6: SURFACE WATER

A. Watersheds

The Delaware River looking south from access just below the Musconetcong River.

A *watershed* (or basin) is the land area within the confines of a drainage divide in which all surface runoff will drain into a river, river system, or body of water. *Sub-watersheds* are those smaller drainage areas that make up a larger watershed. *Watershed management* is the process of managing and protecting all of the water resources within the area of a watershed, rather than on a site-specific basis. The NJDEP recognizes that watersheds are "nature's boundaries," and has established a watershed management approach (NJDEP, 1997). A watershed management approach is based on three key components: 1) a geographic focus; 2) continuous improvement based on sound science; and 3) partnerships/stakeholder involvement. More information concerning watershed management is presented in **Section 10C**.

All of Holland Township is within the Delaware River watershed. **Figure 6a** shows the sub-watersheds and streams either within or partially within Holland Township. The classification system used by the NJDEP assigns each watershed a 14-digit Hydrologic Unit Code (HUC14). The HUC14 is a hierarchical system where the first 4 digits (also known as a HUC4) refer to the major drainage basin. The Delaware River basin is assigned a HUC4 of "0204," and every sub-watershed within this basin has a HUC14 which starts with "0204." Various subsets of the 14 digits codes include HUC4, HUC6, HUC8, and HUC11.

Within Holland, the largest sub-watershed is Hakihokake Creek, also known historically as Quequamissicong Creek. Its named tributaries include the East and West Branches of Spring Mills Brook (entirely within Holland) and Little York Creek (partially within Holland). The Hakihokake Creek also drains part of Alexandria Township, very small portions of Bethlehem and Union Townships, and enters the Delaware River in Milford Boro. The segment of the stream within Milford Boro is usually referred to as Milford Creek[1].

"Water is vital to life and comprises an invaluable natural resource which is not to be abused by any segment of the State's population or economy." (NJAC 7:9B)

[1] Stream names in this part of New Jersey vary greatly between sources.

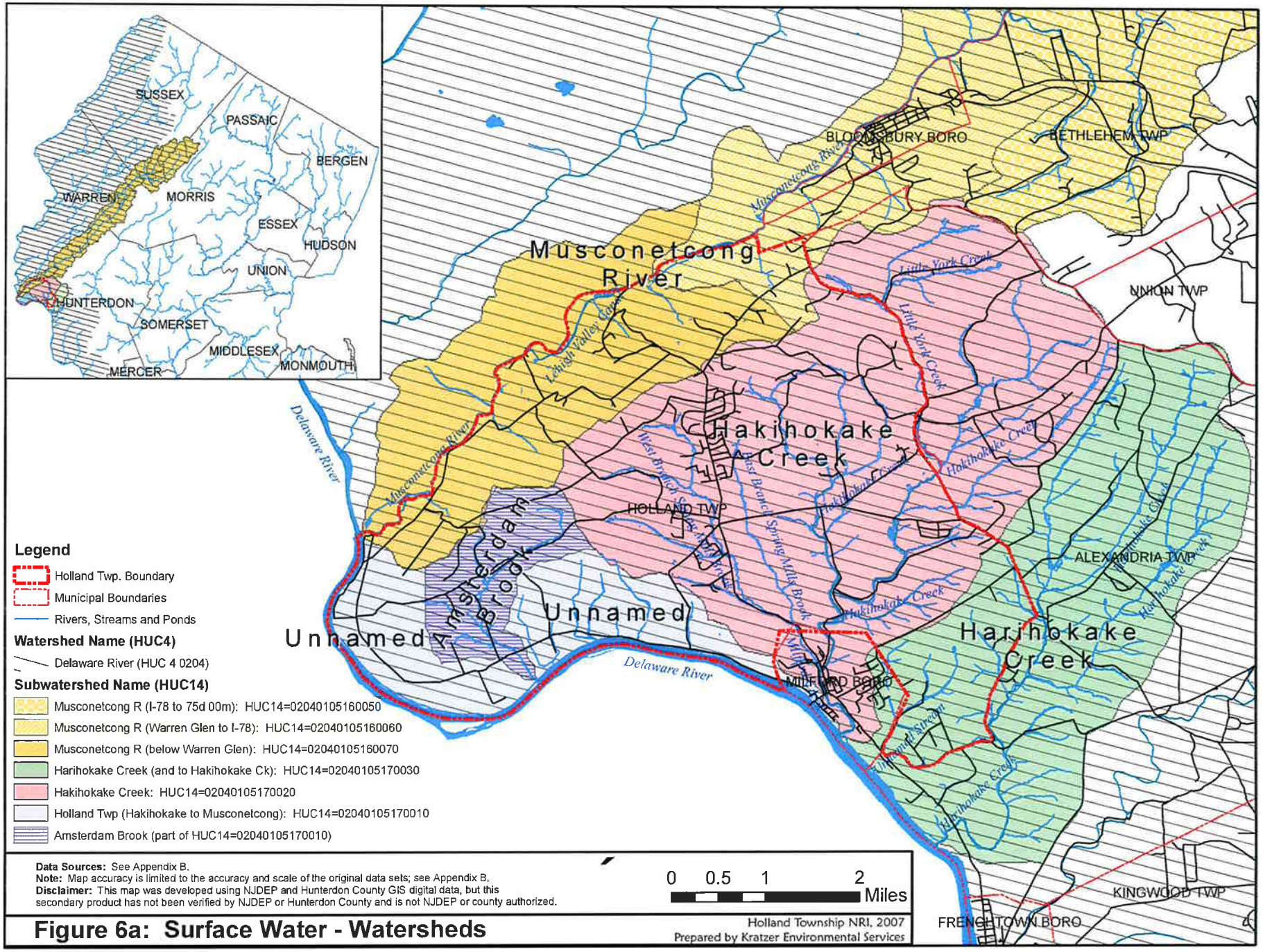


Figure 6a: Surface Water - Watersheds

The second largest portion of Holland lies within the Musconetcong River Watershed. In its entirety, the Musconetcong is much larger than the other sub-watersheds within Holland, and includes portions of Sussex, Morris, Warren and Hunterdon Counties, including Lake Hopatcong. The Musconetcong River forms the northeast border of Holland Township before entering the Delaware River at Riegelsville, NJ.

The Harihokake Creek watershed lies primarily within Alexandria Township, but includes part of Holland Township and a few acres within Union Township. A small unnamed watershed that lies between Harihokake and Hakihokake is grouped with the Harihokake watershed in NJDEP's watershed delineations. It drains parts of Holland Township and Milford Boro and marks the boundary between Milford and Alexandria.

One small sub-watersheds lies entirely within Holland Township, locally known as Amsterdam Brook, as well as and a number of unnamed intermittent streams draining the cliffs along the Delaware River. In addition, some land drains directly to the Delaware River without first entering a stream.

B. Floodplains/Flood Prone Areas

A *floodplain* is the land along a river or stream that is subject to periodic flooding when the river or stream overflows its banks. The Federal Emergency Management Administration (FEMA) is responsible for delineating floodplains. Floodplain management is the operation of a community program of corrective and preventative measures for reducing flood damage. These measures may include zoning, subdivision, or building requirements, and special-purpose floodplain ordinances. Community involvement is an important element in making flood insurance available to home and businesses owners.

