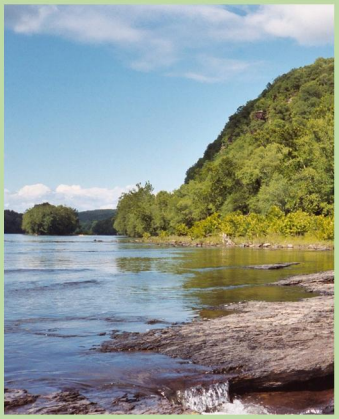
January 2009










Environmental Resource Inventory for Kingwood Township

Hunterdon County, NJ

Prepared for:

Kingwood Township
Environmental Commission

Kratzer Environmental Services

Written by:

Deborah J. Kratzer

Environmental Resource Inventory

For

Kingwood Township

Hunterdon County, NJ

Revised
January 2009

Prepared for
The Kingwood Township Environmental Commission

Written by Deborah J. Kratzer

The 2004 Edition was funded by a National Park Service
Lower Delaware Wild and Scenic River
Municipal Incentive Grant Administered by the Delaware River Greenway Partnership.

The 2009 revised edition is provided as in-kind services as part of an
Association of New Jersey Environmental Commissions (ANJEC) grant.

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"We should act like this is the only planet we have because it is." (Honachevsky, 2000)

Acknowledgements

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Kingwood Township Environmental Resource Inventory
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PREFACE TO THE 2009 EDITION

Kingwood Township completed a comprehensive Environmental Resource Inventory (ERI) in 2004 that won the 2005 Hunterdon County Planning Board's Outstanding Planning Award. However, since that time, many Geographic Information System (GIS) data layers have been updated by the New Jersey Department of Environmental Protection (NJDEP) (e.g. Surface Water Quality Classifications, Land Use/Land Cover, steep slopes) and others or are in need of updating with local information (open space/preserved farmland). In addition, the new version of the GIS software is incapable of importing maps made in the previous version. As a result, it was necessary to re-create all the maps that had been made for the 2004 ERI.

This revision is Kingwood Township's in-kind services commitment for a Smart Growth Planning Grant from the New Jersey Association of Environmental Commissions (ANJEC). The author is the Kingwood Environmental Commission chairperson, and providing this work free of charge. The grant also funded development of a Conservation Element of the Master Plan, completed by Banisch Associates in 2008.

New ArcMap version 9.2 projects have been created, and installed on a computer located at the Kingwood Municipal Township building and made available for use by Kingwood volunteers and staff.

I: INTRODUCTION

A. About This Report

Ecologically Based Planning

Ecology is defined as the science of the relationships between organisms and their environments. The relationships between and among the physical factors of the environment, including the air, geology, topography, soils, and water, and the biotic environment, including plants, animals and decomposers, are a complex web. Humans are a significant part of the ecosystem of Kingwood Township, both affecting and being affected by many physical and biological factors. Even in Kingwood, with a relatively low human density of 106 people per square mile, the cumulative effects of many individual decisions have the potential to alter the environment in ways that cause harm directly to human health, and indirectly through complex environmental functions.

A small tributary of Cain's Run

William Honachefsky, in his book Ecologically Based Municipal Land Use Planning, states,

> "The scientific community needs to articulate more clearly for local decision makers the underlying ecological processes and the consequences resulting from interference or truncation of those processes." (Honachefsky, 2000, p. 32)

Assembling an inventory of the township's ecological infrastructure is the first step in a proactive and ecological approach to protecting and preserving human and ecological health. Analyzing the data, gaining an understanding of the ecological processes involved, and considering the consequences of ignoring them, will help local land planners create an ecologically healthy community.

Goal of the Environmental Resource Inventory

The Association of New Jersey Environmental Commissions (ANJEC) defines "Environmental Resource Inventory" in its Resource Paper, The Environmental Resource Inventory: ERI, as follows:

> "The Environmental Resource Inventory (ERI), also called Natural Resource Inventory (NRI), or Index of Natural Resources, is a compilation of text and visual information about the natural resource characteristics and environmental features of an area. An ERI is an unbiased report of integrated data. It provides baseline documentation for measuring and evaluating resource protection issues. The ERI is an objective listing, rather than an interpretation or recommendation. Identifying significant environmental resources is the first step in their protection and preservation." (ANJEC, no date).

The Municipal Land Use Law requires municipalities' Master Plans to have a land use plan including, but not necessarily limited to, topography, soil conditions, water supply, flood

plains, wetlands, and woodlands. The Kingwood Township Master Plan was written in 1972, and a reexamination report was most recently completed in 2004 (a reexamination is required by law every six years). In addition, various reports have been amended to the Master Plan. These documents address some aspects of the environment and natural resources, but this ERI provides the only comprehensive analysis of environmental information for Kingwood Township. The

> The goal of the ERI is to provide a planning tool containing resource information, data and maps that can be used as part of the Master Plan, as a reference when reviewing development proposals, and as a guide in other township activities in order to better protect the township's natural resources and the overall health and welfare of the community.

Environmental Commission Enabling Legislation gives environmental commissions the authority to conduct such research for inclusion in the Master Plan, and then to use this information to help evaluate development applications.

The ERI will principally be used by the Planning Board, Board of Adjustment and Environmental Commission, but will provide valuable information to anyone interested in the environmental resources of Kingwood Township. Ideally, landowners considering subdivision and development will become familiar with the environmental concerns specific to their property, and thereby have the ability to make resource-sensitive development decisions. Even when subdivision is not an issue, residents may learn to appreciate and maintain our valuable natural resources. Areas of specific concern may emerge which require additional protection strategies, such as further research and monitoring, public outreach and education, habitat restoration, easements, volunteer projects, and/or revised or new ordinances.

Methods

> A Geographic Information System (GIS) is computerized mapping which combines layers of information about a place to provide a better understanding of that place.

Funding for the original ERI in 2004 was obtained from the Lower Delaware Wild and Scenic River's Municipal Incentive Grant, funded by the National Park Service. This revised edition is provided as in-kind services (the author is an Environmental Commission member and providing this work pro bono) as part of an Association of New Jersey Environmental Commissions (ANJEC) grant.

Kingwood Township hired Kratzer Environmental Services to develop its ERI, with the assistance of some volunteer efforts of Environmental Commission members. An inventory of what is currently known about the physical and biotic environment and the human influence on the environment of Kingwood Township has been compiled for this document. The use of computerized mapping (known as Geographic Information Systems, or GIS) aids visualization of the distribution and inter-relationships of resources**.**

Information sources include the Kingwood Township Master Plan and the Open Space Plan; the Internet; and federal, state, county and local databases and contacts. The most current GIS data has been obtained from the New Jersey Department of Environmental Protection GIS Data Web Site and other sources (see **Appendix A** and **Appendix B)**. All digital inventory data will be stored at the Kingwood Township building, where ArcView (GIS software) will also be

available for use by Township officials and staff. The public can either use the New Jersey Department of Environmental Protection's i-MapNJ website or obtain relevant data layers (most are free on the internet), and download the free software, ArcExplorer (see **Internet Resources**, below).

References and related print and Internet resources are listed at the end of each section, so that readers may find more information and updates. Please note that Internet sites may change or be temporarily out of service. If an Internet link doesn't work, try the first part of the address. If that works, you may be able to search for the type of information you want. For example, if you click on http://www.state.nj.us/dep/gis/downloadintra.html and the site no longer exists, try http://www.state.nj.us/dep/gis/ ; if that doesn't work, try http://www.state.nj.us/dep/ .

Limitations of the ERI

It should be noted that the ERI is not intended to produce original research and is not meant to replace the primary data sources upon which it is based. It is intended for preliminary assessments of projects and *cannot substitute for on-site testing and evaluations*. Most maps are presented at a scale of 1:75,000 in order to fit on 8.5 x11 inch paper. "Zooming in" to better view individual lots is possible, but should not exceed the scale at which the data was created. Most data layers used for this report were created at 1:24,000 scale (with an accuracy of $\pm$ 40 feet). Data mapped at 1:100,000, such as the geology data layer, have an accuracy of $\pm$ 166.7 feet (Garie, 1998). GIS data from NJDEP and Hunterdon County are used with permission (see the Terms of Agreement in **Appendix A**), with the required "disclaimer" printed on each map. **Appendix B** provides details of the GIS data used for this report, and where the data may be obtained.

Sometimes mapped features don't line up exactly, since different data producers may have used different methods of acquiring and analyzing the data, used different scales or coordinate systems, and because of differences or errors in the base data.

The NJDEP and Hunterdon County require the following "disclaimer," which is printed on all the maps which use their data: "This map was developed using [NJDEP and/or 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."

Some components of the environment may have been studied or presented in detail, while other important factors may have been minimally addressed. When new or updated information becomes available, or new issues emerge, *updates should be appended to the ERI*.

Management recommendations are not part of the ERI, but are included in the Conservation Element of the Master Plan, completed in December 2008.

B. General Description of Kingwood Township

Kingwood Township was established in 1746. It is located in Hunterdon County, bordered on the west by the Delaware River, to the north by the Boro of Frenchtown and Alexandria Township, to the northeast by Franklin Township, and to the southeast by Delaware Township (see **Figure 1a**). The township encompasses 35.7 square miles (22,848 acres) with a population of 3,782 (2000 Census). Many small streams drain from the gently sloping eastern portion of the township, through steep ravines with scenic waterfalls to the Delaware River, designated in this section as part of the National Wild and Scenic River System.

The township is predominantly a rural municipality, relying almost solely on individual water supply wells and on-site septic systems. Commercial development is mostly centered

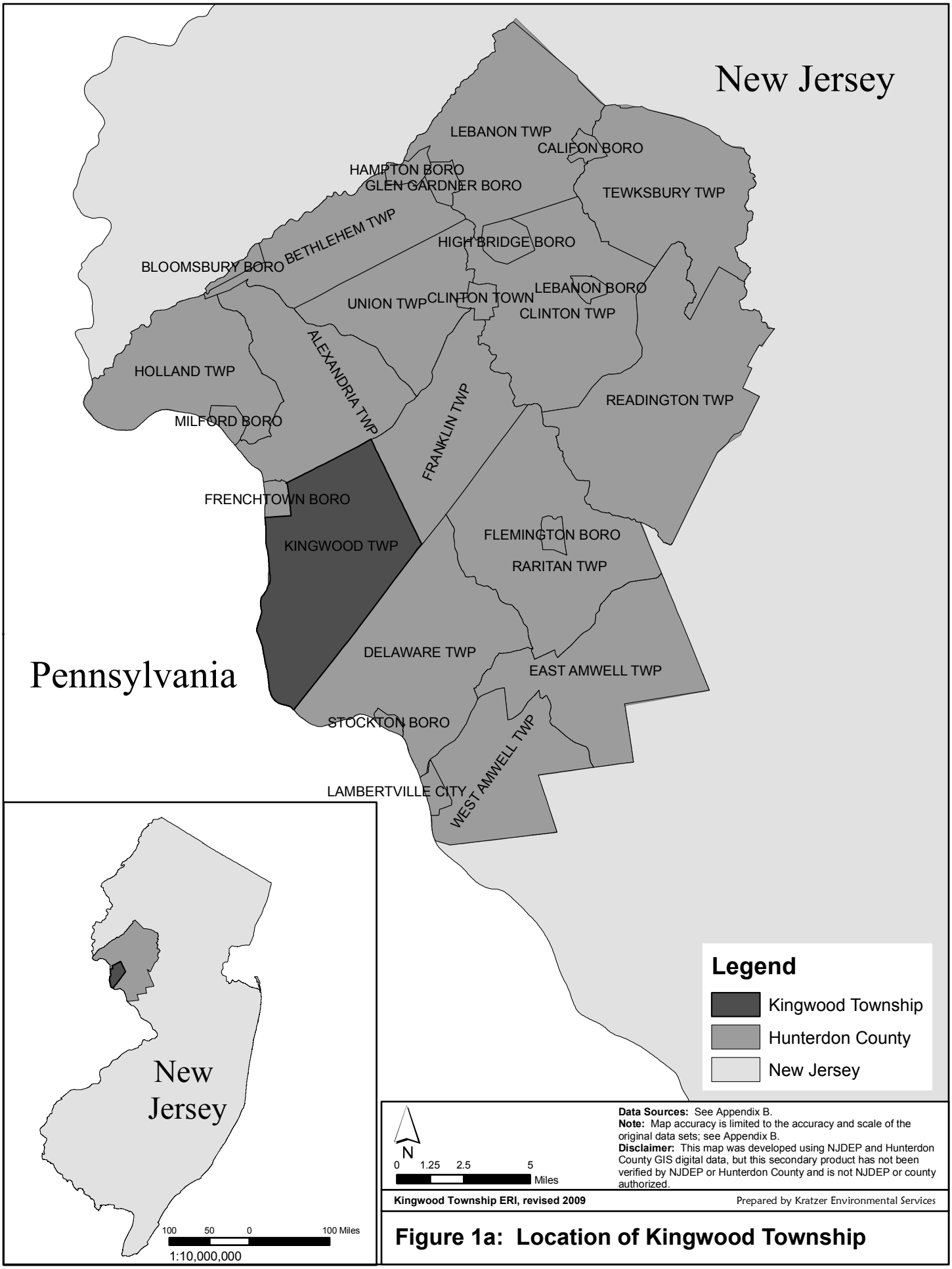


Figure 1a: Location of Kingwood Township

Note: Areas that appear red in this image are green in reality.

N

0 0.25 0.5 1 1.5

Miles

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.

Kingwood Township ERI, revised 2009

Prepared by Kratzer Environmental Services

Figure 1b: Aerial Photographs - 2002

along State Route 12, including the village of Baptistown. **Figure 1b** shows aerial photographs of Kingwood and the surrounding areas taken in 2002[2]. To provide an overview of the township, **Figure 1c** displays named places, roads and tax parcels, while **Figure 1d** shows parcels grouped by blocks.

C. Land Use

Kingwood contains a wealth of natural and historic resources and has preserved some farmland and open space, funded by a portion of the local tax assessment. The major land use type in Kingwood is agriculture (40.4%), followed by forest (33.3%), and wetlands (14.2%). Approximately 9.7% of the land is developed (primarily single family residential) (See **Table** 1).

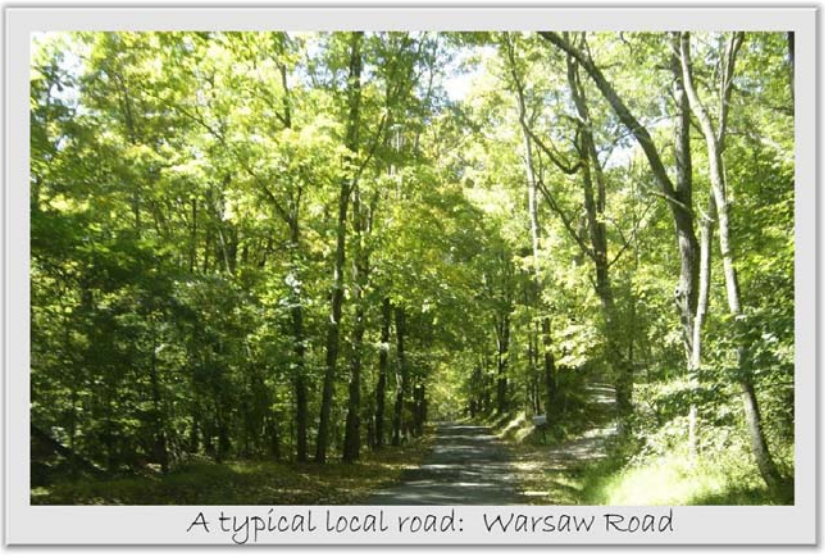
Table 1: 2002 Land Use Type

Land Use Type	Acres	Percent
Agriculture	11,276	40.4%
Barren Land	63	0.2%
Forest	9,302	33.3%
Urban/Residential	2,702	9.7%
Water	610	2.2%
Wetlands	3,966	14.2%
Total:	27,919	100%

Source: NJDEP, March 2008.

In 2001, Kingwood Township was selected by New Jersey Monthly magazine as the second "most livable village" in New Jersey, based on crime rate, cost of living, economic health, quality of education, and the variety and amount of cultural and leisure activities (Levin, 2001).

Fueled by the general trend toward suburban sprawl, added to the desirable characteristics of the township, such as its rural character, the township is experiencing increased development pressure. NJDEP used aerial photos taken in 2002 to determine land use (**Figure 1e)**. In Kingwood Township, changes to urban land use (which is comprised mainly of single family residential) between 1986 to 1995 and 1995 to 2002 are highlighted in **Figure 1f**.



A typical local road: Warsaw Road

Despite the township's relatively secluded and bucolic location, it is influenced by the same variety of environmental issues confronting the world as a whole. Suburban sprawl results in ecological impacts such as further loss of farmland, forests, wetlands, habitat and an increase in impervious surfaces, erosion, pollution, human/wildlife conflicts and the local eradication of species. Even when fields are allowed to lie fallow, aggressive exotic vegetation, such as multiflora rose, and excessive browsing by deer prevent the normal succession to forest growth. Kingwood Township is the site of a several point sources of pollution, such as the DeRewal Superfund Site; nonpoint sources of pollution, such as storm drains, farms and lawns; and loss of habitat. In addition, Kingwood's geology supports a limited water supply that is vulnerable to quantity and quality degradation. These environmental concerns are addressed in more detail in the following chapters.

[2] For the aerial photography, much more detail can be seen when the data is mapped at a larger scale than that used in this report (the 2002 data has pixels of 1 square foot).

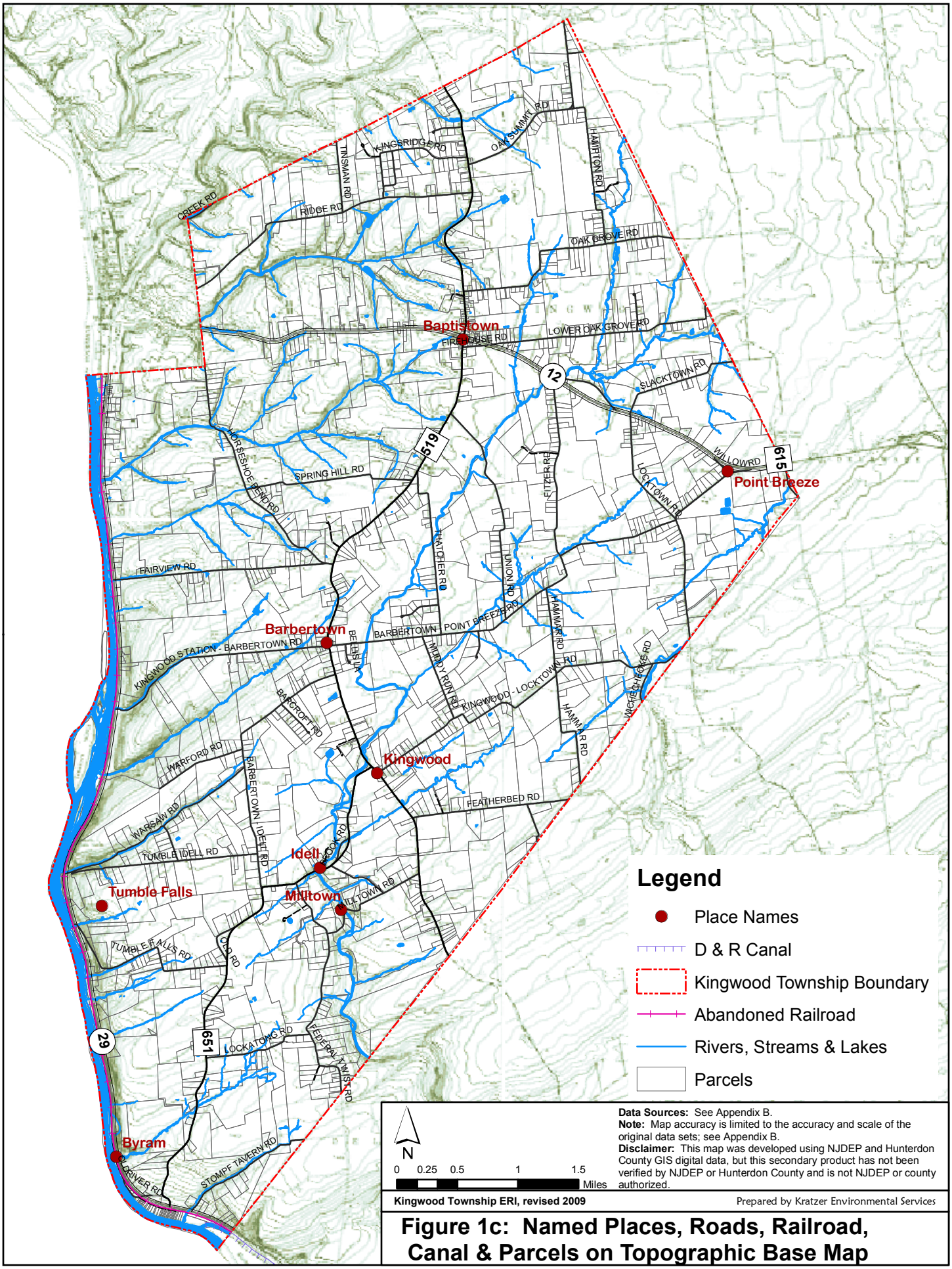


Figure 1c: Named Places, Roads, Railroad, Canal & Parcels on Topographic Base Map

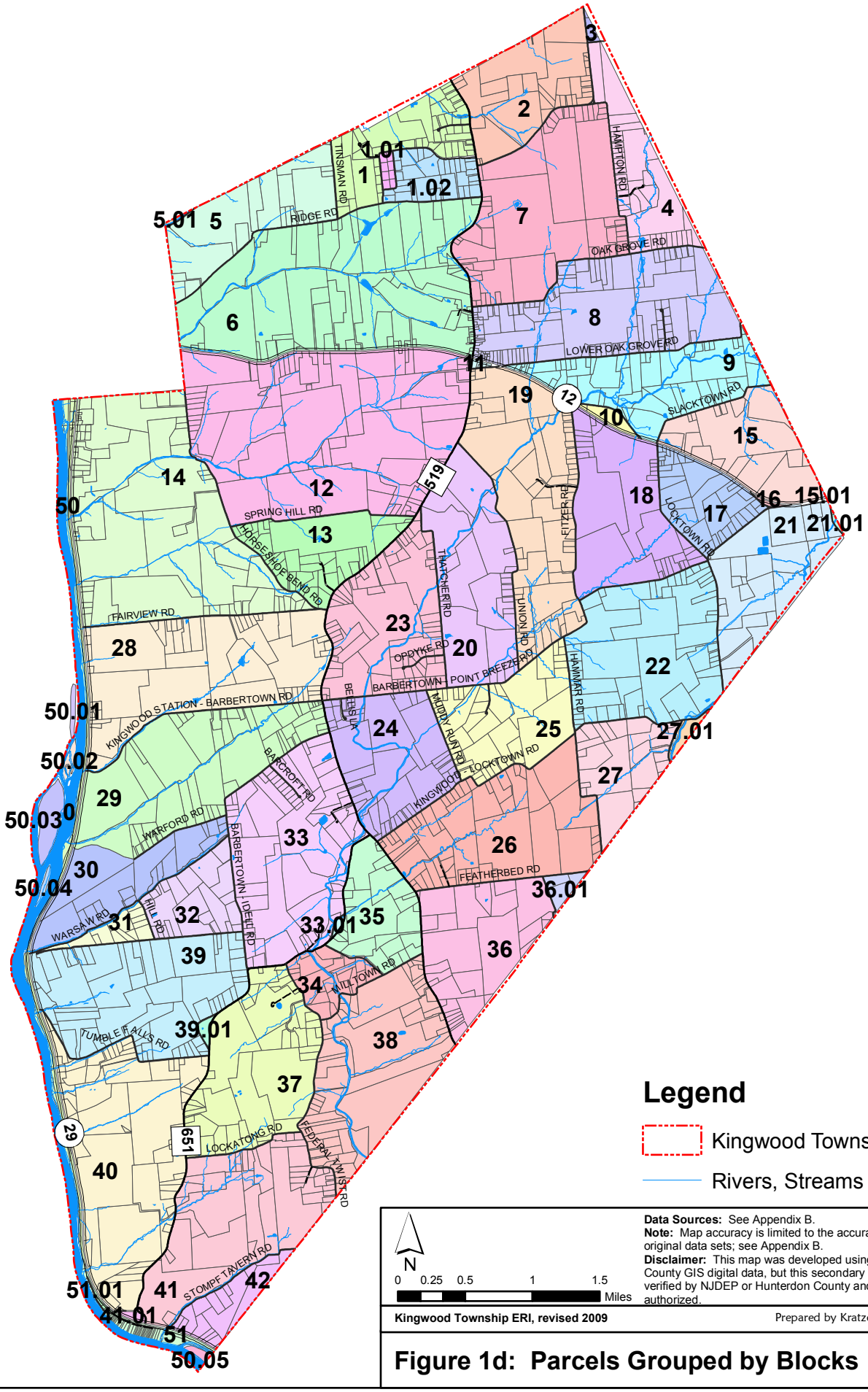
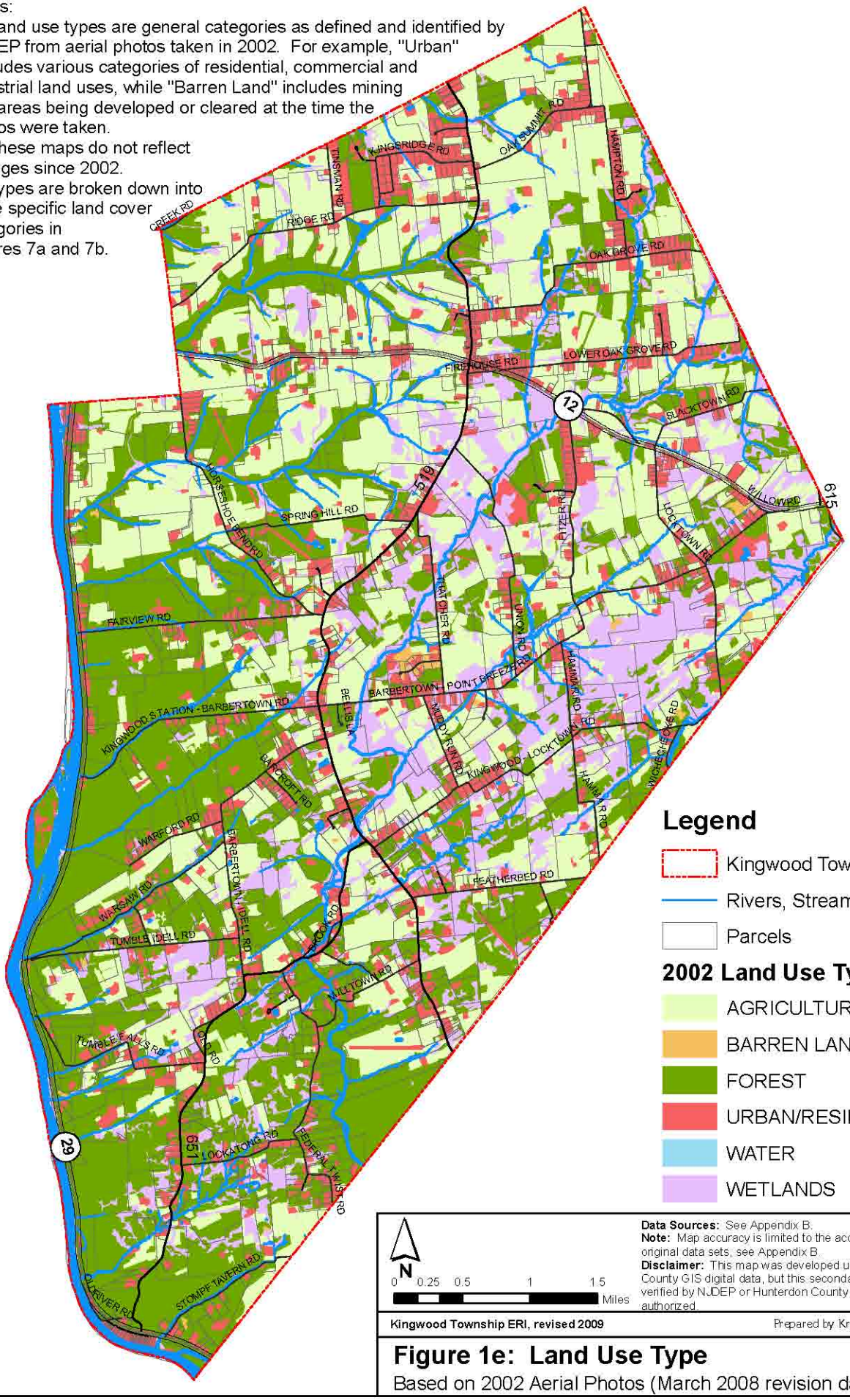


Figure 1d: Parcels Grouped by Blocks

Notes:
1. Land use types are general categories as defined and identified by NJDEP from aerial photos taken in 2002. For example, "Urban" includes various categories of residential, commercial and industrial land uses, while "Barren Land" includes mining and areas being developed or cleared at the time the photos were taken.
2. These maps do not reflect changes since 2002.
3. Types are broken down into more specific land cover categories in Figures 7a and 7b.



Legend

- Kingwood Township Boundary
- Rivers, Streams & Lakes
- Parcels

2002 Land Use Type

- AGRICULTURE
- BARREN LAND
- FOREST
- URBAN/RESIDENTIAL
- WATER
- WETLANDS

N

0 0.25 0.5 1 1.5 Miles

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.

Kingwood Township ERI, revised 2009

Prepared by Kratzer Environmental Services

Figure 1e: Land Use Type

Based on 2002 Aerial Photos (March 2008 revision date)

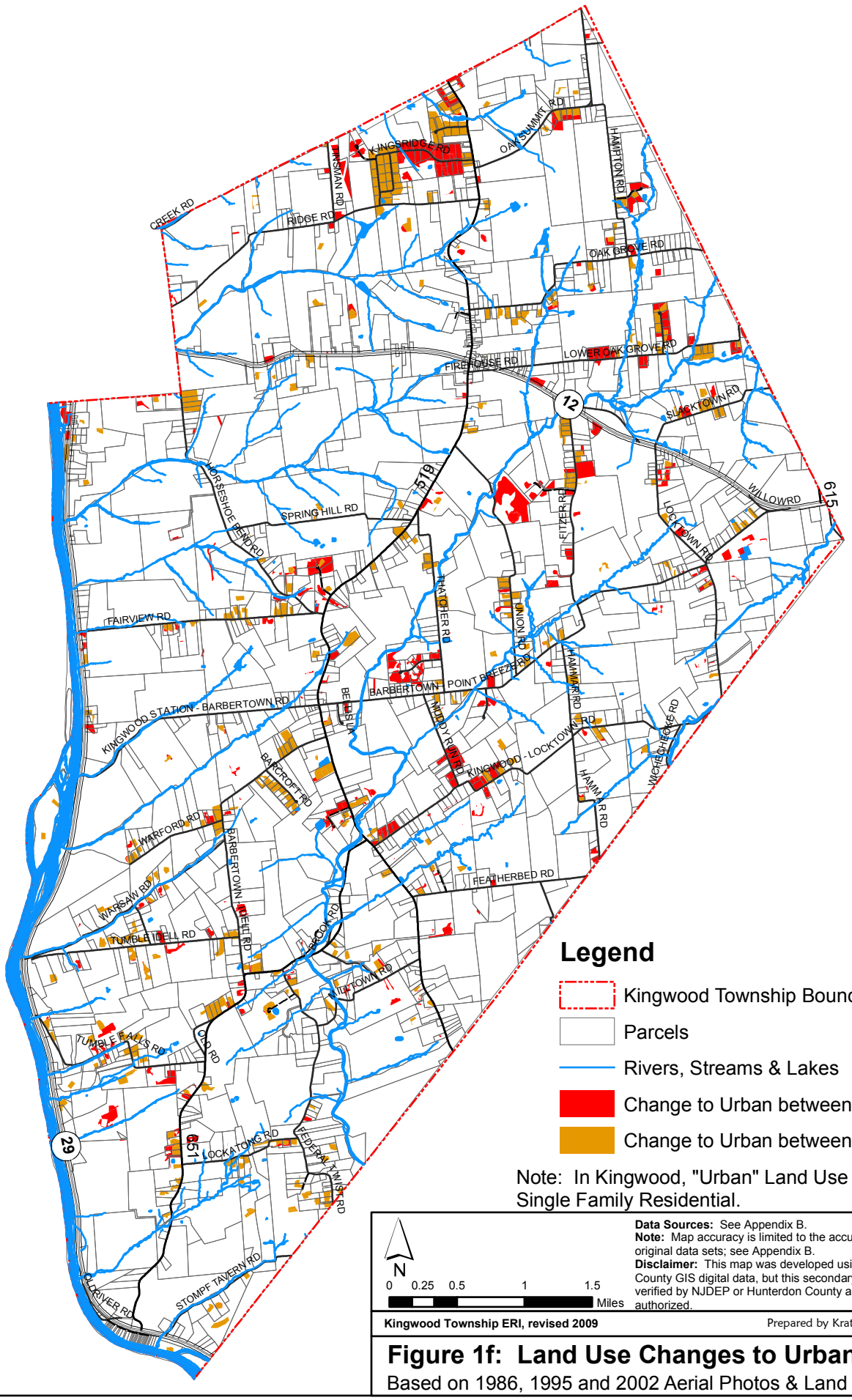


Figure 1f: Land Use Changes to Urban Type

Based on 1986, 1995 and 2002 Aerial Photos & Land Use Data

References: Introduction

Association of New Jersey Environmental Commissions (ANJEC). The Environmental Resource Inventory: ERI. ANJEC; Mendam, NJ. 12 pages.

Garie, Henry L. and Lawrence L. Thornton. New Jersey State Agency Partnership GIS Technical Mapping Standards: Enhancing GIS Technology for Multi-Agency Cooperation. September 1998. Standards Subcommittee State Mapping Advisory Committee: Trenton, NJ.

Honachefsky, William B. Ecologically Based Municipal Land Use Planning. 2000. Lewis Publishers: New York. 255 pages.

Levin, Jay. "Top Towns." New Jersey Monthly. March 2001 pp.64-73

Lower Delaware River Wild and Scenic River Study Task Force. August 1997. Lower Delaware River Management Plan. 106 pages.

NJDEP. March 2008. NJDEP 2002 Land use/Land cover Update, Central Delaware Watershed Management Area, WMA-11, Edition: 20080304. GIS data.

Internet Resources: Introduction

Kingwood Township's Official Home Page: http://www.kingwoodtownship.com

Free GIS Software and Publications

ArcExplorer (free GIS software): http://www.esri.com/software/arcexplorer/index.html

GIS Maps for New Jersey on the Internet

i-MapNJ (an on-line environmental mapping tool): http://www.state.nj.us/dep/gis/depsplash.htm

GIS Data from New Jersey Department of Environmental Protection
(For a complete list of data sources used in this report, see **Appendix B.**)

NJ GIS Home Page: http://www.state.nj.us/dep/gis/

Download GIS data: http://www.state.nj.us/dep/gis/lists.html

II: RESOURCE INVENTORY – PHYSICAL ENVIRONMENT

A. Climate & Meteorology

Climate


A Kingwood sunset

Climate is a major factor in determining the kinds of plants and animals found in an ecosystem. New Jersey has a *temperate climate* because it has mild average temperatures, four seasons, and rainfall distributed throughout the year. The Office of the New Jersey State Climatologist (ONJSC) divides New Jersey into five distinct climate regions. Kingwood resides in the "Northern Zone," grouped with the Valley and Ridge, Highlands and part of the Piedmont physiographic provinces (see **section II.C** for descriptions of physiographic provinces). Since this region is surrounded by land, it can be characterized as having a continental type of climate with minimal influence from the Atlantic Ocean, except when the winds come from the east. The dominant atmospheric circulation is the "prevailing westerlies," the broad, undulating flow of air from west to east across the middle latitudes of North America. Prevailing winds are from the southwest in summer and from the northwest in winter (ONJSC, 2004).

Climate changes naturally over long periods of time. Most climatologists believe that recent changes in climate are the result of human activities, and are attempting to predict the effects and magnitude of future trends. The NJ State Climatologist compiled data for 19 weather stations within New Jersey and created time-series graphs of many variables (e.g. min. and max. temperature, precipitation) for the NJ Climate Report Card (Robinson, Fall 2005, see **Internet Resources**).

Precipitation and Temperature

As the prevailing westerlies shift north and south and vary in strength, they bring wet, dry, hot, and cold airstreams. These influence the weather throughout New Jersey, resulting in highly variable daily weather.

One weather station in Pittstown is currently monitored by the New Jersey Weather and Climate Network, and real-time data and weather forecasts are available on the Internet. However, historical data are not available for this site. The nearest weather station with historical data available is in Flemington, which has been monitored since 1879 for temperature and rainfall (Hartman, 2002) and has been monitored continuously from 1926 – 2000 by the ONJSC. **Table 2.1** displays monthly average highs and lows and mean temperature, average monthly precipitation, and record highs and lows (and the year it occurred in parentheses).

Lambertville also has a meteorological station.

Measurable precipitation falls in New Jersey on approximately 120 days per year. In Flemington, annual precipitation for the period 1926-2000 has averaged 46.42 inches, although the period 1971-2000 has been wetter, averaging 49.34 inches (see **Table 2.1**). Precipitation in Flemington averages 0.44 inches higher than the average for all sites in the northern third of New Jersey for the long-term, and 0.45 inches lower for the most recent 30 years.

Rainfall is distributed fairly evenly throughout the year, with February being the driest month. On average, June and July have the most precipitation, but appear drier because evapotranspiration exceeds precipitation (ONJSC, 2008). During the warm season, thunderstorms (which often occur in the evening) are responsible for most of the rainfall. About twice as many thunderstorms occur here as in the coastal zone, where the nearby ocean helps stabilize the atmosphere. Record rainfalls are more likely to occur in the fall, due to tropical storms (see **Table 2.2**).

An average of 31.8 inches of snow falls annually measured at the Flemington station (about 10" of snow equals 1" of rain). Snow may occur between October and April, while days with snowfall greater than 4" occur only about twice per winter in this area (ONJSC, 2008). Measured in Flemington, the earliest snow on record was on October 11 (which occurred in 1979), and the latest was April 27 (in 1967), both recording an inch (ONJSC, 2004).

Hunterdon County has a growing season of about 167 days. The average date for the last killing spring frost is April 29th (in one year out of 10, the last freeze may be May 9 or earlier). The first frost in fall is around October 13th (in one year out of 10, the first frost may be October 2 or earlier) (Jablonski, 1974). The exact dates vary within the county as well as from one year to another.

During the winter, temperatures are not generally cold enough to keep the soil frozen for the whole winter. Winter rains frequently warm enough to thaw the soil. Heavy rain on partly thawed soils is very erosive.

Table 2.1: Average and Record Weather for Flemington, NJ

Month	*Based on data from 1971-2000*				*Based on data from 1926-2000*		
	Average High	**Average Low**	**Mean**	**Average Precip.**	**Average Precip.**	**Record High**	**Record Low**
January	37°F	18°F	28°F	4.25 in.	3.62 in.	74°F (1950)	-18°F (1984)
February	40°F	20°F	30°F	3.04 in.	3.00 in.	77°F (1930)	-16°F (1934)
March	50°F	28°F	39°F	4.03 in.	3.95 in.	88°F (1998)	-6°F (1984)
April	61°F	37°F	49°F	4.09 in.	3.89 in.	94°F (1976)	14°F (1969)
May	72°F	47°F	60°F	4.87 in.	4.17 in.	99°F (1939)	25°F (1966)
June	80°F	56°F	68°F	4.33 in.	3.93 in.	102°F (1934)	34°F (1978)
July	85°F	62°F	73° F	4.75 in.	4.57 in.	106°F (1936)	41°F (1957)
August	83°F	60°F	72°F	3.98 in.	4.47 in.	104°F (1955)	37°F (1965)
September	76°F	52°F	64°F	4.34 in.	3.90 in.	105°F (1953)	27°F (1963)
October	64°F	40°F	52°F	3.84 in.	3.48 in.	97°F (1941)	18°F (1952)
November	53°F	32°F	43°F	3.90 in.	3.77 in.	84°F (1950)	2°F (1938)
December	42°F	24°F	33°F	3.92 in.	3.67 in.	75°F (1984)	-14°F (1948)
Average Annual Precipitation:				**49.34 in.**	**46.42 in.**		
Source: Office of the New Jersey State Climatologist at http://climate.rutgers.edu/stateclim/							

Extreme Weather

During the warm season, thunderstorms are responsible for most of the rainfall. Most areas receive 25 to 30 thunderstorms per year. In addition, each year between 1 and 10 nor'easters bring strong winds and heavy rains to the state. Approximately five tornadoes appear each year in New Jersey (usually relatively weak ones). Between 1973 and 2005, a total of 7

tornadoes were reported in Hunterdon County. Hail is not frequent, but can be destructive. On July 22, 2003, the area was struck by a rain and hail storm of record proportions, with 1 ¾ inch hail reported in Flemington (NOAA, 2004). **Table 2.2** lists some of the highest snow and rainfall received in one day (although multiple day storms can have higher totals), for the period 1926 to 2000 (the most recent data available on the Internet).

One of the biggest snowstorms on record dropped 23 inches of snow on Kingwood on February 16-17, 2003 (NOAA, 2004).

Table 2.2: Record Precipitation Measured at Flemington, NJ

Rank	Greatest one-day snowfall		Greatest one-day rainfall	
	Amount	Date	Amount	Date
1st	24 in.	Feb. 1961	8.49 in.	Sept. 1999
2nd	21 in.	Feb 1983	7.2 in.	Aug. 1971
3rd	19 in.	Jan. 1996	4.74 in.	Sept 1989
4th	18 in.	Feb. 1979	4.46 in.	Sept. 1942
5th	18 in.	Dec. 1960	4.19 in.	Oct. 1990
Source: Office of New Jersey State Climatologist http://climate.rutgers.edu (data from 1926 – 2000)				

Tropical storms and hurricanes can contribute significant rainfall and can cause flooding. Hurricane Diane, which struck in August 1955, broke four daily rainfall records, for a total of 12.27 inches in 11 days, causing severe flooding that destroyed most of the existing bridges on the Delaware River, including a bridge at the southern-most tip of Kingwood (the bridge abutments remain). The flash flooding from January 19-21, 1996 was caused by torrential rains plus melting snow, causing the Delaware River to crest at its highest stages in most places since the summer of 1955. Tropical Storm Floyd battered New Jersey on September 16, 1999 and brought with it record breaking amounts of rain and damaging winds. Storm totals of 9.52 inches of rain were recorded in Flemington (ONJSC, 2004 and NOAA, 2004).

In September 2004, the remnants of Hurricane Ivan interacted with a slowly moving cold front, causing very widespread heavy rain in the upper and middle sections of the Delaware River Valley. This combined with wet soils and full reservoirs to yield the worst flooding since 1955 (now the 7th highest discharge ever measured on the Delaware River at Riegelsville). This was followed only 7 months later, in April 2005, by a flood which became the new worst Delaware River flood since 1955. It resulted from widespread heavy rainfall up to 5" combined with wet antecedent conditions, melting snow in the mountains, and reservoirs filled to capacity. This resulted in the third highest discharge on record at Riegelsville. The most recent Delaware

Flooding of Delaware River on June 29, 2006

River flood, which crested on June 29, 2006, is the fourth highest on record (see **Table 2.3**) (USGS, 2006). River gage height and forecasts are available in real-time on the internet from USGS and NOAA (see **Internet Resources**).

Major droughts in recent years included 1998-1999 and 2001-2002. A drought spanning July 1998 through September 1999 included a "snow drought" – one of the least snowy seasons on record. This drought was ended by Tropical Storm Floyd. Another year-long drought occurred between October 2001 and November 2002, when drought was ended by a series of nor'easters that resulted in a wetter than normal November (NOAA, 2006).

Table 2.3: Record Delaware River Flows at Riegelsville, NJ

Rank	Date	Gage Height (ft)	Peak Discharge (ft^3/sec)	Probability of Recurrence Interval (years)
1st	August 20, 1955	38.85	340,000	>100
2nd	October 10, 1903	35.90	275,000	>100
3rd	April 4, 2005	34.07	262,000	>100
4th	June 29, 2006	33.62	254,000	
5th	January 8, 1841		250,000 (estimate)	
6th	March 19, 1936	32.45	237,000	
7th	September 19, 2004	30.95	216,000	70
Notes: Flood-frequency statistics at this site are based on peak-flow data from 1907 through 2005 and historical peaks from 1841 and 1903. Flood stage is 22 feet. Moderate flood state is 26 feet. Major flood stage is 30 feet.				
Sources: USGS, 2006 and NOAA National Weather Service, 2006.				

References: Climate and Meteorology

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Ludlum, David M. 1983. The New Jersey Weather Book. New Brunswick, New Jersey: Rutgers University Press.

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NOAA web site: http://www.ncdc.noaa.gov/oa/ncdc.html
Extreme Weather: http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~storms
Frost/Freeze Occurrence for NJ: http://www5.ncdc.noaa.gov/climatenormals/clim20supp1/states/NJ.pdf

NOAA National Weather Service. 2006. Advanced Hydrologic Prediction Service. Delaware River at Riegelsville. http://newweb.erh.noaa.gov/ahps2/hydrograph.php?wfo=phi&gage=rgln4&type=0&view=1,1,1,1,1,1

Office of the New Jersey State Climatologist (ONJSC)
ONJSC web site: http://climate.rutgers.edu/stateclim/
Normals & Extremes. http://climate.rutgers.edu/stateclim/?section=njcp&target=NJCnormex
Precipitation 1895-2007: http://climate.rutgers.edu/stateclim_v1/data/north_njhistprecip.html

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United States Geological Survey (USGS). 2006. National Water Information System: Web Interface Peak Streamflow for the Nation USGS 01457500 Delaware River at Riegelsville NJ http://nwis.waterdata.usgs.gov/nwis/peak?site_no=01457500&agency_cd=USGS&format=html

Internet Resources: Climate and Meteorology

Office of the New Jersey State Climatologist (ONJSC)
- ONJSC Home Page: http://climate.rutgers.edu/stateclim/
- NJ Drought Watch: http://www.njdrought.org/
- Drought Status of Central Region: http://www.njdrought.org/status.html#central
- Weather and Climate Network: http://climate.rutgers.edu/njwxnet

United States Environmental Protection Agency Climate Change: http://epa.gov/climatechange/index.html

National Weather Service Advanced Hydrologic Prediction Service (flood predictions):
- Delaware River at Riegelsville http://newweb.erh.noaa.gov/ahps2/hydrograph.php?wfo=phi&gage=rgln4&view=1,1,1,1,1,1
- Delaware River at Frenchtown http://newweb.erh.noaa.gov/ahps2/hydrograph.php?wfo=phi&gage=fren4&view=1,1,1,1,1,1
- Delaware River at Stockton http://newweb.erh.noaa.gov/ahps2/hydrograph.php?wfo=phi&gage=stkn4&view=1,1,1,1,1,1

USGS Real-time Delaware River Flow:
- Delaware River at Riegelsville http://waterdata.usgs.gov/nwis/uv?01457500
- Delaware River at Frenchtown http://waterdata.usgs.gov/nwis/uv?01458500
- Lockatong Creek at Raven Rock http://waterdata.usgs.gov/nwis/uv?01460880
- Wickecheoke Creek at Stockton, NJ http://waterdata.usgs.gov/nwis/uv?01461300
- Delaware River at Lambertville http://waterdata.usgs.gov/nwis/uv?01462000

B. Air quality

Introduction

The New Jersey Comparative Risk Project (March 2003), funded by the US EPA and the NJDEP, combined the efforts of 73 experts to analyze and rank 88 chemical, physical and biological factors ("stressors") according to their relative negative impacts on human health, ecological quality, and socioeconomic conditions (monetary cost). The study ranked several air pollutants among the highest risks to human health, including ground-level ozone, particulate matter, radon, secondhand tobacco smoke, and volatile organic compounds (VOCs). Air pollution is estimated to have medium to medium-high socioeconomic impact, and lesser impacts to ecological quality (Steering Committee of the NJ Comparative Risk Project, 2003).

Exposure to air pollution is a widespread problem that occurs throughout the entire state. Airborne pollutants come from a wide variety of sources, including industry, utilities, manufacturing and commercial sources, vehicles and residential activities (such as oil burning for home heating, and painting houses). According to the NJDEP Bureau of Air Quality Planning, burning wood also impacts public health and the environment. Burning wood, although often thought of as greenhouse emission neutral since it is a renewable resource, emits fine particulate matter, polycyclic aromatic hydrocarbons (PAHs), and CO_2. Older woodstoves emit approximately 40-60 grams per hour of particulates. However, EPA certified stoves emit only 2-5 grams per hour (NJDEP, BAQP. No Date). Outdoor wood boilers emit from 24-265

grams of particulates per hour, depending on the fuel used (pine and hemlock being the worst polluters) (Northeast States for Coordinated Air Use Management, 2008).

On hot summer days, when pollutant levels are worst, winds in New Jersey are usually blowing from the southwest, carrying air pollution from the Washington, Baltimore and Philadelphia metropolitan areas to New Jersey. In turn, these winds carry the pollution created here to New York, Connecticut and further to the northeast.

After the passage of the Clean Air Act in 1970, the United States Environmental Protection Agency (USEPA) set National Ambient Air Quality Standards (NAAQS) for six pollutants, known as the *Criteria Pollutants*, (ozone, sulfur dioxide, carbon monoxide, nitrogen dioxide, particulate matter, and lead). These pollutants are addressed throughout the country through a planning process and the concentrations of these pollutants in air have been monitored for compliance with the air quality standards.

Concentrations of these six pollutants have been significantly reduced in New Jersey. The state is now in compliance with all NAAQS, except for ozone. New Jersey Department of Environmental Protection (NJDEP) developed the Air Quality Index (AQI) to provide a descriptive rating and a color code (i.e. green=good) in real-time on the internet for many sites, including Flemington, the site closest to Kingwood. Flemington is an automated site, which monitors for ozone (O_3), particulates and meteorological conditions.

The following summaries for ground-level ozone, particulates, air toxics and atmospheric deposition are summarized from the 2005 Air Quality Report, published by the NJDEP Bureau of Air Monitoring (NJDEP Bureau of Air Monitoring, 2005).

Ground-level Ozone

Ground-level ozone forms in the air from volatile organic compounds (VOCs) and nitrogen oxides (NO_x) under conditions of high temperature and bright sunlight. The hottest days of summer can yield unhealthy levels of ozone. **Table 2.4** presents a summary of the number of days the ozone standards were exceeded per year. The 1-hour ozone standard is an average of 0.12 parts per million (ppm), and the 8-hour ozone standard (which became effective in 1997) is an average of 0.08 parts per million (ppm). According to preliminary data for 2003, there were no exceedances of the 1-hour standard in 2003. However, the 8-hour ozone standard was exceeded 7 times in 2003. The Clean Air Act requires that all areas of the country be evaluated and then classified as attainment or non-attainment areas for each of the National Ambient Air Quality Standards. Kingwood is within a non-attainment area for Ozone, rated as category "Severe 2" (the highest category; with the fourth highest daily maximum 1-hour average concentration recorded over a three year period in the range of 0.191 - 0.279 ppm) (NJDEP Bureau of Air Monitoring, 2005).

Table 2.4: Summary of Ground-Level Ozone Exceedances at Flemington, NJ

Year	Ozone Exceedances (days)	
	1-hour averages	8-hour averages
1985	3	New ambient air quality standards for ozone became effective July 18, 1997
1986	4	
1987	4	
1988	14	
1989	3	
1990	6	
1991	1	
1992	0	
1993	0	
1994	0	
1995	1	
1996	0	
1997	0	
1998	0	21
1999	2	23
2000	0	9
2001	3	12
2002	1	19
2003	0	7
2004	0	6
2005	0	13
2006	Data not available	
2007*	1	11
*Data for 2007 is preliminary as of 01/09/09 and subject to change.		
Source: NJDEP Bureau of Air Monitoring, http://www.state.nj.us/dep/airmon/ozytd.htm		

Particulates

Particulate air pollution consists of both solid particles and liquid droplets suspended in the atmosphere, usually less than 70 microns in diameter. In addition to human health and environmental effects, particulate matter is a major cause of reduced visibility. Particles larger than 10 microns are usually trapped by the human respiratory system before they reach the lungs, therefore coarse particles smaller than 10 microns (PM10) are considered more harmful, while fine particles less than 2.5 microns (PM2.5) are even more detrimental to human health (heart and lung conditions, such as asthma, bronchitis, cardiac arrhythmias, heart attacks, and can even be attributed to premature death). Coarse particle sources include windblown dust and industrial sources, while fine particles come from combustion sources or are formed in the atmosphere from gasses.

The nearest monitoring site for particulates are Trenton (for PM10), Washington Crossing and Phillipsburg (for PM2.5), and Flemington (where "smoke shade" is measured, an indirect measurement of particulates, and used for reporting in the Air Quality Index). Although the particulates sometimes reach "moderate" and "unhealthy for sensitive individuals" levels, the New Jersey standard for Total Suspended Particulates and the NAAQS standards are being met for PM2.5 PM10 for annual mean and maximum 24-hour average at these sites. The annual average PM2.5 at Phillipsburg was 13.6µg/M^3 and at Washington Crossing was 12.3 µg/M^3, both below the annual average standard of 15 µg/M^3. Both also had maximum 24-hour averages below the 24-hour standard of 65µg/M^3 (Phillipsburg, 44.7µg/M^3; Washington Crossing, 37.8µg/M^3. The monitoring site at Trenton was below the standards for PM10 for both daily maximum (standard, 150µg/M^3; Trenton, 59µg/M^3) and daily mean (standard, 50µg/M^3; Trenton, 26µg/M^3)(NJDEP Bureau of Air Monitoring, 2005).

Air Toxics

In addition to ozone and PM2.5, there is increasing concern about a group of air pollutants termed *air toxics*. These pollutants include substances known to cause serious health problems, such as damage to the immune system, neurological, reproductive, developmental and respiratory problems and cancer. Toxic pollutants may also be deposited on soil and water, taken up by plants and consumed by animals.

The list of potential air toxics is very large and includes many different types of compounds from heavy metals to volatile organic compounds (VOCs) such as benzene. In 1979, NJDEP adopted a regulation that specifically addressed air toxics emissions. This rule (Control and Prohibition of Air Pollution by Toxic Substances) listed 11 Toxic Volatile Organic Substances (TVOS) and required that sources emitting those TVOS to the air should register with the Department and demonstrate that they were using state-of-the-art controls to limit their emissions.

Under the Clean Air Act Amendments of 1990, USEPA is required to begin to address a list of 188 of these air toxics (known as *Hazardous Air Pollutants*, or HAPs). NJDEP will be working with USEPA to implement these various strategies to reduce air toxics throughout the state.

The USEPA prepared a comprehensive inventory of air toxics emissions for the entire country as part of the National-Scale Air Toxics Assessment (NATA) in 1996. The study determined that on-road mobile sources are responsible for 35% of the toxic emissions, off-road mobile sources (airplanes, trains, construction equipment, lawnmowers, boats, dirt bikes, etc.)

account for 33%; area sources contribute 25% (residential, commercial, and small industrial sources), and major point sources account for the remaining 7%.

The NATA study also estimated levels of pollutants geographically. Although Hunterdon is estimated to have lower levels of air toxics than the more populated and industrial areas of the state, it falls within an area expected to have concentrations of benzene at 5-10 times the health benchmark. NJDEP has determined that 19 of the chemicals were predicted to exceed their health benchmarks in one or more counties in 1996. Pollutants of statewide concern include benzene, 1,3-butadiene, carbon tetrachloride, chloroform, diesel particulate matter, ethylene dibromide, ethylene dichloride and formaldehyde. In parts of the state, acrolein, polycylic organic matter, chromium compounds, acetaldehyde, perchloroethylene, 7-PAH, arsenic compounds, cadmium compounds, nickel compounds, beryllium compounds and hydrazine.

The NJDEP has established four comprehensive air toxics monitoring sites. They are located in Camden, Elizabeth, New Brunswick and Chester. The Camden site has been measuring several toxic volatile organic compounds (VOCs) since 1989. The trend of pollutant concentrations at Camden is downward from 1996 to 2005. However, nine compounds had annual average concentrations that exceeded their health benchmarks, including acetaldehyde, benzene, carbon tetrachloride, chloromethane, formaldehyde, 1,3-butadiene and tetrachloroethylene (NJDEP Bureau of Air Monitoring, 2005).

Atmospheric Deposition

Pollution that is deposited on land or water from the air is called *atmospheric deposition.* Wet deposition is washed from the air by precipitation, while dry deposition refers to particulates that settle out of the atmosphere during dry weather. Sources include motor vehicles, power plants, and incinerators. The major pollutants of concern are sulfur dioxide (SO_2), nitrogen oxides (NO_x), mercury (Hg), and volatile organic compounds (VOCs). In addition, the presence of these pollutants changes the pH of the precipitation which can harm plants and aquatic life. Of the two sites where atmospheric deposition is monitored in New Jersey, the one in Washington Crossing is closest to Kingwood. This site is also part of the National Atmospheric Deposition Program. Results for 2005 show a mean pH value of 4.48 (normal rainfall has a pH of about 5.6). Trends show that pH and concentrations of SO_2 and NO_x are improving (NJDEP Bureau of Air Monitoring, 2005).

A separate study of mercury in lake sediment cores (which may be representative of atmospheric deposition over time) throughout New Jersey demonstrated that, while mercury levels have decreased, they are still present at levels far higher than natural levels. (Kroenke et al, 2003).

Radon

Radon is a radioactive gas that is naturally occurring in New Jersey rocks, soil and ground water, and a common concern in Kingwood Township. Radon gas can become concentrated indoors, where it can increase risks of lung and stomach cancer. New Jersey requires new construction to be tested for radon, and the New Jersey Private Well Testing Act has required testing for radon ("gross alpha particle activity") since March 2004 whenever homes are sold. In Kingwood, 6.7% of the wells tested for gross alpha between 2002 and 2007 exceeded the standard (NJDEP Division of Water Supply, 2008).

References: Air Quality

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2005 Air Quality Report: http://www.state.nj.us/dep/airmon/05rpt.htm
Air Monitoring web site: http://www.state.nj.us/dep/airmon/
Historical Ozone data: http://www.state.nj.us/dep/airmon/histdata.htm

NJDEP, Bureau of Air Quality Planning. No Date. Clearing the Air About Wood Heat. 2 pages. http://www.state.nj.us/dep/baqp/docs/woodburning_issues.pdf

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Northeast States for Coordinated Air Use Management (NESCAUM). September 9, 2008. Contribution of Wood Smoke to Particle Matter Levels in Connecticut Source Characterization of Outdoor Wood Furnaces. 20 pages + appendices. http://www.nescaum.org/documents/source-characterization-of-outdoor-wood-furnaces

Steering Committee of the New Jersey Comparative Risk Project. March 2003. Final Report of the New Jersey Comparative Risk Project. 213 pages.

Internet Resources: Air Quality

Current Air Quality:
Air Now - Northern NJ: http://www.airnow.gov/index.cfm?action=airnow.showlocal&CityID=160
Chester: http://www.state.nj.us/dep/airmon/che.htm
Flemington: http://www.state.nj.us/dep/airmon/fle.htm

NJDEP Bureau of Air Monitoring
Home Page: http://www.state.nj.us/dep/airmon/
Reports: http://www.state.nj.us/dep/airmon/reports.htm
Air Toxics in New Jersey: http://www.state.nj.us/dep/airmon/airtoxics/overview.htm
What you can do to reduce air toxics? http://www.state.nj.us/dep/airmon/airtoxics/youcan.htm

NJDEP Bureau of Air Quality Planning:
Woodburning in NJ: http://www.state.nj.us/dep/baqp/woodburning.html

NJDEP Private Well Testing Act: http://www.state.nj.us/dep/pwta/

NJDEP Radon Information: http://njradon.org or call 1-800-648-0394

United States Environmental Protection Agency Air Topics: http://www.epa.gov/ebtpages/air.html

C. Geology

Geologic history

The Devil's Tea Table is an eroded rock from the Triassic period, which is perched on the cliff in Kingwood Township, along Route 29, just north of Warsaw Road.

Five hundred million years ago, the land that is now New Jersey was at the bottom of the sea, close to the equator. About 400 million years ago, Europe and North America collided, forming the Appalachian Mountains, which were far higher and more rugged than the Rocky Mountains are now.

Flashfloods eroded the mountains to the east and south of what is now Kingwood, dropping mud and silt in extensive floodplain deposits, gradually filling the valleys. This is known as the "Newark episode," which lasted between about 15 and 23 million years. The rate of deposition averaged between 215 and 325 millimeters per 1,000 years, keeping pace with the rate of basin sinking. Shallow lakes formed at the bottom of the desert basin (known as playa lakes). The sediments became rock under the pressure of each successive layer of mud, silt or sand. Dinosaurs walked on these mudflats, leaving footprints that occasionally became fossilized. Fossils of coelacanths and other fish have also been found in Lockatong argillite rocks (although not necessarily in Kingwood).

Roughly 200 million years ago, the supercontinent broke apart, and the Atlantic Ocean was born. This was accompanied by volcanic activity, which resulted in magma flowing at or near the surface. These exist today as the erosion resistant basalt and diabase outcrops found in the Byram area of Kingwood (other examples are the Watchung Mountains, the Palisades, and the Sourland Mountains). When the diabase intruded, the surrounding sedimentary rocks were hardened by heat and pressure, and are known as hornfels rocks, or traprock, which was quarried commercially. These have properties similar to the Lockatong argillite rocks.

Within the past two million years, the climate alternated between cold and warm. During periods of glaciation, the glaciers never came as far south as Kingwood, although this area became a cold tundra. At times, the shoreline of the Atlantic Ocean may have been nearby, while at other times, it may have receded a hundred miles from the present shore.

The following summary (**Table 2.5**) of New Jersey's geologic history is based on information from Gallagher, 1997.

