Watershed Based
Municipal Stormwater Management Plan

Clayton Borough

prepared for

Gloucester County Improvement Authority

on behalf of

Gloucester County Board of Chosen Freeholders
and
Clayton Borough

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MAURICE RIVER WATERSHED

Section 1. Introduction

All New Jersey municipalities were required in early 2004 to obtain a NJPDES Municipal Stormwater General Permit for control of their stormwater discharges. The Gloucester County Board of Chosen Freeholders, through the Gloucester County Improvement Authority (GCIA), is committed to working with all of the municipalities in Gloucester County to cost-effectively accomplish the new stormwater management permit program's goals.

To that end, the GCIA has undertaken watershed-based municipal stormwater management planning throughout the County, and has prepared a Watershed Based Municipal Stormwater Management Plan (MSWMP) for Clayton Borough that includes both municipal and watershed stormwater management information and evaluations. The location of Clayton Borough, in relationship to the eight major watersheds in Gloucester County, is shown on Figure 1.

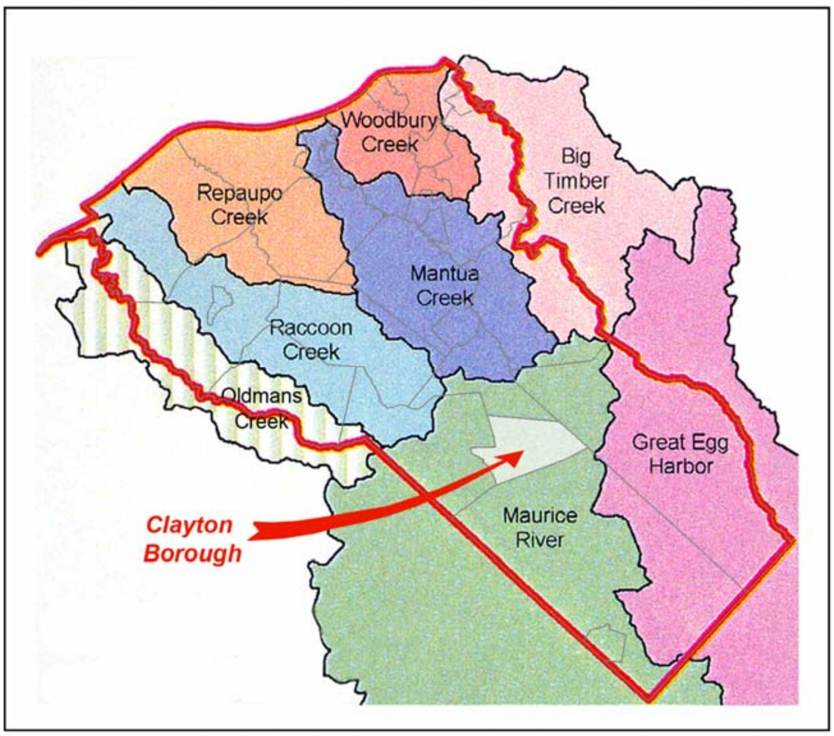
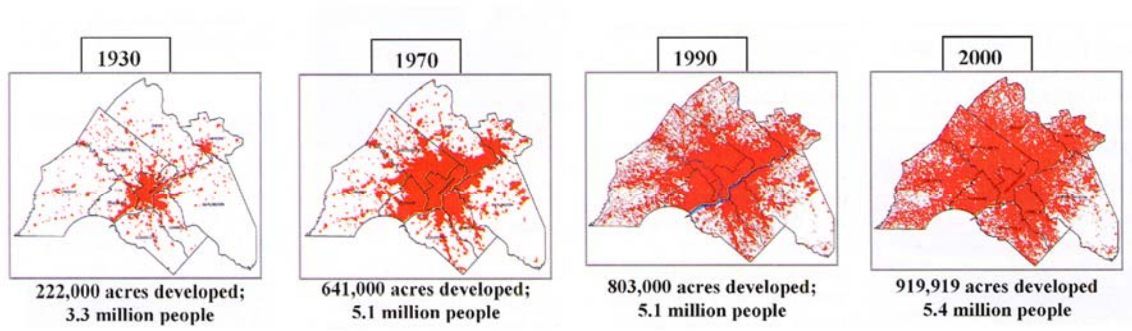


Figure 1. Clayton Borough and Gloucester County Watersheds

The NJDEP's new Stormwater Management Rules in N.J.A.C. 7:8 have been developed to address the adverse impacts that unmanaged land development can have on groundwater recharge and stormwater runoff quality and quantity. Figure 2 shows the expansion of development within the Delaware Valley during the 70 year period from

1930 through 2000. Along with this development has come a corresponding increase in stormwater runoff, and increased impacts associated with non-point source pollution.



Source: DVRPC

Figure 2. Delaware Valley Development Patterns (1930 – 2000)

The Clayton Borough MSWMP was prepared as part of Gloucester County's Stormwater Management Program. The Sample Municipal Stormwater Management Plan included in Appendix C of the New Jersey Stormwater Best Management Practices Manual, dated February 2004, was utilized as a template for preparation of the plan.

The MSWMP provides strategies for Clayton Borough to follow in addressing stormwater management. The plan is required by N.J.A.C. 7:14A-25, the Municipal Stormwater Regulations, and contains the elements required by N.J.A.C. 7:8, the Stormwater Management Rules.

The MSWMP addresses groundwater recharge and stormwater quantity and quality, by incorporating the stormwater design and performance standards for new major development (defined as projects that disturb one or more acres of land or increase the amount of impervious surface by one-quarter acre or more). These standards are intended to minimize the adverse impact of stormwater runoff on water quality, and to address water quantity and the loss of groundwater recharge that provides base flow in receiving water bodies.

The MSWMP also includes:

- Long-term operation and maintenance measures for stormwater facilities associated with new major development projects.
- A "build-out" analysis that is based upon existing zoning and the land available for development.
- Changes that should be made to existing ordinances, the Master Plan, and other municipal land use planning documents, in order to allow various low impact development techniques.
- Mitigation strategies for variances or exemptions from the design and performance standards, including the implementation of specific mitigation projects to offset the effects of such variances or exemptions.

Section 2. Goals

The Clayton Borough MSWMP goals are:

1. The reduction of flood damage, including damage to life and property.

2. The minimization, to the extent practical, of increases in stormwater runoff from new development.

3. The reduction of soil erosion from construction activities.

4. The insurance of adequate stormwater facilities, including culverts, bridges, and other in-stream structures.

5. The maintenance of groundwater recharge.

6. The prevention, to the extent feasible, of non-point stormwater pollution.

7. The maintenance of surface waters to ensure their biological and stormwater management functions, including the restoration, enhancement, and maintenance of their chemical, physical, and biological integrity, in order to protect public health and safeguard aquatic life; the preservation of their scenic and ecological values; and the enhancement of their domestic, municipal, recreational, industrial, and other uses.

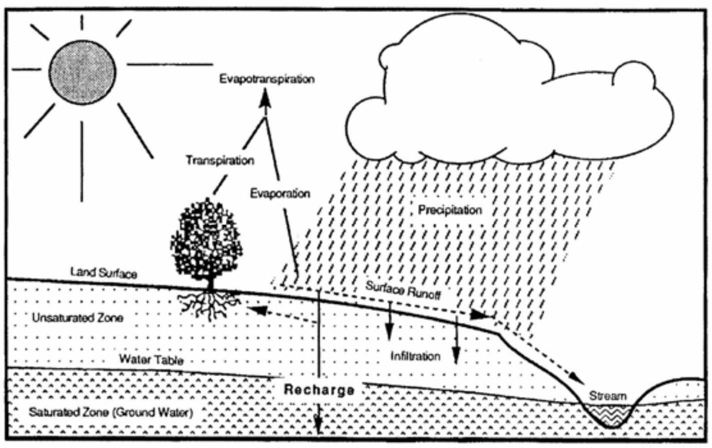
8. The protection of public health and welfare, through the planning, engineering, operation and maintenance of stormwater systems.

The MSWMP outlines specific stormwater standards for new development and proposes stormwater management controls that address impacts from existing development. Preventative and corrective maintenance strategies are included to ensure the long-term effectiveness of stormwater management facilities. The MSWMP provides recommendations for stormwater systems to protect the public health and welfare.

This watershed-based MSWMP includes a discussion of both Clayton Borough and its watershed(s). Land use, zoning, impervious surfaces, and pollutant loadings were evaluated using a Geographic Information System. These efforts provide an initial understanding of surface water quality in the County's watersheds, and establish a basis for evaluating the impacts of future land use and zoning decisions.

Section 3. Stormwater and Development

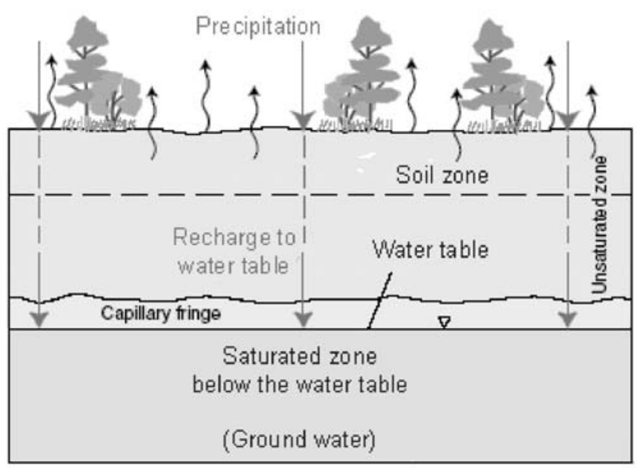
Water moves continuously through the hydrologic or water cycle (see Figure 3). Water evaporates from water bodies and the earth's surface and transpires from vegetation into the atmosphere (these components of the water cycle are jointly referred to as



Source: New Jersey Geological Survey Report GSR-32.

Figure 3. Groundwater Recharge in the Hydrologic Cycle

evapotranspiration). Water vapor in the atmosphere condenses to form clouds which produce precipitation that falls to the earth's surface. A small percentage of this precipitation falls over the land and runs off into streams and lakes flowing to the oceans.



Source: US Geological Survey

Figure 4. Subsurface Water

However, most of the precipitation that falls on land surfaces infiltrates into the ground (see Figure 4), where it either recharges shallow groundwater table aquifers and discharges to streams and springs, sustaining their base flow, or seeps into deeper confined aquifers, where it is stored for long periods and discharges regionally (see Figure 5). Human activities and development of the land can interfere with the natural water cycle, and in doing so, impact a watershed in many ways.

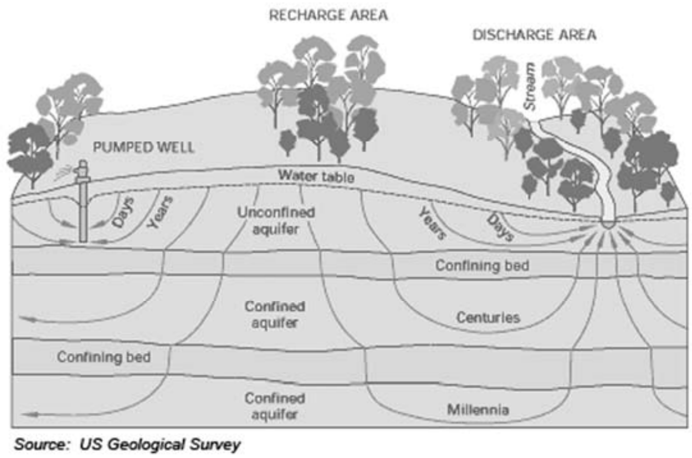


Figure 5. Groundwater Flow Paths

Development can remove beneficial vegetation; replacing it with lawns or impervious cover, thus reducing evapotranspiration and infiltration. Clearing and grading removes depressions that store rainfall and encourage infiltration. Construction activities can also compact the soil and diminish infiltration, resulting in increased volumes and rates of stormwater runoff.

Conversely, increased impervious areas that are connected to each other through gutters, channels, and storm sewers transport runoff more quickly than natural areas. Shortening runoff travel time increases the rainfall-runoff response in the watershed, causing flow in downstream waterways to reach peak rates faster and water levels to increase above natural conditions. These conditions aggravate downstream flooding and erosion and increase the quantity of sediment in stream flow and deposited in stream channels. Impervious areas and storm sewers reduce the potential for surface vegetation to filter and remove pollutants from runoff.

Increased impervious area from land development can also decrease infiltration, and in turn, reduce stream base flow and groundwater recharge. Reductions in stream base flow can dry up habitat in stream channels and adjacent wetlands, and in so doing, adversely impact the health of important biological communities that reside in or depend upon these stream channels and wetlands. Increased impervious area can also increase peak stream flow, channel erosion, and sedimentation and thus can destroy aquatic habitat.

Land development can result in the addition and accumulation of pollutants on the land surface. Runoff and infiltration can mobilize and transport these pollutants to groundwater and streams. Surfaces and cleared areas within a development can receive a variety of pollutants from the atmosphere and from runoff over land surfaces that mobilizes fertilizers, animal wastes, and leakage and corrosion from vehicles. The pollutants may include suspended and dissolved solids containing metals, nutrients and other inorganic compounds; hydrocarbons, pesticides, herbicides and other organic compounds; and pathogens--all of which can become mobilized by precipitation falling on the land.

Land development can also adversely affect water quality and stream biota in subtle ways. Runoff stored in detention or retention basins can become heated, raising the temperature of the downstream waterway and adversely affecting cold water aquatic species, such as trout, and by providing conditions that support unwanted aquatic species. Additionally, development may remove trees along streams or cause stream bank instability that undermines nearby trees. These trees are valuable because they provide shade that maintains cooler water temperatures and increased dissolved oxygen levels during critical summer periods. Trees also help stabilize stream banks, preventing bank erosion, and their leaf litter provides habitat and food for aquatic communities.

Section 4. Background

CLAYTON BOROUGH

Clayton Borough is located in central Gloucester County (see Figure 1). The Borough's characteristics, as they relate to the stormwater management planning goals described in Section 2, are discussed in this background section of the MSWMP.

Zoning and Existing Land Use

Clayton Borough is unique among the 24 municipalities in Gloucester County, for several reasons. In terms of both total area and land area (see Table 1), it is a relatively small sized municipality in Gloucester County.

Table 1. Clayton Borough Area

	Area (sq. mi.)
Total Area	7.35
Land Area	7.18
Water Area	0.17

With its small land area, its location between Philadelphia and the New Jersey Shore, and its major highway access (in particular, Routes 47 and 55), it is likely that Clayton Borough will someday experience significant development pressures. However, more than one-third of the small Borough is comprised of wildlife management areas, lakes and parks.

The existing zoning within the Borough is shown on Figure 6, and the existing land use, based on the NJDEP GIS Land Cover analysis, is shown on Figure 7. The population of Clayton Borough grew slowly but steadily from 1990-2003. As a result, an increase in residential development was seen as well. As shown on Figure 6, a substantial portion of the central region of the Borough is zoned for Community Facilities/Industrial use, with the balance of the Borough's zoning quite fractured. As a result, roughly 50% of the Borough's land area is comprised of medium and high density residential use, with the remaining 50% comprised of mixed urban, agricultural and industrial uses.

The rate of development in Clayton Borough has increased significantly in recent years; however, the projected build-out development in the Borough is still many years away, given its geographic location, its size, and the amount of undeveloped land.

Figure 6. Zoning

Figure 7. Land Cover

Population and Housing

The population of Clayton Borough (see Table 2) is the 11th largest total population in Gloucester County. Table 2 provides the urban population and rural population (if any) breakdown. With respect to housing, the Borough also has the 11th largest number of total housing units in Gloucester County and the number of urban and rural housing units (if any) are shown (see Table 2).

Clayton Borough is one of only 13 municipalities in the County with housing units classified as rural.

Table 2. Clayton Borough Population and Housing (Year 2000)

	Population	Housing Units
Total	7,139	2,680
Urban	6,284	2,361
Rural	855	319

Source: U.S. Census Bureau

Clayton Borough is 13th of 24 municipalities in Gloucester County in terms of population density.

Table 3. Clayton Borough Population Density (1990 – 2003)

	Population	Population Density (persons/sq. mi.)
1990	6,166	859
2000	7,139	994
2003	7,157	997

Source: U.S. Census Bureau and N.J. Department of Labor

Clayton Borough has been one of the moderate growing municipalities in Gloucester County in recent years. Between 1990 and 2000, Clayton Borough experienced a 16 percent growth and the estimated growth from 2000 to 2003 is less than 1 percent (see Table 4).

Table 4. Clayton Borough Population Growth (1990 – 2003)

	Population	Population Change	Percent Growth
1990	6,166		
2000	7,139	973	16
2003	7,157	18	<1

Source: U.S. Census Bureau and N.J. Department of Labor

The Delaware Valley Regional Planning Commission (DVRPC) projects Clayton Borough to grow by 3,066 people over the 30-year period from 2000 to 2030 (see Table 5), with an overall growth of 42.9 percent during those three decades.

Table 5. Clayton Borough Projected Population Growth (2000 – 2030)

	Population	Population Change	Percent Growth
2000	7,139		
2010	8,440	1,301	18.2
2020	9,330	890	10.5
2030	10,205	875	9.4

Source: DVRPC

Surface Water

(a) Watersheds and Hydrologic Unit Codes (HUCs)

There are eight major Watersheds within Gloucester County. Each of these Watersheds and their land areas within the County are shown in Table 6. Also shown in Table 6 is a two character identification code used in this report to identify data tables and figures related to the individual watersheds.

