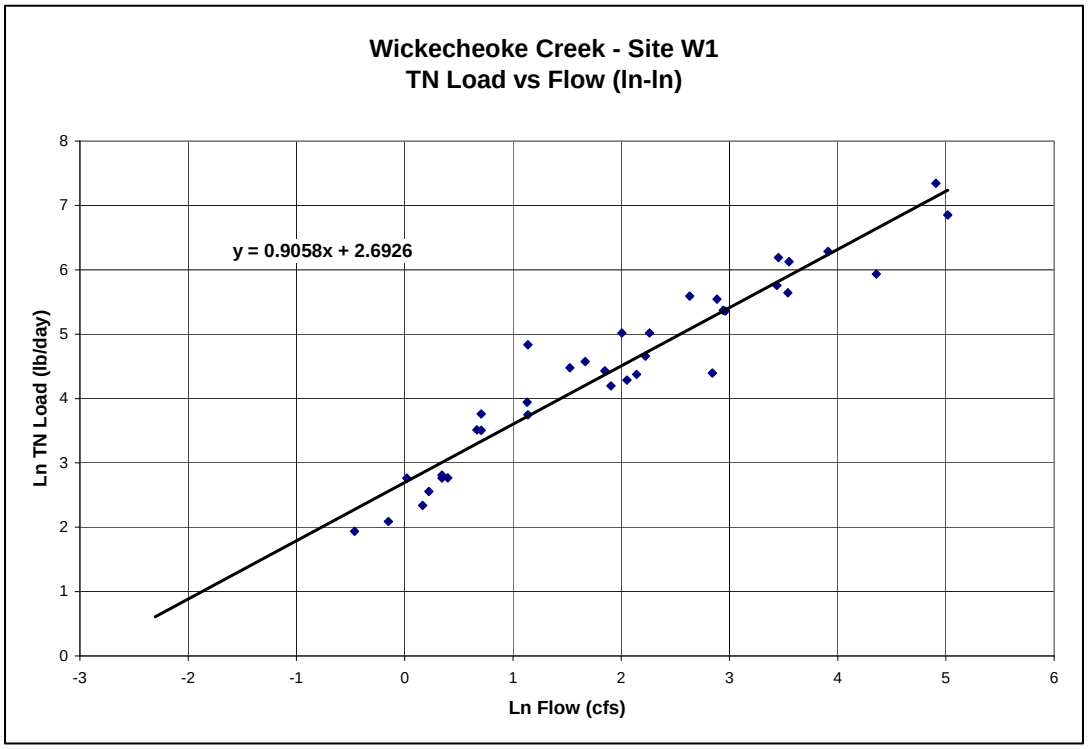


Figure 7: Relationship (natural ln-ln) of total nitrogen (TN) load to flow for site W1 on Wickecheoke Creek



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The estimated non-point source pollutant loads for total phosphorus were calculated based on the NJDEP 2002 land use land cover data and the pollutant loads UAL from the NJDEP TMDL Report (Amendment to the Sussex County and Upper Delaware Water Quality Management Plans: Total Maximum Daily Loads for Phosphorous to Address Seven (7) Stream Segments in the Northwest Water Region, WMA 2 and WMA 11 (Black Creek, Wawayanda Creek, Lockatong Creek and Wickecheoke Watersheds, Proposed by NJDEP in July 2005 and EPA approved on September 2005). Table 3 shows a comparison between estimated and measured loadings for total phosphorus.

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Table 3: Comparison of Unit Aerial Loading (UAL) versus measured loading for Total Phosphorus (TP), at sites L1 (Lockatong Creek) and W1 (Wickecheoke Creek)

Site	Land Use Type	Acres	TP UAL (lb/acre/yr)	TP UAL (lb/yr)	Measured TP (lb/yr)	TP % Difference
Lockatong Creek						
L1	Urban	1,792.60	1.25 - Average	2,240.80		
	Agriculture	5,959.30	1.34	7,985.50		
	Forest, Wetland, Water	6,872.70	0.09	618.5		
	Barren Land	41.8	0.45	18.8		
Totals		14,666.40		10,863.60	11,700.80	7.16
Wickecheoke Creek						
W1	Urban	1,937.00	1.25 - Average	2,421.20		
	Agriculture	6,410.40	1.34	8,589.90		
	Forest, Wetland, Water	8,433.10	0.09	759		
	Barren Land	29.4	0.45	13.2		
Totals		16,809.90		11,783.30	11,243.20	-4.80

The estimated non-point source pollutant loads for total suspended solids and total nitrogen were calculated based on the NJDEP 2002 land use land cover data and the pollutant loads UAL from the New Jersey Stormwater BMP Manual (Chapter 3: Regional and Municipal Stormwater Management Plans, February 2004). Tables 4 and 5 show comparisons between estimated total suspended solids and total nitrogen pollutant loadings and measured loadings.

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Table 4: Comparison of Unit Aerial Loading (UAL) versus measured loading for Total Suspended Solids (TSS), at sites L1 (Lockatong Creek) and W1 (Wickecheoke Creek)

Site	Land Use Type	Acres	TSS UAL (lb/acre/yr)	TSS UAL (lb/yr)	Measured TSS (lb/yr)	TSS % Difference
Lockatong Creek						
L1	Urban	1,792.60	152 - Average	272,475.20		
	Agriculture	5,959.30	300	1,787,790.00		
	Forest, Wetland, Water	6,872.70	40	274,908.00		
	Barren Land	41.8	60	2,508.00		
Totals		14,666.40		2,337,681.20	2,181,300.80	-7.17
Wickecheoke Creek						
W1	Urban	1,937.00	152 - Average	294,424.00		
	Agriculture	6,410.40	300	1,923,120.00		
	Forest, Wetland, Water	8,433.10	40	337,324.00		
	Barren Land	29.4	60	1,764.00		
Totals		16,809.90		2,556,632.00	2,787,261.70	8.27

Table 5: Comparison of Unit Aerial Loading (UAL) versus measured loading for Total Nitrogen (TN), at sites L1 (Lockatong Creek) and W1 (Wickecheoke Creek)

Site	Land Use Type	Acres	TN UAL (lb/acre/yr)	TN UAL (lb/yr)	Measured TN (lb/yr)	TN % Difference
Lockatong Creek						
L1	Urban	1,792.60	13.6 - Average	24,379.36		
	Agriculture	5,959.30	10	59,593.00		
	Forest, Wetlands, Water	6,872.70	3	20,618.10		
	Barren Land	41.8	5	209.00		
Totals		14,666.40		104,799.46	226,774.50	53.79
Wickecheoke Creek						
W1	Urban	1,937.00	13.6 - Average	26,343.20		
	Agriculture	6,410.40	10	64,104.00		
	Forest, Wetlands, Water	8,433.10	3	25,299.30		
	Barren Land	29.4	5	147.00		
Totals		16,809.90		115,893.50	213,001.80	45.59

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Locktong and Wickecheoke Creek Watersheds Build-Out Analysis

While build-out studies are useful, they generally cannot predict when full development will occur. This depends on many pressures, such as the economy, which are generally outside the municipality's control.

NJWSA performed two build-out analysis scenarios for the Lockatong and Wickecheoke Creek watersheds; one was based on the Nitrate Dilution Model described in the Water Quality Management Planning Rule, N.J.A.C. 7:15 - A Recharge-Based HUC 11-Scale Nitrate-Carrying-Capacity Planning Tool for New Jersey, v1.0 (MS Excel Workbook) (http://www.nj.gov/dep/watershedmgt/rules.htm), and the second scenario was based on the municipality zoning ordinance.

Both of these analyses were based on the computerized mapping program, GIS. Having high quality data was imperative to the result. The build-out will be only as good as the information and data collected. Good data are critical to build confidence in the results of the study. Please be advised that all the results and numbers are the best approximate even though we used the most recent data available.

Nitrate Dilution Model Build-Out

Nitrate (NO3) is a constituent found in the effluent from individual on-site wastewater disposal systems (septic systems). Ensuring that nitrate concentrations in ground water do not exceed targets should be one goal when planning or reviewing proposed developments that will use septic systems. The model used in the build-out scenario was developed by Hoffman and Canace (NJGS, 2002) to estimate region-average lot sizes needed to provide enough recharge to dilute nitrate to a specified target on a HUC11-scale planning effort. The model assumes a uniform average-annual recharge with no seasonal adjustment for a regional average.

This model workbook was designed with a municipality-oriented process. After inputting the county and municipality, HUC11s that drain the municipality, the percentage of the municipality in each HUC11, population density (expressed as people per home), HUC11-average ground-water recharge and a nitrate target, the workbook would provide an estimate of the average land area needed (in acres per septic system) to generate enough recharge to dilute the effluent nitrate-nitrogen coming out of the septic system to the specified standard. Currently, the nitrate level is not to exceed 2.0 mg/l (milligrams per liter). This approach assumes that all runoff from impervious cover on the lot is redirected to recharge facilities. This is compatible with the NJDEP's stormwater regulations that require no net decrease in ground-water recharge on developed lots. Please be aware that this nitrate dilution model recharge-area estimate is based on NJDEP Water Quality Management Planning Rules, and should be verified for site conditions by field inspection, based on critical recharge conditions.

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Based on Hoffman's model, the average number of acres per equivalent dwelling units for each of the four municipalities associated with the HUC11 that drain them were estimated. The numbers of acres per septic unit are pretty similar within the same municipality, but slightly different if portions of the municipalities are located in different HUC11s.

A spatially explicit build-out model using a Geographic Information System was built to identify the undevelopable lands. These lands include those areas considered as undevelopable for environmental reasons, such as the Federal, State or local regulated wetlands, floodplains, steep slopes and stream corridors. Urban area was also considered as undevelopable since they were already developed. This build-out scenario was based on land use conditions within the watersheds and not a parcel-based scenario. The New Jersey Department of Environmental Protection's (NJDEP) digital mapped land use/ land cover (LULC) data from 2002, the most recent data available were used. By using this data set, 2002 represents the baseline year of the study.

In this process, protected open space and farmland were not excluded as undevelopable lands since the Nitrate Dilution Model is an estimate of region-average lot sizes needed to provide enough recharge to dilute nitrate to a specified target on a HUC11 planning scale and will require the cooperation between municipalities to decide where the new development should locate to average the nitrate target.

Properties not excluded in this step were deemed available for development. The final step needed to create the build-out scenarios was to identify the type of development that could occur on the available land. Commercial and industrial areas that were available for development were calculated for new additional equivalent dwelling units based on the average number of acres per dwelling unit extracted from the Nitrate Dilution Model.

The build-out results from the Nitrate Dilution Model allowed a total of 4,181 additional equivalent dwelling units for the five municipalities within the watershed area in addition to the 1,346 dwelling units already existing in the study area.

Table 6: New dwelling units at built-out based on Nitrate Dilution Model

Municipality	Total Acres of Each Municipality within the Lock-Wick Project Area	Acres of Constrained Lands	Acres of Developed Lands	Average Acre Per Unit based on Nitrate Dilution Model*	Potential New Dwelling Units (Excluding both Constrained and developed lands)	Existing Dwelling Units	Potential % Increase in Dwelling Units
Franklin Twp	5,501.30	780.2	570.4	5.3	783	164	477
Raritan Twp	3,172.30	1,051.80	329.1	5.6	320	159	201
Kingwood Twp	10,632.40	2,659.10	1,347.10	5.3	1,250	465	269
Delaware Twp	12,630.70	1,428.30	1,513.00	5.3	1,828	554	330
Stockton Boro	24	1.2	6.4	5	1	4	25
Total					4,181	1,346	311

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Zoning Build-Out

A zoning based build-out analysis can help residents understand what their municipality, or a section of it such as a highway corridor, will look like if built to the capacity allowed in current zoning. The analysis can also include environmental, social and economic impacts of full development and evaluate whether the current zoning will achieve the goals of the master plan. A build-out can help identify changes needed in local master plans, zoning ordinances and development regulations. A zoning-based build-out will not address the capacity of the natural or infrastructure systems, because it is based on zoning that may not recognize the capacity of these systems. Table 7 shows the summary of zoning in the five municipalities.

Table 7: Zoning for the five Municipalities within the Lockatong and Wickecheoke Creek Watersheds

Municipality	Zoning Name	Zoning Type	Minimum Lot Size (acre)	FAR (Floor Area Ratio)	Cluster Allowed	Cluster Minimum Lot Size (acre)	Cluster Required Open Space (%)
Delaware Township	Highway Commercial	Commercial/Office/Indus	3.00	0			
	Village Residential/Commercial	Mixed Use	0.46	0			
	Village Residential/Commercial	Mixed Use	3.00	0			
	Agricultural/Residential	Residential	6.00	0	yes	3.0	50
	Agricultural/Residential	Residential	3.00	0	yes	1.5	50
	Village Zone	Residential	0.28	0			
Franklin Township	Neighborhood Business	Commercial/Office/Indus	7.00	8			
	Commercial South	Commercial/Office/Indus	7.00	5			
	Residential	Residential	3.00	0			
	Agricultural Residential	Residential	7.00	0			
Kingwood Township	Village Commercial-1	Commercial/Office/Indus	1.00	0			
	Village Commercial-2	Commercial/Office/Indus	2.00	0			
	Professional Office/Residential	Mixed Use	2.00	15			
	Highway Commercial	Commercial/Office/Indus	4.00	10			
	Business Park	Commercial/Office/Indus	5.00	10			
	Village Residential-2	Residential	2.00	0			
	Agricultural/Residential	Residential	4.00	0	(7ac?)		
Raritan Township	Rural Residential	Residential	6.00	0			
	Rural Residential	Residential	1.84	0	yes		
Stockton Borough	Low Density Residential	Residential	0.92	0			
	Public Land	Park/Conservation	0.00	0			

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We created the spatially explicit build-out model using a Geographic Information System for the zoning-based build-out scenario. This is a computer-based tool used to manage, manipulate, and analyze digital data. The approach allowed us to examine potential changes to specific areas within the watershed.

To create the build-out scenarios, existing land use and property data in the watershed needed to be identified. We used the New Jersey Department of Environmental Protection's (NJDEP) digital mapped land use/ land cover (LULC) data from 2002 and Hunterdon County parcel data as of 2007, the most recent data available. By using this data set, 2002 represents the baseline year of the study.

Next, we identified properties that are available for development. Protected open space and already developed areas were identified as unavailable for development. Permanently protected open space includes state, county, and municipal land. Developed area include privately managed open space (i.e. designated conservation area), and developed properties with existing structures and cannot be subdivided.

Properties not excluded in this step were deemed available for development. Then the areas on each property deemed undevelopable for environmental reasons (including Federal, State or local regulated wetlands, floodplains, steep slopes and stream corridors) were identified, as well as the existing urban area on each property. The final developable area on each property equals the total acres of that property excluding the developed urban area and the undevelopable environmental area. The final step needed to create the build-out scenarios was to identify the type of development that could occur on the available land. Areas that were available for development were calculated for build-out dwelling units base on municipal zoning minimum lot size (**Figure 8**).

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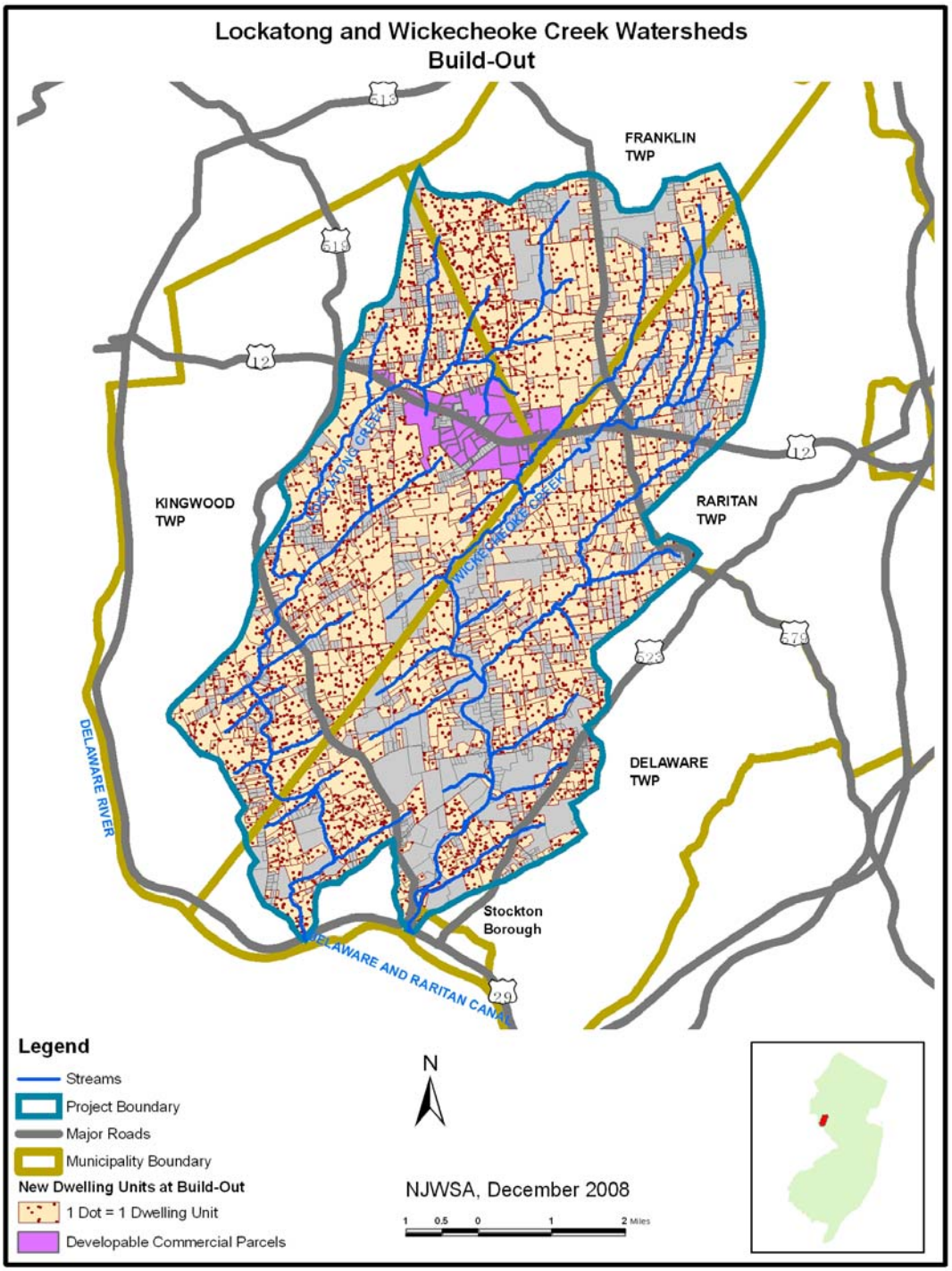
Figure 8: The Lockatong and Wickecheoke Creek Watersheds Build-Out



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The results indicate current zoning for the five municipalities within Lockatong and Wichechoeke Creek watersheds allows for a total of 3,225 new residential units on a total of 974 developable residential parcels (Table 8).

Table 8: New build-out dwelling units based on Zoning breakdown by Municipality and Watershed

		Total Acres	Total Acres of Developable Residential Parcels	Total Acres of Developed Area within the Developable Parcels	Total Acres of Constrained Areas within the Developable Parcels	Build-Out New Dwelling Units	Existing Dwelling Units	Potential % Increase in Dwelling Units
Municipality within the Watersheds								
	Franklin Twp	5,501.30	3,891.20	176.91	630.76	616	164	376
	Raritan Twp	3,172.30	1,885.90	70.56	596.35	194	159	122
	Kingwood Twp	10,632.40	7,425.70	376.70	1,968.29	1,174	465	252
	Delaware Twp	12,630.70	7,324.70	482.40	908.44	1,228	554	222
	Stockton Boro	24.00	12.10	0.16	0.04	13	4	325
Total		31,960.70	20,539.60	1,106.73	4,103.87	3,225	1,346	240
Watersheds								
	Lockatong	14,904.50	11,459.72	589.43	2,360.87	1,965	610	322
	Wichecheoke	17,056.20	9,079.88	517.31	1,743.00	1,260	736	171
Total		31,960.70	20,539.60	1,106.73	4,103.87	3,225	1,346	240

For commercial area build-out analysis, we assume a 60% impervious surface cover with full development, this number 60% comes from an average summary from NJDEP 2002 land use/land cover data for commercial and service areas. The new impervious urban area at build-out will equal 60% at full development excluding the existing urban area in all the developable commercial parcels.

New IS = Total Acres of Parcel * 60% - Existing Urban Area on Property
IS = Impervious Surface

There are 75 developable commercial parcels within the Lockatong and Wichechoke Creek watersheds. Of which, 37 exist in the Lockatong watershed and 38 in the Wichechoke watershed. Most of the developable commercial parcels are located along the Route 12 corridor. A total of 605.4 acres of new impervious surface will be created if this area reaches its full development based on current zoning. Below is a breakdown of the commercial build-out for the Lockatong and Wichechoke watersheds.

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Table 9: Commercial area build-out based on existing zoning

		Total Acres of Developable Parcels	Existing Impervious Urban Acres	Total Impervious Urban Acres at Full Build-Out	New Impervious Urban Acres	Potential % Increase in Urban Impervious Surface
Watersheds						
	Lockatong	767.1	26.2	460.2	434.0	1654
	Wichecheoke	345.2	35.7	207.1	171.4	480
Total		1112.3	62.0	667.4	605.4	977

Non-Point Source Pollutant Loadings Build-Out Based On Current Zoning

Based on the above described build-out results, new impervious surface and land use change can be predicted at build-out, therefore non-point source pollutant loads can now be determined by applying the UALs for total phosphorus, total suspended solids and total nitrogen to predict total pollutant loadings. The zoning based build-out result instead of the Nitrate Dilution Model was used for the non-point source pollutant loadings build-out as the zoning build-out is more accurate than Nitrate Dilution Model which assumes a region wide average groundwater recharge level and lot size.

As used above, the UAL for phosphorus comes from the NJDEP TMDL report, the UAL for total suspended solids and nitrogen come from the New Jersey Stormwater BMP Manual (Chapter 3: Regional and Municipal Stormwater Management Plans, February 2004).

To determine non-point source pollutant loadings at the build-out scenario, first, the new impervious surface at build-out was calculated. For any residential area with the minimum lot size more than 3 acres, we use the average 1.2 acres as the new impervious surface. The 1.2-acre standard comes from a study by Camp Dresser & McKee Inc. (CDM) who performed research associated with the "Watershed Model for Watersheds of the Spruce Run Reservoir" for New Jersey Water Supply Authority in 2003. For all other residential area with zonings less than 3 acres, we used the percentage of impervious surface summarized from NJDEP 2002 land use land cover data and the local zoning information.

In CDM's study, to evaluate the potential build-out land use scenario, modified impervious surface estimates were developed. The method used in this study to determine impervious surface is based on the assumption that large lot zoning (lots >= 3 acres) will be left in a mostly natural state (low impact development) and that only a small percentage of the lot will contain the house, driveway, patio, pool, etc, herein referred to as the homestead. The study showed that the average area of a homestead is approximately 1.2 acres.

After the total acres of new impervious surface is decided at build-out, the agriculture and forested lands which will be lost and contribute to the new impervious surface should then be calculated to compare the land use type change at the build-out (Table 10). These

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comparisons show how much agricultural and forest lands will be lost and become impervious surface, in turn affecting local streams and lakes, specifically for stormwater management measures, causing pollutant loading and water quality issues.

Table 10: Comparison of land use type and acres change at build-out

	Land Use Type	Total Acres -Residential Build-Out	Total Acres - Commercial Build-Out	Total Acres of Build-Out
Lockatong Creek				
	Ag which will be changed to urban at build-out	1,288.7	296.1	1,584.8
	Forest which will be changed to urban at build-out	943.2	137.9	1,081.0
	New Urban Area at Build-Out	**2,231.9**	**434.0**	**2,665.9**
Wickecheoke Creek				
	Ag which will be changed to urban at build-out	885.4	117.0	1,002.3
	Forest which will be changed to urban at build-out	722.9	54.4	777.3
	New Urban Area at Build-Out	**1,608.3**	**171.4**	**1,779.7**

When the total new impervious surface and the associated loss of agricultural and forest lands are determined at build-out, then UALs for total phosphorus, total suspended solids and total nitrogen can apply to the change of land use type to estimate the total new pollutant loading at build-out, and then compare to the estimated current pollutant loadings.

The tables below show the comparisons between estimated current pollutant loadings versus the build-out for total phosphorus, total suspended solids, and total nitrogen. A total of 1,923 lbs of total phosphorus could be added to the watershed at build-out with 1,111 lbs per year added to Lockatong Creek Watershed and 812 lbs per year added to Wickecheoke Creek Watershed. The total suspended solids at build-out could be reduced by about 174,730 lbs per year with 113,463 lbs reduced in Lockatong Creek Watershed and 61,267 lbs reduced in Wickecheoke Creek Watershed. The reason for the reduction on the total suspended solids loads is because UAL for agricultural lands is usually higher than urban areas, especially for low-density residential areas. So when agricultural lands are developed into low-density residential areas, as the case in the Lockatong and Wickecheoke Creek Watersheds, a reduction of total suspended solids at build-out will happen. For the pollutant loads of total nitrogen, the watershed will see an increase of 29,014 lbs per year for the whole watershed with 17,165 lbs increase in Lockatong Creek Watershed and 11,849 lbs added to Wickecheoke Creek Watershed.

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Table 11: Comparison of current non-point source pollutant loadings versus build-out for total phosphorus (TP) based on Unit Aerial Loading (UAL) for Lockatong Creek and Wickecheoke Creek Watersheds

	Land Use Type	Total Acres	TP UAL (lb/acre/yr)	TP UAL (lb/yr)	Total Existing TP Loadings (lb/year)	Post Build-Out TP Loadings (lb/year)	TP Loadings% Difference
Lockatong Creek							
	Ag which will be changed to urban at build-out	1,584.8	1.3	2,123.6			
	Forest which will be changed to urban at build-out	1,081.0	0.1	97.3			
	New urban area at build-out	2,665.9	1.25 - Average	3,332.4			
Totals					10,863.6	11,975.1	10.2
Wickecheoke Creek							
	Ag which will be changed to urban at build-out	1,002.3	1.3	1,343.1			
	Forest which will be changed to urban at build-out	777.3	0.1	70.0			
	New urban area at build-out	1,779.7	1.25 - Average	2,224.6			
Totals					11,783.3	12,594.9	6.9

Table 12: Comparison of current non-point source pollutant loadings versus build-out for total suspended solids (TSS) based on Unit Aerial Loading (UAL) for Lockatong Creek and Wickecheoke Creek Watersheds

	Land Use Type	Total Acres	TSS UAL (lb/acre/yr)	TSS UAL (lb/yr)	Total Existing TSS Loadings (lb/year)	Post Build-Out TSS Loadings (lb/year)	TSS Loadings% Difference
Lockatong Creek							
	Ag which will be changed to urban at build-out	1,584.8	300.0	475,440.0			
	Forest which will be changed to urban at build-out	1,081.0	40.0	43,240.0			
	New urban area at build-out	2,665.9	152 - Average	405,216.8			
Totals					2,337,681.2	2,224,218.0	-4.9
Wickecheoke Creek							
	Ag which will be changed to urban at build-out	1,002.3	300.0	300,690.0			

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	Forest which will be changed to urban at build-out	777.3	40.0	31,092.0			
	New urban area at build-out	1,779.7	152 - Average	270,514.4			
Totals					2,556,632.0	2,495,364.4	-2.4

Table 13: Comparison of current non-point source pollutant loadings versus build-out for total nitrogen (TN) based on Unit Aerial Loading (UAL) for Lockatong Creek and Wickecheoke Creek Watersheds

	Land Use Type	Total Acres	TN UAL (lb/acre/yr)	TN UAL (lb/yr)	Total Existing TN Loadings (lb/year)	Post Build-Out TN Loadings (lb/year)	TN Loadings% Difference
Lockatong Creek							
	Ag which will be changed to urban at build-out	1,584.8	10.0	15,848.0			
	Forest which will be changed to urban at build-out	1,081.0	3.0	3,243.0			
	New urban area at build-out	2,665.9	13.6 - Average	36,256.2			
Totals					104,799.5	121,964.7	16.4
Wickecheoke Creek							
	Ag which will be changed to urban at build-out	1,002.3	10.0	10,023.0			
	Forest which will be changed to urban at build-out	777.3	3.0	2,331.9			
	New urban area at build-out	1,779.7	13.6 - Average	24,203.9			
Totals					115,893.5	127,742.5	10.2

Summary and Recommendations

Due to changes in zoning, open space planning, transfer of development rights, environmental regulations, and socioeconomic factors, and the local ground-water recharge and supply, the actual build-out landscape may deviate from the scenarios predicted in this analysis. However, based on the current situation, the analysis clearly identifies the potential for a large amount of development to occur.

The build-out analysis can go further than accomplished within the scope of this report. In addition to pollutant loadings and impervious surface, the analysis can be used to assess open space plans, and to project school population and demand on municipal services. The build-out analysis can greatly benefit a municipality by envisioning its

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future so steps can be taken to prevent unwanted impacts, and to facilitate plans for future needs.

It is important to note that, although the UAL for total suspended solids of agricultural lands are higher than most of the urban areas, especially for low density residential areas, the total loads of suspended solids due to stormwater runoff may decrease due to the conversion of agricultural lands to low density residential. But the percentage of impervious surface increases dramatically, and if those impervious surfaces are not managed properly to capture stormwater runoff flows, these high flows will increase stream bank erosion, thereby increasing sediment loads to the receiving waters. Properly managing impervious surface with updated zoning, and applying BMPs on agricultural lands (i.e., such as those proposed in ***Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Plan – Recommended Watershed-Based Implementation Projects***) are recommended for the prevention of pollutant loads reaching the streams. Each municipality is also encouraged to do their own build-out analysis for pollutant loads for each parameter for the whole municipality since this report only accomplished the portion of each municipality within the Lockatong and Wickecheoke Creek Watersheds.

The build-out results indicated a total of 4,400 acres of new impervious surface converted from either agricultural or forest lands. Proper policies are needed to accommodate this change and mitigate the impacts of impervious surface, such as restoration and protection of vegetation corridors along riparian zones with municipal ordinances. Examples are presented in ***An Assessment of Municipal Plans, Policies and Regulations Effecting Water Quality in the Lockatong and Wickecheoke Watersheds***. Educational programs are recommended for municipal officials and the public about the problems associated with impervious surface, as well as ways to reduce non-point source pollution. If development in the watershed is further limited, through aggressive land preservation efforts, the ultimate impervious surface cover would be reduced. It may be feasible to accomplish this through widespread participation in New Jersey's farmland preservation and open space protection programs. Stormwater runoff can further be reduced through innovative roadway runoff and drainage mitigation techniques; installation of rain gardens and other runoff controls on individual lots; recognition of site-specific characteristics and construction activities that are prone to, or cause additional soil compaction and the associated loss of infiltration and increased runoff (i.e., installation and maintenance of lawns, athletic fields, and some types of structural stormwater controls); and through continuous public education.

Future work could focus on developing a water budget for the Lockatong and Wichecheoke Creek waterhsheds. Additionally, the impacts on non-point source pollutant loadings from agriculture versus urban development could be further examined and calibrated, as there is great potential within the Watersheds for agricultural and forest lands to be converted to residential development in the future.

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Document Content(s)

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Work/Quality Assurance Project Plan

Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Project

319(h) Grant

Contract: RP05-082

QAPP was organized according to NJDEP specifications:
Appendix D, Quality Assurance Project Plan (QAPP)
Guidance for 319(h) Nonpoint Source Projects

New Jersey Water Supply Authority
Watershed Protection Programs Unit

Draft - June 7, 2006
Revisions - August 30, 2006
Final Draft – January 18, 2007
Final – May 15, 2007
(Response to NJDEP comments italicized and bold in narrative)

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Work/Quality Assurance Project Plan

Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Project

Contract RP05-082

Approved By: **Date**

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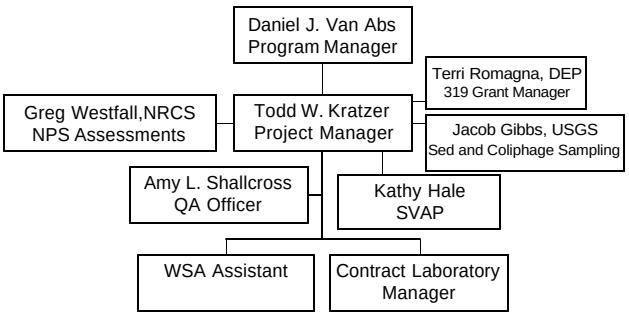
PROJECT ORGANIZATION



Daniel J. Van Abs, PhD, PP/AICP
Program Manager: Coordinates resources (staff and funding) to facilitate the success of the program. Provides overall review of program progress and schedules.

Todd W. Kratzer, PE
Project Manager: Oversees the project schedule and assignments (monitoring and reporting) for project tasks. Supervises field duties; assists with sample collections and training; and provides data analyses, interpretation, management, and reporting. Coordinates efforts with USGS for sampling schedules and collections, and data management.

Amy L. Shallcross, PE
QA Officer: Provides review of field and laboratory QA/QC procedures and manages the implementation of correction measures, if necessary. Provides technical review of field and laboratory data management, validation, and reporting. Assists with sample collections and the associated training.

Kathy Hale
SVAP Specialist: Coordinates and manages field assessment work for segments of the stream channel. Provides training for field assistant(s).

Jacob Gibbs, PhD
Manager for USGS sampling and data management. Coordinates all sampling procedures, efforts, and QA/QC with Project Manager and QA Officer.

Terri Romagna
NJDEP WMA11 319(h) Grant Manager. Reviews and assesses progress and outputs from project, via quarterly progress reports.

Greg Westfall
Manager for NRCS Erosion Assessments. Coordinates phosphorus and sediment loading assessments and RUSLE2 modeling efforts with NRCS personnel and Project Manager.

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Tara Petti
Field Scientist: Assists with sample collections, QA/QC, data management, maintenance and calibration of monitoring equipment, and other duties as necessary.

Thomas Hines, President QC Laboratories, Inc.
Laboratory contact for analytical processing. Oversees proper techniques for sample preservation, transport of samples from field to laboratory, and all laboratory QA/QC procedures for sample analysis and data reporting, as well as assuring supplies of sampling containers, labels, and coolers.

PROBLEM DEFINITION AND BACKGROUND

The Delaware and Raritan Canal transfers water from the Delaware River Basin to the Raritan River Basin, where the raw water is treated to become drinking water for approximately 600,000 people living in and outside of the Raritan Basin, including customers of NJ American (Elizabethtown) Water Company, Middlesex Water Company, the Townships of East Brunswick and North Brunswick, and the City of New Brunswick. The entire length of the Delaware and Raritan Canal (D&R Canal) is classified as FW2-NT; Category 1 status is under consideration by the New Jersey Department of Environmental Protection (NJDEP) but has not been proposed. Since 1997, several of the Canal's water purveyors reported increased concentrations of total suspended solids and total organic carbon in the raw water during and immediately after precipitation events, requiring increased chemical use for removal and increasing sludge generation from residuals. The New Jersey Water Supply Authority (NJWSA) has sponsored three studies to assess pollutant contributions to the Canal; one in the late 1980's by Ebasco; another in the late 1990's by USGS and a third in 2006 by the NJWSA. The Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Program 319(h) proposal provides additional background information and is presented in Attachment 1.

The Lockatong and Wickecheoke Creek Watersheds drain a significant section of western Hunterdon County, in areas predominated by very poor aquifers in the Lockatong and Stockton formations. Theses watersheds flow into the D&R Canal. NJDEP has identified a variety of water quality problems in the two watersheds including impairments for fecal coliform, phosphorus and temperature, plus impaired benthic macroinvertebrate communities. Table 1 shows the 2004 Integrated List results for the Lockatong and Wickecheoke Creek Watersheds, including changes presented in the draft 2006 Integrated List.

The watersheds are primarily rural in nature, with scattered farms, homes, county and local roads, etc. Soils tend to be thin, and water resources minimal, due to their location on the Hunterdon (or Croton) Plateau with its hard argillite bedrock. Approximately 48% of the watershed is forested or wetlands, 40% is agricultural and 10% is urban, according to NJDEP 1995/97 GIS land use information. Development within the watersheds relies primarily on on-site well water and wastewater discharge through septic systems. The Delaware Township MUA is the only permitted WWTP discharge, on a tributary to the

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Wickecheoke Creek. This tributary is known locally as Rose Brook. The agricultural lands are primarily used for crops: sunflowers, sorgum, corn, hay and some pasture.

Streams are "flashy" due to the poor ground water recharge and storage capacity – stormwater moves quickly to streams, and dry periods result in very low or no stream flows. NRCS has noted stream bank erosion and soil erosion from surrounding lands. NJWSA has documented major sediment loading to the Delaware & Raritan Canal during storms. Phosphorus can be contributed to streams by erosion, agricultural and lawn fertilizers, livestock, pets, and wildlife. Fecal coliform bacteria can contribute to stream degradation by septic system failure; and/or livestock, pets and wildlife feces. Temperature violations can be caused by the loss of natural riparian areas, stormwater runoff from impervious surfaces near streams, and the periodic low flows that typify the streams. NJDEP has prepared fecal coliform and phosphorus TMDLs for the Lockatong and Wickecheoke Creeks. This project will provide vital information to support TMDL implementation, along with management approaches to address current problems. The two watersheds were part of the Central Delaware Tributaries (WMA 11) Watershed Management Project (see www.planningpartners.org/projects/past/wma11.html) conducted by the Regional Planning Partnership, which developed information that can be used in this project. The watersheds represent nearly 60 percent of the total drainage into the Delaware and Raritan Canal (Figure 1, downstream of the Delaware River intake). Therefore, these watersheds are very important to the Canal water quality and for the amount of sediment loads that must be dredged from the Canal at the location of discharge. Both watersheds have been granted Category 1 status.

PROJECT/TASK DESCRIPTION

The objectives of this study are to:

- ?? ***Collect water quality and flow data to define the existing conditions within 20 selected subbasins of the Lockatong and Wickecheoke Creek Watersheds (Phase 1, see Figure 2);***
- ?? ***Isolate and target subbasins contributing the largest loadings (Phase 2);***
- ?? ***Provide recommendations to Hunterdon County Health Department and County Soil Conservation Division for on-site source tracking***
- ?? ***Apply results from this project to an appropriate sediment transport and/or water quality model(s) to assist in source-tracking , and to simulate loadings based on existing and future land uses and zoning.***
- ?? ***Supplement the implemention of a watershed management plan to restore and protect water quality and flows, using the modeling results as a water quality/quantity management tool.***

There are 4 components, described below, to the project for defining water quality and identifying loading sources within the mainstem and tributaries of the Lockatong and Wickecheoke watersheds.

1. Water Quality Monitoring - Phase 1

NJWSA will conduct water quality monitoring at 9 sites in the Lockatong watershed and at 11 sites in the Wickecheoke watershed as shown in Figure 2. A synoptic water quality

Table 1. 2004 Integrated Listings for Lockatong and Wickecheoke Creek Watersheds (includes changes presented in the draft 2006 Integrated Listings)

Sublist	Station Name/Waterbody	Site ID	Parameters	Data Source
1	Lockatong Creek at Oak Grove Rd in FranklIn	AN0086	Benthic Macroinvertebrates	NJDEP AMNET
1	Lockatong Creek at Rosemont-Raven Rock Rd Bridge	DRBCNJ0013	Fecal Coliform, Dissolved Oxygen, pH, Nitrate, Dissolved Solids, Total Suspended Solids, Unionized Ammonia	DRBC
5	Lockatong Creek at Rosemont-Raven Rock Rd Bridge	DRBCNJ0013	Phosphorus[*], Temperature[d]	DRBC
1	Lockatong Creek at Rt 12 in KIngwood	AN0087	Benthic Macroinvertebrates	NJDEP AMNET
1	Lockatong Creek at Rt 29 in Delaware	AN0089	Benthic Macroinvertebrates	NJDEP AMNET
1	Lockatong Creek at Rt 519 in KIngwood	AN0088	Benthic Macroinvertebrates	NJDEP AMNET
3	Plum Brook at Rt 579 in Raritan	AN0092	Benthic Macroinvertebrates	NJDEP AMNET
5	Plum Brook near Locktown	01461262	Fecal Coliform[*]	NJDEP/USGS Data
3	Plum Brook near Locktown	01461262	Phosphorus[*]	NJDEP/USGS Data
1	Plum Brook near Locktown	01461262	Temperature[*], pH, Nitrate, Dissolved Solids, Total Suspended Solids, Unionized Ammonia	NJDEP/USGS Data
3	Wickecheoke Creek at Croton	01461220	Phosphorus[*], Dissolved Oxygen	NJDEP/USGS Data
1	Wickecheoke Creek at Croton	01461220	Temperature[d], pH, Nitrate, Dissolved Solids, Total Suspended Solids, Unionized Ammonia	NJDEP/USGS Data
5	Wickecheoke Creek at Croton	01461220	Fecal Coliform[*]	NJDEP/USGS Data
5	Wickecheoke Creek at Locktown - Sergentsville Rd in Delaware	AN0091	Benthic Macroinvertebrates	NJDEP AMNET
1	Wickecheoke Creek at Rt 29 in Stockton	AN0095	Benthic Macroinvertebrates	NJDEP AMNET
3	Wickecheoke Creek at Rt 579 in Raritan	AN0090	Benthic Macroinvertebrates	NJDEP AMNET
1	Wickecheoke Creek at Sergentsville Rd in Delaware	AN0094	Benthic Macroinvertebrates	NJDEP AMNET
1	Wickecheoke Creek at Stockton	01461300, DRBCNJ0012	pH, Dissolved Oxygen, Nitrate, Dissolved Solids, Total Suspended Solids, Unionized Ammonia	NJDEP/USGS Data, DRBC
5	Wickecheoke Creek at Stockton	01461300, DRBCNJ0012	Phosphorus[*], Fecal Coliform[*], Temperature[*]	NJDEP/USGS Data, DRBC
3	Wickecheoke Creek near Sergentsville	01461282	Phosphorus[*]	NJDEP/USGS Data
1	Wickecheoke Creek near Sergentsville	01461282	Temperature[*], pH, Dissolved Oxygen, Nitrate, Dissolved Solids, Total Suspended Solids, Unionized Ammonia	NJDEP/USGS Data
5	Wickecheoke Creek near Sergentsville	01461282	Fecal Coliform[*]	NJDEP/USGS Data

[*] Moved to sublist 4 on the Draft 2006 Integrated List
[d] Delisted on the Draft 2006 Integrated List

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Figure 1. **Direct Drainage to the Delaware & Raritan Canal**

(Downstream of the Delaware River Intake)

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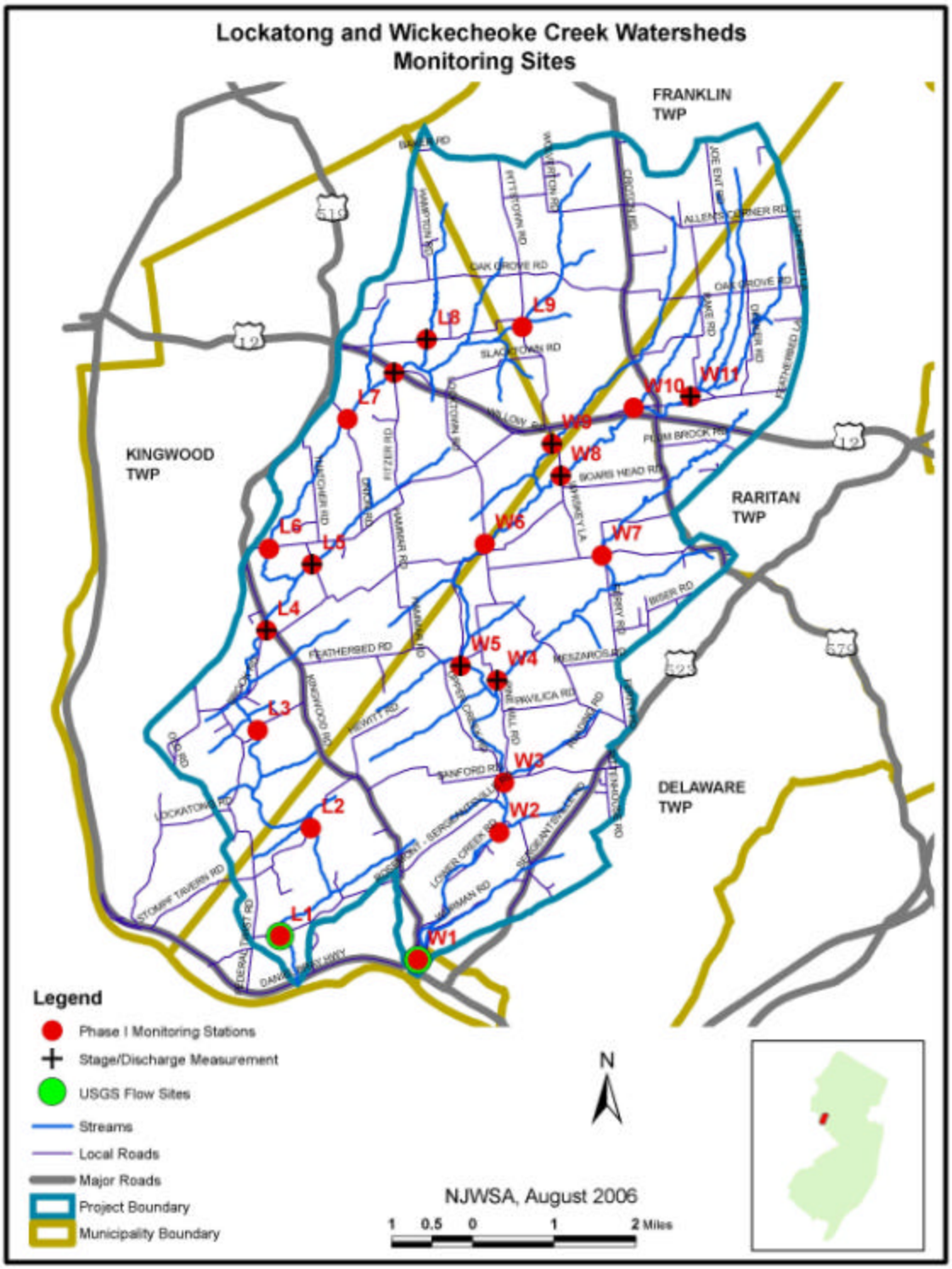
Figure 2. Sampling site locations within the Lockatong and Wickecheoke Watersheds for Phase 1 of the monitoring program.



and flow-monitoring program (Phase 1) will be performed at all 20 sites for 3 storm-induced flows and 3 baseflow conditions. ***Storm flows, or higher flows are represented by an abrupt increase in flow from runoff after the onset of a precipitation event. Lower flow is equivalent to baseflows, or flows unaffected by stormwater.*** USGS flow-monitoring stations, one located near the mouth of each stream, will be used to determine when runoff has commenced from storm events and at what point on the discharge hydrograph the samples were actually collected.

The 20 sampling sites are listed in Table 2, including the type of flow monitoring associated with selected sites. Water quality concentrations during storm-runoff events are dominated by non-point source loadings, whereas point-source/ground water loadings are more prevalent during baseflows. Total phosphorus, total suspended solids (TSS), fecal coliform, nitrite+nitrate, total Kjeldahl nitrogen (TKN), ammonia, boron, and turbidity will be analyzed by QC Laboratories as specified in the Request for Laboratory Services (Attachment 2). QC Laboratories is preparing to analyze E. coliform samples in 2007. Specific-conductivity, pH, and water and air temperature data will be monitored by the field crew at each sampling site using a YSI 63 field meter. The Standard Operating Procedure (SOP) for the YSI meter is presented in Attachment 3. Table 3 presents the sampling schedule and number of samples collected at each site. Flow data will be collected continuously at USGS flow monitoring stations that have been installed as part of this study near the mouth of each watershed. The ***collected data will provide*** a better evaluation of pollutant loadings within the full range of flows experienced during the project period.