Table 2.5: Summary of New Jersey's Geologic History

Period	Million Years Ago	Description of Climate and Fossils Found in Corresponding Bedrock
Paleozoic Era		
Cambrian Period	543 – 505	**Climate:** New Jersey was close to the equator, covered by warm tropical seas. **Fossils:** Trilobites, brachiopods, stromatolites, worm burrows
Ordivician Period	505 – 438	**Climate:** New Jersey continued to be underwater, as the sea above deepened to oceanic depths. **Fossils:** Trilobites, brachiopods, coral, nautiloids, clams, crinoids, and snails
Silurian Period	438 – 408	**Climate:** The sea level rose and fell, with New Jersey remaining at the sea floor. **Fossils:** Coral, brachiopods, clams, brine shrimp, primitive fish, eurypterids (sea scorpions), arthrophycus (fossilized feeding burrow made by a worm-like animal)

Table 2.5: Summary of New Jersey's Geologic History

Period	Million Years Ago	Description of Climate and Fossils Found in Corresponding Bedrock
Devonian Period	408 – 360	**Climate:** Europe collided with North America, forming the mountains which are now the Ridge and Valley and Highlands provinces of New Jersey. The fossils found continued to be aquatic life forms. **Fossils:** Brachiopods, clams, trilobites, nautiloids, crinoids, coral, snails, stromatoporoids, ostracodes, bryozoa
Mississippian, Pennsylvanian & Permian Period	360-245	**Climate:** No geologic record of these time periods is present in New Jersey. At some point, the sea subsided, and New Jersey became dry land, at least in part. **Fossils:** None
Mesozoic Era		
Triassic Period	245 – 208	**Climate:** New Jersey was next to Morocco, part of the supercontinent Pangaea. In the dry interior of the continent, the area experienced greater daily and seasonal fluctuations than the coasts. The rugged landscape consisted of high young mountains and deep valleys formed by faults. The brief rainy seasons' flashfloods dropped mud and silt in low areas, where playa lakes formed. In the end of the Triassic the climate became desert-like. The lakes began to dry up and became salty, resulting in an environment where brine shrimp flourished. When a lake went dry, some fish and other aquatic life became fossils. **Fossils:** dinosaur footprints, thecodonts, fish (including coelacanths), phytosaurs, amphibians, insects, plants
Jurassic Period	208 – 144	**Climate:** The breakup of Pangaea resulted in the beginning of the Atlantic Ocean. Igneous intrusions (molten rock forced into earlier rock formations) formed diabase and basalt bedrock. Because the terrain was mountainous, the net geologic action was erosion, not deposition. **Fossils:** There are no late Jurassic deposits in New Jersey; therefore no fossils exist from this period. However, the fauna probably consisted of the same dinosaurs as the American West, including sauropods, armored dinosaurs, ornithopods (forerunner of hadrosaurus), tenontosaurus (relative of the iguanadon). True flowering plants (angiosperms) appeared at this time.
Cretaceous Period	144 – 65	**Climate:** Southern New Jersey experienced flooding and ebbing. The sea level changed cyclically from deeper to shallower water in this tropical environment. During flooding, greensand marl (glauconite) was formed. During ebbing, clay and sand were deposited. Fossil phytoplankton, clams, snails, crustaceans, ammonites, oysters, reptiles, sharks, burrows, worm tubes and vertebrates such as mosasaurs have been found in New Jersey's coastal plain. **Fossils:** The fossil dinosaurs found include hadrosaurus (which probably washed downstream during a flood), ornithomimus, *Dryptosaurus aquilunguis* (a 17' predator with a great hand claw), *Hadrosaurus foulkii*, and *Hadrosaurus minor*.
Cenozoic Era		
Tertiary Period	65 – 1.8	**Climate:** The climate was warm, and the sea level was higher, covering the Outer Coastal Plan. **Fossils:** On Land: birds, such as the giant flightless birds, Diatryma; tillodont, an extinct mammal the size of a bear, but with rodent-like teeth; possibly others similar to those found in South Dakota badlands, such as brontotherium, and ancestral horses; entelodonts (resembled giant warthogs), diceratherium (semi-aquatic rhinoceros); peccary; prosynthetoceras (a camal); anchitherium (horse); a primitive doglike carnivore. Fossils in Outer Coastal Plan: brachiopods, coral, sponges, clams, sharks, mollusks, crinoids, mammals (probably washed to the sea in floods), crocodiles, snakes, early whales
Quaternary Period	1.8 - present	**Climate:** The climate alternated between cold and warm, resulting in four intervals of glaciation. The glaciers covered northern New Jersey, reaching as far south as Belvidere on the Delaware River. South of the glacial ice, a

Table 2.5: Summary of New Jersey's Geologic History

Period	Million Years Ago	Description of Climate and Fossils Found in Corresponding Bedrock
		treeless, frozen tundra existed. When water was frozen in glaciers, the sea level was lower, resulting in a shoreline over a hundred miles east of the present coast. **Fossils:** Fossils of many familiar and some extinct animals have been found in nearby areas. There were insects, turtles, and snakes. Herbivores included squirrels, groundhogs, porcupines, beaver, muskrats, voles, mice, eastern cottontail rabbits, white-tailed deer, peccaries, tapirs, giant ground sloth, the elk-moose, giant beaver, American mastodon, and mammoth. Carnivores included otters, skunks, bobcats, foxes, black bears, coyotes, jaguars, jaguarundi, short-faced bear and a saber-toothed cat.
Source: Gallagher, 1997.		

Bedrock Geology of Kingwood Township

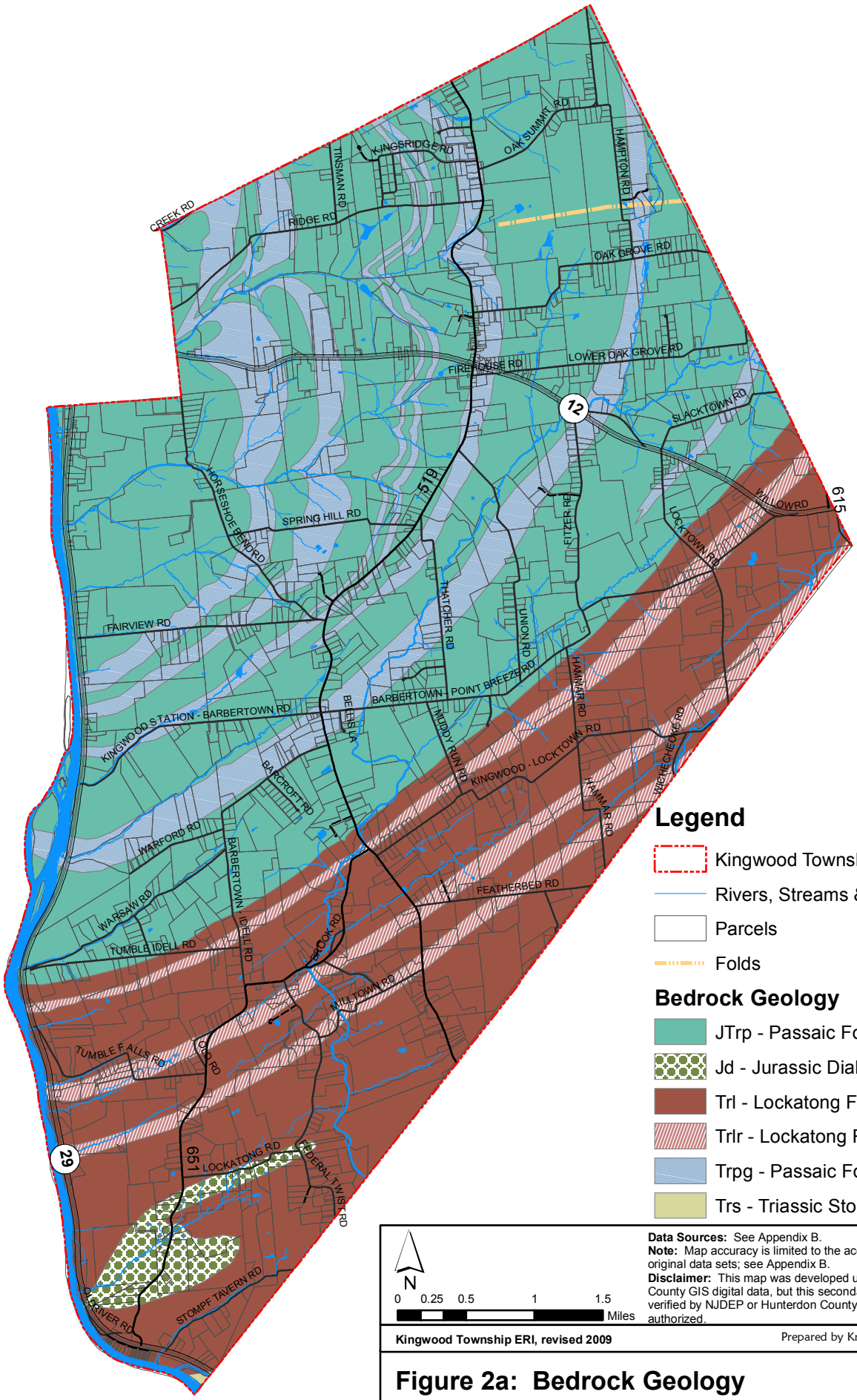
Bedrock is the solid rock beneath the soil and surficial rock. The bedrock geologic formations that exist in what is now Kingwood Township were all formed during the Mesozoic Era (Triassic and Jurassic periods), and belong to a geologic group called the "Late Triassic Newark Group" (See **Table 2.6** and **Figure 2a).** If additional sediments were laid down after that time, they have since been eroded away**.**

The Late Triassic Newark Group lies in a southwest-trending basin that extends from

Table 2.6: Characteristics of Bedrock Types Found in Kingwood Township

Abbreviation and Bedrock Name	When Formed	Approximate Thickness	Lithology (physical character of rocks)	Approx. Acres in Kingwood[3]	Percent of Township[4]
Trl - Lockatong Formation	Upper Triassic	3,774 ft. (1,150 m)	dolomitic or silty argillite, mudstone, sandstone, siltstone, and minor silty limestone	6616	29%
Trlr - Red Bed Lockatong Formation			dolomitic or silty argillite, mudstone, sandstone, siltstone, and minor silty limestone, occasionally red	1401	6%
JTrp - Passaic Formation[5]	Lower Jurassic and Upper Triassic	6,234 ft. (1,900m)	siltstone and shale	11211	49%
JTrpg – Passaic Formation Gray bed			sandstone, siltstone and shale	3244	14%
Jd - Diabase and granophyre[6]	Early Jurassic		diabase, medium- to coarse-grained	390	2%
Trs - Stockton Formation	Upper Triassic	6,004 ft. (1,830 m)	sandstone, mudstone, silty mudstone, argillaceous siltstone, and shale	13	0.06%
Source: NJGS Bedrock Geology GIS data and Van Houten, 1969.			Totals:	22,876	100.06%

[3] There is a discrepancy of 40 acres between this total of 22,876 acres, and Kingwood's official acreage of 22,836.
[4] Percentages are based on a total of 22,876; they add up to more than 100% due to rounding.
[5] Passaic Formation was previously called the Brunswick Formation.
[6] A granophyre is a fine grained granite rock containing relatively large crystals, especially feldspar.



Legend

- Kingwood Township Boundary
- Rivers, Streams & Lakes
- Parcels
- Folds

Bedrock Geology

- JTrp - Passaic Formation
- Jd - Jurassic Diabase
- Trl - Lockatong Formation
- Trlr - Lockatong Red Bed
- Trpg - Passaic Formation Gray bed
- Trs - Triassic Stockton Formation

N

0 0.25 0.5 1 1.5 Miles

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.

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Prepared by Kratzer Environmental Services

Figure 2a: Bedrock Geology

Rockland County, New York, to northeastern Lancaster County, Pennsylvania. This is the largest of the Triassic rift valleys that extend from Nova Scotia to North Carolina. The Newark Group consists of non-marine sedimentary rocks 16,000-20,000 feet thick, and associated intrusions of volcanic rocks. Older rocks, which lie beneath the Newark Group, are exposed to the north in the Highlands and Ridge and Valley Provinces. Younger strata overlap the Newark Group in the Coastal Plain Province to the southeast. The layers generally dip 10 – 20° northwest, and are locally broken by many small normal faults (Van Houten, 1969).

Earthquakes are not unknown in Kingwood. The earthquake of August 2003, with its epicenter only a few miles away in Milford, was felt in Kingwood Township. Damaging earthquakes are rare, but possible. Soils influence the potential for damage from earthquakes. Most areas of Kingwood have shallow depth to bedrock, which dampens the movement of earthquakes. However, soft soils (e.g. silt, clay, and fine sand) amplify the motion of earthquake waves, increasing ground shaking, while wet sandy soils can liquefy (Stanford, 2003).

The Surficial Geology of Kingwood Township

Surficial materials are the unconsolidated sediments that overlie bedrock formations, and that are the parent material for agricultural soils. In Hunterdon County they include stream, wetland, glacial, windblown, and hillslope sediments and weathered bedrock material. The weathered bedrock material may be as much as 200 feet thick, although most are generally less than 20 feet thick. The size of particles in the surficial materials ranges from coarse gravel to clay and peat. They affect the movement of ground water from the surface into underlying bedrock aquifers, and some are aquifers themselves (See **Figure 2b** and **Table 2.7**).

Table 2.7: Types of Surficial Geology Found in Kingwood Township

Deposit Type	Definition
Residuum	weathered bedrock; soil textures dependent on type of rock from which the soil is weathered
Glaciofluvial deposits	deposits of glacial origin, but transported and deposited by river and streams; soil textures dominated by high sand, gravel and silt contents
Lacustrine deposits	glacial lake-bottom sediments; soil textures have high silt and clay contents
Alluvium	Any sediment deposited by flowing water
Eolian deposits	transported by wind; are not typically deep deposits, but may exist as a thin deposit overlying another type of parent material; soil textures dominated by medium and fine sands
Colluvium	transported down-slope by gravity; soil textures dependent on particle-size of colluviated parent material
Source: NRCS Soils Online Study Guide: http://www.nj.nrcs.usda.gov/partnerships/envirothon/soils/	

References: Geology

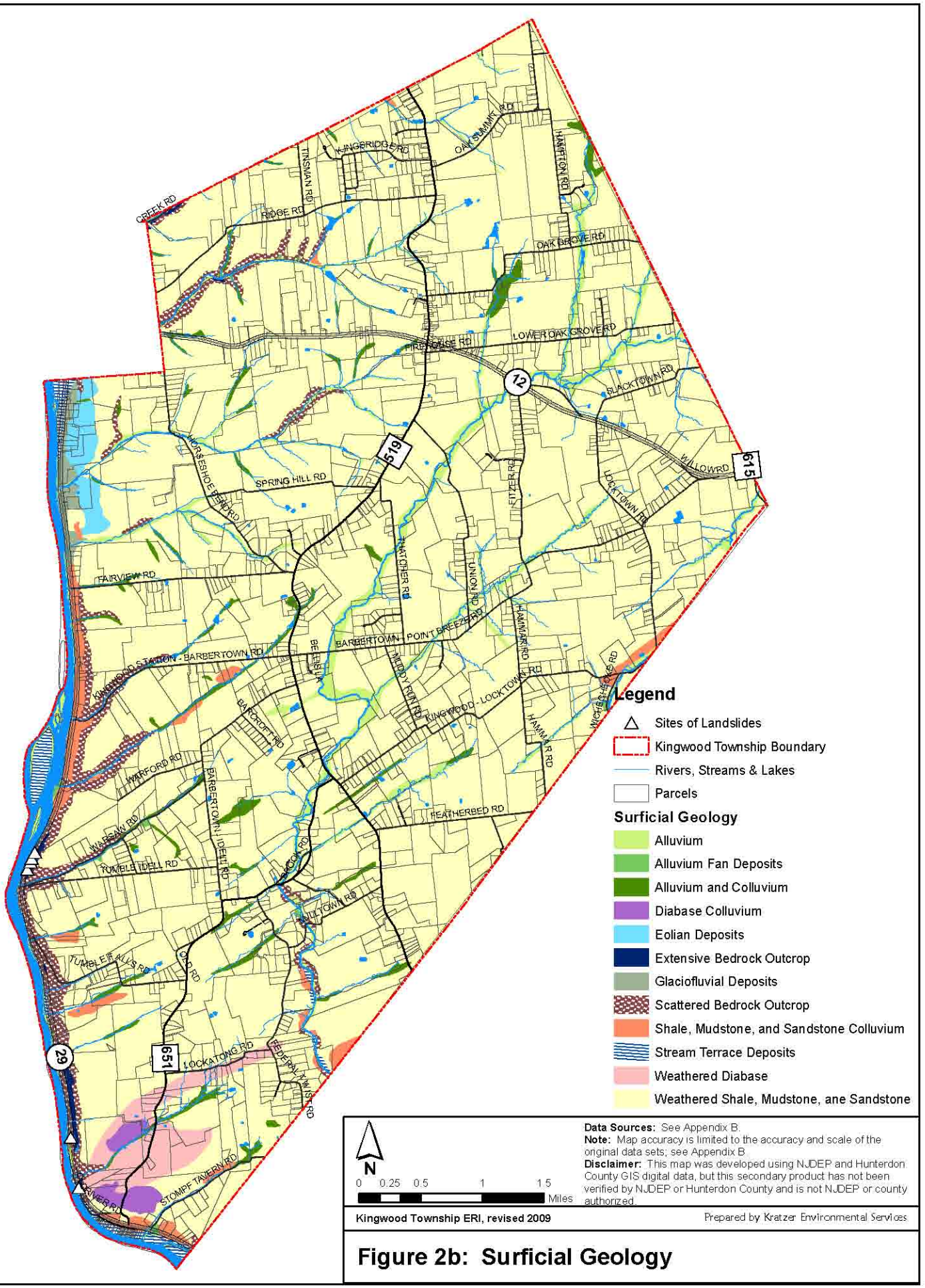
Gallagher, William B. 1997. When Dinosaurs Roamed New Jersey. Rutgers University Press. New Brunswick, NJ. 176 pages.

New Jersey Geological Survey. 1999. The Geology of New Jersey. 2 pages. http://www.state.nj.us/dep/njgs/index.html

NRCS Soils Online Study Guide: http://www.nj.nrcs.usda.gov/partnerships/envirothon/soils/

Stanford, Scott. 2003. Predicting Earthquake damage in New Jersey. NJ Geological Survey Information Circular. 2 pages.

Widmer, Kemble. 1964. The Geology and Geography of New Jersey. Volume 19 of the New Jersey Historical Series. D. Van Nostrand Col, Inc. Princeton, NJ.


Legend
Sites of Landslides
Kingwood Township Boundary
Rivers, Streams & Lakes
Parcels
Surficial Geology
Alluvium
Alluvium Fan Deposits
Alluvium and Colluvium
Diabase Colluvium
Eolian Deposits
Extensive Bedrock Outcrop
Glaciofluvial Deposits
Scattered Bedrock Outcrop
Shale, Mudstone, and Sandstone Colluvium
Stream Terrace Deposits
Weathered Diabase
Weathered Shale, Mudstone, ane Sandstone
N
0 0.25 0.5 1 1.5
Miles
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.
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Prepared by Kratzer Environmental Services
Figure 2b: Surficial Geology

USDI, United State Geological Survey. Ground Water Atlas of the United States: Delaware, Maryland, New Jersey, North Carolina, Pennsylvania, Virginia, West Virginia. HA 730-L. http://capp.water.usgs.gov/gwa/index.html

Van Houten, F.B. 1969. "Late Triassic Newark Group, North Central New Jersey and Adjacent Pennsylvania and New York" IN Geology of Selected Areas in New Jersey and Eastern Pennsylvania and Guide Book. Seymour Subitzky, editor. Rutgers University Press; New Brunswick, New Jersey. Pages 314 – 344.

Internet Resources: Geology

USGS programs in NJ: http://water.usgs.gov/pubs/FS/FS-030-96/

The Geology of New Jersey (NJ Geological Survey): http://www.state.nj.us/dep/njgs/index.html

D. Physiography & Topography

New Jersey can be divided into four regions, known as *physiographic provinces*, which are areas with similar sequences of rock types, geologic structures and a common geologic history (see **Figure 3a**). The northwestern section of New Jersey is part of the *Valley and Ridge Province*, which is characterized by long, parallel ridges and valleys formed by folded and faulted limestones, shales and sandstones of early and middle Paleozoic age. Erosion-resistant sandstone and siltstone bedrock lie beneath the ridges of the Appalachian Mountains while shale and limestone underlie the valleys.

Bordering the Valley and Ridge Province to the southeast, the *Highlands Province* consists of metamorphic rocks of Precambrian age. The granites and gneisses are resistant to erosion and create a hilly upland with deep, steep-sided valleys carved by streams.

The Highlands Province is separated from the *Piedmont Province* by a series of major faults, reaching the Delaware River near Milford. The rocks of the Piedmont are of Late Triassic and Early Jurassic age. As sediments eroded from adjacent uplands, and were deposited along rivers and lakes within the basin, they became compacted and cemented to form conglomerate, sandstone, siltstone and shale. *Diabase* is a rock formed by the cooling of magma at some depth in the crust (i.e. the magma did not erupt at the surface), while basalt formed when the magma was extruded onto the surface. Both basalt and diabase are more resistant to erosion than the surrounding sandstone and shale, therefore they form the ridges and uplands. The Piedmont Province is characterized by gently rolling hills. Overlapping the Piedmont Province to the southeast lies the relatively flat terrain of the *Coastal Plain Province*, which consists of unconsolidated sedimentary formations, such as sands, clays, and marls.

Today's topography resulted from relatively recent erosion from a nearly flat plain. The elevation ranges from 90 feet above mean sea level (adjacent to the Delaware River) to 560 feet (See **Figure 3b**: Elevation Contours). Each line represents ten feet of elevation, and is drawn to follow the contour of the land. **Figure 3c** displays elevation with the hills shaded (called "hillshade") to present a three dimensional effect.

The closer the lines are spaced to each other, the steeper the topography is. Slopes greater than 15% are generally considered "steep slopes" (see **Figure 3d)**. Steeper slopes are more vulnerable to erosion. As the gradient or percent of slope increases, the velocity of runoff water increases, which increases its erosive power. A doubling of velocity of runoff water increases the erosive power fourfold and causes 32 times the amount of material of a given particle size that can be carried (Foth, 1978).

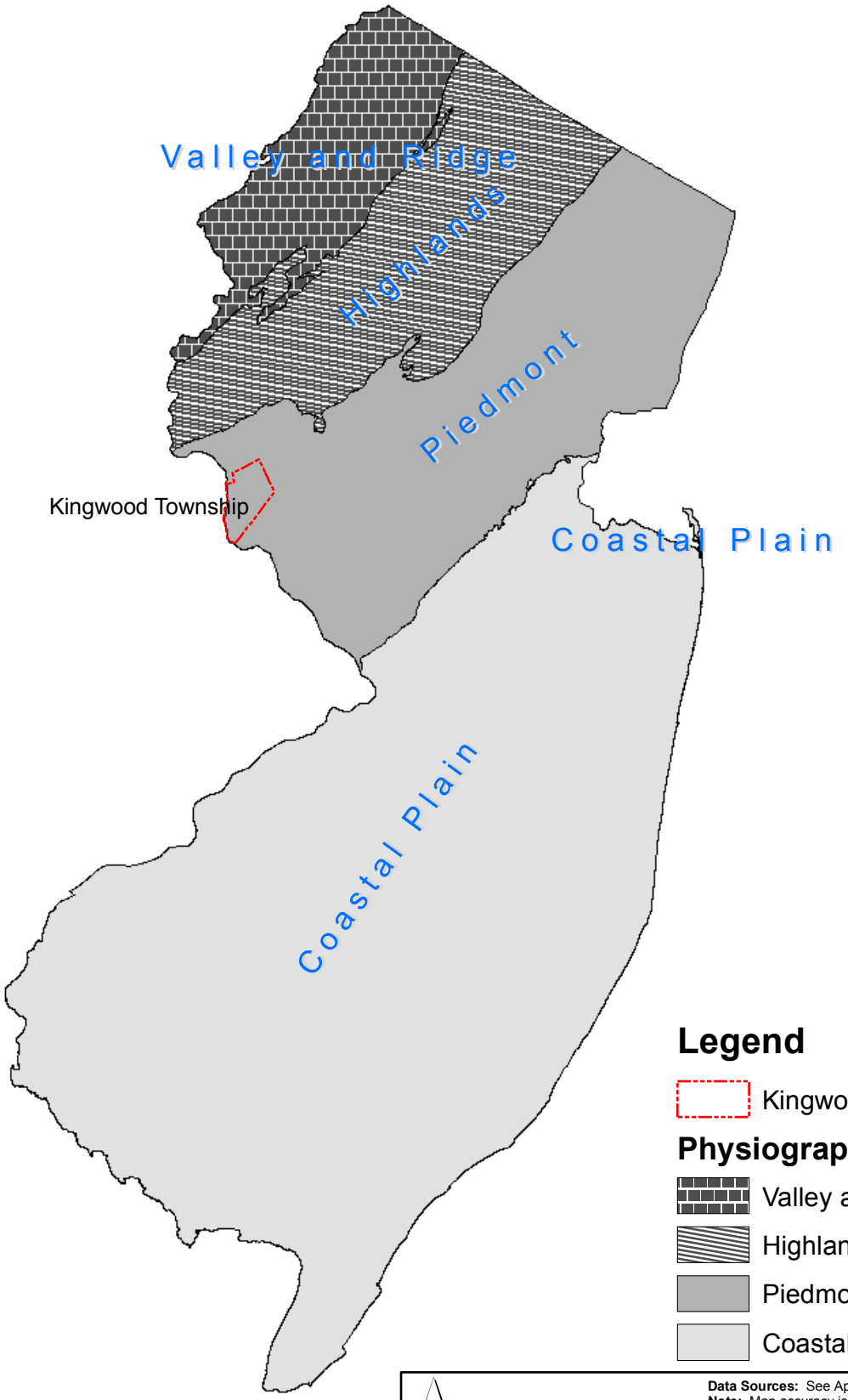


Figure 3a: Physiographic Provinces of New Jersey

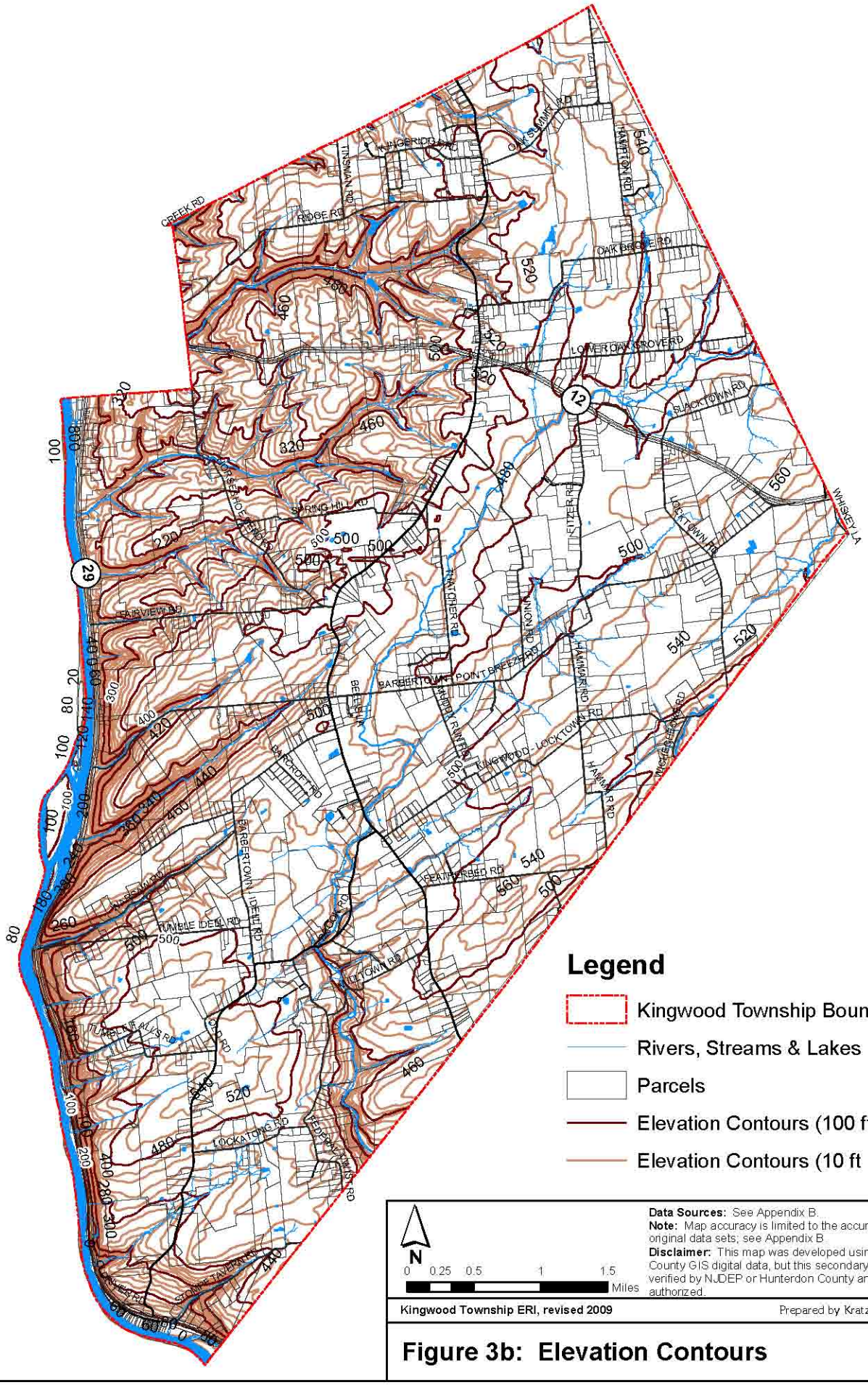


Figure 3b: Elevation Contours

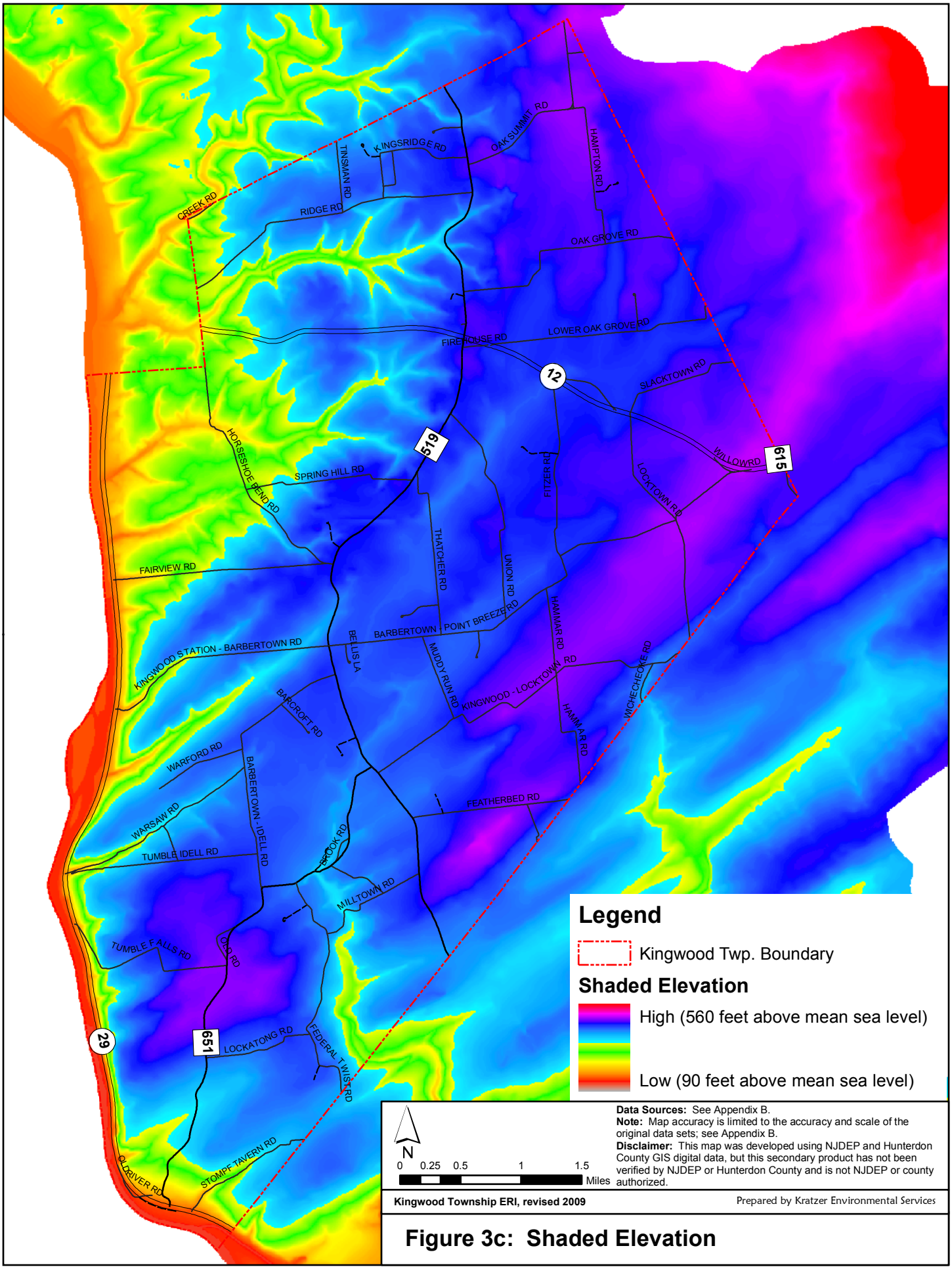
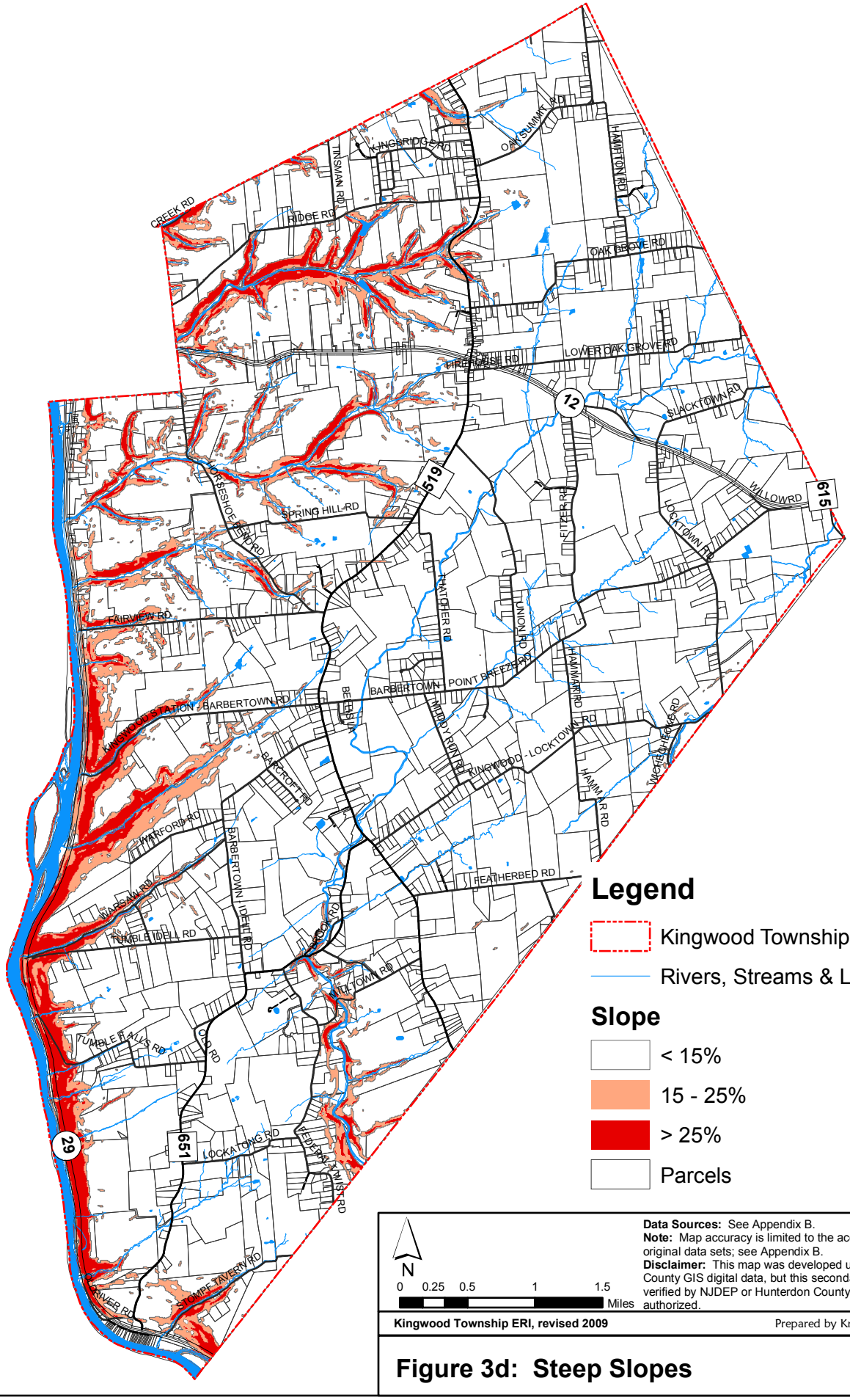


Figure 3c: Shaded Elevation



Legend

- Kingwood Township Boundary
- Rivers, Streams & Lakes

Slope

- < 15%
- 15 - 25%
- > 25%
- Parcels

Data Sources: See Appendix B.
Note: Map accuracy is limited to the accuracy and scale of the original data sets; see Appendix B.
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Figure 3d: Steep Slopes

Erosion causes a number of harmful effects on the environment: loss of soil upon which plants and wildlife depend; loss of soil fertility, because the nutrients and organic material are more easily eroded; gully formation; loss of water that might have been useful for plant growth or ground water recharge; deposition of soil in navigable waters, creating the need for dredging to maintain navigability and sedimentation of streams. Eroded sediment, and the nutrients, pesticides, and other chemicals carried with it, effects aquatic life in many ways. The sediments may bury fish eggs, reduce light available to aquatic plants, and reduces recreational quality and aesthetics.


Erosion caused by ATVs on a steep slope

References: Physiography and Topography

Foth, Henry D. 1978. Fundamentals of Soil Science. John Wiley and Sons: New York. 436 pages.

NJ Geological Survey. The Physiographic Provinces of NJ. http://www.state.nj.us/dep/njgs/enviroed/infocirc/provinces.pdf

Internet Resources: Physiography and Topography

The Physiographic Provinces of NJ (NJ Geological Survey).
http://www.state.nj.us/dep/njgs/enviroed/infocirc/provinces.pdf

E. Soils

Soil Survey Maps

The *soil* is the unconsolidated mineral material on the immediate surface of the earth and which serves as the medium for growth of land plants. The characteristics of each soil type have developed over time (usually many thousands of years) under the influence of the parent material (the bedrock that has broken down into small fragments to form the soil), climate (including moisture and temperature regimes), macro- and microorganisms, and topography. Soil is a basic resource for food production, in addition to its essential role in collecting and purifying water before it enters the ground water. However, soil itself can be a pollutant as dust in the air or as sediment in water.

The US Department of Agriculture Natural Resources Conservation Service (USDA NRCS) is the science-based agency which provides technical assistance based on sound science in the conservation and management of soil, water, and other natural resources to private land owners and local, state, and federal agencies and policy-makers.

One of these technical services is the soil survey. A *soil survey* is an inventory of the country's soil resources to determine soil characteristics and capabilities and to help people understand soils and their uses. Soil surveys help identify the best way to protect soil and water quality through the use of conservation practices and to identify which sites are suitable (and the degree of suitability) for various land uses (e.g. septic systems, roads, agriculture).

The NRCS made soil surveys in 1974 to determine soil characteristics and capabilities and to help people understand soils and their uses (Jablonski, 1974). The soil survey was updated in 1986 and digitized into GIS in 1999. The objective of soil mapping is to separate the landscape into segments that have similar use and management requirements. Therefore, this

data set is not designed for use as a primary regulatory or management tool, but may be used as a broad scale reference source. According to the Soil Survey Geographic Database (SSURGO) information, field investigations and data collection were carried out in sufficient detail to name map units and to identify accurately and consistently areas of about 5 acres. As with other GIS data sets, enlargement of the maps to a scale greater than the accuracy of the data can cause misinterpretation of the data. Onsite sampling, testing, and detailed study of specific sites is essential for determining intensive uses, and managing farms and wetlands (NRCS, 2006).

Beginning in 2005, the NRCS made its soil surveys available online (NRCS, 2006). This provides the means for keeping the information current and available to the public. Users specify a geographic "area of interest" (must be less than 10,000 acres) and then may view a wide variety of tables of soil properties and soil interpretations. However, for this report, the entire SSURGO (Soil Survey Geographic Database) spatial data and tabular data for Hunterdon County were downloaded for use in the GIS (NRCS, 2006) [7].

Soil Series and Map Units

The soil characteristics vary from place to place in slope, depth, drainage, erodibility and other characteristics that affect management. A *soil series* is a basic unit of soil classification consisting of soils that are essentially alike, except that they may differ in surface texture, stoniness, slope or some other attribute. A *map unit* is the area delineated on a soil map, representing an area dominated by one major kind of soil, and is named according to the classification of the dominant soil or soils. However, soils are natural systems, with natural variability, and the range of some observed properties may extend beyond the limits defined for the class. In addition, small areas of contrasting soils may not be visible on the maps. The databases included with the soils data describe the characteristics of each soil map unit. The NRCS has included both estimated and measured data on the physical and chemical soil properties and soil interpretations for engineering, water management, recreation, agronomic, woodland, range and wildlife uses of the soil.

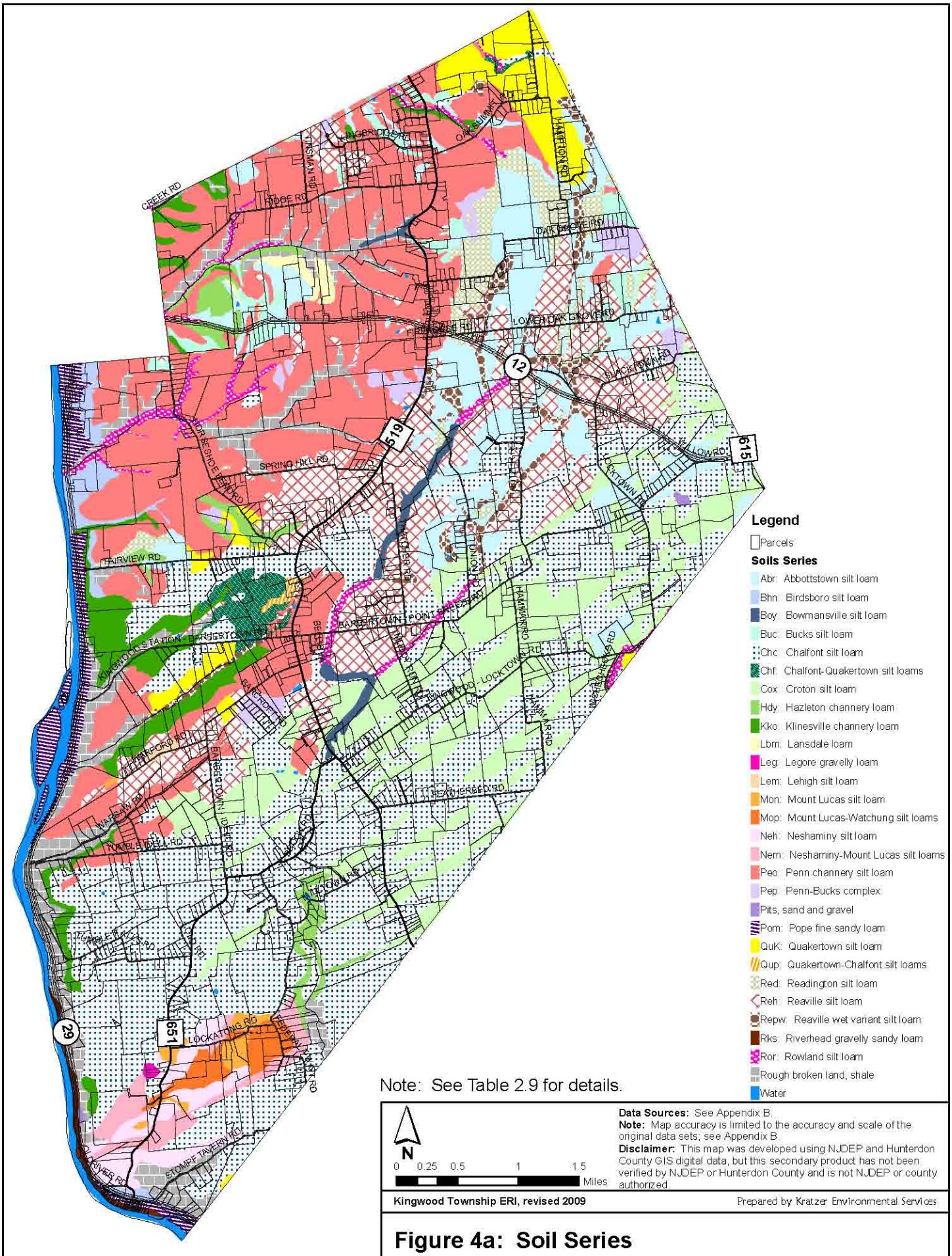
There are 27 soil series' found in Kingwood, such as Croton, Penn and Reaville. A total of 56 different map units are present in Kingwood. These map units are listed in **Table 2.9** and shown on **Figure 4a**. Several important characteristics of these soils are listed in **Table 2.9**, while **Figures 4b – 4h** illustrate the distribution of some soil characteristics. When viewed together, most soils in Kingwood have limitations from at least one of the following factors: poor drainage, high water table, shallow bedrock or steep slopes. The 1974 Soil Survey report also placed an emphasis on limitations of the ground water, especially in relation to the Norton, Penn, Klinesville, Bucks, and Reaville soils. With respect to the Neshaminy, Mount Lucas, and Legore soils, the report states, "Ground water is limited and barely adequate for residential wells."

Depth to Bedrock (Figure 4b)

According to NJDEP (1999), *bedrock* is defined as "any solid body of rock, with or without fractures, which is not underlain by soil or unconsolidated rock material."

The *depth to bedrock* is the distance from the land surface to bedrock. Each soil map unit is characterized by a range of depths to bedrock that is typical for the majority of that soil type. Depth to bedrock is an important factor when determining the suitability of land for building roads, foundations and septic systems.

[7] The maps in this report are the most recent available as of February 2008 (Tabular Data Version 5, 12/7/2006; Spatial Data Version 1, 1/6/2005; Spatial Format=ArcView Shapefile; Coordinate System=UTM Zone 18, Northern Hemisphere (NAD 83)); SSURGO version 2.2; Template database version 32.


Legend
Parcels
Soils Series
Abr: Abbottstown silt loam
Bhn: Birdsboro silt loam
Boy: Bowmansville silt loam
Buc: Bucks silt loam
Chc: Chalfont silt loam
Chf: Chalfont-Quakertown silt loams
Cox: Croton silt loam
Hdy: Hazleton channery loam
Kko: Klinesville channery loam
Lbm: Lansdale loam
Leg: Legore gravelly loam
Lem: Lehigh silt loam
Mon: Mount Lucas silt loam
Mop: Mount Lucas-Watchung silt loams
Neh: Neshaminy silt loam
Nem: Neshaminy-Mount Lucas silt loams
Peo: Penn channery silt loam
Pep: Penn-Bucks complex
Pits, sand and gravel
Pom: Pope fine sandy loam
QuK: Quakertown silt loam
Qup: Quakertown-Chalfont silt loams
Red: Readington silt loam
Reh: Reaville silt loam
Repw: Reaville wet variant silt loam
Rks: Riverhead gravelly sandy loam
Ror: Rowland silt loam
Rough broken land, shale
Water
Note: See Table 2.9 for details.
N
0 0.25 0.5 1 1.5
Miles
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.
Kingwood Township ERI, revised 2009
Prepared by Kratzer Environmental Services
Figure 4a: Soil Series

Kingwood Township has very shallow depths to bedrock, ranging from zero (bedrock is exposed at the surface, with no soil above it) to 60 inches. Areas near the Delaware River, the islands in the river, and a small area on Barbertown-Point Breeze Road have depths greater than 60 inches. There are some soil units in Kingwood that are not restricted by bedrock, including the Birdsboro, Bowmansville and Pope. **Figure 4b** shows the typical range of depths to bedrock for each soil unit.

In some cases, a fragipan layer is encountered with or without the presence of shallow bedrock. A *fragipan* is a subsoil layer, typically high in clay, which is a higher density than the soil above it. A fragipan layer becomes cemented and very hard when dry, and brittle when moist. The layer is low in organic matter and slowly or very slowly permeable to water and also restricts root growth (Soil Science Society of America, 2008). When present in Kingwood, the fragipan layer varies in depth between 15 and 36 inches in depth (see **Figure 4b**).

Depth to Seasonal High Water Table (Figure 4c)

The *depth to seasonal high water table* (SHWT) is the distance between the ground surface and the top of the water surface in the saturated part of an aquifer. A SHWT of less than one foot severely constrains development, while SHWT between 1 and 3 feet also provides obstacles to development. High water tables impact the effectiveness of septic systems, and the freeze/thaw cycles cause frost heaving, which damages structures and roads.

The majority of Kingwood Township has shallow depths to seasonal high water table (see **Figure 4c**).

Hydrologic Soil Group (Figure 4d)

The *hydrologic soil grouping* describes a group of soils having similar runoff potential under similar storm and cover conditions (how much would runoff compared to the rate that water would infiltrate into the ground). The majority of the township has slow to very slow infiltration rates (see **Figure 4d**). The definitions of the hydrologic soil groups are shown in **Table 2.8**.

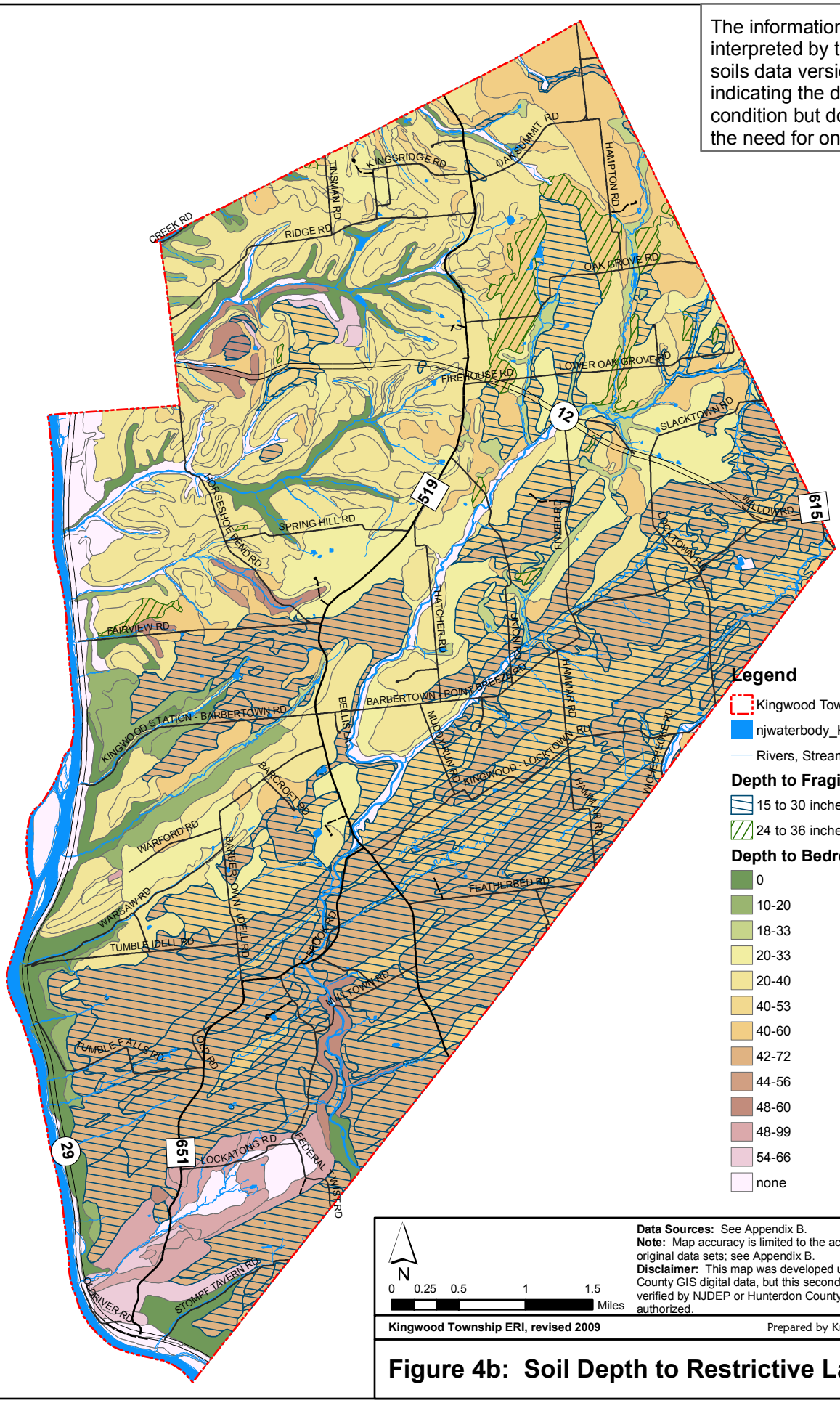
Table 2.8: Hydrologic Soil Grouping

Class	Definition
A	High infiltration rates. Soils are deep, well drained to excessively drained sands and gravels.
B	Moderate infiltration rates. Deep and moderately deep, moderately well and well drained soils that have moderately course textures.
B/D	Drained/undrained hydrology class of soils that can be drained and are classified. Moderate to very slow infiltration rates.
C	Slow infiltration rates. Soils with layers impeding downward movement of water, or soils that have moderately fine or fine textures.
C/D	Drained/undrained hydrology class of soils that can be drained and classified. Slow to very slow infiltration rates.
D	Very slow infiltration rates. Soils are clayey, have a high water table, or are shallow to an impervious layer.
Source: NRCS Soil Survey Geographic (SSURGO) Database.	

Soil Septic Suitability (Figure 4e)

The NRCS SSURGO database provides an interpretation of limitations of each soil for *septic suitability*. The interpretation shown in **Figure 4e** is based on the N.J.A.C. 7:9A Standards for Individual Subsurface Sewage Disposal Systems, Subchapter 10. Disposal Fields. Factors which may affect the functioning of the system, and therefore limit septic suitability, are

The information in this map is interpreted by the SSURGO soils data version 5 (12/07/06), indicating the dominant soil condition but does not eliminate the need for onsite investigation.



Legend

- Kingwood Township Boundary
- njwaterbody_King
- Rivers, Streams & Lakes

Depth to Fragipan Layer

- 15 to 30 inches
- 24 to 36 inches

Depth to Bedrock (inches)

- 0
- 10-20
- 18-33
- 20-33
- 20-40
- 40-53
- 40-60
- 42-72
- 44-56
- 48-60
- 48-99
- 54-66
- none

N

0 0.25 0.5 1 1.5 Miles

Data Sources: See Appendix B.
Note: Map accuracy is limited to the accuracy and scale of the original data sets; see Appendix B.
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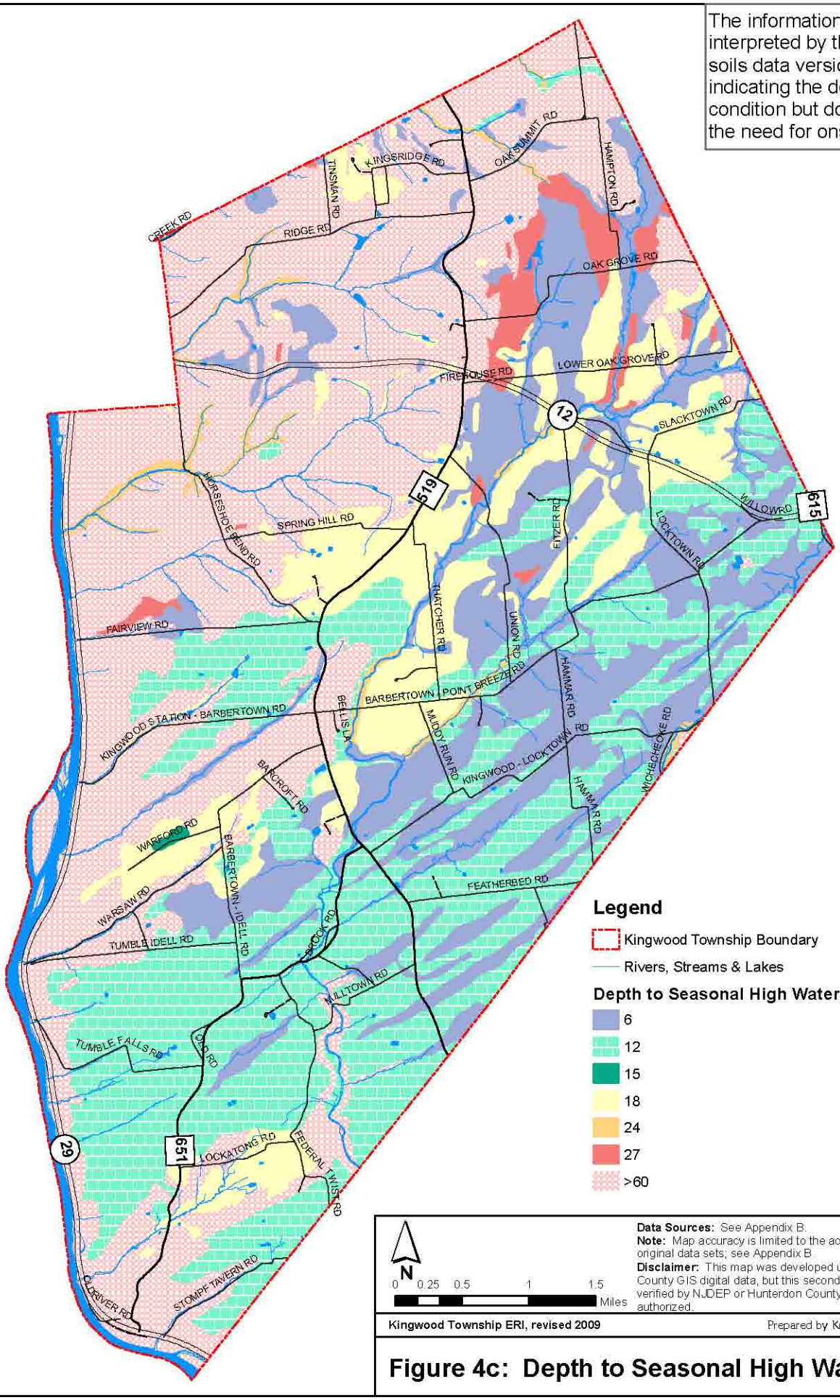
Kingwood Township ERI, revised 2009

Prepared by Kratzer Environmental Services

Figure 4b: Soil Depth to Restrictive Layer

The information in this map is interpreted by the SSURGO soils data version 5 (12/07/06), indicating the dominant soil condition but does not eliminate the need for onsite investigation.



Legend

- Kingwood Township Boundary
- Rivers, Streams & Lakes

Depth to Seasonal High Water Table (inches)

- 6
- 12
- 15
- 18
- 24
- 27
- >60

N

0 0.25 0.5 1 1.5 Miles

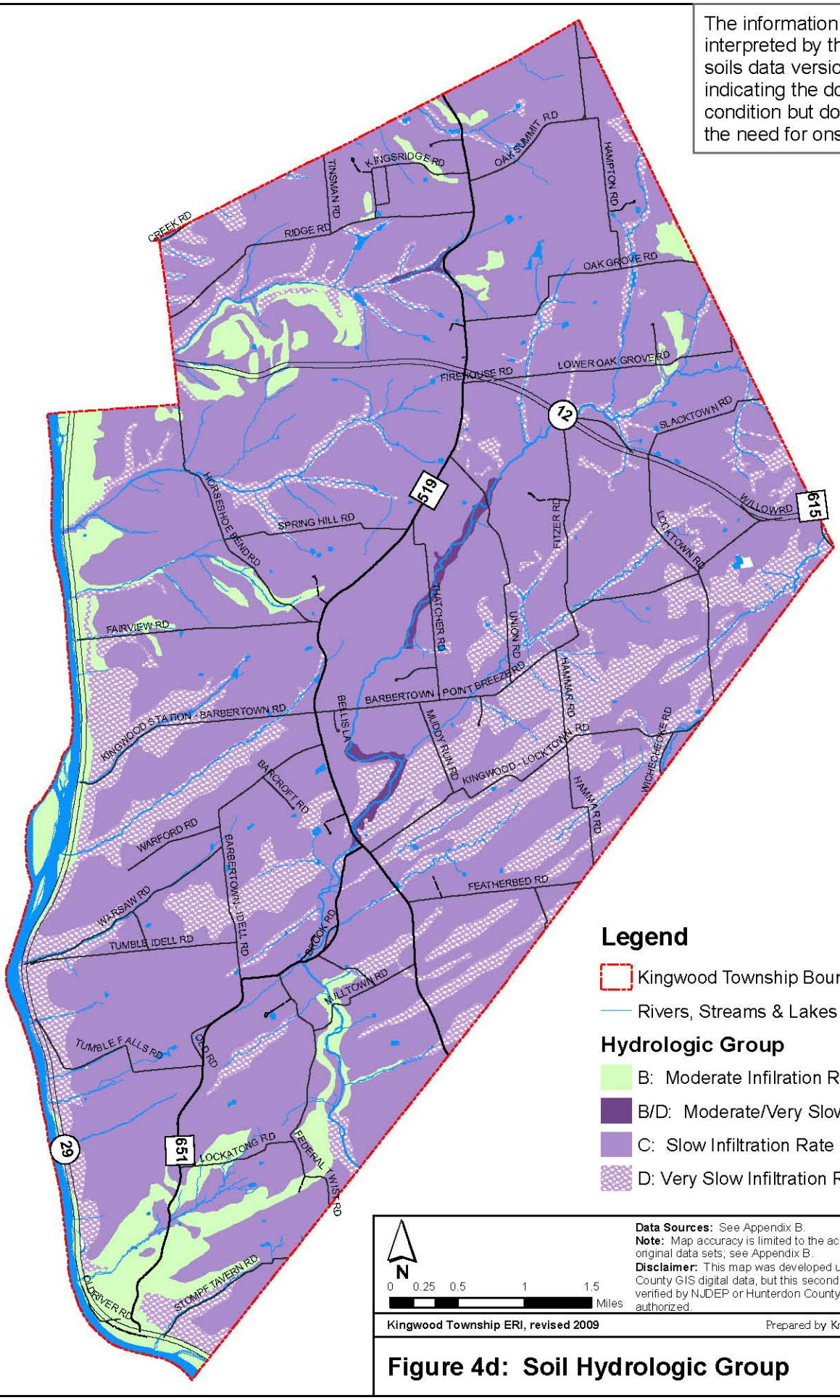
Data Sources: See Appendix B.
Note: Map accuracy is limited to the accuracy and scale of the original data sets; see Appendix B.
Disclaimer: This map was developed using NJDEP and Hunterdon County GIS digital data, but this secondary product has not been verified by NJDEP or Hunterdon County and is not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

Kingwood Township ERI, revised 2009

Prepared by Kratzer Environmental Services

Figure 4c: Depth to Seasonal High Water Table

The information in this map is interpreted by the SSURGO soils data version 5 (12/07/06), indicating the dominant soil condition but does not eliminate the need for onsite investigation.