Table 6. Watersheds Within Gloucester County

ID	Watershed	Area (acres)
BT	Big Timber Creek	12,925
GE	Great Egg Harbor River	36,997
MC	Mantua Creek	32,099
MR	Maurice River	47,177
OC	Oldman's Creek	14,558
RA	Raccoon Creek	31,822
RE	Repaupo Creek	26,222
WC	Woodbury Creek	13,787
		215,587

Clayton Borough is within one of these major watersheds, as shown in Table 7.

Table 7. Clayton Borough Watersheds

ID	Watershed	Area (acres)
MR	Maurice River	4,751.51

The NJDEP requires that municipalities evaluate the impacts of their small municipal separate storm sewer systems (small MS4s) on surface waters at the HUC14 sub-watershed level (these watershed and sub-watershed divisions were developed by the United States Geological Survey (USGS) using a coding system called Hydrological Unit Codes, or HUCs).

Figure 9 shows the HUC14s located partially or entirely within the municipal boundaries of Clayton Borough. The names of the HUC14s are shown in Table 8.

(b) New Jersey Surface Water Quality Standards

The Federal Clean Water Act requires that states maintain surface water quality in high quality waters and restore water quality in impaired waters. Surface Water Quality Standards (SWQS) have been developed by the NJDEP (and Delaware River Basin Commission (DRBC) for the Delaware River) to accomplish this goal. These standards establish "designated uses" to be achieved for surface water bodies and specify the water quality criteria necessary to achieve these uses.

Designated uses established by the NJDEP for New Jersey water bodies include potable water supply (drinking water use), propagation of fish and wildlife (aquatic life use), recreation in and on the water (primary and secondary contact), agricultural and industrial supplies, and navigation. The NJDEP has established stream classifications and antidegradation designations for all of the state's surface water bodies. New Jersey's Water Quality and Monitoring Standards homepage can be found at the following link:

http://www.state.nj.us/dep/wmm/

The Surface Water Quality Standards can be found in N.J.A.C. 7:9B at these links:

http://www.state.nj.us/dep/wmm/sgwqt/swqsdocs.html
http://www.state.nj.us/dep/wmm/sgwqt/sgwqt.html.

In addition, because the Delaware River is an interstate water body, the Delaware River Basin Commission (DRBC) has established interstate zones, designated uses for each zone, and water quality standards to achieve the designated uses along the entire length of the river. Gloucester County adjoins the very lowest end of Zone 3, Zone 4 and the upper most portion of Zone 5. The DRBC's 2004 Delaware River and Bay Integrated List Water Quality Assessment Report, which contains the water quality standards for each

Figure 8. HUC14s

Table 8. Clayton Borough Watersheds and HUC14s

Watersheds	HUC14 Sub-Watersheds No.	HUC14 Sub-Watersheds Name
Maurice River	02040206120010	Little Ease Run (above Academy Rd)
	02040206120020	Little Ease Run (below Academy Rd)
	02040206120030	Still Run (above Silver Lake Road)
	02040206120050	Still Run (Willow Grove Lake – Silver Lake Rd)
	02040206130010	Scotland Run (above Fries Mill)
	02040206130020	Scotland Run (Delsea Dr to Fries Mill)

zone (see Section 2.2), and the results of their 2004 Delaware River and Bay Water Quality Assessment, can be found at the following link:

http://www.state.nj.us/drbc/04IntegratedList/index.htm.

The Surface Water Quality Criteria for all classified waterways in the State depend on their designated uses and reflected Surface Water Classification. The Surface Water Quality Criteria are detailed in N.J.A.C. 7:9B-1.14 and are too voluminous to include in this report.

(c) Impaired Waters

States are required to prepare and submit to the USEPA a report that identifies waters that do not meet or are not expected to meet surface water quality standards (SWQS). This report is commonly referred to as the 303(d) list. In accordance with Section 305(b) of the CWA, the States are also required biennially to prepare and submit to the USEPA a report addressing the overall water quality of the State's waters. This report is commonly referred to as the 305(b) Report or the Water Quality Inventory Report. Those water bodies, which are listed on the 303(d) list, are referred to as "water quality limited" water bodies and a total maximum daily load (TMDL) must be developed for each individual pollutant in these impaired water bodies.

In November 2001, the USEPA issued guidance that encouraged states to integrate 305(b) Report and the 303(d) List into one report. The New Jersey Department of Environmental Protection (NJDEP) chose to develop an Integrated Report for New Jersey starting in 2002. The 2004 Integrated List of Waterbodies combines these two assessments and assigns water bodies to one of five sublists. Sublists 1 through 4 include water bodies that are generally unimpaired. Sublist 5 of the 2004 Report supersedes Sublist 5 of the 2002 Integrated List and the new sublist presents all water quality limited waters and includes waters for which TMDL development is occurring or will occur within two years. The Sublists of water bodies in New Jersey are categorized as follows.

Sublist 1 - water bodies that are attaining the water quality standards and no use is threatened.

Sublist 2 - water bodies that are attaining some of the designated uses; no use is threatened; and insufficient or no data and information is available to determine if the remaining uses are attained or threatened.

Sublist 3 - water bodies where there is insufficient or no data and information to determine if any designated use is attained.

Sublist 4 - water bodies that are impaired or threatened for one or more designated uses but do not require the development of a TMDL [for the reasons described in Sublists 4A, 4B and 4C below].

Sublist 4A. - TMDL has been completed.

Sublist 4B - other pollution control requirements are reasonably expected to result in the attainment of the water quality standard in the near future.

Sublist 4C - impairment is not caused by a pollutant.

Sublist 5 - the water quality standard is not attained. The waterway is impaired or threatened for one or more designated uses by a pollutant(s) and requires a TMDL.

The link to the most recent 2004 NJDEP Integrated Water Quality and Assessment Report is:

http://www.state.nj.us/dep/wmm/sgwqt/wat/integratedlist/integratedlist2004.html

For the purposes of evaluating surface water quality in Gloucester County, the Integrated Lists (Sublists 1-5) were abridged and sorted to include only those locations within the County. (See Watershed Surface Water Quality discussion(s) that follow)

(d) Total Maximum Daily Loads (TMDLs)

TMDLs are required, under Section 303(d) of the federal Clean Water Act, for water bodies that cannot meet surface water quality standards after the implementation of "technology-based" effluent limitations. TMDLs may also be established to help maintain or improve water quality in waters that are not impaired. Based on the 2002 and 2004 integrated list, the NJDEP entered into a Memorandum of Agreement with USEPA that sets out a schedule for completion of TMDLs.

A TMDL allocates the load capacity to point sources in the form of waste load allocations (WLAs) and to nonpoint sources in the form of load allocations (LAs), and may also identify reserve capacity and a margin of safety. WLAs result in Water Quality Based Effluent Limits for point source Wastewater Treatment Plants and requirements based on Best Management Practices (BMPs) for regulated stormwater point sources, such as Combined Sewer Overflows (CSOs). Because nonpoint source pollution does not come from discrete sources, LAs generally identify broad categories of nonpoint sources that contribute to the parameters of concern. The LA then includes specific load reduction measures, through Best Management Practices (BMPs), that may include local ordinances for stormwater management and nonpoint source pollution control, headwaters protection practices, or other mechanisms for addressing the parameters of concern.

A separate TMDL calculation must be prepared for each pollutant listed for each impaired stream segment or lake. A TMDL is considered "proposed" when the NJDEP publishes the TMDL Report as a proposed Water Quality Management Plan Amendment in the New Jersey Register (NJR) for public review and comment. A TMDL is considered "established" when the NJDEP finalizes the TMDL Report and formally submits it to EPA Region 2 for a thirty (30)-day review and approval. The TMDL is considered "approved" when the NJDEP-established TMDL is approved by EPA Region 2. The TMDL is considered "adopted" when the EPA-approved TMDL is adopted by the NJDEP as a water quality management plan amendment and the adoption notice is published in the NJR. The link to New Jersey's TMDLs and their status is:

http://www.nj.gov/dep/watershedmgt/tmdl.htm#intro

In the process of establishing a TMDL, an implementation plan is developed to identify how the various sources will be reduced to their designated allocations. Implementation strategies for non-point sources may include: improved stormwater management, the adoption of ordinances, reforestation of stream corridors, retrofitting stormwater systems, and other Best Management Practices to control stormwater runoff loadings.

(e) Gloucester County's Impaired Waters

There are about 27 different water bodies within Gloucester County that are considered impaired for their designated use, because they do not meet their respective water quality standards for one or more pollutant parameters. The impaired parameters include phosphorus, mercury, copper, silver, PCBs, dioxin, benthic macroinvertebrates, pH, fecal coliform, total coliform, and total suspended solids. The NJDEP has prepared or will prepare TMDLs for each water body and impaired parameter. . (See Watershed Surface Water Quality discussion(s) that follow)

(f) Gloucester County's TMDLs

At this time, the NJDEP has proposed 17 TMDLs that address impaired water bodies in Gloucester County. The full text of these proposals can be found and downloaded at the following link:

http://www.nj.gov/dep/watershedmgt/tmdl.htm#intro .

Fourteen of the 17 TMDL proposals were proposed by the NJDEP in April 2003 and were based on the 2002 Integrated Report. These TMDLs were approved in September 2003, but have not yet been adopted. Three of the 17 TMDL proposals were proposed by the NJDEP in May and July 2005, and these TMDLs have not yet established.

Ground Water

Gloucester County is located in the Atlantic Coastal Plain Physiographic Province. Beneath Gloucester County are a series of geologic units that form aquifers or aquifer systems and confining units (aquitards). The geologic units consist largely of layers of unconsolidated sediments of clays, silts, sands and gravels, deposited over many millions of years, and extending from the land surface, hundreds or thousands of feet to bedrock. These sand and gravel layers and units when grouped together form the aquifers or aquifer systems and the layers and units containing higher amounts of silts and clays when grouped together form the confining units.

The geologic units in the County dip gently to the south-east, and they outcrop (and are exposed) in broad, irregular, northeast-southwest trending bands on the land surface. The oldest formations outcrop along and under the Delaware River, and progressively younger units outcrop in sequence, moving southeasterly towards the Atlantic Coast.

There are several major coastal plain aquifers or aquifer systems which outcrop and are exposed in Gloucester County. Starting with the oldest and most westerly, they are: the Potomac-Raritan-Magothy (PRM) aquifer system, which outcrops along and under the Delaware River; the Englishtown aquifer system; the Wenonah-Mount Laurel aquifer; and the Kirkwood-Cohansey aquifer system.

The Wenonah-Mount Laurel, Englishtown, and PRM aquifers are exposed in their respective outcrops, but dip into the subsurface, becoming semi-confined or confined at depth in a southeasterly direction. The Kirkwood-Cohansey aquifer system remains exposed throughout its outcrop and is exposed and unconfined within Gloucester County.

There are a few other minor geologic units outcropping in the County that may yield very small amounts of water, including the Merchantville, Marshalltown and Vincentown Formations. However, because of their low permeability's, these formations are more often regarded as confining units. In addition to these minor geologic units, small, shallow, deposits of more recent sands with gravel from the Bridgeton, Pennsauken and Cape May Formations can be found on the surface in the County, particularly capping hills and along stream banks.

The aquifers or aquifer systems in Gloucester County are separated by relatively impermeable geologic confining units that vary in thickness and in their confining ability, ranging from semi-confining to confining. These confining units also outcrop in broad, highly irregular, northeast-southwest trending bands on the land surface and are located between the aquifers' outcrops.

Confining geologic units in the County, starting with the oldest and most westerly outcropping, are: the Woodbury-Merchantville (between the PRM and the Englishtown); the Marshalltown (between the Englishtown and the Wenonah-Mount Laurel); and the Hornerstown-Navesink-Vincentown (between the Wenonah-Mount Laurel and the Kirkwood-Cohansey). Water in the subsurface tends to move very slowly, if at all, from one aquifer to another, because of the confining units between the aquifers.

Minimizing the impacts of stormwater runoff on the ground water of Clayton Borough is a primary goal of this MSWMP, as is protecting Clayton Borough's surface waters.

(a) Stormwater Runoff and Ground Water Recharge

In New Jersey's Atlantic Coastal Plain, precipitation averages about 43.75 inches per year. On average, about 45 percent of the annual precipitation results in runoff (or about 19.75 inches per year), and about 55 percent of the precipitation is lost into the atmosphere as evapotranspiration. The infiltration, or groundwater recharge, component of runoff provides the base stream flow in the Atlantic Coastal Plain. At an average runoff rate of 19.75 inches per year, the maximum recharge rate of 15 inches per year indicates that as much as 75 percent of the runoff will recharge the ground water.

In Clayton Borough, the water table aquifer receiving recharge is the Kirkwood-Cohansey aquifer; this is a major source of water supply for residents and businesses in the area. Water table aquifers are susceptible to ground water contamination, and protection of the Borough's ground water is important.

Because the upper geologic unit in Clayton Borough has the ability to transmit large quantities of water downward, store the precipitation from individual storm events, and discharge the stored water as base flow to streams in a more uniform manner than would result from direct runoff, the streams in the Borough can benefit from groundwater recharge and stream base flow maintenance. For this reason, groundwater recharge in the Borough is a significant and necessary stormwater management strategy. Stormwater management in new major development and redevelopment within Clayton Borough should incorporate measures that address and maximize potential groundwater recharge, to the greatest extent possible.

(b) Well head Protection Areas (WHPAs)

Water supply wells in exposed unconfined aquifers depend on surface recharge to maintain groundwater levels and groundwater quality, thereby directly linking stormwater management and recharge with water supply. Largely because of this linkage, unconfined public community water supply (PCWS) wells and public non-community water supply (PNCWS) wells have designated "wellhead protection areas" (WHPAs). Water supply wells in the confined portions of aquifers, away from the exposed outcrop area, are not directly linked to surface recharge, and have no WHPAs.

WHPAs establish the approximate area within which contamination, released on the surface, will travel to the well head, over the prescribed period of time. WHPAs include three tiers; the inner boundary, Tier 1, includes an area with a 2 year travel time, the middle boundary, Tier 2, includes an area with a 5 year travel time and the outer boundary, Tier 3, includes an area with a 12 year travel time. WHPAs serve as warning zones, within which high risk activities should be avoided, and further provide a prioritization for clean-up of surface and groundwater contamination that occurs within a WHPA.

Geology (surficial) and Wellhead Protection Areas in Clayton are shown in Figure 9. Clayton has two confined PCWS wells on Chestnut Street near the water tower. Since these wells are confined, there are no associated WHPAs. Southeast of Wilson Lake, there is a PNCWS well which has a small WHPA associated with it. In addition, there are two unconfined PCWS wells protected by WHPAs. The first well is at the northern boundary of the Borough near Filbert Street. Its Tier 1 WHPA extends south past Wilson Avenue in Clayton, and the remainder of the Tier 1 WHPA reaches into Glassboro and

Elk Township. The second unconfined well is located off of North Delsea Drive across from Louis Drive. Its Tier 1 and Tier 2 WHPAs encompass the area between Delsea Drive and the Conrail railway line, extend north to the other WHPA in the Borough and reach south approximately 2,000 feet.

The locations of WHPAs for PCWS wells in Clayton Borough should be considered in future redevelopment, zoning, land use and stormwater management decisions.

(c) New Jersey Groundwater Quality Standards

The NJDEP's has established Ground Water Quality Standards (GWQSs) for all of the ground waters in the State of New Jersey (N.J.A.C. 7:9-6). Like the SWQSs, the GWQSs establish the designated uses for the State's ground water, and specify the ground water quality criteria for specific constituents, including toxic pollutants, consistent with those designated uses.

The GWQSs establish classification areas according to the geographic extent (both vertical and horizontal) of geologic formations, or units, within which ground water is classified for the designated uses. Designated uses may include any human withdrawal of ground water (for example, for potable, agricultural or industrial water), the discharge of ground water to surface waters of the State which support human use or ecological systems, or the direct support of ecological systems.

The GWQSs include three major classes of ground water:

Class I	Ground Water of Special Ecological Significance
Class II	Ground Water for Potable Water Supply
Class III	Ground Water With Uses Other Than Potable Water Supply

Under the NJDEP GWQSs, the primary designated use for Class I ground waters is the maintenance of special ecological resources supported by the ground water within the classification area; secondary designated uses of Class I waters is use for potable water, agricultural water and industrial water, if these uses are viable using water of natural quality and do not impair the primary use (for example, by altering ground water quality).

Class I ground water is further designated as either Class I-A (Exceptional Ecological Areas) or Class I-PL (Pinelands). Ground water within watersheds of FW-1 surface waters (a Category One surface water classification), and certain "Natural Areas" designated by the NJDEP in the GWQSs, are designated as Class I-A ground waters.

Class III ground waters are ground waters that are not suitable for potable use due to their natural hydrogeologic characteristics, such as aquitards - Class III-A ground water, or due to their natural water quality that is unsuitable for conversion to potable water, such as saline ground water (Class III-B).

Figure 9. Geology and Well Head Protection Areas

All ground waters in New Jersey not designated as Class I or Class III are designated as Class II ground waters. Class II ground waters are further classified as either Class II-A or Class II-B. The designated uses of Class II-B waters are any reasonable use other than potable use; however, the NJDEP has not designated any ground waters as Class II-B.