Stage/discharge relationships, based on instantaneous flow measurements, will be developed at selected sites upstream of the USGS stations to determine whether flow versus drainage area is proportional throughout the watersheds. ***Sites are initially selected to partition the watershed into subsections representing the lower, middle, and upper watershed areas. Tributaries that contribute flow during summertime baseflows are also selected. Visual inspections of channel characteristics and instantaneous flow measurements are used to determine areas of stream reaches that gain or lose flow and those reaches or tributaries that provide a more constant baseflow from springs. Water quality monitoring sites that do not have a flow-to-drainage-area ratio consistant with the continuous USGS flow-measurement stations, near the mouth of the streams, are selected for the development of a stage/discharge relationship. Instantaneous flow measurements are conducted according to "USGS Measurement and Computation of Streamflow, Water Supply Paper 2175" at selected sites (see Table 2), usually near bridges for establishing an accessible elevation datum on the bridge deck.*** Associations between flow and drainage area can be established to determine if there are stream segments that are gaining or losing flow, thus providing more accurate loading estimates at the upstream sites. Water quality data combined with flow from the first phase will provide a summary of subreaches exhibiting greater loadings of the measured parameters.

2. Water Quality Monitoring - Phase 2

The monitoring sites will be reevaluated, based on results from Phase 1, and relocated where necessary, to focus on the subreaches with the greater loadings, or where the concentration of fecal coliform or total phosphorus exceed the Standards. ***Each parameter can be associated with specific sources (see LOADINGS AND WATER QUALITY INDICATORS section).***

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Table 2. Monitoring site locations and flow monitoring for Phase 1 of the monitoring program.

Site Code[1]	Other Site Codes	Location	Flow-measurement
Lockatong Watershed (sites ordered from downstream to upstream)			
L1	DRBCNJ0013	Rosemont-Raven Rock Rd Bridge	USGS, Continuous
L2		Stompf Tavern Rd Bridge	
L3		Milltown Rd Bridge	
L4	AN0088, 8869600629, 8869600622	Route 519 Bridge	WSA, Instantaneous
L5		Muddy Run, Muddy Run Rd Bridge	WSA, Instantaneous
L6		Barbertown-Point Breeze Rd Bridge	
L7		Union Rd Bridge (Kingwood Park)	
Rt 12 Bridge	AN0087, 01460860, 6969601069	Route 12 Bridge	WSA, Instantaneous
L8		Middle Trib, Lower Oak Grove Rd Bridge (#K131)	WSA, Instantaneous
L9		Rt 615 (Pittstown Rd) Bridge	
Wickecheoke Watershed (sites ordered from downstream to upstream)			
W1	DRBCNJ0012, 01461300, 8853600031, AN0095	Rt 29 Bridge	USGS, Continuous
W2		Just Downstream of WWTP Trib	
W3	01461282	Rosemont-Sergeantsville Rd (Rt 604 at Covered Bridge)	
W4	8857600022, 8857600019	Plum Brook, Pinehill Rd Bridge	WSA, Instantaneous
W5		Old Mill Rd Bridge	WSA, Instantaneous
W6	8853600715	Locktown Rd Bridge	
W7		Plum Brook, Locktown-Flemington Rd Bridge	
W8		Whiskey Lane Bridge	WSA, Instantaneous
W9		Trib - Whiskey Lane Bridge	WSA, Instantaneous
W10		Trib – Old Croton Rd Bridge	
W11		Rake Rd Bridge	WSA, Instantaneous

[1] Sampling sites are located in Figure 1.

Table 3. Number of water quality and QA/QC samples analyzed for each parameter per month.

			Number of Samples/Site							
Year/ Month	**Monitoring Phase**	**Number of sites**	**Routine**	**TKN & Ammonia**	**NO_2+NO_3**	**Coliphage**	**Sediment total P**	**SVAP**	**Cross-section survey**	**QA/QC**
2006										
August	1	20	2	2	2					2 Blank, 4 Dupl
September	1	20	2	2	2					2 Blank, 4 Dupl
October	1	20	1	1	1			v		1 Blank, 2 Dupl
November	1							v		
December	1	20	1	1	1					1 Blank, 2 Dupl
2007										
February	2	14	1	pending	pending					1 Blank, 1 Dupl
April	2	14	1	pending	pending					1 Blank, 1 Dupl
May	2	14	2*	pending	pending			v		2 Blank, 2 Dupl
June	2	14	2	pending	pending			v		2 Blank, 2 Dupl
July	2	14	2	pending	pending			v	v	2 Blank, 4 Dupl
Coliphage		6				6				3 Blank, 0 Dupl
Sed TP		4					4			
Routine		6	1							1 Blank, 1 Dupl
Aug - Sept	2								v	Missed samples

Schedule subject to change due to unanticipated weather or flow conditions.

Routine parameters are: fecal coliform, E. coliform (only during 2007), TSS, total P, turbidity, boron, specific conductivity, pH, and air and water temperature.

* In addition to the routine sampling events, two or three additional sampling events for only fecal coliform and E. coliform analyses will be conducted during May through July 2007, if necessary, to satisfy the DEP data density of 5 samples in 30 days***. Only* conductivity, pH, and air and water temperature monitoring will accomodate any additional bacterial samplings.***

Land use and land cover will be partitioned in the drainage area from each sampling site to determine relationships between land use and loadings. If land use does not indicate potential sources for elevated loadings, then further investigation will be conducted in Phase 2 for those stream reaches that may be prone to direct discharges, livestock, or other potential sources of loadings. Sites having constant or prevalent greater loadings of solids, nutrients, and/or bacteria than neighboring sites will continue to be monitored in Phase 2. When access is possible, subbasins upstream of sites with greater loadings will be monitored to further isolate the source(s) of contamination.

During Phase 2, the total number of monitoring sites is anticipated to be 14 or fewer. Each of these sites will be sampled 9 times for most of the water quality parameters listed in Phase 1. Ammonia, TKN, and nitrite+nitrate will not be monitored during the second phase, unless the results from Phase 1 show that these water quality parameters are good indicators for the existing loadings (see "Loadings and Water Quality Indicators" section). ***If nitrate parallels the boron***

results, then this will depict loadings emanating mainly from human sources and only boron will be necessary to further track these sources. Total Kjeldahl nitrogen (TKN) and ammonia concentrations at or near the detection limits will be basis for discontinuing these parameters. However, TKN loadings directly associated with flow may indicate that these loadings can be directly associated with stormwater runoff, a basis for continuing the sampling for this parameter. Due to the change in the 2007 DEP standards for using E. Coli as the ambient bacteria standard, both E. Coli and fecal coliform will be included in each sampling event during Phase 2. If required, there will be additional samplings for the bacteria parameters to fulfill the DEP requirement of 5 samples within a 30 day period.

3. Sediment and Coliphage sampling

The USGS will ***collect and*** analyze sediment samples at 4 sites for total phosphorus. There are approximately 4 sites that exhibit fine-grained sediments for this type of sampling: 3 within the Lockatong Creek and 1 within the Wickecheoke Creek. Water column samples may be analyzed for coliphage at up to 6 sites. ***USGS, or private laboratory that uses the EPA-approved protocols will perform the analyses. If a private laboratory is selected for the coliphage analysis, the analytical technique will be submitted to the NJDEP for review***. Samples ***for sediment phosphorus and coliphage,*** processed by the USGS, will be subject to their field and laboratory QA/QC and protocol: *U.S. Geological Survey, variously dated, National field manual for the collection of water-quality data: U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chaps. A1-A9,* available online at http://pubs.water.usgs.gov/twri9A. Sampling sites will be selected based on the results from both Phase 1 and Phase 2. Coliphage are viruses that can infect E. coliform bacteria. By determining the genetic grouping of the viruses, the bacteria can be associated with either human or animal fecal contamination.

4. Land Use and Stream Channel Erosion

The NRCS has been contracted to perform sediment erosion and transport estimates for both watersheds based on land use, including road drainage, construction, and agricultural practices. Using the RUSLE2 model, sediment loads will be estimated from subbasins in the watersheds. Stream channel erosion and bank stability will be assessed using a modification of the "USDA Stream Visual Assessment Protocol," photo-documentation, and possibly transect surveys of the channel geometry at selected sites by Authority personnel. All land-use erosion assessments and modeling performed by the NRCS will follow their standard protocol. Low-altitude photoreconnaissance is also being considered for determining the location and extent of channel erosion that is not visible from the sampling sites. A Scope of Work for the NRCS effort is included in Attachment 1.

SAMPLING SITE SELECTION

Sampling sites were selected based on accessibility; representation of land uses/covers within the watersheds; and to isolate smaller watershed areas for further assessment of potential "hot spots." The site locations will be relocated, as appropriate, to further "zero in" on sediment, bacterial, and phosphorus loading sources in Phase 2, after the initial synoptic assessment of water quality during Phase 1.

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LOADINGS AND WATER QUALITY INDICATORS

There are many sources of solids, nutrients, and bacterial loadings to the Lockatong and Wickecheoke watersheds. Specific water quality parameters: total phosphorus, total suspended solids (TSS), fecal coliform, E. coliform, nitrite+nitrate, total Kjeldahl nitrogen (TKN), ammonia, boron, turbidity, specific conductivity, pH, water and air temperature, and flow will be used to refine the location of the loads, as related to the following loading sources.

Point-source loadings

The Delaware Township MUA is the only permitted wastewater treatment plant (WWTP) discharge, located on a tributary to the Wickecheoke Creek (locally known as Rose Brook). A site on this tributary, near the confluence with the mainstem, will be sampled for all of the parameters listed above. All of these parameters are by-products of the bacterial and chemical decomposition of human wastes. Properly maintained and fully-functional WWTPs discharge these components at levels within their permitted limits. Malfunctioning, or mechanical bypass of treatment systems will convey elevated concentrations of these parameters in the effluent.

Septic-system non-point source loadings

Malfunctioning septic systems can be traced with fecal coliform, E. coliform, nitrite+nitrate, and boron analyses. This loading occurs during both storm-induced and baseflows, with higher concentrations usually occurring during the lower flows (less dilution). Fecal coliform and E. coliform can originate from human and animal feces, and can also be present naturally in ponded stream reaches having a silty/mucky anoxic bed material.

Nitrate and boron are very conservative and do not normally become attached to soil particles. Therefore, both of these will be present at stream locations where septic-system problems are encountered. Boron is more indicative of septic discharge, since laundry whiteners are the primary, or in many instances the sole source of this contaminant, whereas nitrate can also enter a stream from agricultural and natural sources. Livestock and wildlife manure, leaf litter, and detritus all produce nitrate. Both of these constituents will be measured during Phase 1 to determine their association and effectiveness for source tracking.

Agricultural/Residential non-point source loadings

Both animal and crop farming can add loads of nutrients, solids, and bacteria to surface and ground water. Application of fertilizers for lawn maintenance can also introduce high levels of nutrients to these water systems. Total phosphorus, nitrite+nitrate, ammonia, TKN, TSS, fecal coliform, E. coliform, and turbidity are good indicators for these loading sources.

Road runoff and drainage non-point source loadings

There are many gravel and dirt roads within the project watersheds, and dirt drainage ditches along both unpaved and paved roads. Runoff from roads occurs quickly, carrying sediment and other road debris into either drainage ravines along the roads or directly into adjacent streams. When roads are positioned on steep slopes, runoff from the surface is quickly concentrated and fast, deeply scouring drainage ravines and carrying large volumes of sediments into the receiving

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stream. Sediments conveyed from steep roads and ravines contain a mixture of sediment sizes, ranging from fine silt to boulders. Runoff flows carrying this material enhances the scouring and erosion of the roadways and stream channels. Turbidity and TSS, and possibly TKN and total phosphorus will provide the best indication of rill and gully erosion.

Internal stream loadings

Stream channels displaying incised/undercut and eroding banks, and scouring and deposition of the channel substrate, can contribute large loads of sediments and nutrients during higher flows. Sediments contain bacteria, nutrients, and solids. Deposits of sediments can be resuspended during storm flows, putting these loads back into the water column. Pooled reaches usually contain a larger supply of deposited sediments. Of the water quality parameters being measured in this project, TKN, TSS, total phosphorus, and turbidity will provide the best indication of suspended sediments. Nitrite+nitrate, fecal coliform, and E. coliform may also prove to be good secondary indicators.

QUALITY OBJECTIVES AND CRITERIA

The project QA is guided by the *NJDEP Field Sampling and Procedures Manual, August 2005*.

Both internal and external quality control will be used in the project. Internally, field sampling and measurement personnel will be trained prior to executing water quality and quantity monitoring. Field blanks will be collected during each sampling event to determine possible sample contamination from collection, preservation, and transport processes. Duplicate samples will be collected from the same water sample, by pouring half of the collected water into each of two containers for laboratory analyses. All monitoring equipment will be calibrated, using the manufacturers' recommended procedure and the Standard Operating Procedures (SOP) in Attachment 3, before sampling and checked during sampling, as necessary. Erratic readings, those at levels beyond the normal range, or those that have problems stabilizing, are considered suspect and reviewed immediately with an in-field calibration check. The Authority's QA Officer will report any data anomalies to the Project Manager and reviews/corrections will be implemented immediately.

External quality controls will be performed by the contract laboratory by using methods blanks, spikes, duplicate samples, maintenance of holding times, and records of analytical equipment calibration. All laboratory QA/QC reports will be reported to the Authority for each sampling event. These reports will be reviewed by the Authority's QA Officer and the Project Manager for possible errors and omissions. Any uncertainty relating to the laboratory data and/or QA report will immediately be presented to the laboratory manager for verification or, if necessary and possible, for reprocessing of the sample.

TRAINING REQUIREMENTS

Field crews will be trained prior to the first sampling event. ***NJDEP does not employ a certification for personnel collecting water quality samples (communications with Marc Ferko). All personnel involved with sample collections are trained prior to the actual sampling event on proper techniques for collecting representative samples, avoidance of sample contamination, and preservation as specified in the NJDEP Field Sampling and***

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Procedures Manual, August 2005. Techniques for collecting samples by wading and from bridge samplers will be presented and performed, and flow measurement techniques will be demonstrated and applied. The Authority has qualified staff with years of experience in both teaching and performing sample collection and handling techniques, sampling equipment calibration, and visual assessment protocol. Todd Kratzer and Amy Shallcross will provide training to field staff for grab sampling, flow measurements, and calibration and use of a Yellow Springs Instrument (YSI) hand meter; and Kathy Hale will present visual assessment protocol techniques.

LABORATORY CERTIFICATION

The contract laboratories: QC laboratories, Inc, and USGS, are certified for the laboratory analyses to be used in this program. ***QC Laboratories, NJ certification ID# PA166, is certified for the TSS, turbidity, nitrite+nitrate, TKN, ammonia, fecal coliform, boron, and total phosphorus analyses. They are also certified for E. Coli analysis, using the EPA 1103.1 E. Coli technique, NJ certification ID# PA001.*** USGS uses techniques accepted by DEP for coliphage and sediment total phosphorus analyses. The Authority has obtained certification for "analyze immediately" conductivity, pH, and temperature to be measured with a YSI hand meter. The SOP and certification are presented in Attachments 3 and 4, respectively.

DOCUMENTATION AND RECORDS

The final QAPP will be available on the Authority's Web site with any addendums attached. Those listed on the "Distribution List" will be notified to update their files with any changes to the file on the Web. Any addendums that address monitoring or sampling will be submitted to the Office of Quality Assurance at DEP.

Reports on the monitoring program will be submitted in the quarterly report to the 319(h) grant manager for review. The reports will include copies of field data sheets, chain-of-custody, meter calibration records, and laboratory QC reports for that portion of the sampling program. The collected data will be provided in the report and available on the Authority's Web site. Any QC problems will be submitted to the Office of Quality Assurance and the 319(h) grant manager for evaluation.

The final report will include an Appendix containing all field and laboratory results, laboratory reporting limits for each parameter, and any noted QC discrepancies. The report will be formatted as a Word® document. All field data will be provided as an Excel® spreadsheet.

SAMPLING PROCESS DESIGN

Ambient Samples

Samples will be collected by trained field personnel at selected locations that best represent the existing water quality and flow conditions at each sampling site. Samples will be collected from either a bridge, by wading into the channel, or by use of an extension rod from the stream bank. Personnel wading to collect samples will enter the stream at a location downstream from the sample-collection site and move upstream to the site to prevent disturbance of sediments. Samples will always be collected upstream from the wader's location. At most sites, a single

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location that visually represents the average flow will be sampled. Average flow is the location within the channel where the width and depth of the flow volume represents an approximate average condition. At sites having water depths of 2 or more feet, samples will be collected at approximately 1 foot below the water surface. When a channel has a split flow, or a tributary enters at the site and there is no access to a more representative site, the sample will contain a visual flow-weighted volume of sample from the individual flow channels. Whenever possible, the samples will be collected at a downstream location that best represents the mixed volume of flow.

All samples will be collected from ambient stream sites with a collection bottle. The collection bottle will be either a 500ml or 1 liter capacity. This bottle will be used to fill all of the routine, duplicate, and blank sample bottles. The bottle will be filled and purged 2 times at the site before the actual sample is collected. As each sample bottle is filled, an air space will be left to allow the sample to be shaken for mixing the contents prior to analysis. All sample containers will be pre-labeled and grouped for individual sites prior to the sampling event. Site code, date, and the collection time will be written on the label with an indelible ink pen and also entered onto the field data sheet. As samples are collected, they will be immediately transferred to an enclosed ice chest and stored at $4^{o}C$ until processed for analysis. Bacteria samples will be sealed in zip-lock bags to add additional prevention against possible contamination from ice water. Samples requiring special preservatives will be put into bottles that were prepared with the proper preservatives and transported in the iced coolers. TSS and turbidity do not require any preservatives. Boron will be preserved with nitric acid. Ammonia, TKN, NO_2+NO_3, and total phosphorus will be preserved with sulfuric acid. Fecal coliform and E. coliform samples will be collected in sterile containers with a sodium thiosulfate (dechlorination) tablet. All samples will be cooled in sealed ice chests, transported to the laboratory, and processed within the required holding time.

Tables 4 and 5 show the water quality parameters to be analyzed by the laboratory and in the field, and the expected detection limit for each parameter, respectively. Field monitoring for pH, specific conductivity, and air and water temperature will accompany the sample collections, in addition to flow measurements at selected sites. A Yellow Springs Instrument (YSI) hand meter will be used to measure pH, specific conductivity, and air and water temperature. The meter probe will be totally submersed in the water column, suspended above the channel bottom at sites with fine-grained sediments. At sites having water depths of 2 feet, or more, the probe will be positioned approximately 1 foot below the water surface. During low flows, it may be necessary to gently position the probe on available rock substrate in shallow water. The probe will always be oriented so that the sensors on the probe will not be in direct contact with the substrates.

When the streams are not wadeable due to higher flows, or during very low flows that create shallow, pooled stream reaches with silty sediments, the collection bottle will be strapped to a weighted harness that is suspended from a line, and lowered from a bridge deck. The harness submerges the sampling bottle horizontally into the water, thus not disturbing the sediment, and tips upward as it is withdrawn from the water to collect the sample. The weighted harness design was based on an adaptation of the design illustrated in *Chapter 5A of the NJDEP Field Sampling Procedures Manual, August 2005*. The collection harness can also be connected to an extension pole to fill the collection bottle from the channel bank during higher flows at sites where a bridge is not present.

Table 4. Water quality parameters, analytical and preservation methods, and holding time.

Parameter	Container	Method	Preservation	Holding Time
Water and air temperature	N/A	SM 2550B	N/A	Analyzed at site
Specific conductivity	N/A	SM 2510B	N/A	Analyzed at site
pH	N/A	SM 4500-H B	N/A	Analyzed at site
Fecal coliform	Plastic	SM 9222D	Cool 4°C, 0.008% $Na_2S_2O_3$	6 hours
E. Coli.	Plastic	EPA 1103.1	Cool 4°C, 0.008% $Na_2S_2O_3$	6 hours
Total phosphorus	Plastic	EPA 365.1 & 365.2	Cool 4°C, H_2SO_4 to pH<2	28 days
Nitrite+Nitrate - N	Plastic	EPA 300 and SM 4500 NO_3 F	Cool 4°C, H_2SO_4 to pH<2	28 days
Total Kjeldahl Nitrogen	Plastic	EPA 350.2 and 350.3	Cool 4°C, H_2SO_4 to pH<2	28 days
Ammonia - N	Plastic	EPA 350.2	Cool 4°C, H_2SO_4 to pH<2	28 days
Boron - total	Plastic	EPA 200.7	HNO_3 to pH<2	6 months
Turbidity (NTU)	Plastic	EPA 180.1	Cool 4°C	48 hours
Total Suspended Solids	Plastic	SM 2540D	Cool 4°C	7 days
Sediment Total P	Plastic	USGS[1]	Cool 4°C	7 days
Coliphage	Plastic	EPA Coliphage method or USGS[2]	Cool 4°C, 0.008% $Na_2S_2O_3$	48 hours

[1] Modification of EPA methods 365.1 and 365.2. Sampling methods are described in *USGS Water Quality Information, Field Procedures*.

[2] Application of EPA 1601 or 1602 technique.

Duplicate Samples

Duplicate samples will be collected by equally dividing the water in the collection bottle between 2 identical sample containers for each parameter. The collection bottle is refilled as necessary to fill all of the regular and duplicate containers.

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Field/Method Blanks

The sampling container will be rinsed twice with distilled water and then used to transfer distilled water into a group of the same bottles used for the ambient samples. These bottles will be labeled the same as the ambient samples and undergo the same preservation, transport, and analytical processes.

SAMPLING METHOD REQUIREMENTS

Samples will be collected, preserved, and transported within recommended holding times to the contract laboratory (QC Laboratories) as prescribed in the *NJDEP Field Sampling Procedures Manual, August 2005*.

Table 5. Field and laboratory analyses and detection limits.

Parameter	Field/Lab Measurement	Detection Limit
Water Temperature	Field	0.1 ^{o}C
Air Temperature	Field	0.1 ^{o}C
Specific Conductivity	Field	0.1 us/cm
pH	Field	0.1 Standard Unit
Fecal coliform & E. coliform*	Laboratory	1 colony/100 ml
Total Phosphorus	Laboratory	0.02 mg/l
Nitrite+Nitrate	Laboratory	0.04 mg/l
Ammonia	Laboratory	0.02 mg/l
TKN	Laboratory	0.05 mg/l
TSS	Laboratory	1 mg/l
Turbidity	Laboratory	0.1 mg/l
Boron	Laboratory	5 µg/l
Coliphage	Private Laboratory or USGS	Not applicable
Sediment Total Phosphorus	USGS	0.8 mg/kg for a 100 mg sample

* E. Coliform will be included for analyses during the 2007 sampling events.
Specific analytical method and holding time for each parameter are listed in Table 4.

The sampling crew will meet at a designated site for each sampling event. Arrangements for sample pick-up, and replacement of ice chests and sample containers, will be made with QC Laboratories prior to initiating the sample collection. Water-quality monitors will be calibrated prior to embarking for the first sampling site, and as necessary during the sampling event, according to the manufacturer's recommended technique. Calibration notes will be recorded and filed for each calibration. The following equipment will be loaded into the field vehicle for each day of sampling:

- ? ? Hip boots
- ? ? Clip board, pencils, and waterproof marker
- ? ? Site-Visit Data sheets (Appendix A)

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- ? ? Equipment Calibration Log sheets (Appendix B)
- ? ? Chain-Of-Custody sheets (Appendix C)
- ? ? Streamflow Data sheets (Appendix D)
- ? ? Labeled sample-collection containers for each site, preservatives included
- ? ? Coolers with ice
- ? ? Zip-lock bags for storing bacteria-sample containers
- ? ? Bridge and shoreline sampler
- ? ? Flow-measurement equipment and spare parts
- ? ? Rain gear
- ? ? First-Aid kit
- ? ? Emergency and personnel phone numbers
- ? ? Cell phone
- ? ? Vehicle communication radio
- ? ? Field water quality meters
- ? ? Calibration equipment for the field meters
- ? ? Distilled/deionized water in squirt bottles
- ? ? Sun screen and insect repellent
- ? ? Spare clothes
- ? ? Drinking water
- ? ? Antibacterial cleanser for hands

Each sampling crew will consist of a minimum of 2 staff for sampling efficiency and safety. Samples will be collected consecutively in an upstream direction for half of the sampling events and in a downstream direction for the other half of the sampling events. This will determine if water quality has temporal variability during the day. Collection of samples will commence between 6 and 11 a.m. for low-flow samples. Storm-flow samples will be collected at times commensurate with the runoff hydrograph at the USGS gaging sites. Appropriate sample bottles will be filled at each site, using a collection bottle. Samples will be collected, preserved and transported to the laboratory as specified in the "Sampling Process Design" section.

SAMPLE HANDLING AND CUSTODY PROCEDURES

All samples will be packed into a dark cooler for preservation at 4 ^{o}C. Specific preservation requirements and holding times are listed in Table 4. A chain-of-custody form will be attached to the cooler and signed by the sample collector and then by the laboratory analyst as he/she receives the samples. The chain-of-custody form will be similar to that presented in Chapter 10 of the NJDEP Field Sampling Procedures Manual, "New Jersey Department of Environmental Protection External Chain of Custody and Sample Analysis Request Form." An example is presented in Appendix C.

ANALYTICAL METHODS REQUIREMENTS

A contract has been awarded to QC Laboratories for the "Laboratory" analyses presented in Table 5. "Field" measurements will be conducted at the site by NJWSA staff, using a Yellow Springs Instrument (YSI) 63 conductivity, pH, and temperature meter. The meter will be

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calibrated just before the start of each sampling run, and during the sampling run, as required. The detection limits listed in Table 5 are anticipated.

QUALITY CONTROL REQUIREMENTS

Field and laboratory audits, and field orientation and training, will be performed by the QA Officer and Project Manager prior to initiation of the sampling program, and semi-annually, or more frequent as necessary, thereafter. Field monitoring equipment will be calibrated the morning of each sampling run; rechecked in the field if erratic or unstable readings occur; and as directed in the SOP (Attachment 3). All calibrations and field checks are recorded in the Equipment Calibration Log. A field blank will be collected during each sampling event. Duplicate samples will be collected at a frequency of one per every 10 samples.

The Authority has obtained certification for the YSI hand meter for "analyze immediately" conductivity, pH, and temperature.

All laboratory instrument and process blanks, control samples, calibrations, and duplicates will conform to the laboratory's NELAP or ELCP requirements for QC.

INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

Field equipment, including the YSI pH/conductivity/temperature instrument and flow meter, will be inspected and tested prior to the commencement of sampling. Spare parts will be kept with the equipment at all times. Damaged, and/or malfunctioning equipment will be reported to the Project Manager immediately for repair or replacement. Field crews are trained in equipment handling and maintenance to provide remedy for most problems while in the field. Any equipment damage or malfunction is recorded on the data sheet at the time of the incident. After each use, the pH/conductivity probes are rinsed with distilled deionized (DI) water. If the pH probe is not to be used for more than a week, it will be stored in pH 4 buffer. Prior to its next use, it will be placed in pH 7 buffer for a minimum of 5 minutes to stabilize, and then calibrated.

INSTRUMENT CALIBRATION AND FREQUENCY

The YSI pH/conductivity/temperature meter will be calibrated using standard solutions that are traceable to N.I.S.T. (National Institute of Standards and Technology) standards. A 2- or 3-point calibration will be used to bracket the pH range that is normally encountered at the sampling sites. Conductivity will be calibrated using a buffer that is within the normal levels expected in the field. If ambient stream pH and/or conductivity is outside the calibration range, a field calibration will be performed to adjust the range. All calibration data are recorded on the Equipment Calibration Log. Calibration solutions are poured into polypropylene containers that were rinsed twice with DI water and once with the solution. After calibration, the solutions are discarded. Calibration standards are dated for when they were received, opened, and a 6-month expiration time. These solutions are replaced every 6 months to provide accurate calibrations.

The velocity/flow-measurement equipment is calibrated using a "spin-test" as described by Rantz and others in the *USGS Measurement and Computation of Streamflow*, *Water Supply Paper 2175*. The vertical shaft is inspected and rid of any debris, and lubricated with a light oil prior to use. Protected from the wind, the cups are spun and timed until they stop. The duration

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should not be less than 1 minute. If the test fails, then the appropriate maintenance will be conducted according to the manufacturer's specifications, the shaft inspected, oiled, and the test repeated. Spin-test results and flow measurements will be recorded on the Streamflow Data Sheet (Appendix D). The mechanical setup and disassembly will be performed according to the manufacturer's instructions.

INSPECTION/ACCEPTANCE REQUIREMENTS

Field equipment calibration aliquots will be used once and discarded. All solutions will be replaced every 6 months to maintain accuracy in calibrations. Meter readings are noted after stabilization during each calibration. If the meter is within the known accuracy range of both the equipment and standard solution, the calibration is complete. If the meter is not providing an accurate reading, the calibration process will be repeated. The electronic equipment is not used unless calibrations are within the manufacturer's accuracy range.

Field and laboratory blanks that are not providing data below the laboratory reporting limits, and duplicate data outside the acceptable range of precision, will be investigated immediately by the QA Officer and reported to the Project Manager. Data collected during these sampling events are noted as suspect with STORET remark codes. The codes that may be associated with data are:

B Results based upon colony counts outside the acceptable range.
C Value calculated (used for flow estimates related to stage/discharge ratings).
D Field measurement (i.e., conductivity, pH, temperature, and flow).
J Estimated value.
K Actual value is known to be less than the value given.
L Actual value is known to be greater than the value given.
Q Sample held beyond normal holding time.
T Value reported is less than criteria of detection.
U Indicates material was analyzed but not detected.
Z Too many colonies were present to count (TNTC), numeric value is filtration volume.

DATA ACQUISITION REQUIREMENTS

Data used in this program will be compiled from the following sources: USDA, NRCS, USGS, DRBC, NJDEP, Hunterdon County, NJWSA, and Delaware, Raritan, Kingwood, and Franklin Townships.

NRCS has obtained Farm Service Agency data for cropland, used in the analysis for sheet and rill erosion and ephemeral gully erosion. NRCS data from their 1986 Sediment, Erosion and Animal Waste (SESAW) Study has been applied to the Lockatong and Wickecheoke Creek watersheds to estimate the annual soil loss per acre of cropland.

NJDEP GIS data will be used for historical changes in land use. Their water quality data, combined with USGS, DRBC, and municipal data, will be used to supplement the NJWSA database. County Parcel GIS data, in combination with municipal zoning data and all pertinent ordinances, will be used to estimate build-out and the anticipated affect on water quality. Municipal Environmental/Natural Resource Inventories and Hydrogeology reports, when

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available, and NJDEP TMDLs will supplement the Watershed Characterization and Assessment Report. The combined water quality database will facilitate the targeting and magnitude of contaminant source contributions. Phase 1 of the Authority's water quality monitoring program will provide a screening of problem stream reaches in the watersheds and Phase 2 will focus on the possible source(s) within the 20 subwatersheds, as related to point and non-point contributions. The water quality data characterization of various subreaches will be compared to the appropriate land-use/cover and ortho-photo GIS layers, and supplemented with Google Earth® images for locating potential contaminant sources.

Graphical presentation of temporal and spatial trends in water quality, and flow-integrated statistical analyses will provide information on the location and magnitude of pollutant loadings during baseflow and stormflow conditions. Water quality targets will be developed as part of the Lockatong and Wickecheoke Watershed Restoration and Protection Plan.

USDA Stream Visual Assessment Protocol (SVAP) will be used to assess sections of the watershed for reference conditions and levels of anthropogenic impact. This level of assessment is vital for characterizing the aquatic ecosystems, and for restoration efforts in areas experiencing channel destabilization from modifications to the watershed hydrology and/or land uses.

All data used in this project will be collected and analyzed under the guidance of this QC program and the QC programs of the cooperating water quality collection agencies.

DATA MANAGEMENT

Historical water quality, GIS, and flow data will be stored in both personal computers and a network computer at the Authority for use and backup. All Site-Visit and Streamflow data will be entered into an Excel spreadsheet, including site attribute data. Data collected with a YSI hand meter will be reported on the Site-Visit Data Sheet and entered into the Excel spreadsheet. Calibration data for the YSI meter will be recorded in the Equipment Calibration Log. Data analyzed by the contract laboratory will be entered into a spreadsheet by the laboratory and sent, via email attachment or disk, to the Authority for entry into the database. The laboratory is expected to provide the data within 2 weeks after each sampling event. Original data sheets and digital databases will be stored at the NJWSA Watershed Protection Programs office in Somerville, NJ.

Data will be compared to the original field data sheets for verification by Authority personnel, prior to release of the database for public distribution. Data from QC tests will be stored in a separate file. STORET remark codes will be used, when necessary, for the water quality and flow data. The Authority is considering the possibility of entering their data into the EPA STORET database. Otherwise, all numerical field and laboratory data will be delivered to DEP as digital files (e.g., Excel®).

Data exceeding two standard deviations may be labeled as outliers and disregarded, pending the number of samples and skewness of the distribution.

Data collected as part of the SVAP effort will be stored as a separate Excel database.

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ASSESSMENT AND RESPONSE ACTIONS

Field sample collections and laboratory processes will be audited by the QA Officer before the start of the sampling program and semi-annually, or as needed, during the program. Data will be reviewed and assessed for the field collections after each sampling event. Data received from the laboratory are reviewed immediately upon arrival at the Authority by the QA Officer and the Project Manager. Any discrepancies or uncertainties in either the field or laboratory data will be presented to the Project Manager. If the discrepancy(ies) cannot be resolved by the Project Manager, through discussions with field or laboratory personnel, or changes in sample collection protocol, a memo will be routed to the Program Manager to explain the problem, possible causes, and recommended solution(s). Pending the severity of the problem, contacts on the Distribution List may be notified.

Changes in sample collection or analysis protocols will be sent to contacts on the Distribution List for approval, prior to implementation, as an amendment to this QAPP.

REPORTS

Quarterly progress reports and a final report will be submitted to the 319(h) grant manager during the duration of this program. A monitoring program report, with a comprehensive data summary, will be submitted at the conclusion of the monitoring program to the program members on the Distribution List and will be available on the Authority's Web site. The monitoring program report is anticipated to be completed by Spring 2008. The Lockatong and Wickecheoke Watershed Restoration and Protection Plan is anticipated to be completed, and submitted for NJDEP approval, by Summer 2008. The final Plan will be submitted to the contacts on the Distribution List and available on the Authority's Web site.

DATA REVIEW, VERIFICATION, AND VALIDATION

Data exceeding the established range of water quality that has been historically collected at several of the monitoring sites will be scrutinized for cross-contamination, interferences, and reporting errors to verify the accuracy. Duplicate analyses should match within the established laboratory variance for the specific parameters. Data uncertainties will be reported to the Project Manager by either the QA Officer or the Authority's Field Scientist. Discrepancies in data collected in the field will be checked against the Equipment Calibration Log and the Site-Visit Data Sheet. Laboratory data inconsistencies (i.e., ammonia greater than TKN, or extreme variation in any data) will be presented to the Project Manager who will contact the contract laboratory for their internal review of blanks, calibrations, duplicates, and possible reporting errors. Data showing inconsistencies will also be compared to meteorological and flow data, and seasonal variation, to determine possible causes.

One Authority staff person will review and verify all of the field data as it is entered into the Excel database. The Excel database will then be reviewed for correct data entries and validated by a second Authority staff. Questionable data will be highlighted for review, followed by a final review by the QA Officer and/or Project Manager prior to approval.

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VALIDATION AND VERIFICATION METHODS

Data passing the verification and validation reviews by Authority personnel will be entered into the "Validated" Excel database. Any data anomalies will be referenced with the proper STORET remark code that will be located in the spreadsheet column next to the data value. Validated data will be put on the Authority's Web page and available for public distribution.

RECONCILIATION WITH DATA QUALITY OBJECTIVES

Validated data will be analyzed statistically and graphically to determine temporal and spatial relationships. The database will present a minimum of 4 storm-runoff events. Data density and grouping should be adequate to meet the intended uses of the dataset. The six samples collected in Phase 1 will be sufficient to determine a screening level of differences in water quality. Phase 2 will include selected sites from Phase 1 with some relocations, pending results from Phase 1. Therefore, the resulting database will contain 6 to 15 data at each site for the selected parameters at the end of the sampling program. Most sites will have 8 to 15 data per parameter that will provide reliable statistical and graphical interpretations for defining the variation of water quality over a range of stream flows and for tracking potential sources of contamination within the subbasins. Fecal coliform and E. coliform will be sampled 6 to 16 times per site, including the additional samples for meeting the DEP criteria of 5 samples within 30 days.

Data collected during the SVAP will include a distribution of sites to provide a valid interpretation between those with and without impacts to the aquatic system from anthropogenic activities.

Note: Italicized and bolded text represents placement of a response to a DEP comment(s). Attachment 4 presents comments from DEP and our associated responses.

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Appendix A

Site-Visit Data Sheet

Site Number/Name: **Date(s) of recent rain:**

Date (mm/dd/yy): **Sampling Crew:**

Weather conditions [circle]: some clouds, overcast, raining, drizzle, sunny, calm, breezy, windy, humid, hot, cold, snowing, sleeting

Channel conditions [circle]: no flow; trickle; aquatic plants (sparse, moderate, dense coverage; attached, rooted, floating); water color; turbid; clear; swimmers; boaters; fishermen; turtles; frogs/tadpoles; snakes; fish, edge ice, floating ice, submerged ice; emergent insects

tape + leader =

Gage reading (to nearest 0.01'): + 0.35 = Time (military, 24 hr):

Laboratory Water Quality Samples (check those that were collected):

Fecal Coliform:_____

E. Coliform:_____

Time Collected (military, 24 hr):_____

Nitrite: _____ Nitrate:_____

TKN:_____ Ammonia:_____

Total P:_____ Turbidity:_____

Boron:_____ TSS:_____

Sediment TP:_____ Coliphage:_____

On-site monitoring Time (military, 24 hr)**:**

Air Temperature (^{o}C): _____ Instrument type (i.e., YSI 63):_____

Water Temperature (^{o}C):_____ Instrument type (i.e., YSI 63):_____

pH (standard units):_____ Instrument type (i.e., YSI 63):_____

Specific Conductivity (us/cm):_____ Instrument type (i.e., YSI 63):_____

Conductivity (us/cm):_____ Instrument type (i.e., YSI 63):_____

Other site characteristics/notes:

Appendix B
Equipment Calibration Log

pH (YSI 63)

Date	Time	Initials/ Name	Initial Meter Value	Standard Solution Temp (^oC)	Standard Solution Value	Difference	AutoCal Final Value[#]

[#] Automatically temperature-compensated by meter.

Specific Conductivity (YSI 63)

Date	Time	Initials/ Name	Initial Meter Value[*]	Standard Solution Temp (^oC)	Standard Solution Value (us/cm)	Difference	Final Value[*] (us/cm)	Temp Coeff	Cell Constant Pre/Post

[*] Automatically compensated for variation from 25°C . Note: $SC = C_T/(1 + (0.0191 \times (T-25)))$
SC = Specific Conductivity, C_T = Conductivity at measured temperature, and T = Measured temperature.

Water Temperature (YSI 63)

Date	Time	Initials/ Name	Meter Value (^oC)	NIST-Calibrated Thermometer Value (^oC)	Difference

Analyst signature: Date:

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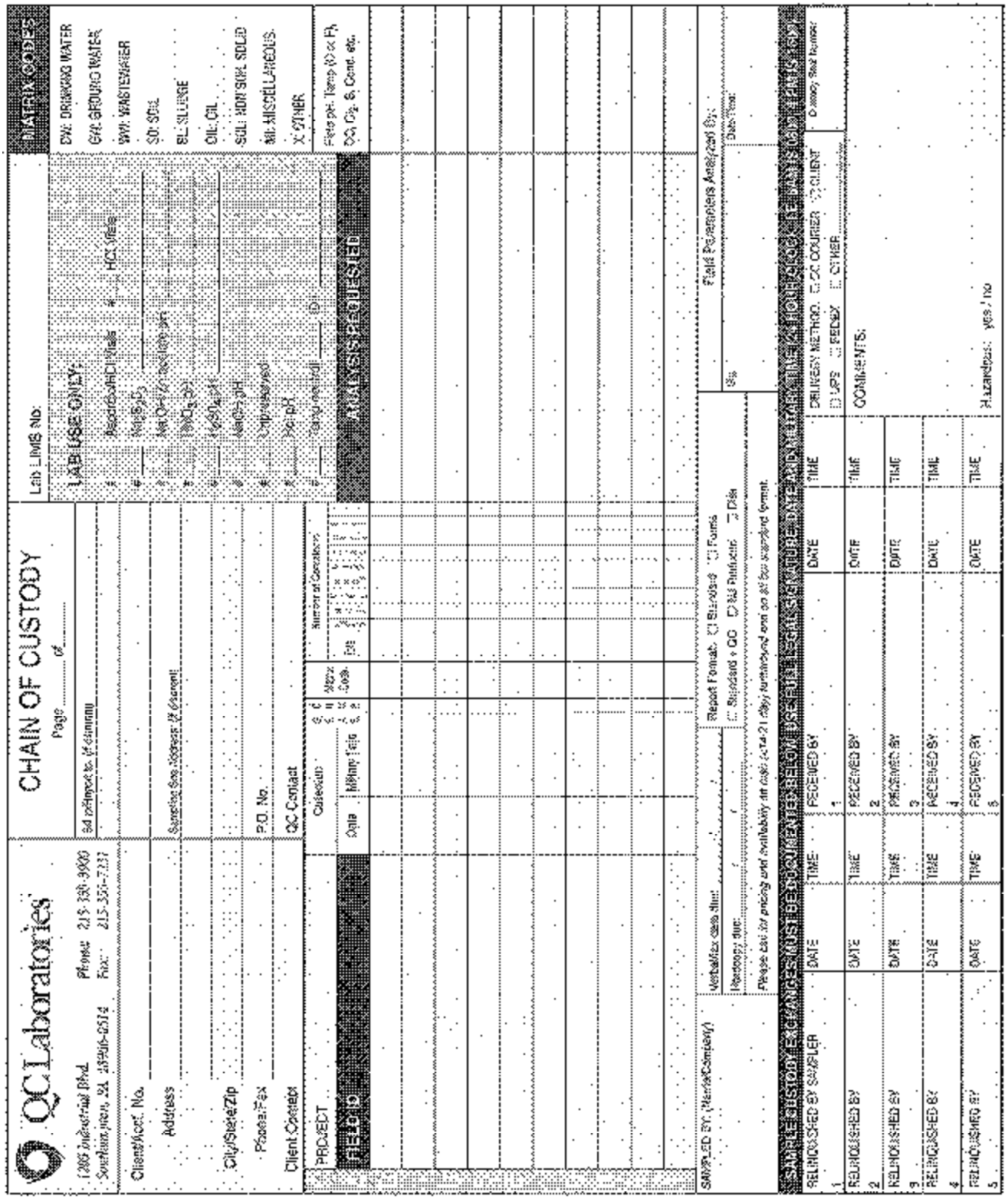
Appendix C
Chain Of Custody Form



Appendix D

LOCK/WICK MONITORING PROGRAM
STREAMFLOW DATA SHEET

River Mile (RM/Trib 1/Trib 2/State) ___ ___ ___ ___ ___/___ ___ ___/___ ___ ___/___ ___ ___ ___
Station Name ___
Station Number ___ ___ ___
Date (Yr/Mo/Day) ___ ___/___ ___/___ ___ Time (HHMM) ___ : ___
Party ___ Agency ___ ___ ___ ___
Location of Test Site From Gage Station ___
Weather Conditions ___
Dates of Last Rains ___ ___/___ ___/___ ___ ___ ___/___ ___/___ ___
Water Temperature ___
Air Temperature ___

Gage		Time	Tape Reading	Leader Length	Total Gage
Read-ings	Before			+	=
	After			+	=

Gage Height at Zero Flow ___
Type of Meter ___
Spin Test in Seconds ___
Tape Reading at Near Bank ___
Tape Reading at Far Bank ___
Total Width of Stream ___
Interval Width Chosen ___
Total Number of Intervals ___ (minimum 15)

Flow Width = (total width) - (zero flow intervals) ___
Flow Area = Sum (incremental width X incremental depth) ___
Average Depth = flow area / flow width ___
Average Velocity = total discharge / total flow area ___

CONVERSIONS

inches	feet
1 =	0.083
2 =	0.167
3 =	0.250
4 =	0.333
5 =	0.417
6 =	0.500

Inches	feet
7 =	0.583
8 =	0.667
9 =	0.750
10 =	0.833
11 =	0.917
12 =	1.000

Inches	feet
1/16 =	0.0052
1/8 =	0.0104
1/4 =	0.0208
1/2 =	0.0417

Interval #	Tape reading[1]	Dist from stream edge[2]	Interval Width (tenths)	Interval Depth (tenths)	Observation Depth[3] (tenths)	Revolutions[4]	Time (sec.)
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

Calculations completed by ___ Checked by ___
Remarks:

[1] Tape reading is the actual reading that the tape shows at the edge of the stream actual reading where testing is completed is at the opposite edge, and all interval r

[2] The stream edge for our purposes is the point where the water presently meets one edge to begin measurement and the opposite edge to terminate, giving the str

[3] The Observation Depth is 0.6 of the depth if the depth is less than 2'. If the dep must be taken at 0.2 and 0.8 of the depth. The two velocities will be averaged, the give the Interval Discharge.

[4] Start the stopwatch on a click but do not count that click as a revolution.