Legend

- Kingwood Township Boundary
- Rivers, Streams & Lakes

Hydrologic Group

- B: Moderate Infilration Rate
- B/D: Moderate/Very Slow Infiltration Rate
- C: Slow Infiltration Rate
- D: Very Slow Infiltration Rate

N

0 0.25 0.5 1 1.5 Miles

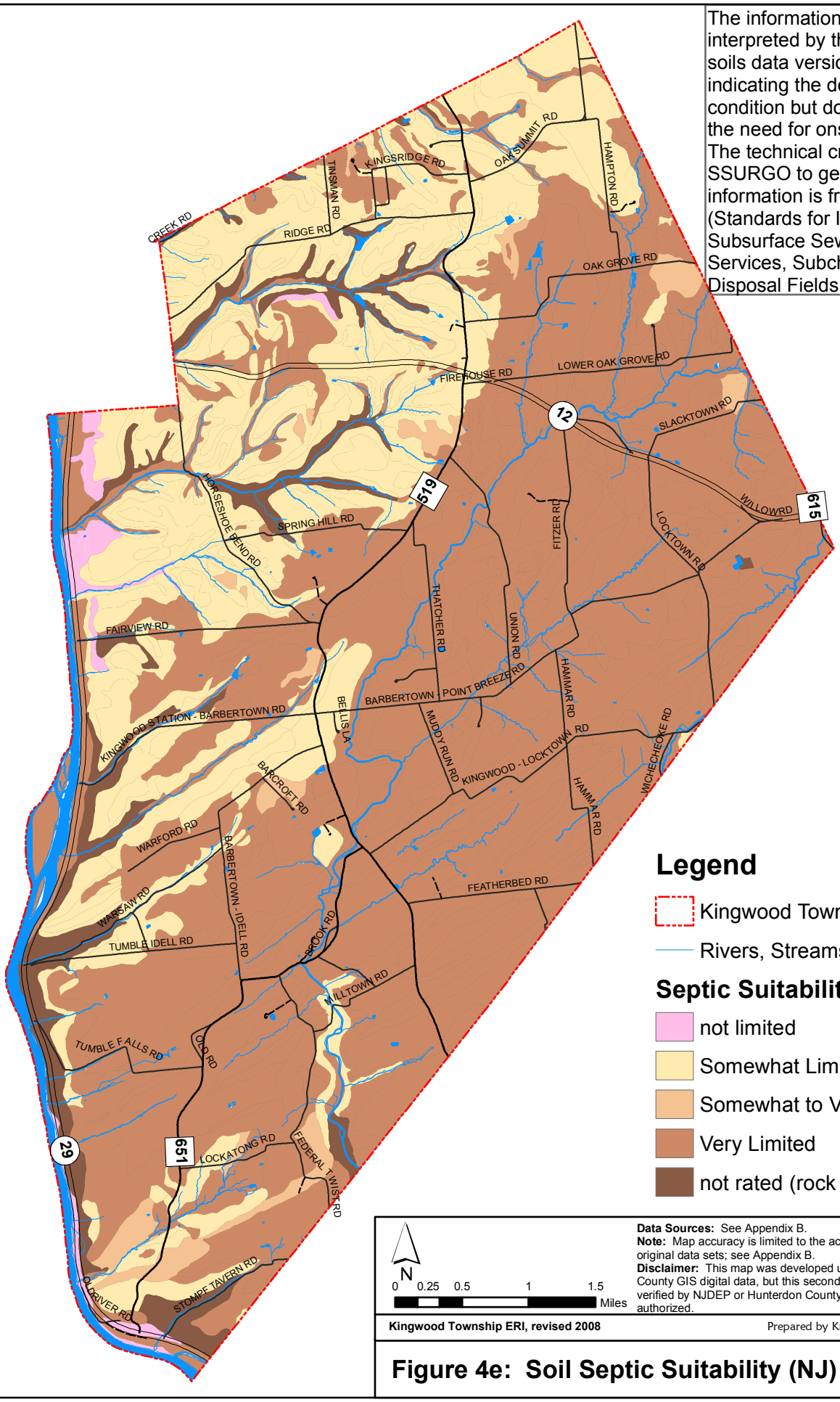
Data Sources: See Appendix B.
Note: Map accuracy is limited to the accuracy and scale of the original data sets; see Appendix B.
Disclaimer: This map was developed using NJDEP and Hunterdon County GIS digital data, but this secondary product has not been verified by NJDEP or Hunterdon County and is not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

Kingwood Township ERI, revised 2009

Prepared by Kratzer Environmental Services

Figure 4d: Soil Hydrologic Group

The information in this map is interpreted by the SSURGO soils data version 5 (12/07/06), indicating the dominant soil condition but does not eliminate the need for onsite investigation. The technical criteria used by SSURGO to generate this information is from N.J.A.C. 7:9A (Standards for Individual Subsurface Sewerage Disposal Services, Subchapter 10 Disposal Fields).



Legend

- Kingwood Township Boundary
- Rivers, Streams & Lakes

Septic Suitability

- not limited
- Somewhat Limited
- Somewhat to Very Limited
- Very Limited
- not rated (rock outcrops)

N

0 0.25 0.5 1 1.5 Miles

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.

Kingwood Township ERI, revised 2008

Prepared by Kratzer Environmental Services

Figure 4e: Soil Septic Suitability (NJ)

excessively coarse substratum (which allows effluent to percolate to ground water too rapidly); presence of water (including depth to high water table, flooding, and hydric soils); depth to restrictive layer (bedrock or restrictive substratum) and steep grades over 25%. N.J.A.C 7:9A prohibits septic systems in soils subject to flooding; in locations with the combination of slope greater than 10% and less than 50 feet upslope of any bedrock outcrop where signs of ground water seepage can be detected (NJDEP, 1999).

In Kingwood, the suitability of soils for septic tank absorption fields is very limited. Portions of some soil units have areas where septic system disposal fields would not be permitted due to flooding, hyrdic soils, or steep slopes; while some areas have no technical limitations and bedrock outcrop areas were not rated. These general suitability guidelines would need to be used in combination with on-site testing, the SSURGO interpretation report "Sewage Disposal (NJ)," and N.J.A.C.7:9A subchapter 10 to determine what types of disposal field installations would be appropriate in any given situation. In soils with more than one limiting factor, a disposal field must be a type approved as an acceptable option for each of the soil suitability classes which apply (NJDEP, 1999).

Erodibility (Figure 4f)

Erosion is the wearing away of the land surface by running water, wind, ice, or other geological agents. Erosion is often accelerated as a result of human activities. The *erodibility* takes into account the affects of infiltration rate, permeability and total water capacity and factors that resist the forces of the rainfall and runoff. The majority of Kingwood Township is rated "potentially highly erodible", while some areas are "highly erodible," and small areas are considered not highly erodible (see **Figure 4f)**..

Soil Drainage Class (permeability) (Figure 4g)

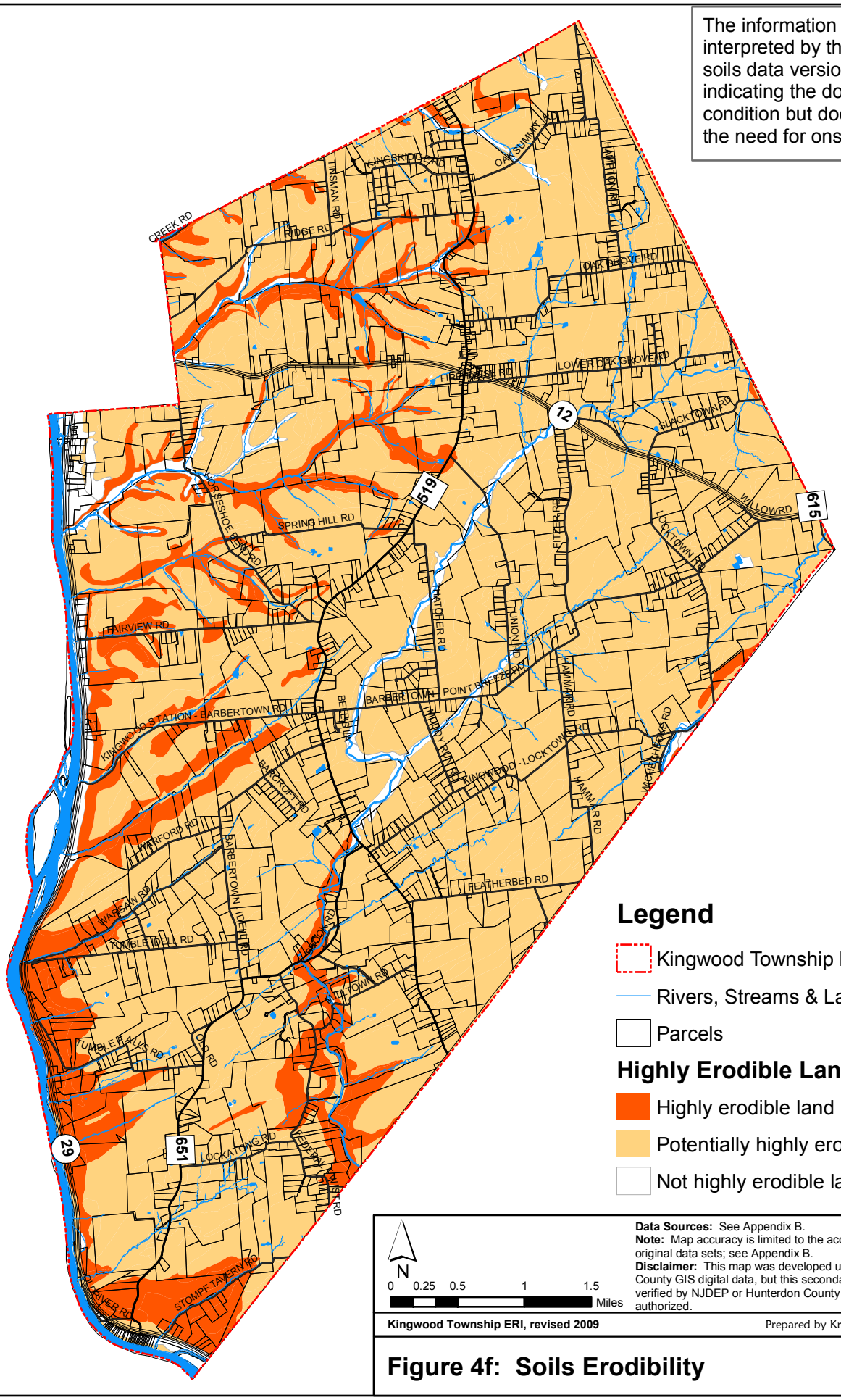
Soil Drainage Class is a code identifying the natural drainage condition of the soil and refers to the frequency and duration of periods when the soil is free of saturation or partial saturation during soil formation, and does not refer to saturation due to recently altered drainage (manmade or natural). The categories are as follows: excessively drained, somewhat excessively drained, well drained, moderately well drained, poorly drained, and somewhat poorly drained. The largest portion of Kingwood Township has somewhat poorly drained soils, followed in area by well drained soils. Poorly drained soils most likely coincide with wetlands. The steeper slopes and rocky soils tend to be somewhat excessively drained, while some areas are moderately well drained (see **Figure 4g).**

Prime Farmland Soils

Prime Farmland Soils include soils that have the best combination of physical and chemical characteristics for economically producing sustained high yields of crops when treated and managed according to acceptable farming methods and is also available for these uses. These soils have the soil quality, growing season, and moisture supply needed; they are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding (USDA NRCS NJ, 2006).

Farmlands of statewide importance include those soils with characteristics that are nearly Prime Farmland. They economically produce high yields of crops when treated and managed according to acceptable farming methods. Some may produce yields as high as Prime Farmland if conditions are favorable (NRCS NJ, 2006). Kingwood Township has some prime farmland soils, while most of the remainder of the township has farmland of statewide importance (see **Figure 4h).**

The information in this map is interpreted by the SSURGO soils data version 5 (12/07/06), indicating the dominant soil condition but does not eliminate the need for onsite investigation.



Legend

- Kingwood Township Boundary
- Rivers, Streams & Lakes
- Parcels

Highly Erodible Lands (HEL)

- Highly erodible land
- Potentially highly erodible land
- Not highly erodible land

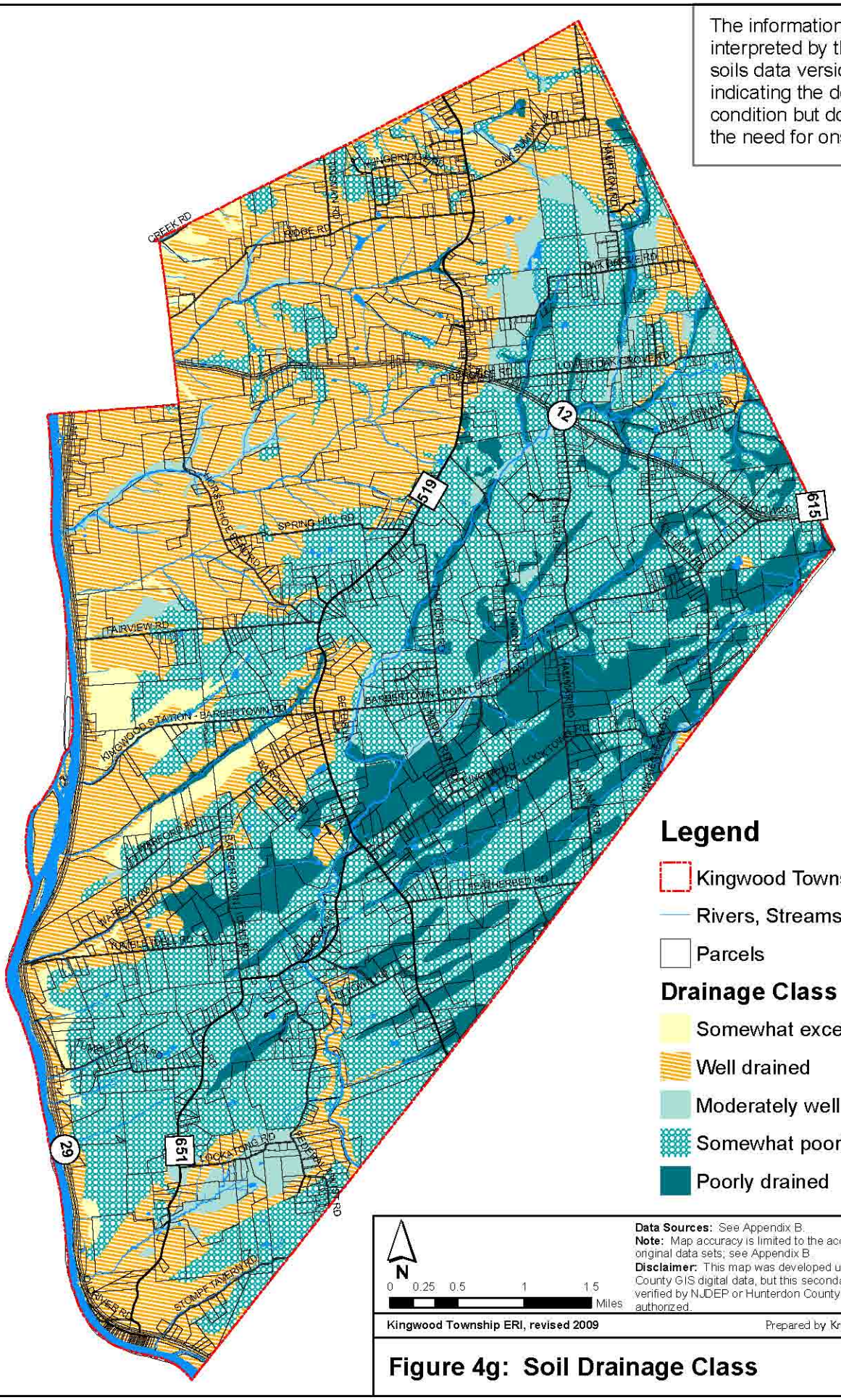
Data Sources: See Appendix B.
Note: Map accuracy is limited to the accuracy and scale of the original data sets; see Appendix B.
Disclaimer: This map was developed using NJDEP and Hunterdon County GIS digital data, but this secondary product has not been verified by NJDEP or Hunterdon County and is not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

Kingwood Township ERI, revised 2009

Prepared by Kratzer Environmental Services

Figure 4f: Soils Erodibility

The information in this map is interpreted by the SSURGO soils data version 5 (12/07/06), indicating the dominant soil condition but does not eliminate the need for onsite investigation.



Legend

- Kingwood Township Boundary
- Rivers, Streams & Lakes
- Parcels

Drainage Class

- Somewhat excessively drained
- Well drained
- Moderately well drained
- Somewhat poorly drained
- Poorly drained

N

0 0.25 0.5 1 1.5 Miles

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.

Kingwood Township ERI, revised 2009

Prepared by Kratzer Environmental Services

Figure 4g: Soil Drainage Class

Other

Annual flood frequency is a descriptive term used to describe the frequency of flooding that is likely to occur in a year. **Frequent** is > 50% chance of flooding in a given year; **occasional** is 5 to 50%; **rare** is 0 to 5% chance of flooding. For those soils which experience frequent or occasional flooding, duration of annual flooding in a normal year and the months during which flooding occurs in a normal year are also noted.

Potential Frost Action is an interpretation rating of the susceptibility of the soil to frost heaving. Most soils within Kingwood are moderately susceptible to frost action, while the rest are highly susceptible (except gravel pits and rough broken land, which is rated "none").

Hydric soils are those soils that are wet long enough to periodically produce anaerobic conditions, thereby influencing the growth of plants. For delineation of hydric soils the *ponding* event must last greater than seven days. Hydric Soils are marked **Y** for yes, when they meet the requirements for a hydric soil. Hydric soils are shown with wetlands in **Figure 6d**.

References: Soils

Jablonski, C.F. 1974. Soil Survey: Hunterdon County, New Jersey. US Department of Agriculture, Soil Conservation Service in cooperation with the New Jersey Agricultural Experiment Station at Rutgers. 131 pages.

Lewis-Brown, Jean C. and Eric Jacobsen. 1995. Hydrogeology and Ground-water flow, Fractured Mesozoic Structural-Basin Rocks, Stony Brook, Beden Brook, and Jacobs Creek Drainage Basins, West-Central New Jersey. US Geological Survey Water-Resources Investigations Report 94-4147. West Trenton, New Jersey. 83 pages.

NJDEP Division of Water Quality, Bureau of Nonpoint Source Pollution Control. August 15, 1999. N.J.A.C. 7:9A Standards for Individual Subsurface Sewage Disposal Systems, Subchapter 10. Disposal Fields. 130 pages. http://www.state.nj.us/dep/dwq/pdf/njac79a.pdf

US Department of Agriculture, Natural Resources Conservation Service (NRCS). 2006. Soil Data Mart (Hunterdon County data (tabular data version 5, December 12, 2006). http://soildatamart.nrcs.usda.gov/

US Department of Agriculture, Natural Resources Conservation Service, NJ (NRCS NJ). 2006. Soils Online Study Guide: Geology of New Jersey. http://www.nj.nrcs.usda.gov/partnerships/envirothon/soils/geology.html

Internet Resources: Soils

Hunterdon Soil Conservation District: http://www.nj.gov/agriculture/divisions/anr/nrc/conservdistricts.html

NRCS New Jersey Office: http://www.nj.nrcs.usda.gov/

NRCS Soils Website: Helping People Understand Soils: http://soils.usda.gov/

NRCS Soil Data Mart (download soils data for GIS): http://soildatamart.nrcs.usda.gov/

NRCS Soils Online Study Guide: http://www.nj.nrcs.usda.gov/partnerships/envirothon/soils/

Web Soil Survey Site (soils online): http://websoilsurvey.nrcs.usda.gov/app/

Web Soil Survey: How to Use it: http://websoilsurvey.nrcs.usda.gov/app/Help/WSS_HomePage_HowTo.pdf

Table 2.9: Characteristics of Soil Types Found in Kingwood Township

Map Unit Symbol	Map Unit Name	Depth to Restrictive Layer (inches)	Seasonal High Water Table Depth	Months of Seasonal High Water Table	Annual Flood Frequency	Hydrologic Group	Potential Frost Action	Drainage Class	Hydric Soil?	Prime Farmland?	Septic Suitability	Reason(s) for Septic Suitability Limit
AbrA	Abbottstown silt loam, 0 to 2 percent slopes	B: 40-60 F: 15-30	6	Nov-June	NONE	C	HIGH	SP			VL	DPZS, RS, RH, ECS
AbrB	Abbottstown silt loam, 2 to 6 percent slopes	40-60	6	Nov-June	NONE	C	HIGH	SP			VL	DPZS, RS, RH, ECS
BhnA	Birdsboro silt loam, 0 to 2 percent slopes	none	>60		NONE	B	MOD	W		P	N	not limited
BhnB	Birdsboro silt loam, 2 to 6 percent slopes	none	>60		NONE	B	MOD	W		P	N	not limited
BhnC2	Birdsboro silt loam, 6 to 12 percent slopes, eroded	none	>60		NONE	B	MOD	W			N	not limited
BoyAt*	Bowmansville silt loam, 0 to 2 percent slopes, frequently flooded	none	6	Jan-Dec	FREQUENT; Brief Duration; Nov-May	B/D	HIGH	P	Y		VL	DAZS; NP-F; NP-H
BucB	Bucks silt loam, 2 to 6 percent slopes	40-53	>60		NONE	B	MOD	W		P	VL	RS, ECS
BucC2	Bucks silt loam, 6 to 12 percent slopes, eroded	40-60	>60		NONE	B	MOD	W			VL	RS, ECS
ChcA	Chalfont silt loam, 0 to 2 percent slopes	B: 42-72 F: 15-30	12	Nov-Mar	NONE	C	HIGH	SP			VL	DPZS, RS, RH, ECS
ChcB	Chalfont silt loam, 2 to 6 percent slopes	B: 42-72 F: 15-30	12	Nov-Mar	NONE	C	HIGH	SP			VL	DPZS, RS, RH, ECS
ChcC2	Chalfont silt loam, 6 to 12 percent slopes, eroded	B: 42-72 F: 15-30	12	Nov-Mar	NONE	C	HIGH	SP			VL	DPZS, RS, RH, ECS
ChcCb	Chalfont silt loam, 6 to 12 percent slopes, very stony	B: 42-72 F: 15-30	12	Nov-Mar	NONE	C	HIGH	SP			VL	DPZS, RS, RH, ECS
ChfB	Chalfont-Quakertown silt loams, 0 to 6 percent slopes	B: 42-72 F: 15-30	12	Nov-Mar	NONE	C	HIGH	SP			VL	DPZS, RS, RH, ECS
CoxA	Croton silt loam, 0 to 2 percent slopes	B: 40-60 F: 15-30	6	Nov-May	NONE	D	HIGH	P	Y		VL	DPZS, RS, RH, NP-H, DMB
CoxB	Croton silt loam, 2 to 6 percent slopes	B: 40-60 F: 15-30	6	Nov-May	NONE	D	HIGH	P	Y		VL	DPZS, RS, RH, NP-H,

Map Unit Symbol	Map Unit Name	Depth to Restrictive Layer (inches)	Seasonal High Water Table Depth	Months of Seasonal High Water Table	Annual Flood Frequency	Hydrologic Group	Potential Frost Action	Drainage Class	Hydric Soil?	Prime Farmland?	Septic Suitability	Reason(s) for Septic Suitability Limit
												DMB
CoxBb	Croton silt loam, 0 to 6 percent slopes, very stony	B: 40-60 F: 15-30	6	Nov-May	NONE	D	HIGH	P	Y		VL	DPZS, RS, RH, NP-H, DMB
HdyB	Hazleton channery loam, 2 to 6 percent slopes	B: 48-60 F: 15-30	>60		NONE	B	MOD	W		SI	SL	DMB
HdyC2*	Hazleton channery loam, 6 to 12 percent slopes, eroded	48-60	>60		NONE	B	MOD	W		SI	SL	DMB
HdyD	Hazleton channery loam, 12 to 18 percent slopes	44-56	>60		NONE	B	MOD	W			SL	DMB
HdyEb*	Hazleton channery loam, 18 to 40 percent slopes, very stony	48-60	>60		NONE	B	MOD	W			SL	DMB
KkoC	Klinesville channery loam, 6 to 12 percent slopes	10-20	>60		NONE	D	MOD	SE			SL	ECS
KkoD	Klinesville channery loam, 12 to 18 percent slopes	10-20	>60		NONE	D	MOD	SE			SL	ECS
LbmB	Lansdale loam, 2 to 6 percent slopes	54-66	>60		NONE	B	MOD	W		P	SL	ECS
LbmC2	Lansdale loam, 6 to 12 percent slopes, eroded	54-66	>60		NONE	B	MOD	W		SI	SL	ECS
LbmD	Lansdale loam, 12 to 18 percent slopes	none	>60		NONE	B	MOD	W			N	not limited
LegB	Legore gravelly loam, 2 to 6 percent slopes	48-60	>60		NONE	B	MOD	W		P	SL	ECS, RS
LemB	Lehigh silt loam, 2 to 6 percent slopes	40-60	15	Sept-May	NONE	C	HIGH	SP			VL	RS, RH, DPZS, DMB
MonB	Mount Lucas silt loam, 2 to 6 percent slopes	48-99	18	Oct-Apr	NONE	C	HIGH	MW		P	VL	DPZS, DMB
MopBb	Mount Lucas-Watchung silt loams, 0 to 6 percent slopes, very stony	none	18	Oct-Apr	NONE	C	HIGH	MW			VL	DPZS, DAZS, RS, RH, NP-H
NehB	Neshaminy silt loam, 2 to 6 percent slopes	48-99	>60		NONE	B	MOD	W		P	SL	DMB

Map Unit Symbol	Map Unit Name	Depth to Restrictive Layer (inches)	Seasonal High Water Table Depth	Months of Seasonal High Water Table	Annual Flood Frequency	Hydrologic Group	Potential Frost Action	Drainage Class	Hydric Soil?	Prime Farmland?	Septic Suitability	Reason(s) for Septic Suitability Limit
NehC2	Neshaminy silt loam, 6 to 12 percent slopes, eroded	54-66	>60		NONE	B	MOD	W		SI	SL	DMB
NehDb	Neshaminy silt loam, 12 to 18 percent slopes, very stony	54-66	>60		NONE	B	MOD	W			SL	DMB
NehEb	Neshaminy silt loam, 18 to 35 percent slopes, very stony	54-66	>60		NONE	B	MOD	W			VL	NP-St, DMB
NemCb	Neshaminy-Mount Lucas silt loams, 6 to 12 percent slopes, very stony	48-99	>60		NONE	B	MOD	W			SL to VL	DMB, DPZS
PeoB	Penn channery silt loam, 2 to 6 percent slopes	20-40	>60		NONE	C	MOD	W		P	SL	ECS
PeoC2	Penn channery silt loam, 6 to 12 percent slopes, eroded	20-40	>60		NONE	C	MOD	W		SI	SL	ECS
PeoD	Penn channery silt loam, 12 to 18 percent slopes	20-40	>60		NONE	C	MOD	W			SL	ECS
PepB	Penn-Bucks complex, 2 to 6 percent slopes	40-60	>60		NONE	C	MOD	W		P	SL to VL	ECS, RS
PepC2	Penn-Bucks complex, 6 to 12 percent slopes, eroded	20-40	>60		NONE	C	MOD	W			SL to VL	ECS, RS
PHG*	Pits, sand and gravel	none	>60		NONE			W			-	
PomAs*	Pope fine sandy loam, high bottom, 0 to 2 percent slopes, occasionally flooded	none	>60		Occasional; Brief Duration; Jan-May	B	MOD	W		P	VL	NP-Fl
QukA	Quakertown silt loam, 0 to 2 percent slopes	40-60	>60		NONE	C	MOD	W		P	SL	ECS
QukB	Quakertown silt loam, 2 to 6 percent slopes	40-60	>60		NONE	C	MOD	W		P	SL	ECS
QukC2	Quakertown silt loam, 6 to 12 percent slopes, eroded	40-60	>60		NONE	C	MOD	W		SI	SL	ECS
QupC2	Quakertown-Chalfont silt loams, 6 to 12 percent slopes, eroded	40-60	>60	Nov-Mar	NONE	C	MOD	W		SI	SL to	ECS, DPZS, RS,

Map Unit Symbol	Map Unit Name	Depth to Restrictive Layer (inches)	Seasonal High Water Table Depth	Months of Seasonal High Water Table	Annual Flood Frequency	Hydrologic Group	Potential Frost Action	Drainage Class	Hydric Soil?	Prime Farmland?	Septic Suitability	Reason(s) for Septic Suitability Limit
											VL	RH, ECS
RedB	Readington silt loam, 2 to 6 percent slopes	B: 40-60 F: 24-36	27	Nov-Mar	NONE	C	MOD	MW		P	VL	RS, RH, ECS, DPZS
RedC2	Readington silt loam, 6 to 12 percent slopes, eroded	B: 40-60 F: 24-36	27	Nov-Mar	NONE	C	MOD	MW		SI	VL	RS, RH, ECS, DPZS
RehA	Reaville silt loam, 0 to 2 percent slopes	20-40	18	Jan-Dec	NONE	C	HIGH	SP		SI	VL	RS, RH, DAZS, ECS
RehB	Reaville silt loam, 2 to 6 percent slopes	20-33	18	Jan-Dec	NONE	C	HIGH	SP		SI	VL	DAZS, ECS
RehC2	Reaville silt loam, 6 to 12 percent slopes, eroded	20-33	18	Jan-Dec	NONE	C	HIGH	SP		SI	VL	DAZS, ECS
RepwA	Reaville wet variant silt loam, 0 to 2 percent slopes	18-33	6	Jan-Dec	NONE	D	HIGH	P	Y		VL	DAZS, RS, RH, NP-H, ECS
RepwB	Reaville wet variant silt loam, 2 to 6 percent slopes	18-33	6	Jan-Dec	NONE	D	HIGH	P	Y		VL	DAZS, RS, RH, NP-H, ECS
RksB	Riverhead gravelly sandy loam, 3 to 8 percent slopes	none	>60		NONE	B	MOD	W		P	N	not limited
RksC	Riverhead gravelly sandy loam, 8 to 15 percent slopes	none	>60		NONE	B	MOD	W		SI	N	not limited
ROPF*	Rough broken land, shale	0	>60		NONE	D	NONE	W			-	-
RorAt*	Rowland silt loam, 0 to 2 percent slopes, frequently flooded	none	24	Jan-Dec	FREQUENT; Brief Duration; Nov-Mar	C	HIGH	MW			VL	NP-F, DAZS
Water	Water	none	-	-	-	-	-	-	-		-	-

*These map unit symbols have changed in this SSURGO version.

Notes: See preceding text for descriptions of these various characteristics.
Depth to Restrictive Layer measured in inches from surface: **B**=Depth to Bedrock; **F**=Depth to Fragipan
Hydrologic Group explanations see **Table 2.7**.
Potential Frost Action: **HIGH**=high; **MOD**=Moderate; **NONE**=none
Drainage Class: **W**=well drained; **MW**=moderately well drained; **E**=excessive; **SE**=somewhat excessively; **P**=poorly; **SP**=somewhat poorly.
Hydric Soils: **Y**=yes
Prime Farmland: **Y**=yes; **SI**=Statewide Importance

Map Unit Symbol	Map Unit Name	Depth to Restrictive Layer (inches)	Seasonal High Water Table Depth	Months of Seasonal High Water Table	Annual Flood Frequency	Hydrologic Group	Potential Frost Action	Drainage Class	Hydric Soil?	Prime Farmland?	Septic Suitability	Reason(s) for Septic Suitability Limit
Septic Suitability: **SL**=somewhat limited; **VL**=very limited; **N**=not limited Reason for Septic Suitability Limit: **DPZS**= Depth to perched zone of saturation; **RS**= Restrictive substratum; **RH**= Restrictive horizon; **ECS**=Excessively Coarse substratum; **DAZS**=Depth to apparent zone of saturation; **DMB**=Depth to Massive Bedrock; **NP-F**=not permitted due to flooding; **NP-H**=not permitted due to hydric soils; **NP-S**=not permitted due to being too steep												
Source: Soil Survey Geographic (SSURGO) Database for Hunterdon County, New Jersey Survey Area Version: 5; Date: 12/07/2006. Note that several Soil Map Units' names, and some data categories and interpretations have changed in this version as compared to the 2004 ERI.												

The information in this map is interpreted by the SSURGO soils data version 5 (12/07/06), indicating the dominant soil condition but does not eliminate the need for onsite investigation.

Legend

- Kingwood Township Boundary
- Rivers, Streams & Lakes
- Parcels

Prime Farmland Soils

- Prime Farmland Soils
- Farmland of statewide importance

N

0 0.25 0.5 1 1.5 Miles

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.

Kingwood Township ERI, revised 2009

Prepared by Kratzer Environmental Services

Figure 4h: Prime Farmland Soils

F. Hydrology: Ground Water

Introduction

Cliffs along Route 29 display uneven ground water discharge through fractures.

Water is essential to all life on Earth. The abundance of water distinguishes the Earth from any other planet, but the amount of water on Earth has remained constant for millennia. Even though the quantity of water is great, only a small portion can be used for drinking water and other human needs. Ninety-seven percent of the world's water supply is saltwater stored in the oceans. The remaining 3% is fresh water. However, most of this is unavailable for human use because it is frozen in the polar ice caps, glaciers, and icebergs; too difficult to tap (below 1.6 miles depth); or too polluted. This leaves 0.003% of water that is available as fresh surface or ground water that humans can use (Miller, 1988).

Surface water is water that is visible above the ground surface, such as creeks, rivers, ponds, lakes, and wetlands. *Ground water* means that portion of water beneath the land surface that is within the zone of saturation (below the water table) where pore spaces are filled with water. An *aquifer* is a water-bearing rock or rock formation where water is present in usable quantities. Water is constantly recycled through the *hydrologic cycle*, also known as the *water cycle* (see **Figure 5a**). Precipitation falls on the ground and some travels on the surface of the land (called *runoff*), entering streams, and eventually making its way back to the ocean. Runoff can pick up chemicals and soil on its way, depositing these pollutants in waterways. This is especially true of "uncontrolled runoff" on soils which are vulnerable to erosion, as discussed in **Section II.E** of this report. Some of the water from precipitation enters the ground but remains in the shallow layers where it is available for use by plants. Much water re-enters the atmosphere through evapotranspiration by plants; some seeps back to the surface water. Natural soil processes cleanse the water. However, if pollutants are abundant in the

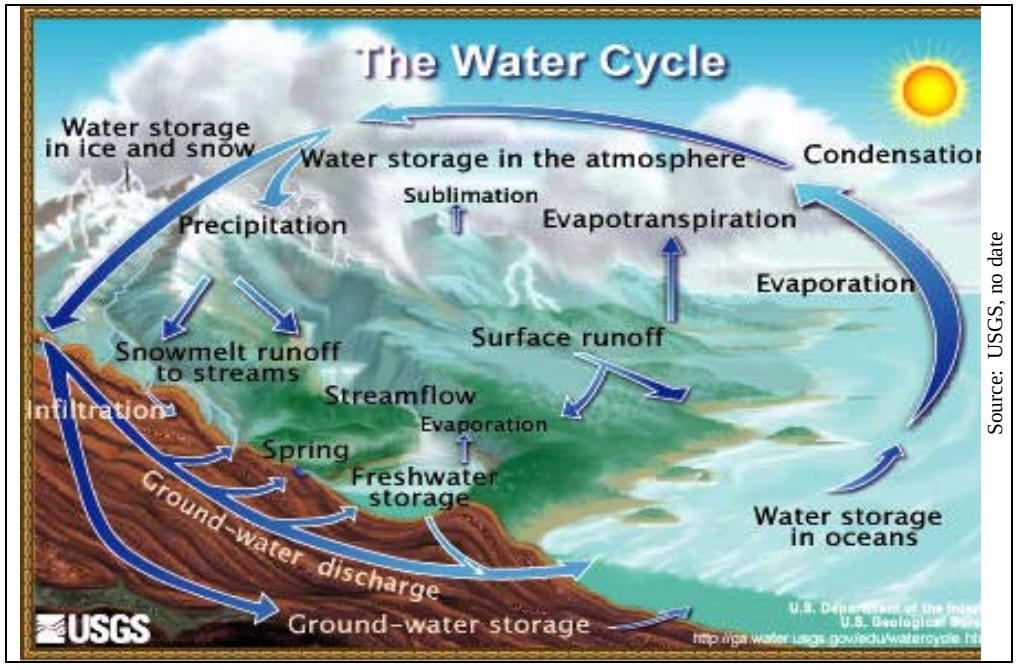


Figure 5a: The Water Cycle

soil or underground, they can be spread by water and cause health and other problems. A smaller portion of the water penetrates deeper into the ground and enters (or recharges) the saturated zone where most wells obtain their water, called the aquifer.

The Aquifers in Kingwood Township

Almost half of New Jersey's drinking water comes from ground water. Kingwood Township relies exclusively on ground water. Kingwood, like most of the Piedmont Physiographic Province, is underlain by dense, almost impermeable, bedrock that yields water mostly from *secondary porosity*[8] and permeability provided by fractures. Therefore, the distribution and orientation of these fractures controls the rates and directions of ground water flow.

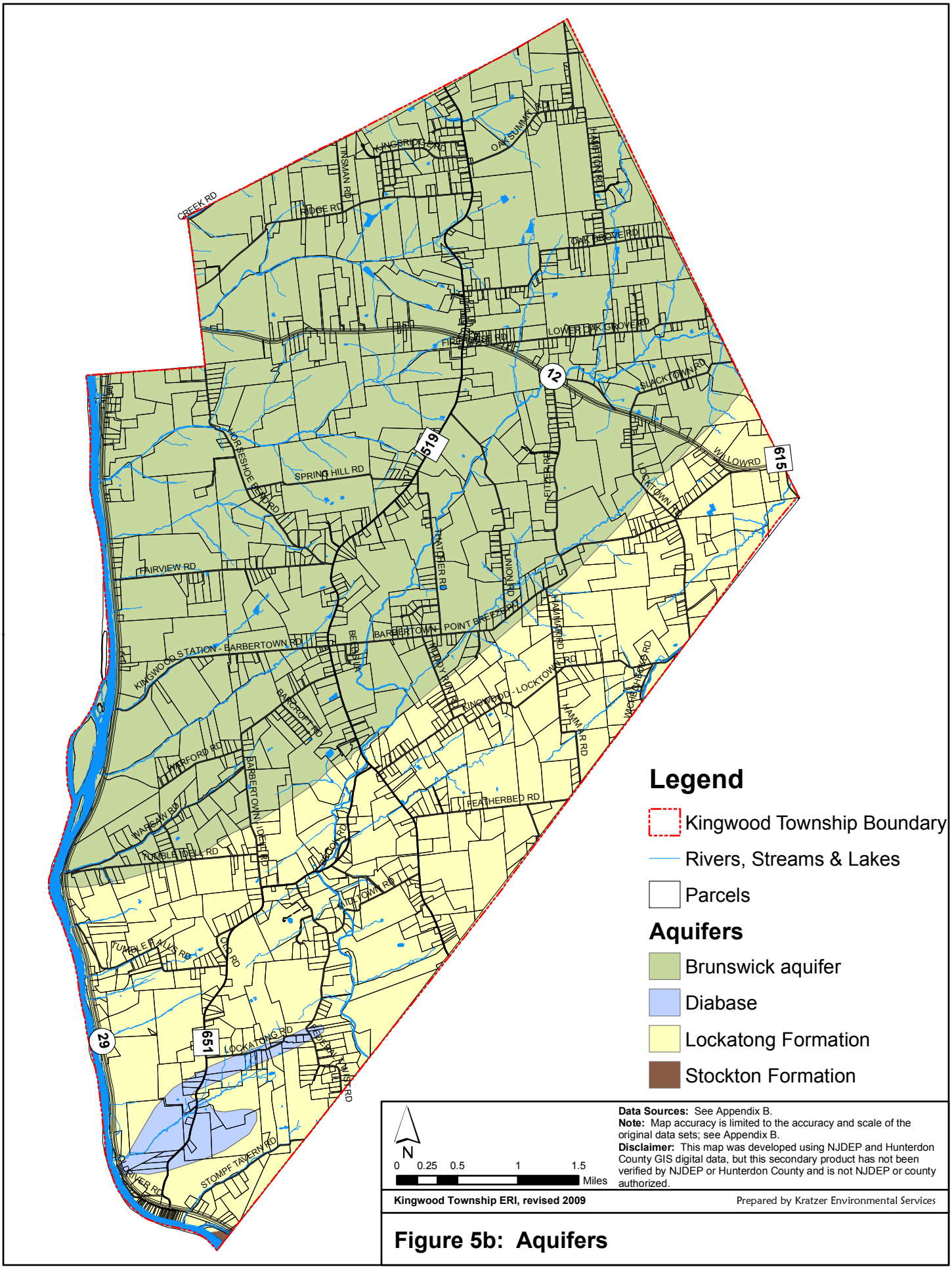
The aquifers in Kingwood Township consist of the Late Triassic Newark Group of sedimentary rocks in the shallow parts of the Stockton, Lockatong, and Passaic formation and diabase rocks (see **Figure 5b** and **Table 2.10**). Rocks near the land surface experience

Table 2.10: Characteristics of the Aquifers in Kingwood Township

Aquifer	State Rank	Aquifer Characteristics
Brunswick aquifer	C	Sandstone, siltstone, and shale of the Passaic Formation. Ground water stored and transmitted in fractures. The water-bearing units are composed of fissile[9] shale and siltstone, and the confining units are composed of massive siltstone. Water is normally fresh, slightly alkaline, non-corrosive and hard. Calcium-bicarbonate type waters dominate. Subordinate calcium-sulfate waters are associated with high total dissolved solids.
Stockton Formation	C	Arkosic sandstone. Ground water stored and transmitted in fractures. The water-bearing units are composed of sandstone and the confining units are composed of siltstone. Water is fresh, slightly acidic, corrosive and moderately hard. Calcium-bicarbonate type waters dominate.
Lockatong Formation	D	Silty argillite, mudstone and fine-grained sandstone and siltstone with minor limestone. Ground water stored and transmitted in fractures. The water-bearing units are composed of fissile shale, and the confining units are composed of massive, thick bedded argillaceous siltstone. The Lockatong Formation is one of the poorest sources of ground water in New Jersey, but yields more water than the diabase rocks. Water is normally fresh, slightly alkaline, non-corrosive and hard. Calcium-bicarbonate type waters dominate.
Diabase	E	Hard and dense igneous rocks. Ground water stored and transmitted in fractures, which are sparse. Few high-capacity wells. Water is normally fresh, slightly to highly alkaline, moderately hard, and of the calcium-bicarbonate type. Because fractures in the diabase are so widely spaced, many unsuccessful wells have been drilled into these rocks.
Note: "State Rank" is based on High Capacity Wells (such as water-supply, irrigation, and industrial-supply wells sited and tested for maximum yield. Many of the wells have boreholes exceeding the standard six-inch diameter for domestic wells. State Rank is best viewed on a relative basis, with "A" yielding the most water, and "E" the least. Median High Capacity Wells Yield (in gpm): [A] > 500; [B] 251 to 500; [C] 101 to 250; [D] 25 to 100; [E] <25		
Sources: NJGS Readme.txt with GIS data; Lewis-Brown, 1995; Vecchioli and Palmer, 1962 in Lewis-Brown, 1995.		

[8] *Porosity* is the measure of voids in soil or rock, which are available to hold water (like holes in a sponge). *Primary porosity* is due to spaces between the soil or rock particles or within porous rock particles. *Secondary porosity* is found in fractures in bedrock. Aquifers with primary porosity store far more water than those with only secondary porosity.

[9] *Fissile* means capable of being split.


Legend
Kingwood Township Boundary
Rivers, Streams & Lakes
Parcels
Aquifers
Brunswick aquifer
Diabase
Lockatong Formation
Stockton Formation
N
0 0.25 0.5 1 1.5
Miles
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.
Kingwood Township ERI, revised 2009
Prepared by Kratzer Environmental Services
Figure 5b: Aquifers

weathering, caused by freezing and thawing of water, which has widened fractures and dissolved some of the intergranular cement in the sedimentary rocks. Rocks below the weathered zone, which is usually about 75 feet thick, have no primary porosity (Lewis-Brown, 1995). *Unconfined* conditions commonly exist above this level because pores and fractures in this material are usually well-connected. Below this level, *confined* conditions are caused by the presence of low-permeability layers containing relatively few fractures.

The Stockton, Lockatong, and Passaic formations are characterized by several layers of extensively fractured rocks (water-bearing units) that typically are 1 to 10 feet thick interbedded with layers of sparsely fractured rocks (confining units) that typically are 30 to 100 feet thick. These geologic formations extend thousands of feet below ground, but the density of fractures decreases with depth. Water-bearing, interconnected fractures are present only from the land surface to a depth of about 500 feet (Houghton, 1990 in Lewis-Brown, 1995). For this reason, wells extended beyond 500 feet usually do not increase well productivity (the extra storage provided by the greater length of the well bore-hole may be necessary, however, to supply enough water for the well's intended use). The aquifer consists of the whole 500 foot thick sequence of water bearing units and confining units.

The argillite rocks of the Lockatong formation and diabase rocks are among the poorest (lowest yielding) aquifers in New Jersey due to the scarcity of fractures (Canace, 1995; Elam and Popoff, 1972; Hordon, 1995; Kasabach, 1966, and U.S. Geological Survey, 1993).

Movement of ground water is usually quite slow, on average; ranging from about one foot per day to perhaps ½ inch per month. Therefore, in some areas, it might take days for water to travel from the point where it enters the ground, to a point of discharge into a stream, or it might take millennia (Heath, 1983). However, ground water in Kingwood, because it is present in fractures, can potentially move much more quickly. "The rates of movement in … large fractures may approach those observed in surface streams" (Heath, 1983; Freeze and Cherry, 1979). A contaminant could travel quickly through fractures, with little soil contact to allow for filtration or degradation of pollutants. Thus, a well located on a large fracture might have a very good yield, but may be highly susceptible to contamination.

Water that flows to pumped wells generally is derived mostly from the water bearing units intersected by the well opening. Other water-bearing units provide water by leakage through confining units. Wells near surface water bodies can also derive a significant amount of water from the surface water body by induced infiltration (Lewis-Brown, 1995). Wells located near surface water often have higher yields (Vecchioli and Palmer, 1962 in Lewis-Brown, 1995), but could be vulnerable to pollution, if the surface water carries pollutants.

The response of the aquifer to withdrawals from a well or wells determines the well's performance. Drawdown and recovery tests may be performed to determine whether the well will produce enough water for its intended use, and whether that use can be sustained for the foreseeable future. The well's *drawdown* is the difference between the water level before pumping and the water level during pumping (see **Figure 5c**). A *cone of depression* is the conical-shaped depression of the water table around a pumping well caused by the withdrawal of water.

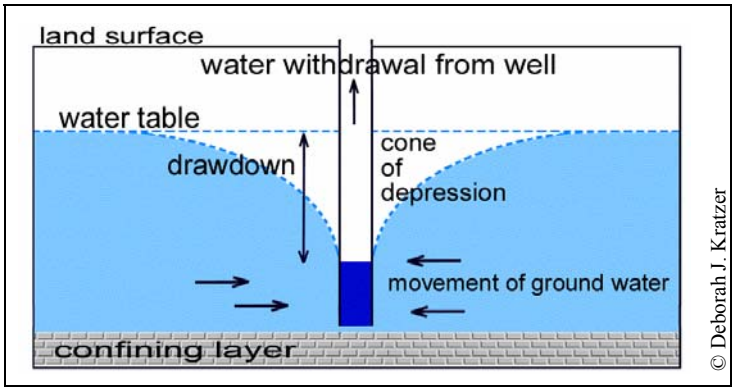


Figure 5c: Illustration of Drawdown and Cone of Depression

Because of pumping, ground water in the vicinity of the well will deviate from the natural direction of ground water flow and flow towards and into the well (see **Figure 5c**).

In 1995, the Kingwood Township Planning Board contracted Robert Hordon to analyze ground water data from the argillite formation of Kingwood Township (the Lockatong formation and the Lockatong red beds). Hordon examined well records for 143 wells drilled between 1986 and 1995. According to Hordon, the data are limited by lack of consistent pump test methods, accuracy of identification of rock units, and incomplete forms. However, the following observations were made (Hordon, 1995):

- **Depth**: Well depths ranged from 100 to 800 feet, averaging 399 feet. Newer wells are being drilled deeper.

- **Yield**: Well yields ranged from 0.125 gpm (one pint) to 100 gpm. The mean (average) was 9 gpm and the median (middle value) was 5 gpm. For wells that underwent less than a four hour pump test (all but 31), these yields would be considered "initial yields," and long-term yields would be expected to be lower. Hordon's analysis also noted that current yields are less than historic yields.

- **Drawdown during pump test**: Drawdowns varied from 0 feet to 699 feet. The mean was 222 and median drawdown was 190 feet. These numbers are very high, and provide evidence that the argillite is a poor aquifer.

- **Recovery**: Recovery was not measured for any of the wells, but would have provided useful information about the ability of the water table to recover to its pre-pumped level.

- **Nitrate-nitrogen**: Nitrate-nitrogen values were available for 105 of the wells. Many were below the detection limit, but the highest was 6.41 mg/L (the criteria for nitrate-nitrogen is 10 mg/L, however, any value over the natural background level of 2 mg/L is indicative of pollution (Canace, 2004), possibly from septics or fertilizer use). Hordon used the Trela-Douglas dilution model to estimate the lot size required to allow infiltration of precipitation for maintaining a nitrate-nitrogen concentration less than 10 mg/L. This model and other nitrate dilution models can be used to predict future nitrate levels under various planning scenarios.

Although not included in the above study, wells drilled in the Brunswick (Passaic) formation would be expected to perform somewhat better, while any wells drilled in diabase would be expected to be worse.

Kingwood Township now has a well ordinance which requires hydrogeologic studies for major subdivisions and other major water uses. Nearby, one aquifer test was performed in the headwaters of the Lockatong Creek for Snyder Farm (owned by Rutgers University) in 1996 and one was performed in the headwaters of Wickecheoke Creek for Shetland Crossing Golf Course in 2001. These are included in the *NJGS Hydro database*, which provides a compilation of values for the hydrologic properties of geologic materials in New Jersey by the New Jersey Geological Survey. The database includes values derived from the analysis of aquifer pumping tests and other tests, performed over the past century and updated as new ones are completed. The data are intended to be used for characterization of the hydrogeologic properties of individual geologic and hydrogeologic units throughout the state. Using these data, NJGS has

compiled summaries for geologic and hydrogeologic units in New Jersey of horizontal hydraulic conductivity values, transmissivity values, and vertical hydraulic conductivity values (NJGS, 2002).

Recharge

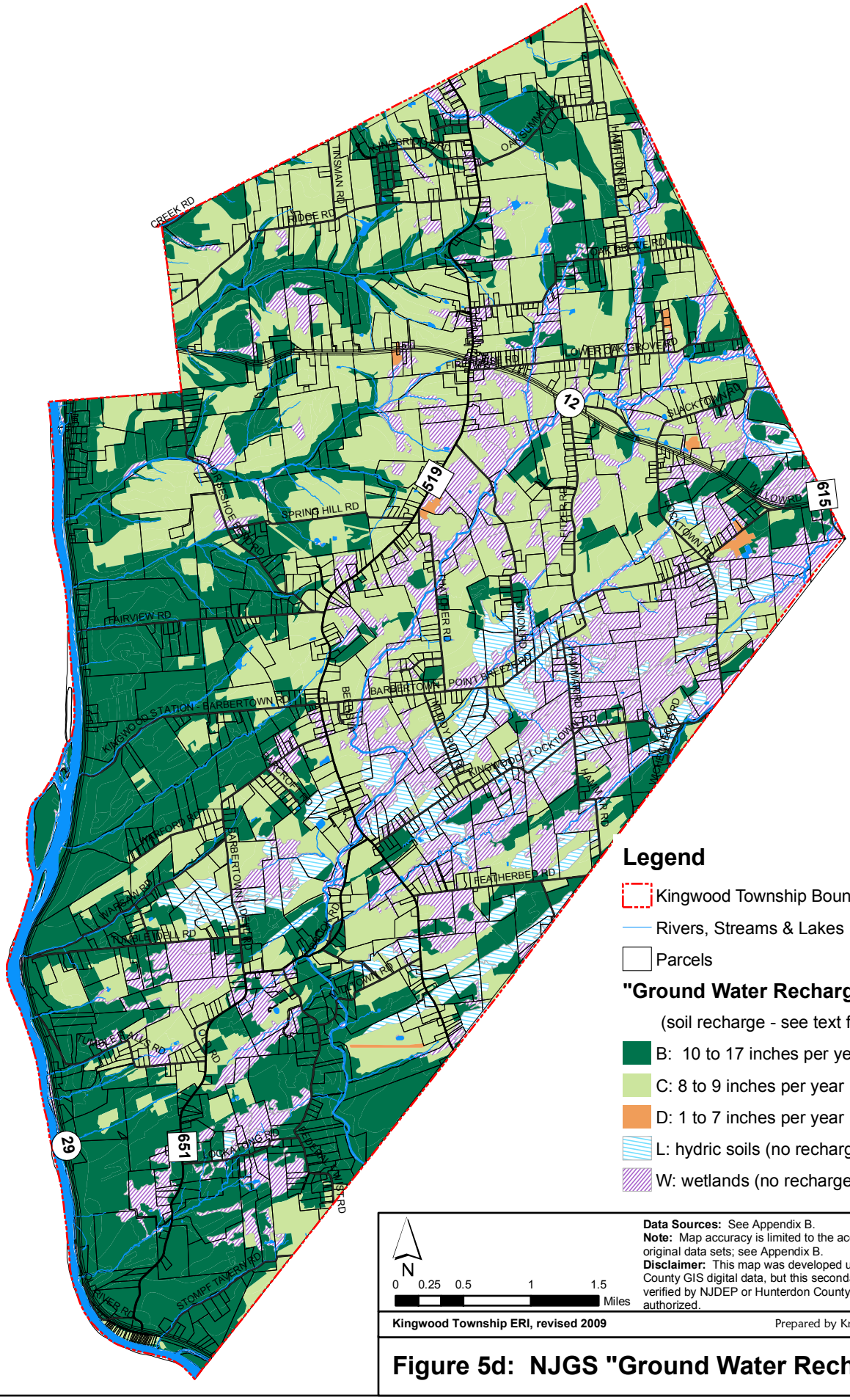
Ground water *recharge* is defined as water added to an aquifer (for example, precipitation that seeps into the ground). A g*round water recharge area* is the land area that allows precipitation to seep into the saturated zone. These areas are generally at topographically high areas with discharge areas at lower elevations, commonly at streams or other water bodies (i.e. the ground water returns to surface water). In general, ground water divides coincide with, or are slightly offset from, surface water divides (Lewis-Brown, 1995)(watersheds are described in **Section II.F** and shown in **Figure 6a**). Most ground water flows through the shallow layers of soil and weathered bedrock to the nearest stream. A smaller percentage penetrates deeper and recharges the aquifer.

Many factors affect the amount of recharge that will occur in a given area, including climate (e.g. the amount, intensity, and form of precipitation, and the effect of wind, humidity and air temperature on evapotranspiration), soil, surficial geology, and vegetation factors. In addition, recharge of ground water varies seasonally. During the growing season, precipitation is intercepted by plants and returned to the atmosphere through transpiration (part of the hydrologic cycle, see **Figure 5a**). Evaporation likewise, is higher during the warmer months. Therefore, most recharge occurs during late fall, winter, and early spring, when plants are dormant and evaporation rates are minimal (Heath, 1983).

Recharge rates are expressed in terms of the amount of precipitation that reaches the aquifer per unit of time (e.g. inches/year is used in **Figure 5d**). Recharge rates vary from year to year, depending on the amount of precipitation, its seasonal distribution, air temperature, land use and other factors. Relative to land use, recharge rates in forests are much higher than those in urban areas (Heath, 1983). This is because urban areas have large areas covered with impermeable surfaces, hastening runoff to surface water, instead of allowing precipitation to percolate into the ground.

N.J.S.A. 58:11A, 12-16 required the NJDEP to publish a methodology to map and rank aquifer-recharge areas. In addition, the legislation required the development of ground-water protection practices designed to encourage ecologically sound development in aquifer-recharge areas (Charles et. al., 1993).

To fulfill the requirements of this legislation, the NJ Geological Survey developed GSR-32, which estimates ground water recharge (but not aquifer recharge), and is useful for evaluating the relative effect of present and future land uses on recharge areas (Charles et. al., 1993). For this method, recharge was calculated based on data for precipitation, soil, land-use/land-cover, surface runoff, and evapotranspiration. This method was then applied by NJGS to create a GIS coverage (see **Figure 5d**). There were a number of assumptions made for the calculations and model inputs which limit the accuracy of the method: 1.) the calculated ground water recharge includes any water entering the ground (lesser amounts actually enter the aquifer); 2.) assumes that all water which migrates below the root zone recharges the aquifer (which doesn't happen); 3.) addresses only natural ground water recharge, and does not include artificial recharge, withdrawals or natural discharge; 4.) wetlands and water bodies were eliminated from analysis, because the direction of flow between ground water and surface water is site-specific and also varies seasonally, and this level of detail was beyond the scope of the study (these areas were assumed to provide no recharge or discharge); and 5.) stream baseflows used may not be representative of local streams (Charles et. al., 1993). An additional limitation


Legend
Kingwood Township Boundary
Rivers, Streams & Lakes
Parcels
"Ground Water Recharge" State Rank
(soil recharge - see text for discussion)
B: 10 to 17 inches per year
C: 8 to 9 inches per year
D: 1 to 7 inches per year
L: hydric soils (no recharge calculated)
W: wetlands (no recharge calculated)
N
0 0.25 0.5 1 1.5
Miles
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.
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Prepared by Kratzer Environmental Services
Figure 5d: NJGS "Ground Water Recharge"

of the data is that they estimate long-term average annual recharge, which does not represent the reduced recharge during critical summertime conditions (NJ Water Supply Authority, 2002).

Keeping these limitations in mind, the method estimated recharge rates from 1 to 16 inches per year in Kingwood (excluding surface water, wetlands and hydric soils), for estimated average annual subsurface recharge (see **Figure 5d)**. This represents 2 to 34% of precipitation.

For comparison, in 1966, the State Geologist estimated recharge to be 10 to 15% of precipitation for areas similar to Kingwood Township (Kasabach, 1966), while a typical figure for recharge in the sandy coastal areas of New Jersey is approximately 50% of rainfall.

As previously mentioned, only a portion of water entering the ground actually recharges the aquifer, but the GSR-32 did not attempt to quantify this amount. According to Lewis-Brown (1995), of the US Geological Survey, "…only about 6% of the recharge at land surface reaches depths greater than 75 feet below land surface." In contrast, Robert Canace, of the NJ Geological Survey, suggested that 20% of the estimated recharge should be used for planning purposes, representing the portion of recharge actually available for use during drought conditions (Canace, 1995). Using the 6% figure, Kingwood may have usable recharge of 0.06 to 0.96 inch. If assuming that 20% of ground recharge is aquifer recharge, 0.2 to 3.2 inches are added to ground water per year. While it is unknown at this time which figure is closer to actual conditions in Kingwood, the general principle is this: Recharge is limited. Therefore, if withdrawals of ground water are greater than the recharge amounts, the aquifer would experience a continuous net reduction in the available water supply.

Ground Water Quality

Pollution, such as nitrates, bacteria, metals, pesticides and antibiotics, can enter ground water via non-point sources (including septic systems and runoff from fields and roads), point sources (including discharge pipes), and rain. The New Jersey Comparative Risk Project (2003) identified a number of possible human health risks from drinking water, including lead (which, when present, is usually from the plumbing (NJDEP, 2004)), radon, arsenic, MTBE, nitrates, and waterborne pathogens.

The New Jersey Private Well Testing Act (N.J.S.A. 58:12A-26 et seq.) became effective in September 2002. The PWTA requires mandatory statewide private well testing upon the sale of a house. The well water must be tested for Primary Contaminants[10] (bacteria, Volatile Organic Compounds, arsenic, lead and nitrates) and Secondary Contaminants[11] (pH, iron and manganese). Beginning March 16, 2004, gross alpha particle activity is also required in Hunterdon County. A report summarizing the first 6 years of data generated by the PWTA revealed that arsenic standards are frequently exceeded in Kingwood Township (a new arsenic Maximum Contaminant Level of 5 µg/l became effective in 2006) (see **Table 2.11**) (NJDEP Division of Water Supply / Bureau of Safe Drinking Water And Division of Science, Research and Technology, July 2008). The report concluded that: 1.) certain geologic formations in the Piedmont region contain layers that may leach arsenic into the ground water as it passes through, and 2.) wells drilled into bedrock aquifers are more susceptible to fecal coliform contamination than wells in the coastal plain. In time, the data from the PWTA can be used to determine water quality trends and assessments of the safety of private well sources.

[10] Primary contaminants are contaminants that may a cause potential health risk if consumed on a regular basis above the established maximum contaminant levels (MCLs).

[11] Secondary parameters are regulated by the State for aesthetic or other concerns (taste, odor, staining, scaling of home fixtures) rather than health effects. Whether or not these natural water quality parameters are a problem depends on the amount of the substance present.

The New Jersey Geological Survey (NJGS) and the United States Geological Survey (USGS) are involved in ground water monitoring and protection. Ground water monitoring sites within Kingwood and its watersheds are shown on **Figure 5e**, listed in **Table 2.12**, and described in the paragraphs below.

Table 2.11: Private Well Testing Act Results 2002-2007

Parameter	Kingwood			Hunterdon County	New Jersey
	Number of Wells Sampled	Exceedances	% Exceedances	% Exceedances	% Exceedances
VOC	244	0	0%	0.6%	1.4%
Arsenic	194	79	41%	18%	11.8%
Gross Alpha	135	9	6.7%	4%	9.6%
Nitrate	244	1	0.41%	0.80%	2.7%
Bacteria (Fecal coliform/E. Coli)	*Township data not available*			3.9%	2.2%
Source: NJDEP Division of Water Supply / Bureau of Safe Drinking Water And Division of Science, Research and Technology, July 2008					

Table 2.12: Ground Water Quality Monitoring Sites

Site Number		Watershed	Site Name	Sampled
NJGS Ambient Ground Water Quality of the New Jersey Part of the Newark Basin				
In Kingwood	22	Lockatong	No names	one sample each 1985 – 1988
	23	Lockatong		
	24	Warford		
	101	Lockatong		
	102	Lockatong		
Outside Kingwood	21	Nishisakawick		
	20	Delaware River		
	100	Wickecheoke		
	103	Wickecheoke		
	119	Lockatong		
	120	Wickecheoke		
	121	Lockatong		
NJGS/USGS Ambient Ground Water Quality Site				
190439		D & R Canal	Bull's Island	2001. Results of the sampling are reported by the USGS in their yearly series on water resources data of New Jersey. Most recent available: DeLuca, M.J., Hoppe, H.L., Doyle, H.A. and Gray, B.J., 2002, Water resources data New Jersey water year 2001, vol. 3, water-quality data: U.S. Geological Survey water-data report NJ-01-3, 580p.
NJGS Hydro Database				
FILNUM 163		Lockatong	Snyder Farm (Rutgers Univ.)	1996
FILNUM 249		Wickecheoke	Shetland Crossing Golf Course	2001
New Jersey USGS website (no GIS coverage available)				
190008		Wickecheoke	MAGNESIUM	One sample: 1985
190062		Wickecheoke	MAGNESIUM ELEKTRON	Two samples: 1968 and 1985
190235		Unknown	AGRICULTURAL	One sample: 1988
Sources: GIS data layers for the above monitoring programs and the USGS website http://wwwnj.er.usgs.gov/gw/.				