Because of the different ground water quality criteria, the necessary stormwater management measures may vary among these areas. However, the three contaminants for which the NJDEP has required a projection of build-out stormwater pollutant loading are nitrogen, phosphorus and total suspended solids (see Section 5). These three pollutants are of particular significance with regard to surface water quality, but are not included in the list of constituent criteria for ground water. It is anticipated that ground water quality issues will not be a significant concern for new major development projects, if the projects comply with the new design and performance standards in N.J.A.C. 7:8.

Soils

One of the main objectives of the new NJDEP Stormwater Management Rules is to promote ground water recharge in order to replenish aquifers, maintain base flow in streams and assist in maintaining the groundwater supply. Ground water recharge is significantly affected by land use (e.g., commercial vs. agricultural uses), as well by the type of natural soil present on the ground surface. The National Resource Conservation Service (NRCS) has grouped soil types throughout the United States into four different Hydrologic Soil Groups (HSGs): A, B, C and D, depending on their infiltration ability and the potential rate of ground water recharge.

Group A soils have high infiltration rates and recharge potential and provide little direct runoff. They generally include well-drained and sorted sands and gravels. Group B soils have moderately high recharge potential, while Group C soils have lower infiltration rates and generally include more silt and clay particles with higher direct runoff potential. Group D soils have very low recharge rates and a high direct runoff potential. Some soils may have two classifications depending on whether or not they contain soil layers with different infiltration characteristics. For example, a soil classified as A/D has both a Group A soil layer that is well-drained and a Group D soil layer that is poorly drained.

The NJDEP’s new stormwater regulations encourage new development in areas with soils that do not recharge significant amounts of water to aquifers; that is, in Group C and D soil areas. The regulations encourage the protection of the natural condition, infiltration and recharge rates in Group A or B soil areas. However, many Group D soil areas are located in wetlands or adjacent to wetlands and water bodies and these areas are not developable. It may not be possible to completely avoid disturbance and new development in Group A and B soil areas. But, the NJDEP’s new stormwater regulations require equal amounts of ground water recharge before and after new development.

Figure 10 depicts the hydrologic soil groupings in Clayton Borough. Clayton soils are primarily Group B and moderately well draining. The exceptions to this are the Group C/D and Group D soils along the waterways and associated with wetlands.

Figure 10. Soils

MAURICE RIVER WATERSHED

Topography

Figure MR-1 (see Appendix A) provides an aerial photograph (2000) of the Maurice River Watershed and depicts general land use and other planimetric relationships within the watershed. It is a "birds-eye" view of the watershed that allows a quick assessment of watershed conditions as they existed at that time. This watershed appears generally to be a rural watershed.

Figure MR-2 (see Appendix A) provides the USGS Quadrangle (topographic map) for this watershed. Relief (elevation difference) within the Maurice River Watershed is about 160 feet, with elevations ranging from a low of 3.3 to a high of 164 feet above mean sea level. Lower elevations occur along the waterways and wetlands and higher elevations occur along the watershed's boundaries. The land surface elevations and relief in this watershed have been sculpted by surface runoff and erosion of the unconsolidated coastal plain sediments at the land surface. But, the relief in this watershed is generally small, although there are a few localized land areas with steeper slopes. Hills with steeper slopes, often capped by more erosion resistant sediments (gravels), can generally be found within the watershed, providing some structural control and forming drainage boundaries.

The river is about 10 miles long as it traverses Gloucester County, and the average stream gradient (slope) along the length of the watershed's stream channel (the long profile) is 0.0006 (excluding any estuarine portions). In general, stream slopes within the watershed are extremely flat.

In this watershed, surface drainage has eroded the land surface in dendritic drainage patterns that exhibit little structural control because of the relatively uniform resistance to erosion from the underlying sediments. Generally, the streams in the watershed consist of short straight sections connected by bends and kinks. For the most part, there is little or no stream braiding or meandering and stream channels are not heavily incised. The streams in the watershed appear to be "graded." Stream base level, gradient, channel section, sediment load and flow are in relative dynamic equilibrium. Uncontrolled development within the watershed could, however, upset this equilibrium.

Hydrology

The Maurice River Watershed encompasses portions of both Gloucester County and neighboring Salem and Cumberland Counties to the south. Much of the Watershed is outside of the County and so, the neighboring municipalities in Salem County impact water quality in some of the streams and HUC-14s.

The Maurice River has a total drainage area of 386 square miles (including approximately 74 square miles in Gloucester County) and flows south for 50 miles through Cumberland County to the Delaware Bay. The only major tributary of this river within Gloucester County is Scotland Run, but other tributaries include Little Ease Run and Still Run. The River and its tributaries are shown on Figure MR-3 (see appendix A). In Gloucester County, this watershed contains 12 HUC14 sub-watersheds and these are listed in Table MR-1.

Surface Water Quality

(a) Surface Water Classifications

The surface waters in the Maurice River Watershed are classified FW1-NT, PL, FW2-NT, or FW2-NTC1.

The designated uses for surface water classification FW1-NT (non-trout fresh surface waters that are to be maintained in their natural state of quality and not subject to any man-made wastewater discharges or increases in runoff from anthropogenic activities) as described by the N.J.A.C. 7:9B-1.12(a) are:

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

The designated uses for PL, Pinelands waters as described by the N.J.A.C. 7:9B-1.12(b) are:

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

The designated uses for surface water classification FW2-NT (non-trout fresh surface waters not designated as FW1 or PL) as described by the N.J.A.C. 7:9B-1.12(c) are:

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

Table MR-1. Maurice River Watershed HUC14s

Municipality	HUC14 Sub-Watershed	
	No.	**Name**
Franklin Township	02040206120020	Little Ease Run (below Academy Rd)
	02040206120040	Reed Branch (Still Run)
	02040206120050	Still Run (Willow Grove Lake - Silver Lake Rd)
	02040206130010	Scotland Run (above Fries Mill)
	02040206130020	Scotland Run (Delsea Drive to Fries Mill)
	02040206130030	Indian Branch (Scotland Run)
	02040206130040	Scotland Run (below Delsea Drive)
	02040206140010	Maurice River (Blackwater Branch to/including Willow Grove Lake)
	02040206140020	Burnt Mill Branch/Hudson Branch
	02040206140040	Blackwater Branch (above/including Pine Br)
Elk Township	02040206120010	Little Ease Run (above Academy Rd)
	02040206120030	Still Run (above Silver Lake Road)
	02040206120040	Reed Branch (Still Run)
	02040206120050	Still Run (Willow Grove Lake - Silver Lake Rd)
Monroe Township	02040206120010	Little Ease Run (above Academy Rd)
	02040206130010	Scotland Run (above Fries Mill)
	02040206130020	Scotland Run (Delsea Drive to Fries Mill)
Clayton Borough	02040206120010	Little Ease Run (above Academy Rd)
	02040206120020	Little Ease Run (below Academy Rd)
	02040206120030	Still Run (above Silver Lake Road)
	02040206120050	Still Run (Willow Grove Lake - Silver Lake Rd)
	02040206130010	Scotland Run (above Fries Mill)
	02040206130020	Scotland Run (Delsea Dr to Fries Mill)
Glassboro Borough	02040206120010	Little Ease Run (above Academy Rd)
	02040206120030	Still Run (above Silver Lake Road)
Washington Township	02040206120010	Little Ease Run (above Academy Rd)
	02040206130010	Scotland Run (above Fries Mill)
Newfield Borough	02040206140020	Burnt Mill Branch/Hudson Branch

The designated uses for surface water classification FW2-NTC1 (non-trout Category One fresh surface waters not designated as FW1 or PL) have the same designated uses as FW2-NT but the water way is considered a Category One water. There are special antidegredation policies applied to Category One waters in order to protect against "measurable changes in water quality characteristics because of their clarity, color, scenic setting, other characteristics of aesthetic value, exceptional ecological significance, or exceptional fisheries resources." (N.J.A.C. 7:B, June 2005)

(b) Surface Water Quality Data

Ambient Biomonitoring Network - The NJDEP has established an Ambient Biomonitoring Network (AMNET) to document the health of the state's waterways. There are over 800 AMNET sampling sites throughout the state of New Jersey. These sites are sampled for benthic macroinvertebrates by the NJDEP on a five-year cycle. Streams are classified as non-impaired, moderately impaired, or severely impaired, based on this AMNET data. The data is used to generate a New Jersey Impairment Score (NJIS), which is based on a number of biometrics related to benthic macroinvertebrate community dynamics. The AMNET sites within this watershed are shown in Figure MR-4 (see Appendix A) and the most recent AMNET scores for Impaired Waters within this watershed are included in the data in Appendix B.

Conventional Water Quality Data – The NJDEP utilizes conventional surface water quality data from a number of sources to bi-annually evaluate the impairment of surface water bodies. These water quality data include the federal Storage and Retrieval repository (STORET) data and other Existing Sources. The STORET and Existing Sources sampling locations within this watershed are shown in Figure MR-4 and the most recent data for Impaired Waters within this watershed are included in the data in Appendix B

(c) Impaired Waters

For the purpose of evaluating surface water quality in this watershed, the NJDEP Integrated List (Sublists 1-5) were abridged and sorted to provide the locations of impaired waters within this watershed and these are listed in Table MR-2. A map showing the locations of impaired water is included as Figure MR-4 (Appendix A). There are fifteen (15) different sites within this watershed that are considered impaired for their designated uses, because they do not meet their respective water quality standards for one or more pollutant parameters. The impaired parameters include: mercury, benthic macroinvertebrates, pH, and fecal coliform.

Table MR-2. Maurice River Impaired Waters List

No.	Location	Parameter	Priority
1.	Blackwater Branch at Main Rd in Franklin	Benthic Macroinvertebrates	Low
2.	Burnt Mill Branch at Forest Grove Rd in Newfield	Benthic Macroinvertebrates	Low
3.	Franklinville Lake-17	Fecal Coliform	High
4.	Holly Green Campground Pond-17	Fecal Coliform	High
5.	Indian Branch at Rt 47 in Franklin	Benthic Macroinvertebrates	Low
6.	Indian Branch at Sta Rd in Janvier (Franklin.)	Benthic Macroinvertebrates	Low
7(a).	Indian Branch near Malaga	Fecal Coliform	High
7.	Indian Branch near Malaga	pH	Medium
8.	Iona Lake-17	Fecal Coliform	High
9.	Little Ease Run at Grant Ave in Franklin	Benthic Macroinvertebrates	Low
10.	Little Ease Run at Leonard Cake Rd in Franklin	Benthic Macroinvertebrates	Low
11(a.).	Little Ease Run at Porchtown	Fecal Coliform	High
11(b).	Little Ease Run at Porchtown	pH	Medium
12(a).	Malaga Lake-17	Fecal Coliform	High
12(b).	Malaga Lake-17	Mercury	High
13.	Still Run at Little Mill Rd in Franklin	Benthic Macroinvertebrates	Low
14.	Still Run near Malaga	pH	Medium
15(a).	Wilson Lake	Fecal Coliform	High
15(b).	Wilson Lake	Mercury	High

(d) TMDL Proposals

The NJDEP has proposed two sets of TMDLs that address impaired water bodies in this watershed. The full text of these proposals can be found and downloaded at the following link:

http://www.nj.gov/dep/watershedmgt/tmdl.htm#intro .

Both of the sets of TMDLS were proposed by the NJDEP in April 2003 and were based on the 2002 Integrated Report. These TMDLs were approved in September 2003, but have not yet been adopted.

A list of this watershed's TMDL proposals is included in Table MR-3. The locations of TMDLs in this watershed are shown on Figure MR-4 Water Quality (Appendix A).

Table MR-3. Maurice River TMDL Proposals

Location	Parameter	Status
Little Ease Run at Porchtown	Fecal Coliform	Approved September 2003
Indian Branch near Malaga	Fecal Coliform	Approved September 2003

The TMDL proposals are for fecal coliform for Little Ease Run at Porchtown and for Indian Branch near Malaga. Waste load allocation reductions have been proposed for the affected waterways. The TMDL proposals discuss possible sources of fecal coliform as well as the method use to develop the TMDLs and remediation plan. (See Section 8 Water Quality-TMDL Stormwater Management Strategies).

Category One Waters

Category One Waters are designated in New Jersey's rules for Surface Water Quality Standards (SWQSs) (N.J.A.C. 7:9B-1.4) "for protection from measurable changes in water quality characteristics because of their clarity, color, scenic setting, other characteristics of aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance or exceptional fisheries resources". The new Stormwater Management Rules require establishment of a Special Water Resource Protection Area (SWRPA) along these waters to buffer them from new major development and redevelopment. In accordance with N.J.A.C. 7:8, development within or around these areas may be subject to special stormwater management measures,

The Category One Waters in the Maurice River Watershed are:

1. Beaverdam Branch FW2-NT(C1)* Within the boundaries of Glassboro Wildlife Management Area

2. Little Ease Run FW2-NT(C1) Run and tributaries within the Glassboro Wildlife Management Area, except FW1 tributaries

Category One waterways within the Maurice River Watershed include the segments of Beaverdam Branch and Little Ease Run and its tributaries within the Glassboro Wildlife Management Area.

Hydrogeology

The Maurice River Watershed is underlain by the Kirkwood-Cohansey aquifer system, which is unconfined at the surface and provides the water table aquifer in this portion of Gloucester County.

Soils

The Maurice River Watershed is characterized primarily by moderately well-draining

Group B soils. The C/D soils are located, as expected, along the river itself and its major tributaries in the wetlands areas. Figure MR-5 (see Appendix A) shows the potential amounts of infiltration and ground water recharge throughout the watershed.

Critical Habitats

The NJDEP Division of Fish and Wildlife Endangered Nongame Species Program developed a Geographic Information System (GIS) called the *Landscape Project*, which is described as a "pro-active, ecosystem-level approach to the long-term protection of imperiled and priority species and their important habitats in New Jersey." Version 2 of the Landscape project is now available interactively on the web and for download. According to the NJDEP's Metadata, "Version 2 was created by intersecting imperiled and priority species data with NJDEP 1995/97 Land Use/Land Cover update. The resulting data layer identifies, delineates and ranks (based on the conservation status of species present) habitat statewide. Each patch is coded for the number of sightings of priority, state threatened, state endangered and federally listed species present. The data is designed to be used for state and local planning, open space acquisition and land-use regulation."

The NJDEP Division of Fish and Wildlife describes the *Landscape Project* and the importance of preserving natural habitat as follows:

> New Jersey is the most densely populated state in the nation. One of the consequences of this distinction is the extreme pressure that is placed on our natural resources. As the population grows, we continue to lose or impact the remaining natural areas of the state. As more and more habitat is lost, people are beginning to appreciate the benefits and necessity of maintaining land in its natural state.
>
> For example, we know that wetlands are critical for recharging aquifers, lessening the damage from flooding and naturally breaking down contaminants in the environment. Forests and grasslands protect the quality of our drinking water, help purify the air we breathe and provide important areas for outdoor recreation. Collectively, these habitats are of critical importance to the diverse assemblage of wildlife found in New Jersey, including more than 70 species classified as threatened or endangered.
>
> Many imperiled species require large contiguous tracts of habitat for survival. The consequence of the rapid spread of suburban sprawl is the loss and fragmentation of important wildlife habitat and the isolation and degradation of the smaller habitat patches that remain. Small patches of fields, forests and wetlands interspersed with development provide habitat for common species that do well living near humans, but do not provide the necessary habitat for most of our imperiled wildlife. We need to

> protect large, contiguous blocks of forest, grassland and wetlands to assure the survival of imperiled species over the long-term.
>
> In addition to providing habitat for the conservation of imperiled species, protecting critical wildlife areas will result in more open space for outdoor recreation. Recent surveys by the U.S. Fish and Wildlife Service show that more than 60% of Americans participate in some form of wildlife-related recreation. Open spaces provide places where people can escape the confines of urban and suburban living.

Most critical habitats are supported in part or in total by the surrounding surface and ground water resources, and they are consequently impacted by development, non-point source pollution and stormwater runoff. Critical Habitats mapped by the NJDEP's Landscape Project within this watershed are shown on Figure MR-6 (see Appendix A). The Critical Habitats within this watershed may include Grassland, Forest, Forested Wetland, Emerging Wetland, Beach, Bald Eagle Foraging, Urban Peregrine Falcon Nesting, and Wood Turtle habitats that should, to the extent practical, be conserved and protected from the adverse impacts caused by uncontrolled development and stormwater runoff.

Section 5. Build-Out Analysis and Pollutant Loading Projections

Build-out analyses and pollutant loading projections have been prepared for each municipality, HUC14 and watershed within Gloucester County, generally in accordance with the NJDEP's methodology described by their guidance and regulations. The build-out analyses and pollutant loading projections are tools to assess the potential impacts from development and stormwater runoff within each of the County's municipalities and watersheds.

Some municipalities in Gloucester County are essentially fully developed ("built–out"); little new development can or will occur in these municipalities. However, the potential for significant redevelopment exists in these highly developed municipalities, and the existing development in built-out municipalities contributes pollutants to the watershed. Thus, all of the municipalities in the County, regardless of their remaining developable land areas were evaluated in the County's build-out analyses and pollutant loading projections.

Furthermore, in order to add more meaning to the pollutant loading projections, the County has compared present land use and future (build-out) land use by projecting the pollutant loadings under both conditions. The County utilized powerful GIS data management and mapping software to perform these analyses for each municipality, HUC14 and watershed.

The build-out analyses and pollutant loading projections allow municipalities, the County and others to quantifiably project the impacts from development on surface waters. Using this tool, municipalities and the County are in a better position to develop strategies to minimize, manage and/or mitigate these impacts through improved stormwater management and construction practices and potentially through modifications to the land use and zoning, before build-out occurs.