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Attachment 1

319(h) Grant Proposal: Watershed Restoration and Protection Plan for the Lockatong and Wickecheoke Creek Watersheds, Hunterdon County, New Jersey

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Attachment 2

Request for Laboratory Services

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Attachment 3

Standard Operating Procedure For "Analyze Immediately" Conductivity, pH, and Temperature Monitoring

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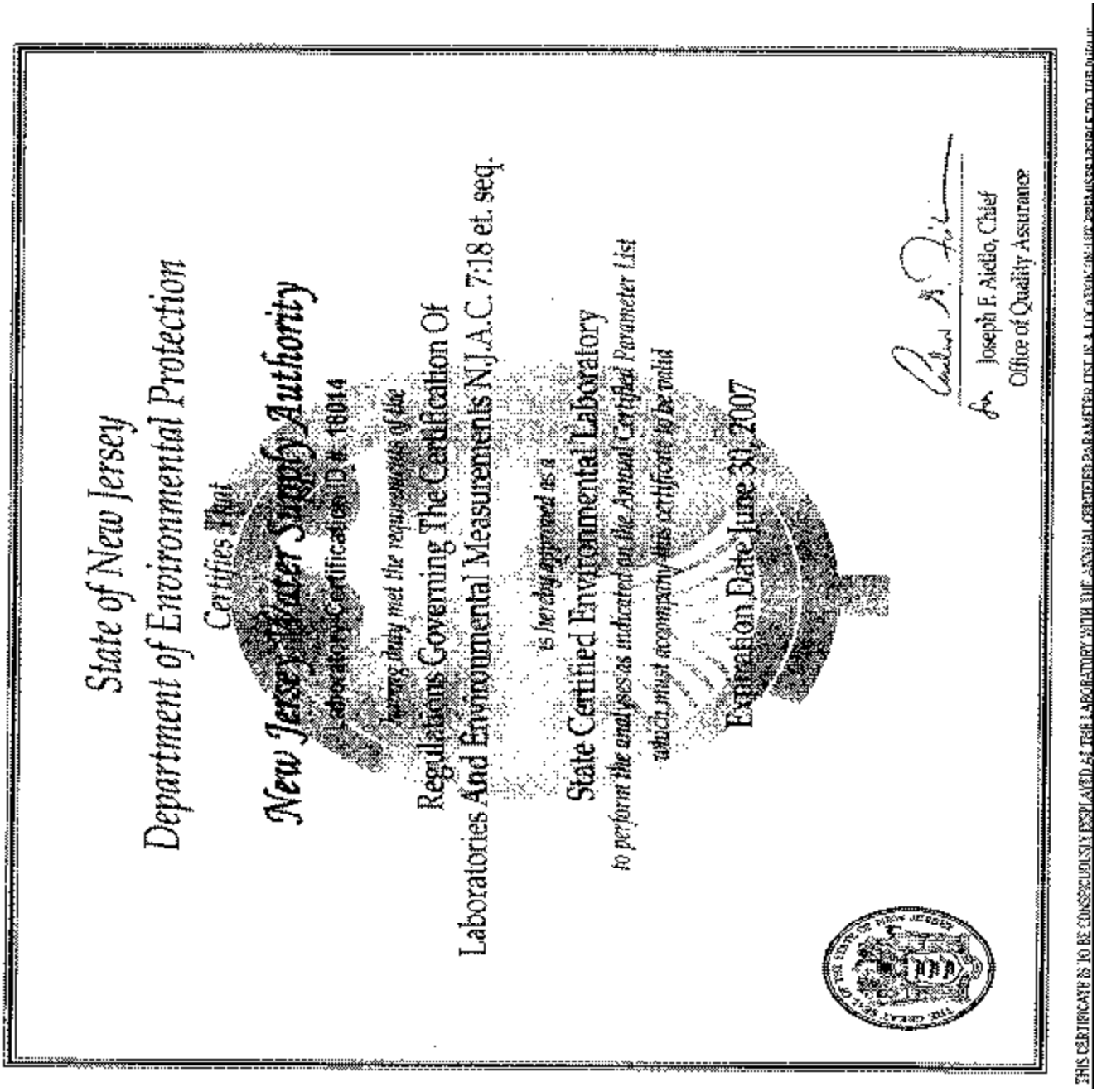
Attachment 4

"Analyze-Immediately" Certification



Attachment 4 (Continued)

New Jersey Department of Environmental Protection
Environmental Laboratory Certification Program

ANNUAL CERTIFIED PARAMETER LIST AND CURRENT STATUS

Effective as of 03/29/2007 until 06/30/2007

Laboratory Name: NEW JERSEY WATER SUPPLY AUTHORITY Laboratory Number: 18014 Activity ID: SLC060004
74 E MAIN ST
Somerville, NJ 08876

Category: WPP02 -- Inorganic Parameters, Nutrients and Dema

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	WPP02.45500	NPW	Wheatstone Bridge	[SM 2510 B]	Specific conductance

Category: WPP03 -- Analyze-Immediately Inorganic Parameters

Status	Code	Matrix	Technique Description	Approved Method	Parameter Description
Certified	WPP03.09000	NPW	Electrometric	[SM 4500-H B]	pH
Certified	WPP03.14000	NPW	Thermometric	[SM 2550 B]	Temperature

for Joseph F. Aiello, Chief

KEY: AE = Air and Emissions, BT = Biological Tissues, DW = Drinking Water, NPW = Non-Potable Water, SCM = Solid and Chemical Materials

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Attachment 5

Responses to Comments From NJDEP

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From: Todd W. Kratzer, P.E. **Date: September 1, 2006**
To: Beth Torpey
Subject: Responses to-

Waterhshed Restoration and Protection Plan for the Lockatong and Wickecheoke Watersheds

QAPP Review
August 7, 2006
Beth Torpey

Responses italicized beneath each item.

✍✍**Need cover page with RP number**
Revisions applied

✍✍**Spell out items such as NJDEP, NJWSA, the first time mentioned in the body of the document**
Revisions applied

✍✍**What laboratory is being used?**
QC Laboratories, Inc. has been contracted for analyzing total suspended solids, turbidity, nitrite+nitrate, total Kjeldahl nitrogen, ammonia, total phosphorus, fecal coliform, and boron. A contract amendment is anticipated in 2007 to include analyses for E. Coliform. Sediment total phosphorus will be analyzed by USGS. Coliphage will either be analyzed by USGS or a private laboratory that uses the EPA approved protocols.

✍✍**Lab certification Number.**
QC Laboratories, Inc - NJ Certification ID# PA166

✍✍**Are the methods listed in Table three the same as the laboratory uses?**
Yes, analytical methods listed in Table 3(now Table 4) for total suspended solids, turbidity, nitrite+nitrate, total Kjeldahl nitrogen, ammonia, total phosphorus, fecal coliform, and boron are used by QC Laboratories

✍✍**Please submit overall location map – particularly indicating the 60 percent of the total drainage area into the D&R Canal.**
Maps included as Figures 1 and 2.

✍✍**The goals for Phases one and two aren't stated until page 20.**
Goals are presented in Project/Task Description section, page 8.

Part 1. - Page 10 – Water Quality Monitoring – Phase I:

✍✍**Will fecal and E. coliform samples be collected during the first six high and low flow events or only during the "two to three additional sampling events" for those parameters?**
Fecal coliform will be collected during each sampling event. Both fecal coliform and E. coliform will be analyzed for all samples collected in 2007. Two to three additional

sampling runs will be necessary if DEP requires 5 samples to be collected within a 30-day periond. If necessary, this will be performed from May through July in 2007.

✍✍**Will the other parameters be sampled for during the two to three additional sampling events?**

Only conductivity, pH, and air and water temperature will be monitored during the bacteria sampling.

✍✍**Define "higher" flow and "lower" flow.**

Higher flow is represented by a stormwater runoff hydrograph, the abrupt increase in flow from runoff just following the initiation of a precipitation event. Lower flow is equivalent to baseflows, or flows unaffected by stormwater.

✍✍**Table 2 does not present the sampling schedule and number of samples collected at each site. Please coordinate table descriptions with what is actually on them.**

Revisions applied.

✍✍**The data collected, not "The two stations" will allow for better evaluation.**

Revisions applied.

✍✍**Instantaneous flow measurement from where?**

Instantaneous flow measurements are those that are performed to associate flow with water surface elevation, also known as the development of a stage/discharge relationship. The measurements are conducted at selected sites, usually near bridges for establishing an accessible datum on the bridge deck.

✍✍**How will you determine "up to 8 stations" to "associate" water depth with flow?**

Sites are initially selected to partition the watershed into subsections representing the lower, middle, and upper watershed areas. Tributaries that contribute flow during summertime baseflows are also selected. Visual inspections of channel and flow characteristics are used to determine areas of stream reaches that gain or lose flow and those reaches or tributaries that provide a more constant baseflow from artesian wells. Water quality monitoring sites that do not have a flow-to-drainage-area ratio consistant with the continuous USGS flow-measurement stations, near the mouth of the streams, are selected for the development of a stage/discharge relationship.

Part 2. - Phase II –

✍✍ **what is the rational behind the re-evaluation. Page 20 says that you're going to focus on sources. How will you use the data from Phase one to do this?**

Data obtained from Phase 1 of the program will be analyzed to determine which monitoring sites are contributing the greatest loadings of each water quality constituent. Each parameter can be associated with specific sources (see LOADINGS AND WATER QUALITY INDICATORS section). Land use and land cover will be partitioned in the drainage area from each sampling site to determine relationships between land use and loadings. If land use does not indicate potential sources for elevated loadings, then

further investigation will be conducted in Phase 2 for those stream reaches that may be prone to direct discharges, livestock, or other potential sources of loadings.

✍✍ **What is the rational for excepting ammonia, TKN and nitrite+nitrate?**

The omission of ammonia, TKN, and nitrite+nitrate from further analyses in Phase 2 will be based on the results from Phase 1 (see *PROJECT/TASK DESCRIPTION, Water Quality Monitoring - Phase 2*).

Part 3:

✍✍**Sediment - Who is collecting the samples? Are they certified for this parameter? What lab? Are they certified for this parameter?**

USGS will be collecting these samples and conducting the analytical procedures, subject to their field and laboratory QA/QC and protocols that are accepted by NJDEP.

✍✍**What medium will be sampled for coliphage – sediment? Water? Who is collecting the samples? Are they certified for this parameter? What lab? Are they certified for this parameter? Certification number?**

Water column samples will be processed for coliphage (see Project/Task Description, Sediment and Coliphage sampling). NJWSA staff will be collecting the samples. Either the USGS or a private laboratory that uses the EPA approved methodology will be performing the analyses. If a private laboratory is selected for this procedure, NJDEP will be provided the analytical method(s) for their review.

Quality Objectives and Criteria:

✍✍**Are personnel certified – not trained - for all of the water quality parameters?**

NJDEP does not require NJWSA personnel to be certified for collecting water quality samples (communications with Marc Ferko). All personnel involved with sample collections are trained prior to the actual sampling event on proper techniques for collecting representative samples, avoidance of sample contamination, and preservation as specified in the NJDEP Field Sampling and Procedures Manual, August 2005..

Table 4:

✍✍**Please make the top of this table easily readable**

Revision applied.

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From Beth Torpey

Notes:

- ?? L and W Creeks drain into D&R Canal from western Hunterdon Co.
- ?? Impaired for fecal , P, Temp and benthic on integrated list
- ?? Fecal and P TMDLs done
- ?? Both watersheds = C-1
- ?? Parameters:

  Phase I: Temp, conductivity, pH, fecal coliform and E. coliform, TP, Nitrite+nitrate, total Kjeldalhl, Ammonia, Boron, Turbidity, TSS Sediment TP, Coliphage - 20 locations

✍✍ 3 hi flow, 3 lo flow,

✍✍ 2 to 3 additional for fecal and e-coliform

Phase II: Temp, conductivity, pH, fecal coliform and E. coliform, TP, Boron, Turbidity, TSS – 14 locations or fewer – 9 events

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Characterization and Assessment of the Lockatong and Wickecheoke Creek Watersheds

NJ WATER SUPPLY AUTHORITY

AUGUST 2009 – FINAL DRAFT

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Acknowledgements

This report was prepared by Jen Zhang, Watershed Protection Specialist and Todd Kratzer, Senior Watershed Protection Specialist as a compilation of information from existing data and reports.

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Project Background

In April 2005, the New Jersey Department of Environmental Protection (NJDEP) approved the New Jersey Water Supply Authority (NJWSA) Section 319 grant proposal, "Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Plan, Hunterdon County, New Jersey". The Authority and the New Jersey office of the USDA-Natural Resources Conservation Service (NRCS) submitted this project, with support from each of the four watershed municipalities: Delaware, Franklin, Kingwood and Raritan Townships. This project focuses on protecting and restoring the Lockatong and Wickecheoke Creeks, recently designated as Category 1 streams by NJDEP. The proposal entails a science-based process for developing a watershed restoration and protection plan that addresses existing and potential water resources issues. Total NJDEP funding is $237,290. The Authority and NRCS are providing $73,200 of in-kind match, for a project total of $310,490.

The purpose of the characterization and assessment is to provide an in-depth evaluation of the current conditions within the Lockatong and Wickecheoke watersheds, which constitute the largest contributing drainage area to the Delaware & Raritan (D&R) Canal other than the Delaware River itself. An evaluation and assessment of the field investigations and analyses, and previous studies within these watersheds, will be used to determine the management measures that will be required to allow the streams to achieve full attainment of their designated uses. The characterization and assessment report is intended to provide preliminary assessments of the watersheds and will be used in conjunction with on-site testing and evaluations.

Physical Setting of the Lockatong and Wickecheoke Watersheds

The Central Delaware Watershed Management Area (WMA11) encompasses a drainage area of approximately 271.9 square miles, which includes parts of Hunterdon, Mercer and Monmouth Counties and includes 27 municipalities. The combined Lockatong-Wickecheoke watersheds are one of the five major watersheds within this WMA. The headwaters of the Lockatong and Wickecheoke Creeks are in the Hunterdon (or Croton) Plateau with its hard argillite bedrock.

Lockatong and Wickecheoke, though separate streams, are most appropriately considered as an integrated unit – complementary components of an exceptional watershed area located in a rather remote part of Hunterdon County (**Figure 1**). The Lockatong-Wickecheoke Watersheds encompass approximately 49.9 square miles (31,917 acres). It includes portions of Franklin Township, Delaware Township, Raritan Township, and Kingwood Township. Both the Lockatong and Wickecheoke Creek are third order (tributaries are first and second order) streams that flow into the D & R Canal.

The Lockatong Creek is 13 miles long and originates from springs and wetlands near Quakertown in Franklin Township. It flows south through farms and woodlands in Franklin, Kingwood and Delaware Townships falling 500 feet in elevation before flowing into the D&R Canal (and Delaware River). It drains a 23.3 square mile watershed passing by cliff and rock formations, waterfalls, hemlock groves and historic old mills on its way to the Delaware.

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The Wickecheoke is 14 miles long and originates from wetlands in Franklin and Raritan Townships, flowing south through Delaware and Kingwood Townships to the D&R Canal and Delaware River at Prallsville Mills in Stockton. The Wickecheoke Creek passes under the last covered bridge in New Jersey. It drains a 26.6 square mile watershed.

Along their course to the Delaware, the streams traverse steep hemlock ravines, and create picturesque waterfalls. The total watershed area is comprised of six sub-watersheds, also known as 14-digit Hydrologic Unit Codes (HUC14s) for delineating smaller watershed areas as shown in **Table 1**. **Figure 2** depicts the HUC 14 areas. These streams drain into the Delaware & Raritan Canal, a major recreational area and potable water supply maintained by the NJWSA. During low flows, the stream inflow is contained within the Canal. During high flows, the inflow spills over the Canal's west embankment into the Delaware River.

Table 1: HUC14s in the Lockatong and Wickecheoke Creek Watersheds

HUC 14	Associated Area
02040105200040	Wickecheoke Creek above Locktown
02040105200060	Wickecheoke Creek below Locktown
02040105200050	Plum Brook
02040105200010	Lockatong Creek above route 12
02040105200020	Lockatong Creek from Milltown to route 12
02040105200030	Lockatong Creek below Milltown

These watersheds are still predominantly rural, having areas of agricultural and residential development. The major roads running through the watersheds include: State Highway 12, and County Routes 519, 523 and 579. State Highway 29 runs along the southern border of the watersheds. The upper segments of the streams, including the headwater segments, are designated as FW2-Non Trout status. The lower third (approximately) of the streams are categorized as FW2-Trout Maintenance status. Both streams and all the tributaries are classified as Category 1 status.

Because population estimates are done based upon political boundaries instead of watershed boundaries, it is not possible to determine the exact population of the watersheds. According to the 2000 Census Bureau estimates, the population of Delaware was 5,153; Franklin was 3,138; Kingwood was 3,879; Raritan was 19,430. The population in these watersheds may at first seem relatively low, yet since 1970 the population of Delaware has gown 38%, Franklin has grown 39%, Kingwood has grown 65%, and Raritan has grown 186% (although much of the Raritan growth has been in the Route 202/31 corridor). Because of their underlying geology and steep topography, these watersheds are particularly sensitive to the growing pressure of development and its associated environmental impacts. If growth continues at these rates, the health of these creeks will continue to decline, reflecting the associated impacts.

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Figure 1: Project Area

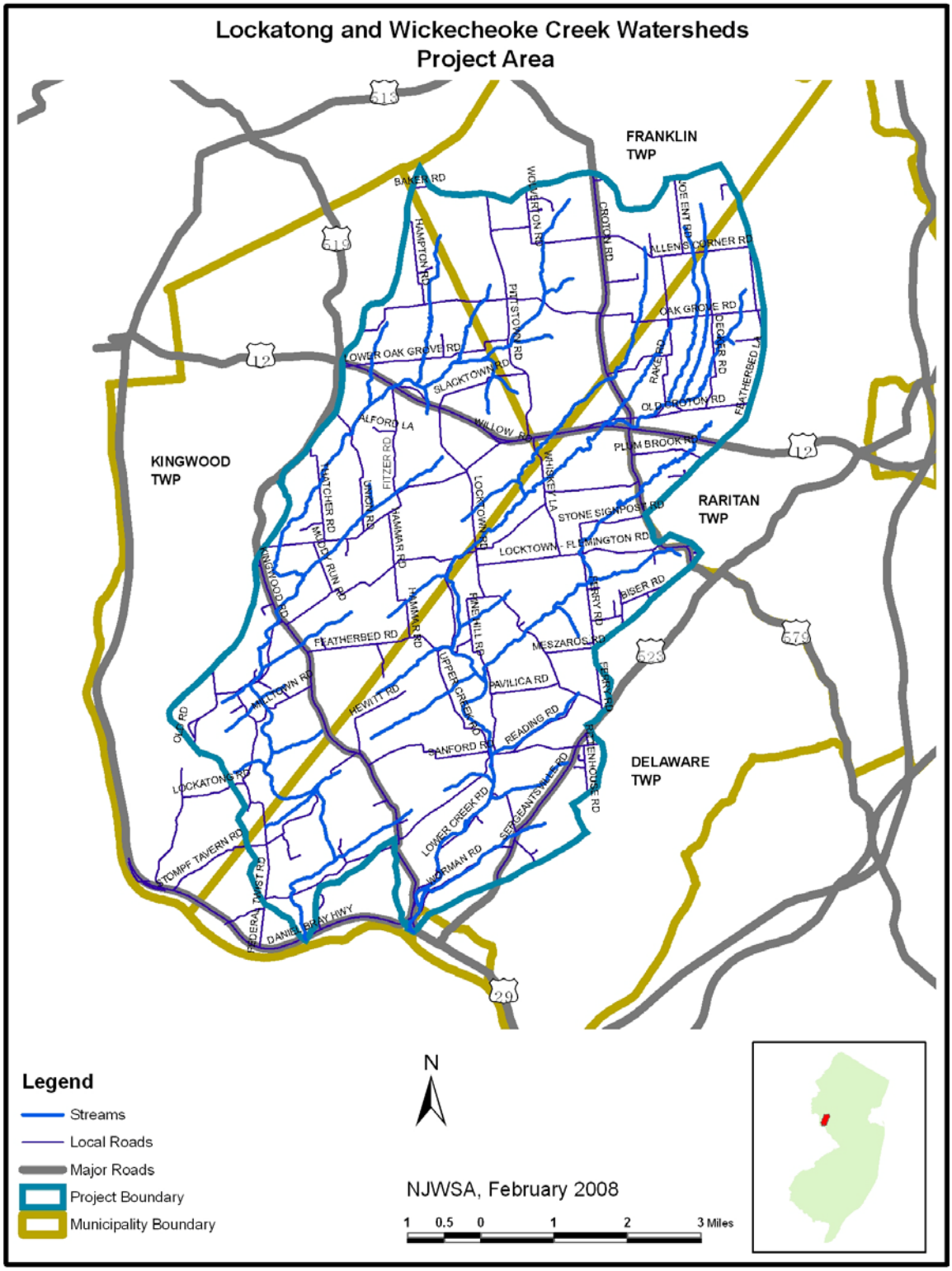

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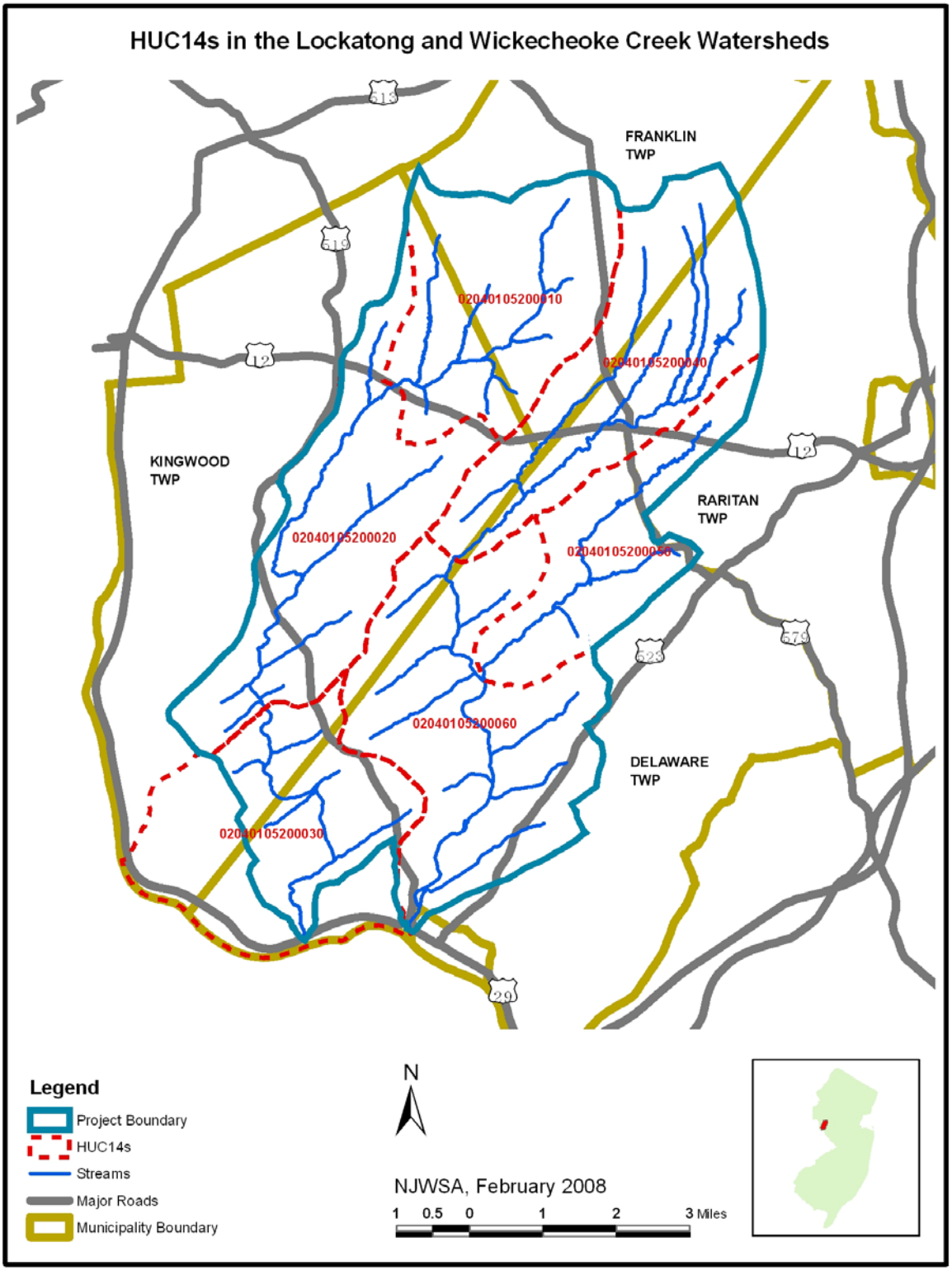
Figure 2: HUC14s in the Lockatong and Wickecheoke Creek Watersheds



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Previous and Existing Watershed Projects

Over the years, all four watershed municipalities have made efforts to protect water resources within their jurisdictions. After numerous studies and investigations, all four towns have downzoned (increasing average lot size) to protect aquifers where bedrock is of Lockatong and Stockton argillite. Several studies have also contributed to knowledge of the watersheds.

State of the Watershed Project

Local residents realized the importance of a comprehensive study of these creeks early in the nineties, and initiated a number of grass root projects which were cooperative efforts crossing municipal boundaries. In 1994, the Environmental Commissions of Kingwood, West Amwell and Delaware Township began the 'State of the Watershed Project", funded from NJDEP. This was a massive initial effort that mobilized a large number of local volunteers to do research, surveys, stream walks, and monitoring. The results were ultimately compiled into a report that documented the history, status and existing conditions of the Lockatong, Wickecheoke and Alexauken Creeks (1996, John Brunner, State of the Watershed Report).

Biological Monitoring Project

In 1996, The Environment Endowment for New Jersey funded a biological monitoring project, including an educational report about the history and natural resources of the creeks. Lockatong Creek biological monitoring data were collected from 1995 to 1997, and Wickecheoke Creek biological monitoring data were collected from 1998 to1999. Undertaken as a partnership between the Kingwood and Delaware Environmental Commissions, this project received an award from the Delaware River Greenway, and has certainly increased public awareness of the importance of protecting these creeks (2002, Craig Kologie, The Lockatong and Wickecheoke Watershed Management Plan).

Lockatong Greenway Project by Hunterdon County Land Trust Alliance

The health of the Wickecheoke has greatly benefited from being the focus of a New Jersey Conservation Foundation greenway project. Over the past 20 years, over 1000 acres of land have been protected with their assistance. The Hunterdon County Land Trust Alliance (HLTA) has selected the Lockatong as one of its first project areas. In 1999, a successful application was submitted to Green Acres non-profit matching grant acquisition program for $500,000 to fund this work. HLTA is beginning landowner outreach efforts with the goal of a greenway along the Lockatong.

The Lockatong and Wickecheoke Watersheds Planning Project as hosted by ANJEC

In 1997, ANJEC initiated a project funded by a grant from William Penn Foundation to support consensus building and open space and resource protection planning on a regional basis using a Geographic Information System (GIS) approach. The group also received additional funding from the Wild and Scenic River Program through the Heritage Conservancy and the New Jersey

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Department of Environmental Protection (DEP)/Environmental Services Program (ESP) matching grant program to complete this planning effort. This funding was designated to create the GIS map layers needed to develop a watershed protection plan, including a resource inventory, and management strategies. Public outreach was also funded by the grant to present Best Management Practices (BMPs) and the benefits of donating conservation easements to the municipal residents. Biological monitoring of the Wickecheoke was conducted as part of this grant.

The Lockatong and Wickecheoke Watersheds Management Plan

In 1998, a Lockatong and Wickecheoke Steering Committee was created including participants from Kingwood, Delaware, Raritan, West Amwell and Franklin Township Environmental Commissions, Hunterdon Land Trust Alliance, D&R Greenway and ANJEC to prepare a management plan for the watersheds. This plan was made possible by funding and assistance from ANJEC, the Hunterdon County Land Trust Alliance, the William Penn Foundation, the Heritage Conservancy, and the NJDEP/ESP, and was prepared by Castle Valley Consultants in Doylestown, PA. This plan was finished in 2002 including a comprehensive inventory of natural resources and planning strategies to protect the water quality and ecosystem health of these watersheds. It aimed to encourage the four watershed municipalities to work together to find practical and sustainable ways to preserve the high quality environmental resources of the region.

Lower Delaware River Management Plan

The Lower Delaware River Wild and Scenic River Study was authorized by Congress on October 23, 1992, through P.L. 102-460. The study area, as set forth by the Study, is the Delaware River segment between the Erie Lackawanna Railroad Bridge south of the Delaware Water Gap National Recreation Area, and Washington Crossing, Pennsylvania.

To increase the effectiveness of the study's public outreach activities and to facilitate the compilation of resource information, a cooperative agreement was established between the National Park Service and the Delaware River Greenway Partnership. The agreement also provided for the creation of a Geographic Information System (GIS). The GIS contains up-to-date information about the location of many natural and cultural resources. GIS maps provided for the study include base maps, wetlands and floodplains, and resource maps for each municipality.

The Lower Delaware River Management Plan was submitted to Congress as part of the Lower Delaware River Wild and Scenic River designation package. The Plan sets forth a vision for the wise use and management of the diverse resources in the River corridor. It is meant to be used and referred to by all levels of government, property owners and organizations that have an interest in the protection of the Lower Delaware River corridor. The Management Plan includes six major goals and recommends actions to maintain and improve the Lower Delaware River corridor, its tributaries and surrounding natural, historic and cultural resources. The first goal of the Plan is to protect, or enhance where practical, water quality of the Delaware River and its tributaries. The Plan provides for economic growth in a manner that does not adversely affect the region's resources. This Plan includes the contiguous tributaries to the Lower Delaware

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River, including the Lockatong and Wickecheoke Creeks. The Lower Delaware River Management Plan was signed in law by president Bill Clinton on November 1, 2000 through P. L. 106-418, 106th Congress.

Regulations for the Review Zone of the D&R Canal State Park

The Delaware and Raritan Canal Commission was created pursuant to the Delaware and Raritan Canal State Park Law of 1974, N.J.S.A. 13:13A-1 et seq. The Commission is authorized to and has prepared and adopted a Master Plan for the physical development of the Delaware and Raritan Canal State Park and to establish zones in which it reviews all private and public projects that affect the Park and ensure that the projects conform as nearly as possible to the Master Plan adopted by the Commission.

The Regulations for the Review Zone of the D&R Canal State Park were adopted in August 2004. They establish the procedures for review and set forth the standards that will be considered by the Commission. The rules are intended to encourage consideration of the natural and recreational resources of the Park and its waterways at the earliest stages of land use planning and to promote cooperation between the Commission and municipal, county and state reviewing agencies, and private land users.

Central Delaware Tributaries Watershed Management Area Planning Project

Funded by the NJDEP Division of Watershed Management, the Regional Planning Partnership started this project in November 2000. Project team partners included Isles, Inc., the Association of New Jersey Environmental Commissions (ANJEC), the Mercer County Soil Conservation District, and the Hunterdon County Soil Conservation District. This project was designed to produce a watershed management area plan that will protect and enhance water resources in the Central Delaware Tributaries, including the Lockatong and Wickecheoke Creek watersheds.

This project involved intensive data collection and public outreach for identifying current conditions, key issues, and potential strategies and actions for addressing problems in the planning areas. It was completed in February 2003. Please refer to the project's website (www.planningpartners.org/projects/past/WMA11.html) for details.

Limnological Study of the Wickecheoke Creek Ecosystem

At the request of officers of Magnesium Elektron Incorporated, the Department of Environmental Science, Rutgers University, undertook a limnological survey of the Wickecheoke Creek ecosystem. The study was carried out under the guidance of Dr. Kathleen Irwin Keating.

The purpose of the survey was to document the overt biological consequences of the addition of M. E. I. effluents to the creek ecosystem. To answer the questions essential to this study, sampling regimes were structured to generate data that would demonstrate the boundaries and severity of the impacts of M. E. I. effluents on various subjectively delineated modules of the Wickecheoke Creek ecosystem.

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Data generated by the two years of monitoring in this study (June 1979 through June 1981) demonstrated that the highest concentrations of total dissolved solids measured in the creek were similar to those of (relatively low salt) natural seawater. The impact of these effluents on the stream biota would create a restructuring of dominance. Since the organisms native to this system are of freshwater taxa, they do not fare well in constant contact with saline water. The stream waters, in contrast, are safe (in terms of very short term contact) for any eukaryotic organism (from algae to humans). A mammal would not find the salt-water in the most severely effected part of the impact zone acceptable as drinking water, but small quantities ingested would not be harmful. Some non-aquatic forms might actually seek out the salt-laden waters for very brief contact, but any non-marine creature (fish, rabbit, dear and human) which has the capacity to avoid prolonged contact with the saltier waters will do so.

Land Use & Land Cover & Impervious Surface

Both the Lockatong and Wickecheoke creek watersheds are mostly undeveloped but very susceptible to degradation, with very similar land use patterns and geological features. The lands bordering these streams are primarily wooded which provides shade, helps stabilize stream banks and contributes to their ability to support a variety of pollution sensitive aquatic organisms. Presently, the stream corridors are lightly developed, however, pressure for land-use/land-cover changes is mounting. A dense commercial area has been approved and construction has been initiated in Kingwood Township, along Route 12 near Baptistown, and an expansion to an extensive greenhouse operation in Franklin Township is proposed. Each of these projects could negatively affect the headwaters of the creeks, and thus the entire downstream water quality and quantity.

These watersheds are at risk from changing land uses and already are showing signs of stress, including loss of stream buffer and additional impervious surface. Most of these changes may be characterized as impacts to natural habitats. These include (in order of frequency) a change from agriculture to residential use; from forest to residential; from wetlands to residential; from forest to agriculture; and from wetland to agriculture.

The Lockatong and Wickecheoke Creek watersheds are primarily rural in nature, with scattered farms, homes, county and local roads, etc. However, from 1986 to 1995, new urban areas[1] have increased 1.64% (percent of the total watershed area) from 2,709 to 3,233 acres, and agricultural areas have decreased 2.05% from 13,824 to 13,169 acres (**Table 2 and Figure 3**). These trends continue from 1995 to 2002 with new urban areas increasing 1.67% and agricultural areas decreasing 2.27% (**Table 3 and Figure 4**). Totally, the watersheds lost 1380 acres of agriculture and 282 acres of wetlands, with an increase of 1057 acres of urban area from 1986 to 2002 (**Table 4 and Figure 5)**. Recent changes can be seen in land use maps created from aerial photographs taken in 1995 and 2002 (**Figure 6**), the land use changes between 1986 and 2002 are shown in **Figure 7**. The combined Lockatong and Wickecheoke watersheds are approximately 11.8 percent "urban" or developed according to the NJDEP 2002 data. Much of

[1] "Urban areas" are defined as such in the NJDEP land use/land cover GIS products, and generally include any developed land area. Such areas are not necessarily in cities or suburbs.

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the remaining land is forested or agriculture, with 18 percent of the total area as wetlands, situated mostly in the headwaters and mid-watershed areas (**Figure 8**). Soils tend to be thin, and water resources minimal, due to the location on the Hunterdon (or Croton) Plateau with its hard argillite bedrock. Without additional protection of these watersheds, stream degradation will continue, from both a water quantity and water quality perspective. The stream systems are very susceptible to loss of flow during dry periods, from a combination of ground water uses and subsurface conveyance. Loss of flow creates an associated increase in contamination levels after loss of dilution, and a restructuring of the aquatic ecosystem.

A study by USEPA (1990) described how the hydrologic characteristics and pollutant loadings in a watershed are directly related to the amount of impervious cover in that watershed. Once the amount of impervious cover is greater than 5% to 10%, there is a significant reduction in the health of a stream. Even though currently the impervious surface in the Lockatong and Wickecheoke Creek watersheds is 2% (total 642 acres of impervious cover according to the 2002 NJDEP land use and land cover data, which includes local roads in the impervious area calculation). These watersheds will be very sensitive to any future increase in impervious cover because the natural underlying argillite geology already acts as an impervious surface, since it is so dense, and allows little recharge causing greater runoff and erosion problems.

Impervious surfaces do not allow rain and storm water to recharge naturally. Instead, this water becomes runoff, often contaminated with pollutants, which then enters the streams. Runoff from impervious areas can contain a variety of pollutants that are detrimental to water quality, including sediment, nutrients, road salts, heavy metals, pathogens, bacteria, and petroleum hydrocarbons.

The degradation caused by impervious cover in a watershed is serious and often irreversible. The amount of impervious surface that would degrade the Lockatong and Wickecheoke will be lower because of the underlying geology. With the current low level of imperviousness in the watersheds, many of the negative impacts associated with higher levels of imperviousness are already visible. Watershed municipalities must recognize these early signs of vulnerability to impervious cover, and institute strategies to prevent further degradation.

Table 2: Land Use and Land Cover 1986 and 1995

Land Use Type	Acre 1986	Land Use Percent 1986	Acre 1995	Land Use Percent 1995	Acre Change	Percent Change
AGRICULTURE	13,824	43.31	13,170	41.26	-654	-2.05
BARREN LAND	27	0.09	45	0.14	17	0.05
FOREST	9,230	28.92	9,396	29.44	166	0.52
URBAN	2,709	8.49	3,233	10.13	524	1.64
WATER	138	0.43	143	0.45	5	0.01
WETLANDS	5,987	18.76	5,929	18.58	-58	-0.18

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Table 3: Land Use and Land Cover 1995 and 2002

Land Use Type	Acre 1995	Land Use Percent 1995	Acre 2002	Land Use Percent 2002	Acre Change	Percent Change
AGRICULTURE	13,170	41.26	12,444	38.99	-724	-2.27
BARREN LAND	45	0.14	73	0.23	28	0.09
FOREST	9,396	29.44	9,735	30.50	339	1.06
URBAN	3,233	10.13	3,766	11.80	532	1.67
WATER	143	0.45	193	0.61	50	0.16
WETLANDS	5,929	18.58	5,705	17.87	-225	-0.70

Table 4: Land Use and Land Cover 1986 and 2002

Land Use Type	Acre 1986	Land Use Percent 1986	Acre 2002	Land Use Percent 2002	Acre Change	Percent Change
AGRICULTURE	13,824	43.31	12,444	38.99	-1,380	-4.32
BARREN LAND	27	0.09	73	0.23	46	0.14
FOREST	9,230	28.92	9,735	30.50	505	1.58
URBAN	2,709	8.49	3,766	11.80	1,057	3.31
WATER	138	0.43	193	0.61	55	0.17
WETLANDS	5,987	18.76	5,705	17.87	-282	-0.89

Figure 3: Comparison of Land Use Acres in 1986 and 1995

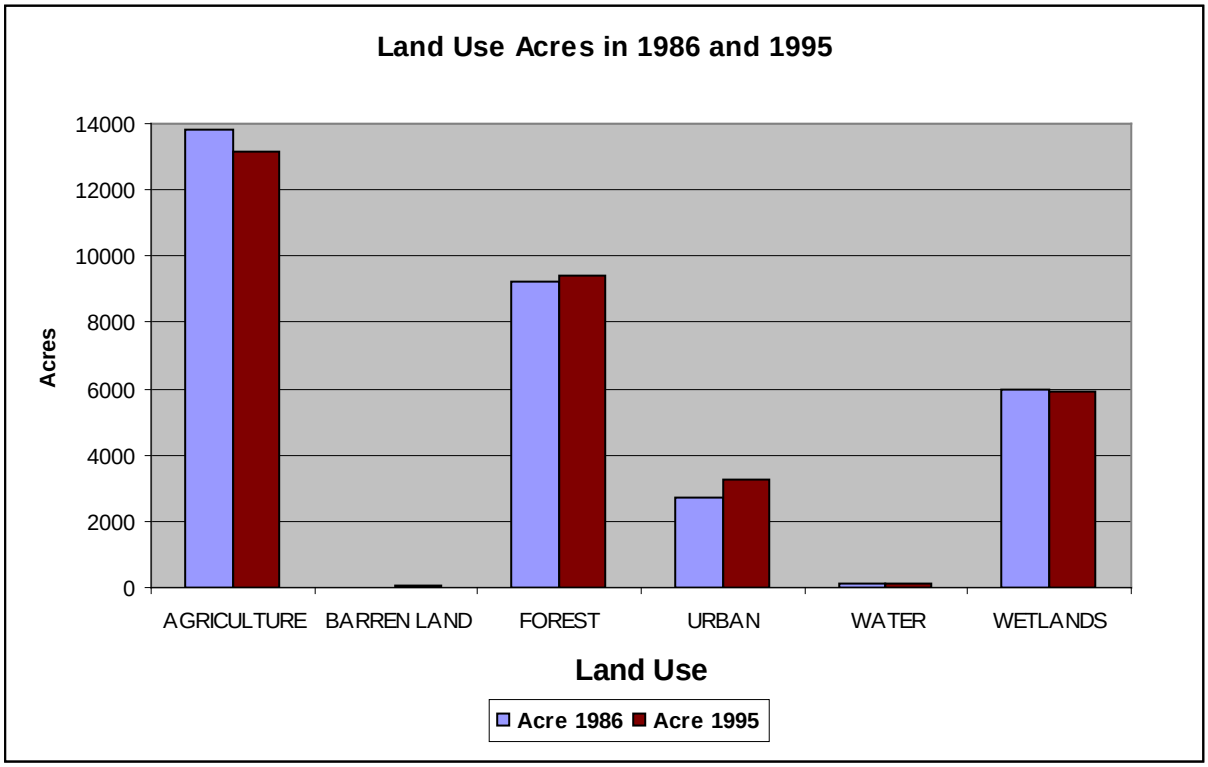

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Figure 4: Comparison of Land Use Acres in 1995 and 2002

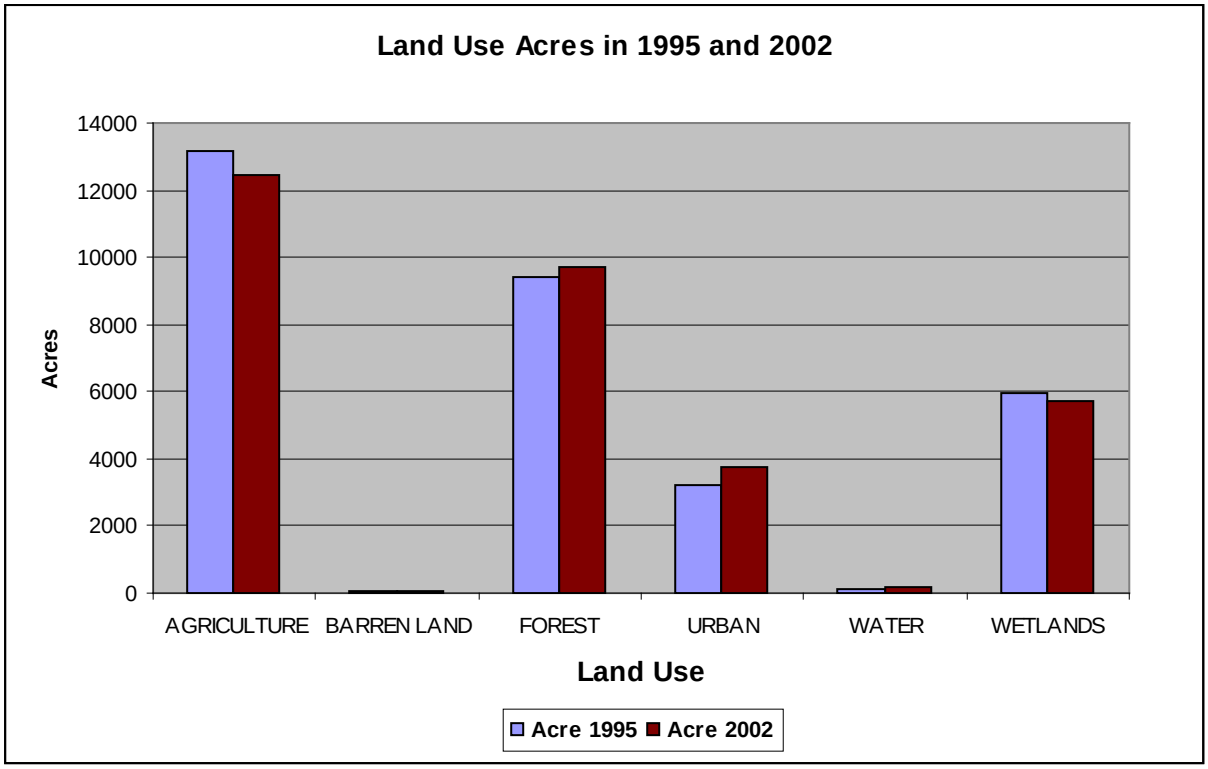

Figure 5: Comparison of Land Use Acres in 1986 and 2002

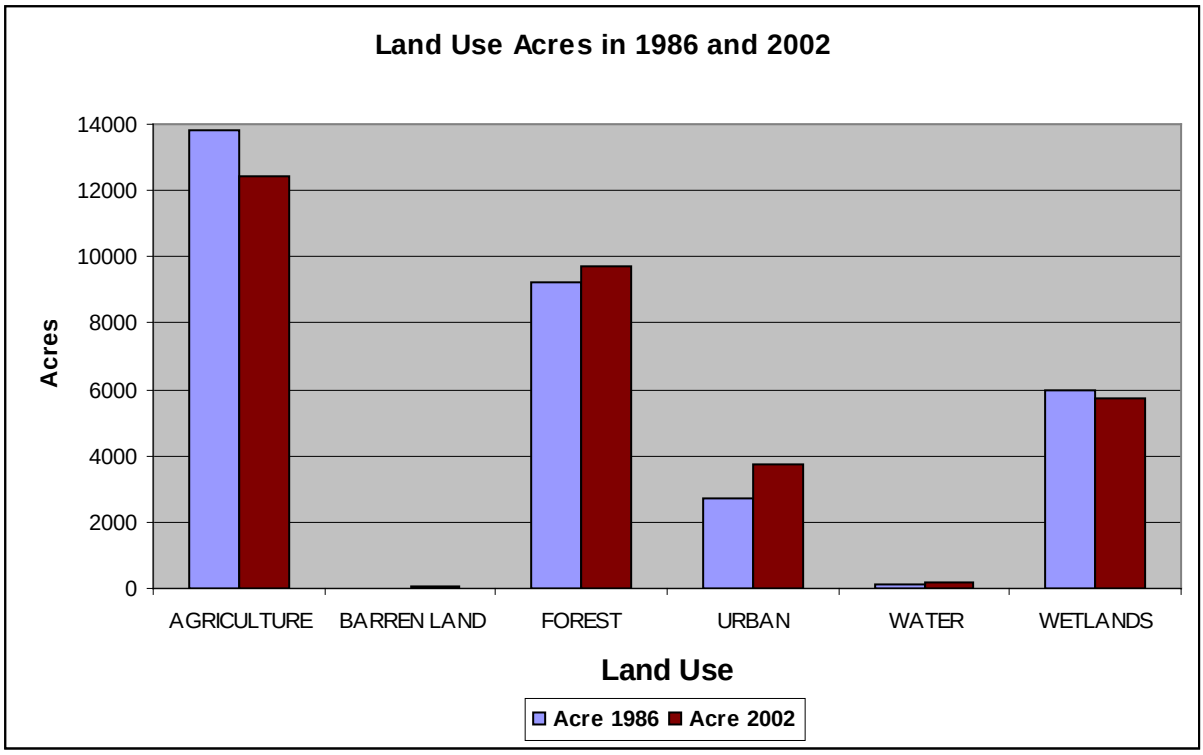

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Figure 6: Land Use and Land Cover Changes from 1995 to 2002

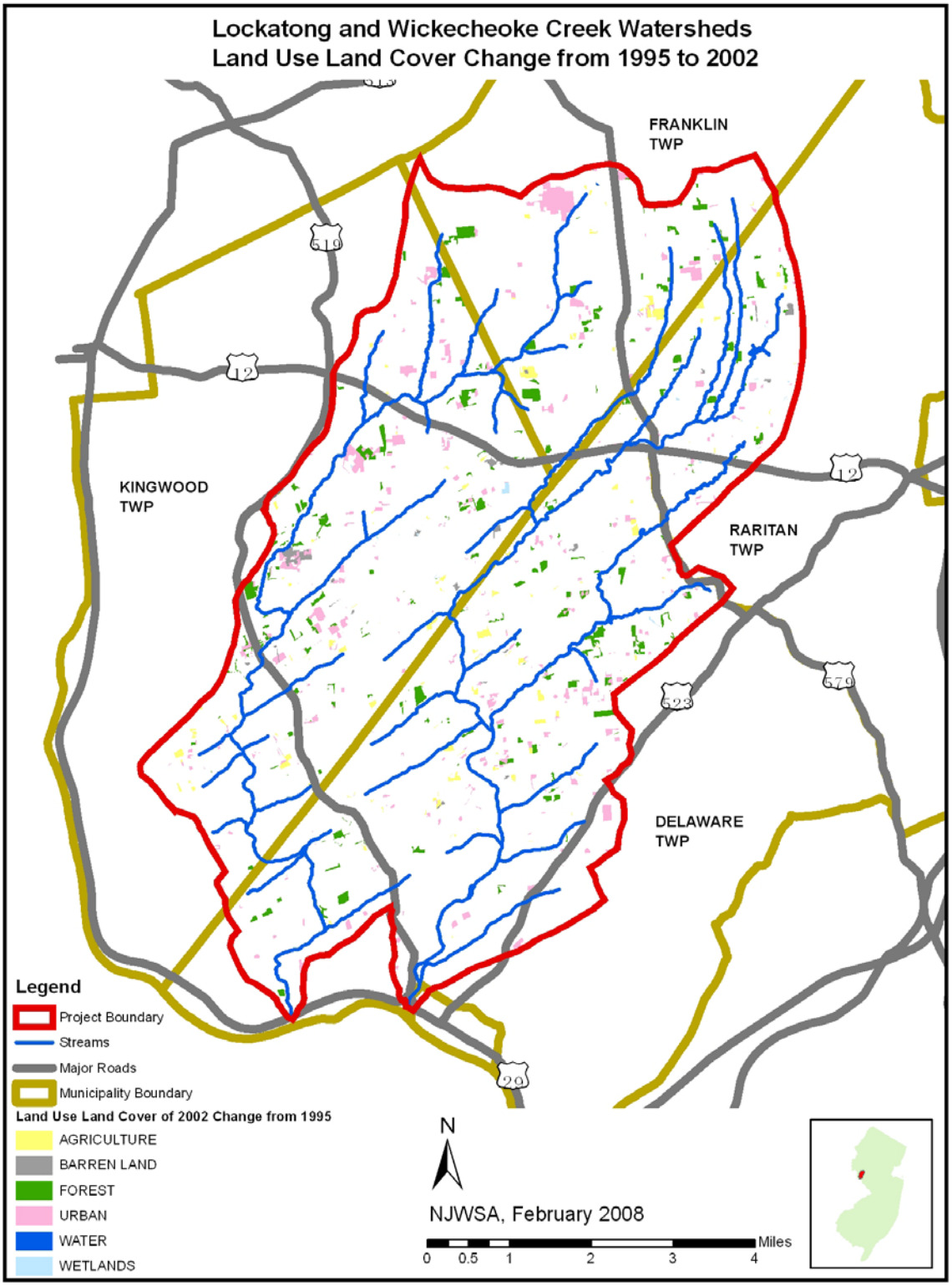

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Figure 7: Land Use and Land Cover Changes from 1986 to 2002