Flood prone areas in Holland are shown in **Figure 6b**, based on FEMA determinations and also on soils which show evidence of flooding. Frequent flooding occurs in areas adjacent to the Musconetcong River, Amsterdam Brook, Spring Mills East and West Branches, Hakihokake Creek and Harihokake Creek. Flooding occasionally occurs along the Delaware River, including portions of Route 627 (Riegelsville-Milford Road). A small area in one of the headwater tributaries of Hakihokake Creek is mapped as rarely flooded. The remainder of the township is not subject to flooding.

Delaware River flooding in September 2004 (caused by tropical storm Ivan) and April 2005 (caused by a major thunderstorm) (see **Section 2B** and **Table 2.3** for more information about these and other floods) damaged an estimated 3,500 homes and forced the evacuation of more than 5,500 people in New Jersey and Pennsylvania. In response, a Flood Mitigation Task Force was established to study and implement measures to reduce future impacts of flooding in New Jersey communities. Findings of the draft report include the following:

- The floodplains should be expected to flood.
- No set of measures, alone or in combination, will stop or eliminate flooding in the Delaware River Floodplain.
- The potential for hurricanes and other extreme weather events to be more intense and more frequent means that the risks and foreseeable consequences of flooding are increasing in magnitude.

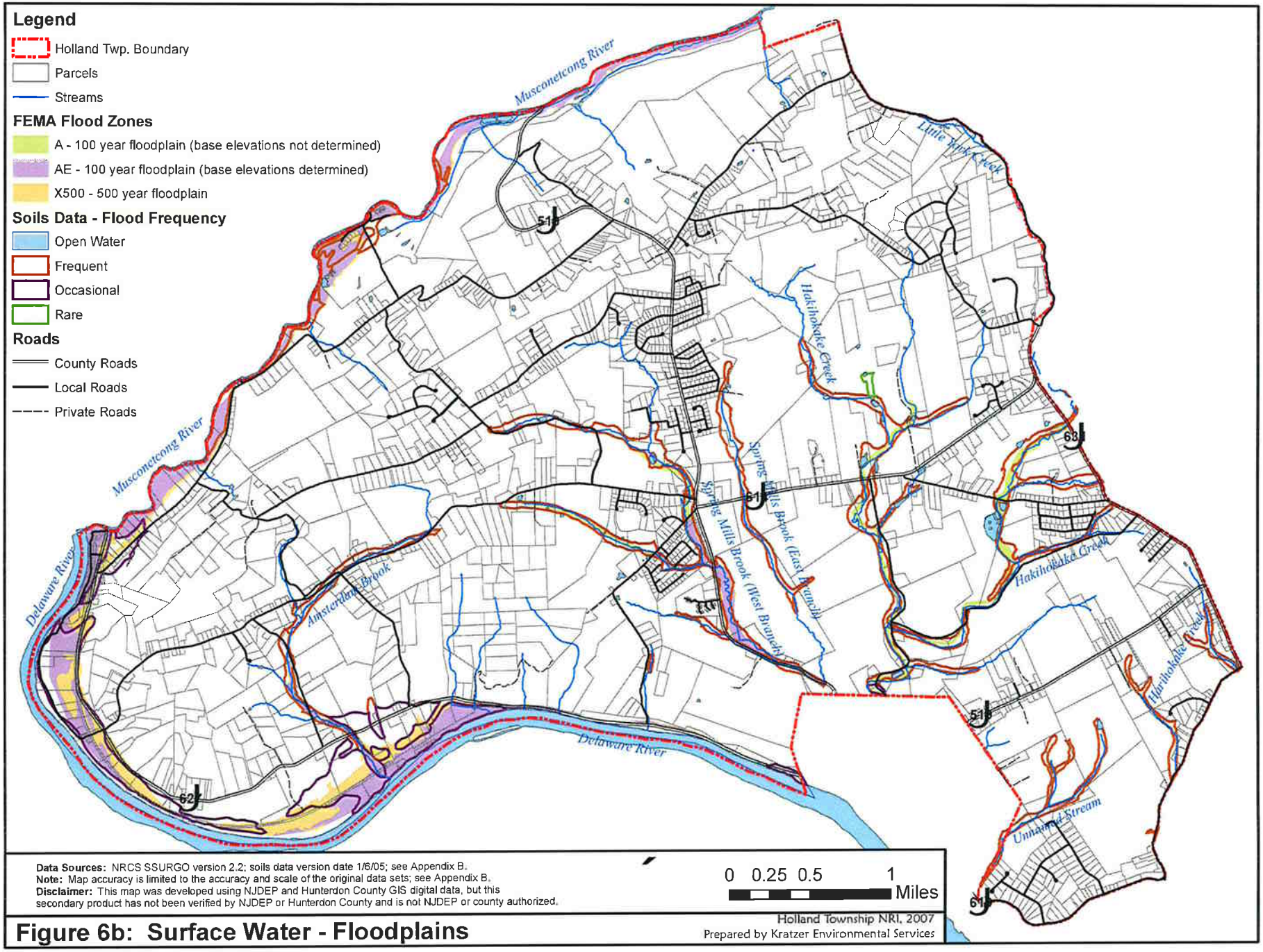


Figure 6b: Surface Water - Floodplains

- Better planning, stricter protection of flood plains, increased efforts to restore disturbed and developed floodplain areas, and more rational rebuilding standards can significantly reduce economic loss to New Jersey from flooding when it occurs.
- The current patchwork of floodplain delineations, many of them long out of date, must be updated if risk reduction strategies are to be effective in reducing losses.
- The Delaware River Basin Commission's (DRBC) "Recommendations to Address Flood Warning Deficiencies" must be fully implemented to provide the public with adequate response time and information as incorporated in the recommendations below (New Jersey Flood Mitigation Task Force, 2006 DRAFT).

Riparian buffer and wetlands protection regulations and ordinances can also reduce flood damage by protecting those areas most susceptible to flooding and providing natural flood control.

C. Wetlands

A *wetland* is a transitional area between aquatic and terrestrial ecosystems. Wetlands are those areas that are inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation. To determine if an area is a wetland, the vegetation (plants that like wet conditions), soils (wetland types, which often show mottling) and hydrology (low spots or evidence of water) are evaluated. A *transition area*, or buffer, is an area of land adjacent to a freshwater wetland which minimizes adverse impacts on the wetland or serves as an integral component of the wetlands ecosystem (N.J.S.A. 13:9B 9B-3).

Wetland plants may include New York Ironweed, here being enjoyed by a black swallowtail butterfly.

In the past, wetlands were often regarded as wastelands – only useful when drained and filled. In contrast, a 1978 Tufts University study showed that one acre of wetland provides at least $153,000 (1978 dollars) of public value, considering proven monetary benefits of flood protection, pollution reduction, water supply, recreation and aesthetics (Fair, 2004). Some of the benefits of wetlands include:

- Wetlands protect drinking water by filtering out pollutants and sediments that would otherwise obstruct and contaminate our waters.
- Wetlands soak up runoff from heavy rains and snow melts, providing natural flood control.
- Wetlands release stored waters during droughts.

- Wetlands provide critical habitats for a major proportion of the state's fish and wildlife, including many endangered, commercial and recreational species.
- Wetlands provide high quality open space for recreation and tourism (NJDEP Land Use Regulation, 2006).