Build-out analyses and pollutant loading projections are a tool and an initial step for assessing and quantifying adverse impacts from development and stormwater runoff. There are, however, a number of reservations associated with the NJDEP's Build-out methodology, and with build-out and pollutant loading analyses in general.

1. The methodology over-simplifies the complex hydrologic and pollutant transport mechanisms associated with these processes and development.

2. The methodology does not account for the transient nature of development within a given municipality and watershed. It ignores the differences in time over which build-out will occur. For example, one municipality or portion of a watershed

might take 10 years to essentially build-out, while another might take 100 years or more.

3. The impervious surface coverage analyses presume that all development within a zone occur at the maximum impervious coverage permitted within the zone. Although it would be reasonable to assume an average impervious coverage, the maximum permitted impervious coverage is the extreme. Furthermore, many municipal land use zones do not specify a maximum impervious coverage and an assumption must be used that may not be optimal (similar zones in other municipalities within the County were used to estimate impervious coverage).

4. The NJDEP presented very little information about the origin and conditions that apply to their land cover pollutant loading coefficients for total phosphorus, total nitrogen and total suspended solids. For example, what are the climatic, soils, hydrologic, geologic, topographic, and vegetative conditions that these coefficients represent, and even more importantly, what stormwater runoff controls were employed that generated these coefficients? Without this information, it is not possible to fully understand the implications of pollutant loadings using these coefficients. The methodology is highly sensitive to these coefficients.

5. Because the NJDEP's methodology projects pollutant loadings for only three parameters, total phosphorus, total nitrogen and total suspended solids, the pollutant loading projections are biased against agricultural land uses. For example, changes in land use from agriculture to low density rural development occurs throughout much of Gloucester County. The NJDEP's pollutant loading coefficients for agriculture are two to three times greater than those for low density residential development. The resulting annual pollutant loadings will then be two to three times lower for land transitioning from agriculture to residential development.

   This might be misconstrued to imply that the loss of agricultural lands to residential development is somehow desirable. Furthermore, because of the significant amount of agricultural land in some municipalities and watersheds in Gloucester County, the method makes residentially and commercially developed municipalities and watersheds appear less prone to the impacts of nonpoint source pollution, which is not the case.

   In Gloucester County and other similar areas in New Jersey, agriculture is recognized as being fundamentally important and vital to society, and as such the County does not advocate transitioning from agricultural land uses to residential or other more intense forms of development.

6. The NJDEP's land cover coefficients do not appear to consider or incorporate the new stormwater management techniques now required by the new New Jersey stormwater regulations and the new LID BMP strategies. Furthermore, most

municipalities have required some form of stormwater runoff control in new development for 20 years or more. The NJDEP land cover coefficients may, therefore, be very conservative with respect to present development conditions and greatly overestimate the adverse impacts at build-out.

7. In addition to nitrogen, phosphorous and suspended solids there are a number of other pollutants associated with non-point source pollution and stormwater runoff from development. These include among other parameters, petroleum hydrocarbons, metals and pathogenic organisms which are not currently accounted for by the NJDEP's methodology.

8. Malfunctioning and/or inadequate onsite wastewater disposal systems are believed to be a major source of non-point pollution. The NJDEP's method does not account for pollution resulting from onsite systems.

Despite these reservations, the build-out analyses and pollutant loading projections are valuable tools for assessing the potential impacts from development and stormwater runoff. The build out analyses and pollutant loading projections in Gloucester County have been developed with the flexibility to easily adjust the pollutant loading coefficients, zoning and other elements of the analyses and projections. The County utilized powerful GIS data management and mapping software to perform these analyses and create this flexibility for each municipality, HUC14 and Watershed. In the future, municipalities and the County may choose to make adjustments that will better project the impacts of stormwater runoff and development.

The following GIS-based method was used for the build-out analyses and pollutant loading projections and to prepare the figures presented in this report.

1. Using GIS digital coverages from the NJDEP and DVRPC (existing land use), the eight Watersheds, 54 HUC14 areas and the 24 municipalities within the County were identified, their boundaries delineated and the results saved as a GIS feature layers. ESRI's ArcGIS mapping software was then used to provide the land areas of existing land uses within each of the HUC14s, watersheds and municipalities.

2. Using the Gloucester County Planning Department's GIS data, municipal zoning areas were integrated with the HUC14 drainage areas to establish the zoning within each municipality and HUC14 drainage area. Municipal zoning is highly variable throughout the County. A "crosswalk" was used to associate all municipal zones with the zones provided by the NJDEP for pollutant loading projections.

3. Existing (present) impervious land coverage was determined for each HUC14 and municipality using aerial mapping techniques.

4. Constrained areas were determined from the NJDEP's and the County's GIS coverages, including surficial water bodies, wetland areas, Category One resource

protection areas and their associated 300 foot buffers, designated open space and protected park areas. These were saved as GIS feature layers and integrated with the existing land use, HUC14 and municipal zoning feature layers. The build-out amount of impervious land coverage within each HUC14 and municipality was then calculated from the zoning layer.

Build-out land areas available for new development and redevelopment were calculated by subtracting the constrained areas from the developable areas based on zoning for each HUC14, Watershed and municipality. In essence, the land available for new development is agricultural, forest and/or barren lands and the land available for redevelopment consists of the existing residential, commercial and industrially zoned areas.

5. The build-out (future) impervious surface coverage was calculated by multiplying build-out land areas available for new development and redevelopment by the maximum impervious surface coverage, using (whenever available) the maximum impervious surface coverage percentages specified within each municipal zoning ordinance for that area.

6. Pollutant loading projections were calculated for each municipality and HUC14, using the pollutant loading coefficients provided by the NJDEP Stormwater BMP Manual and shown in Table 9. Pollutant loading projections were made for all 24 municipalities, 54 HUC14s and the eight Watersheds for both the existing land use (present) and build-out (future) conditions.

Table 9. Pollutant Loads For Various Land Cover Types

Land Cover	**Total Phosphorus Load (lbs/acre/year)**	**Total Nitrogen Load (lbs/acre/year)**	**Total Suspended Solids Load (lbs/acre/yr)**
High, Medium Density Residential	1.4	15	140
Low Density, Rural Residential	0.6	5	100
Commercial	2.1	22	200
Industrial	1.5	16	200
Urban, Mixed Urban, Other Urban	1.0	10	120
Agricultural	1.3	10	300
Forest, Water, Wetlands	0.1	3	40
Barrenland/Transitional Area	0.5	5	60

Source: NJDEP Stormwater BMP Manual 2004.

CLAYTON BOROUGH

Build-Out, Impervious Cover and Pollutant Loading Projections

The results of the Clayton Borough Build-out analysis, including the existing and build-out (future) conditions, are presented in Table 10. This table provides the total area, constrained area, and developable area in acres for each HUC14 within Clayton Borough.

Table 10 also provides the impervious areas in acres and percent for both existing and build-out conditions, in order to allow comparison of the results for these conditions. In general, impervious percentages greater than about 10 to 15 percent may indicate potential watershed impairment from stormwater and development. The total pollutant loadings for phosphorous, nitrogen and total suspended solids are projected in pounds per year for both the existing and build-out conditions, in order to allow comparison of the pollutant loadings.

Included in this plan and in the New Jersey Stormwater Management Regulations and guidance are strategies to minimize, manage and/or mitigate build-out impacts, through improved stormwater management and construction practices. In addition, modifications to current land use and zoning will change the build-out impacts and the County's GIS can be used to evaluate the results of such changes.

Table 10. Clayton Borough Pollutant Loading Projections

Watershed	HUC14 Sub-Watershed No.	HUC14 Sub-Watershed Name	Area (Acres) Total	Area (Acres) Constrained	Area (Acres) Developable	Impervious Acres Existing	Impervious Acres Build-Out	Impervious Percent Existing	Impervious Percent Build-Out	Phosphorus Existing	Phosphorus Build-Out	Nitrogen Existing	Nitrogen Build-Out	Total Suspended Solids Existing	Total Suspended Solids Build-Out
Maurice River Watershed	02040206120010	Little Ease Run (above Academy Rd)	2,071.26	1,274.24	796.98	114.64	457.14	5.5%	22.07%	714.6	1,129.2	6,723.3	11,938.9	121,021	124,737
	02040206120020	Little Ease Run (below Academy Rd)	827.25	146.09	681.15	85.99	259.41	10.4%	31.36%	490.1	912.5	4,290.1	9,641.5	93,371	94,188
	02040206120030	Still Run (above Silver Lake Road)	316.85	147.01	169.84	6.77	82.50	2.1%	26.04%	164.3	181.1	1,361.8	1,823.0	36,650	24,578
	02040206120050	Still Run (Willow Grove Lake - Silver Lake Rd)	829.32	163.72	665.59	148.67	332.94	17.9%	40.15%	556.8	958.6	5,100.3	10,211.2	89,744	100,180
	02040206130010	Scotland Run (above Fries Mill)	573.54	381.55	192.00	24.75	84.90	4.3%	14.80%	104.3	167.7	1,031.1	1,616.3	23,270	21,825
	02040206130020	Scotland Run (Delsea Dr to Fries Mill)	30.93	18.08	12.85	2.60	4.69	8.4%	15.16%	15.4	8.8	122.1	77.7	3,515	1,339
		Total	**4,649.15**	**2,130.69**	**2,518.41**	**383.42**	**1,221.58**	**8.2%**	**26.28%**	**2,045.40**	**3,357.86**	**18,628.76**	**35,308.55**	**367,570.17**	**366,847.64**

MAURICE RIVER WATERSHED

Build-out, Impervious Cover and Pollutant Loading Projections

The Maurice River watershed is located in the southeastern portion of Gloucester County and includes municipalities in Gloucester, Cumberland and Salem Counties. Gloucester County occupies less than 20 percent of the watershed. These build-out projections include Gloucester County municipalities and their relative contribution to the watershed: Franklin Township (49%), Elk Township (18%), Monroe Township (13%), Clayton Borough (10%), Glassboro Borough (6%), Washington Township (3%) and Newfield Borough (2%). Figure MR-7 (see Appendix A) shows the existing land use, based on DVRPC 2000 land use data. Figure MR-8 (see Appendix A) shows the constrained areas in the watershed.

The watershed is largely undeveloped; approximately 50 percent is wooded land and approximately 25 percent is agriculture. The results of the Maurice River Watershed build-out analysis, including both existing and build-out (future) conditions, are presented in Table MR-4. This table provides the total area, constrained area, and developable area in acres for each HUC14 within the watershed and County.

Table MR-4 also provides the impervious areas in both acres and percent for existing and build-out conditions, in order to allow comparison of the results. In general, impervious percentages greater than about 10 to 15 percent may indicate potential watershed impairment from stormwater and development. The total pollutant loadings for phosphorous, nitrogen and total suspended solids are projected in pounds per year for both the existing and build-out conditions, in order to allow comparison of the pollutant loadings.

Table MR-4. Maurice River Watershed Pollutant Loading Projections

Municipality	HUC14 Sub-Watershed		Area (Acres)			Impervious Area				Total Pollutant Load (Lbs/Year)					
	No.	Name	Total	Constrained	Developable	Acres		Percent		Phosphorus		Nitrogen		Total Suspended Solids	
						Existing	Build-Out	Existing	Build-Out	Existing	Build-Out	Existing	Build-Out	Existing	Build-Out
Clayton Boro	02040206120010	Little Ease Run (above Academy Rd)	2,071.26	1,274.24	796.98	114.64	457.14	5.53%	22.07%	715	1,129	6,723	11,939	121,021	124,737
	02040206120020	Little Ease Run (below Academy Rd)	827.25	146.09	681.15	85.99	259.41	10.39%	31.36%	490	912	4,290	9,641	93,371	94,188
	02040206120030	Still Run (above Silver Lake Rd)	316.85	147.01	169.84	6.77	82.50	2.14%	26.04%	164	181	1,362	1,823	36,650	24,578
	02040206120050	Still Run (Willow Grove Lake-Silver Lake Rd)	829.32	163.72	665.59	148.67	332.94	17.93%	40.15%	557	959	5,100	10,211	89,744	100,180
	02040206130010	Little Ease Run (above Academy Rd)	573.54	381.55	192.00	24.75	84.90	4.32%	14.80%	104	168	1,031	1,616	23,270	21,825
	02040206130020	Little Ease Run (below Academy Rd)	30.93	18.08	12.85	2.60	4.69	8.41%	15.16%	15	9	122	78	3,515	1,339
		Sub-Total	**4,649.15**	**2,130.69**	**2,518.41**	**383.42**	**1,221.58**	**8.25%**	**26.28%**	**2,045**	**3,358**	**18,629**	**35,309**	**367,570**	**366,848**
Elk Twp	02040206120010	Little Ease Run (above Academy Rd)	8.00	0.09	7.91	1.08	2.37	13.50%	29.63%	2	11	30	119	502	1,107
	02040206120030	Still Run (above Silver Lake Rd)	3,250.69	890.11	2,360.57	149.36	694.23	4.59%	21.36%	2,190	2,652	18,634	26,883	471,845	310,096
	02040206120040	Reed Branch (Still Run)	3,426.98	1,478.34	1,948.64	100.01	1,191.42	2.92%	34.77%	1,899	3,464	15,702	35,763	434,119	347,750
	02040206120050	Still Run (Willow Grove Lake-Silver Lake Rd)	1,543.87	415.22	1,128.65	83.74	304.36	5.42%	19.71%	983	1,166	8,345	11,579	216,831	139,822
		Sub-Total	**8,229.54**	**2,783.76**	**5,445.77**	**334.19**	**2,192.38**	**4.06%**	**26.64%**	**5,074**	**7,294**	**42,711**	**74,344**	**1,123,297**	**798,775**
Franklin Boro	02040206120020	Little Ease Run (below Academy Rd)	2,298.46	627.08	1,671.36	141.51	444.84	6.16%	19.35%	1,231	1,835	11,395	17,786	245,270	222,605
	02040206120040	Reed Branch (Still Run)	1,396.13	274.95	1,121.18	32.09	168.18	2.30%	12.05%	1,078	673	9,034	5,606	240,310	112,118
	02040206120050	Still Run (Willow Grove Lake-Silver Lake Rd)	2,924.91	743.52	2,181.39	162.49	405.15	5.56%	13.85%	1,550	1,577	14,495	14,033	316,940	240,410
	02040206130010	Little Ease Run (above Academy Rd)	77.62	0.94	76.69	4.89	11.50	6.30%	14.82%	80	46	632	383	17,628	7,669
	02040206130020	Little Ease Run (below Academy Rd)	4,524.13	1,175.50	3,348.63	195.10	534.52	4.31%	11.81%	1,500	2,147	16,327	18,308	305,605	344,071
	02040206130030	Still Run (above Silver Lake Rd)	4,234.54	1,287.92	2,946.62	113.82	441.99	2.69%	10.44%	1,244	1,768	13,914	14,733	272,236	294,661
	02040206130040	Reed Branch (Still Run)	3,927.97	650.60	3,277.38	201.73	619.86	5.14%	15.78%	2,174	2,525	20,997	22,721	452,324	364,995
	02040206140010	Little Ease Run (above Academy Rd)	109.21	0.00	109.21	4.29	16.59	3.93%	15.19%	30	66	410	556	6,805	10,978
	02040206140020	Little Ease Run (below Academy Rd)	1,928.35	228.86	1,699.48	92.94	327.32	4.82%	16.97%	1,376	1,247	12,520	11,184	289,519	190,635
	02040206140040	Reed Branch (Still Run)	1,652.33	370.46	1,281.86	68.74	223.53	4.16%	13.53%	1,119	862	9,822	7,518	230,117	137,115
		Sub-Total	**23,073.65**	**5,359.83**	**17,713.80**	**1,017.60**	**3,193.48**	**4.41%**	**13.84%**	**11,382**	**12,746**	**109,546**	**112,828**	**2,376,756**	**1,925,257**
Glassboro Boro	02040206120010	Little Ease Run (above Academy Rd)	2,159.52	1,466.88	692.65	170.37	311.90	7.89%	14.44%	529	1,060	5,435	11,175	80,097	108,481
	02040206120030	Still Run (above Silver Lake Rd)	649.29	151.57	497.73	108.59	237.66	16.72%	36.60%	333	726	3,459	7,721	49,836	80,892
		Sub-Total	**2,808.81**	**1,618.45**	**1,190.38**	**278.96**	**549.56**	**9.93%**	**19.57%**	**862**	**1,786**	**8,894**	**18,896**	**129,933**	**189,374**
Monroe Twp	02040206120010	Little Ease Run (above Academy Rd)	1,765.74	392.15	1,373.59	93.50	595.96	5.30%	33.75%	1,139	2,277	9,804	24,140	239,565	222,611
	02040206130010	Little Ease Run (above Academy Rd)	4,218.97	1,148.24	3,070.72	353.56	1,284.73	8.38%	30.45%	1,952	4,958	19,850	52,432	336,973	489,572
	02040206130020	Little Ease Run (below Academy Rd)	1.05	0.00	1.05	0.02	0.26	1.90%	24.76%	1	1	10	16	189	147
		Sub-Total	**5,985.76**	**1,540.39**	**4,445.36**	**447.08**	**1,880.95**	**7.47%**	**31.42%**	**3,092**	**7,236**	**29,664**	**76,587**	**576,727**	**712,330**
Newfield Boro	02040206140020	Little Ease Run (below Academy Rd)	1,118.40	131.40	987.02	132.45	200.68	11.84%	17.94%	669	898	6,522	8,607	124,146	125,618
Washington Twp	02040206120010	Little Ease Run (above Academy Rd)	257.61	22.34	235.27	42.04	52.91	16.32%	20.54%	151	281	1,413	2,924	25,353	30,608
	02040206130010	Little Ease Run (above Academy Rd)	1,053.98	98.77	955.22	210.57	284.27	19.98%	26.97%	890	1,399	8,151	14,245	146,052	149,046
		Sub-Total	**1,311.59**	**121.11**	**1,190.49**	**252.61**	**337.18**	**19.26%**	**25.71%**	**1,041**	**1,680**	**9,564**	**17,169**	**171,405**	**179,654**
		Total	**47,176.90**	**13,685.63**	**33,491.23**	**2,846.31**	**9,575.81**	**6.03%**	**20.30%**	**24,166**	**34,998**	**225,529**	**343,739**	**4,869,834**	**4,297,855**

Section 6. Design and Performance Standards

Clayton Borough must amend its land use ordinances to incorporate the design and performance standards for stormwater management measures as presented in N.J.A.C. 7:8-5, to minimize the adverse impact of stormwater runoff on water quality and water quantity and loss of groundwater recharge in receiving water bodies. This requirement will be met by adopting a Municipal Stormwater Control Ordinance that meets these requirements or by amending an existing stormwater control ordinance to meet these requirements.

