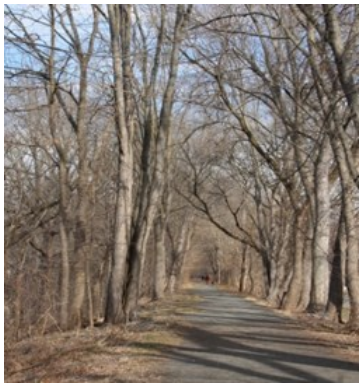
FINAL March 2018

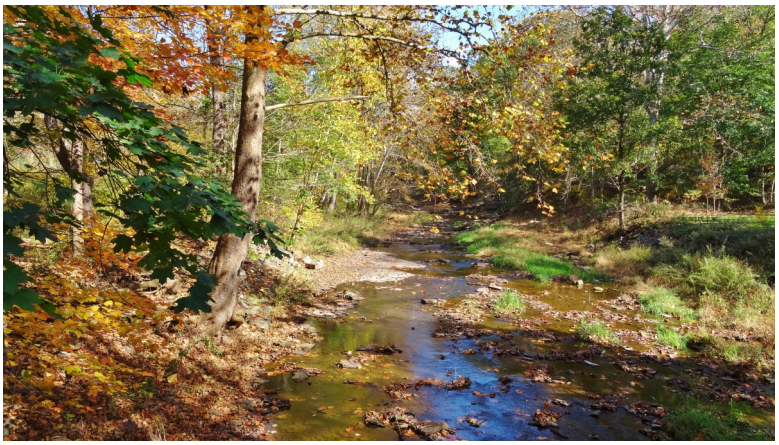
Environmental Resource Inventory

for

Frenchtown Borough

Hunterdon County, NJ





Prepared for:

Frenchtown Borough

FRENCHTOWN, N.J.
INC. 1867
ON THE DELAWARE

Kratzer Environmental Services

ENVIRONMENTAL RESOURCE INVENTORY

The Borough of Frenchtown

Hunterdon County

New Jersey

Prepared By

Kratzer Environmental Services

For

The Borough of Frenchtown

FINAL

March 2018

Kratzer Environmental Services

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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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2017 Frenchtown Borough Council	
Mayor: Brad Myhre Council President: Michele Liebtag	Members: Liz Johnson, John Hindman, Holly Low, Caroline Scutt, William Sullivan
2017 Frenchtown Environmental Commission	
Joel Boriek, Chairman Tom Woodruff, Vice Chairman Rocco Musolino, Planning Board Liaison	Jim Meade Bill O'Brien Pete Palac Margaret Waldock
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Table 7.8 (pages 158 to 162): Chuck Bargeron, Univ. of Georgia, Bugwood.org; Ted Bodner at USDA-NRCS PLANTS Database; Britton and Brown, 1913; John D. Byrd, Mississippi State University, Bugwood.org; Steve Dewey, Utah State University, Bugwood.org; Tom Heutte, USDA Forest Service, Bugwood.org; James H. Miller, USDA Forest Service, Bugwood.org; Mohlenbrock , 1995; Jan Samanek, State Phytosanitary Administration, Bugwood.org; Jil M. Swearingen, USDI National Park Service, Bugwood.org; USDA PLANTS Database, Bugwood.org ; Richard Webb, Self-employed horticulurist, Bugwood.org

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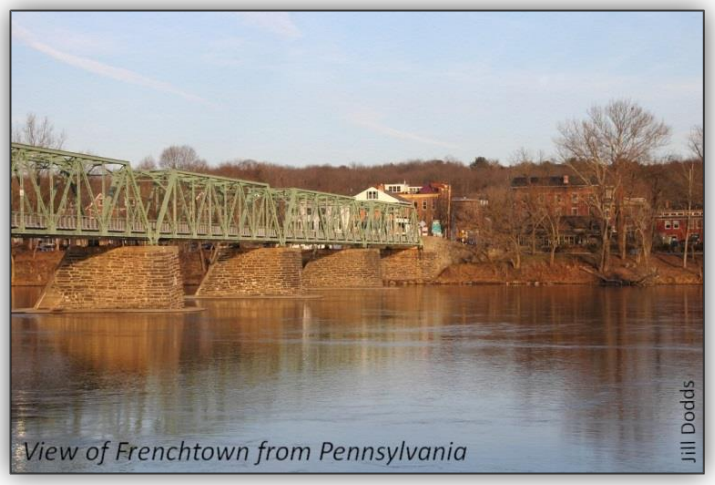
Ecologically Based Planning


View of Frenchtown from Pennsylvania
Jill Dodds

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 the Borough of Frenchtown, both affecting and being affected by many physical and biological factors. With Frenchtown's population of 1,488[1] (US Census, 2010) in a borough just over a square mile in area, the cumulative effects of many individual decisions have altered and have the potential to impact the environment and human health.

> "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 Borough's environmental and biological 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 and maintain an ecologically healthy community.

Goal of the Environmental Resource Inventory

The goal of the Environmental Resource Inventory (ERI) is to provide objective, reliable environmental data in one document. This enables Borough officials (the Mayor, Borough Council, Planning Board, Environmental Commission, Shade Tree Commission, Sustainable Frenchtown, and the Ad Hoc Committees) can make more informed decisions. By taking numerous variables into consideration, they will better protect the Borough's natural resources and the overall health and welfare of the community. Similarly, it is a tool for the public to use.

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 (Municipal Land Use Law, 2002).

[1] The current population density of Frenchtown Borough is 1,161 person/mi^2. The population of Hunterdon County as a whole is 128,349 persons (300 persons/mi$^{2)}$, and for the entire State of New Jersey, the population is 8,791,894 (1,008 persons/mi^2) (US Census, 2010).

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

> "The Environmental Resource Inventory (ERI), or Index of Natural Resources, is a compilation of text, tables, maps and other visual information about the natural resource characteristics and environmentally significant features of an area. Traditionally called "Natural Resources Inventory," the title "Environmental Resources Inventory" is now commonly used, reflecting the addition of manmade features to the inventory, such as historic sites, brownfields and contaminated sites. An ERI provides baseline documentation for measuring and evaluating resource protection issues. It is an objective index and description of features and their functions, rather than an interpretation or recommendation. Identifying significant environmental resources is the first step in their protection and preservation and in assuring that future development or redevelopment protects public health, safety and welfare." (ANJEC, no date).

The ERI will principally be used by the Planning Board and Environmental Commission, but will provide valuable information to anyone interested in the natural resources of the Borough of Frenchtown. This objective information may facilitate resource-sensitive development decisions. In addition, familiarity with environmental concerns enables residents to appreciate and to learn how to 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

Funding for this report was provided through a grant from Sustainable Jersey and funds approved by Frenchtown Borough Council.

An inventory of what is currently known about the physical and biological environment and the human influence on the environment of Frenchtown has been compiled for this document. The most current GIS data have been obtained from the New Jersey Department of Environmental Protection GIS Data Web Site and other sources (see **Appendix A** and **Appendix B)**. A total of 100 GIS data layers from 20 sources were used for this report's 51 maps.

What is GIS?

"A geographic information system (GIS) integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information.

GIS allows us to view, understand, question, interpret, and visualize data in many ways that reveal relationships, patterns, and trends in the form of maps, globes, reports, and charts." (GIS.com, 2013)

Further sources include the internet, and federal, state, county and local databases and contacts. All digital inventory data used in this report will be provided to the Frenchtown Environmental Commission. The public can also use GIS data by using either the New Jersey Department of Environmental Protection's NJ-GeoWeb website or obtain relevant data layers (most are free on the internet), and download the free software, ArcExplorer to view the data (see **Internet Resources**, at the end of this section).

When viewing the digital document (as opposed to a printed copy) maps in PDF[2], clicking on the tab "Layers" at the left side of the screen will allow users to turn on or off the various data layers. Viewing the separate layers in this way is often helpful, especially for complex maps[3].

References and related Internet resources (with links) 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 using an Internet search engine.

The following chapters present objective information about the Borough of Frenchtown's natural resources, including climate, geology, soils, water, floodplains, wetlands, and forests, and cultural resources such as infrastructure and open space. Environmental concerns in Frenchtown include air and water pollution, rare, threatened and endangered species and invasive species.

Limitations of the ERI

It should be noted that the ERI is not meant to replace the primary data sources upon which it is based. Details about each data layer, including the date, scale and methods of developing the data, are provided in **Appendix B**. The ERI is intended for preliminary assessments of projects and *cannot be substituted for on-site testing and evaluations*. Most maps are presented at a scale of 1:36,000 in order to fit on 8.5 x 11 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).

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.

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 which uses their data.

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.

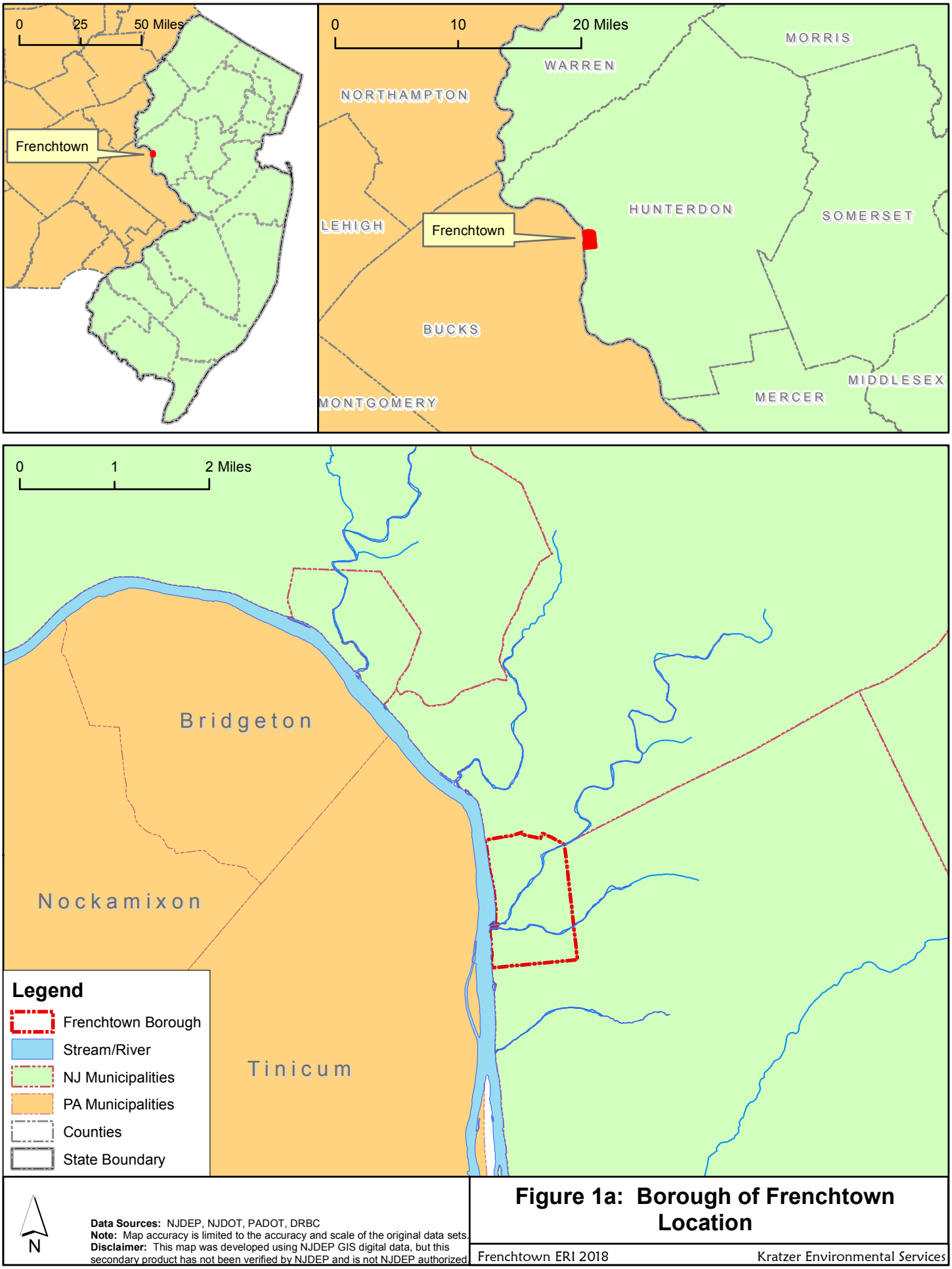
Following the guidelines provided by ANJEC, management recommendations are not included in the ERI.

B. General Description of the Borough of Frenchtown

Frenchtown is located on the western edge of Hunterdon County, NJ (see **Figure 1a**), and is bordered by Alexandria Township to the north and Kingwood Township on the eastern and southern sides. The Delaware River forms the western boundary of the borough, and Tinicum Township (Bucks County) is Frenchtown's Pennsylvania neighbor. The Delaware River separates New Jersey from Pennsylvania, flowing south into the Delaware Bay then on to the Atlantic Ocean.

[2] PDF stands for "Portable Document Format," a digital format which allows the document to appear the same to everyone, requiring only the download of the free Adobe® Reader® at http://www.adobe.com/products/acrobat/readstep2.html.

[3] A few maps are so large in this format that they are included as a simple graphic in the report, but are available separately in PDF.



Data Sources: NJDEP, NJDOT, PADOT, DRBC
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 1a: Borough of Frenchtown Location

Frenchtown ERI 2018 Kratzer Environmental Services

Frenchtown encompasses 1.34 square miles (857 acres), comprising 819 acres of land and 38 acres of water. The Borough's population of 1,488 live in 630 housing units, a density of 491 units/mile^2. The average housing density in Hunterdon County is 105 units/mile^2 (US Census, 2010).

C. Land Use and Land Use Change

Figures 1b through 1f show aerial photographs of Frenchtown and the surrounding areas. In **Figure 1b**, aerial photography taken in 1930, although not very high resolution, and not georeferenced[4], illustrates the prevalence of agriculture, the lack of development in the western half of the borough (on the slopes near Ridge Road) and the scarcity of forests at that time. Aerial photographs taken in 1995, 2002, 2007 and 2012 are shown in **Figure 1c, 1d, 1e and 1f** respectively.[5] These aerial photographs are georeferenced. Other options for viewing aerial photos online are listed in **Internet Resources**, at the end of this section.

The New Jersey Department of Environmental Protection (NJDEP) used aerial photography taken in 1986, 1995, 2002, 2007 and 2012 to determine land use and land use change. The Land Use Type is the generalized category of six land uses: agriculture, barren, forest, urban, water and wetlands. Definitions are as follows (USGS, 2010):

Agriculture includes all lands used primarily for the production of food and fiber and associated farm structures.

Forest land is covered by woody vegetation (excluding wooded wetlands, which are included in the wetlands category). These areas are capable of producing timber and other wood products, and of supporting many kinds of outdoor recreation. Forests are important environmentally, because they affect air quality, water quality, wildlife habitat and climate.

Any areas periodically covered with water are included in the *water* land use type.

Wetlands are those areas that are inundated or saturated by surface or ground waters at a frequency and duration sufficient to support vegetation adapted for life in saturated soil conditions. Included in this category are naturally vegetated swamps, marshes, bogs, etc., as well as formerly natural wetlands that have been altered (sometimes filled) and are now part of a managed recreational area, but which still show signs of soil saturation on the aerial imagery. These areas do not currently support typical wetland vegetation, but are vegetated primarily by grasses and other planted vegetation that may be routinely mowed. Wetlands are further discussed in **Section 6C** of this report.

Barren Land includes areas being developed or cleared at the time the photos were taken (none in Frenchtown).

The *Urban Land* type is characterized by intensive land use where the landscape has been altered by human activities. It encompasses various categories of residential, commercial, educational and industrial land.

The 2012 land use types within the Borough of Frenchtown are illustrated in **Figure 1h**, and summarized in **Table 1.1**. Frenchtown is 38% urban/residential, with a nearly equal (37%) proportion of forest. Detailed categories of land use/land cover are shown in **Section 7 (Figures 7a, 7b and 7c)** of this report.

[4] Georeferencing involves defining the location of something in physical space using map coordinates and assigning a coordinate system. This is the strength of GIS, because features can be defined in relation to other features.

[5] The 2002, 2007 and 2012 aerial photography data are high resolution, with pixels of 1 square foot. This is much more detail than can be shown in this report. See NJ-GeoWeb in **Internet Resources**, at the end of this section.

0 0.2 0.4 Miles

N

Data Sources: NJDEP, NJDOT, FEMA
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 1b: Borough of Frenchtown 1930 Aerial Photography

0 0.2 0.4 Miles

N

Data Sources: NJDEP, NJDOT, FEMA
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized

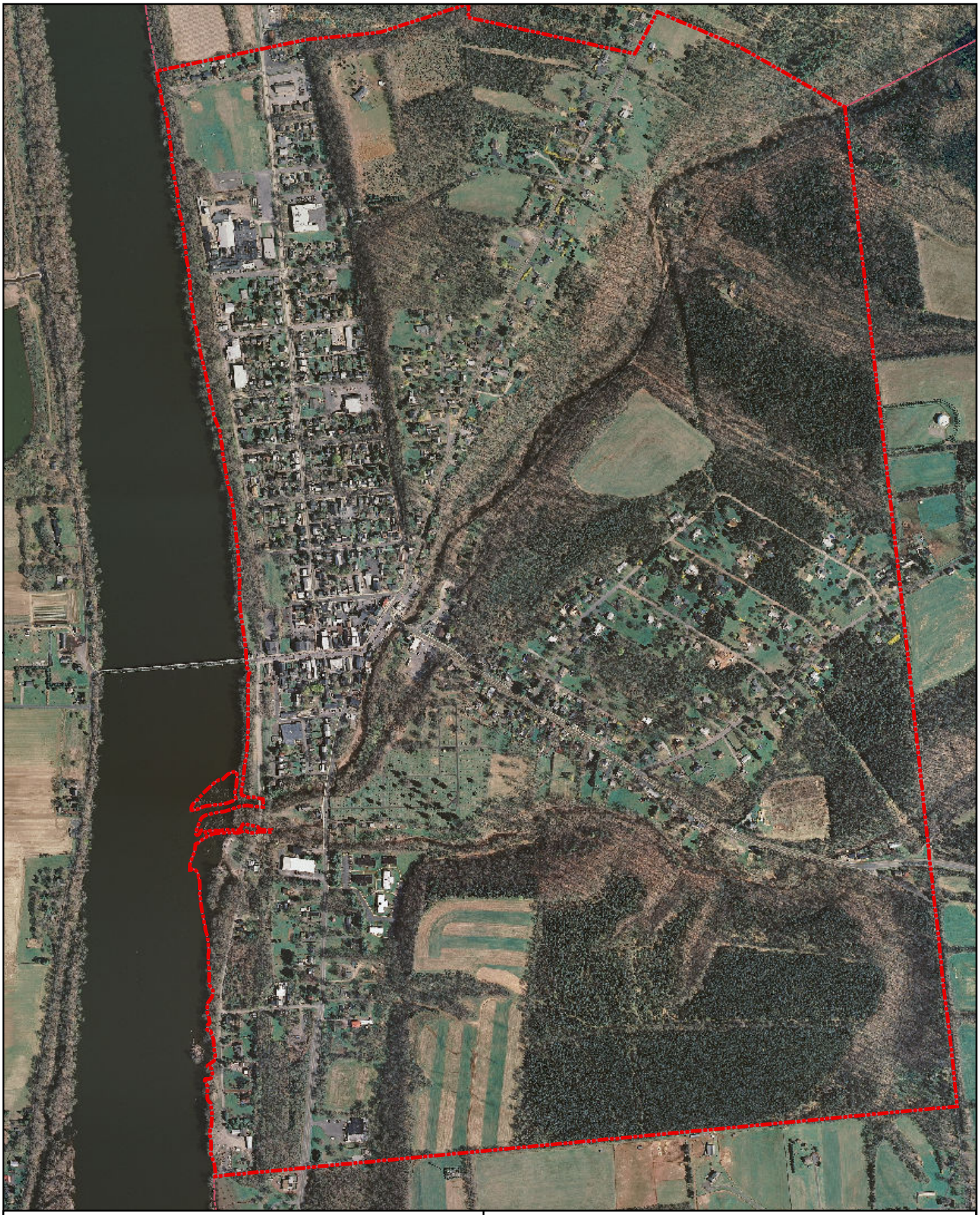
Figure 1c: Borough of Frenchtown 1995 Aerial Photography

0 0.2 0.4 Miles

N

Data Sources: NJDEP, NJDOT, FEMA
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized

Figure 1d: Borough of Frenchtown 2002 Aerial Photography

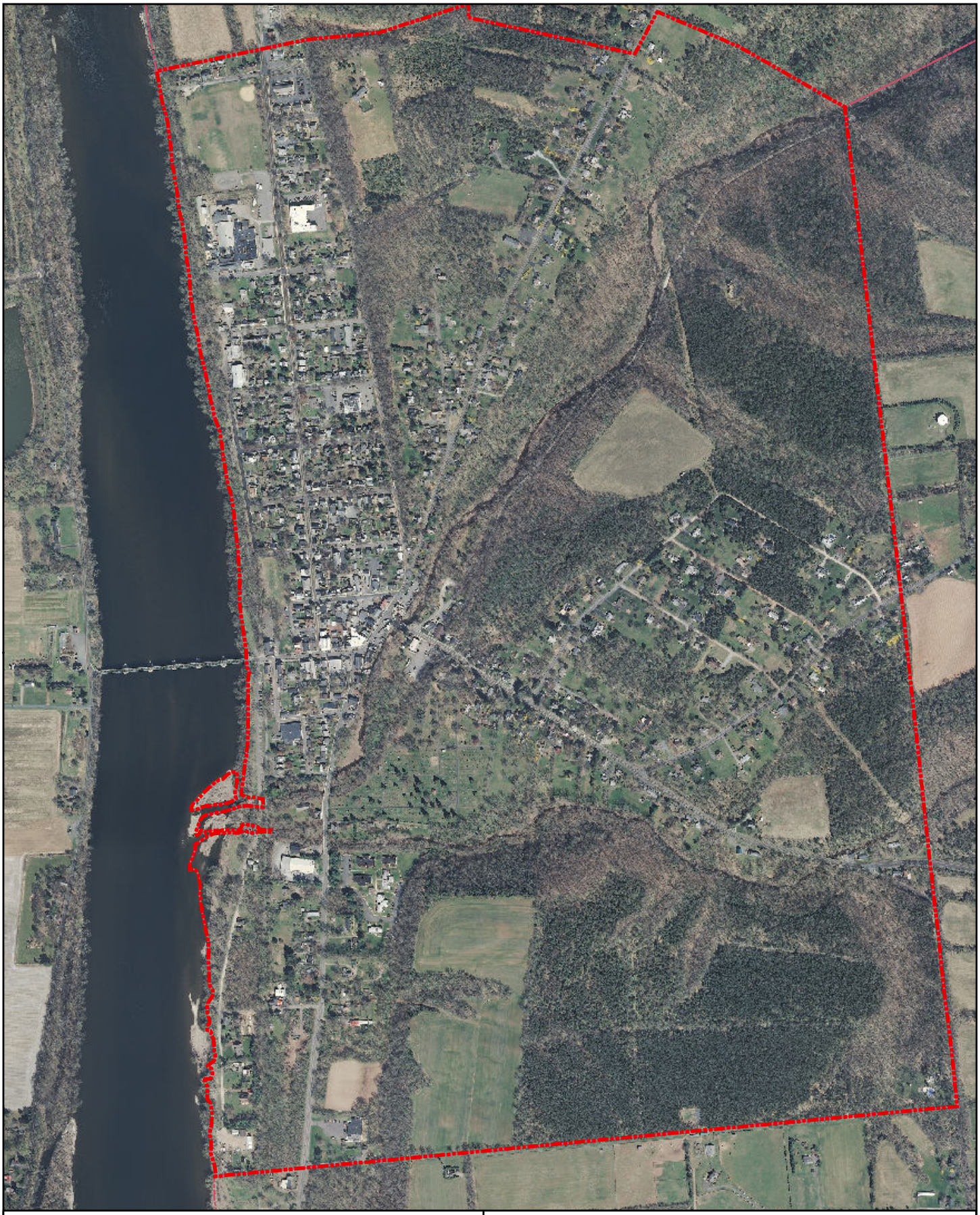


0 0.2 0.4 Miles

N

Data Sources: NJDEP, NJDOT, FEMA
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 1e: Borough of Frenchtown 2007 Aerial Photography

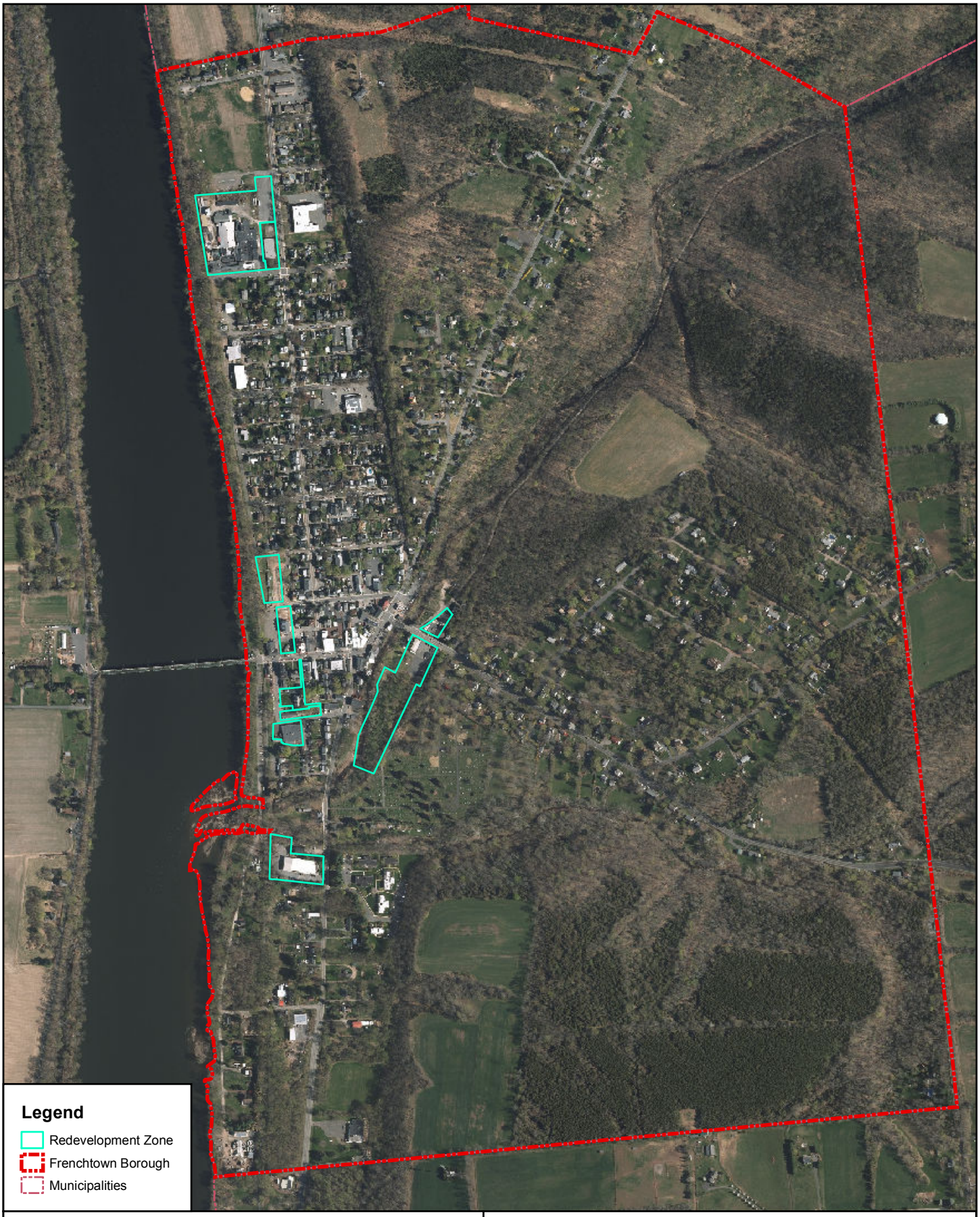


0 0.2 0.4 Miles

N

Data Sources: NJDEP, NJDOT, FEMA
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized

Figure 1f: Borough of Frenchtown 2012 Aerial Photography



Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized

Figure 1g: Borough of Frenchtown 2015 Aerial Photography

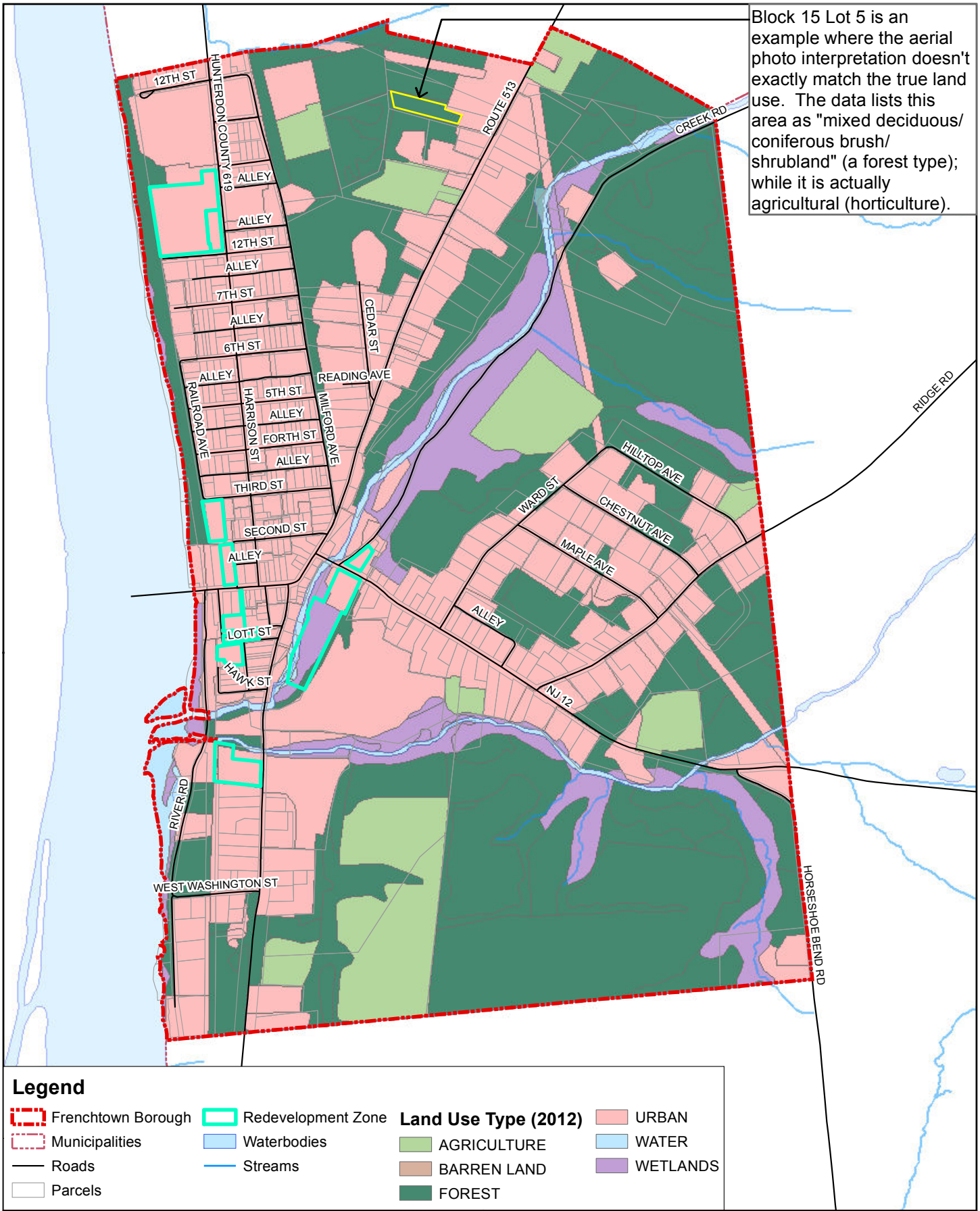


Figure 1h: Borough of Frenchtown Land Use Type (2012)

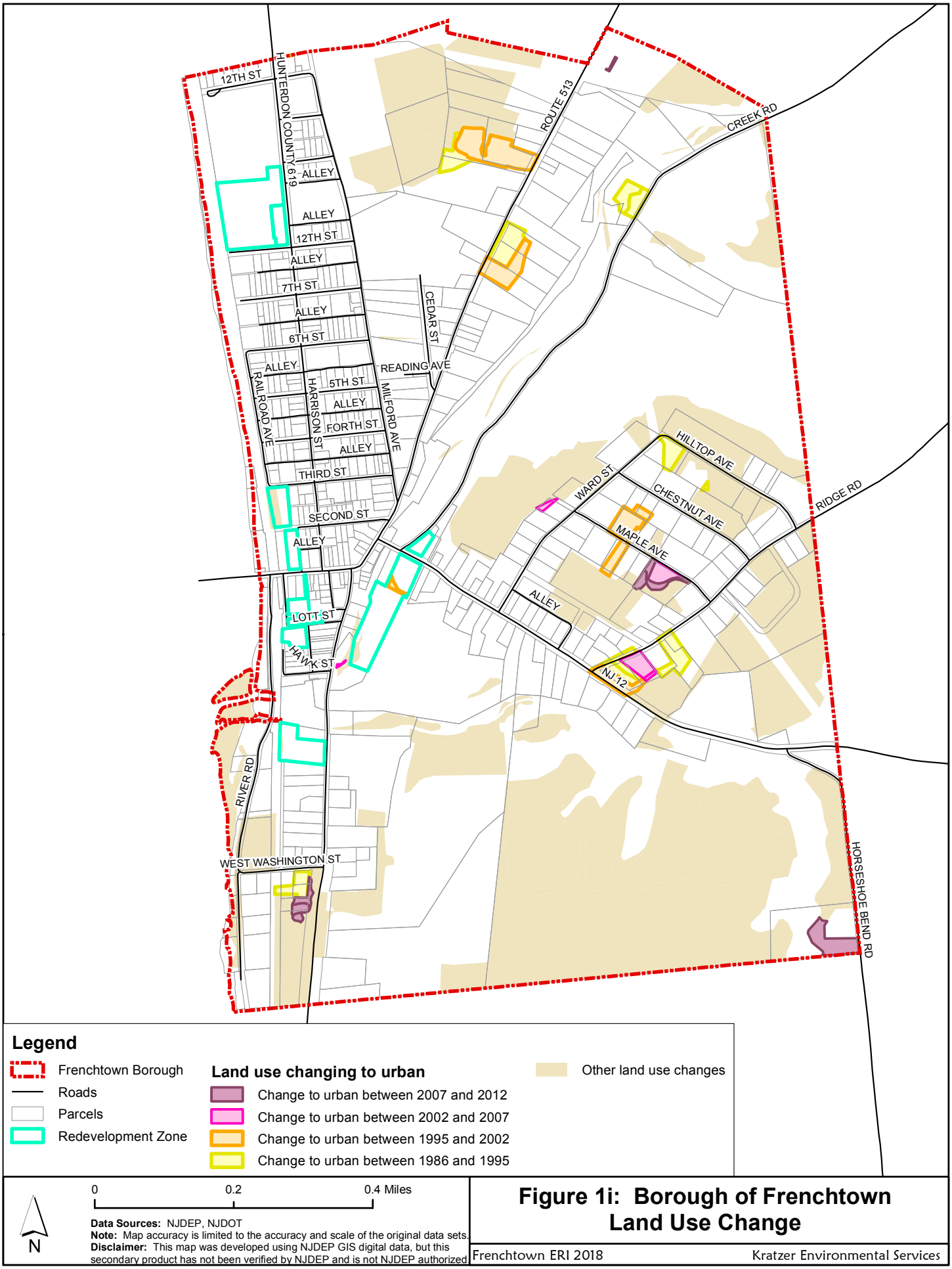


Figure 1i: Borough of Frenchtown Land Use Change

Table 1.1: 2012 Land Use Type

Land Use Type	Acres	Percent
Agriculture	54.4	7.6%
Barren Land	0.0	0.0%
Forest	297.4	41.4%
Urban/Residential	295.0	41.1%
Water	14.5	2.0%
Wetlands	57.2	8.0%
Total:	**718.5**	**100.0%**

*Area calculated with GIS differs from area from other sources, such as tax maps.

Source: NJDEP, 2015

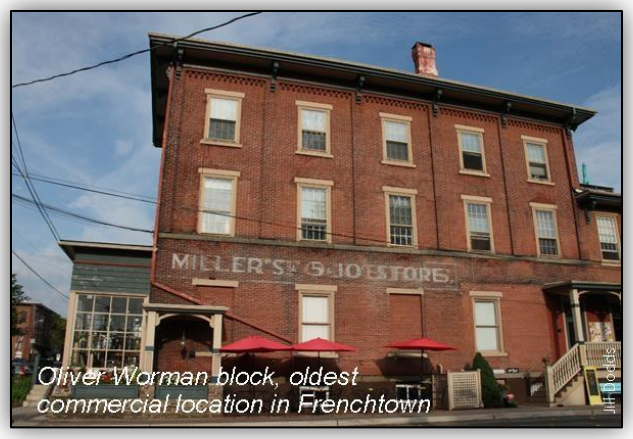


Table 1.2 shows the percentages of Frenchtown in each land use type in 1986, 1995, 2002, 2007 and 2012 the changes over time. In the 26 year period between 1986 and 2012, land use has not changed a great deal in Frenchtown. There are about 18 less acres of agriculture (2.5% of the area) and about 4.8 fewer acres of forest (0.7%). Urban lands and wetlands increased nearly one percent each. An increase in water of 11.8 acres is about half accounted for by the change in aerial photography resolution between 1995 and 2002, and half due to a loss in wetlands along the Delaware River near the mouths of the Nishisakawick and Little Nishisakawick Creeks.

Figure 1i highlights the areas that have changed to urban or barren land types from another type (such as agriculture) over this time period. Changes that are not towards urbanization are shown in tan. An example of this is an area that changed from *brushland/shrubland* to *coniferous forest (>50% crown closure)*. Some land changed within the urban type, such as changing from *other urban or built-up land* to *residential, single unit, low density*; while other areas changed from the urban type to another type, for example changing from *other urban or built-up land* to *cropland and pastureland* and these are also shown in tan. It is possible that some changes may reflect refinement of the data interpretation, and not actual land use changes.

Table 1.2: Change in Land Use Type from 1986 to 2012*

Land Use Type	1986 Percent	1995 Percent	2002 Percent	2007 Percent	2012 Percent	26 year change (Acres)	26 year change (Percent)
Agriculture	10.1%	8.8%	8.7%	8.4%	7.6%	-18.2	-2.5%
Barren Land	0.0%	0.0%	0.1%	0.0%	0.0%	0.0	0.0%
Forest	42.1%	43.6%	40.7%	40.7%	41.4%	-4.8	-0.7%
Urban/Residential	40.3%	40.2%	40.5%	40.9%	41.1%	5.2	0.7%
Water	0.4%	0.4%	1.2%	1.9%	2.0%	11.8	1.6%
Wetlands	7.1%	7.0%	8.7%	8.0%	8.0%	6.0	0.8%
Total:	100.0%	100.0%	100.0%	100.0%	100.0%		

*Some changes may be artifacts rather than actual changes, such as due to the increase in resolution in 1995 and 2002 or changes in definitions. Red text indicates decreased percent from the preceding assessment, while blue indicates increased percent.

Source: NJDEP, 2015; NJDEP, 2010; NJDEP, 2008; NJDEP, 2000; NJDEP, 1998

References: Introduction

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US Census 2010. http://factfinder2.census.gov/faces/nav/jsf/pages/community_facts.xhtml; http://quickfacts.census.gov/qfd/states/34/3453850.html

US Geological Survey (USGS). 2010. Edited by NJDEP, Bureau of Geographic Information Systems (BGIS) 1998, 2000, 2001, 2002, 2005, 2007, 2010. NJDEP MODIFIED ANDERSON SYSTEM 2007 derived from: A Land Use and Land Cover Classification System for Use with Remote Sensor Data, USGS Professional Paper 964, 1976. 35 pages. http://www.state.nj.us/dep/gis/digidownload/metadata/lulc07/anderson2007.html

Internet Resources: Introduction

Aerial photography:

Google Earth[6]: http://www.google.com/earth/index.html (free download)

HistoricAerials.com[7]: http://historicaerials.com (free to use, but maps have watermark unless purchased)

Free online mapping:

NJ-GeoWeb (NJDEP): http://www.state.nj.us/dep/gis/geowebsplash.htm

NJ Map: An Interactive Atlas for Ecological Resources, Environmental Education, and Sustainable Communities: http://www.njmap2.com/

[6] Users of Google Earth may also view several years of historic imagery of Frenchtown from 1993 through 2017. On the menu bar, click View, then click Historical Imagery and use the slider bar to choose the year.

[7] HistoricAerials.com allows viewing of historic aerial photography between 1931 and 2013.

Hunterdon County's Official Home Page: http://www.co.hunterdon.nj.us/index.html

Environmental Education

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

Free GIS Software

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

Frenchtown's Official Home Page: https://frenchtownboro.com/

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/index.html
Download GIS data: http://www.state.nj.us/dep/gis/listall.html
NJ Geographic Information Network: https://njgin.state.nj.us/NJ_NJGINExplorer/index.jsp
State of NJ GIS Open Data: http://njogis-newjersey.opendata.arcgis.com/datasets/public-solar-facilities-in-new-jersey

NJDEP Rules and Regulations (current and proposed): http://www.nj.gov/dep/rules/

2: LOCAL & REGIONAL CONDITIONS

A. Climate & Meteorology

Climate

The American Meteorological Society defines *weather* as atmospheric variations on the short-term (minutes to days), including characteristics such as temperature, precipitation and wind. In contrast, *climate* is defined as the meteorological conditions in terms of long-term averages (a month or more) (American Meteorological Society, 2015).

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 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, No Date).

The NJ State Climatologist has collected and evaluated more than a century of data from 19 stations within NJ in order to chart weather variables over the past century (e.g. min. and max. temperature, precipitation). The weather station nearest to Frenchtown that was evaluated for this climate study was Flemington[8], which has been monitored since 1879 (Robinson, 2010; Hartman, 2002). According to the NJ State Climatologist, a "Preponderance of evidence suggests climate change is occurring and humans are responsible for a significant portion of recent changes." (Robinson, September 30, 2016).

According to the National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center (NCDC), the temperature trend (annual average) in New Jersey is +0.3 °F per decade, and the precipitation trend is +0.24 inches per decade (for the period of record 1895 to 2016) (NOAA, February 7, 2017). NOAA summarizes New Jersey's climate as follows:

- Average annual temperatures have increased by 3°F over the past century.
- Precipitation has been variable, with wetter than average conditions over the past decade.
- Sea level along the New Jersey coast has risen by more than 16 inches over the past century (Runkle et. al., 2017)

The impacts of climate change in New Jersey may include increasing temperature, changing precipitation patterns (more intense river flooding during winter and spring, and drought during summer and fall), rising sea levels, retreating shores, saltwater intrusion, infrastructure damage, challenges for agriculture and fishing, and increased risks to human health (such as increasing respiratory ailments and diseases such as Lyme disease) (USEPA, August, 2016).

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. The Office of the New Jersey State Climatologist (ONJSC)

[8] The Flemington weather monitoring station is located about 12 miles east of Frenchtown, in Flemington, Hunterdon County south of Route 202 and east of Route 31. See **Figure 2a.**

divides New Jersey into five distinct climate regions. Frenchtown is included in the Northern Zone, which mainly encompasses the Appalachian Highlands portion of the state (ONJSC, No Date).

This region has higher elevations and is more northern than the rest of the state; therefore it experiences colder temperatures – on average 10°F colder than the Coastal Zone in the winter. The Northern Zone receives an average of 40 to 50 inches of snow, compared with an average of 10 to 15 inches in the south. This region is cloudier and wetter, as well. As moist air comes in from the west or off the ocean, it rises when it encounters the mountains, generating clouds and precipitation. During the warm season, thunderstorms are responsible for most of the rainfall, often developing in the evening. About twice as many thunderstorms occur here as in the Coastal Zone, where the Atlantic Ocean helps stabilize the atmosphere (ONJSC, No Date).

The ONJSC's New Jersey Weather and Climate Network maintains weather stations that transmit real-time data and weather forecasts online. Of these stations, the Flemington station is nearest to Frenchtown. **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).

Measurable precipitation falls in this area on approximately 120 days per year. At the Flemington station, annual precipitation has averaged 46.47 inches (for the period 1898-2017), which is a mid-range value within the average of 40 to 51 inches in New Jersey (see **Table 2.1**) (ONJSC, No Date; ONJSC, August 2017).

Table 2.1: Temperature & Precipitation at Flemington, NJ

Month	*Based on data from 1898-2017*	*Based on data from 1898-2017*	*Based on data from 1899-2017*		*Based on data from 1898-2017*
	Temperature (°F)				**Mean Precipitation**
	Avg. High	**Avg. Low**	**Mean**	**Max High**	**Min Low**
January	42.0	17.1	29.4	74°F (1950)	-18°F (1977)	3.60 in.
February	37.9	19.4	30.5	49.3°F (1954)	6.3°F (1934)	3.08 in.
March	51.4	30.9	39.7	65.7°F (1945)	20.4°F (1960)	3.97 in.
April	57.7	44.7	50.3	72.7°F (1941)	32.7°F (1971)	3.90 in.
May	67.3	51.2	60.6	81.4°F (1944)	38.4°F (1967)	4.02 in.
June	74.9	64.8	69.4	88.1°F (1945)	51.8°F (1980)	4.09 in.
July	79.9	70.3	74.6	93.9°F (1955)	56.4°F (1962)	4.79 in.
August	77.4	67.7	72.5	91.4°F (1944)	55.6°F (1982)	4.50 in.
September	71.4	60.4	65.7	84.8°F (1941)	45.7°F (1963)	3.97 in.
October	61.1	47.6	54.5	75.9°F (1947)	33.8°F (1964)	3.62 in.
November	50.6	37.6	43.5	61.2°F (1931)	26.7°F (1976)	3.44 in.
December	44.9	20.9	33.1	53.3°F (2015)	12.7°F (1989)	3.88 in.
					Average Annual Precipitation:	46.47 in.
Sources: ONJSC, August 2017 (averages and extremes).						

Rainfall is distributed fairly evenly throughout the year, with February being the driest month. On average, the summer months have the most precipitation, but appear drier because evapotranspiration exceeds precipitation (ONJSC, May 2013). Record rainfalls are more likely to occur in August and September, due to tropical storms (see **Table 2.2**).

An average of 31.7 inches of snow falls annually in the Flemington area (about 10" of snow equals 1" of rain). Typically, the majority of snowfall in the region occurs during the months of January and February. During an average winter, Frenchtown can expect approximately 8-9 days of snowfall greater than or equal to an inch, with accumulations of greater than 4 inches occurring on two days (ONJSC, 1971-2000). The earliest snowfall

accumulation on record at the Flemington weather station was on October 11 (in 1979, with 1.0"), and the latest was April 27 (in 1967, with 1.0") (ONJSC, 1893-2010).

The growing season in Hunterdon County lasts for about 167 days. The average date for the last killing spring frost is April 29th (statistically speaking, in one year out of 10 the last freeze may be as late as May 9). The first frost of fall occurs around October 13th (in one year out of 10, the first frost may be as early as October 2) (Dunlap, D.V. as cited in Jablonski 1974). Extremely late frost/freeze events were recorded in Hunterdon County during May of 2007, with the latest taking place on the 14th of the month (NOAA, 1996-2017). Exact dates vary from place to place 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 are frequently warm enough to thaw the soil. Heavy rain on partly thawed soils is very erosive (Jablonski, 1974).

Extreme Weather

Most areas of New Jersey receive 25 to 30 thunderstorms per year, with fewer storms near the coast than farther inland. In addition, each year between 1 and 10 nor'easters bring strong winds and heavy rains to the state. Although approximately five tornadoes appear each year in New Jersey (usually relatively weak ones) (ONJSC, No Date), they are relatively uncommon in Frenchtown. Six tornadoes have been documented in the county since 1950, with events in 1973, 1974, 1994 (2), 2003 and 2016. Two additional severe storms in the Hunterdon area have produced funnel clouds, including one directly over Frenchtown Borough in 2009 (NOAA, 1996-2017). During the same period, 30 hail events were recorded in Hunterdon County. One noteworthy hailstorm in 2007 produced golf ball size hail in Frenchtown Borough and caused significant crop damage as it moved on to Pittstown (NOAA, 1996-2017).

Table 2.2 lists some of the highest snow and rainfall received in one day at Flemington (*although multiple day storms can have higher totals*), for the period 1899 to 2017 (the most recent data available on the Internet) (ONJSC, August 2017).

Table 2.2: Highest Daily Precipitation Measured at Flemington

Rank	Greatest one-day snowfall		Greatest one-day rainfall	
	Amount	Date	Amount	Date
1st	24.0	Feb. 4, 1961	8.49	Sept. 17, 1999
2nd	21.0	Feb. 12, 1983	7.53	Aug. 28, 2011
3rd	20.0	Jan. 24,1982	5.72	Apr 16, 2007
4th	19.0	Jan 8, 1996	4.74	Sept. 20. 1989
5th	18.0	Feb. 19, 1979	4.48	Jul. 19, 1921
6th	18.0	Dec. 12, 1960	4.46	Aug. 9, 1942
Sources: ONJSC, 1893-2010 and ONJSC, June 13, 2013				

The flow of the Delaware River is measured continuously at Frenchtown[9] (gauge height only; the nearest site where actual discharge is measured continuously is at Belvidere, NJ). The flow level at Frenchtown (and many other NJ sites) is reported in real-time at the National Weather Service Advanced Hydrologic Prediction Website (see **Internet Resources**). Flood stage at this location is 16 feet, moderate flooding occurs at 18 feet, and a major flood is one greater than 20 feet stage. During the period of record[9] for the Delaware River at Frenchtown, the river has experienced 7 major floods, 2 moderate floods, and 3 minor floods since record keeping began in 1903 (National Weather Service, August 2017).

[9] The period of record for this gage is as follows: Annual maximum gage, water years 1936-1956 and 2005-2006; continuous-record gage-height, water years 2008 to the current year.

The top 10 highest flows on record and the 10 most recent flood events are listed in **Table 2.3 Table 6.3** shows an example of flood prediction and past flows of the Delaware River at Frenchtown. River gauge height and forecasts are available in real-time on the internet from USGS and NOAA (see **Internet Resources**).

Tropical storms and hurricanes can contribute significant rainfall and can cause flooding (see **Table 2.3**). 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. 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[10].