However, already over 54% of the total wetlands in the continental US have been lost, and an additional 200,000 acres disappear every year (NJDEP Land Use Regulation, 2006). Loss of wetlands has resulted in erosion, flooding, sedimentation, and decreased populations of many types of wildlife. Structures built in wetlands suffer from frost heaving and other structural problems.

New Jersey protects wetlands under the 1987 New Jersey Freshwater Wetlands Protection Act (N.J.S.A. 13:9B). This law requires NJDEP to regulate virtually all activities proposed within wetlands and transition areas or buffers around freshwater wetlands, including cutting of vegetation, dredging, excavation or removal of soil, drainage or disturbance of the water level, and filling or discharge of any materials. Development which would impair the wetland's ability to provide the values listed above (filtration, flood control, etc.) is prohibited. There are limited exemptions for existing farming, ranching, or forestry operations.

On-site inspection (direct testing and observation of soils, hydrology and vegetation) by a qualified professional is needed prior to making any disturbance within a wetland or transition area. Only an official determination from NJDEP, called a *Letter of Interpretation* (LOI) can verify the presence, absence, or boundaries of freshwater wetlands and transition areas on a site. Copies of these maps are filed at the NJDEP and the township building, but unfortunately, NJDEP does not digitize these determinations into a GIS layer[2].

In addition to defining the boundary of the wetland, the LOI establishes the value of the wetland, which will determine the width of the regulated transition area. *Ordinary Value* wetlands, such as man-made drainage ditches and swales, have a 0 foot buffer. *Intermediate Value* wetlands have a 50 foot buffer, which includes those wetlands not included in the definitions of Ordinary or Exceptional value. *Exceptional Value* wetlands have a 150 foot buffer width. Exceptional Value wetlands include wetlands which provide habitat for endangered and threatened species and those contiguous with FW-1, FW-2 Trout Production waters and their tributaries, and Category 1 classified streams (see **Section 6D**, below). A determination of threatened and endangered species habitat is provided by using the Landscape Project data (see **Section 7E**).

There are several types of freshwater wetlands in Holland Township, such as coniferous or deciduous wooded wetlands, scrub/shrub wetlands, and herbaceous wetlands and vernal pools (see **Section 7B**).

The New Jersey freshwater wetlands maps (which were used to make **Figure 6c**) provide guidance on where wetlands are found in Holland Township. For this GIS data layer, NJDEP mapped all freshwater wetland polygons greater than 1 acre in area and all linear freshwater wetland features greater than 10 feet in width, using the 1995/1997 aerial photos. This dataset is intended to serve as a resource for analysis rather than regulatory delineations. The maximum transition area widths of 150 feet are mapped in **Figure 6C**, because the GIS data does not distinguish wetland values.

[2] Digitizing involves giving latitude and longitude coordinates to areas and lines to depict mapped features.

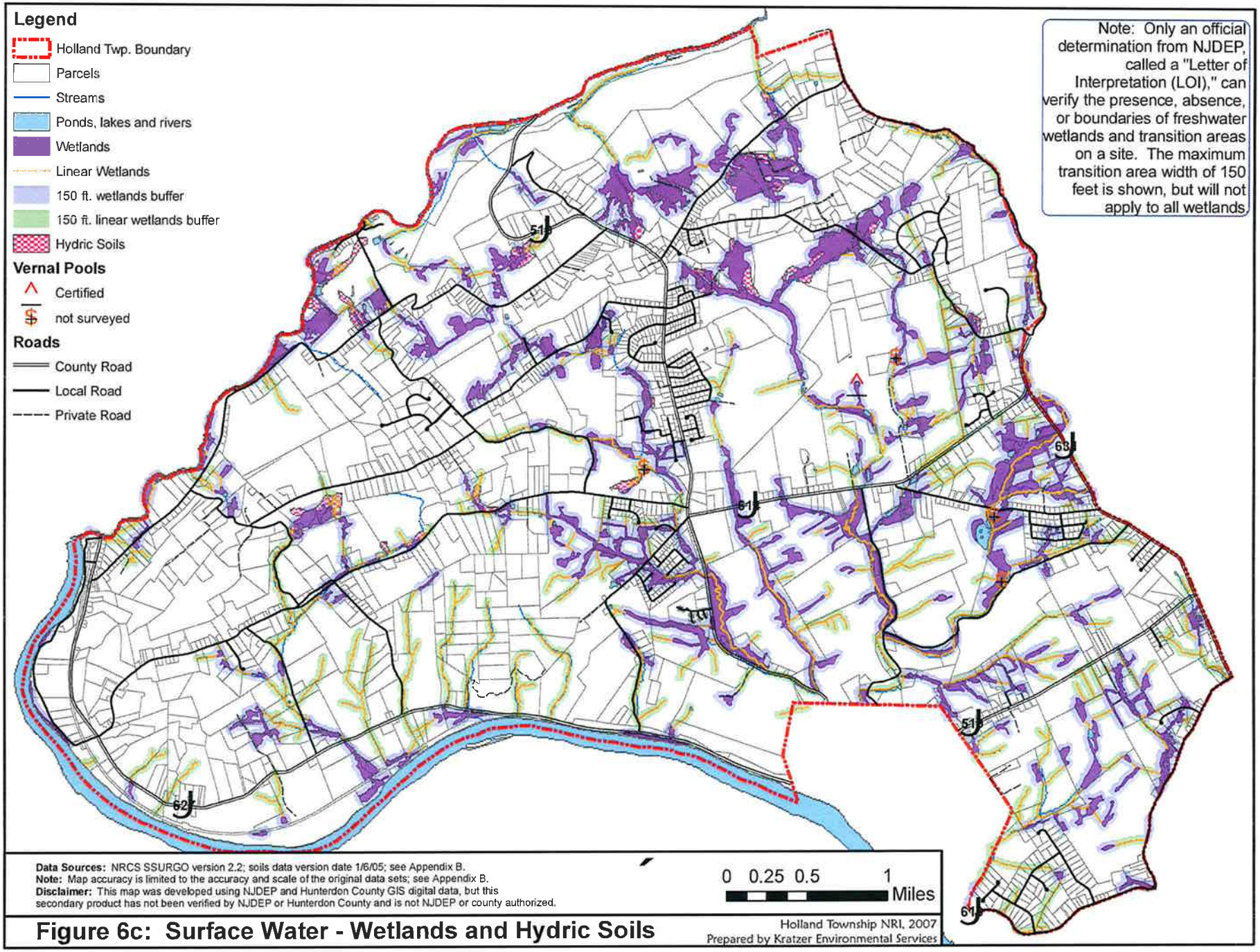


Figure 6c: Surface Water - Wetlands and Hydric Soils

Holland Township NRI, 2007
Prepared by Kratzer Environmental Services

D. Surface Water Quality Standards

Surface Water Quality Standards (SWQS) are the rules in chapter N.J.A.C. 7:9B which set forth designated uses, use classifications, and water quality criteria for the State's waters based upon the uses, and the NJDEP's policies concerning these uses, classifications and criteria, which are necessary to protect the State's waters. The SWQS operate in conformance with the Federal Water Pollution Control Act (33 U.S.C. 1313(c)), commonly known as the Clean Water Act (CWA), and the Federal Water Quality Standards Regulation at 40 CFR 131.