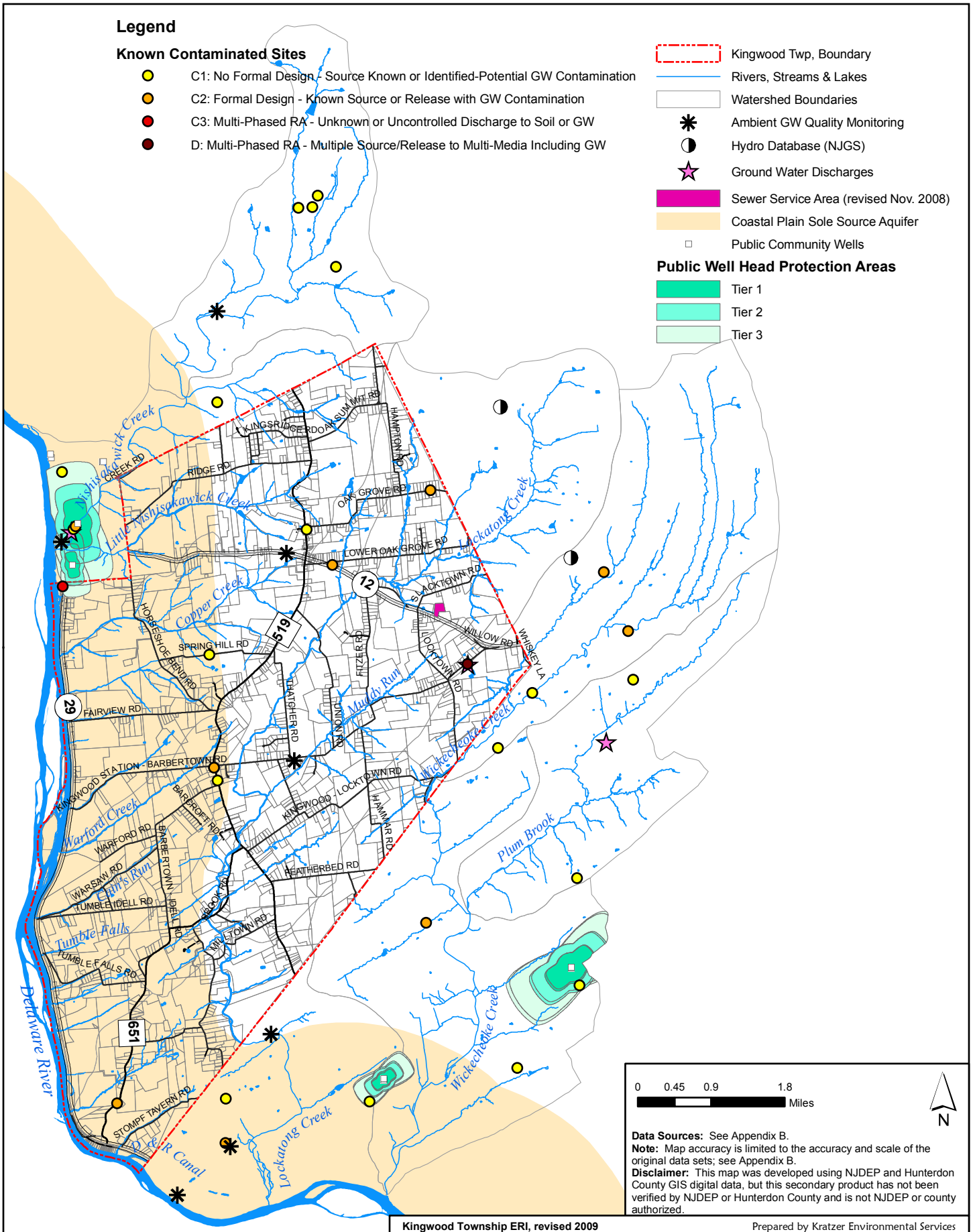


Figure 5e: Ground Water Monitoring Sites, WHPA, Sole Source Aquifer and Known Contaminated Sites

The *NJGS Ambient Ground-Water Quality of the New Jersey Part of the Newark Basin* provides sets of files that summarize natural ground-water quality in sedimentary bedrock formations of the Newark basin part of the Piedmont Physiographic province of New Jersey. This information provides all interested parties with natural water chemistry and ranges of many water-quality parameters. The sample analyses and well information are presented in **Table 2.13**, even though the analyses available for Kingwood Township are from the 1980's and are based on only a few samples.

NJGS/USGS Ambient Ground-Water-Quality Network (AGWQN) monitoring wells in New Jersey is maintained jointly by the New Jersey Geological Survey (NJDEP) and the United States Geological Survey. The AGWQN is designed to monitor the quality of ground water at or near the water table throughout the State. Shallow ground water is generally the first and most significantly affected part of the ground water system, and the quality of this water is directly related to human activities at the land surface. The network consists of 150 shallow ground water wells throughout the state. Every year approximately 30 sites are sampled, with the cycle of sampling all 150 wells to be completed every 5 years. Results of the sampling are reported by the USGS in their yearly series on water resources data of New Jersey. Only one site is located nearby, at Bull's Island, just south of Kingwood's boundary.

New Jersey USGS has a database of ground water quality throughout the state at various times. Data for three sites within Kingwood are available on the internet. These sites appear to be investigations of problem wells. USGS remarks that water is generally hard and may have elevated concentrations of iron and sulfate.

Ground Water Quality Standards

The New Jersey Ground Water Quality Standards (GWQS; N.J.A.C. 7.9-6) specify the quality criteria and designated uses for ground water, and serve as the basis for setting ground water discharge standards under the New Jersey Pollutant Discharge Elimination System program, as well as for establishing standards for ground water cleanups and other relevant laws. The criteria are numerical values assigned to each constituent (pollutant). The GWQS also contain technical and general policies to ensure that the designated uses can be adequately protected.

Ground water within watersheds of FW1 surface waters (see **section II.F** for surface water classifications), state-owned Natural Areas, and the major aquifers of the Pinelands Area are designated Class I. The designated use for Class I ground water is the maintenance of special ecological resources, with secondary uses being potable, agricultural and industrial water. The designated use of Class II ground waters is to provide potable water using conventional treatment. Class II criteria specify the levels of constituents above which the water would pose an unacceptable risk for drinking water. Class III ground waters can be used for anything other than for potable water, and encompass all areas that are not designated as Class I or Class II. It should not be assumed that ground water quality everywhere meets the criteria for each classification area in view of natural variability and the possibility of localized pollution (NJDEP, 2004).

All of Kingwood is designated Class II.

Known Contaminated Sites

The NJDEP Bureau of Planning and Systems compiled a list of Known Contaminated Sites (KCS). The *Known Contaminated Sites List, 2005* for New Jersey (as required under N.J.S.A. 58:10-23.16-17) are those sites and properties within the state where contamination of soil or ground water has been identified or where there has been, or there is suspected to have

Table 2.13: Ground Water Quality for Five sites within Kingwood Township (NJGS)

Well Number	Date of Sample	Temperature (deg C)	Specific Conductance (us/cm)	Solids residue at 180 C, dissolved	Solids, sum of constituents, dissolved	Oxygen dissolved (mg/L)	pH (standard units, field)	Alkalinity, field (MG/L)	Hardness, total (mg/L) as CACO3	Nitrogen, ammonia, dissolved	Nitrogen, nitrite, dissolved (MG/L)
22	01-29-86	12	610		380	0.2	9.1	321	17		
22	03-08-88	12	689	405		0.2	9.4	330	8	<0.010	<0.010
23	02-12-86	13	478		286	1.2	9.3	211	67		
24	01-28-86	10.5	400		285	2.7	7.7	163	190		
101	12-18-85	11.5	470		329	0.9	7.6	262	190		
102	12-19-85	10.5	426		308	0.4	7.3	220	190		
	Average	**11.58**	**512.17**	**405.00**	**317.60**	**0.93**	**8.40**	**251.17**	**110.33**	**<.01**	**<.01**

Well Number	Date of Sample	Nitrogen, annonia +organic (MG/L	Nitrogen, NO2+NO3, dissolved	Phosphorus, dissolved, (mg/L as P)	Photosphorus, dissolved (MG/L	Calcium, dissolved (mg/L as CA)	Magnesium, dissolved, (mg/L as MG)	Sodium, dissolved (mg/L as NA)	Potassium, dissolved (mg/L as NA)	Chloride, dissolved (mg/L as CL)	Sulfate, dissolved (mg/L as SO4)
22	01-29-86					3.7	1.8	150	1.5	18	1.6
22	03-08-88	<0.20	<0.100	0.04	0.01	1.8	0.91	160	1.8	18	0.6
23	02-12-86					14	7.5	74	0.7	3.5	42
24	01-28-86					47	16	21	2.2	7.7	73
101	12-18-85					62	9.1	34	3.5	4.8	21
102	12-19-85					63	8.7	26	5.4	6.2	40
	Average	**<0.20**	**<0.100**	**0.04**	**0.01**	**31.92**	**7.34**	**77.50**	**2.52**	**9.70**	**29.70**

Well Number	Date of Sample	Flouride, dissolved (mg/L as F)	Silica, dissolved (mg/L as SiO2)	Aluminum, dissolved (ug/L as AL)	Arsenic, dissolved (ug/L as As)	Barium, dissolved (ug/L as Ba)	Beryllium, dissolved (ug/L as Be)	Cadmium, dissolved (ug/L as Cd)	Chromium, dissolved (ug/L as Cr)	Cobalt, dissolved (ug/L as CO)	Copper, dissolved, (ug/L as Cu)
22	01-29-86		11			19	<0.5	<1.0		<3	<10
22	03-08-88	1.4	10	<10	<1			3	<1		<1
23	02-12-86		17			70	<0.5	<1.0		<3	<10
24	01-28-86		15			72	<0.5	<1.0		<3	<10
101	12-18-85		36			18	<0.5	<1.0		<3	<10
102	12-19-85		26			73	<0.5	<1.0		<3	<10
	Average	**1.40**	**19.17**	**<10**	**<1**	**50.40**	**<0.5**	**3.00**	**<1**	**<3**	**<10**

Well Number	Date of Sample	Iron, dissolved (ug/L as Fe)	Lead, dissolved (ug/L as Pb)	Lithium, dissolved (ug/L as Li)	Manganese, dissolved (ug/L as Mn)	Mercury, dissolved (ug/L as Hg)	Molybdenum, dissolved (ug/Las Mo)	Strontium, dissolved (ug/L as Sr)	Vanadium, dissolved (ug/Las V)	Zinc, dissolved (ug/L as Zn)	Uranium, nat., dissolved (ug/L as U)	Carbon, org., dissolved (mg/L as C)	Phenols, total (ug/L)
22	01-29-86	8	<10	29	<1		<10	87	<6	<3	0.4		
22	03-08-88	3	<5		1	<0.1				<3		0.4	2
23	02-12-86	<3	<10	<4	<1		<10	910	<6	61	1		
24	01-28-86	3	10	22	14		10	4400	<6	600	16		
101	12-18-85	100	<10	15	48		<10	310	<6	840			
102	12-19-85	370	<10	16	260		<10	480	<6	34			
	Average	**96.80**	**<10**	**20.50**	**80.75**	**<.1**	**10.00**	**1237**	**<6**	**383.75**	**5.80**	**0.40**	**2.00**

been, a discharge of contamination. It is important to note that some of the cases listed may have been fully remediated and should no longer be considered contaminated sites. Additionally new contaminated sites may have been identified since the creation of this list and are not included here. For further information contact NJDEP's Site Remediation Programs (SRP) lead program, which are identified with each site listed in this data base (see **Table 2.14**).

Sites identified in the Known Contaminated Sites can undergo a variety of activities, ranging from relatively simple soil removals to highly complex remedial activities. The sites included in this dataset are handled under various regulatory programs administered by the NJDEP's Site Remediation Program, including the New Jersey Brownfield and Contaminated Site Remediation Act, Industrial Site Recovery Act, Solid Waste Management Act, Spill Compensation & Control Act, Underground Storage of Hazardous Substances Act, Water Pollution Control Act and the Federal Comprehensive Environmental Response, Compensation and Liability Act, Superfund Amendments and Reauthorization Act, and Resource Conservation and Recovery Act Corrective Action Program. A site can be regulated under more than one of these regulatory programs.

The Federal legislation, collectively known as Superfund, requires that a National Priorities List (NPL) of sites throughout the United States be maintained and revised at least annually. NJDEP and USEPA conduct and oversee cleanups at Superfund sites with both public and private funds. The lead agency maintains direct oversight of the work at the site and has the most current and detailed information about the status of the cleanup (NJDEP, 2002).

Table 2.14: Known Contaminated Sites

	SITE ID	NAME	LEAD	Status[3]	Status Date	Remedial Level[4]
In Kingwood Township		Little Nishisakawick Creek Watershed				
	44231	KINGWOOD TWP GARAGE 288 KINGWOOD STA BARBERTOWN RD	BSCM	Active	1/28/2003	C1
	126681	35 BYRAM KINGWOOD ROAD	BFO-N	Active	11/14/2002	C2
		Copper Creek Watershed				
	66354	DEREWAL SUPERFUND SITE RTE 29 (RIVER RD)	BDC	Active	5/15/1985	C3
	79499	107 SPRING HILL ROAD	BFO-N	Active	2/5/1999	C1
		Warford Creek Watershed				
	42672	BANBERTOWN GARAGE [sic] RTE 519 & KINGWOOD STA	BSCM	Active	8/18/1994	C2
		Lockatong Creek Watershed				
	61909	FORGE ANVIL TAVERN 650 RTE 519	BFO-N	Active	3/20/1997	C1
	6723	MAGNESIUM ELEKTRON INC[12] 500 BARBERTOWN PT BREEZE RD	BNCM	Active	11/14/1995	D
	6720	CHRIS CITGO 1120 RT 12N	BSCM	Active	12/10/1998	C2
	89019	360 OAK GROVE RD	BFO-N	Active	6/7/2001	C2
Outside Kingwood Township		Wickecheoke Creek Watershed				
	171415	837 SERGEANTSVILLE ROAD	BFO-N	Active	4/6/2004	C1
	185085	545 ROSEMONT RINGOES ROAD	BFO-N	Active	3/30/2005	C1
	124321	KNIGHT FARM 68 UPPER CREEK RD	BFO-N	Active	9/10/2002	C2
	69971	24 MESZAROS ROAD	BFO-S	Active	7/1/1997	C1

[12] Magnesium Elektron, Incorporated (MEI) changed it's name to MEL Chemicals in 2008.

		24 MESZAROS RD				
	164922	50 LOCKTOWN SCHOOL ROAD	BFO-N	Active	11/24/2003	C1
	129935	81 WHISKEY LA	BFO-N	Active	1/15/2003	C1
	165184	855 ROUTE 579	BFO-N	Active	12/3/2003	C1
	15415	CROTON TEXACO 601 RT 12 & RT 579	BSCM	Active	8/6/1992	C2
	91890	953 CROTON ROAD	BFO-N	Active	11/19/2004	C2
	Lockatong Creek Watershed					
	189714	96 FEDERAL TWIST ROAD	BFO-N	Active	3/17/2005	C1
	91888	68 KINGWOOD STOCKTON ROAD	BFO-N	Active	1/9/2002	C1
	78991	56 FEDERAL TWIST RD	BFO-N	Active	5/20/1999	C2
	Nishisakawick/Little Nishisakawick Creek Watersheds					
	6736	FRENCHTOWN MOBIL 22 RACE ST	OWR	Active	5/9/2000	C1
	55643	FOREIGN MAGIC INCORPORATED FRENCHTOWN-MILFORD RD	BSCM	Active	5/7/1998	C1
	67613	STEM BROTHERS INC RACE ST & KINGWOOD AVE	BSCM	Active	9/21/1999	C2
	92424	152 TINNSMAN ROAD	BFO-N	Active	9/20/2001	C1
	80410	STERLING BROOK FARM 630 RTE 513	BFO-N	Active	10/5/2000	C1
	170726	382 MECHLIN CORNER ROAD	BFO-N	Active	3/25/2004	C1
	158455	26 ALEXANDRIA DRIVE	BFO-N	Active	9/23/2003	C1
	183092	37 ALEXANDIA DRIVE	BFO-N	Active	11/1/2004	C1

[3]STATUS describes the site's position in the remedial process:

Active: This status is designated when a contaminated site is assigned to a remedial program and measures such as a preliminary assessment, remedial investigation or cleanup work is underway.

Pending: This status is designated when a contaminated site awaits the execution of an oversight documents such as a Memorandum of Agreement or an Administrative Consent Order or the availability of resources for publicly funded action prior to assignment to a specific remedial program bureau.

[4]REM = REMEDIAL LEVEL, as defined below:

C1: No Formal Design - Source Known or Identified-Potential GW Contamination
C2: Formal Design - Known Source or Release with GW Contamination
C3: Multi-Phased RA - Unknown or Uncontrolled Discharge to Soil or GW
D: Multi-phased RA Multiple Source/Release to Multi-media Including GW

Source: NJDEP Known Contaminated Sites GIS data.

Within Kingwood, there are 9 KCSs, including one Superfund site (see **Figure 5e**). An additional 20 KCSs lie in watersheds shared with Kingwood, and therefore may also be impacting Kingwood's environmental quality. More detailed information was available for only 3 of these sites, which are described briefly, below:

- The superfund site is known as the *DeRewal Chemical Company* on Route 29. This was the site of a chemical manufacturing facility between 1970 and 1974. As a result of manufacturing activities and numerous spills, the shallow aquifer became contaminated with Volatile Organic Compounds (VOCs) and metals at levels exceeding ground water quality criteria, and the soil was contaminated with VOCs, Polycyclic Aromatic Hydrocarbons, and metals. Contamination was also detected in the deeper aquifer at levels below ground water quality criteria. The USEPA added the site to the National Priorities List of Superfund sites (NPL) in 1984. USEPA completed removal of approximately 60,000 tons of contaminated soil from the site in 1998 (NJDEP, 2001).

Evaluations in 2003 resulted in USEPA initiating a system to extract contaminated ground water and dispose of it off-site, which is ongoing.

- *Magnesium Elektron, Inc.* (MEI) (now known as MEL Chemicals) manufactures zirconium chemicals, including zirconium chloride and zirconium sulfate. The zirconium ore used up until 2003 contained traces of radioactive uranium and thorium. The manufacturing process includes the use of strong sulfuric and hydrochloric acids, and generates waste saltwater byproducts, including sodium sulfate and sodium chloride. In the past, these waste products were stored in lagoons which leaked, and also discharged to Wickecheoke Creek. Sodium chloride and sodium sulfate salts now contaminate the ground water aquifer in the area close to the plant. Between 1988 and 1991, MEI installed 20 on-site and 30 off-site monitoring wells in order to define the area of contamination. Beginning in 1990, NJDEP required MEI to remediate the site. This is done by continuously pumping the contaminated ground water from 7 on-site wells at a rate of 125 gpm (gallons per minute) to prevent further off-site migration of salt contamination. The saltwater waste that is generated is trucked offsite for disposal at the Trenton, New Jersey Waste Water Treatment Facility, which has a brackish water discharge into the tidal section of the Delaware River. As required by NJDEP, MEI continues to monitor the aquifer, report results to the NJDEP, and to provide bottled water to homeowners with impacted wells. In addition to the ground water contamination, one on-site lagoon currently stores historically generated solid waste (NJDEP, 2001; Beaupre, 2003; Zgurzynski, 2004).

- The former *Mobil Service Station* on 22 Race Street Frenchtown Borough has experienced contamination of ground water and soil with VOCs, while surface water and sediments have been contaminated with petroleum hydrocarbons. This site is located directly adjacent to Nishisakawick Creek, a tributary of the Delaware River. The underground tanks and contaminated soil were removed, however, petroleum product continued to seep into the creek. NJDEP's Division of Publicly Funded Site Remediation planned further remediation for 2002 (NJDEP, 2001).

More in-depth information concerning the remaining Known Contaminated Sites was not available.

Underground Storage Tanks (USTs) are defined as non-earthen containment devices (e.g. concrete, steel, plastic) and related equipment at least 10% beneath the surface of the ground, containing hazardous substances, including fuel and oil. Because of the danger of hazardous substances leaking and contaminating the soil and ground water, USTs[13] are regulated, and there may be financial assistance available for removal and remediation of USTs. The USTs on record with NJDEP are listed in **Table 2.14**. Of the 15 Underground Storage Tanks, 9 require no further action, 4 are assigned to a program, and 2 are awaiting assignment. One tank, at the DeRewal superfund site, is classified as an active underground storage tank system which is in compliance with NJDEP's deadline requirements for leak detection, spill, overfill and cathodic protection required by N.J.A.C 7:14B-1 et seq (NJDEP, 2009).

In addition to the sites listed in **Table 2.14 and 2.15**, the Delaware River within Kingwood Township has been impacted by possible past and/or continuing inputs from the

[13] Heating oil USTs with an aggregate capacity of 2,000 gallons or less are exempt from the UST regulations. Heating oil USTs of any size, used exclusively to heat residential buildings, are exempt from the UST regulations.

Lehigh River, Boarhead Farms (Upper Black Eddy, PA), Crown Vantage Landfill (Alexandria Township), and others.

Table 2.15: Underground Storage Tanks

Case Identification Number	Case Name	Address	Status	Status Date	Lead Bureau	REM
G000004969	DEREWAL CHEMICAL COMPANY	RTE 29 (RIVER RD)	Active	2009		
99-12-10-1550-33	KOCHES REPAIRS INC	1282 RTE 12 WEST	ATP		BUST	
94-02-10-1148	BAPTISTOWN CORNER STORE	RTE 519 & 12	NFA	1997	BUST	C1
94-07-22-1134	BARBERTOWN GARAGE	RTE 519/KINGWOOD	ATP		BUST	C2
96-10-08-1829-06	BARBERTOWN/IDELL & KINGWOOD RD	BARBERTOWN/ IDELL & KINGWOOD RD	NFA	1997	BUST	B
92-11-16-1238	KINGWOOD TWP ELEMENTARY SCH	RTE 519	NFA	1993	BUST	C1
89-03-20-1504	PRECISION DRILLING	RT 519	NFA	1992	BUST	
99-06-04-1406-10	TOWNSHIP OF KINGWOOD-GARAGE	288 KINGWOOD STATION-BARBERTOWN ROAD	AA		BFO-IN	
99-12-10-1550-33	COMMERCIAL PROPERTY-DISCOUNT AUTO PARTS	1266 STATE ROUTE 12	NFA	2001	BFO-IIN	B

Notes: **BUST** is the Bureau of Underground Storage Tanks; **BFO-IN** is the Bureau of Field Operations - Initial Notice Section
NFA = No Further Action; **AA** = Awaiting Assignment; **ATP** = assigned to project; See Table 2.13 for REM definitions; **Active** = Active Facility with Compliant Tank

Source: NJDEP Site Remediation, Bureau of Underground Storage Tanks. http://www.nj.gov/dep/srp/bust/njust.zip

Ground Water Level Monitoring

The *ground water level* is the distance from the land surface (i.e. top of well casing) to the water in a well. Ground water level monitoring is critical for determining the current state of the ground water, identifying trends and predicting ground water drought (current drought declarations are based on reservoir levels, which may not correlate with local ground water stress). In addition to drought, over-withdrawal of ground water can occur in areas where more ground water is being pumped out of the aquifer than is replenished through recharge. This could lead to a drop in the ground water level, affecting well performance, and sometimes causing wells to go dry, as well as causing a decrease in the baseflows of adjacent streams. Wells do occasionally fail in Kingwood, demonstrating the vulnerability of these aquifers to over-withdrawal.

The Hunterdon County Master Plan of 1972 recommended that "a network of observation wells be established… several years prior to …development so that gradual changes from the natural environment will be recorded." (Elam and Popoff, 1972). The nearest US Geological Survey well level monitoring site is located in Sergeantsville, Delaware Township. This is a shallow well 21 feet deep, located within the Stockton aquifer and monitored since 1965 (see **Internet Resources**, below).

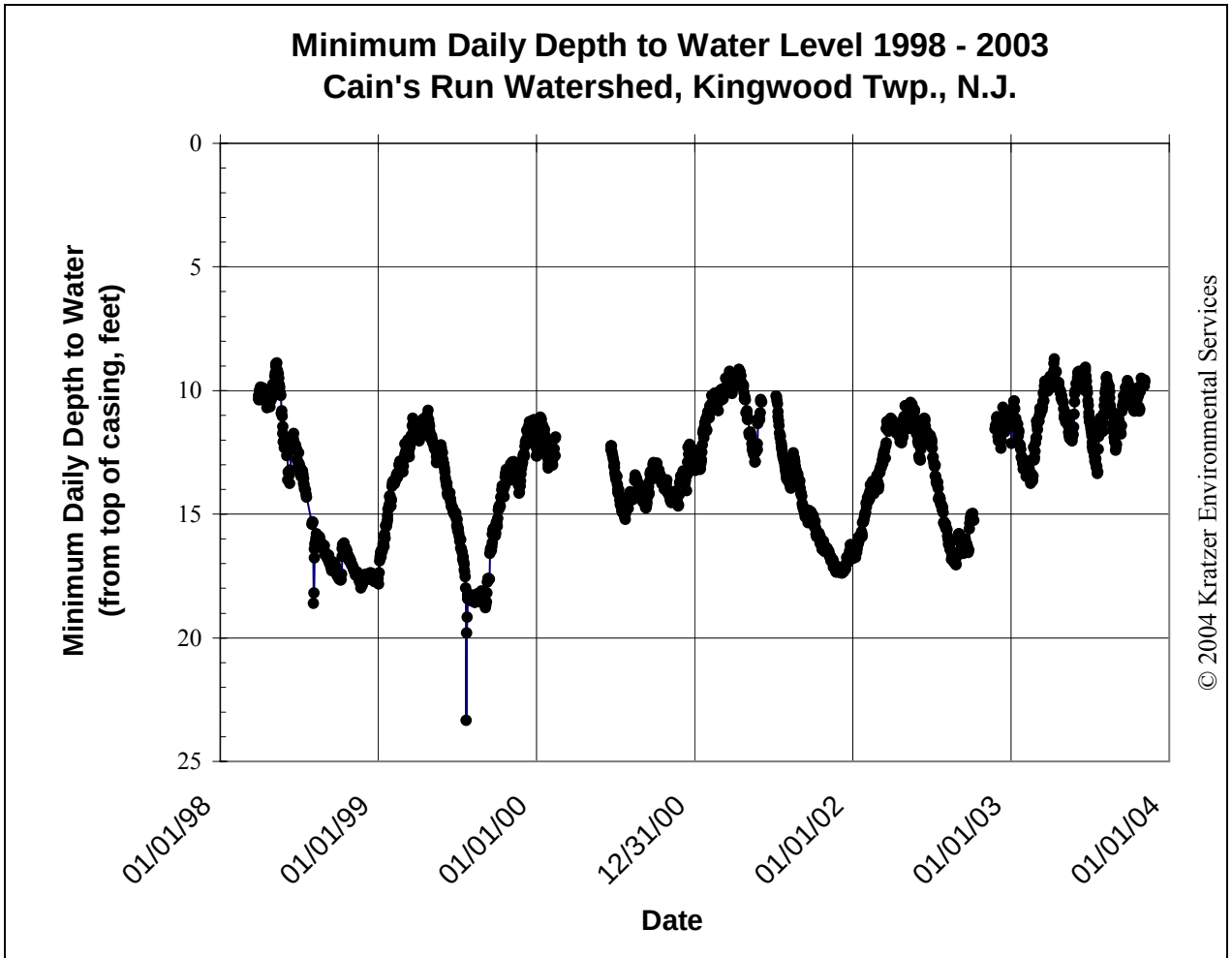
A very small portion of Kingwood lies in the Stockton aquifer, however, so the USGS monitoring site is not representative of Kingwood's ground water. Therefore, Kratzer Environmental Services initiated ground water monitoring in one well in the Lockatong aquifer in March 1998. The well selected is located in the Lockatong argillite geology, in Cain's Run (also known as Warsaw Creek) watershed. This well was drilled in about 1985, and is used for residential water supply. The distance to the nearest well is approximately 200 feet. A pressure transducer continuously monitors (at ½ hour intervals) ground water level and water temperature. Precipitation data have also been collected at the site for correlation with ground water level.

The ground water level for the period 1998 – 2003 is shown in **Figure 5f** (Kratzer and Kratzer, 2003).

On two instances, the well level dropped drastically as a result of pumping of nearby wells. In August 1998, the well experienced a drawdown of 5 ½' over a 48 hour period, with a recovery time of approximately five days. The only known candidate for a 48 hour commercial well test is the Devil's Tea Table property, which is approximately 0.8 miles from this well, on the opposite side of the Cain's Run drainage area. A well nearer to Devil's Tea Table experienced temporary well failure at this time. Another acute drawdown was observed in July 1999. Over a period of 24 hours, the well experienced about 9' of drawdown and recovery took about three days.

Preliminary data suggests that it takes only 4-12 hours for precipitation to begin to recharge this well. Recharge in a more-porous homogenous geology usually takes much longer, on the order of days or weeks. The small time lag in the recharge illustrates how wells located at sites with recharge from localized, shallow fractures have a minimal water-filtration capacity and are thus very vulnerable to ground water contamination from surface pollution sources.

Ground water level varies seasonally, due to the seasonality of recharge (see Recharge section, above). Seasonal variation in this well is about 11 feet.



Source: Kratzer Environmental Services, 2004.

Figure 5f: Ground Water Level

Public Wells and Wellhead Protection Areas

The Public Community Water Supply (PCWS) Wells are wells that supply potable water to public communities, and serve at least 15 connections used by year-round residents or which serve at least 25 year-round residents. A Well Head Protection Area (WHPA) in New Jersey is a map area calculated around each PCWS well in New Jersey that delineates the horizontal extent of ground water captured by a well pumping at a specific rate over a two-, five-, and twelve-year period of time for unconfined wells (Tier 1, Tier 2 and Tier 3, respectively). WHPA delineations are conducted in response to the Safe Drinking Water Act Amendments of 1986 and 1996 as part of the Source Water Area Protection Program (SWAP). The delineations are the first step in defining the sources of water to a public supply well. Within these areas, potential contamination will be assessed and appropriate monitoring will be undertaken as subsequent phases of the NJDEP SWAP.

There are no PCWSs in Kingwood Township, however, **Figure 5e** shows four PCWSs in watersheds shared with Kingwood Township. The Well Head Protection Areas for Frenchtown Boro's two public wells extend slightly within Kingwood's boundary.

Monitoring information from these wells could be used in a more detailed analysis of local ground water conditions.

Sole-Source Aquifer

As defined by the U.S. Environmental Protection Agency (EPA), s*ole-source aquifers* (SSA) are those aquifers that contribute more than 50% of the drinking water to a specific area and the water would be impossible to replace if the aquifer were contaminated. The EPA must review any federally-funded project in an area that could affect ground water in a sole-source aquifer, including the *aquifer's recharge zone* and its *stream-flow source zone*. The recharge zone is the area through which water recharges the aquifer. The stream-flow source zone is the upstream area that contributes recharge water to the aquifer. Roughly the western half of Kingwood Township is designated as part of the stream-flow source zone for the Coastal Plain SSA (see **Figure 5e**).

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Internet Resources: Ground Water

General Ground Water Information

Ground Water Primer (US EPA): http://www.epa.gov/seahome/gwprimer.html

Hunterdon County Well and Septic System Care in Hunterdon County: http://www.co.hunterdon.nj.us/health/wellguide.htm

NJDEP Bureau of Freshwater and Biological Monitoring: http://www.state.nj.us/dep/wmm/bfbm/groundwater.html

Comparative Risk Project (NJDEP Div. of Science, Research and Technology): http://www.state.nj.us/dep/dsr/njcrp/

NJDEP Division of Science, Research and Technology, Private Well Testing Act http://www.nj.gov/dep/pwta/

NJDEP Standards and Rule Proposals:

Bureau of Water Quality Standards and Assessment: http://www.state.nj.us/dep/wms/bwqsa/

Notices of rule proposals and adoptions: http://www.nj.gov/dep/rules/

Hydrogeology

Aquifer and Well Characteristics in New Jersey (USGS): http://wwwnj.er.usgs.gov/gw/table_1.html

Ground Water Level at New Jersey well number USGS 402644074563601 BIRD OBS (USGS) http://nwis.waterdata.usgs.gov/nj/nwis/gwlevels/?site_no=402644074563601

New Jersey Geological Survey Home Page: http://www.state.nj.us/dep/njgs/index.html

NJGS Hydrogeologic Data (horizontal hydraulic conductivity values, transmissivity values, and vertical hydraulic conductivity values): http://www.state.nj.us/dep/njgs/geodata/dgs02-1.htm

New Jersey District Ground Water Information (USGS): http://wwwnj.er.usgs.gov/gw/

USGS - Water Resources of NJ: http://nj.usgs.gov/

Known Contaminated Sites (NJDEP)

NJDEP Site Remediation Program. 2001. Publicly Funded Cleanups Site Status Report 2001. http://www.nj.gov/dep/srp/kcsnj/

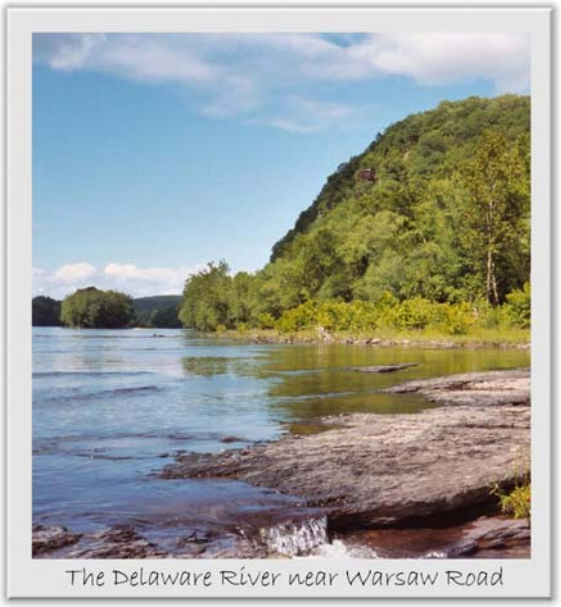
GIS data: http://www.state.nj.us/dep/gis/stateshp.html#KCSL

Site Remediation Programs (SRP): http://www.state.nj.us/dep/srp

The Petroleum Underground Storage Tank Remediation, Upgrade and Closure Fund ("UST Fund"): http://www.nj.gov/dep/srp/finance/ustfund/

G. Hydrology: Surface Water

Watersheds


The Delaware River near Warsaw Road

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 VI.B**.)

All of Kingwood Township is within the Delaware River watershed. **Figure 6a** shows the sub-watersheds (hydrologic unit codes or HUC-14) and streams either within or partially within Kingwood Township. Several sub-watersheds lie entirely within Kingwood Township: Copper Creek, Warford Creek, Cain's Run, Tumble Falls, and a number of unnamed streams. In addition, some land drains directly to the Delaware River without first entering a stream. Lockatong Creek is the largest sub-watershed within Kingwood Township. Lockatong Creek also drains portions of Franklin and Delaware Townships. Wickecheoke creek watershed lies primarily within Delaware Township, and partially within Kingwood and Raritan Townships and Stockton Boro. A small portion of Little Nishisakawick Creek lies within Frenchtown Boro, with the major portion in Kingwood. Nishisakawick Creek lies within Alexandria and Kingwood Townships and Frenchtown Boro.


The Delaware River from Frenchtown Bridge

Surface Water Quality Standards

According to NJDEP, in its October 2006 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.

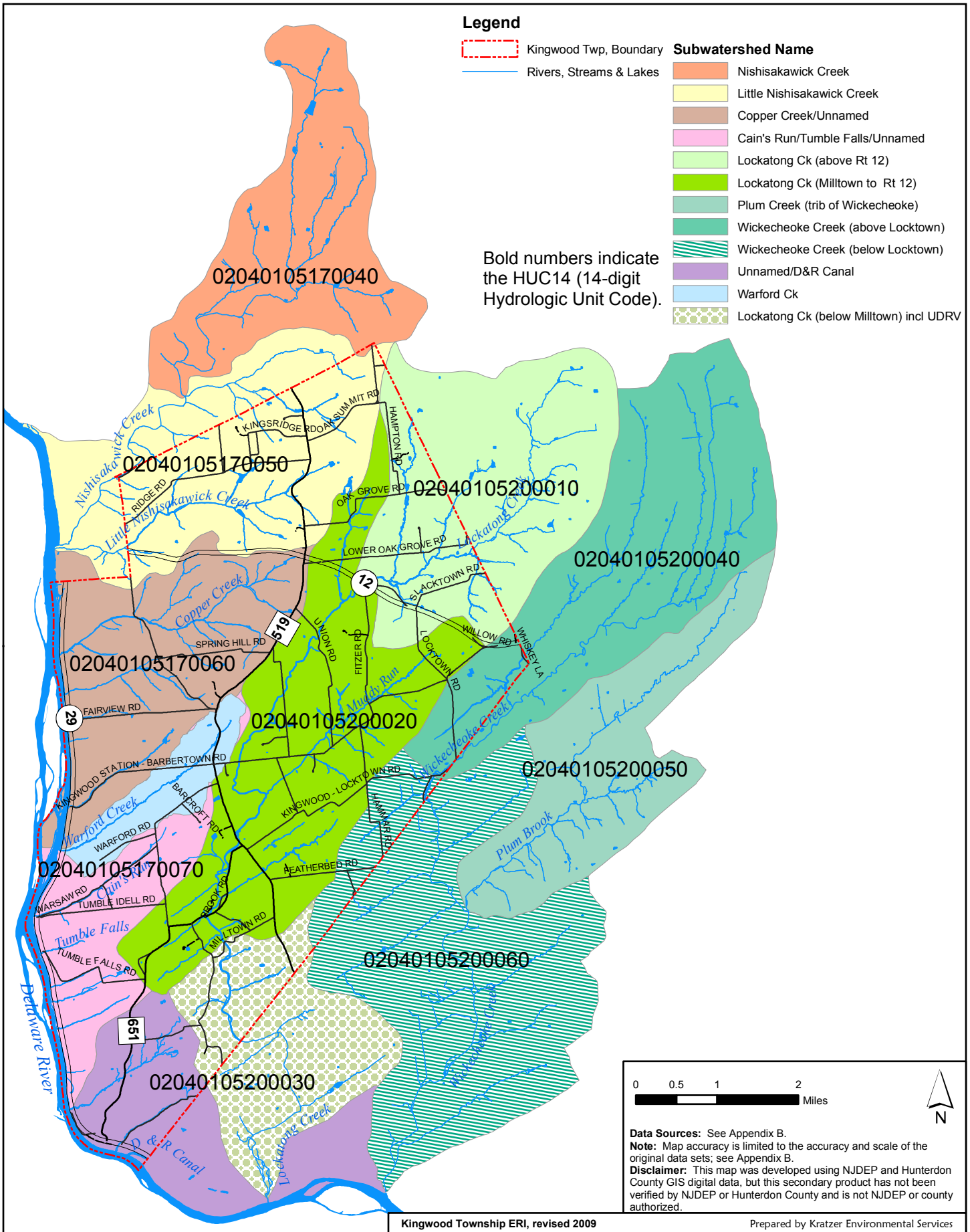


Figure 6a: Streams and Sub-watersheds

"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."

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 theFederal 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.

Surface water classifications are names assigned by the NJDEP to group waters according to designated uses (designated uses include potable water, propagation of fish and wildlife, recreation, agricultural and industrial supplies, and navigation) and water quality criteria. 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. **Table 2.16** describes the definitions of the categories, while **Figure 6b** illustrates the stream categories within Kingwood. In **Figure 6b**, "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, its antidegradation status and its trout water status.

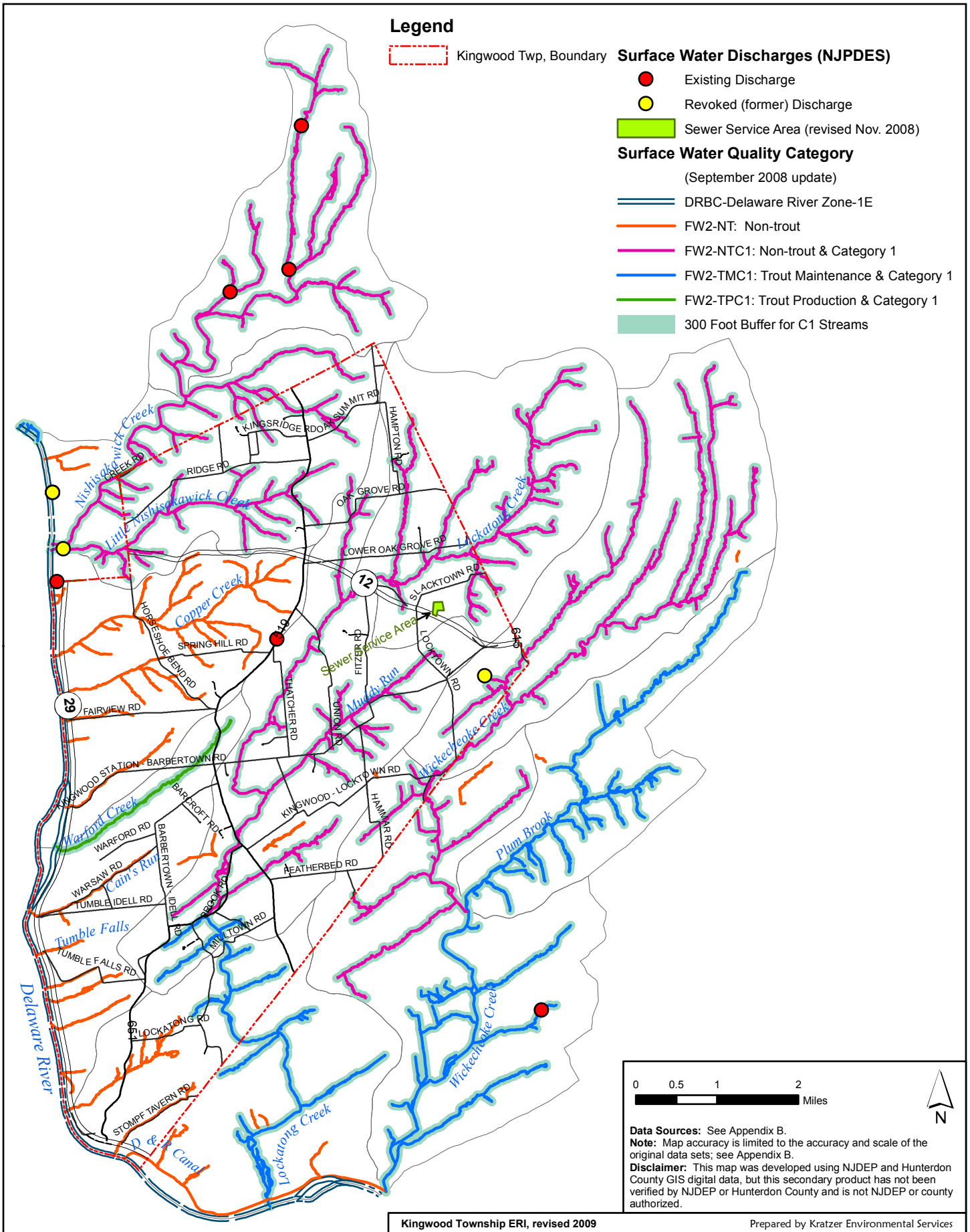
The SWQS are used by several NJDEP programs, including the New Jersey Pollutant Discharge Elimination System program, Site Remediation program, Stream Encroachment, Land Use Regulation Program and Total Maximum Daily Loads (TMDLs). TMDLs represent the assimilative capacity of surface water for a given parameter of concern. The development of TMDLs includes balancing the impacts from point sources, nonpoint sources and natural background levels of a specific pollutant. Waters requiring TMDLs are identified in a list of impaired waters (303d) and a surface water quality inventory report (305b), which NJDEP prepares every two years.

Category 1 (C1) Streams

Waterways can be designated Category One because of exceptional ecological significance, exceptional water supply significance, exceptional recreational significance, exceptional shellfish resource, or exceptional fisheries resource. The Category One 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 Category One waters and upstream tributaries of Category One waters. However, where the buffer is already disturbed, the width may be reduced in the disturbed area, but will not 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.

Table 2.16: Surface Water Quality Standards Classification

Category	Definition
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). 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.
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.
Freshwater	
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.
Source: NJDEP 2009: http://www.state.nj.us/dep/wms/bwqsa/swqs.htm	



Kingwood Township ERI, revised 2009 Prepared by Kratzer Environmental Services

Figure 6b: Surface Water Quality Classifications and Surface Water Discharges (NJPDES)


Warford Creek

Five streams within Kingwood Township are designated Category 1 by NJDEP. The entire length of Warford Creek is within Kingwood, the majority of Little Nishisakawick and Lockatong Creeks are within Kingwood, while a portion of the Nishisakawick and Wickecheoke Creeks are within Kingwood.

Little Nishisakawick Creek: The NJDEP upgraded from Category Two to Category One antidegradation designation the entire length of the Little Nishisakawick Creek (and unnamed tributaries) based on "exceptional ecological significance". Data on the health of the benthic macroinvertebrate community in Little Nishisakawick Creek indicate low stress (non-impaired) to the aquatic community with a high percentage and good diversity of pollution-intolerant organisms. The in-stream habitat quality assessment indicates a slightly less than optimal (sub-optimal) habitat quality. Sightings of the State threatened long-tailed salamander have been reported in the Little Nishisakawick Creek. These amphibians are primarily associated with cool, clear forested, rock streams. Little Nishisakawick Creek, along with Nishisakawick Creek and Wickecheoke Creek, contain the second largest concentration of this amphibian in the State, next to the limestone regions of Warren and Sussex counties.

Lockatong Creek: The NJDEP upgraded from Category Two to Category One antidegradation designation the entire length of the Lockatong Creek (and named and unnamed tributaries) based on "exceptional ecological significance". The use classifications such as FW2-NT and FW2-TM, applicable to different segments of the Creek remain the same as indicated at N.J.A.C. 7:9B-1.15(d). An assessment of the physical/chemical monitoring data demonstrated that the water quality of the Lockatong Creek meets standards except for temperature and phosphorus (which will be addressed in accordance with the Total Maximum Daily Load (TMDL) schedule). Data on the health of the benthic macroinvertebrate community in Lockatong Creek indicate low stress (non-impaired) to the aquatic community. The in-stream habitat quality assessment indicates a less than optimal (sub-optimal) habitat quality. The Lockatong Creek received a good Fish Index of Biotic Integrity (IBI) rating with 15 different species identified in the stream and a suboptimal habitat assessment rating.

Nishisakawick Creek: The NJDEP upgraded from Category Two to Category One antidegradation designation the entire length of the Nishisakawick Creek (and unnamed tributaries) based on "exceptional ecological significance". An assessment of the physical/chemical monitoring data demonstrated that the water quality of the Nishisakawick Creek meets standards except for fecal coliform (which is being addressed with a TMDL). Data on the health of the benthic macroinvertebrate community in this stream indicate low stress (non-impaired) to the aquatic community with a high percentage and good diversity of pollution-intolerant organisms. The in-stream habitat quality assessment indicates an exceptional (optimal) habitat quality. The Nishisakawick Creek received a good Fish IBI rating with 12 different species identified in the stream and an optimal habitat assessment rating. Nishisakawick Creek has reported State threatened wood turtle sightings, primarily in the upper portions of the drainage. Sightings of the State threatened long-tailed salamanders have been reported in the Nishisakawick Creek throughout the upper and lower portions of the drainage area (see comments for **Little Nishisakawick Creek**).

Wickecheoke Creek: The NJDEP upgraded from Category Two to Category One antidegradation designation the entire length of the Wickecheoke Creek (including Plum Brook and unnamed tributaries) based on "exceptional ecological significance". The use classifications, such as FW2-NT and FW2-TM, applicable to different segments of the Wickecheoke Creek remain the same as indicated at N.J.A.C. 7:9B-1.15(d). An assessment of the physical/chemical monitoring data demonstrated that the water quality of the Wickecheoke Creek meets standards except for temperature, phosphorus, and fecal coliform (being addressed through TMDLs). Data on the health of the benthic macroinvertebrate community gathered at various locations along the Wickecheoke Creek indicate low to moderate stress (non-impaired to moderately impaired) to the aquatic community with a mixture of pollution-tolerant to -intolerant organisms. The in-stream habitat quality assessment indicates an exceptional (optimal) habitat quality. The Wickecheoke Creek received a good Fish IBI rating with 10 different species identified in the stream and a suboptimal habitat assessment rating. Wickecheoke Creek has also reported State threatened wood turtle sightings, primarily in the upper portions of the drainage. Sightings of the State threatened long-tailed salamanders have been reported in the Wickecheoke Creek throughout the upper and lower portions of the drainage.


Wickecheoke Creek

Lockatong Creek Floodplain at Union Road/Kingwood Park

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 Kingwood are shown in **Figure 6c**. Areas along the Nishisakawick, Little Nishisakawick, Copper, Lockatong, and Wickecheoke Creeks experience frequent flooding. Flooding occasionally occurs on the Delaware River islands and the land bordering the river,

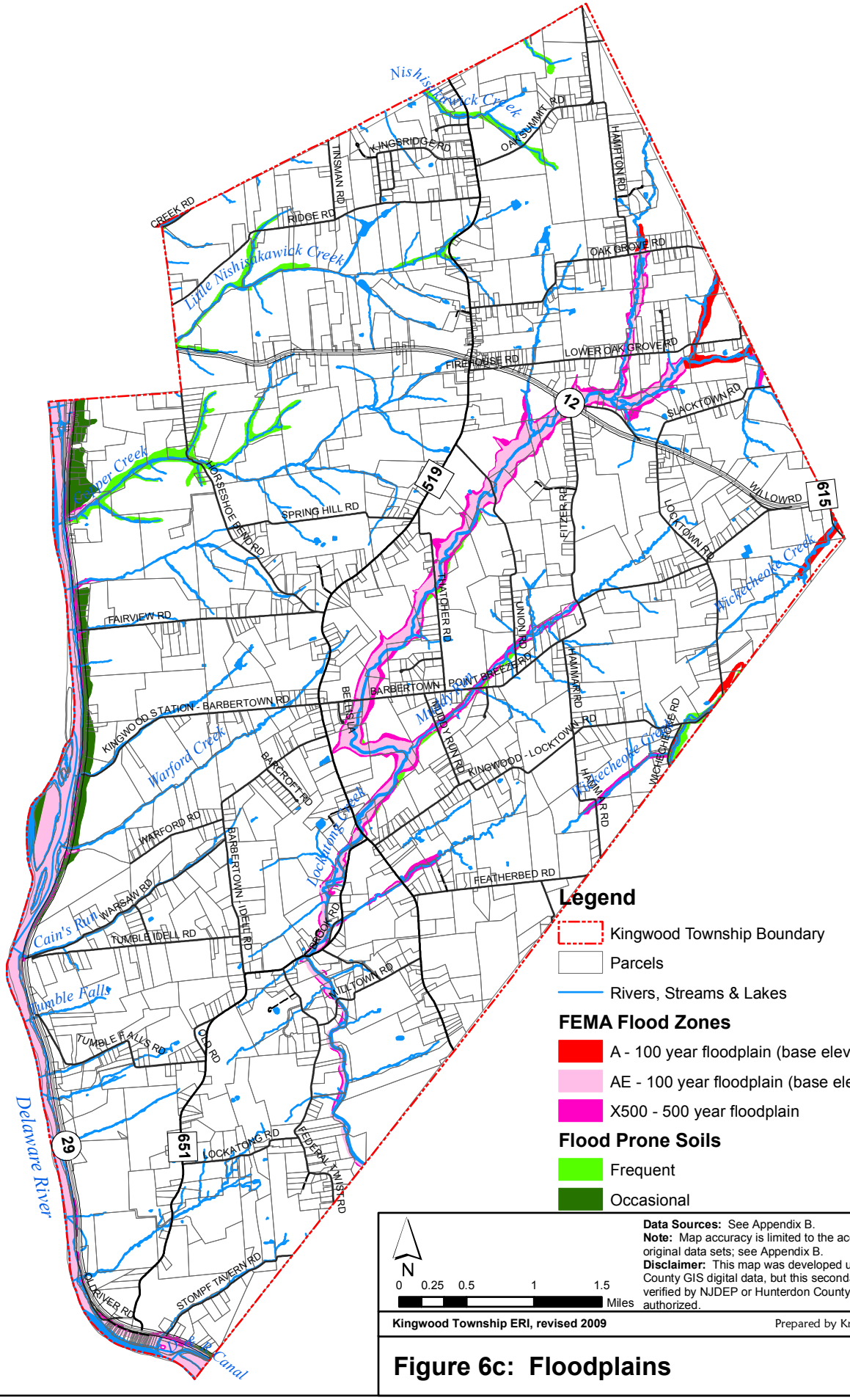


Figure 6c: Floodplains

including portions of Route 29. The low-lying areas near Frenchtown along Route 29 are rarely flooded. The remainder of the township is not subject to flooding.

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, 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.

Point source discharges are regulated by NJDEP under the New Jersey Pollutant Discharge Elimination System (NJPDES). There is only one such discharge existing within Kingwood Township, which is the Kingwood Township Elementary School sewage treatment discharge (see **Table 2.17** and **Figure 6b**). Frenchtown Boro's municipal sewage treatment plant discharge is immediately upstream of Kingwood's boundary, on the Delaware River. Three other discharges are listed below, but are not active.

Table 2.17: NJ Pollutant Discharge Elimination System (NJPDES) Surface Water Discharges

NJPDES ID	Facility Name	Pipe Category	Discharge Type	Receiving Waters
Existing Permitted Discharges				
NJ0023311.001A	Kingwood Twp - Elementary School	Sanitary	Municipal Minor	Krial Pond
NJ0029831.001A	Frenchtown Boro	Sanitary	Municipal Minor	Delaware River
Revoked/Terminated Permitted Discharges				
NJ0035360.001A	Hunterdon Industrial Gases	Industrial	Industrial Minor	Delaware River via ditch
NJ0027537.001A	Magnesium Elektron Inc	Industrial	Industrial Major	Delaware River
NJ0004782.001A NJ0004782.002A NJ0004782.003A	Frenchtown Properties Inc. (terminated 1995)	Thermal	Industrial Minor	Delaware River
Note: for Discharge Type: **Municipal Minor** - publicly owned sewage treatment plants which discharge less than 1 million gallons per day (MGD) **Industrial Minor** - based on the amount of pollutant(s) in the effluent **Industrial Major** - based on the amount of pollutant(s) in the effluent				
Source: NJDEP Bureau of Point Source Permitting, November 2007				

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 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.

The NJDEP instituted new stormwater management requirements in February 2004 that establish 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.

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

Non-point source pollution coming off a construction site in Kingwood

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 groundwater 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.

In the past, wetlands were often regarded as wastelands – only useful when drained and filled. However, we now recognize some of the benefits wetlands provide (NJDEP Land Use Regulation, 2003):

- 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.

Over 54% of the total wetlands in the continental US have already been lost, and an additional 200,000 acres disappear every year (NJDEP Land Use Regulation, 2003). 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 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 is prohibited. There are limited exemptions for existing farming, ranching, or forestry operations.

The regulations define the transition area width according to the value of the wetland. *Ordinary Value* wetlands, such as swales, have a 0 foot buffer; *Intermediate Value* wetlands have a 50 foot buffer; while *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 C1 classified streams.

The New Jersey freshwater wetlands maps (see **Figure 6d**) provide guidance on where wetlands are found in the Township. For this GIS data layer, a contractor for NJDEP used the 2002 aerial photos and mapped all Land Use/Land Covers, from which all wetland types were selected. In addition, NJDEP mapped all linear wetlands greater than 10 feet in width. This dataset is intended to serve as a resource for analysis rather than regulatory delineations. In addition, updates to the maps may be made based on more in-depth analysis and field inspection for regulatory purposes. In **Figure 6d**, the maximum transition area widths of 150 feet are mapped, because the GIS data does not distinguish wetland values. 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.

There are several types of freshwater wetlands in Kingwood Township, such as coniferous or deciduous wooded wetlands, scrub/shrub wetlands, and herbaceous wetlands. Later in this report, **Figure 7a** (land cover classifications) shows these various types of wetlands, while **Figure 8a** (the Landscape Project) provides wildlife value rankings for two types of wetlands - forested and emergent.

Surface Water Quality and Flow Monitoring

Surface water quality data have been collected at sites on several streams and the Delaware River within Kingwood Township by the Delaware River Basin Commission (DRBC), NJDEP, USGS and non-profit groups. Surface water monitoring sites are displayed on **Figure 6h**. The various monitoring programs are discussed below.

New Jersey Water Supply Authority (NJWSA): The NJWSA has undertaken a study of the Lockatong and Wickecheoke Creeks with a 319(h)[1] grant for the development of an inter-municipal watershed management plan. There were 15 monitoring sites on the Lockatong and 18 sites on the Wickecheoke that were sampled for nutrients, solids, bacteria and instantaneous flow measurements between 2006 and 2007. As part of this study, continuous flow measurement stations were established by USGS near the mouths of both streams. The watershed management plan will be completed in 2008.

Delaware River Basin Commission (DRBC): From 2000-2003, the DRBC monitored water quality in the Delaware River at Bulls Island and in five tributaries within Kingwood (Wickecheoke, Lockatong, Cain's Run, Warford and Nishisakawick). Wickecheoke, Lockatong and Nishisakawick Creeks are also monitored for stream flow at the water quality sampling sites. This effort is 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. The following illustrations (**Figures 6e, 6f** and **6g**) show the water quality data that were collected by the DRBC for May through September, 2000 – 2003, for selected streams bordering and within Kingwood Township. The DRBC data show exceedances to the NJDEP Surface Water Quality Standards for fecal coliform (**Figure 6e**), total phosphorus (**Figure 6f**) and pH and dissolved oxygen (single sample in Lockatong Creek) (**Figure 6g**). All

[1] Congress amended the Clean Water Act (CWA) in 1987 to establish the section 319 Nonpoint Source Management Program, which awards grant money to support a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific nonpoint source implementation projects (USEPA, 2008).