Table 2.3: Floods Recorded on the Delaware River at Frenchtown*

Major Flood Crests (in order of highest gauge height first)			
Rank**	**Gauge Height (feet)**	**Date**	**Tropical Storm?**
1	27.79	8/20/1955	Connie and Diane
2	24.40	10/10/1903	
3	23.60	4/4/2005	
4	23.40	6/29/2006	
5	21.93	3/19/1936	
6	21.70	3/13/1936	
7	20.70	9/19/2004	Ivan
8	19.02	9/9/2011	Lee
9	18.60	5/24/1942	
10	17.24	12/12/1952	
Most Recent Flood Crests (in order of most recent first)			
Rank**	**Gauge Height (feet)**	**Date**	**Tropical Storm?**
8	19.02	9/9/2011	Lee
12	16.68	8/29/2011	Irene
11	17.21	3/12/2011	
14	13.95	10/2/2010	
4	23.40	6/29/2006	
3	23.60	4/4/2005	
7	20.70	9/19/2004	Ivan
13	15.75	6/30/1973	
1	27.79	8/20/1955	Connie and Diane
10	17.24	12/12/1952	

* The period of record for this gage is as follows: Annual maximum gage, water years 1936-1956 and 2005-2006; continuous-record gage-height, water years 2008 to the current year.

**Rank refers to the relative severity of each flood, i.e. Rank 1 is the highest flood crest on record (1903 - present).

Sources: Wikipedia. July 19, 2017; National Weather Service, August 6, 2017

[10] This was during a period when the Frenchtown gage was not active, so it is not listed in Table 2.3. However, based on the peak flow records at Riegelsville, the 1996 flood would now rank as the 8th highest flow (USGS, 2018).

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; NOAA, 2004). While Floyd didn't make the list of top ten floods, it was locally memorable in Frenchtown, since high flow in Nishisakawick Creek washed out the footbridge in Frenchtown Park (there is no flow gauge on the creek).

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 basin. This combined with wet soils and full reservoirs to yield the worst flooding since 1955 (now the seventh highest discharge ever measured on the Delaware River at Frenchtown). This was followed only 7 months later, in April 2005, by a flood that 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 Frenchtown. Extremely heavy rain throughout the Delaware River watershed resulted in flash flooding that crested on June 29, 2006, and is the fourth highest on record (USGS, 2018; DRBC, November 16, 2016).

The year 2011 is the wettest year on record as measured at the Flemington station, with 76.45 inches of rain. Not coincidentally, the Delaware River at Frenchtown flooded three times that year. The first, on March 12, 2011, occurred when heavy rains combined with melting snow to cause minor flooding in Frenchtown. In August, Hurricane Irene triggered minor flooding. Tropical storm Lee followed shortly after Irene, resulting in moderate flooding on September 9, 2011 (ONJSC, 2017; DRBC, 2015).

Superstorm Sandy, which made landfall near Atlantic City on October 29, 2012, was notable not for rain totals, but for sustained wind and wind gusts and devastating damage to homes, trees and infrastructure (Robinson, November 7, 2012).

At the other extreme, extended periods of time with less than normal amounts of precipitation result in drought; agriculture suffers, wells can fail, reservoir levels fall and water supplies can be threatened.

Table 2.4: Lowest Annual Precipitation

Rank	Flemington Station*			NJ Climate Division 1 (North)**		
	Year	Amount (inches)	Deviation from Mean	Year	Amount (inches)	Deviation from Mean
1st	1965	30.86	-15.61	1965	30.84	-16.11
2nd	1916	33.96	-12.51	1963	34.69	-12.26
3rd	1957	34.01	-12.46	1964	34.69	-12.26
4th	1930	34.73	-11.74	1930	36.22	-10.73
5th	1980	35.57	-10.9	2001	37.10	-9.85
* Flemington station from 1895-2017; with a mean of 46.47 inches annually. **Average of 10 stations in northern NJ from 1895-2017; with a mean of 46.95 inches annually.						
Source: ONJSC, August 2017; ONJSC, September 2017						

NJDEP provides information about droughts according to Drought Region, using indicators of 90-day precipitation, 90-day stream flow, reservoir levels and ground water levels for each region. Frenchtown lies within the Northwest Drought Region (see **Figure 2a** and **Internet Resources**).

During a *drought watch*, voluntary water conservation measures are encouraged. During a *drought warning*, measures are taken to manage water supplies in order to avert a *drought emergency*. A water supply emergency results in mandatory restrictions on water use in order to curtail water demand.

Significant droughts in recent years included 1998-1999, 2001-2002 and 2017. 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 the drought was ended

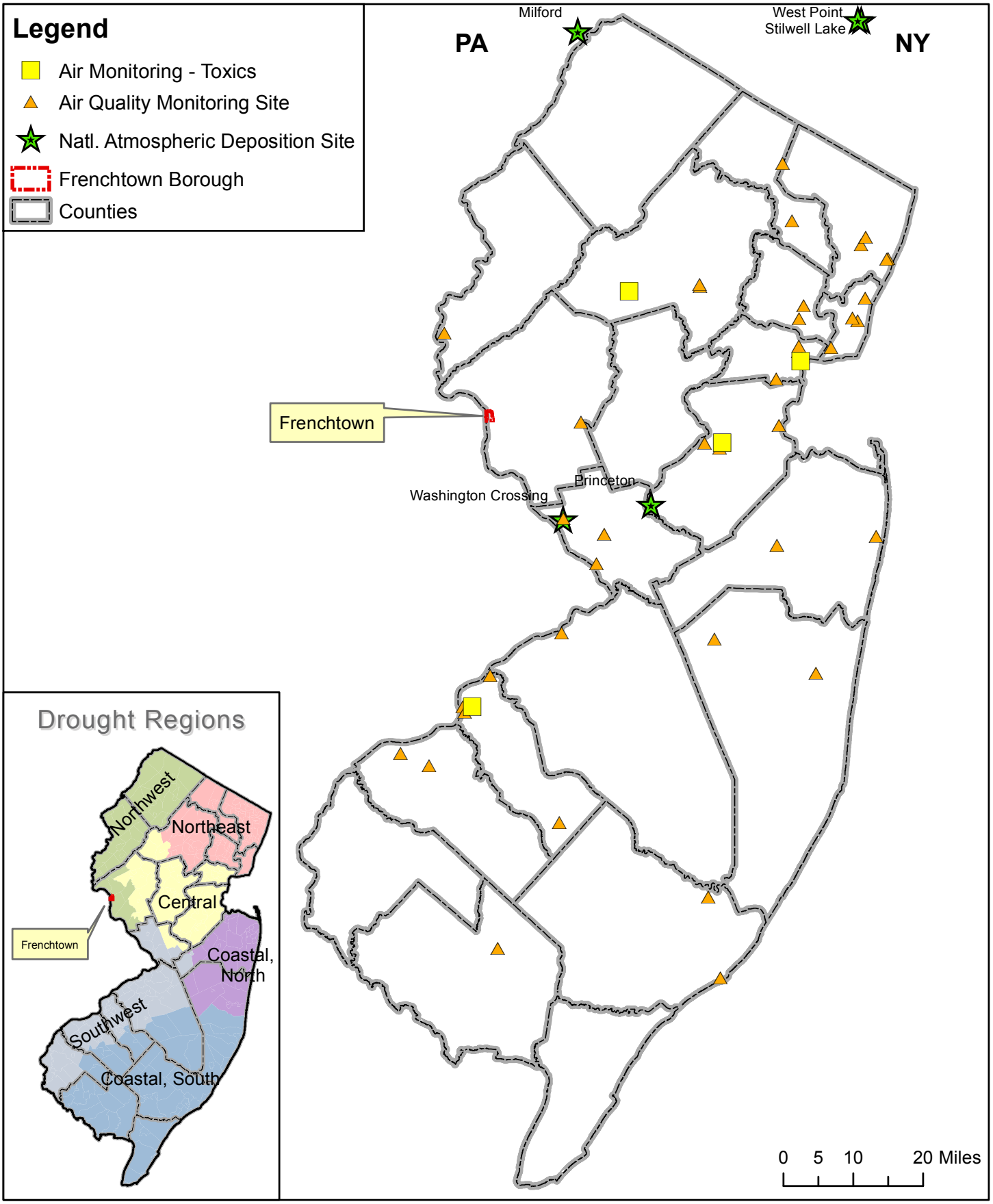

Figure 2a: Weather and Air Quality Monitoring and Drought Regions

Data Sources: NJDEP, NADP
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

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Prepared by Kratzer Environmental Services

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by a series of nor'easters that resulted in a wetter than normal November. The drought of record for the region, however, is considered 1963-1965, when three consecutive years included 3 of the 4 driest years since record-keeping began in 1895 (ONJSC, September 2017). The five years with lowest precipitation, based on an average of 10 stations in Northern New Jersey, are shown in Table 2.4.

B. Air Quality

The New Jersey Comparative Risk Project (March 2003), funded by the United States Environmental Protection Agency (USEPA) 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[11], 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). 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.

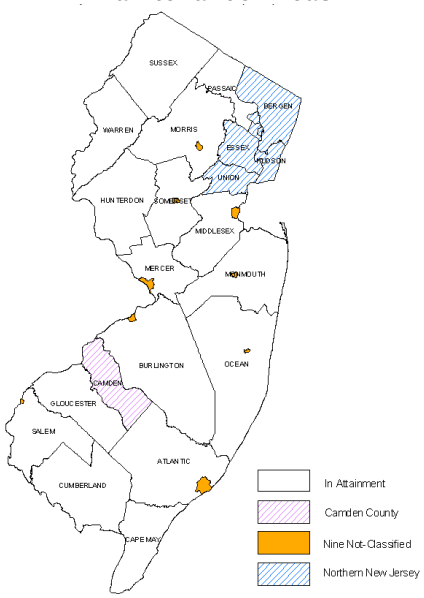
After the passage of the Clean Air Act in 1970, the USEPA set National Ambient Air Quality Standards (NAAQS) for six pollutants, known as the *Criteria Pollutants:* nitrogen dioxide, lead, sulfur dioxide, ozone, carbon monoxide, and particulate matter. These pollutants are addressed throughout the country through a planning process and the concentrations of these pollutants in air have been monitored for compliance with the air quality standards. Since 1970, concentrations of these six pollutants have been significantly reduced throughout the country (USEPA, 2017). Areas of the country where air pollution levels persistently exceed the NAAQS are designated *nonattainment*.

NJ has never exceeded the NAAQS for nitrogen dioxide (NO_2), and has not exceeded the standard for lead since the early 1970s. As of 2014, Warren County was the only county to exceed the sulfur dioxide (SO_2) standard, but since Pennsylvania's Portland Power Plant shut down its coal-fired units all of New Jersey is in attainment of the SO_2 standard. Five New Jersey counties, and selected urban areas in ten additional counties, are included in the state's three 8-hour carbon monoxide (CO) maintenance plan areas (see **Table 2.5**). All of Hunterdon County is currently in attainment of the standard for CO. Thirteen New Jersey counties are presently designated as nonattainment areas for both the particulate matter ($PM_{2.5}$) annual standard of 15 $\mu g/m^3$, and for the 24-hour 35 $\mu g/m^3$ standard (see **Table 2.5**). Although Hunterdon County is currently in attainment with this standard, three adjacent counties (Morris, Somerset and Mercer) are included in the Northern New Jersey/New York/Connecticut nonattainment area. However, Hunterdon County is part of the New York-Northern New Jersey-Long Island (NY-NJ-CT) nonattainment area for the Ozone standard (1997 8-hour ozone standard of 0.08 ppm; revised in 2008 to 0.075 ppm (both primary and secondary); revised in 2012 to 0.075 ppm 8-hour ozone NAAQS (see **Table 2.5**) (NJDEP Bureau of Air Quality Planning, January 25, 2013).

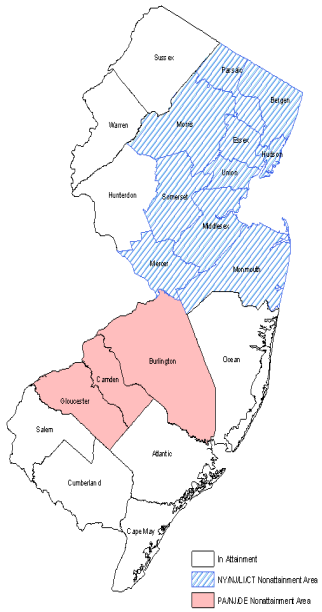
[11] Radon is discussed in **Section 3E** and Radon in ground water is discussed in **Section 5E**.

Table 2.5: National Ambient Air Quality Standards Nonattainment

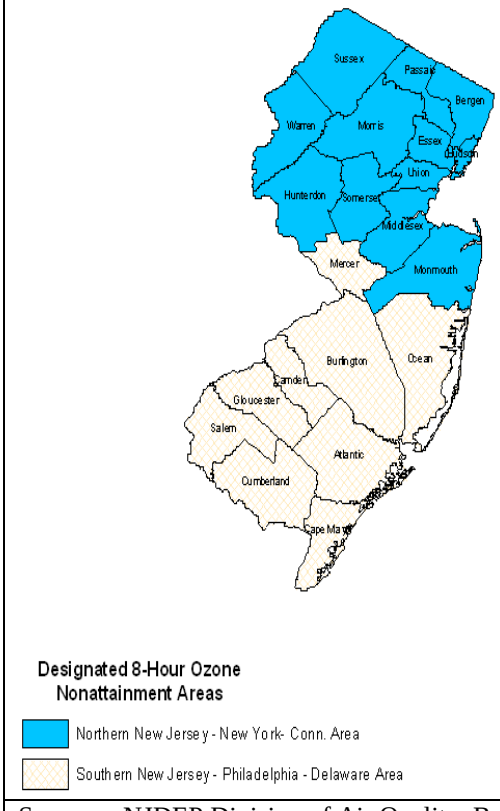
New Jersey Carbon Monoxide (CO) Maintenance Areas



New Jersey Annual Fine Particulate Matter ($PM_{2.5}$) Nonattainment Areas



New Jersey 8-Hour Ozone Nonattainment Areas



Standards:

Carbon Monoxide [76 FR 54294, Aug 31, 2011]
Primary Standard:
8-hour average = 9 ppm not to be exceeded more than once per year.
1-hour standard = 35 ppm not to be exceeded more than once per year.

***Particle Pollution*, $PM_{2.5}$** [as of Dec 14, 2012]
Primary:
Annual mean, averaged over 3 years=12 µg/m^3;
Secondary:
Annual mean, averaged over 3 years=15 µg/m^3;
Primary & Secondary:
24-hour 98th percentile, averaged over 3 years=35 µg/m^3

Ozone*, *8-hour [73 FR 16436, Mar 27, 2008]
Primary & secondary:
Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years = 0.075 ppm

Sources: NJDEP Division of Air Quality, Bureau of Evaluation and Planning, April 18, 2017

The USEPA requires New Jersey to report the emissions from major sources annually. To accomplish this, the Emission Statement Rule (N.J.A.C. 7:27-21) requires the annual reporting of emissions from stationary sources for the following air contaminants; carbon monoxide (CO), sulfur dioxide (SO_2), ammonia (NH_3), total suspended particulate matter (TSP),

respirable particulate matter (PM_{10} and $PM_{2.5}$), lead (Pb), volatile organic compounds (VOC), oxides of nitrogen (NO_x), carbon dioxide (CO_2), methane (CH_4) and the 36 toxic air pollutants (TAPs).

NJDEP developed the Air Quality Index (AQI) to provide a descriptive rating and a color code (e.g. green=good) in real-time on the internet for many sites. The monitoring station closest to Frenchtown Borough is located in Flemington (NJDEP Bureau of Air Monitoring, February 13, 2013; see **Internet Resources** for links to current air quality at these sites; see **Figure 2a** for locations). The following paragraphs provide more information about ground-level ozone, particulates, air toxics and atmospheric deposition.

Ground-level Ozone

Ground-level ozone (O_3) causes serious adverse health and environmental effects. It forms in the air from volatile organic compounds (VOCs) and nitrogen oxides (NO_x) under conditions of high temperature and bright sunlight. Sources include vehicles, power plants and factories. The hottest days of summer can yield unhealthy levels of ozone.

The National Ambient Air Quality Standards (NAAQS) for ozone were revised in 2008 because the USEPA determined that the 1997 standard was inadequate to protect public health. The standard of 0.075 ppm is calculated as an average over 3 years of the annual fourth-highest daily maximum 8-hour concentration. The 1-hour ozone standard was revoked June 15, 2005 (USEPA, December 14, 2012).

According to the most recent three years of monitoring data for the Flemington site, the 8-hour ozone standard of 0.075 ppm was exceeded 4 times, twice in May and on two more dates in June. 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. Based on the 3-year period from January 2010 through December 2012, the USEPA had designated all of New Jersey as moderate non-attainment with respect to the 8-hour ozone standard. New Jersey's 2015 Ozone Summary states that significant improvements have been made but further reductions in both VOCs and NOx will be needed as the 8-hour ozone standard was lowered to 0.070 in October 2016. (US EPA, May 3, 2013; NJDEP Bureau of Air Monitoring, 2012b; NJDEP, 2015 Ozone Summary).

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. Particulate matter smaller than 2.5µ (µ=microns, equal to 0.001 millimeter) diameter ($PM_{2.5}$) are considered *Fine Particulates*, while larger particles are considered *Coarse Particulates*. Coarse Particulates are made up of Total Suspended Particulates (TSP) and Inhalable Particulates (PM_{10}). All sizes are harmful to the environment, but coarse particles smaller than 10 microns (PM_{10}) are inhalable, therefore are considered harmful to human health, while fine particles less than 2.5 microns ($PM_{2.5}$) are even more detrimental to human health. Coarse particle sources include windblown dust and industrial sources, while fine particles come from combustion sources or are formed in the atmosphere from gaseous emissions. In December 2012, the EPA revised the standard from 15.0 $\mu g/m^3$ to 12.0 $\mu g/m^3$. An area will meet the standard if the three-year average

of its annual average $PM_{2.5}$ concentration (at each monitoring site in the area) is less than or equal to 12.0 $\mu g/m^3$ (US EPA, December 14, 2012).

The nearest monitoring sites for particulates are Trenton Library and Washington Crossing (for $PM_{2.5}$ filter sampler); and Ewing and Flemington (for $PM_{2.5}$ continuous sampler). 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 $PM_{2.5}$ and maximum 24-hour average at these sites. The annual average $PM_{2.5}$ at Trenton Library was 8.2 µg/M^3, Washington Crossing was 7.8 µg/M^3, Ewing was 6.8 µg/M^3 and Flemington was 5.6 µg/M^3, all below the annual average standard of 12 µg/M^3. Each also had maximum 24-hour averages below the 24-hour standard of 35µg/M^3 (Trenton Library, 28.8 µg/M^3, Washington Crossing, 25.5 µg/M^3, Ewing, 22.2 µg/M^3 and Flemington, 21.4 µg/M^3) (NJDEP Bureau of Air Monitoring, 2015).

Air Toxics

In 1979, NJDEP adopted a regulation that specifically addressed air toxics emissions. This rule (Control and Prohibition of Air Pollution by Toxic Substances, N.J.A.C. 7:27-17) 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 (NJDEP Air Toxics in NJ, January 29, 2016). 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 works 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, and updated in 1999, 2002 and 2005. The 2005 study update determined that, in New Jersey, on-road mobile sources are responsible for 33% of the toxic emissions; nonpoint/area sources contribute 31% (residential, commercial, and small industrial sources); non-road mobile sources (airplanes, trains, construction equipment, lawnmowers, boats, dirt bikes, etc.) account for 29%; and point sources account for the remaining 7%.

The NJDEP has established four comprehensive air toxics monitoring sites. They are located in Elizabeth, New Brunswick, Chester and Camden. Pollutant concentrations are trending downward, but many of them still exceed the NJDEP health benchmarks (NJDEP Air Toxics in NJ, 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 (trout are particularly sensitive) and deplete nutrients from soils.

The closest National Atmospheric Deposition Program (NADP) site is located in Washington Crossing, NJ (Mercer County), which has been monitored since 1981. Results for 2016 show a mean pH value of 5.2. This is more acidic than normal rainfall (pH of 5.6), but is an improvement from the 1980s, when pH averaged 4.3. Trends show decreasing concentrations of SO_4, NO_3, Mg, and N; but no improvement in NH_4, Ca, K, Na and Cl (NADP, 2017).

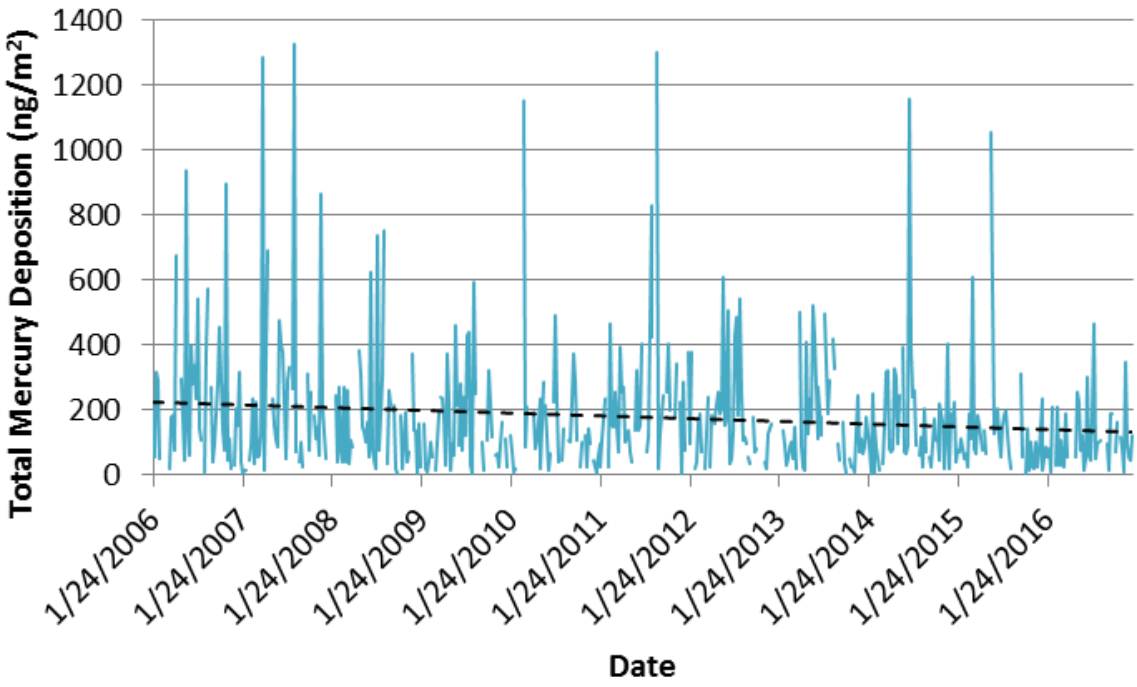
Mercury (Hg) is a highly toxic heavy metal. Human health concerns of mercury include neurotoxicity (low-level exposure is linked to learning disabilities in children) and interference in reproduction, while both methyl mercury and mercuric chloride are listed by EPA as possible human carcinogens. Environmental effects have not been adequately studied, but animals, especially fish-eaters, experience effects similar to humans. The exposure to mercury is not from ambient air, but from deposition of airborne mercury onto surface water, vegetation and soil, which can then enter the food and water supply. On the basis of preliminary data from the New

Jersey Air Deposition Network, the deposition of mercury from the air is higher than the national average of 10 µg/m^2/year. In NJ, the major sources of mercury are steel and iron manufacturing, coal combustion, products (such as broken fluorescent tubes), and municipal and sludge incineration. Mercury persists in the atmosphere up to two years and reaches the surface through atmospheric deposition, where it may persist as methyl mercury in the soil for decades. Mercury is never removed from the environment, but accumulates in biological tissue (bioaccumulation) (see **Section 6.I for Fish Consumption Advisories**) (NJDEP New Jersey Mercury Task Force, December 2001; NADP, 2017a).

In New Jersey, two sites are monitored as part of the Atmospheric Mercury Network (AMNet) for mercury (as dry deposition): NJ54 Elizabeth Lab and NJ30 New Brunswick, but the data is not publicly available (NADP, 2017c). The New Brunswick site is the closest to Frenchtown.

The Mercury Deposition Network (MDN) provides a long-term record of total mercury (Hg) deposition in precipitation throughout the United States and Canada, including one site in New Jersey (see **Table 2.6**). Standard procedures include automated weekly collection modified to preserve mercury. Ten years of data show a gradually decreasing trend in mercury deposition at the New Brunswick site (NADP, 2017b).

Table 2.6: Mercury Deposition Network (MDN) Site NJ30 (New Brunswick) 2006 to 2016



MDN Site NJ30 (New Brunswick)
Latitude: 40.4728 Longitude: -74.4226
Date Range Displayed: 01/17/2006 to present
Average (mean) = 178.2 ng/m2
Median (middle value) = 115.43
Minimum = 2.48 collected on 10/20/2015
Maximum = 1326.41 collected on 8/14/2007
Source: NADP, 2017b

In addition to directly measuring mercury in precipitation, a study of mercury in lake sediment cores can be representative of atmospheric deposition over long periods of time. A 2003 study by the NJDEP Division of Science, Research and Technology, with sites 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; Schuster et al, 2004).

C. Existing Infrastructure

Public Water

Public water purveyors may be government agencies, private companies, or quasi-government groups. Water purveyors are regulated by the NJDEP Bureau of Safe Drinking Water, under the Safe Drinking Water Act. *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.

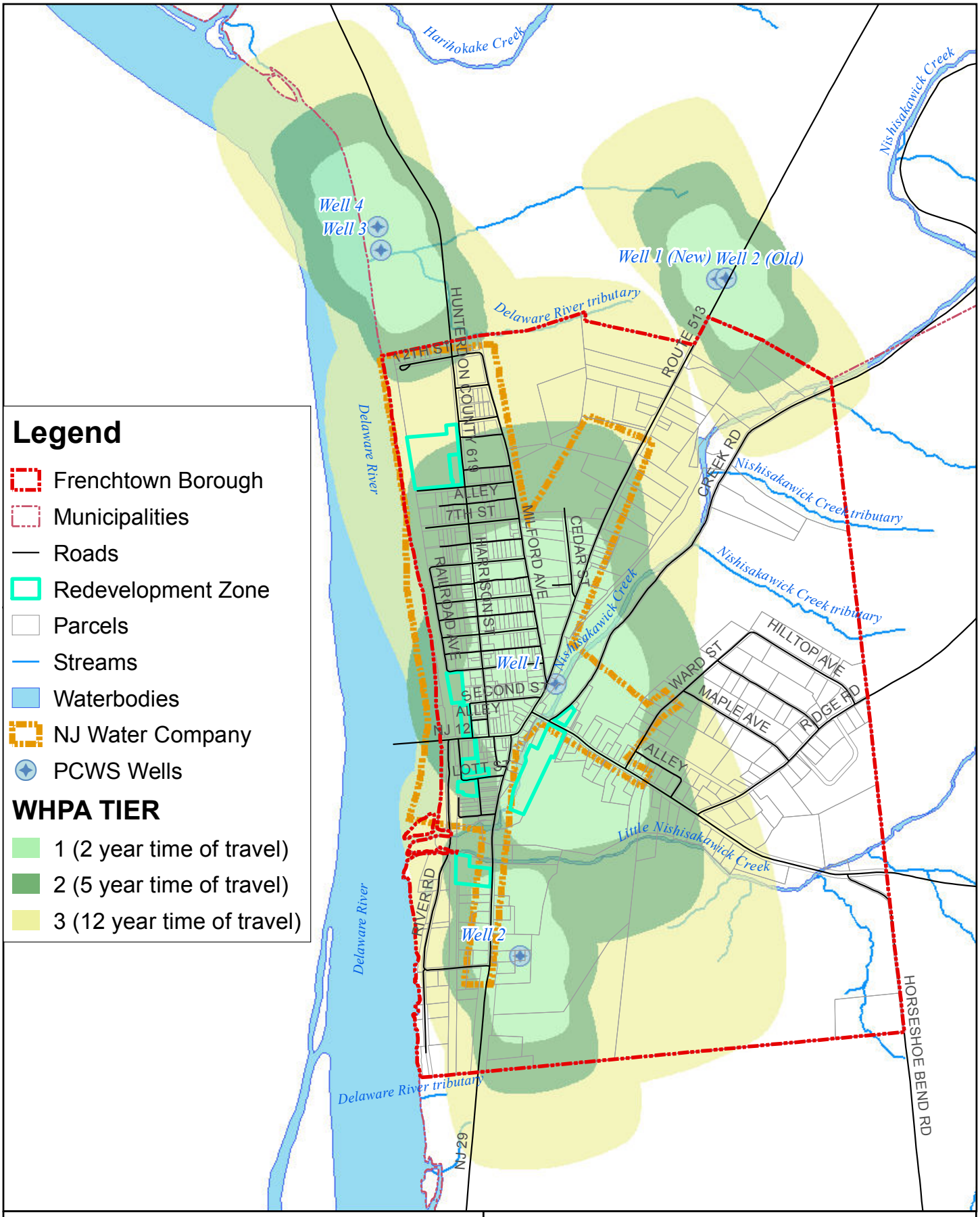
In Frenchtown, the majority of the town relies on public water drawn from three municipal wells, operated and managed by New Jersey American Water. However, all homes in the 0.43 northern end of Everittstown Rd as well as some homes in the Hilltop Avenue neighborhood still rely on private wells. Locations of the Frenchtown Water Department's three municipal wells are shown on **Figure 2b.** A discussion of the aquifer that these wells draw from is found in **Section 5C** and water quality in **Section 5E**.

Water use for the Borough's three wells averaged 110,000 gallons/day in 2016, for a population of 1,373 in 596 households (Census 2010), resulting in an average water use of 80 gallons/day/capita or 185 gallons/day/household. Water quality is good and in compliance with current water quality standards (NJAW, 2016). A *Well Head Protection Area* (WHPA) is an area calculated around a PCWS well that outlines the horizontal extent of ground water captured by a well pumping at a specific rate over two-, five-, and twelve-year periods of time for unconfined wells (see **Figure 2b)**.

Sewer Service Areas

The NJDEP administers the Statewide *Water Quality Management (WQM)* Planning rules found in N.J.A.C. 7:15 (NJDEP, 2016). The rules establish a mechanism for determining whether proposed projects or activities are consistent with the statewide WQM Plan (see **Internet Resources and Section 10C**). This process includes development and adoption of a *Wastewater Management Plan (WMP)*, a document that provides 20 year planning (or to build-out for non-urban communities) for wastewater and certain other water quality concerns.

As of January 2014, there were approximately 519 parcels served by public sewer and 27 parcels served by septic systems (K. Bogen, personal communication, 2017). The properties with septic systems are located on Hilltop, Maple, and Chestnut Avenues. Frenchtown's WMP was completed in 2014 in collaboration with the Hunterdon County Planning Department (Bogen, 2014). In addition, Frenchtown also recently upgraded their wastewater treatment plant, which became operational in late 2015.



Legend

- Frenchtown Borough
- Municipalities
- Roads
- Redevelopment Zone
- Parcels
- Streams
- Waterbodies
- NJ Water Company
- PCWS Wells

WHPA TIER

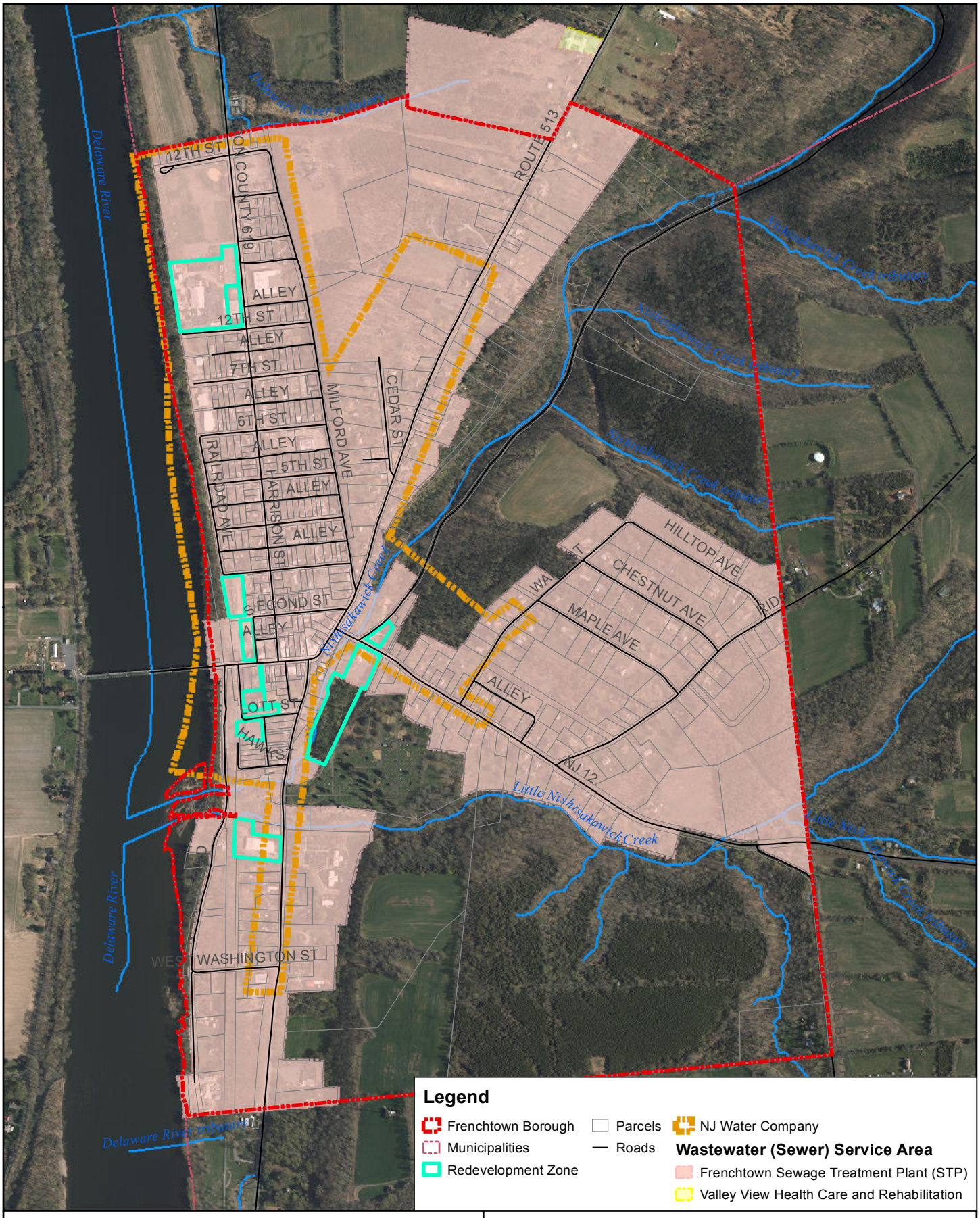
- 1 (2 year time of travel)
- 2 (5 year time of travel)
- 3 (12 year time of travel)

0 0.25 0.5 Miles

N

Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized

Figure 2b: Borough of Frenchtown Public Water



Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 2c: Borough of Frenchtown Public Sewer and Water

Frenchtown ERI 2018 — Kratzer Environmental Services

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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

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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

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Avg. Temp.: http://climate.rutgers.edu/stateclim_v1/monthlydata/index.php?stn=283029&elem=avgt
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Internet Resources: Local & Regional Conditions

Climate and Meteorology

Frenchtown Floods: http://frenchtown.com/floods/

National Weather Service Advanced (NOAA) Hydrologic Prediction Service (flood predictions):

Delaware River at Riegelsville (upstream of Frenchtown):
http://water.weather.gov/ahps2/hydrograph.php?wfo=phi&gage=rgln4&prob_type=stage&source=hydrograph

Delaware River at Frenchtown:
http://water.weather.gov/ahps2/hydrograph.php?wfo=phi&gage=fren4&prob_type=stage&source=hydrograph

National Weather Service Forecast Frenchtown, NJ:
http://forecast.weather.gov/MapClick.php?CityName=Frenchtown&state=NJ&site=PHI&textField1=40.5258&textField2=-75.0563&e=0#.WZHrC2SGNo4

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 Northwest Region: http://www.njdrought.org/current.html#northwest
Weather and Climate Network Index: http://climate.rutgers.edu/njwxnet

USGS Real-Time Stream Flow Stations:

01458500 Delaware River at Frenchtown:
https://waterdata.usgs.gov/nj/nwis/uv/?site_no=01458500&PARAmeter_cd=00065,00060,62614

Index of NJ sites https://waterdata.usgs.gov/nj/nwis/

Air Quality

Current Air Quality: http://www.njaqinow.net/

Daily Air Quality Index Forecast: http://www.airnow.gov/index.cfm?action=airnow.local_state&stateid=31&tab=0

What you can do to reduce air toxics? http://www.state.nj.us/dep/airmon/airtoxics/youcan.htm

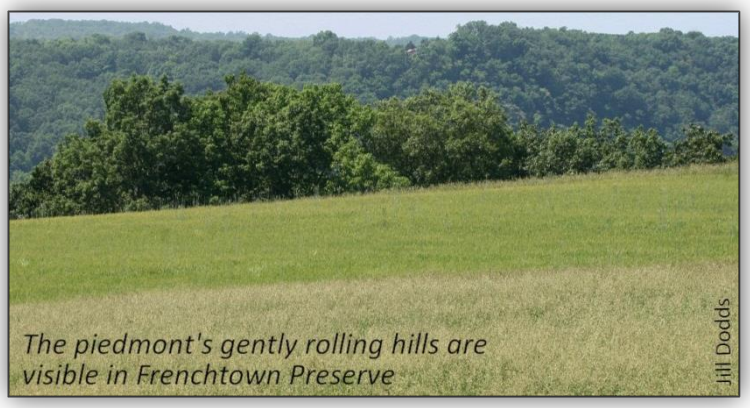
NJDEP Radon Information: http://njradon.org or call 1-800-648-0394 609-984-5425

NJDEP Rules and Regulations (current and proposed): http://www.nj.gov/dep/rules/

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

3: PHYSIOGRAPHY, TOPOGRAPHY & GEOLOGY

A. Physiography



The piedmont's gently rolling hills are visible in Frenchtown Preserve

New Jersey can be divided into four regions, known as *physiographic provinces*, which are areas with a common geologic history and similar sequences of rock types and geologic structures (see **Figure 3a**). The geologic history of New Jersey is summarized in **Table 3.1**.

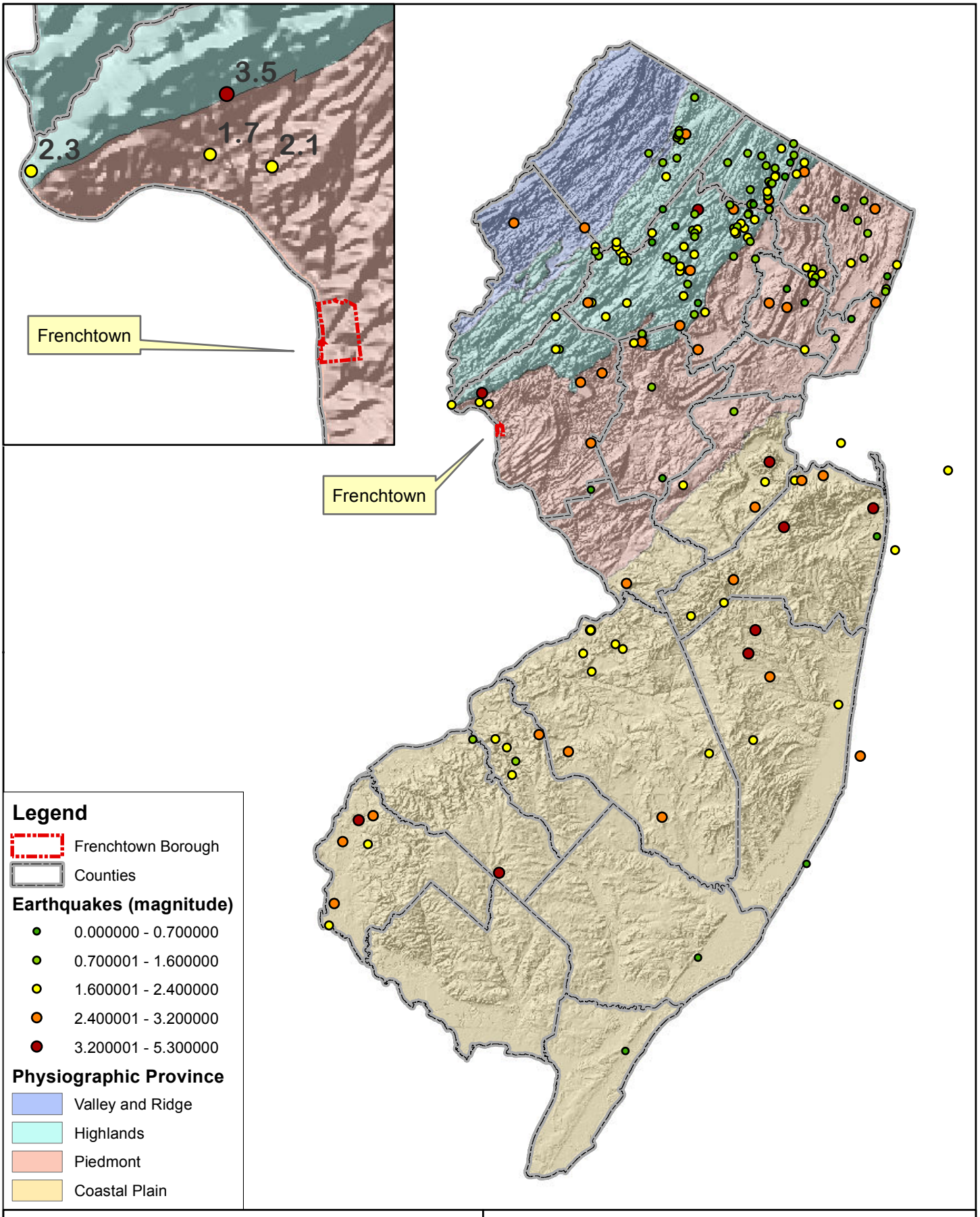
During the Precambrian and Paleozoic Eras, the land that is now New Jersey was at the bottom of the sea, close to the equator. About 400 million years ago, the continents Europe and North America collided; forming the Appalachian Mountains, which at that time reached far higher and were more rugged than the Rocky Mountains are now (Gallagher, 1997).

In New Jersey, the Appalachian Mountains are known as the *Valley and Ridge Province.* This Province is characterized by long, parallel ridges and valleys, and encompasses the northwestern section of New Jersey. High Point, with an elevation of 1,803 feet and the highest point in New Jersey, is located in this Province (NJGS, 2006).

Bordering the Valley and Ridge Province to the southeast, the *Highlands Province* consists of a series of ridges. Metamorphic granite and gneiss rocks 1.2 billion to 900 million years old (the oldest rocks in the state) are resistant to erosion and create a hilly upland. Wawayanda Mountain is the highest point (1,496 feet) in the Highlands. Elevations decrease to the southeast and southwest. The Highlands Province is also characterized by deep, steep-sided valleys carved by streams (NJGS, 2006).

The Highlands Province is separated from the *Piedmont Province* by a series of major faults, including the Ramapo Fault, where the crystalline rocks of the Highlands touch the much younger sedimentary and igneous rocks of the Piedmont. The Piedmont Province is characterized by gently rolling hills. The rocks of the Piedmont are of Late Triassic and Early Jurassic age, 240 to 140 million years old (NJGS, 2006).

Sediments that eroded from adjacent uplands were deposited along rivers and lakes within the basin, and they became compacted and cemented to form conglomerate, sandstone, siltstone and shale bedrock. Roughly 200 million years ago, the supercontinent Pangaea broke apart, and the Atlantic Ocean was born. This was accompanied by volcanic activity, which resulted in magma flowing at the surface (forming basalt) or near the surface (forming diabase) (Lucey, 1970). The specific rock formations in Frenchtown are discussed in **Section 3C**.Frenchtown lies entirely within the Piedmont Physiographic Province (NJGS, 2006) (see **Figure 3a**).



Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 3a: Borough of Frenchtown Physiographic Provinces

Overlapping the Piedmont Province, the relatively flat terrain of the *Coastal Plain Province* consists of unconsolidated sedimentary formations, such as sands, clays, and marls. These range in age from 90 to 10 million years old (NJGS, 2006).

Within the past two million years, the climate alternated between cool and warm. During periods of glaciation, the glaciers extended as far south as Perth Amboy, NJ, while the area below that became cold tundra. At times, the Coastal Plain was under the Atlantic Ocean, although at other times, the shore may have extended a hundred miles beyond the present shore (White, 1998).

Table 3.1: Summary of New Jersey's Geologic History

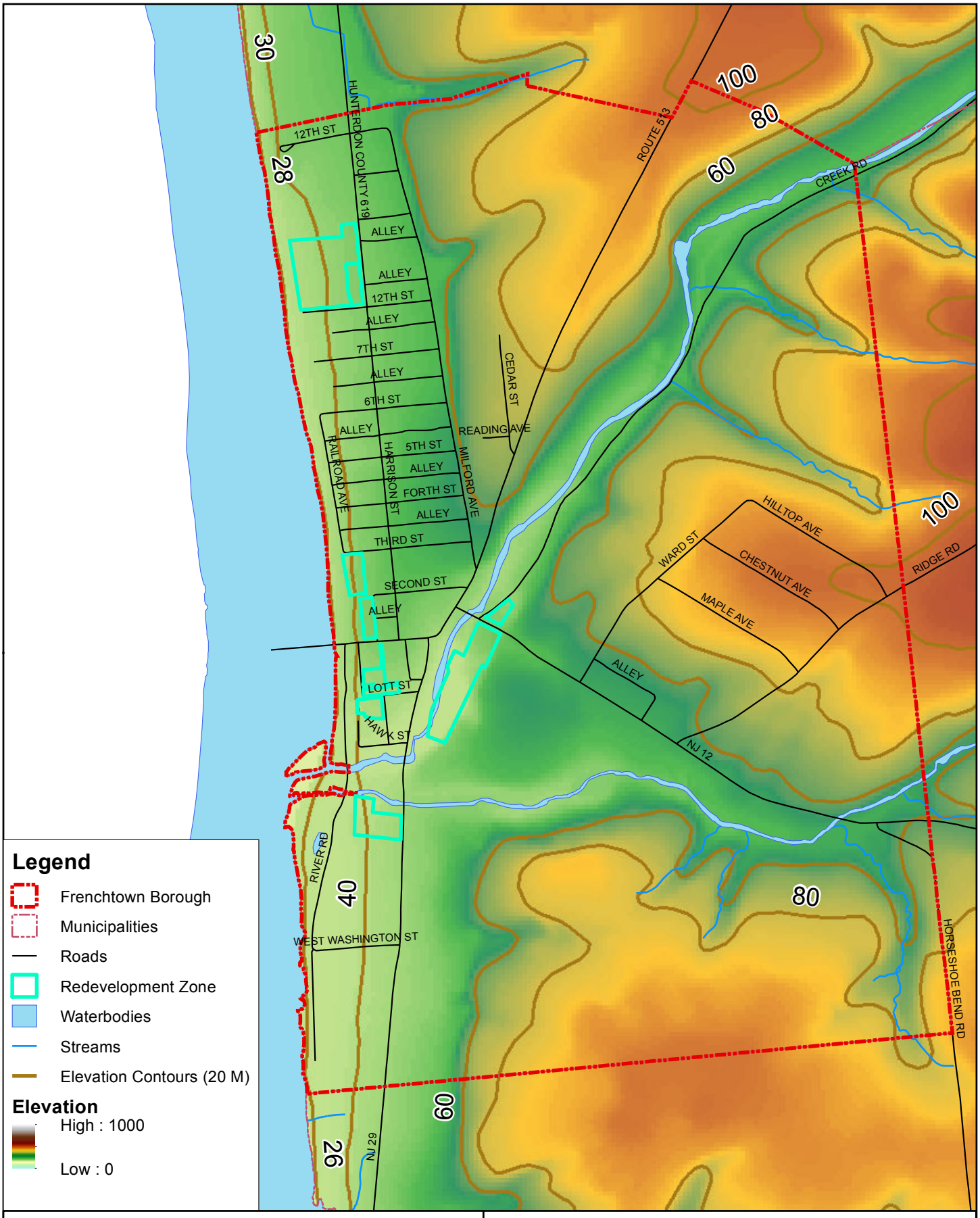
Period	Million Years Ago	Description of Climate and Fossils Found in Corresponding Bedrock
Precambrian Era		
	Up to 544	**Climate:** New Jersey was under the sea. **Fossils:** stromatolites; most life forms were soft bodied and left no fossils
Paleozoic Era		
Cambrian Period	544 – 505	**Climate:** New Jersey was close to the equator, covered by warm tropical seas. **Fossils:** trilobites, brachiopods, stromatolites, worm burrows
Ordovician Period	505 – 440	**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	440 – 410	**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)
Devonian Period	410 – 360	**Climate:** Europe collided with North America, forming the mountains that 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, bryozoans
Mississippian, Pennsylvanian & Permian Periods	360-248	**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	248 – 200	**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	200 – 145	**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	145 – 65	**Climate:** Northern New Jersey was above sea level, while southern New Jersey

Period	Million Years Ago	Description of Climate and Fossils Found in Corresponding Bedrock
Period		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. **Fossils:** 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. 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 much of the Coastal Plain (see **Figure 3a**). **Fossils:** Fossils of land animals include birds, such as the diatryma (a giant flightless bird), tillodont (an extinct mammal the size of a bear, but with rodent-like teeth) and possibly others similar to those found in the South Dakota badlands, such as brontotherium, ancestral horses, entelodonts (resembled giant warthogs), diceratherium (semi-aquatic rhinoceros), peccary, prosynthetoceras (a camal), anchitherium (horse), and a primitive doglike carnivore. Fossils found in the Outer Coastal Plain include brachiopods, corals, sponges, clams, sharks, mollusks, crinoids, mammals (probably washed to the sea in floods), crocodiles, snakes, and early whales.
Quaternary Period	1.8 - present	**Climate:** The climate alternated between cool 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, 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.
Sources: Gallagher, 1997; University of California Museum of Paleontology et al., 2003; USGS, 2002		

B. Topography

Topography depicts the relief features of an area. The elevation in Frenchtown ranges from about heights of 97.5 meters (320 feet) (midpoint along the town's southern boundary and also northwest of Ridge Rd. at the eastern edge of the Borough atop the bluffs overlooking the Delaware River) to 36.6 meters (120 feet) above mean sea level (along the Delaware River's shoreline) (NJGS, 1999a) (see **Figure 3b**). In **Figure 3b**, each line represents 20 meters of elevation, and is drawn to follow the contour of the land. **Figure 3b** also uses shaded colors to illustrate elevation in Frenchtown (NJGS, 1999b).