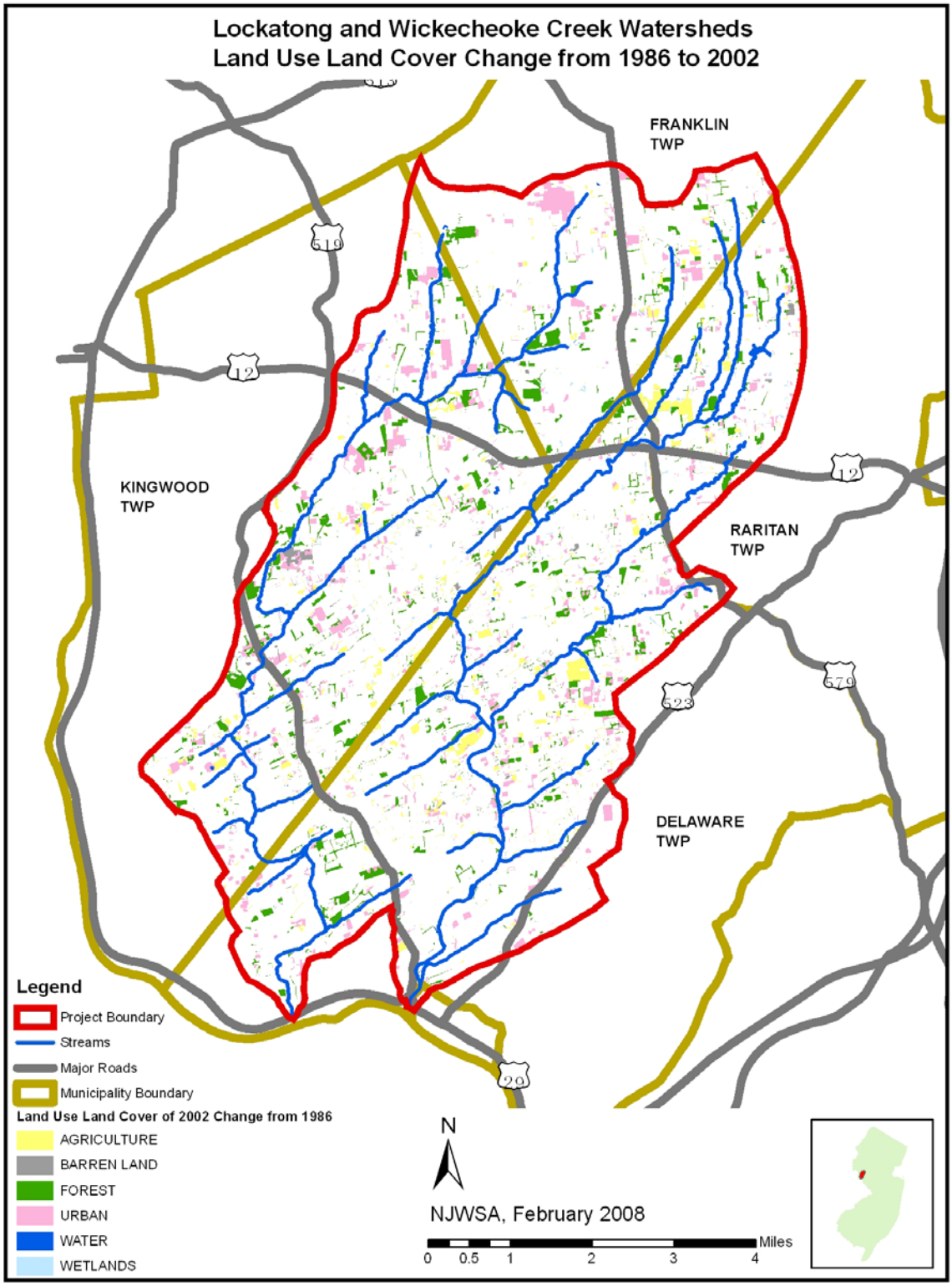

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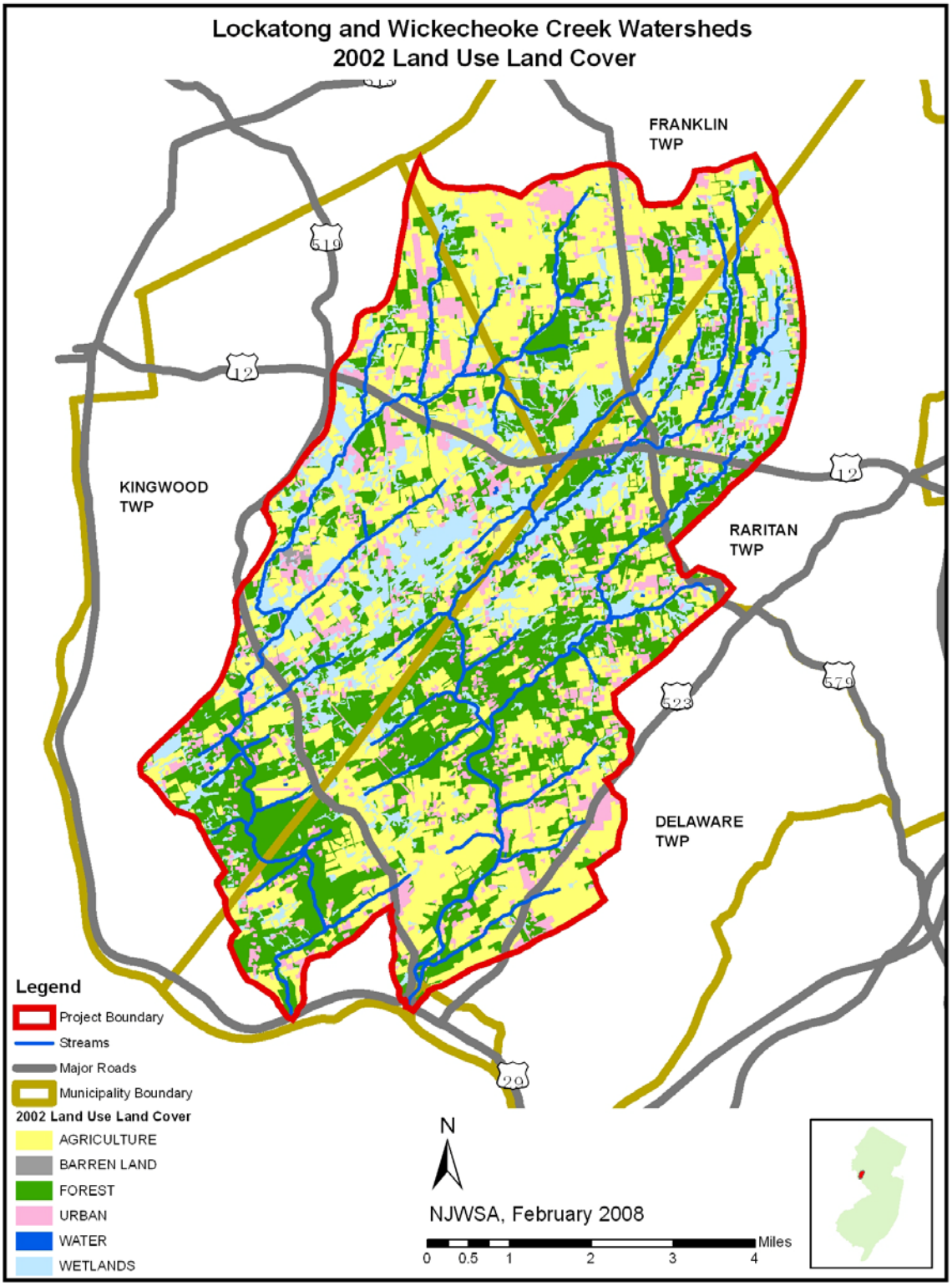
Figure 8: 2002 Land Use Land Cover



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Open Space Preservation in the Watersheds

The preservation of open space is very beneficial to the health of these watersheds, and is perhaps the single most effective tool for protecting water quality and quantities. The benefits of preserving land include limiting the amount of impervious cover in the landscape, increasing the infiltration of storm water, decreasing runoff and erosion, decreasing non-point source pollution, providing habitat and increasing biodiversity, supporting agriculture, providing recreational opportunities, protecting the quality of life and inherently increasing land values.

It is important to protect both the stream corridors and the upland areas from which they receive runoff and base flow. Open space preservation should be planned and implemented to avoid the creation of isolated islands of open space. New Jersey has taken a very impressive step with the creation of the Garden State Preservation Trust, which was structured to save an estimated 1 million acres of open space and farmland. This was a wonderful funding opportunity for local municipalities to use for developing open space and farmland preservation plans.

The New Jersey Conservation Foundation (NJCF) has been acquiring both land and easements along the Wickecheoke for over 20 years. The Hunterdon Land Trust Alliance (HLTA) also started the acquisition process along the Lockatong creek. Both groups have matching grants from Green Acres. The towns could facilitate these initiatives by offering to participate in the necessary matches. This would be a cost effective strategy that would take full advantage of these groups as acquisition resources. There are a total of 6,776 acres of preserved open space and farmland protected by the State, County, local and non-profit organizations as of August 2009, equaling 21% of the total watershed area (**Figure 9**).

The NJ Water Supply Authority has also authorized the use of its Source Water Protection Fund for the Raritan Basin System as match to specific purchases in the watersheds, in collaboration with other land acquisition agencies.

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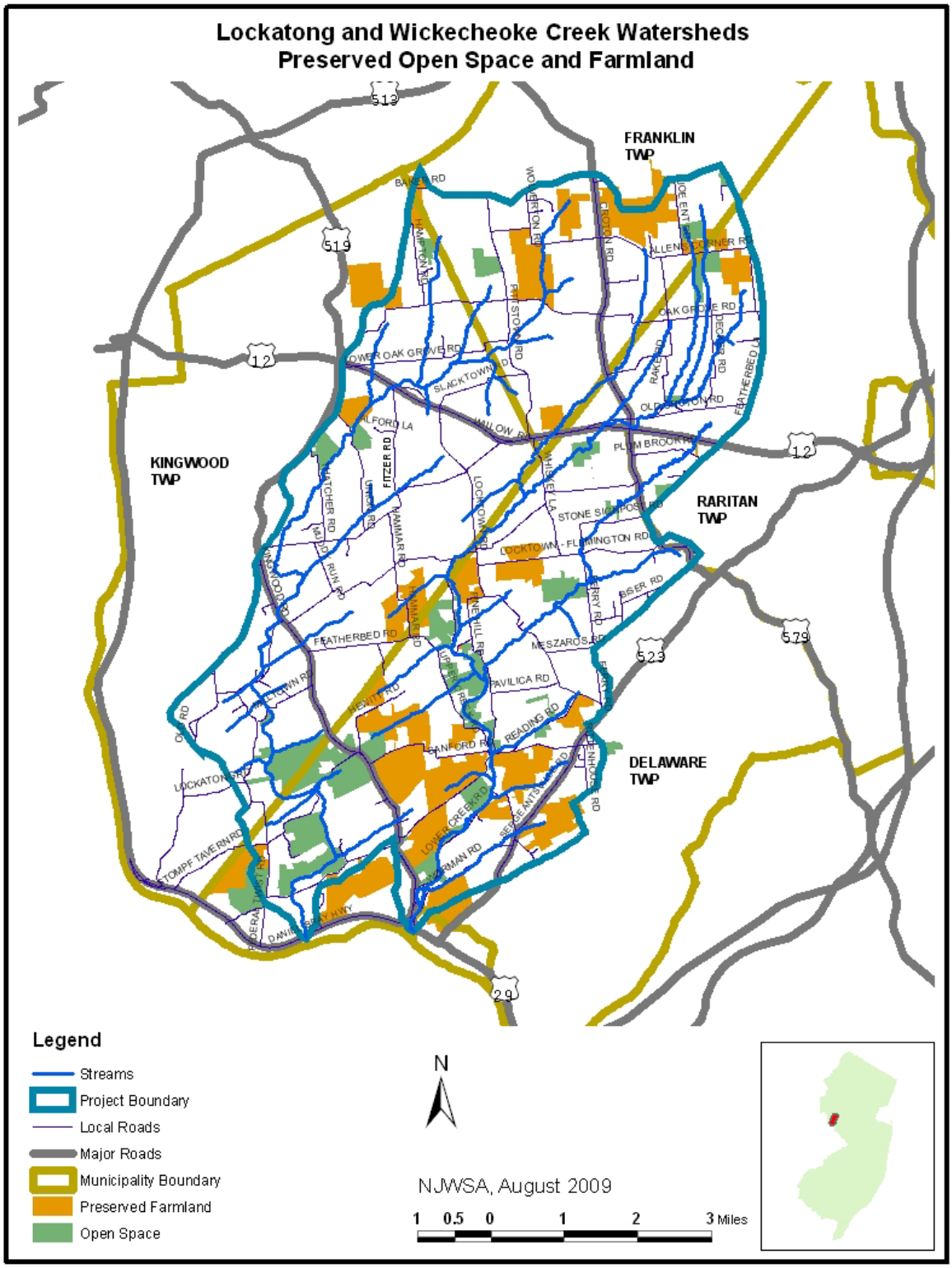
Figure 9: Preserved Open Space and Farmland



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Geology & Topography

The predominant bedrock of these drainage basins is “Lockatong argillite”. This very hard sedimentary rock provides natural aesthetics along these creeks but also constitutes a natural vulnerability for water quality and quantity from anthropogenic activities. This type of rock was named Lockatong argillite because some of its best surface exposures occur along the Lockatong Creek, which cuts along its bedding planes and reveals many of its layers.

Lockatong argillite underlies 69% of the Lockatong watershed, and 55% of the Wickecheoke watershed. This is a hard, dense sedimentary rock formation that was originally formed as a lake bottom deposit in the Triassic period. These deposits are very resistant to erosion and weathering, and thus form elevated topographic features. It is a notoriously poor source of ground water. It is not very porous at the upper levels, so its soils do not drain well and are susceptible to flooding, high run off and erosion.

This geology also has negative implications for septic systems. Although properly located and maintained septic systems provide good treatment of waste, including some ground water recharge, there are areas within the Lockatong and Wickecheoke watersheds that have aging septic systems, as well as many systems that have been inappropriately located in wet soils. Malfunctioning systems create water quality problems to streams from both surface and subsurface conveyance of septic contaminants. In a consolidated rock formation such as argillite, distance alone may not provide a sufficient margin of safety for septic system effluent. For example, if an effluent encounters a favorable set of interconnected fractures, it may reach a well at a greater distance and at a much faster rate.

Often referred to as blue jingle, this rock makes for very beautiful cliffs, spectacular waterfalls, and rocky slopes throughout the creek corridor. But since most rainfall cannot penetrate this rock formation and recharge the aquifer, it must flow over the surface into the streams. This can cause runoff and flash flooding problems during relatively minor storm events. Many of the stream banks are severely eroded even though the watersheds are as yet lightly developed. This results in sedimentation from stream bed and bank erosion, which has negative impacts on aquatic life. Also, when rainfall does not recharge the aquifer but instead becomes runoff, it is not filtered through the soil and rock media which can remove pollutants. This unfiltered runoff is a major source of non-point source pollution. It is particularly important that residents be aware of sources and impacts from non-point source pollution. In watersheds where geology prevents the natural filtration of ground water through soil and vegetative processes prior to reaching streams as base flow; vegetative stream buffers become critical for filtration of the surface water that enters streams during storm runoff events. These buffers can remove a significant amount of the impurities in runoff before it enters a stream, and can also reduce runoff velocity and peak flows to suppress soil and channel erosion.

The existing topography resulted from relatively recent erosion from a nearly flat plain. The elevation ranges from 20 feet above mean sea level (adjacent to the Delaware River) to 700 feet for these watersheds.

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Slopes greater than 15% are generally considered “steep slopes” (**Figure 10**). The closer the topographic lines are spaced to each other, the steeper the land surface. Steeper slopes are more vulnerable to erosion. When developed, areas with steep slopes can harm water quality with sedimentation. Left undisturbed, stable slopes can act as natural filters which improve water quality. As the gradient or percent of slope increases, the velocity of runoff water increases, which increases its erosive energy. A doubling of velocity of runoff water increases the erosive power fourfold and causes 32 times the amount of material of a given particle size that can be carried by the flow (Foth, 1978).

Erosion causes a number of harmful effects on the environment: loss of soil upon which plants and wildlife depend; loss of soil fertility, because the nutrients and organic material are more easily eroded; gully formation; and sedimentation of streams and the D&R Canal. Eroded sediment, and the nutrients, pesticides, and other chemicals carried with it, affect aquatic life in many ways. The sediments may bury fish eggs, reduce light available to aquatic plants, and reduce recreational quality and aesthetics.

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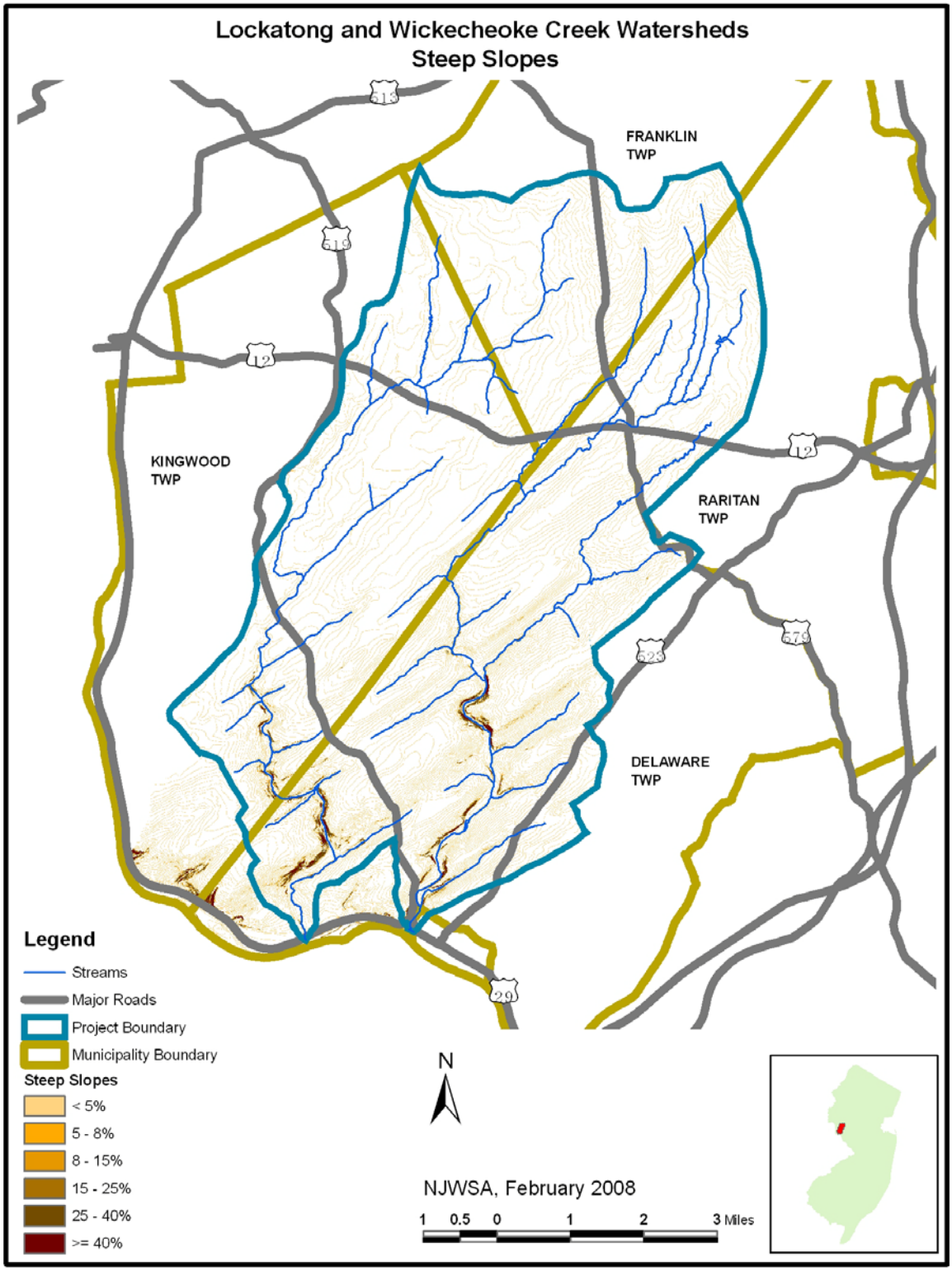
Figure 10: Steep Slopes



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Soil

The soil is the unconsolidated mineral material on the immediate surface of the earth and which serves as the medium for growth of land plants, and provides a natural filter for ground water recharge. The characteristics of each soil type have developed over time (usually many thousands of years) under the influence of the parent material (the bedrock that has broken down into small fragments to form the soil), climate (including moisture and temperature regimes), macro- and microorganisms, and topography. Soil is a basic resource for food production, in addition to its essential role in collecting and purifying water before it enters the ground water. However, soil itself can be a pollutant, such as dust in the air or as sediment in water.

The US Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) made soil surveys in 1974 to determine soil characteristics and capabilities, and to help people understand soils and their uses. The soil survey was updated in 1986 and digitized into GIS in 1999. The objective of soil mapping is to separate the landscape into segments that have similar use and management requirements.

According to the Soil Survey Geographic Database (SSURGO) information, field investigations and data collection were carried out in sufficient detail to name map units and to identify accurately and consistently areas of about 5 acres. Although very useful, the SSURGO database should be used as a reference to determine where onsite sampling, testing, and detailed studies of specific soil characteristics is essential for accurately determining potential uses, and effectively managing farms and wetlands.

The soil characteristics vary from place to place in slope, depth, drainage, erodibility and other physical, chemical and biological attributes that affect management. There are over 50 soil types in the watershed regions. This report includes maps and tables of several important characteristics of these soils. When viewed together, most soils in these watersheds have limitations from at least one of the following factors: poor drainage, high water table, shallow bedrock or steep slopes. Limited depth to bedrock in much of the watershed areas indicates potential restrictions for development in the area.

Extent of Hydric Soils

Hydric soils are those soils that are wet long enough to periodically produce anaerobic conditions, thereby influencing the type of vegetative growth. For delineation of hydric soils the ponding or flooding event must last at least seven days during the growing season. Hydric Soils are marked Y for “yes” in SSURGO, when they meet the requirements for a hydric soil. **Figure 11** presents the areal extent of hydric soils within the watersheds.

Extent of Hydrologic Soil Groups

The hydrologic soil grouping describes the rate that water infiltrates into the ground, as shown in **Table 5**. Small areas near the headwaters of Lockatong Creek and the areas where Lockatong and Wickecheoke Creeks empty into D&R Canal have moderate to high infiltration rates (Class

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A). The majority of the area within these watersheds have slow to very slow infiltration rates which fall into the class C & D soils; these soils indicate a high risk for surface ponding and seepage to local surface and shallow ground water resources and an elevated potential for malfunctioning septic systems. **Figure 12** presents the areal extent of hydrologic soil groups within the watersheds.

Table 5: Hydrologic Soil Grouping

Class	Definition	Acres	Percent within the Watersheds
A	High infiltration rates. Soils are deep, well drained to excessively drained sands and gravels.	6	0.01%
B	Moderate infiltration rates. Deep and moderately deep, moderately well and well drained, soils that have moderately course textures.	3,811	11.9%
B/D	Drained/undrained hydrology class of soils that can be drained and are classified. Moderate to very slow infiltration rates.	159	0.5%
C	Slow infiltration rates. Soils with layers impeding downward movement of water, or soils that have moderately fine or fine textures.	22,341	69.9%
C/D	Drained/undrained hydrology class of soils that can be drained and classified. Slow to very slow infiltration rates.	97	0.3%
D	Very slow infiltration rates. Soils are clayey, have a high water table, or are shallow to an impervious layer.	5,533	17.3%
Source: NRCS Soil Survey Geographic (SSURGO) Database.			

Extent of Land Capability Classes

Capability class is the broadest category in the land capability classification system. Class codes 1, 2, 3, 4, 5, 6, 7, and 8 are used to represent both irrigated and nonirrigated land capability classes. They tell about a rating of the soil for agricultural use, the number indicates progressively greater limitations and narrower choices for use.

Based on the land capability class code, NJWSA grouped them into three categories: soils that have slight limitations on their use for agricultural production; soils that have moderate limitations that reduce the selection of tolerant plants or require moderate conservation practices; soils that have severe or very severe limitations that reduce the choice of plants, are susceptible to erosion, or require special conservation practices or very careful management. Most of the areas within these watersheds have severe to very severe limitations for agricultural use. **Figure 13** presents the areal extent of land capability classes within the watersheds.

Extent of Erodibility Classifications

Erosion is the wearing away of the land surface by running water, wind, ice, or other geological agents. Erosion is often accelerated as a result of human activities. The soil erodibility factor (known as “K”) is a number which quantifies the susceptibility of soil particles to detachment and movement by water. This factor is used in the Revised Universal Soil Loss Equation

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(RUSLE) to calculate soil loss by overland flow. It takes into account the effects of infiltration rate, permeability and total water capacity and factors that resist the forces of the rainfall and runoff. A larger K value equals a greater susceptibility to erosion. **Figure 14** presents the areal extent of erodibility classifications within the watersheds.

There are three categories for the soil erodiblity: 1. Soil that meets the requirement for highly erodible lands. 2. Potentially highly erodible lands. 3. Soil that does not meet the requirement for highly erodible lands. Most soils of the watersheds are either highly erodible or potentially highly erodible.

Extent of Depth to Bedrock

The depth to bedrock is the distance from the land surface to bedrock. These watersheds have very shallow depths to bedrock, ranging from zero (bedrock is exposed at the surface, with no soil above it) to approximately 60 inches. The bedrock depth in most of these watersheds ranges from 40 to 60 inches. Areas near the D&R Canal and some small areas along the banks of the lower Wickecheoke creek have depths greater than 60 inches. **Figure 15** presents the areal extent of soil depth to bedrock within the watersheds.

Extent of Depth to High Water Table

The water table is the top of the water surface in the saturated part of an aquifer. The type of water table is listed, with the months during which the seasonal high water table occurs at the depth specified in a normal year. The types of water table include apparent and perched.

Soils with a depth to the water table from the land surface of more than 6 feet have very high hydraulic conductivity and low water holding capacity. Soils with a depth to water table of from 1 to 6 feet commonly have a layer with low hydraulic conductivity, wet conditions at shallower depths in the profile. Soils with a depth to water table of less than 1 foot may have a saturated zone, a layer of low hydraulic conductivity, or seepage. Soils with these characteristics are wet to the surface most of the time, or water is ponded. **Figure 16** presents the areal extent of various depths to the high water table within the watersheds. Some headwaters and much of the lower watershed areas have depth to water table exceeding six feet, but most of the areas within the watersheds have a depth to water table of less than 2.5 feet.

Extent of Septic System Suitability

The NRCS database provides an interpretation of limitations of each soil for septic suitability. Soils within these watersheds are nearly all rated to have either “moderate” or “severe” limitations for septic tank absorption fields, with the majority being “severe”. Limitations are usually depth to rock, slow percolation rate, land slope, flooding, wetness, and/or filtering ability. The database used to generate the Septic System Suitability map came from the NRCS recently released SSURGO 2006 dataset by linking the septic limitation attribute information to GIS database (source of data: http://soildatamart.nrcs.usda.gov/). Under NJDEP regulations, septic systems generally are built to overcome such limitations through the use of mounded

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infiltration fields. **Figure 17** presents the areal extent of septic system suitability within the watersheds.

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Figure 11: Hydric Soil

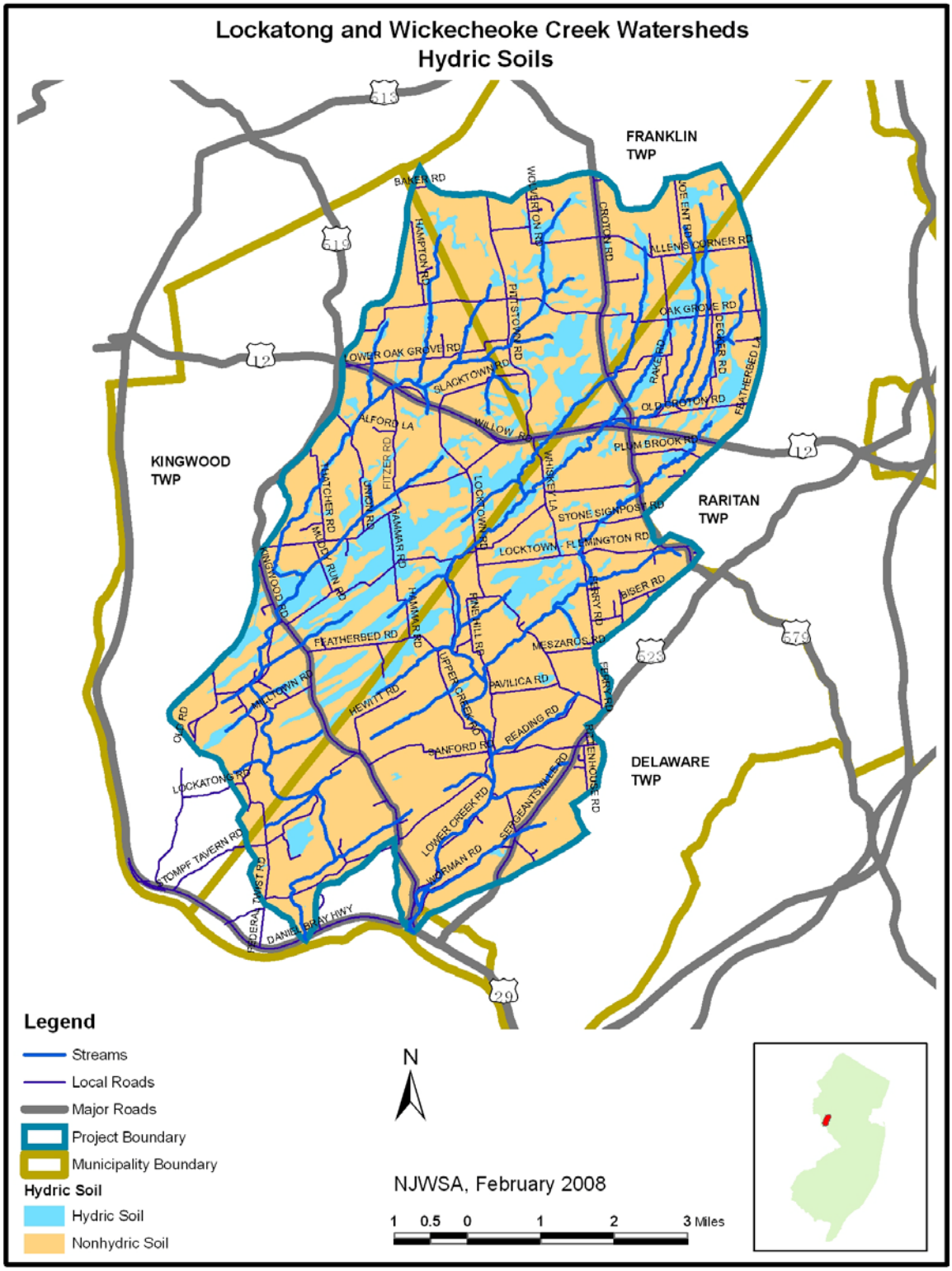

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Figure 12: Hydrologic Soil Group

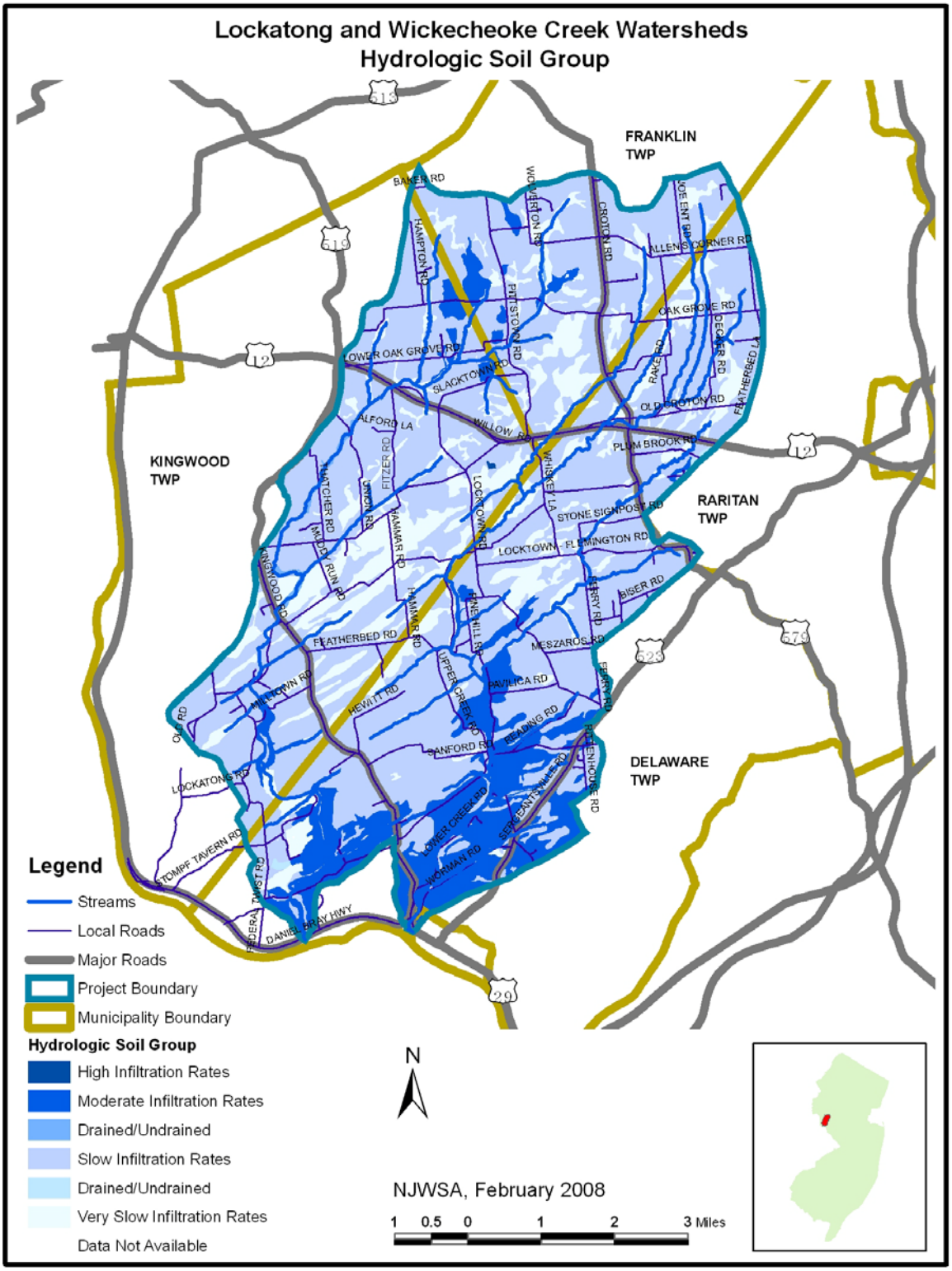

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Figure 13: Soil Capability Class

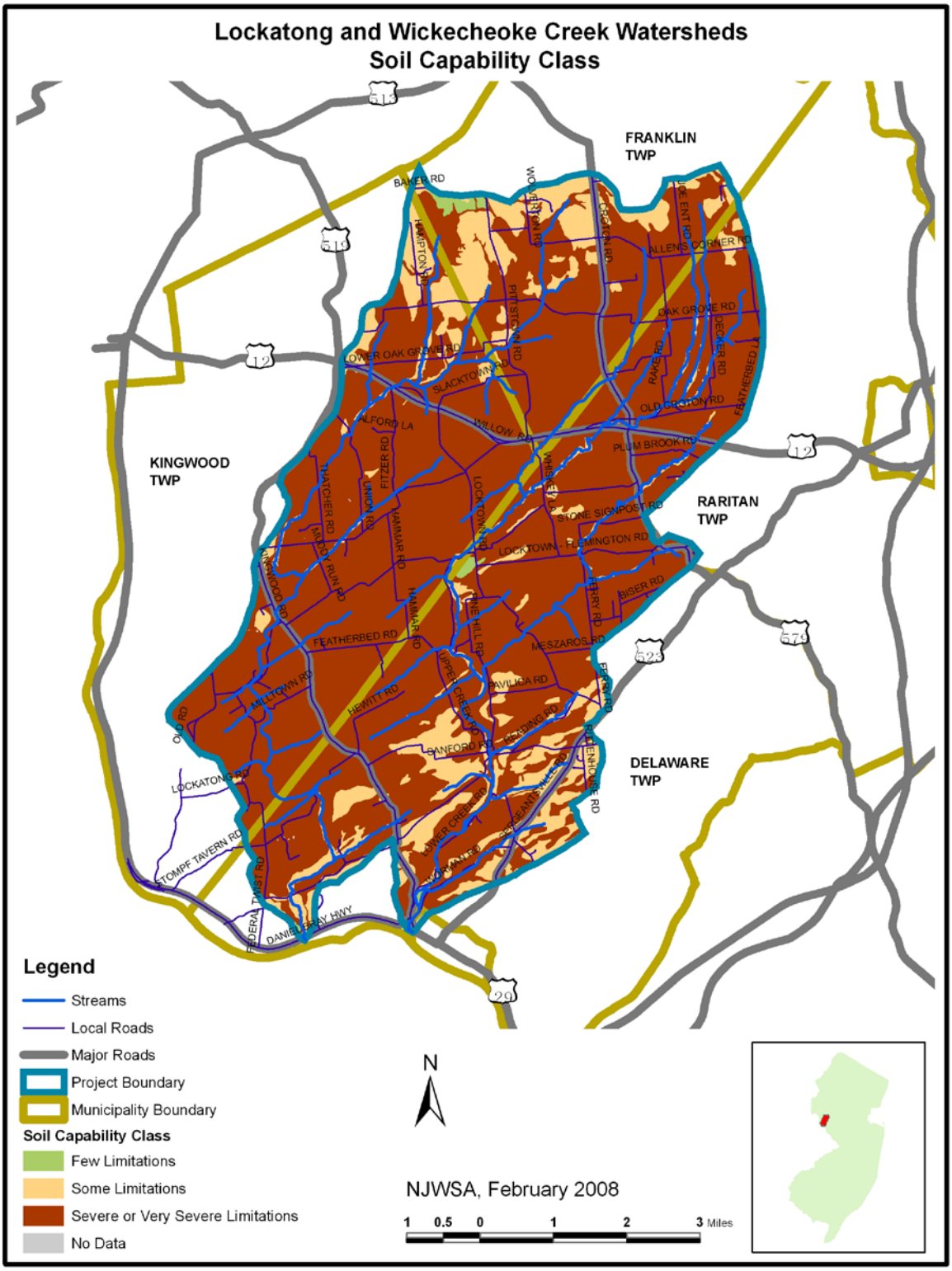

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Figure 14: Soil Erodibility

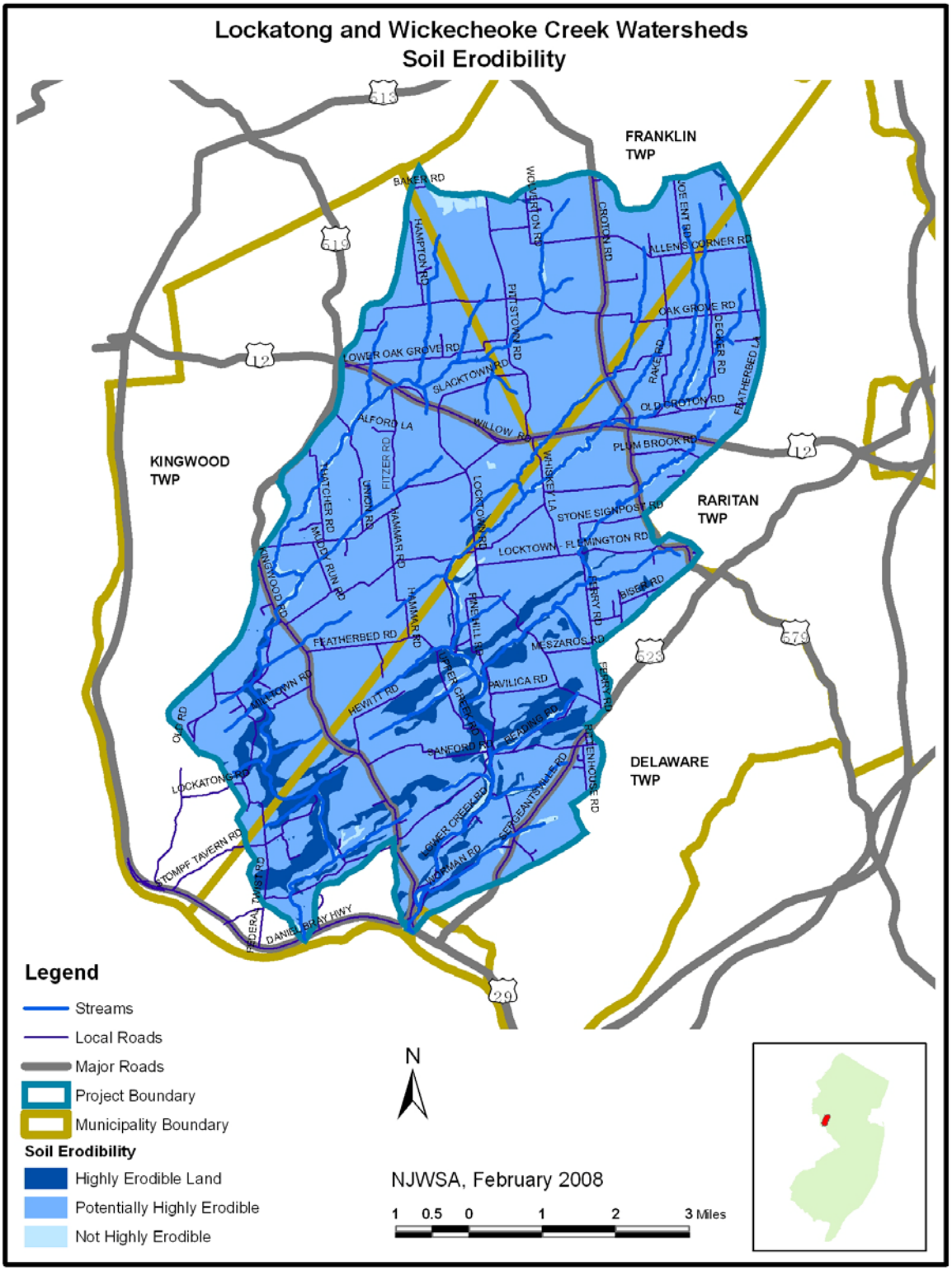

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Figure 15: Soil Depth to Bedrock

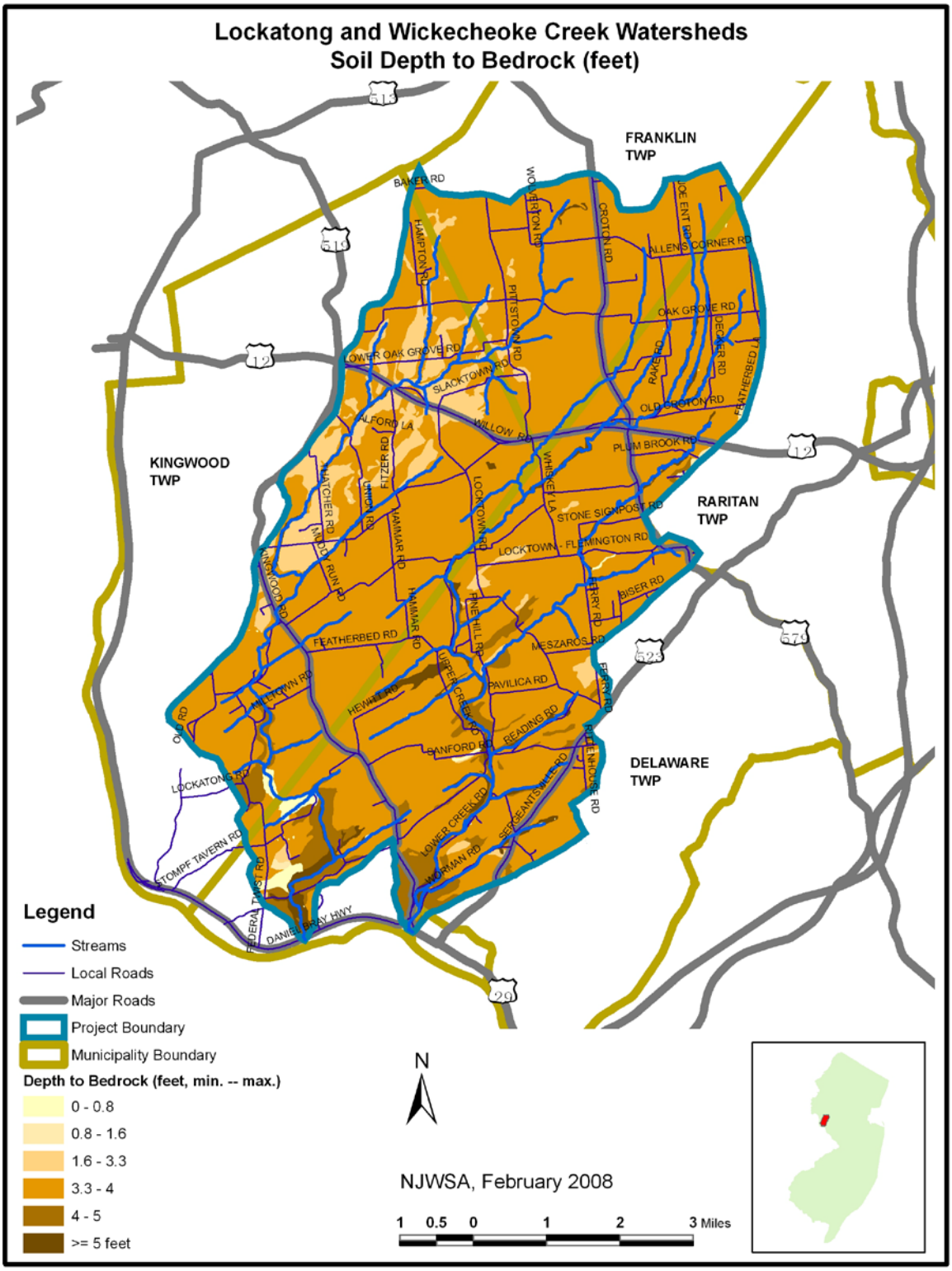

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Figure 16: Soil Depth to High Water Table