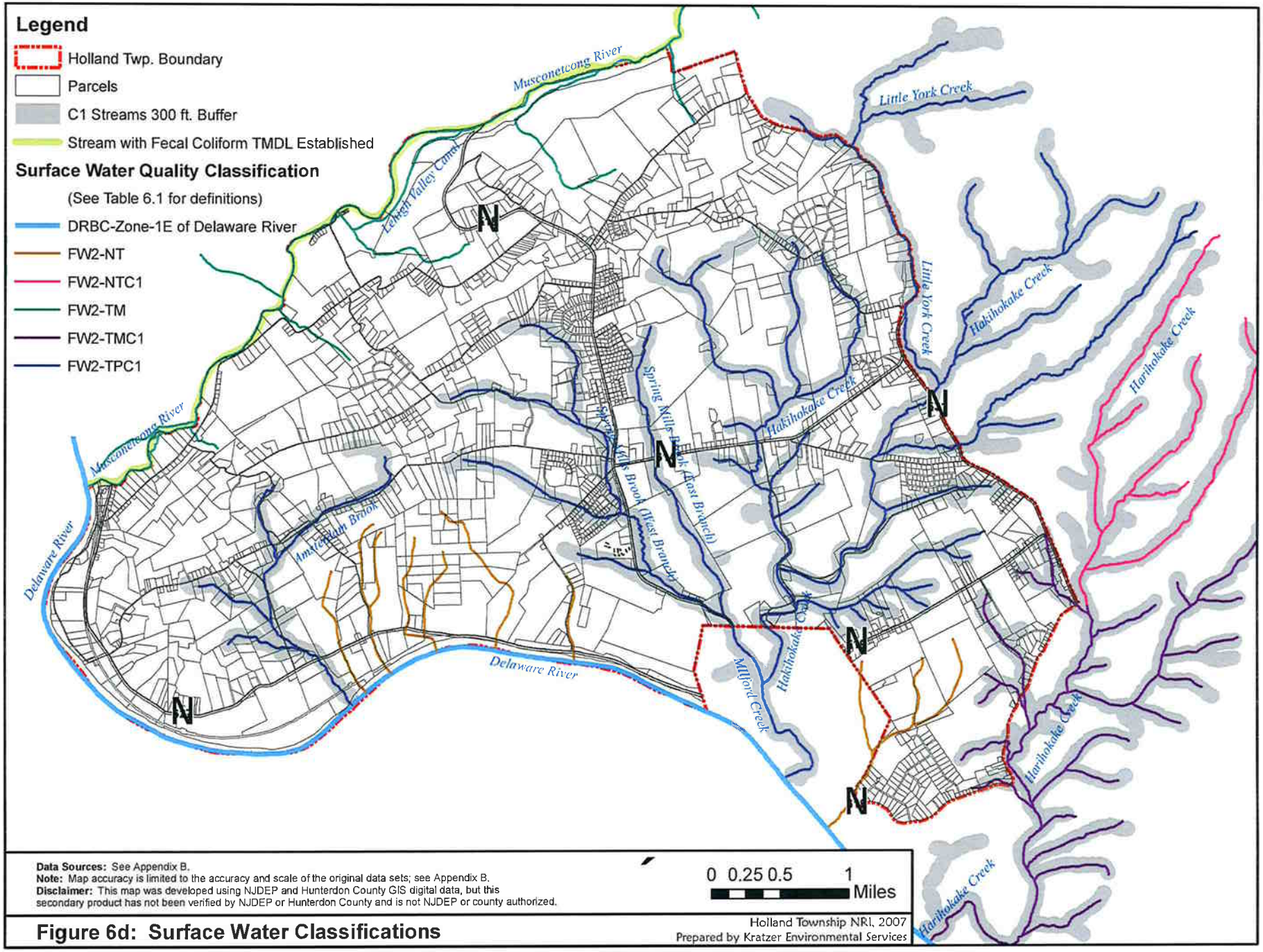
According to NJDEP, in its November 2003 Surface Water Quality Standards N. J. A. C. 7:9B,

> "Water is vital to life and comprises an invaluable natural resource which is not to be abused by any segment of the State's population or economy. It is the policy of the State to restore, maintain and enhance the chemical, physical and biological integrity of its waters, to protect the public health, to safeguard the aquatic biota, protect scenic and ecological values, and to enhance the domestic, municipal, recreational, industrial, agricultural and other reasonable uses of the State's waters.
>
> "The restoration, maintenance and preservation of the quality of the waters of the State for the protection and preservation of public water supplies is a paramount interest of the citizens of New Jersey. In order to provide adequate, clean supplies of potable water, it is the policy of the State that all fresh waters be protected as potential sources of public water supply. Therefore, point and nonpoint sources of pollutants shall be regulated to attain compliance with the Surface Water Quality Standards human health criteria outside of regulatory mixing zones." (NJAC 7:9B)

According to the designated uses under the SWQS, NJDEP assigns *surface water classifications* to each stream in order to group waters and assign water quality criteria. Designated uses include potable water, propagation of fish and wildlife, recreation, agricultural and industrial supplies, and navigation. The *criteria* are numerical targets for constituent concentrations (such as toxic pollutants) or narratives that describe in-stream conditions to be attained, maintained or avoided, so that the specified uses are protected for the different use classifications.

The SWQS are used by several NJDEP programs, including the New Jersey Pollutant Discharge Elimination System program, Site Remediation program, Stream Encroachment, Land Use Regulation Program and Total Maximum Daily Loads (TMDLs, see **Section 6H**).

Table 6.1 describes the definitions of the categories, while **Figure 6d** illustrates the stream categories within Holland. In **Figure 6d**, "category" is shown, which is a compendium of all surface water classification designations for a given water body. Category describes a stream's surface water classification in terms of its general surface water class (e.g. FW2), its trout water status (e.g. TP) and its antidegradation status (e.g. C1).



Data Sources: See Appendix B.
Note: Map accuracy is limited to the accuracy and scale of the original data sets; see Appendix B.
Disclaimer: This map was developed using NJDEP and Hunterdon County GIS digital data, but this secondary product has not been verified by NJDEP or Hunterdon County and is not NJDEP or county authorized.