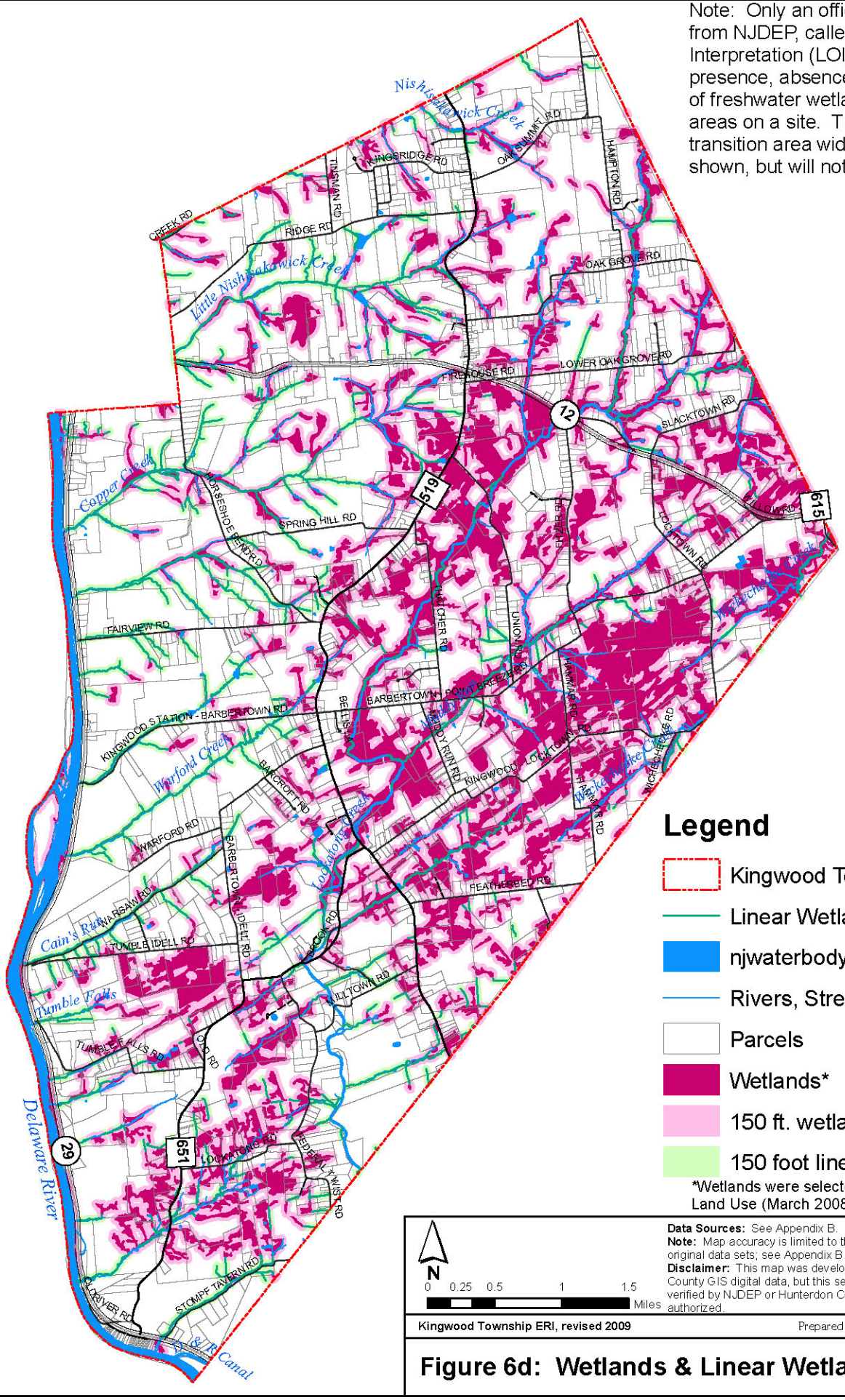
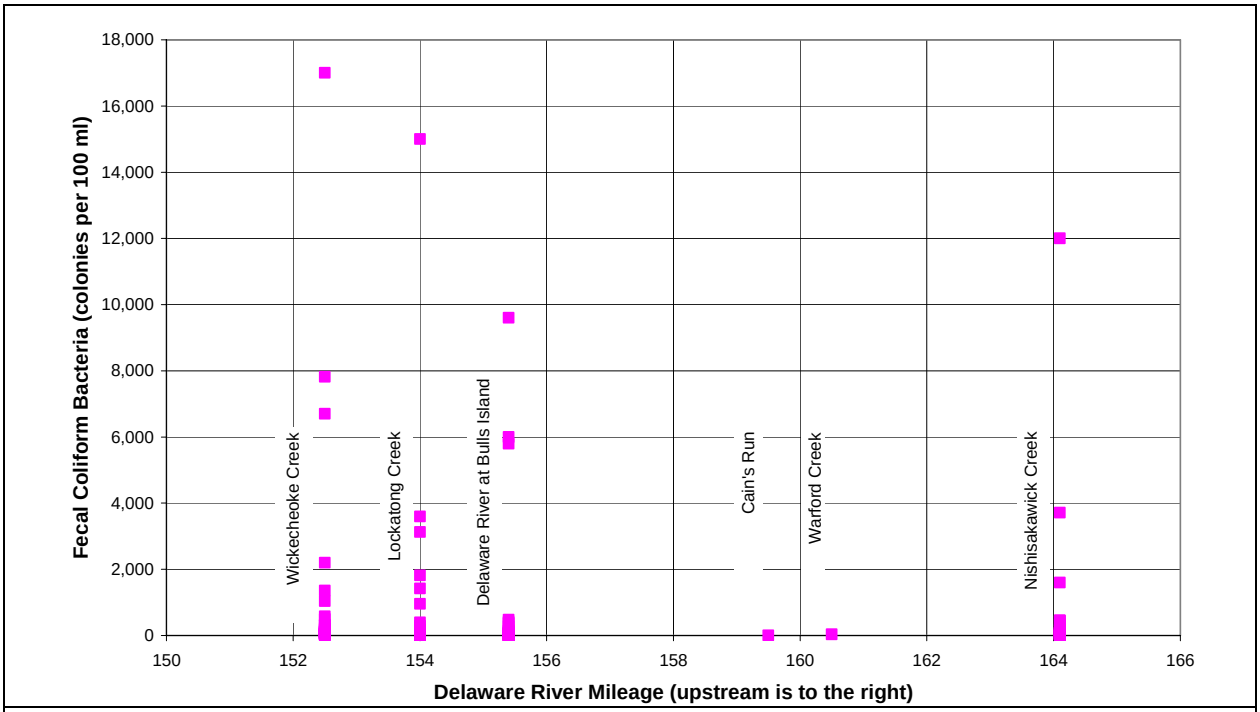
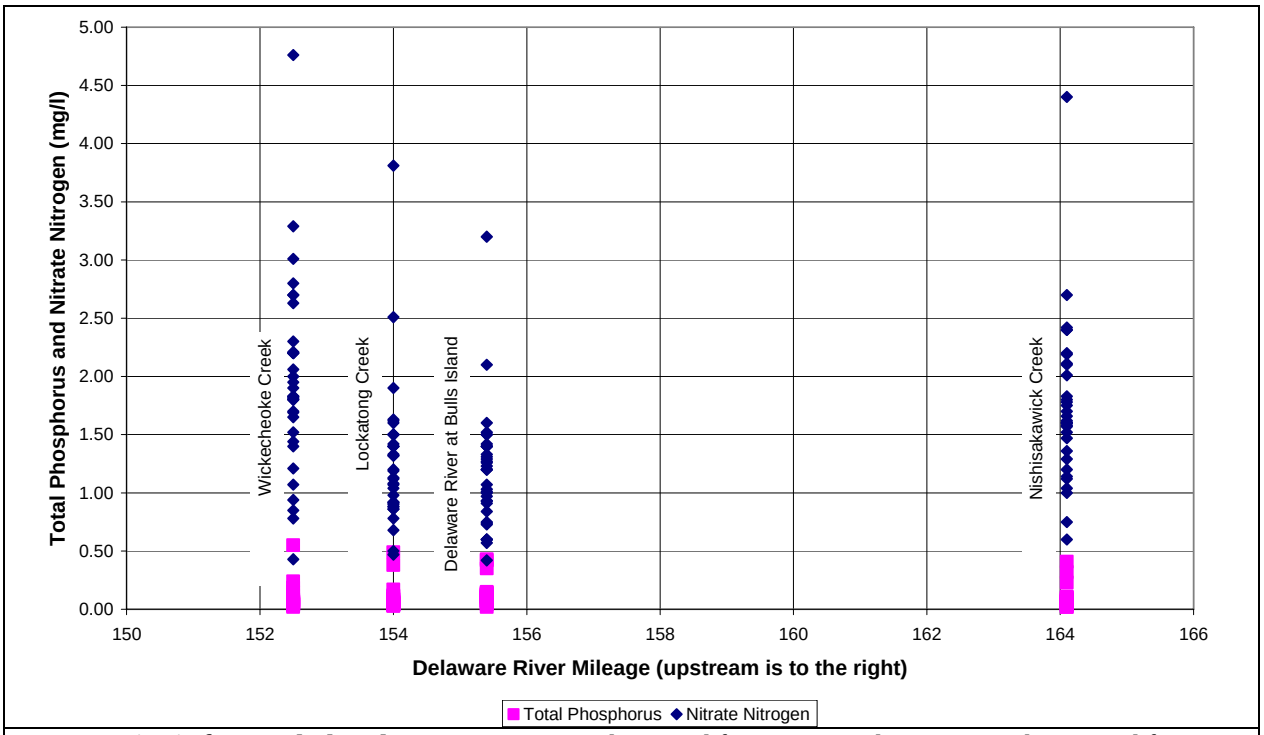


Figure 6d: Wetlands & Linear Wetlands



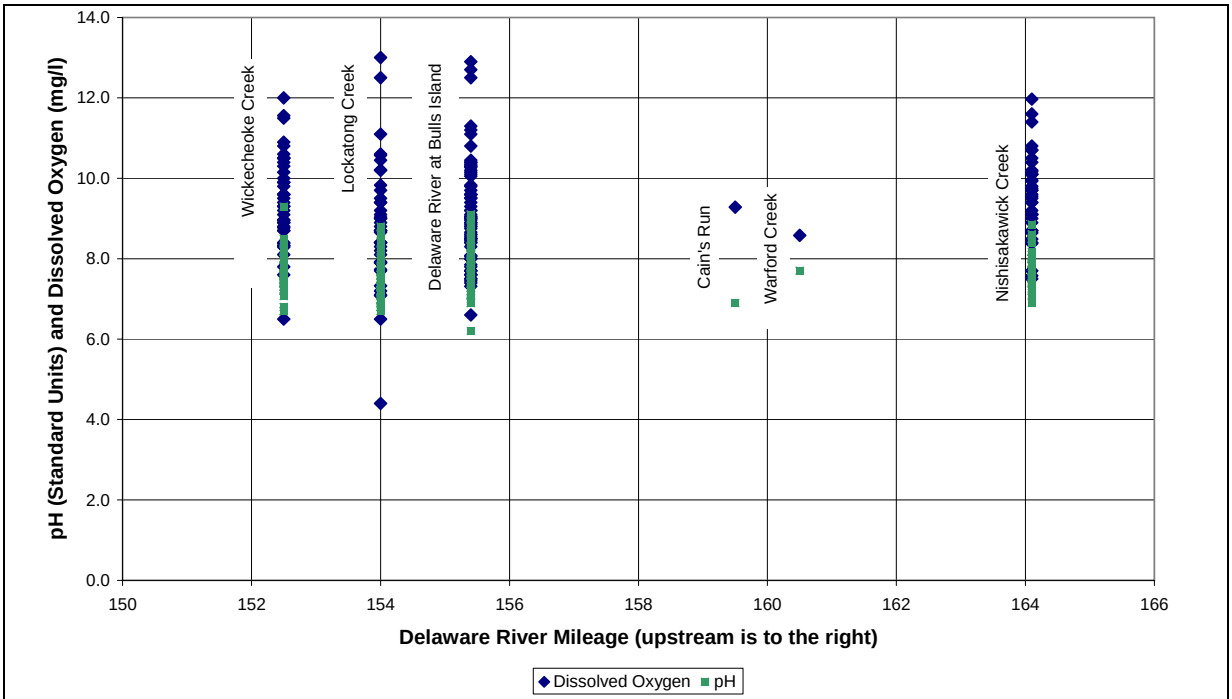
NJDEP criteria for Fecal Coliform: Geometric average < 200 colonies/100 ml and not more than 10% of samples to exceed 400 colonies/100 ml. These criteria are usually targeted for a 30-day period, but have been used on an annual, or historical (all data) basis for Total Maximum Daily Load reductions.
Data Source: USEPA STORET database.

Figure 6e: Fecal Coliform for Selected Streams in Kingwood Township



NJDEP criteria for Total Phosphorus: Not to exceed 0.1 mg/l for streams and not to exceed 0.05 mg/l for lakes, ponds, and reservoirs, and those waters flowing into lakes. Nitrate is not regulated for ambient conditions.
Data Source: USEPA STORET database.

Figure 6f: Phosphorus & Nitrogen for Selected Streams in Kingwood Township



NJDEP criteria for D.O.: FW2-NT 24-hour average not less than 5.0 mg/l and not less than 4.0 mg/l at any time. FW2-TM 24-hour average not less than 6.0 mg/l and not less than 5.0 mg/l at any time. FW2-TP Not less than 7.0 mg/l at any time. **NJDEP criteria for pH:** 6.5 to 8.5 standard units
Data Source: USEPA STORET database

Figure 6g: Dissolved Oxygen and pH of Selected Streams in Kingwood Township

water quality data presented here are available on the internet from the EPA STORET database (Kratzer, 2004).

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 are monitoring sites on the Lockatong and Wickecheoke Creeks.

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.

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 the program, sites in each of New Jersey's five Water Regions are sampled for benthic macroinvertebrates on a rotating schedule (once every five years). Sites are sampled in every sub-watershed, statewide, where the health of in-stream benthic macroinvertebrate communities

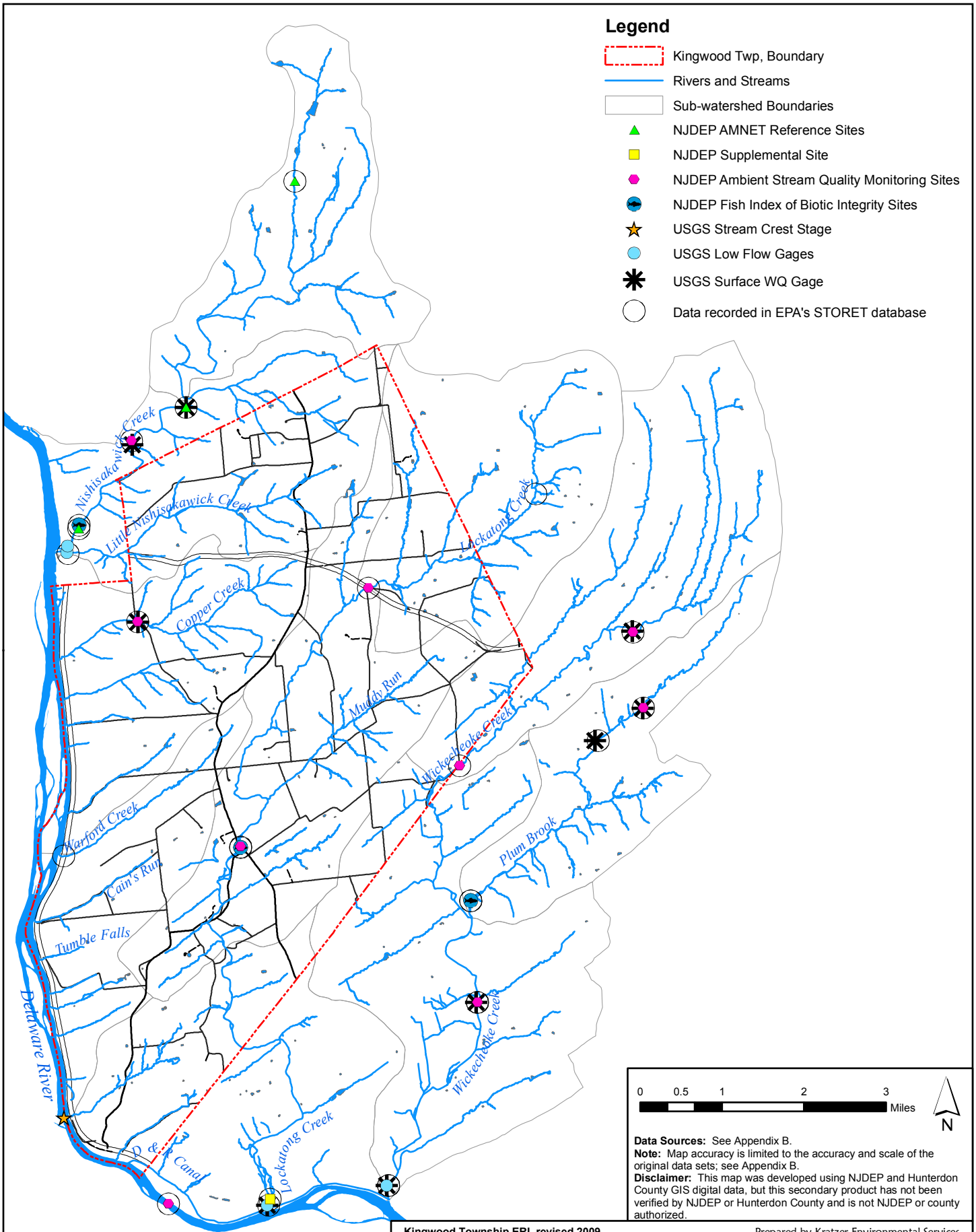


Figure 6h: Surface Water Monitoring Sites

are evaluated using the US Environmental Protection Agency's (USEPA) Rapid Bioassessment Protocol (RBP) 2. AMNET sites are located on Nishisakawick, Little Nishisakawick, Lockatong and Wickecheoke Creeks.

NJDEP AMNET Reference Sites with Ecoregion Sections for New Jersey: The locations were selected because they were minimally impacted, had sampling data for 4 seasons, and provided a good point of comparison for other sites. One reference site is located on Nishisakawick Creek.

Lockatong Creek during high flow (top) and normal flow (bottom)

USGS Continuous-Stream Flow Gaging: These sites are maintained by the United States Geological Survey (USGS), Water Resource Division (WRD). The nearest sites are located at Riegelsville and Trenton, and are not shown on the map. The data are available real-time on the Internet.

USGS Stream Crest Gaging: There is one USGS Stream Crest Gage within Kingwood Township, which is named "DELAWARE RIVER TRIB AT BYRAM NJ," where flow is measured occasionally or the site may have been discontinued.

USGS Stream Low Flow Gaging: USGS occasionally measures stream flow at sites on the Nishisakawick, Little Nishisakawick, Lockatong and Wickecheoke Creeks.

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 Nishisakawick, Little Nishisakawick, Lockatong and Wickecheoke Creeks.

USGS Point Pleasant Water Intake: Water quality is measured continuously at the Point Pleasant, PA water intake (not shown on map).

Fish Consumption Advisories

When toxic pollutants are present in surface water, they are consumed by the organisms that live in the water. The process of *bioaccumulation* is when there is an increase in concentration of certain fat-soluble chemicals, such as DDT and PCBs, in successively higher trophic levels of a food chain or web. For example, insects living in contaminated sediments may have accumulated a certain amount of a toxin. Fish, by eating many of these insects, then ingest the toxin into their own bodies. Anything that eats that contaminated fish, including humans and other predators, will absorb the toxin into its body. When the concentration of toxin becomes high enough, the individual's health will be impacted.

The NJDEP samples fish for certain toxic pollutants and, when necessary, issues *fish consumption advisories*, as a guide to limit the human health effects of consuming these fish and the pollutants they contain. This information is intended to help individuals make an informed

choice on the number of meals of fish to consume. The 2006 fish consumption advisories for fish caught in the vicinity of Kingwood Township are listed in **Table 2.18**. See the **Internet References** for more information, such as fish preparation guidelines and annual updates.

Table 2.18: 2006 Fish Consumption Advisories for Fish Caught in the Vicinity of Kingwood Township - Fish Consumption Recommendations to Reduce Exposure to Dioxin, PCBs and Mercury

LOCATION	SPECIES	ADVISORY/PROHIBITION	
		General Population [1,2] Range of Recommended Meal Frequency	High-Risk Individuals [2,3]
		DO NOT EAT MORE THAN	DO NOT EAT MORE THAN
New Jersey Statewide – All water bodies except those listed below	American Eel	Four meals per year	Do not eat
	Striped bass	One meal per month	Do not eat
	Largemouth Bass Smallmouth Bass Chain Pickerel	One meal per week	One meal per month
	Yellow bullhead & Sunfish (bluegill, pumpkinseed, and redbreast sunfish)	No restrictions	One meal per month
	Brown Bullhead	No restrictions	One meal per week
	All freshwater fish without specific advisories	One meal per week	One meal per month
Delaware River (Phillipsburg to Trenton) (Hunterdon/Mercer Co.)	Channel Catfish	Four meals per year	Do not eat
	Largemouth Bass	No restrictions	One meal per month
	White Sucker	One meal per month	One meal per month
	Smallmouth Bass	One meal per week	One meal per month
	Striped bass	Four meals per year	Do not eat
	American Eel	One meal per month	Do not eat

[1] Range of Recommended Meal Frequency corresponds to a cancer risk of 1 in 10,000 to 1 in 100,000 over a lifetime.

[2] Eat only the fillet portions of the fish. Use proper trimming techniques to remove fat, and cooking methods that allow juices to drain from the fish (e.g., baking, broiling, frying, grilling, and steaming). See web site for full description. One meal is defined as an eight-ounce serving.

[3] High-risk individuals include infants, children, pregnant women, nursing mothers and women of childbearing age.

Notes: Not all species were found or analyzed in all water bodies, or inadequate data were available to list some species. To reduce your exposure, eat those fish with the lowest meal restrictions. Do not combine meal restrictions. (For example, If you eat multiple species or catch fish from more than one area, the recommended guidelines for different species and different locations should not be combined.)

Source: NJDEP Division of Science and Research http://www.state.nj.us/dep/dsr/njmainfish.htm

References: Surface Water

Kratzer, Todd W. January 2004. Personal Communication. Water Resources Engineer at Delaware River Basin Commission (formerly).

NJDEP. February 2004. Rule proposals. http://www.state.nj.us/dep/rules

NJDEP Bureau of Point Source Permitting. November 2007. NJPDES Surface Water Discharges GIS data. http://www.state.nj.us/dep/gis/stateshp.html#NJPDESSWD

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NJDEP Land Use Management, Water Monitoring and Standards. Surface Water Quality Standards N.J. A.C 7:9B Surface Water Classifications Proposed Amendment: N.J.A.C. 7:9B-1.15 DEP Docket Number: 23-03-10/412. http://www.state.nj.us/dep/rules

NJDEP Land Use Regulation Program**.** June 2003. Freshwater Wetlands Program Home Page. http://www.state.nj.us/dep/landuse/fww/fww.html

NJDEP Office of Environmental Planning. January 1997. Draft Statewide Watershed Management Framework Document for the State of New Jersey.

NJDEP Site Remediation Program. 2001. Status Report. http://www.state.nj.us/dep/srp/publications/site_status/2001/

NJDEP Water Monitoring Management. October 2006. Surface Water Quality Standards N. J. A. C. 7:9B. http://www.state.nj.us/dep/wms/bwqsa/swqs.htm

NJDEP Water Monitoring Management. Category One Fact Sheet. http://www.state.nj.us/dep/wms/bwqsa/factsheet2.pdf

NJDEP Water Monitoring and Standards. 2004. Home Page. http://www.state.nj.us/dep/wms/bwqsa/swqs.htm

NJDEP Water Monitoring Management. 2004. Monitoring Results. http://www.state.nj.us/dep/wmm/

U.S. Environmental Protection Agency. 2004. STORET Database. http://www.epa.gov/storet

U.S. Environmental Protection Agency. 2008. Polluted Runoff (Nonpoint Source Pollution) Nonpoint Source Management Program - Clean Water Section 319 website. http://www.epa.gov/owow/nps/cwact.html

U.S. Geological Survey. November 1995. Water Resources Division. Summary of Monthly Hydrologic Conditions in New Jersey.

Internet Resources: Surface Water

General Water Resources Protection:

Home*A*Syst: Evaluate your home and property for pollution and health risks (USDA): http://www.nj.nrcs.usda.gov/partnerships/homeasyst/

Farm*A*Syst: Tools to help farmers better manage their operation to avoid environmental problems (USDA) http://www.nj.nrcs.usda.gov/partnerships/farmasyst/

SEEDS: The State Environmental Education Directory Website: http://www.state.nj.us/dep/seeds/index.html

Basic Watershed Information (Division of Watershed Management): http://www.state.nj.us/dep/watershedmgt/basicinfo2.htm

The Clean Water Book: Choices for Watershed Protection: http://www.state.nj.us/dep/watershedmgt/cleanwaterbook/waterbook_tble.htm

Wetlands:

Freshwater Wetlands Program (NJDEP Land Use Regulation)
http://www.state.nj.us/dep/landuse/fww/fww.html

Freshwater Wetlands Program: Before You Buy – Before You Build presentation
http://www.state.nj.us/dep/enforcement/wetland-training/ontheroad/

Stream Encroachment Program (NJDEP Land Use Regulation):
http://www.state.nj.us/dep/landuse/se/se.html

Surface Water Quality:

USEPA STORET Database: http://www.epa.gov/storet

NJDEP Water Monitoring Management: http://www.state.nj.us/dep/wmm/

Delaware River Basin Commission: http://www.state.nj.us/drbc/

NJDEP Regulations:

NJDEP Rule proposals http://www.state.nj.us/dep/rules

Information about C1 classification of streams (NJDEP, Water Monitoring and Standards)
http://www.nj.gov/dep/cleanwater/c1rule.html

Total Maximum Daily Load (TMDL) (NJDEP) http://www.nj.gov/dep/watershedmgt/tmdl.htm

NJDEP stormwater rule: http://www.njstormwater.org/

Phone Contacts:

NJ Drought Hotline: 1-800-448-7379

NJ Environmental Incident Hotline (hazardous spill, fire, explosion, illegal dumping, wildlife problem):
1-877-WARNDEP / 1-877-927-6337 (toll-free, 24 hours)

NJDEP Land Use Enforcement: 1-609-292-1240

NJDEP Land Use Regulation (stream encroachment), Hunterdon County: 1-609-984-0194

NJDEP Land Use Regulation (wetlands), if you want to build near suspected wetlands, call and ask for the Letter of Interpretation (LOI) information and application package: 1-609-292-0060

NJDEP Land Use Regulation (wetlands), Hunterdon County: 1-609-777-0454

III: RESOURCE INVENTORY – BIOTIC ENVIRONMENT

A. The Historical Landscape

Humans arrived in New Jersey at least 9,000 - 10,000 years ago (Ashley, 2004). An archeological study was done in 1996 at the site of the DeRewal Superfund site. The study found more than 3,000 Native American artifacts[2], many dating back more than 1,000 years. At the time the first Europeans arrived in the area, there may have been as few as 2,000 or as many as 12,000 humans living in New Jersey (compared to 3,782 now living in Kingwood Township and 8.4 million in New Jersey, according to the 2000 census). These Indians belonged to the Lenape tribe.

The Indians cleared the forests for village sites and agriculture, and cut wood for fuel, shelters, canoes, tools and other implements. It was also common practice to deliberately set fires for the purposes of driving game and thinning and opening up forests.

Although the Indians affected the landscape of New Jersey, according to Robichaud and Anderson (1994) it was the European settlers and their descendents who truly disturbed the vegetation. Europeans first began settling New Jersey as early as 1620, and "By the time New Jersey became a state in 1778, no extensive areas of land well suited to farming remained wooded in the central part of the state"(Robichaud and Anderson, 1994). The remaining forests were frequently and repeatedly cut for cordwood.

The human population of New Jersey continued to grow, but the introduction of coal in 1850 began to allow the woodlands to recover to some extent. For example, Hunterdon County was only 14% forested in 1899, but had increased to 36% forest cover in 1987 (Robichaud and Anderson, 1994). Kingwood Township is approximately 33% forested, according to the 2002 Land Use/Land Cover GIS data.

Despite the burgeoning human population of NJ, the fact that most of the population is concentrated in urban areas has allowed some areas to remain rural or natural. Kingwood Township is one of these areas. However, recently there has been a shift of population from urban and developed areas to rural areas, extending the suburbs and eliminating farms, forests and wetlands along the way.

References: The Historical Landscape

Ashley, Gail M., PhD. Department of Geological Sciences, Director of Quaternary Studies Program, Rutgers University. Personal Communication May 16, 2004.

Robichaud, Beryl and Karl H. Anderson. 1994. Plant Communities of New Jersey: A Study in Landscape Diversity. New Brunswick, New Jersey: Rutgers University Press. 287 pages.

US Census Quick Facts: http://quickfacts.census.gov/qfd/states/34/34019.html

US EPA and Hunter Research Inc. Archeological study.

[2] Many of the artifacts are on display at the Kingwood Township Municipal Building.

B. Today's Landscape

The New Jersey Comparative Risk Project (March 2003) ranked habitat fragmentation and habitat loss as the highest ranking stressors of Statewide ecological quality. Certain species that require large expanses of intact habitat are becoming less common. Other factors which impact ecological health include exotic species (e.g. the hemlock wooly adelgid (an insect which causes the decline and death of hemlock trees) and exotic diseases, overpopulations of deer and geese, and pollution.

The 2002 Land Use/Land Cover (LU/LC) data layer was directly digitized from the 2002 digital color infrared orthophotography (the aerial photos are shown in **Figure 1b**, while the broad categories of Land Use Type are shown in **Figure 1e**) of New Jersey with a 1 foot pixel resolution by a contractor of NJDEP. The classification system used was a modified Anderson Classification System that provided the parameters for proper and consistent coding of the LU/LC feature classes and subclasses. It should be noted that 1) changes since 2002 are not shown, and 2) the method is not 100% accurate. The land cover classifications are shown in **Figure 7a** and **Table 3.1**.

The largest portion of land in Kingwood Township is agricultural cropland and pasture, which comprises approximately 38% of the land area, followed by deciduous forest (>50% crown closure), 19%, followed by almost equal amounts of deciduous wooded wetlands, and rural residential (single unit), 7.93% and 7.90% respectively.

Table 3.1: Kingwood 2002 Land Use/Land Cover

Land Use Type	Code	Land Use/Land Cover	ACRES	% of Twp.
AGRICULTURE 11,276 acres 40.4%	2100	CROPLAND AND PASTURELAND	10,614.90	38.02
	2200	ORCHARDS/VINEYARDS/NURSERIES/HORTICULTURAL AREAS	75.4632	0.27
	2400	OTHER AGRICULTURE	585.88	2.10
BARREN LAND 63 acres 0.2%	7400	ALTERED LANDS	0.86	0.003
	7500	TRANSITIONAL AREAS	62.31	0.22
FOREST 9302 acres 33.3%	4110	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	781.14	2.80
	4120	DECIDUOUS FOREST (>50% CROWN CLOSURE)	5,453.72	19.53
	4210	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	89.07	0.32
	4220	CONIFEROUS FOREST (>50% CROWN CLOSURE)	581.52	2.08
	4230	PLANTATION	22.30	0.08
	4311	MIXED FOREST (>50% CONIFEROUS W/ 10-50% CROWN CLOSURE)	46.27	0.17
	4312	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	258.55	0.93
	4321	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	55.55	0.20
	4322	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN CLOSURE)	119.86	0.43
	4410	OLD FIELD (< 25% BRUSH COVERED)	365.86	1.31
	4420	DECIDUOUS BRUSH/SHRUBLAND	236.30	0.85
	4430	CONIFEROUS BRUSH/SHRUBLAND	461.89	1.65
	4440	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	829.57	2.97
URBAN 2,702 acres 9.7%	1120	RESIDENTIAL, SINGLE UNIT, MEDIUM DENSITY	12.85	0.05
	1130	RESIDENTIAL, SINGLE UNIT, LOW DENSITY	134.74	0.48
	1140	RESIDENTIAL, RURAL, SINGLE UNIT	2,204.90	7.90
	1200	COMMERCIAL/SERVICES	65.57	0.23

	1300	INDUSTRIAL	25.10	0.09
	1400	TRANSPORTATION/COMMUNICATION/UTILITIES	22.95	0.08
	1440	AIRPORT FACILITIES	14.52	0.05
	1463	UPLAND RIGHTS-OF-WAY UNDEVELOPED	32.70	0.12
	1499	STORMWATER BASIN	7.25	0.03
	1700	OTHER URBAN OR BUILT-UP LAND	124.62	0.45
	1710	CEMETERY	2.29	0.01
	1800	RECREATIONAL LAND	48.62	0.17
	1804	ATHLETIC FIELDS (SCHOOLS)	5.93	0.02
WATER 610 acres 2.2%	1419	BRIDGE OVER WATER	0.31	0.00
	5100	STREAMS AND CANALS	545.80	1.95
	5200	NATURAL LAKES	0.69	0.002
	5300	ARTIFICIAL LAKES	63.65	0.23
WETLANDS 3,966 acres 14.2%	1461	WETLAND RIGHTS-OF-WAY	3.58	0.01
	1711	CEMETERY ON WETLAND	1.14	0.00
	1750	MANAGED WETLAND IN MAINTAINED LAWN GREENSPACE	20.17	0.07
	1850	MANAGED WETLAND IN BUILT-UP MAINTAINED REC AREA	16.43	0.06
	2140	AGRICULTURAL WETLANDS (MODIFIED)	1,182.14	4.23
	2150	FORMER AGRICULTURAL WETLAND (BECOMING SHRUBBY, NOT	90.82	0.33
	6120	FRESHWATER TIDAL MARSHES	1.71	0.01
	6210	DECIDUOUS WOODED WETLANDS	2,213.28	7.93
	6220	CONIFEROUS WOODED WETLANDS	10.07	0.04
	6231	DECIDUOUS SCRUB/SHRUB WETLANDS	159.13	0.57
	6232	CONIFEROUS SCRUB/SHRUB WETLANDS	37.20	0.13
	6233	MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)	102.25	0.37
	6234	MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	67.63	0.24
	6240	HERBACEOUS WETLANDS	19.64	0.07
	6251	MIXED WOODED WETLANDS (DECIDUOUS DOM.)	14.48	0.05
	6252	MIXED WOODED WETLANDS (CONIFEROUS DOM.)	9.29	0.03
	7430	DISTURBED WETLANDS (MODIFIED)	16.58	0.06
Grand Total			27,919.05	100%
Source: NJDEP, 2008				

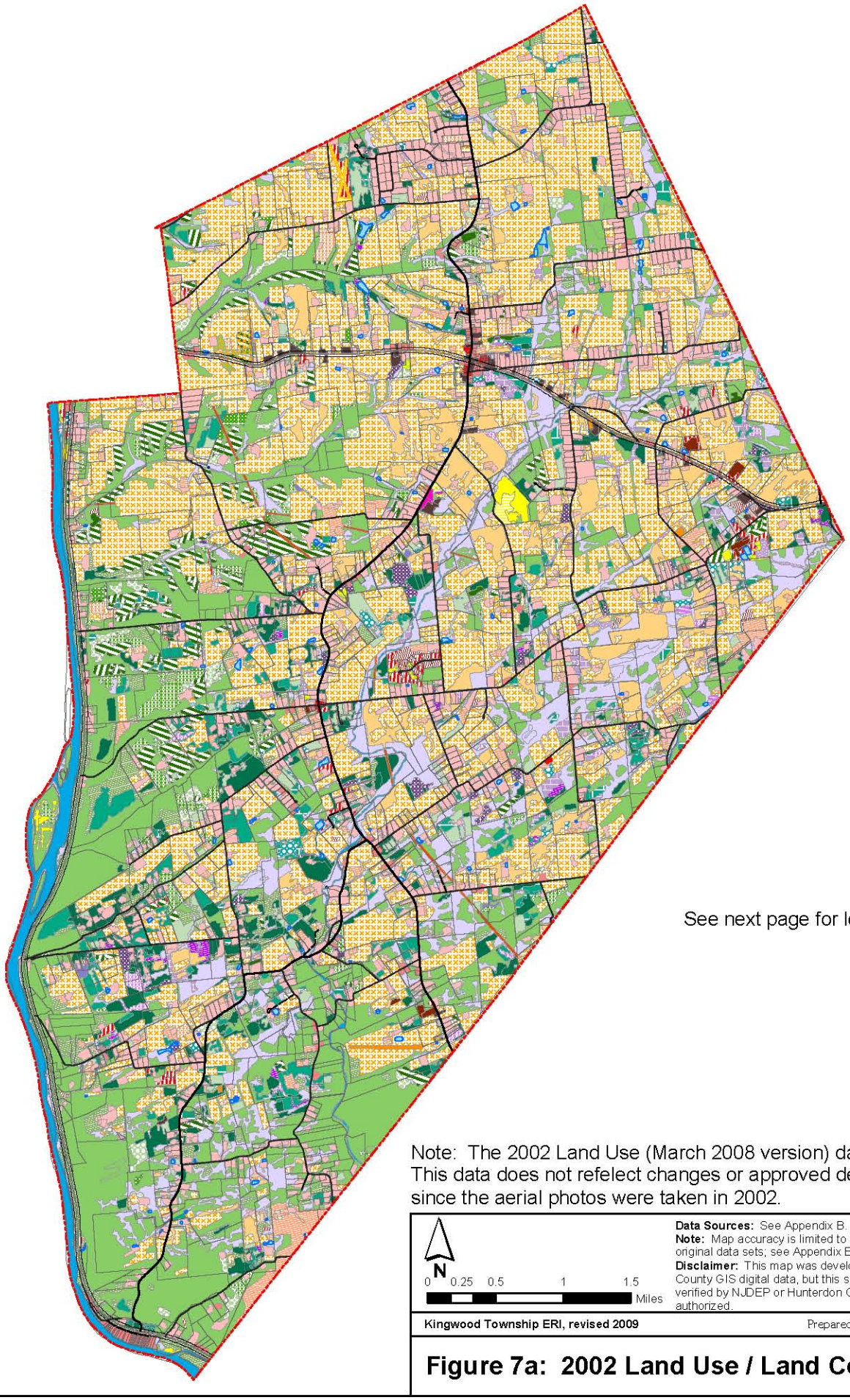
References: Today's Landscape

Bredon, Thomas F. 1989. "A Preliminary Natural Community Classification for New Jersey." Reprinted from: E. F. Karlin (editor). New Jersey's Rare and Endangered Plants and Animals. Ramapo College Institute for Environmental Studies, Mahway, NJ. 280 pages.

Robichaud, Beryl and Karl H. Anderson. 1994. Plant Communities of New Jersey: A Study in Landscape Diversity. New Brunswick, New Jersey: Rutgers University Press. 287 pages.

Steering Committee of the New Jersey Comparative Risk Project. March 2003. Final Report of the New Jersey Comparative Risk Project. 213 pages.

NJDEP. March 2008. NJDEP 2002 Land use/Land cover Update, Central Delaware Watershed Management Area, WMA-11, Edition: 20080304. GIS data.



See next page for legend of land uses.

Note: The 2002 Land Use (March 2008 version) data layer was used. This data does not refelect changes or approved developments since the aerial photos were taken in 2002.

N

0 0.25 0.5 1 1.5 Miles

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.

Kingwood Township ERI, revised 2009

Prepared by Kratzer Environmental Services

Figure 7a: 2002 Land Use / Land Cover

Legend

- Kingwood Township Boundary
- Parcels

2002 Land Cover - Urban Types

- 1120 - Residential, single unit, medium density
- 1130 - Residential, single unit, low density
- 1140 - Residential, rural, single unit
- 1200 - Commericial/services
- 1300 - Industrial
- 1400 - Transportation/Communications/Utiltities
- 1440 - Airport Facilities
- 1463 - Upland Rights-of-Way, Undeveloped
- 1499 - Stormwater Basin
- 1700 - Other Urban or Built-up Land
- 1710 - Cemetery
- 1800 - Recreational Land
- 1804 - Athletic Fields (schools)

2002 Land Cover - Agriculture Types

- 2100 - Cropland and Pastureland
- 2200 - Orchards, Vineyards, Nurseries, Horticultural Areas, Sod Farms
- 2400 - Other Agriculture

2002 Land Cover - Forest Types

- 4110 - Decidious Forest (10-50% Crown Closure)
- 4120 - Deciduous Forest (>50% Crown Closure)
- 4210 - Coniferious Forest (10-50% Crown Closure)
- 4220 - Coniferous Forest (>50% Crown Closure)
- 4230 - Plantation
- 4311 - Mixed Forest (>50% Coniferous with 10-50% Crown Closure)
- 4312 - Mixed Forest (>50% Coniferous with >50% Crown Closure)
- 4321 - Mixed Forest (>50% Deciduous with 10-50% Crown Closure)
- 4322 - Mixed Forest (>50% Deciduous with >50% Crown Closure)
- 4410 - Old Field (< 25% Brush Covered)
- 4420 - Deciduous Brush/Shrubland
- 4430 - Coniferous Brush/Shrubland
- 4440 - Mixed Deciduous/Coniferous Brush/Shrubland

2002 Land Cover - All Wetland Types

- 1461 - Wetlands rights-of-way (modified)
- 1711 - Cemetery on Wetland
- 1750 - Managed Wetland, in Maintained Lawn Green space
- 1850 - Managed Wetland, in Built-up Maintained Rec Area
- 2140 - Ag. Wetlands (Cranberry Farms & Modified Uplands)
- 2150 - Former Ag. Wetlands (Becoming Shrubby not Built-up)
- 6120 - Freshwater Tidal Marshes
- 6210 - Deciduous Wooded Wetlands
- 6220 - Coniferous Wooded Wetlands
- 6231 - Deciduous Scrub/Shrub Wetlands
- 6232 - Coniferous Scrub/Shrub Wetlands
- 6233 - Mixed Scrub/Shrub Wetlands (Deciduous Dom.)
- 6234 - Mixed Scrub/Shrub Wetlands (Coniferous Dom.)
- 6240 - Herbaceous Wetlands (Non-Tidal)
- 6251 - Mixed Forested Wetlands (Deciduous Dom.)
- 6252 - Mixed Forested Wetlands (Coniferous Dom.)
- 7430 - Disturbed Wetlands (Modified)

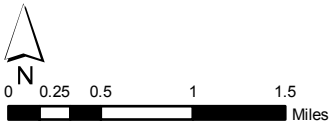
2002 Land Cover - Water Types

- 1419 - Bridge Over Water
- 5100 - Streams and Canals
- 5200 - Natural Lakes
- 5300 - Artificial Lakes

2002 Land Cover - Barren Land Types

- 7400 - Altered Lands
- 7500 - Transitional Areas (sites under construction)

Note: The 2002 Land Use (March 2008 version) data layer was used. This data does not refelect changes or approved developments since the aerial photos were taken in 2002.



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.

Kingwood Township ERI, revised 2009

Prepared by Kratzer Environmental Services

Legend for Figure 7a: 2002 Land Use / Land Cover

Internet Resources: Today's Landscape

Forest Health (NJDEP Division of Parks and Forestry):
http://www.state.nj.us/dep/parksandforests/forest/njfs_forest_health.html

Native Plants: Bowman's Hill Wildflower Preserve: http://www.bhwp.org

Natural Heritage Program (NJDEP Division of Parks and Forestry)
http://www.state.nj.us/dep/parksandforests/natural/heritage/index.html

C. Wildlife

General

New Jersey hosts 325 bird species, 90 mammal species, 79 reptile and amphibian species and over 400 species of fish. Per square mile, New Jersey has the greatest wildlife diversity of any state in the nation, according to the NJ Division of Fish and Wildlife. New Jersey's geographic position where northern ecosystems reach their southern limit and where southern ecosystems reach their northern limit provides a wide variety of habitats including mountains, valleys, rolling hills, wetlands, pinelands, beaches, estuaries and rivers (NJDEP, 2005).

The NJ Division of Fish and Wildlife website offers checklists for birds, mammals, reptiles and amphibians of New Jersey, noting the status of each (e.g. common or rare) (see **Internet Resources** below). A variety of plant and animal species enjoy Kingwood Township's diversity of habitat types, including uplands, wetlands and open water (see **Section IIIA,** above, for habitat descriptions), although a catalogue of those specifically found within the boundaries of Kingwood has never been done.

A few species of interest are discussed below.

White-tailed Deer

The largest herbivore living wild in New Jersey is the white-tailed deer (*Odocoileus virginianus*). Although the deer is a large animal, individuals tend to stay in a one square mile or less home range, one of the smallest among wild ruminants. Fawns weigh approximately 7½ pounds at birth while adult females average 100 pounds and adult males average 150 pounds (Burnett, No Date).

Biologists have estimated that before the arrival of European settlers, there were about 8-11 white-tailed deer per square mile. By the early 1900's, New Jersey's deer herd was reduced to a handful. However, the adaptability of deer to human-altered habitats has resulted in the current overabundance of the species. Studies have shown that deer densities of over 10-15 per square mile have negative impacts on native songbird and wildflower populations, while deer populations in excess of 20 per square mile prevent tree regeneration (Pennsylvania Audubon, no date). For comparison, NJDEP's hunting figures for Deer Management Zones 10 and 11 (which encompass Kingwood and some surrounding areas) show that between 28 and 34 deer per square mile are *taken* by


A white-tailed deer

hunters each year (see **Table 3.2**), therefore populations are well over the ecological carrying capacity.

The deer overpopulation results in excessive damage to agricultural crops, gardens and residential landscaping; an increased incidence of deer/vehicle collisions; prevention of forest regeneration (thereby impacting forest ecology); and the potential for reduced deer health due to inadequate nutrition and the spread of disease (Bowman's Hill, 2004; Honachevsky, 2000; Native Plant Society, 2004; Pennsylvania Audubon, 2004; Sauer, 1998). Despite all this, many people still enjoy seeing deer, and many also gain satisfaction from hunting deer. Deer hunting contributes to the economy, as well, as deer hunters in New Jersey spend more than 100 million dollars each year as they enjoy in excess of 1.6 million recreation-days hunting deer.

Table 3.2: Deer Hunting

Year	Deer Harvested per Square Mile		Estimated Number of Deer Harvested in Kingwood Township
	Deer Management Zone 10	Deer Management Zone 11	
2001-2002	33.7	31.6	1,203 – 1,128
2002-2003	30.9	28.7	1,103 – 1,025
Source: New Jersey Fish and Wildlife Digest.			Estimates were calculated by multiplying columns to the left by area of township (35.7 square miles).

Black Bears

Black bears, the largest land mammals in the state, are occasionally seen in Kingwood Township. They are most frequently seen during the breeding season of June and July, when the males travel extensively in search of females. Black bears are omnivorous in food preferences, consuming a range of foods from skunk cabbage, berries, nuts, insects, small mammals, road-kill and human garbage. Black bears are sometimes responsible for damage to bird feeders, beehives, sweet corn, livestock, garbage, etc. Black bears that are fed, unintentionally or intentionally, can become dangerous and may have to be destroyed. The Division of Fish and Wildlife offers information and techniques for damage and nuisance prevention (see **Internet Resources** below).

Coyotes

The population of eastern coyotes was reduced to 100 in the state in 1975, but has rebounded to the current population of 3,000. The coyote is the largest wild canine found in NJ, primarily nocturnal, and extremely wary of humans. The coyote closely resembles a small German shepherd, except that its snout is longer, and its tail is bushier, black-tipped, and held horizontally or lower. They are not pack animals, although the young may remain with the parents for 1½ years. Coyotes are opportunistic predators, feeding on small animals, carrion, insects, fruit and other vegetable matter. They occasionally kill and eat small livestock (e.g. chickens, sheep) and pets, and raid garbage. Sightings alone should not cause alarm but are a signal to take measures to make a property less hospitable to the coyotes and to safeguard children, pets and livestock (McBride, 2007). Within Kingwood Township, 13-24 coyote sightings were reported in Kingwood Township in 2002 (Burnett, 2002).

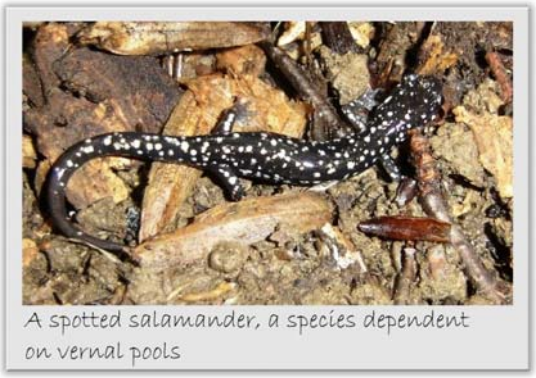
Northern Copperheads

The northern copperhead (*Agkistrodon contortix mokase*n) is the only venomous snake found in Kingwood. Northern copperheads are active from May through October and prefer rotting woodpiles in rocky, wooded areas, including rocky talus slopes and forest habitats. This species does not appear on the list of rare species in **Section III.C** because it has not been

formally documented in the township (**Appendix C** includes a reporting form which can be used by anyone wishing to document a species of special concern).

Wildlife of Vernal Pools

Vernal pools are defined as confined depressions, either natural or man-made, that maintain ponded water for part of the year, have no permanent outflow, and are devoid of breeding fish populations. These temporary wetlands provide habitat to many species of amphibians, several of which breed exclusively in vernal pools, as well as a multitude of insects, reptiles, plants, and other wildlife (see **Table 3.3**).



A spotted salamander, a species dependent on vernal pools

The NJ Freshwater Wetlands Protection Act (adopted in 1989) did little to protect vernal pools because wetlands less than one acre in size were exempt from regulatory protection. Most vernal pools in NJ are less than $^1/_4$ acre; therefore vernal pools could be filled, drained, or modified with a general permit. The loss of this critical habitat put the species that depend on vernal pools at risk. The NJDEP approved new regulations in September 2001, providing protection for vernal pools.

Table 3.3: Vernal Pool Amphibians and Reptiles

Obligate Vernal Pool Breeding Amphibians	Facultative Vernal Pool Breeding Amphibians	Reptiles that Inhabit Vernal Pools on a Seasonal Basis
Marbled salamander *Special Concern*	Green frog	Wood turtle *THREATENED*
Spotted salamander	Bullfrog	Spotted turtle *Special Concern*
Jefferson salamander *Special Concern*	Pickerel frog	Mud turtle
Wood frog	Southern leopard frog	Eastern painted turtle
Blue-spotted salamander *ENDANGERED*	Carpenter frog *Special Concern*	Common snapping turtle
Eastern tiger salamander *ENDANGERED*	Northern spring peeper	
Eastern spadefoot toad	Northern cricket frog	
	New Jersey chorus frog	
	Upland chorus frog	
	Northern gray treefrog	
	Southern gray treefrog *ENDANGERED*	(These reptiles visit vernal pools primarily to eat the eggs and larvae of amphibians.)
	Pine barrens treefrog *ENDANGERED*	
	Four-toed salamander	
	Long-tailed salamander *THREATENED*	

Note: Species in black are either known to occur in Kingwood Township or their ranges include Hunterdon County; species in grey have ranges which do not include Hunterdon County, therefore it would be unlikely to find them in Kingwood.

Sources: Tesauro, no date; Kenney et al, no date; Schwartz and Golden, 2002; N.J.A.C 7:7A, Appendix 1.

NJDEP Division of Fish and Wildlife, Nongame Species Program directs the Vernal Pool Project, which is an effort to map and survey the vernal pools throughout the state. Because of the ephemeral nature and small size of vernal pools, the program recruits volunteers to visit possible vernal pools and confirm, or "certify," whether the sites fulfill the regulatory definition. The state has identified 24 potential vernal pools within Kingwood, two of which have been certified. Other vernal pools may exist that were not identified by this project, and some identified as possible vernal pools may not be.

Wildlife of Aquatic Habitats

A NJDEP program called *Integrated Biological Aquatics Assessment* combines various studies in an evaluation of the ecological health of aquatic habitats. Beginning in 2000, the Endangered and Nongame Species Program conducted surveys for freshwater mussels, dragonflies and damselflies (*Odonata*) and stream-associated reptiles and amphibians (often grouped under the term "herptiles") at selected Ambient Biomonitoring Network (AMNET; see Section II G) sites, in addition to stream habitat assessments. These efforts have identified 12 native freshwater mussel species, 9 of which are listed as endangered, threatened or special concern; 172 *Odonata* species, of which 43 are considered rare; and 72 herptile species, 17 of which are listed as endangered or threatened. Macroinvertebrate populations at several sites in Kingwood were studied and are discussed in Section IIG (surface water).

The Bureau of Freshwater and Biological Monitoring evaluates fish populations with its Fish Index of Biotic Integrity (IBI), which uses fish populations as an indicator of stream water quality. A "Good" IBI rating was determined for Lockatong Creek (15 fish species were present) and an "Excellent" IBI rating for Nishisakawick Creek (18 species). A list of species found in the IBI study may be found in **Table 3.4**.

Recreational fishing often focuses on trout or American shad. Trout are stocked in the Delaware & Raritan feeder canal and Lockatong Creek. Warford Creek supports naturally reproducing trout. American Shad is an anadromous fish species which returns from the ocean to spawn in the Delaware River in early spring. The shad migration is monitored by the NJ Fish and Wildlife service with hydroacoustic equipment that is mounted on piers of the Route 202 Bridge at Lambertville, NJ (see **Internet Resources**, below). See **Section II.G**. for Fish Consumption Advisories.

Table 3.4 List of Fishes Collected During Index of Biotic Integrity Sampling of Lockatong Creek and Nishisakawick Creek (listed in 2001 order of abundance)

COMMON NAME	SCIENTIFIC NAME	2001		2006	
		# FOUND	SIZE RANGE (INCHES)	# FOUND	SIZE RANGE (INCHES)
FIBI026: Nishisakawick Creek Creek Road @ Frenchtown Park – 2001 and 2006					
Blacknose Dace	*Rhinichthys atratulus*	591		275	
Longnose Dace	*Rhinichthys cataractae*	142		27	
American Eel*	*Anguilla rostrata*	85		47	
White Sucker*	*Catostomus commersoni*	65		6	
Common Shiner	*Luxilus cornutus*	57		116	
Tesselated Darter	*Etheostoma olmstedi*	39		23	
Creek Chub	*Semotilus atromaculatus*	25		18	
Cutlips Minnow	*Exoglossum maxillingua*	15		15	
Margined Madtom	*Noturus insignis*	5		3	
Rainbow Trout*	*Oncorhynchus mykiss*	3	11.4-13.8		
Rock Bass*	*Ambloplites rupestris*	1	5.1	3	3.9 - 7.0
Smallmouth Bass*	*Micropterus dolomieu*	1	4.7	10	4.1 - 11.5
Bluegill	*Lepomis macrochirus*			11	1.5 - 9.1
Fallfish	*Semotilus corporalis*			5	
Satinfin Shiner	*Cyprinella analostana*			4	
Spotfin Shiner	*Cyprinella spiloptera*			3	
Pumpkinseed	*Lepomis gibbosus*			2	2.6 - 3.9
Green Sunfish	*Lepomis cyanellus*			1	2.8 - 2.8
Sea Lamprey	*Petromyzon marinus*			1	
Brown Trout	*Salmo trutta*			1	2.2 - 2.2
Hybrid Redbreast x	*Lepomis auritis x*			1	3.0 - 3.0

COMMON NAME	SCIENTIFIC NAME	2001		2006	
		# FOUND	SIZE RANGE (INCHES)	# FOUND	SIZE RANGE (INCHES)
Bluegill	*macrochirus*				
	Number of Fish Species	12		18	
	Number of Fish	1,029		572	
	FIBI Score – Rating	44 – Good		48 – Excellent	
	Habitat Score – Rating	167 - Optimal		165 – Optimal	
	Nearby AMNET station AN0082 Water Quality Rating:	1993-Non-Impaired; 1997-Non-Impaired; 2003 – Non-impaired			
FIBI027: Lockatong Creek at CR 519 – 2001 and 2006					
Blacknose Dace	*Rhinichthys atratulus*	503		284	
White Sucker*	*Catostomus commersoni*	130		18	
Tesselated Darter	*Etheostoma olmstedi*	95		50	
Common Shiner	*Luxilus cornutus*	65		200	
Creek Chub	*Semotilus atromaculatus*	60		51	
Banded Killifish	*Fundulus diaphanus*	56		45	
Satinfin Shiner	*Cyprinella analostana*	53		26	
Green Sunfish*	*Lepomis cyanellus*	53	1.9 - 4.5	19	2.0 - 4.7
Swallowtail Shiner	*Notropis procne*	48		8	
American Eel*	*Anguilla rostrata*	15		24	
Redbreast Sunfish*	*Lepomis auritus*	12	2.2 - 4.3	14	2.5 - 5.0
Spottail Shiner	*Notropis hudsonius*	6		9	
Fathead Minnow	*Pimephales promelas*	4			
Brown Bullhead*	*Ameiurus nebulosus*	2	7.1 - 8.7		
Largemouth Bass*	*Micropterus salmoides*	1	2.0	3	2.2 - 2.6
Pumpkinseed	*Lepomis gibbosus*			7	2.3 - 3.3
Bluegill	*Lepomis macrochirus*			1	2.4
	Number of Fish Species	15		15	
	Number of Fish	1,103		753	
	FIBI Score – Rating	38 – Good		38 – Good	
	Habitat Score – Rating	134 - Sub-Optimal		127 - Sub-Optimal	
	Nearby AMNET station AN0088 Water Quality Rating:	1992 – Non-impaired; 1997 – Non-impaired; 2003 – Non-impaired			
* Regulated as a fishable species under current New Jersey Fish and Wildlife codes					
Sources: NJDEP BFBM, 2002 and NJDEP BFBM, 2008.					

References: Wildlife

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Tesauro, Jason. No date. New Jersey's Vernal Pools. NJDEP Endangered and Nongame Species Program. 4 pages.

Internet Resources: Wildlife

Endangered and Nongame Species Program (NJDEP, Division of Fish and Wildlife)

Home Page: http://www.state.nj.us/dep/fgw/ensphome.htm

Checklists for birds, mammals, reptiles and amphibians of New Jersey, with status (e.g. common or rare): http://www.state.nj.us/dep/fgw/chklists.htm

Vernal Pools: http://www.njfishandwildlife.com/ensp/vernalpool.htm

Fish Index of Biotic Integrity (Bureau of Freshwater Fisheries): http://www.state.nj.us/dep/wmm/bfbm/fishlist2001.html

Fish and Wildlife (NJDEP, Division of Fish and Wildlife)

Home Page: http://www.njfishandwildlife.com/

Bear Information:http://www.njfishandwildlife.com/bearinfo.htm

Deer Information: http://www.njfishandwildlife.com/deer.htm

Delaware River Fishing Report 2004: http://www.state.nj.us/dep/fgw/del_river_rpt04.htm

Delaware River American Shad Hydroacoustic Reports – 2004: http://www.state.nj.us/dep/fgw/del_acoustic04.htm

Fishing in NJ: http://www.state.nj.us/dep/fgw/fishing.htm

Fish Fact Sheets: http://www.state.nj.us/dep/fgw/fishfact.htm

Integrated Biological Aquatics Assessment http://www.state.nj.us/dep/fgw/ensp/ibaa03.htm

List of Fishes Collected During 2001 IBI Sampling: http://www.state.nj.us/dep/wmm/bfbm/fishlist2001.html

Regulations (hunting, fishing, nongame): http://www.njfishandwildlife.com/njregs.htm

Impacts of White-tailed Deer

Deer resistant/tolerant Native Plants (Bowmans Hill Wildflower Preserve)
http://www.bhwp.org/native/native_plant_info_sheets/Deer_Tolerant_Resistant_Native_Plants.pdf
Impacts of deer on native plants (Bowmans Hill Wildflower Preserve)
www.bhwp.org/native/impact_of_deer.htm

The Ecological Impact of White-tailed Deer (PA Audubon)
http://www.audubon.org/chapter/pa/pa/deer_report.html

Impact of Deer on Biodiversity (Native Plant Society of New Jersey)
http://www.npsnj.org/deer_biodiversity.htm

D. Endangered, Threatened and Special Concern Species

The health of an area's animal and plant populations can be an indicator of the health and sustainability of the environment for people. The decline or disappearance of one (or more) species may signal the deterioration of the habitat. Other species, and human health and welfare, may soon follow. Preserving the future of endangered and threatened species helps preserve our own species, benefiting human health and quality of life by protecting watersheds, preserving land in its natural state, and restoring wildlife habitat. Many people also place an intrinsic value on all species.

The NJDEP Division of Fish and Wildlife, Endangered and Nongame Species Program's (ENSP) mission is: "To actively conserve New Jersey's biological diversity by maintaining and enhancing endangered and nongame wildlife populations within healthy functioning ecosystems." The program is responsible for the protection and management of New Jersey's wildlife, including over 70 species currently listed as endangered or threatened, plus another 55 species of special concern. **Table 3.5** presents the definitions used by NJDEP in describing the status of species. In order to better document the status or change in status of species, NJDEP solicits information from the general public concerning sightings of endangered, threatened and special concern species. A reporting form is available on the Internet, and is included in **Appendix C**.

Table 3.5: Definitions of Species Status

Species Status	Definition Used by NJDEP
Endangered	Applies to a species whose prospects for survival within the state are in immediate danger due to one or several factors, such as loss or degradation of habitat, over-exploitation, predation, competition, disease or environmental pollution, etc. An endangered species likely requires immediate action to avoid extinction within NJ.
Threatened	Applies to species that may become Endangered if conditions surrounding it begin to or continue to deteriorate. Thus, a Threatened species is one that is already vulnerable as a result of, for example, small population size, restricted range, narrow habitat affinities, significant population decline, etc.
Special Concern	Applies to species that warrant special attention because of some evidence of decline, inherent vulnerability to environmental deterioration, or habitat modification that would result in their becoming Threatened. This category would also be applied to species that meet the foregoing criteria and for which there is little understanding of their current population status in the state.
Stable (or increasing)	Applies to species that appear to be secure in NJ and not in danger of falling into any of the preceding categories in the near future.
Undetermined	A species about which there is not enough information available to determine the status.
Source: http://www.njfishandwildlife.com/spclspp.htm	

Many species are naturally rare in parts of their range, especially at the periphery. New Jersey often lies at the southern periphery of the range for many "northern" species and at the northern edge of the range of many "southern" species. Therefore, a species considered rare or imperiled within the state of New Jersey is not necessarily in danger of extinction worldwide. For state-wide species lists, see **Internet Resources**, below.

A search of NJDEP Division of Parks and Forestry *Natural Heritage Database* in December 2007 for rare species presently recorded in Kingwood Township revealed the documented presence of two critically imperiled bird species (red-shouldered hawk and vesper sparrow), one imperiled bird (bobolink), one rare bird (Cooper's hawk), two rare reptiles (map and wood turtles), and one imperiled amphibian (long-tailed salamander). Three imperiled or critically imperiled invertebrates are found within the township (a mussel and two damselflies), as well as 6 critically imperiled vascular plants and 8 imperiled vascular plants. No lists are available for non-vascular plants. No species known to occur in Kingwood are found on the Federal endangered species list. **Table 3.6** lists these endangered, threatened and special concern species, their conservation status, date observed and habitat, while **Table 3.7** defines the state status codes used in the Natural Heritage Database.


The state threatened wood turtle is found in Kingwood Township.

Fact sheets, including photos, for most of the rare animals listed below are presented in **Appendix C**. **Appendix C** also includes a list of Hunterdon County rare species and natural communities. If suitable habitat is present in Kingwood, these species also have potential to be present.

Table 3.6: Species Presently Recorded in the NJ Natural Heritage Database for Kingwood Township

Scientific Name	Common Name	State Rank	Last ob-served	Habitat
Vertebrates, birds:				
Accipiter cooperii	Cooper's hawk	S2B, S4N		forests and forested wetlands
Ammodramus savannarum	Grasshopper sparrow	S2B,S3N		
Buteo lineatus[3]	red-shouldered hawk	S1B, S2N	1989	remote and extensive old growth forests containing standing water for nesting sites; Hardwood, softwood, or mixed swamp featuring mature, closed overstory, variable to dense understory, near streams or open water.
Catharus fuscescens	veery	S1		
Dolichonyx oryzivorus[16]	Bobolink	S2B, S3N	1989	low-intensity agricultural habitats, such as hayfields and pastures for breeding; Open field or meadow dominated by grasses or

[3] Fact sheets with photos of these species can be found in **Appendix C**.

Scientific Name	Common Name	State Rank	Last ob-served	Habitat
				forb species. Sparse saplings and fence posts used for perches.
Falco sparverius	American Kestrel	S3B, S3N		
Pooecetes camineus[16]	vesper sparrow	S1B, S2N	1984	open areas, such as cultivated fields, grasslands, fallow fields and pastures; especially uncultivated strips along fence-rows
Strix varia	Barred owl	S2B, S2N		
Sturnella magna	Eastern meadowlark	S3B, S3N		
Vertebrates, reptiles:				
Glyptemys insculpta[16]	wood turtle	S2	1992	clean freshwater streams for mating, feeding and hibernation; undisturbed uplands for egg laying and foraging; Mosaics of forested, scrub-shrub, emergent wetlands, upland forest, old fields and agricultural lands.
		S3		ponds, river-bottoms and lakes, preferably with an abundance of aquatic vegetation and areas with fallen trees and other debris for basking
Terrapene carolina carolina	Eastern box turtle	S3		
Vertebrate, amphibian:				
Ambystoma jeffersonianum	Jefferson salamander	S3		
Ambystoma opacum	Marbled salamander	S3		
Bufo Woodhousii fowleri	Fowler's toad	S3		
Eurycea longicauda longicauda[16]	long-tailed salamander	S2	1990	clean, calcareous (limestone) wetlands; mines or caves with calcareous ground water; aquatic habitats within upland deciduous forests; shallow streams with shale bottoms
Gyrinophilus p. porphyriticus	Northern spring salamander	S3		
Vertebrate, fish:				
Acipenser brevirostrum	shortnose sturgeon	S1		
Invertebrates:				
Lampsilis cariosa[16]	yellow lampmussel	S1	1997	large rivers, often in sand/silt substrates
Vascular plants:				
Agastache scrophulariifolia	purple giant hyssop	S2	198?	woods and thickets
Asimina triloba	pawpaw	S1	1987	
Carex jamesii	James' sedge	S1	1987	
Cheilanthes lanosa	hairy lipfern	S2	1984	
Cynoglossum virginianum var virginianum	wild comfrey	S2	2006	open woods
Cystopteris protrusa	lowland fragile fern	S2	1987	
Hybanthus concolor	green violet	S1	1974	rich woods
Phaseolus plystachios var. polystachios	wild kidney bean	S2	1896	
Ptelea trifoliate	wafer ash	S1	1981	Woods and thickets
Ranunculus micranthus	rock buttercup	S2	1994	
Ribes missouriense	Missouri gooseberry	S1	1985	
Scutellaria nervosa	veined skullcap	S2	1987	Woods and thickets
Selaginella rupestris	rock spike-moss	S2	1984	

Scientific Name	Common Name	State Rank	Last ob-served	Habitat
Note: The following species were in the November 2003 database, but were not in the December 2007 database search: Animals: *Graptemus geographica* (common map turtle), *Gomphus vastus* (cobra clubtail), *Stylurus spiniceps* (arrow clubtail). Plants: *Aster praealtus* (willow-leaf aster), *Aster praealtus* (willow-leaf aster), *Carex hithcockiana* (Hitchcock's sedge), *Carex maadii* (Mead's sedge), *Pycanthemum torrei* (Torrey's mountain mint), *Rhynchospora globularis* (coarse grass-like beaked rush) , *Valerianella radiate* (beaked corn salad), *Verbena simplex* (narrow-leaved vervain).				
Sources: NJDEP Natural Heritage Database, as of December 2007. Habitat information for vascular plants, where available, is from Newcomb, 1977.				

The New Jersey Endangered Species Conservation Act was signed into law on Dec.14, 1973, preceding the federal Endangered Species Act by two weeks. According to NJ DEP Commissioner Bradley Campbell, (Bean, 2003), these regulations have done a good job of protecting listed species that occur in wetlands and in the Pinelands area, but have often failed to protect species found elsewhere.