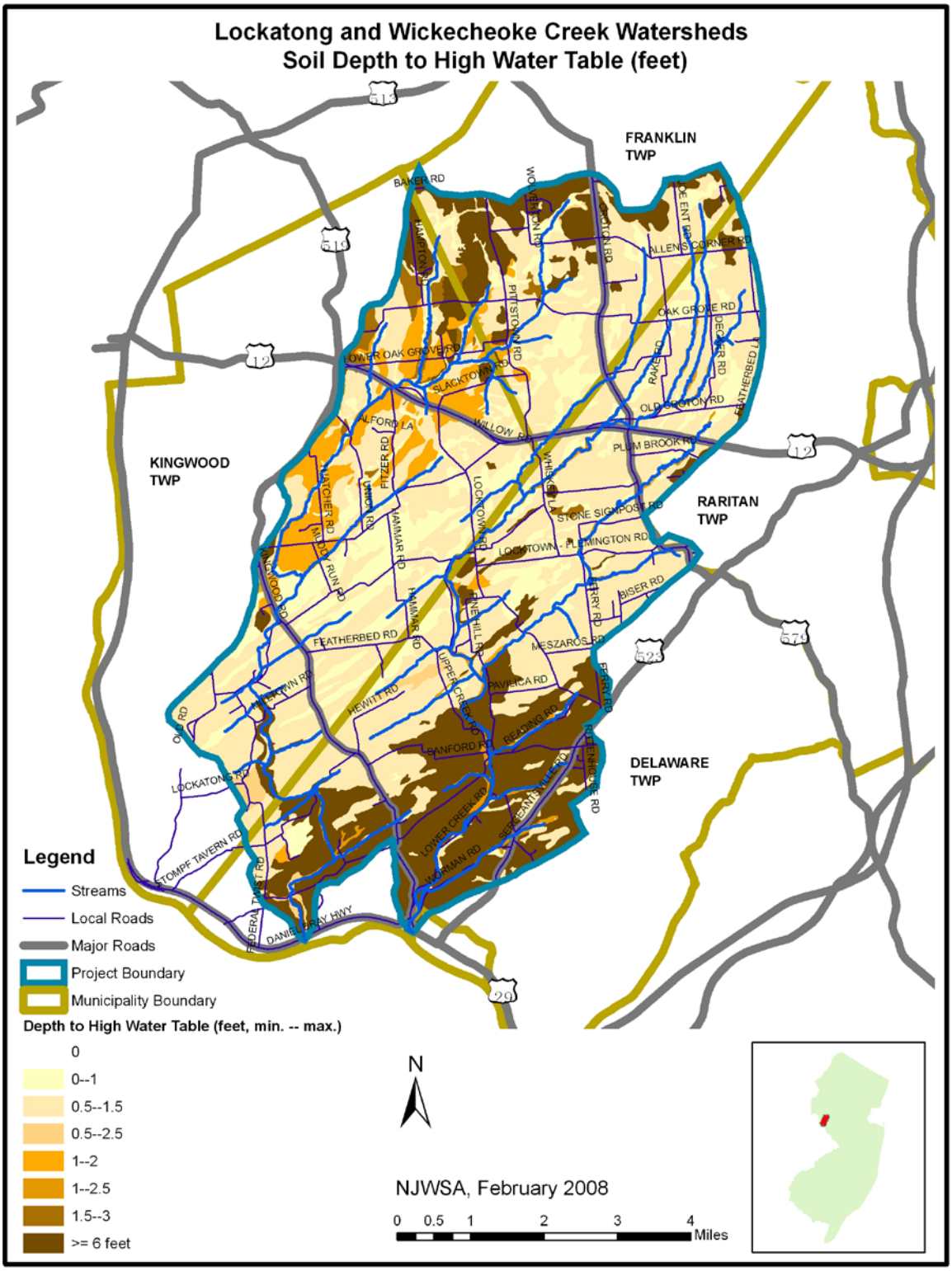

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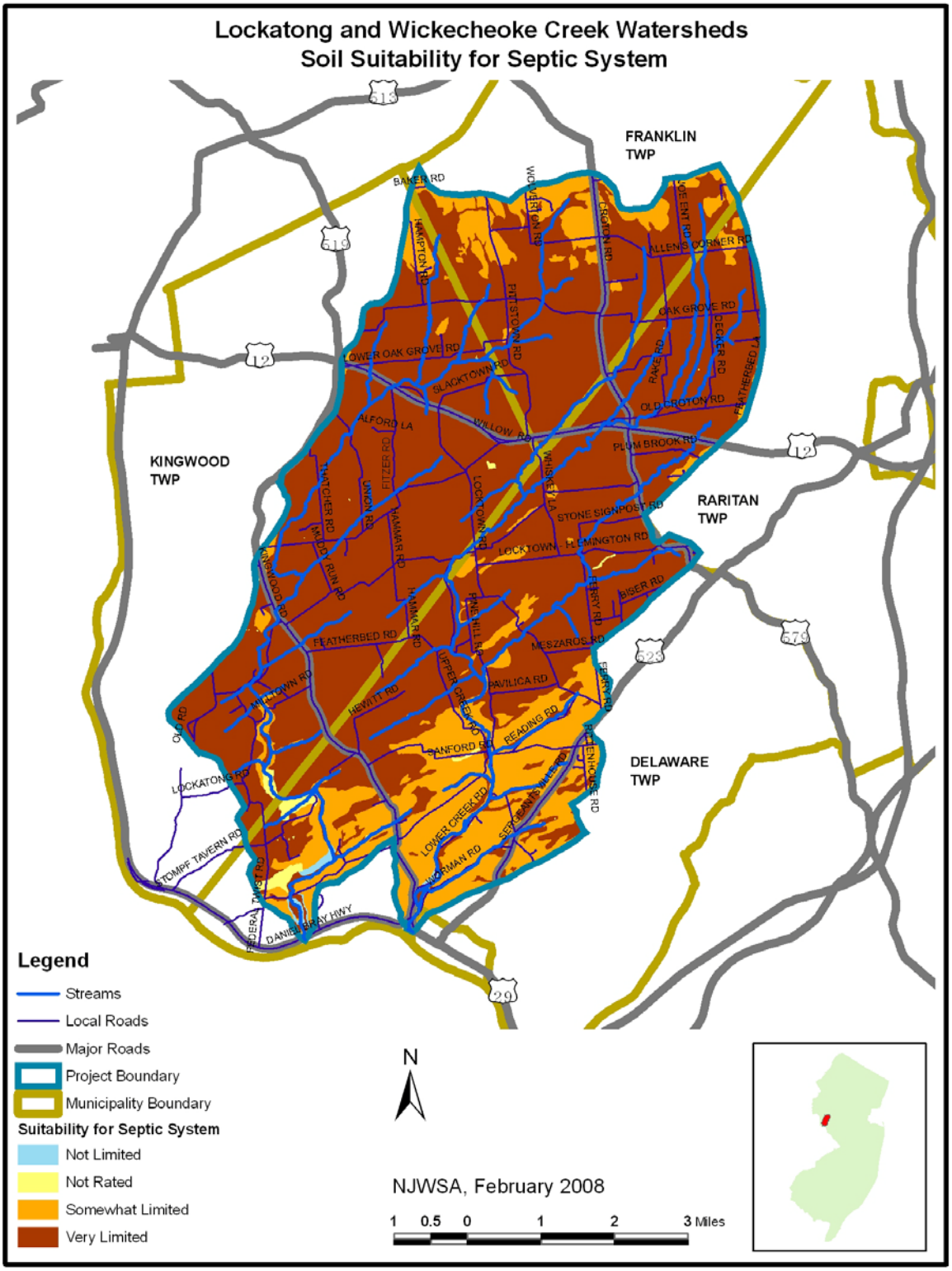
Figure 17: Soil Suitability for Septic System



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Surface Water: Hydrology and Quality

Surface water is water that is visible above the ground surface, such as creeks, rivers, ponds, lakes, and wetlands. Since the predominant geological feature of these watersheds is Lockatong and Stockton argillite, it acts as an impervious surface, turning rainwater quickly into stormwater runoff, providing little opportunity for filtration or recharge. Runoff very quickly makes its way into the creeks, via direct inflow and tributaries. This has significant implications for flooding, erosion, non-point source pollution, and loss of recharge. Surface water flow has been monitored by the USGS (continuous monitors near the mouth of each stream) and the Authority since 2006. Lower base flows mainly originate in the headwaters for the Lockatong Creek and from two tributaries near the mouth of the Wickecheoke Creek.

Water Quality

Prior to 1991 Wickecheoke Creek at Stockton was the only NJDEP ambient physical/chemical water quality monitoring station on the Delaware River tributaries between the Musconetcong River and the Assunpink Creek. This station was discontinued in 1991. NJDEP routine monitoring has been limited to biological assessments, and fecal coliform monitoring performed by the Hunterdon County Department of Health on behalf of NJDEP. Based upon the last ambient monitoring assessment, Wickecheoke Creek had good overall water quality, with conditions degrading to fair in mid-summer. Water quality problems observed were elevated stream temperatures in warm weather periods and excessive levels of total nitrogen. From 1999 to 2004, the Delaware River Basin Commission (DRBC) maintained two water quality and flow monitoring stations as part of the Lower Delaware Monitoring Program, one each near the mouth of the Lockatong and Wickecheoke creeks, which provided a good water quality assessment.

Since 1997, several of the D&R Canal's water purveyors reported increased concentrations of total suspended solids in the raw water during and immediately after precipitation events, requiring increased chemical use for removing the particulates, subsequently increasing the sludge generation from residuals. NJWSA has sponsored three studies to assess pollutant contributions to the Canal; one in the late 1980's by Ebasco, one in the late 1990's by the U.S. Geological Survey (USGS), and the last one published in 2006 by NJWSA that addressed non-point source pollution.

Lockatong and Wickecheoke Creek are listed on Sublist 4 and 5 of NJDEP's 2006 Integrated List of Water Bodies (**Table 6**). These water bodies have been identified as having known water quality impairments (not meeting surface water quality standards) for water temperature, fecal coliform, and total phosphorus. TMDLs have been developed for the fecal coliform and total phosphorus listings. Sublist 1 is for parameters meeting water quality standards; Sublist 3 is for waters needing additional data; and Sublist 4 is for waters that have known impairments for which TMDLs have been developed (e.g., fecal coliform bacteria). Sublist 5 is for waters that have known impairments for which TMDLs have not yet been developed (e.g., temperature).

According to the NJDEP's 2006 Integrated List database, the entire Lockatong Creek and downstream segment of Wickecheoke Creek do not meet the surface water quality standard for

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total phosphorus. The phosphorus concentrations in the upstream section of Wickecheoke Creek could not be decided due to insufficient data. The sanitary quality of the watersheds is marginally acceptable; fecal coliform levels tend to increase during the growing season and during storm water flows. Warm summertime temperatures in conjunction with low flow conditions, especially in the trout maintenance sections of the streams, threaten aquatic life.

Table 6: 2006 Integrated Listings for Lockatong and Wickecheoke Creek Watersheds

Sublist	Station Name/Waterbody	Site ID	Parameters	Data Source
1	Lockatong Creek at Oak Grove Rd in FranklIn	AN0086	Benthic Macroinvertebrates	NJDEP AMNET
1	Lockatong Creek at Rosemont-Raven Rock Rd Bridge	DRBCNJ0013	Fecal Coliform, Dissolved Oxygen, pH, Nitrate, Dissolved Solids, Total Suspended Solids, Unionized Ammonia	DRBC
5	Lockatong Creek at Rosemont-Raven Rock Rd Bridge	DRBCNJ0013	Phosphorus, Temperature	DRBC
1	Lockatong Creek at Rt 12 in Kingwood	AN0087	Benthic Macroinvertebrates	NJDEP AMNET
1	Lockatong Creek at Rt 29 in Delaware	AN0089	Benthic Macroinvertebrates	NJDEP AMNET
1	Lockatong Creek at Rt 519 in Kingwood	AN0088	Benthic Macroinvertebrates	NJDEP AMNET
3	Plum Brook at Rt 579 in Raritan	AN0092	Benthic Macroinvertebrates	NJDEP AMNET
5	Plum Brook near Locktown	01461262	Fecal Coliform	NJDEP/USGS Data
3	Plum Brook near Locktown	01461262	Phosphorus	NJDEP/USGS Data
1	Plum Brook near Locktown	01461262	Temperature, pH, Nitrate, Dissolved Solids, Total Suspended Solids, Unionized Ammonia	NJDEP/USGS Data
3	Wickecheoke Creek at Croton	01461220	Phosphorus	NJDEP/USGS Data
1	Wickecheoke Creek at Croton	01461220	Temperature, pH, Nitrate, Dissolved Solids, Total Suspended Solids, Unionized Ammonia	NJDEP/USGS Data
5	Wickecheoke Creek at Croton	01461220	Fecal Coliform	NJDEP/USGS Data
5	Wickecheoke Creek at Locktown - Sergentsville Rd in Delaware	AN0091	Benthic Macroinvertebrates	NJDEP AMNET
1	Wickecheoke Creek at Rt 29 in Stockton	AN0095	Benthic Macroinvertebrates	NJDEP AMNET
3	Wickecheoke Creek at Rt 579 in Raritan	AN0090	Benthic Macroinvertebrates	NJDEP AMNET
1	Wickecheoke Creek at Sergentsville Rd in Delaware	AN0094	Benthic Macroinvertebrates	NJDEP AMNET
1	Wickecheoke Creek at Stockton	01461300, DRBCNJ0012	pH, Dissolved Oxygen, Dissolved Solids, Total Suspended Solids, Unionized Ammonia	NJDEP/USGS Data, DRBC
5	Wickecheoke Creek at Stockton	01461300, DRBCNJ0012	Phosphorus, Fecal Coliform, Temperature	NJDEP/USGS Data, DRBC
3	Wickecheoke Creek near Sergentsville	01461282	Phosphorus	NJDEP/USGS Data
1	Wickecheoke Creek near Sergentsville	01461282	Temperature, pH, Dissolved Oxygen, Nitrate, Dissolved Solids, Total Suspended Solids, Unionized Ammonia	NJDEP/USGS Data
5	Wickecheoke Creek near Sergentsville	01461282	Fecal Coliform	NJDEP/USGS Data

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Recent fecal coliform TMDL development was constrained by limited in-stream data. The watersheds represent nearly 60 percent of the total drainage into the Delaware and Raritan Canal (downstream of the Delaware River intake) and so are important to Canal water quality. Sediment loads require periodic Canal dredging where the streams discharge to the Canal.

Water Quality Assessments by NJWSA Since 2006

The NJWSA has initiated an intensive water quality sampling program for sites throughout these watersheds. The program was initiated in August 2006 and will continue through July 2007. There are two phases to the monitoring program. Phase 1 – baseline water quality assessment for 6 sampling events at 9 sites on the Lockatong Creek and 11 sites on the Wickecheoke Creek from August through December 2006. Water samples were collected at each site and analyzed for boron, total suspended solids (TSS), turbidity, total Kjeldahl nitrogen (TKN, combined organic and ammonia nitrogen), ammonia, nitrite, nitrate, total phosphorus (TP), and fecal coliform. Phase 2 – water quality monitoring to further isolate watershed areas exhibiting greater contaminant loadings, for the period February through July 2007. Phase 2 sample collections were conducted at a total of 7 sites on each stream: 3 of the same sites used in Phase 1 plus 4 additional sites. Water samples were collected and analyzed for boron, TSS, turbidity, TP, fecal coliform, and E. coliform. When necessary, the other parameters were selected for analyses. A field meter was used at each site during sample collections to measure conductivity, pH, and water and air temperatures. Phase 1 and Phase 2 monitoring sites are presented in **Figures 18** and **19**, respectively. All analyses were performed in conformance with a Quality Assurance Program Plan approved by the NJDEP. Surface Water Quality Standards associated with each parameter are presented in **Table 7**.

Table 7: Ambient water quality criteria

Parameter	Water Quality Criteria
Fecal Coliform	Geometric Average not to exceed 200 colonies/100ml
	90% of all values must not exceed 400 colonies/100ml
Escherichia Coliform	Geometric Average not to exceed 126 colonies/100ml Single sample not to exceed 235 colonies/100ml
Boron	No criterion
Nitrate-N	Not to exceed 10 mg/l as N
Ammonia	Seasonal criteria based on pH and water temperature
Total Kjeldahl Nitrogen (TKN)	No criterion
TP	Not to exceed 0.10 mg/l
Total Suspended Solids (TSS)	Not to exceed 25 mg/l in Trout Maintenance waters and not to exceed 40 mg/l in Non-Trout waters
Turbidity	30-day average not to exceed 15 NTU, never to exceed 50 NTU
Water Temperature	Not to exceed a summer average of 20 ^{o}C in Trout Maintenance waters and not to exceed a summer average of 27.8 ^{o}C in Non-Trout waters
PH	Not to exceed the range: 6.5 to 8.5
Specific Conductance	No criterion

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Data from the Phase 1 monitoring were analyzed to determine the status of water quality within the sub-basins of these watersheds. **Figures 20** and **21** illustrate the relative water quality ranking for each monitoring site as a composite of all measured water quality parameters for the Wickecheoke and Lockatong monitoring sites, respectively. The lower ranking numbers represent better water quality. Phase 2 monitoring will be performed to further isolate potential sources of pollution that have been identified in Phase 1.

Figure 20: Wickecheoke Creek water quality ranking

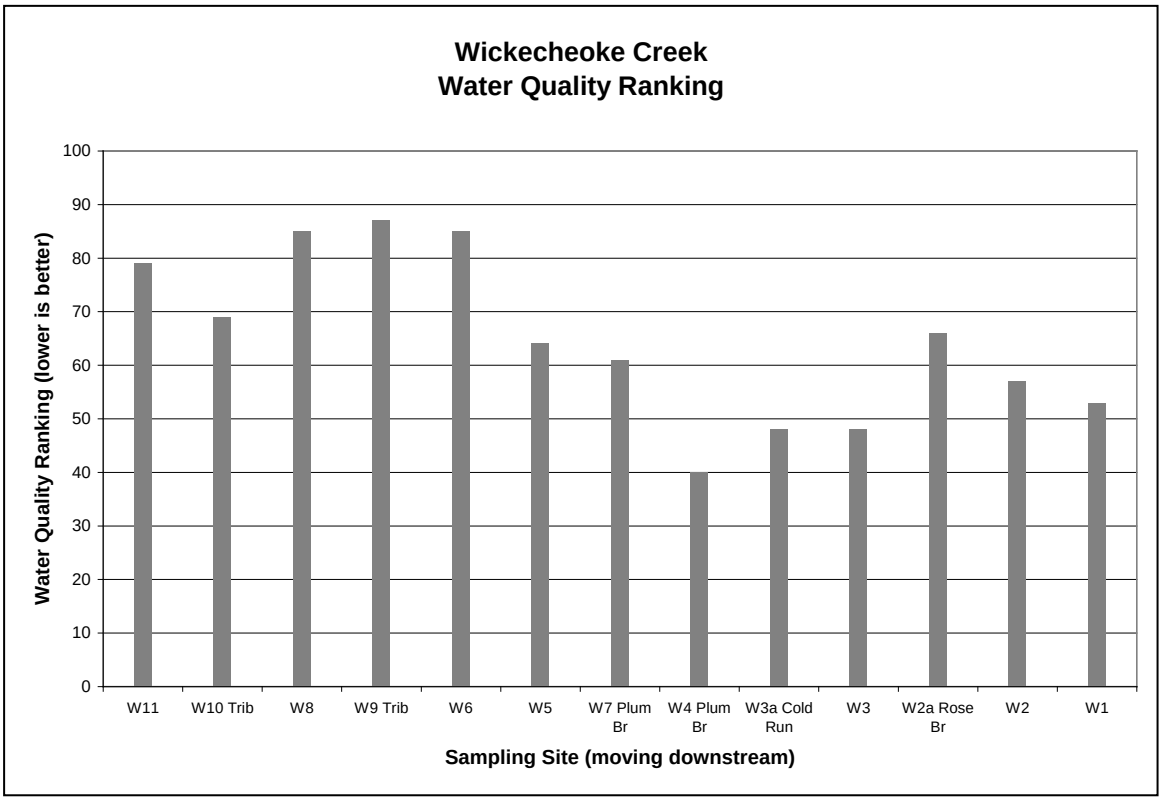

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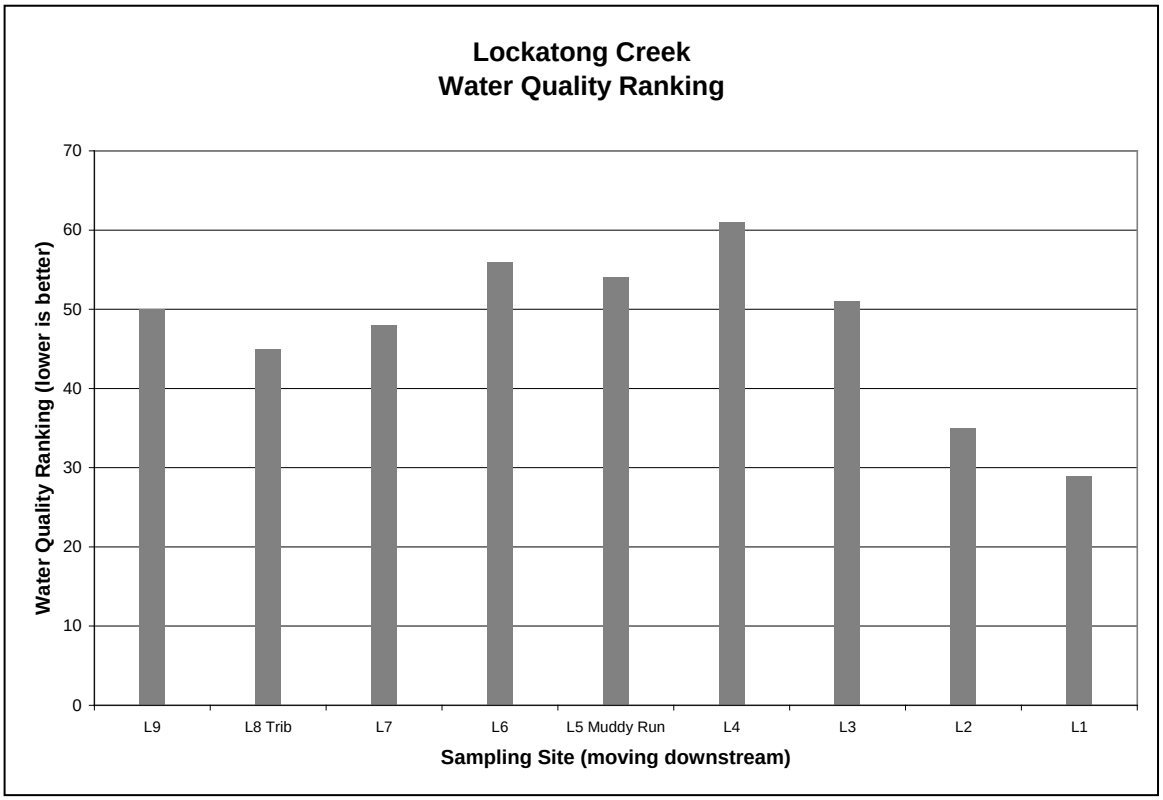
Figure 21: Lockatong Creek water quality ranking



Water quality ranking was based on the characteristics of individual parameters. Each parameter was ranked for each site with specific criteria that are presented in **Table 8**.

Table 8: Ranking criteria for each water quality parameter

Parameter	Units	Ranking Criteria
Fecal coliform	#/100ml	Geometric average and number exceeding 400
Boron	ug/l	Maximum value and data range*
Nitrate-N	mg/l	Maximum value and data range*
Ammonia	mg/l	Average
TKN	mg/l	Average
TP	mg/l	Average and number exceeding 0.10
TSS	mg/l	Data range*
Turbidity	mg/l	Data range*
Water Temperature	^{o}C	Number exceeding 20
pH	Standard Units	Data range* and number < 6.5 and > 8.5
Specific Conductance	us/cm	Data range*

* A tighter grouping of the data indicated less influence from flow and seasonal variations.

The Wickecheoke Creek data showed a greater potential for problem sources in the upper half of the watershed (mostly headwaters) and also in Cold Run and Rose Brook. Discharge from the Delaware Township Municipal Utilities Authority flows into Rose Brook. The main water quality constituents that are indicating potential problems in the headwater sections of the

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watershed are fecal coliform, boron, TKN, TP, TSS, turbidity, and pH. The subsequent downstream sites showed a reduced affect from most of the water quality detriments. Fecal coliform, nitrate, TP, and pH anomalies were present in Cold Run and Rose Brook. Mainstem sampling sites, downstream of these tributary confluences, reflect the influent quality from these two streams.

Water quality data from the Lockatong Creek present elevated concentrations of boron, nitrate, and TP in the upper half of the watershed. Fecal coliform and specific conductance levels are highest in the mid section of the watershed, while ammonia, TKN, TSS, turbidity, water temperature, and pH levels fluctuate throughout the stream reach.

Potential Sources of Water Quality Impacts

Development within the watersheds relies primarily on on-site well water, and wastewater treatment using on-site septic systems. The Delaware Township MUA is the only permitted WWTP discharge (primarily serving the Sergeantville area), which releases treated effluent to a tributary (locally known as Rose Brook) of the Wickecheoke Creek, just south of the intersection of Rosemont-Ringoes Road and Sergeantville Road. Occasional discharges occur from Magnesium Elektron Inc., via a decommissioned settling lagoon, to another tributary of Wickecheoke Creek that is south of Willow Road and east of Locktown Road.

Pollutant loadings in the surface waters of these watersheds are primarily from non-point sources. Non-point source pollution has begun to negatively affect some areas of the watersheds, most likely due to malfunctioning septic systems; erosion from road drainage, fields, and stream channel banks; and agricultural operations which have not implemented soil conservation and best management practices. Phosphorus can be contributed to streams by erosion, agricultural and lawn fertilizers, livestock, pets, and wildlife. Fecal coliform bacteria sources include septic system malfunction and the introduction of livestock, pet and wildlife feces. Higher water temperature can be caused by the loss of natural riparian areas or vegetated cover, stormwater runoff from impervious surfaces near streams, and the periodic shallow, low flows that typify the streams. Also, numerous stream segments have shown eroded stream banks and degradation of riparian habitat from ATV (all-terrain vehicle) traffic.

The agricultural lands are primarily used for hay and pastures, a significant shift from the tilled acreage of past decades. Lockatong and Wickecheoke Creeks are affected by runoff from cropland and from pastureland. Agricultural non-point source pollutants are suspected of contributing nutrient and sediment loads. Most of these agricultural sources are believed to be on the decline, however the loadings are being replaced by increasing quantities of runoff and erosion from increased road surfaces and roadside drainage. Developed areas and roads are known sources of increased storm water runoff, and sediment and metal loadings. Suburban landscape runoff and storm drain discharges are known sources of pesticides, metals, nutrient, and sediment loadings, all contributing to rural and suburban non-point source pollution loads.

These streams are susceptible to septic system leachate, which is suspected to have contributed to nutrient enrichment and fecal coliform contamination. Septic system malfunction or failure is mostly attributed to lack of maintenance, and/or improper location or system design, especially

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in wet soil areas. NJDEP has prepared fecal coliform and total phosphorus TMDLs for the Lockatong and Wickecheoke Creeks. This project will provide vital information to support TMDL implementation, along with management approaches to address current problems.

Preliminary Stream Visual Assessment

Due to the limited ground water recharge and storage capacity, stormwater is usually conveyed quickly to the receiving streams, creating large runoff flows and minimal baseflow, especially during dry periods. During 2006, the NRCS and the NJWSA have noted stream bank erosion and soil erosion from runoff flows. NJWSA has documented major sediment loading to the Delaware & Raritan Canal following storms.

Based on field observations by NJWSA staff, the following problems were identified:

- Abundant algae on most of the stream bottom;
- Deer foraging areas denuded of vegetation;
- Streambank erosion in many stream sections;
- Unstable banks and a large amount of sediment build up in the stream channel;
- Limited riparian buffer vegetation;
- Presence of household pets, ducks, and geese in, or in close proximity to the stream;
- Shifting stream channel undercutting roadways and eroding lawns;
- Stream channel migration from original configuration at some bridges;
- Livestock access to stream segments;
- Constructed in-channel and stream-side ponds;
- Enhanced erosion from roadway runoff and roadside drainage ravines, and maintenance;
- Stormwater conveyed directly to drop-outfalls along the stream bank or channel;
- Erosion of gravel/dirt roads and driveways;
- Sediment from urban runoff, roadway drainage, construction and streambank erosion;
- Nutrients and pesticides from agriculture, recreational fields, and lawn maintenance;
- Septic systems in areas of saturated soil conditions; and
- Salts and oil/grease from residential and commercial areas and roadways.

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Figure 18: Monitoring Stations – Phase I

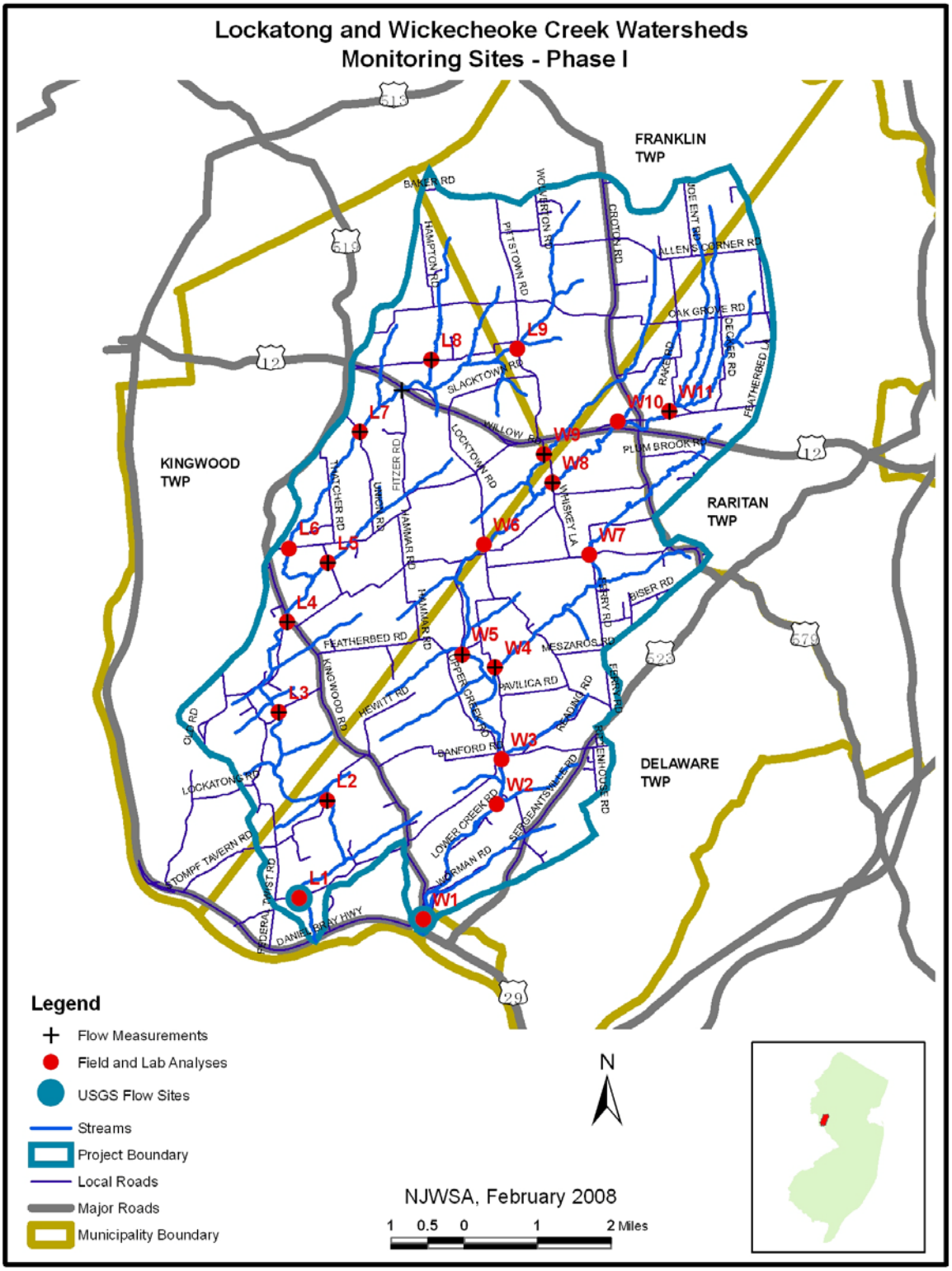

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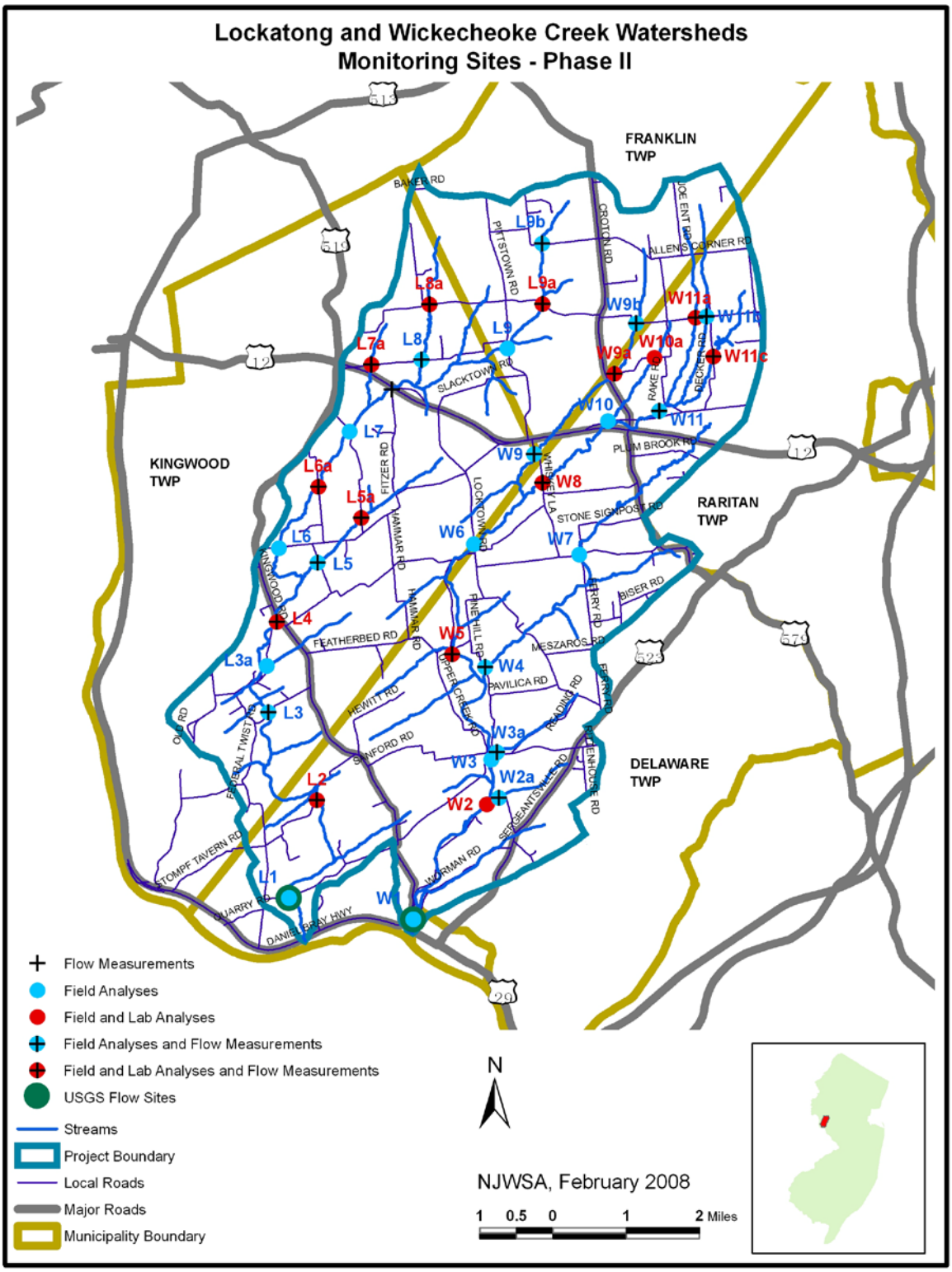
Figure 19: Monitoring Stations – Phase II



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Ground Water: Hydrology and Quality

Ground water is defined as water below the land surface; know as an aquifer in the saturated zone. Ground water recharge is the movement of water from the land surface through soils (infiltration), past the root zone and down through the unsaturated (vadose) zone to a point where the water fills all the pore space in the soils and bedrock (the "saturated zone"). Aquifers usually provide a source of water that is economically available and of suitable quality for human supply. Aquifers must have a net recharge larger than the amount of water being extracted.

A ground water recharge area is the land area that allows precipitation to seep into the saturated zone. These areas are generally at topographically high areas with discharge areas at lower elevations, commonly at streams or other water bodies (i.e. a portion of the ground water returns to surface water). A large percentage of precipitation flows through the shallow layers of soil and weathered bedrock to the nearest stream. A smaller percentage penetrates deeper and recharges the aquifer. Aquifers often are used for water supply, and supply surface waters with baseflow (stream flow occurring during periods with no runoff) for both human water uses and for maintaining aquatic ecosystems. Estimating the relative recharge rates of various land areas provides a way by which the most critical ground water recharge areas can be mapped and protected through various mechanisms, including zoning, development regulation and land preservation. Critical recharge areas exhibit either fractures near or at the ground surface or permeable soils that provide a faster rate of water movement from the surface to ground water.

Since ground water provides both stream flow and a potable water supply, this natural resource is a critical factor in both stream ecosystem health, and land development and uses.

Many factors affect the amount of recharge that will occur in a given area, including climate (e.g. the amount, intensity, and form of precipitation, and the effects of wind, humidity and air temperature on evapotranspiration), soil, surficial geology, land cover, and vegetation factors. In addition, recharge of ground water varies seasonally. During the growing season, precipitation is intercepted by plants and returns to the atmosphere through transpiration. Evaporation likewise is higher during the warmer months. Therefore, most recharge occurs during late fall, winter, and early spring, when plants are dormant and evaporation rates are minimal (Heath, 1983).

N.J.S.A. 58:11A, 12-16 requires NJDEP to publish a methodology to map and rank aquifer-recharge areas. In addition, the legislation requires the development of ground-water protection practices designed to encourage ecologically sound development in aquifer-recharge areas (Charles et. al., 1993). To fulfill the requirements of this legislation, NJ Geological Survey (NJGS) developed a method (GSR-32) which estimates ground water recharge (infiltration to the shallower soils, a portion of which may be aquifer recharge), and is useful for evaluating the relative effect of present and future land uses on recharge areas. There were a number of assumptions made for the calculations and model inputs that limit the accuracy of the method. For instance, the calculated ground water recharge includes any water entering the ground (lesser amounts actually enter the aquifer). Recharge from surface water bodies, wetlands and hydric soils are not evaluated by the method. Therefore, these areas were eliminated from the

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assessment, because the direction of flow between ground water and surface water is site-specific and also varies seasonally, and this level of detail was beyond the scope of the study.

Recharge rates are expressed in terms of the amount of precipitation that reaches the aquifer per unit of time (e.g. inches/year). Recharge rates vary from year to year, depending on the amount of precipitation, its seasonal distribution, air temperature, land use and other factors. Keeping these limitations in mind, NJGS has estimated ground water recharge results for the entire watersheds using GSR-32 at two different precipitation levels – annual average precipitation and drought of record precipitation (1964-1966) – based on 1995/97 land use/land cover data. The estimated recharge rates of these watersheds from the NJGS 95/97 dataset indicate that the maximum recharge rate in non-drought conditions is 16.28 inches per year (**Figure 24**) while the maximum recharge rate in drought conditions is 12.84 inches per year (**Figure 25**). The average ground water recharge ranges from 8.61 to 15.92 inches per year for rated areas within the Lockatong and Wickecheoke sub-watersheds, with the highest infiltration rates occurring at the headwaters of Wickecheoke Creek in Raritan Township. The average rate of recharge for 1995 was 12 inches per year for the entire Central Delaware Watershed Management Area (Watershed Management Area 11).

As the 2002 land use/land cover data are now available, NJWSA created a new ground water recharge analysis for the watersheds using GSR-32 as well as another new analysis using 1986 land use/land cover data to track the ground water recharge change (**Figure 22, 23, 26 and 27**). By mapping recharge capacity, land areas that are more efficient for recharge (i.e., have the highest estimated recharge rates and therefore provide the greatest recharge volumes in the least land area) can be identified and therefore should be more protected from detrimental activities. However, there also exist areas that are nearly constantly saturated at or just below the ground surface that help maintain flow to nearby streams. These areas should also be protected for providing storage, in part due to development limitations, in part to protect stream flow, and in part to reduce runoff. Recharge can be reduced through changes in soil permeability (e.g., impervious surfaces and soil compaction), soil aspect (e.g., slope, surface roughness), and vegetation. Recharge can be contaminated by a wide variety of sources: intentional treated discharges (e.g., septic systems); accidental discharges (e.g., spills); and incidental discharges (e.g., fertilizer and pesticide applications to specific targets that penetrated past the root zone, beyond the intended target(s)).

Relative to land use, recharge rates in forests are much higher than those in urban areas (Heath, 1983). This is because urban areas have large areas covered with impermeable surfaces, hastening runoff to surface water, instead of allowing precipitation to percolate into the ground. In 1986, the total infiltration to the soil volume for the Lockatong and Wickecheoke watersheds was 7,060 million gallons per year (MGY); it lost 486 MGY by 1995, because of the increased development and related loss of forested area and agriculture area. There appears to not be as great a ground water recharge volume loss between 1995 (6,574 MG/year) and 2002 (6,690 MG/year), since the new urban development losses were balanced by the revised 2002 mapping protocol that reclassified many wetland areas to either urban or forested areas. Theoretically, wetlands were assumed to not provide recharge to ground water and were eliminated from this analysis. This limitation of the method is beyond our scope of study.

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The ground water resource is critical to the region. It provides base flow to streams that support both aquatic ecosystems and surface water supplies. The resource serves as a direct source of water supply for a wide variety of human uses, including potable water, industrial, agricultural and recreational supplies. As previously mentioned, only a portion of water entering the ground actually recharges the aquifer, but the GSR-32 did not attempt to quantify this amount. According to Lewis-Brown (1995), of the US Geological Survey, "…only about 6% of the storm water infiltration at the land surface reaches depths greater than 75 feet." In contrast, the NJ Statewide Water Supply Plan (1996) suggested that 20% of the estimated recharge could be used for planning purposes, representing the portion of recharge actually available for use during drought conditions (NJDEP, 1996). However, 20% was specifically recommended for regional aquifers, rather than localized aquifers. As such, the 20% value may be high for these watersheds. The numbers extracted from Matthew J. Mulhall's technical report "Evaluation of Ground water Resources of West Amwell Township, Hunterdon County, New Jersey" (February 2003) indicated 19% of ground water goes to the aquifer. Using the 6% figure from USGS, these watersheds may have a usable recharge of 401 million gallons for year 2002. Assuming that 20% of recharge is actually aquifer recharge, 1,338 million gallons are added to ground water per year. If we adopt the 19% figure from Mulhall's study, then 1,271 million gallons of water will become aquifer recharge. While it is unknown at this time which figure is closer to actual conditions in these watersheds, the general principle is this: Recharge is limited. Therefore, if withdrawals of ground water are greater than the recharge amounts, the aquifer would experience a continuous net reduction in the available water supply.

Causes of Ground Water Contamination

Although it was once believed that ground water was naturally protected from contamination, research in the 1970s (USEPA, 1990) showed that contaminants did indeed pass through the many layers of soil and particles of sand, gravel, crushed rocks and larger rocks to reach ground water and aquifers. Ground water contamination may originate on the surface of the land (e.g., dumps, accidental spills, fertilizers, and pesticides), underground but above the water table (e.g., septic systems, underground storage tanks, and underground pipelines) or underground below the water table (e.g., mines and waste disposal in wells). The location at which a contaminant is introduced and the rate at which the contaminant moves through the ground determines the amount of time it takes the substance to reach the ground water.

Ground water contamination occurs from a variety of sources including substances that occur naturally (e.g., iron, sodium, sulfur, arsenic, radiation, calcium and selenium) or from anthropogenic substances, including synthetic organic chemicals and hydrocarbons, liquid waste (leachate) from landfills, as well as heavy metals, road salt, bacteria and viruses. Other sources include improper disposal of used motor oil and other household hazardous materials including batteries, paints and cleaning products. In addition, waste products from septic tanks, pet and other animal wastes can make their way into ground water supplies. Land use activities involving the application of fertilizers and pesticides have the potential to degrade ground water quality. When too much fertilizer is applied, the plants cannot assimilate it so it makes its way to local streams and ground water. Past industrial practices and waste storage areas also contribute to ground water contamination.

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Since recharge is minimal in these watersheds, ground water supplies must be well protected. The aquifers are vulnerable to pollution because of the bedrock's fractured nature. Malfunctioning/failed septic systems, storage tanks, and other sources of pollution could cause very serious water quality consequences if underlain by fractures. This geology is noted to be a source of good water quality, but it requires long-term protection due not only to its very limited quantities of water, but also to its vulnerability to impairments of quality.