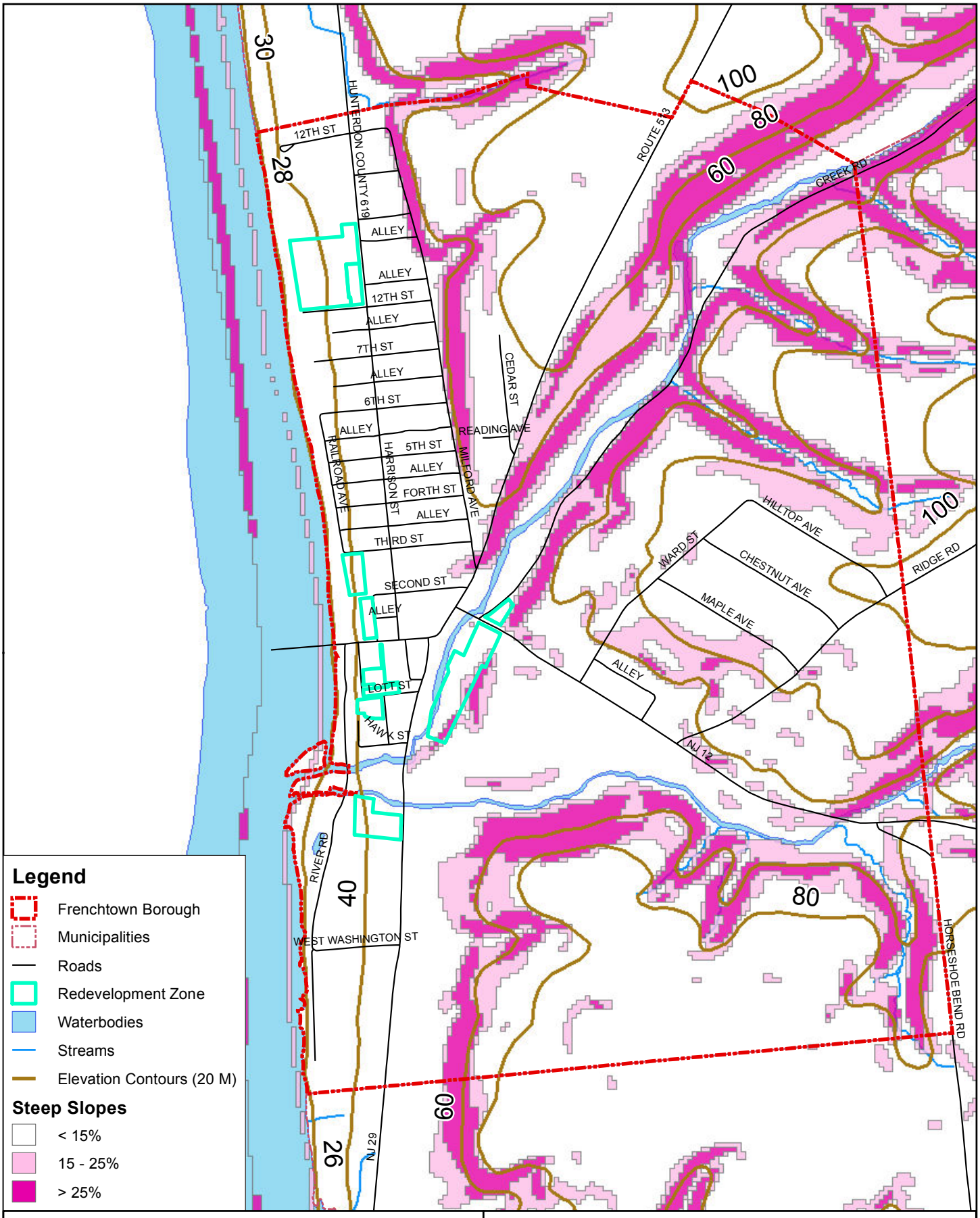
Steep slopes present difficulties for driveway construction and for usable areas around a house. In addition, steeper slopes are more vulnerable to erosion. As the gradient or percent of slope increases, the velocity of runoff water increases, which increases its erosive power. A doubling of velocity 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). The steepest slopes are along the Nishisakawick Creek and Little Nishisakawick Creek (**Figure 3c).**



Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 3b: Borough of Frenchtown Elevation

Frenchtown ERI 2018 Kratzer Environmental Services



Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
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Figure 3c: Borough of Frenchtown 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; sedimentation of streams; and deposition of soil in navigable waters, creating the need for dredging to maintain navigability. Eroded sediment, and the nutrients, pesticides, and other chemicals carried with it, affects aquatic life in many ways. The sediments may bury fish eggs, clog the gills of tadpoles and aquatic invertebrates, reduce light available to aquatic plants, and reduce recreational quality and aesthetics.

Slopes greater than 10 or 15% are generally considered "steep slopes." Steep topography can be seen in **Figure 3c**. In Frenchtown, most of the area east of the Delaware River above the floodplain consists of moderately to severely steep slopes. Additional steep slopes are scattered throughout the borough, many associated with steam corridors, such as along Nishisakawick and Little Nishisakawick Creeks (NJDEP NJFFS, April 17, 2009).

Steep slopes in Frenchtown Park

C. Bedrock Geology of Frenchtown

Bedrock is the solid rock beneath the soil and surficial rock. There are three main bedrock formations of the New Jersey Piedmont; the Stockton Formation, the Lockatong Formation, and the Passaic (formerly Brunswick) Formation, all of which were deposited during the Late Triassic to Early Jurassic Periods (240 to 140 million years ago). Only the Passaic Formation is seen near the surface in what is now the Borough of Frenchtown (**Table 3.2** and **Figure 3d**). If additional sediments were laid down after that time, they have since been eroded away.

Late Triassic and Early Jurassic Bedrock of the Piedmont (240 to 140 million years old)

During the late Triassic Period (240 to 140 million years ago), the supercontinent Pangaea began to break apart. The Highlands were uplifted, while the area to the east of these faults shifted downward. The climate was arid, and sediments from the mountains were eroded during seasonal torrential rains and deposited in broad alluvial fans over the plains. These sediments are known as the Newark Supergroup, a northeast-trending lens shape bounded on the northwest by faults. The composite thickness of the layers of the Newark basin total approximately 7,500 meters (24,600 feet) (Lucey, 1970; Drake et al., 1996).

Streams laden with sediments flowed down from the Highlands at high velocities, where they spread out on a low, flat plain. These layers of sediment accumulated to form the Stockton Formation and then the Passaic Formation on top of the Stockton. In certain sections of the Piedmont, a thick lacustrine[12] clay lens, the Lockatong Formation, is also found. In Frenchtown,

[12] Lacustrine means formed in a lake environment

the sedimentary layers of the Passaic Formation are mostly siltstone and shale with some sandstone included in lenses of the Passaic Formation gray bed. These Triassic-Jurassic sedimentary rocks exhibit two types of fracturing. Bedding fractures resulted from changes in the characteristics of the sediments at the time of deposition. In addition, fracturing occurred when weak sedimentary layers were pulled apart as the continents separated. Often these fractures have a vertical or near vertical orientation and extend a few inches to a few feet across (Van Houten, 1969). These small faults trend NE/SW near the Delaware River, but at the Flemington Fault, they shift to a N/S orientation.

During the Triassic-Jurassic Periods, there were three or more periods of volcanic activity as Pangaea continued to break apart, forming the Atlantic Ocean. Two types of igneous rock occur in New Jersey; basalt and diabase, together commonly known as traprock. Lava that came to the surface and solidified formed *basalt*, a hard, fine grained, dense textured, extrusive igneous rock. The bottom of the lava flows cooled quickly, with little time to form crystals, therefore the rock is fine grained and dense, while the top of the flow is porous and spongy due to escaping bubbles of steam and other gasses as the lava cooled and solidified. Basalt and diabase are more erosion-resistant than the sandstones and shales, forming the ridges and hills of the Piedmont (Lucey, 1970). Although best known from the Palisades in northeastern New Jersey, diabase intrusions can be found at Sourland Mountain, Cushetunk Mountain (Round Valley), and farther south near Lambertville.

D. Earthquakes

Damaging earthquakes are rare in Frenchtown, but possible. Soils influence the potential for damage from earthquakes. Many areas of Frenchtown have relatively shallow depth to bedrock, which dampens the movement of earthquakes (NRCS, September 28, 2016). 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). Although no recorded earthquakes have had their epicenter in Frenchtown, four have occurred within 10 miles (see **Figure 3a** and **Table 3.3**), the closest being a 2.1 magnitude quake just north of Milford, New Jersey on Monday July 28, 2008 at 1 km depth (NJGS, 2017).

Table 3.3: Earthquakes within 10 miles in the vicinity of Frenchtown

Date	Magnitude	Location (NJGS database)	Municipality	Comments
12/14/1984	1.7	North of Milford, NJ	Holland Township	1.45 km deep
08/26/2003	3.5	3.0 km north of Milford, NJ	Holland Township	3 km deep
07/28/2008	2.1	15 km SE of Phillipsburg, NJ	Holland Township	1 km deep
12/21/2009	2.3	13 km S of Phillipsburg, NJ	Holland Township	3 km deep
Source: NJGS, 2017				

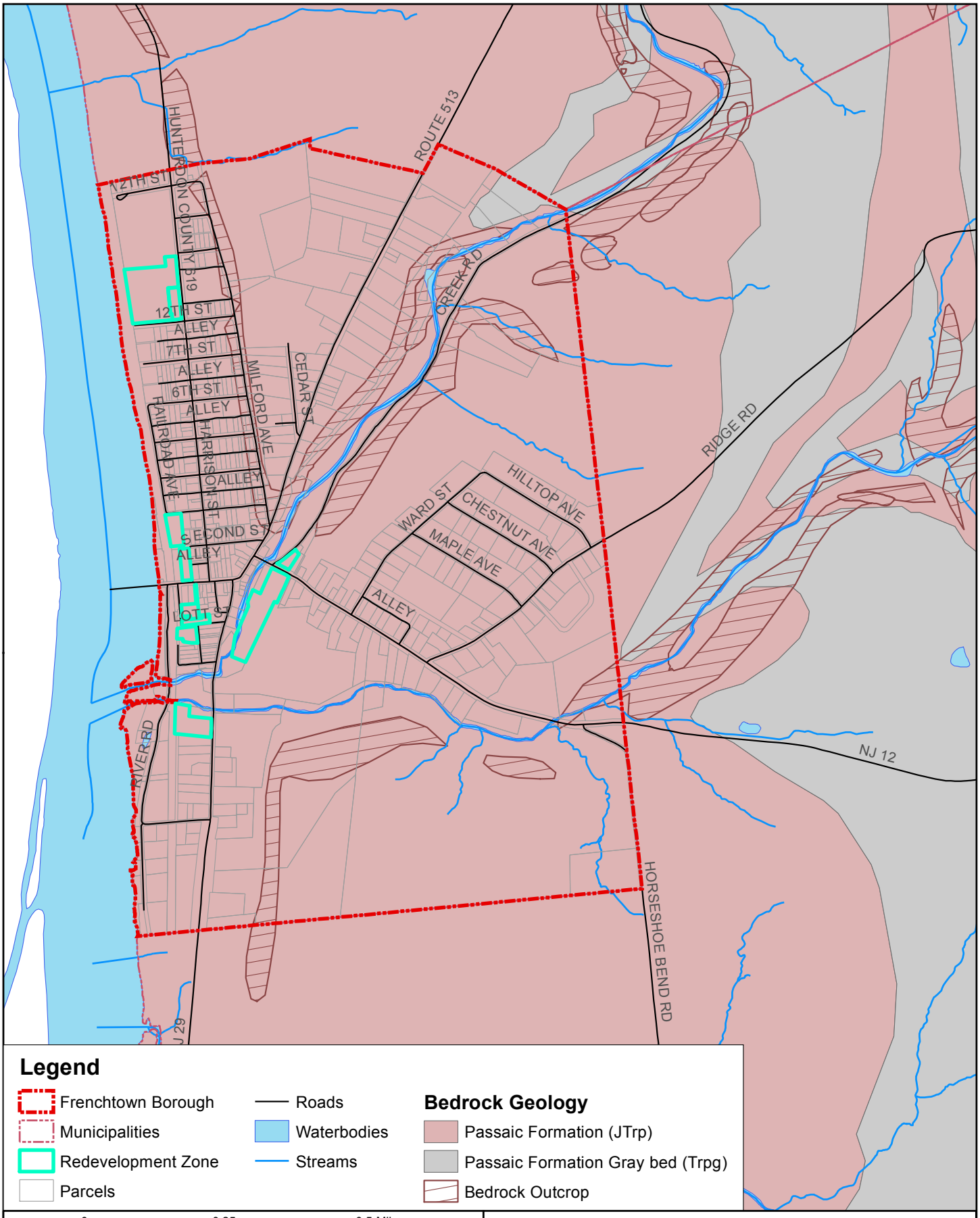


Figure 3d: Borough of Frenchtown Geology

Table 3.2: Characteristics of Bedrock Types Found in Frenchtown

Geologic Formation	Lithology (physical character of the rocks)		Area (acres) in Frenchtown	Percent of Frenchtown
	General	Detailed		
JTrp – Passaic Formation	Siltstone and shale	Interbedded sequence of reddish-brown to maroon and purple, fine-grained sandstone, siltstone, shaly siltstone, silty mudstone and mudstone, separated by interbedded olive-gray, dark-gray, or black siltstone, silty mudstone, shale and lesser silty argillite. Reddish-brown siltstone is medium-to fine-grained, thin-to medium-bedded, planar to cross-bedded, micaceous, locally containing mud cracks, ripple cross-lamination, root casts and load casts. Shaly siltstone, silty mudstone, and mudstone form rhythmically fining upward sequences up to 15 feet thick. They are fine-grained, very-thin- to thin-bedded, planar to ripple cross-laminated, fissile, locally bioturbated, and locally contain evaporate minerals.	713.68	99.33%
Trpg – Passaic Formation Gray bed	Sandstone, siltstone and shale	Rhythmic cycles 2 to 7 m (7-23 ft) of thick gray-bed sequences contain basal thin-bedded to finely laminated shale to siltstone, which grade upward through laminated to microlaminated, locally calcareous mudstone to siltstone and finally into massive silty mudstone. Lowest part of cycle has some desiccation features and local fossils; middle part has highest organic content and the most fossils; highest part contains mudcracks, burrows, and root casts. Gray-bed cycles are abundant in lower half of Passaic Formation and less common in upper half. Rocks of the Passaic Formation have been locally thermally metamorphosed to hornfels where in contact with igneous intrusions. Total thickness of formation ranges from 3500 to 3600 m (11,480-11,810 ft).	4.80	0.67%
		Total:	**718.48***	**100.00**
*GIS acres differs from other measures of the borough's area.				
Source: NJGS, 2009; Drake et al., 1996; Olsen, et al., 1996; Monteverde et al., 2014				

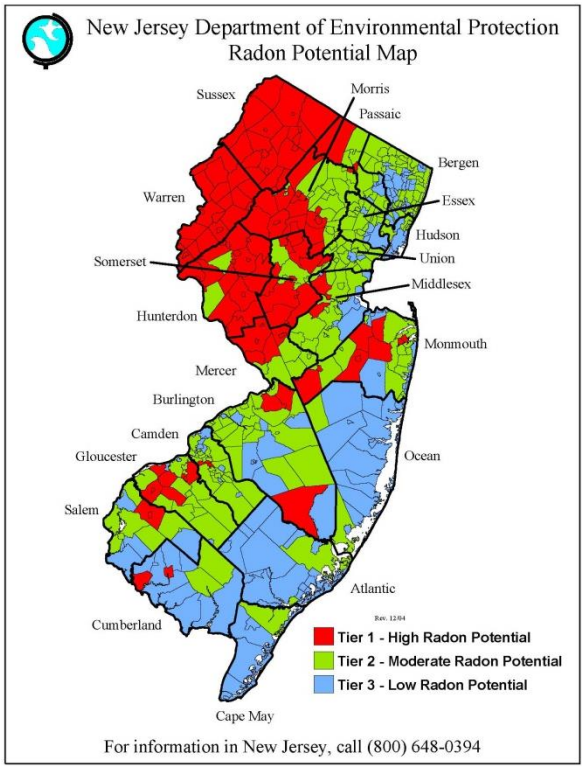
E. Radon

The natural decay of uranium and thorium produce *radon gas*, which has been shown to cause lung cancer. Radon can accumulate in enclosed spaces, such as homes, to unhealthy levels. Considering the potentially serious health risk, the U.S. Environmental Protection Agency (EPA) and the NJDEP recommend mitigation if radon levels are ≥4 pCi/L (picocuries per liter) (NJDEP, 2015).

Not only do proterozoic rocks of the New Jersey Highlands, which are geologically continuous with rocks of the Reading Prong in Pennsylvania, contain uranium but also the Triassic-Jurassic rocks of the Piedmont Province, including the Passaic Formation (Harper, 2013) that underlays Frenchtown. Radioactive minerals are more concentrated in granite, near faults, and in lake-bed formations.

Cambrian and Ordovician rocks are the source of the highest radon levels in New Jersey, with over 50% of homes having radon above 4 pCi/L. The southern section of the Piedmont Province, where Frenchtown is situated, also has elevated radon, with 32% over this level (Muessig et al., 1992). The Borough of Frenchtown is considered to be *Tier 1 - High Radon Potential*, with over 30% homes tested having levels >4 pCi/L. (see **Figure 3e**) (NJDEP, 2015).

Radon in drinking water is discussed in **Section 5f**.



Source: NJDEP Radiation Protection Element, 2015

Tier 1: High potential – at least 25 homes tested with 25 percent or more having radon concentrations greater than or equal to 4 pCi/L

Tier 2: Moderate potential – at least 25 homes tested with 5 to 24 percent having radon concentrations greater than or equal to 4 pCi/L

Tier 3: Low potential – at least 25 homes tested with less than 5 percent having radon concentrations greater than or equal to 4 pCi/L

Regardless of the Tier designation, the NJDEP recommends that all homes should be tested for radon. Radon concentration can vary widely within a tier location, depending upon the geology and amount of uranium in the soil. Homes in low or moderate radon potential areas can have elevated radon concentrations. The NJDEP and the U.S. Environmental Protection Agency both recommend that action be taken to mitigate your home if test results indicate radon levels of 4 pCi/L of radon or higher.

Figure 3e: 2015 Radon Potential Map

F. The Surficial Geology of Frenchtown

Surficial materials are the unconsolidated sediments that overlie bedrock formations, and that are the parent material for soils. Surficial geology deposits in the area consist of materials deposited fluvial (stream) and colluvial (gravity) processes and windblown sediments that are generally less than 10 feet thick, but can be up to 50 feet thick in the riparian areas (Monteverde et al., 2014). The characteristics of surficial geology types found in Frenchtown are provided in **Table 3.4** and illustrated in **Figure 3f**.

Historic Fill

Historic fill is defined by NJDEP as non-indigenous material placed on a site in order to raise the topographic elevation of the site. Large areas (over 5 acres) of historic fill have been mapped by NJDEP, as required by the Brownfield and Contaminated Site Remediation Act (N.J.S.A. 58:10B-1 et seq.). Some areas of fill are inferred by comparing the extent of swamps and alluvial deposits shown on historical geologic and topographic maps to current maps. Small areas of fill are not mapped. While most urban and suburban areas are underlain by an irregular layer of excavated indigenous soil mixed with various amounts of non-indigenous material, this material generally does not meet the definition of historic fill. Also, there may be historic fill areas that were not detectable on aerial photography or by archival map interpretation, particularly along streams in urban and suburban areas (NJGS, 2016)**.**

Areas of historic fill in Frenchtown are shown on **Figure 3f** (NJGS, 2016). Much of the mapped fill makes up the old railroad bed that runs along the river northward toward Milford. Also, there is a strip of fill along Nishisakawick Creek and Creek Road, encompassing there area that is now Frenchtown Park, and the buildings and parking areas of the general store, pizza place and hardware store (NJGS, 2016).

Table: 3.4: Characteristics of Surficial Geology Found in Frenchtown

Abbre-viation	Deposit Type	Lithology	Geologic Age*	Notes	Area (acres)
Qaf	Alluvial fan deposits	Sand, silt, pebble-to-cobble gravel; reddish brown, yellowish brown to brown. As much as 40 feet thick.	Holocene and late Pleistocene, locally middle Pleistocene	Contain minor amounts of organic matter. Form fans at mouths of steep streams.	2.5
Qal	Alluvium	Sand, gravel, silt, minor clay and peat; reddish brown, yellowish brown, brown, gray. As much as 20 feet thick.	Holocene and late Pleistocene	Contains variable amounts of organic matter. Deposited in modern floodplains and channels.	60.4
Qcal	Alluvium and colluvium	Interbedded alluvium as in unit Qal and colluvium as in units Qcg, Qcb, Qcs, Qcc, Qccb, and Qcl. As much as 20 feet thick.	Holocene and late Pleistocene	Deposited in headwater areas of valleys.	4.2
Qe	Eolian deposits	Windblown fine sand and silt; very pale brown, yellowish brown. As much as 15 feet thick.	late Pleistocene, locally of early to middle Pleistocene and Pliocene age on uplands	Form sand sheets and, locally, dunes.	2.4
Qst	Postglacial stream terrace deposits	Sand, silt, pebble-to-cobble gravel; yellowish brown to reddish brown. As much as 20 feet thick.	Holocene and late Pleistocene	Form stream terraces with surfaces up to 40 feet above the modern floodplain. Where	58.6

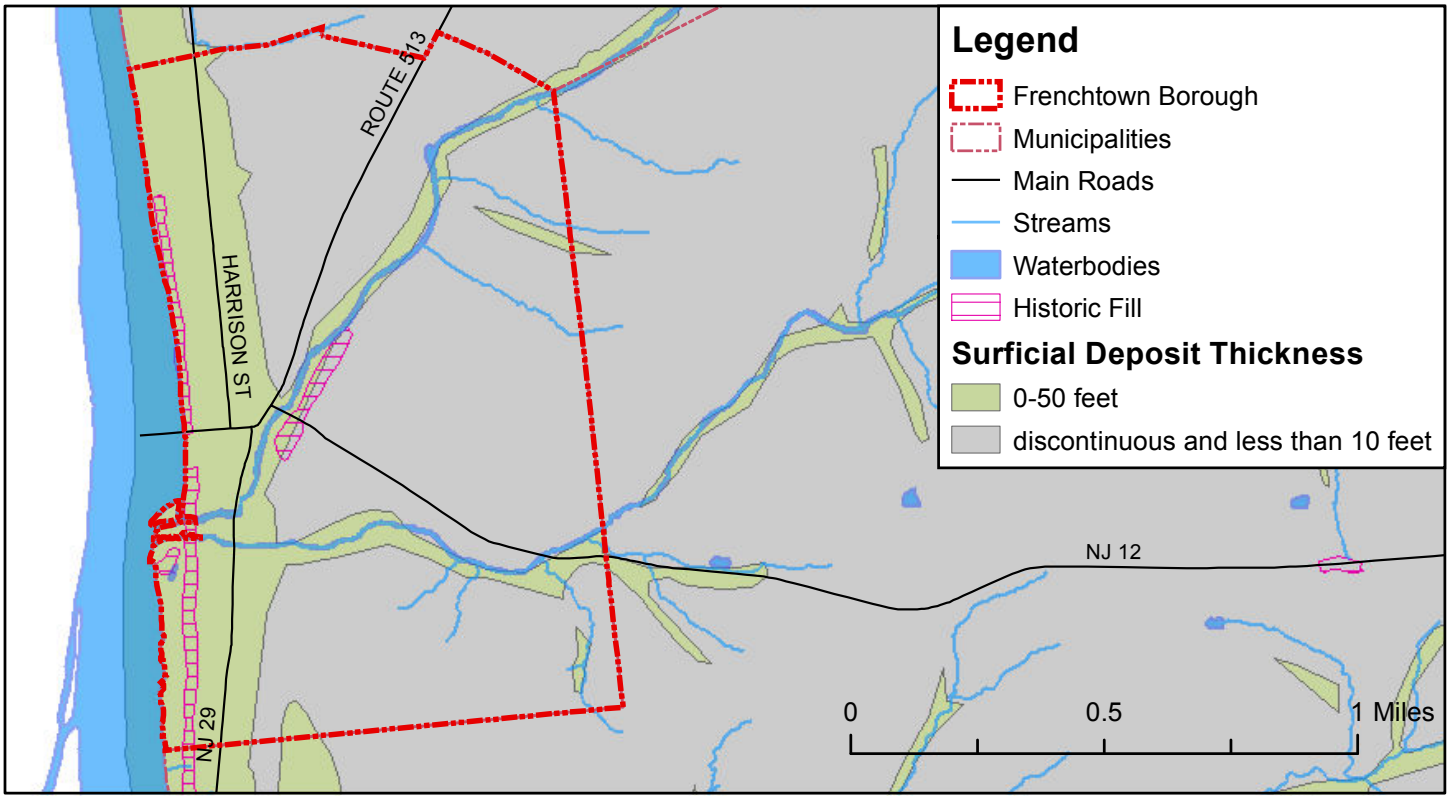
Abbre-viation	Deposit Type	Lithology	Geologic Age*	Notes	Area (acres)
				more than one terrace occurs, the youngest is designated Qst1; the older, higher terrace is Qst2. Laid down after late Wisconsinan glacial deposition ended.	
Qwf	Late Wisconsinan glaciofluvial deposits	Sand and pebble-to-cobble gravel, minor silt; yellowish brown to reddish brown. As much as 50 feet thick.	late Pleistocene, late Wisconsinan	Form plains and terraces (undifferentiated) deposited by glacial streams during the late Wisconsisan glaciation. Where plains and terraces are differentiated they are mapped separately as units Qwfv and Qwft, respectively.	85.4
Qws	Weathered shale, mudstone, and sandstone	Silty sand to silty clay with shale, mudstone, or sandstone fragments; reddish brown, yellow, light gray. As much as 10 feet thick on shale and mudstone, 30 feet thick on sandstone.	Pleistocene		505.0
				Total Area	718.5
***Note on Geologic time periods: Pleistocene: 2.6 million years ago – 11,700 years ago Holocene: 11,700 years ago – present Late Wisconsinan glaciation: 21,000 years ago (White, 1998; Wikipedia, 2017)					
Source: NJGS, 2006					

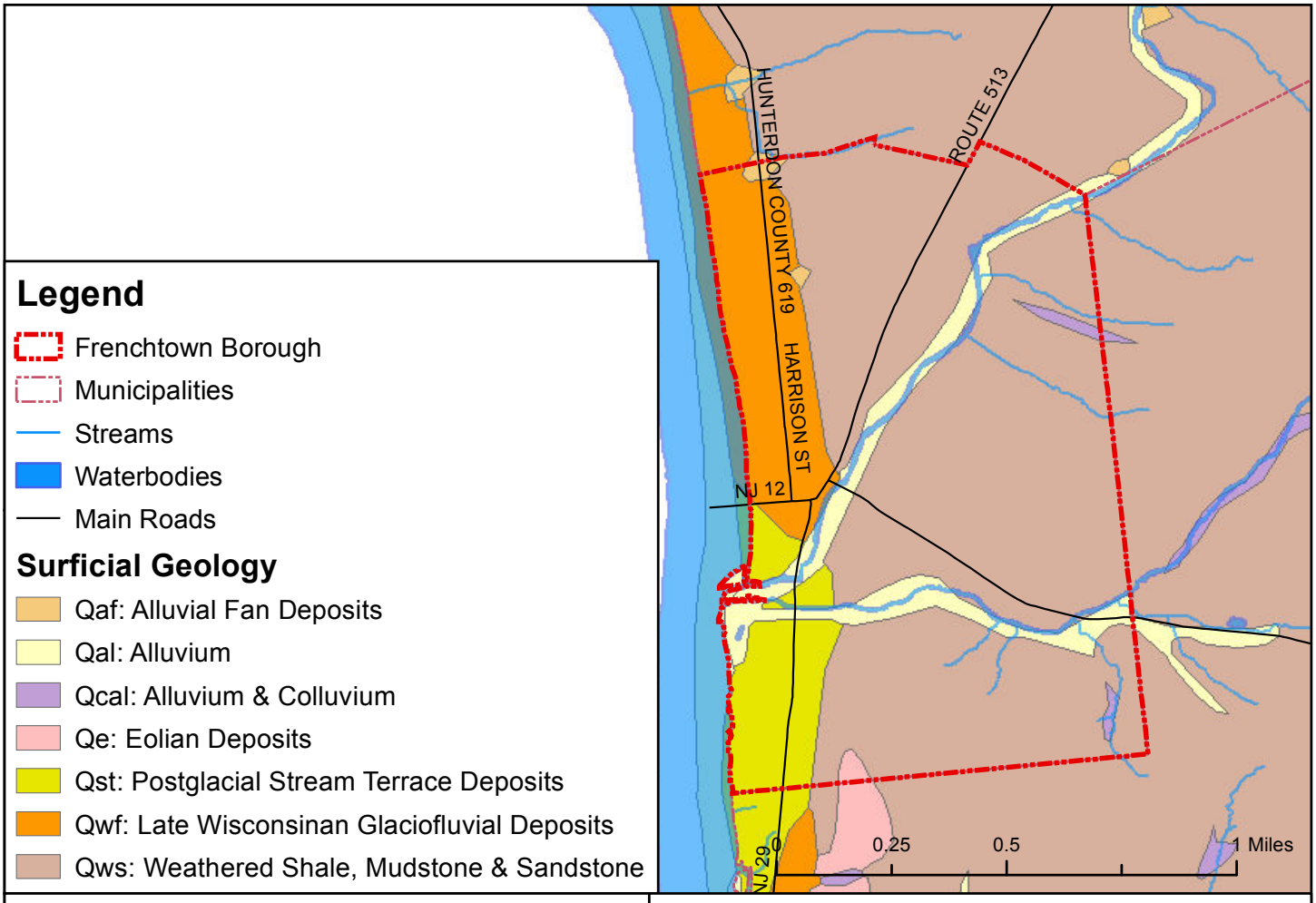
Landslide

A landslide is a natural geologic process in which earth materials (including rock, earth, debris) move down a slope under the influence of gravity. A landslide can occur rapidly or slowly, and can involve large or small amounts of material. Triggers for landslides include a heavy rainfall event, earthquakes or human activity. Although no landslides have been reported from within the Borough boundaries, they have occurred in the nearby area. In April 2005, a landslide caused by heavy rain occurred along Milford-Frenchtown Road one mile south of Milford. A rockslide caused by frost heave closed Route 627 north of Milford, New Jersey on February 29, 2000. Several rockfalls have occurred along Route 29 roughly four miles south of Frenchtown, in Kingwood Township. While landslides have occurred elsewhere in Hunterdon County, the County is considered to have low landslide potential (NJGS, 2006a; NJGS, 2015; Hunterdon County Department of Public Safety and Health Services, 2016 (draft)).

Mining & Quarrying

According to the New Jersey Geological Survey, there are no sand and gravel quarrying operations and no records of mining within the borough of Frenchtown (NJGS, 2006b).





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Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 3f: Borough of Frenchtown Surficial Geology

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4: SOILS

A. 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 (Soil Science Society of America, 2017). 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 (USDA NRCS, 2017A).

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 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 (also known as 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 (USDA NRCS, 2017C).

Beginning in 2005, the NRCS made its soil surveys available online (USDA NRCS, 2017C). 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. 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 (USDA NRCS, September 28, 2016) [13].

B. Soil Series and Map Units

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 map unit descriptions below indicate a percentage of the map unit that fits the defined characteristics, for example stating that the soil "makes up 85 percent of the map unit" or "makes up 55 percent of the map unit. 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 10 different soil series' found in the Borough of Frenchtown, such as Birdsboro, Bucks and Riverhead. A total of 14 different map units are present in Frenchtown. These map units are described below and listed in **Table 4.2**, along with several important properties of these soils, and shown on **Figure 4a**. **Figures 4b** through **4h** illustrate the distribution of some soil characteristics (descriptions, tabular data and GIS data are from USDA NRCS, September 28, 2016).

Map Unit Descriptions[14]

BhnB: Birdsboro silt loam, 2 to 6 percent slopes

The Birdsboro component makes up 85 percent of the map unit[15]. Slopes are 2 to 6 percent. This component is on stream terraces on piedmonts. The parent material consists of old alluvium derived from sandstone and siltstone and/or shale. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 3 percent. Nonirrigated land capability classification is 2e. This soil does not meet hydric criteria.

BhnC2: Birdsboro silt loam, 6 to 12 percent slopes, eroded

The Birdsboro, eroded component makes up 85 percent of the map unit. Slopes are 6 to 12 percent. This component is on stream terraces on piedmonts. The parent material consists of old alluvium derived from sandstone and siltstone and/or shale. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is high. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation

[13] The maps in this report use the most recent data available (Hunterdon County, NJ; Tabular Data Version 12, 9/28/2016; Spatial Data Version 4, 9/28/2016; Spatial Format=ArcView Shapefile; Coordinate System=UTM Zone 18, Northern Hemisphere (NAD 83)).

[14] These soil map unit descriptions are directly from the NRCS Soil Survey Geographic (SSURGO) database report titled "Map Unit Description (Brief, Generated) Hunterdon County, New Jersey." Survey Area Version: 12 Survey Area Version Date: 09/28/2016.

[15] In other words, the description is representative of approximately 85 percent of the map unit, while approximately 15 percent of the map unit may differ in one or more characteristics, for example slope or depth to restrictive layer.

within a depth of 72 inches. Organic matter content in the surface horizon is about 3 percent. Nonirrigated land capability classification is 3e. This soil does not meet hydric criteria.

BucB - Bucks silt loam, 2 to 6 percent slopes

The Bucks component makes up 85 percent of the map unit. Slopes are 2 to 6 percent. This component is on hills on piedmonts. The parent material consists of silty noncalcareous loess over residuum weathered from sandstone and shale. Depth to a root restrictive layer, bedrock, paralithic, is 40 to 53 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 3 percent. Nonirrigated land capability classification is 2e. This soil does not meet hydric criteria.

FNAT - Fluvaquents and Udifluvents, 0 to 3 percent slopes, frequently flooded

The *Fluvaquents*, wet, frequently flooded component makes up 55 percent of the map unit. Slopes are 0 to 3 percent. This component is on flood plains on river valleys. The parent material consists of sandy alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is frequently flooded. It is not ponded. A seasonal zone of water saturation is at 6 inches during January, February, March, April, December. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 5w. This soil meets hydric criteria.

The *Udifluvents*, loamy, frequently flooded component makes up 45 percent of the map unit. Slopes are 0 to 3 percent. This component is on flood plains on river valleys. The parent material consists of sandy alluvium. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is moderately well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches (or restricted depth) is moderate. Shrink-swell potential is low. This soil is frequently flooded. It is not ponded. A seasonal zone of water saturation is at 24 inches during January, February, March, April, December. Organic matter content in the surface horizon is about 3 percent. Nonirrigated land capability classification is 2w. This soil does not meet hydric criteria.

Map unit: KkoC - Klinesville channery loam, 6 to 12 percent slopes

The Klinesville component makes up 85 percent of the map unit. Slopes are 6 to 12 percent. This component is on hills on piedmonts. The parent material consists of fine-loamy residuum weathered from shale. Depth to a root restrictive layer, bedrock, paralithic, is 10 to 20 inches. The natural drainage class is somewhat excessively drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. Nonirrigated land capability classification is 4e. This soil does not meet hydric criteria.

Map unit: KkoD - Klinesville channery loam, 12 to 18 percent slopes

The Klinesville component makes up 85 percent of the map unit. Slopes are 12 to 18 percent. This component is on hills on piedmonts. The parent material consists of fine-loamy residuum weathered from shale. Depth to a root restrictive layer, bedrock, paralithic, is 10 to 20 inches. The natural drainage class is somewhat excessively drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is very low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 1 percent. Nonirrigated land capability classification is 6e. This soil does not meet hydric criteria.

PeoB - Penn channery silt loam, 2 to 6 percent slopes

The Penn component makes up 85 percent of the map unit. Slopes are 2 to 6 percent. This component is on hills on piedmonts. The parent material consists of fine-loamy residuum weathered from acid reddish shale, siltstone, and fine-grain sandstone. Depth to a root restrictive layer, bedrock, paralithic, is 20 to 40 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 3 percent. Nonirrigated land capability classification is 2e. This soil does not meet hydric criteria.

PeoC2 - Penn channery silt loam, 6 to 12 percent slopes, eroded

The Penn, eroded component makes up 85 percent of the map unit. Slopes are 6 to 12 percent. This component is on hills on piedmonts. The parent material consists of fine-loamy residuum weathered from acid reddish shale, siltstone, and fine-grain sandstone. Depth to a root restrictive layer, bedrock, paralithic, is 20 to 40 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 3 percent. Nonirrigated land capability classification is 3e. This soil does not meet hydric criteria.

PomAs - Pope fine sandy loam, high bottom, 0 to 2 percent slopes, occasionally flooded

The Pope, high bottom, occasionally flooded component makes up 85 percent of the map unit. Slopes are 0 to 2 percent. This component is on flood plains on piedmonts. The parent material consists of coarse-loamy alluvium derived from sandstone and shale. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is occasionally flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 3 percent. Nonirrigated land capability classification is 1. This soil does not meet hydric criteria.

RehB - Reaville silt loam, 2 to 6 percent slopes

The Reaville component makes up 85 percent of the map unit. Slopes are 2 to 6 percent. This component is on interfluves on piedmonts. The parent material consists of interbedded fine-grained fine-loamy residuum weathered from sandstone and siltstone and/or shale. Depth to a root restrictive layer, bedrock, paralithic, is 20 to 33 inches. The natural drainage class is somewhat poorly drained. Water movement in the most restrictive layer is moderately low. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 18 inches during January, February, March, November, December. Organic matter content in the surface horizon is about 3 percent. Nonirrigated land capability classification is 3w. This soil does not meet hydric criteria.

RksB - Riverhead gravelly sandy loam, 3 to 8 percent slopes

The Riverhead component makes up 85 percent of the map unit. Slopes are 3 to 8 percent. This component is on water sorted moraines on outwash plains. The parent material consists of glaciofluvial deposits derived from granite and gneiss. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. Nonirrigated land capability classification is 2s. This soil does not meet hydric criteria.

RksC - Riverhead gravelly sandy loam, Map unit: 8 to 15 percent slopes

The Riverhead component makes up 85 percent of the map unit. Slopes are 8 to 15 percent. This component is on water sorted moraines on outwash plains. The parent material consists of glaciofluvial deposits derived from granite and gneiss. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is high. Available water to a depth of 60 inches (or restricted depth) is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. There is no zone of water saturation within a depth of 72 inches. Organic matter content in the surface horizon is about 2 percent. Nonirrigated land capability classification is 3e. This soil does not meet hydric criteria.

ROPF - Rough broken land, shale

Generated brief soil descriptions are created for major soil components. The Rubble land is a miscellaneous area.

RorAt - Rowland silt loam, 0 to 2 percent slopes, frequently flooded

The Rowland, frequently flooded component makes up 85 percent of the map unit. Slopes are 0 to 2 percent. This component is on flood plains on piedmonts. The parent material consists of red and brown fine-loamy alluvium derived from sandstone and shale and/or conglomerate. Depth to a root restrictive layer is greater than 60 inches. The natural drainage class is moderately well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is moderate. Shrink-swell potential is low. This soil is frequently flooded. It is frequently ponded. A seasonal zone of water saturation is at 24 inches during January, February, March, April, May, November, December. Organic matter content in the surface horizon is about 3 percent. Nonirrigated land capability classification is 5w. This soil does not meet hydric criteria.

C. Soil Quality

Soil is arranged in horizontal layers called horizons. These horizons have technical designations largely useful for soil scientists to distinguish one soil series from another. The descriptions in the NRCS soil survey are done using soil in its native state where possible, so a soil profile which has been disturbed may not match the written description for the series. This is the way the degree of disturbance is assessed—by comparing the soil in its native condition to the profile observed at a specific site. For example, the upper horizon is often an *A horizon*, commonly known as "*topsoil*." An A horizon typically exhibits increased organic matter, reduced clay percentage, a more granular structure of the soil aggregates, and a lower bulk density than the *B horizon* below it. If the A horizon is removed (a common practice in construction), this is evident to a trained observer and the soil would be described as having the A horizon missing. The material on the new surface does not automatically become an A horizon merely as a result of its position. It is possible over time for the newly exposed surface to acquire the characteristics of an A horizon, however this is not automatic and is highly management dependent. In technical writing, in particular guidance documents intended for post-construction remediation, the use of the term "topsoil" should be used with caution if at all because there is no legal definition of topsoil and the materials available in commerce are highly variable in quality (Muldowney, 2011).

Soils vary naturally in their capacity to function. *Soil quality* is defined as the capacity of a specific kind of soil to function to sustain plant and animal productivity, maintain or enhance water and air quality, and support human health and habitation. *Inherent* or *intrinsic soil qualities* or characteristics of the soil are determined by factors of soil formation (climate, parent material, topography, time and biota). These are properties which cannot be altered by management except by actually replacing the present material with a different material altogether. An example is the soil's percent sand. The inherent soil quality is used to evaluate the suitability of soils for specific uses (buildings, roads, agriculture, septic systems, etc.). An example is soil particle size: A loam soil will have higher water holding capacity than a sandy soil, therefore will have a higher inherent quality for storing water (USDA NRCS, 2017B).

Contrasting with intrinsic soil properties are management-dependent soil properties, also known as *dynamic soil qualities*. As the term suggests, these can be altered significantly (for better or for worse) by the management of a specific parcel of land and they can have significant consequences for overall environmental quality. Dynamic quality is determined by soil characteristics that are affected by human use and management practices, including physical, chemical and biological properties. Soil quality or health may be evaluated by either comparing to a reference condition that represents full capacity of a soil for a specific function, or to a baseline for the management-dependent soils properties (such as before and after a land use change) (USDA NRCS, 2017B).

Degradation of soil quality occurs in many forms. Significant issues are cutting and filling, compaction, excess salt content and organic matter content. *Cutting and filling* operations actually remove, bury, or invert existing horizons such that they no longer behave in a hydrologically coherent way, with precipitation and gases readily able to enter the soil surface and transmit to horizons lower in the profile. *Compaction*, the increase of bulk density as a result of compression from the surface, is another common form of soil degradation. Compaction can be avoided by not working soil at too high a moisture content. Even foot traffic on a near saturated soil can result in lasting damage which does not resolve itself naturally. A compacted soil can have runoff characteristics more similar to pavement than to the soil in good condition (Muldowney, 2011).

Excess salt content often results from deicing salts but sometimes from fertilizer preparations. It is especially common on roadside verges. The remedy is to either prevent or to wash the salt from the profile with excess water. Sodium salts are especially damaging because sodium causes the clays to disperse. In contrast to sodium chloride, calcium chloride is relatively harmless to plants and soil (Muldowney, 2011; Wikipedia, 2017).

Organic matter content is another dynamic soil property. Rutgers New Jersey Agricultural Experiment Station (see **Internet Resources**) provides a chart for interpretation of organic matter percentages in New Jersey soils. Soils with a high organic content are better able to resist other forms of degradation than soils with depleted organic matter. Organic matter in the upper horizons of soil is a measure of carbon storage in soil. Soil is the largest terrestrial reservoir of carbon and has the greatest potential for long term storage if degraded soils are managed in a way that builds up carbon. Silt loams, like the Preakness, are able to store more carbon in the form of organic matter than sandier soil. Keeping soil in good condition reduces runoff, produces cleaner runoff, requires less irrigation, grows more robust plantings, and sequesters more atmospheric carbon than a damaged soil (Muldowney, 2011).

D. Characteristics of Frenchtown Soils

Soil properties contained in the NRCS soil survey and mapped in **Figures 4b through 4h** are *intrinsic* soil properties. These are properties which cannot be altered by management except by actually replacing the present material with a different material altogether.

Depth to Bedrock (Figure 4b)

According to NJDEP (2012), *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.

Bedrock outcrops (where the depth to bedrock equals zero inches) are common in the Borough of Frenchtown and easily visible along Milford Avenue and in the ravines of the Nishisakawick and Little Nishisakawick Creeks. Elsewhere, depth to bedrock ranges from about 2 to 10 feet from the surface. Depth to bedrock is not rated in the older developed areas. **Figure 4b** shows the range of depths to bedrock for the majority of each soil unit (see **Table 4.2** and **Figure 4b**).

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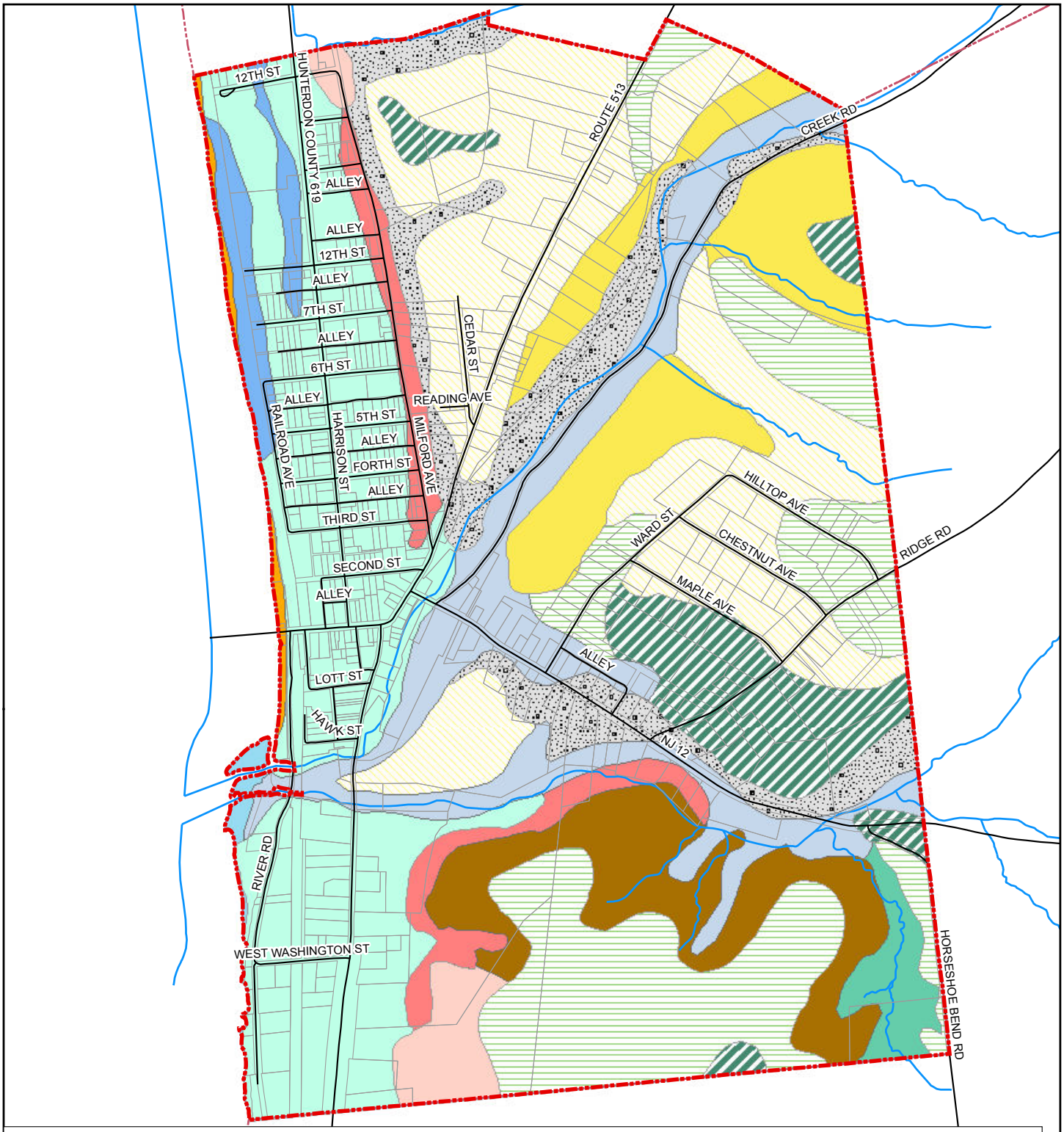
Depth to Seasonal High Water Table (Figure 4c)

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 a water bearing zone. A SHWT of less than one foot severely constrains development, while SHWT between 1 and 3 feet also provides obstacles to development. On-site investigation will often reveal that these areas are actually wetlands or floodplains. 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 Frenchtown is not rated for SHWT and only the Fluvaquents and Udifluvents soils in the immediate vicinity of the Delaware River have a depth less than 2 feet (see **Figure 4c**; see **Figure 6c for floodplains**).



Legend

- Frenchtown Borough
- Municipalities
- Roads
- Parcels
- Streams

Soil Map Units

- BhnB: Birdsboro silt loam, 2-6% slopes
- BhnC2: Birdsboro silt loam, 6-12% slopes, eroded
- BucB: Bucks silt loam, 2-6% slopes
- FNAT: Fluvaquents/Udifluvents, 0-3% slopes/freq. flooded
- KkoC: Klinesville channery loam, 6-12% slopes
- KkoD: Klinesville channery loam, 12-18% slopes
- PeoB: Penn channery silt loam, 2-6% slopes
- PeoC2:Penn channery silt loam, 6-12% slopes, eroded
- PomAs: Pope fine sandy loam, 0-2% slopes/occ. flooded
- RehB: Reaville silt loam, 2-6% slopes
- RksB: Riverhead gravelly sandy loam, 3-8% slopes
- RksC: Riverhead gravelly sandy loam, 8-15% slopes
- RorAt: Rowland silt loam, 0-2% slopes/freq. flooded
- ROPF: Rough broken land, shale
- WATER

N

0 0.25 0.5 Miles

Data Sources: NJDEP, NJDOT, USDA NRCS
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 4a: Borough of Frenchtown Soil Map Units

Frenchtown ERI 2018 Kratzer Environmental Services

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 water would runoff compared to the rate that water would infiltrate into the ground). Most of Frenchtown has slow or very slow infiltration rates. The steeper slopes of the borough have moderate infiltration rates, while the stream bottoms have moderate to very slow infiltration rates (see **Figure 4d**). The definitions of the hydrologic soil groups are shown in **Table 4.1**.