The design and performance standards in the adopted or amended ordinance must include the language for maintenance of stormwater management measures consistent with the stormwater management rules at N.J.A.C. 7:8-5.8 Maintenance Requirements, and language for safety standards consistent with N.J.A.C. 7:8-6 Safety Standards for Stormwater Management Basins.

After adoption or amendment of the ordinance, it must be submitted to the County, along with this MSWMP, for approval.

Furthermore, during construction of major development within the Clayton Borough, municipal inspectors must observe the construction of stormwater management measures to ensure that they are constructed and function as designed.

The New Jersey stormwater design and performance standards represent an initial effort to control non-point sources of pollution and to improve groundwater recharge. The effective control of point sources of pollution took many years. The USEPA and the NJDEP believe that further water quality improvements can now best be achieved by controlling non-point sources of pollution and stormwater runoff.

New stormwater management measures and design and performance standards will emerge over the ensuing years. The stormwater rules, NJPDES stormwater permits, and municipal stormwater plans and ordinances will similarly evolve and require amendments. Municipalities will be expected to control stormwater runoff, to improve or maintain surface water quality and groundwater recharge and to continue to utilize appropriate stormwater design and performance standards to achieve this goal.

With the increasing emphasis on non-point source pollution and concerns over the adverse impacts of uncontrolled land development, effective alternatives to the centralized stormwater conveyance and treatment strategies have been developed that are the basis for many of the new stormwater management standards in the State. New strategies have been developed to minimize and even prevent adverse stormwater runoff impacts from occurring.

Such strategies, known collectively as Low Impact Development techniques or LIDs, reduce and/or prevent adverse runoff impacts through sound site planning and both nonstructural and structural techniques that preserve or closely mimic a site's natural or pre-developed hydrologic response to precipitation. These new stormwater management strategies are explained in more detail in Section 8 of this MSWMP.

Section 7. Plan Consistency

There are no approved Regional Stormwater Management Plans (RSWMPs) in Gloucester County at this time. However, Regional Stormwater Management Planning is being conducted by the County Planning Department, NJ Soil Conservation Districts/Program and Rowan University in portions of a number of the County's watersheds. These include portions of the Maurice River (upper portions, including Scotland Run, Little Ease Run and Still Run), Raccoon Creek (upper portions) and Mantua Creek (Chestnut Branch).

The Gloucester County Stormwater Management Program is working closely with these regional efforts. When these or any future RSWMPs are approved by the appropriate regional water quality management planning agency and NJDEP, and adopted as part of the regional water quality management plan, the new New Jersey stormwater management regulations require that municipal stormwater management plans be revised to provide consistency.

Presently, TMDLs have been proposed for certain surface water bodies in Gloucester County. Section 4 of this MSWMP addresses impaired surface waters, TMDLs and supporting surface water quality data. When these ongoing TMDL proposals or any future TMDLs proposals are finally approved, the new New Jersey stormwater management regulations require that municipal stormwater management plans be revised to provide consistency.

The Clayton Borough MSWMP is consistent with the Residential Site Improvement Standards (RSIS) at N.J.A.C. 5:21. Clayton Borough will utilize the most current update of the RSIS in the stormwater management review of residential areas. This Municipal Stormwater Management Plan will be updated to be consistent with any future updates to the RSIS.

Furthermore, Clayton Borough's stormwater management ordinance(s) will require all new development and redevelopment plans to comply with New Jersey's Soil Erosion and Sediment Control Standards. During construction, municipal inspectors will observe on-site soil erosion and sediment control measures and report any inconsistencies to the Gloucester County Soil Conservation District.

Section 8. Stormwater Management Strategies

Low Impact Development Techniques

The NJDEP's new Stormwater Management Rules include the specific provisions that must be addressed in a municipal stormwater management plan (N.J.A.C. 7:8-4.2(c)). One of these requirements is that the plan include an evaluation of the extent to which the master plan (including the land use element), official map, and development regulations (including zoning ordinances) implement the principles of the Stormwater Management Rules relating to nonstructural stormwater management strategies (N.J.A.C. 7:8-5.3(b)).

New stormwater management techniques have been developed that minimize and prevent adverse stormwater effects from land disturbance. These techniques are referred to by the NJDEP as Low Impact Development techniques (LIDs) and include both nonstructural and structural Best Management Practices (BMPs). LID-BMPs first minimize quantitative and qualitative changes to a site's pre-developed hydrology (i.e., employ nonstructural techniques first) and then provide stormwater management through smaller sized structural techniques distributed throughout the site. The link to the NJDEP website to download the BMP Manual is:

http://www.njstormwater.org/bmp_manual2.htm

Nonstructural LID-BMPs include such practices as minimizing site disturbance, preserving important site features, reducing and disconnecting impervious cover, flattening slopes, utilizing native vegetation, minimizing turf grass lawns and maintaining natural drainage features. It may be possible at some sites to satisfy all stormwater management requirements through nonstructural LID-BMPs. Structural BMPs are considered LIDs if they are located close to the source of runoff. Structural LID-BMPs include various types of basins, filters, devices and permeable surfaces located within residential lots and otherwise throughout residential, commercial, industrial or institutional development.

Because LIDs rely on nonstructural or relatively small structural BMPs distributed throughout a land development site, ownership and maintenance may be similarly distributed to an array of property owners. The new Stormwater Management rule requires the use of deed restrictions for LID-BMPs to ensure that property owners fully recognize, understand and support the continuing use of LID-BMPs for stormwater management.

The NJDEP believes that effective, state-wide use of such practices can best be achieved through modifications to municipal master plans and land use ordinances to include LID goals and to provide for the use of specific LID-BMPs. The Stormwater Management Rules require municipalities to review their master plans and ordinances in order to incorporate LID techniques to the maximum extent practicable.

The NJDEP Stormwater Management Rules (N.J.A.C. 7:8) require, in Section 5.2(a) that Major Development (disturbing one acre or more or increasing impervious surface by 1/4 acre) incorporate nonstructural stormwater management strategies "to the maximum extent practicable." Nonstructural LID-BMPs are to be given preference over structural BMPs. Where it is not possible to fully comply with the Stormwater Management Rules through nonstructural LIDs, structural LID-BMPs are to be used in conjunction with standard structural BMPs to meet the Rules' requirements.

N.J.A.C. 7:8-5 further requires that an applicant seeking approval for major development or redevelopment specifically identify which and how these nine nonstructural strategies are incorporated or provide an engineering, environmental, or safety reason for their non-incorporation.

The NJ BMP manual contains a LID checklist which planning boards and development applicants can use to ensure LID techniques are being applied. This checklist is available in Appendix D.

(a) Nonstructural LID-BMPs

The NJDEP's new Stormwater rule's design and performance standards require the maximum possible use of nine nonstructural strategies.

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 pre-construction time of concentration.
5. Minimize land disturbance including clearing and grading.
6. Minimize soil compaction.
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 discharge into and through stable vegetated areas.
9. Provide preventative source controls.

The nonstructural LID-BMPs have been grouped by the NJDEP into four general categories:

I. **Vegetation and Landscaping** – reduces runoff volumes and peaks through infiltration, surface storage, and evapotranspiration, provides pervious surface for groundwater recharge and removes pollutants from stormwater. Key techniques include:

A. **Preservation of Natural Areas** – preserve areas with significant hydrologic functions including forested areas, riparian corridors and soils/geology with high recharge potential.
B. **Native Ground Cover** – reduce the use of turf grass and preserve areas that naturally minimize runoff.
C. **Vegetative Filters and Buffers** – provide native ground cover and grass areas to filter stormwater runoff from pervious areas and to provide locations for runoff to infiltrate.

II. **Minimizing Land Disturbance –** reduces runoff volume and pollutant loads and maintains existing recharge rates and other hydrologic functions. Key techniques include:

A. Planning and design to fit the development to the terrain, limiting clearing and grading.
B. Evaluating site conditions and constraints including soil types, geology, topography, slopes, drainage areas, wetlands, and floodplains to maintain high recharge areas and provide runoff storage areas.
C. Utilizing construction techniques that limit disturbance and soil compaction.
D. Restricting the future expansion of buildings and other improvements that will adversely affect runoff volumes and rates or recharge rates.

III. **Impervious Area Management** – reduces water quality impacts, runoff volume and peak rates, runoff velocity, erosion and flooding. Key techniques include:

A. **Streets –** use minimum acceptable pavement widths and incorporate pervious vegetated medians and islands with curb cuts for runoff access.
B. **Sidewalks –** use pervious pavement with infiltration storage beneath and disconnect from the street drainage system.
C. **Parking and Driveways –** use pervious pavement wherever practical **and** reduce parking space requirements by sharing requirements in mixed uses and by reducing parking space lengths by allowing for overhang into pervious areas.
D. **Pervious Paving Materials –** Use pervious materials in parking spaces, driveways, access roadways and sidewalks, including pavers, porous pavement and gravel.
E. **Unconnected Impervious Areas –** Disconnect impervious areas and runoff form the site's drainage system allowing the sheet flow to cross pervious areas through curb cuts or by eliminating curbing and using shoulders and swales.
F. **Vegetated Roofs –** install lightweight vegetative planting beds on new or existing roofs.

IV. Time of Concentration Modification – minimize reductions to the time of concentration caused by changes in hydrologic characteristics in order to minimize the peak runoff rate. Key techniques include:

A. **Surface Roughness Changes** – increase surface roughness through the use of land cover and decrease the amount of connected smooth surfaces in order to increase runoff travel time throughout the drainage area.
B. **Slope Reduction** – reduce slopes in graded areas and/or provide terraces and reduced slope channels to increase runoff travel length and time.
C. **Vegetated Conveyance** – use vegetated channels and swales to increase roughness and runoff travel time and to provide opportunities for runoff treatment and infiltration.

In order to assure to the maximum extent possible the use of Nonstructural LIDs in new major development, the NJDEP prepared a Nonstructural Strategies Evaluation Worksheet, and this worksheet is included in Appendix D.

(b) Structural LID-BMPs

In addition to these nonstructural LID-BMPs, structural stormwater management measures can be LID-BMPs. These structural BMPs become LID-BMPs by storing, infiltrating, and/or treating runoff close to the source of the stormwater. Unlike standard structural BMPs that are located along a site's drainage system, structural LID-BMPs are normally dispersed throughout a development and more closely mimic the hydrology. LID-BMPs are typically standard structural BMPs, but their location, closer to the runoff source, allows them to be smaller in size. Standard structural BMPs that can be implemented at a LID scale include: drywells, infiltration systems, bioretention basins, and both surface and subsurface detention basins; downsized, to address stormwater close to its source as LIDs.

There are a number of structural stormwater BMPs that may be used to address the groundwater recharge and stormwater quality and quantity requirements of the NJDEP Stormwater Management Rules in N.J.A.C. 7:8. The structural BMPs include the following techniques (see also *New Jersey Stormwater Best Management Practices Manual,* February 2004, which includes the planning, design, construction, and maintenance guidelines for these structural BMPs):

1. Bioretention Systems
2. Constructed Stormwater Wetlands
3. Dry Wells
4. Extended Detention Basins
5. Infiltration Basins
6. Manufactured Treatment Devices
7. Pervious Paving Systems
8. Rooftop Vegetated Cover
9. Sand Filters

10. Vegetative Filters
11. Wet Ponds

Other BMPs that possess similar levels of effectiveness, efficiency, and endurance may also be utilized, provided that such levels can be demonstrated.

Clayton Borough will review the Master Plan and local land use ordinances and incorporate structural stormwater management strategies (LID and standard structural stormwater BMPs) to the extent practicable and in accordance with sound planning, science, engineering and construction principles, as they apply to its unique environment.

Other Stormwater Management Strategies

MAURICE RIVER WATERSHED

(a) Gloucester County Stormwater Management Program's Watershed Workshop

The Gloucester County Stormwater Management Program held a Maurice River Watershed workshop, inviting representatives from each municipality in the watershed to an evening discussion of stormwater management issues and strategies. The resulting issues and recommended strategies are presented below.

- **Geese Management**: Increasing geese populations have become a problem throughout both the suburban and rural portions of southern New Jersey. Stormwater detention ponds, grass and lawn areas and farm fields provide habitat for geese. Although the populations sometimes add to the areas aesthetics, there are adverse impacts to water quality and the land that result, especially with over population.

  The new New Jersey Stormwater regulations require municipalities to pass ordinances prohibiting the feeding of waterfowl. In addition, municipalities should encourage land cover types and practices in new development that discourage geese from resting, nesting and feeding in areas that would otherwise provide attractive habitat, such as stormwater management facilities. Changes to State and federal laws regarding hunting were discussed and recommended at the workshop.

  See also the Upper Maurice River Watershed Regional Stormwater Management Plan, which contains a thorough description of geese management strategies in the Appendix.

- **Localized Roadway Flooding**: Localized roadway flooding occurs at a number of locations in the watershed, including Gorgo Lane in Newfield, Burnt Mill Branch near the railroad, Malaga Lake in Franklin and along Route 55. Particularly at locations where state, county and municipal roadways intersect, runoff from state and county roadways sometimes becomes a burden to local roads and stormwater systems, and ownership and responsibility for its management is sometimes unclear and neglected.

The new New Jersey stormwater regulations and the design and performance standards, address this issue for all new major development (defined as projects that disturb one or more acres of land or increase the amount of impervious surface by one-quarter acre or more), including new roadway construction and reconstruction. State, County and local roadway agencies must comply with these new regulations and control their stormwater runoff accordingly. Unfortunately, the new regulations can not resolve already existing, localized roadway flooding

Most municipalities and the County Highway Division do not have plans or maps of their stormwater system, nor is there a method in place for State, County or local agencies to share stormwater system information, even though these systems must frequently work together. Furthermore, there are typically few if any systems for inspecting and recording the stormwater system's condition or maintenance activities.

The Gloucester County Stormwater Program includes an extensive outfall mapping component for Gloucester County's municipalities and the County Highway Division. The program is using GPS dataloggers to map and record data in a digital format for stormwater outfalls throughout the County. The County program will produce outfall maps for each municipality and the County Highway Division and store the digital data in a GIS for easy sharing, updates and retrieval.

The outfall maps are a first step in defining the County's stormwater systems. In order to assist municipalities with stormwater system management, the County will purchase dataloggers for use by municipalities in mapping the other components of their stormwater systems (inlets, pipes, ditches, culverts, basins etc.). An understanding of the stormwater systems and drainage may help resolve existing localized roadway flooding, and it will assist the municipalities and County in providing the maintenance assurances required by their new stormwater NJPDES permits.

- **Silver Lake**: Silver Lake, in Clayton Borough on its western border with Elk Township, may be impaired and unable to meet water quality standards. Water quality analysis is required to determine its status and further evaluation by the appropriate state and county agencies is recommended. Additional stormwater management strategies, if any, would be based on the results of this evaluation.

- **Scotland Run Golf Course**: Scotland Run Golf Course is requesting permission to divert stormwater for irrigation purposes from the headwaters of Scotland Run. The net loss in stream flow, if any, should be considered in order to prevent adverse impacts to downstream water quality and aquatic habitat.

(b) Upper Maurice River Regional Stormwater Management Plan

The Gloucester Soil Conservation District (GSCD) with the New Jersey Department of Agriculture, State Soil Conservation Committee (SSCC) and the Burlington, Camden and Cape-Atlantic Soil Conservation Districts prepared an Upper Maurice River Regional Stormwater Management Plan dated October 2004 that includes the upper portions of the Maurice River Watershed, eighty-five percent of which is in Gloucester County (there is a small portion in Salem and Cumberland Counties too). This regional stormwater plan concluded that:

> The Upper Maurice River Watershed is in overall good condition. The streams and rivers are not significantly impacted by development and do not exhibit significantly degraded areas in regards to stream erosion, water quality, riparian buffer width, floodplain management and wetlands quality. However, it must be noted that Gloucester County is one of the fastest growing counties in the Delaware Valley and as a result is experiencing rapid development…
>
> The watershed is not significantly impacted by stormwater at this time. However, to prevent degradation of the Upper Maurice River and to assure that it remains in its existing condition, steps to minimize the impacts of urbanization on this watershed are vital. To address these and other issues a variety of management strategies are proposed. New development must continue to adequately address stormwater management issues appropriately. To do so, all new development must comply with the regulations set forth in the new NJDEP Stormwater Management Rule N.J.A.C. 7:8 and the Residential Site Improvement Standards.