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Figure 22: Non-drought Ground Water Recharge in 1986
(Subsection of the watersheds for illustrative purposes)

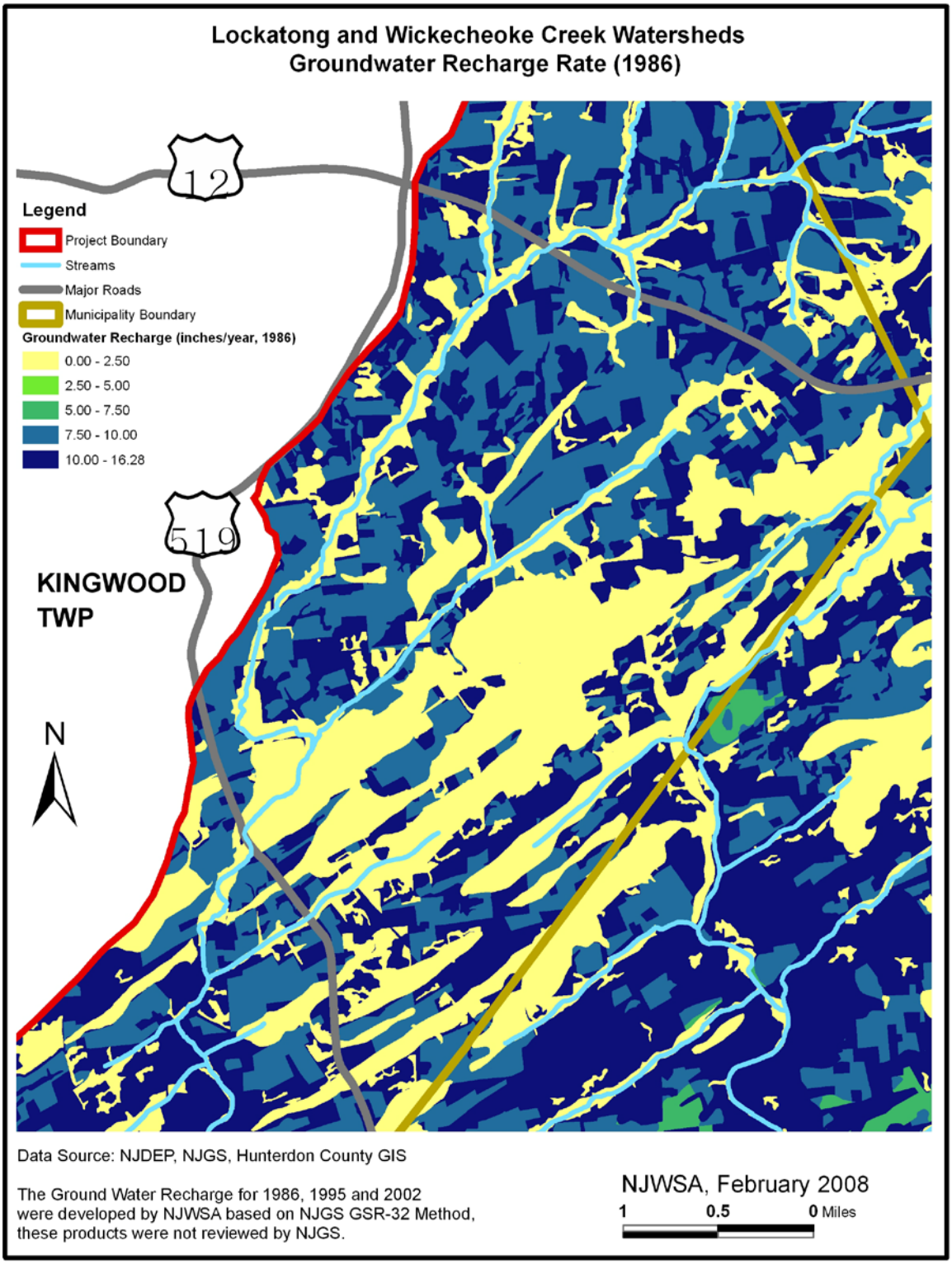

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Figure 23: Drought Ground Water Recharge in 1986
(Subsection of the watersheds for illustrative purposes)

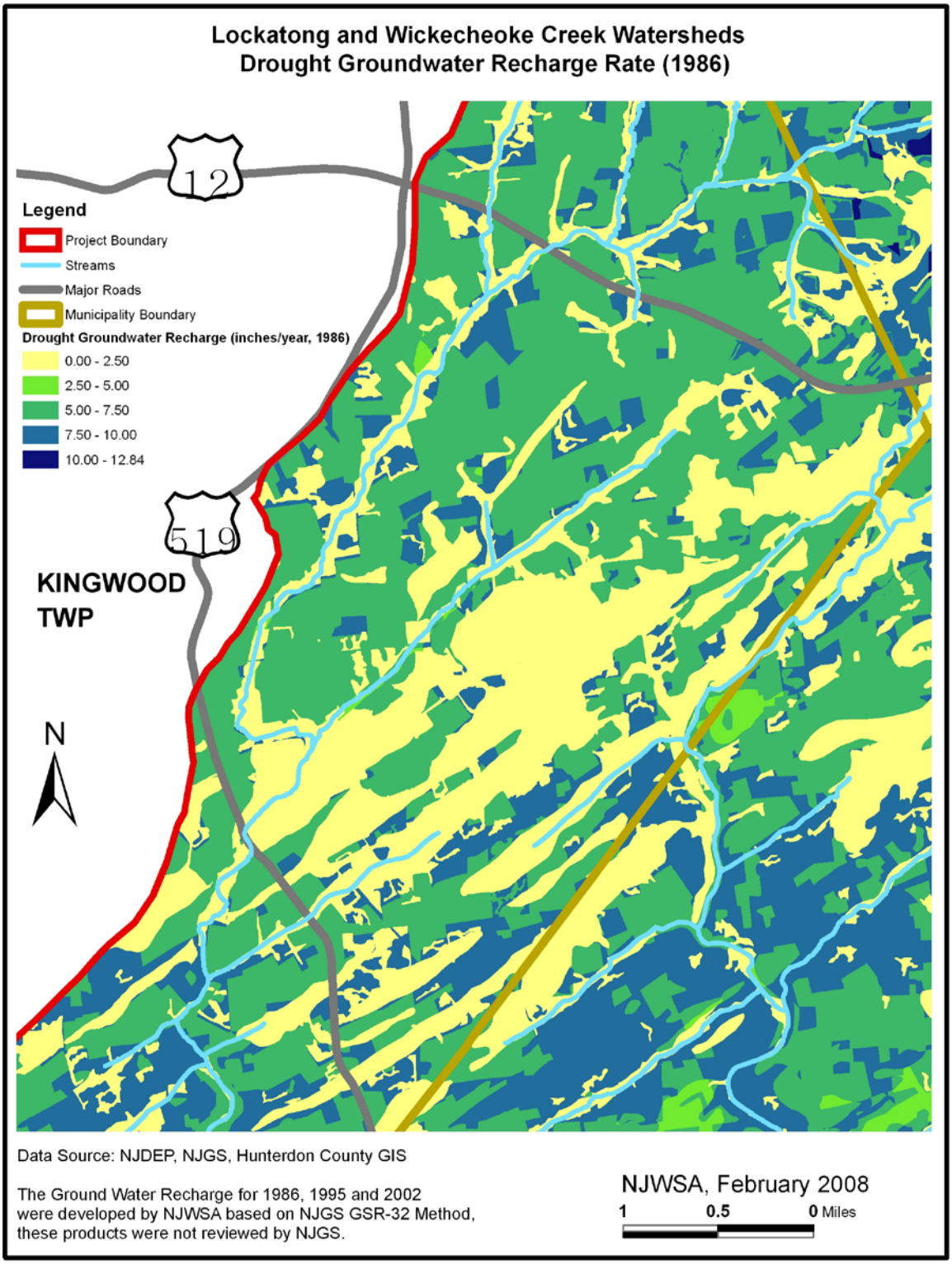

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Figure 24: Non-drought Ground Water Recharge in 1995
(Subsection of the watersheds for illustrative purposes)

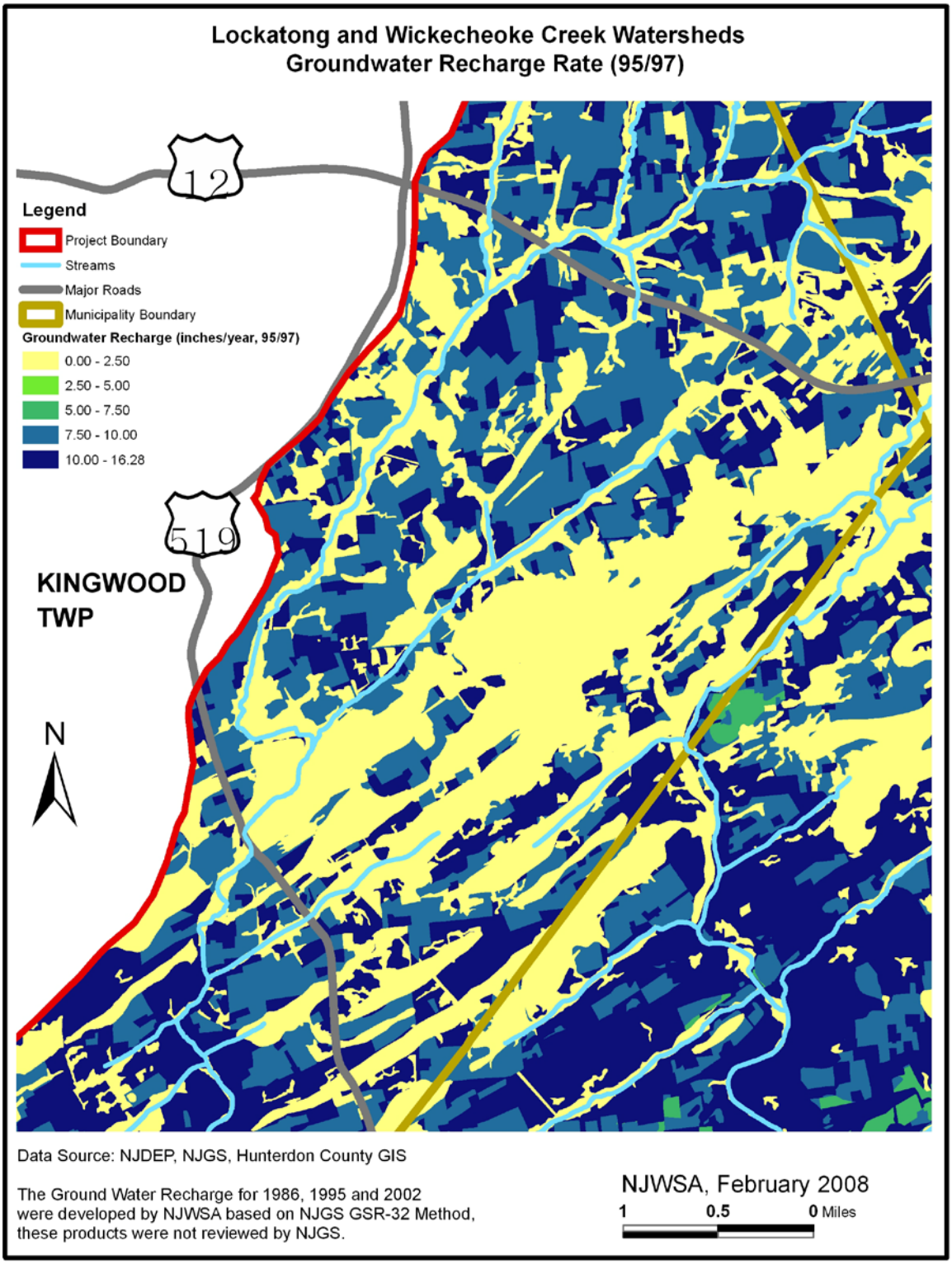

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Figure 25: Drought Ground Water Recharge in 1995
(Subsection of the watersheds for illustrative purposes)

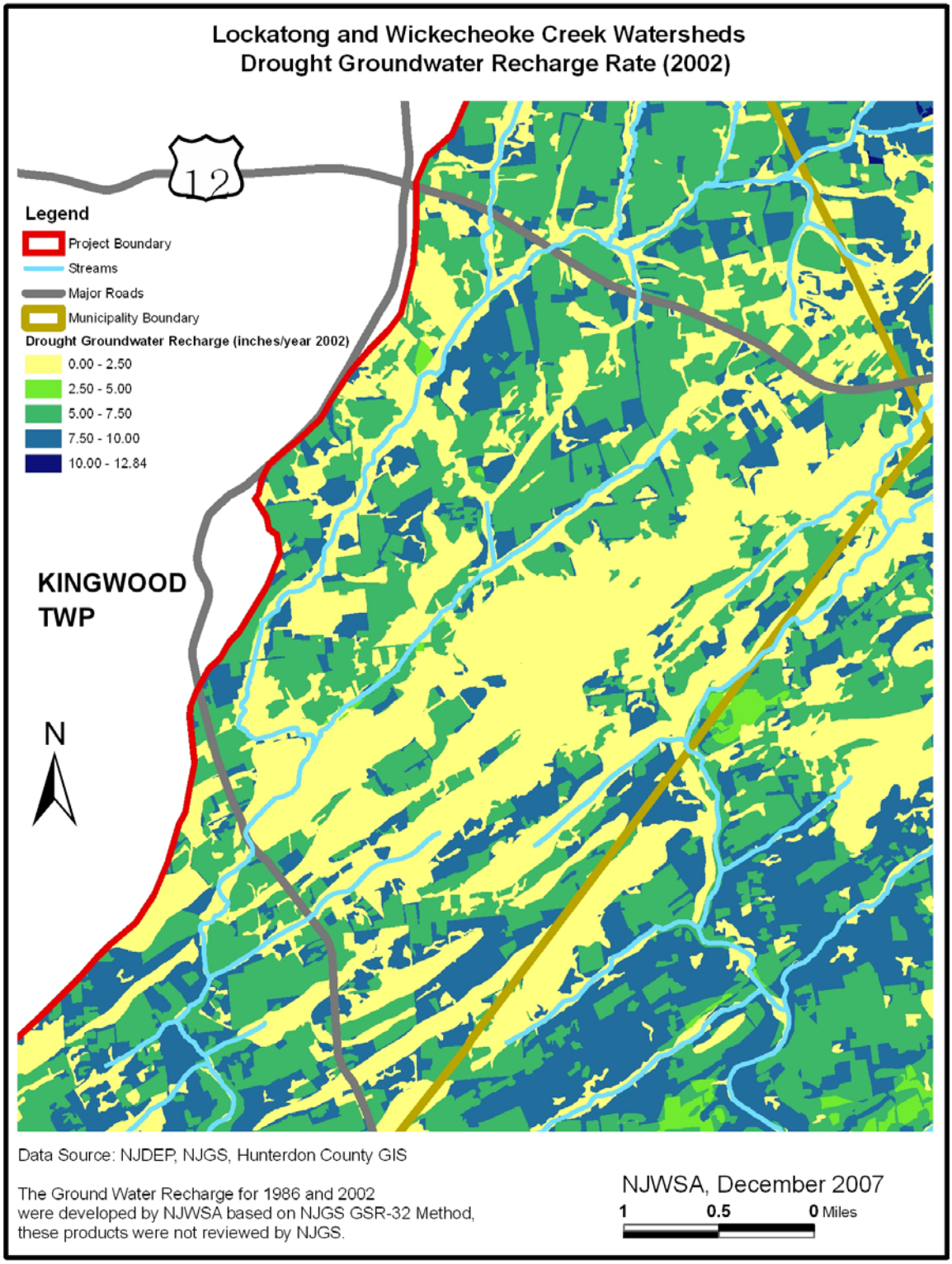

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Figure 26: Non-drought Ground Water Recharge in 2002
(Subsection of the watersheds for illustrative purposes)

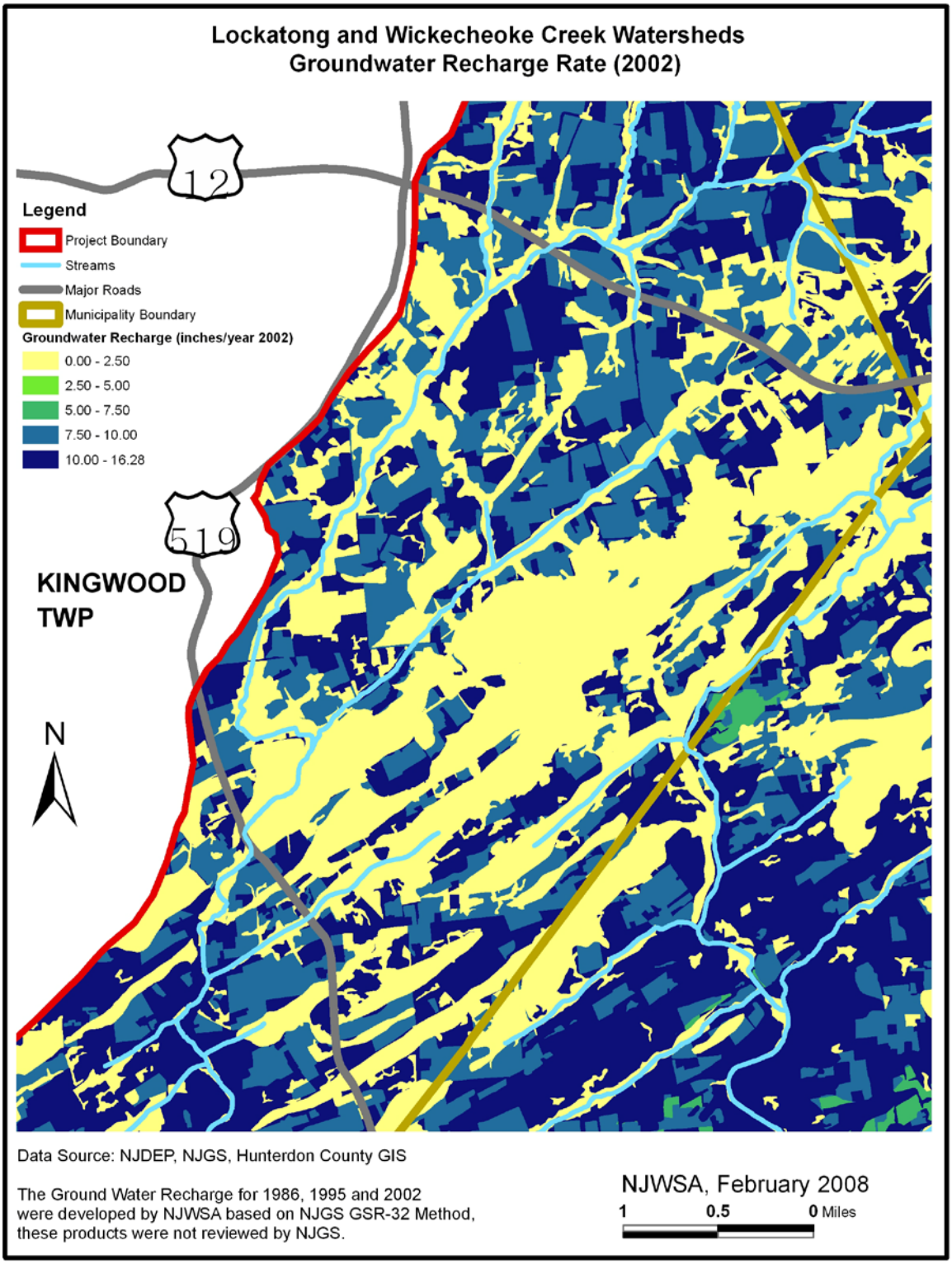

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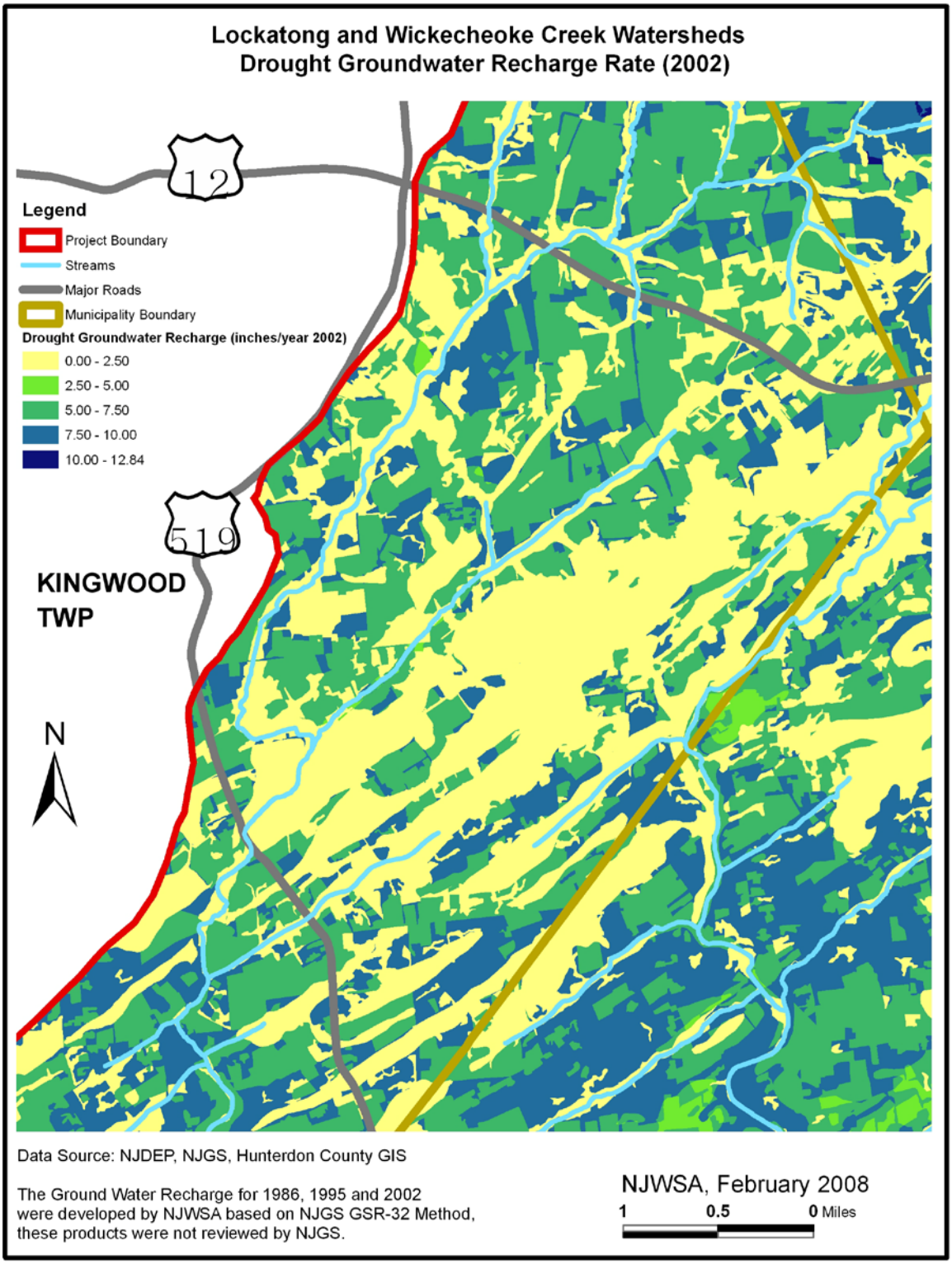
Figure 27: Drought Ground Water Recharge in 2002
(Subsection of the watersheds for illustrative purposes)



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Known Contaminated Sites

A "known contaminated site" is a place where contamination of soil or ground water is confirmed and where remediation is either underway or pending. Known contaminated sites include those which have or had contamination present at levels greater than the applicable soil cleanup criteria, ground water quality standards and/or maximum contaminant levels of the Safe Drinking Water Standards. Contamination is normally identified at a site through sampling of the soil, sediment, surface water and/or ground water. There have also been instances where visual inspection has been used to confirm the existence of contamination (e.g., identification of floating hazardous substance), and air testing for volatile compounds.

NJSA 58:10-23.16-17, the New Jersey statute on the discharge of petroleum products, debris and hazardous substances into waters, requires that the NJDEP prepare, adopt and update a master list for the cleanup of all hazardous discharge sites throughout the State. The master list, called the Contaminated Sites List (of which Known Contaminated Sites is a sub-list), must include an inventory of the sites that have been cleaned up, that have been identified as in need of cleanup, and that will be cleaned up. The list of sites used in this report is based on the most recent GIS coverage April 2005 Known Contaminated Sites list obtained from the NJDEP Site Remediation Program. Case complexity levels are based on the NJDEP Site Remediation Program's 1989 Case Assignment Manual, which determines levels based on the overall degree of contamination at a site.

Sites identified in the Known Contaminated Sites can undergo a variety of activities, ranging from relatively simple soil removals to highly complex remedial activities. The sites included in this dataset are handled under various regulatory programs administered by the NJDEP's Site Remediation Program, including the New Jersey Brownfield and Contaminated Site Remediation Act, Industrial Site Recovery Act, Solid Waste Management Act, Spill Compensation & Control Act, Underground Storage of Hazardous Substances Act, Water Pollution Control Act and the Federal Comprehensive Environmental Response, Compensation and Liability Act, Superfund Amendments and Reauthorization Act, and Resource Conservation and Recovery Act Corrective Action Program. A site can be regulated under more than one of these regulatory programs and often proceeds through several remedial action levels over time. Site remedial action levels are classified as follows:

- "A" – An emergency action taken to stabilize an environmental and/or health threatening situation from sudden or accidental release of hazardous substances. Appropriate remedial actions involving a single phase of limited or short-term duration.
- "B" – A single phase remedial action in response to a single contaminant category effecting only soils. May be a sub-site of a more complex case. Does not include ground water investigation or remediation. Examples of level B cases include, but are not limited to "cut-n-scrape"; surface drum removals; fences; temporary capping or tarping.
- "C-1" – A remedial action that does not involve formal design where the source is known/identified. May include the potential for (unconfirmed) ground water contamination. Examples of C-1 cases are regulated or unregulated storage tanks containing gas or heating oil; septic tanks, etc.

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- "C-2" – A remedial action that consists of a formal engineering design phase, and is in response to a known source or release. Since the response is focused in scope and address a known, presumably quantifiable source, this remedial level is of relatively shorter duration than responses at sites with higher remedial levels. Usually involves cases where ground water contamination has been confirmed or is known to be present.
- "C-3" – A multi-phase remedial action in response to an unknown and/or uncontrolled source or discharge to the soils and/or ground water. In this remedial level, the contamination is unquantifiable (or presumed unquantifiable) and, therefore, no determinable timeframe for the conclusion of the remedial action is known.
- "C-4" or "D" – A multi-phase remedial action in response to multiple, unknown and/or uncontrolled sources or releases affecting multiple media which includes known contamination of ground water. In this remedial level, the contamination is unquantifiable (or presumed unquantifiable) and, therefore, no determinable timeframe for the conclusion of the remedial action is known.

Based on this system, Level A and B sites generally do not affect water resources or are of short-term duration. Ground and surface water contamination sites are in Levels C and D. **Table 9** provides a listing of 16 known contaminated sites within the Lockatong and Wickecheoke watersheds that are classified as levels C through D as defined above. Many of the known contaminated sites fall within major transportation corridors or within town centers. Additional information and identification of sites within a specified area are available from the NJDEP Site Remediation Program at www.state.nj.us/dep/srp.

Table 9: Known Contaminated Sites Within Lockatong and Wickecheoke Creek Watersheds

Site ID	List Date	Address	Owner	Remediation Level	Municipality	Watershed Location
015795	8/6/1992	601 RT 12 & RT 579	CROTON TEXACO, H.V.K. INC. C/O M KOZICKI	C2: Formal Design - Known Source or Release with GW Contamination	Raritan, NJ	Wickecheoke
024980	11/14/1995	500 BARBERTOWN PT BREEZE RD	MAGNESIUM ELEKTRON INC	D: Multi-Phased RA - Multiple Source/Release to Multi-Media Including GW	Kingwood, NJ	Lockatong
G000029966	3/20/1997	650 RTE 519	TAVERN, AVILA BENNETT D	C1: No Formal Design - Source Known or Identified-Potential GW Contamination	Kingwood, NJ	Lockatong
G000031679	7/1/1997	24 MESZAROS RD	PROVENZANO, JAMES F & DONNA M	C1: No Formal Design - Source Known or Identified-Potential GW Contamination	Stockton, NJ	Wickecheoke
003408	12/10/1998	1120 RT 12N	CITGO, WILDGEN, CHRIS	C2: Formal Design - Known Source or Release with GW Contamination	Kingwood, NJ	Lockatong
G000034866	5/20/1999	56 FEDERAL TWIST RD	SCHUMACHER, DAVID & LORRAINE	C2: Formal Design - Known Source or Release with GW Contamination	Delaware, NJ	Lockatong
G000063001	6/7/2001	360 OAK GROVE RD	SPINELLI, JAMES G & LISA LYNN S	C2: Formal Design - Known Source or Release with GW Contamination	Franklin, NJ	Lockatong
129838	1/9/2002	68 KINGWOOD STOCKTON RD	WEISEL, JAMES H	C1: No Formal Design - Source Known or Identified-Potential GW Contamination	Delaware, NJ	Wickecheoke
164247	9/10/2002	68 UPPER CREEK RD	KNIGHT FARM, KNIGHT, DOUGLAS & GRACE	C2: Formal Design - Known Source or Release with GW Contamination	Delaware, NJ	Wickecheoke
172554	1/15/2003	81 WHISKEY LN	HANAFIN, ROSEMARIE A	C1: No Formal Design - Source Known or Identified-Potential GW Contamination	Kingwood, NJ	Wickecheoke
216745	11/24/2003	50 LOCKTOWN SCHOOL RD	NOVAK, GREGORY & JOSEPH C	C1: No Formal Design - Source Known or Identified-Potential GW Contamination	Delaware, NJ	Wickecheoke
217044	12/3/2003	855 RT 579	PYATT, HAROLD & DOLORES	C1: No Formal Design - Source Known or Identified-Potential GW Contamination	Delaware, NJ	Wickecheoke
225211	4/6/2004	837 SERGEANTSVILLE RD	ALLEN, ARTHUR F & LINDA M	C1: No Formal Design - Source Known or Identified-Potential GW Contamination	Stockton, NJ	Wickecheoke
129840	11/19/2004	953 CROTON RD	THOMPSON, SCOTT & ANNE	C2: Formal Design - Known Source or Release with GW Contamination	Franklin, NJ	Wickecheoke
249274	3/17/2005	96 FEDERAL TWIST RD	FABIJANIC, JOHN J & SHERRY E	C1: No Formal Design - Source Known or Identified-Potential GW Contamination	Delaware, NJ	Lockatong
243427	3/30/2005	545 ROSEMONT RINGOES RD	JOHNSON, LOUISE	C1: No Formal Design - Source Known or Identified-Potential GW Contamination	Delaware, NJ	Wickecheoke

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Wildlife Species Habitat (Threatened and Endangered)

Threatened and endangered wildlife species habitat information was derived from the NJDEP Division of Fish and Wildlife's Landscape Project data. The Landscape Project has developed GIS coverages for several types of habitat, including grasslands, forests, forested wetlands and emergent wetlands. Each habitat can be broken into five levels: that which harbors Federal Threatened and Endangered species; that which harbors State Endangered species, State Threatened species or Species of Special Concern; and that which may provide Suitable Habitat for Threatened and Endangered species. The Lockatong and Wickecheoke watersheds contain extensive critical forest and wetland habitats. By definition, all of the areas in the wildlife species habitat coverage are non-urban.

Lockatong Creek provides a habitat for the state threatened long-tailed salamander (Eurycea longicauda). This species has been documented from several areas of the lower half of this drainage. More recent surveys, conducted under contract by the NJDEP, found the species south of the Milltown dam and bridge in 1990.

Wickecheoke Creek provides habitat for a few state threatened species. Long-tailed salamanders have been documented in the Sergeantville covered bridge area as early as 1973. The species presence here was confirmed in 1990 by the DEP. Another threatened species, the Cooper's hawk (Accipiter cooperi) has been documented to nest in the stream corridor ravine west of Pine Hill Road. One other species, the state threatened wood turtle (Clemmys insculpta), is a likely resident of the creek. A 1990 record exists for this species from near Route 12 just west of the Delaware Township border. Suitable hibernation and terrestrial stream corridor habitat for this species occurs along the Wickecheoke and in other areas adjacent to these watersheds.

Headwater areas are usually the most biologically diverse areas of a watershed. The swamps, springs and small tributaries which are the sources of flow for the Lockatong and Wickecheoke creeks are home to diverse aquatic ecosystems. The protection of these headwaters is critical to the health of the creeks. They are more vulnerable to negative impacts. These wetland ecosystems are very sensitive to hydrologic changes, as turtles and salamanders in particular have very specific habitat needs.

The Lockatong and Wickecheoke creeks offer excellent opportunities for fishing. The lower sections of both streams are classified as trout maintenance waters, and are stocked seasonally. These watersheds offer refuge to a number of threatened and endangered species, thus maintaining critical habitat is essential to their survival. Biodiversity is a key element regarding the stability and well being of a watershed and its ecosystem.

Other species, although not on the threatened and endangered list, are valuable indicators; since they will only exist where key habitats remain intact. In order to insure biodiversity of the region, the ecosystem must be regarded as a whole, made up of interrelated and interdependent components. One additional issue is the potential to create connections between habitat patches using public open space and voluntary landowner agreements, so that the endangered and threatened species can be better maintained.

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Water Resource Protection - Critical Areas

Criteria

To evaluate if a parcel or area is protective of water resources, the mechanisms for water resources protection need to be determined. The threats to water resources emanate from loss of vegetation (particularly forests and wetlands); placement of impervious surfaces over ground water recharge areas; increased runoff; and activities in riparian areas and floodplains. Open spaces that limit these threats protect water resources.

The criteria considered here come from the Raritan Basin Watershed Management Project - Water Resource Protection Criteria, which includes a list of 20 criteria that protect water resources (See **Table 10** below). Most of these criteria are also applicable to the Lockatong and Wickecheoke Creek watersheds for determining "Critical Areas." In addition to the critical area criteria used in the Raritan Basin project, we consider adding "very limited" suitability to septic system soils to the Lockatong and Wickecheoke Creek Watersheds criteria, but all the final criteria will be subject to the final approval by the committee members.

Table 10: Initial Criteria "Brainstormed" from the Raritan Basin Watershed Management Project

A. Recharge Areas	H. Floodplains and Riparian Corridors	O. Trout Production Streams
B. Wellhead Protection Areas	I. Wetlands	P. Vegetative Cover
C. Drinking Water Source Areas	J. Mature Forest	Q. Soil Type
D. Headwaters	K. Threatened or Endangered Species	R. Proximity to Water Body
E. Water Pollution Hazard Areas	L. Contamination and Previous Use	S. Land Use/Land Cover
F. Areas with Steep Slopes	M. Size of Parcel	T. % Impervious Surface
G. Lakes and Ponds	N. Length of Stream	
Criteria are listed in no particular order. These criteria were specifically included for their protection of water resources.		

GIS Coverages for the Original Model

The Raritan Project open space work group consolidated the 20 initial criteria into four GIS coverages that encompass water resources protection criteria. In addition, they recommended exclusion of the areas that are currently developed or preserved. **Table 11** outlines the GIS coverages and the criteria represented by each. An explanation of the selected coverages is presented below.

Wellhead Protection Areas

Wellhead Protection Areas show the spatial extent from where ground water flows into a well for a specific time period. A Wellhead Protection Area is divided by multiple times of travel: Tier 1 (2 years), Tier 2 (5 years), Tier 3 (12 years). Tier 1 and Tier 2 are used in this open space model to indicate the spatial extent in which ground water pollution, if it occurs, poses a significant threat to the water quality of the well. Tier 3 was not included in this model because it allows a longer time frame in which to manage a threat to water quality. To focus attention on potentially available open space, developed lands within a Wellhead Protection Area were excluded from

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this coverage. Of note, this GIS coverage, available from NJDEP, only includes wellhead protection areas for public community supply wells. Individual home or property owner wells are excluded. There are two public community supply wells in these watersheds, one belongs to Delaware Township MUA and another one is owned by Rosemont Water Company.

Table 11: Elements of the GIS Model for Water Resources Protection

GIS Coverage to be Used	Initial Criterion/Criteria Addressed by Coverage (see Table 5)	Protection Area Includes
Wellhead Protection Areas (WHPA)	Wellhead Protection Areas (A) Recharge Protection (B)	Undeveloped portions of Tiers 1 & 2
Ground Water Recharge (NJGS GSR-32 calculation)	Ground Water Recharge (B)	Open spaces within the undeveloped areas of highest recharge rate that comprise 25% of ground water recharge volume for each HUC-11 watershed
Riparian Areas (Raritan Project coverage)	Headwaters (D); Floodplains (H); Lakes and ponds (G); Wetlands (I); Proximity to Water Body (R); Trout Production Streams (O)	Use complete Raritan Project methodology (Riparian soils, wildlife corridor, 100-yr floodplain, wetlands) for existing riparian areas
Threatened and Endangered Wildlife Species Habitat	Threatened and Endangered Species (K); Mature Forests (J); Vegetative Cover (P); Wetlands (I)	Emergent wetlands and forested wetlands that protect various categories of T&E species, from NJDEP Landscape Project; plus dense forest area as defined by Spruce Run Initiative
Preserved Open Space	Preserved Open Space (Determines proximity and linkage of preservation targets to existing, dedicated open space)	All open space identified in Green Acres and NJ Conservation Foundation coverages, plus others as available
Land Use/Land Cover or Percent Impervious Cover	LU/LC (S); Percent Impervious (T); Vegetative Cover (P)	NJDEP 1995/97 Land Use/Land Cover

Ground Water Recharge Rates

Ground water recharge rates were calculated using NJGS Method GSR-32, which estimates ground water recharge (or infiltration of precipitation) to below the plant root zone using municipality-based climatic, soil type, and land use/land cover information. For the Raritan Basin, ground water recharge rates were developed from the NJDEP 1995/1997 land use/land cover data. Both the volume and the rate of recharge were used to develop this criterion. The goal of the criterion is to protect areas that contribute the largest amount of recharge in the shortest amount of time. The subcommittee determined that the areas that contribute the top 25 percent of the recharge should be preserved. The analyses were performed using HUC 11 watersheds to minimize the effects of local climatic and geologic conditions within the Raritan Basin and ensure that areas determined to be protective of ground water recharge were not concentrated in one area or one WMA. To determine the area that preserves the top 25 percent of volume, the volumes for each land use polygon were ranked by recharge rate then cumulatively summed to equal 25 percent of the annual recharge volume. This ensures that properties desirable to be preserved recharge the quickest. In doing so, large slowly recharging areas will not be selected over quickly recharging areas based on volume alone, although these areas also contribute a large amount of recharge over time. Given the smaller area in the

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Lockatong and Wickecheoke Creek watersheds, adapting this criterion to HUC14 sub-watersheds using the 2002 land use land cover data will provide more useful results.

Riparian Areas

The Raritan Project methodology defines riparian areas as the areas adjacent to streams that either are within the 100-year flood prone areas, contain hydric soils, contain streamside wetlands and associated transition areas, or are within a 150-foot or 300-foot wildlife passage corridor on both sides of a stream (with the width dependent on stream order). The same method was applied to the Central Delaware Watershed Management Area (WMA11), which includes the Lockatong and Wickecheoke watersheds. Data to develop the riparian areas coverage were obtained from FEMA (floodplains), NRCS (hydric soils) and the NJDEP hydrography (wetlands, lakes and ponds, stream information). For this project, the 2002 land use/land cover data would then be compared to the riparian area map to determine how much is still in natural cover, how much is agricultural, and how much is developed.

Wildlife Species Habitat - Threatened and Endangered

Threatened and endangered wildlife species habitat information was derived from the New Jersey DEP Division of Fish and Wildlife's Landscape Project data. This information was included in the model to represent high quality vegetated areas, which are beneficial to and protective of water resources (Please refer to section **Wildlife Species Habitat** for details). It should be noted that other models, such as for the Spruce Run Initiative in northern Hunterdon County, used only habitat within the emergent wetlands and forested wetlands coverages to emphasize the link with water resources. Forests were addressed separately by inclusion of dense forests, and by the common relationship of forests to higher ground water recharge.

Soil Limitation to Septic Systems

The NRCS database provides an interpretation of limitations of each soil for septic suitability. Soils within these watersheds are mostly rated to have either "moderate" or "severe" limitations for septic tank absorption fields. Of those with moderate limitations, the reasons are usually depth to rock, slow percolation rates (percs) and/or slope. Severe limitations usually are caused by wetness and/or slow percs, while some soils also have limitations of depth to rock, flooding, slope and/or poor filtering ability. Soils with "very limited" suitability to septic systems are recommended for the critical area model to reflect any potential restrictions for installing on-site wastewater treatment systems.

Preserved Open Space

The preserved open space coverage will be a compilation of all known open space and preserved areas including federal and state-owned lands, land trust properties, county and municipal open space properties, etc. The Green Acres Program and various land trusts have available data. This coverage will allow land trust organizations to coordinate their efforts in making greenways or aggregating preserved lands to further protect water resources. This coverage will be used to

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exclude these areas from the model since they are already preserved. However, the model will allow for planning efforts to link existing open space to high priority critical areas.

Land Use/Land Cover

NJDEP's 2002 Land use/ land cover data will be used to create a file of developed areas to exclude from the model. This data is available via the NJDEP web site.

GIS Model

The GIS model aggregates all the water resources protection open space criteria into a single coverage. Each criterion of the model will be given the same weight. For an area of land, the number of criteria met will be calculated resulting in each area receiving a tally from 0-5. The database file associated with the final GIS coverage contains the information about which criteria are met. Also contained in the coverage's database are whether or not an area of land is urban or preserved open space. These will be added to the database so that developed land and preserved open space will not be included as desirable even if some criteria were met. The construction of this model allows for a broad-scale analysis of all critical areas, while preserving information on the underlying criteria so that land preservation priorities can be established using any combination of criteria.

Conclusions

The surface water classifications for the entire length of Lockatong and Wickecheoke Creeks are listed as FW2-TM (C1) and FW2-NT (C1) waters. Land use in the area is primarily agricultural, forest and residential. While the two streams comprising the watersheds have much in common, they also maintain an individual and distinct character. Because the hydrology and ecology of these two creeks are very fragile, any development that does not address their particular vulnerabilities could have significant negative effects. As previously addressed, mismanaged land cover, land use, or anthropogenic activities, or any combinations, can increase stormwater runoff and degradation to surface and ground water quantity and quality. Local citizens and municipalities should realize the importance of these nearly pristine stream corridors and work together to protect the health of these waterways. The Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Plan prioritizes remediation strategies, and provides guidance for the long-term protection of these watersheds.

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Document Content(s)

Lock Wick Characterization Assess .PDF.....1-64

Lockatong and Wickecheoke Creek Watershed Sediment and Phosphorus Source Report

Dredging of Delaware & Raritan Canal at Wickecheoke Creek Outlet on November 3, 1999

USDA Natural Resources Conservation Service for the New Jersey Water Supply Authority Clinton, New Jersey

December 2007

(As Amended)

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Executive Summary

Request and Problem Identification

In 2005 a Memorandum of Agreement was signed, at the request of the New Jersey Water Supply Authority (NJWSA), for the Natural Resources Conservation Service (NRCS) to conduct a study to determine, in part, the sources and amounts of sediment entering the streams and being deposited into the Canal. The study was to focus on the Wickecheoke (17,015 acres) and Lockatong Creek (17,810 acres) Watersheds which represent nearly 65 percent of the total drainage area (in New Jersey) of 53,860 acres to the D&R Canal. This study did not include the drainage from the Delaware River.

The identified problem is the continued sedimentation of the D&R Canal which results in annual public and private costs of nearly $3 million. The Canal serves as the water supply conduit to over 1.5 million Central New Jersey residents. It is also the recreational centerpiece of a 63 mile long linear state park.

Analysis

The two watersheds were subdivided into a total of six HUC-14 subwatersheds. NRCS identified over 1,500 crop fields in the Lockatong and Wickecheoke Creek watersheds. A random sample of twenty percent of these 1,500 crop fields was taken. The twenty percent sample amounted to 308 fields on which the annual soil losses (soil erosion) was determined using the Revised Universal Soil Loss Equation (RUSLE). RUSLE has factors related to rainfall, soil erodibility, length and percent of slope, cover management and conservation practice. Annual soil loss that exceeds the T value results in the degradation of the soil resource. Only 18 of the 308 fields sampled had this soil loss. Twelve of the 18 fields were located in the Upper Lockatong Creek subwatershed. Crops grown in these fields were primarily soybeans and mixed vegetables. Most of the remainder of the crop fields were in permanent hay resulting in very low soil losses on a per acre basis. A gross projected soil loss of 11,978 tons per year results when the average subwatershed erosion rates are projected for all the cropland.

The forest land use category accounts for about thirty one percent of the area of the Lockatong and Wickecheoke watersheds. These forests are mostly smaller woodlots but a few larger forested patches are present in some large forested wetlands throughout the watersheds and on very steep slopes in the southern reaches of the watersheds. Commercial woodland harvests are very limited in this watershed (Shuart, 2006). Forestry activity in the watershed is normally limited to timber stand improvement, some pre-commercial thinning and small scale timber harvests. Timber harvest activities are also severely limited in wetlands by the NJ Freshwater Wetlands Act and along streams by the Flood Hazard Area Control Act (“Stream Encroachment”). Shuart reports that he knows of no erosion problems in woodlands in the watershed and feels that the limited forest activity should not cause excess sediment sources from woodlands. The NJ State Forest Service does not maintain data on timber harvests.

The 10,763 acres of forestland in the watershed has an estimated erosion rate of 0.1 ton per acre per year which results in 1,076 tons of soil erosion from forestland in the watershed. A sediment delivery ratio of 33 percent yields 355 tons of sediment to the D&R Canal.

Field observations indicate that streambank erosion, which occurs throughout the watershed, is a contributing source of sediment to the Canal. Streambank erosion not only serves as a source of sediment but is also a significant threat to the integrity of several county and municipal roads. Episodic events such as Hurricane Floyd and other intense precipitation events may be putting large loads of sediment and rubble into the streambeds which in turn move downstream incrementally, similar to a conveyor belt, into the Canal. Depending on the methodology used, there is an estimated range of 248 to 12,295 tons of soil loss per year due to streambank erosion.

An analysis, using GIS technology, of the stream drainage density vs. the effective drainage density (includes the road network) shows that the drainage density of the watersheds and their subwatersheds is increased significantly by the road network. Field observations of both paved and unpaved roadways in these watersheds indicate that there can be a disproportionate (in terms of the land area affected) amount of sediment moving from both the road network and/or its drainage system and unprotected (from erosion) outlets.
Also, where road stream crossings occur, on both paved and unpaved roads, there is uncontrolled road runoff entering the stream without any sort of pre-treatment. Frequently there is little, if any, area for the installation of a detention basin, check dams or other structural measures due to the steep slopes and relatively narrow stream corridors. A total of 3,723 tons per year of soil loss is estimated to occur from paved and unpaved road surfaces exclusive of any road treatment (such as sand, etc.) used for deicing and winter traction.

Construction sites in the watershed represent a very small portion of the overall land use. There is minimal sediment delivery from construction sites of these sizes due to the relative lack of connection to the existing natural drainage network. Construction activities within this watershed do not have a significant impact on sediment production to the D&R Canal.

Results

Sediment yield (reaching the D&R Canal) is estimated to be coming from the following sources: cropland, forestland, roadways and associated drainage, and stream banks.

Recommendations (in Priority Order)

1. Improve water infiltration into the soil on all land uses.

2. Install measures to reduce the volume and velocity of road runoff to stream corridors from roadways for runoff that is currently disposed of through road ditches/culverts over steep slopes into streams. Measures may include the establishment of stormwater retention areas on private property (with easements) for the infiltration of water back into the soil.

3. Improve water infiltration into the soil on existing hay land, cropland and pastureland by various measures including avoiding agricultural field operations that increase soil compaction, increasing soil organic matter, and others.

4. Acquire conservation easements from property owners and require implementation of forest management plans that have the primary objective of clean and abundant water. Measures may include increasing soil organic matter, micro-topography restoration for surface water storage and better deer management to protect understory and groundcover for reduced phosphorus and nitrogen runoff.

5. Require the development and implementation of a soil and water conservation plan for resource management systems for all farmland assessed property in the watershed.

6. Require a conservation lease on all rented agricultural land that is at least five years in length and renewable at least a year in advance of termination and provide compensation on a pro-rated basis including conservation practices and soil amendments.

7. Develop and implement an on-going information, technical assistance and cost sharing program for all property owners in the watersheds to implement best management practices.

8. Install permanent buffer strips on the approximately 32 percent of the cropland with a distance of 100 feet or less between the cropland and stream corridors using such programs as the Conservation Reserve Enhancement Program (CREP).

9. Retrofit existing gradient diversion and terrace systems where these are causing severe gully erosion at their outlets particularly where cropping and tillage practices obviate their need. Stabilize eroded former surface water runoff outlets. Any new diversion or terrace systems must try to maximize storage and outlets should be to stable outlets where they will

not result in new erosion.

10. Modify stream corridor to reduce the “conveyor belt” movement of sediment, cobbles and other rubble downstream toward the D&R Canal. The “conveyor belt” refers to the fact that material moves downstream incrementally and is highly dependent on the volume of streamflow.

11. This study has been heavily dependent on modeling to develop estimates of the sources of sediment to the D&R Canal. It is recommended that a “fingerprinting” study using radioisotopes be made to more accurately determine the sources of sediment.

12. Exclude all livestock from stream corridors leaving a buffer area to intercept any animal waste runoff toward the stream.

13. Implement pasture management practices to minimize accumulation and runoff of animal waste.

14. Exclude all clean water from stockpiled animal waste and dispose of animal waste by recycling in the soil on cultivated land.

15. Minimize footprint and disturbed area of house and preserve all other topography and vegetation of the site.

16. Minimize driveway length and nature of treatment (unpaved better than paved).

17. Practice regular septic system maintenance with pumping done at a minimum of once every three years.

Introduction

The NJ Water Supply Authority requested USDA Natural Resources Conservation Service (NRCS) to conduct a study to determine, in part, the sources and amounts of sediment entering the streams and being deposited into the Canal.

Literature Review

There has been considerable research on identifying sources of sediment in watersheds.

A study in the Stony Brook Basin in New Jersey found that the average annual rate of suspended sediment discharge was 8,800 tons, or 200 tons per square mile. Annual yields within the Basin, which is in the Piedmont Lowlands section of the Piedmont physiographic province in west-central New Jersey, range from 25 to 400 tons per square mile. A trend analysis of sediment records was performed between 1956 and 1970. It showed that there was an increase between 1956 and 1961. After 1967, sediment yields decreased. This decrease was noted to be due to an estimated 20 percent reduction in sediment discharge from the Basin. This was the result of the combined effect of operation of seven (7) sediment retention reservoirs constructed under Public Law 566 through the then-Soil Conservation Service to reduce sedimentation to Carnegie Lake (Mansue and Anderson, 1974). A report by Drexel University (Phillips and Weggel, 1994) showed that one of these seven reservoirs known as Curlis Lake, had had its capacity reduced to approximately 73 percent of its original capacity due to sedimentation.