NJDEP provided additional protection of threatened and endangered species by designating waters that provide critical habitat for endangered species as Category One (C1) waters (**Figure 6b** illustrates the locations of C1 streams). Rare, threatened and endangered species are often very sensitive to pollution and habitat disturbances, therefore should benefit from the C1 regulations aimed to establish stream buffers and maintain water quality.

Table 3.7: Definitions of State Element Ranks Used In Natural Heritage Database

Rank	Definitions
S1	Critically imperiled in New Jersey because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres). Species ranked S1 are often restricted to specialized habitats and/or restricted to an extremely small (3%) geographical area of the state. Also included are species which were formerly more abundant, but because of habitat destruction or some other critical factor of its biology, they have been demonstrably reduced in abundance. In essence, these are species for which, even with intensive searching, sizable additional occurrences are unlikely to be discovered.
S2	Imperiled in New Jersey because of rarity (6 to 20 occurrences). Historically many of these species may have been more frequent, but now, largely through habitat destruction, are known from fewer extant occurrences. The S2 rank also includes species which occur in habitats restricted to 10 % of the total state area.
S3	Rare in state with 21 to 100 occurrences (plant species in this category have only 21 to 50 occurrences). Includes species which are widely distributed in the state but often occurring in small populations, and also in habitats which may be common or widespread. Species having a moderately restricted distribution (but greater than 10%) in New Jersey, but are locally abundant, are also included. Species ranked S3 are not yet imperiled in state but may soon be if additional populations are destroyed.
B	Refers to the breeding population of the element in the state.
N	Refers to the non-breeding population of the element in the state.
Note:	To express uncertainty, the most likely rank is assigned and a question mark added (e.g., G2?). A range is indicated by combining two ranks (e.g., G1G2, S1S3).
Source:	http://www.nj.gov/dep/parksandforests/natural/heritage/spplant_ap1.html for complete code definitions.

References: Endangered, Threatened and Special Concern Species

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NJDEP Office of Natural Lands Management (ONLM). June 2002. Frequently Asked Questions About The Natural Heritage Grid Map. 2 pages. File name: gisgridfaqs.doc.

NJDEP Office of Natural Lands Management (ONLM). November 2002. Frequently Asked Questions About The Natural Heritage Priority Sites GIS File. 2 pages. File name: gissitefaqs.doc.

Schwartz, Vicki and David M. Golden. 2002. Field Guide to Reptiles and Amphibians of New Jersey. New Jersey Division of Fish and Wildlife, Endangered and Nongame Species Program. Vineland, NJ. 89 pages.

Internet Resources: Endangered, Threatened and Special Concern Species

Endangered and Nongame Species Program (NJDEP, Division of Fish and Wildlife)

Home Page: http://www.state.nj.us/dep/fgw/ensphome.htm

Endangered & Threatened Wildlife of New Jersey List, and links to Natural History Profiles: http://www.state.nj.us/dep/fgw/tandespp.htm

Special Concern – Species Status Listing: http://www.njfishandwildlife.com/spclspp.htm

Checklists for birds, mammals, reptiles and amphibians of New Jersey, with status (e.g. common or rare): http://www.state.nj.us/dep/fgw/chklists.htm

Species Reporting Form: http://www.njfishandwildlife.com/ensp/rprtform.htm also link to pdf form

Landscape Project Home Page (wildlife habitat mapping for community land-use planning and endangered species conservation): http://www.njfishandwildlife.com/ensp/landscape/

Conserve Wildlife Foundation of NJ: http://www.conservewildlifenj.org/

Vernal Pools: http://www.njfishandwildlife.com/ensp/vernalpool.htm

Fish Index of Biotic Integrity (Bureau of Freshwater Fisheries): http://www.state.nj.us/dep/wmm/bfbm/fishlist2001.html

Natural Heritage Program (NJDEP Division of Parks and Forestry)

Home Page: http://www.state.nj.us/dep/parksandforests/natural/heritage/index.html

Rare Species Lists, Reports & Forms:

http://www.nj.gov/dep/parksandforests/natural/heritage/rarelist.html

Species Reporting Forms:
http://www.nj.gov/dep/parksandforests/natural/heritage/repform.html
Mailing Address: DEP - Division of Parks and Forestry,
Office of Natural Lands Management, Natural Heritage Program, PO Box 404, Trenton, NJ 08625-0404

Natural Lands Links (NJDEP Office of Natural Lands Management):
http://www.state.nj.us/dep/parksandforests/natural/index.html

E. Protecting Habitats for Endangered, Threatened and Special Concern Species

The Landscape Project

The Landscape Project is a pro-active, ecosystem-level approach to the long-term protection of rare species and their important habitats in New Jersey. Its goal is to protect New Jersey's biological diversity by maintaining and enhancing rare wildlife populations within healthy, functioning ecosystems. It provides users with peer reviewed, scientifically sound wildlife data that is easily accessible and can be used by state, county, and local governments, as well as nongovernmental conservation organizations and private land owners for planning, open space acquisition, and land-use regulation. The New Jersey Department of Environmental Protection (NJDEP), Division of Fish and Wildlife, Endangered and Nongame Species Program is responsible for the Landscape Project.

The dataset was created by intersecting endangered, threatened and rare species data with the 1995 Land Use / Land Cover GIS layer, which was derived from TM satellite imagery. The resulting data layer identifies, delineates and ranks (based on the conservation status of species present) critical habitat statewide (see **Table 3.8** for rank definitions). Each patch is coded for the number of special concern, state threatened, state endangered and federally listed species present. **Figure 8a** shows emergent wetlands and forested wetlands habitats. **Figure 8b** displays forest and grassland habitats.

Table 3.8: The Landscape Project Rank Definitions

Rank	Definition
1	Suitable Habitat - designates a patch as suitable habitat, no species documented
2	Special Concern - patch where species of special concern have been documented
3	State Threatened - patch where state threatened species have been documented
4	State Endangered - patch where state endangered species have been documented
5	Federal T E - patch where federal T E species have been documented
Note: Not all categories are present for each habitat within Kingwood Township.	
Source: The Landscape Project GIS metadata file.	

Natural Heritage Priority Sites

Natural Heritage Priority Sites represent some of the best remaining habitat for rare species and exemplary natural communities in the state. They have been identified through the Natural Heritage Database by the NJDEP Office of Natural Lands Management (ONLM) as areas critically important for preservation of New Jersey's biological diversity. The database provides detailed, up-to-date information on rare species and natural communities for planners,

developers, and conservation agencies for use in resource management, environmental impact assessment, and both public and private land protection efforts. According to the ONLM, if these sites become degraded or destroyed, we may lose some of the unique components of our natural heritage.

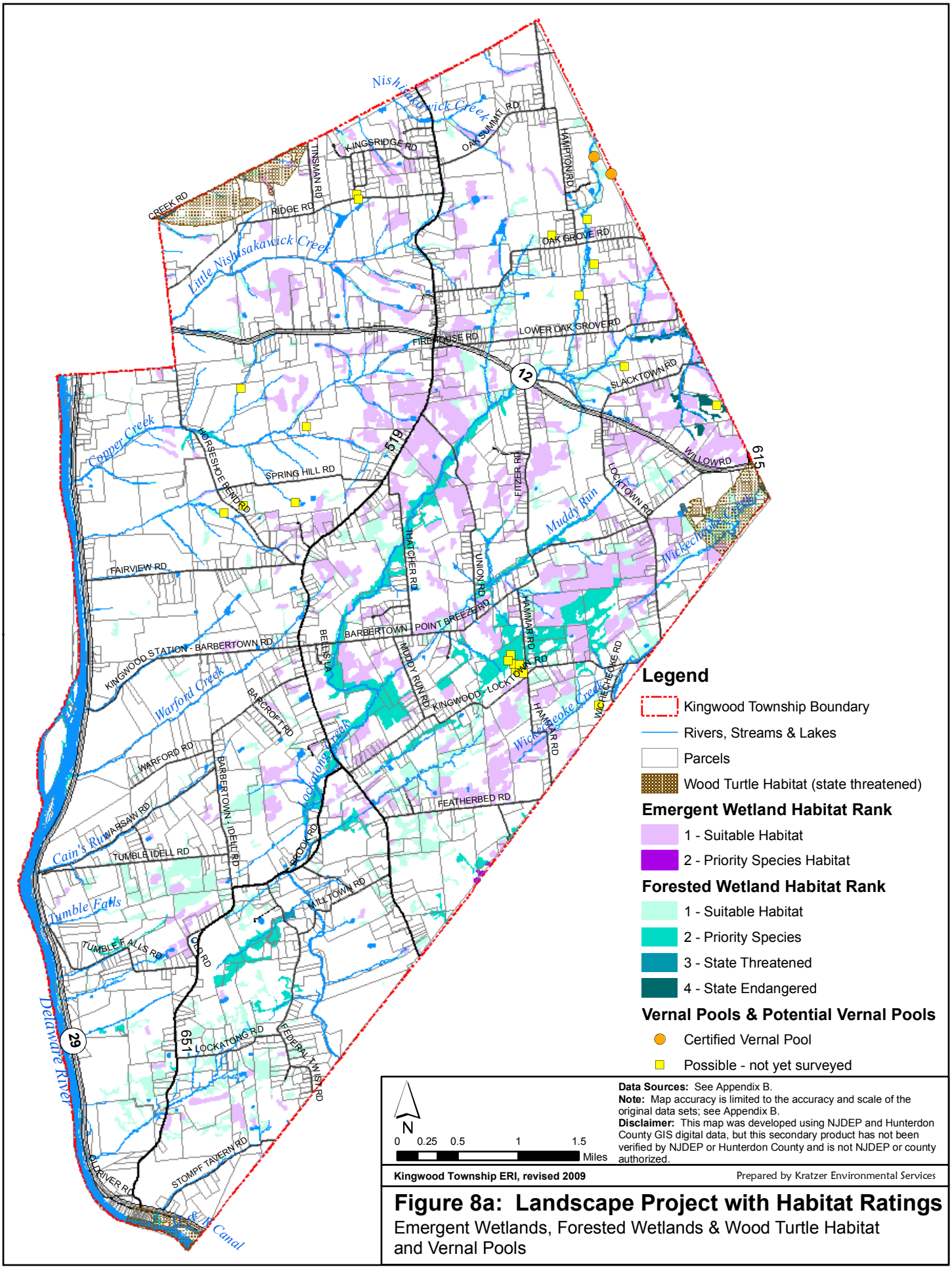
Within Kingwood Township, there are four Natural Heritage Priority Sites (see **Figure 9a**). **Table 3.9** provides descriptions of the sites. They are all ranked **B4**[4], which is defined as sites which have "Moderate significance, such as a viable occurrence of a globally rare element, a good occurrence of any natural community, a good or excellent occurrence or only viable state occurrence of an element that is critically imperiled in the State, an excellent occurrence of an element that is imperiled in the State, or a concentration (4+) of good occurrences of elements that are imperiled in the State or excellent occurrences of elements that are rare in the State."

Table 3.9: Natural Heritage Priority Sites Descriptions

Site Name: Treasure Island	**Site Code:** S.USNJHP1 * 548
Location: Kingwood Township, Hunterdon County **Description:** Wooded island in the Delaware River. **Boundary Justification:** Includes extent of habitat for several rare plant species plus some buffer. **Site Significance:** Biodiversity Significance B4 (moderate significance) **Comments:** Three state listed endangered plant species (2 extant, 1 historical) plus special concern plant species. Historical occurrence of state listed threatened animal.	
Site Name: Devils Tea Table	**Site Code:** S.USNJHP1 * 203
Location: Kingwood Township, Hunterdon County **Description:** This site is a red shale (and sandstone?) cliff and adjacent dry woods overlooking the Delaware River. **Boundary Justification:** Bounds drawn to include cliffs and dry woods that provide habitat for known occurrences of rare plants. **Site Significance:** Biodiversity Significance B4 (moderate significance) **Comments:** Contains an occurrence of a shale cliff natural community and populations of endangered and special concern plant species.	
Site Name: Byram	**Site Code:** S.USNJHP1 * 151
Location: Kingwood Township, Hunterdon County **Description:** Wooded rocky diabase hillside. **Boundary Justification:** Extent of upland habitat for rare plant species. **Site Significance:** Biodiversity Significance B4 (moderate significance) **Comments:** One special concern plant species plus historically documented plant species.	
Site Name: Bulls Island	**Site Code:** S.USNJHP1 * 144
Location: Kingwood and Delaware Townships, Hunterdon County **Description:** Wooded floodplain. **Boundary Justification:** Includes extent of rare plant and animal habitats plus buffer. **Site Significance:** Biodiversity Significance B4 (moderate significance) **Comments:** Several state listed endangered plants (both historic and extant) and two state listed threatened animals.	
Source: NJDEP Office of Natural Lands Management (ONLM) database search.	

These Natural Heritage Priority Sites are considered some of the best and most viable occurrences of endangered and threatened species and natural communities, but they do not

[4]Biodiversity Significance Ranks are as follows: **B1** – Outstanding significance; **B2** – Very high significance; **B3** – High significance; **B4** – Moderate significance; **B5** – Of general biodiversity interest or open space.



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.

Kingwood Township ERI, revised 2009

Prepared by Kratzer Environmental Services

Figure 8a: Landscape Project with Habitat Ratings

Emergent Wetlands, Forested Wetlands & Wood Turtle Habitat and Vernal Pools

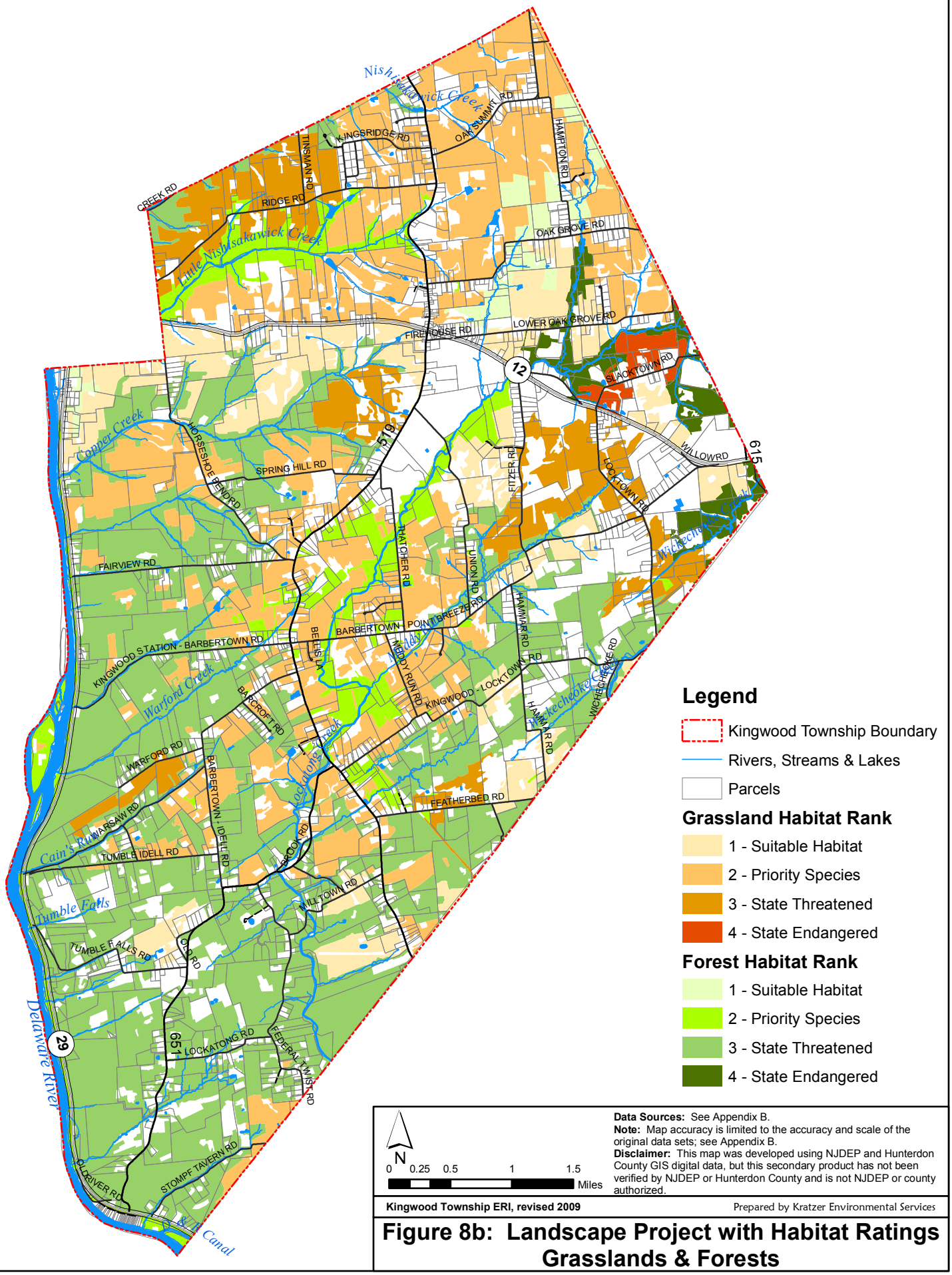


Figure 8b: Landscape Project with Habitat Ratings Grasslands & Forests

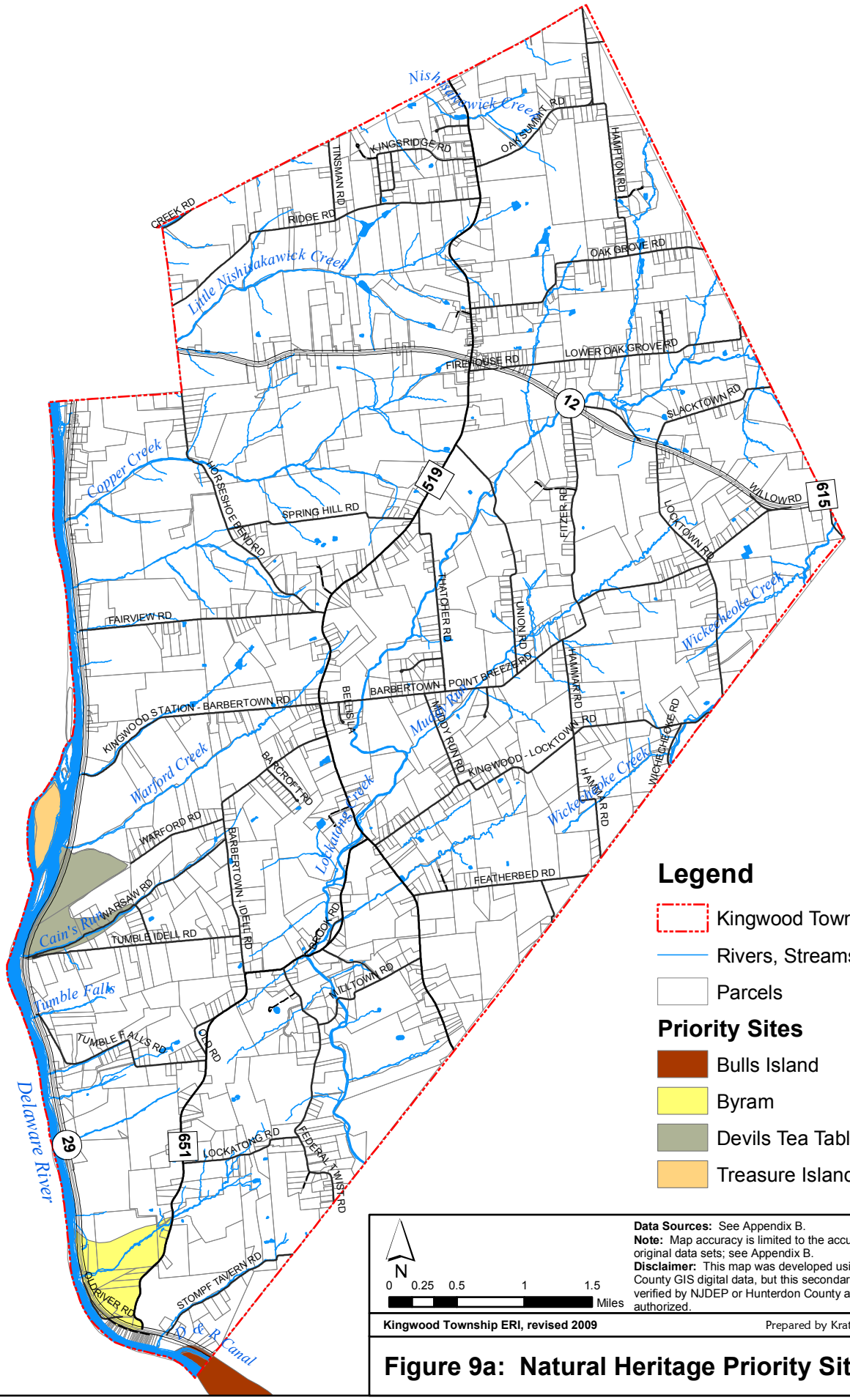


Figure 9a: Natural Heritage Priority Sites

cover all known habitats for endangered and threatened species in Kingwood Township. Information on whether or not endangered or threatened species have been documented on a specific piece of land can be obtained by requesting a search of the Natural Heritage Database from the Office of Natural Lands Management. In addition, some areas have never been surveyed, but may also contain endangered or threatened species.

The ONLM has also developed the Natural Heritage Grid Map (see **Figure 9b**), which provides a general representation of the locations of rare plant species and natural communities as of June 2002, including both historically and recently documented habitat. The purpose of the Grid Map is to document rare plant species and natural community habitat to inform decision-makers who need to address the conservation of natural resources. The map identifies potentially sensitive areas, and indicates where custom database searches are needed for land use decision-making. The Grid Map does not include habitat for animal species, and not all areas have been surveyed.

References: Protecting Habitats

NJDEP Office of Natural Lands Management (ONLM). June 2002. Frequently Asked Questions About The Natural Heritage Grid Map. 2 pages. File name: gisgridfaqs.doc.

NJDEP Office of Natural Lands Management (ONLM). November 2002. Frequently Asked Questions About The Natural Heritage Priority Sites GIS File. 2 pages. File name: gissitefaqs.doc.

Internet Resources: Protecting Habitats

Landscape Project (NJDEP, Division of Fish Wildlife)
Home Page: http://www.njfishandwildlife.com/ensp/landscape/

NJDEP Office of Natural Lands Management (ONLM)
http://www.state.nj.us/dep/parksandforests/natural/index.html

Natural Heritage Program (NJDEP Division of Parks and Forestry)
Home Page: http://www.state.nj.us/dep/parksandforests/natural/heritage/index.html

F. Exotic Species

Exotic species (also called alien or introduced species) are a threat to natural areas. Exotic species are those that have been introduced to an area intentionally (e.g. as sources of food, for landscaping purposes or the release of unwanted pets) or unintentionally (e.g. in the ballast of a ship or in a load of lumber), by people; thus, they are not part of the original natural community.

Some exotic species cannot compete against native species, and never cause problems. However, some species adapt well to their new environment and proliferate. They compete with native species for space, nutrients and light, and can result in the local elimination of native species. The new environment may harbor no natural population controls, such as insects to eat the invading plant and thereby control its population. Some of the most problematic invasive exotic species in Kingwood Township include multiflora rose and autumn olive (see **Table 3.10**). According to Robichaud and Anderson, "…as many as 25 percent of the plant species

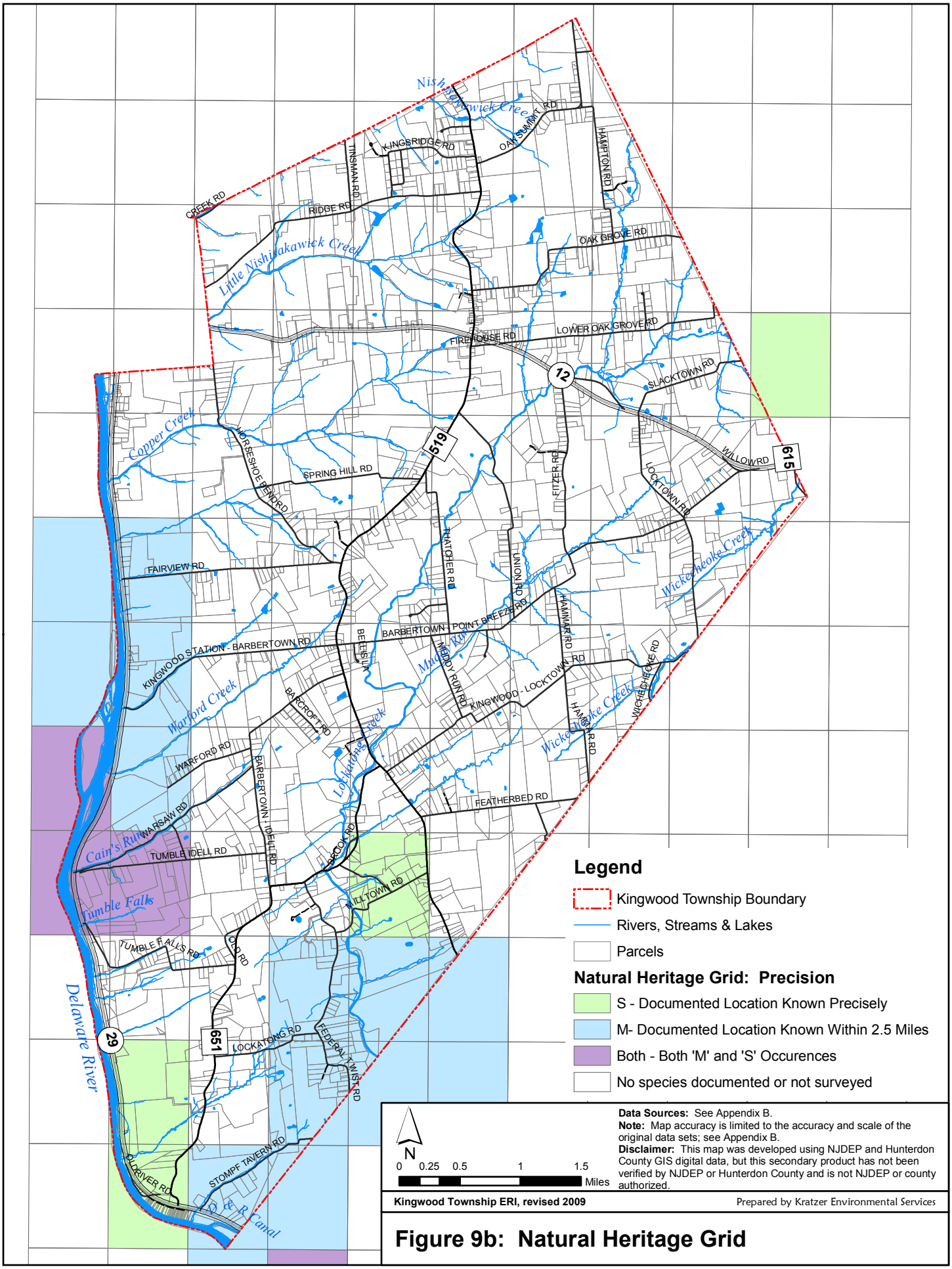


Figure 9b: Natural Heritage Grid

now present in New Jersey are exotic plants."

Native plants can be susceptible to exotic diseases, which they have not evolved resistance to. The chestnut blight fungus was an accidental introduction which destroyed all mature chestnut trees, once one of the dominant trees in the New Jersey (and Kingwood) landscape. Another introduced fungus, Dutch elm disease, destroys American elm, a tree species common in Kingwood Township up until a year or two ago.

In addition, native plants may have little resistance to certain introduced insects, and/or these insects may have no natural enemies in their new surroundings, allowing them to rapidly reach pest proportions. Several introduced insects, which are impacting the woodlands of Kingwood Township, include the hemlock wooly adelgid, gypsy moth, and pine looper. They weaken their host trees, which often succumb to successive years of infestation, to diseases carried by the insect pests, or other environmental stresses.

Table 3.10: Invasive Exotic Plants

Scientific Name	Common Name	Problems Caused
Acer platanoides	Norway maple	Dispersed seeds easily sprout in shade, crowding out native plants. Canopy produces deep shade and roots produce a toxic substance preventing growth of wildflowers and other trees under its canopy.
Ailanthus altissima	Tree of Heaven	Aggressive in disturbed areas, crowding out native plants.
Alliaria petiolata	Garlic Mustard	Aggressive in shady habitats, crowding out native plants.
Celastrus orbiculatus	Oriental bittersweet	The vine twines around surrounding plants, impeding sap flow. Also makes host plants too heavy, increasing wind damage.
Cirsium arvense	Canada Thistle	Competes with crops and degrades pastures (inedible to livestock).
Elaeagnus umbellate	Autumn Olive	Sprouts vigorously in disturbed areas, produces shade, preventing sprouting of native trees.
Euonymus alatus	Burning Bush	Grows well in many sites, especially upland forests and pastures, crowding out native plants.
Hedera helix	English Ivy	Grows vigorously in deep shade, inhibiting growth of native woodland plants. Vines up tree trunks, adding to weight, and increasing likelihood of wind damage.
Ligustrum vulgare	Common privet	Crowds out more desirable native plants.
Lonicera japonica Thunberg	Japanese honeysuckle	Spreads aggressively in disturbed habitats, crowding out native plants.
Lythrum salicaria	Purple loosestrife	Spreads aggressively in wetlands, eliminating open water habitats and crowding out native plants. Contributes to the loss of wildlife which depend on these wetlands and native plants.
Microstegium vimenium	Japanese stilt grass	Spreads aggressively in disturbed, moist, shady areas, crowding out native plants.
Miscanthus sinensis	Chinese silver grass	Spreads along roadsides and clearings, crowding out native plants.
Polygonum cuspidatum	Japanese Knotweed	Spreads aggressively in disturbed, sunny areas, especially river banks and wetlands, crowding out native plants.
Rosa multiflora	Multiflora rose	Spreads everywhere, except standing water, crowding out native plants and degrading pastures.
Vinca minor	Periwinkle	Spreads in shady forests, crowding out native plants.
Source: Fact sheets by Courtney, 1997.		

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References: Exotic Species

Courtney, John Mark. 1997. Fact Sheets: Invasive Exotics. Bowman's Hill Wildflower Preserve, New Hope, PA. www.bhwp.org.

Newcomb, Lawrence. 1977. Newcomb's Wildflower Guide. Little, Brown and Company: Boston, MA. 490 pages.

Robichaud, Beryl and Karl H. Anderson. 1994. Plant Communities of New Jersey: A Study in Landscape Diversity. New Brunswick, New Jersey: Rutgers University Press. 287 pages.

Internet Resources: Exotic Species

Federal efforts concerning invasive species Home Page: http://www.invasivespecies.gov

Invasive Species – New Jersey: http://www.invasivespecies.gov/geog/state/nj.shtml

Native Plant Society of New Jersey – Invasive Species: http://www.npsnj.org/invasive_species_0103.htm

NJ Forest Service - Forest Health: http://www.state.nj.us/dep/parksandforests/forest/njfs_forest_health.html

IV: RESOURCE INVENTORY - HISTORIC RESOURCES

The area that is now Kingwood has been inhabited by humans for thousands of years. An archeological study was done in 1996 at the site of the DeRewal Superfund site, just south of Frenchtown along the Delaware River. The study found more than 3,000 Native American artifacts[1], many dating back more than 1,000 years.

Earliest European ownership of Kingwood Township land occurred in 1676. Some of the land was purchased from Native Americans in 1703. Kingwood Township's settlers came from various countries, including France, Holland, Germany, Ireland, Scotland, England, and Wales. Many were Methodist, Quaker, Presbyterian or Baptist (Farnham, 1988).

The Township of Kingwood was established in 1746. A number of structures and cemeteries date over 250 years old. The Kingwood Township Historical Society aims to educate and archive historical information concerning the township and its inhabitants. **Table 4.1** lists some information resources available from the Historical Society.

Within Kingwood Township, there is part of one location on the National Register of Historic Places: the Delaware and Raritan Canal Historic District. The canal, built between 1830 and 1834, was used primarily to transport coal from Pennsylvania to New York City. The canal and towpath, now part of Bulls Island State Park and the D&R Canal State Park, are popular for recreation, such as canoeing, biking and jogging (National Register of Historic Places, 2009; Wikipeidia, 2009).

Sal DeSapio, Township Historian, has assembled the historic inventory listed in **Table 4.2** and displayed in **Figure 10**.

Table 4.1: Resources Available from the Kingwood Township Historical Society

Publication	Requested Donation	
	In Person	By Mail
"Kingwood Township of Yesteryear" by Barbara and Alexander Farnham	$7.00	$8.50
1873 Map of Kingwood	$1.00	$2.50
"Crossroads of the Revolution" "Fireplaces of Kingwood" "Kingwood's Hidden Past- A Display of Artifacts found at the Derewal Archaeological Site" "Life Along The Delaware" "Place & Road Names of Kingwood" "The Belvidere & Delaware Railroad" "Traditions of Kingwood"		
Contact Mildred Wehr, Historical Society Secretary @ 908-996-2948 Sal DeSapio- Township Historian PO Box 199, Baptistown, NJ, 08803-0199 Tel./ Fax (908)-996-4851 email- sald@ptd.net		

[1] Many of the artifacts are on display at the Kingwood Township Municipal Building.

Kingwood United Methodist Church was built circa 1860.

Table 4.2: Historic and Prehistoric Sites in Kingwood Township

Block	Lot	Place Name	Year
Historic Churches & Cemeteries			
2	19	"Old Stone" Church (Presb.)	Circa 1837
6	53	Baptistown Baptist Cemetery	Circa 1742
7	1	Oak Summit Cemetery	Circa 1752
17	4	Locktown Road Cemetery	Circa 1860
22	27	Locktown Baptist Cemetery	Circa 1832
38	9	Methodist Church & Cemetery	Circa 1860
38	5.02	Pulpit Rock	Circa 1770
Historic Houses			
		Bonham Place	Circa 1837
		Pearson R. Neice House	Circa 1848
8	40	Roat-Parke House	Circa 1736
23	15	Warne-Strimple-Holt Homestead	Circa 1752
29	13	Bray-Cox-VanSickle Homestead	Circa 1740
28	16	LeQuear Homestead	Circa 1750
36	2	Elijah Rittenhouse Homestead	Circa 1793
39	29	Niece- Wanamaker Homestead	Circa 1804
Historic Schools			
2	17	Oak Summit School	Circa 1849
14	43	Fairview School	Circa 1916
Historic Sites			
7	7	Murfin-Hoff Plantation	Circa 1715
50	1	Prehistoric Site	Circa 6,000 BC
National Register Historic District			
		D&R Canal Historic District	1825-
Note: Most of the houses and sites listed above are private property. You must secure permission from the property owner in order to see the property.			
Source: DeSapio, 2004; National Register of Historic Places, 2009			

Table 4.3: Historic and Potentially Historic Arch Culverts in Kingwood Township

Culvert #	Road	Stream	Historic?	Upstream Headwall	Downstream Headwall
K062	Tumble-Idell Rd	branch of Delaware River (tributary of Cain's run)	Possibly eligible for NRHP	stone	stone
K100	Spring Hill Rd	branch of Delaware River	Eligible for NRHP	stone	stone
K166	Creek Road	branch of Nishisakawick Creek	Possibly eligible for NRHP	stone	stone
K078	Fairview Rd	over branch of Delaware River	Eligible for NRHP	stone	stone
K106	County Route 519	branch of Nishisakawick Creek	unknown	stone	concrete
K111	County Route 519	Lockatong Creek	unknown	stone	stone
Source: Hunterdon County Culvert Data, 2008					

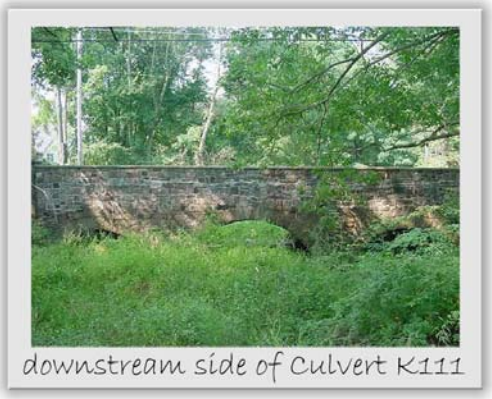
References: Historic Resources

DeSapio, Salvadore. February 2004. Township Historian. Personal Communication.

Farnham, Barbara & Alexander. 1988. Kingwood Township of Yesteryear. Stockton, NJ: Kingwood Studio Publications.

Hunterdon County. April21, 2008. Hunterdon County Culvert Data.


upstream side of Culvert K100


downstream side of Culvert K111

National Register of Historic Places. 2009. http://www.nationalregisterofhistoricplaces.com/nj/Hunterdon/state.html

Wikipeidia. 2009. Delaware and Raritan Canal. http://en.wikipedia.org/wiki/Delaware_and_Raritan_Canal

Internet Resources: Historic Resources

Ancient America: Learning Lenape: http://www.njskylands.com/hs_lenape_083.htm

Hunterdon County History and Historic Preservation: http://www.co.hunterdon.nj.us/planning/historic.htm

Hunterdon County's Open Space, Farmland and Historic Preservation Trust Fund: http://www.co.hunterdon.nj.us/openspac.htm

History of New Jersey (includes section on Hunterdon County) (ROOTS-L): http://www.rootsweb.com/roots-l/USA/nj/history.html


downstream side of Culvert K166

Read more about Kingwood

Farnham, Barbara & Alexander. 1988. "Kingwood Township of Yesteryear". Stockton, NJ: Kingwood Studio Publications

Lequear, John W. 1957. "Traditions of Hunterdon". Flemington, NJ: The Democrat Press

Myers, Kenneth V. Circa 1981. "Old Stones at Oak Summit". Flemington, NJ: The Democrat Press

Snell, James P. 1881. "History of Hunterdon and Somerset Counties, New Jersey". (Orig. Pub.) Philadelphia: Everets & Peck (reprint available from The Hunterdon County Historical Society, Flemington, NJ)

(Various Authors). Circa 1964. "The First 250 Years of Hunterdon County 1714-1964" Flemington, NJ: Hunterdon County Board of Chosen Freeholders.

Zdepski, Stephen. 1974. "Baptists in Kingwood, New Jersey" Phillipsburg, NJ: Harmony Printing Company

V: RESOURCE INVENTORY – OPEN SPACE & FARMLAND

A. Funding Sources & Tools

Funding for open space comes from a variety of sources, including municipal, county, state and federal sources and private land trusts. Private land trusts are non-profit organizations that "can often act faster and be more creative in their real estate transactions than established government agencies" according to Howe (1989). Landowners are able to reap tax benefits through charitable donations to a land trust. Many successful open space purchases combine a number of funding sources and strategies.

In 1997, Kingwood Township residents approved the establishment of a 3 cent tax for every $100 assessed value to provide a stable source of funding for the preservation of the township's agricultural base, rural character and natural resources.

In addition, Hunterdon County residents approved a 3 cent tax per $100 valuation to fund an Open Space, Recreation, Farmland and Historic Preservation Trust Fund in 1999, which was renewed in 2005, and expires on December 31, 2009. This revenue is dedicated to the acquisition of lands for recreation, conservation, general open space, farmland, and historic preservation throughout Hunterdon County.

The Garden State Preservation Trust Act provides state funds for land acquisition and park development through the Green Acres program and funding for farmland preservation through the State Agriculture Development Committee (SADC). Various programs under the SADC include Purchase of Development Rights, Fee Simple (outright purchase), the Eight Year Program, and the Planning Incentive Grant (PIG). To participate in the Eight Year Program, landowners agree to deed-restrict their farms solely to agricultural use for a period of eight years. In return, they receive certain benefits and increase their score when applying to other programs. The PIG program seeks to preserve reasonably contiguous farms. In order to participate, a township must 1) identify a reasonably contiguous project area; 2) demonstrate a commitment to funding; 3) have an Agricultural Advisory Committee appointed by the mayor; and 4) adopt a Farmland Preservation Element of the municipal Master Plan.

Farmland owners may wish to pursue various programs through the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS), which either rents or buys easements or cost-shares habitat restoration and conservation measures. These include the Conservation Reserve Program (CRP), Environmental Quality Incentives Program (EQIP), Wetlands Reserve Program (WRP), and Wildlife Habitat Incentives Program (WHIP) (see **Internet Resources**).

Private land trusts working to preserve land in Kingwood Township include the New Jersey Conservation Foundation, Hunterdon Land Trust Alliance and the New Jersey Natural Lands Trust. These organizations and the Association of New Jersey Environmental Commissions (ANJEC) are sources for in-depth information concerning open space preservation through various funding, planning, and zoning techniques (see **Internet Resources**).

B. Greenway Establishment & Maintenance

A *greenway* is a corridor of undeveloped land or open space, which often protects environmental features, such as a stream corridor, floodplain, forested ridgeline, or animal migration route, but which can also preserve a scenic view and provide recreational

opportunities, such as parks or biking/hiking trails. Greenway corridors also have the potential for positive economic impacts, by creating jobs, enhancing property values, expanding local businesses, attracting new businesses, increasing local tax revenues, decreasing local government expenditures, and promoting a local community. The publication Economic Impacts of Protecting Rivers, Trails and Greenway Corridors outlines procedures for analyzing economic impacts of a greenway project, and provides examples. Decision makers can benefit from recognition of potential economic impacts as well as intrinsic values of greenways in support of decisions that enhance the well-being of the community (National Park Service, 1995).

Garden State Greenways is an online planning tool designed for all those involved in conserving open space, farmland, and historic areas in New Jersey. It uses GIS to identify *hubs* **(**larger areas of undeveloped land with important natural resource values) and linear *connectors* between these hubs. The goal of the program is to help coordinate efforts of both private groups and government agencies (NJ Conservation Foundation, 2005).

Local governments often use a variety of planning and zoning techniques for establishing greenways, including creating a greenway map and adopting it as part of the Master Plan, creating a Greenway Overlay District, cluster zoning and Transfer of Development Rights. These strategies can be combined with farmland preservation, private land trusts, and conservation easements to meet the Township's open space, farmland and recreation goals (Howe, 1989).

Before a greenway is established, issues of maintenance, public access and monitoring of easements must be addressed to ensure long-term success of the project (Howe, 1989).

C. Open Space

The purposes of open space preservation include:

- provide adequate active and passive recreation;
- provide recreational and open space opportunities on an equal and accessible basis for all citizens;
- maintain water quality and groundwater recharge areas;
- protect sensitive environmental features;
- protect historic areas;
- maintain biodiversity;
- minimize erosion or damage from flooding;
- maintain rural character (ANJEC, no date).


Community Day at Kingwood Park

In 2000, the Kingwood Township Open Space Committee completed an open space and recreation plan which inventoried current open space and recreation lands within the township. The Open Space and Recreation Plan was adopted as part of the Master Plan. This plan established a goal of 2,100 acres of preserved open space, or 9.2% of the township's land area.

An updated inventory of the preserved open space properties is presented in **Table 5.1** and **Figure 11**. Using the acreage figures in the GIS data files[2], a total of 1,038 acres have been preserved as open space, recreational and publicly owned land in Kingwood Township, which is approximately 4.5% of the township.

[2] "*GIS Acres*" is from the GIS data, and may not be the same as acreage recorded on a deed. In some cases, only a portion of the acreage of a property is preserved, although the full acreage is listed.

Table 5.1: Preserved Open Space in Kingwood Township

BLOCK	LOT	NAME	OWNERSHIP	GIS ACRES[19]	DATE
4.00	7.00	Rawlyk NJDEP	state	43.90	
5.01	2.00	easement (addnl acres in Alexandria)	state	2.09	
13.00	2.00	Kent NJDEP	state	10.99	
14.00	35.00	Flagg - NJDEP	state	123.22	
19.00	5.01	NJDEP	state	not avail	
19.00	7.00	Melnyk Property	municipal	0.65	1997
19.00	8.00	Kingwood Township Park	municipal	51.46	1988
20.00	1.00	Melnyk Property	municipal	71.66	
20.00	1.01	Melnyk Property	municipal	not avail	1997
20.00	2.00	Kent NJDEP	state	59.79	
20.00	4.00	Kingwood Township School	Bd. of Ed.	28.99	2002
21.00	8.00	NJDEP (managed by NJCF)	state	39.81	2002
23.00	1.00	Kent NJDEP	state	1.55	
27.01	4.00	Van Houten (addnl 1.9 acres	state	0.11	
28.00	37.00	Fox	state	14.00	2007
38.00	12.00	Kingwood	municipal/state	0.94	
38.00	13.00	Milltown Preserve	state	2.76	
38.00	13.01	Milltown Preserve	state	3.28	
38.00	13.02	Milltown Preserve	state	5.27	
38.00	23.00	Holdings (fee purchase)	state	21.80	
38.00	24.00	Holdings (fee purchase)	state	0.91	
38.00	27.00	NJDEP	state	14.17	
39.00	25.00	NJDEP - D&R Canal State Park	state	8.58	2004
40.00	5.00	NJDEP	state	2.70	
40.00	20.00	NJDEP - D&R Canal State Park	state	180.01	
40.00	23.00	Martin Woods (easement)	state easement	48.44	2001
40.00	24.00	Kugler Woods	state easement	119.10	2001
40.00	26.00	NJDEP - D&R Canal State Park	state	31.67	2003
40.00	26.01	NJDEP - D&R Canal State Park	state	3.60	
41.00	4.00	Delaware River Bluffs	state easement	16.63	
41.00	11.00	non-profit conservation land	easement	3.09	
41.00	16.00	Kugler Woods	state easement	115.03	2001
41.00	23.00	Kugler Woods	state easement	0.16	2001
41.01	2.00	Kugler Woods	state easement	2.53	2001
42.00	8.00	NJDEP	state	0.58	1997
50.00	1.00	DeRewal Superfund Site	municipal/state	5.52	2001
50.00	2.00	Kingwood Angler's Access	state	4.19	1977
50.00	4.00	NJDEP - D&R Canal State Park	state	2.11	
50.00	5.00	DeRewal Superfund Site	municipal/state	2.01	2001
50.00	10.00	Kingwood Angler's Access	state	3.44	1977
50.00	11.00	NJDEP - D&R Canal State Park	state	0.27	
50.00	16.00	NJDEP - biking/hiking path	state	5.64	1988
50.00	17.00	NJDEP - D&R Canal State Park	state	0.37	
50.00	100.00	NJDEP - biking/hiking path	state	107.69	1986
50.00	100.02	NJDEP - D&R Canal State Park	state	3.48	
50.00	100.03	NJDEP - D&R Canal State Park	state	5.51	
50.04	1.00	NJDEP - Rush Island	state	7.32	1988
50.05	1.00	NJDEP - Bull's Island	state	7.03	1986

BLOCK	LOT	NAME	OWNERSHIP	GIS ACRES[19]	DATE
51.00	1.00	NJDEP - biking/hiking path	state	0.86	1986
51.00	2.00	NJDEP - biking/hiking path	state	1.72	1986
51.00	47.00	NJDEP - Bull's Island	state	8.35	1976
51.00	100.00	NJDEP - biking/hiking path	state	11.16	1986
51.00	100.06	NJDEP - D&R Canal State Park	state	2.38	
51.01	100.00	NJDEP - biking/hiking path	state	2.46	1986
			Total Acres (approximate):	**1,038.22**	
Notes: Parts of some of these properties are not open to public access.					
Sources: DeSapio, 2004; Hunterdon County GIS, 2003; Schmid, 2009 Note on sources: Efforts have been made to make this inventory as accurate as possible. Any errors, omissions and newly preserved properties should be brought to the attention of the Kingwood Environmental Commission.					

According to the Open Space and Recreation Plan, protection of the Delaware River Bluffs and the Lockatong Creek stream corridor are a high priority for protection, and currently being pursued by the state of New Jersey in cooperation with the Hunterdon Land Trust Alliance (HLTA).

Kingwood Township Park, the first municipality owned park, was opened on a 48-acre parcel on Union Road in October 1997. Many active recreation opportunities are available, including baseball and soccer fields and a tot playground. Passive recreation opportunities for visitors to the park include a picnic area under mature hardwood trees, a portion of the jogging track which borders the Lockatong Creek (therefore a nature trail) and fishing in Lockatong Creek.


Lockatong Creek in Kingwood Park

The township also owns the former DeRewal Superfund site. Although remediation activities are ongoing on the property, it has been planted with trees and wetlands plants, and adjoins the NJDEP owned biking/hiking path. In 2002, the township purchased the Melnyk property, which lies between the school and Kingwood Township Park.

Additional public lands include the state access to the Delaware River for boating and fishing, the 68 acre biking/hiking trail on the old railroad right-of-way along Route 29, and playground and fields at Kingwood Township School. A portion of Bulls Island State Park lies within Kingwood Township.

Approximately 1,038 acres of open space plus 1,476 acres of farmland have been preserved in Kingwood Township, for a total of 2,514 acres, or about 11% of the land area.

D. Farmland

Preservation of farmland is recognized as a priority at the national, state, county and local levels. Through various public forums and opinion surveys, Hunterdon County residents have clearly stated their desire to preserve the County's rural character (Hunterdon County website, 2009).

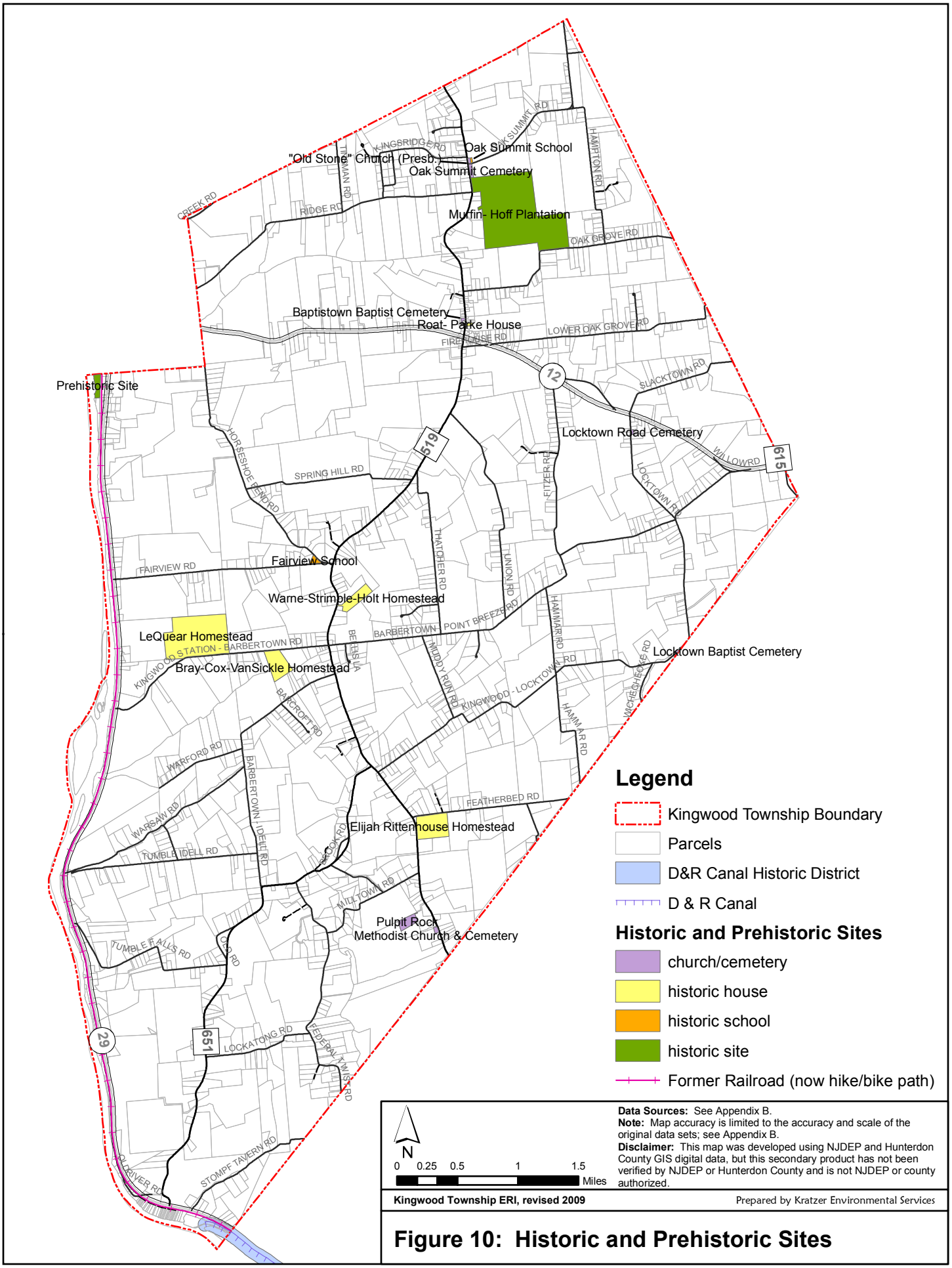
Agriculture is an important sector of the economy, while offering a quality of life and rural atmosphere that most residents value. Farms require less governmental services than residential development, thereby stabilizing property taxes. Agriculture also maintains clean air by generating little traffic, provides fresh local produce, and offers attractive vistas. Farmland, which typically has minimal impervious surfaces, provides ground water recharge areas. Preservation of farmland allows agriculture to exist as a viable and beneficial industry now and into the future. Efforts to preserve farmland are important because the land that is best for development is typically prime farmland. Once developed, farmland is lost and is a non-renewable resource (Hunterdon County Website, 2009).

Among the counties of New Jersey, Hunterdon County ranks number one for the most farms and the most acres farmed. Within Hunterdon County, Kingwood Township ranks 4th (behind Delaware, Readington and East Amwell) in the number of acres farmed, with 7,797 acres (Hunterdon County Agriculture Development Board, 2008).

Agricultural Development Areas (ADAs) in Kingwood Township are shown on **Figure 11 (inset)**. ADAs are areas where agricultural operations currently exist and are likely to continue, based on the presence of existing farms and productive agricultural soils (farmland soils are shown in **Figure 4h**). The ADAs were delineated by Hunterdon County and approved by the State. The State Agricultural Development Committee (SADC) and the County Agricultural Development Board (CADB) will only fund the preservation of farmland parcels that lie within an ADA.

Preserved farms in Kingwood are shown in **Figure 11. Table 5.2** lists these preserved farms, a total of **1,476** acres, which is 6.5% of the township (about 19% of the farmed acres).

Preserved Farmland in Kingwood Township



Legend

- Kingwood Township Boundary
- Parcels
- D&R Canal Historic District
- D & R Canal

Historic and Prehistoric Sites

- church/cemetery
- historic house
- historic school
- historic site
- Former Railroad (now hike/bike path)

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.

Kingwood Township ERI, revised 2009

Prepared by Kratzer Environmental Services

Figure 10: Historic and Prehistoric Sites

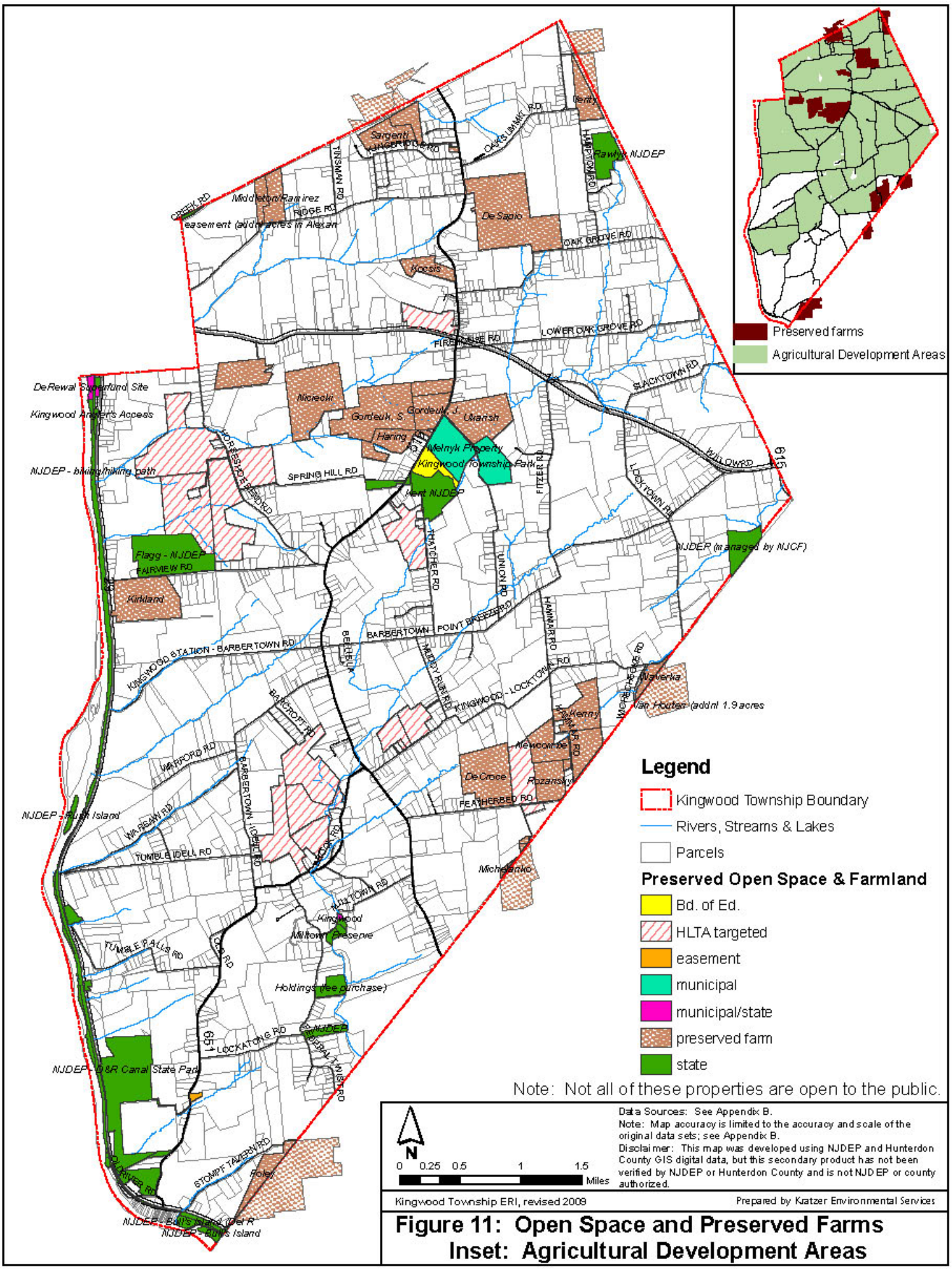

Preserved farms
Agricultural Development Areas
Legend
Kingwood Township Boundary
Rivers, Streams & Lakes
Parcels
Preserved Open Space & Farmland
Bd. of Ed.
HLTA targeted
easement
municipal
municipal/state
preserved farm
state
Note: Not all of these properties are open to the public.
N
0 0.25 0.5 1 1.5
Miles
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.
Kingwood Township ERI, revised 2009
Prepared by Kratzer Environmental Services
Figure 11: Open Space and Preserved Farms
Inset: Agricultural Development Areas

Table 5.2: Preserved Farmland in Kingwood Township

BLOCK	LOT	NAME	OWNERSHIP	GIS ACRES[19]	DATE
1.00	6.00	Sargenti	preserved farm	29.58	2006
1.00	6.01	Sargenti	preserved farm	not avail	2006
1.00	6.02	Sargenti	preserved farm	46.69	2006
4.00	2.00	Verity	preserved farm	39.35	2008
5.00	2.00	Middleton/Ramirez	preserved farm	38.59	2008
5.00	2.01	Middleton/Ramirez	preserved farm	20.25	2008
6.00	31.02	Kocsis	preserved farm	34.83	
7.00	7.00	DeSapio	preserved farm	73.95	2003
7.00	7.01	DeSapio	preserved farm	125.18	2003
12.00	19.00		preserved farm	58.22	
12.00	27.00	Niciecki	preserved farm	137.81	1991
12.00	34.00	Gordeuk, J.	preserved farm	46.04	1991
12.00	34.01	Gordeuk, S.	preserved farm	141.43	1991
12.00	34.02	Gordeuk, J.	preserved farm	24.91	1991
12.00	35.00	Haring	preserved farm	51.25	1991
19.00	5.00	Ukarish	preserved farm - municipal	97.42	
26.00	22.00	DeCroce	preserved farm	116.16	
26.00	25.00	Newcombe	preserved farm	51.19	2008
26.00	27.00	Rozansky	preserved farm	49.54	2006
26.00	27.03		preserved farm	3.30	2006
27.00	6.04	Kenny	preserved farm	66.20	
27.00	10.00	Kenny	preserved farm	47.68	
27.01	2.00	Waverka	preserved farm	15.96	1997
28.00	2.00	Kirkland	preserved farm	115.38	
36.00	11.00	Michelanko	preserved farm	3.28	
36.00	24.00	Michelanko	preserved farm	2.29	
36.00	24.01	Michelanko	preserved farm	1.61	
42.00	6.00	Foley	preserved farm	38.08	2002
			Total Acres (approximate):	**1,476.17**	
Note: These preserved farms, with the exception of the Ukarish property, are private property.					
Sources: DeSapio, 2004; Hunterdon County CADB, 2007; Schmid, 2009 Note on sources: Efforts have been made to make this inventory as accurate as possible. Any errors, omissions and newly preserved properties should be brought to the attention of the Kingwood Environmental Commission.					

References: Open Space & Farmland

Association of New Jersey Environmental Commissions. No Date. Resource Paper: Open Space Plan. 12 pages. http://anjec.org/pdfs/OpenSpacePlan.pdf

DeSapio, Sal. Kingwood Township Committee Member. Personal Communication. April 6, 2004.

Hershey, Leilani. Kingwood Township Environmental Commission. Personal Communication. June, 2004.

Howe, Linda. 1989. Keeping our Garden State Green: A Local Government Guide for Greenway and Open Space Planning. Association of New Jersey Environmental Commissions. 57 pages.

Kingwood Township Open Space Committee. 2000. Kingwood Township Open Space and Recreation Plan. 25 pages.

Hunterdon County Website

Agriculture Development Board: http://www.co.hunterdon.nj.us/cadb.htm
Preserved Farms (October 2007): http://www.co.hunterdon.nj.us/cadb/farms.htm
Why preserve farmland? (October 2005): http://www.co.hunterdon.nj.us/cadb/preserve.htm

Hunterdon County Agriculture Development Board. December 4, 2008. Hunterdon County Comprehensive Farmland Preservation Plan. Hunterdon County Planning Department. 141 pages. http://www.co.hunterdon.nj.us/pdf/cadb/FarmlandPlan/FARMLAND_PLAN_08_12_12.pdf

Hunterdon County, Information Technology, Division of Geographic Information Systems. 2003. Open Space within Hunterdon County, New Jersey. http://gis.co.hunterdon.nj.us/

National Park Service. 1995. Economic Impacts of Protecting Rivers, Trails, and Greenway Corridors: A Resource Book. Fourth Edition. 154 pages. http://www.nps.gov/pwro/rtca/econ_all.pdf

NJ Conservation Foundation
Garden State Greenways. http://www.gardenstategreenways.org
2005 Annual Report. http://njconservation.org/documents/NJCF2005AnnualReport.pdf

Schmid, Elizabeth. Kingwood Township Open Space & Farmland Coordinator. Personal Communication. January, 2009.