Table 4.1: Hydrologic Soil Grouping

Class	Definition
A	High infiltration rates. Soils are deep, Wto excessively drained sands and gravels.
B	Moderate infiltration rates. Deep and moderately deep, moderately well and well drained soils that have moderately course textures.
C	Slow infiltration rates. Soils with layers impeding downward movement of water, or soils that have moderately fine or fine textures.
D	Very slow infiltration rates. Soils are clayey, have a high water table, or are shallow to an impervious layer.
Source: USDA NRCS, 2016	

Soil Drainage Class (Figure 4e)

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: well drained, moderately well drained, excessively drained, somewhat excessively drained, poorly drained, and somewhat poorly drained. For the most part, Frenchtown has somewhat poorly drained soils in the vicinity of the Delaware River and poorly drained soils in the riparian zones of the Nishisakawick and Little Nishisakawick Creeks, while the hillsides away from the center of town are well drained, moderately well drained and somewhat excessively drained (see **Figure 4e).**

Potential Frost Action (Figure 4f)

Potential Frost Action is an interpretation rating of the susceptibility of the soil to frost heaving. Most soils within Frenchtown have moderate potential frost action, with the exception of the Fluvaquents/Udifluvents along the Delaware River and the Rowland silt loam soils near the Nishisakawick and Little Nishisakawick Creeks, which have high potential for frost action (see **Figure 4f)**.

Prime Farmland Soils (Figure 4g)

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 are 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, 2017A).

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 (USDA NRCS NJ, 2017B).

Table 4.2: Characteristics of Soil Types Found in Frenchtown

Map Unit Symbol	Map Unit Name	Depth to Bedrock (inches)	Depth to Seasonal High Water Table (inches)	Flooding	Ponding	Potential for Frost Action	Hydrologic Group[2]	Drainage Class	Hydric Soil?	Prime Farmland?[3]	Landforms	Septic Disposal Field Rating Class (NJ)	Septic Limiting Features (NJ)[4]	Acres	Percent of Borough
BhnB	Birdsboro silt loam, 2 to 6 percent slopes	—	—	none	none	moderate	B	well drained	no	P	stream terraces, hills	not limited to very limited	MB	14	2%
BhnC2	Birdsboro silt loam, 6 to 12 percent slopes, eroded	—	—	none	none	moderate	B	well drained	no	SI	stream terraces, hills, ridges	not limited to very limited	MB; ECS	23	3%
BucB	Bucks silt loam, 2 to 6 percent slopes	39-59"	—	none	none	moderate	B	well drained	no	P	hills, drainage-ways, hillsides	very limited	DAZS; RH; RS; MB	44	6%
FNAT	Fluvaquents and Udifluvents, 0 to 3 percent slopes, frequently flooded	—	15	Frequent Duration: Brief (2-7 days) to Very brief (4-48 hrs)	none	high	B/D	poorly drained	yes	no	floodplains	very limited	NP-hydric; NP-flooding; DAZS	3	< 1%
KkoC	Klinesville channery loam, 6 to 12 percent slopes	10-20"	—	none	none	moderate	D	somewhat excessively drained	no	no	hills	very limited	MB	140	19%
KkoD	Klinesville channery loam, 12 to 18 percent slopes	10-20"	—	none	none	moderate	B	well drained	no	no	hills	very limited	MB; ECS	53	7%
PeoB	Penn channery silt loam, 2 to 6 percent slopes	20-39"	—	none	none	moderate	D	somewhat excessively drained	no	P	hills	very limited	MB; DAZS	105	15%
PeoC2	Penn channery silt loam, 6 to 12 percent slopes, eroded	20-39"	—	none	none	moderate	D	somewhat excessively drained	no	SI	hills	very limited to somewhat limited	MB	44	6%

Map Unit Symbol	Map Unit Name	Depth to Bedrock (inches)	Depth to Seasonal High Water Table (inches)	Flooding	Ponding	Potential for Frost Action	Hydrologic Group[2]	Drainage Class	Hydric Soil?	Prime Farmland?[3]	Landforms	Septic Disposal Field Rating Class (NJ)	Septic Limiting Features (NJ)[4]	Acres	Percent of Borough
PomAs	Pope fine sandy loam, high bottom, 0 to 2 percent slopes, occasionally flooded	—	—	Frequent (Nov-May) Duration: Brief (2 to 7 days)	Frequent (Nov-May) Depth: 0-0.5' Duration: Brief (2 to 7 days)	moderate	C	somewhat poorly drained	no	P	floodplains, stream terraces	very limited to not limited	NP-flooding; DAZS	146	20%
RehB	Reaville silt loam, 2 to 6 percent slopes	20-39"	46	none	none	moderate	C	moderately well drained	no	SI	interfluves	very limited	DAZS; MB; RH; RS; NP-hydric	11	2%
RksB	Riverhead gravelly sandy loam, 3 to 8 percent slopes	—	—	none	none	moderate	B	somewhat excessively drained	no	P	moraines, ridges, hills	not limited to very limited	RH; RS; MB	< 1	< 1%
RksC	Riverhead gravelly sandy loam, 8 to 15 percent slopes	—	—	none	none	moderate	C	well drained	no	SI	moraines, ridges, hills	not limited to very limited	RH; RS; MB	13	2%
ROPF	Rough broken land, shale	0"	—	none	none	---	C	well drained	no	no	hills	very limited	MB: NP-steep	53	7%
RorAt	Rowland silt loam, 0 to 2 percent slopes, frequently flooded	---	61	Frequent (Nov-March) Duration: Brief (2-7 days)	Frequent (Nov-March) Depth: 0-0.5' Duration: Brief (2-7 days)	high	B/D	poorly drained	no	no	floodplains, stream terraces	very limited to not limited	NP-flooding; DAZS; NP-hydric; RH; RS	68	10%
WATER	WATER	---	---	---	---	---	---	---	---	---	---	---	---	2	< 1%

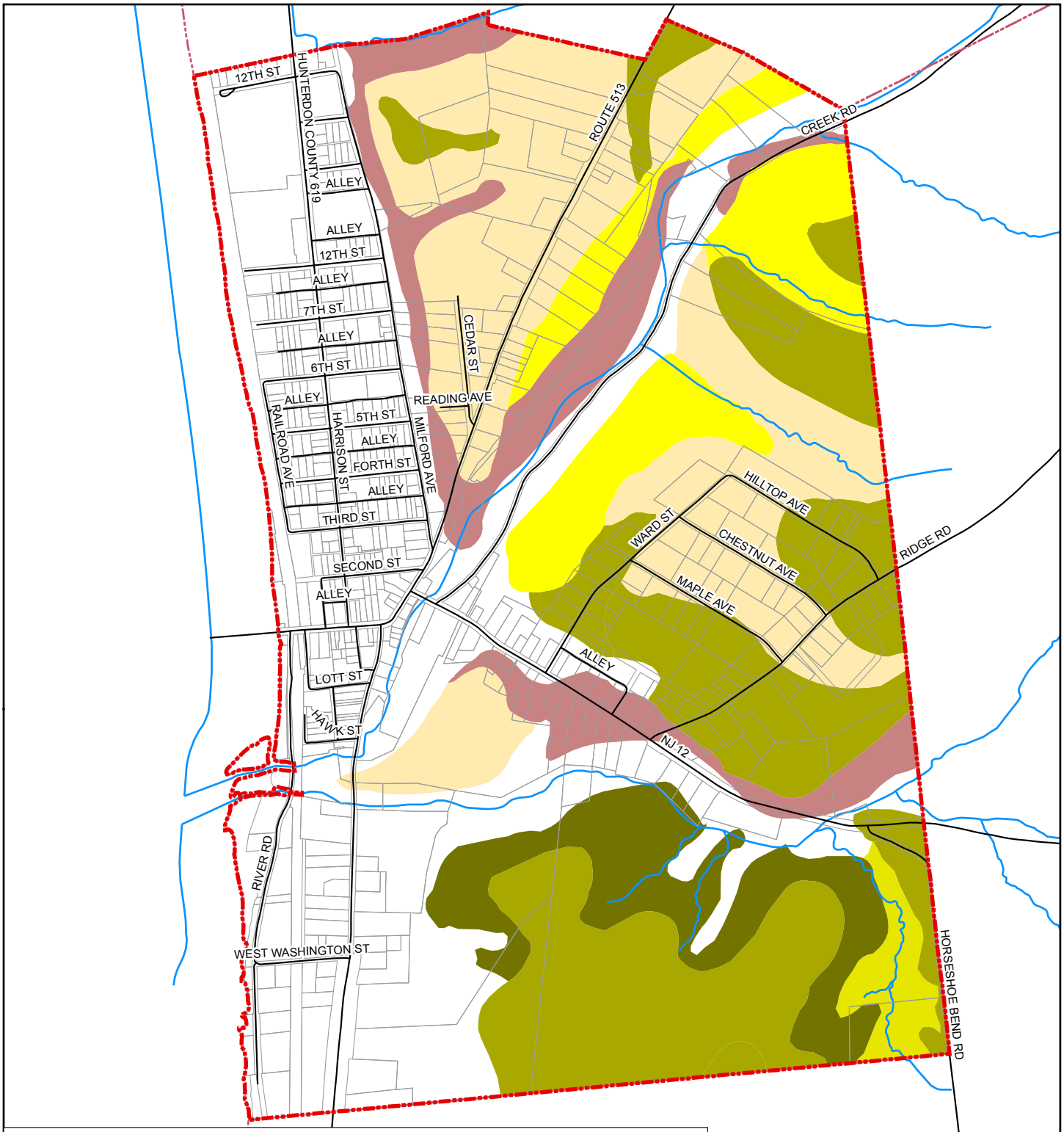
Notes:

-- = data not provided

[2]**Hydrologic Group:** see **Table 4.1** for definitions

[3]**P** = Prime Farmland; **SI** = Farmland of Statewide Importance

Map Unit Symbol	Map Unit Name	Depth to Bedrock (inches)	Depth to Seasonal High Water Table (inches)	Flooding	Ponding	Potential for Frost Action	Hydrologic Group[2]	Drainage Class	Hydric Soil?	Prime Farmland?[3]	Landforms	Septic Disposal Field Rating Class (NJ)	Septic Limiting Features (NJ)[4]	Acres	Percent of Borough
[4]Septic System Limitation Interpretation (NJ): **DAZS**= Depth to apparent zone of saturation; **DPZS**= Depth to perched zone of saturation; **ECH**=Excessively coarse horizon; **ECS**=Excessively coarse substratum; **MB**=Depth to massive bedrock ; **NP-Flooding**=Not Permitted – Flooding; **NP-Hydric**=Not Permitted - Hydric Soil **; NP-Steep**= Not Permitted - Too Steep ; **RH**= Restrictive horizon; **RS**= Restrictive substratum															
Source: USDA NRCS, 09/28/2016. The information in this map is from the SSURGO soils data Soil Service Area (SSA) Hunterdon County, New Jersey. SSA Version 12 (09/28/2016), indicating the dominant soil condition but does not eliminate the need for onsite investigation															



Legend

- Frenchtown Borough
- Municipalities
- Roads
- Streams
- Parcels

Depth to Bedrock (minimum)

- 0 inches
- 28 inches
- 46 inches
- 58 inches
- 76 inches
- 122 inches
- no rating

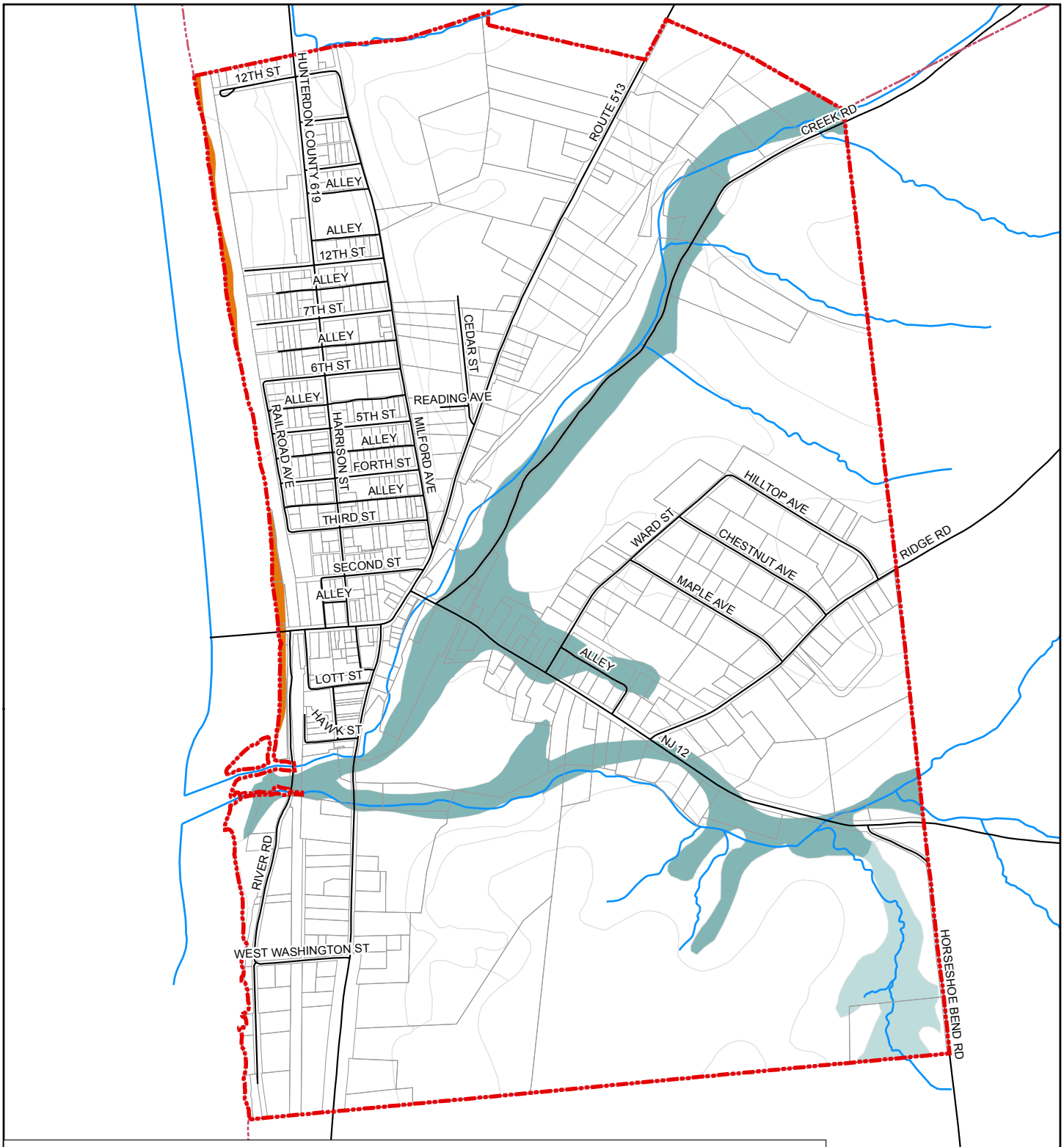
0 0.25 0.5 Miles

N

Data Sources: NJDEP, NJDOT, USDA NRCS
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 4b: Borough of Frenchtown Soils: Depth to Restrictive Layer

Frenchtown ERI 2018 Kratzer Environmental Services



Legend

- Frenchtown Borough
- Municipalities
- Parcels
- Roads
- Streams

Water Table Depth - Annual Minimum

- no rating
- 15 inches
- 46 inches
- 61 inches

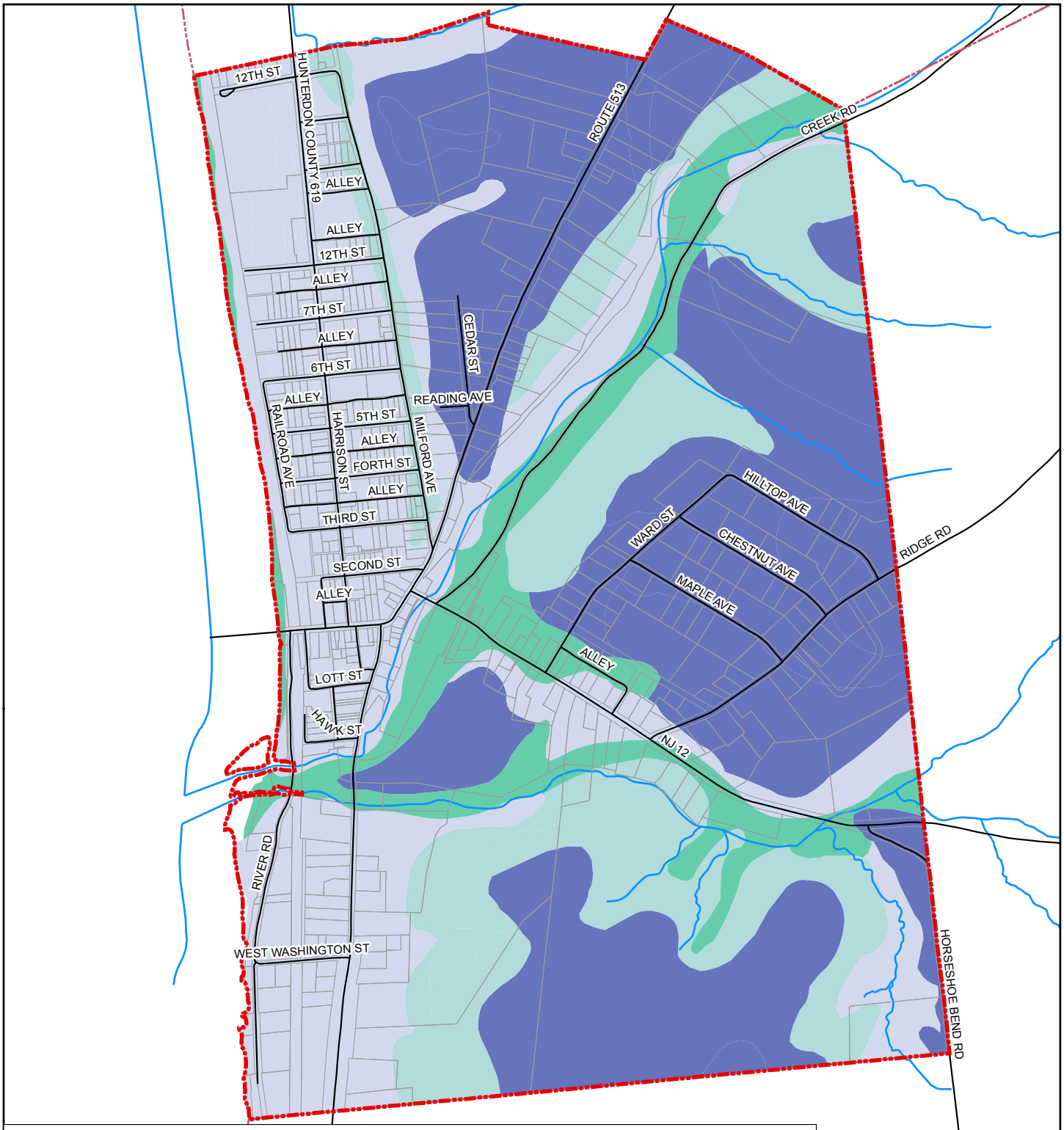
N

0 0.25 0.5 Miles

Data Sources: NJDEP, NJDOT, USDA NRCS
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 4c: Borough of Frenchtown Soils: Depth to High Water Table

Frenchtown ERI 2018 Kratzer Environmental Services



Legend

- Frenchtown Borough
- Municipalities
- Parcels
- Roads
- Streams

Hydrologic Group

- no rating
- B: Moderate infiltration rates
- B/D: Moderate to very slow infiltration rates
- C: Slow infiltration rates
- D: Very slow infiltration rates

0 0.25 0.5 Miles

N

Data Sources: NJDEP, NJDOT, USDA NRCS
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 4d: Borough of Frenchtown Soils: Hydrologic Group

Frenchtown ERI 2018 Kratzer Environmental Services

Frenchtown has 311 acres of Prime Farmland Soils (40% of the borough), including the Birdsboro, Bucks and Penn silt loams and the Pope and Riverhead sandy loams. An additional 92 acres (12%) is classified as Farmlands of Statewide Importance. These include similar soils, but generally on steeper (6 to 18%) slopes than the prime agricultural soils (see **Figure 4g).**

Septic Suitability (Figure 4h)

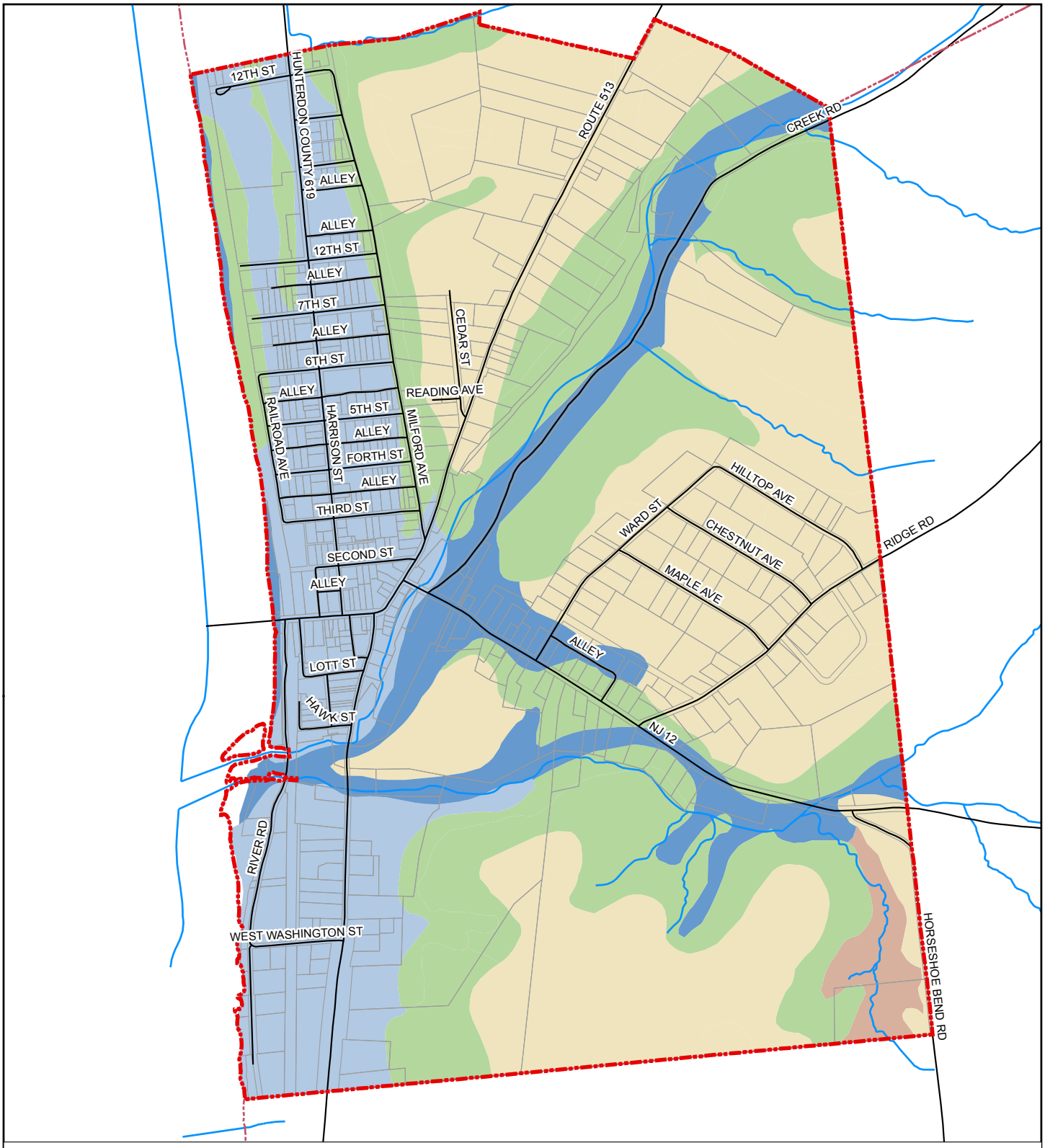
The NRCS SSURGO database provides an interpretation of limitations of each soil for *septic suitability*. The interpretation shown in **Figure 4h** is based on the N.J.A.C. 7:9A Standards for Individual Subsurface Sewage Disposal Systems, Subchapter 10 Disposal Fields (NJDEP, 2012). Soil characteristics which may affect the functioning of the system, and therefore limit septic field suitability, include: fractured rock or excessively coarse substratum; massive rock or hydraulically restrictive; hydraulically restrictive horizon, permeable substratum; excessively coarse horizon; hydraulically restrictive horizons; and zones of saturation. Construction of septic systems in ground subject to surface flooding are prohibited. In cases where there is the possible presence of freshwater wetlands in a proposed subsurface sewage disposal system site, the applicant must adhere to the Freshwater Wetlands Protection Act, N.J.S.A. 13:9B-1 et seq. In addition, steep slopes may also be unsuitable for septic systems (NJDEP, 2012).

Figure 4h illustrates the least limiting condition, the most limiting condition and the dominant condition for septic tank absorption fields, based on the soil characteristics. The dominant condition for 79% of the borough is very limited septic suitability; while 48% of the area has conditions that range from somewhat limited to very limited (see also **Section 2C** for Sewer Service Areas).

Flooded and Hydric Soils

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. In Frenchtown, the Pope fine sandy loam soil along the Delaware River and the Rowland silt loam along the creek corridors are frequently flooded (see **Table 4.2**; **Figure 6c** shows floodplains, which encompass the frequently flooded soils).

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. Only one hydric soil may be found in Frenchtown, the Fluvaquents and Udifluvents, 0 to 3 percent slopes, frequently flooded soil (see **Table 4.2**; **Figure 6d** shows wetlands and hydric soils).



Legend

- Frenchtown Borough
- Municipalities
- Parcels
- Roads
- Streams

Drainage Class

- not rated
- Somewhat excessively drained
- Moderately well drained
- Well drained
- Somewhat poorly drained
- Poorly drained

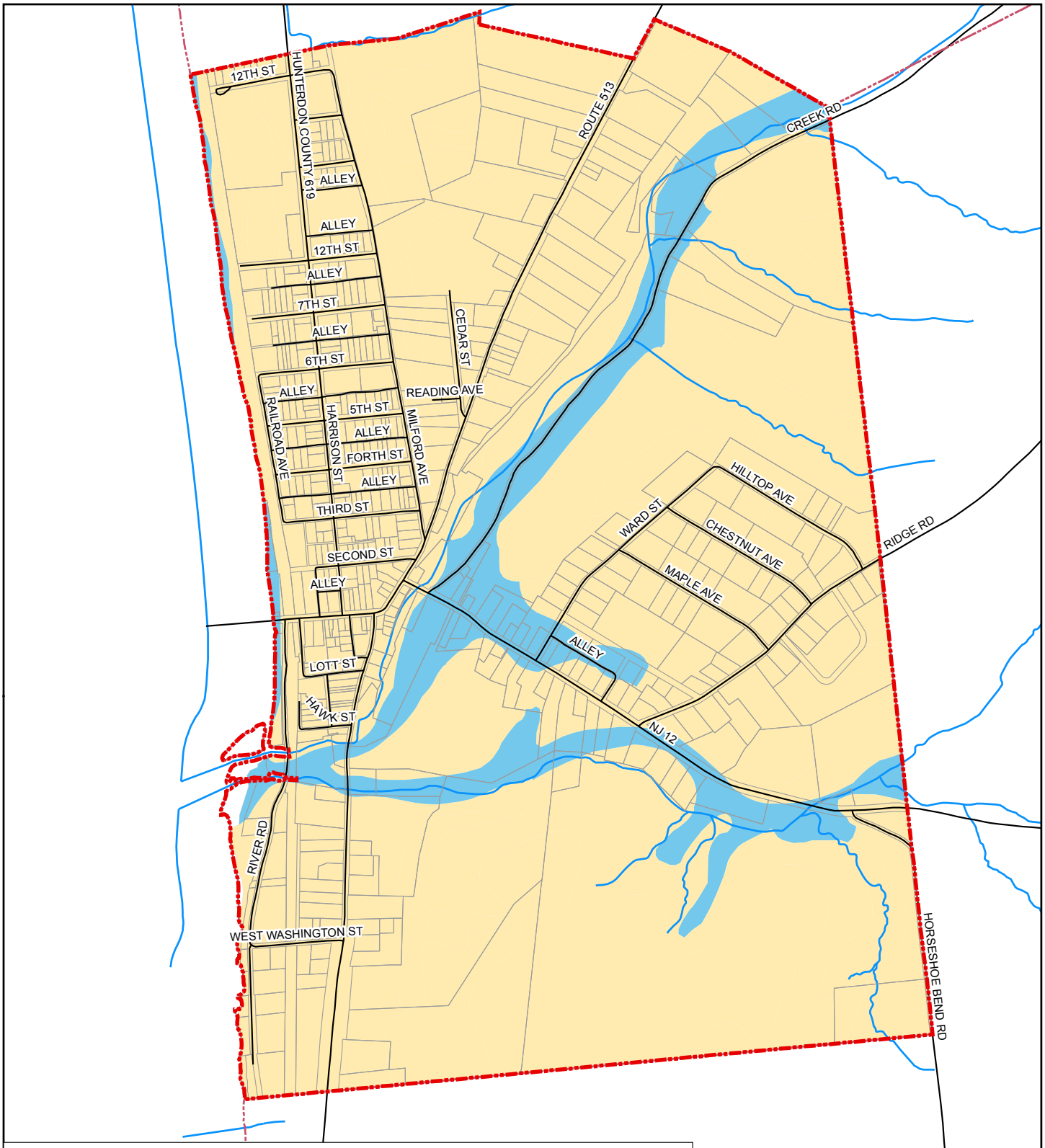
0 0.25 0.5 Miles

N

Data Sources: NJDEP, NJDOT, USDA NRCS
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 4e: Borough of Frenchtown Soils: Drainage Class

Frenchtown ERI 2018 Kratzer Environmental Services



Legend

- Frenchtown Borough
- Municipalities
- Parcels
- Roads
- Streams

Potential for Frost Action

- no rating
- High
- Moderate

0 0.25 0.5 Miles

N

Data Sources: NJDEP, NJDOT, USDA NRCS
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 4f: Borough of Frenchtown Soils: Potential for Frost Action

Legend

- Frenchtown Borough
- Municipalities
- Parcels
- Roads
- Streams

Farmland Soils

- All areas are prime farmland
- Farmland of statewide importance
- Not prime farmland

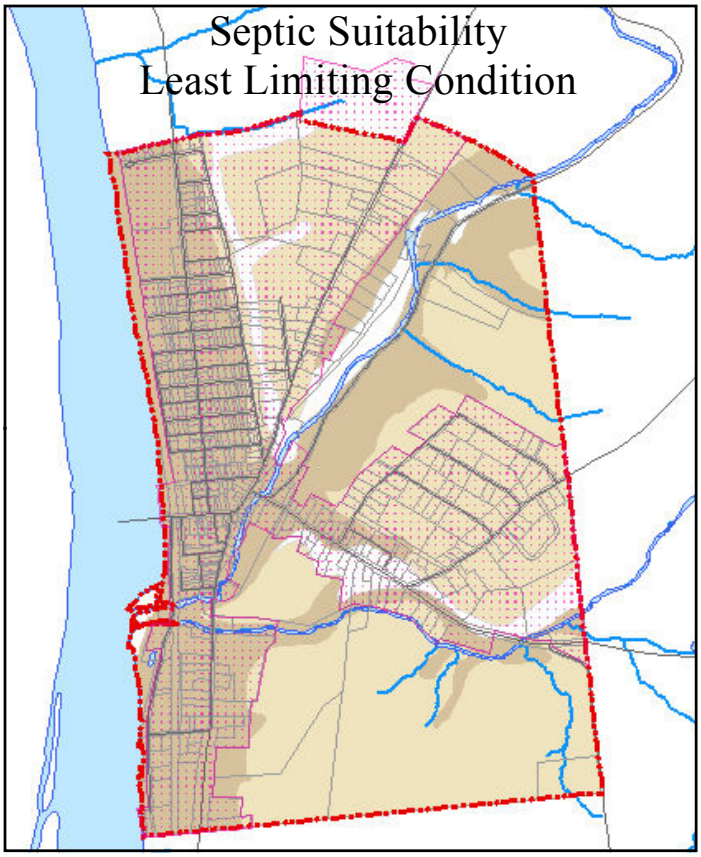
0 0.25 0.5 Miles

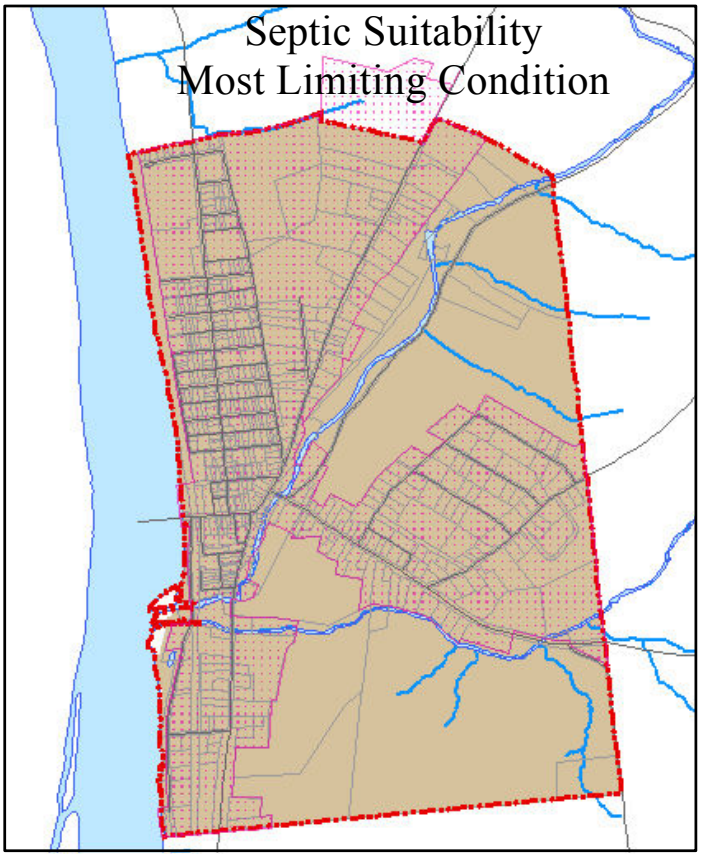
N

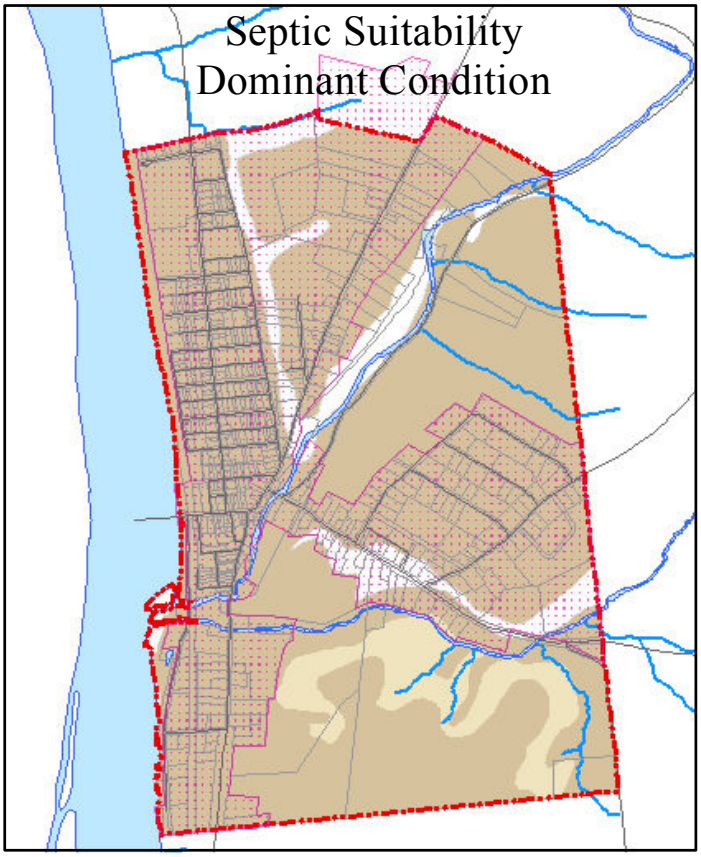
Data Sources: NJDEP, NJDOT, USDA NRCS
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 4g: Borough of Frenchtown Farmland Soils

Frenchtown ERI 2018 Kratzer Environmental Services







Legend

- Frenchtown Borough
- Roads
- Parcels
- Frenchtown STP Service Area
- Streams
- Waterbodies

Septic Tank Absorption Fields

- Not rated
- Somewhat limited
- Very limited

0 0.125 0.25 0.5 0.75 1 Miles

N

Data Sources: NJDEP, NJDOT, USDA NRCS
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 4h: Borough of Frenchtown
Soils: Septic Limitations

References: Soils

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Internet Resources: Soils

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NRCS Education: Unlock the Secrets in the Soil: https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/soils/health/

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

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

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

Rutgers New Jersey Agricultural Experiment Station Soil Testing Laboratory Interpretation of Organic Matter Levels in New Jersey Soils: http://njaes.rutgers.edu/soiltestinglab/pdfs/nj-om-interpret.pdf

5: GROUND WATER & DRINKING WATER

A. Water Cycle

Even though the quantity of water on the earth 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* is 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 *surface runoff*), entering streams (where it can be seen as high flows after rain events), and eventually making its way back to the ocean. Some of the water from precipitation enters the ground but remains in the shallow layers where it is available for use by plants, where it returns to the atmosphere through *transpiration* by plants, while some water re-enters the atmosphere directly through *evaporation* from surface water. Evaporation and transpiration combined are known as *evapotranspiration*. The water that migrates below the root zone travels underground and exits the system as stream flow, known as *ground water baseflow* or *ground water recharge*. Ground water baseflow can be calculated by measuring stream flow during dry weather conditions. A smaller portion of the water penetrates deeper into the ground and enters (or recharges) the saturated zone of the fractured bedrock, called the *aquifer*, where most wells obtain their water.

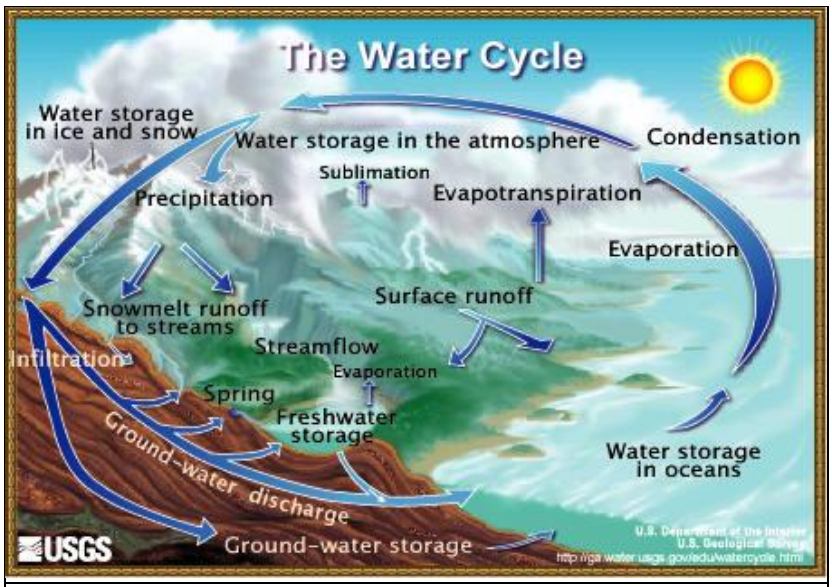


Figure 5a: The Water Cycle Diagram
Source: USGS, no date

Pollutants can enter water as it travels the water cycle. Surface runoff can pick up chemicals and soil on its way, depositing these pollutants in waterways. This is especially true of "uncontrolled runoff" on soils that are vulnerable to erosion. Water seeping into the soil can be cleansed of many pollutants by natural processes. However, if the pollutant is one that is resistant to break-down, or if the pollutant doesn't get exposed to the soil long enough (such as

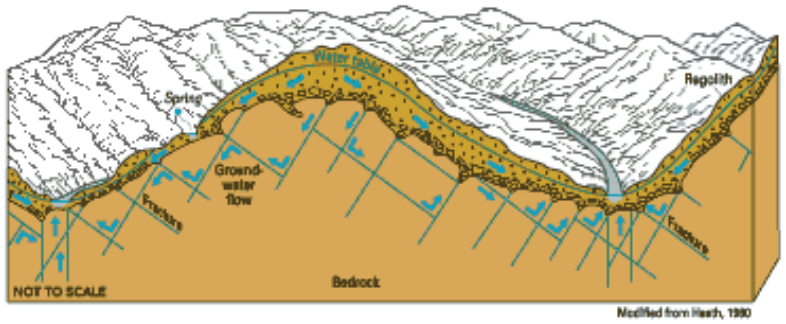


Figure 5b: Bedrock Aquifer Diagram

Ground water percolates downward through the regolith which is a layer of weathered rock, alluvium, colluvium, and soil to fractures in underlying bedrock. The water moves from highland recharge areas to discharge areas, such as springs and streams at lower altitudes. This example is in the Piedmont and Blue Ridge Province.

Source: Modified from Heath, 1980 in USGS, 2016.

by entering a bedrock fracture or by entering the ground water through sub-surface disposal), pollutants can spread underground and pollute sources of drinking water.

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 fractured rock aquifers 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 also 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.

An understanding of the water cycle emphasizes the connections between surface and ground water. While the Borough of Frenchtown relies primarily on water from public wells (not individual wells) fed by ground water, the water is no less part of the natural water cycle, and is susceptible to human impacts and the influence of climate and geology.

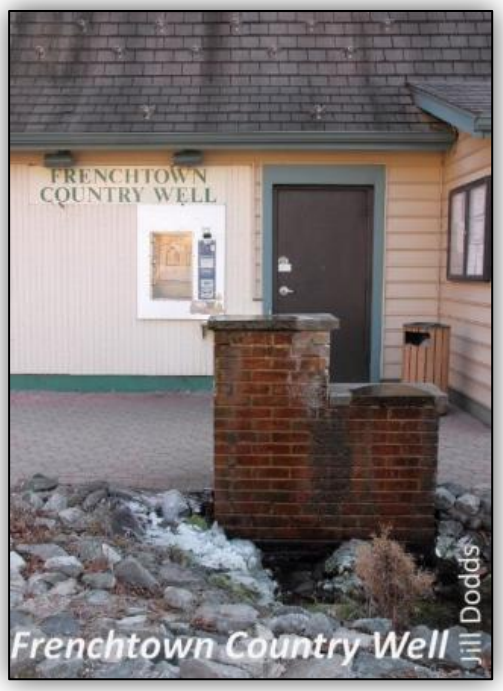
B. The Aquifer in Frenchtown

Almost half of New Jersey's drinking water comes from ground water. In the northern half of New Jersey, aquifer boundaries roughly correspond to physiographic province boundaries (discussed in **Section 3a** and **Figure 3a**).

The hydrogeologic characteristics of an aquifer are dependent on the type of bedrock. The report Geology as a Guide to Regional Estimates of Water Resources states:

> "The six guiding principles in the application of geology to rock country [bedrock aquifer] wells are: (1) there is no correlation between depth and yield, (2) each drainage basin, no matter how minor, is a surface and ground water entity, (3) water is usable only from fractures, fissures and solution openings, (4) successful industrial wells are completed in the first 200 to 500 feet of rock, (5) porous and permeable Pleistocene or deep weathered rock regolith zones above the rock will usually act as a built-in reservoir to increase well capacity and (6) glacial till, heavy clay soil, or bedrock close to the surface will decrease well yields." (Widmer, 1968, p. 11)

Natural recharge occurs primarily through direct precipitation on the outcrop area of the geologic formations. The ground water moves through the aquifers, eventually discharging into streams or directly into the Delaware River Basin aquifer systems and distributed by wells (USEPA, May 1988).



The density of housing and impervious surfaces can impact aquifers and may result in reduced recharge, lowered yields, increased interference (wells interfering with each other), and degradation of ground water quality. In any aquifer, if the rate of water use exceeds the recharge rate, well yields will decrease (see **Section 5D**). Furthermore, these changes can alter stream flow dynamics resulting in higher flows after storm events and lowered flows between events.

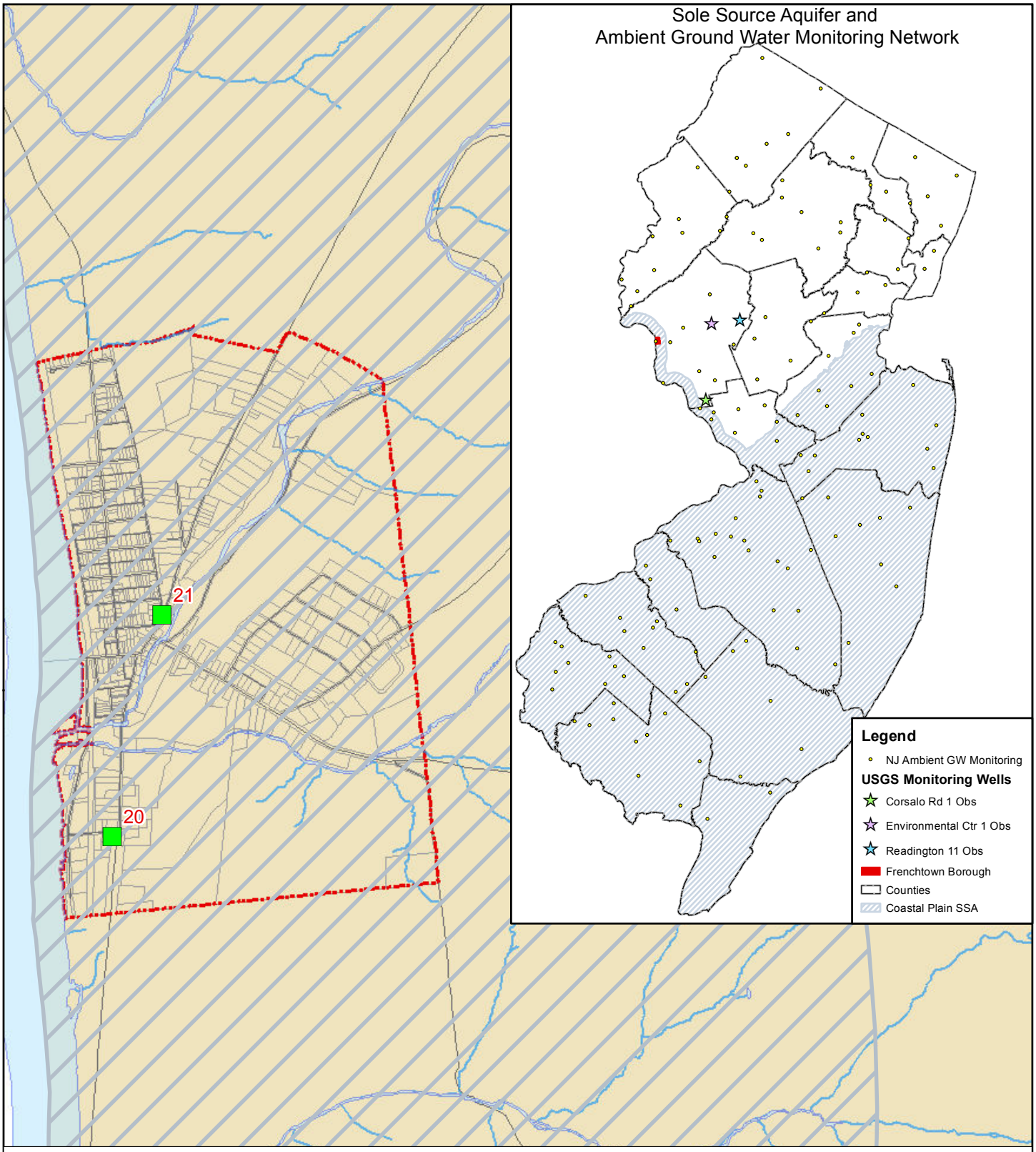
Frenchtown Borough relies exclusively on ground water from public and private wells in the Passaic aquifer (formerly called Brunswick) (see F**igure 5c** and **Table 5.1.**

In bedrock aquifers such as the Passaic, which is in the Late Triassic Newark Group, sedimentary rocks near the land surface experience weathering, caused by freezing and thawing of water, which has widened fractures and dissolved some of the intergranular cement in the sedimentary rocks. This type of bedrock yields water mostly from *secondary porosity*[16] and permeability provided by fractures. Rocks below the weathered zone, which is usually about 75 feet thick, have no *primary porosity* (Lewis-Brown and Jacobsen, 1995). Therefore, the distribution and orientation of these fractures control the rates and directions of ground water flow. The water bearing structures underground may bear little resemblance to the overlying topography.

Table 5.1: Characteristics of Frenchtown's Aquifer

Aquifer Unit	Aquifer Rank▪	Characteristics	Common Range*	
			Depth (ft)	Yield (gpm)
Passaic (Brunswick) aquifer (ba)	C	Sandstone, siltstone, and shale of the Newark Group. Ground water stored and transmitted in fractures. Unconfined to partially confined in upper 200 ft; confined at greater depth. Water is normally fresh, slightly alkaline, non-corrosive and hard; may have large concentrations of iron and sulfate. Calcium-bicarbonate type waters dominate. Subordinate calcium-sulfate waters are associated with high total dissolved solids. Includes conglomerate facies (bac) along the northwest margin of the basin.	30-1,500	10-500
▪**Aquifer Rank** is from NJGS GIS data. It 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: Herman et al, 1998; *USGS, January 14, 2013a				

[16] *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.



Legend

- Frenchtown Borough
- Roads
- Parcels
- Streams
- Waterbodies
- Brunwick aquifer (ba)
- Well number
- Coastal Plain Sole Source Aquifer

0 0.25 0.5 Miles

N

Data Sources: NJDEP, NJDOT, USGS
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 5c: Borough of Frenchtown Aquifer & Sole Source Aquifer

Frenchtown ERI 2018 Kratzer Environmental Services

Unconfined[17] conditions commonly exist above this level of about 75 feet 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 (Lewis-Brown and Jacobsen, 1995).

The 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 300-500 feet in the Piedmont (Houghton, 1990). In the Triassic-Jurassic Passaic Formation, wells are drilled to these deep depths because there is a good potential to encounter additional water-bearing fractures and therefore, to increase the yield. For this reason, wells extended beyond this depth 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 extensive fracturing and interconnection of these fractures results in most wells in the Passaic Formation being capable of transmitting and storing sufficient volumes of water to meet most needs.