The stormwater management strategies proposed in the Upper Maurice River Watershed Regional Stormwater Management Plan are stated below:

- **Stormwater Recharge and Zoning-Based Recharge**: Changes in land use from rural agricultural to emerging suburban/urban development invariably and irrevocably alter natural runoff retention/infiltration capabilities of the soil. Because of this, the enhancement of stormwater facilities to provide for recharge of runoff to groundwater should be considered as part of the regional stormwater management plan for the Upper Maurice River. As the landscape is altered in the construction process, the natural soil horizons are disturbed and the forested areas are removed, the capacities of the soils in the post-development condition to mimic pre-development water retention and infiltration is severely impaired and reduced. This reduction results in increased overland flow, decrease of retained moisture, and ultimately reduction in stream baseflow. The use of infiltration as a sole method, or in combination with detention where conditions are conducive for success, should be examined and put to use as possible methods of stormwater management. In this manner, the recharge capabilities of the existing watershed could be maintained, thus assuring overall watershed health.

- **Low Impact Development**: Low Impact Development (LID) provides a variety of techniques to maintain or restore the pre-developed hydrologic characteristics of the site. We recommend that all municipalities adopt and require, when acceptable, Low Impact Development techniques as part of their land development and stormwater management ordinances. These techniques control stormwater runoff and pollutants at the sources, by promoting a reduction of impervious cover, maintaining the natural features, flattening grades and by constructing and/or maintaining grass swales, streets without curbs, depression storage, etc. LID also provides a means to retrofit highly urbanized areas to reduce stormwater runoff and pollutant loadings.

- **Pre-Development Site Analysis**: Accurately assessing the true hydrologic condition of a development site or drainage area is critical to designing effective stormwater management facilities. A variety of techniques, tools and models are available for the engineer or hydrologist to simplify and quantify the complex interaction between rainfall, watershed storage and runoff. However, the accurate measurement or calculation of the input parameters of these techniques is complicated by the unique hydrology of the Upper Maurice River Watershed. Carefully delineating the effective drainage area and calculating reasonable time parameters can help to ensure the accuracy of the pre-development site analysis. The critical step is a comparison of the calculated runoff to observed conditions at the "outlet" of the drainage area. The result of these efforts will be better stormwater design, decreased management costs and positive environmental benefits.

- **Adoption of DelMarVa Peak Rate Factor**: As part of more accurately modeling existing conditions in the Upper Maurice River, utilizing regionalized factors in the calculation of stormwater runoff is critical. The DelMarVa peak rate factor (PRF) replaces the national average PRF in the dimensionless unit hydrograph used by the NRCS stormwater runoff prediction methodologies. The DelMarVa hydrograph has been formally recommended for use in the coastal plain of New Jersey and should be required for all hydrologic analyses in this watershed.

- **Forest and Forest Buffers**: The hydrology of the Upper Maurice River Watershed is significantly influenced by the vast forests and forested wetlands. In upland forests, the combination of soils, slope and vegetation provide an ideal mechanism for recharging precipitation. This recharged rainfall in turn supports the stream base flows. Development in these sub-basin watersheds will most likely reduce not only the forest cover, but also the recharge capacity of the site. To the greatest extent possible, forest areas should be retained and forest buffers utilized to infiltrate rainfall and excess runoff. Forested land is widely regarded as providing the greatest positive impact in all watersheds, producing very little surface water runoff and supporting the natural hydrology of the watershed.

- **Culvert Maintenance**: Numerous rural and secondary roads cross the Upper Maurice River Watershed. The culverts that drain the streams under these roads often appear undersized or at least partially obstructed with debris or sediment. These restrictions tend to pond runoff on the upstream side of the roads within the wetland riparian corridors. The culverts are in effect acting as the outlet of a natural detention basin. Despite this natural detention, roadway flooding does not appear to be a serious concern. The current configurations provide significant benefits to the watershed, including attenuation of stormwater runoff, reducing downstream peak flows and increasing the potential for infiltration. To maintain this condition it is recommended that existing culverts and cross-drains be maintained at their current size and geometry unless flooding is evident.

- **Canada Goose Management**: Suburban development has become an attractive home for resident and migratory Canada Geese. Ponds, lakes and stormwater basins, with their combination of open water and managed turf, provide suitable habitat for Canada Geese to rest, nest and feed. While many people enjoy seeing Canada Geese, they do not necessarily enjoy the assorted negative impacts associated with the Canada goose population that inhabit the area. These impacts include goose feces, aggressive behavior, turf and property damage and natural resource degradation. To help prevent the degradation caused by Canada geese, we recommend that all local and county governments adopt policies and ordinances to reduce or eliminate the current practices that create this attractive habitat for geese. These preventive measures include ordinances prohibiting the feeding of waterfowl and practices to discourage geese from populating desirable areas.

- **Lake and Pond Management and Maintenance:** The many ponds and lakes of the Upper Maurice River Watershed provide significant regional benefits. Beyond the aesthetic benefit to the community, these waterbodies help to reduce the slope of the stream network, provide regional stormwater attenuation and serve as sediment basins, trapping much of the excess sediment carried by the streams. In order to maintain these positive benefits, all lakes and ponds within the watershed must be actively managed to ensure the stability and continued functionality of these important features. Therefore, we recommend a comprehensive management plan and maintenance schedule for all of the publicly and privately held lakes and ponds in the Upper Maurice River Watershed. These plans should focus on dam maintenance, siltation and dredging and vegetation management.

Because the Upper Maurice River Watershed in Gloucester County is not yet significantly degraded by development, the principle goal of these stormwater management strategies is maintaining existing water quality and stream channel conditions, as development occurs in the future. In order to meet this goal, the municipalities in the watershed (Franklin Township Elk Township, Monroe Township, Clayton Borough, Glassboro Borough, Washington Township and Newfield Borough in Gloucester County and Upper Pittsgrove and Pittsgrove Townships in Salem County and

Vineland City in Cumberland County) must work together to accomplish these stormwater management strategies.

One way to assure this cooperation is through the formation of a Regional Stormwater Management Committee, comprised of stakeholders, working with a Lead Planning Agency, to finalize the Regional Stormwater Management Plan for the Upper Maurice River Watershed, in accordance with the most recent NJDEP requirements. Once this final plan is approved by the appropriate regional water quality management planning agency and the NJDEP, and adopted as part of the regional water quality management plan, the new stormwater management regulations require that municipal stormwater management plans be revised to provide consistency.

(c) Water Quality-TMDL Stormwater Management Strategies

The NJDEP has proposed two sets of TMDLs that address impaired water bodies in this watershed. The TMDL proposals are for fecal coliform for Little Ease Run at Porchtown and for Indian Branch near Malaga. Waste load allocation reductions have been proposed for the affected waterways. The TMDL proposals discuss possible sources of fecal coliform as well as the method use to develop the TMDLs and remediation plan. The full text of these proposals can be found and downloaded at the following link:

http://www.nj.gov/dep/watershedmgt/tmdl.htm#intro .

The TMDL remediation plans and stormwater strategies are summarized below.

Fecal Coliform: Fecal Coliform contamination may have either point or non-point sources or both. Point sources generally involve sewage discharges. Because sewage treatment plants have permits that require disinfection to levels well below water quality standards, the proposed TMDLs address non-point sources, involving stormwater runoff. These non-point stormwater sources include runoff from various land uses that transport fecal coliform from geese and other wildfowl, farms, and domestic pets to the receiving water. Non-point sources also include "illicit" sources, such as failing onsite disposal systems and the illegal connections of sanitary drains from buildings to storm sewers.

A number of stormwater management strategies were included in the TMDL Fecal Coliform proposals to remediate the affected waterways.

- **Phase II NJPDES Permits and the Municipal Stormwater Regulation Program**: Fecal Coliform loadings may be reduced by the new requirements to enforce a pet waste ordinance and an ordinance prohibiting the feeding of wildfowl on public property. The NJPDES permit requirements also require the annual inspection and cleaning (if necessary) of catch basins, the performance of good housekeeping practices at maintenance yards and public education and employee training aimed at reducing non-point sources of pollution, including fecal coliform. Additional reductions in fecal coliform levels may result from the elimination of illicit connections and failing on-site sewage disposal systems. Fecal coliform contributions from agricultural activities can be controlled by the implementation of agricultural conservation management plans and best management practices.

- **Little Ease Run:** The TMDL proposal for Little Ease Run at Porchtown found that Franklinville Lake attracts populations of Canadian Geese. Additionally, many older homes located along the stream corridor, as well as around Franklinville Lake may have failing septic systems. A cattle farm and sheep farm located along Franklinville Lake was suggested as another possible source. Additional monitoring is required to identify the source(s) of the impairment. Possible remediation methods suggested include the use of agricultural BMPs, as well as community based geese management programs.

- **Indian Branch:** The TMDL proposal for Indian Branch near Malaga found that the majority of land cover along the stream corridor is forest. Some small horse farms and cattle farms were observed near the NJDEP's monitoring site. Additionally, some homes along the stream corridor use onsite systems or possibly cesspools. It was suggested that additional monitoring is needed to determine if onsite systems are a source. Possible remedial methods include the use of agricultural BMPs.

Section 9. Mitigation Plans

Section 6 of this MSWMP addresses the design and performance standards for stormwater management measures applicable to major development projects. In some instances, however, site specific conditions may prevent strict compliance with these standards. In accordance with N.J.A.C. 7:8-4.2(c)11, such projects may be granted a variance or exemption from these standards by the Municipal Zoning Board or Planning Board, if a mitigation plan is approved by the Board and mitigation plan implementation is a condition of the major development project approval.

To the extent possible, a mitigation plan should offset the impacts on groundwater recharge, stormwater quantity control, and/or stormwater quality control that would be created by granting the variance or exemption to the development project. In addition, to the extent possible, the proposed mitigation project(s) should be located within the same HUC14 sub-drainage basin(s) as the major development project, and if not, within the same Watershed Management Area.

A mitigation plan may include more than one mitigation project, in order to achieve the objectives of location and/or impact offsets. The Municipal Stormwater Coordinator Public Works Director (if different), and Engineer (if different) will develop and maintain a list of mitigation projects that can be implemented in order to comply with the mitigation plan provisions of this MSWMP. Included as part of the list of projects will be quantitative estimates of the offsets to groundwater recharge, stormwater quantity control, and/or stormwater quality control for each of the mitigation projects.

The mitigation plan must include a detailed plan and schedule for implementation of the mitigation project(s). Implementation may be accomplished as a part of the major development project, or the Municipality may accept funding for the project(s), at the discretion of the Municipality. If the Municipality chooses to accept funding in lieu of implementation, such funding shall include any costs that must be incurred by the Municipality in implementing the mitigation project(s), including design, permitting, land and/or easement acquisition, construction, and provisions for the long-term operation and maintenance of the mitigation project(s).

A mitigation plan must clearly demonstrate that strict compliance with the design and performance standards for stormwater management measures cannot be achieved. Before submitting a mitigation plan that does not meet the objectives of the MSWMP with regard to mitigation project location and/or impact offsets, the developer shall request that the Municipality determine whether it can identify other projects, consistent with those objectives, that the Municipality can add to its list.

A mitigation plan that includes a mitigation project or projects not taken from the Municipality's list may be submitted for review by the Municipality. Such projects must be reviewed and accepted by the Municipality, before a mitigation plan including such projects can be submitted to the Zoning Board or Planning Board for review. A mitigation plan including projects not already listed by the Municipality must include quantitative estimates of the offsets to groundwater recharge, stormwater quantity control, and/or stormwater quality control for each of those unlisted mitigation projects.

The mitigation plan must include provisions for ensuring the long-term operation and maintenance of the mitigation project(s), by clearly identifying the party responsible for the operation and maintenance of each mitigation project. If the Municipality accepts a mitigation plan that designates the Municipality as the responsible party for mitigation project operation and maintenance, provisions for funding the associated costs by the developer shall be included in the mitigation plan.

If implementation of a mitigation plan is a condition of approval for a major development project by the Municipal Zoning Board or Planning Board, such approval shall also include the requirement that the developer execute a funding agreement with the Municipality for mitigation plan implementation, as a further condition of approval. The funding agreement, in form acceptable to the Municipality, shall provide for funding by the developer of all costs to implement the plan that will be incurred by the Municipality, including the cost of long-term operation and maintenance of any mitigation projects.

Section 10. Gloucester County Stormwater Management Program

The Gloucester County Board of Freeholders, in an effort to help municipalities address non-point source pollution and stormwater management, has established a Gloucester County Stormwater Management Program that provides assistance with many of the NJPDES permit requirements. The Gloucester County Stormwater website at http://www.gcstormwater.com provides a web link to learn more about the new NJDEP stormwater management rules, the NJPDES stormwater management permit requirements and the ongoing Gloucester County Stormwater Management Program.

The purpose of the program is to help municipalities meet the NJDEP's permit requirements through a regional effort in a fiscally responsible manner.

The County is addressing a number of each town's permit requirements to help alleviate the financial burden, while providing coordinated efforts that will better manage our environment. By utilizing a countywide watershed based approach; the end product will be a plan for each municipality tailored to the specific needs of the watershed.

The Gloucester County Freeholder Board's watershed-based approach to stormwater management is unique in the state of New Jersey. Through economies of scale and the use of technology, not necessarily available at the local level, the regional plan saves local taxpayers more, by coordinating preparation of the NJDEP required MSWMP for each of the 24 municipalities. The County not only saves time and money, but is better prepared to control non-point source pollution and to encourage improvements in water quality throughout Gloucester County.

The overall long term goal of stormwater management is to have all waters in New Jersey meet water quality standards for their designated uses. That is, ensure that our rivers, lakes and coastal waters are fishable, swimmable, and support healthy ecosystems. The *New Jersey Nonpoint Source and Stormwater Management Program Plan*, (NJDEP, December, 2000) indicates that "Nonpoint sources of pollution from stormwater runoff have long been thought to be major contributors to the degradation of water quality in New Jersey." It further states:

> The task ahead will not be easy. Controlling point sources of pollution took many years, many new governmental and private partners and billions of federal and private dollars. Successfully managing nonpoint sources of pollution and stormwater runoff can be expected to require a similar if not greater commitment.

APPENDIX A. WATERSHED FIGURES

MR-1

MR-2

MR-3

MR-4

MR-5

MR-6

MR-7

MR-8

Figure 9 for Appendix A

APPENDIX B. WATER QUALITY DATA

Maurice River Watershed
AMNET Scores

Watershed	Site Name	Site Number	Location	Municipality	Impairment Score 1995/1996	Impairment Score 2000/2001	Habitat Score 2000/2001	Impairment Rating 1995/1996	Impairment Rating 2000/2001	Chironomid Larvae Abnormalities	Site Activity
Maurice River	Blackwater Br	AN0738	Main Rd	Franklin Twp	6	6	143	**Severe**	**Severe**	False	True
Maurice River	Burnt Mill Br	AN0734	W Blvd	Newfield Boro	12	24	154	**Moderate**	**None**	False	True
Maurice River	Indian Br	AN0724	Rt 47	Franklin Twp	12	21	163	**Moderate**	**Moderate**	True	True
Maurice River	Little Ease Run	AN0726A	Carpenter Rd	Glassboro Boro	99	9	151	**No Sample**	**Moderate**	False	True
Maurice River	Ltl Ease Run	AN0727	Grant Ave	Franklin Twp	21	21	162	**Moderate**	**Moderate**	False	True
Maurice River	Ltl Ease Run	AN0728	Leonard Cake Rd	Franklin Twp	21	18	154	**Moderate**	**Moderate**	False	True
Maurice River	Reed Br	AN0731	Royal Ave	Franklin Twp	15	15	174	**Moderate**	**Moderate**	False	True
Maurice River	Scotland Run	AN0721	Rt 322	Monroe Twp	24	15	155	**None**	**Moderate**	False	True
Maurice River	Scotland Run	AN0722	Clayton - Williamstown Rd (Rt 610)	Clayton Boro	24	18	166	**None**	**Moderate**	False	True
Maurice River	Scotland Run	AN0723	Rt 538	Franklin Twp	27	21	166	**None**	**Moderate**	False	True
Maurice River	Scotland Run	AN0725	Rt 40	Franklin Twp	18	24	173	**Moderate**	**None**	True	True
Maurice River	Still Run	AN0729	Aura Rd	Elk Twp	24	30	172	**None**	**None**	True	True
Maurice River	Still Run	AN0730	Ltl Mill Rd	Franklin Twp	18	18	169	**Moderate**	**Moderate**	False	True
Maurice River	Still Run	AN0732	Rt 40	Franklin Twp	24	21	162	**None**	**Moderate**	False	True
Maurice River	UNT to Ltl Ease Ru	AN0726	Carpenter Rd	Glassboro Boro	9	99	999	**Moderate**	**No Sample**	False	False

Impairment Score	**Impairment Rating**
24 - 30	**Non-Impaired**
9 - 21	**Moderately Impaired**
0 - 6	**Severely Impaired**

Non-Impaired (unshaded)

Sublist 5 (shaded)