A 5-year study (Gellis and Landwehr, 2006) to examine sources of sediment to the Chesapeake Bay began in 2001. Three subbasins were selected for sediment-source studies between 2001 and 2004: the Pocomoke River subbasin in, Maryland and Delaware (157 km^2), the Little Conestoga Creek subbasin in Pennsylvania (110 km^2), and Mattawoman Creek, subbasin in Maryland (144 km^2).

The Pocomoke River subbasin in Maryland was the first analyzed to test multiple fingerprinting techniques for identifying sediment sources in the watersheds. Fingerprints include: ^{7}Be, ^{137}Cs, ^{210}Pb, total carbon, total nitrogen, total phosphorus, and stable isotopes (N and C). The subbasin sampling strategy was focused to distinguish upland sediment sources (land use) versus origin in the stream corridor (stream bed and banks). Potential sediment sources in the watershed were cropland, forest, channel and ditch banks, and ditch beds. Samples of fine-grained suspended sediment were obtained during seven storms between July 2001 and November 2002. Channel corridor (channel and ditch banks, and ditch beds) were significant sources averaging 76.5% of the total sediment sources for the seven storms. Cropland was an important source of sediment for two storms with the highest peak flow which occurred in the late summer and fall when harvesting began and vegetative cover was low. Ditch beds, which contributed an average of 46.1% of sediment for the seven storms, were important sources of sediment over a range of peak flows.

The sources of sediment due to agricultural, construction and other activities are relatively well-known. Lesser known are the impacts of roads and their drainage network on watershed sediment yield. One study (Maholland, B, et al, 2005) found that most unimproved (dirt) roads connect directly or indirectly with streams and, therefore, act as extensions of stream networks by effectively increasing watershed drainage density and subsequently sediment loads to streams. Paved roads contribute to sediment yield through their increased runoff which is collected in ditches and directed through culverts all of which can increase erosion, particularly when the road ditches and/or culvert outfalls are directed to steep slopes which often occur adjoining a stream corridor.

Background

The Wickecheoke (17,015 acres or 26.5 sq. mi.) and Lockatong Creek (17,810 acres or 27.8 sq. mi.) watersheds represent nearly 65 percent of the total drainage area (in New Jersey) of 53,860 acres to the D&R Canal (Figure 1). This study did not include the drainage from the Delaware River. The Canal system is operated and maintained by the NJ Water Supply Authority, a major water purveyor in the state. Approximately 85 million gallons per day (mgd) of water is removed from the D&R Canal (and the interconnected Spruce Run and Round Valley Reservoirs) by five water purveyors (East Brunswick Water Utility, Middlesex Water Company, New Brunswick Water Utility, New Jersey American Water Company and North Brunswick Water Utility) for public consumption by 1.5 million people. Water from the D&R Canal is sold to these water purveyors in a raw, untreated condition. These companies treat the water prior to distributing it to their customers.

Subwatershed names, drainage areas and hydrologic unit codes are shown in Table 1. The location of the subwatersheds is shown in Figure 2.

Table 1 – Subwatershed Names and Hydrologic Unit Codes

Subwatershed Name	Drainage Areas (Acres)	14-Digit Hydrologic Unit Code
Upper Lockatong Creek	5,424	02040105200010
Middle Lockatong Creek	6,173	02040105200020
Lower Lockatong Creek	6,213	02040105200030
Upper Wickecheoke Creek	6,073	02040105200040
Middle Wickecheoke Creek	3,636	02040105200050
Lower Wickecheoke Creek	7,306	02040105200060
TOTAL	34,825	02040105200

Source: NJDEP Hydrologic Unit Code – 14 (HUC-14) Data

Figure 1 - Watershed Location Map

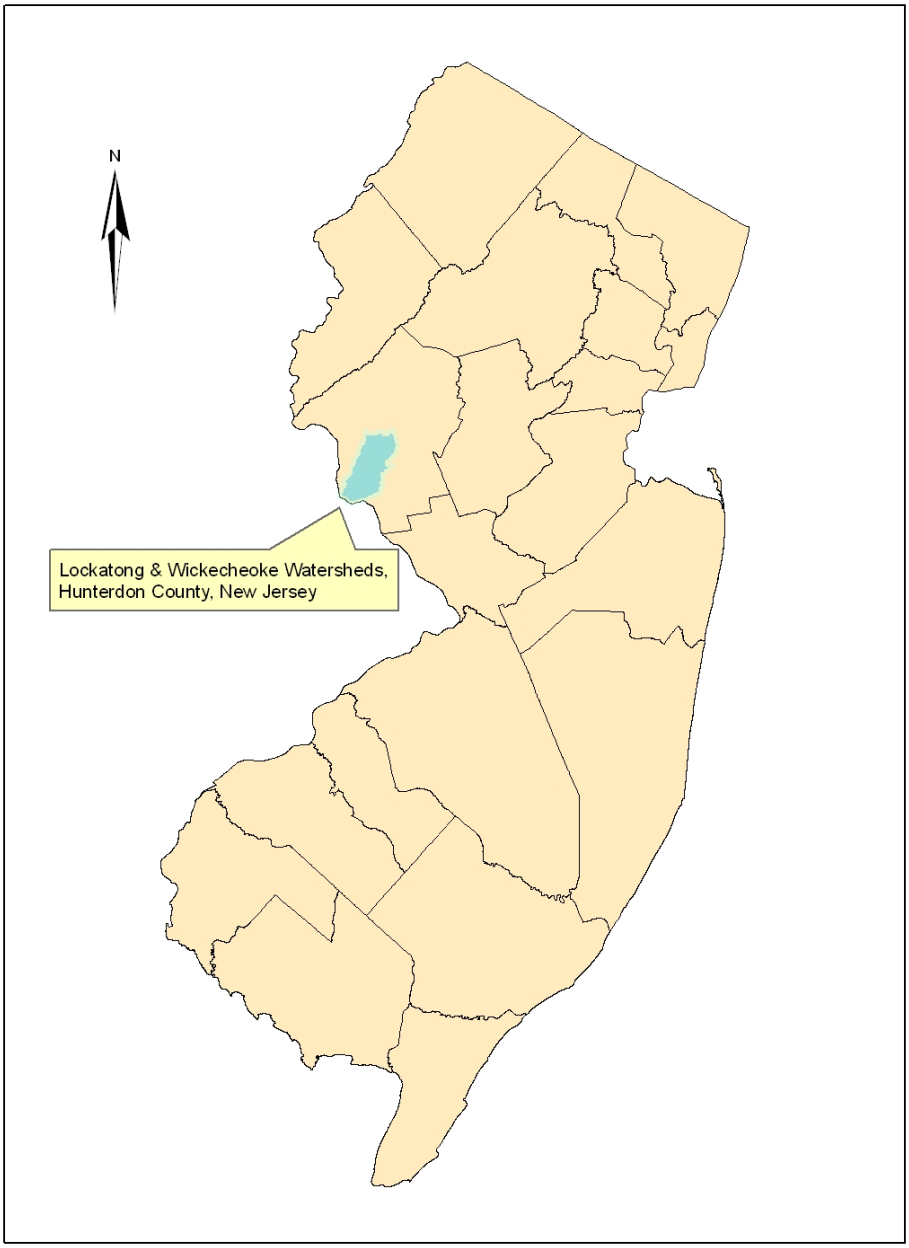
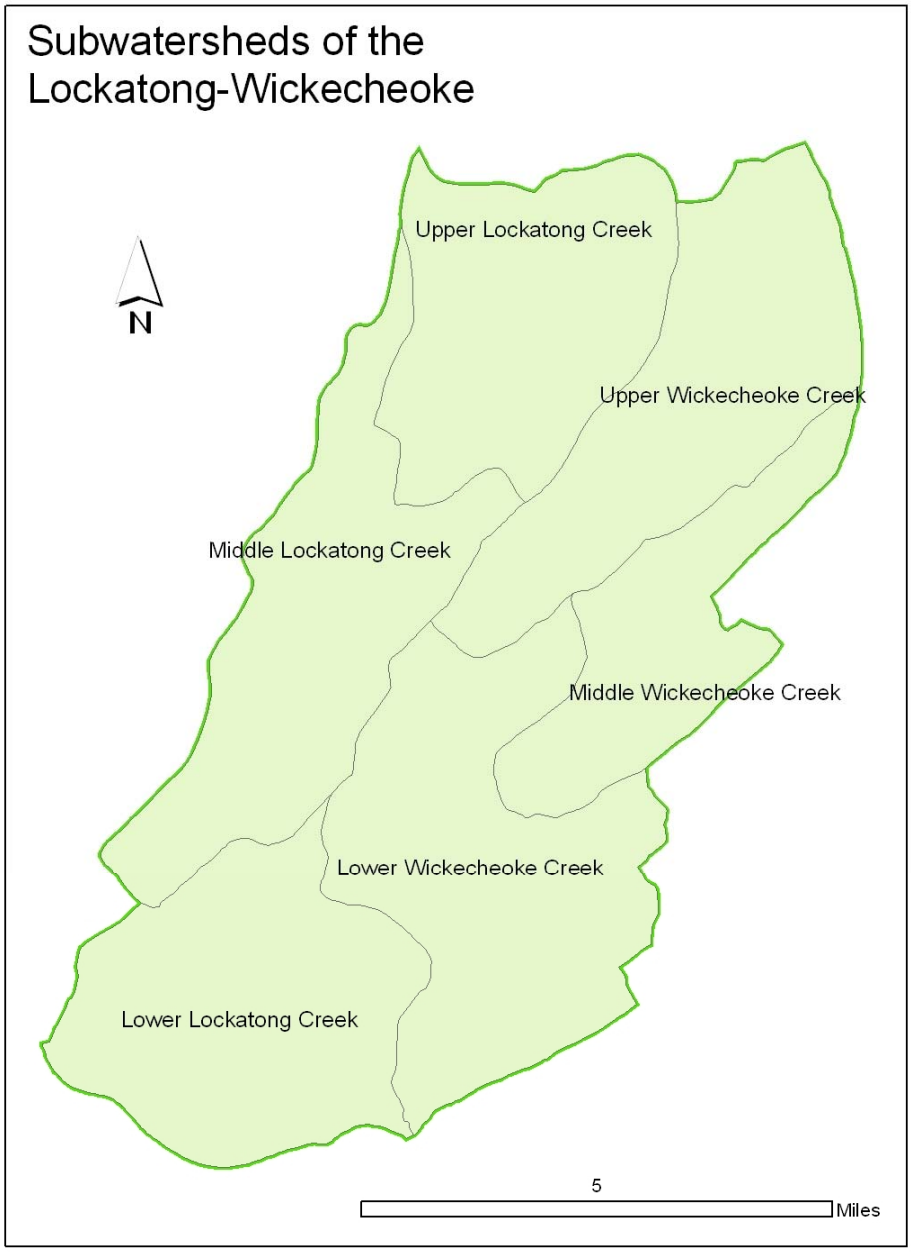


Figure 2 – Sub-watershed Map



Acreages used for cropland and total subwatershed and watersheds in this report vary slightly depending on data source. The Hydrologic Unit Code-14 data layer and NJDEP land

cover layer were used for characterizing the watershed in this section. Land use (NJDEP, 1995/97) in the Lockatong and Wickecheoke Creek watersheds is as shown in Table 2.

Farm Service Agency data for cropland was used in the analysis and results for cropland sheet and rill erosion.

Table 2 – Lockatong and Wichecheoke Creek Watershed Land Use

Land Use	Acres	Percent
AGRICULTURE*	13,959	40.1
BARREN LAND	48	0.1
FOREST	10,763	30.9
URBAN	3,450	9.9
WATER	355	1.0
WETLANDS	6,250	18.0
TOTAL	34,825	100.0

* Includes cropland, hayland, pasture, farmstead, etc.
Source: NJDEP 1995/1997 Land Use Cover

Problem Definition

Sediment entering the Canal causes two major problems. First, the larger, heavier particles are deposited in the Canal reducing capacity and thus require frequent removal; secondly the smaller particles remain in suspension and require costly treatment at the water treatment plants. Potential sources of sediment include various land uses including agriculture, new construction, streambank and channels, unpaved roads and unprotected road ditches and outlet and other source.

The soil erodibility is dependent on the soil erodibility factor (K). Other factors that affect soil erosion include the rainfall (R), the length and percent of slope (LS), vegetative cover (C), and conservation practice (P). These factors are further described under the Revised Universal Soil Loss Equation (RUSLE) discussion under Agriculture.

According to the Natural Resources Conservation Service (NRCS) 1986 Sediment, Erosion and Animal Waste (SESAW) Study, the average annual sheet and rill erosion rate from each of the 42,072 acres of “all cropland” in the Delaware Tributaries (upper) (Watershed 7) was 9.8 tons per acre per year. The Lockatong and Wickecheoke Creek watershed is included within this region. At that time, the average annual sheet and rill erosion from the 33,730 “cultivated cropland” acres was 12.0 tons per acre per year for the Delaware Tributaries while the Lockatong and Wickecheoke Creeks had an average of 4.07 and 4.25 tons per acre per year.

In order to narrow down the SESAW results to the Lockatong and Wickecheoke Creek Watershed, Ebasco, an environmental consultant and author of a 1987 study done for the New Jersey Water Supply Authority, obtained the NRCS National Resource Inventory Primary Sampling Unit data base from NRCS and determined the erosion rates for a number of randomly selected points within the watershed.

The Lockatong Creek watershed averaged 7.9 tons per acre per year for cropland and the Wickecheoke Creek watershed averaged 8.7 tons per acre per year for cropland (Ebasco, 1987). Table 3 shows the soil erosion estimates (based on the SESAW data) and computed sediment yield. The total amount of erosional debris exported from a drainage basin is its sediment yield. Sediment yield is generally expressed as either a volume or as a weight – i.e., as acre-feet (one-foot depth of material over one acre) or as tons.

Table 4 shows the cropland and hayland acreage trends between 1987 and 2004. Even though there was an increase in the diversity of non-traditional tilled crops such as sod, the total number of acres of tilled crops (corn and soybeans) dropped significantly. At the same time the acreage of land harvested for hay increased significantly. The total acreage of cropland decreased in both the watersheds.

Table 3 – Lockatong and Wickecheoke Creek Watersheds Average Annual Soil Erosion Rates (SESAW Data) and Estimated Sediment Yield

Land Use	Number of Points	Percent of Area	Average Annual Erosion (Tons per Acre Per Year)
Lockatong Creek			
Forest, not grazed, no commercial harvest	26	34.7	0.10
Corn	10	13.3	13.3
Soybeans	9	12.0	10.2
Cropland not harvested	6	8.0	0.30
Improved hayland	5	6.7	0.35
Farmstead	3	4.0	2.7
Wheat	2	2.7	1.6
Rotation, hay-pasture	2	2.7	1.6
Pasture	2	2.6	0.21
Other row crops	1	1.3	6.7
All other lands	9	12.0	2.08
TOTAL	75	100.0	4.07
Watershed Yield = 4.07 tons/acre-year x 23.1 sq.mi. x 640 acres x 0.15 = 9028 tons/year			
Wickecheoke Creek			
Forest, not grazed, no commercial harvest	21	27.3	0.06
Corn	17	22.1	14.68
Soybeans	7	9.1	6.53
Improved Hayland	6	7.8	0.66
Pasture	5	6.5	1.21
Wheat	3	3.9	4.64
Other Cropland not Harvested	3	3.9	0.29
Farmstead	2	2.6	0.17
Native Pasture	1	1.3	0.19
All other land	12	15.5	0.47
TOTAL	77	100.0	4.25
Watershed Yield = 4.25 tons/acre-year x 26.1 sq.mi. x 640 acres x 0.14 = 9933 tons/year			

Source: Ebasco, 1987

Table 4 – Lockatong and Wickecheoke Creek Watershed Cropland and Hayland Trends 1987- 2004 (Acres)

Crop	Lockatong Creek			Wickecheoke Creek		
	1987	2004	Percent Change	1987	2004	Percent Change
Corn	1,966	391	-80.1	3,691	241	-93.5
Soybeans	1,774	1,208	-28.0	1,520	203	-86.6
Wheat/Small Grain	399	278	-30.3	651	580	-10.9
Sod crop	-	337	337.	-	-	-
Other row crops (including vegetables and nursery stock)	192	55	-71.4	-	25	-
Other Cropland not harvested	1,183			651		
Hayland	1,389	2,275	+63.8	1,303	4,132	+217.1
Total Cropland	6,903	6,221	-9.9	7,816	5,181	-33.7

1987 Figures (Ebasco, 1987 and SCS National Resource Inventory, 1987)
2004 Figures (NRCS, Farm Services Agency, 2004)

Sediment Costs

On-going D&R Canal Maintenance

Table 5 shows the estimated annual costs for sediment in the D&R Canal. According to the New Jersey Water Supply Authority, maintenance cleaning occurs at the Prallsville Lock (mouth of Wickecheoke Creek) at least 12 times a year. Approximately 300 cubic yards of debris are removed from this location annually. The cost for this amounts to $200,000 not including disposal.

Dredged spoil is held at U.S. Route 202 Sediment Stockpile Site. The cost of permanent disposal of the dredged spoil ranges from $20 to $80 per cubic yard.

Major D&R Canal Dredging

Removal of approximately 700,000 cubic yards of sediment from 32 miles of the Canal between Prallsville Lock and Kingston Lock was completed in the fall of 1985. The cost of the project was approximately $20,100,000. This major dredging is anticipated to have approximately a 40 year life span with another major dredging to take place in 2020. It has been estimated that, due to disposal costs, this is likely to cost $40,000,000 which is equivalent to an annual cost of $1,205,000. The remainder of the Canal, which has never received a major dredging, may need to be done sooner than the Prallsville Lock to Kingston Lock section.

Sediment Removal Water Treatment Costs

According to the water purveyor customers of New Jersey Water Supply Authority, suspended sediment in the Canal has been a problem for approximately 15 years. Specifically, since 1997, several water purveyors have noticed that the raw water withdrawn from the Canal (at locations many miles downstream of the Lockatong and Wickecheoke Creek watershed outlet) during precipitation events has required increased amounts of chemicals for removal of suspended solids which, in turn, generates increased amounts of sludge or residuals (Gibs, et al., 2001). Formerly increased turbidity would follow a storm event for up to two days, now it can last up to a week (Falco, 2004; Finnegan, 2004; Maloney, 2004)

A total of approximately $1.5 million is spent annually for the treatment and disposal of sediment in the raw water being taken from the D&R Canal (Falco, 2004; Finnegan, 2004; Maloney, 2004).

Episodic Events

The Hurricane Floyd event on September 16-17, 1999 resulted in major expenses for the New Jersey Water Supply Authority in terms sediment and debris removal from the Canal at various points. The major damage area occurred at the outlet of the Wickecheoke Creek into the Canal at Prallsville, New Jersey (Prallsville Lock). Nearly two thirds of the Canal capacity was filled with sediment, rubble and debris. The cost for removal of this material was approximately $70,000. In September 23, 2004 and April 4-5, 2005 the Delaware River had major flooding. The April 4-5, 2005 event caused approximately $3,500 worth of damages (in terms of equipment and labor costs) (Shepherd, 2005). This does not include the cost of hauling to or the cost of dumping the material at the U.S. Route 202 Sediment Stockpile Site. These numbers were annualized and are presented in Table 5.

Table 5 – Estimated Annual Costs of Sediment in D&R Canal

On-going D&R Canal Maintenance	Major D&R Canal Dredging	Episodic Events (Hurricane Floyd)	Sediment Removal Water Treatment Costs	TOTAL COSTS DUE TO SEDIMENT
$200,000	$1,205,000	$735	$1,500,000	$2,905,735

Sources: Figures for On-going Canal Maintenance, Major Canal Dredging and Episodic Events were provided by New Jersey Water Supply Authority.
Sediment Removal Water Treatment Costs were provided by:
New Brunswick Water Utility
Middlesex Water Company
North Brunswick Water Utility

Agriculture

Sheet and Rill Erosion on Cropland

General

NRCS conducted a study to determine the sheet and rill erosion from the approximately 11,400 acres of cropland in the watershed. The next step was to determine and apply the appropriate sediment delivery ratio. As a result, an estimate was made of the annual tons of sediment being deposited into the Canal from cropland sheet and rill erosion at the point where each of these two streams empty into the Canal.

Methodology

The Revised Universal Soil Loss Equation (RUSLE) was used to estimate the annual soil loss from cropland which is measured in tons per acre per year. It needs to be emphasized that RUSLE only measures sheet and rill erosion which is the movement of soil down slope and not necessarily off the field. Also, some cropland may experience ephemeral and gully erosion which was not measured due to the low number of fields/acres that were in annually tilled cropland. Gully erosion, to a limited extent, on land adjoining cropland is present in some situations where surface water practices outlet. This will be discussed later.

Field Identification

The first task involved the determination of the location and extent of cropland fields in the watershed. The Farm Services Agency-USDA, New Jersey provided their digital layer of tracts, fields and field acreages for Hunterdon County. Using Arc View Geographic Information Systems (GIS) and overlaying this layer on 1995-1997 aerial photography illustrated where the cropland fields were located. A comparison was done of this map to the aerial slides taken by FSA of the County in 2004. As a result, additional cropland was added to the inventory as well as the removal of some cropland fields that had been converted to other uses (mostly urban). Each field was assigned an identification number consisting of the FSA assigned tract and field number. Those fields added to the inventory via the aerial slides were identified with a tract number in the 8,000s and a field number and computed acreage. After combining these two data sources, slightly more than 1,500 fields were then entered into the inventory.

Subwatershed

Each of the two watersheds were further divided into 3 subwatersheds (lower, middle, and upper) using the Hydrologic Unit Code-14 watershed delineation. Any field that was partially in two or more subwatersheds was assigned to the subwatershed containing most of its acreage. For those fields straddling watershed boundaries, if the majority of the field was in the study area then the entire field was included. Very few fields were in this situation.

Random field selection

To simplify and accelerate the process it was determined that RUSLE soil loss calculations would be done on a sample of the 1,500 plus fields. As a result, the decision was made to randomly select enough fields to represent 20% of the cropland acreage. Cropland fields in each subwatershed, that represented approximately 20% of the cropland in that subwatershed, were randomly selected using a random number generator. Due to the relocation of some fields into adjacent watersheds as described above, the 20% random acreage figure varied by watershed.

RUSLE Factors – Use and Selection

RUSLE employs the use of 5 factors to compute sheet and rill erosion from cropland. The definitions of these five factors is shown in Table 6 as well as the range found in the watersheds. In the RUSLE formula “A” equals tons of soil loss per acre per year and is the product of RKLSCP. An explanation of the factors is presented below.

1. **R** factor: Erosive rainfall factor obtained from FOTG – constant of 160
2. **K** factor: Soil erodibility factor obtained from FOTG for each soil series, and then adjusted for RUSLE. The K value for the dominant soil in the field was used.
3. **LS** factor: Length and slope factor obtained from field office data gathered in either making Highly Erodible Land determinations or conservation planning. Many LS factors for each soil mapping unit were gathered and then a representative factor selected from the several values. In-field LS factors were calculated only in a few isolated cases where existing field office data was not available.
4. **C** factor: Cover management factor, all 300+ fields were observed in the field (as opposed to viewing aerial photographs, etc) to determine the current cropping pattern. Based on the field observation an appropriate C value was chosen.
5. **P** factor: Practice factor, an appropriate factor was chosen based primarily on the cropping pattern, row direction, buffer strips, or terraces through the visual field inspection described for the C factor above.
6. **T** factor: Not a component of RUSLE, but is the comparison soil loss to which "A" is compared. For a given soil, "A" should be less than or not greater than "T". The "T" value represents the maximum annual soil loss which can be tolerated for the maintenance of soil productivity.

Table 6 - RUSLE Soil Loss Factors in the L&W Watershed (A=RKLSCP)

Soil loss equation (RUSLE) Parameter	Name/function	Variability in range in Watershed
A	Annual soil loss in tons per acre per year	Values found during study 0.04 to 9.98
R	Erosive rainfall index	Constant of 160 (Hunterdon County)
K	Soil erodibility index	Values from 0.17 to 0.35
LS	Length and % slope factor	Computed by soil mapping unit- values range from .26 to 1.86
C	Cover management factor	Values from 0.004 to 0.43
P	Practice factor	Values from 0.7 to 1.0
T	Soil loss tolerance	2 to 5 tons per acre per year

Results

As noted above, all 5 of the RUSLE soil loss factors were gathered for each of the 308 randomly selected fields. The factors were entered into an EXCEL spreadsheet and the soil loss for each field was calculated. The results are presented in the Table 7. Column 9 shows the average soil loss in tons per acre per year for the 20 percent sample of cropland in each subwatershed. The average soil loss was multiplied by the number of total acres of

cropland (col.2) to produce the projected annual soil loss (in tons) from all cropland fields in each subwatershed and is shown in column 10.

Discussion

The soil loss numbers discussed here are for a point in time and are based on a 20 percent random sample. Since farmers frequently change cropping patterns or rotations the soil loss figures will change accordingly. A review of Table 7, column 9, above shows that soil loss in the watershed, on average, is well within acceptable limits. "T" values, or acceptable soil loss per acre per year, for the watershed soils range from 2 to 5 tons per acre per year. Most of the cropland fields in the watershed have "T" values of 3 and 4. The primary reason that there are low erosion rates is that most of the cropland in the watershed is being used to produce grass hay. Eighteen (18) of the 308 fields sampled had annual soil losses which exceed the "T" value. Twelve (12) of the eighteen (18) fields were located in the Upper Lockatong Creek subwatershed. Crops grown in these fields were primarily soybeans and mixed vegetables. A gross projected soil loss of 11,978 tons per year results when the average sub watershed erosion rates are projected for all the cropland.

An inspection of the raw data (soil loss for each of the 308 fields sampled) indicates the following:

1. The total soil loss from all 308 fields was determined to be 2, 293 tons per year.
2. The lowest calculated soil loss was 0.04 tons/acre/year (grass hay on a relatively flat field) while the highest was 9.98 (soybeans on an 8-15 percent or C slope)
3. The majority of fields sampled (252 of the 308 fields or 81.8%) had a soil loss of less than 1 ton per acre per year
4. Eighteen (18) of the fields (5.8%) were experiencing soil loss greater than acceptable limits ("T").

Below in Table 8 is presented the annual soil loss for each of the 308 sampled fields. Each field is placed into one of five groups. A careful review shows that over 90% (93.2%) of the fields have a soil loss of less than 3 tons per acre per year. Three fields had annual soil losses greater than 3 tons per acre but less than 4 tons per acre.

Table 7 –Crop Field Soil Loss by Subwatershed

				Acres of cropland types (in 20% sample fields)					
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Sub-Watershed	**Total* Acres ---------- Cropland Acres****	**No of fields smpld.**	**Acs. smpld**	**Grass hay**	**Small grain**	**Vege-tables**	**other**	**20% Sample average soil loss tons/ Ac/Yr**	**Projctd. gross erosion from sub WS in tons per yr.**
Lockatong-Lower	6,184 **1,260**	35	252	218	16	0	17	0.44	554
Lockatong Middle	6,186 **2,229**	61	455	232	103	0	83	0.72	1,605
Lockatong Upper	5,420 **2,732**	56	516	133	272	12	99	2.79	7,622
Wickcheoke. Lower	7,301 **2,763**	81	551	443	104	0	4	0.57	1,575
Wickcheoke. Middle	3,633 **580**	27	140	122	0	0	18	0.09	52
Wickcheoke. Upper	6,069 **1,838**	48	362	308	12	0	28	0.31	570
Totals	34,793 **11,402**	**308**	**2,276**	**1,456**	**507**	**12**	**249**		**11,978**

* Subwatershed and Watershed Acres are based on HUC-14 data

** Cropland Acres are based on Farm Service Agency Cropland Data

Note: A 20 percent random sample was taken and therefore the averages are not true averages. The true average could be considerably higher or lower.

Table 8 - Annual soil loss by field, subwatershed and amount (308 sampled fields)

	Number of Fields with Annual Soil Loss (tons per acre per year)					
Subwatershed	**0.0 to 0.99 t/ac/yr**	**1.0 to 1.99 t/ac/yr**	**2 .0 to 2.99 t/ac/yr**	**3.0 to 4.99 t/ac/yr**	**5.0 to 10 t/ac/yr**	**Total fields**
Lockatong-lwr	32	1	1	1	0	35
Lockatong-mdl	50	1	7	3	0	61
Lockatong-upr	31	6	8	6	6	56
Wickecheokee-lwr	67	6	4	2	1	81
Wickecheokee-mdl	27	0	0	0	0	27
Wickecheokee-upr	45	0	1	1	1	48
Total	252	14	21	13	8	308

Table 9 - Lockatong and Wickecheoke Creek Watershed Cropland Sediment Yield

Watershed	Projected Gross Erosion from Cropland* (Tons/Year) Source: Kent Hardmeyer	Sediment Delivery Ratios Source:Max Olynyk	Sediment Yield to the Canal Tons/Year	Cubic Yards/Year**
Lockatong Lower -	554	25 %	139	103
Lockatong Middle -	1,605	23%	369	273
Lockatong Upper -	7,622	20%	1,524	1,129
Wickecheoke Lower -	1,575	20%	315	233
Wickecheoke Middle -	52	30%	16	12
Wikecheoke Upper -	570	23%	131	97
TOTAL	**11,978**	**-**	**2,494**	**1,847**

* This is based on the average soil loss rate for the 20 percent sample of cropland (Table 7, Column 10). Includes sheet and rill erosion.

** Assumes 1.35 tons per cubic yard or 100 lbs/cu foot (Max Olynyk, 2005)

Table 9 shows the sediment yield to the D&R Canal due to cropland erosion. Sediment is removed from the Prallsville (Wickecheoke Creek) Lock on the D&R Canal at least 12

times a year. Approximately 300 cubic yards of debris (wood and household trash) is removed from this location annually (Joe Shepherd, NJWSA, 2004). According to the Ebasco report (1988), an estimate of approximately 740 cubic yards (1,000 tons/1.35 tons per cu. yd.) were removed annually at that time.

The 342 cubic yards of sediment at the Prallsville Lock (Wickecheoke Creek outlet) from sheet and rill cropland erosion approximately equals the sediment removed annually at this location. (This does not necessarily mean that entire amount of sediment removed annually is coming from agricultural sources as there are many other sources as defined in this report.) The remainder of the sediment delivered to the outlets of the watersheds travels downstream in the D&R Canal. Travel time from Raven Rock to the Route 18 Spillway (entire Canal length of approximately 63 miles) is approximately 8 days with the velocity in the reach from Raven Rock to Lower Ferry Road estimated to be 0.9 ft/s. while the velocity decreases to an average of 0.45 to .22 ft/s. from Lower Ferry Road to the Route 18 Spillway (Gibs, et al, 2001).

The remainder of the sediment coming from the Wickecheoke Creek watershed may be either going over the weir into the Delaware River during high flow events or going further down the Canal as finer sediment as a portion of the approximately 700,000 cubic yards of sediment removed in 1985 from the 32 miles of the Canal between the Prallsville (Wickecheoke Creek) Lock and the Kingston Lock. Estimated life span of this dredging is approximately 40 years with another dredging scheduled in 2020.

The above results indicate that agricultural land uses, from a soil resource management perspective, are within generally acceptable limits for well managed land. The major exception seems to be the Upper Lockatong Creek subwatershed where a number of fields were identified as being over the T value (Table 8) and where all the vegetable fields in the entire Watershed were identified as being located (Table 7). Observations by the water purveyors, mentioned previously, that the sediment problem and their treatment costs have increased since 1997 do not conform with the cropland erosion analysis which shows the decreasing trends in the acreage of tilled agricultural land. It is interesting to note that there are no Lockatong and Wickecheoke Creek sites on Sublists 3 or 5 of the 2004 NJDEP Integrated List that show Total Suspended Solids as a parameter.

Contributions from other non-agricultural land uses are likely to be more significant. These non-agricultural contributors to sediment are explored later in this report.

Other Agricultural Sources of Sediment

During the past 60+ years a number of agricultural producers have installed surface water control practices to reduce ephemeral and gully erosion on their cropland. These practices include grassed and stoned-center waterways, diversions (divert incoming surface water runoff before it enters the cropfield) and terraces (control surface water

runoff within a cropfield). These practices most often outlet directly on the surface at the edge of a cropfield or, in some cases, outlet through an underground outlet system. The surface outlets for these runoff control structures discharge into an area that is often wooded or in some other non-cropland use that would have been cleared for cropping many years ago but was too steep for cultivation. The common practice has been to install a “level lip spreader” where the outlet is equal in elevation so that the concentrated flow of water is spread out in a less erosive, sheet flow. Unfortunately, over time, leaves, branches and other debris cause the former sheet flow to become concentrated and erosive. This potential for soil erosion is further exacerbated by the presence of steep slopes between the end of the practice and the nearest stream. In some cases, the result of this process has been the development of severe, gully erosion. Figure 3 shows an example of this problem in the watershed.

A geographic analysis was performed to identify the potential for soil erosion and sediment transport from existing runoff control practices (waterways, terraces and diversions) relative to steep slopes and distances from the nearest receiving stream. Geographic layers which were intersected were a cropland layer, with field identification for those areas known to have these runoff control features; steep slopes (either greater than 8 percent or greater than 10 percent) and the distance between the field edge and the receiving waterway, in increments of 50 feet, from 50 to 250 feet.

Figure 4 shows the acres of cropland with surface runoff control practices by subwatershed. While these eroding outlet conditions may have been significant sediment sources at one time, this is no longer the case, especially when considered relative to other sediment sources.

An analysis of the land that is permanently preserved farmland in the watershed was performed as it relates to these practices. Permanently preserved farmland, as a condition of its preservation by the State, is required to have a soil and water conservation plan. Implementation of the plan is not required. Figure 5 shows the location and extent of the permanently preserved farmland in the watershed.

Figure 3 - Cropland Runoff Practice Outlet Potential Erosion

Gully formed at outlet of Terrace System along lower Wickecheoke Creek

Figure 4 – Acres of Cropland with Surface Water Control Practices by Subwatershed Within 300 Feet of Stream

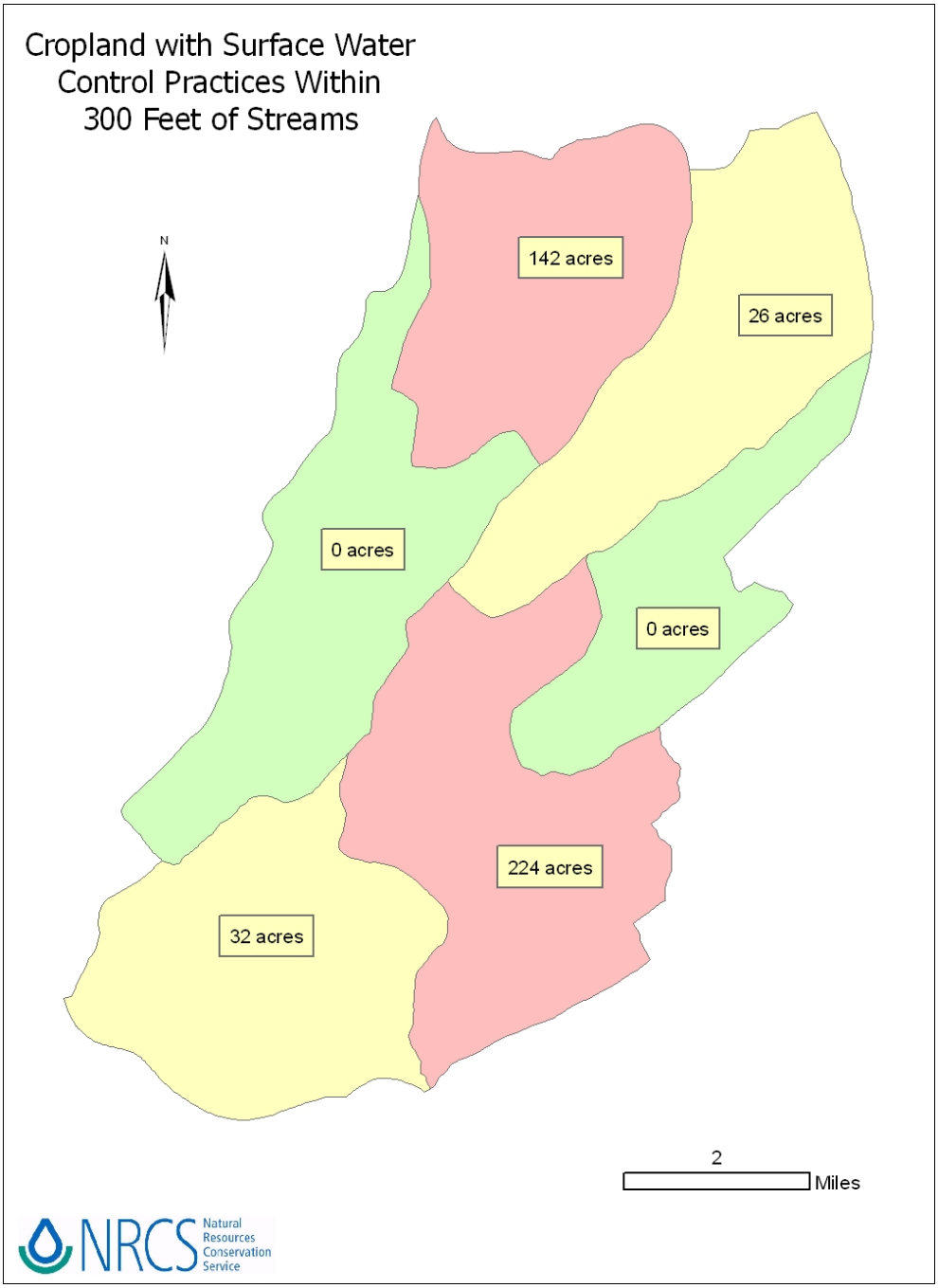
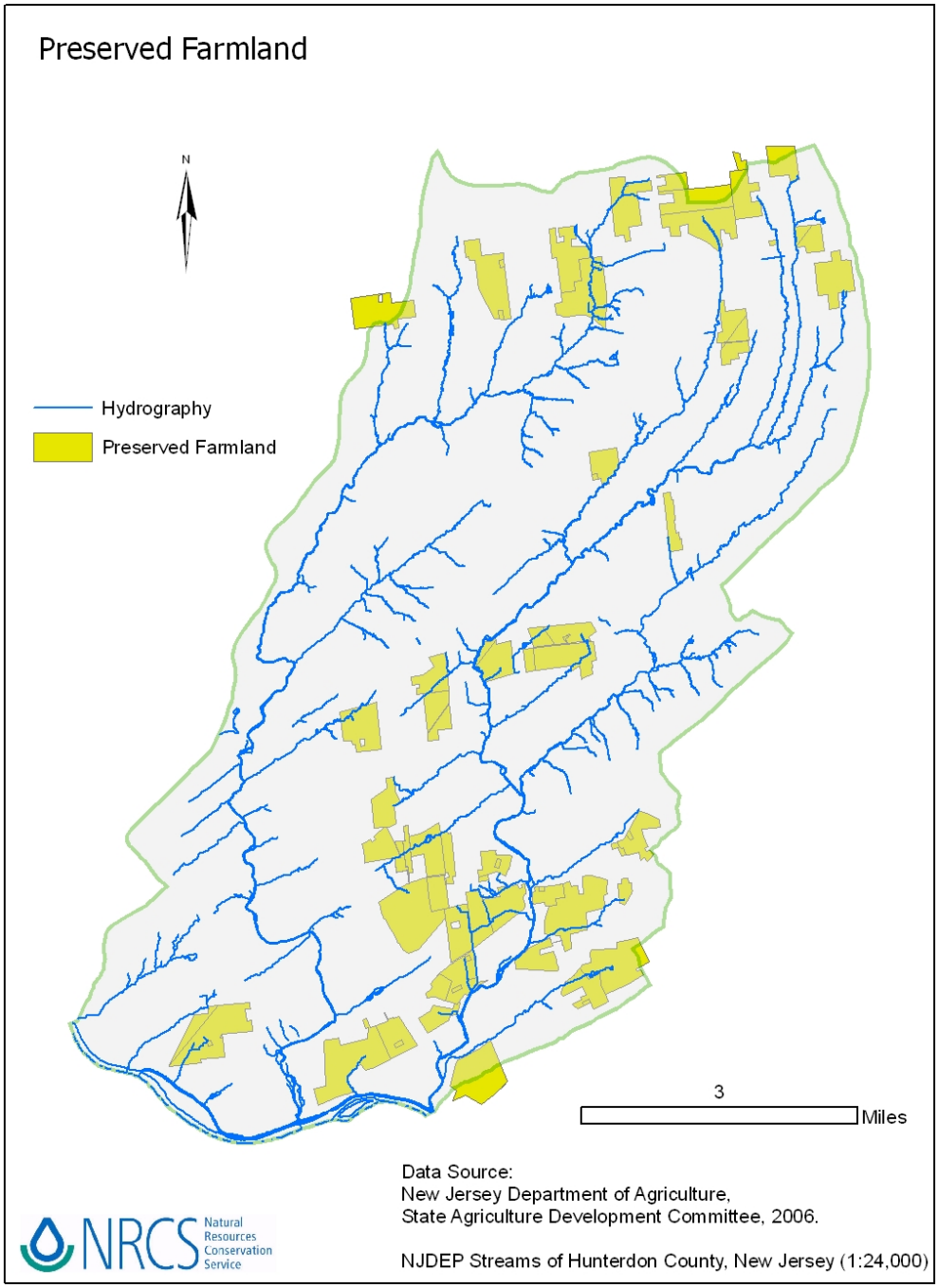


Figure 5 - Location and Extent of Permanently Preserved Farmland



Forest Sediment Sources

The “Forest” land use category accounts for about 31% of the area of the Lockatong and Wickecheoke watersheds (see Table 2.) These forests are mostly smaller woodlots but a few larger forested patches are present in some large forested wetlands throughout the watersheds and on very steep slopes in the southern reaches of the watersheds.

The NJ State Forest Service requires that forest landowners, with more than 50% of their acreage in non-appurtenant woodlands, have a forest management plan on file with the state to be eligible for farmland assessment tax evaluation. Management plans are prepared by private consultant foresters and are reviewed and approved by NJ State Forest Service foresters. State foresters visit the woodlots at least once every three years for an inspection. Many larger farms, with less than 50% of their land in forests, do not have forest management plans.

Commercial woodland harvests are very limited in this watershed (Shuart, 2006). Forestry activity in the watershed is normally limited to timber stand improvement, some pre-commercial thinning and small scale timber harvests. Timber harvest activities are also severely limited in wetlands by the NJ Freshwater Wetlands Act and along streams by the Flood Hazard Area Control Act (“Stream Encroachment”). Shuart reports that he knows of no erosion problems in woodlands in the watershed and feels that the limited forest activity should not cause excess sediment sources from woodlands. The NJ State Forest Service does not maintain data on timber harvests. They do maintain a brief database that lists the number of forestry plans and acres under a management plan by township and county.

According to Patric (1976), erosion from undisturbed as well as carefully managed forest land is 0.05 to 0.10 ton/acre/year. Using a rate of 0.1 ton per acre per year for the 10,763 acres of forestland in the watershed results in 1,076 tons of soil erosion from forestland in the watershed. A sediment delivery ratio of 33 percent yields 355 tons of sediment to the D&R Canal.

Figure 6 - Streambank Erosion on Wickecheoke Creek on Lower Creek Road

Stream Sediment Sources

Literature Review

Stream bank erosion has been identified as a significant source of nutrient and sediment loading to streams in the Chesapeake Bay Watershed and Piedmont region of Pennsylvania and Maryland (LandStudies, 2005). In addition, "legacy sediments" have been identified as being easily erodible and containing high concentrations of nitrogen and phosphorus. Legacy sediments refer to sediments that were deposited in floodplains as a result of settlement activities from early colonization to the mid-twentieth century (Legacy Sediments: A Brief History, www.landstudies.com, 2005). Stream bank erosion, based on a number of Pennsylvania Department of

Environmental Protection – funded studies has been determined to a major source of pollution, sometimes *the* major pollution source.

Methodology

Several methods of stream bank erosion estimation have been developed. Rosgen (Rosgen, 2001) developed a prediction model which incorporates a stream erodibility index and calculated near-bank stresses. Streambank characteristics involving measurements of bank heights, angles, materials, presence of layers, rooting depth, rooting density and percent of bank protection are used to develop the streambank erodibility index.

Jennings, et al. (2001) used field measurements of bank height, bankfull height, root depth, root density, bank angle and surface protection along with bank material and stratification information to determine the Bank Erosion Hazard Index (BEHI) each time a stream reach was surveyed. Generally, the higher the BEHI score the greater the streambank erosion rate.

The method used in this study has been used over the past 31 years of physically observing the behavior of streams and discussing it with fellow SCS/NRCS geologists. It is highly empirical and is a paradigm to determine volume (Olynyk, 2006). A stream's bank must first be determined to be eroding. This determination is a straightforward conclusion based on the bare surface of the bank itself. If there is evidence of vegetative growth, then the bank is assumed to be non-eroding. If bare soil is visible, the bank is assumed to be eroding. Rock lined streambanks are almost always non-vegetative but their susceptibility to erosion is quite low and requires large, episodic, and sometimes catastrophic hydrologic events.

Once a streambank is determined to be eroding, the volume of material eroded is calculated. First the length of the eroded segment is determined, followed by the height of the eroding portion of the bank. The height is usually measured from the streambed up. Note that occasionally, when a stream is experiencing abnormally high flows, this distance must be either estimated or measured when the streamflow ebbs.

Also note that the height is the height of the entire streambank, since undercutting would eventually cause the entire slope to fail. Additionally, if there is evidence of vegetative growth near the streambed but then obvious erosion above it, the cause of erosion is almost never the stream. Rather, the bare streambank above the vegetative height is being attacked from the surface or, on very rare occasions, seeps within the bank.

The third measurement necessary to complete a volumetric calculation is the surficial distance perpendicular from the stream. This is commonly referred to as the lateral recession. Most of this agency's erosion calculations are based on annual assessments. Therefore, a lateral recession rate would be a distance per year. This distance, when obtained by observers inexperienced at determining lateral recession

rates, is almost always overly aggressive, i.e., the number is way too high. It is suggested that the observer estimate the lateral recession over ten years. This appears to temper the penchant for inexperienced, overly high estimates. The ten year recession is then simply divided by ten to establish an annual recession rate.

The three distances, length, height, and lateral recession of an eroding streambank now are used to determine the volume of material annually eroded from the particular segment in question. There are instances where weight (often in tons) is the desired calculation. Highly arenaceous soils may have a bulk density of as little as 80 pounds per cubic foot, while argillaceous soils may reach 120 pounds per cubic foot. An average bulk density of 100 pounds per cubic foot is therefore a convenient value often used to convert volume to pounds per cubic foot, and from there a straightforward calculation to the popular tons and tons per year (Olynyk, 2006).

Results

Table 10 shows the results of a stream survey of streambank erosion that was made in August 2006. The survey was made from field observation at a limited number of access points along the streams. This estimate was based on a GIS-generated total stream length for each of the six subwatersheds. This calculation was based on an assumption that between one and two percent of the streambank was eroding. The total estimate for streambank erosion is 248 tons per year of sediment.

Table 10 also shows a second estimate that was made using the main stem and tributaries for each of the six subwatersheds. This calculation assumed that the entire one side of the main stem was eroding. The total estimate for streambank erosion is 12,295 tons per year of sediment.

Discussion

Field observations indicate that streambank erosion is a contributing source of sediment to the Canal. Streambank erosion does occur throughout the watersheds. Streambank erosion not only serves as a source of sediment but is also a significant threat to the integrity of several county and municipal roads.