Figure 6d: Surface Water Classifications

Holland Township NRI, 2007
Prepared by Kratzer Environmental Services

Table 6.1: Surface Water Quality Standards Classification

Category	Definition
Freshwater General Surface Water Class	
FW1	FW1 means those fresh waters, as designated in N.J.A.C. 7:9B-1.15(h) Table 6, that are to be maintained in their natural state of quality (set aside for posterity) and not subjected to any man-made wastewater discharges or increases in runoff from anthropogenic activities. These waters are set aside for posterity because of their clarity, color, scenic setting, other characteristic of aesthetic value, unique ecological significance, exceptional recreational significance, exceptional water supply significance, or exceptional fisheries resource(s). In all FW1 waters the designated uses are: 1. Set aside for posterity to represent the natural aquatic environment and its associated biota; 2. Primary and secondary contact recreation; 3. Maintenance, migration and propagation of the natural and established aquatic biota; and 4. Any other reasonable uses.
FW2	FW2 means the general surface water classification applied to those fresh waters that are not designated as FW1 or Pinelands Waters. In all FW2 waters the designated uses 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.
Delaware River	The designated uses for the main-stem Delaware River and Delaware Bay are those contained in "Delaware River Basin Commission, Water Quality Regulations, Administrative Manual - Part III," Article 3, dated October 23, 1996, including all amendments and future supplements thereto.
Trout Water Status - this is for information only and does not affect the water quality criteria for those waters.	
TP	*Trout production* waters means waters designated at N.J.A.C. 7:9B-1.15(b) through (g) for use by trout for spawning or nursery purposes during their first summer.
TM	*Trout maintenance* waters means waters designated at N.J.A.C. 7:9B-1.15(b) through (g) for the support of trout throughout the year.
NT	*Nontrout waters* means fresh waters that have not been designated in N.J.A.C. 7:9B-1.15(b) through (h) as trout production or trout maintenance. These waters are generally not suitable for trout because of their physical, chemical, or biological characteristics, but are suitable for a wide variety of other fish species.
Antidegradation	
ONRW	*Outstanding National Resource Waters* are high quality waters that constitute an outstanding national resource (for example, waters of National/State Parks and Wildlife Refuges and waters of exceptional recreational or ecological significances) as designated in N.J.A.C. 7:9B-1.15(i). Waters classified as FW1 waters and Pinelands waters are Outstanding National Resource Waters.
Non-degradation	*Nondegradation waters* means those waters set aside for posterity because of their clarity, color, scenic setting, other characteristic of aesthetic value, unique ecological significance, exceptional recreational significance, or exceptional water supply significance. These waters include all waters designated as FW1 in this subchapter. The quality of Nondegradation waters shall be maintained in their natural state (set aside for posterity) and shall not be subject to any manmade wastewater discharges. The Department shall not approve any activity which, alone or in combination with any other activities, might cause changes, other than toward natural water quality, in the existing surface water quality characteristics.
C1	*Category one waters* means those waters designated in the tables in N.J.A.C. 7:9B-1.15(c) through (h), designated for purposes of implementing the antidegradation policies set forth at N.J.A.C. 7:9B-1.5(d), 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 resource(s).

Table 6.1: Surface Water Quality Standards Classification

Category	Definition
	Category One Waters shall be protected from any measurable changes (including calculable or predicted changes) to the existing water quality. Water quality characteristics that are generally worse than the water quality criteria, except as due to natural conditions, shall be improved to maintain or provide for the designated uses where this can be accomplished without adverse impacts on organisms, communities or ecosystems of concern.
C2	*Category two waters* are those waters not designated as Outstanding National Resource Waters or Category One at N.J.A.C. 7:9B-1.15 for purposes of implementing the antidegradation policies set forth at N.J.A.C. 7:9B-1.5(d). For Category Two Waters, water quality characteristics that are generally better than, or equal to, the water quality standards shall be maintained within a range of quality that shall protect the existing/designated uses, as determined by studies acceptable to the Department, relating existing/designated uses to water quality. Where such studies are not available or are inconclusive, water quality shall be protected from changes that might be detrimental to the attainment of the designated uses or maintenance of the existing uses. Water quality characteristics that are generally worse than the water quality criteria shall be improved to meet the water quality criteria.
Source: NJDEP 2003: http://www.state.nj.us/dep/wmm/sgwqt/swqsdocs.html	

E. Streams Adopted for Category 1 Classification

Waterways can be designated Category One (C1) because of exceptional ecological significance, exceptional water supply significance, exceptional recreational significance, exceptional shellfish resource, or exceptional fisheries resource. The C1 designation provides additional protections that help prevent water quality degradation and discourage development where it would impair or destroy natural resources and environmental quality.

The antidegradation provisions of the SWQS are triggered when an applicant proposes an activity that has the potential to lower water quality. Previously approved wastewater discharges authorized through the NJPDES program as well as existing developments are not subject to the antidegradation policies unless a new or expanded activity is proposed. Under the February 2004 Stormwater Management rules, 300 foot buffers must be maintained in a natural state adjacent to all C1 waters and upstream tributaries of C1 waters (including named and unnamed tributaries). However, where the buffer is already disturbed, the width may be reduced in the disturbed area, but will not be permitted to extend less than 150 feet from either bank. The buffer will not affect existing development. The buffer requirement can also be adjusted to reflect local conditions through the approval of a stream corridor protection plan as part of a regional stormwater management plan. Wetlands contiguous with C1 streams are considered Exceptional Value Wetlands, which receive a buffer width of 150 feet.

The entire length of the Harihokake Creek was adopted by NJDEP for C1 classification on July 12, 2004 (Round 3, proposed Nov. 3, 2003), including all named and unnamed tributaries, based on "exceptional ecological significance". The use classifications remain as follows: Source to Rt. 519 Bridge, including all tributaries FW2-NT and Rt. 519 Bridge to Delaware River, including all tributaries FW2-TM as indicated at N.J.A.C. 7:9B-1.15(d). Data on the health of the benthic macroinvertebrate community in Harihokake Creek indicate low stress (non-impaired) to the aquatic community with high percentage and good diversity of intolerant organisms. The in-stream habitat quality assessment indicates optimal to slightly less than optimal habitat quality at different locations throughout creek. The Harihokake Creek received a good Fish IBI rating with 13 different species identified in the stream and an optimal

habitat assessment rating. Harihokake Creek supports a non-impaired aquatic community with optimal to suboptimal habitat quality, and a good Fish IBI rating. With respect to endangered and threatened species, Harihokake Creek has reported wood turtle sightings, primarily in the upper portions of the drainage. In addition, Harihokake Creek is a cool, clear forested rock stream with shale/argillite-underlain substrate, which provides suitable habitat for the State threatened long-tailed salamander. See **Section 7D** and **Appendix C** for further information about these species.


Hakihokake Creek at Javes Road.

Hakihokake Creek is also classified FW2-TP(C1) for its entire length, including headwaters known as Little York Creek. In addition, a tributary to the Delaware River locally known as Amsterdam Brook, and listed in the regulation as "Tributary, Delaware River 57000 UNT to 57000 @170.90 (Holland) - Holland Township (Hakihokake to Musconetcong)" is designated for its entire length as FW2-TP(C1) (NJDEP, N.J.A.C. 7:9B, 2004).

The Musconetcong River has been nominated for C1 status by NJDEP, the Delaware Riverkeeper Network (DRN), NJPIRG Citizen Lobby, Environmental Federation, Sierra Club NJ Chapter and Musconetcong Watershed Association (MWA). Justifications include open space resources in the watershed, inclusion in the Wild and Scenic Rivers system, importance as a state water resource, endangered and threatened species habitat, drinking water source, and recreational resource (NJDEP web site, 2006). A regulation to designate the Musconetcong as a C1 stream has not yet been proposed.

F. Point Source Pollution

Point source pollution refers to discernible, confined, and discrete conveyance, including, but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container,


Left: The Delaware River at Gilbert Generating Station. Right: The paper plant at Hughesville.

rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel, or other floating craft, from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture (NJDEP SWQS NJAC 7:9B p.7).

Point source discharges are regulated by NJDEP under the New Jersey Pollutant Discharge Elimination System (NJPDES). There are 12 such discharges existing within Holland Township (see **Table 6.2** and **Figure 6d**).