Wells near surface water bodies can also derive a significant amount of water from the surface water body by *induced infiltration* (Lewis-Brown and Jacobsen, 1995). These wells located near surface water often have higher yields (Vecchioli and Palmer, 1962 in Lewis-Brown and Jacobsen, 1995), but can be vulnerable to pollution if the surface water carries pollutants. In general, the yield of a well is primarily dependent on the number and size of fractures directly intersected by the well bore, although some water comes from other water-bearing units leaking through confining units. Kasabach (1966) indicates that initial yields in the Passaic Formation are high and that these yields decrease with time as fractures are dewatered.

The 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 5d**). A *cone of depression* is the conical-shaped depression of the water table around a pumping well caused by the withdrawal of water. Because of

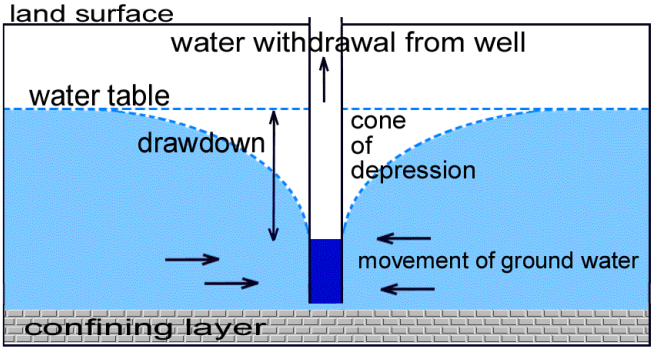


Figure 5d: Drawdown and Cone of Depression Diagram

[17] *Unconfined aquifers* (also called water table aquifers) occur where water only partly fills an aquifer, therefore the upper surface of the saturated zone is free to rise and decline. Where an aquifer is overlain by a confining bed, and water completely fills an aquifer, it is known as a *confined aquifer* (also called an artesian aquifer) (Heath, 1983).

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 5d**).

C. Sole-Source Aquifers

The Safe Drinking Water Act (SDWA) of 1974 contains a provision in Section 1424(e) that provides for designating an aquifer that is the sole or principal drinking water source for an area and that, if contaminated, would create significant hazard to public health. 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. Once designated, no Federal financial assistance may be approved for any project that may contaminate the aquifer through a recharge zone so as to create a significant hazard to public health (US EPA, May 1988). Therefore, 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* (the area through which water recharges the aquifer) and its *stream-flow source zone* (the upstream area that contributes recharge water to the aquifer).

The New Jersey Coastal Plain SSA was approved by EPA in 1988 (NJDEP NJGS, April 5, 2000). While the recharge zone is defined as the New Jersey Coastal Plain physiographic province, in south Jersey, its stream-flow source zone includes all upstream parts of the Delaware River watershed in New Jersey, Delaware, Pennsylvania and New York. However, the designated project review area is restricted to that part of the streamflow-source zone that lies within two miles of the mainstem Delaware River, which encompasses Frenchtown Borough (see **Figure 5c**)(NJDEP NJGS, April 5, 2000).

The Kirkwood-Cohansey aquifer of the coastal plain is a surficial aquifer. The same bedrock that outcrops in Frenchtown dips at an angle toward the southeast, deeper and deeper beneath the surface, but connected by complex ground water flow paths. Because ground water and surface water interact where the water table is at or near the land surface, very small variations in ground water levels resulting from climatic changes and contaminants from human activities can have a significant effect on the aquifer. Contaminants may flow to deeper aquifers and remain in the ground water system for hundreds or even thousands of years (Buxton, 1995).

D. Recharge

Ground water recharge is defined as water added to an aquifer (for example, precipitation that seeps into the ground deep enough to enter the saturated zone of the fractured bedrock). 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[18] coincide with, or are slightly offset from, surface water divides (Lewis-Brown and Jacobsen, 1995) (watersheds are described in **Section 6A** 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.

[18] A ground water divide is a line on a water table where on either side of which the water table slopes downward. It is analogous to a drainage divide between two drainage basins on a land surface. http://www.srh.noaa.gov/jetstream/append/glossary_g.htm

Recharge rates are expressed in terms of the amount of precipitation that reaches the aquifer per unit of time (e.g. inches/year during a drought year is used in Figure 5e). New Jersey receives an average of about 40 to 51 inches of precipitation per year (lowest along the southeast coast, highest in the north-central parts of the state) (ONJSC, no date), and references vary widely about how much reaches the aquifer (Lewis-Brown and Jacobsen, 1996; Kasabach, 1966; USGS, 2013) in bedrock aquifer areas like Frenchtown. This is because, while precipitation can be accurately measured, recharge cannot be directly measured. 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 Section 5A). Likewise, evaporation is higher during the warmer months. Together, these are known as evapotranspiration. Therefore, most recharge occurs during late fall, winter, and early spring, when plants are dormant and evaporation rates are minimal (Heath, 1983).

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.

To ensure that water is available during all weather conditions for human consumption as well as ecosystems dependent on water, the NJDEP established the Planning Threshold, or *dependable yield,* to be used for planning purposes. *Dependable yield* is defined as "the water yield maintainable by a ground water system during projected future conditions, including both a repetition of the most severe drought of record and long-term withdrawal rates without creating undesirable effects." The most severe drought on record was in the early 1960's (see **Section 2A**), and this is used in the 1996 Statewide Water Supply Plan. However, the Plan acknowledged that there is insufficient long-term precipitation data to prove that this is the worst drought that could occur in the future, in duration or severity, and recommended re-evaluation of safe-yield estimates and development of optimal strategies for severe droughts (NJDEP OEP, 1996). 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).

In view of the importance of not exceeding the aquifers' safe yield, the New Jersey Geological Survey has completed studies quantifying recharge, as discussed in the following sections.

New Jersey Geological Survey Recharge Method GSR-32

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[19], surface runoff, and evapotranspiration. This method was then applied by NJGS

[19] Land use/land cover data from 1995-1997 were used for this study. Changes in land use/land cover and impervious surfaces affect recharge, but are not reflected in the recharge values, because this involves complex calculations, and NJGS has not updated this GIS data layer.

to create a GIS coverage (see **Figure 5e**). There were a number of assumptions made for the calculations and model inputs that limit the accuracy of the method: 1) the calculated ground water recharge includes any water entering the ground (in actuality, lesser amounts actually enter the aquifer); 2) assumes that all water that migrates below the root zone recharges the aquifer (which does not 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); 5) stream baseflows used may not be representative of local streams (Charles et. al., 1993) and 6) does not consider topography, depth to bedrock, presence of impervious surfaces, and/or type of bedrock underlying soils. An additional limitation 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).

Applying the GSR-32 method to Frenchtown, the estimated average annual subsurface recharge rates range from 0 to 15 inches per year (excluding surface water, wetlands and hydric soils) and 0 to 12 inches per year during drought (shown on **Figure 5e**) (NJGS, October 8, 2004).

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, Frenchtown may have usable recharge of 0 to 0.72 inch. If assuming that 20% of ground recharge is aquifer recharge, 0 to 2.4 inches are added to ground water per year. While it is unknown at this time which figure is closer to actual conditions in Frenchtown, 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 (NJGS, October 8, 2004).

New Jersey Geological Survey Ground Water Potential

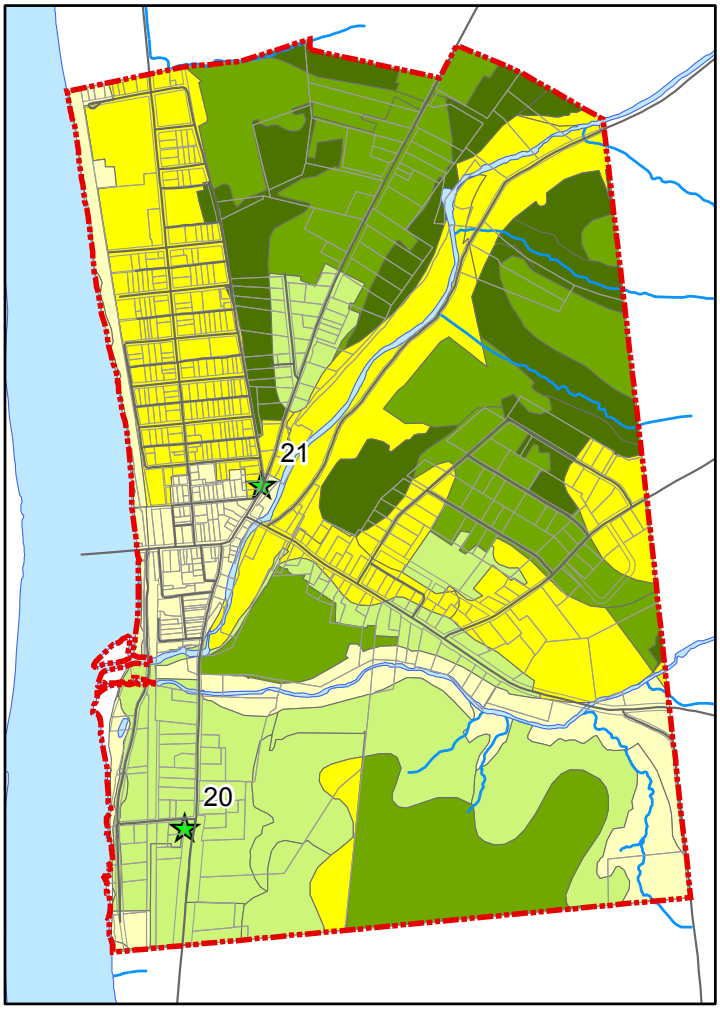
In 2005, also in response to N.J.S.A. 58:11A, 12-16, the NJ Geological Survey developed a qualitative representation of the potential for aquifer recharge. This was created by combining ground water recharge rankings and aquifer rankings.

NJGS assigned a relative rank based on the inches of ground water recharge per year (mapped in **Figure 5e**), from A (highest recharge) to E (lowest recharge). Relative values of aquifer yield (based on high yield industrial wells and described in **Table 5.1**) were assigned to each aquifer, from A (highest yield) to E (lowest yield). The State Rank for the aquifer underlying Frenchtown is C. For both data sets, areas of wetlands, open water and hydric soils were not ranked, since individual areas differ in whether they increase or decrease recharge, which varies seasonally. These two ranks are combined in the format "aquifer recharge rank/ground water recharge rank" and illustrated in **Figure 5e**. For example, A/A would be an area with the highest relative recharge and highest yield, and an area designated E/E would have the lowest recharge and lowest yield, while other combinations would lie somewhere in between (NJGS, January 4, 2005).

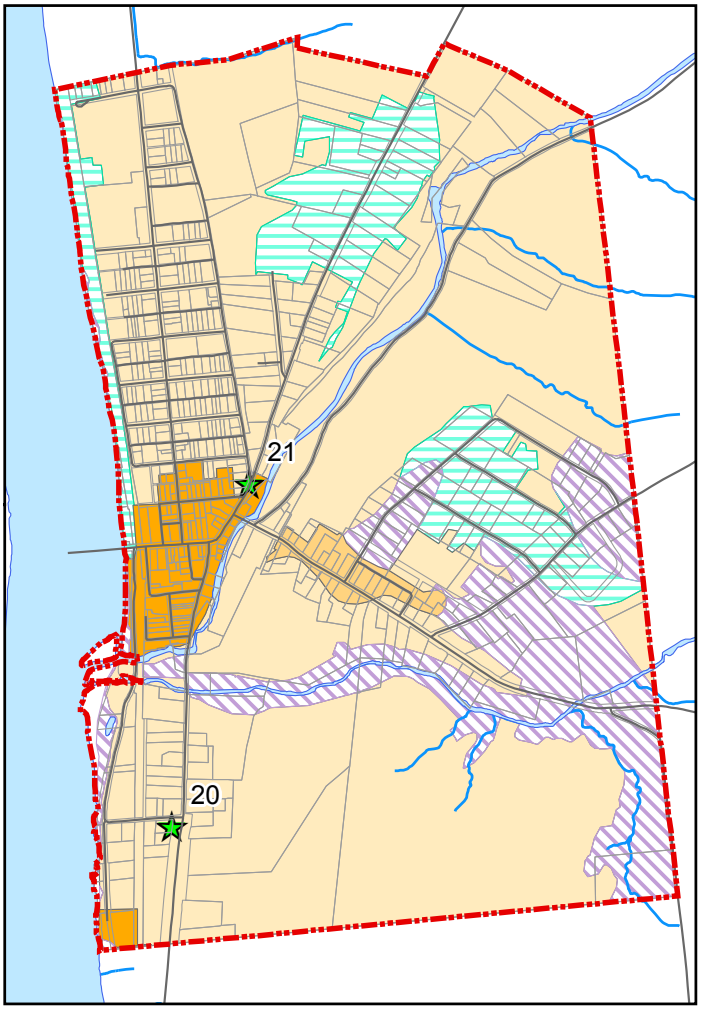
Water Availability Workbook

In 2014, NJGS released the Computer Workbook Investigating Water Availability in New Jersey on a Watershed Management Area Basis (Snook et. al., 2014), which is a

Drought Recharge



Aquifer Rank/Ground Water Recharge Rank



Legend

- Frenchtown Borough
- Roads
- Parcels
- Waterbodies
- Streams
- Well number

Estimated drought recharge value (inch/year)

- 0 - 1
- 2 - 7
- 8 - 9
- 10 - 11
- 12

Aquifer Rank	High Yield Wells	Ground water recharge rank	Recharge
A	> 500 gpm	A	18 to 23 in/yr
B	250 to 500 gpm	B	10 to 17 in/yr
C	100 to 250 gpm	C	8 to 9 in/yr
D	25 to 100 gpm	D	1 to 7 in/yr
E	< 25 gpm	E	0 in/yr
L: hydric soils-no recharge calculated			
W: wetlands and open water--no recharge calculated			

Legend

- Frenchtown Borough
- Roads
- Parcels
- Well number
- Streams
- Waterbodies

Aquifer Recharge/Recharge Rank

- B/C
- C/C
- D/C
- L: hydric soils (no recharge calculated)
- W: wetlands (no reharge calculated)

N

0 0.25 0.5 Miles

Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 5e: Borough of Frenchtown Aquifer Potential & Recharge

spreadsheet tool to estimate potential unconfined aquifer and stream baseflow water availability. The workbook contains estimates of streamflow, how much water is used depletively and consumptively on a HUC11[20] basis, and the volume of water that remains and is available. *Depletive uses* are those where the water is withdrawn from one watershed and discharged after use to a different basin where it is available for use again. *Consumptive uses* are those where the water is lost to evapotranspiration and no longer available for use. The user specifies a Low Flow Margin (LFM) that estimates the amount of water that the combined surface water-unconfined aquifer system can lose to depletive and consumptive water use without experiencing unacceptable ecological impacts. If the full allocation of depletive and consumptive uses plus the LFM exceeds water availability, the HUC11 is "stressed." It is important to recognize that this doesn't mean that water is not available in that HUC11, since alternatives may exist and the specifics of water use in a HUC11 need to be evaluated on a case-by-case basis (Snook et. al., 2014).

According to the worksheet, the HUC11 that includes all of Frenchtown and parts of Holland, Alexandria and Kingwood (Hakihokake/Harihokake/Nishisakawick Ck) has a net water availability of 0.9 mgd (million gallons per day) and current full allocation of water equal to 1.4 mgd. Thus, this HUC11 is stressed, even before the user designates a LFM percentage to remain for ecological health (Snook et. al., 2014).

E. 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, 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, August 17, 2017)), radon, arsenic, MTBE (methyl-t-butyl ether, which is a fuel oxygenate), nitrates, and waterborne pathogens.

In addition, radioactive substances (including uranium, thorium, radium, and radon) from natural sources (see **Section 3D)** are frequently found in ground water in New Jersey. Almost all rocks and soil contain at least some radioactive substances, which can sometimes exceed safe levels in drinking water.

Public Water Wells

The Frenchtown Water Department serves 1,373 people from the three wells shown in **Figure 2b**. These wells are all located in the Passaic aquifer. Water quality is good and in compliance with current water quality standards (NJAW, 2016; NJDEP Division of Water Supply and Geoscience, July 9, 2013). Water quality testing results are available online (see **Internet Resources**).

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

[20] HUC11s are explained in **Section 6A**.

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)[21]. 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 6 PCWSs and their associated Well Head Protection Areas in and near the Borough of Frenchtown, shown on **Figure 2b**.

Private Wells

The New Jersey Private Well Testing Act (N.J.S.A. 58:12A-26 et seq.) became effective in September 2002, mandating private well testing upon the sale of a house. The number of wells tested in a municipality reflects the number of real estate transactions involving homes with private wells. The well water must be tested for Primary Contaminants[22] (bacteria, Volatile Organic Compounds, arsenic, lead and nitrates) and Secondary Contaminants[23] (pH, iron and manganese). Beginning March 16, 2004, gross alpha particle activity is also required in Hunterdon County.

Since Frenchtown is served primarily by public water systems, just 30 private wells have been tested pursuant to this regulation (see **Table 5.2**). Results of data generated by the PWTA revealed that arsenic standards are frequently exceeded in Frenchtown Borough. Of these 30 wells tested, 21 of those tested exceeded the arsenic[24] Maximum Contaminant Level (MCL) of 5 µg/l; one well exceeded the primary drinking water MCL for bacteria; and two exceeded the MCL for gross alpha. The secondary standards were exceeded three times for iron, once for manganese and once for pH.

Table 5.2: NJ Private Well Testing Act Data Summary (September 2002 to April 2014) in Frenchtown Borough

Parameter	Number of Wells Sampled	% of Wells Exceeding MCL	MCL
Nitrate	30	0.0	10 mg/l
Arsenic	30	70.0	5* µg/l
Iron	30	10.0	0.3 mg/l
Manganese	30	3.3	0.05 mg/l
Gross Alpha	27	7.4	(initial)[25] 5 pCi/L (final) 15 pCi/L
Mercury	Testing is not required under PWTA		2 µg/l
VOC	30	0.0	*
Fecal coliform or E. coli	30	3.3	0 colonies
pH	30	3.3	6.5-8.5
* MCLs vary for the 26 Volatile Organic Compounds (VOCs) required by the PWTA.			
Source: NJDEP Division of Water Supply and Geoscience, January 19, 2017; Atherhold et. al., 2008			

[21] Protection of wells serving single homes or up to 14 connections is important, but the ground water capture areas have not been delineated for these.

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

[23] 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.

[24] Wells drilled in northern NJ can contain high levels of naturally occurring arsenic (from bedrock). Other sources include past use of pesticides and waste from glass or electronics production.

[25] Results greater than 5 pCi/L requires a second gross alpha count. The MCL for gross alpha is 15 pCi/L.

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.

NJGS Studies

The NJ Geological Survey studied ground water quality in the Newark Basin in 1994. NJGS ground water monitoring sites are shown in **Figure 5c** (NJGS, January 14, 2014).

The NJ Geological Survey analyzed data from 150 wells in the Newark Basin (including the Passaic Aquifer) in order to characterize the natural range of ground water quality parameters (Serfes, 1994; Serfes and Herman, 1995). Two of the sites were located in Frenchtown (sites 20 and 21 on **Figure 5c**). Results of all sites combined showed that ground water in the Newark Basin, including the Passaic Formation, is normally fresh (total dissolved solids less than 1,000 mg/l), somewhat oxidizing, slightly alkaline, non-corrosive, hard and of good natural quality. Calcium bicarbonate waters dominate, but calcium-sulfate waters exist and are associated with high total dissolved solids. Standards were exceeded for manganese in 27% of samples, maximum hardness in 21%, corrosivity 31% of the time, total dissolved solids 14%, sodium 8% and sulfate 8% of the time. The primary drinking water standard for gross alpha particle activity (radon and progeny) was exceeded in 6% of the samples, for radium in 3%, and for lead 1% of the time (Herman et al., 1998; Serfes, 1994). In addition, the water may have large concentrations of iron and sulfate (USGS, January 14, 2014; Serfes, 1994).

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. Every year approximately 30 sites are sampled, with the cycle of sampling all 150 shallow ground water wells completed every 5 years. Beginning in 2014, the sampling cycle changed to a 3-year cycle (Bousenberry, 2016). Results of the sampling are reported by the USGS in their yearly series on water resources data of New Jersey (Bousenberry, 2016). One AGWQN site is in Frenchtown and one is nearby in Kingwood Township (sites 190454 and 190450, respectively, shown on **Figure 5c**). These were sampled in 2003 and 2007 and the results are show in **Table 5.3**.

F. Ground Water Quality Standards

The New Jersey Ground Water Quality Standards (GWQS; N.J.A.C. 7:9C) (last amended (see August 16, 2010) 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 (see **Section 5H**), 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 6D** for surface water classifications), state-owned Natural Areas, and the major aquifers of the Pinelands Area are

Table 5.3: Ground Water Quality for One Site in Frenchtown and One in Kingwood*

Major ions & Field Parameters

UID	Municipality	Date Sampled	Temperature Water Degrees Celsius	Barometric Pressure mm of Mercury	Specfic Conductance Wat. Unfilt. microsimens per cm @25° Celsius	Dissolved Oxygen Wat. Unfilt. mg/l	pH Wat. Unfilt. Field Standard Units	pH Wat. Unfilt. Laboratory Standard Units	Bicarbonate Wat. Filt. Incremental Titration Field mg/l	Organic Carbon Wat. Filt. mg/l	Calcium Wat. Filt. mg/l	Magnesium Wat. Filt. mg/l	Sodium Wat. Filt. mg/l
			P00010	**P00025**	**P00095**	**P00300**	**P00400**	**P00403**	**P00453**	**P00681**	**P00915**	**P00925**	**P00930**
190450	Kingwood	20030625	15.6	758	406	0.2	8	8.1	146	0.3	30.6	12.2	35.8
190450	Kingwood	20070716	15	752	404	0.2	7.8	8.1	160	0.5	31.2	10.8	35.7
190454	Frenchtown	20030625	12.5	761	478	6.8	6.5	7	98	0.7	30.5	10	43.1
190454	Frenchtown	20070716	13.9	759	627	5.3	6.5	7.1	108	1.5	36.1	10.7	67.6

Major ions & Field Parameters (continued)

UID	Municipality	Date Sampled	Potassium Wat. Filt. mg/l	Chloride Wat. Filt. mg/l	Sulfate Wat. Filt. mg/l	Fluoride Wat. Filt. mg/l	Silica Wat. Filt/ mg/l	Alkalinity Wat. Filtered Incremental Titration Field mg/l as Calcium Carbonate	Turbidity Wat. Unfiltered Field Nephelometric Turbidity Units	Residue On Evaporation Dried @ 180 Degrees Celsius Wat. Filt. mg/l	Specfic Conductance Wat. Unfiltered Laboratory microsimens per cm @25 degrees Celsius
			P00935	**P00940**	**P00945**	**P00950**	**P00955**	**P39086**	**P61028**	**P70300**	**P90095**
190450	Kingwood	20030625	2.05	28.2	23.6	0.3	16.2	138	2.5	250	397
190450	Kingwood	20070716	1.1	25.7	24.9	0.32	16.5	132	0.4	238	414
190454	Frenchtown	20030625	7.2	66.9	24.6	<0.2	9.3	80	1.1	266	450
190454	Frenchtown	20070716	8.18	89.2	44.4	0.12	10.2	88	0.9	358	637

Nutrients

UID	Municipality	Date Sampled	Ammonia Wat. Filtered mg/l as Nitrogen	Nitrite Wat. Filtered mg/l as Nitrogen	Ammonia + organic N Wat. Filtered mg/l as Nitrogen	Nitrite + Nitrate Wat. Filtered mg/l as Nitrogen	Orthophosphate Wat. Filtered mg/l as Phosphorus
			P00608	**P00613**	**P00623**	**P00631**	**P00671**
190450	Kingwood	20030625	<0.04	0.043	<0.1	3.42	<0.02
190450	Kingwood	20070716	<0.02	0.103	0.06	2.61	0.006
190454	Frenchtown	20030625	<0.04	<0.008	0.06	3.41	0.19
190454	Frenchtown	20070716	<0.02	<0.002	0.3	4.4	0.301

Trace Elements

UID	Municipality	Date Sampled	Arsenic Wat. Filt. µg/l	Barium Wat. Filt. µg/l	Boron Wat. Filt. µg/l	Cadmium Wat. Filt. µg/l	Chromium Wat. Filt. µg/l	Copper Wat. Filt. µg/l	Iron Wat. Filt. µg/l	Lead Wat. Filt. µg/l	Manganese Wat. Filt. µg/l	Nickel Wat. Filt. µg/l	Zinc Wat. Filt. µg/l	Antimony Wat. Filt. µg/l	Aluminum Wat. Filt. µg/l	Selenium Wat. Filt. µg/l
			P01000	**P01005**	**P01020**	**P01025**	**P01030**	**P01040**	**P01046**	**P01049**	**P01056**	**P01065**	**P01090**	**P01095**	**P01106**	**P01145**
190450	Kingwood	20030625	7.4	71	2490	0.04	<0.8	0.3	4	<0.08	4	1.44	<1	<0.3	3	0.4
190450	Kingwood	20070716	7.7	79	2080	0.03	0.17	0.37	<6	0.06	3.6	0.21	<0.6	0.11	<40	0.06
190454	Frenchtown	20030625	1.4	64	142	<0.04	0.8	0.9	<8	<0.08	1.4	1.27	1.2	<0.3		3.9
190454	Frenchtown	20070716	1.9	72	240	0.04	0.25	0.88	<6	<0.12	<0.2	0.43	1.1	0.13	<4.8	6.2

Pesticides

UID	Municipality	Date Sampled	Prometon Wat. Filtered Recoverable	2-Chloro-4-isopropylamino -6-amino-s-triazine Wat. Filtered Recoverable	Dieldrin Wat. Filtered Recoverable	Atrazine Wat. Filt. Recoverable
			µg/l	µg/l	µg/l	µg/l
			P04037	**P04040**	**P39381**	**P39632**
190450	Kingwood	20030625	Below reporting limit	Below reporting limit	Below reporting limit	Below reporting limit
190450	Kingwood	20070716	Below reporting limit	Below reporting limit	Below reporting limit	0.004
190454	Frenchtown	20030625	0.02	Below reporting limit	0.037	Below reporting limit
190454	Frenchtown	20070716	0.02	0.009	0.066	0.007

VOCs (only the results greater than the reporting limit are shown below)

UID	Municipality	Date Sampled	Trichloromethane Wat. Unfiltered Recoverable	Trichloroethane Wat. Unfiltered Recoverable
			µg/l	µg/l
			P32106	**P34488**
190450	Kingwood	20030625	Below reporting limit	Below reporting limit
190450	Kingwood	20070716	Below reporting limit	Below reporting limit
190454	Frenchtown	20030625	Below reporting limit	0.9
190454	Frenchtown	20070716	1	0.9

Radionuclides

UID	Municipality	Date Sampled	Gross beta radioactivity Wat. Filtered Cs-137 curve	Alpha radioactivity Wat. Filtered Th-230 curve	Alpha radioactivity 2-sigma combined uncert. Wat. Filtered Th-230 curve	Beta radioactivity 2-sigma combined uncert. Wat. Filtered Cs-137 curve	Gross-alpha radioactivity 72 hour count	Gross-alpha radioactivity 30 day count	Gross-beta radioactivity 30 day count	Gross-beta radioactivity 72 hour count
			pci/l	pci/l	pci/l	pci/l	pci/l	pci/l	pci/l	pci/l
			P03515	**P04126**	**P75987**	**P75989**	**P62636**	**P62639**	**P62645**	**P62642**
190450	Kingwood	20030625	3	3	1.9	2.5				
190450	Kingwood	20070716					5.4	3	2.6	1.1
190454	Frenchtown	20030625	9		1.2	3.3				
190454	Frenchtown	20070716					0.5	-0.5	7	7.8

*Parameters tested but below the reporting limit for all samples are not shown in this table.

Source:

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. *Class II* waters are those not specifically designated Class I or Class III. 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 (NJDEP Bureau of Water Quality Standards and Assessment, November 7, 2016). Frenchtown's ground water is designated Class II (to provide potable water with conventional treatment). 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 (see **Section 5I** and **Figure 5f**).

G. 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 primarily 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.

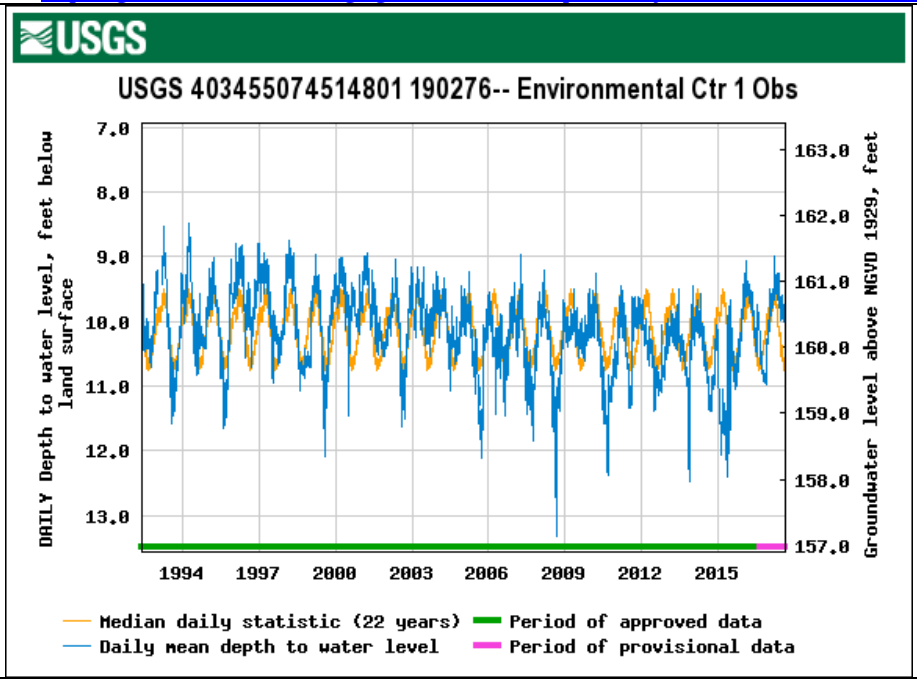
Ground water level varies seasonally, due to the seasonality of recharge (see Recharge section, above).

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).

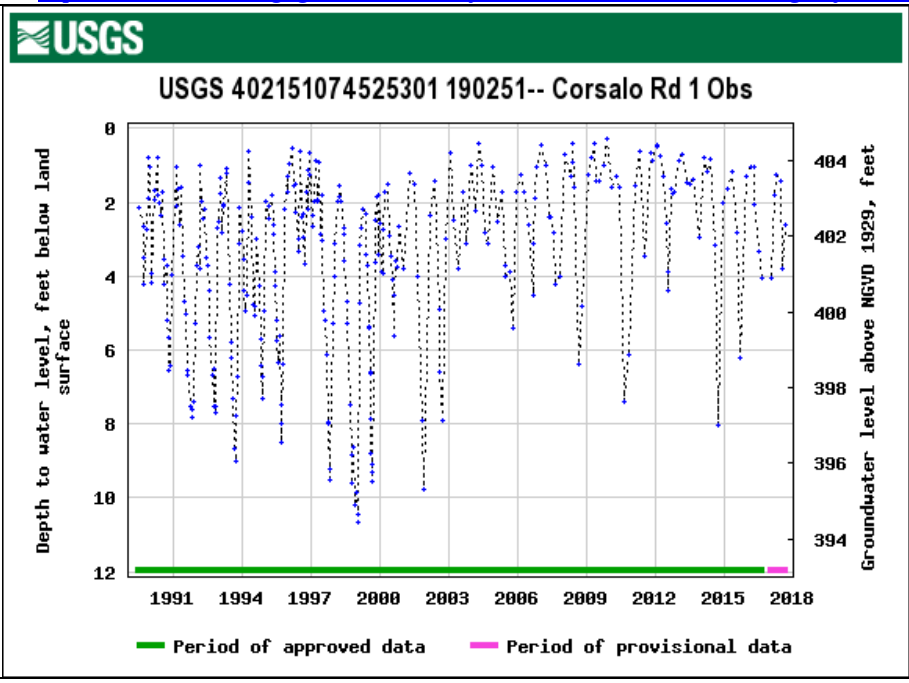
The United States Geological Survey (USGS) maintains a nation-wide network of wells to monitor the effects of droughts and other climate variability on ground water levels. While there are no USGS monitoring wells within Frenchtown, there are three within 20 miles (see **Table 5.4, Figure 5c (inset)** and **Internet Resources**). The nearest of these is located in Clinton Township ("Environmental Ctr 1 Obs") which is 175 feet deep, located within the Stockton aquifer and monitored since 1992. The network has two wells within the Passaic Formation (the same formation as Frenchtown's wells). The nearest of these is in West Amwell Township ("Corsalo Rd 1 Obs"), approximately 14.5 miles southeast of Frenchtown), which is 299 feet deep, and monitored since 1989. The other is in Readington Township ("Readington 11 Obs"), located approximately 16.5 miles east of Frenchtown), which is 101 feet deep, and monitored since 1989. While these wells do not precisely represent the ground water levels within Frenchtown, due to intervening ground water divides (boundaries), they are among the factors that NJDEP uses to determine drought status (see **Internet Resources**). A description of these sites and graphs of ground water levels are shown in **Table 5.4**. These graphs illustrate the seasonal variability of ground water levels, where the lowest ground water levels typically occur during June-September, while the highest levels usually occur between January-March.

Table 5.4: USGS Real-Time Ground Water Level Network – Wells Near Frenchtown

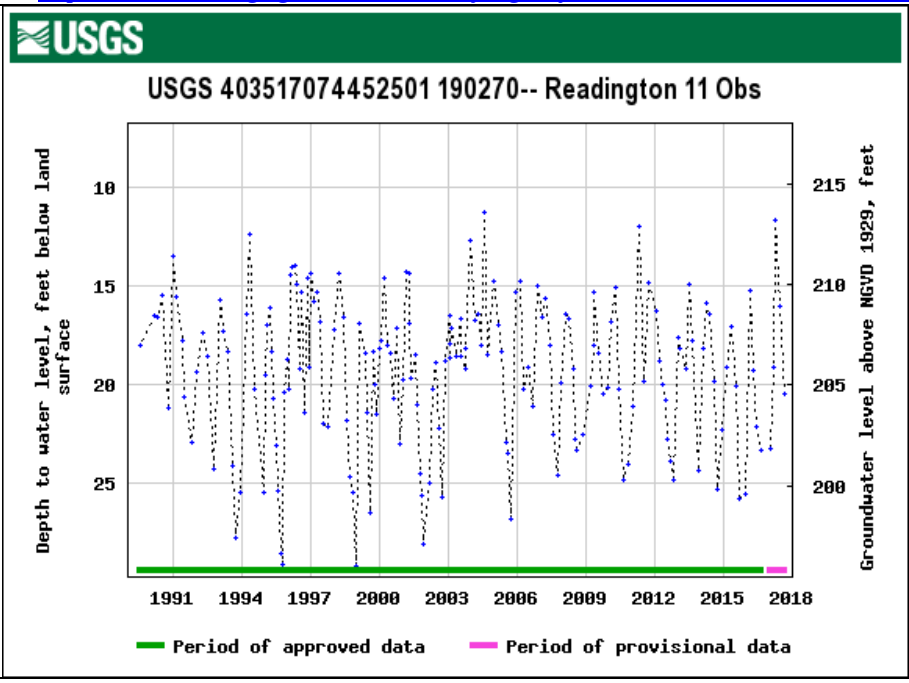
Site Number:	**USGS 403455074514801 190276-- Environmental Ctr 1 Obs**
Location:	Latitude 40°34'38", Longitude 74°51'39" NAD27 Hunterdon County, New Jersey, Hydrologic Unit 02030105 About 10.5 miles east of Frenchtown in Clinton Township
Well Characteristics:	**Depth:** Well depth: 175 feet **Land surface altitude:** 170.4 feet above NGVD29.
Aquifer:	Well completed in "Early Mesozoic basin aquifers" (N300ERLMZC) national aquifer. Well completed in "Stockton Formation" (231SCKN) local aquifer
Begin date:	05/20/1992
Extremes:	*Highest Water Level*: **8.49'** *Median*: **10.13'** *Lowest Water Level*: **13.32'**
Websites:	https://waterdata.usgs.gov/nwis/inventory?agency_code=USGS&site_no=403455074514801 https://groundwaterwatch.usgs.gov/AWLSites.asp?ncd=njn&S=403455074514801



Site Number: USGS 402151074525301 190251-- Corsalo Rd 1 Obs	
Location:	Latitude 40°21'51", Longitude 74°52'53" NAD27 Hunterdon County, New Jersey , Hydrologic Unit 02040105 About 14.5 miles southeast of Frenchtown in West Amwell Township
Well Characteristics:	**Depth:** Well depth: 299 feet **Land surface altitude:** 405 feet above NGVD29
Aquifer:	Well completed in "Early Mesozoic basin aquifers" (N300ERLMZC) national aquifer. Well completed in "Passaic Formation" (227PSSC) local aquifer
Begin date:	06/28/1989
Extremes:	*Highest Water Level*: **-0.22'** *Median*: **2.06'** *Lowest Water Level*: **10.56'**
Websites:	https://groundwaterwatch.usgs.gov/AWLSites.asp?S=402151074525301 https://nwis.waterdata.usgs.gov/nwis/inventory/?site_no=402151074525301&agency_cd=USGS



Site Number:	USGS 403517074452501 190270-- Readington 11 Obs
Location:	Latitude 40°35'17", Longitude 74°45'25" NAD27 Hunterdon County, New Jersey, Hydrologic Unit 02030105 About 16 miles east of Frenchtown in Readington Township
Well Characteristics:	Depth: Well depth: 101 feet Land surface altitude: 224.99 feet above NGVD29.
Aquifer:	Well completed in "Early Mesozoic basin aquifers" (N300ERLMZC) national aquifer. Well completed in "Passaic Formation" (227PSSC) local aquifer
Begin date:	07/14/1989
Extremes:	Highest Water Level: 8.38' Median: 18.81' Lowest Water Level: 29.99'
Websites:	https://groundwaterwatch.usgs.gov/AWLSites.asp?mt=g&S=403517074452501&ncd=awl https://waterdata.usgs.gov/nwis/inventory?agency_code=USGS&site_no=403517074452501



Sources: USGS, 2017a; USGS 2017b; USGS, 2017c

H. Ground Water Discharges

New Jersey regulates the discharge of pollutants to ground water under the authority of the New Jersey Water Pollution Control Act (WPCA) N.J.S.A. 58:10A. The New Jersey Pollutant Discharge Elimination System (NJPDES) permit program regulations are contained in N.J.A.C. 7:14A (NJDEP, January 5, 2009).

NJPDES permits are required for discharges to ground water of both sanitary and industrial wastes. These permits, which limit the mass and/or concentration of pollutants discharged, are issued to sanitary and industrial facilities that have ongoing, operational discharges of wastewater to ground water. The purpose is to restrict the discharge of pollutants to the ground waters of the state and protect the public health and the environment. Discharges from past activities may continue to be regulated under the Site Remediation Program or the Division of Solid and Hazardous waste.

There are two ground water discharges within Frenchtown, described below in **Table 5.5** and shown on **Figure 5f** (NJDEP, July 18, 2007).

Table 5.5: NJPDESGW in Frenchtown

Map ID	FACILITY	PI #	NJPDES #	Discharge Type
1	ROUTE 12 BUSINESS PARK[26]	208051	NJ0145891	GW
2	COZZE BROTHERS	47908	NJG0111210	SM
Source: NJDEP, July 18, 2007				

I. Contaminated Sites

On May 7, 2012, NJDEP adopted amendments, repeals, and new rules to implement site remediations through the *Site Remediation Reform Act (SRRA)*, N.J.S.A. 58:10C-1 et seq., and related amendments to the *Brownfield and Contaminated Sites Act (Brownfield Act)* N.J.S.A. 58:10B-1 et seq., the *Spill Compensation and Control Act (Spill Act)*, N.J.S.A. 58:23-11 35 seq., the *Industrial Site Recovery Act (ISRA)*, N.J.S.A. 13:1K-6 et seq., and the *Underground Storage of Hazardous Substances Act (UST Act)*, N.J.S.A. 58:10A-21 et seq. This major shift requires remediations of contaminated sites to proceed under the supervision of a *Licensed Site Remediation Professional (LSRP)* (hired by the property owner) instead of NJDEP. The goal of these changes is to increase the pace of remediation, in order to decrease the threat of contamination to public health and safety and the environment, and to more quickly return properties to productive use that are underutilized due to contamination (NJDEP SRP, July 27, 2017).

Some key provisions create a licensing board and a code of ethics (including penalties for violations) for LSRPs; establish obligations of each person responsible for conducting remediation; institute mandatory timeframes for the completion of key phases of site remediation; set forth the circumstances under which NJDEP would undertake direct oversight of a remediation; and require NJDEP to establish presumptive remedies for residential development, schools and childcare facilities to ensure that the remediation at these sites is protective of human health and safety and of the environment (NJDEP SRP, July 27, 2017).

The LSRP program does not apply to unregulated underground storage tanks (i.e. residential tanks) (see **Internet Resources**).

Known Contaminated Sites List (KCSL)

The NJDEP Site Remediation Program compiles a list of Known Contaminated Sites (KCS). The *Known Contaminated Sites List*[27] (non-homeowner) for New Jersey (as required under N.J.S.A. 58:10-23.16-17 and also the New Residential Construction Off-Site Conditions Disclosure Act N.J.S.A 46:3C1 et seq.) contains sites defined as those sites and properties within the state where contamination of soil or ground water has been confirmed at levels equal to or greater than applicable standards. Sites identified in the Known Contaminated Sites list can undergo a variety of activities, ranging from relatively simple soil removals to highly complex remedial activities. It is important to note that the list may include sites where remediation is either currently under way, required but not yet initiated or has been completed (and no longer considered contaminated). In addition, new contaminated sites may have been identified since the creation of this list and are not included here (NJDEP SRP, April 27, 2017).

Within the Borough of Frenchtown, there are 2 KCSs (see **Table 5.6** and **Figure 5f**). An additional 6 KCSs are near Frenchtown (in the same subwatersheds), and therefore could also

[26] Note that either the name or location of this discharge is incorrect.
[27] The GIS data is updated periodically (the most recent data currently available is from April 27, 2017. The tabular data is updated more frequently (see **Internet Resources)**.

impact Frenchtown's environmental quality.

Homeowner sites are not included in the GIS data or in **Table 5.6** because they generally involve small heating oil discharges from leaking underground storage tanks (USTs) that are resolved relatively quickly (see **Internet Resources** for a link to NJDEP's grant program for removal and cleanup of USTs) (NJDEP SRP, July 27, 2017).

More detailed information was available for several of these sites, which are described briefly below.

- Crown Vantage Landfill (as of June 30, 2004):

> "The Crown Vantage Landfill is an inactive landfill located on the bank of the Delaware River in Alexandria Township. The landfill accepted various wastes for approximately forty years, beginning in the late 1930s. Coal ash, household trash, appliances, construction debris, chemical solvents, metal foil, waste paper and paper fiber sludge from a nearby paper company were reportedly deposited in the landfill while it was in operation. In 1991, the Responsible Party for the landfill conducted a preliminary investigation of the site in response to two Notices of Violations from NJDEP's Division of Hazardous Waste Management and Division of Solid Waste Management. The investigation revealed there were approximately 800 drums on the surface of the landfill and volatile organic vapors present in the soil. The Responsible Party subsequently removed approximately 475 empty drums and 69 drums containing wastes, including flammable liquids. Sampling of the ground water conducted in 1994 did not reveal the presence of any volatile organic compounds at levels exceeding New Jersey ground water quality criteria. Arsenic and lead were detected in the ground water at levels exceeding applicable standards, but it is not known whether these were associated with disposal activities at the landfill. Numerous half-buried empty drum carcasses remained along the western edge of the landfill and there was an area of stained soil approximately 300 square feet in size that may have resulted from dumping of chemicals. In 2001, NJDEP was awarded funds from Crown Vantage Paper Company's bankruptcy estate to conduct remedial work at the landfill. NJDEP's Remedial Response Element removed drums and some contaminated soil, fenced the site and conducted limited soil sampling outside the fenced area in 2002. NJDEP is evaluating whether additional publicly funded remedial actions are required at the site." (NJDEP SRP, April 14, 2011)

- DeRewal Chemical Company:

> "The DeRewal Chemical Company site is located in Kingwood Township, New Jersey. From 1970 to 1973, the DeRewal Chemical Company used the site for the storage of chemicals. Chemicals handled included a range of metals, acid solutions and fertilizer nutrients and associated compounds. Numerous chemical spills were reported in 1973, including one incident in which the contents of a tank truck containing an acidic chromium solution were allowed to drain onto the soil. The DeRewal Chemical Company ceased operations at the site around 1974. The U.S. Environmental Protection Agency's (EPA's) soil cleanup has been completedand a groundwater cleanup was also performed. The New Jersey Department of Environmental Protection (NJDEP) has initiated a groundwater monitoring program at the site." (USEPA, 2017; USEPA, June 14, 2017).

- Curtis Specialty Papers

> This former paper mill, in production from 1907 to 2003, is located along the Delaware River in Milford and Alexandria, approximately 2.2 miles north of Frenchtown. Security personnel and chain-link fencing currently restrict access to the site. Site characterization began as part of remedial activities related to releases such as spills during site operations. From 2007 to 2008, EPA sampled surface and subsurface soil, surface water, sediment, and soil gas and removed and disposed of drums and other containerized waste and low-level radiation devices. In 2011 to 2013, the site owners and operators removed hazardous and regulated materials. After flooding and erosion in 2011 exposed additional problems, over 10,000 cubic yards of contaminated soils

were removed, 11 buildings were demolished and the banks of the creek were stabilized. In 2014, the site owners further dismantled infrastructure, including removal of PCB impacted soil. Ground water samples identified two volatile organic compounds (VOCs) at levels of concern: toluene and benzene; while the VOC tetrachloroethylene (perc or PCE) was detected at low levels and at isolated locations. EPA's preferred alternative for further clean-up is in-situ biological treatment (anaerobic biological oxidation) and institutional controls. (USEPA, May 2015)

- Former Mobil Service Station (2003 status report):

"This former service station is located adjacent to Nishisakawic [sic] Creek, a tributary of the Delaware River. The site is separated from the creek by a retaining wall. In 1999 gasoline from a leaking 4,000 gallon underground gasoline storage tank seeped through the retaining wall into the creek, creating a sheen on the surface water and causing gasoline vapors to accumulate in neighboring homes. The service station owner removed the underground tanks, excavated the contaminated soil down to bedrock and backfilled the excavation with clean soil. However, subsequent episodes of seepage into the creek occurred, indicating petroleum product remained in the ground water and/or bedrock fractures. NJDEP's Remedial Response Element removed surface debris from the site in 2002 and installed on-site ground water monitor wells in 2003. NJDEP will implement remedial actions to address the contaminated ground water in 2004." (NJDEP SRP, 2003)

Table 5.6: Contaminated Sites in and Near Frenchtown

Preferred ID # (PI#)	NAME	LEAD	Status*	Status Date	Remedial Level**
Known Contaminated Sites (KCS) in Frenchtown					
604927	Arvid N Myhre Building Construction Co 1 7th St, Frenchtown	LSRP	Active	2013	C1
013692	Frenchtown Mobil 22 Race St, Frenchtown	Publicly funded	Active	2010	C2
Known Contaminated Sites (KCS) near Frenchtown					
006924	Curtis Papers Inc 404 Frenchtown Rd, Milford	Traditional	Active	2013	C3
024969	Alexandria Township Municipal Garage 255 Hickory Corner Rd, Alexandria	LSRP	Active	2012	C2
012642	Bridge Street Service Center 736 Frenchtown Rd, Alexandria	LSRP	Active	2010	C2
G000009765	Crown Vantage Landfill 500 Milford Frenchtown Rd, Alexandria	Traditional	Active	2007	C3
G000004969	Derewal Chemical Co Route 29 (River Rd), Kingwood	Publicly funded	Active	1995	C3
653464	97 Horseshoe Bend Rd, Kingwood	LSRP	Active	2014	B

*__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.

**__REM__ = REMEDIAL LEVEL, as defined below:

B: Single phase remedial action; single contamination affecting only soils.
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

Sources: NJDEP SRP, April 27, 2017; NJDEP SRP, June 23, 2017; NJDEP SRP, August 28, 2017; NJDEP Data Miner, September 3, 2017a

Classification Exception Area (CEA)

The *Classification Exception Area* (CEA) dataset identifies those sites where ground water contamination has been identified and the NJDEP has established a Classification Exception Area (CEA). CEAs are institutional controls in geographically defined areas within which the New Jersey Ground Water Quality Standards (NJGWQS) for specific contaminants have been exceeded. When a CEA is designated for an area, the constituent standards and designated aquifer uses are suspended for the term of the CEA. This data is intended to provide information to the public regarding areas of contaminated ground water to prevent inappropriate well placement, preventing potential health risks and can minimize unintended contaminant plume migration (NJDEP SRP, June 23, 2017). There are no CEAs in Frenchtown, but there is one in a subwatershed upstream of Frenchtown. A CEA was established in 2001 at the Alexandria Township Municipal Garage due to benzene and MTBE (see **Table 5.6** and **Figure 5f**). The CEA extends to the Alexandria Municipal Garage property boundaries, the depth is 75 feet and the ground water flow is to the southeast (NJDEP SRP, June 23, 2017).

Deed Notice

A *Deed Notice* is defined by NJSA 58:10B-13a as a "...notice to inform prospective holders of an interest in the property that contamination exists on the property at a level that may statutorily restrict certain uses of, or access to, all or part of that property...." The purpose of the deed notice GIS layer is to minimize any chance of exposure to contaminants remaining on the property (NJDEP SRP, August 28, 2017). There are no Deed Notices delineated within Frenchtown, but there is one approximately 1.5 miles north of Frenchtown (see **Table 5.6** and **Figure 5f**). The Deed Notice for the Crown Vantage site was established in 2014 (NJDEP SRP, August 28, 2017).