One hypothesis could be that episodic events such as Hurricane Floyd and other intense precipitation events may be putting large loads of sediment and rubble into the streambeds which in turn move downstream incrementally, similar to a conveyor belt, into the Canal.

Wolman and Schick (1967) discussed post-colonial land use changes in the northeastern United States and its effect on sediment yield. They proposed that in the late 1800s, when forestland was converted to agriculture, sediment yields increased from 100 tons per square mile to 600 tons per square mile. During the 1960s, many rural areas became urbanized resulting in another increase in sediment from construction activity which resulted in sediment yields exceeding 2,000 tons per square

Table 10 – Lockatong and Wickecheoke Creek Watersheds Streambank Erosion

Subwatershed*	tributary streambank total length (miles) both banks	Main stem streambank (miles) both banks	total length (ft.)	trib length (ft)	main length (ft)	Main banks as % of whole for subwatershed	1% of total stream network in ft eroding./100' on main stem only	2% of total stream network in ft. eroding/100' on main stem only	Typical Ht (ft.)	Lateral Recession(ft/yr)	cubic ft	Tons/yr	Lower Limit Estimate**	one side main stem eroding for entire length (cubic ft.)	Tons/yr	Upper Limit Estimate***
1	40.2	4.2	234432	212256	22176	9%	9.46	18.919	3	0.05	351.65	17.582		15919	795.96	
2	50.2	13.1	334224	265056	69168	21%	20.70	41.39	4	0.15	2005.3	100.27		79517	3975.8	
3	54.1	9.7	336864	285648	51216	15%	15.20	30.408	5	0.05	842.16	42.108		35706	1785.3	
													159.96			6557.1
4	56.3	11.6	358512	297264	61248	17%	17.08	34.168	3	0.05	537.77	26.888		22295	1114.7	
5	34.5	4	203280	182160	21120	10%	10.39	20.779	4	0.15	1219.7	60.984		54648	2732.4	
6	57.3	14.8	380688	302544	78144	21%	20.53	41.054	5	0.05	951.72	47.586	87.872	37818	1890.9	5738.04
TOTALS													247.83			12295.14

* Subwatershed:
1 – Upper Lockatong Creek
2 – Middle Lockatong Creek
3 – Lower Lockatong Creek
4 - Upper Wickecheoke Creek
5 - Middle Wickecheoke Creek
6 – Lower Wickecheoke Creek

** Lower Limit Estimate (Max Olynyk, August 2006)
*** Upper Limit Estimate – assumes one side of the entire length of the main stem eroding

mile. The estimated yield per square mile in the Lockatong and Wickecheoke Creek watershed is 127 tons per square mile. This would place this watershed between a watershed with predominantly forested land use and a watershed with more intensive agricultural land use in terms of sediment production.

Costa (1975) estimated that land clearing for agriculture caused 34 percent of eroded sediment to be transported through the basin and 66 percent was retained in storage. Of the 66 percent of sediment in storage, 21 percent was deposited on floodplains and 79 percent was retained on hillslopes as colluvium and sheetwash deposits. Costa found that channels initially responded to the increased sediment load by aggrading. As sediment loads decreased as a result of decreasing agricultural practices and the use of soil conservation practices, stream channels began to incise and scour of stream channels became an important source of sediment. The highest rates of erosion were observed on Piedmont streams due the two centuries of farming that disturbed the topsoil.

Recent studies in Pennsylvania show that 50 to 90 percent of the sediment load generated in a watershed is not coming from overland flow as previously thought, but from the stream channel banks themselves (POWR, 2005). In two watersheds, the Baltimore County Little Gunpowder Falls Water Quality Management Plan using the Storm Water Management Module (SWMM) pollutant load model provided an estimate of the amount of sediment attributable to washoff from the watershed and the amount attributable to stream channel erosion. For the Chesapeake Bay watershed as a whole approximately two-thirds of the sediment load was the result of channel erosion and not watershed sediment contribution (Langland and Cronin, 2003). This is consistent with the findings of Trimble (1997), where stream channel measurements from 1983 to1993 in San Diego Creek indicated that two-thirds of the sediment yield was the result of channel erosion.

Recently, technology to differentiate the source of fine sediments in the suspended load of streams using naturally occurring radionuclides has been applied within the Goodwin Creek watershed in north central Mississippi as part of the Conservation Effects Assessment Program (CEAP). This watershed is one of twelve benchmark CEAP watersheds across the country which have been chosen to evaluate the effectiveness of conservation practices applied under various landscape and agricultural conditions in difference parts of the country. Preliminary data from Goodwin Creek show that fine sediment is predominantly derived from the land surface during the initial part of a runoff event. The latter parts of the same runoff event indicate that the sources of fine sediment shifted to predominantly channel bank sources (Wilson and Kuhnle, 2006).

Figure 7 - Streambank Erosion on Plum Brook Upstream of Locktown-Flemington Road

Figure 8 - Streambank Erosion on Wickecheoke Creek at Worman Road

Road Surface and Stormwater Management Sediment Sources

Earlier in this report there was a discussion of the impact of the road network of a watershed on the effective drainage density, that is, the combined density of the stream network and the road network. Roads increase the efficiency of the water removal from a watershed by decreasing the time it takes for water to move to a receiving stream or water body. This often results in increases in the volume and rate of runoff as well as the sediment delivery to the outlets of the watersheds. Digital information on the location and extent of roads (both public and private), bridges and culverts in the watershed was obtained from Hunterdon County. Based on this information, Table 11 shows the natural drainage density and the effective drainage density by subwatershed. The Hunterdon County GIS data shows that there are 35 stream crossings and 209 culverts in the watersheds. Table 12 shows the number of acres of roadways in each subwatershed. An average road width of thirty (30) feet was used to determine the surface area (includes cut and fill slopes) of the roadway exposed to rainfall impact. Based on this information, the average percent impervious surface in the watershed due to road surfaces is one percent (Table 12).

Table 11 – Stream Drainage Density and Effective Drainage Density Adjusted for Road Network Connectivity to Streams in Lockatong and Wickecheoke Creek Watersheds

Watershed/Subwatershed	Stream Drainage Density (miles/sq. mi.)	Effective Drainage Density* (miles/sq. mi.)	Increase in Drainage Density (%)
Upper Lockatong Creek	2.877	5.120	178.0
Middle Lockatong Creek	3.910	6.583	168.4
Lower Lockatong Creek	5.121	7.465	145.8
Upper Wickecheoke Creek	4.179	6.642	158.9
Middle Wickecheoke Creek	3.721	6.550	176.0
Lower Wickecheoke Creek	3.772	6.606	175.1
TOTAL	3.960	6.520	164.6

Source: Hunterdon County GIS Roads Data
Hydrography - NJDEP

* Effective drainage density refers to the combination of the stream drainage density and the man-made drainage density (due to the road network)

An analysis, using GIS technology, of the stream drainage density vs. the effective drainage density (includes the road network) shows that the drainage density of the watersheds and their subwatersheds is increased significantly by the road network.

Table 12 – Road Acres and Road Percent Imperviousness in the Lockatong and Wickechoeoke Creek Watersheds

HUC14	Subwatershed	Road Acres	Road Percent Imperviousness in Subwatershed
02040105200040	Upper Wickecheoke Creek	57	0.9%
02040105200010	Upper Lockatong Creek	46	0.8%
02040105200020	Middle Lockatong Creek	62	1.0%
02040105200050	Middle Wickecheoke Creek	39	1.1%
02040105200060	Lower Wickecheoke Creek	78	1.1%
02040105200030	Lower Lockatong Creek	55	0.9%

Source: HUC-14 - NJDEP
Road Network - Hunterdon County GIS Data

A GIS analysis was performed to determine the location of culvert outlets relative to slope, particularly in steep slope areas (defined as those greater than 8 and 10 percent) as well as the distance of the culvert outlets from streams. Nine culvert locations were identified as occurring on these steep slope locations (Table 13). The GIS data for road culverts is incomplete as a significant gully erosion problem occurs at a road culvert location near the Pine Hill Road crossing of Plum Brook in Delaware Township which is not identified in the road culvert data.

Field observations of both paved and unpaved roadways in these watersheds indicate that there can be a disproportionate (in terms of the land area affected) amount of sediment moving from both the road network and/or its drainage system and unprotected (from erosion) outlets. As was mentioned previously, one example which has been observed are several road culverts which carry intercepted road and upper lying land runoff under Pine Hill Road in Delaware Township and outlet it at the top of a 400 foot + long, 25%+ slope which drains directly into the Plum Brook. Visual observations show that a major gully is forming at the base of this long, steep slope and the voided soil is moving directly into the Brook.

Also, where road stream crossings occur, on both paved and unpaved roads, there is uncontrolled road runoff entering the stream without any sort of pre-treatment. Frequently there is little, if any, area for the installation of a detention

basin, check dams or other structural measures due to the steep slopes and relatively narrow stream corridors. An example of road runoff carrying sediment into the stream network can be found at the Pine Hill Road crossing of Plum Brook in Delaware Township. Table 14 shows those locations, identified by GIS analysis, where road crossings of streams occur on slopes greater than 10 percent for a distance of at least 100 feet on one side of the stream crossing.

Table 13 – Road Culverts, Steep Slopes and Adjoining Streams

STREET NAME	ROUTE NUMBER	SLOPE GREATER THAN 10 PERCENT	SLOPE GREATER THAN 8 PERCENT	STREAM
FEDERAL TWIST RD			X	LOCKATONG CREEK
STOMPF TAVERN RD		X	X	DELAWARE R UNNAMED TRIB 2-3500
STOMPF TAVERN RD			X	DELAWARE R UNNAMED TRIB 2-3500
PAVILICA RD			X	WICKECHEOKE CREEK
UPPER CREEK RD			X	WICKECHEOKE CREEK
FEDERAL TWIST RD			X	DELAWARE&RARITAN CANAL 88672 UNT TO 88672 @ 1.00
LOWER CREEK RD		X	X	WICKECHEOKE CREEK
WORMAN RD		X	X	WICKECHEOKE CREEK-UNNAMED TRIB #3-20
ROSEMONT - SERGEANTSVILLE RD	604		X	WICKECHEOKE CREEK
*PINE HILL ROAD		X		PLUM CREEK

Source: * Based on visual observation
Culvert Data - Hunterdon County GIS
Hydrography – NJDEP
Digital Elevation Model – NJ Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA)

Table 14 – Bridge Crossings, Steep Slopes and Streams Crossed

BRIDGE STRUCTURE NUMBER	STREET NAME	ROUTE NUMBER	STREAM
D325	LOWER CREEK RD		WICKECHEOKE CREEK
D496	UPPER CREEK RD		WICKECHEOKE CREEK 88536 UNT TO 88536 @ 5.40
D488	OLD MILL RD		WICKECHEOKE CREEK
K047	BYRAM - KINGWOOD RD	651	LOCKATONG CREEK 88696 UNT TO 88696 @ 5.10
D333	PINE HILL RD		PLUM BROOK
K087	MILLTOWN RD		LOCKATONG CREEK
D481	STRIMPLES MILL RD		LOCKATONG CREEK
D494	FEATHERBED LA		WICKECHEOKE CREEK 88536 UNT TO 88536 @ 5.40
D494a	FEATHERBED LA		WICKECHEOKE CREEK 88536 UNT TO 88536 @ 5.40
D304b	ROSEMONT - SERGEANTSVILLE RD	604	WICKECHEOKE CREEK
D304a	ROSEMONT - SERGEANTSVILLE RD	604	WICKECHEOKE CREEK

Source: Bridge Crossing Data – Hunterdon County GIS
Hydrography – NJDEP
Digital Elevation Model – NJ Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information and Analysis (BGIA)

All county roads are paved (Copp, 2006). Information on the location and extent of unpaved vs paved roads was gathered from each of the four municipal road superintendents. Table 15 shows the breakdown of road types by subwatershed. In addition, there are 6.448 miles of roads shown as “private” in the watershed. These can be broken down into 0.538 miles bituminous, 0.453 miles dirt, and 5.457 miles paved.

Table 15 – Road Surface Type by Subwatershed

Subwatershed	Road Surface Type (Miles)				
	Paved	Bituminous	Unpaved	Dirt	Total
Upper Wickecheoke Creek	21.241	2.129	0.000	0.000	23.370
Upper Lockatong Creek	11.963	6.684	0.348	0.000	18.995
Middle Lockatong Creek	19.382	5.492	0.000	0.899	25.773
Middle Wickecheoke Creek	13.542	2.028	0.498	0.000	16.068
Lower Wickecheoke Creek	20.729	6.931	4.680	0.000	32.340
Lower Lockatong Creek	15.484	5.241	2.026	0.000	22.751
TOTALS	102.341	28.505	7.552	0.899	139.297

Source: Paved, Bituminous and Dirt – Hunterdon County Highway Department
Unpaved – Delaware, Franklin, Kingwood and Raritan Twnshp Hwy Departments

Table 16 – Road Surface Type by Municipality in Watershed

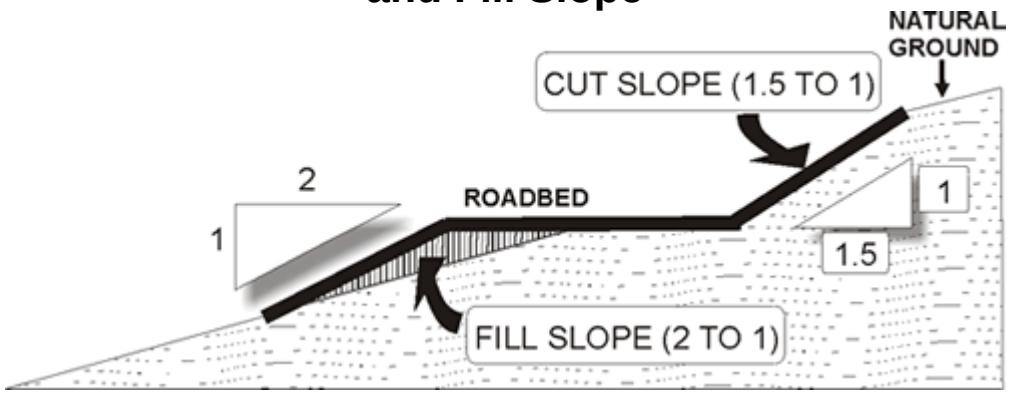
Municipality	Road Surface Type (Miles)				
	Paved	Bituminous	Dirt	Unpaved	Total*
Delaware Twp	42.587	10.238	0.000	5.478	58.303
Franklin Twp	10.334	6.898	0.000	0.341	17.573
Kingwood Twp	35.817	8.472	0.899	1.521	46.709
Raritan Twp	13.455	2.895	0.000	0.000	16.350

*Total Road miles do not include Stockton Borough which has 0.3 miles of roadway

Source: Paved, Bituminous and Dirt – Hunterdon County Highway Department
Unpaved – Delaware, Franklin, Kingwood and Raritan Township Highway Departments

Table 16 shows the road surface type by municipality in the watershed. Surface erosion occurs from nearly all roads. When ditches or culverts drain near a stream (within 200 feet), the sediment delivery ratio is 100% (Burroughs and King, 1989).

Figure 9 – Typical Roadway and its Associated Cut slope and Fill Slope



Source: Layman's Guide to Access Road Construction: Design Guidelines, North Carolina Department of Environment and Natural Resources, Division of Forest Resources

The following is the methodology used by Sturhan (1997) for determination of the soil loss from roads including their associated cutslope, ditch and fillslope (Figure 9) which has been used to analyze the road network in this watershed:

One Acre of Road (built on Moderately weathered sedimentary rocks) = 30 tons/Acre/Year

Tread: 40% of 30 Tons/Acre/Year = 12
Cutslope/Ditch: 40% of 30 Tons/Acre/Year = 12
Fillslope: 20% of 30 Tons/Acre/Year = 6

Basic Erosion Rate x Cut/Fill Slope Correction Factor For Vegetative Cover

Cutslope/Ditch: 12 Tons/Acre/Year x 0.37 = 4.44 Tons/Acre/Year
Fillslope: 6 Tons/Acre/Year x 0.18 = 1.08 Tons/Acre/Year

Basic Erosion Rate x Road Tread Surfacing Factor

12 Tons/Acre/Year x 1.0 = 12 Tons/Acre/ Year

Product of Above x Traffic/Precipitation Factor

12 Tons/Acre/Year x 2 (Mod. Traff./Active Secondary) = 24 Tons/Acre/Year

Number Acres of **Unpaved Roads** (Assumed Road Width of 30 feet including cut and fill slope x 5,280 ft/Road mile x 7.34 Unpaved Road Miles/43,560 sq.ft/A) x 29 Tons/Acre/Year = **774 Tons/Year**

One Acre of Road (built on Moderately weathered sedimentary rocks) = 30 tons/Acre/Year

Tread: 40% of 30 Tons/Acre/Year = 12

Cutslope/Ditch: 40% of 30 Tons/Acre/Year = 12
Fillslope: 20% of 30 Tons/Acre/Year = 6

Basic Erosion Rate x Cut/Fill Slope Correction Factor For Vegetative Cover

Cutslope/Ditch: 12 Tons/Acre/Year x 0.37 = 4.44 Tons/Acre/Year
Fillslope: 6 Tons/Acre/Year x 0.18 = 1.08 Tons/Acre/Year

Basic Erosion Rate x Road Tread Surfacing Factor

12 Tons/Acre/Year x 0.03 = .36 Tons/Acre/ Year

Product of Above x Traffic/Precipitation Factor

0.36 Tons/Acre/Year x 2 (Mod. Traff./Active Secondary) = 0.72 Tons/Acre/Year

Number Acres of **Paved Roads** (Assumed Road Width of 30 feet including cut and fill slope x 5,280 ft/Road mile x 130 Paved Road Miles/43,560 sq.ft/acre) x 6.24 Tons/Acre/Year = **2949 Tons/Year**

Table 17 shows the estimated amounts of sediment produced by the two road types.

Table 17 – Estimated Soil Loss by Paved vs. Unpaved Road Public Road Surfaces in Lockatong and Wickecheoke Creek Watersheds

Municipality	**Road Surface Soil Loss (Tons/Year)**	
	Paved	Unpaved
Delaware	1188	578
Franklin	389	36
Kingwood	1003	160
Raritan	369	-0-
Watershed Total	2949	774

Source: Roadway Miles - Hunterdon County GIS Data
Unpaved Roadways – Local Municipal Road Superintendents

Figure 10 shows that distribution of private and public roads as well as the location and extent of various road surfaces throughout the watershed.

The sediment contributions are due to not only road surfaces (unpaved roads) and road ditches but also to seasonally applied road sand for improving winter driving safety.
The road superintendents of the four watershed municipalities were surveyed to determine where and how much road sand they use in treating roadways within each town and the amounts were allocated according to the number of road miles maintained in each municipality within the watersheds. There are

approximately 419 tons of sand used in the watersheds per year. Hunterdon County does not use sand for winter road treatment on its roads (Copp, 2006). Table 18 shows the amount of road sand applied by municipality, based on their respective municipal total and the number of road miles within the watershed.

Table 18 – Estimated Annual Road Sand Amounts by Municipality Adjusted by Road Length within the Lockatong and Wickecheoke Creek Watersheds

Municipality	Road Sand Use in Entire Municipality/County (Cubic Yards)	Road Sand Used on Watershed Roads (Cubic Yards)
Delaware Township	60*	30*
Franklin Township	230	101
Kingwood Township	400**	288**
Raritan Township	-0-	-0-
Hunterdon County	-0-	-0-
TOTAL	690	419

Source: Hunterdon County Highway Department
Local Municipal Road Superintendents
* "Grit" – 3/8 inch stone used on unpaved roads only
** Groundup iron slag from Allentown, PA

Figure 10 - Location and Extent of Road Surface Types for Identified Private and Public Roads

Figure 11 - Streambank Erosion on Lockatong Creek at Downstream of Thatcher Road

Construction Sediment Source

A review of information obtained from the State Erosion and Sediment Control Program administered by Hunterdon County Soil Conservation District (Testa, 2007), shows that there is not a significant area of the watershed that is in active soil disturbance due to construction activities (Table 19). This program oversees the development and implementation of soil erosion and sediment control plans for any soil disturbance activity of more than 5000 square feet. Table 20 shows the percent of the actively disturbed sites one acre or less in size represent the largest proportion of sites. There is minimal sediment delivery from construction sites of these sizes due to the relative lack of connection to the existing natural drainage network. As a result of this review, it is concluded that construction activities within this watershed do not have a significant impact on sediment production to the D&R Canal.

Table 19 – Construction Sediment Sources by Municipality

Municipality*	Acres Currently Disturbed**
Delaware	212
Franklin	378
Kingwood	286
Raritan	435
TOTAL	1311

* Municipal totals represent the entire municipality including that portion within the watershed.
** Acres Currently Disturbed represent those acres on which construction activities are currently disturbing the soil.
Source: Chris Testa. 2007. Hunterdon County Soil Conservation District

Table 20 – Construction Sediment Sources by Size of Disturbed Acres

Acres Disturbed	Number of Sites	Percent
</= 1	79	44.9
2-5	53	30.2
6-10	20	11.4
11-20	7	3.9
21-150	17	9.6
-	176	100.0

Source: Chris Testa. 2007. Hunterdon County Soil Conservation District

Sediment Sources from Outside of this Watershed

The Lockatong and Wickecheoke Creek Watershed is approximately 65 percent of the New Jersey influent drainage to the D&R Canal. However, in terms of the daily flow to the Delaware and Raritan Canal, the Delaware River contributes the major part of the flow to the Canal. Localized storm events are more likely to increase the potential for sedimentation from New Jersey tributaries to the D&R Canal. Regional storm events are more likely to increase the potential for sedimentation from the Delaware River Basin to the D&R Canal. Identification of the sources of sediment to the D&R Canal from the Delaware River was not a part of this study, however, these sources may be significant based on the portion of D&R Canal flow derived from the Delaware River source (See Table 21). According to the New Jersey Water Supply Authority (Kratzer, 2007), most River sediments are removed upstream of the Bulls Island Lock, unless the Canal dike is overtopped and inundated with greater River flows.

Table 21 – Relative Streamflow of the Lockatong and Wickecheoke Creeks to D&R Canal Flow on April 26, 2007

Stream	Stream Flow
Delaware & Raritan Canal at Port Mercer, NJ	161
Lockatong Creek	23
Wickecheoke Creek	25

Source: USGS New Jersey Water Science Center, West Trenton, NJ

Summary

Table 22 – Lockatong and Wickecheoke Creek Watershed Sediment Sources and Relative Amounts Delivered to D&R Canal*

Sediment Source	**Estimated Sediment Delivered to D&R Canal (Tons Per Year)**
Cropland	2494
Forestland	355
Roadways	3314
Streambank	248 -12,300

* Does not include the Delaware River Basin sources

According to Patric (1976), the geologic norm for erosion is between 0.18 and 0.30 tons per acre per year which would amount to approximately 10,450 tons of erosion per year or 3,134 tons (33 percent sediment delivery ratio) of sediment yield to the D&R Canal from the Lockatong and Wickecheoke Creek watershed.

As was mentioned in the Literature Review, the documented amount of sediment in the Stony Brook Basin ranged from 25 to 400 tons per square mile. Based on an estimated sediment yield shown in Table 22, this 54.3 square mile watershed has a sediment yield of approximately 118 to 340 tons per square mile which falls into this range.

The estimates made for sediment sources in this watershed were based on modeling. The modeling was done both for the soil erosion process as well as to develop the sediment yield. The relative contribution of sediment from the various sources is highly dependent on the inputs to each of these models. Table 22 shows examples of sediment delivery ratios for various sediment sources.

Table 23 – Sediment Source and the Delivery Ratio

Sediment Source	**Delivery Ratio** (Percentage)
Sheet erosion	33
Gullies	80
Roadbanks	80
Streambanks	100

Source: USDA NRCS, 1983

Table 24 – Relative Soil Erosion Rates and Delivery Ratio for Sediment Sources in Lockatong and Wickecheoke Creek Watershed

Sediment Source	**Relative Soil Erosion Rate**	**Sediment Delivery Ratio (Percent)**
Agricultural Cropland	Low	33
Forestland	Low	33
Roadways	High	80
Streambank	High	100

The annual sediment yield is the product of the annual gross erosion (tons/unit area) and the sediment delivery ratio (less than 1). Many factors influence the sediment delivery ratio and, because these are not uniform from watershed to

watershed, the relationship between sediment yield and erosion varies considerably. Factors influencing the sediment delivery ratio include the sediment source, proximity of sediment sources, transport system, texture of eroded material, depositional area, and watershed characteristics. Table 24 shows the sediment sources and their relative soil erosion rate and their sediment delivery ratio.

Agricultural Phosphorus Sources

Sources of contamination of freshwater by phosphorus can come from a number of agricultural sources including inorganic fertilizers, animal manures and others. Wildlife wastes have been identified as a contributing factor to excessive nutrients and pathogens causing water quality problems in some areas of the country.

Animal Waste

Animal waste, when it is improperly managed, can be a source of phosphorus to surface water in a watershed. The potential for agricultural animal waste is shown by reviewing the trends in animal numbers from Farmland Assessment data for the four municipalities (Delaware, Franklin, Kingwood and Raritan Townships) in the watershed over the past twenty years (Table 19). In nearly all categories there has been a downward trend in terms of number of animals.

The local Natural Resources Conservation Service office indicates that there are no Environmental Quality Incentives Program (EQIP) contracts/plans and that there are no comprehensive nutrient management plans (CNMP) in this watershed. Existing soil and water conservation plans are for two individual farm operators who each rent approximately 1000 acres of land in this watershed. Approximately 70 percent of the tillable land in this watershed is rented to farm operators (Bartok, 2005). Generally, the plans address crop rotation, minimum tillage, and nutrient and pest management. Also the plans include some hay planting.

Table 24 - Trends in Agricultural Animals in Lockatong and Wickecheoke Creek Watersheds Vicinity Municipalities (1983 - 2004)

Tax Year	Beef Cattle	Dairy	Equine	Sheep	Swine
1983	3407	2252	1252	2181	1640
1984	NA	NA	NA	NA	NA
1985	2534	1540	1360	1902	1412
1986	NA	NA	NA	NA	NA
1987	2604	1574	1619	2071	1839
1988	2595	1680	1363	2020	1344
1989	1348	1117	1150	1284	1154
1990	1480	888	1258	2092	1428
1991	1574	1064	1170	1965	1586
1992	1804	759	1285	1949	1164
1993	1640	1000	1121	1657	1356
1994	1863	820	1141	2086	799
1995	1886	698	1219	1962	1084
1996	1923	673	1209	1949	1000
1997	1714	721	1240	2042	793
1998	1501	518	1199	2106	843
1999	1436	516	1185	1988	971
2000	1249	510	1144	1802	850
2001	984	171	1373	1669	702
2002	1027	183	1644	1696	734
2003	1152	189	1532	1429	722
2004	1050	90	1411	1424	707

Source: New Jersey Farmland Assessment Data 1983 - 2004
NA – Data Not Available

Wildlife

Wildlife have been identified, mostly in anecdotal fashion, as a contributing factor to excessive nutrients and pathogens causing water quality problems in some areas of the country. Canada geese and white-tailed deer have been identified as possible contributors to excess phosphorus in the watershed.

Resident Canada goose populations have been increasing for several decades. Resident goose numbers increased dramatically from a statewide population of about 50,000 in 1990 to about 100,000 in 1998 according to the NJ Div. of Fish & Wildlife. Liberal hunting seasons and bag limits have been instituted in recent years to try to control the rapidly expanding resident goose population. The

population is reported to be relatively stable at about 95,000 birds statewide since 2000. The population estimate for the Piedmont Region of New Jersey is about 30,000 – 40,000 resident Canada geese (T. Nichols, Personal Communication). Local resident geese congregate on open water bodies such as large farm ponds, lakes and reservoirs. In addition geese may feed in large numbers on waste grains in crop fields and grasses in large closely mowed open grass fields (ball fields, golf courses, corporate lawns). The University of Missouri (*The Water Line* – Univ. Missouri 1997) reports that each individual Canada goose dropping can include up to .016 grams of phosphorus, geese can produce up to 28 droppings per day with an equivalent of 163 grams of phosphorus (.36 pounds) annually. Much of this watershed is forested, urban or agricultural operations not attractive to Canada geese. Some cropland, wetlands and water bodies would provide suitable habitat for resident geese. It would be difficult to determine the Canada goose contribution of phosphorus to the watershed without additional detailed local goose population investigation.

White-tailed deer are managed by the NJ Division of Fish and Wildlife in discrete units called Deer Management Zones (DMZ's). The Lockatong and Wickecheoke watersheds are entirely with in DMZ's 10 and 11. Table 20 shows deer population estimates for those DMZ's since 2000. New Jersey deer harvest regulations represent some of the most liberal in the nation with hunters able to legally harvest almost unlimited number of deer if all seasons are hunted and multiple permits are purchased. Deer population estimates for the two DMZ's that make up this watershed indicate a downward trend in deer density. Deer also only represent one wildlife species of many in the watershed. Other mammals, birds, reptiles and amphibians are abundant throughout the watershed and may indeed contribute more phosphorus than deer. With an overall deer population estimate of about 50 deer per square mile, the 54 square mile Lockatong and Wickecheoke watershed could include about 2700 deer. With an average deer weight of 100 pounds it takes 10 deer to make one animal unit (1000 lb). The 2700 deer represent 270 animal units spread out over the entire 35,000 acre watershed and deer droppings should not represent a significant contribution to phosphorus.

Table 25 - Trends in White-tailed Deer Densities in Deer Management Zones 10 and 11 that include the Lockatong and Wickecheoke Creek Watersheds (2000 - 2005)

Year	**Deer Density (Deer/Square Mile)**			
	Zone 10	**5 Year Average**	**Zone 11**	**5 Year Average**
2005	48.1	58.6	45.2	43.3
2004	42.7	59.5	34.1	42.8
2003	65.5		40.5	
2002	69.9		48.1	
2001	66.7		48.7	
2000	52.9		42.6	

Source: C. Kandoth, Personal Communication

Cropland Runoff

A potential source of phosphorus in surface water is agricultural cropland runoff.

Phosphorus Index

The Phosphorus Index is a method to evaluate the relative risk of surface water impacts from the phosphorus contained in land applied organic wastes. The Index operates on a field specific basis. It is important to remember that the Phosphorus Index is a general assessment tool that has limitations, and should be viewed as such. This tool is intended to help in the selection of management alternatives that can reduce the probability of phosphorus impacting water resources. Any attempt to use this tool as a regulatory method is beyond its scope and purpose.

The Phosphorus Index includes two separate methodologies: one for typical crop production systems and one for systems utilizing raised beds and plastic mulch. The reason for this is the unique runoff characteristics of the latter. The Phosphorus Index for a raised bed-plastic mulch crop system is completely independent from the Phosphorus Index for typical crop production systems and stands alone.

Table 25 shows that within each methodology, a series of site characteristics critical to potential phosphorus loss are listed down the left column, with weighting factors in parentheses. Site characteristics that are critical to potential phosphorus loss include the soil erosion, soil runoff class, distance of the phosphorus application edge from surface water, soil test phosphorus values and phosphorus application method for both organic and inorganic sources. The relative risk factors for each are listed across the top with multipliers in parentheses. The score for each site characteristic is obtained by multiplying the weight factor by the risk factor.

Table 26 shows the methodology for computation of the site characteristic factor B soil runoff class.

The Phosphorus Index was applied to the same sample of the 1500 fields used in the sheet and rill erosion analysis earlier in this report. This amounted to approximately 300 fields in this 20 percent sample. The results of this analysis are shown in Table 28.

Buffer Distance Analysis for the Selected Cropfields

The Natural Resources Conservation Service initially estimated the annual soil loss on a 20 percent sample of fields of the total of approximately 1500 fields in

the watersheds. A multi-ring analysis to determine the Site Characteristic C. The distance of phosphorus application from surface water was determined by using geographic information system technology. The results of this analysis for all of the approximately 1500 fields in the watershed are shown in Table 27.

Table 26 - New Jersey Phosphorus Index for Typical Crop Production Systems

Site Characteristic	None (0)	Low (3)	Medium (5)	High (10)	Very High (20)	Score
A. Soil Erosion (1.5)	<1 ton/ac/yr	1-5 tons/ac/yr	6-10 tons/ac/yr	11-15 tons/ac/yr	>15 tons/ac/yr	
B. Soil Runoff Class* (1.0)	Negligible	Very low or low	Medium	High	Very High	
C. Distance of P application edge from surface water (1.5)	>250 ft.	100-250 ft	50-99 ft	20-49 ft	<20 ft	
D. Soil Test P Rutgers values (1.5)	Very Low (Below optimum)	Low (Below optimum)	Medium (Below optimum)	High (Optimum)	Very High** (Above optimum)	
E. Phosphorus Application Method: Both organic and inorganic sources (1.0)	None applied	Placed with planter deeper than 2 inches; or injected deeper than 2 inches; or applied and incorporated less than 7 days before planting crop	Applied and incorporated 7 days – 3 months before planting crop; or surface applied to hayland during the growing season	Applied and incorporated> 3 months before planting crop; or surface applied < 3 months before planting crop; or surface applied to hayland outside of the growing season; or surface applied to good pasture (70% or more living cover)	Surface applied to overgrazed pasture with less than 30% living cover; or surface applied without incorp. >3 months before planting crop	

* See Soil Runoff Class Designation

** Where soil test lab results indicate P levels in the very high range where no additional P is recommended for crop growth purposes, P may still be applied in the organic (manure/compost) form in accordance with the recommendations of this Index without known environmental problems. However, there may be nutrient-plant-animal interaction consequences thus suggesting avoiding additional P applications in both fertilizer and manure sources.

Table 27 - Soil Runoff Class Designation: for Use in Phosphorus Index, Site Characteristic B

Slope %	EFH Ch. 2 Curve Number <50	EFH Ch. 2 Curve Number 51-60	EFH Ch. 2 Curve Number 61-70	EFH Ch. 2 Curve Number 71-80	EFH Ch. 2 Curve Number >80
<1	Negligible	Negligible	Negligible	Negligible	Very Low
1-2	Negligible	Negligible	Very Low	Very Low	Low
3-5	Negligible	Negligible	Low	Low	Medium
6-8	Very Low	Very Low	Medium	Medium	High
9-16	Very Low	Low	Medium	High	Very High
>16	Low	Medium	High	Very High	Very High

EFM Ch. 2 – NRCS Engineering Field Handbook Chapter 2

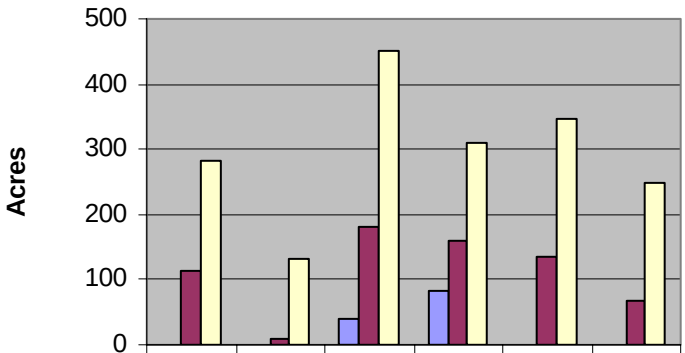
Table 28 - Phosphorus Application Distance from Surface Water

Phosphorus Application Distance (Feet)	Number of Fields	Percent of Fields
>250	847	56.5
100-250	175	11.8
50-99	104	6.7
20-49	140	9.3
<20	234	15.7
-	1500	100.0

Table 29 – Phosphorus Application Distance from Surface Water and Phosphorus Index by Field

Phosphorus Index / Phosphorus Application Distance (Feet)	Phosphorus Index <30	Phosphorus Index 30 - 50	Phosphorus Index >50
<20	1	32	11
20-49	3	58	14
50-99	25	67	14
100-250	55	74	14
>250	182	8	0

Figure 12 – Phosphorus Index by Acres and Subwatershed



	Upper W	Middle W	Lower W	Upper L	Middle L	Lower L
>50	0	0	39	84	0	0
30-50	113	10	181	160	135	67
<30	283	133	452	311	346	250

Phosphorus Index Designation

>100 Very High Potential for P Loss – Very high potential for P movement from this site given current management practices and site characteristics. No additional phosphorus should be applied to this site. Active remediation techniques should be implemented in an effort to reduce the P loss potential from this site.

51-100 - High Potential for Phosphorus Loss – High potential for P movement from this site given current management practices and site characteristics. Phosphorus-based nutrient management planning should be used for this site. Phosphorus application should be limited to crop removal of P, or soil test based P recommendations. All practical management practices for reducing P losses by surface runoff, subsurface flow, or erosion should be implemented.

30-50 - Medium Potential for Phosphorus Loss – Medium potential for P movement from this site given current management practices and site characteristics. Nitrogen-based nutrient management planning is satisfactory for

this site. However, resultant phosphorus applications should not exceed 1.5 times the P amount to be removed by the crop. Practices should be implemented to reduce P losses by surface runoff, subsurface flow, and erosion.

<30 - Low Potential for Phosphorus Loss – Low potential for P movement from this site given current management practices and site characteristics. There is a low probability of an adverse impact to surface waters from P losses from this site. Nitrogen-based nutrient management planning is satisfactory for this site. Soil P levels and P loss potential may increase in the future due to N-based nutrient management.

Table 30 - Phosphorus Index Analysis Results for Selected Cropland Sample

Phosphorus Index	Number of Fields	Percent of Fields
>100	0	0.0
51-100	9	3.0
30-50	71	23.6
<30	221	73.4
TOTAL	301	100

Table 29 shows the results for the number and percent of the sampled cropfields in terms of their phosphorus index. The range of phosphorus index values is from 12.5 to 67.5 with a mean of 24.7.

Conclusions

The Natural Resources Conservation Service staff has made multiple visits to the watersheds to view and analyze the status and trends of land use and management as it relates to the identified problem: sediment in the D&R Canal. As previously stated, this analysis did not evaluate sediment sources, which may be significant, from the Delaware River Basin, however, it is believed that most River sediments are removed upstream of the Bulls Island Lock, unless the Canal dike is overtopped and inundated with greater River flows (Kratzer, 2007).

The Revised Universal Soil Loss Equation (RUSLE) model used above, shows that sheet and rill erosion due to agricultural land use contributes a relatively low amount of sediment. In fact, soil erosion for the vast majority of agricultural cropland is well within acceptable levels for the management of the soil resource. Protection of the water resource may require additional best management practices other than those normally used for the protection of the soil resource.

Based on the scientific literature for similar watersheds in the Piedmont Plateau reviewed above, it seems highly likely that stream channel erosion and its associated sediment yield are higher than was identified here. Further it seems highly likely that legacy sediments from past (not current) agricultural practices are contributing a significant portion of sediment to the D&R Canal. Episodic

events, such as Hurricane Floyd (1999) and Hurricane Ivan (2004), have moved massive amounts of sediment from the Delaware River directly into the D&R Canal. These events have also accelerated channel erosion along the main stem and tributaries in these watersheds.

Roads and their associated drainage network were evaluated using a model in use in Washington state. GIS technology identified the location and extent of the public and private road network and its impact on increasing the effective drainage of the watershed. Sediment originating from the road system and its associated drainage network is considered to be a significant sediment source as a result of its connectivity to the natural drainage network and ultimately the D&R Canal.

Agricultural Cropland and Forestland Erosion

The earlier studies done by NRCS and EBASCO suggest that cropland erosion in these watersheds was much greater than it is today. This is the result of much greater acreages of tilled crops such as corn and soybeans in these watersheds in 1987 vs. today. As a result of field observations and analysis of the current cropland sheet and rill erosion, it is concluded that sheet and rill erosion from agricultural cropland is not a major source of sediment to the Canal.

Additionally, the analysis of another land use, forestland, has determined that sheet and rill erosion from forestland does not significantly contribute to the stream sediment load. The relative contributions of these land uses could change in an upward direction if, due to market conditions, the type of tillage practices and intensity of cropping were to change on agricultural cropland or an increased amount of logging were to take place on forestland. Currently, the trends in the intensity of use for agricultural and forested lands here do not appear to be increasing the sediment source risk.

Agricultural Surface Water Practice Outlet Erosion

Field observations and aerial photo interpretation have identified a number of crop fields, particularly in the lower part of the Wickecheoke Creek watershed, that have had gradient diversion and/or terrace systems installed to control runoff on these fields. These practices are often as much as 50 years old. These practices when originally built, often with technical assistance from the Natural Resources Conservation Service, were to have “level lip spreaders” areas to convey surface runoff at a non-erosive velocity to the outlet. Unfortunately, over time, these areas have not been maintained. These practices often outlet into outlets which, over time, have become degraded due to the volume and velocity of runoff being directed to them. These outlets can be along property line hedgerows, field boundaries and other unprotected areas. As a result of the

concentrated runoff being outletted into these areas significant gully erosion may be present. This gully erosion may be a significant contributor of sediment.

Over time, the technology for controlling cropland surface water runoff has changed from gradient structures to underground outlet structures which can better store and release surface water runoff from a crop field at a safer volume and velocity. Also, in many cases, the original purpose for the practice has changed. For example, corn, soybeans or other cultivated crops may no longer be grown on a field but rather the field is in permanent hay. These type of cropping or other tillage changes may eliminate the need for these practices. While these eroding outlet conditions may have been significant sediment sources at one time, this is no longer the case, especially when considered relative to other sediment sources.

Stream Corridor Erosion

In addition, another significant sediment source is stream corridor erosion resulting from streambank erosion and streambed erosion. This source has been exacerbated by recent episodic events such as Hurricane Floyd (1999) and Hurricane Ivan (2004) and other higher intensity precipitation events and the average annual precipitation in New Jersey during the 1971-2000 period to the present being nearly three inches greater than the period of record (1895-2006) (Robinson, 2007). Stream corridors also are likely to carry the vestiges of the legacy sediments from the previously high sheet and rill erosion from agricultural cropland.

Roadways and their Associated Drainage System

Water, when it is relatively free of sediment, acts as a “pollutant” in trying to dissipate its energy it will tend to pick up sediment. The road network and its associated drainage system is identified as a significant contributor to sediment to the Lockatong and Wickecheoke Creeks and ultimately to the Delaware and Raritan Canal. The road network, as it is discussed here, includes both public and private roads. There are several reasons for the road network and its associated drainage system to be so identified and they include the increase in the volume and rate of runoff, as well as the greater efficiency of sediment delivery to the outlets of the watersheds, on this land use. This is particularly true where road runoff is channeled through large culverts that outlet onto unprotected slopes directly into streams as well as at a number of road way stream crossings. The current trends in this land use are to increase water removal efficiency (paving of formerly unpaved roads) and to increase in the number of acres in this land use predominantly through the widening of existing public roads and the development of private roads.

Construction Erosion

A review of information obtained from the State Erosion and Sediment Control Program administered by Hunterdon County Soil Conservation District (Testa, 2007), shows that there is not a significant area of the watershed that is in active soil disturbance due to construction activities. The percent of the actively disturbed sites one acre or less in size represent the largest proportion of sites. There is minimal sediment delivery from construction sites of these sizes due to the relative lack of connection to the existing natural drainage network. It is concluded that construction activities within this watershed do not have a significant impact on sediment production to the D&R Canal.

Recommendations

(See Executive Summary for Prioritized Recommendations)

Institutional and Further Study

- Develop and implement an on-going information, technical assistance and cost sharing program for all property owners in the watersheds to implement best management practices.

- Install signage as the public enters the watersheds indicating that the watersheds are a water supply area. Studies have shown that watershed signage incrases awareness in terms of identification of local watersheds as well as behaviors and actions that impact local water quality (Ellwood, 2003).

- Acquire conservation easements from property owners and require implementation of a forest management plans that have a primary objective of clean and abundant water.

- This study has been heavily dependent on modeling to develop estimates of the sources of sediment to the D&R Canal. It is recommended that a "fingerprinting" study using radioisotopes be made to more accurately determine the sources of sediment.

Cropland

- Require the development and implementation of a soil and water conservation plan for resource management systems for all farmland assessed property in the watershed.

- Require a conservation lease on all rented agricultural land that is at least five years in length and renewable at least a year in advance of termination and provide compensation on a pro-rated basis including conservation practices and soil amendments.

- Retrofit existing gradient diversion and terrace systems where these are causing severe gully erosion at their outlets particularly where cropping and tillage practices obviate their need. Stabilize eroded former surface water runoff outlets. Any new diversion or terrace systems must try to maximize storage and outlets should be to stable outlets where they will not result in new erosion.

- Install underground outlet gradient diversion and terrace systems, where existing cropping and tillage practices require surface water runoff control.

- Improve water infiltration into the soil on existing hay land by various measures including avoiding agricultural field operations that increase soil compaction, increasing soil organic matter, and others.

- Install permanent buffer strips on the approximately 32 percent of the cropland with a distance of 100 feet or less between the cropland and stream corridors using such programs as the Conservation Reserve Enhancement Program (CREP).

- Install conservation systems on the approximately 7 percent of the fields that are identified as having soil losses over the T value.

Forestland

- Require the development and implementation of a forest management plan for farmland assessment that includes practices for water quality and quantity as well as species richness and diversity of tree age and size class in addition to forest stand improvement. Measures may include:

    - Micro-topography restoration for surface water storage
    - Better deer management to protect understory and groundcover for reduced phosphorus and nitrogen runoff

- Identify and preserve old-growth forest as an important record and benchmark for soil and vegetation changes over time.

Stream Corridor and Floodplains

- Modify stream corridor to reduce the “conveyor belt” movement of sediment, cobbles and other rubble downstream toward the D&R Canal. The “conveyor belt” refers to the fact that material moves downstream incrementally and is highly dependent on the volume of streamflow. Measures may include:

    - Instream placement of measures to slow down and impede the above Movement
- Implement the most environmentally friendly streambank stabilization techniques possible to protect eroding streambanks near roads, bridges and homes. This may include soil bioengineering systems utilizing native plant materials and low volumes of rock with practices such as stone toe protection and rock stream barbs.
- Plant willows and grasses, where there is sufficient sunlight, to provide closer cover of soil that can lay down during flood events

Roadways and Associated Drainage System

- Install measures to reduce the volume and velocity of surface water runoff to stream corridors from roadways. Measures should include the relocation of outlets and manner of conveyance of road surface water runoff that is currently disposed of through road culverts over steep slopes into streams or steep road gradients near road stream crossings. Measures may include:

    - Conveyance measures including stone-center waterways and underground outlets

    - Outlets to include protected outlets or sediment basins.

Pasture Land and Exercise Lots

- Exclude all livestock from stream corridors leaving a buffer area to intercept any animal waste runoff toward the stream.

- Separate exercise lots from pasture land.

- Practice rotational grazing and provide livestock adequate water so as to enhance water infiltration in soil and vegetation quality for livestock needs.

- Implement pasture management practices to minimize accumulation and runoff of animal waste.

- Improve water infiltration into the soil on existing pasture land by various measures including avoiding agricultural field operations that increase soil compaction when conditions are wet, increasing soil organic matter, and others.

- Exclude all clean water from stockpiled animal waste and dispose of animal waste by recycling in the soil on cultivated land.

Rural Residential Land

- Minimize footprint and disturbed area of house and preserve all other topography and vegetation of the site.

- Minimize driveway length and nature of treatment (unpaved better than paved).

- Practice regular septic system maintenance with pumping done at a minimum of once every three years.

- Install raised beds on the contour and provide depressional rain garden to slow runoff.

Natural Resources Conservation Service Personnel

Name	Title	Years of Service
Gail Bartok	District Conservationist	20
Gary Casabona	GIS Specialist	10
Tim Dunne	Biologist	26
Kent Hardmeyer	Resource Conservationist	38
Fred Kelly	Resource Conservationist	26
David Lamm	State Conservation Engineer	28
Max Olynyk	Geologist	30
ShayMaria Silvestri	GIS Specialist	10
Ron Taylor	State Soil Scientist	37
Chris Smith	State Resource Conservationist	27
Gregory Westfall	Water Resource Planner	34

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