Maurice River Watershed
Fecal Coliform Data

Watershed	Site Name	Site ID	HUC	Sampling Agency	Sample Date	Result Value (CFU/100mL)	Standard (CFU/100mL)
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	06/04/98	20	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	06/17/98	140	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	08/27/98	20	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	09/03/98	24,000	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	09/17/98	130	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	**1998 AVG**	4,862	200
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	07/11/00	20	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	07/18/00	20	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	07/25/00	20	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	08/01/00	790	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	08/08/00	80	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	**2000 AVG**	**186**	200
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	07/10/01	50	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	07/17/01	20	400

Maurice River Watershed
Fecal Coliform Data

Watershed	Site Name	Site ID	HUC	Sampling Agency	Sample Date	Result Value (CFU/100mL)	Standard (CFU/100mL)
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	07/24/01	20	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	07/31/01	50	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	08/07/01	70	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	**2001 AVG**	**42**	200
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	05/29/02	40	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	06/05/02	90	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	06/12/02	40	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	06/19/02	40	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	06/26/02	80	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	**2002 AVG**	**58**	200
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	07/09/03	40	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	07/16/03	20	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	07/23/03	1,100	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	07/30/03	40	400

Maurice River Watershed
Fecal Coliform Data

Watershed	Site Name	Site ID	HUC	Sampling Agency	Sample Date	Result Value (CFU/100mL)	Standard (CFU/100mL)
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	08/06/03	230	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	**2003 AVG**	**286**	200
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	06/02/04	130	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	06/09/04	60	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	06/16/04	170	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	06/23/04	130	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	06/30/04	40	400
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	**2004 AVG**	**106**	200
Maurice River	Little Ease Run at Porchtown	01411458	02040206	USGS	06/17/98	433	400
Maurice River	Little Ease Run at Porchtown	01411458	02040206	USGS	08/13/98	80	400
Maurice River	Little Ease Run at Porchtown	01411458	02040206	USGS	09/03/98	1,300	400
Maurice River	Little Ease Run at Porchtown	01411458	02040206	USGS	09/17/98	170	400
Maurice River	Little Ease Run at Porchtown	01411458	02040206	USGS	**1998 AVG**	**496**	200

Non-Impaired

Impaired

Maurice River Watershed
pH Data

Watershed	Site Name	Site ID	HUC	Sampling Agency	Sample Date	pH
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	11/24/97	4.5
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	11/24/97	4.3
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	03/11/98	4.2
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	03/11/98	4.2
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	06/04/98	4.6
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	06/04/98	5.4
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	08/27/98	5.3
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	08/27/98	5.3
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	12/08/98	5.4
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	02/10/99	4.2
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	02/10/99	4.1
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	05/25/99	4.3
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	05/25/99	4.2
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	08/11/99	5.6
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	08/11/99	6.1
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	11/16/99	4.6
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	11/16/99	4.6
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	02/07/00	4.4

Maurice River Watershed
pH Data

Watershed	Site Name	Site ID	HUC	Sampling Agency	Sample Date	pH
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	02/07/00	4.4
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	05/10/00	4.5
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	05/10/00	4.6
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	08/14/00	4.6
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	08/14/00	4.7
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	11/15/00	4.7
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	11/15/00	4.6
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	02/20/01	4.4
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	02/20/01	4.3
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	05/09/01	4.6
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	05/09/01	4.7
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	08/22/01	5.5
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	08/22/01	6.6
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	12/11/01	5.5
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	12/11/01	5.7
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	02/19/02	4.7
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	02/19/02	5.2

Maurice River Watershed
pH Data

Watershed	Site Name	Site ID	HUC	Sampling Agency	Sample Date	pH
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	06/18/02	4.1
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	06/18/02	4.2
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	08/20/02	5.2
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	08/20/02	5.8
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	11/25/02	3.7
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	11/25/02	4.0
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	03/05/03	3.3
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	05/13/03	3.7
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	05/13/03	4.2
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	08/12/03	4.1
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	08/12/03	4.3
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	11/24/03	4.1
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	11/24/03	4.3
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	02/09/04	3.9
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	02/09/04	4.2
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	05/19/04	4.0
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	05/19/04	4.6

Maurice River Watershed
pH Data

Watershed	Site Name	Site ID	HUC	Sampling Agency	Sample Date	pH
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	09/09/04	4.2
Maurice River	Indian Branch near Malaga	01411466	02040206	USGS	09/09/04	4.7
Maurice River	Little Ease Run at Porchtown	01411458	02040206	USGS	11/25/97	6.1
Maurice River	Little Ease Run at Porchtown	01411458	02040206	USGS	11/25/97	6.0
Maurice River	Little Ease Run at Porchtown	01411458	02040206	USGS	03/25/98	5.6
Maurice River	Little Ease Run at Porchtown	01411458	02040206	USGS	03/25/98	5.6
Maurice River	Little Ease Run at Porchtown	01411458	02040206	USGS	05/20/98	5.8
Maurice River	Little Ease Run at Porchtown	01411458	02040206	USGS	05/20/98	6.3
Maurice River	Little Ease Run at Porchtown	01411458	02040206	USGS	09/03/98	6.1
Maurice River	Little Ease Run at Porchtown	01411458	02040206	USGS	09/03/98	6.8
Maurice River	Still Run near Malaga	01411453	02040206	USGS	11/24/98	6.6
Maurice River	Still Run near Malaga	01411453	02040206	USGS	11/24/98	6.6
Maurice River	Still Run near Malaga	01411453	02040206	USGS	02/25/99	6.0
Maurice River	Still Run near Malaga	01411453	02040206	USGS	02/25/99	6.7
Maurice River	Still Run near Malaga	01411453	02040206	USGS	05/17/99	6.6
Maurice River	Still Run near Malaga	01411453	02040206	USGS	05/17/99	6.8
Maurice River	Still Run near Malaga	01411453	02040206	USGS	09/20/99	5.6

Maurice River Watershed
pH Data

Watershed	Site Name	Site ID	HUC	Sampling Agency	Sample Date	pH
Maurice River	Still Run near Malaga	01411453	02040206	USGS	09/20/99	5.3
Maurice River	Still Run near Malaga	01411453	02040206	NJDEP	12/03/02	6.0
Maurice River	Still Run near Malaga	01411453	02040206	NJDEP	03/13/03	5.4
Maurice River	Still Run near Malaga	01411453	02040206	NJDEP	06/12/03	6.1
Maurice River	Still Run near Malaga	01411453	02040206	NJDEP	09/09/03	6.1
Maurice River	Still Run near Malaga	01411453	02040206	NJDEP	12/10/03	6.3
Maurice River	Still Run near Malaga	01411453	02040206	NJDEP	12/10/03	6.3
Maurice River	Still Run near Malaga	01411453	02040206	NJDEP	03/09/04	6.3
Maurice River	Still Run near Malaga	01411453	02040206	NJDEP	06/01/04	6.5
Maurice River	Still Run near Malaga	01411453	02040206	NJDEP	09/02/04	6.4

Impaired

Non-Impaired

Maurice River Watershed
Mercury Data

Watershed	Site Name	Species	Date	N	Total Weight (g)	Total Length (cm)		Age (years)		Sex	Hg Concentration (mg/kg wet weight)
						Avg.	Range	Avg.	Range		
Maurice River	Malaga Lake	Esox niger	1996	1		29.3	29.3				0.88
Maurice River	Malaga Lake	Esox niger	1996	1		31	31				0.99
Maurice River	Malaga Lake	Esox niger	1996	1		32	32				0.73
Maurice River	Malaga Lake	Esox niger	1996	1		34	34				1.38
Maurice River	Malaga Lake	Esox niger	1996	1		36.2	36.2				0.97
Maurice River	Malaga Lake	Micropterus salmoides	1996	1		32.4	32.4				0.95
Maurice River	Wilson Lake	Esox niger	1992	1		39.78	34.4 - 50.6	2.5	1 - 4		0.80
Maurice River	Wilson Lake	Chain Pickerel	10/28/1992		1056.1	50.6				M	1.06
Maurice River	Wilson Lake	Chain Pickerel	10/29/1992		339.4	37.8				M	0.24
Maurice River	Wilson Lake	Chain Pickerel	10/30/1992		287.9	36.3				M	0.38
Maurice River	Wilson Lake	Chain Pickerel	10/31/1992		245.3	34.4				F	1.53
Maurice River	Wilson Lake	Largemouth Bass	1992		574	355					0.74
Maurice River	Wilson Lake	Largemouth Bass	1992		830	470					1.75
Maurice River	Wilson Lake	Largemouth Bass	1992		781	400					0.88
Maurice River	Wilson Lake	Largemouth Bass	1992		509	345					0.90
Maurice River	Wilson Lake	Largemouth Bass	1992		199	256					0.90
Maurice River	Wilson Lake	Chain Pickerel	1992		628	470					1.14
Maurice River	Wilson Lake	Chain Pickerel	1992		135	305					0.88
Maurice River	Wilson Lake	Chain Pickerel	1992		620	470					1.30
Maurice River	Wilson Lake	Chain Pickerel	1992		172	295					0.66
Maurice River	Wilson Lake	Chain Pickerel	1992		94	257					0.91
Maurice River	Wilson Lake	Yellow Perch	1992		270	261					0.72
Maurice River	Wilson Lake	Yellow Perch	1992		180	245					0.65
Maurice River	Wilson Lake	Yellow Perch	1992		294	295					1.23
Maurice River	Wilson Lake	Yellow Perch	1992		350	300					1.08
Maurice River	Wilson Lake	Yellow Perch	1992		129	220					0.48
Maurice River	Wilson Lake	Pumpkinseed Sunfish	1992		140	182					1.52
Maurice River	Wilson Lake	Pumpkinseed Sunfish	1992		210	204					0.26

Maurice River Watershed
Mercury Data

Watershed	Site Name	Species	Date	N	Total Weight (g)	Total Length (cm)		Age (years)		Sex	Hg Concentration (mg/kg wet weight)
						Avg.	Range	Avg.	Range		
Maurice River	Wilson Lake	Pumpkinseed Sunfish	1992		152	185					0.60
Maurice River	Wilson Lake	Golden Shiner (forage)	1992		0	0					0.47
Maurice River	Wilson Lake	Golden Shiner (forage)	1992		0	0					0.29
Maurice River	Wilson Lake	Golden Shiner (forage)	1992		0	0					0.29
Maurice River	Wilson Lake	Golden Shiner (forage)	1992		0	0					0.40
Maurice River	Wilson Lake	Golden Shiner (forage)	1992		0	0					0.31

Women of reproductive age and children:

< 0.08 ppm	No Advisories
0.08 - 0.18 ppm	Limited Consumption (Less than one meal per week)
0.19 - 0.54 ppm	Limited Consumption (Less than one meal per month)
> 0.54 ppm	No consumption advised

Others:

< 0.35 ppm	No Advisories
0.35 - 0.93 ppm	Limited Consumption (Less than one meal per week)
0.947 - 2.81 ppm	Limited Consumption (Less than one meal per month)
> 2.81 ppm	No consumption advised

Non-Impaired

Impaired

APPENDIX C. MUNICIPAL REGULATION CHECKLIST

A P P E N D I X B

Municipal Regulations Checklist

A checklist for incorporating nonstructural stormwater management strategies into local regulations

As part of the requirements for municipal stormwater management plans in the Stormwater Management Rules at N.J.A.C. 7:8-4, municipalities are required to evaluate the municipal master plan, and land use and zoning ordinances to determine what adjustments need to be made to allow the implementation of nonstructural stormwater management techniques, also called low impact development techniques, which are presented in *Chapter 2: Low Impact Development Techniques*. *Chapter 3: Regional and Municipal Stormwater Management Plans* provides information on the development of municipal stormwater management plans, including the evaluation of the master plan, and land use and zoning ordinances. This checklist was prepared to assist municipalities in identifying the specific ordinances that should be evaluated, and the types of changes to be incorporated to address the requirements of the Stormwater Management Rules.

Part 1: Vegetation and Landscaping

Effective management of both existing and proposed site vegetation can reduce a development's adverse impacts on groundwater recharge and stormwater runoff quality and quantity.

A. Preservation of Natural Areas

Municipal regulations should include requirements to preserve existing vegetated areas, minimize turf grass lawn areas, and use native vegetation.

❑ Yes ❑ No Are applicants required to provide a layout of the existing vegetated areas, and a description of the conditions in those areas?

❑ Yes ❑ No Does the municipality have maximum as well as minimum yard sizing ordinances?

❑ Yes ❑ No Are residents restricted from enlarging existing turf lawn areas?

❑ Yes ❑ No Do the ordinances provide incentives for the use of vegetation as filters for stormwater runoff?

❑ Yes ❑ No Do the ordinances require a specific percentage of permanently preserved open space as part of the evaluation of cluster development?

B. Tree Protection Ordinances

Municipalities often have a tree ordinance to minimize the removal of trees and to replace trees that are removed. However, while tree ordinances protect the number of trees, they do not typically address the associated leaf litter or smaller vegetation that provides additional water quality and quantity benefits. Municipalities should consider enhancing tree ordinances to a forest ordinance that would also maintain the benefits of a forested area.

❑ Yes ❑ No Does the municipality have a tree protection ordinance?

❑ Yes ❑ No Can the municipality include a forest protection ordinance?

❑ Yes ❑ No If forested areas are present at development sites, is there a required percentage of the stand to be preserved?

C. Landscaping Island and Screening Ordinances

Municipalities often have ordinances that require landscaping islands for parking areas. The landscaping islands can provide ideal opportunities for the filtration and disconnection of runoff, or the placement of small LID-BMPs. Screening ordinances limit the view of adjoining properties, parking areas, or loading areas. Low maintenance vegetation can be required in islands and areas used for screening to provide stormwater quality, groundwater recharge, or stormwater quantity benefits.

❑ Yes ❑ No Do the ordinances require landscaping islands in parking lots, or between the roadway and the sidewalk? Can the ordinance be adjusted to require vegetation that is more beneficial for stormwater quality, groundwater recharge, or stormwater quantity, but that does not interfere with driver vision at the intersections?

❑ Yes ❑ No Is the use of bioretention islands and other stormwater practices within landscaped areas or setbacks allowed?

❑ Yes ❑ No Do the ordinances require screening from adjoining properties? Can the screening criteria require the use of vegetation to the maximum extent practicable before the use of walls or berms?

D. Riparian Buffers

Municipalities may have existing buffer and/or floodplain ordinances that require the protection of vegetation adjacent to streams. Municipalities should consult existing regulations adopted by the Department to ensure that riparian buffer or floodplain ordinances reflect the requirements of the Department within these areas. The municipality should consider conservation restrictions and allowable maintenance to ensure the preservation of these areas.

❑ Yes ❑ No Is there a stream buffer or floodplain ordinance in the community?

❑ Yes ❑ No Is the ordinance consistent with existing state regulatory requirements?

❑ Yes ❑ No Does the ordinance require a conservation easement, or other permanent restrictions on buffer areas?

❑ Yes ❑ No Does the ordinance identify or limit when stormwater outfall structures can cross the buffer?

❑ Yes ❑ No Does the ordinance give detailed information on the type of maintenance and/or activities that is allowed in the buffer?

Part 2: Minimizing Land Disturbance

The minimization of disturbance can be used at different phases of a development project. The goal is to limit clearing, grading, and other disturbance associated with development to protect existing features that provide stormwater benefits. Zoning ordinances typically limit the amount of impervious surfaces on building lots, but do not limit the amount of area that can be disturbed during construction. This strategy helps preserve the site's existing hydrologic character, as well as limiting the occurrence of soil compaction.

A. Limits of Disturbance

Designing with the terrain, or site fingerprinting, requires an assessment of the characteristics of the site and the selection of areas for development that would minimize the impact. This can be incorporated into the requirements for existing site conditions and the environmental impact statement. Limits of disturbance should be incorporated into construction plans reviewed and approved by the municipality. Setbacks should be evaluated to determine whether they can be reduced. The following maximum setbacks are recommended for low impact development designs:

- front yard – 20 feet;
- rear yard – 25 feet; and
- side yard – 8 feet.

❑ Yes ❑ No As part of the depiction of existing conditions, are environmentally critical and environmentally constrained areas identified? (Environmentally critical areas are areas or features with significant environmental value, such as steep slopes, stream corridors, natural heritage priority sites, and habitats of threatened and endangered species. Environmentally constrained areas are those with development restrictions, such as wetlands, floodplains, and sites of endangered species.)

❑ Yes ❑ No Can any of the existing setbacks be reduced?

❑ Yes ❑ No Are there maximum turf grass or impervious cover limits in any of the setbacks?

❑ Yes ❑ No Do the ordinances inhibit or prohibit the clearcutting of the project site as part of the construction?

❑ Yes ❑ No Is the traffic of heavy construction vehicles limited to specific areas, such as areas of proposed roadway? Are these areas required to be identified on the plans and marked in the field?

❑ Yes ❑ No Do the ordinances require the identification of specific areas that provide significant hydrologic functions, such as existing surface storage areas, forested areas, riparian corridors, and areas with high groundwater recharge capabilities?

❑ Yes ❑ No Does the municipality require an as-built inspection before issuing a certificate of occupancy? If so, does the inspection include identification of compacted areas, if they exist within the site?

❑ Yes ❑ No Does the municipality require the restoration to compacted areas in accordance with the Soil Erosion and Sediment Control Standards?

B. Open Space and Cluster Development

Open space areas are restricted land that may be set aside for conservation, recreation, or agricultural use, and are often associated with cluster development requirements. Since open space can have a variety of uses, the municipality should evaluate its open space ordinances to determine whether amendments are necessary to provide improved stormwater benefits.