Table 6.2: NJ Pollutant Discharge Elimination System (NJDPES) Surface Water Discharges

NJPDES ID. #	Facility Name	Comments	Pipe *	Discharge Type*	Receiving Waters
NJ0004421.001A	Fibermark - Hughesville	Discharge pt at metering bldg - approx 100 ft from river	B	IMI	Musconetcong River
NJ0004421.002A	Fibermark - Hughesville	At discharge	B	IMI	Musconetcong River via mill race
NJ0004448.001A	Fibermark - Warren Glen	At end of pipe	B	IMJ	Musconetcong River via mill tailrace
NJ0005517.001A	JCP&L - Gilbert G S		B	IMJ	Delaware River (Zone 1E)
NJ0005517.003A	JCP&L - Gilbert G S		B	IMJ	Delaware River (Zone 1E)
NJ0005517.004A	JCP&L - Gilbert G S	004A 005A 006A combine and discharge at XXX0	B	IMJ	Delaware River (Zone 1E)
NJ0005517.005A	JCP&L - Gilbert G S	004A 005A 006A combine and discharge at XXX0	B	IMJ	Delaware River (Zone 1E)
NJ0005517.006A	JCP&L - Gilbert G S	004A 005A 006A combine and discharge at XXX0	B	IMJ	Delaware River (Zone 1E)
NJ0031372.001A	Corrugated Paper Group Lp	At outfall	C	IMI	Delaware River (Zone 1E)
NJ0005517.002A	JCP&L - Gilbert G S		B	IMJ	Delaware River (Zone 1E)
NJ0005517.XXX0	JCP&L - Gilbert G S	Outfall has combined discharge from 004A 005A 006A	B	IMJ	Delaware River (Zone 1E)
NJ0140619.001A	Holland Twp Municipal Garage	Location from Site Plan	B	IMI	Hakihokake Ck via unnamed tributary & storm sewer

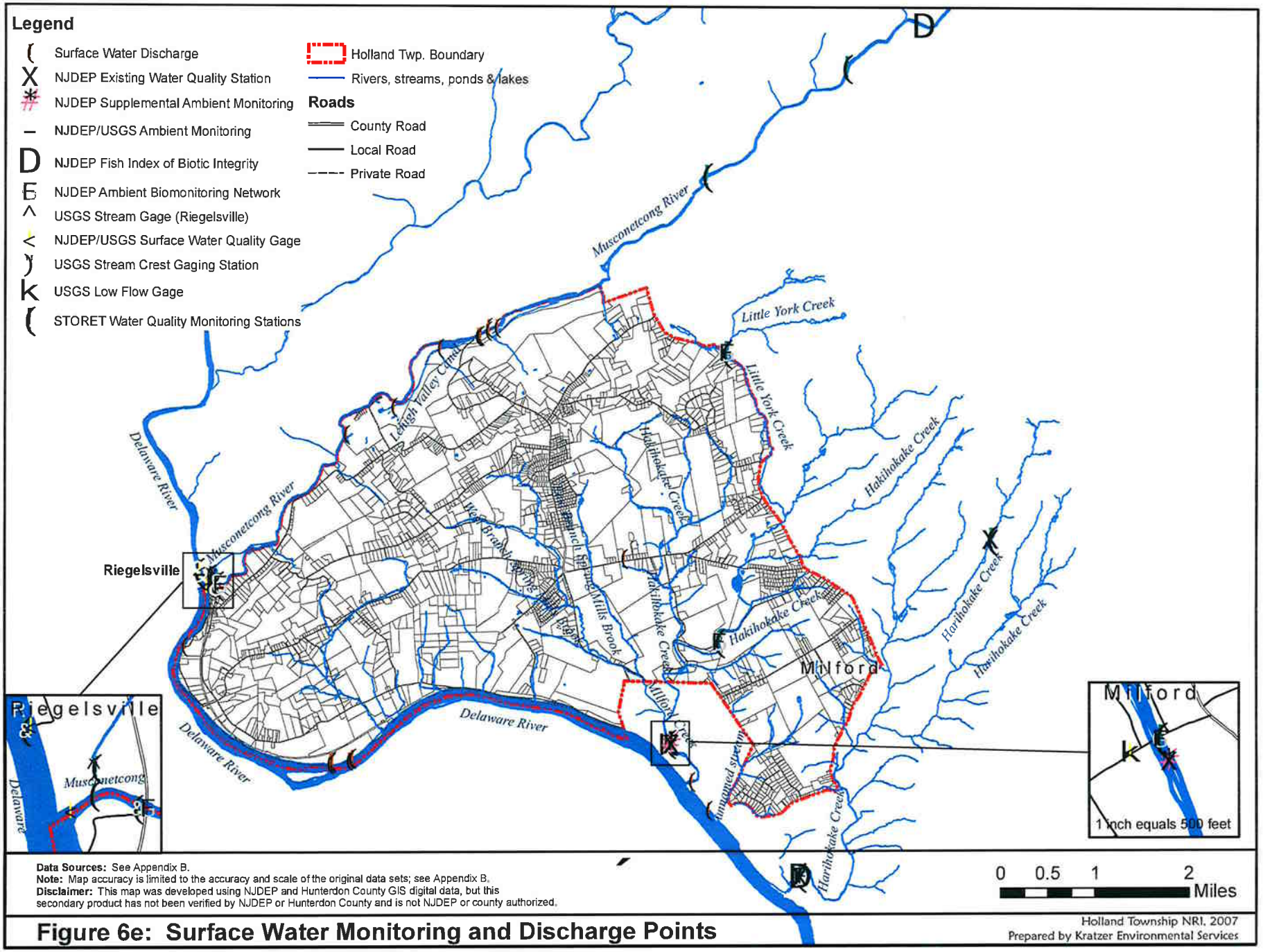
***Notes for Above Codes** (NJDEP's codes and definitions were used):
Pipe category: **B**=Industrial discharge; **C**=thermal discharge
Discharge type: **IMJ**=Industrial Major - based on the amount of pollutant(s) in the effluent; **IMI**= Industrial Minor - based on the amount of pollutant(s) in the effluent

Source: GIS data layer NJPDES Surface Water Discharges in New Jersey (2005) file name=njdesswd.shp

G. Nonpoint Source Pollution

Nonpoint source or NPS pollution is any man-made or man-induced activity, factor, or condition, other than a point source, from which pollutants are or may be discharged. Nonpoint pollution may temporarily or permanently change any chemical, physical, biological, or radiological characteristic of water from what was or is the natural, pristine condition of such water. Nonpoint source pollution is directly associated with stormwater.

When water flows off impervious surfaces, such as buildings, homes, parking lots and roads and through storm drains and ditches, it is known as *stormwater*. As the velocity of water increases, the amount that can infiltrate into the soil and ground water is reduced and scouring



Data Sources: See Appendix B.
Note: Map accuracy is limited to the accuracy and scale of the original data sets; see Appendix B.
Disclaimer: This map was developed using NJDEP and Hunterdon County GIS digital data, but this secondary product has not been verified by NJDEP or Hunterdon County and is not NJDEP or county authorized.

Figure 6e: Surface Water Monitoring and Discharge Points

Holland Township NRI, 2007
Prepared by Kratzer Environmental Services

and erosion increase. The stormwater eventually discharges into streams and rivers, carrying pollutants that it has picked up along the way (e.g. trash, used motor oil, sediments, fertilizers, pesticides, pet droppings, etc.). The transport of these pollutants into local water bodies can result in the destruction of fish, wildlife, and habitats; threats to public health due to contaminated food and drinking water supplies; and losses of recreational and aesthetic values.