Internet Resources: Open Space & Farmland

Bull's Island Recreation Area: http://www.state.nj.us/dep/parksandforests/parks/bull.html

Hunterdon County Agriculture Development Board: http://www.co.hunterdon.nj.us/cadb.htm
Mailing Address: Hunterdon Co. Ag. Development Board, PO Box 2900, Flemington, NJ 08822-2900
Phone: 908.788.1490

D&R Greenway Land Trust: http://www.drgreenway.org/index.html

Hunterdon County's Open Space, Farmland and Historic Preservation Trust Fund:
http://www.co.hunterdon.nj.us/openspac.htm

Hunterdon Land Trust Alliance: http://www.hlta.org

Natural Resources Conservation Service (NRCS) Conservation Programs:
http://www.nrcs.usda.gov/Programs/index_alph.html

NJDEP Green Acres Program: http://www.state.nj.us/dep/greenacres/index.html

VI: REGIONAL RELATIONSHIPS

A. Hunterdon County Planning Board

The Hunterdon County Planning Board was established by the Board of Chosen Freeholders in 1957. The office is located at the Route 12 County Complex, Building #1. The mailing address is PO Box 2900, Flemington, New Jersey 08822-2900. They may be reached by phone at 908-788-1490 or by email at planning@co.hunterdon.nj.us. The Hunterdon County Planning Board's responsibilities are as follows:

- Prepare and adopt a master plan for the physical development of the County.
- Review subdivision and site plan applications.
- Encourage municipal cooperation in matters of mutual and regional concern.
- Advise the Board of Chosen Freeholders on capital budgets and expenditures.
- Maintain a file on municipal master plans and development regulations.

Reference: Hunterdon County Planning Board

Hunterdon County Planning Board. Feb. 2004. HCPB Duties.
http://www.co.hunterdon.nj.us/planning/hcpbduties.htm

Internet Resources: Hunterdon County Planning Board

Home Page: http://www.co.hunterdon.nj.us/planning.htm

Resources currently available on the above website include:

Community Design	Transportation Plan - FINAL – June 2008
Woodland Conservation	Farmland Preservation Plan - FINAL – Dec. 2008
Plan Endorsement	Hunterdon County Growth Management Plan – Dec. 2007
Rural Redevelopment Projects	United We Ride Coordinated County Human Services Transportation Plan – July 2007
Transfer of Development Rights	Creating Fair and Predictable Land Development Regulations (slide show): http://www.co.hunterdon.nj.us/planning/woodlandregs/LandUseRegs.htm
County Growth Management Plan	Interpreting Development Plans: Knowing the Right Questions to Ask: http://www.co.hunterdon.nj.us/planning/woodlandplans/InterpretingWoodlandsDevelopmentPlans.htm
Cross-Acceptance	
Environmental Toolbox	
County Wastewater Management Plan Information	

B. Watershed Management

The NJDEP's Division of Watershed Management administers a variety of programs aimed at protecting and restoring water quality, controlling water pollution and ensuring adequate water supplies. The aim is to manage water resources in a holistic, watershed basis, so that more comprehensive strategies can be implemented (NJDEP Division of Watershed Management, 2009).

Watershed management is the process of managing all of the water resources within the area of a watershed, rather than on a site-specific basis. 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.

In the Statewide Watershed Framework Document (NJDEP, 1997), the NJDEP provides a framework to move toward a more holistic, rather than site-specific, approach to most effectively protect our water resources today and well into the future. The key elements of this plan include:

- *Watershed Management Areas:* The state has been divided into 20 watershed management areas. Kingwood Township is located within Watershed Management Area 11, known as "Central Delaware Tributaries" (See **Figure 12**.)

- *Strategic Monitorin*g: Monitoring activities will be strategically coordinated by watershed to address various needs including water quality assessment, prioritization, watershed modeling, air deposition and evaluation.

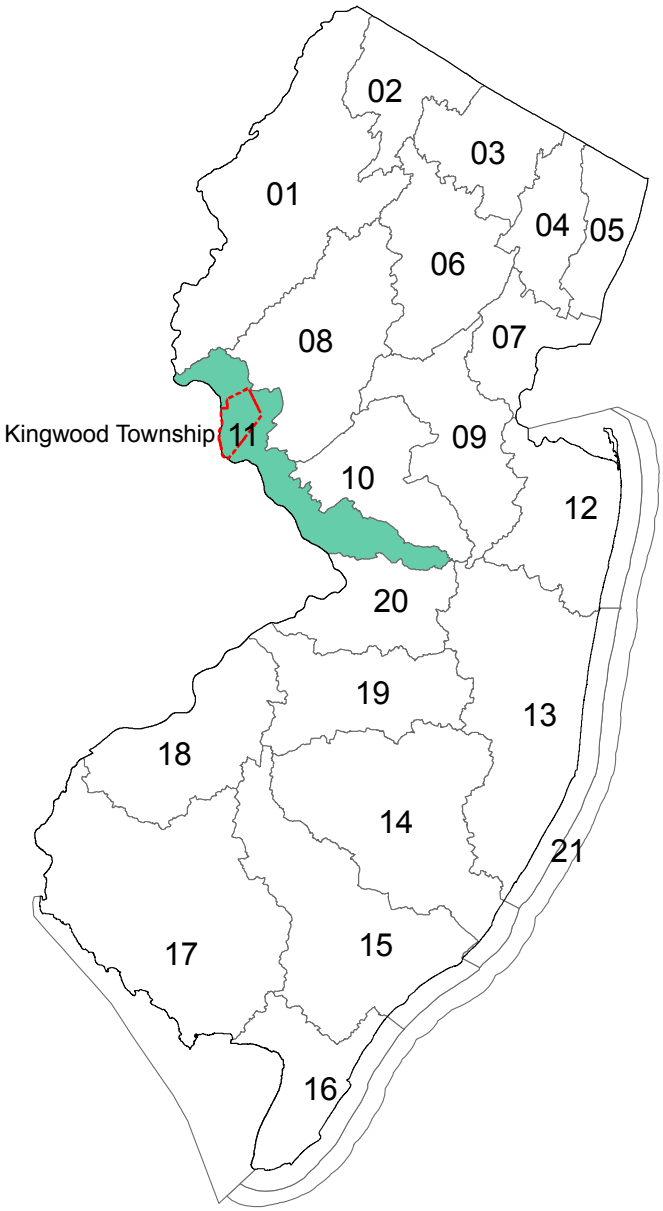
- *Watershed-based Permitting:* NJDEP will issue permits and renewals for discharges to surface water (DSW) within the same water region so that the permits expire in the same fiscal year. Watershed-based DSW permits will be issued/renewed in five year cycles.

- *Watershed Management Plan*s: NJDEP administers the Statewide **Water Quality Management (WQM)** Planning rules, N.J.A.C. 7:15 in conjunction with the Statewide WQM Plan, which together constitute the Continuing Planning Process conducted pursuant to the Water Quality Planning Act, N.J.S.A. 58:11A-1 et seq., the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq., and N.J.S.A.13:1D-1 et seq., and as required by Sections 303(e) and 208 of the Federal Clean Water Act (33 U.S.C.1251 et seq.).

    - According to these rules, the Commissioner of the NJDEP shall not undertake, or authorize through the issuance of a permit, any project or activity that affects water quality and conflicts with the applicable sections of adopted WQM Plans or the Statewide WQM Planning rules. The rules establish a mechanism for the determination of consistency of proposed projects or activities, and procedures for amendments.

    - Watershed management plans will be developed for each of the 20 watershed management areas. Plans will include: baseline information, water resource trends and priority concerns, watershed goals and objectives, selected management strategies, including pollution trading agreements where appropriate, and implementation schedules.

- *Wastewater Management Planning*: Certain changes to a WQM Plan also require a **Wastewater Management Plan (WMP)** amendment. This document provides 20 year planning for wastewater and certain other water resource protection concerns, including, but not limited to, an evaluation of depletive and consumptive water use, detailed land use, environmental build-out and pollutant loading. All wastewater management



Watershed Management Areas

Legend

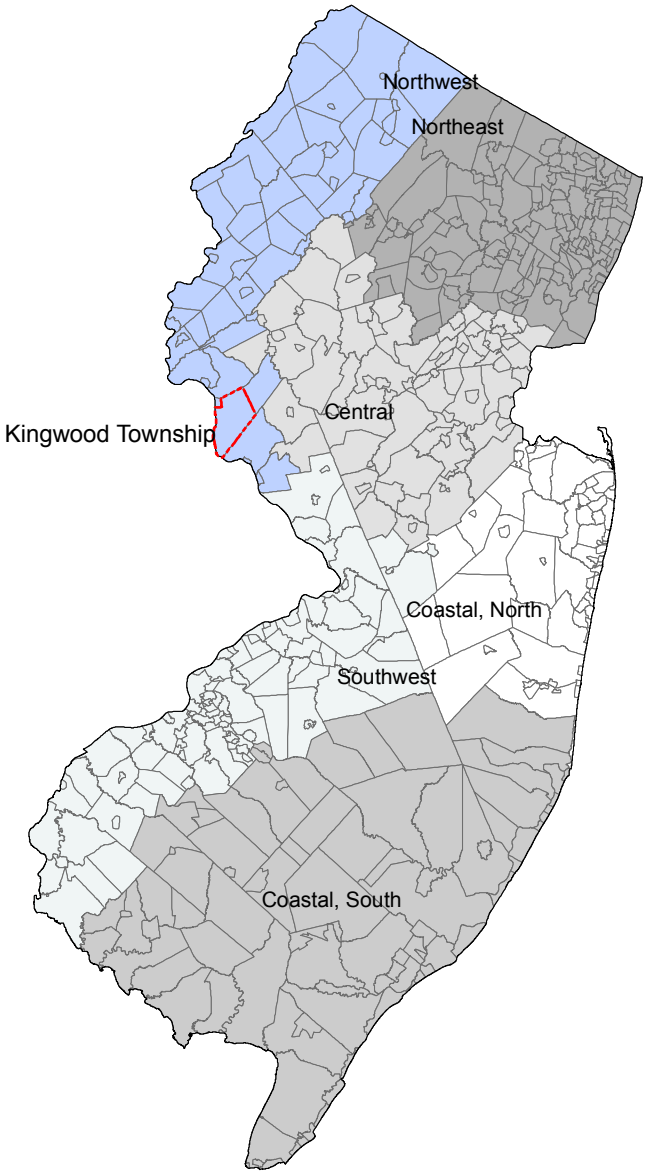
Kingwood Township Boundary

state

Watershed Management Areas

<all other values>

WMA 11 - "Central Delaware"



Drought Regions

Legend

Kingwood Township Boundary

state

Drought Region

Northwest

Northeast

Central

Coastal, North

Southwest

Coastal, South

0 12.5 25 50 Miles

Kingwood Township ERI, revised 2009

Prepared by Kratzer Environmental Services

N

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 12: Watershed Management Areas & Drought Regions

planning agencies must prepare and submit a WMP to the NJDEP. A WMP is valid only upon its adoption by the Governor or his designee as WQM plan amendment.

- *Watershed-based Stormwater Management Planning:* **Stormwater Management Plans (SWMP)** are required to address regional stormwater concerns and will be integrated as elements of Water Quality Management Plans. The purpose of these plans is to reduce flooding, prevent pollution, and produce cost efficiencies through development of regional/watershed-based solutions instead of site-specific requirements.

    - Two sets of new stormwater rules became effective February 2, 2004. The first set of rules is known as the Phase II New Jersey Pollutant Discharge Elimination System Stormwater Regulation Program Rules (N.J.A.C 7:14A). These rules are intended to address and reduce pollutants associated with existing stormwater runoff. The permit program establishes the Statewide Basic Requirements that must be implemented to reduce nonpoint source pollutant loads, including such measures as the development of a municipal stormwater management plan, adoption and implementation of ordinances (e.g. litter control, pet waste, street sweeping and catch basin cleaning); locating discharge points and public education.

    - The second set of rules is the Stormwater Management Rules (N.J.A.C. 7:8), which describe the required components of regional and municipal stormwater management plans, and establish the stormwater management design and performance standards for proposed development. These standards include ground water recharge, runoff quality and quantity controls, and buffers for Category One streams.

- *Geographic Information Systems (GIS):* GIS is utilized for data development, data updates and enhancements, assessment and modeling, and improved data sharing.

Kingwood Township has responsibility for wastewater management planning within the township.

References: Watershed Management

NJDEP Division of Watershed Management Home Page. 2009. http://www.nj.gov/dep/watershedmgt/

NJDEP Office of Environmental Planning. January 1997. Draft Statewide Watershed Management Framework Document for the State of New Jersey.

Internet Resources: Watershed Management

Division of Watershed Management Home Page: http://www.nj.gov/dep/watershedmgt/

Division of Watershed Management programs
http://www.state.nj.us/dep/watershedmgt/water_quality_management_planning.htm

Water Quality Management Plan Amendment & Revision Pre-Application Form (Oct. 2003):
http://www.state.nj.us/dep/watershedmgt/DOCS/CDApplicationForm.pdf

Wastewater Management Plan (WMP) Completeness Checklist:
http://www.state.nj.us/dep/watershedmgt/DOCS/WMPchecklist%202-05-03.pdf

WQMP Amendment and Revision Facilities Table Outline:
http://www.state.nj.us/dep/watershedmgt/DOCS/FacilitiesTable.pdf

List of Water Quality Management Planning Agencies (Oct. 2003):
http://www.state.nj.us/dep/watershedmgt/DOCS/WMPagencylist.pdf

Executive Order 109 [concerning Wastewater Management Plans] (Jan. 2000)
http://www.state.nj.us/infobank/circular/eow109.htm

Water Quality Management Plan Consistency Determination Fact Sheet (Feb. 2003):
http://www.state.nj.us/dep/watershedmgt/DOCS/CD%20Fact%20Sheet.pdf

Water Quality Management Plan Consistency Determination Application Form (Feb. 2003)
http://www.state.nj.us/dep/watershedmgt/DOCS/CDApplicationForm.pdf

Model Stormwater Control Ordinances for Municipalities (Dec. 2003)
http://www.state.nj.us/dep/watershedmgt/DOCS/pdfs/ModelSWOrdinance2.pdf

Stream Buffer Conservation Zone Model Ordinances (Dec. 2003)
http://www.state.nj.us/dep/watershedmgt/DOCS/pdfs/StreamBufferOrdinance.pdf

Address: Additional information may be obtained from the NJDEP, Division of Watershed Management, PO Box 418, 401 E. State Street, Trenton, NJ 08625-0418.

C. Drought Regions (NJDEP)

NJDEP provides information about droughts according to Drought Region (see **Figure 12).** Kingwood Township lies within the Northwest Drought Region.

Internet and Phone Resources: Drought

NJDEP Drought Home Page: http://www.state.nj.us/dep/drought/

NJDEP Drought Hotline: 1-800-4-ITS-DRY or 1-800-448-7379
Outside NJ: 1-609-633-0560

D. Lower Delaware Scenic & Recreational River

Segments of the Delaware River between the Delaware Water Gap and Washington Crossing were designated into the National Wild and Scenic River System in 2000. With this addition of about 65 miles of the Delaware, ¾ of the non-tidal Delaware River is now included in the national system. The Delaware River is the longest free flowing river east of the Mississippi River.
The Delaware River has the longest water quality anti degradation policy of any river in the United States of America (Lower Delaware Wild and Scenic River, 2009).

The management area for the Lower Delaware Scenic and Recreational Area extends from the river to the prominent ridgelines, about a mile from the river, which roughly follows Route 519 within Kingwood Township. Kingwood Township joined others in their support of the designation.

The Management Plan recommends actions to maintain and improve the Lower Delaware River, its tributaries and surrounding natural, historic and cultural resources. While each level of government retains its existing level of authority, designation requires federal agencies to make decisions compatible with the plan.

Lower Delaware River Wild and Scenic Management Committee formed with the purpose of reminding participating agencies of the Management Plan goals, and to provide oversight and guidance to participating agencies. The functions of the committee include: prioritizing goals; setting timetables; providing education on river management actions; acting as a watch dog/sheep dog; encouraging other agencies to adopt the plan goals; tracking activity in the river corridor and acting as an information clearinghouse across political boundaries; providing technical assistance; and updating the plan (at least every 5 years).

The committee membership is open to the public and includes representatives of the municipalities, watershed associations, counties, the Delaware River Basin Commission (DRBC), the Delaware River Greenway Partnership (DRG), the State of New Jersey (DEP), the Commonwealth of Pennsylvania (DCNR, DEP, Fish & Boat Commission), the Delaware & Lehigh Canal National Heritage Corridor Commission, and the National Park Service.

References: Lower Delaware Wild and Scenic River

Lower Delaware Wild and Scenic River Home Page. 2009. http://www.lowerdelawarewildandscenic.org/

Lower Delaware River Wild and Scenic River Study Task Force with assistance from the National Park Service, Northeast Field Office. 1997. Lower Delaware River Management Plan. 106 pages.

US Department of the Interior, National Park Service. Lower Delaware River Official Map and Guide.

Internet Resources: Lower Delaware Wild and Scenic River

Lower Delaware Wild and Scenic River: http://www.lowerdelawarewildandscenic.org/

Lower Delaware River Study Report: http://www.nps.gov/phso/sp/jrivlod2.htm

Lower Delaware River Management Committee Action Plan – 2007 to 2011.
http://www.nps.gov/chal/sp/p07new3.htm

Delaware River Basin Commission Wild and Scenic River Information:
http://www.state.nj.us/drbc/wild_scenic.htm

E. Delaware River Greenway Partnership

Delaware River Greenway Partnership (DRGP) is a non-profit organization, founded in 1998, that works to bring individuals, communities, businesses, recreational users and all levels of government together to promote and protect a continuous corridor of natural and cultural resources along the Delaware River and its tributaries.

The organization's mission is to engage with public and private partners to promote stewardship of the Wild and Scenic Lower Delaware River and its tributaries and to foster a shared sense of place among communities that adjoin the river by preserving and enhancing its ecological, scenic, historic, cultural and recreational resources. In reaching this mission, the DRGP's activities focus on three areas: 1) River corridor protection, 2) Land and water trail development, and 3) Stewardship and community involvement.

DRGP's activities are concentrated in the region from the Delaware Water Gap through the upper Estuary, but some projects necessarily extend beyond these boundaries.

In 2000, DRGP played a leading role in the successful campaign to include the Lower Delaware River in the National Wild and Scenic Rivers System.

Reference: Delaware River Greenway Partnership

DRGP Home Page: http://www.delrivgreenway.org/

F. Lockatong & Wickecheoke Creek Watersheds Restoration and Protection Plan

The Lockatong and Wickecheoke Creek Watersheds Restoration and Protection Plan study has been supported by a 319(h) grant awarded by the NJ Department of Environmental Protection (NJDEP) and in-kind services from NJ Water Supply Authority (NJWSA) and the National Resources Conservation Service (NRCS). Data collected during the study have revealed significant cause/affect relationships between existing land use(s) and the existing hydrology and water quality of these streams. The reports listed below present the Watershed Restoration and Protection Plan and supporting information.

References: Lower Delaware Wild and Scenic River

NJ Water Supply Authority Lockatong & Wickecheoke Project: http://www.njwsa.org/WPU/lock_wick.htm

Internet Resources: Lower Delaware Wild and Scenic River

NJ Water Supply Authority Lockatong & Wickecheoke Project: http://www.njwsa.org/WPU/lock_wick.htm

Includes the following documents:

DRAFT - Lockatong and Wickechoeke Creek Watersheds Restoration and Protection Plan

DRAFT - Recommended Watershed-Based Implementation Projects

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

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

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

Lockatong and Wickecheoke Creeks Project Work/Quality Assurance Project Plan

Characterization and Assessment of the Lockatong and Wickecheoke Creek Watersheds

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

G. NJ State Development & Redevelopment Plan

According to the NJ Office of Smart Growth, the *State Plan* provides a vision for the future that will preserve and enhance the quality of life for all residents of New Jersey. The purpose of the State Plan is to:

> "Coordinate planning activities and establish Statewide planning objectives in the following areas: land use, housing, economic development, transportation, natural resource conservation, agriculture and farmland retention, recreation, urban and suburban redevelopment, historic

preservation, public facilities and services, and intergovernmental coordination *(N.J.S.A. 52:18A-200(f)).*" (NJ Office of Smart Growth, 2009).

The *cross-acceptance* process was designed to encourage consistency between municipal, county, regional, and state plans to create a meaningful, up-to-date and viable State Plan (N.J.S.A. 52:18A-202.b.).

Plan Endorsement is the official recognition by the New Jersey State Planning Commission that a local, county, regional, or state agency plan is consistent with the State Development and Redevelopment Plan (State Plan). In order to be endorsed, plans must be consistent the goals, policies and strategies of the State Plan, the State Plan Policy Map and applicable State statutes and regulations. Municipalities, counties, groups of municipalities and counties, and regional and state agencies with the authority to implement plans are eligible to apply for Plan Endorsement (Hunterdon County Planning Board, 2009).

The plan provides a balance between growth and conservation by designating planning areas that share common conditions with regard to development and environmental features. Approximately half of Kingwood Township has been designated as a Planning Area 4, Rural Planning Area, and half Planning Area 4B, Rural/Environmentally Sensitive. The Delaware River Bluffs and the area bounded by Kingwood Locktown Road and Hammar Road have been designated as Planning Area 5, Environmentally Sensitive Area (see **Figure 13**). These areas are for limited growth and conservation. There are no "areas for growth" (metropolitan, suburban or designated centers) within Kingwood.

The land area in adjacent townships (Frenchown, Delaware, Alexandria and Franklin) share these designations, with the addition of some state park land (see **Figure 13**).

References: State Development and Redevelopment Plan

Hunterdon County Planning Board: http://www.co.hunterdon.nj.us/planning.htm

NJ Office of Smart Growth: http://www.nj.gov/dca/osg/plan/index.shtml

Internet Resources: State Development and Redevelopment Plan

i-MapNJ web site: http://www.state.nj.us/dep/gis/depsplash.htm

NJ Office of Smart Growth: http://www.nj.gov/dca/osg/plan/index.shtml

VII: CONCLUSION

This ERI has summarized and presented the objective resource data available for Kingwood Township. The data show that some areas are more sensitive to development impacts. Following the recommendation of ANJEC, specific resource management options or recommendations are not included in this document, but are addressed in the Conservation Element of the Master Plan, completed and adopted in 2008.

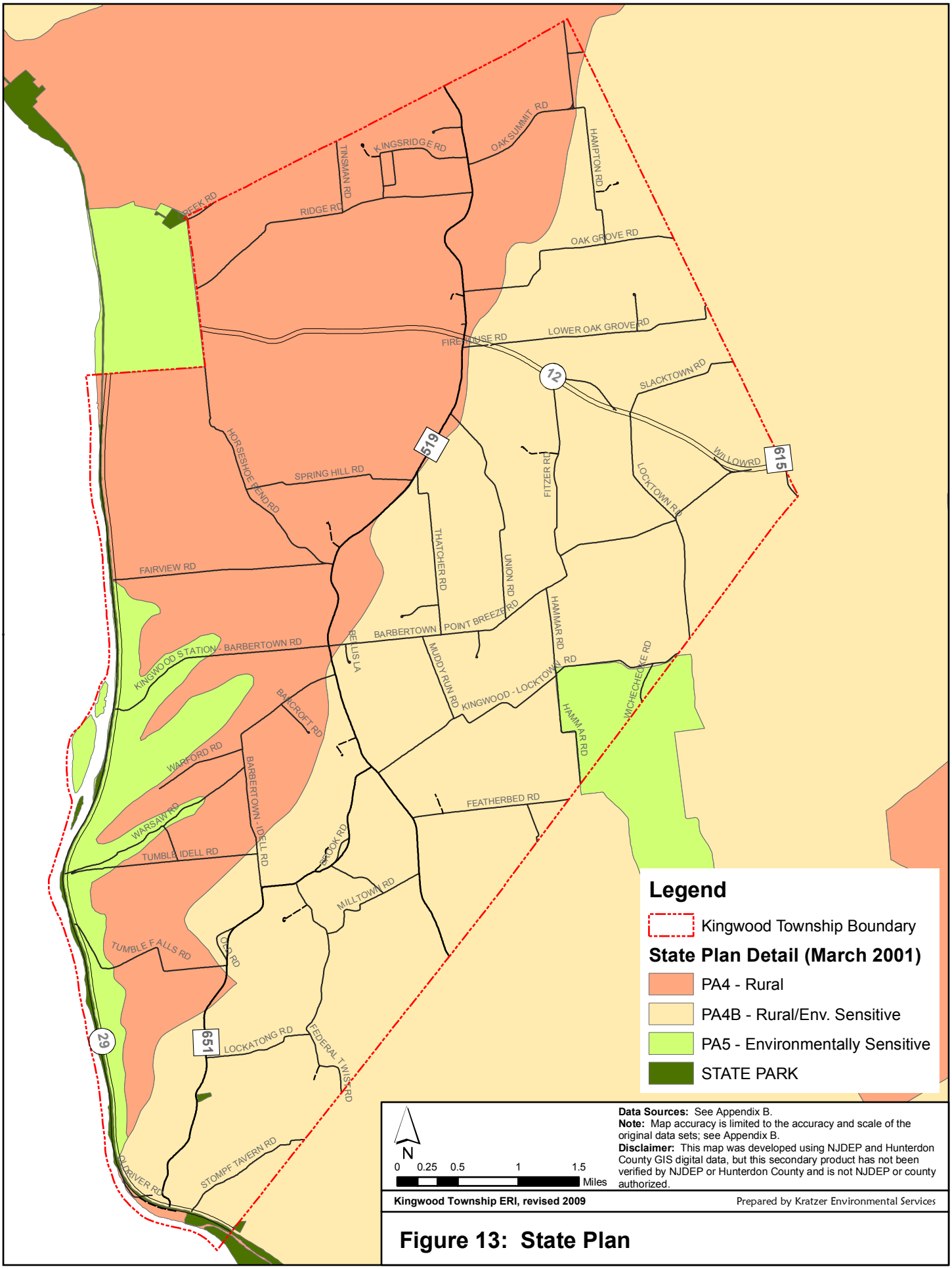


Figure 13: State Plan

APPENDIX A

Contents

1. Terms of Agreement for use of NJDEP GIS data
2. Spatial Data Distribution Agreement for use of Hunterdon County GIS Data
3. Cautions and Restrictions on Use of Natural Heritage Data

1. Terms of Agreement for use of NJDEP GIS data

(Required by NJDEP Office of Information Management, Bureau of Geographic Information and Analysis.)

1. Digital data received from the NJDEP are to be used solely for internal purposes in the conduct of daily affairs.

2. The data are provided, as is, without warranty of any kind and the user is responsible for understanding the accuracy limitations of all digital data layers provided herein, as documented in the accompanying Data Dictionary and Readme files. Any reproduction or manipulation of the above data must ensure that the coordinate reference system remains intact.

3. Digital data received from the NJDEP may not be reproduced or redistributed for use by anyone without first obtaining written permission from the NJDEP. This clause is not intended to restrict distribution of printed mapped information produced from the digital data.

4. Any maps, publications, reports, or other documents produced as a result of this project that utilize NJDEP digital data will credit the NJDEP Geographic Information System (GIS) as the source of the data with the following credit/disclaimer:

> This (map/publication/report) was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized.

5. Users shall require any independent contractor, hired to undertake work that will utilize digital data obtained from the NJDEP, to agree not to use, reproduce, or redistribute NJDEP GIS data for any purpose other than the specified contractual work. All copies of NJDEP GIS data utilized by an independent contractor will be required to be returned to the original user at the close of such contractual work. Users hereby agree to abide by the use and reproduction conditions specified above and agree to hold any independent contractor to the same terms. By using data provided herein, the user acknowledges that terms and conditions have been read and that the user is bound by these criteria.

2. Spatial Data Distribution Agreement for use of Hunterdon County GIS Data

(Required by County of Hunterdon Division of Geographic Information Systems.)

- Digital data received from the County of Hunterdon is to be used solely for internal purposes in the conduct of daily affairs.

- The data is provided, as is, without warranty of any kind and the user is responsible for understanding the accuracy limitations of all digital data layers provided herein, as documented in the accompanying Data Dictionary and readme files. Any reproduction or manipulation of the above data must ensure that the coordinate reference system remain intact.

- Digital data received from the County of Hunterdon may not be reproduced or redistributed for use by anyone, without first obtaining written permission from the County of Hunterdon. This clause is not intended to restrict the distribution of printed mapped information produced from the digital data.

- Any sale distribution is prohibited without prior approval from the County of Hunterdon.

- Users agree to hold the County of Hunterdon, New Jersey and all their employees, and agents harmless from any claim, suit, or proceeding arising out of the use of the data in accordance with this agreement, including indemnification of the County of Hunterdon and the State of New Jersey for reasonable expenses incurred in defending such claims.

- The reproduction of any hard copy products, as provided by the County of Hunterdon, with the intent to sell for a profit is prohibited without the written consent from the County of Hunterdon.

- Any maps, publications, reports, or other documents produced as a result of this project which utilize Hunterdon County digital data will credit the County's Geographic Information System as the source of the data with the following credit/disclaimer:

  > "This (map/publication/report) was developed using Hunterdon County, New Jersey, Geographic Information System digital data, but this secondary product has not been verified by Hunterdon County and is not county-authorized."

- Users shall require any independent contractor, hired to undertake work which will utilize digital data obtained from the County of Hunterdon, to agree not to use, reproduce, or redistribute Hunterdon County GIS digital data for any purpose other than the specified contractual work. All copies of Hunterdon County GIS digital data utilized by an independent contractor will be required to be returned to the original user at the close of such contractual work.

- Users hereby agree to abide by the use and reproduction conditions specified above and agree to hold any independent contractor to the same terms. By using data provided herein, the user acknowledges the terms and conditions have been read and that the user is bound by these criteria.

3. Cautions and Restrictions on Use of Natural Heritage Data

(Required by NJDEP Division of Parks and Forestry, Natural Lands Management.)

CAUTIONS AND RESTRICTIONS ON NATURAL HERITAGE DATA

The quantity and quality of data collected by the Natural Heritage Program is dependent on the research and observations of many individuals and organizations. Not all of this information is the result of comprehensive or site-specific field surveys. Some natural areas in New Jersey have never been thoroughly surveyed. As a result, new locations for plant and animal species are continuously added to the database. Since data acquisition is a dynamic, ongoing process, the Natural Heritage Program cannot provide a definitive statement on the presence, absence, or condition of biological elements in any part of New Jersey. Information supplied by the Natural Heritage Program summarizes existing data known to the program at the time of the request regarding the biological elements or locations in question. They should never be regarded as final statements on the elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments. The attached data is provided as one source of information to assist others in the preservation of natural diversity.

This office cannot provide a letter of interpretation or a statement addressing the classification of wetlands as defined by the Freshwater Wetlands Act. Requests for such determination should be sent to the DEP Land Use Regulation Program, P.O. Box 401, Trenton, NJ 08625-0401.

The Landscape Project was developed by the Division of Fish & Wildlife, Endangered and Nongame Species Program to map critical habitat for rare animal species. Some of the rare species data in the Landscape Project is in the Natural Heritage Database, while other records were obtained from other sources. Natural Heritage Database response letters will list all species (if any) found during a search of the Landscape Project. However, any reports that are included with the response letter will only reference specific records if they are in the Natural Heritage Database. This office cannot answer any inquiries about the Landscape Project. All questions should be directed to the DEP Division of Fish and Wildlife, Endangered and Nongame Species Program, P.O. Box 400, Trenton, NJ 08625-0400.

This cautions and restrictions notice must be included whenever information provided by the Natural Heritage Database is published.

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

APPENDIX B: METADATA FOR GIS DATA LAYERS USED FOR THE KINGWOOD TOWNSHIP ENVIRONMENTAL RESOURCE INVENTORY

Descriptions of Data Layers

Data Disclaimers in **Appendix A** apply to the use of these data layers and the maps created from them. The user is responsible for understanding the accuracy limitations of the digital data layers, as documented in the accompanying report and metadata summaries, and the metadata files which accompany the data.

Contents

1. Descriptions of GIS Data Layers
(Listed alphabetically by source and alphabetically by title of data layer.)

2. Summary of GIS Data Layers
(Grouped according to the figure(s) the layer is used in.)

1. Descriptions of Data Layers

Federal Emergency Management Agency

FEMA Flood Hazard Zones - Q3 Flood Data, HUNTERDON COUNTY, NEW JERSEY
Publication Date: 5/23/1996 Geospatial Data Presentation Format: vector digital data
Scale: 1:24,000 Online Linkage: FEMA_Flood_ES_redmap5353314.zip
Used for Figure: 6c
Short Description: The Q3 Flood Data are derived from the Flood Insurance Rate Maps (FIRMs) published by the Federal Emergency Management Agency (FEMA).

Hunterdon County GIS

NJDEP 10 Meter DEM Slopes and Steep Slopes
Publication Date: **4/15/2003** Geospatial Data Presentation Format: vector digital data
Scale: Online Linkage: http://gis.co.hunterdon.nj.us/Hunterdon/HC_GIS_MAP_Download.htm
Used for Figure: 3d
Short Description: Steep slopes in Hunterdon County.

Active Canals
Publication Date: Geospatial Data Presentation Format: vector digital data
Scale: Online Linkage: http://gis.co.hunterdon.nj.us/Hunterdon/HC_GIS_MAP_Download.htm
Used for Figure: 1d
Short Description: Active canals in Hunterdon County.

Boundary - Kingwood Boundary Clipped from Municipalities of Hunterdon County
Publication Date: 1/22/2001 Geospatial Data Presentation Format: vector digital data
Scale: 1:12,000 Online Linkage: http://gis.co.hunterdon.nj.us/website/HC_GIS_MAP_Download.htm
Used for Figure: most
Short Description: Boundary of Kingwood Township clipped from the layer of the boundaries of municipalities in Hunterdon.

Boundary - Municipalities of Hunterdon County
Publication Date: 1/22/2001 Geospatial Data Presentation Format: vector digital data
Scale: Online Linkage: http://gis.co.hunterdon.nj.us
Used for Figure: 1a
Short Description: Boundaries of municipalities in Hunterdon.

Contours - 20 feet - Kingwood Township
Publication Date: 7/19/2005 Geospatial Data Presentation Format: vector digital data
Scale: Online Linkage: http://gis.co.hunterdon.nj.us/Hunterdon/HC_GIS_MAP_Download.htm
Used for Figure: 3b
Short Description: This data set represents topographic elevation contour lines at 20 foot contours intervals for Kingwood Township. These data are georegistered to the NAD83 N.J. State Plane Coordinate System.

County Preserved Farmland
Publication Date: 4/21/2003 Geospatial Data Presentation Format: vector digital data
Scale: Online Linkage: http://gis.co.hunterdon.nj.us/Hunterdon/HC_GIS_MAP_Download.htm
Used for Figure: 11
Short Description: This data set represents farms preserved within Hunterdon County, and was obtained from the Hunterdon County GIS website. It does not include recently preserved properties.

Elevation Contours - 10 foot
Publication Date: 1/1/2003 Geospatial Data Presentation Format: vector digital data
Scale: Online Linkage: http://gis.co.hunterdon.nj.us/Hunterdon/HC_GIS_MAP_Download.htm
Used for Figure: 3b
Short Description: Elevation contours at 10 foot intervals.

Hunterdon CADB Agricultural Development Areas
Publication Date: 4/21/2003 Geospatial Data Presentation Format: vector digital data
Scale: Online Linkage: http://gis.co.hunterdon.nj.us/Hunterdon/HC_GIS_MAP_Download.htm
Used for Figure: 11
Short Description: This data set represents preserved Agricultural Development Areas within Hunterdon County, and was obtained from the Hunterdon County GIS website.

Lakes - Hunterdon County
Publication Date: 10/13/2000 Geospatial Data Presentation Format: vector digital data
Scale: 1:1,000 Online Linkage: http://gis.co.hunterdon.nj.us/Hunterdon/HC_GIS_MAP_Download.htm
Used for Figure: most
Short Description: Lakes located within or adjacent to Hunterdon County were digitized to provide a hydrologic dataset for use in base mapping and analysis.

Open Space - Hunterdon County
Publication Date: 4/21/2003 Geospatial Data Presentation Format: vector digital data
Scale: 1:12,000 Online Linkage: http://gis.co.hunterdon.nj.us/Hunterdon/HC_GIS_MAP_Download.htm

Used for Figure: 11
Short Description: This data set shows the location and relationship of all open space and recreational lands in the County of Hunterdon.

Parcels - Kingwood Township
Publication Date: 2/4/2004 Geospatial Data Presentation Format: vector digital data
Scale: Online Linkage: http:\\gis.co.hunterdon.nj.us
Used for Figure: most
Short Description: This data set represents tax map parcels in Kingwood Township, and was obtained from the Hunterdon County GIS website.

Railroads
Publication Date: 5/7/2007 Geospatial Data Presentation Format: vector digital data
Scale: 1:2,400 Online Linkage: http://gis.co.hunterdon.nj.us/Hunterdon/HC_GIS_MAP_Download.htm
Used for Figure: 1d
Short Description: This data set represents the railroad network for Hunterdon County.

Rivers - Hunterdon County
Publication Date: 10/16/2000 Geospatial Data Presentation Format: vector digital data
Scale: 1:1,000 Online Linkage: http://gis.co.hunterdon.nj.us/Hunterdon/HC_GIS_MAP_Download.htm
Used for Figure: most
Short Description: Rivers located within or adjacent to Hunterdon County were digitized to provide a hydrologic dataset for use in base mapping and analysis.

Road Centerlines - Hunterdon County
Publication Date: 9/12/2007 Geospatial Data Presentation Format: vector digital data
Scale: Online Linkage: http://gis.co.hunterdon.nj.us
Used for Figure: most
Short Description: All road and ramp centerlines for Hunterdon County, as delineated by centerline striping using GPS in January 1998.

Streams - Hunterdon County
Publication Date: 10/4/2000 Geospatial Data Presentation Format: vector digital data
Scale: Online Linkage: http://gis.co.hunterdon.nj.us/Hunterdon/HC_GIS_MAP_Download.htm
Used for Figure: most
Short Description: This data set represents streams within Hunterdon County, and was obtained from the Hunterdon County GIS website.

NJDEP Division of Landuse Management (DLM), Bureau of Freshwater & Biological Monitoring (BFBM)

Ambient Stream Quality Monitoring Sites (1998 - 2008)
Publication Date: 5/24/2007 Geospatial Data Presentation Format: vector digital data
Scale: Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/swpts.zip
Used for Figure: 6h
Short Description: This dataset is a GIS layer of points representing ambient stream sites monitored cooperatively by the NJDEP and the USGS for water quality parameters.

NJDEP AMNET Reference Sites with Ecoregion Sections for New Jersey
Publication Date: 2/26/2000 Geospatial Data Presentation Format: vector digital data
Scale: 1:12,000 Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/amnetref.zip
Used for Figure: 6h
Short Description: This data represents reference sites for the AMNET project at NJDEP. The NJDEP AMNET locations were selected because they were minimally impacted, had sampling data for 4 seasons, and provided a good point of comparison for other sites.

NJDEP Fish Index of Biotic Integrity Monitoring Network (2000-2006)
Publication Date: 12/19/2005 Geospatial Data Presentation Format: vector digital data
Scale: 1:24,000 Online Linkage: http://www.nj.gov/dep/gis/digidownload/zips/statewide/fibi2005.zip
Used for Figure: 6h
Short Description: This data represents the NJDEP Fish Index of Biotic Integrity (FIBI) Monitoring Network sample point locations for the years 2000 to 2006.

NJDEP Stormwater Rule Areas Affected by 300 Foot Buffers
Publication Date: 12/20/2005 Geospatial Data Presentation Format: vector digital data
Scale: 1:24,000 Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/strmwtrupc1.zip
Used for Figure: 6b
Short Description: The polygon layer was created by NJDEP to support water management and monitoring activities within NJDEP, and to be a valuable layer for computerized cartographic products. Please be advised that this layer is intended to be used as a GUIDE for finding areas that may be impacted by the stormwater rule.

NJDEP Supplemental Ambient Surfacewater Monitoring Network (SASMN)
Publication Date: 10/19/2007 Geospatial Data Presentation Format: vector digital data

Scale: 1:2,400 Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/sasmn.zip
Used for Figure: 6h
Short Description: This data represents sampling points for the Supplemental Ambient Surfacewater Monitoring Network (formerly EWQ) project at NJDEP. The SASMN Network was designed to provide supplemental data for water quality for the entire state.

NJDEP Surface Water Quality Standards of New Jersey
Publication Date: 9/30/2008 Geospatial Data Presentation Format: vector digital data
Scale: 1:24,000 Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/swqs.zip
Used for Figure: 6b
Short Description: This data, based on hydrography stream network, is a digital representation of New Jersey's Surface Water Quality Standards in accordance with "Surface Water Quality Standards for New Jersey Waters" as designated in N.J.A.C. 7:9 B. The Surface Water Quality Standards (SWQS) establish the designated uses to be achieved and specify the water quality (criteria) necessary to protect the State's waters. Designated uses include potable water, propagation of fish and wildlife, recreation, agricultural and industrial supplies, and navigation. In addition, a layer was created to show a 300 foot buffer around all C1 stream segments using ArcMap.

STORET Water Quality Monitoring Stations
Publication Date: 8/1/2005 Geospatial Data Presentation Format: vector digital data
Scale: Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/storet.zip
Used for Figure: 6h
Short Description: This GIS layer represents locations of water quality monitoring stations from NJDEP's NJ STORET database. NJ STORET maintains NJDEP's water quality monitoring data from January 1, 1999 to the present.

NJDEP Division of Watershed Management (DWM), Bureau of Watershed Regulation (BWR)

New Jersey Statewide Sewer Service Area
Publication Date: 11/30/2008 Geospatial Data Presentation Format: vector digital data
Scale: Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/statessa.zip
Used for Figure: 5e
Short Description: This is a graphical representation of the States Sewer Service Area (SSA) mapping. The SSA mapping shows the planned method of wastewater disposal for specific areas.

NJDEP Environmental Regulation (ER), Division of Water Quality (DWQ), Bureau of Point Source Permitting - Region 1 (PSP-R1)

NJPDES Surface Water Discharges in New Jersey, (1:12,000)
Publication Date: 11/20/2007 Geospatial Data Presentation Format: vector digital data
Scale: 1:12,000 Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/njpdesswd.zip
Used for Figure: 6b
Short Description: New Jersey Pollutant Discharge Elimination System (NJPDES) surface water discharge pipe GIS point coverage compiled from GPSed locations, NJPDES databases, and permit applications.

NJDEP Green Acres

NJDEP State Owned, Protected Open Space and Recreation Areas in NJ
Publication Date: 1/1/2005 Geospatial Data Presentation Format: vector digital data
Scale: varies Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/newstate.zip
Used for Figure: 11
Short Description: This data set contains protected open space and recreation areas owned in fee simple interest by the (NJDEP. Types of property in this data layer include parcels such as parks, forests, historic sites, natural areas and wildlife management areas. The data was derived from a variety of sources with variable scale and level of accuracy.

NJDEP Geological Survey

DGS00-1 NJDEP Drought Regions of New Jersey
Publication Date: 5/1/2004 Geospatial Data Presentation Format: vector digital data
Scale: 1:24,000 Online Linkage: http://www.state.nj.us/dep/njgs/geodata/dgs00-1.zip
Used for Figure: 12
Short Description: This shape file delineates New Jersey drought regions, counties, and municipalities. Drought regions provide a regulatory basis for coordinating local responses to regional water-supply shortages.

DGS02-1 New Jersey Geological Survey Hydro Database
Publication Date: 7/21/2005 Geospatial Data Presentation Format: tabular digital data
Scale: Online Linkage: http://www.state.nj.us/dep/njgs/geodata/dgs02-1.htm
Used for Figure: 5e

Short Description: The NJGS hydrologic properties database is a compilation of values for the hydrologic properties of geologic materials in New Jersey. The Microsoft (MS) Access97 database (hydro.mdb) includes values derived from the analysis of aquifer pumping tests, in-situ hydrologic testing such as slug injection and removal tests, lab permeameter tests, etc.

DGS02-2 GIS Coverages of Public Community Water Supply Well Head Protection Areas for New

Publication Date: 3/14/2005 Geospatial Data Presentation Format: vector digital data
Scale: 1:24,000 Online Linkage: http://www.state.nj.us/dep/njgs/geodata/dgs02-2.htm
Used for Figure: 5e
Short Description: A Well Head Protection Area (WHPA) in New Jersey is a map area calculated around a Public Community Water Supply (PCWS) well in New Jersey that delineates the horizontal extent of ground water captured by a well pumping at a specific rate over a two-, five-, and twelve-year period of time for confined wells.

DGS02-3 Ground Water Recharge for Hunterdon County, NJ

Publication Date: 10/8/2004 Geospatial Data Presentation Format: vector digital data
Scale: 1:24,000 Online Linkage: http://www.njgeology.org/geodata/dgs02-3/dgs02-3.htm
Used for Figure: 5d
Short Description: An estimation of ground-water recharge for Hunterdon County. Ground-water recharge is estimated using the NJGS methodology from NJ Geological Survey Report GSR-32. Land-use/land-cover, soil and municipality-based climatic data were combined and used to produce an estimate of ground-water recharge in inches/year.

DGS02-7 Physiographic Provinces of New Jersey

Publication Date: 6/30/2002 Geospatial Data Presentation Format: vector digital data
Scale: 1:100,000 Online Linkage: http://www.state.nj.us/dep/njgs/geodata/dgs02-7.htm
Used for Figure: 3a
Short Description: This data set delineates the boundaries of NJ's 4 Physiographic Provinces. The boundary between each province is determined by a major change in topography and geology.

DGS04-6 Bedrock Geology of New Jersey. (Scale 1:100,000) - bedrock

Publication Date: 6/30/1999 Geospatial Data Presentation Format: vector digital data
Scale: 1:100,000 Online Linkage: http://www.state.nj.us/dep/njgs/geodata/
Used for Figure: 2a
Short Description: The Bedrock Geology of New Jersey consists of statewide data layers (geology, faults, folds, dikes). The GIS data were scanned and digitized from United States Geological Survey Miscellaneous Investigations and Open-File Series 1:100,000 scale geologic maps compiled from 1984 to 1993.

DGS04-6 Bedrock Geology of New Jersey. (Scale 1:100,000) - folds

Publication Date: 6/30/1999 Geospatial Data Presentation Format: vector digital data
Scale: 1:100,000 Online Linkage: http://www.state.nj.us/dep/njgs/geodata/
Used for Figure: 2a
Short Description: NJGS scanned and digitized data from USGS 1:100,000 scale geologic maps compiled from 1984 to 1993.

DGS05-2 NJ's Ambient Ground Water Quality Network data

Publication Date: 5/24/2007 Geospatial Data Presentation Format: vector digital data
Scale: Online Linkage: http://www.njgeology.org/geodata/dgs05-2.htm
Used for Figure: 5e
Short Description: This data layer shows the point locations of wells sampled for the Ambient Ground-Water Quality Monitoring Network (AGWQMN), which is an NJDEP/USGS cooperative project.

DGS06-3: Landslides in New Jersey

Publication Date: 3/1/2007 Geospatial Data Presentation Format: vector digital data
Scale: Online Linkage: http://www.njgeology.org/geodata/dgs06-3.htm
Used for Figure: 2b
Short Description: This GIS point shapefile of Landslides in New Jersey contains point locations and other attributes for 133 historic and recent landslide locations in NJ mapped by the NJGS. The landslides have occurred in the northern and central part of the state and include slumps, debris flows, rockfalls and rockslides.

DGS98-5 Aquifers of New Jersey

Publication Date: 1/1/1998 Geospatial Data Presentation Format:
Scale: 1:250,000 Online Linkage: http://www.state.nj.us/dep/njgs/geodata/dgsdown/dgs98-5.zip
Used for Figure: 5b
Short Description: This data layer consists of the NJ Geological supply depiction of the aquifers of NJ.

DGS98-6 Sole-Source Aquifers of New Jersey (1:100,000)

Publication Date: 5/19/1998 Geospatial Data Presentation Format: vector digital data
Scale: 1:100,000 Online Linkage: http://www.state.nj.us/dep/njgs/geodata/dgs98-6.zip
Used for Figure: 5e
Short Description: This coverage allows users to identify EPA-defined sole-source aqufiers in New Jersey. This is in support of some federally-mandated programs.

DGS99-3 Surficial Geology of Hunterdon County, New Jersey (1:24,000)
Publication Date: 1/1/1993 Geospatial Data Presentation Format: vector digital data
Scale: 1:24,000 Online Linkage: http://www.state.nj.us/dep/njgs/geodata/dgs99-3.zip
Used for Figure: 2b
Short Description: DGS99-3 is an ARC/INFO Geographic Information Systems (GIS) coverage of surficial geologic materials of Hunterdon County, New Jersey. Surficial materials are the unconsolidated sediments that overlie bedrock formations, and that are the parent material for agronomic soils.

New Jersey Public Community Water Supply Wells Database
Publication Date: 3/3/2005 Geospatial Data Presentation Format: vector digital data
Scale: 1:24,000 Online Linkage: http://www.state.nj.us/dep/njgs/geodata/dgs97-1.zip
Used for Figure: 5e
Short Description: The Public Community Water Supply (PCWS) Wells is a GIS point coverage with associated Microsoft Access relational database. It contains information for the wells in New Jersey that supply potable water to public communities.

NJDEP 14 Digit Hydrologic Unit Code delineations for New Jersey (DEPHUC14)
Publication Date: 1/20/2006 Geospatial Data Presentation Format: vector digital data
Scale: 1:24,000 Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/dephuc14.zip
Used for Figure: 6a, 6b
Short Description: Drainage basins were delineated from 1:24,000-scale. This data is not field checked and has no guarantees as to its accuracy. The minimum polygon size has not been defined, but the 14-digit hydrologic units have a defined minimum size of 3,000 acres. Some basins are smaller, which gives a reasonable geographic arrangement to the 14 digit sub-watersheds.

NJDEP Natural and Historic Resources (NHR), Historic Preservation Office

NJDEP Merged Inventory Historic Properties of New Jersey
Publication Date: 10/20/2004 Geospatial Data Presentation Format: vector digital data
Scale: Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/historicalsites.z
Used for Figure: 10
Short Description: This data is produced and maintained by the New Jersey Historic Preservation Office (HPO) to provide provide accurate cultural resource information to government, regulated customers, and the public.

NJDEP Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS)

Boundary - NJDEP County Boundaries for the State of New Jersey
Publication Date: 1/23/2003 Geospatial Data Presentation Format: vector digital data
Scale: 1:24,000 Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/stco.zip
Used for Figure: 1a, 3a, 12
Short Description: New Jersey county boundaries were digitized into NJDEP's GIS to provide basic jurisdictional information.

Boundary - NJDEP County Boundary for Hunterdon County, New Jersey
Publication Date: 1/1/2003 Geospatial Data Presentation Format: vector digital data
Scale: 1:24,000 Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/cnb/huncnb.zip
Used for Figure: 1a, 3a, 12
Short Description: This data contains the Hunterdon County boundary.

Boundary - NJDEP Municipality Boundaries for the State of New Jersey
Publication Date: 11/14/2007 Geospatial Data Presentation Format: vector digital data
Scale: 1:24,000 Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/stmun.zip
Used for Figure: 1a, 3a, 12
Short Description: Municipal boundaries in New Jersey were gathered from USGS topoquads and other sources in 1987.

Boundary - NJDEP State Boundary of New Jersey
Publication Date: 11/1/1998 Geospatial Data Presentation Format: vector digital data
Scale: 1:24,000 Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/state.zip
Used for Figure: 1a, 3a, 12
Short Description: This data represents the New Jersey State Boundary.

Natural Heritage Grid Map
Publication Date: 2/1/2004 Geospatial Data Presentation Format: vector digital data
Scale: 1:24,000 Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/nhpgrid.zip
Used for Figure: 9b
Short Description: The Natural Heritage Grid Map was produced by the Office of Natural Lands Management (ONLM) to provide a general portrayal of the geographic locations of rare plant species and ecological communities for the entire state without providing sensitive detailed information.

New Jersey 2002 High Resolution Orthophotography (59 files)
Publication Date: 7/31/2003 Geospatial Data Presentation Format: remote sensing image

Scale: 1:2,400 Online Linkage: http://njgin.nj.gov/OIT_IW/
Used for Figure: 1c
Short Description: Digital color infrared (CIR) orthophotography of New Jersey in State Plane NAD83 Coordinates, U.S. Survey Feet. The digital orthophotography was produced at a scale of 1:2400 (1"=200') with a 1 foot pixel resolution. Digital orthophotography combines the image characteristics of a photograph with the geometric qualities of a map. There are 45 files which cover Holland Township.

NJDEP 10-meter Digital Elevation Grid of the Central Delaware Watershed Management Area

Publication Date: 6/1/2002 Geospatial Data Presentation Format: raster digital data
Scale: 1:24,000 Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/wmalattice/wma11lat.zip
Used for Figure: 3c
Short Description: A lattice is the ESRI GRID raster file generated from USGS DEM files. Digital Elevation Model (DEM) is the terminology adopted by the USGS to describe terrain elevation data sets in a digital raster form. A lattice can be used as source data to create other layers which require elevation information. Examples of layers which can be derived from a lattice include aspect, contour, hillshade, slope, flow accumulation and flow direction.

NJDEP 2002 Land use/Land cover Update, Central Delaware Watershed Mgmt. Area, WMA-11 (ed. 03/2008)

Publication Date: 3/4/2008 Geospatial Data Presentation Format: vector digital data
Scale: 1:2,400 Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/lulc02/w11lu02.zip
Used for Figure: 1f, 1g, 7a
Short Description: The 2002 Land Use/Land Cover (LU/LC) data sets were mapped by Watershed Management Area (WMA). There are additional reference documents listed in this file under Supplemental Information which should also be examined by users of these data sets. The data was created by comparing the 1995/97 land use/land cover (LU/LC) layer from NJ DEP's geographical information systems (GIS) database to 2002 color infrared (CIR) imagery and delineating areas of change. The digital orthophotography was produced at a scale of 1:2400 (1"=200') with a 1 foot pixel resolution.

NJDEP 2002 Streams Update for New Jersey (DRAFTS) for WMA11

Publication Date: 10/1/2005 Geospatial Data Presentation Format: vector digital data
Scale: 1:2,400 Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/hydro02/w11hydro02.zip
Used for Figure: 6a
Short Description: Streams dataset created by heads-up digitizing of hydrography features from the 2002 color infrared (CIR) imagery.

NJDEP 2002 Waters of New Jersey (Lakes and Ponds), Version 20080501

Publication Date: 05/01/2008 Geospatial Data Presentation Format: vector digital data
Scale: 1:24,000 Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/njwaterbody.zip
Used for Figure: most
Short Description: This metadata file contains generic water body information which was transferred from several sources to polygons extracted from the 2002 Land Use/Land Cover data sets..

NJDEP Linear Non-Tidal Wetlands of Hunterdon County, New Jersey, 1986

Publication Date: 11/1/1998 Geospatial Data Presentation Format: vector digital data
Scale: 1:12,000 Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/line/hunline.zip
Used for Figure: 6d
Short Description: This data was derived from the freshwater wetlands (FWW) data generated under the New Jersey Freshwater Wetlands Mapping Program. The FWW are network coverages with both linear and polygon wetlands delineated and coded. Linear wetlands features were reselected out of FWW to form this dataset. Any arc that was a linear wetland feature was given a valid wetlands (CLASS) code in the original data set. This dataset is intended to serve as a resource for analysis rather than regulatory delineations. The NJDEP may change the linework based on more in depth analysis and field inspection for regulatory purposes. In addition, a layer showing a 150 foot buffer (which will not apply to all wetlands) around all linear wetlands was created with ArcMap.

NJDEP Natural Priority Sites

Publication Date: 3/1/2007 Geospatial Data Presentation Format: vector digital data
Scale: 1:24,000 Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/prisites.zip
Used for Figure: 9a
Short Description: The Natural Heritage Priority Sites Coverage was created to identify the best habitats for rare plant and animal species and natural communities through analysis of information in the NJ Natural Heritage Database.

NJDEP Place Name Locations in the State of New Jersey

Publication Date: 8/6/2004 Geospatial Data Presentation Format: vector digital data
Scale: 1:24,000 Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/placenam04.zip
Used for Figure: 1d
Short Description: The place name locations in this data were obtained via download from the United States Geological Survey, taken from the USGS 7.5' topoquad series revised in 2004.

NJDEP Watershed Management Areas in New Jersey

Publication Date: 4/5/2000 Geospatial Data Presentation Format: vector digital data
Scale: 1:24,000 Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/depwmas.zip
Used for Figure: 12
Short Description: This layer is a simplified version of the ARC/INFO dephuc14 data, and shows the outlines of the watershed management regions and areas to be used for the statewide watershed initiative.

Wetlands selected from 2002 Land Use/Land Cover (March 2008 edition)

Publication Date: 3/4/2008 Geospatial Data Presentation Format: vector digital data
Scale: 1:2,400 Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/lulc02/w11lu02.zip
Used for Figure: 6d
Short Description: This is a graphical representation wetlands based on the 2002 land use/land cover information (March 2008 edition). It was created by selecting only wetlands type land uses. This data is intended to serve as a resource for analysis rather than regulatory delineations. The NJDEP may change the linework based on more in depth analysis and field inspection for regulatory purposes. In addition, a 150 foot buffer (which will not apply to all wetlands) was created around all wetlands using ArcMap.

NJDEP Site Remediation Program and Waste Management (SRWM)

NJDEP Known Contaminated Site List for New Jersey, 2005

Publication Date: 11/18/2005 Geospatial Data Presentation Format: vector digital data
Scale: 1:1,000 Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/kcsl.zip
Used for Figure: 5e
Short Description: The Known Contaminated Sites List for New Jersey 2005 are those sites and properties within the state where contamination of soil or ground water has been identified or where there has been, or there is suspected to have been, a discharge of contamination. This list of Known Contaminated Sites may include sites where remediation is either currently under way, required but not yet initiated or has been completed.

NJDEP Bureau of Standards and Assessment, Water Assessment Team

NJDEP 2006 Water Quality Monitoring and Assessment Report (Integrated List)

Publication Date: 1/11/2007 Geospatial Data Presentation Format: vector digital data
Scale: Online Linkage: http://www.state.nj.us/dep/gis/digidownload/zips/statewide/ir_2006.zip
Used for Figure: 6h
Short Description: his data set spatially represents the assessment results for the 2006 Integrated Report (305(b), 303(d) results). This contains NJ waterbodies and the status for each designated use assessment .

Rutgers University Center for Remote Sensing & Spatial Analysis

Vernal Pools

Publication Date: Geospatial Data Presentation Format:
Scale: Online Linkage:
Used for Figure: 7a
Short Description: Vernal Pools locations obtained from Rutgers website and plotted as point locations on map.

United States Department of Agriculture, Natural Resources Conservation Service

Soil Survey Geographic 2005 (SSURGO) Database for Hunterdon

Publication Date: 12/7/2006 Geospatial Data Presentation Format: vector digital data
Scale: 1:20,000 Online Linkage: http://SoilDataMart.nrcs.usda.gov/
Used for Figure: 4a-h, 6c, 6d
Short Description: SSURGO depicts information about the kinds and distribution of soils on the landscape. The soil map and data used in the SSURGO product were prepared by soil scientists as part of the National Cooperative Soil Survey. Hunterdon County soils data sets were downloaded from the Natural Resource Conservation Service (NRCS) Soil Data Mart. The soil map units are linked to attributes and interpretations in the National Soil Information System relational database. Photographic or digital enlargement of these maps to scales greater than at which they were originally mapped can cause misinterpretation of the data. The depicted soil boundaries, interpretations, and analysis derived from them do not eliminate the need for onsite sampling, testing, and detailed study of specific sites for intensive uses. Thus, these data and their interpretations are intended for planning purposes only.

United States Geological Survey

DGS99-1: USGS Topo Quads

Publication Date: 5/27/1999 Geospatial Data Presentation Format: bitmap images
Scale: 1:24,000 Online Linkage: http://www.state.nj.us/dep/njgs/geodata/index.htm
Used for Figure: 1d

Short Description: N.J. Geological Survey DGS99-1 is a set of monochromatic, bit-mapped, TIFF (tagged image file format) images covering New Jersey. The images are derived from the U.S. Geological Survey 7-1/2' topographic quadrangle map Digital Raster Graphics (DRG) imagery.

Digital Orthophoto Quadrangles (DOQQ) 1995 - Kingwood (8 files)

Publication Date: 11/1/1997 Geospatial Data Presentation Format: remote-sensing image
Scale: 1:40,000 Online Linkage: http://njgin.nj.gov/OIT_IW/index.jsp
Used for Figure: 1b
Short Description:

United States Geological Survey, Water Resource Division

USGS stream crest gaging locations in New Jersey

Publication Date: 4/17/2002 Geospatial Data Presentation Format: vector digital data
Scale: Online Linkage: http://www.njgeology.org/geodata/dgs02-5/creststage.zip
Used for Figure: 6h
Short Description: This dataset is a GIS point coverage of stream crest gaging stations within the USGS, WRD streamflow-data-collection networks in the New Jersey District. Some of these sites are measured occasionally. Other points in this coverage represent discontinued gages.

USGS stream lowflow gaging locations in New Jersey

Publication Date: 4/17/2002 Geospatial Data Presentation Format: vector digital data
Scale: 1:24,000 Online Linkage: http://www.njgeology.org/geodata/dgs02-5/lowflow.zip
Used for Figure: 6h
Short Description: This dataset is a GIS point coverage of stream lowflow gaging stations within the United States Geological Survey (USGS), Water Resource Division (WRD) streamflow-data-collection networks in the New Jersey District. Some of these sites are currently reporting streamflow data on the Interent.

USGS surface-water quality gaging stations in New Jersey

Publication Date: 4/17/2002 Geospatial Data Presentation Format: vector digital data
Scale: 1:24,000 Online Linkage: http://www.njgeology.org/geodata/dgs02-5/wqgages.zip
Used for Figure: 6h
Short Description: This dataset is a GIS point coverage of water-quality gaging stations within the United States Geological Survey (USGS), Water Resource Division (WRD) streamflow-data-collection networks in the New Jersey District. Some of these sites are currently reporting water quality data on the Interent.