- ❑ Yes ❑ No Are open space or cluster development designs allowed in the municipality?
- ❑ Yes ❑ No Are flexible site design incentives available for developers that utilize open space or cluster design options?
- ❑ Yes ❑ No Are there limitations on the allowable disturbance of existing vegetated areas in open space?
- ❑ Yes ❑ No Are the requirements to re-establish vegetation in disturbed areas dedicated for open space?
- ❑ Yes ❑ No Is there a maximum allowable impervious cover in open space areas?

Part 3: Impervious Area Management

The amount of impervious area, and its relationship to adjacent vegetated areas, can significantly change the amount of runoff that needs to be addressed by BMPs. Most of a site's impervious surfaces are typically located in the streets, sidewalks, driveway, and parking areas. These areas are further hampered by requirements for continuous curbing that prevent discharge from impervious surfaces into adjacent vegetated areas.

A. Streets and Driveways

Street widths of 18 to 22 feet are recommended for low impact development designs in low density residential developments. Minimum driveway widths of 9 and 18 feet for one lane and two lanes, respectively, are also recommended. The minimum widths of all streets and driveways should be evaluated to demonstrate that the proposed width is the narrowest possible consistent with safety and traffic concerns and requirements. Municipalities should evaluate which traffic calming features, such as circles, rotaries, medians, and islands, can be vegetated or landscaped. Cul-de-sacs can also be evaluated to reduce the radius area, or to provide a landscape island in the center.

- ❑ Yes ❑ No Are the street widths the minimum necessary for traffic density, emergency vehicle movement, and roadside parking?
- ❑ Yes ❑ No Are street features, such as circles, rotaries, or landscaped islands allowed to or required to receive runoff?
- ❑ Yes ❑ No Are curb cuts or flush curbs with curb stops an allowable alternative to raised curbs?
- ❑ Yes ❑ No Can the minimum cul-de-sac radius be reduced or is a landscaped island required in the center of the cul-de-sac?
- ❑ Yes ❑ No Are alternative turn-arounds such as "hammerheads" allowed on short streets in low density residential developments?
- ❑ Yes ❑ No Can the minimum driveway width be reduced?
- ❑ Yes ❑ No Are shared driveways permitted in residential developments?

B. Parking Areas and Sidewalks

A mix of uses at a development site can allow for shared parking areas, reducing the total parking area. Municipalities require minimum parking areas, but seldom limit the total number of parking spaces. Table 1 shows recommendations for minimum parking space ratios for low impact design:

Table 1: Low Impact Development Parking Space Ratios

Use	Parking Ratio per 1000 sq. ft. of Gross Floor Area
Professional office building	Less than 3.0
Shopping centers	Less than 4.5

❑ Yes ❑ No Can the parking ratios be reduced?

❑ Yes ❑ No Are the parking requirements set as maximum or median rather than minimum requirements?

❑ Yes ❑ No Is the use of shared parking arrangements allowed to reduce the parking area?

❑ Yes ❑ No Are model shared parking agreements provided?

❑ Yes ❑ No Does the presence of mass transit allow for reduced parking ratios?

❑ Yes ❑ No Is a minimum stall width of 9 feet allowed?

❑ Yes ❑ No Is a minimum stall length of 18 feet allowed?

❑ Yes ❑ No Can the stall lengths be reduced to allow vehicle overhang into a vegetated area?

❑ Yes ❑ No Do ordinances allow for permeable material to be used in overflow parking areas?

❑ Yes ❑ No Do ordinances allow for multi-level parking?

❑ Yes ❑ No Are there incentives to provide parking that reduces impervious cover, rather than providing only surface parking lots?

Sidewalks can be made of pervious material or disconnected from the drainage system to allow runoff to re-infiltrate into the adjacent pervious areas.

❑ Yes ❑ No Do ordinances allow for sidewalks constructed with pervious material?

❑ Yes ❑ No Can alternate pedestrian networks be substituted for sidewalks (e.g., trails through common areas)?

C. Unconnected Impervious Areas

Disconnection of impervious areas can occur in both low density development and high density commercial development, provided sufficient vegetated area is available to accept dispersed stormwater flows. Areas for disconnection include parking lot or cul-de-sac islands, lawn areas, and other vegetated areas.

❑ Yes ❑ No Are developers required to disconnect impervious surfaces to promote pollutant removal and groundwater recharge?

❑ Yes ❑ No Do ordinances allow the reduction of the runoff volume when runoff from impervious areas are re-infiltrated into vegetated areas?

❑ Yes ❑ No Do ordinances allow flush curb and/or curb cuts to allow for runoff to discharge into adjacent vegetated areas as sheet flow?

Part 4: Vegetated Open Channels

The use of vegetated channels, rather than the standard concrete curb and gutter configuration, can decrease flow velocity, and allow for stormwater filtration and re-infiltration. One design option is for vegetated channels that convey smaller storm events, such as the water quality design storm, and provide an overflow into a storm sewer system for larger storm events.

❑ Yes ❑ No Do ordinances allow or require vegetated open channel conveyance instead of the standard curb and gutter designs?

❑ Yes ❑ No Are there established design criteria for vegetated channels?

APPENDIX D. LOW IMPACT DEVELOPEMNT CHECKLIST

APPENDIX A

Low Impact Development Checklist

A checklist for identifying nonstructural stormwater management strategies incorporated into proposed land development

According to the NJDEP Stormwater Management Rules at N.J.A.C. 7:8, the groundwater recharge, stormwater quality, and stormwater quantity standards established by the Rules for major land development projects must be met by incorporating nine specific nonstructural stormwater management strategies into the project's design to the maximum extent practicable.

To accomplish this, the Rules require an applicant seeking land development approval from a regulatory board or agency to identify those nonstructural strategies that have been incorporated into the project's design. In addition, if an applicant contends that it is not feasible to incorporate any of the specific strategies into the project's design, particularly for engineering, environmental, or safety reasons, the Rules further require that the applicant provide a basis for that contention.

This checklist has been prepared to assist applicants, site designers, and regulatory boards and agencies in ensuring that the nonstructural stormwater management requirements of the Rules are met. It provides an applicant with a means to identify both the nonstructural strategies incorporated into the development's design and the specific low impact development BMPs (LID-BMPs) that have been used to do so. It can also help an applicant explain the engineering, environmental, and/or safety reasons that a specific nonstructural strategy could not be incorporated into the development's design.

The checklist can also assist municipalities and other land development review agencies in the development of specific requirements for both nonstructural strategies and LID-BMPs in zoning and/or land use ordinances and regulations. As such, where requirements consistent with the Rules have been adopted, they may supersede this checklist.

Finally, the checklist can be used during a pre-design meeting between an applicant and pertinent review personnel to discuss local nonstructural strategies and LID-BMPs requirements in order to optimize the development's nonstructural stormwater management design.

Since this checklist is intended to promote the use of nonstructural stormwater management strategies and provide guidance in their incorporation in land development projects, municipalities are permitted to revise it as necessary to meet the goals and objectives of their specific stormwater management program and plan within the limits of N.J.A.C. 7:8.

Low Impact Development Checklist

A checklist for identifying nonstructural stormwater management strategies incorporated into proposed land development

Municipality: ____________________

County: ____________________ Date: ____________________

Review board or agency: ____________________

Proposed land development name: ____________________

Lot(s): ____________________ Block(s): ____________________

Project or application number: ____________________

Applicant's name: ____________________

Applicant's address: ____________________

____

Telephone: ____________________ Fax: ____________________

Email address: ____________________

Designer's name: ____________________

Designer's address: ____________________

____

Telephone: ____________________ Fax: ____________________

Email address: ____________________

Part 1: Description of Nonstructural Approach to Site Design

In narrative form, provide an overall description of the nonstructural stormwater management approach and strategies incorporated into the proposed site's design. Attach additional pages as necessary. Details of each nonstructural strategy are provided in Part 3 below.

Part 2: Review of Local Stormwater Management Regulations

Title and date of stormwater management regulations used in development design:

____

Do regulations include nonstructural requirements? Yes: __________ No: __________

If yes, briefly describe: ____

____

____

List LID-BMPs prohibited by local regulations: ______________________________

____

____

Pre-design meeting held? Yes: ______ Date: ______________ No: __________

Meeting held with: ____

____

____

Pre-design site walk held? Yes: ______ Date: ______________ No: __________

Site walk held with: ____

____

____

Other agencies with stormwater review jurisdiction:

Name: ____

Required approval: ____

Name: ____

Required approval: ____

Name: ____

Required approval: ____

Part 3: Nonstructural Strategies and LID-BMPs in Design

3.1 Vegetation and Landscaping

Effective management of both existing and proposed site vegetation can reduce a development's adverse impacts on groundwater recharges and runoff quality and quantity. This section of the checklist helps identify the vegetation and landscaping strategies and nonstructural LID-BMPs that have been incorporated into the proposed development's design to help maintain existing recharge rates and/or minimize or prevent increases in runoff quantity and pollutant loading.

A. Has an inventory of existing site vegetation been performed? Yes: ____________ No: __________

If yes, was this inventory a factor in the site's layout and design? Yes: __________ No: __________

B. Does the site design utilize any of the following nonstructural LID-BMPs?

Preservation of natural areas? Yes: ________ No: __________ If yes, specify % of site: ________

Native ground cover? Yes: ________ No: __________ If yes, specify % of site: ________

Vegetated buffers? Yes: ________ No: __________ If yes, specify % of site: ________

C. Do the land development regulations require these nonstructural LID-BMPs?

Preservation of natural areas? Yes: ________ No: __________ If yes, specify % of site: ________

Native ground cover? Yes: ________ No: __________ If yes, specify % of site: ________

Vegetated buffers? Yes: ________ No: __________ If yes, specify % of site: ________

D. If vegetated filter strips or buffers are utilized, specify their functions:

Reduce runoff volume increases through lower runoff coefficient: Yes: ________ No: __________

Reduce runoff pollutant loads through runoff treatment: Yes: ________ No: __________

Maintain groundwater recharge by preserving natural areas: Yes: ________ No: __________

3.2 Minimize Land Disturbance

Minimizing land disturbance is a nonstructural LID-BMP that can be applied during both the development's construction and post-construction phases. This section of the checklist helps identify those land disturbance strategies and nonstructural LID-BMPs that have been incorporated into the proposed development's design to minimize land disturbance and the resultant change in the site's hydrologic character.

A. Have inventories of existing site soils and slopes been performed? Yes: ________ No: ________

If yes, were these inventories factors in the site's layout and design? Yes: ________ No: ________

B. Does the development's design utilize any of the following nonstructural LID-BMPs?

Restrict permanent site disturbance by land owners? Yes: ________ No: ________

If yes, how: ____

____

Restrict temporary site disturbance during construction? Yes: ________ No: ________

If yes, how: ____

____

Consider soils and slopes in selecting disturbance limits? Yes: ________ No: ________

If yes, how: ____

____

C. Specify percentage of site to be cleared: ________________ Regraded: ________________

D. Specify percentage of cleared areas done so for buildings: ________________

For driveways and parking: ________________ For roadways: ________________

E. What design criteria and/or site changes would be required to reduce the percentages in C and D above?

____

____

____

F. Specify site's hydrologic soil group (HSG) percentages:

HSG A: __________ HSG B: _____________ HSG C: ______________ HSG D: _____________

G. Specify percentage of each HSG that will be permanently disturbed:

HSG A: __________ HSG B: _____________ HSG C: ______________ HSG D: _____________

H. Locating site disturbance within areas with less permeable soils (HSG C and D) and minimizing disturbance within areas with greater permeable soils (HSG A and B) can help maintain groundwater recharge rates and reduce runoff volume increases. In light of the HSG percentages in F and G above, what other practical measures if any can be taken to achieve this?

____

____

____

I. Does the site include Karst topography? Yes: ________ No: ________

If yes, discuss measures taken to limit Karst impacts:

____

____

____

____

____

____

3.3 Impervious Area Management

New impervious surfaces at a development site can have the greatest adverse effect on groundwater recharge and stormwater quality and quantity. This section of the checklist helps identify those nonstructural strategies and LID-BMPs that have been incorporated into a proposed development's design to comprehensively manage the extent and impacts of new impervious surfaces.

A. Specify impervious cover at site: Existing: ____________________ Proposed: __________________

B. Specify maximum site impervious coverage allowed by regulations: ___________________________

C. Compare proposed street cartway widths with those required by regulations:

Type of Street	Proposed Cartway Width (feet)	Required Cartway Width (feet)
Residential access – low intensity		
Residential access – medium intensity		
Residential access – high intensity with parking		
Residential access – high intensity without parking		
Neighborhood		
Minor collector – low intensity without parking		
Minor collector – with one parking lane		
Minor collector – with two parking lanes		
Minor collector – without parking		
Major collector		

D. Compare proposed parking space dimensions with those required by regulations:

Proposed: ______________________________ Regulations: _________________________________

E. Compare proposed number of parking spaces with those required by regulations:

Proposed: ______________________________ Regulations: _________________________________

F. Specify percentage of total site impervious cover created by buildings:

By driveways and parking: ____________________ By roadways: __________________________

G. What design criteria and/or site changes would be required to reduce the percentages in F above?

____

____

____

____

H. Specify percentage of total impervious area that will be unconnected:

Total site: ______ Buildings: _________ Driveways and parking: _________ Roads: _________

I. Specify percentage of total impervious area that will be porous:

Total site: ______ Buildings: _________ Driveways and parking: _________ Roads: _________

J. Specify percentage of total building roof area that will be vegetated: __________________________

K. Specify percentage of total parking area located beneath buildings: __________________________

L. Specify percentage of total parking located within multi-level parking deck: ___________________

3.4 Time of Concentration Modifications

Decreasing a site's time of concentration (Tc) can lead directly to increased site runoff rates which, in turn, can create new and/or aggravate existing erosion and flooding problems downstream. This section of the checklist helps identify those nonstructural strategies and LID-BMPs that have been incorporated into the proposed development's design to effectively minimize such Tc decreases.

When reviewing Tc modification strategies, it is important to remember that a drainage area's Tc should reflect the general conditions throughout the area. As a result, Tc modifications must generally be applied throughout a drainage area, not just along a specific Tc route.

A. Specify percentage of site's total stormwater conveyance system length that will be:

Storm sewer: ____________ Vegetated swale: ______________ Natural channel: ________________

Stormwater management facility: ________________________ Other: _________________________

Note: the total length of the stormwater conveyance system should be measured from the site's downstream property line to the downstream limit of sheet flow at the system's headwaters.

B. What design criteria and/or site changes would be required to reduce the storm sewer percentages and increase the vegetated swale and natural channel percentages in A above?

____

____

____

C. In conveyance system subareas that have overland or sheet flow over impervious surfaces or turf grass, what practical and effective site changes can be made to:

Decrease overland flow slope: ____

____

____

Increase overland flow roughness: ____

____

____

3.5 Preventative Source Controls

The most effective way to address water quality concerns is by pollution prevention. This section of the checklist helps identify those nonstructural strategies and LID-BMPs that have been incorporated into the proposed development's design to reduce the exposure of pollutants to prevent their release into the stormwater runoff.

A. Trash Receptacles

Specify the number of trash receptacles provided: ____________________________

Specify the spacing between the trash receptacles: ____________________________

Compare trash receptacles proposed with those required by regulations:

Proposed: ______________________ Regulations: ____________________________

B. Pet Waste Stations

Specify the number of pet waste stations provided: ___________________________

Specify the spacing between the pet waste stations: ___________________________

Compare pet waste stations proposed with those required by regulations:

Proposed: ______________________ Regulations: ____________________________

C. Inlets, Trash Racks, and Other Devices that Prevent Discharge of Large Trash and Debris

Specify percentage of total inlets that comply with the NJPDES storm drain inlet criteria: _________

D. Maintenance

Specify the frequency of the following maintenance activities:

Street sweeping: Proposed: ______________________ Regulations: ________________________

Litter collection: Proposed: ______________________ Regulations: ________________________

Identify other stormwater management measures on the site that prevent discharge of large trash and debris:

____

____

E. Prevention and Containment of Spills

Identify locations where pollutants are located on the site, and the features that prevent these pollutants from being exposed to stormwater runoff:

Pollutant: ____________________ Location: ____________________

Feature utilized to prevent pollutant exposure, harmful accumulation, or contain spills:

Pollutant: ____________________ Location: ____________________

Feature utilized to prevent pollutant exposure, harmful accumulation, or contain spills:

Pollutant: ____________________ Location: ____________________

Feature utilized to prevent pollutant exposure, harmful accumulation, or contain spills:

Pollutant: ____________________ Location: ____________________

Feature utilized to prevent pollutant exposure, harmful accumulation, or contain spills:

Pollutant: ____________________ Location: ____________________

Part 4: Compliance with Nonstructural Requirements of NJDEP Stormwater Management Rules

1. Based upon the checklist responses above, indicate which nonstructural strategies have been incorporated into the proposed development's design in accordance with N.J.A.C. 7:8-5.3(b):

No.	Nonstructural Strategy	Yes	No
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 pre-construction time of concentration.		
5.	Minimize land disturbance including clearing and grading.		
6.	Minimize soil compaction.		
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 discharge into and through stable vegetated areas.		
9.	Provide preventative source controls.		

2. For those strategies that have not been incorporated into the proposed development's design, provide engineering, environmental, and/or safety reasons. Attached additional pages as necessary.

APPENDIX E. CLAYTON BOROUGH MITIGATION PROJECTS