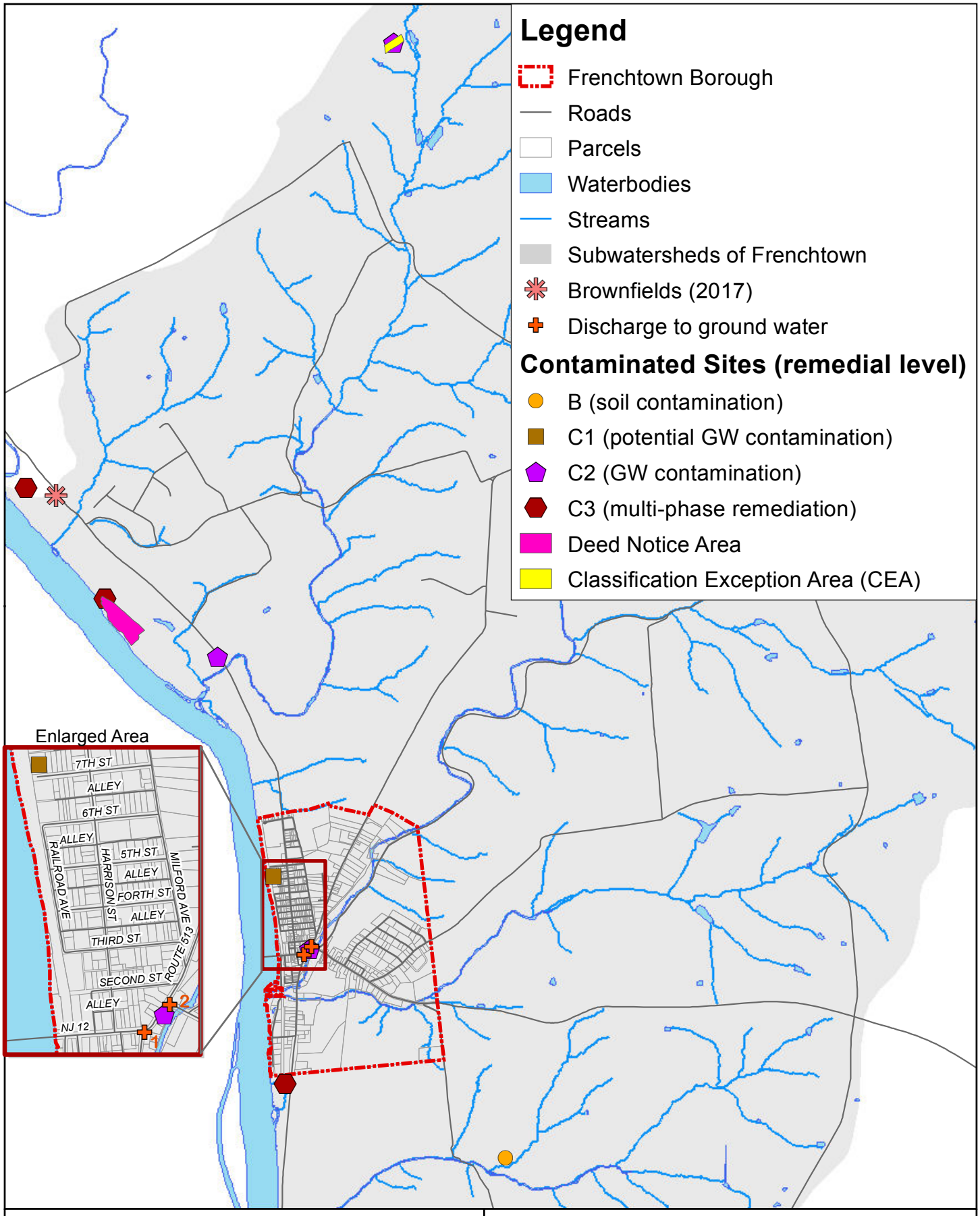
National Priorities List

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 SRP, January 31, 2013).

There are no superfund Sites within Frenchtown, but there is one just south and another just north of the borough. The DeRewel Chemical Company site on Route 29 (River Rd) in Kingwood (on Frenchtown's southern boundary) was added to the federal (USEPA) NPL list in 1995. The Curtis Papers site on Frenchtown Road in Milford (approximately 2.2 miles north of Frenchtown) was added in 2008. The Crown Vantage Landfill, on Milford Frenchtown Road in Alexandria (approximately 1.5 miles north of Frenchtown), was formerly on the federal (USEPA) NPL list, but has subsequently been removed (NJDEP SRP, April 27, 2017).

Remediated Sites

A current Data Miner search revealed that 14 contaminated sites within Frenchtown have been remediated (7 homeowner and 7 non-homeowner) (NJDEP SRP, September 3, 2017). These cases are closed and are not listed in **Table 5.6.**



Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 5f: Borough of Frenchtown Discharges and Contaminated Sites

Brownfields

The New Jersey Department of Community Affairs (DCA) Office of Smart Growth defines *brownfields* as any former or current commercial or industrial site, currently vacant or underutilized, on which there has been, or there is suspected to have been, a discharge of a contaminant. The purpose of the Brownfields and Contaminated Site Remediation Act (N.J.A.C. 58:10) is to develop strict remediation standards in order to protect public health and safety and the environment. In order to encourage clean-up of contaminated sites, NJDEP provides financial incentives, liability protection, cleanup procedures that are cost effective and regulatory action that is timely and efficient (NJDEP Site Remediation Program, July 11, 2013; NJDEP, January 31, 2017).

The Brownfields SiteMart was developed to highlight and denote locations of brownfield sites in order to promote the redevelopment of brownfields throughout the State. There are currently no brownfield sites in the borough of Frenchtown. There is one brownfield nearby at the Curtis Paper Mill, about 2 miles north of Frenchtown (NJDEP, January 31, 2017).

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Brownfields SiteMart Search: http://www.njbrownfieldsproperties.com/Search.aspx

Drinking Water
Ground Water and Drinking Water (US EPA): https://www.epa.gov/ground-water-and-drinking-water

Lead in Drinking Water: http://www.nj.gov/dep/watersupply/dwc-lead.html

NJ American Water - Frenchtown
NJ Drinking Water Watch: https://www9.state.nj.us/DEP_WaterWatch_public/JSP/WSDetail.jsp?tinwsys=417
Your Utility and Its Water Quality: http://www.nj.gov/dep/watersupply/dwc_systems.html

NJDEP Private Well Testing Act: http://www.nj.gov/dep/watersupply/pw_pwta.html

Story Map: NJ Private Well Testing Act Data Summary (Sep. 2002 to Apr. 2014)
http://njdep.maps.arcgis.com/apps/MapSeries/index.html?appid=826ec9fae77543caa582a787d5f088e7

Drought and Ground Water Level
NJDEP Drought Information: www.njdrought.org

USGS New Jersey Real-Time Groundwater Level Network
NJ: https://groundwaterwatch.usgs.gov/NetMapT1L2.asp?ncd=rtn&sc=34
Corsalo Rd 1 Obs (West Amwell): https://groundwaterwatch.usgs.gov/AWLSites.asp?S=402151074525301
Readington 11 Obs (Readington): https://groundwaterwatch.usgs.gov/AWLSites.asp?mt=g&S=403517074452501&ncd=awl
Environmental Ctr 1 Obs (Clinton): https://groundwaterwatch.usgs.gov/AWLSites.asp?ncd=njn&S=403455074514801

Ground Water Quality
NJDEP Ground Water Monitoring: http://www.state.nj.us/dep/wmm/bfbm/groundwater.html

Comparative Risk Project: http://www.state.nj.us/dep/dsr/njcrp/

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

Radioactivity in Ground Water
NJDEP: North Jersey Homeowner's Guide to Radioactivity in Drinking Water:
http://www.state.nj.us/dep/rpp/rms/agreedown/urwater.pdf
US EPA: Basic Information about the Radionuclides Rule.
http://water.epa.gov/lawsregs/rulesregs/sdwa/radionuclides/basicinformation.cfm

Septic Systems
Well and Septic System Care in Hunterdon County: http://www.co.hunterdon.nj.us/pdf/health/Well_and_Septic.pdf

Other
NJDEP Data Miner: https://www13.state.nj.us/DataMiner

NJDEP Laws & Rules: http://www.nj.gov/dep/landuse/lawsregs.html
- NJDEP Rules & Regulations (current & proposed): http://www.nj.gov/dep/rules/
- Site Remediation Reform Act, N.J.S.A. 58:10C.: http://www.nj.gov/dep/srp/regs/statutes/srra.pdf
- Brownfield & Contaminated Sites Act, N.J.S.A. 58:10B: http://www.nj.gov/dep/srp/regs/statutes/bcsra.pdf
- Spill Compensation and Control Act: http://www.nj.gov/dep/srp/regs/statutes/spill_act.pdf
- Industrial Site Recovery Act: http://www.nj.gov/dep/srp/regs/statutes/isra.pdf
- Underground Storage Tanks: http://www.nj.gov/dep/rules/rules/njac7_14b.pdf
- Ground Water Quality Standards: http://www.nj.gov/dep/rules/rules/njac7_9c.pdf

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

Underground Storage Tank (NJDEP): http://www.nj.gov/dep/srp/bust/

USEPA – Region 2: http://www.epa.gov/region02/water/

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

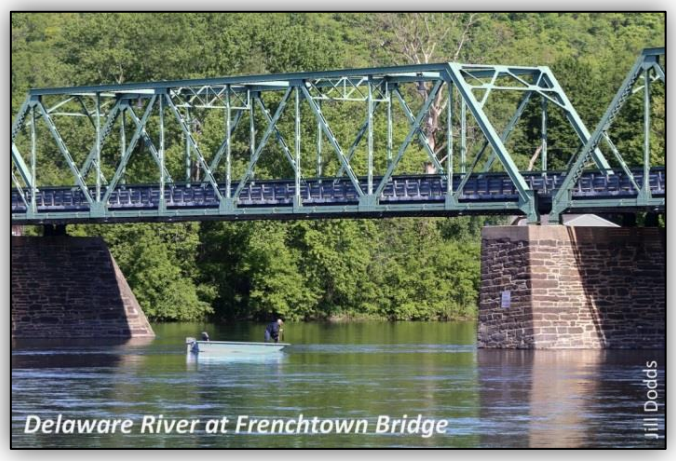
USGS - Water Resources of NJ: http://nj.usgs.gov/

6: SURFACE WATER

A. Watersheds

Watersheds

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. The Borough of Frenchtown is within the Delaware River watershed (see top left inset in **Figure 6a**). This watershed covers 13,539 square miles, draining parts of Pennsylvania, New Jersey, New York and Delaware (DRBC, 2017).



The Delaware River watershed is made up of smaller watersheds, including the Musconetcong and Pequest Rivers. Sub-watersheds are those smaller drainage areas that make up a larger watershed, including the Nishisakawick and Little Nishisakawick (see bottom right inset of **Figure 6a** and **Figure 6b)**.

Watershed Management Areas

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, January 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 10D**. NJDEP has divided the state's watersheds into 20 *Watershed Management Areas (WMAs)*. The Delaware River basin is divided into three WMAs in New Jersey. Frenchtown falls within *WMA 11: Central Delaware* (see top right inset in **Figure 6a**).

> "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." (NJDEP NJAC 7:9B, October 17, 2016).

Hydrologic Unit Codes (HUC)

The classification system used by the NJDEP assigns each sub-watershed a *14-digit Hydrologic Unit Code (HUC14[28])*. The HUC14 is a hierarchical system where the first 2 digits refer to the USGS Water Resources Region and the first 4 digits (also known as a HUC4) refer to the major drainage basin, or sub-region. Therefore, a HUC2 of "02" is in the Mid-Atlantic

[28] The HUC14s have a minimum size of 3,000 acres, although some basins are defined with smaller areas. At other times, small subwatershed units are combined. Note, however, that the HUC12 numbers are not consistent with this system.

Region, and a HUC4 of "0204" is in the Delaware-Mid Atlantic Coastal major drainage basin (USGS, June 23, 2017).

The middle Delaware River basin ("Middle Delaware-Musconetcong") is assigned a HUC8 of "02040105," and every sub-watershed within this basin has a HUC that starts with "02040105." Fourteen digit hydrologic unit codes (HUC14) sub-watersheds and streams either within and surrounding the Borough of Frenchtown are shown in **Table 6.1** and **Figure 6a**.

Table 6.1: Hydrologic Unit Codes for Frenchtown's Sub-watersheds

HUC4	HUC8	14-Digit Hydrologic Unit Code (HUC14)	Sub-watershed Name
0204	02040105	02040105170030	Harihokake Creek (and to Hakihokake Ck)
0204	02040105	02040105170040	Nishisakawick Creek (above 40d 33m)
0204	02040105	02040105170050	Nishisakawick Creek (below 40d 33m)
0204	02040105	02040105170060	Kingwood Twp(Warford-Little Nishisakawk)
Source: NJDEP NJGS, February 25, 2011			

B. Floodplains & Floods

Floodplains

A *floodplain* is the land along a river or stream that is subject to periodic flooding when the river or stream overflows its banks. As required by the Flood Disaster Protection Act of 1973, the Federal Emergency Management Administration (FEMA) is responsible for delineating floodplains.

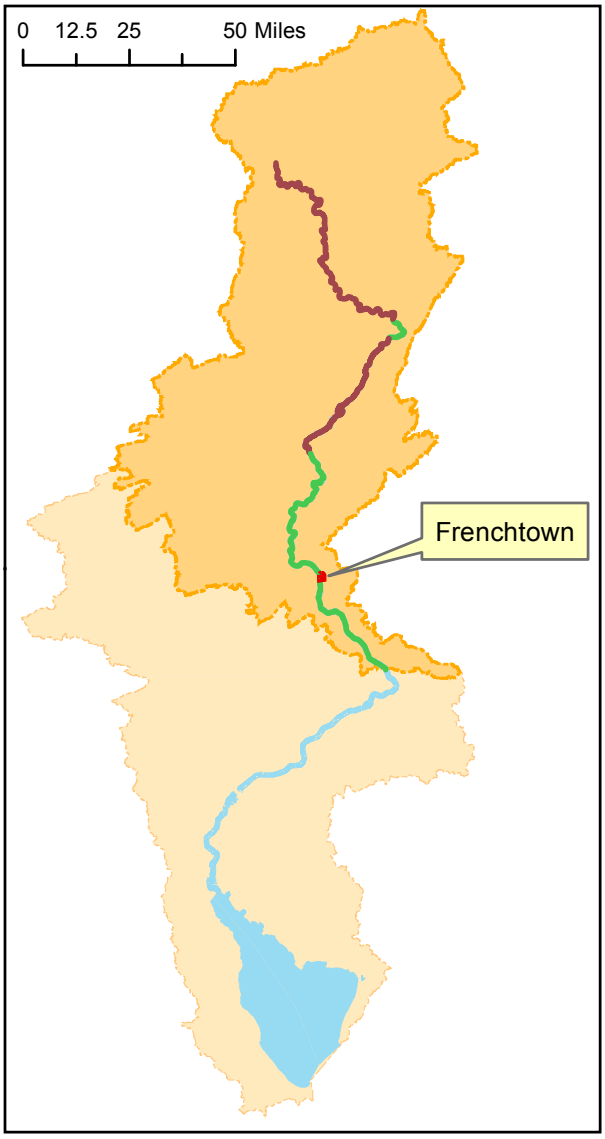
According to FEMA, "Everyone lives in some type of flood zone." (FEMA, June 21, 2007) FEMA defines these geographic areas based on studies of flood risk.

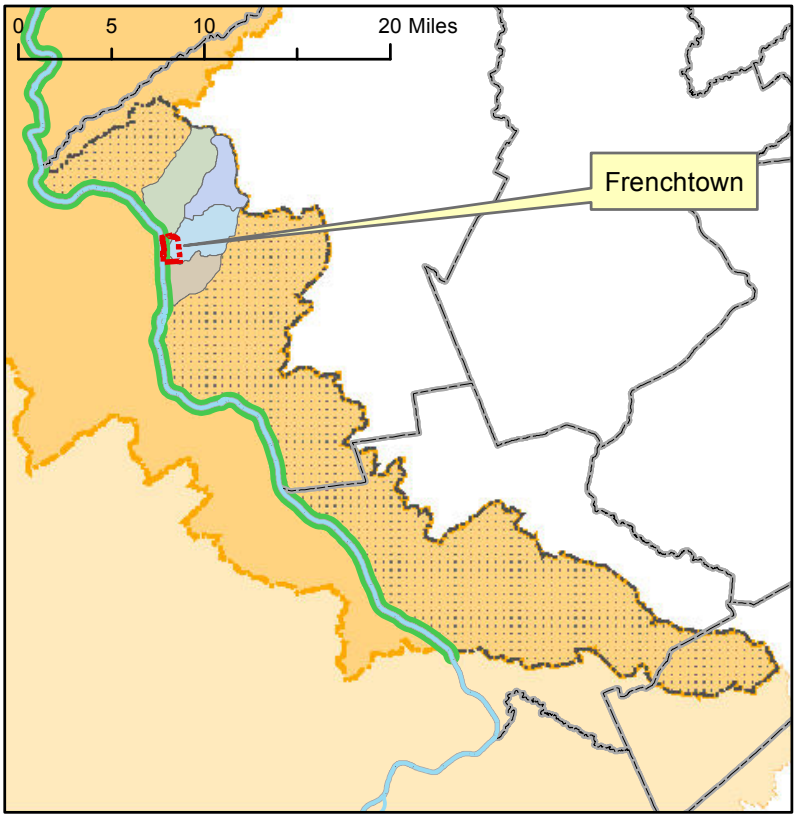
FEMA provides accurate flood hazard and risk data to states and communities to guide mitigation actions. The National Flood Insurance Program (NFIP) is the basis of the NFIP regulations and flood insurance requirements. Flood hazard mapping is an important part of the NFIP. FEMA uses the best available technical data, such as statistical information on river flows, to create the *Flood Insurance Rate Maps* (FIRMs) that show the flood zone boundaries (FEMA, June 29, 2017).

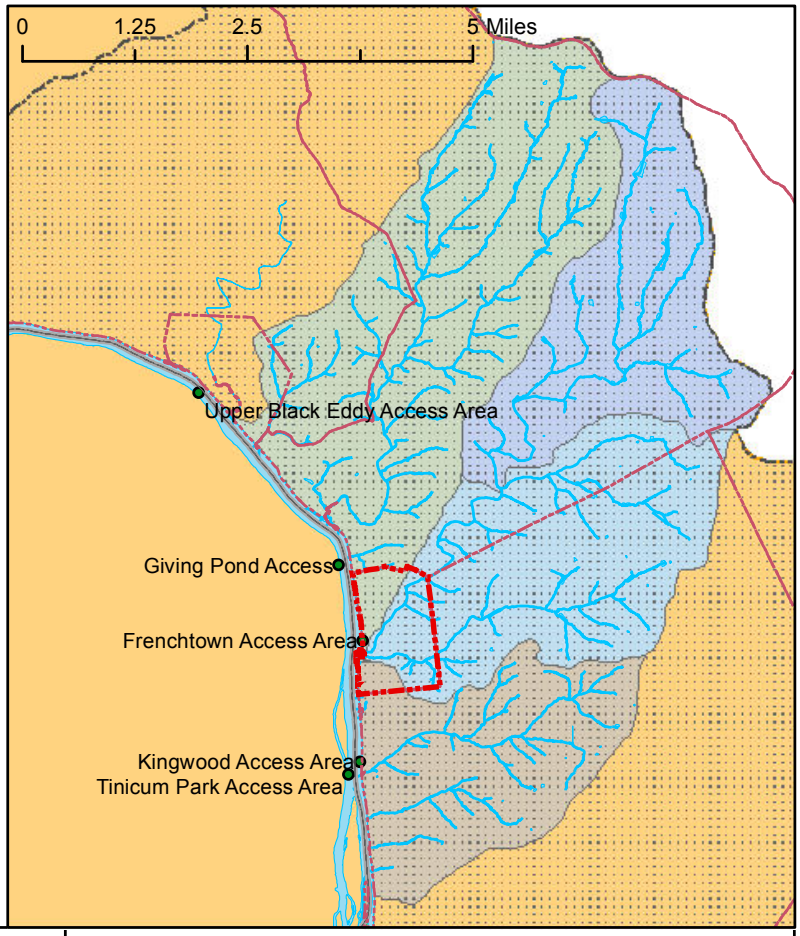
The flood zone boundaries shown in **Figure 6c** are produced by FEMA.

Special Flood Hazard Areas (SFHAs) are defined as areas subject to inundation by a flood having, on average, about 1 in 100 chance in any given year, also referred to as the 1% annual chance flood[29] (FEMA, March 7, 2017). Below are brief definitions of the FEMA flood zones that occur within Frenchtown.

[29] Flood designations are based on statistical averages, not the number of years between big floods. The term "100-year flood" does not mean a flood that happens once every 100 years. It is a statistical designation that there is a 1 in 100 chance that a flood of any given size will be equaled or exceeded during any year. Changes and variability in climate and land use over time can change flood frequency (Dinicola, 2005).







Legend

- Frenchtown Borough
- Municipalities
- New Jersey
- River Access
- Counties
- Water
- Watershed Management Area 11

Subwatershed (HUC14)

- Harihokake Creek (and to Hakihokake Ck)
- Nishisakawick Creek (above 40d 33m)
- Nishisakawick Creek (below 40d 33m)
- Kingwood Twp(Warford-Little Nishisakawk)

Special Protection Waters

- Outstanding Basin Waters
- Significant Resource Waters
- Watershed of Special Protection Waters
- Delaware River Basin (watershed)

N

Data Sources: NJDEP, DRBC
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 6a: Borough of Frenchtown Watershed

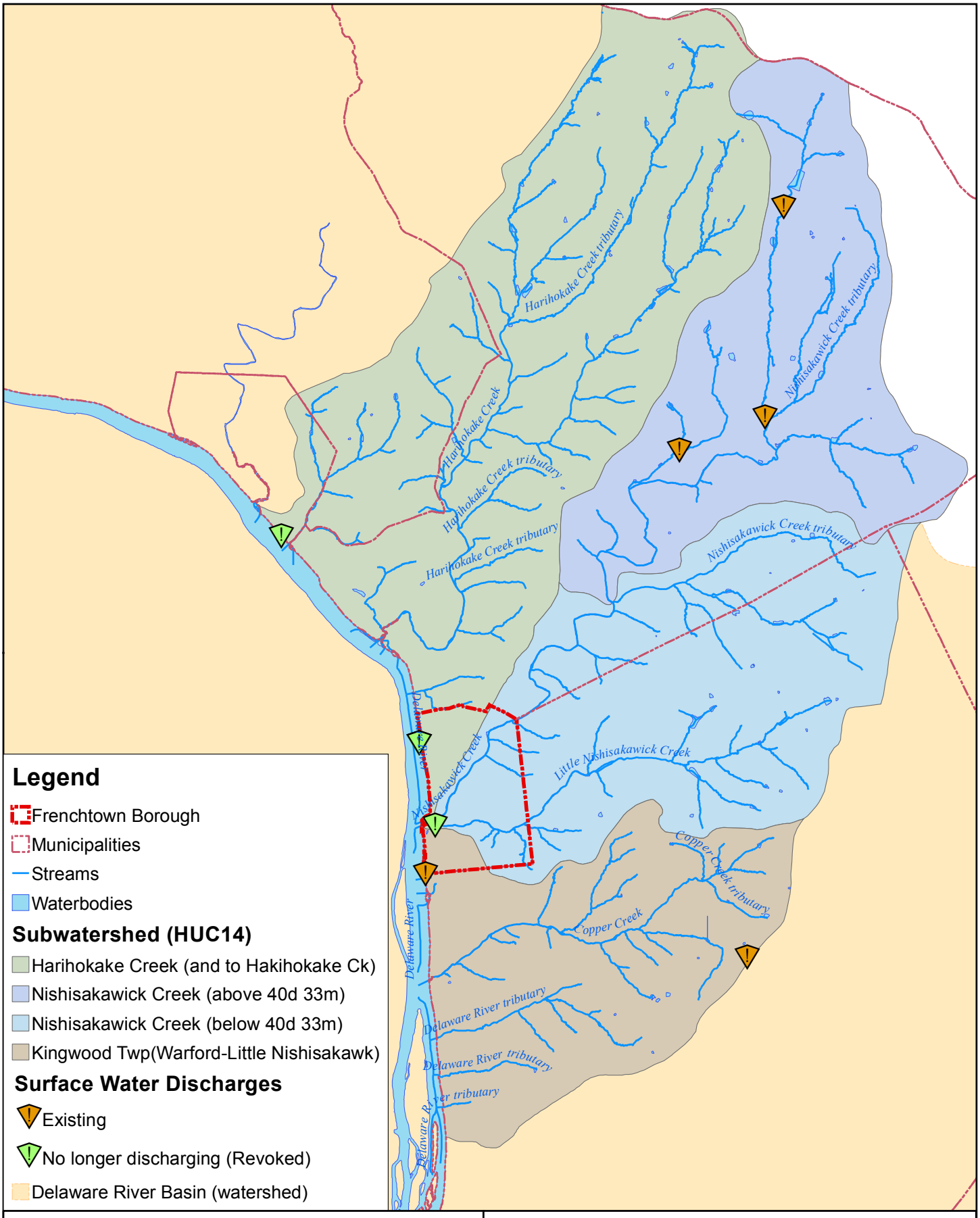


Figure 6b: Borough of Frenchtown Subwatersheds and NJPDES

Frenchtown ERI 2018 Kratzer Environmental Services

Zones with a high-risk of flooding, or SFHAs, include *Zone A* and *Zone AE*. *Zone A* corresponds to the 1% annual chance floodplains that are determined by approximate methods of analysis (i.e., not with Base Flood Elevations). *Zone AE* corresponds to the 1% annual chance floodplains that are determined by detailed methods of analysis, which includes detailed hydraulic analyses to determine Base Flood Elevations. In communities such as Frenchtown that participate in the NFIP, all homeowners in Zones A and AE are required to get flood insurance in order to get a loan from a federally regulated lender (FEMA, March 7, 2017; FEMA, August 6, 2017).

Areas in *Zone X*, which includes the majority of Frenchtown, have low to moderate risk of flooding and are not in the SFHAs. They correspond to areas outside the 1% annual chance floodplain, areas of 1% annual chance sheet flow[30] flooding where average depths are less than 1 foot, areas of 1% annual chance stream flooding or where the contributing drainage area is less than 1 square mile. No Base Flood Elevations or depths are shown within this zone. Areas with a 0.2% annual chance of flooding (typically referred to as the 500 year flood) are not considered high risk. The zone includes areas of little hazard, such as those with average depths of less than 1 foot and minimal hazard, such as ponding and local drainage problems. Insurance purchase is not required in this zone (FEMA, March 7, 2017).

Flood Facts

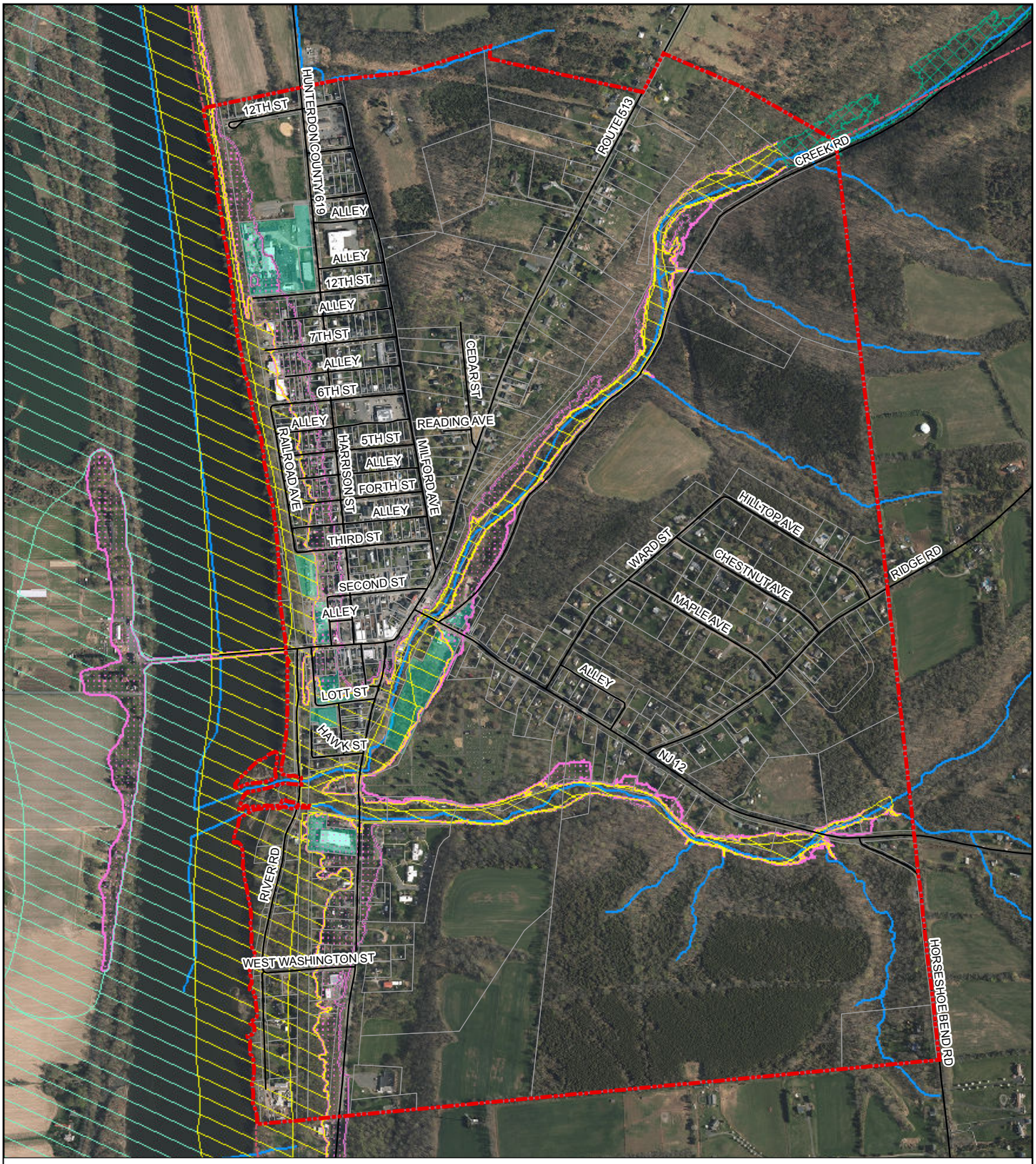
- Floods and flash floods happen in all 50 states.
- Hurricanes, winter storms and snowmelt are common (but often overlooked) causes of flooding.
- New land development can increase flood risk, especially if the construction changes natural runoff paths.
- Federal disaster assistance is usually a loan that must be paid back with interest.
- If you live in a Special Flood Hazard Area (SFHA) or high-risk area and have a Federally backed mortgage, your mortgage lender requires you to have flood insurance
- 20 to 25% of all flood claims are filed in low to moderate flood risk areas.

(FEMA, July 25, 2017; FEMA, June 21, 2007)

Floodplains in Frenchtown are shown in **Figure 6c**, based on FEMA determinations (FEMA, January 11, 2017). Frequent flooding occurs in areas adjacent to the Delaware River, where the 1% annual chance floodplain extends roughly 100 feet from the river's edge north of 12th Street; about 200 to 400 feet from 12th Street to near Lott Street; widens to as much as 900 feet in the vicinity of the mouths of the Nishisakawick and Little Nishisakawick Creek; and narrows somewhat to roughly 500 feet from to Frenchtown's southern boundary. Due to the flatter topography across the river in Pennsylvania, the floodplain extends approximately 2,000 feet from the river's banks on the Pennsylvania side. The floodplain of Nishisakawick Creek extends upstream about 1.1 miles from its confluence with the Delaware River and is approximately 400 feet wide between the river and Route 12 and about 200 feet wide north of Route 12. The floodplain of Little Nishisakawick Creek extends upstream about 0.9 miles from the confluence and is approximately 100 to 200 feet wide.

Floodplain management is the operation of a community program of corrective and preventative measures for reducing flood damage. Community involvement is an important element in making flood insurance available to home and business owners. These measures may include zoning, subdivision, or building requirements, and special-purpose floodplain ordinances. Riparian buffer and wetlands protection regulations and ordinances can also reduce flood damage by protecting those areas most susceptible to flooding and providing natural flood control. These efforts benefit downstream areas, as well. Delaware River flow and flood forecast gages at Frenchtown are shown in **Table 6.2**. Past floods are covered in **Section 2.**

[30] Sheet flow, or overland flow, is flow that occurs overland in places where there are no defined channels, so the flood water spreads out over a large area at a uniform depth.



Legend

- Frenchtown Borough
- Municipalities
- Roads
- Streams
- Parcels
- Redevelopment Zone

Flood Zone

- AE (base elevations determined)
- A (base elevations not determined)
- X (0.2 % annual chance flood hazard)
- X (area of minimal flood hazard)

0 0.25 0.5 Miles

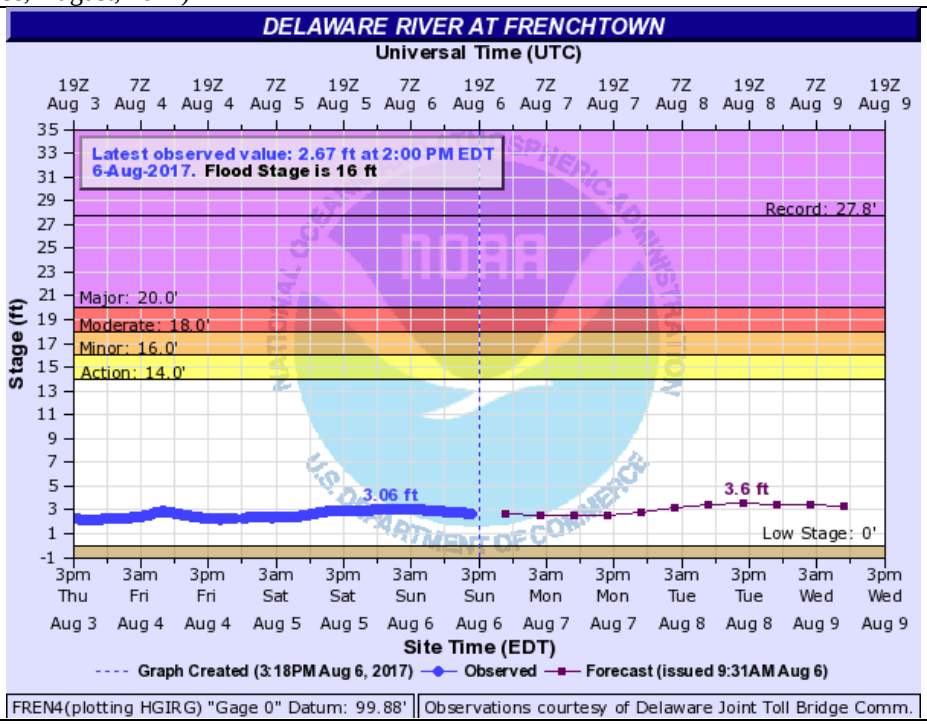
N

Data Sources: NJDEP, NJDOT, FEMA
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

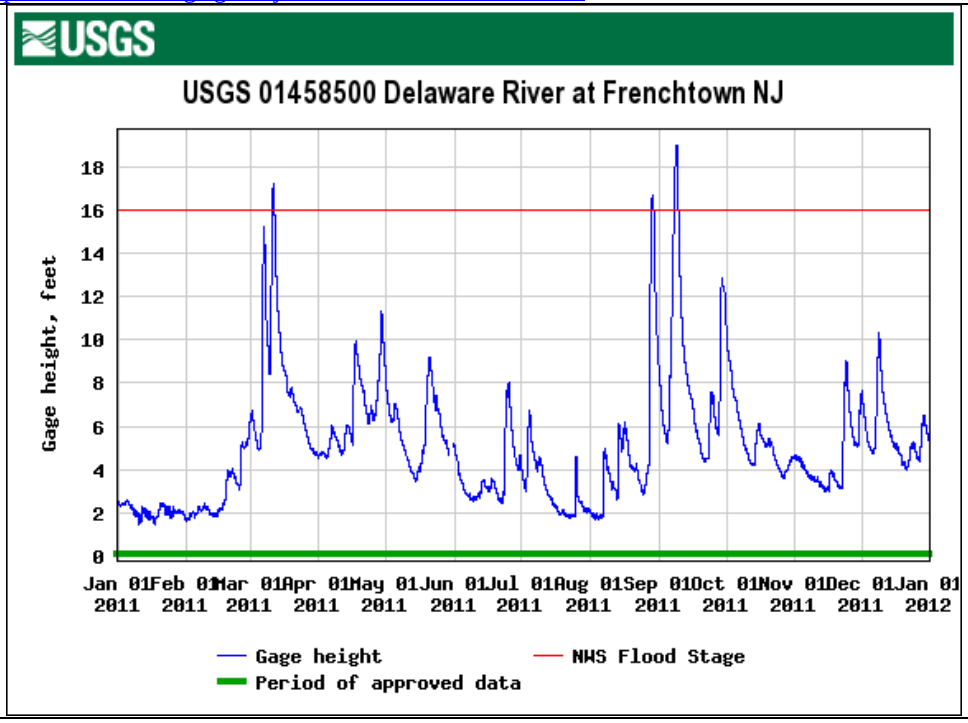
Figure 6c: Borough of Frenchtown FEMA's National Flood Hazard Areas

Table 6.2: Delaware River Flood and Flow Resources

National Weather Service Advanced (NOAA) Hydrologic Prediction Service (flood predictions)
Delaware River at Frenchtown. http://water.weather.gov/ahps2/hydrograph.php?wfo=phi&gage=fren4 (National Weather Service, August, 2017)



USGS National Water Information System Data
By default, the site displays the most recent flow information. In this example, the Delaware River flow for the year 2011 is shown to illustrate the three floods (over 16 feet gage height) that occurred that year.
Website: https://waterdata.usgs.gov/nj/nwis/uv?site_no=01458500



Frenchtown has a Flood Damage Prevention ordinance (Chapter XXIII Flood Damage Prevention of the Borough Code).

Delaware River floods are covered in **Section 2**.

C. Wetlands

A *wetland* is a transitional area between aquatic and terrestrial ecosystems. Wetlands are those areas that are inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation. To determine if an area is a wetland, the vegetation (plants that like wet conditions), soils (wetland types, which often show mottling) and hydrology (low spots or evidence of water) are evaluated[31]. A *transition area*, or buffer, is an area of land adjacent to a freshwater wetland that minimizes adverse impacts on the wetland or serves as an integral component of the wetlands ecosystem (N.J.S.A. 13:9B-3 in NJDEP Division of Land Use Management, June 20, 2016).

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

- Wetlands protect drinking water by filtering out pollutants and sediments that would otherwise obstruct and contaminate our waters.
- Wetlands soak up runoff from heavy rains and snow melts, providing natural flood control.
- Wetlands release stored waters during droughts.
- Wetlands provide critical habitats for a major proportion of the state's fish and wildlife, including many endangered, commercial and recreational species.
- Wetlands provide high quality open space for recreation and tourism (NJDEP Land Use Regulation, February 19, 2016 and June 20, 2016).

The value of wetlands was not broadly accepted until at least the 1970s and 1980s. By then, more than half of the country's wetlands had been destroyed (NJDEP Land Use Regulation, February 19, 2016). Loss of wetlands has resulted in erosion, flooding, sedimentation, and decreased populations of many types of wildlife. Structures built in wetlands suffer from frost heaving and other structural problems.

New Jersey protects wetlands under the 1987 New Jersey Freshwater Wetlands Protection Act (N.J.S.A. 13:9B) and Rules (N.J.A.C. 7:7A) (NJDEP Division of Land Use Management, June 20, 2016 and July 17, 2017)[32]. Under these, NJDEP regulates virtually all activities proposed within wetlands and transition areas or buffers around freshwater wetlands,

[31] The statute specifies the 3-parameter approach (i.e. hydrology, soils and vegetation) enumerated in the April 1, 1987 interim-final draft "Wetland Identification and Delineation Manual" developed by the United States Environmental Protection Agency, and any subsequent amendments thereto.

[32] At the time of this writing, a revision of the wetlands rule is pending adoption (NJDEP, 2017).

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 that would impair the wetland's ability to provide the values listed above (filtration, flood control, etc.) is prohibited. There are limited exemptions for existing farming, ranching, or forestry operations.

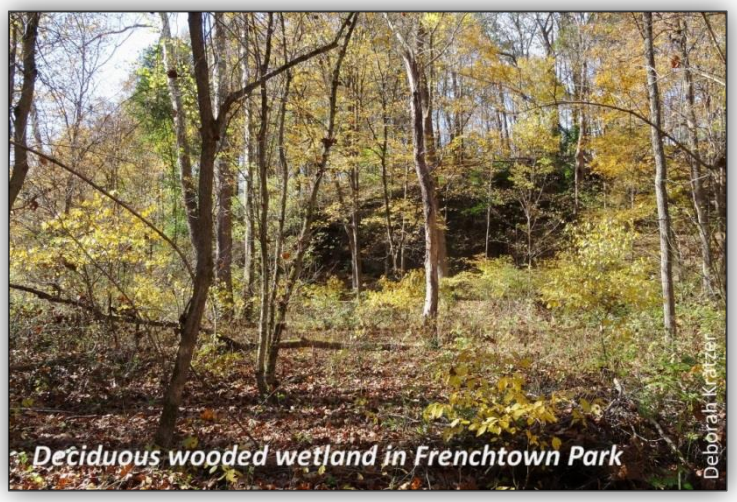
On-site inspection (direct testing and observation of soils, hydrology and vegetation) by a qualified professional is needed prior to making any disturbance within a wetland or transition area. Only an official determination from NJDEP, called a *Letter of Interpretation* (LOI) can verify the presence, absence, or boundaries of freshwater wetlands and transition areas on a site. Copies of these maps are filed at the NJDEP and the township building, but unfortunately, NJDEP does not digitize these determinations into a GIS layer[33].

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

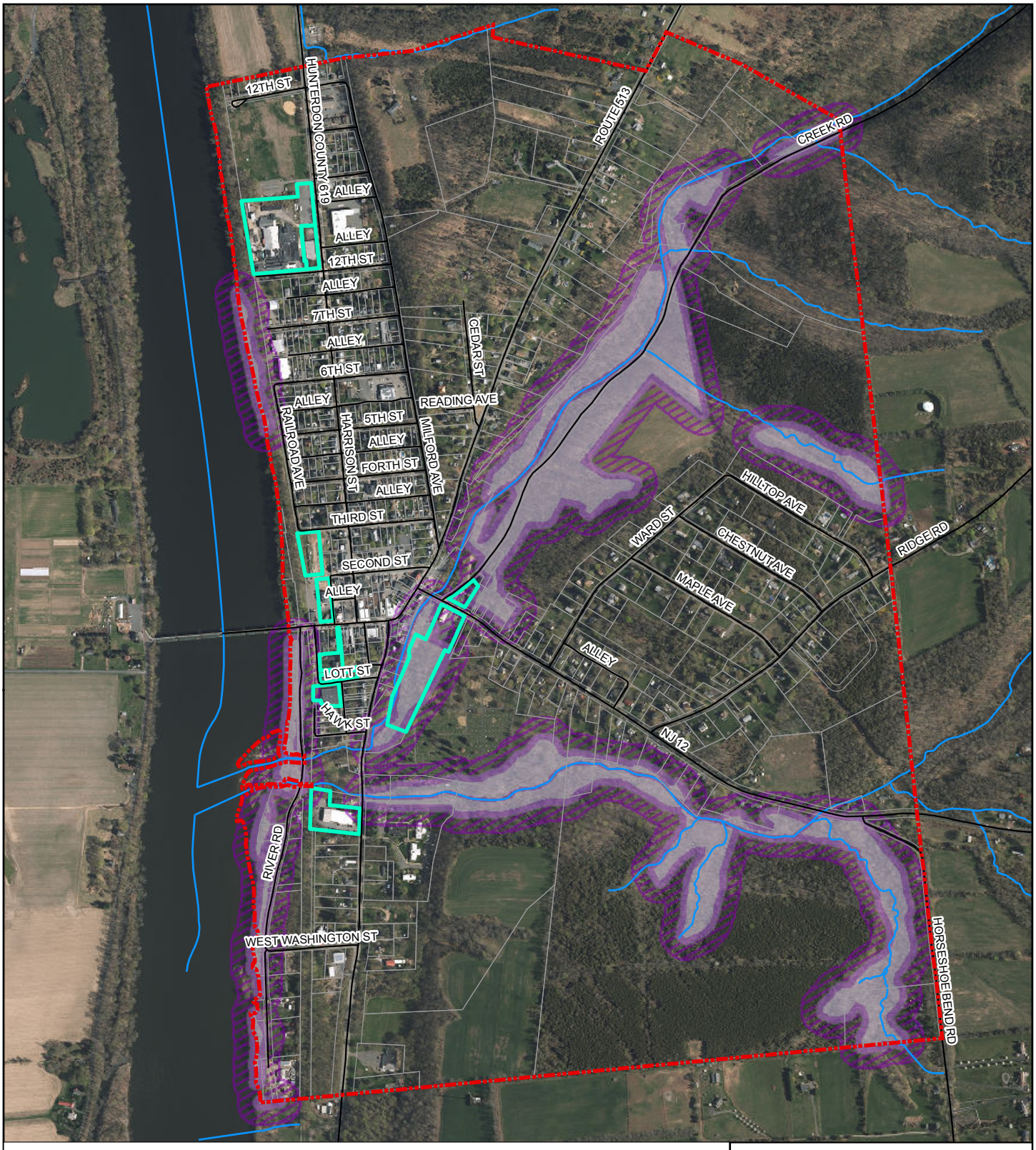
The wetlands shown in **Figure 6d** were determined by selecting all wetlands land use types from NJDEP's 2012 Land Use GIS data. **Figure 6d** provides guidance on where wetlands are found in Frenchtown. This dataset is intended to serve as a resource for analysis rather than regulatory delineations because it is derived from aerial photos rather than on-site surveys. The maximum transition area width of 150 feet is illustrated on the map in **Figure 6d**, because the GIS data does not determine the value of each wetland. The actual transition area width required by the NJDEP is determined in the LOI.

There are approximately 58 acres of wetlands within Frenchtown, or 7% of the borough (NJDEP, February 17, 2015).

There are several types of freshwater wetlands in Frenchtown, such as deciduous wooded wetlands, deciduous scrub/shrub wetlands, and agricultural wetlands (see **Section 7A** and **Figure 7c**).



[33] Digitizing involves georeferencing the information by establishing the relationship between coordinates (latitude and longitude) on a map or image with the specific real world coordinates.



Legend

- Frenchtown Borough
- Roads
- Redevelopment Zone
- Parcels
- Streams
- Wetlands (2012 Land Use)
- 50 foot buffer applies to some wetlands
- 150 foot buffer applies to some wetlands

Note: 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 (buffers).

0 0.25 0.5 Miles

N

Data Sources: NJDEP, NJDOT, FEMA
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 6d: Borough of Frenchtown Wetlands

D. Surface Water Quality Standards

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

According to the Surface Water Quality Standards N.J.A.C. 7:9B,

> "Water is vital to life and comprises an invaluable natural resource which is not to be abused by any segment of the State's population or economy. It is the policy of the State to restore, maintain and enhance the chemical, physical and biological integrity of its waters, to protect the public health, to safeguard the aquatic biota, protect scenic and ecological values, and to enhance the domestic, municipal, recreational, industrial, agricultural and other reasonable uses of the State's waters.
>
> "The restoration, maintenance and preservation of the quality of the waters of the State for the protection and preservation of public water supplies is a paramount interest of the citizens of New Jersey.... Toxic substances in waters of the State shall not be at levels that are toxic to humans or the aquatic biota, or that bioaccumulate in the aquatic biota so as to render them unfit for human consumption.... Human health-based ambient criteria have been established in freshwaters due to consumption of fish and water, and in saline water due to consumption of fish. For carcinogens, the criteria have been established at levels which would result in no greater than a one-in-one-million lifetime excess cancer risk. For non-carcinogens, the criteria have been established which would result in no appreciable risk of deleterious effect."
>
> (NJDEP, Re-adopted: October 17, 2016).

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

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

Table 6.3 describes the definitions of the surface water classifications. In **Figure 6e**, "category" is shown, which is a compendium of all surface water classification designations for a given water body. Category describes a stream's surface water classification in terms of its general surface water class (e.g. FW2), its trout water status (e.g. TP) and its antidegradation status (e.g. C1). The surface waters within Frenchtown are categorized as follows (as defined by N.J.A.C. 7:9B(f)(NJDEP, October 17, 2016)):

- **FW2-NT(C1):**
  - Nishisakawick Creek
  - Nishisakawick Creek UNT (unnamed tributaries)
  - Little Nishisakawick Creek
  - Little Nishisakawick Creek UNT (unnamed tributaries)
- **FW2-NT:**
  - Delaware River UNT (unnamed tributary joining the Delaware River approximate 800 feet upstream of Frenchtown's boundary)

The *Category One (C1)* antidegradation designation provides streams with additional protections that help prevent water quality degradation and discourage development where it would impair or destroy natural resources and water quality. Waterways can be designated C1 because of exceptional ecological significance, exceptional water supply significance, exceptional recreational significance, exceptional shellfish resource, or exceptional fisheries resource Surface Water Quality Standards & riparian buffer ((NJDEP Water Monitoring and Standards, June 15, 2017).

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 Stormwater Management rules (N.J.A.C. 7:8) and the Flood Hazard Area Control Act rules (N.J.A.C. 7:13), for certain activities proposed adjacent to waters designated as C1, 300 foot buffers must be maintained in a natural state adjacent to all C1 waters and upstream tributaries of C1 waters (including named and unnamed tributaries), unless the disturbance is less than one acre and new impervious surface is less than 0.25 acres. However, where the buffer is already disturbed, the width may be reduced in the disturbed area, but will not be permitted to extend less than 150 feet from either bank. The buffer will not affect existing development. The buffer requirement can also be adjusted to reflect local conditions through the approval of a stream corridor protection plan as part of a regional stormwater management plan (NJDEP Water Monitoring and Standards, June 15, 2017).

Table 6.3: Surface Water Quality Standards Classification

Category	Definition
Freshwater General Surface Water Class	
FW1	**FW1** means those fresh waters, as designated in N.J.A.C. 7:9B-1.15(j), 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).
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 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.
Trout Water Status - this is for information only and does not affect the water quality criteria for those waters.	
TP	***Trout production*** means waters designated at N.J.A.C. 7:9B-1.15I through (i) for use by trout for spawning or nursery purposes during their first summer.

Table 6.3: Surface Water Quality Standards Classification

Category	Definition
TM	***Trout maintenance*** means waters designated at N.J.A.C. 7:9B-1.15I through (i) 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-1.15I through (h) as trout production or trout maintenance. These waters are generally not suitable for trout because of their physical, chemical, or biological characteristics, but are suitable for a wide variety of other fish species.
Antidegradation	
ONRW	***Outstanding National Resource Waters*** means 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 significance). Waters classified as FW1 waters and Pinelands waters are Outstanding National Resource Waters.
FW1/Non-degrada-tion	***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.
C1	***Category one waters*** means those waters designated in the tables in N.J.A.C. 7:9B-1.15(c) through (i), 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 based on exceptional ecological significance, exceptional recreational significance, exceptional water supply significance or exceptional fisheries resource(s) to protect their aesthetic value (color, clarity, scenic setting) and ecological integrity (habitat, water quality and biological functions).
C2	***Category two waters*** means 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).
Source: NJDEP, October 17, 2016	

Most of the state's Category One waters were designated in 1985 amendments to the SWQS, however no specific basis for these upgrades was documented. C1 upgrades after that were documented, based on their value as trout production (FW2-TP) waters or exceptional ecological significance or exceptional water supply significance. NJDEP proposed upgrading both the Nishisakawick and Little Nishisakawick Creeks to C1 in November 2003 based on exceptional ecological significance and adopted the rule changes on July 10, 2004.