Stream bank erosion.

The NJDEP's February 2004 stormwater management requirements established new performance standards for all major developments, requirements for best management practices (BMP), and establishment of buffer area protections for Category One waterways. The emphasis is on increasing ground water recharge and reducing nonpoint source pollution (N.J.A.C. 7:8).

The purpose of the Municipal Stormwater Regulation Program is to ensure a consistent approach to stormwater management statewide, reduce costs for regulated entities, and allow for a simple process for requesting authorization. All municipalities within the State are assigned either Tier A (more developed or coastal) or Tier B (less developed and non-coastal; Holland Township is Tier B). The permits address stormwater quality related issues to new and existing development and redevelopment by requiring the preparation of a stormwater program and implementation of specific permit requirements referred to as Statewide Basic Requirements (SBRs). The Tier B Permit concentrates on new development and redevelopment projects and public education. The Tier A Permit has additional requirements aimed at controlling stormwater pollutants from existing development. In addition, NJPDES permits are required for public complexes and highway systems.

Many resources are available on the Internet (see **Internet Resources**), including a New Jersey Stormwater Best Management Practices Manual (April 2004), model ordinances and general educational materials. The BMP manual provides examples of ways to meet the standards contained in the rule. A program called New Jersey Conservation Reserve Enhancement Program (NJ-CREP) is designed to assist farmers in reducing nonpoint source pollution caused by agricultural water runoff sources.

A number of storm drain systems and BMP installations exist along roads and parking lots but these have not been mapped.

H. Total Maximum Daily Loads

When surface waters do not meet the New Jersey Surface Water Quality Standards, *Total Maximum Daily Loads* (TMDLs) must be developed, as specified under Section 303(d) of the Federal Clean Water Act. A TMDL identifies all the contributors to surface water quality impacts and sets goals for load reductions for specific pollutants in order to meet the Surface Water Quality Standards. Regulations concerning TMDLs are contained in EPA's Water Quality Planning and Management Regulations (40 CFR 130).

TMDLs represent the assimilative capacity of surface water for a given parameter of concern. The development of TMDLs includes balancing the impacts from point sources, nonpoint sources and natural background levels of a specific pollutant. The TMDL then

quantifies the amount of a pollutant a water body can assimilate without violating a state's water quality standards and allocates that load capacity to known point and nonpoint sources in the form of waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, plus a margin of safety (MOS) (NJDEP Division of Watershed Management, 2005). Load allocations (for nonpoint source pollution) consist of identifying categories of nonpoint sources that contribute to the parameters of concern, followed by recommendations for implementation measures for specific load reductions. Examples include best management practices (BMPs), including structural (stormwater runoff controls) and non-structural (local ordinances for stormwater management and nonpoint source pollution control) mechanisms for addressing the water quality parameter(s) of concern.

Waters requiring TMDLs are identified as sublist 5 in the Integrated List of Waterbodies that combines the 303d list of impaired waters and the surface water quality inventory report (305b), which NJDEP prepares every two years. After the Integrated List is approved, the NJDEP Division of Watershed Management writes a TMDL report, which is a proposed Water Quality Management Plan Amendment. When this is published in the NJ Register for public review and comment, the TMDL is considered *proposed.* NJDEP then considers comments received during public comment and finalizes the TMDL report, and the TMDL is considered *established* when it is formally submitted to the US EPA Region 2 for thirty-day review. The TMDL is considered *approved* when the US EPA Region 2 approves it. Next, the TMDL is referred to as *adopted* when the EPA-approved TMDL is adopted by NJDEP as a water quality management plan amendment and the adoption notice is published in the NJ Register.

The **Musconetcong River at Riegelsville** has a fecal coliform TMDL which was approved September 23, 2003 based on the sites at Riegelsville (Site ID #01457400) and Bloomsbury (Site ID #01457000) (NJDEP Division of Watershed Management, September 2003). The TMDL report states that "Land use in the area is predominantly agriculture, with urban, including some older development on septic systems, and forest. Potential sources of fecal coliform include: livestock; land application of manure; older septic systems in Warren Glen, Finesville area, Bloomsbury, Hampton, New Hampton, and Asbury; geese; and beaver in the river between Finesville and the Delaware River. Strategies: prioritize for EQIP/SCCSP funds to install agricultural BMPs; organize local community based goose management programs; Phase II stormwater program" (NJDEP Division of Watershed Management, September, 2003). In addition, the Musconetcong River at Riegelsville TMDL for total phosphorus will be completed in 2006 (NJDEP Division of Watershed Management, 2006c).

Hakihokake Creek has a TMDL approved for fecal coliform for 8 stream miles at based on the site at the Bridge Street Bridge in Milford (Site ID #DRBCNJ0023). According to the TMDL report (NJDEP Division of Watershed Management, Approved September 15, 2005), potential sources of fecal coliform include: "several houses containing septic systems, an outhouse approximately ten feet from the stream, wildlife, including excessive populations of deer and bear, and farms containing horses and cows." Recommendations include further monitoring of fecal coliform for source identification and source reduction (e.g. install agricultural BMPs, public education, ordinances) (NJDEP Division of Watershed Management, Approved September 15, 2005).

In addition to the stream segments described above, the 2006 Integrated List includes the following sites in sublist 5: Harihokake Creek, non-attainment for total phosphorus; Musconetcong River below Warren Glen (based on the USGS sampling sites at Riegelsville and Bloomsbury), non-attainment for temperature, and sublist 4 for E. coli; and the Delaware River between Easton and Trenton, non-attainment for various pollutants (depending on the sub-

segment, fecal coliform, arsenic, copper, chromium, and lead; and in fish tissue, mercury, PCB's, DDX, dioxin and chlordane)(NJDEP Division of Watershed Management, 2006a).

I. Surface Water Quality and Flow Monitoring

Surface water quality data have been collected at sites on several streams and the Delaware River within Holland Township by the NJDEP, and USGS and the Delaware River Basin Commission. Surface water monitoring sites are displayed on **Figure 6e**. The various monitoring programs are discussed below. A list of the sites sampled for each program is provided in **Table 6.3.**

Water Quality and Flow Sites and Programs

1. NJDEP Ambient Biomonitoring Network for New Jersey (AMNET): In 1992, NJDEP reactivated its Ambient Biomonitoring Network (AMNET) to support its Statewide Water Quality Inventory (305(b)), Impaired Waters (303(d)), and Watershed Programs. Under this program, sites in each of New Jersey's five Water Regions are sampled for benthic macroinvertebrates on a rotating schedule once every five years. The health of in-stream benthic macroinvertebrate communities are evaluated using the US Environmental Protection Agency's (USEPA) Rapid Bioassessment Protocol (RBP) 2. Benthic macroinvertebrates (bottom dwelling organisms visible to the naked eye) are collected, identified and counted; then a *New Jersey Impairment Score* is developed based on these results. In addition, *Stream Habitat Assessments* and limited physical and chemical water quality parameters are measured at each site. AMNET data for these sites are listed in **Table 6.4**.

2. Fish Index of Biotic Integrity Stations: No sampling sites exist within Holland Township, but one site on the Musconetcong is near Bloomsbury (sampled in 2003), and one site on the Harihokake is at the mouth of the creek in Alexandria Township (sampled in 2001). See **Table 7.4** for the results.