2. Summary of GIS Data Layers (layers in bold were updated since the 2004 ERI)

Map	Source of Data	Data Title	Date
most			
	Hunterdon County	Boundary - Kingwood Boundary Clipped from Municipalities of Hunterdon County	1/22/2001
	NJDEP, OIRM, BGIS	**Lakes – NJ Waterbody**	**6/19/2008**
	Hunterdon County	Parcels - Kingwood Township	2/4/2004
	Hunterdon County	Rivers - Hunterdon County	10/16/2000
	Hunterdon County	**Road Centerlines - Hunterdon County**	**9/12/2007**
	Hunterdon County	Streams - Hunterdon County	10/4/2000
1a			
	Hunterdon County	Boundary - Municipalities of Hunterdon County	1/22/2001
1a, 3a, 12			
	NJDEP, OIRM, BGIS	Boundary - NJDEP County Boundaries for the State of New Jersey	1/23/2003
	NJDEP, OIRM, BGIS	Boundary - NJDEP County Boundary for Hunterdon County, New Jersey	1/1/2003
	NJDEP, OIRM, BGIS	**Boundary - NJDEP Municipality Boundaries for the State of New Jersey**	**11/14/2007**
	NJDEP, OIRM, BGIS	Boundary - NJDEP State Boundary of New Jersey	11/1/1998
1b			
	USGS	Digital Orthophoto Quadrangles (DOQQ) 1995 - Kingwood (8 files)	11/1/1997
1c			
	NJDEP, OIRM, BGIS	New Jersey 2002 High Resolution Orthophotography (59 files)	7/31/2003
1d			
	Hunterdon County	Active Canals	
	Hunterdon County	**Railroads**	**5/7/2007**
	NJDEP, OIRM, BGIS	**NJDEP Place Name Locations in the State of New Jersey**	**8/6/2004**
	USGS	DGS99-1: USGS Topo Quads	5/27/1999
1f, 1g, 7a			
	NJDEP, OIRM, BGIS	**NJDEP 2002 Land use/Land cover Update, Central Delaware Watershed Mgmt. Area, WMA-11 (ed. 03/2008)**	**3/4/2008**
2a			
	NJDEP, GS	DGS04-6 Bedrock Geology of New Jersey. (Scale 1:100,000) - bedrock	6/30/1999
	NJDEP, GS	DGS04-6 Bedrock Geology of New Jersey. (Scale 1:100,000) - folds	6/30/1999
2b			
	NJDEP, GS	**DGS06-3: Landslides in New Jersey**	**3/1/2007**
	NJDEP, GS	DGS99-3 Surficial Geology of Hunterdon County, New Jersey (1:24,000)	1/1/1993
3a			
	NJDEP, GS	DGS02-7 Physiographic Provinces of New Jersey	6/30/2002
3b			
	Hunterdon County	**Contours - 20 feet - Kingwood Township**	**7/19/2005**
	Hunterdon County	Elevation Contours - 10 foot	1/1/2003
3c			
	NJDEP, OIRM, BGIS	NJDEP 10-meter Digital Elevation Grid of the Central Delaware Watershed Management Area (WMA 11)	6/1/2002
3d			
	Hunterdon County	**NJDEP 10 Meter DEM Slopes and Steep Slopes**	**4/15/2003**
4a-h, 6c, 6d			
	USDA, NRCS	**Soil Survey Geographic 2005 (SSURGO) Database for Hunterdon**	**12/7/2006**
5b			
	NJDEP, GS	DGS98-5 Aquifers of New Jersey	1/1/1998
5d			
	NJDEP, GS	**DGS02-3 Ground Water Recharge for Hunterdon County, NJ**	**10/8/2004**
5e			
	NJDEP, DWQ, BNPC	**NJPDES Regulated Discharge to Ground Water Facility Locations**	**7/18/2007**
	NJDEP, GS	**DGS02-1 New Jersey Geological Survey Hydro Database**	**7/21/2005**
	NJDEP, GS	**DGS02-2 GIS Coverages of Public Community Water Supply Well Head Protection Areas for New Jersey**	**3/14/2005**

	NJDEP, GS	**DGS05-2 NJ's Ambient Ground Water Quality Network data**	**5/24/2007**
	NJDEP, GS	DGS98-6 Sole-Source Aquifers of New Jersey (1:100,000)	5/19/1998
	NJDEP, GS	**New Jersey Public Community Water Supply Wells Database**	**3/3/2005**
	NJDEP, SRWM	**NJDEP Known Contaminated Site List for New Jersey, 2005**	**11/18/2005**
5e			
	NJDEP, DWM, BWR	**New Jersey Statewide Sewer Service Area**	**11/30/2008**
6a			
	NJDEP, OIRM, BGIS	**NJDEP 2002 Streams Update for New Jersey (DRAFTS) for WMA11**	**10/1/2005**
6a, 6b			
	NJDEP, GS	**NJDEP 14 Digit Hydrologic Unit Code delineations for New Jersey** (DEPHUC14)	**1/20/2006**
6b			
	NJDEP, DLM, BFBM	**NJDEP Stormwater Rule Areas Affected by 300 Foot Buffers**	**12/20/2005**
	NJDEP, DLM, BFBM	**NJDEP Surface Water Quality Standards of New Jersey**	**9/30/2008**
	NJDEP, ER, DWQ,PSPR1	**NJPDES Surface Water Discharges in New Jersey, (1:12,000)**	**11/20/2007**
6c			
	FEMA	FEMA Flood Hazard Zones - Q3 Flood Data, HUNTERDON COUNTY, NEW JERSEY	5/23/1996
6d			
	NJDEP, OIRM, BGIS	NJDEP Linear Non-Tidal Wetlands of Hunterdon County, New Jersey, 1986	11/1/1998
	NJDEP, OIRM, BGIS	**Wetlands selected from 2002 Land Use/Land Cover (March 2008 edition)**	**3/4/2008**
6h			
	NJDEP, DLM, BFBM	**Ambient Stream Quality Monitoring Sites (1998 - 2008)**	**5/24/2007**
	NJDEP, DLM, BFBM	NJDEP AMNET Reference Sites with Ecoregion Sections for New Jersey	2/26/2000
	NJDEP, DLM, BFBM	**NJDEP Fish Index of Biotic Integrity Monitoring Network (2000-2006)**	**12/19/2005**
	NJDEP, DLM, BFBM	**NJDEP Supplemental Ambient Surfacewater Monitoring Network (SASMN)**	**10/19/2007**
	NJDEP, DLM, BFBM	**STORET Water Quality Monitoring Stations**	**8/1/2005**
	NJDEP, WAT	**NJDEP 2006 Water Quality Monitoring and Assessment Report (Integrated List)**	**1/11/2007**
	USGS, WRD	USGS stream crest gaging locations in New Jersey	4/17/2002
	USGS, WRD	USGS stream lowflow gaging locations in New Jersey	4/17/2002
	USGS, WRD	USGS surface-water quality gaging stations in New Jersey	4/17/2002
7a			
	Rutgers CRSSA	Vernal Pools	
8a, 8c			
	NJDEP, ENSP	NJDEP Landscape Project - Emergent (version 2)	2/1/2004
	NJDEP, ENSP	NJDEP Landscape Project - Forested Wetland (version 2)	2/1/2004
	NJDEP, ENSP	NJDEP Landscape Project - Wood Turtle (version 2)	2/1/2004
8b, 8c			
	NJDEP, ENSP	NJDEP Landscape Project - Forest (version 2)	2/1/2004
	NJDEP, ENSP	NJDEP Landscape Project - Grassland (version 2)	2/1/2004
9a			
	NJDEP, OIRM, BGIS	**NJDEP Natural Priority Sites**	**3/1/2007**
9b			
	NJDEP, OIRM, BGIS	Natural Heritage Grid Map	2/1/2004
10			
	NJDEP, NHR, HPO	**NJDEP Merged Inventory Historic Properties of New Jersey**	**10/20/2004**
	Local sources	database linked to parcels	06/2004
11			
	Hunterdon County	County Preserved Farmland	4/21/2003
	Hunterdon County	Hunterdon CADB Agricultural Development Areas	4/21/2003
	Hunterdon County	Open Space - Hunterdon County	4/21/2003
	NJDEP, GA	**NJDEP State Owned, Protected Open Space and Recreation Areas in NJ**	**1/1/2005**
	Local sources	**database linked to parcels**	**01/2008**
12			
	NJDEP, GS	DGS00-1 NJDEP Drought Regions of New Jersey	5/1/2004
	NJDEP, OIRM, BGIS	NJDEP Watershed Management Areas in New Jersey	4/5/2000

APPENDIX C. ENDANGERED SPECIES

Contents:

1. List of Rare Species of Hunterdon County

2. Rare Species Reporting Form

The following fact sheets are authored by the NJDEP Endangered and Nongame Species Program. These rare species have been reported within Kingwood Township. Fact sheets were not available for all species.

3. Fact Sheet: Bobolink	File Name: appendix_C_bobolink.pdf
4. Fact Sheet: Red Shouldered hawk	File Name: appendix_C_redshldhawk.pdf
5. Fact Sheet: Vesper Sparrow	File Name: appendix_C_vespersparrow.pdf
6. Fact Sheet: Longtail Salamander	File Name: appendix_C_lngtlsalamander.pdf
7. Fact Sheet: Wood Turtle	File Name: appendix_C_woodturtle.pdf
8. Fact Sheet: Mussels	File Name: appendix_C_mussels.pdf

HUNTERDON COUNTY
RARE SPECIES AND NATURAL COMMUNITIES
PRESENTLY RECORDED IN THE NEW JERSEY NATURAL HERITAGE DATABASE

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	GRANK	SRANK
*** Vertebrates					
ACCIPITER COOPERII	COOPER'S HAWK		T/T	G5	S3B,S4N
AMMODRAMUS HENSLOWII	HENSLOW'S SPARROW		E	G4	S1B
AMMODRAMUS SAVANNARUM	GRASSHOPPER SPARROW		T/S	G5	S2B
ASIO OTUS	LONG-EARED OWL		T/T	G5	S2B,S2N
BARTRAMIA LONGICAUDA	UPLAND SANDPIPER		E	G5	S1B
BUTEO LINEATUS	RED-SHOULDERED HAWK		E/T	G5	S1B,S2N
CIRCUS CYANEUS	NORTHERN HARRIER		E/U	G5	S1B,S3N
CISTOTHORUS PLATENSIS	SEDGE WREN		E	G5	S1B
CLEMMYS INSCULPTA	WOOD TURTLE		T	G4	S3
CLEMMYS MUHLENBERGII	BOG TURTLE	LT	E	G3	S2
CROTALUS HORRIDUS HORRIDUS	TIMBER RATTLESNAKE		E	G4T4	S2
DOLICHONYX ORYZIVORUS	BOBOLINK		T/T	G5	S2B
EURYCEA LONGICAUDA LONGICAUDA	LONGTAIL SALAMANDER		T	G5T5	S2
HALIAEETUS LEUCOCEPHALUS	BALD EAGLE	LT	E	G4	S1B,S2N
LYNX RUFUS	BOBCAT		E	G5	S3
MELANERPES ERYTHROCEPHALUS	RED-HEADED WOODPECKER		T/T	G5	S2B,S2N
PASSERCULUS SANDWICHENSIS	SAVANNAH SPARROW		T/T	G5	S2B,S4N
PETROCHELIDON PYRRHONOTA	CLIFF SWALLOW		S/S	G5	S2B
POOECETES GRAMINEUS	VESPER SPARROW		E	G5	S1B,S2N
STRIX VARIA	BARRED OWL		T/T	G5	S3B
*** Ecosystems					
CAVE AQUATIC COMMUNITY	CAVE AQUATIC COMMUNITY			G4?	S2
CAVE TERRESTRIAL COMMUNITY	CAVE TERRESTRIAL COMMUNITY			G4?	S3
SHALE CLIFF/ROCK OUTCROP COMMUNITY	SHALE CLIFF/ROCK OUTCROP COMMUNITY			G3	S2?
*** Invertebrates					
ALASMIDONTA UNDULATA	TRIANGLE FLOATER			G4	S3
CICINDELA MARGINIPENNIS	COBBLESTONE TIGER BEETLE			G2G3	S1
ENALLAGMA BASIDENS	DOUBLE-STRIPED BLUET			G5	S3
LAMPSILIS CARIOSA	YELLOW LAMPMUSSEL			G3G4	S1

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	GRANK	SRANK
LEPTODEA OCHRACEA	TIDEWATER MUCKET			G4	S1
POLYGONIA PROGNE	GRAY COMMA			G5	SH
PTICHODIS BISTRIGATA	SOUTHERN PTICHODIS			G3	S1S3
*** Other types					
BAT HIBERNACULUM	BAT HIBERNACULUM			G?	S2
*** Vascular plants					
ADLUMIA FUNGOSA	CLIMBING FUMITORY			G4	S2
AGASTACHE NEPETOIDES	YELLOW GIANT-HYSSOP			G5	S2
AGASTACHE SCROPHULARIIFOLIA	PURPLE GIANT-HYSSOP			G4	S2
AGRIMONIA MICROCARPA	SMALL-FRUIT GROOVEBURR			G5	S2
ARISTOLOCHIA SERPENTARIA	VIRGINIA SNAKEROOT			G4	S3
ASIMINA TRILOBA	PAWPAW		E	G5	S1
ASPLENIUM PINNATIFIDUM	LOBED SPLEENWORT		E	G4	S1
ASTER PRAEALTUS	WILLOW-LEAF ASTER		E	G5T5?	S1
BOTRYCHIUM ONEIDENSE	BLUNT-LOBE GRAPE FERN			G4Q	S2
CACALIA ATRIPLICIFOLIA	PALE INDIAN PLANTAIN		E	G4G5	S1
CARDAMINE ANGUSTATA	SLENDER TOOTHWORT			G5	S3
CAREX AMPHIBOLA VAR AMPHIBOLA	NARROW-LEAF SEDGE		E	G5T4Q	S1
CAREX BUSHII	BUSH'S SEDGE		E	G4	S1
CAREX DEWEYANA	DEWEY'S SEDGE		E	G5T5	S1
CAREX FRANKII	FRANK'S SEDGE			G5	S3
CAREX HITCHCOCKIANA	HITCHCOCK'S SEDGE			G5	S2
CAREX JAMESII	JAMES' SEDGE		E	G5	S1
CAREX LEPTONERVIA	FINE-NERVE SEDGE		E	G4	S1
CAREX MEADII	MEAD'S SEDGE			G4G5	SX.1
CAREX OLIGOCARPA	FEW-FRUIT SEDGE		E	G4	S1
CAREX PALLESCENS	PALE SEDGE			G5	S2
CAREX WILLDENOWII VAR WILLDENOWII	WILLDENOW'S SEDGE			G5T5	S2
CASTILLEJA COCCINEA	SCARLET INDIAN-PAINTBRUSH			G5	S2
CERCIS CANADENSIS	REDBUD		E	G5T5	S1
CHEILANTHES LANOSA	HAIRY LIPFERN			G5	S2
CHENOPODIUM SIMPLEX	MAPLE-LEAF GOOSEFOOT			G5	S2
CRATAEGUS CALPODENDRON	PEAR HAWTHORN		E	G5	S1
CRATAEGUS DODGEI	DODGE'S HAWTHORN			G4	S2
CRATAEGUS HOLMESIANA	HOLMES' HAWTHORN			G5	S1
CRATAEGUS SUCCULENTA	FLESHY HAWTHORN		E	G5	S1

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	GRANK	SRANK
CUSCUTA CEPHALANTHI	BUTTONBUSH DODDER		E	G5	S1
CYNOGLOSSUM VIRGINIANUM VAR VIRGINIANUM	WILD COMFREY			G5T5	S2
CYSTOPTERIS PROTRUSA	LOWLAND FRAGILE FERN			G5	S2
DESMODIUM HUMIFUSUM	TRAILING TICK-TREFOIL		E	G1G2Q	SH
DICENTRA CANADENSIS	SQUIRREL-CORN		E	G5	S1
DOELLINGERIA INFIRMA	CORNEL-LEAF ASTER			G5	S2
DRABA REPTANS	CAROLINA WHITLOW-GRASS		E	G5	SH
ELLISIA NYCTELEA	AUNT LUCY		E	G5	S1
ERAGROSTIS FRANKII	FRANK'S LOVE GRASS			G5	S2
HYBANTHUS CONCOLOR	GREEN VIOLET		E	G5	S1
HYDROPHYLLUM CANADENSE	BROAD-LEAF WATERLEAF		E	G5	S1
HYPERICUM PYRAMIDATUM	GREAT ST. JOHN'S-WORT			G4	S3
ISOTRIA MEDEOLOIDES	SMALL WHORLED POGONIA		E	G2	S1
JEFFERSONIA DIPHYLLA	TWINLEAF		E	G5	S1
KUHNIA EUPATORIOIDES	FALSE BONESET		E	G5T5	S1
LATHYRUS VENOSUS	VEINY VETCHLING		E	G5	SH
LECHEA INTERMEDIA VAR INTERMEDIA	LARGE-POD PINWEED			G5T4T5	S2
LEMNA VALDIVIANA	PALE DUCKWEED		E	G5	S1
LINUM SULCATUM	GROOVED YELLOW FLAX		E	G5T5	S1
MONARDA CLINOPODIA	BASIL BEEBALM		E	G5	SH
ONOSMODIUM VIRGINIANUM	VIRGINIA FALSE-GROMWELL		E	G4	S1
PANICUM OLIGOSANTHES VAR OLIGOSANTHES	FEW-FLOWER PANIC GRASS			G5T5?	S1S2
PENSTEMON LAEVIGATUS	SMOOTH BEARDTONGUE		E	G5	S1
PHLOX PILOSA	DOWNY PHLOX		E	G5T5	SH
PINUS PUNGENS	TABLE MOUNTAIN PINE		E	G4	S1.1
PRUNUS ALLEGHANIENSIS	ALLEGHENY PLUM		E	G4T4	S1
PRUNUS PUMILA VAR DEPRESSA	LOW SAND CHERRY			G5T5	S2
PTELEA TRIFOLIATA	WAFER-ASH		E	G5T5	S1
PYCNANTHEMUM CLINOPODIOIDES	BASIL MOUNTAIN-MINT		E	G2	S1
PYCNANTHEMUM TORREI	TORREY'S MOUNTAIN-MINT		E	G2	S1
RANUNCULUS MICRANTHUS	ROCK BUTTERCUP			G5	S2
RANUNCULUS TRICHOPHYLLUS VAR TRICHOPHYLLUS	THREAD-LEAF WATER BUTTERCUP			G5T5	S2
RHYNCHOSPORA GLOBULARIS	COARSE GRASS-LIKE BEAKED-RUSH		E	G5?	S1
RIBES MISSOURIENSE	MISSOURI GOOSEBERRY		E	G5	S1

NAME	COMMON NAME	FEDERAL STATUS	STATE STATUS	GRANK	SRANK
RUDBECKIA FULGIDA	ORANGE CONEFLOWER		E	G5T4?	S1
SALIX LUCIDA SSP LUCIDA	SHINING WILLOW			G5T5	S1
SCUTELLARIA NERVOSA	VEINED SKULLCAP			G5	S2
SEDUM TELEPHIOIDES	ALLEGHENY STONECROP			G4	SX.1
SELAGINELLA RUPESTRIS	ROCK SPIKE-MOSS			G5	S2
SOLIDAGO RIGIDA	PRAIRIE GOLDENROD		E	G5T5	S1
STACHYS TENUIFOLIA	SMOOTH HEDGE-NETTLE			G5	S3
STELLARIA PUBERA	STAR CHICKWEED		E	G5	SH
TRIOSTEUM ANGUSTIFOLIUM	NARROW-LEAF HORSE-GENTIAN		E	G5	S1
VALERIANELLA RADIATA	BEAKED CORNSALAD		E	G5	S1
VERBENA SIMPLEX	NARROW-LEAF VERVAIN		E	G5	S1
VICIA CAROLINIANA	CAROLINA WOOD VETCH		E	G5	S1
VIOLA CANADENSIS	CANADIAN VIOLET		E	G5T?	S1
108 Records Processed					

Code	Definition
Federal Status	**Federal Status (U.S. Fish and Wildlife Service definitions)**
LT	Taxa formally listed as threatened.
Species Status	**State Status**
E	Endangered: Applies to a species whose prospects for survival within the state are in immediate of extinction within NJ.
T	Threatened: Applies to species that may become Endangered if conditions surrounding it begin to or continue to deteriorate.
SRank	**State Rank Definitions**
S1	Critically imperiled in New Jersey.
S2	Imperiled in New Jersey.
S3	Rare in state. Species ranked S3 are not yet imperiled in state but may soon be if additional populations are destroyed.
B	Refers to the breeding population of the element in the state.
N	Refers to the non-breeding population of the element in the state.
Note:	To express uncertainty, the most likely rank is assigned and a question mark added (e.g., G2?). A range is indicated by combining two ranks (e.g., G1G2, S1S3).
Source: http://www.nj.gov/dep/parksandforests/natural/heritage/spplant_ap1.html for complete code definitions.	

Natural Heritage Rare Species Reporting Form

This form is used to report a personal field sighting of a rare species tracked by the Natural Heritage Database. It may also be used to summarize locational information from a published or unpublished report. Species tracked include those appearing on the Special Plants of New Jersey List and the Special Animals of New Jersey List. The Office of Natural Lands Management can provide copies of the lists upon request. Note: For anadromous fish species, only reports of spawning areas are requested. For most bird species, only breeding reports are requested. Consult the Endangered and Nongame Species Program to determine if a non-breeding report of a bird species is desired.

In order for this form to be processed, the sections preceded by an asterisk (*) must be completed.

Send completed form to : DEP - Division of Parks and Forestry, Office of Natural Lands Management, Natural Heritage Program, PO Box 404, Trenton, NJ 08625-0404. Forms for endangered and nongame wildlife will be forwarded to the Endangered and Nongame Species Program for review.

Common Name_____

***Scientific Name**_____

Today's Date_____

Location:

***Location Map:** A mapped location of the occurrence must accompany this form. The ideal format is to locate the site on a photocopied section of a USGS 7.5 minute topo map, and to also sketch a second map showing finer details. Be sure to provide the name of the USGS map.

***Directions to Site:** Describe how to get to the site from a readily relocated permanent landmark such as a road intersection.

_____

_____

_____

_____

Biology/Habitat:

*Date and Approximate Time of the Observation:

_____

Weather Conditions (animal reports):

clear ____overcast ____calm ____windy____

Describe temperature, precipitation, and other significant weather factors:

_____

_____

_____

Identification: How was the species identification made? Was it based on a sighting, tracks, call, or road kill? Name the identification manuals used or the experts consulted. Were there identification problems?

_____

_____

_____

_____

***Number of Individuals Observed:**

1-10 ____ 11-50 ____ 51-100 ____ 101-1000 ____ 1001-10,000 ____ >10,000____

If possible, provide the exact number of individuals. For rhizomatous plants such as grasses and sedges, what was counted as an individual - separate culms or entire clumps or patches?

_____

_____

_____

Life Stages Present: Check off life stages observed or provide an estimate of the numbers of individuals for each life stage.

For plants:

vegetative ____ in bud ____ flower ____ fruit____ seed dispersing ____ seedling ____ dormant ____

For animals: eggs ____ larvae ____ immature _____ adult female ____

adult male _____ adult, sex unknown ____

Associated Species: List any associated species such as predators, prey, food plants, parasites, host species, and additional rare species observed at the site.

_____

_____

_____

_____

***Additional Biological Data:** What else was observed? Provide information on the general condition or vigor of the individuals and viability of the population, and animal behavior such as mating or nesting behavior.

_____

_____

_____

_____

_____

Habitat Data: Describe the general area where the occurrence is located. List natural community types, dominant vegetation, and information on the physical environment such as substrate type, hydrology, moisture regime, slope, and aspect. Also, if possible, provide information on the surrounding land use.

_____

_____

_____

_____

Conservation: Are there natural or man made threats to this occurrence? Please describe.

_____

_____

_____

_____

Ownership: If known, please provide landowner name, address, phone #.

_____

_____

_____

Information Source:*Name and Address and Phone # (of person filing report):

_____

_____

_____

*Does this information come directly from a field visit ____, or a published or unpublished report?____
Citation: For information taken from a published or unpublished report, please provide a copy of the cover page and the pertinent portions of the report. If a copy can not be provided, list below the author, date, title, publisher, and page numbers.

_____

_____

_____

_____

Voucher: Was the observation vouchered with a photograph?____ a specimen?____ If possible, attach a copy of the photograph. If specimen voucher, please provide the name of the repository:

_____

_____

_____

Confirmation: Would you accompany a biologist to the site if needed? ____yes ____no.
Additional Comments: (use extra sheets if needed)

_____

_____

_____

Revised 9/98

Department of Environmental Protection
P. O. Box 402
Trenton, NJ 08625-0402

Last Updated: April 28, 2003

Bobolink, *Dolichonyx oryzivorus*

Status: ***State:*** Threatened ***Federal:*** Not listed

Identification

Photo by S. Maslowski, courtesy US FWS

Amid a sea of agriculture, the bubbly "bobo-o-link!" song of the bobolink echoes from within an overgrown weedy field. On a fall day at Cape May, a chorus of "plink" notes is heard overhead as a flock of bobolinks passes above a fallow grassland. These are the song and call of the bobolink, a sparrow-sized member of the blackbird family.

Bobolinks exhibit sexual dimorphism (gender differences) in plumage during the breeding season. The nuptial male is black overall with a creamy nape and hindneck, a white rump, and white scapulars (feathers at the base of the wing). The plumage of the female, which camouflages her during nesting, is relatively drab. The female is buffy with dark brown streaking on the back, sides, and rump and has dark stripes on the head. In non-breeding plumage, adult males resemble females. Immature bobolinks also resemble adult females but are more yellow and lack streaking on the sides of the body. All ages and sexes have a short, finch-like bill and pointed tail feathers.

Habitat

Bobolinks inhabit low-intensity agricultural habitats, such as hayfields and pastures, during the breeding season. In addition, lush fallow fields and meadows of grasses, forbs, and wildflowers are occupied. Bobolink nests are often placed in areas of greatest vegetative height and density. Although small numbers of bobolinks may nest in grasslands of 2 to 4 hectares (5-10 acres), larger sized fields support higher densities of nesting pairs (Jones and Vickery 1997a).

Similar habitats are occupied by bobolinks throughout their annual cycle. During migration, bobolinks inhabit fallow and agricultural fields, as well as coastal and freshwater marshes. On their South American wintering grounds, they occur in grasslands, marshes, rice fields, and farm fields.

Status and Conservation

Historic clearing of forests in the eastern United States during the 1700s and 1800s enabled numerous grassland species to expand their ranges, inhabiting the growing agricultural landscape. As a result, the bobolink became a common breeding species in the hayfields and pastures of New Jersey. However, by the early 1900s, bobolink

population declines were noted in the Northeast. The slaughter of migrant bobolinks in rice fields of the southern United States, market hunting, and modernized farming techniques likely caused this decline. During the 1960s and 1970s, changing agricultural practices, the conversion of fallow fields to forests, and the development of agricultural lands further shrunk bobolink populations in New Jersey.

Modern farming techniques, including frequent rotation of hayfields, early mowing of hay, decreased vegetative diversity, and the change from warm-season to cool-season grasses, have rendered agricultural fields less favorable for nesting bobolinks. In addition, alfalfa (Medicago sativa) fields, which offer poor nesting habitat for bobolinks, have replaced many timothy (Phleum spp.) and clover (Fabaceae) fields. The area of land cultivated as hay fields in the northeastern United States declined from 12.6 to 7.1 million hectares (31.1 to 17.5 million acres) from 1940 to 1986 (Martin and Gavin 1995). During the same period, the percentage of sites where alfalfa replaced hay increased from 20% to 60% (Bollinger and Gavin 1992). Habitat loss is largely responsible for the decline of bobolink populations in the United States and New Jersey detected by the Breeding Bird Survey from 1966 to 1999 (Sauer et al. 2000).

Due to population declines and habitat loss, the bobolink was listed as a threatened species in New Jersey in 1979. The New Jersey Natural Heritage Program considers the bobolink to be "demonstrably secure globally," yet "imperiled in New Jersey because of rarity" (Office of Natural Lands Management 1992).

Red-shouldered Hawk, *Buteo lineatus*

Status: ***State:*** Endangered (breeding population), Threatened (nonbreeding population)
Federal: Migratory Nongame Bird of Management Concern

Identification

© G.M. Jett/ VIREO

The red-shouldered hawk is a crow-sized buteo, or soaring hawk. The adults are strikingly plumed, with rufous (brownish red) shoulder patches and a rufous barred breast. Rufous lesser and median upperwing coverts form the "red shoulders" evident on this species. The flight feathers of adults are barred black and white and show a white crescent-shaped window across the primaries, which is visible in flight. The underparts, which are rufous with white barring, often exhibit thin, dark streaks on the chest. The head and back are dark brown. The black tail is bisected by several narrow white bands. Although females average slightly larger than males, plumage is similar for both sexes. The call of the red-shouldered hawk is a series of nasal drawn-out "aahhh" cries.

Juvenile red-shouldered hawks can be distinguished from adults by their overall browner, less brilliant plumage. The shoulder patches of juveniles are paler rufous and the crescents across the primaries are tawny. The underparts are whitish with variable amounts of brown streaking. The tail is brown with several thin pale bands. Adult plumage appears in the second year.

The red-shouldered hawk is a long-tailed buteo with squared-off wings and a protruding head. Characterized by quick choppy wingbeats interspersed with short glides, the flight style of this hawk is similar to that of an accipiter. When soaring, most buteos hold their wings straight out, whereas the red-shouldered hawk bows its wings forward.

Habitat

Mature wet woods such as hardwood swamps and riparian forests typify red-shouldered hawk breeding habitat. Nesting territories, which occur in deciduous, coniferous, or mixed woodlands, are typically located within remote and extensive old growth forests containing standing water. Consequently, breeding barred owls (Strix varia) and Cooper's hawks (Accipiter cooperii) are often found in habitats containing red-shouldered hawks.

Red-shouldered hawks select large deciduous and, to a lesser extent, coniferous trees for nesting. Nests have been documented in oak (Quercus spp.), pine (Pinus spp.), maple (Acer spp.), ash (Fraxinus spp.), beech (Fagus grandifolia), birch (Betula spp.),

basswood (Tilia americana), chestnut (Castanea dentata), hemlock (Tsuga canadensis), elm (Ulmus spp.), cherry (Prunus spp.), hickory (Carya spp.), and tulip poplar (Liriodendron tulipifera). Forest characteristics include a closed canopy of tall trees, an open subcanopy, and variable amounts of understory cover.

Red-shouldered hawks inhabit wetland forest types unique to the different physiographic regions throughout northern and southern New Jersey. In north Jersey, they occupy riparian forests, wooded wetlands, beaver meadows, and mesic (slightly moist) lowland forests. Within the Pequannock Watershed, red-shouldered hawks are found in stream bottomlands and coniferous or mixed forests containing eastern hemlock or white pine (Pinus strobus). Nests are predominately located in wilderness areas where there are abundant wetlands, small forest openings, and limited areas of large open water such as lakes. In the Pequannock Watershed, red-shouldered hawks avoid areas of human inhabitation, steep uplands, dry slopes, open water, areas with limited conifers, and areas with too many or too few forest openings. Although red-shouldered hawks require extensive tracts of forested habitat for nesting, territories may also contain edges where the birds forage.

The majority of red-shouldered hawk nests in southern New Jersey are contained within vast contiguous freshwater wetlands. Hardwood or mixed hardwood/cedar swamps containing red maple (Acer rubrum), black gum (Nyssa sylvatica), sassafrass (Sassafras albidum), sweetbay magnolia (Magnolia virginiana), and Atlantic white cedar (Chamaecyparis thyoides) are occupied by red-shouldered hawks. Often, such large forested tracts are surrounded by oak/pine forests or agricultural fields. Although red-shouldered hawks nest in large contiguous tracts of wet old growth forests in Cumberland County, they occupy younger wet woods, often on private property safeguarded from high levels of human activity, in Cape May County.

An-area sensitive species, the red-shouldered hawk typically nests away from residences, roads, and development. In the Pequannock Watershed, red-shouldered hawk nests were located an average of 1,013 m and a standard deviation of plus or minus 614 m (3,324 ± 2,014 ft.) from the nearest building; and an average of 812 m and a standard deviation of plus or minus 634 m (2,664 ± 2,080 ft) from the nearest road (Bosakowski et al. 1991). Red-shouldered hawks avoid small fragmented woodlots and forests that do not contain trees large enough for nesting.

Red-shouldered hawks require large contiguous wooded tracts of 100 to 250 hectares (250 to 620 acres) (Johnsgard 1990). Eastern populations occupy breeding home ranges of 109 to 339 hectares (270 to 838 acres) (Crocoll 1994). In the Pequannock Watershed, red-shouldered hawk breeding densities were estimated at one nest per 450 hectares (1,112 acres) with an average distance of 1.2 to 1.6 km (0.75 to 1.0 mi.) between nests in areas containing the highest breeding concentrations (Bosakowski et al. 1991). Home range sizes of males exceed those of females, during both the breeding and nonbreeding seasons. Individuals of either sex may expand their home ranges while rearing young or throughout the winter months.

During the nonbreeding season, red-shouldered hawks are less restrictive in their habitat use. They inhabit the traditional wetland forests occupied during the breeding season as well as uplands, fragmented woods, smaller forests, open areas, and edges.

Status and Conservation

The red-shouldered hawk was once considered a common resident of wet lowland forests in New Jersey. Only a century ago, bounties were placed on birds of prey, which were accused of poultry and game predation. This unfortunate practice, coupled with egg collecting and the placement of wild red-shouldered hawks in captivity, may have caused initial population declines. The clearing of forests and filling of wetlands exacerbated red-shouldered hawk declines, which were noted as early as the mid-1920s. Reduced numbers of red-shouldered hawks wintering in New Jersey were documented from the early 1950s to the 1970s, as development increased and forest contiguity and patch size decreased. As a result, the red-shouldered hawk, with an estimated 100 breeding pairs in the state, was listed as a threatened species in New Jersey in 1979. In 1982, the U.S. Fish and Wildlife Service listed the red-shouldered hawk as a Migratory Nongame Bird of Management Concern due to population declines and restricted habitat requirements. In addition, the red-shouldered hawk was included on the National Audubon Society's Blue List of Imperiled Species from 1972 to 1986, the final year of the list.

During the 1980s, habitat loss continued to pose an increasing threat, causing red-shouldered hawk populations to decline ever further. By the late 1980s and early 1990s, the state's breeding population was estimated at only 36 pairs, nearly one-third the population size at the time of original listing. As a result, the breeding population of the red-shouldered hawk was reclassified as endangered in 1991. The nonbreeding population remained listed as threatened. The New Jersey Natural Heritage Program considers the red-shouldered hawk to be "demonstrably secure globally," yet "imperiled in New Jersey because of rarity" (Office of Natural Lands Management 1992). Habitat loss and declines of red-shouldered hawks in the Northeast have resulted in the listing of this species as threatened in New York and of special concern in Connecticut.

Vesper Sparrow, *Pooecetes gramineus*

Status: ***State:*** Endangered ***Federal:*** Not listed

Identification

© R. & N. Bowers

The "bay-winged bunting," as it was formerly known, was given the name "vesper sparrow" because it frequently sings during the early evening hours and well into the night. The rich, musical song of the vesper sparrow, which is reminiscent of the song sparrow's (Melospiza melodia) melody, consists of a pair of repeated notes, represented as, "here-here where-where," followed by a series of descending trills. The first two notes are long, slurred, low-pitched whistles while the latter two notes are higher-pitched. The call of the vesper sparrow is a short "hsip."

The vesper sparrow is a stocky, short-tailed, grayish-brown sparrow with a streaked breast. The upperparts are pale gray-brown and marked with black streaking. The breast is grayish white and streaked with black. A brown cheek patch, which reaches behind the eye, is adjacent to a white sub-mustachial stripe that extends down from the bill. A thin, dark malar stripe (mustache) also extends from the bill, separating the white sub-mustachial stripe from the white throat. There is a white eye-ring that stands out against the brown cheek. Rich brown lesser coverts appear as chestnut shoulder patches on adults. However, the brilliance of these patches is variable and, depending on the view of the bird, may be difficult to see. The wings are marked with a pair of narrow, white wing bars. The tail, which is a key diagnostic indicator in flight, is notched and black with white outer tail feathers, similar to that of a junco (Junco hyemalis). The bill is conical-shaped with a dark upper mandible (jaw) and a flesh-colored lower mandible. Likewise, the legs are flesh colored. The iris is reddish brown to dark brown. Although males are slightly larger, the sexes are otherwise similar. Juveniles resemble adults but are buffer overall, have broader wing bars, and lack the chestnut shoulder patches.

Habitat

Inhabitants of open areas, vesper sparrows reside in cultivated fields, grasslands, fallow fields, and pastures. Agricultural fields containing crops of corn, soybean, alfalfa (Medicago sativa), hay, timothy (Phleum spp.), wheat (Agropyron spp.), or strawberry may be occupied. Farmed areas that are adjacent to fallow fields or contain uncultivated strips along fence-rows are favored. These fallow areas provide nesting habitat, cover, foraging sites, and singing perches. On active farmlands, human disturbance and crop

harvesting can threaten nesting sparrows. Fallow fields and grasslands provide a safer haven for nests.

Vesper sparrow habitats are typically sparsely vegetated with patches of bare ground, low vegetation (1 to 8 in.), and scattered shrubs or saplings. Habitats are typically dry and well drained. Nests are placed within clumps of herbaceous cover that afford protection from predators. Elevated perches, such as fence posts, shrubs, or weeds, provide singing posts from which males can advertise their territories and attract mates. Territory size may range from 0.5 to 3.2 hectares (1.2 to 7.9 acres). Similar habitats are used throughout the year.

Status and Conservation

The vesper sparrow was formerly a common, widespread breeding species within agricultural fields and pastures in the Garden State. Turnbull (1869), Stone (1894a, 1894b), Griscom (1923), Hausman (1935), and Cruickshank (1942) considered it to be a common to abundant summer bird in open cultivated areas of northern New Jersey and the Pine Barrens. However, even at this time, these authors noted its rarity in areas with suburban development. By the 1950s and 1960s, the vesper sparrow, which was by then considered an uncommon breeding species, had undergone population declines resulting from increased development of rural farmlands. Further declines in the Northeast were noted during the mid-1970s and early 1980s. The number of vesper sparrows detected on New Jersey Christmas Bird Counts plummeted from an average of 44 per year in 1971-1973 to four per year in 1983-1985. Likewise, numerous breeding populations documented in the state in the early 1980s were absent by the mid-1990s. The Breeding Bird Survey has shown a significant annual decline in the number of vesper sparrows detected on surveys in the New Jersey from 1966 to 1999 (Sauer et al. 2000).

Due to its dependence on habitats created by farming, the vesper sparrow has suffered significant population declines resulting from the ebb of agriculture in New Jersey. Consequently, the vesper sparrow was listed as a threatened species in New Jersey in 1979. As the breeding population continued to decline and nesting habitat dwindled, the status of the vesper sparrow was reclassified as endangered in 1984. Currently, it is a rare and local breeding species in the state. The New Jersey Natural Heritage Program considers the vesper sparrow to be “demonstrably secure globally.” yet “imperiled in New Jersey because of rarity” (Office of Natural Lands Management 1992). The National Audubon Society included the vesper sparrow on its Blue List of Imperiled Species from 1978 to 1980 and listed it as a local problem species in 1982 due to declines in the eastern population. Throughout much of the Northeast, the vesper sparrow has declined and, as a result, has been listed as endangered in Connecticut and Rhode Island, threatened in Massachusetts, and of special concern in New York.

Long-tailed Salamander, *Eurycea longicauda longicauda*

Status: ***State:*** Threatened ***Federal:*** Not listed

Identification

© Blaine Rothauser

Well deserving of its name, the long-tailed salamander's tail accounts for nearly two-thirds of its total length. In addition to tail size, these salamanders can be recognized by their coloration and pattern. The slender, bright yellow body is unmarked below and speckled above with black spots that form a herringbone pattern on the tail. Although typically yellow, individuals may range from orange to reddish-orange and, in older specimens, brown. Speed, agility, and the ability to regenerate their tails enable long-tailed salamanders to evade potential predators. Adults measure 10 to 16 cm (4.0 to 6.25 in.) in length (Conant and Collins 1991).

Habitat

Long-tailed salamanders inhabit clean, calcareous (limestone) spring-fed seepages, spring kettleholes, swampy floodplains, artesian wells, and ponds associated with springs. They may also reside in abandoned mines or caves that are permeated by calcareous ground water.

Aquatic habitats occupied by long-tailed salamanders often occur within upland deciduous forests that may also contain calcareous fens, limestone outcrops, or caves. Forest types typically include mature, closed canopy maple/mixed deciduous, mixed hardwood, or hemlock/mixed deciduous woodlands. Overstory vegetation may include silver maple (Acer saccharinum), red maple (A. rubrum), yellow birch (Betula alleghaniensis), white oak (Quercus alba), sugar maple (A. saccharum), black walnut (Juglans nigra), sycamore (Platanus occidentalis), American elm (Ulmus americana), tulip poplar (Liriodendron tulipifera), gray birch (B. populifolia), basswood (Tilia americana), slippery elm (Ulmus rubra), red cedar (Juniperus virginiana), eastern cottonwood (Populus deltoides), willow (Salix spp.), or eastern hemlock (Tsuga canadensis). In addition, alder (Alnus spp.), sumac (Rhus spp.), poison ivy (Toxicodendron radicans), spicebush (Lindera benzoin), sassafras (Sassafras albidum), wild grape (Vitis spp.), rhododendron (Rhododendron spp.), or maple-leaved viburnum (Viburnum acerifolium) may comprise the shrub layer.

Herbaceous species that make up the ground cover include jewelweed (Impatiens capensis), smartweed (Polygonum spp.), skunk cabbage (Symplocarpus foetidus), Solomon's seal (Polygonatum biflorum), violets (Viola spp.), pickerelweed (Pontederia cordata), sedge (Carex spp.), cattail (Typha spp.), may apple (Podophyllum peltatum),

columbine (Aquilegia canadensis), bloodroot (Sanguinaria canadensis), cardinal flower (Lobelia cardinalis), and bulrush (Scirpus spp.), as well as numerous grasses and ferns. . Stony loam, gravelly sandy loam, silt loam, stony silt loam, and muck gravelly loam soil types may be found at long-tailed salamander sites. On the ground, rotting logs, stones, moss, and leaf litter provide cover for the salamanders.

Status and Conservation

Due to habitat loss and pollution of larval ponds, the long-tailed salamander was listed as a threatened species in New Jersey in 1979. The New Jersey Natural Heritage Program considers this species to be "demonstrably secure globally," yet "imperiled in New Jersey because of rarity" (Office of Natural Lands Management 1992).

From the 1960s to the 1980s, biologists have conducted studies to determine the distribution, habitat use, life history, and breeding ecology of the long-tailed salamander in New Jersey. Currently, surveys are conducted to monitor known sites and locate additional populations, enabling biologists to document changes in the range of this species throughout the state. The Freshwater Wetlands Protection Act and environmental reviews of proposed development afford protection to long-tailed salamander habitats in New Jersey.

Wood Turtle, *Clemmys insculpta*

Status: ***State:*** Threatened ***Federal:*** Not listed

Identification

© Robert Zappalorti

As the taxonomic name insculpta indicates, the wood turtle is distinguished by the sculpted or grooved appearance of its carapace, or upper shell. Each season a new annulus, or ridge, is formed, giving each scute (a scale-like horny layer) a distinctive pyramid-shaped appearance. As the turtle ages, natural wear smoothes the surface of the shell. While the scutes of the carapace are brown, the plastron, or underneath shell, consists of yellow scutes with brown or black blotches on each outer edge. The legs and throat are reddish-orange. The male wood turtle has a concave plastron while that of the female is flat or convex. The male also has a thicker tail than the female. Adult wood turtles measure 14 to 20 cm (5.5 to 8.0 in.) in length (Conant and Collins 1991).

Habitat

Unlike other turtle species that favor either land or water, the wood turtle resides in both aquatic and terrestrial environments. Aquatic habitats are required for mating, feeding, and hibernation, while terrestrial habitats are used for egg laying and foraging. Freshwater streams, brooks, creeks, or rivers that are relatively remote provide the habitat needed by these turtles. Consequently, wood turtles are often found within streams containing native brook trout (Salvelinus fontinalis). These tributaries are characteristically clean, free of litter and pollutants, and occur within undisturbed uplands such as fields, meadows, or forests. Open fields and thickets of alder (Alnus spp.), greenbrier (Smilax spp.), or multiflora rose (Rosa multiflora) are favored basking habitats. Lowland, mid-successional forests dominated by oaks (Quercus spp.), black birch (Betula lenta), and red maple (Acer rubrum) may also be used. Wood turtles may also be found on abandoned railroad beds or agricultural fields and pastures. Nevertheless, wood turtle habitats typically contain few roads and are often over one-half of a mile away from developed or populated areas (Zappalorti et al. 1984). Individuals from relict or declining populations are also sighted in areas of formally good habitat that have been fragmented by roads and development.

Status and Conservation

Historically, the wood turtle was a fairly common species within suitable habitat in New Jersey. By the 1970s, however, declines were noted as wood turtles were absent from many historic sites due to habitat loss and stream degradation. Consequently, the wood turtle was listed as a threatened species in New Jersey in 1979. The New Jersey Natural Heritage Program considers the wood turtle to be "demonstrably secure globally," yet "rare in New Jersey" (Office of Natural Lands Management 1992).

Since the late 1970s, biologists have monitored and surveyed wood turtle sites in New Jersey, providing valuable data regarding the life history, reproduction, and habitat use of these turtles in the state. There is, however, a continuing need to examine the productivity and juvenile survival of wood turtles, which may be threatened by disturbance or predation.

In 1995, the wood turtle was proposed for inclusion on the federal endangered species list. Despite declines in several northeastern states, populations were considered stable enough throughout the species' entire range to deny listing. However, the wood turtle was considered by the U.S. Fish and Wildlife Service as a species that, "although not necessarily now threatened with extinction may become so unless trade in them is strictly controlled" (U.S. Fish and Wildlife Service 1995). As a result, international trade of these turtles is strictly monitored and regulated through the CITES Act (Convention on International Trade in Endangered Species of Wild Flora and Fauna Act). The New Jersey Endangered Species Act prohibits the collection or possession of wood turtles.

MUSSELS

FRESHWATER MUSSELS:

Dwarf wedgemussel, *Alasmidonta heterodon*

Status: ***State:*** Endangered ***Federal:*** Endangered

Brook floater, *Alasmidonta varicosa*

Status: ***State:*** Endangered (pending) ***Federal:*** Species of Special Concern

Green floater, *Lasmigona subviridis*

Status: ***State:*** Endangered (pending) ***Federal:*** Species of Special Concern

Yellow lampmussel, *Lampsilis cariosa*

Status: ***State:*** Threatened (pending) ***Federal:*** Species of Special Concern

Eastern lampmussel, *Lampsilis radiata*

Status: ***State:*** Threatened (pending) ***Federal:*** Not listed

Eastern pondmussel, *Ligumia nasuta*

Status: ***State:*** Threatened (pending) ***Federal:*** Not listed

Tidewater mucket, *Leptodea ochracea*

Status: ***State:*** Threatened (pending) ***Federal:*** Not listed

Triangle floater, *Alasmidonta undulata*

Status: ***State:*** Threatened (pending) ***Federal:*** Not listed

Identification

All freshwater mussels have a calcium carbonate bivalve shell that is divided into a left and right half. The shell consists of three layers; the outer periostracum, the middle calcium carbonate, and the inner nacre. The periostracum (or epidermis) protects underlying calcium carbonate from the corrosive action of low pH water and damage from moving sand and gravel. A thin prismatic layer of crystalline calcium carbonate lies beneath the periostracum. The nacre or mother-of-pearl is the innermost and often thickest layer of the shell. It is comprised of thin, stacked calcium carbonate plates that lie parallel to the shell's surface. In many species, the color and texture of the nacre are important for identification.

Lateral and pseudocardinal teeth, separated by an interdentum, are located dorsally inside the shell. Lateral teeth are elongated and raised interlocking structures along the hinge line of a valve, whereas pseudocardinal teeth are triangular-shaped hinge teeth near the shell's anterior-dorsal margin. The interdentum is a flattened area of the hinge plate between the lateral and pseudocardinal teeth. The three points of apposition, which are taxonomically important in most species, serve to hold the two valves together. Some groups entirely lack lateral and pseudocardinal teeth. The umbo or beak is the dorsally raised, inflated area of the bivalve shell. Representing the oldest part of the shell, umbones appear as external swellings and are often points of taxonomic significance.

The valves are held closed by internal mussels. Empty shells show scars of former mussel attachment areas. Freshwater mussels have a large, muscular foot that extends between the valves and functions in locomotion and anchorage. The anterior and posterior retractor muscles draw the foot into the shell, while the anterior protractor helps in foot extension. Large anterior and posterior abductors draw the shell together.

Habitat

New Jersey's Endangered and Threatened Freshwater Mussel Species:

The **dwarf wedgemussel** is a rare freshwater mussel with a trapezoid-to-ovate or "humpbacked" shell rarely exceeding 1.5 in. in length. It is characterized by having two lateral teeth on the right valve of the shell, but only one on the left (thus the species name *heterodon*). The ventral margin is mostly straight. The beaks are low and rounded, projecting only slightly above the hinge line. The periostracum, or outer shell, is dark brown or yellowish brown and often exhibits greenish rays in young mussels. The nacre, or inner shell, is bluish or silvery white.

The dwarf wedgemussel once existed in 70 localities within 15 major Atlantic slope drainage basins from New Brunswick, Canada to North Carolina (U.S. Fish and Wildlife Service 1993). Today however, this species is thought to be extirpated from all but approximately 30 small sites in New Hampshire, Vermont, Maryland, North Carolina, New York, Connecticut, Virginia, and New Jersey.

In New Jersey, the dwarf wedgemussel historically inhabited areas of the Delaware, Hackensack, and Passaic rivers. These populations, however, are thought to

be extirpated because of water quality degradation and other factors. There are only three known active state occurrences of this elusive species; the Paulins Kill, Pequest River, and a portion of the upper Delaware River.

Preferred habitat of the dwarf wedgemussel ranges from muddy sand to sand and gravel/pebble bottoms in rivers and creeks with slow to moderate current. Favoring clean and relatively shallow water with little silt deposition, this species is known to co-occur with other freshwater mussels such as the eastern elliptio (*Elliptio complanata*), triangle floater (*Alasmidonta undulata*), creeper (*Strophitus undulatus*), eastern floater (*Pyganodon cataracta*) and eastern lampmussel (*Lampsilis radiata*).

Fish species identified as suitable hosts for the dwarf wedgemussel include the tessellated darter (*Etheostoma olmstedi*), mottled sculpin (*Cottus bairdi*) and Johnny darter (*Etheostoma nigrum,* not found in N.J.) (Michaelson and Neves 1995).

The **brook floater** has a small, kidney-shaped shell that is slightly thicker towards the anterior. There is a conspicuous posterior slope with wavy ridges perpendicular to the growth lines. The ventral margin is straight and slightly concave centrally. The outer shell color ranges from yellowish brown to dark brown and the nacre is a glossy bluish-white to orange in the umbo region. The pseudocardinal teeth exist as weak knobs and lateral teeth are absent. The species has a bright orange to pinkish foot.

The brook floater ranges from the Savannah River Basin in South Carolina north to the St. Lawrence River Basin in Canada and west to the Ohio River Basin of West Virginia. In New Jersey, there are reported occurrences in the Stony Brook, Musconetcong, Raritan, Lamington and upper Delaware rivers.

Habitat of the brook floater includes rapids or riffles on rock and gravel substrates. The species prefers small streams and is commonly associated with the eastern elliptio (*Elliptio complanata*) (Clarke 1981). Reported host fishes for the species that occur in New Jersey include the slimy sculpin (*Cottus cognatus*), longnose dace (*Rhinicthys cataractae*), golden shiner (*Notemigonus crysoleucas*) and pumpkinseed (*Lepomis gibbosus*).

The **green floater** is a small, rare mussel with an ovate trapezoid shell that is fragile and thin. The posterior ridge is rounded. The outer shell is light yellow or brown with many green rays, especially in juveniles. The pseudocardinal and lateral teeth are small and delicate. The beak cavity is shallow. The nacre can be white to blue and is iridescent towards the posterior end.

Photo courtesy North Carolina Wildlife Resources Commission

The green floater can be found from the Cape Fear River Basin in North Carolina north to the Hudson River Basin and westward to St. Lawrence River Basin in New York. In New Jersey, the species once occurred in the Passaic, Raritan, Delaware, and Pequest rivers, but is now represented by a single known individual in the Stony Brook in Mercer County.

This species can be found in smaller streams, most often in pools and eddies with gravelly and sandy bottoms (Ortmann 1919). It is averse to strong currents (Clarke

1985). The host fish is not known. There is some evidence that the green floater may not require a host fish in order to complete its life cycle (Barfield and Watters 1998, Lellis and King 1998).

The **yellow lampmussel** has a medium-sized shell, with males elliptical and somewhat elongate and females more ovate. Shells are moderately inflated and thick. The anterior margin is rounded and the ventral margin is slightly curved. The umbos are swollen and raised above the hinge line. The pseudocardinal teeth are compressed and the beak cavity is somewhat deep. The periostracum is smooth, shiny and usually yellow with brown patches. The nacre is white to bluish white. There may be green or black rays on the posterior slope.

Photo courtesy North Carolina Wildlife Resources Commission

The species ranges from Georgia to the Lower Ottawa River Canada and eastward to Nova Scotia. New Jersey occurrences of the yellow lampmussel are restricted to the Delaware River.

The yellow lampmussel prefers large rivers that drain more than 1,200 sq. Km (Strayer 1993), and is often found in sand/silt substrates. Although the host fish has not been identified, a migratory species such as the alewife is the suspected host.

Shells of the **eastern lampmussel** are elliptical and have a rounded posterior ridge. The posterior and anterior ends are rounded and swollen umbos extend above the hinge line. The periostracum is brown and extensively rayed. The nacre is white and may be tinged with pink or salmon. This species has long lateral teeth and two pseudocardinal teeth on the left and right valves.

Photo courtesy North Carolina Wildlife Resources Commission

The eastern lampmussel ranges from South Carolina north to the St. Lawrence River Basin. In New Jersey, the species is known from locations in the Ramapo, Pequannock, and Wallkill rivers.

The eastern lampmussel is found in a variety of habitats. It is reported to prefer medium to coarse sands. The host fish is unknown.

The **eastern pondmussel** can be distinguished by its bluntly pointed posterior and distinctive posterior ridge. The shells are elongate and twice as long as wide. The dorsal margin is straight and the ventral margin (the side that opens) is curved. The beaks are low and located in the anterior quarter of the shell. The lateral teeth are long and straight. The pseudocardinal teeth are compressed. The nacre is white, but can also vary

Photo courtesy North Carolina Wildlife Resources Commission

from an iridescent blue to salmon. The periostracum is greenish yellow to dark olive or brown.

The eastern pondmussel occurs from Cape Fear River Basin, North Carolina, to the St. Lawrence River Basin, Canada, and westward through northern parts of the continent's Interior Basin. In New Jersey, the species can be found in the Delaware River and several of its tributaries.

The eastern pondmussel is often associated with tidewaters. The host fish is unknown.

The **tidewater mucket** appears similar to the yellow lampmussel. The shell is small; males are elliptical and females are ovate, subinflated and thin. The anterior end is rounded; the posterior margin is evenly rounded, somewhat pointed in males and truncated in females. The beaks are moderately swollen, raised above the hinge line, and are located near the middle of the shell. The periostracum is yellow to brown or olive green and is often covered with fine green rays. The pseudocardinal teeth are compressed; the lateral teeth are short and curved. The beak cavity is shallow and the nacre is bluish-white and sometimes pink.

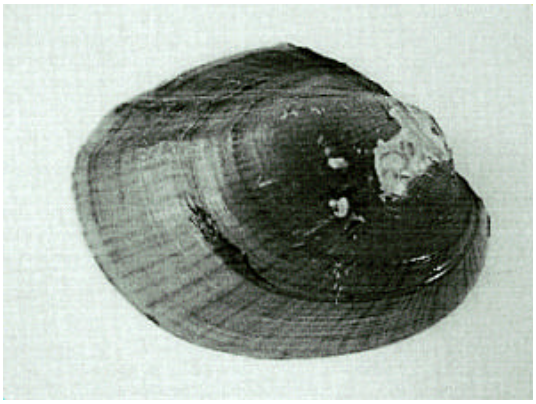


Photo courtesy North Carolina Wildlife Resources Commission

The tidewater mucket ranges from the Savannah River Drainage Basin in Georgia north into Nova Scotia. In New Jersey, the species occurs in the Delaware River.

This species is associated with tidewaters and can be found in sand/silt substrates. The host fish is undetermined.

The **triangle floater** is a small, ovate to triangular shaped mussel. The lateral teeth are absent, but there is an interdental projection in the left valve. The pseudocardinal teeth are large and well-developed. The periostracum is yellowish-green to black and is extensively rayed. The nacre is pinkish-salmon posteriorly and whitish on the anterior portion.

The triangle floater is a generalist and can be found in a variety of stream and river habitats. The host fish is not determined.

Status and Conservation

The dwarf wedgemussel is afforded protection through federal and state Endangered Species acts, federal and state Clean Water acts, Flood Hazard Area Control Act rules (stream encroachment), and environmental reviews of proposed development projects. The other species listed above are scheduled to be listed as state endangered or threatened in late 2001/early 2002. Federal and state Clean Water acts, stream encroachment rules, environmental reviews of proposed development projects and the state Endangered Species Act will serve to help protect existing populations.

APPENDIX D. LOCAL & REGIONAL CONSERVATION GROUPS

The following nonprofit groups may be of interest to readers of this report. Listing does not constitute an endorsement by Kingwood Township or Kratzer Environmental Services.

Association of NJ Environmental Commissions	www.anjec.org
ANJEC is a private, nonprofit educational organization for environmental commissioners, concerned individuals and organizations to protect natural resources and improve the quality of life in NJ.	
Bowman's Hill Wildflower Preserve	www.bhwp.org
The mission of Bowman's Hill Wildflower Preserve is to lead people to a greater appreciation of native plants, to an understanding of their importance to all life, and to a commitment to the preservation of a healthy and diverse natural world.	
Central Jersey Trout Unlimited	www.cjtu.org
Our mission is to conserve, protect and restore New Jersey's cold water fisheries and their environments.	
ConserveOnline	www.conserveonline.org
ConserveOnline is a "one-stop" online, public library, created and maintained by The Nature Conservancy in partnership with other conservation organizations.	
Conserve Wildlife Foundation of New Jersey	www.conservewildlifenj.org
The Conserve Wildlife Foundation of NJ is a private, not-for-profit organization dedicated to conserving and protecting New Jersey's endangered and threatened wildlife.	
D&R Greenway Land Trust	www.drgreenway.org
D&R Greenway Land Trust is a non-profit land preservation organization for central New Jersey. Its mission is to preserve and protect a network of natural lands and open spaces, to provide appropriate access and to inspire a conservation ethic for land preservation.	
Delaware River Greenway Partnership	www.delrivgreenway.org
The mission of the Delaware River Greenway Partnership is to promote the public and private stewardship of a regional corridor of natural, historic, cultural, scenic and recreational resources along the Delaware River and its tributaries, and to acknowledge the nationally recognized Delaware River system through a public/private partnership.	
Delaware Riverkeeper Network	www.delawareriverkeeper.org
The Delaware Riverkeeper is the voice of the Delaware River and its streams, championing their rights as living members of our community, and is leader for the Delaware Riverkeeper Network.	
Earth Share of New Jersey	www.earthsharenj.org
A coalition of leading environmental organizations working to promote human health and welfare through environmental management, conservation, advocacy, research, education, and grassroots organizing in New Jersey.	
Hunterdon Coalition	www.hunterdoncoalition.org
The Hunterdon Coalition is made up of a mix of local officials and activists to promote public involvement in land use decisions.	
Hunterdon County - Rutgers Cooperative Research and Extension	
	www.co.hunterdon.nj.us/depts/rutgers/rutgers.htm

The Cooperative Extension serves as the educational outreach arm of the US Dept. of Agriculture to provide research based information concerning agriculture, nutriction and food safety.
Hunterdon Land Trust Alliance www.hlta.org The HLTA's mission is to preserve the county's scenic beauty, and its environmental and historic resources; to provide for the permanent preservation of farmland and to support and foster agricultural viability; and to promote the conservation and appropriate management of woodlands and open space.
International Rivers www.irn.org International Rivers Network protects rivers and defends the rights of communities that depend on them.
Kingwood Twp. Environmental Commission kingwoodtownship.com/environmental The EC is an advisory commission to the Township Committee. Its responsibilities include to protect, develop or use natural resources. Also acquires property, development rights and easements.
National Wildlife Federation www.nwf.org The National Wildlife Federation promotes wildlife conservation.
Native Plant Society of New Jersey www.npsnj.org The Native Plant Society of NJ is a statewide non-profit organization founded for the appreciation, protection, and study of the native flora of New Jersey.
Natural Resources Defense Council www.nrdc.org The Natural Resources Defense Council's purpose is to safeguard the Earth: its people, its plants and animals and the natural systems on which all life depends.
NatureServe www.natureserve.org NatureServe is a network providing the scientific basis for effective conservation of rare and endangered species and threatened ecosystems. NJ Natural Heritage Program is the local program for NJ: www.state.nj.us/dep/parksandforests/natural/heritage/index.html
New Jersey Aquarium www.njaquarium.org The New Jersey Academy for Aquatic Sciences promotes the understanding, appreciation and protection of aquatic life and habitats through research, education and youth development programs.
New Jersey Audubon www.njaudubon.org The NJAS is a statewide non-profit organization which fosters environmental awareness and a conservation ethic among NJ's citizens; protects NJ's birds, other animals, and plants, especially endangered and threatened species; and promotes preservation of NJ's valuable natural habitats.
New Jersey Chapter Sierra Club www.newjersey.sierraclub.org Mission is to explore, enjoy, and protect the wild places of the earth; To practice and promote the responsible use of the earth's ecosystems and resources; To educate and enlist humanity to protect and restore the quality of the natural and human environments.
New Jersey Community Water Watch www.waterwatchonline.org/nj New Jersey Community Water Watch is a joint program between AmeriCorps and the NJPIRG Law and Policy Center that works to empower students and community members to address water quality problems in NJ's urban areas through education, cleanups and stream monitoring.
New Jersey Conservation Foundation www.njconservation.org The NJCF mission is to preserve New Jersey land and natural resources for the benefit of all now and for future generations. As a leading innovator and catalyst for saving land, NJCF: creates and promotes strong land use policies; protects strategic lands.
New Jersey Department of Agriculture, Division of Agriculture & Natural Resources www.nj.gov/agriculture/divisions/anr/

The Division of Agricultural and Natural Resources is responsible for a variety of services and programs that maintain and enhance the viability of New Jersey agriculture and related agribusinesses.
New Jersey Future www.njfuture.org New Jersey Future's mission is to achieve smart growth statewide: growth that protects New Jersey's open lands and natural resources, improves communities, transportation and housing choices through research, policy analysis, public education and advocacy.
New Jersey Section - American Water Works Association www.njawwa.org The NJAWWA is dedicated to the promotion of public health and welfare in the provision of drinking water of unquestionable quality and sufficient quantity by advancing the technology, science, management and government policies relative to the stewardship of water.
PlanSmart NJ www.plansmartnj.org PlanSmart NJ is a statewide civic action group committed to improving the quality of community life through the advancement of sound land use planning and regional cooperation.
Save Our Resources Today www.sort.org Environmental news, links and calendar of events.
The Nature Conservancy - New Jersey chapter www.nature.org/wherewework/northamerica/states/newjersey/ The mission of the Nature Conservancy is to preserve the plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive.
Watershed Partnership for New Jersey www.wpnj.org The Watershed Partnership for NJ is a statewide network of watershed education and outreach representatives from more than 70 non-profit, government, educational and private organizations.
Wild New Jersey www.wildnj.com/ Created to foster an understanding of, and respect for, wildlife and wild places in the Garden State.