Little Nishisakawick Creek

In 2014, the Little Nishisakawick Creek was upgraded to C1 antidegradation designation for its entire length based on exceptional ecological significance (NJDEP, November 2003; NJDEP, July 10, 2004).

The long-tailed salamander is a state threatened species found in the Nishisakawick and Little Nishisakawick Creeks

The state threatened long-tailed salamander (*Eurycea longicauda*) is found in the Little Nishisakawick Creek. The subwatersheds of the Little Nishisakawick, Nishisakawick and Wickecheoke Creeks (the latter is south of Frenchtown in neighboring Kingwood and Delaware Townships) contain the second largest concentration of this species' populations in the state, next to the limestone regions of Warren and Sussex counties. Long-tailed salamanders are primarily associated with cool, clear forested, rock streams. In addition, Little Nishisakawick Creek supports a non-impaired benthic macroinvertebrate community with

suboptimal habitat quality (see **Table 6.9**) and a good Fish IBI rating (see **Table 6.10**). Data on the health of the stream indicate that the Little Nishisakawick Creek is a stream of exceptional ecological significance (NJDEP, November 2003).

Nishisakawick Creek

In 2004, NJDEP upgraded the classification for the entire length of the Nishisakawick Creek to a C1 antidegradation designation based on exceptional ecological significance (NJDEP, November 2003; NJDEP, July 10, 2004).

Like the Little Nishisakawick Creek, the Nishisakawick supports a population of state threatened long-tailed salamanders. The state threated wood turtle *(Glyptemys insculpta)* has also been sighted in the Nishisakawick, primarily in the upper portions of the drainage.

NJDEP assessed the physical and chemical water quality monitoring data and determined that the water quality of the Nishisakawick Creek met standards except for fecal coliform. The benthic macroinvertebrate community data showed a high percentage and good diversity of pollution intolerant organisms in Nishisakawick Creek, indicating low stress (non-impaired) to the aquatic community. The in-stream habitat quality assessment indicated an exceptional (optimal) habitat quality (see **Table 6.9**) and the creek had a good Fish IBI rating with 12 different species identified in the stream and an optimal habitat assessment rating (see **Table 6.10**).

Data on the health of the stream indicated that the Nishisakawick Creek is a stream of exceptional ecological significance. This supported the change in surface water quality standards of the entire length of the Nishisakawick Creek including all named and unnamed tributaries from Category Two to Category One **(**NJDEP, Water Monitoring and Standards, November 3, 2003).

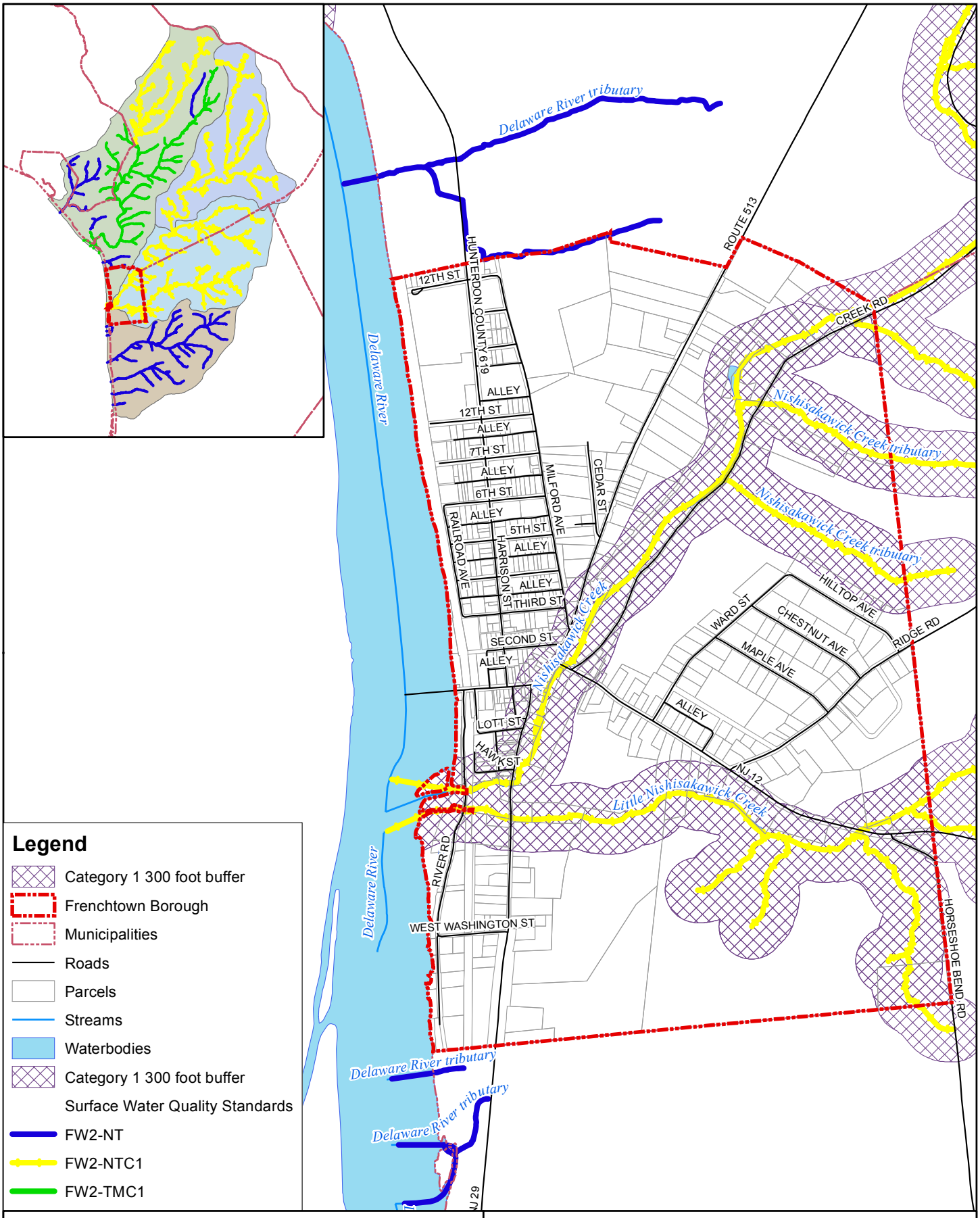
E. Integrated List and Total Maximum Daily Loads

States are required by the Federal Clean Water Act (US Federal Water Pollution Control Act, January 4, 2011) to develop a biennial Water Quality Inventory Report (required under Section 305(b) of the act) and a List of Water Quality Limited Segments (required under Section 303(d)). Since 2001, the USEPA has recommended that states integrate these two, producing the *Integrated List.* The goal is to provide an effective tool for maintaining high quality waters where designated uses (designated by the SWQS, discussed above in **Section 6D**) are attained, and improving the quality of surface waters that do not attain their designated uses (NJDEP BEARS, May 2017a).

The Integrated List is subject to regulatory requirements, which include public participation and submission to the USEPA for approval and adoption. The Integrated List identifies the status of all applicable designated uses for every assessment unit (usually by HUC14[34] sub-watershed) by labeling the results of each designated use assessment as *Fully Supporting*, *Not Supporting*, or *Insufficient Information* (see **Table 6.4**)

The NJDEP is required to use all existing and readily available data to assess water quality for the Integrated List. As a result, assessment of the HUC14s that encompass Frenchtown may include upstream sites (see **Section 6H** for site information). A methods document summarizes each step in the assessment process; to evaluate stations and data quality, combine stations to evaluate an assessment unit, assess designated uses, rank and prioritize assessment units that do not attain designated uses, develop a monitoring and assessment plan and provide for public participation (NJDEP Water Monitoring and Standards, February 2015).

[34] HUC14 = 14-digit Hydrologic Unit Code (see **Section 6a** for definition)



Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 6e: Borough of Frenchtown Surface Water Quality Standards

The results of the 2014 (draft) Integrated List (the most recent assessment available at the time of this writing), which summarizes whether or not the surface water quality of Frenchtown's three sub-watersheds meet the SWQS, are shown in **Table 6.4** and **Figure 6f**. The water quality in the Nishisakawick Creek meets all designated uses, while the other assessment units have various impairments. **Table 6.5** displays more information about the impaired waters within Frenchtown.

Table 6.4: 2014 Integrated List (Overview)

Assessment Unit (HUC14)	Sub-watershed	Designated Use★				
		Aquatic Life General	Aquatic Life Trout	Primary Contact Recreation	Public Drinking Water Supply	Fish Consumption
02040105170030	Harihokake Creek (and to Hakihokake Ck)	N	F	N	F	I
02040105170040	Nishisakawick Creek (above 40d 33m)	F	N/A	F	F	I
02040105170050	Nishisakawick Creek (below 40d 33m)	F	N/A	F	F	I
02040105170060	Kingwood Twp(Warford-Little Nishisakawk)	N	N/A	N	F	I
Delaware River 1E	Delaware River Zone 1E*	N	NA	F	N	N

★**Designated Uses:** F = Fully Supporting; N = Not Supporting; I = Insufficient Information

Minimum Suite of Parameters Needed to Determine if Water Quality is "Fully Supporting" a Use:

Aquatic Life – General: Biological data
Aquatic Life – Trout: Biological data, Temperature and Dissolved Oxygen (DO)
Fish Consumption: Fish tissue data
Primary Contact Recreation: Pathogenic Indicator Bacteria
Public Drinking Water Supply: Nitrate and Total Dissolved Solids (TDS)

*Delaware River is assessed by Delaware River Basin Commission and uses different methods and results were the same for 2014 and 2016 (DRBC, August 2016)

Sources: DRBC, August 2016; NJDEP BEARS, May 2017b

When surface waters do not meet the SWQS, *Total Maximum Daily Loads* (TMDLs) must be developed, as specified under Section 303(d) of the Federal Clean Water Act (US Federal Water Pollution Control Act, January 4, 2011). A TMDL identifies all the contributors to surface water quality impacts and sets goals for load[35] reductions for specific pollutants in order to meet the SWQS. Regulations concerning TMDLs are contained in EPA's Water Quality Planning and Management Regulations (USEPA, 2017).

TMDLs represent the assimilative capacity of surface water for a given parameter of concern. The development of TMDLs includes balancing the impacts from point sources, nonpoint sources and natural background levels of a specific pollutant. The TMDL then quantifies the amount of a pollutant a water body can assimilate without violating a state's water quality standards and allocates that load capacity to known point and nonpoint sources in the form of waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, plus a margin of safety (MOS). Load allocations (for nonpoint source pollution) consist of identifying categories of nonpoint sources that contribute to the parameters of concern, followed by recommendations for implementation measures for specific load reductions.

[35] Load is the total amount of material (pollutants) entering the system from one or multiple sources; measured as a rate in weight per unit time (USEPA, 2017).

Examples include best management practices (BMPs), including structural (stormwater runoff controls) and non-structural (local ordinances for stormwater management and nonpoint source pollution control) mechanisms for addressing the water quality parameter(s) of concern (NJDEP Division of Watershed Management, March 9, 2017).

Table 6.5: 2014 Integrated Water Quality Assessment (Details)

Parameter (cause of impairment)	Source	Station Number	First on 303(d) List	Designated Use	Sublist 5 Subpart (A, R, L)	Priority Ranking*
02040105170030	Harihokake Creek (and to Hakihokake Ck)					
Phosphorus (Total)	• Agriculture • Urban Runoff/Storm Sewers	01458300	2006	Aquatic Life	5	Medium
Escherichia coli	• Agriculture • Urban Runoff/Storm Sewers	01458300	2008	Recreation	5	Medium
02040105170040	Nishisakawick Creek (above 40d 33m)					
No impairments on the 2014 list						
02040105170050	Nishisakawick Creek (below 40d 33m)					
No impairments on the 2014 list						
02040105170060	Kingwood Twp(Warford-Little Nishisakawick)					
Phosphorus (Total)	• Package Plant or other permitted small flows discharges • Agriculture • Urban Runoff/Storm Sewers	01458710	2006	Aquatic Life	5	Medium
Escherichia coli	• Agriculture • Urban Runoff/Storm Sewers	01458300	2008	Recreation	4	-
Delaware River 1E						
DDT and its metabolites in Fish Tissue	• Contaminated Sediments • Source Unknown	Delaware River (DRBC)	2006	Fish Consumption	5L	Low
Mercury in Fish Tissue	• Atmospheric Deposition - Toxics • Municipal Point Source Discharges	Delaware River (DRBC)	2006	Fish Consumption	5	Low
PCB in Fish Tissue	• Contaminated Sediments • Source Unknown	Delaware River (DRBC)	2006	Fish Consumption	5L	Low
pH	• Source Unknown	DRBC	2008	Aquatic Life	5	Medium
Turbidity	• Source Unknown	DRBC	2014	Aquatic Life	5	Medium
*Medium priority = NJDEP expects to complete TMDL in the near future, but not within the next two years. Low priority = NJDEP does not expect to complete TMDL in the immediate or near future.						
Sources: NJDEP BEARS, May 2017b; NJDEP BEARS, May 2017c; NJDEP BEARS, May 2017d						

Waters requiring TMDLs are identified and prioritized in the Integrated Water Quality Assessment. After the Integrated List is approved, the NJDEP writes a TMDL report, which is a proposed Water Quality Management Plan Amendment. When this is published in the NJ Register for public review and comment, the TMDL is considered *proposed*. NJDEP then

considers comments received during public comment and finalizes the TMDL report, and the TMDL is considered *established* when it is formally submitted to the US EPA Region 2 for thirty-day review. The TMDL is considered *approved* when the US EPA Region 2 approves it. Next, the TMDL is referred to as *adopted* when the EPA-approved TMDL is adopted by NJDEP as a water quality management plan amendment and the adoption notice is published in the NJ Register (NJDEP BEARS, March 9, 2017).

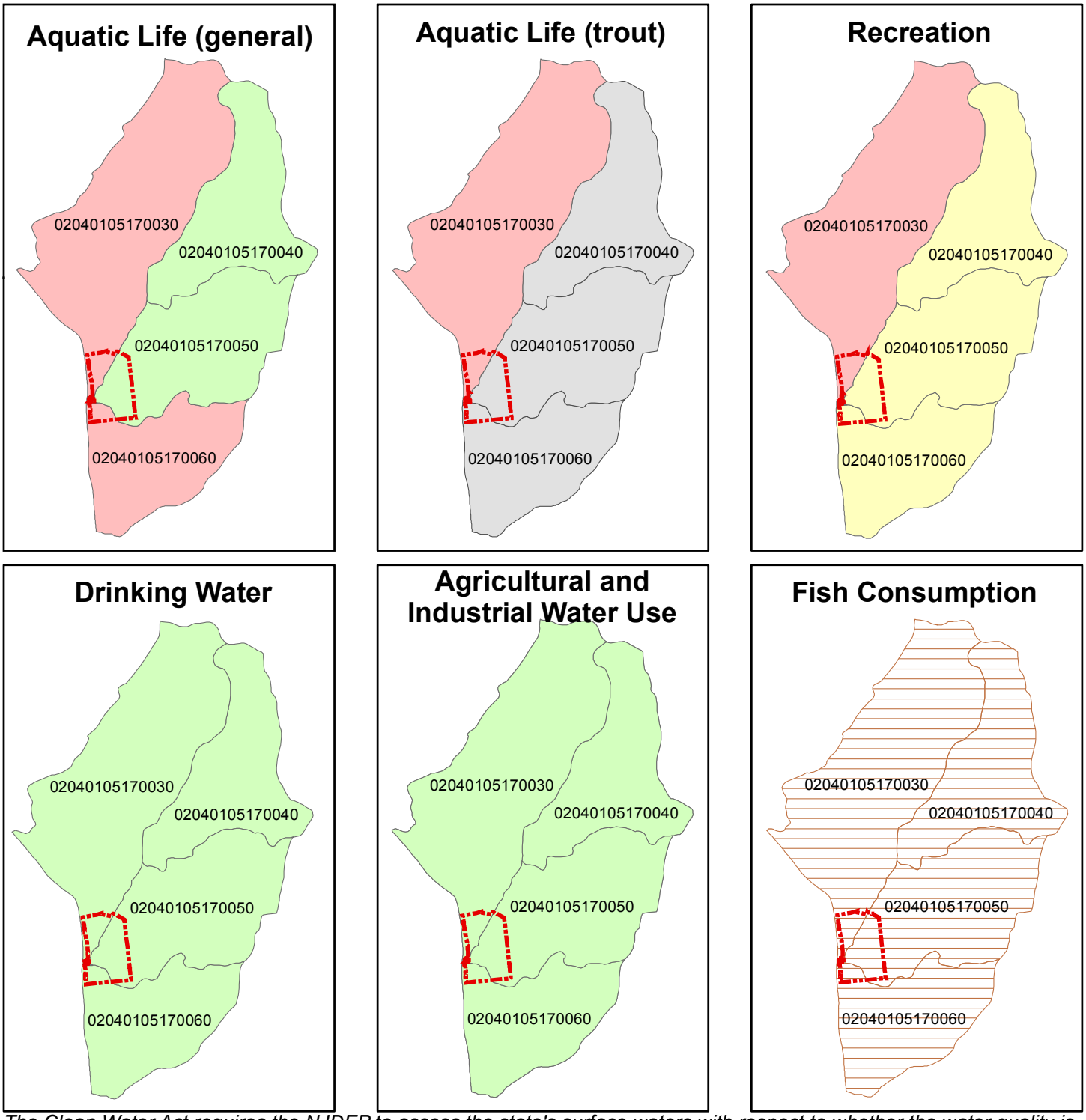
The 2002 Integrated List of Waterbodies identified several waterbodies in the Northwest Water Region as being impaired by pathogens (bacteria), as indicated by the presence of fecal coliform concentrations exceeding surface water quality standards. In 2003, NJDEP established 28 TMDLs addressing fecal coliform loads to 28 stream segments including Nishisakawick and Copper Creeks[36] (NJDEP BEARS, September 29, 2003).

Since there are no significant point sources of pollution in these watersheds, no effluent limits were imposed. It was determined that nonpoint sources (NPS) are the primary contributors to fecal coliform loads in these streams. NPS pollution can include storms transporting fecal coliform from sources such as geese, farms, and domestic pets to the receiving water. NPS pollution also includes sources such as failing sewage conveyance systems and failing or inappropriately located septic systems. The TMDL determined that, in order to meet surface water quality standards, the wasteload allocation (WLA) reduction for Nishisakawick Creek would need to be reduced by 77% (including a margin of safety) and for Copper Creek a 98% reduction (including a margin of safety) would be required. Current monitoring no longer uses fecal coliform as the biological indicator in fresh waters, and instead uses *E. coli*.

No other TMDLs for Frenchtown's sub-watersheds are scheduled for completion, at least in the next two years (NJDEP BEARS, May 2017d.

States may remove an assessment unit/pollutant combination from the Integrated List under specific situations, in a process commonly referred to as *delisting*. The 2014 Integrated List delisted Delaware River 1E for the pollutant Chlordane in Fish Tissue because the applicable water quality standard was attained. However, the reason for the recovery is unspecified. (NJDEP BEARS, May 2017e).

[36] Copper Creek is included in the HUC14 02040105170060 Kingwood Twp(Warford-Little Nishisakawick).



The Clean Water Act requires the NJDEP to assess the state's surface waters with respect to whether the water quality is good enough to support the designated uses. The surface waters in and around Frenchtown are designated to be used for aquatic life (general and trout), recreation, drinking water, agricultural and industrial use and fish consumption. The assessments are done on a HUC14 level (see Section 6A and Figure 6b). Assessment details are presented in Table 6.5 and Table 6.6.

Legend for All Maps on This Page

Frenchtown Borough

Integrated List by HUC14

- Not Applicable
- Sublist 2 (supporting)
- Sublist 3 (insufficient information)
- Sublist 4 (nonsupporting with TMDL)
- Sublist 5 (nonsupporting)

0 2.5 5 Miles

N

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

Figure 6f: Borough of Frenchtown 2012 Integrated List

F. Point Source Pollution

Point source pollution (as defined by N.J.A.C. 7:9B Surface Water Quality Standards) 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 (NJDEP, October 17, 2016).

Point source discharges are regulated by NJDEP under the New Jersey Pollutant Discharge Elimination System (NJPDES). There is one existing discharge within Frenchtown, and 4 revoked/terminated discharges within the Borough (see **Table 6.6** and **Figure 6b**) (NJDEP, NJDEP, June 14, 2017).

Table 6.6: NJ Pollutant Discharge Elimination System Surface Water Discharges

Map ID	NJPDES ID.	Facility Name	Status*	Discharge Type*	Receiving Waters	Data Miner Reports Web Link
NJPDES Within Frenchtown						
	NJ0004782.001A	Frenchtown Properties Inc	R	B Minor	Delaware River Zone 1E	
	NJ0004782.002A	Frenchtown Properties Inc	R	B Minor	Delaware River Zone 1E	
	NJ0004782.003A	Frenchtown Properties Inc	R	B Minor	Delaware River Zone 1E	
	NJ0029831.001A	Frenchtown Boro	E	A Minor	Delaware River Zone 1E	https://www13.state.nj.us/DataMiner/SearchSite.aspx?PV=37470
	NJ0035360.001A	Hunterdon Industrial Gases	R	B Minor	Delaware River Zone 1E via ditch	
NJPDES within the HUC14s of Frenchtown						
	NJ0004456.001A	Crown Paper Co - Milford	R	B Major	Delaware River Zone 1E	https://www13.state.nj.us/DataMiner/SearchSite.aspx?PV=14568
	NJG0023001.001A	Camp Tecumseh - Salvation Army Camp	E	ASC Minor	Nishisakawick Creek	https://www13.state.nj.us/DataMiner/SearchSite.aspx?PV=37700
	NJG0023311.001A	Kingwood Twp - Elementary School	E	ASC Minor	Copper Ck via storm water conveyance	https://www13.state.nj.us/DataMiner/SearchSite.aspx?PV=36309
	NJG0027553.001A	Alexandria Twp BOE - Wilson School	E	ASC Minor	Nishisakawick Creek via Frenchtown Ck	https://www13.state.nj.us/DataMiner/SearchSite.aspx?PV=37356
	NJG0035670.001A	Alexandria Twp BOE - Middle School	E	ASC Minor	Nishisakawick Creek	https://www13.state.nj.us/DataMiner/SearchSite.aspx?PV=15803

***Notes for Above Codes**
Status: **E**=Existing in the Point Source Permitting Regions; **R**=Revoked/Terminated - Pipe no longer permitted for discharge
Discharge type: **A**= Domestic Surface Water Discharge; **B**= Industrial/Commercial/Thermal Discharge; **ASC**= Consolidated School GP

Source: NJDEP, June 14, 2017

G. Nonpoint Source Pollution

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

Impervious surfaces are materials that prevent the infiltration of water into the soil (e.g. parking lots, roads, buildings, sidewalks and compacted soil). The construction of impervious surfaces disrupts the natural water cycle, and is one of the more significant landscape impacts attributable to urbanization (Hasse and Lathrop, December 2016). When water flows off impervious surfaces, it is known as *stormwater*. Nonpoint source pollution is directly associated with stormwater.

An increase in impervious surface results in less water infiltrating to the soil and groundwater, which instead runs off the surface and gains velocity. 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. In addition, increased stormwater results in greater frequency and magnitude of floods (Hasse and Lathrop, December 2016; Kaplan and Ayers, 2000).

Studies have shown that the level where impacts begin to be seen is above 10% impervious surfaces, and that impacts become severe over 25 to 30% (Kaplan and Ayers, 2000).

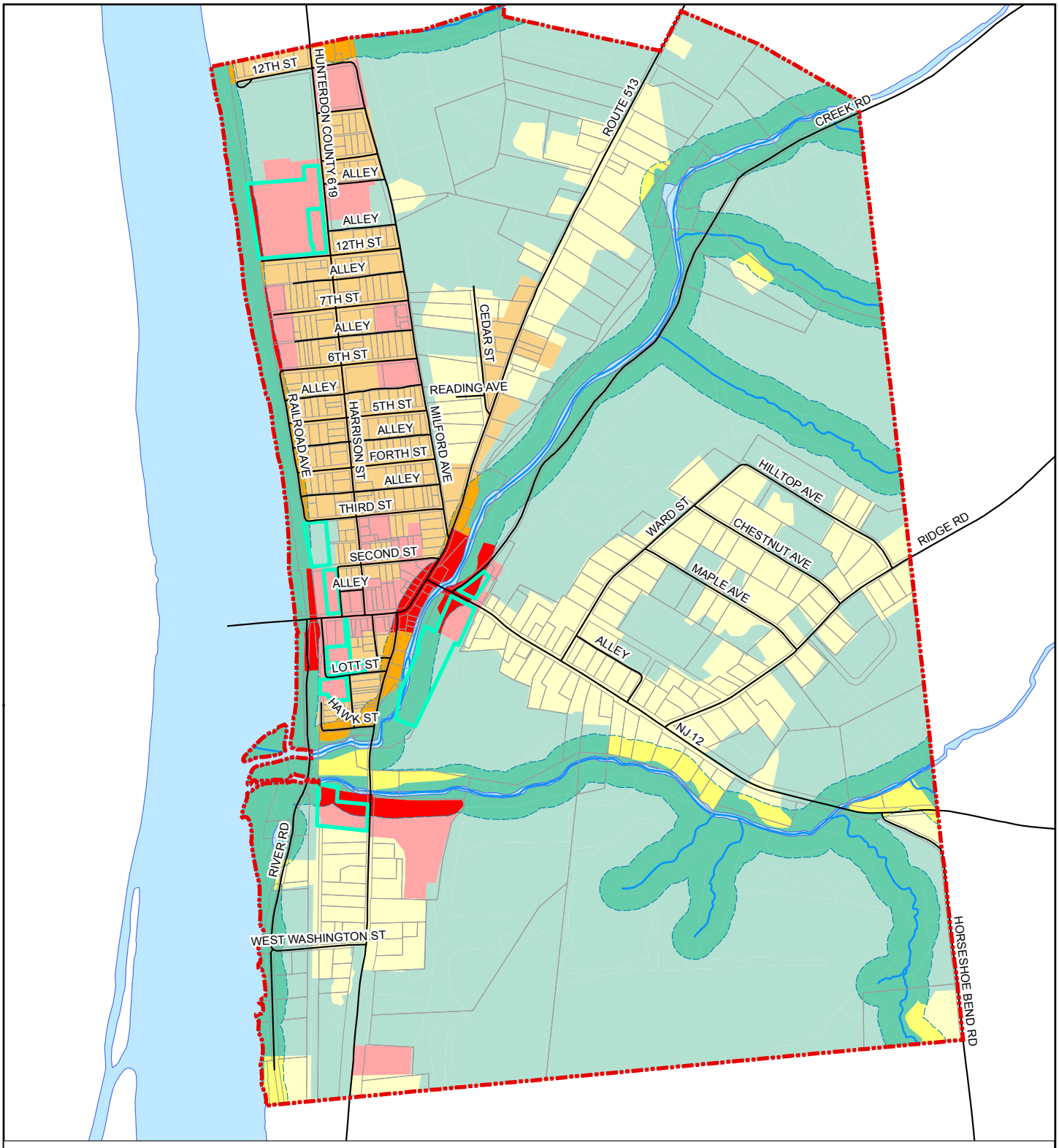
NJDEP determined approximate percent impervious surface based on particular land uses. Because so much of the borough is forested, 70% of Frenchtown has less or equal to 10% impervious surface; 16% of the borough has between 10 and 25% impervious surface, and 14% of the borough has greater than 25% impervious surfaces (see **Figure 6g** and **Table 6.7**) (NJDEP, February 17, 2015).

The goals of New Jersey's Stormwater Management Rule (N.J.A.C. 7:8) include reducing runoff, flooding, erosion and non-point pollution for public safety; maintaining ground water recharge, ecological and biological integrity; and protecting the integrity of stream channels for biological functions, infrastructure and public safety. There are requirements for stormwater management measures and regional and municipal stormwater management planning (NJDEP, June 20, 2016).

The purpose of the Municipal Stormwater Regulation Program is to ensure a consistent approach to stormwater management statewide, reduce costs for regulated entities, and allow for a simple process for requesting authorization. All municipalities within the State are assigned either Tier A (more developed or coastal municipalities) or Tier B (less developed and non-coastal, including Frenchtown) (NJDEP Bureau of Nonpoint Pollution Control, 2009).

The permits address stormwater quality related issues to new and existing development and redevelopment by requiring the preparation of a stormwater program and implementation of specific permit requirements referred to as Statewide Basic Requirements (SBRs). The Tier B Permit concentrates on new development and redevelopment projects and public education. The Tier A Permit has additional requirements aimed at controlling stormwater pollutants from existing development (NJDEP Bureau of Nonpoint Pollution Control, March 23, 2017).

Frenchtown adopted a Stormwter Management Plan (2006) and Stormwater Ordinance (2014), which may be obtained from the Borough Clerk (see **References**).



Legend

		Impervious Surface (2012 Land Use)	Impervious Surface within 150' Riparian Zone
Frenchtown Borough	Redevelopment Zone	0 to 10%	0 to 10%
Roads	Parcels	10 to 25%	10 to 25%
150' Riparian Buffer		25 to 50%	25 to 50%
Streams		50 to 95%	50 to 95%
Waterbodies			

0 0.25 0.5 Miles

N

Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 6g: Borough of Frenchtown Percent Impervious Surface

Frenchtown ERI 2018 Kratzer Environmental Services

Table 6.7: Impervious Surface in Frenchtown

Impervious Surface	Acres	Percent	Acres in 150' Riparian Buffer*	Percent of Riparian Buffer*
0 to 10%	485.8	67.6%	141.5	85.0%
10.1 to 25%	127.4	17.7%	10.6	6.4%
25.1 to 50%	62.6	8.7%	5.5	3.3%
50.1 to 95%	42.7	5.9%	8.8	5.3%
Total:	718.5	100.0%	166.4	100.0%
*Riparian buffer zone was created by making a 150' buffer around streams and waterbodies within Frenchtown and then the 2012 Land Use data was clipped to the riparian buffer (NJDEP, Bureau of Geographic Information and Analysis (BGIA), February 17, 2015)				
Source: 2012 Land Use data (NJDEP, February 17, 2015)				

H. Surface Water Quality and Flow Monitoring

The various water quality and flow monitoring programs in the region are discussed below. A list of the sites sampled for each program is provided in **Table 6.8** and shown on **Figure 6h**. Sites located outside of Frenchtown (but upstream) are included because of the usefulness of knowing the water quality and stream flow entering the borough.

NJDEP Ambient Stream Quality Monitoring Sites for New Jersey (SWpoints)

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, and 2.) USGS's annual reports "Water Resources Data-New Jersey". There are no sites in this network within the borough, but there are three sites upstream; one each on the Nishisakawick, Harihokake, and Copper Creeks (NJDEP BFBM. November 20, 2008).

NJDEP Existing Water Quality Stations in New Jersey (EWQPOI)

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. Two locations in this sampling network are located on the Harihokake Creek in Alexandria, upstream of Frenchtown (NJDEP, October 19, 2007).

NJDEP Ambient Biomonitoring Network (AMNET) (Biopts)

Sites are sampled for benthic aquatic macroinvertebrate using the Rapid Bioassessment Protocol in order to make assessments at three levels of impairment; non-impaired, moderately impaired, and severely impaired. Sites are sampled every 5 years. The data is used as a primary environmental indicator of water quality impairment for New Jersey's Environmental Performance Partnership Agreement (NEPPS) with USEPA. There are two monitoring sites within Frenchtown, on the Nishisakawick and the Little Nishisakawick; and there are 5 stations upstream of the borough (NJDEP BFBM, June 6, 2017). AMNET sites are listed in **Table 6.8**.

Biological (macroinvertebrate) sampling is described in more detail below, and results are summarized in **Table 6.9**.

Fish Index of Biotic Integrity Stations (FIBI)

The Fish Index of Biotic Integrity supplements the macroinvertebrate biomonitoring network by assessing the biological health of a stream based on resident fish populations. Like AMNET, sites are sampled once every 5 years. One site is located within Frenchtown, on the Nishisakawick Creek. One site is upstream of Frenchtown in Alexandria, on the Harihokake Creek (NJDEP BFBM, November 26, 2014). FIBI is described in more detail below, sites are listed in **Table 6.8,** and results are summarized in **Table 6.10**.

NJDEP/USGS Surface WQ Gage (WQgage)

This network is jointly funded by USGS and NJDEP. USGS maintains a network of gages across NJ at which surface water quality is measured. As project needs and funding levels change, different sites may be active in any given year. The data measured at the active sites are published annually as part of the USGS' series of annual water-data reports. While no sites are located within the Borough, two stations are upstream of the borough on the Nishisakawick and one is on Copper Creek (USGS, April 17, 2002a).

USGS Stream Low Flow Gaging (Lowflow)

USGS measures gage height (relative height of water level; not actual flow volume) occasionally at these sites. There are no active sites located in Frenchtown's subwatersheds; however there are two inactive flow gauges in Frenchtown and one upstream of Frenchtown's border in the Harihokake watershed (USGS, April 17, 2002b).

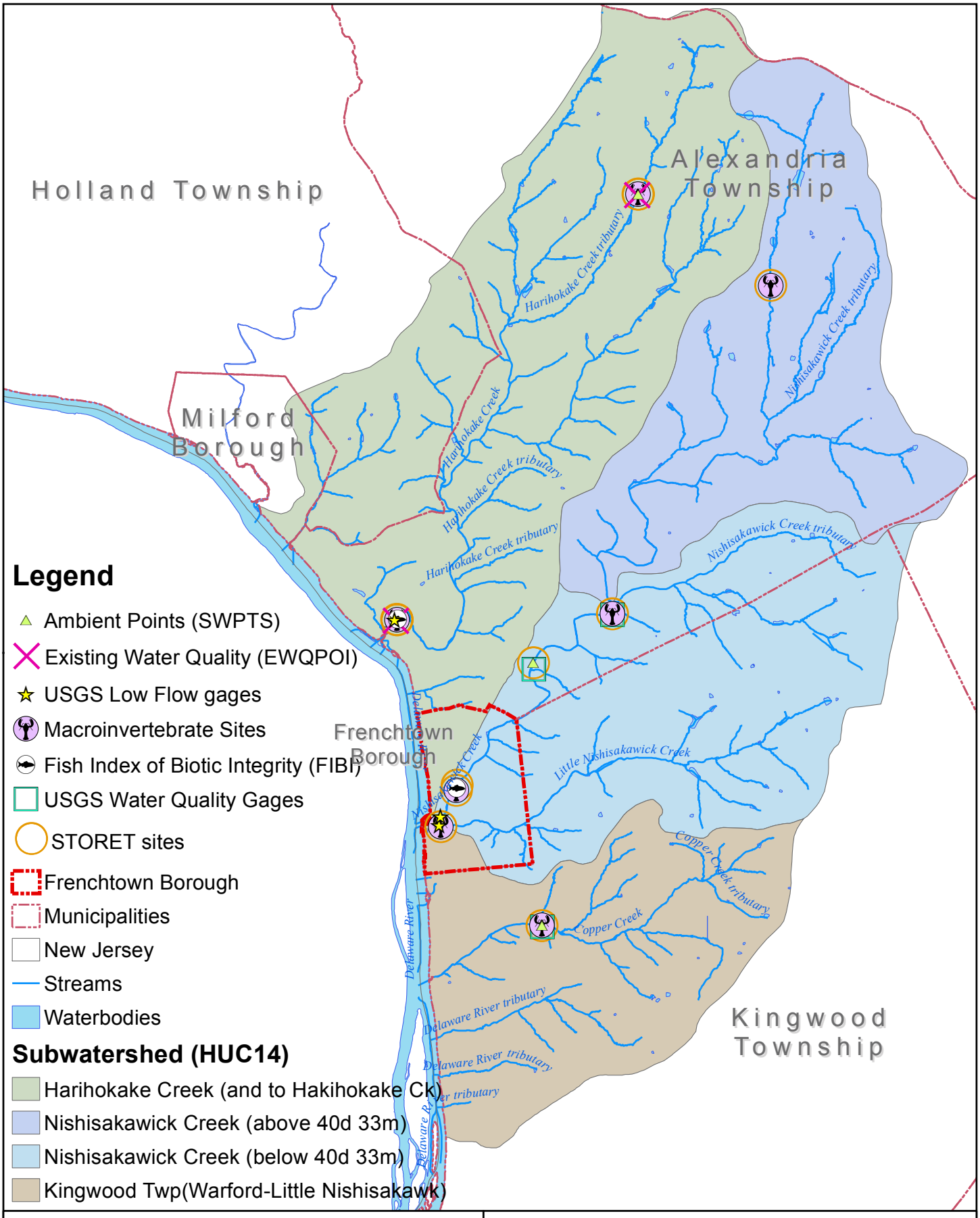
STORET Stations

Data collected by some sampling programs and from certain sites are input into EPA's national water quality database. These sites are indicated by an asterisk in **Table 6.8** and by an orange circle on **Figure 6h**. It is possible that data from other sites might be available, even if not noted here (NJDEP BFBM, August 1, 2005).

Table 6.8: Surface Water Monitoring Stations

Program Name	Station ID	Name	Municipal-ity	Sub-watershed	Data Collected
Upstream sites, within Watersheds of Frenchtown					
Biopts	*AN0078	Harihokake Ck Hartpence Rd	Alexandria	Harihokake Creek	Habitat and Macroin-vertebrates
Biopts	*AN0079	Harihokake Ck River Rd	Alexandria	Harihokake Creek	Habitat and Macroin-vertebrates
Biopts	*AN0080	Nishisakawick Ck Airport Rd	Alexandria	Nishisakawick Creek	Habitat and Macroin-vertebrates
Biopts	*AN0081	Nishisakawick Ck off Creek Rd	Alexandria	Nishisakawick Creek	Habitat and Macroin-vertebrates
Biopts	*AN0084	Copper Ck Horseshoe Bend Rd	Kingwood	Copper Creek	Habitat and Macroin-vertebrates

Program Name	Station ID	Name	Municipal-ity	Sub-watershed	Data Collected
FIBI	*FIBI034	Harihokake Creek Milford-Frenchtown Rd (CR 619)	Alexandria	Harihokake Creek	Fish Index of Biotic Integrity
LowFlow INACTIVE	*1458400	Harihokake C Nr Frenchtown, NJ	Alexandria	Harihokake Creek	Stream Flow
WQgages	1458560	Nishisakawick Creek Near Everittstown, NJ	Alexandria	Nishisakawick Creek	Stream Flow (continuous) and water quality
WQgages	*1458570	Nishisakawick Creek Near Frenchtown, NJ	Alexandria	Nishisakawick Creek	Stream Flow (continuous) and water quality
WQgages	1458710	Copper Creek Near Frenchtown, NJ	Kingwood	Copper Creek	Stream Flow (continuous) and water quality
EWQPOI	*1458400	Harihokake C On Route 619 (River Rd) above Frenchtown	Alexandria	Harihokake Creek	water quality
EWQPOI	*01458300	Harihokake Creek On Hartpence Rd (Bridge # a-21)	Alexandria	Harihokake Creek	water quality
SWpoints	01458710	Copper Creek near Frenchtown	Kingwood	Copper Creek	Water Quality RP
SWpoints	01458570	Nishisakawick Creek near Frenchtown	Alexandria	Nishisakawick Creek	Stream Flow (staff) and water quality
SWpoints	01458300	Harihokake Creek at Hartpence Rd near Mount Pleasant	Alexandria	Harihokake Creek	Stream Flow (RP) and water quality
Sites in Frenchtown					
Biopts	*AN0082	Nishisakawick Ck Creek Rd (Frenchtown Pk)	Frenchtown	Nishisakawick Creek	Habitat and Macroin-vertebrates
Biopts	*AN0083	Ltl Nishisakawick Rt 29	Frenchtown	Little Nishisakawick Creek	Habitat and Macroin-vertebrates
FIBI	*FIBI026	Nishisakawick Creek at Creek Rd @ Frenchtown Park	Frenchtown	Nishisakawick Creek	Fish Index of Biotic Integrity
LowFlow INACTIVE	1458600	Nishisakawick C at Frenchtown, NJ	Frenchtown	Nishisakawick Creek	Stream Flow
LowFlow INACTIVE	1458700	L Nishisakawick C At Frenchtown, NJ	Frenchtown	Little Nishisakawick Creek	Stream Flow
*Data from these program sites are input into STORET, EPA's water quality database.					
Sources: SWPTS (NJDEP BFBM, November 20, 2008); BIOPTS(AMNET)(NJDEP BFBM, June 6, 2017); EWQPOI (NJDEP BFBM, October 19, 2007); FIBI (NJDEP BFBM, November 26, 2014); STORET (NJDEP BFBM, August 1, 2005); WQgages (USGS, April 17, 2002a); Lowflow (USGS, April 17, 2002b)					



Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized

Figure 6h: Borough of Frenchtown Surface Water Quality and Flow Monitoring

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Macroinvertebrate Data (AMNET) (Biopts)

Macroinvertebrates are larger-than-microscopic fauna, which are found in freshwater and estuarine environments, and are an essential part of the aquatic food web. These include insects (primarily immature forms), worms, mollusks (snails, clams) and crustaceans (scuds, shrimp, crayfish, etc.), most of which are bottom-dwelling (benthic). They are more easily collected and quantified than other biological indicators (fish or periphyton communities). Assessments of benthic macroinvertebrates provide a good indication of localized conditions of water quality. Due to the creatures' limited mobility, they are suitable for the evaluation of site-specific pollution impacts. Different species differ in their sensitivity to pollutants and environmental impacts from both point and non-point sources of pollution. Combined with relevant chemical/physical parameters, benthic macroinvertebrate communities can be used to identify sources of impairment (NJDEP BFBM, December 2012).

The Ambient Biomonitoring Network (AMNET) is the NJDEP's ongoing macroinvertebrate monitoring program. From 1992 to 2004, the New Jersey Impairment Score (NJIS) was used to assign a rating of non-impaired, moderately impaired, or severely impaired. Beginning in 2004, an improved index has been used, which takes into account the different ecoregions in the state. The Highlands, Ridge and Valley and Piedmont regions (including Frenchtown) comprise the region using the *High Gradient Macroinvertebrate Index (HGMI)*. In addition, the HGMI uses genus-level instead of family level identification, which provide four assessment rating levels; excellent, good, fair and poor. NJDEP uses this information in assessing progress toward the goals of the Clean Water Act through the Integrated Water Quality Monitoring and Assessment Report (see **Section 6E**), and for designation of Category 1 waters, based on exceptional ecological significance (see **Section 6D**) (NJDEP BFBM, December 2012). Locations of monitoring sites are shown on **Figure 6h and listed in Table 6.8;** and results are shown in **Table 6.9**.

Table 6.9: Macroinvertebrate and Habitat Scores

Site ID	Site	Date of Sampling	Macroinvertebrate Rating NJIS or HGMI*	Habitat Analysis
The following sites are in Frenchtown				
AN0082	Nishisakawick Ck Creek Rd (Frenchtown Pk)	4/12/1993	NJIS: Non-impaired (30)	-
		7/22/1997	HGMI: Excellent (79.33)	Optimal (171)
		4/29/2003	HGMI: Excellent (73.59)	Optimal (185)
		11/8/2007	HGMI: Excellent (68.62)	Suboptimal (142)
		Round 5	HGMI: Excellent (77.71)	Suboptimal (145)
AN0083	Ltl Nishisakawick Rt 29	7/21/1992	NJIS: Non-impaired (24)	-
		7/10/1997	HGMI: Excellent (73.86)	Suboptimal (148)
		4/29/2003	HGMI: Good (56.48)	Suboptimal (159)
		11/8/2007	HGMI: Good (52.49)	Suboptimal (120)
		Round 5	HGMI: Excellent (83.63)	Suboptimal (142)
The following sites are upstream of Frenchtown				
AN0078	Harihokake Ck Hartpence Rd	Round 1	NJIS: Non-impaired (30)	-
		Round 2	HGMI: Excellent (79.83)	Optimal (171)
		Round 3	HGMI: Good (60.63)	Suboptimal (158)
		Round 4	HGMI: Good (59.6)	Suboptimal (146)
		Round 5	HGMI: Good (60)	Suboptimal (153)
AN0079	Harihokake Ck River Rd	Round 1	NJIS: Moderate impairment (21)	-
		Round 2	HGMI: Excellent (79.57)	Suboptimal (146)
		Round 3	HGMI: Good (54.33)	Optimal (174)
		Round 4	HGMI: Good (59.27)	Suboptimal (142)
		Round 5	HGMI: Excellent (67.72)	Suboptimal (150)
AN0080	Nishisakawick Creek Airport Rd	4/12/1993	NJIS: Non-impaired (30)	-
		7/22/1997	HGMI: Excellent (74.59)	Optimal (180)
		4/23/2003	NJIS: Non-Impaired HGMI: Excellent (66.01)	Optimal (170)
		11/14/2007	HGMI: Excellent (67.15)	Suboptimal (150)
		Round 5	-	-
AN0081	Nishisakawick Creek off Creek Rd	1/22/1993	NJIS: Non-impaired (27)	-
		7/22/1997	HGMI: Excellent (76.13)	Optimal (165)
		4/29/2003	HGMI: Excellent (66.05)	Optimal (175)
		11/8/2007	HGMI: Excellent (77.10)	Suboptimal (131)
		Round 5	HGMI: Good (57.15)	Optimal (163)
AN0084	Copper Ck Horseshoe Bend Rd	Round 1	NJIS: Moderate impairment (21)	-
		Round 2	HGMI: Good (47.43)	Suboptimal (144)
		Round 3	HGMI: Excellent (68.01)	Suboptimal (159)
		Round 4	HGMI: Excellent (78.79)	Suboptimal (133)
		Round 5	HGMI: Excellent (77.69)	Suboptimal (157)

* Parameter:
HGMI (High Gradient Macroinvertebrate Index): **Excellent** 63 - 100 Full Attainment; **Good** <63-42 Full Attainment; **Fair** <42-21 Non-Attainment; **Poor** < 21 Non-Attainment

NJIS (New Jersey Impairment Score): A composite of 5 scores based on family level taxonomy. **N=Non-impaired**: score of 24 to 30; benthic community comparable to other undisturbed streams within the region; community characterized by a maximum taxa richness, balanced taxa groups, and good representation of intolerant individuals. **M=Moderately Impaired**: score of 9 to 21; **S= Severely Impaired**: score of 0 to 9; benthic community drastically different from those in less impaired situations.

HABITAT SCORES: **OPTIMAL**= 160 – 200; **SUB-OPTIMAL**=110 – 159; **MARGINAL**= 60 – 109; **POOR**= < 60. Parameters evaluated included in-stream substrate, channel morphology, bank structural features, and riparian vegetation for the sample site and its immediate surroundings (usually 100-200 foot radius).

Sources: NJDEP BFBM, November 15, 2005a; NJDEP BFBM, November 15, 2005b; NJDEP BFBM, February 17, 2009; NJDEP BFBM, December 2012; NJDEP BFBM, June 6, 2017

Fish Index of Biotic Integrity Stations (FIBI) Data

Fish are good indicators of long term water quality because they are relatively mobile and long-lived, compared to macroinvertebrates. The monitoring of stream fish communities is used (in concert with macroinvertebrate data as described above) in determining the *aquatic life use* and to help measure the state's success in attaining the Clean Water Act goal of "fishable" waters (see **Section 6E**). In New Jersey, Surface Water Quality Criteria (SWQS) include descriptors such as *trout production, trout maintenance and non-trout* waterways (see **Section 6D** and **Table 6.4**).

In the northern half of the state, the Northern Fish Index of Biotic Integrity (FIBI) is used to measure the health of high gradient wadeable streams. The fish community is given scores for characteristics such as species richness, trophic composition, abundance, and overall health, which were selected based on their sensitivity to anthropogenic impacts. These scores are combined into a single ecologically based index, which is compared to a healthy fish assemblage. NJDEP samples each site once every five years (NJDEP, BFBM, August 10, 2017a).

FIBI scores in Nishisakawick Creek at Frenchtown Park demonstrate good to excellent FIBI scores and optimal to sub-optimal habitat scores (see **Table 6.10**).

One site in Harihokake Creek, a stream within Frenchtown's watershed, determined that this stream has good fish population health and optimal to sub-optimal habitat (see **Table 6.10**). In addition, the 2012 sampling event was the first time wild brown trout were collected at this site. Currently, the Harihokake is designated *trout maintenance*, but the presence of young-of-

Table 6.10: Fish Index of Biotic Integrity (FIBI) and Habitat Scores

Site Code	Site Name	Parameter*	Date Sampled		
			Round 1	Round 2	Round 3
The following site is in Frenchtown					
FIBI026	Nishisakawick Creek Creek Road @ Frenchtown Park (40 31 41N; 75 03 33W)	FIBI	7/24/2001 Good (44)	7/10/2006 Excellent (48)	06/20/2011 Good (44)
		Number of Fish Species Identified	12	18	15
		Total Number of Fish Collected	1029	572	822
		Habitat	Optimal (167)	Optimal (165)	Sub-Optimal (140)
The following site is upstream of Frenchtown, in Alexandria Township					
FIBI034	Harihokake Creek Milford-Frenchtown Rd. (CR 619) (40 32 53N; 75 04 08W)	FIBI	08/07/2001 Good (40)	8/1/2006 Good (44)	06/29/2012 Good (68.8)
		Number of Fish Species Identified	13	19	16
		Number of Fish Species Identified	310	475	822
		Habitat	Optimal (163)	Sub-Optimal (156)	Sub-Optimal (151)

* Parameter:

FIBI (Fish Index of Biotic Integrity) (pre-2012): **Excellent**=45-50; **Good** =37-44; **Fair** =29-36; **Poor**=10-28

High Gradient FIBI (2012): **Excellent**=76-100; **Good**=51-75; **Fair**=26-50; **Poor** =0-25

HABITAT SCORES: **OPTIMAL**= 160 – 200; **SUB-OPTIMAL**=110 – 159; **MARGINAL**= 60 – 109; **POOR**= < 60. Parameters evaluated included in-stream substrate, channel morphology, bank structural features, and riparian vegetation for the sample site and its immediate surroundings (usually 100-200 foot radius).