3. NJDEP Existing Water Quality Stations in New Jersey: These data represent sampling points for the EWQ (Existing Water Quality) project at NJDEP. The EWQ Network was designed to provide supplemental data for water quality for the entire state to support water management and monitoring activities within NJDEP, and to be a valuable layer for computerized cartographic products. There is one monitoring sites on the Musconetcong River.

4. NJDEP Ambient Stream Quality Monitoring Sites for New Jersey: These data represent ambient stream sites monitored cooperatively by the NJDEP and the USGS for water quality parameters. This network was established in 1976 to determine status and trends of ambient surface waters in New Jersey. The sampling frequency is four times per year. A wide range of conventional parameters, metals, pesticides and sediments are monitored in this program. Metals, pesticides and sediments are monitored on a reduced sampling frequency. Data is available from the following sources: 1.) the USGS computerized data system, NWIS, 2.) EPA's computerized data system, STORET or 3.) USGS's annual reports "Water Resources Data-New Jersey". The 1997 network revision focused on supporting evolving water quality initiatives at NJDEP

5. NJDEP Ambient Supplemental Surface Water Monitoring: Water quality is measured at sites on the Musconetcong River at Riegelsville, Delaware River at Riegelsville.

6. NJDEP/USGS Surface WQ Gage: This network is jointly funded by the USGS and the NJ Department of Environmental Protection. Water quality is measured at sites on the

Musconetcong River at Riegelsville, Delaware River at Riegelsville, and Hakihokake Creek at Milford.

7. USGS Continuous-Stream Flow Gaging: These sites are maintained by the United States Geological Survey (USGS), Water Resource Division (WRD). The nearest site was the Delaware River at Riegelsville, but it is no longer active.

8. USGS Stream Crest Gaging: There is one USGS Stream Crest Gage located at Delaware River at Riegelsville, where gage height is measured (relative height of water level; not actual flow volume). Real-time data is available on the Internet.

9. USGS Stream Low Flow Gaging: USGS has measured stream flow at Hakihokake Creek at Milford; however, this site is inactive.

10. Delaware River Basin Commission (DRBC): The DRBC monitored water quality in the Delaware River and for water quality and stream flow in tributaries as part of a larger 5 year program to define and protect the existing water quality in the Lower Delaware Wild and Scenic River, or enhance it where practicable. The data will be used to fulfill Goal 1 of the Lower Delaware River Management Plan and to develop antidegradation (Special Protection Waters) regulations for the Lower Delaware River and the adjoining tributaries.

Table 6.3: Surface Water Monitoring Stations (shown on Figure 6e)

Program Name	Station ID	Data	Name	Type of Data Collected	GIS layer
1. NJDEP Ambient Biomonitoring Network	AN0073	S	Musconetcong River at Rt.579 Church Street		
	AN0074	S	Musconetcong River at Rt. 627 River Rd at RR Bridge	Macro-invertebrates and Habitat	biopts2004.shp
	AN0075	S	Hakihokake Creek at Myler Rd		
	AN0076	S	Hakihokake Creek at Miller Park Road		
	AN0077	S	Hakihokake Creek at Bridge Street		
	AN0078	S	Harihokake Creek at Hartpence Rd		
	AN0079	S	Harihokake Creek at Rt. 619 River Road		
2. Fish Index of Biotic Integrity	FIBI061		Musconetcong at Route 632/Asbury-Bloomsbury Road	Fish populations	fibi.shp
	FIBI034	S	Harihokake Creek at Milford-Frenchtown Rd (CR 619)		
3. NJDEP Existing Water Quality Sites	01457400		Musconetcong River at River Road		ewqpoi.shp
	01458100	S	Hakihokake Creek on Bridge St. in Milford		
	01458400	S	Harihokake Creek on Route 619 (River Road)		
4. NJDEP/USGS Ambient Stream Quality Monitoring Sites for NJ	01457500		Delaware River at Riegelsville	conventional parameters, metals, pesticides and sediments? Flow- Gage staff?	swpts05.shp
	01457400		Musconetcong River at River Road		
5. NJDEP Supplemental Ambient Surface Water Monitoring	01458400 [Amnetref AN0077 Bfbmid 11b]	S	Harihokake Creek at River Road	conventional parameters, metals, pesticides,	sasmn.shp

Table 6.3: Surface Water Monitoring Stations (shown on Figure 6e)

Network				sediments	
6. NJDEP/USGS Surface Water Quality Gage	01457000	S	Musconetcong River near Bloomsbury, NJ		wqgages.shp
	01457400	S/N	Musconetcong River at Riegelsville, NJ		
	01457500	S/N	Delaware River at Riegelsville, NJ		
	5700017400	S/N	Delaware River at Riegelsville NJ		
	01458100		Hakihokake Creek at Milford, NJ		
7. USGS Continuous Streamflow Gage Station (inactive)	1457500		Delaware River at Riegelsville, NJ	Flow	streamgage_sp .shp
8. USGS Stream Crest Gaging Station	1457500		Delaware River at Riegelsville, NJ	Gage height	Creststage.shp
9. USGS Low Flow Gage Site (inactive)	145810		Hakihokake Creek at Milford, NJ	Gage height	Lowflow.shp
10. DRBC	DRBCNJ0026		Delaware River at Riegelsville Bridge	Water quality	none available
	DRBCNJ0024		Delaware River at Milford Bridge		
	DRBCNJ0021		Delaware River at Frenchtown Bridge		
	DRBCNJ0025		Musconetcong River at Riegelsville	Water quality and flow	
	DRBCNJ0023		Hakihokake Creek at Milford		
	DRBCNJ0022		Harihokake Creek near Delaware River		
Data: S = data is in STORET; N= data is in NWIS.					
Sources: GIS data files; see file names listed above.					

Table 6.4: Water Quality Parameters for Monitoring Sites in and near Holland

Site Name	Agency	Site Code	Parameters[3]	Years[4]
Delaware River				
Delaware River at Riegelsville	USGS	01457500	Too numerous to list	1934-2004
Delaware River at Riegelsville Bridge	DRBC	DRBCNJ 0026	Same as DRBCNJ0024 except not chlorophyll or pheophytin	1999-2000
Delaware River at Milford Bridge	DRBC	DRBCNJ 0024	Total Alkalinity; Chloride; Chlorophyll; Pheophytin-a; Dissolved oxygen (DO); Dissolved oxygen saturation; Flow; Enterococcus Bacteria; Hardness; Ammonia as NH3; Nitrate Nitrogen as NO3; Nitrite + Nitrate Nitrogen as N; pH; Phosphorus as P; Orthophosphate as PO4; Dissolved Solids; Specific conductance; Water Temperature; Turbidity	
Delaware River at Frenchtown Bridge	DRBC	DRBCNJ 0021		
Musconetcong River				
Musconetcong River at Riegelsville	NJDEP	01457400	Alkalinity, Carbonate as CaCO3; Arsenic; Beryllium; 5-Day BOD; Boron; Cadmium; Calcium; Total Organic Carbon; Chloride; Chlorophyll α; Chromium; Copper; Dissolved oxygen (DO); Dissolved oxygen saturation; Flow; Fecal Coliform;	1999-2003

[3] Not all parameters sampled all years.
[4] Years represents range of years; not all parameters sampled all years; most recent data available, unknown if sampled more recently or plans for future sampling.