Sources: NJDEP BFBM, August 10, 2017a; NJDEP BFBM, August 10, 2017b

the-year brown trout documents natural reproduction and nominates this section for upgrade to trout production (NJDEP, BFBM, August 10, 2017b).

I. 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. 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 state and regional *fish consumption advisories*, to reduce exposure to dioxin, PCBs and mercury. This information is intended to help individuals make an informed choice on the number of meals of fish to consume. The 2016 fish consumption advisories for fish caught anywhere in the state are listed in **Table 6.11**. See the **Internet References** for more information, such as fish preparation guidelines and annual updates.

Table 6.11: 2016 Fish Consumption Advisories – Statewide Freshwaters

LOCATION	SPECIES	ADVISORY/PROHIBITION(1)	
		General Population Range of Recommended Meal Frequency(2)	High-Risk Individuals (3)
		DO NOT EAT MORE THAN:	DO NOT EAT MORE THAN:
Delaware River – Phillipsburg to Trenton	Largemouth Bass	No restrictions	One meal per month
	Smallmouth Bass	One meal per week	One meal per month
	Striped Bass	Four meals per year	Do Not Eat
	Channel Catfish	Four meals per year	Do Not Eat
	White Sucker	One meal per month	Do Not Eat
	American Eel	One meal per month	Do Not Eat

New Jersey Statewide – All water bodies except those listed separately	Trout - (Brown, Brook Rainbow and Hybrid)	One meal per week	One meal per week
	Chain Pickerel	One meal per week	One meal per month
	Sunfish (bluegill, pumpkinseed and redbreast)	No restrictions	One meal per week
	Brown Bullhead	No restrictions	One meal per month
	Yellow Bullhead	No restrictions	One meal per month
	Common Carp	One meal per week	One meal per month
**** Important Consumption Reminders **** (1) 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 or grilling, and steaming). See text for full description. (2) 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.			
Source: NJDEP Division of Science and Research, 2016 http://www.state.nj.us/dep/dsr/njmainfish.htm See interactive map for up to date fish advisories: http://njdep.maps.arcgis.com/apps/MapJournal/index.html?appid=922dff1885394cf19ccf1d9c8d52b4f0			

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General Water Resources Protection
SEEDS: The NJ Environmental Education Directory Website: http://www.state.nj.us/dep/seeds/index.html

Basic Watershed Information (Watershed Restoration Section):
http://www.nj.gov/dep/watershedrestoration/info.html

The Clean Water Book: Choices for Watershed Protection:
http://www.nj.gov/dep/watershedrestoration/waterbook_tble.html

NJDEP Laws & Rules: http://www.nj.gov/dep/landuse/lawsregs.html

Water Quality Fact Sheets and Bulletins (NJ Agricultural Experiment Station Rutgers Cooperative Research & Extension): http://njaes.rutgers.edu/pubs/subcategory.asp?cat=6&sub=50&order=LastRevised

Floodplains & Floods
FEMA Flood Map Service Center: http://msc.fema.gov/portal

Flood Hazard Area Program (NJDEP Land Use Regulation) http://www.nj.gov/dep/landuse/fha_main.html

FloodSmart: The Official Site of the National Flood Insurance Program: http://www.floodsmart.gov

National Weather Service Advanced (NOAA) Hydrologic Prediction Service (flood predictions):
Delaware River at Frenchtown:
https://water.weather.gov/ahps2/hydrograph.php?wfo=phi&gage=fren4&view=1,1,1,1,1,1&toggles=10,7,8,2,9,15,6

National Weather Service Forecast Frenchtown, NJ:
http://forecast.weather.gov/MapClick.php?lat=40.5294&lon=-75.0623#.WYdfe4QrLb0

USGS Real-Time Stream Flow Station, Delaware River at:
Frenchtown NJ (gage height): https://waterdata.usgs.gov/nj/nwis/uv?site_no=01458500
Belvidere NJ (discharge):
https://waterdata.usgs.gov/nj/nwis/uv/?site_no=01446500&PARAmeter_cd=00065,00060,62614

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

Freshwater Wetlands Program: Before You Buy – Before You Build: http://www.nj.gov/dep/landuse/bybob.html

SWQS
Category One Waters: http://www.nj.gov/dep/wms/bears/c1waters.htm

wood turtle *(Glyptemys insculpta):*
http://www.conservewildlifenj.org/species/fieldguide/view/Glyptemys%20insculpta/

long-tailed salamander (*Eurycea longicauda*):
http://www.conservewildlifenj.org/species/fieldguide/view/Eurycea%20longicauda%20longicauda/

Integrated List & TMDL
NJDEP Integrated WQ monitoring and Assessment Report: http://www.nj.gov/dep/wms/bears/generalinfo.htm

NJDEP Total Maximum Daily Load (TMDL): http://www.nj.gov/dep/wms/bears/tmdls.html

USEPA Laws and Regulations: http://www2.epa.gov/laws-regulations

USEPA Watershed Assessment, Tracking & Environmental Results 2010 Waterbody Reports:
Harihokake Creek (and to Hakihokake Ck)
Nishisakawick Creek (above 40d 33m)
Nishisakawick Creek (below 40d 33m)
Kingwood Twp(Warford-Little Nishisakawk)

Point Source Pollution
NJPDES Permitting: http://www.nj.gov/dep/dwq/database.htm

Non-Point Source Pollution / Stormwater:
NJDEP's Stormwater Website (includes links to all of the following, and more): http://www.njstormwater.org/ or http://www.nj.gov/dep/dwq/fd.htm
NJDEP Municipal Stormwater Regulation Program: http://www.state.nj.us/dep/dwq/msrp_home.htm
Stormwater Best Management Practices Manual: http://www.njstormwater.org/bmp_manual2.htm
Clean Water NJ: http://www.cleanwaternj.org/index.htm
Multimedia Resources: http://www.cleanwaternj.org/multimedia.html
Green Infrastructure: http://www.nj.gov/dep/gi/

USEPA Nonpoint Source Pollution: http://water.epa.gov/polwaste/nps/index.cfm

Surface Water Quality and Flow
Benthic Macroinvertebrate Sampling: http://www.state.nj.us/dep/wms/bfbm/downloads.html

National Weather Service Advanced (NOAA) Hydrologic Prediction Service (flood predictions):
Delaware River at Frenchtown:
https://water.weather.gov/ahps2/hydrograph.php?wfo=phi&gage=fren4&view=1,1,1,1,1,1&toggles=10,7,8,2,9,15,6

NJDEP Drought Information: http://www.njdrought.org/

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

USGS Real-Time Stream Flow Station, Delaware River at:
Frenchtown NJ (gage height): https://waterdata.usgs.gov/nj/nwis/uv?site_no=01458500

USGS Real-time flow data index of NJ sites: http://waterdata.usgs.gov/nj/nwis/current/?type=flow

Water Quality Data Portal: https://www.waterqualitydata.us/

Fish Advisories & Guides
NJ Division of Science & Research Fish Advisories Home Page: http://www.state.nj.us/dep/dsr/njmainfish.htm

Fish Smart Eat Smart: http://www.state.nj.us/dep/dsr/fishsmart.pdf

NJDEP Regulations:
NJDEP Rules & Regulations, current and proposed: http://www.state.nj.us/dep/rules

Phone Contacts:
NJ Drought Hotline: 1-800-4-ITS DRY (1-800-448-7379) or http://www.njdrought.org/

NJ Environmental Incident Hotline (hazardous spill, fire, explosion, illegal dumping, wildlife problem):
1-877-WARNDEP / 1-877-927-6337 (toll-free, 24 hours) or http://www.nj.gov/dep/warndep.htm

NJDEP Bureau of Coastal & Land Use Compliance & Enforcement: 1-609-292-1240

NJDEP Division of Land Use Regulation (Wetlands, Streams/Rivers, Flood Hazard Areas):
Technical Support Center: (609) 777-0454 or http://www.nj.gov/dep/landuse/contact.html
Forms: http://www.nj.gov/dep/landuse/forms.html

7: BIOLOGICAL RESOURCES

A. Dominant Vegetation (Land Cover)

The New Jersey Comparative Risk Project (March 2003) listed 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 that impact ecological health include exotic species (e.g. the hemlock wooly adelgid, an insect that causes the decline and death of hemlock trees) and exotic diseases, overpopulations of deer and geese, and pollution.

The 2012 Land Use/Land Cover (LU/LC) data layer was created by a consultant to NJDEP by comparing the 2007 LU/LC layer to 2012 color infrared imagery (2007 and 2012 aerial photos are shown in **Figure 2e** and **Figure 2f**, respectively) and delineating and coding areas of change with a 1 foot pixel resolution. The classification system used was a modified Anderson Classification System (USGS, 2012) 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 2012 are not shown, and 2) the method is not 100% accurate (for example, Frenchtown has a number of duplexes and rental apartments that may not be reflected in the land cover data). In addition, since it is based on interpretation of aerial photographs, it cannot provide information about the particular species found in an area. The land cover classifications are shown in **Figures 7a, 7b, and 7c**. The numbers of acres of each within Frenchtown are included in **Table 7.1** (NJDEP, 2015).

The largest portion of land in Frenchtown has a land cover of *Residential, Single Unit, Low Density* (11.93% of the borough), followed by *Streams and Canals* (10.29%), *Coniferous Forest (>50% Crown Closure)* (9.80%) and *Deciduous Forest (>50% Crown Closure)* (9.20%). Together, these top four land uses make up 41% of the borough (NJDEP, 2015).

Table 7.1: 2012 Land Use/Land Cover (Anderson Classification) in Frenchtown

TYPE12	Code	Land Cover	Acres	Percent of Borough
AGRICULTURE 54.41 acres 7.57%	2100	CROPLAND AND PASTURELAND	52.86	7.36%
	2400	OTHER AGRICULTURE	1.55	0.22%
FOREST 297.43 acres 41.40%	4110	DECIDUOUS FOREST (10-50% CROWN CLOSURE)	40.85	5.69%
	4120	DECIDUOUS FOREST (>50% CROWN CLOSURE)	72.24	10.05%
	4210	CONIFEROUS FOREST (10-50% CROWN CLOSURE)	4.51	0.63%
	4220	CONIFEROUS FOREST (>50% CROWN CLOSURE)	78.41	10.91%
	4311	MIXED FOREST (>50% CONIFEROUS WITH 10-50% CROWN CLOSURE)	2.62	0.36%
	4312	MIXED FOREST (>50% CONIFEROUS WITH >50% CROWN CLOSURE)	8.61	1.20%
	4321	MIXED FOREST (>50% DECIDUOUS WITH 10-50% CROWN CLOSURE)	0.91	0.13%
	4322	MIXED FOREST (>50% DECIDUOUS WITH >50% CROWN	32.84	4.57%

TYPE12	Code	Land Cover	Acres	Percent of Borough
		CLOSURE)		
	4410	OLD FIELD (< 25% BRUSH COVERED)	1.50	0.21%
	4420	DECIDUOUS BRUSH/SHRUBLAND	7.40	1.03%
	4430	CONIFEROUS BRUSH/SHRUBLAND	32.10	4.47%
	4440	MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND	15.44	2.15%
URBAN 294.97 acres 41.05%	1110	RESIDENTIAL, HIGH DENSITY OR MULTIPLE DWELLING	15.58	2.17%
	1120	RESIDENTIAL, SINGLE UNIT, MEDIUM DENSITY	48.68	6.78%
	1130	RESIDENTIAL, SINGLE UNIT, LOW DENSITY	92.76	12.91%
	1140	RESIDENTIAL, RURAL, SINGLE UNIT	54.80	7.63%
	1200	COMMERCIAL/SERVICES	32.30	4.50%
	1300	INDUSTRIAL	10.60	1.48%
	1400	TRANSPORTATION/COMMUNICATION/UTILITIES	2.36	0.33%
	1462	UPLAND RIGHTS-OF-WAY DEVELOPED	1.73	0.24%
	1463	UPLAND RIGHTS-OF-WAY UNDEVELOPED	6.69	0.93%
	1700	OTHER URBAN OR BUILT-UP LAND	6.04	0.84%
	1710	CEMETERY	14.46	2.01%
	1800	RECREATIONAL LAND	7.48	1.04%
	1804	ATHLETIC FIELDS (SCHOOLS)	1.50	0.21%
WATER 14.49 acres 2.02%	1419	BRIDGE OVER WATER	0.18	0.03%
	5100	STREAMS AND CANALS	13.76	1.91%
	5190	EXPOSED FLATS	0.55	0.08%
WETLANDS 57.18 acres 7.96%	1461	WETLAND RIGHTS-OF-WAY	0.67	0.09%
	1711	CEMETERY ON WETLAND	0.29	0.04%
	1750	MANAGED WETLAND IN MAINTAINED LAWN GREENSPACE	1.02	0.14%
	2140	AGRICULTURAL WETLANDS (MODIFIED)	0.01	0.00%
	6210	DECIDUOUS WOODED WETLANDS	53.20	7.40%
	6231	DECIDUOUS SCRUB/SHRUB WETLANDS	1.89	0.26%
	6240	HERBACEOUS WETLANDS	0.11	0.02%
		Total:	718.48	100.00%
Source: NJDEP, 2015				

B. Wildfire Fuel Hazard

The New Jersey Forest Fire Service (NJFFS), a division of NJDEP, assessed *Wildfire Fuel Hazard* (WFH) throughout New Jersey (see **Figure 7d**). The purpose is to provide information for NJ Forest Fire Service personnel, government agencies, and others interested in assessing WFH throughout New Jersey. Modified Anderson Land Use/Land Cover Classifications from the 2002 Land Use/Land Cover dataset were assigned Wildfire Fuel Hazard Rankings (0 = Water, 1 = Low, 2 = Moderate, 3 = High, 4 = Very High, 5 = Extreme, 6 = Urban, 7 = Agriculture, 8 = Barren Land). Areas with 30% or greater slope and Wildfire Fuel Hazard 1 to 4 were increased by 1 (e.g. Low became Moderate, etc.) (NJDEP, 2009).

Roughly half of Frenchtown is classified as

Table 7.2 Wildfire Fuel Hazard

Fuel Hazard	Fire Description	Acres	Percent
0	water	8.7	9.4
1	low	124.8	16.2
2	moderate	143.5	17.8
3	high	23.4	2.8
4	very high	12.9	1.4
5	extreme	127.1	16.1
6	urban	214.8	27.8
7	agriculture	62.6	8.4
8	barren land	0.6	0.1
	Total	718.5	100.0%

Legend

- Frenchtown Borough
- Roads
- Parcels
- Redevelopment Zone

2012 Land Cover: Agriculture Type

- 2100: Cropland and pastureland
- 2400: Other agriculture

2012 Land Cover: Forest Type

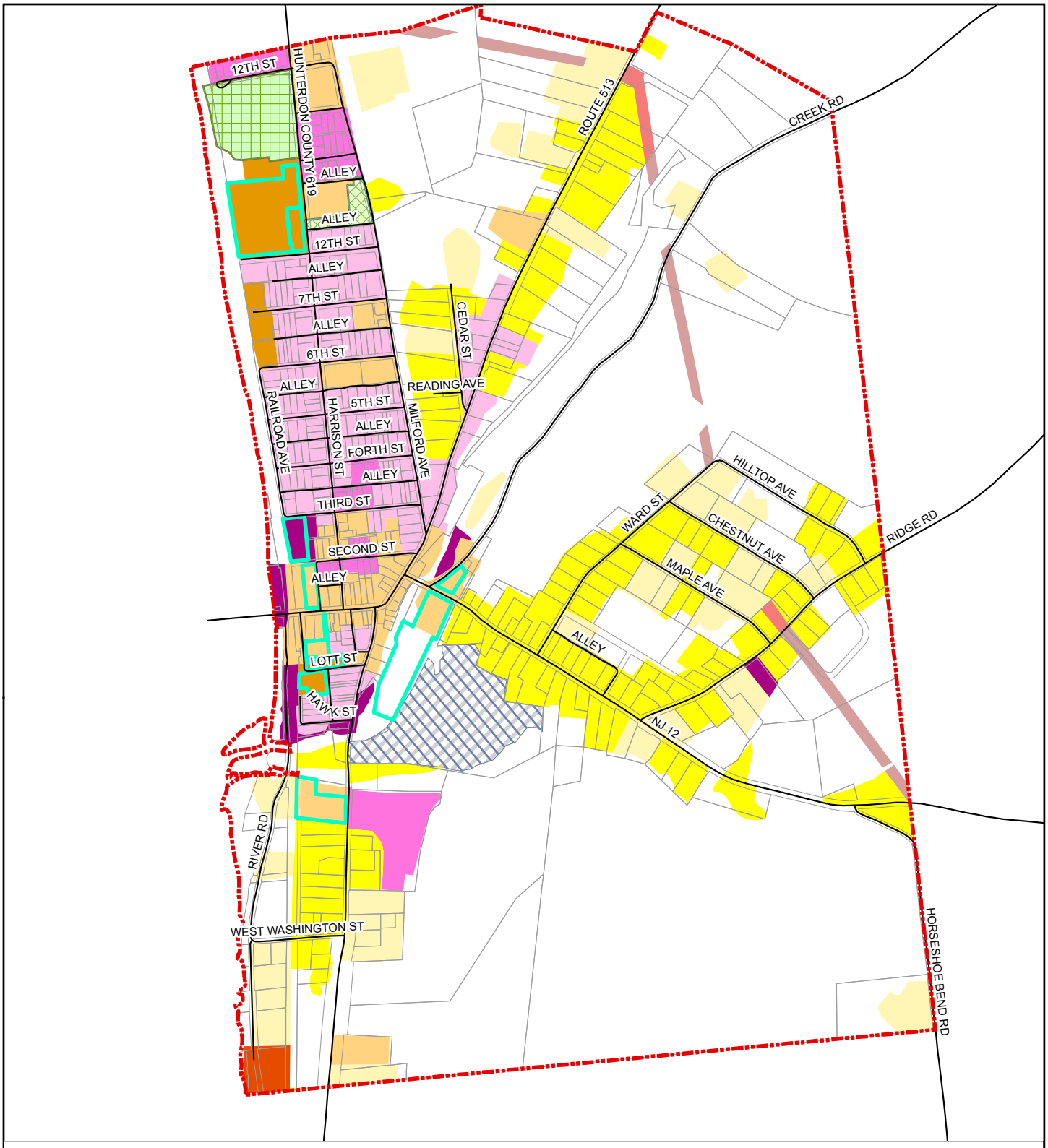
- 4110: Deciduous Forest (10-50% crown closure)
- 4120: Deciduous Forest (>50% crown closure)
- 4210: Coniferious Forest (10-50% crown closure)
- 4220: Coniferous Forest (>50% crown closure)
- 4311: Mixed Forest (>50% con. w/10-50% crown closure)
- 4312: Mixed Forest (>50% con. w/>50% cc)
- 4321: Mixed Forest (>50% dec. w/10-50% cc)
- 4322: Mixed Forest (>50% dec. w/>50% cc)
- 4410: Old Field (< 25% brush covered)
- 4420: Deciduous Brush/Shrubland
- 4430: Coniferous Brush/Shrubland
- 4440: Mixed Dec./Con. Brush/Shrubland

0 0.25 0.5 Miles

N

Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 7a: Borough of Frenchtown 2012 Land Cover: Agriculture and Forest



Legend

- Frenchtown
- Roads
- Parcels
- Redevelopment Zone

2012 Land Cover: Urban Type

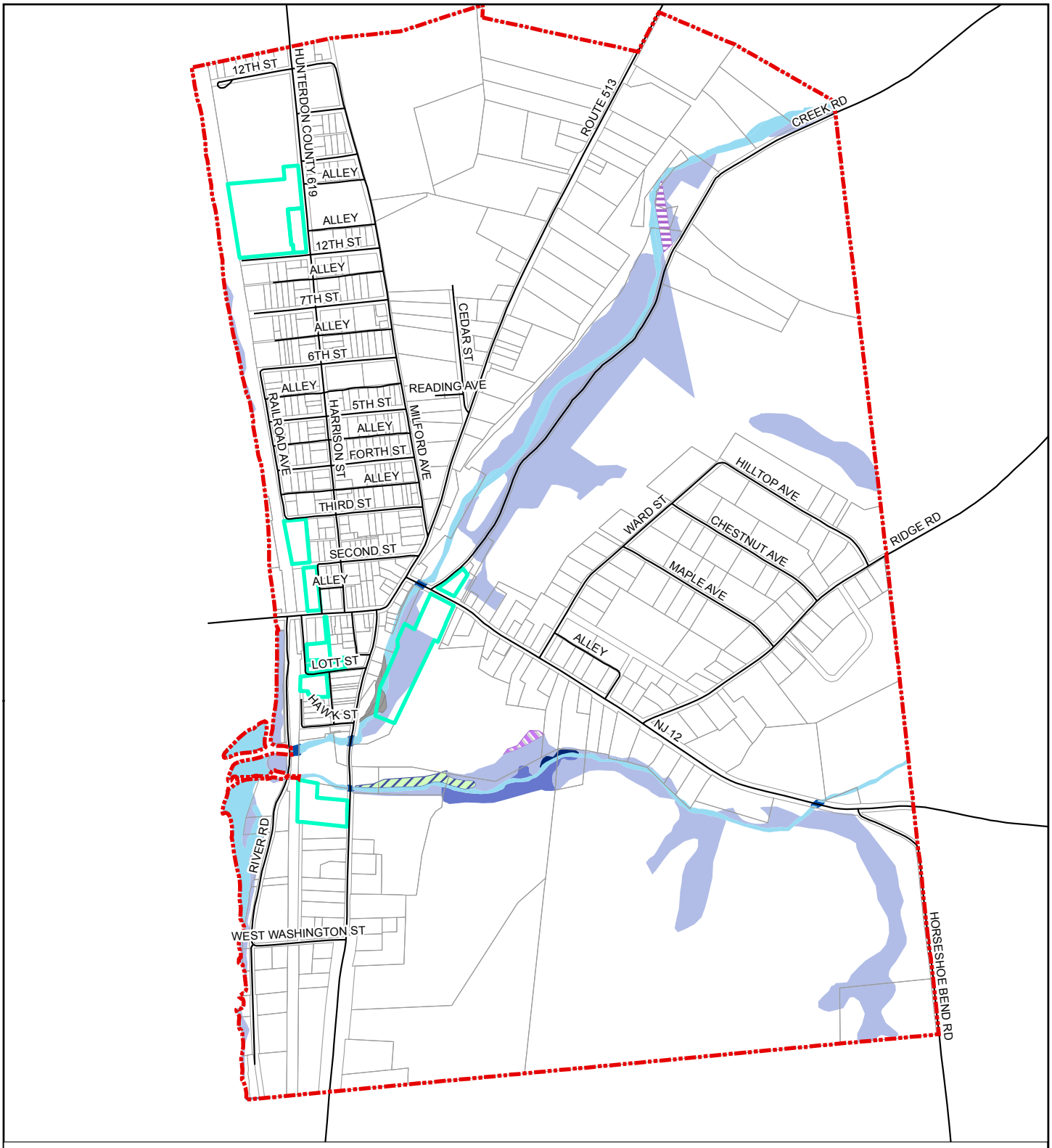
- 1110: Residential, high density/multiple dwelling
- 1120: Residential, single unit, medium density
- 1130: Residential, single unit, low densitiy
- 1140: Residential, rural, single unit
- 1200: Commercial/services
- 1300: Industrial
- 1400 Transportation/Communication/Utilities
- 1462: Upland rights-of-way (ROW) developed
- 1463: Upland ROW undeveloped
- 1700: Other urban/built-up land
- 1710: Cemetery
- 1800: Recreational Land
- 1804: Athletic fields (schools)

0 0.25 0.5 Miles

N

Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 7b: Borough of Frenchtown 2012 Land Cover: Urban



Legend

- Frenchtown
- Roads
- Parcels
- Redevelopment Zone

2012 Land Cover: Water Type

- 1419: Bridge Over Water
- 5100: Streams and Canals
- 5190: Exposed Flats

2012 Land Cover: Wetlands Type

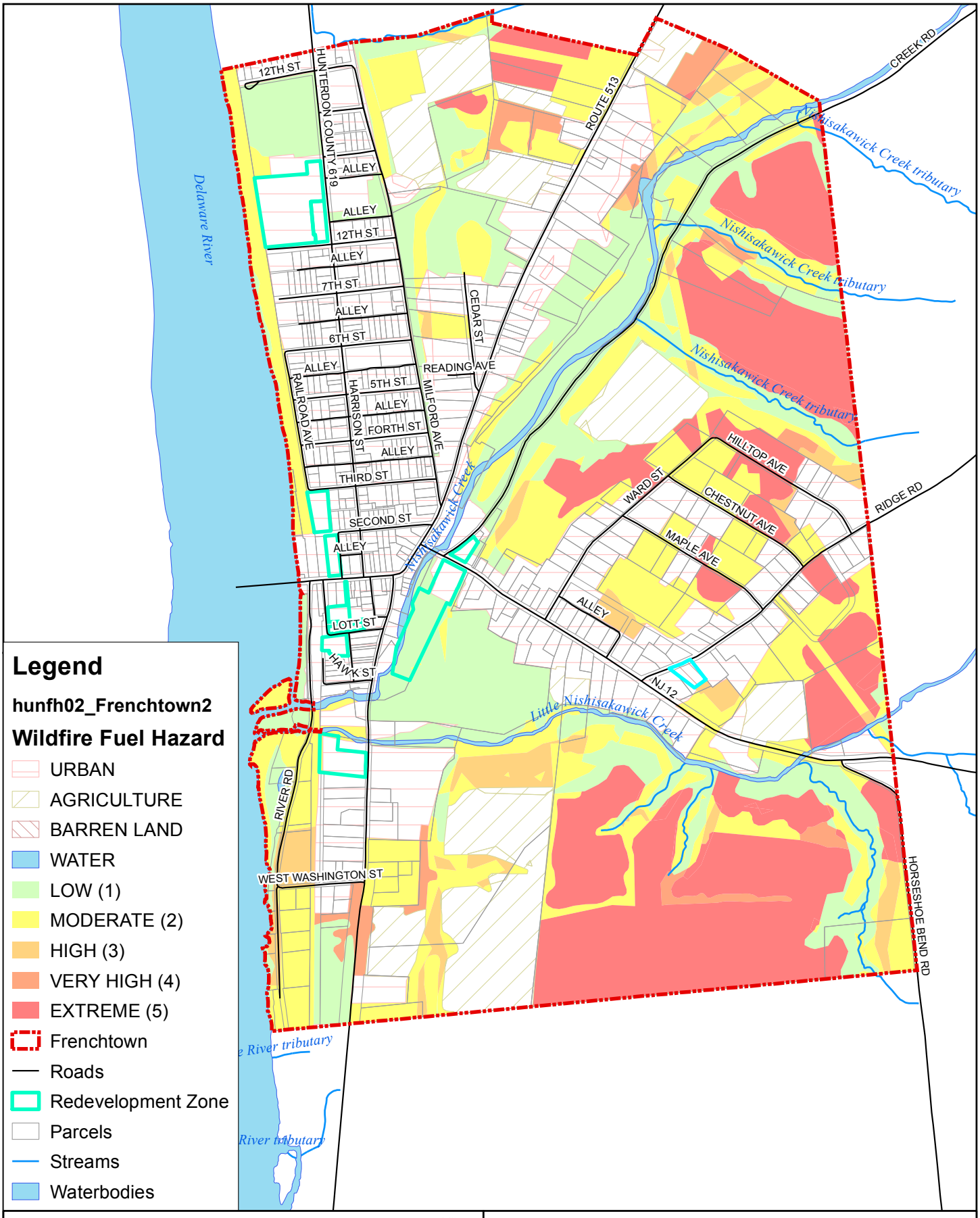
- 1461: Wetland rights-of-way
- 1711: Cemetery on wetland
- 1750: Managed wetland in maintained lawn greenspace
- 2140: Agricultural wetlands (modified)
- 6210: Deciduous wooded wetlands
- 6231: Deciduous scrub/shrub wetlands
- 6240: Herbaceous wetlands

0 0.25 0.5 Miles

N

Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 7c: Borough of Frenchtown 2012 Land Cover: Water and Wetlands



Legend

hunfh02_Frenchtown2

Wildfire Fuel Hazard

- URBAN
- AGRICULTURE
- BARREN LAND
- WATER
- LOW (1)
- MODERATE (2)
- HIGH (3)
- VERY HIGH (4)
- EXTREME (5)
- Frenchtown
- Roads
- Redevelopment Zone
- Parcels
- Streams
- Waterbodies

0 0.25 0.5 Miles

N

Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 7d: Borough of Frenchtown Wildfire Fuel Hazard

Urban or Agricultural Land. Undeveloped areas reflect a gradient from Low to Extreme WFH. Mature deciduous forests, such as those found along the river and bordering the creeks, have less undergrowth, and therefore are low to moderate fire hazards. Approximately 20% of the borough is evaluated as high, very high or extreme wildfire fuel hazard. Most of the areas with Very High or Extreme WFH are in the portions of the borough with brush/shrubland, old fields or coniferous forest.

C. Wildlife

New Jersey hosts 323 bird species, 89 mammal species, 44 reptile, 34 amphibian, 90 freshwater fish and over 300 marine finfish species (NJDEP 2004a, 2004b, 2016). This high diversity in such a small state is partly due to New Jersey's geographic position where northern ecosystems reach their southern limit and where southern ecosystems reach their northern limit. In addition, the state provides a wide variety of habitats including mountains, valleys, rolling hills, wetlands, pinelands, beaches, estuaries and rivers. The NJDEP website offers checklists for the birds, mammals, reptiles and amphibians of New Jersey; with notes on the status of each (e.g. common or rare) (see **Internet Resources**). A variety of plant and animal species may enjoy Frenchtown's diversity of habitat types.

Birds

To date, 316 species of birds have been documented in Hunterdon County (Sullivan et. al., 2009), but the list may be revised with additional sightings and surveys (see **Appendix C.1**). Twenty-nine of those species are only rare visitors to New Jersey, and are not included on the NJDEP list of state birds. In addition to those exceptional sightings, an impressive 89% (287 species) of the birds included on the state list may be seen at least occasionally in Hunterdon County. Endangered, threatened and special concern birds are discussed in **Section 7E,** and non-indigenous birds in **Section 7G**. The Canada goose, a native species which may disproportionately affect the environment, is discussed below.

Canada Goose

The Canada goose (*Branta canadensis*) is one of New Jersey's most easily recognized birds, with its black head and neck, white check patch and undersides, brown back and large size (2'-3' tall, 10-12 lbs.). There are two distinct populations in New Jersey: migratory geese that visit the state in the winter and non-migratory geese that nest in the state. Sources have estimated the state population of resident Canada geese at approximately 83,000 to 96,800 (USDA, January 2003; NJDEP, March 2001).

While many people enjoy the sight of a few geese, this high population of non-migrating geese can cause the following problems:

- overgrazing of lawns and athletic fields, which impacts aesthetics and causes erosion
- damage to cropland, increasing erosion hazard and crop losses
- accumulations of feces on land, creating a health risk from disease-causing organisms
- degradation of water quality, from fecal bacteria, nitrogen and phosphorous

- hazards to aircraft at airports
- aggression and attacks on humans
- noise (USDA, January 2003; NJDEP, March 2001).

As migratory game species, Canada geese are afforded federal and state protection. Therefore, any management techniques involving handling nests, eggs or birds require a permit (NJDEP Division of Fish and Wildlife, No date).

Mammals

Twenty-eight of the 89 mammals listed on the NJDEP checklist are restricted to marine environments, leaving 61 species that may be observed at various locations around the state (**Appendix C.2**). Some of the listed mammals are limited to specific regions within the state, while others enjoy a wide range. A mammal list is not available specifically for either Hunterdon County or the Borough. Endangered mammals are discussed in **Section 7E,** and non-indigenous mammals in **Section 7G**. Two large native mammals that frequently clash with the human population are discussed below.

Black Bear

Black bears (*Ursus americanus*), the largest land mammals in the state, have been documented in every county in New Jersey (NJ Division of Fish & Wildlife, 2017). After indiscriminate hunting and habitat loss for centuries, the bear population has rebounded in the last 30 years. The 2012 bear population was estimated at approximately 2,800-3,000 in the area north of I-80 and west of I-287, where the largest proportion of New Jersey's bears reside (NJ Division of Fish & Wildlife, 2012). Estimates were not available for the rest of the state.

Bears 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. They 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 (NJ Division of Fish & Wildlife, 2017). The Division of Fish and Wildlife offers information and techniques for damage and nuisance prevention (see **Internet Resources**).

White-tailed Deer

The white-tailed deer (*Odocoileus virginianus*), the largest herbivore living wild in New Jersey, is seen frequently in and around Frenchtown. Although the deer is a large animal, individuals tend to stay in a one square mile or less home range, one of the smallest ranges among wild ruminants (Burnett, 2004).

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 by unregulated hunting. However, efforts to protect the deer herd were so successful that deer were considered over-populous by the 1920's (Latham et al, 2005). In

addition, deer have been able to adapt to human-altered habitats. Studies have shown that deer densities of over 10-15 per square mile have negative impacts on the diversity of understory vegetation and on the native songbird and wildflower populations that depend on a diverse understory, while deer populations in excess of 20 per square mile prevent tree regeneration (Latham et al, 2005).

Where deer are overabundant, this results in excessive damage to agricultural crops, gardens and residential landscaping; an increased incidence of deer/vehicle collisions; prevention of forest regeneration (which impacts plants and animals dependent on the forest); and the potential for reduced deer health due to inadequate nutrition and the spread of disease (Honachefsky, 2000; Latham et al, 2005; Sauer, 1998). Despite these impacts, deer remain a natural part of the ecosystem, and are not solely responsible for diversity loss and habitat degradation.

Documentation of deer population numbers is not available for Hunterdon County or Frenchtown, therefore it is unknown whether the population exceeds either the number that can be sustained over an extended period (*ecological carrying capacity*) or the number that can coexist compatibly with local human populations (*cultural carrying capacity*) (NJDEP, 1999).

The state is divided into 70 Deer Management Zones (DMZs), with differing deer hunting regulations applied to different DMZs. The portion of Frenchtown north of Route 12 falls within DMZ 10, while the rest of the borough is in DMZ 11. Both zones utilize the same regulations (Regulation Set 8). Data from the 2015-16 season indicate that 2,182 deer were harvested in zone 10 and 1,369 in Zone 11 (NJDEP Division of Fish and Wildlife, February 13, 2017).

Reptiles and Amphibians

Of the 39 non-marine reptile species recorded in New Jersey, 23 have ranges which include Hunterdon County (**Appendix C.3**). Similarly, there are 34 species of amphibians in the state, 25 of which range into Hunterdon County (**Appendix C.4**). Although lists of reptiles and amphibians (collectively known as herptiles) are not maintained by county, their potential presence in the Hunterdon area can be extrapolated from the species range maps provided by the state's Division of Fish and Wildlife (NJDEP, Division of Fish & Wildlife, June 6, 2016). Endangered, threatened and special concern herptiles are discussed in **Section 7E,** and the sole non-indigenous reptile is mentioned in **Section 7G**.

Fish

The New Jersey Division of Fish and Wildlife (2016) currently reports a total of 90 freshwater fish species in the state (**Appendix C.5**), although one of those (the longnose gar) is considered extirpated. Roughly two-thirds of those species are native to the state, while the others have been introduced either accidentally or deliberately. Some species introduced as game fish have become naturalized, while others do not readily reproduce and are repeatedly stocked for recreational purposes (NJ Division of Fish & Wildlife, 2016). Endangered fish species are discussed in **Section 7E,** and non-indigenous fish in **Section 7G**.

Recreational fishing is available in Frenchtown (with a license and subject to fishing regulations). Frenchtown is noted as a choice location to fish on the Delaware River (Recreational Boating and Fishing Foundation, September 13, 2013). Trout are stocked in the Nishisakawick Creek, and pulloffs located along Creek Road provide access to those waters (NJDEP Division of Fish and Wildlife, June 4, 2013).

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 (Conserve Wildlife Foundation, 2002).

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. In addition, many rare species depend on large tracts of continuous undisturbed habitat to survive. If these habitats are interrupted by developed areas, the patches may become too small to support certain species.

The NJ Endangered Species Conservation Act was signed into law on December 14, 1973 (N.J.S.A. 23:2A-1 - 15), preceding the federal Endangered Species Act by two weeks. This milestone legislation established laws to protect and restore the state's endangered and threatened wildlife whose survival in New Jersey is imperiled by loss of habitat, over-exploitation, pollution, or other impacts (NJDEP, October 6, 2004). In February 2012, NJDEP updated the Endangered and Nongame Species rules (N.J.A.C. 7:25), revising the species list based on science, upgrading the status of some recovering species and adding some declining species to the list (NJDEP Division of Fish and Wildlife, April 2, 2012 and January 18, 2011).

Table 7.3 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. People should use the appropriate reporting forms (see **Internet Resources** and **Appendix D.1 and D.2)**.

Table 7.3: Definitions of Species Status

STATE STATUS	STATE STATUS DEFINITIONS
Animals: Two animal lists provide state status codes after the Endangered and Nongame Species Conservation Act of 1973 (N.J.S.A. 23:2A-13 et. seq.): the list of endangered species (N.J.A.C. 7:25-4.13) and the list defining status of indigenous, nongame wildlife species of New Jersey (N.J.A.C. 7:25-4.17(a)). The status of animal species is determined by the Endangered and Nongame Species Program (ENSP), with the review and approval of the Endangered and Nongame Species Advisory Committee. Status for animals separated by a slash(/) indicate a dual status. First status refers to the state breeding population, and the second status refers to the migratory or winter population.	

E	An **endangered species** is one whose prospects for survival within the state are in immediate danger due to one or many factors - a loss of habitat, over exploitation, predation, competition, disease. An endangered species requires immediate assistance or extinction will probably follow.
T	A **threatened species** is a species that may become endangered if conditions surrounding the species begin to or continue to deteriorate.
SC	The term **Special Concern** applies to animal 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 a Threatened species. 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.
S	A **stable species** is one whose population is not undergoing any long-term increase/decrease within its natural cycle.
U	An **undetermined species** is one about which there is not enough information available to determine the status.
Plants: Plant taxa listed as endangered are from New Jersey's official Endangered Plant Species List (N.J.A.C. 7:5C – 5.1).	
E	Native New Jersey plant species whose survival in the State or nation is in jeopardy.
FEDERAL STATUS	**FEDERAL STATUS DEFINITIONS**
LE	Taxa formally listed as **endangered.**
LT	Taxa formally listed as **threatened.**
REGIONAL STATUS	**REGIONAL STATUS CODES FOR PLANTS AND ECOLOGICAL COMMUNITIES**
LP	Indicates taxa listed by the **Pinelands Commission** as endangered or threatened within their legal jurisdiction. Not all species currently tracked by the Pinelands Commission are tracked by the Natural Heritage Program. A complete list of endangered and threatened Pineland species is included in the NJ Pinelands Comprehensive Management Plan.
HL	Indicates taxa or ecological communities protected by the **Highlands Water Protection and Planning Act** within the jurisdiction of the Highlands Preservation Area.
GLOBAL & STATE CODE	The Nature Conservancy developed a ranking system for use in identifying elements (rare species and ecological com-munities) of natural diversity most endangered with extinction. Each element is ranked according to its global, national, and state (or subnational in other countries) rarity. These ranks are used to prioritize conservation work so that the most endangered elements receive atten-tion first. Definitions for element ranks are after The Nature Conservancy (1982: Chapter 4, 4.1-1 through 4.4.1.3-3).
GLOBAL CODE	**GLOBAL ELEMENT RANK DEFINITIONS**
G1	**Critically imperiled globally** because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.
G2	**Imperiled globally** because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.
G3	Either **very rare and local throughout its range or found locally** (even abundantly at some of its locations) in a restricted range (e.g., a single western state, a physiographic region in the East) or because of other factors making it vulnerable to extinction throughout its range; with the number of occurrences in the range of 21 to 100.
G4	**Apparently secure globally**; although it may be quite rare in parts of its range, especially at the periphery.
G5	**Demonstrably secure globally**; although it may be quite rare in parts of its range, especially at the periphery.
GH	Of **historical occurrence** throughout its range i.e., formerly part of the established biota, with the expectation that it may be rediscovered.
STATE CODE	**STATE ELEMENT RANK DEFINITIONS**
S1	**Critically imperiled in New Jersey** because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres). Elements so ranked are often restricted to very specialized conditions or habitats and/or restricted to an extremely small geographical area of the state. Also included are elements 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 elements 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 elements may have been more frequent but are now known from very few extant occurrences, primarily because of habitat destruction. Diligent searching may yield additional occurrences.
S3	**Rare in state** with 21 to 100 occurrences (plant species and ecological communities in this category have only 21 to 50 occurrences). Includes elements which are widely distributed in the state but with small populations/acreage or elements with restricted distribution, but locally abundant. Not yet imperiled in state but may soon be if current trends continue. Searching often yields additional occurrences.
S4	**Apparently secure** in the state, with many occurrences.
S5	**Demonstrably secure** in state and essentially ineradicable under present conditions.
SH	Elements of **historical occurrence** in New Jersey. Despite some searching of historical occurrences and/or potential habitat, no extant occurrences are known. Since not all of the historical occurrences have been field surveyed, and unsearched potential habitat remains, historically ranked taxa are considered possibly extant, and remain a conservation priority for continued field work with the expectation they may be rediscovered.
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: NJDEP Division of Fish and Wildlife, March 22, 2010	

Endangered, Threatened & Special Concern Animals

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 50 endangered, 36 threatened and 100 species currently listed as special concern (NJDEP Division of Fish and Wildlife, April 2, 2012 and February 21, 2012). For state-wide species lists, see **Internet Resources**.

A search of NJDEP Division of Parks and Forestry *Natural Heritage Database* in December 2016 revealed the documented presence of 15 rare animal species in Frenchtown (see **Tables 7.3** for code definitions and **Table 7.4** for list)**.** The shortnose sturgeon, which occurs in the Delaware River, is listed as Endangered at both the federal and state level. Two bird species are also listed as endangered in New Jersey. Species on the state Threatened list include one amphibian, three birds, a reptile and a bivalve. Special concern animal species, which warrant concern due to evidence of decline or vulnerability, include five birds and an insect. One additional state Threatened species, the osprey (*Pandion haliaetus*), is known from the immediate vicinity of Frenchtown but has not been officially documented within the Borough. A summary of the habitat requirements for each species is provided in **Appendix D.3**.

Of the 316 bird species that have been documented in Hunterdon County, 65 (about 20%) are listed as Endangered, Threatened or Special Concern (**Appendix D.4**). Although Frenchtown Borough occupies a relatively

small portion of the county, it has a number of features that would make it attractive to a variety of bird species. These include a large parcel of open space, high quality stream corridors, a position along the Delaware River, and adjacent preserved lands. In addition to the ten rare bird species currently documented in the vicinity via the Natural Heritage Database, it is likely that a number of additional rare birds utilize habitat within the Borough.

Table 7.4: Natural Heritage Database Animal Species in Frenchtown

Class	Common Name	Scientific Name	Feature Type	LP Rank	Protection Status	Global Rank	State Rank
Amphibia	Longtail Salamander	*Eurycea l. longicauda*	Occupied habitat	3	State Threatened	G5T5	S2
Aves	American Kestrel	*Falco sparverius*	Breeding sighting	3	State Threatened	G5	S2B, S2N
	Bald Eagle	*Haliaeetus leucocephalus*	Foraging	4	State Endangered	G5	S1B, S2N
	Bald Eagle	*Haliaeetus leucocephalus*	Nest	4	State Endangered	G5	S1B, S2N
	Bobolink	*Dolichonyx oryzivorus*	Breeding sighting	3	State Threatened	G5	S2B, S3N
	Brown Thrasher	*Toxostoma rufrum*	Breeding sighting	2	NJ Special Concern	G5	S3B, S4N
	Cliff Swallow	*Petrochelidon pyrrhonota*	Breeding sighting, confirmed	2	NJ Special Concern	G5	S3B, S3N
	Eastern Meadowlark	*Sturnella magna*	Breeding sighting	2	NJ Special Concern	G5	S3B, S3N
	Grasshopper Sparrow	*Ammodramus savannarum*	Breeding sighting	3	State Threatened	G5	S2B, S3N
	Great Blue Heron	*Ardea herodias*	Foraging	2	NJ Special Concern	G5	S3B, S4N
	Red-shouldered Hawk	*Buteo lineatus*	Breeding sighting	4	State Endangered	G5	S1B, S3N
	Wood Thrush	*Hylocichla mustelina*	Breeding sighting	2	NJ Special Concern	G5	S3B
Insecta	Cobra Clubtail	*Gomphus vastus*	Exuviae sighting	2	NJ Special Concern	G5	S3
	Cobra Clubtail	*Gomphus vastus*	Territorial display	2	NJ Special Concern	G5	S3
Osteichthyes	Shortnose Sturgeon	*Acipenser brevirostrum*	Summering area, Adult sighting	5	Federal & State Endangered	G3	S1
Reptilia	Wood Turtle	*Glyptemys insculpta*	Occupied habitat	3	State Threatened	G4	S2
Bivalvia	Yellow Lampmussel	*Lampsilis cariosa*	Occupied habitat	3	State Threatened	G3G4	S2

Note: See **Table 7.2** for Global and State Rank definitions, and **Table 7.5** for Landscape Project Rank definitions.

Source: Natural Heritage Program, December 15, 2016

Endangered, Threatened & Special Concern Plants

The Endangered Plant Species List Act (N.J.S.A. 13:1B-15.151) was enacted in 1989, defining endangered plants as "any native plant species whose survival in the State or the nation is in jeopardy... and any species having five or fewer extant populations within the State." The Division of Parks and Forestry has the responsibility of creating the list of NJ endangered plant species (N.J.A.C. 7:5C–1.1). While the rule does not provide any protection for officially listed species, several regulatory agencies within NJDEP responsible for protecting plant habitat have incorporated the Endangered Plant Species List into their criteria for review of permits (NJDEP Division of Parks and Forestry, January 4, 2007).

Table 7.5: Natural Heritage Database Plant Species in Frenchtown

Scientific Name	Common Name	Federal Status	State Protection
Cystopteris protrusa	Lowland Fragile Fern		
Regional Status	**Global Rank**	**State Rank**	**Last Observed**
HL	G5	S2 (Imperiled in NJ)	2015-07-08

Description: Spleenwort family (Aspleniaceae)
Rhizomes long-creeping, with the growing tip of the rhizome extending 1-4 cm beyond the cluster of fronds of the season by midsummer; fronds bipinnate-pinnatifid, up to 40 cm long; stipes dark at the base, usually straw-colored above; blades lanceolate and acute but not long-attenuate at the apex, without bulblets.
Habitat:
Alluvial soil in floodplain woods. Recent record from Frenchtown Boro Park.

Scientific Name	Common Name	Federal Status	State Protection
Ribes missouriense	Missouri Gooseberry		E
Regional Status	**Global Rank**	**State Rank**	**Last Observed**
LP, HL	G5	S2 (Imperiled in NJ)	2016-06-08

Description: Gooseberry family (Grossulariaceae)
Shrub with stout nodal spines; lobed leaves with a rotund outline, the two principal sinuses extending nearly to the middle; flowers white or pinkish in age, solitary or in small corymbiform clusters, sepals reflexed; stames at full anthesis evidently longer than the sepals; fruit red to purple.
Habitat:
Moist or dry upland woods. Recent records from Kingwood Township.

Note: For status and rank definitions, refer to **Table 7.2.**

Sources: NJDEP ONLM, December 15, 2016; Description and illustration of *Cystopteris protrusa* from Montgomery and Fairbrothers, 1992; Description of *Ribes missouriense* from Gleason and Cronquist, 1991.

Information on the rare plants and natural communities of NJ is tracked in the *New Jersey Natural Heritage Database* by the NJDEP Office of Natural Lands Management (ONLM). A search of the Natural Heritage Database in December 2016 revealed, based on data currently

recorded in the database, the possibility of two special concern plants in Frenchtown (see **Table 7.6** for code definitions and **Table 7.5** for the species list). Both are ranked as S2 (imperiled) in New Jersey due to rarity (6 to 20 occurrences in the state) (NJDEP ONLM, December 2015).

Appendix D.5 includes a list of Hunterdon County rare plant species and natural communities. The species found in nearby locations within the county could be present in Frenchtown if suitable habitat is present within the Borough.

E. Protecting Endangered, Threatened and Special Concern Species

Wildlife Action Plan

NJDEP Division of Fish and Wildlife prepared a Wildlife Action Plan (WAP) in 2008, required by the US Fish and Wildlife Service in order to qualify for future federal funds through the State Wildlife Grants program. This program provides federal funds to states for the conservation of species that are endangered, threatened, or have special conservation needs. A 25% match, provided by citizen contributions, is required. NJ has received approximately $1.2 million dollars of State Wildlife Grants funding each year (NJDEP, January 23, 2008).

The report states,

> "The greatest threats to NJ's natural resources include habitat loss, destruction, alteration, and fragmentation. This has been a recurring theme within NJ for years as it is the most densely populated state in our nation with an annually increasing population requiring additional homes, roads, commercial buildings, schools, etc. Additional threats include, but are not limited to, invasive species (flora and fauna, aquatic and terrestrial), pollution, and unsustainable land management practices." (NJDEP, January 23, 2008)

A WAP specific to each region identifies habitats, wildlife of greatest conservation need, and threats. Conservation goals and actions are identified and prioritized, and potential partnerships are outlined with landowners, the public and conservation organizations, wildlife professionals and local, state and federal agencies. Frenchtown is in the Skylands Landscape region.

The Landscape Project

The state's *Landscape Project* (see **Figure 7g**) 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 (NJDEP Division of Fish and Wildlife, 2012).

The NJDEP, Division of Fish and Wildlife, Endangered and Nongame Species Program is responsible for the Landscape Project. Version 3.1 was released in 2012. The dataset was created by intersecting endangered, threatened and priority species data with the 2007 Land Use/Land Cover GIS layer, which was derived from aerial photography. The resulting data layer identifies, delineates and ranks (based on the conservation status of species present) critical habitat statewide. **Table 7.5** lists rank definitions. Each habitat patch is coded for the number of special concern, state threatened, state endangered and federally listed species present.

Most of the undeveloped land in Frenchtown is ranked as habitat for priority species according to the Landscape Project Version 3.3. The section of the Delaware River is Rank 3 for the presence of a state threatened species (yellow lampmussel). Thirty-two percent of the borough is Rank 4 for the presence of state endangered species; 20% is Rank 3 for state threatened species; and 6% is Rank 2 for special concern species (see **Table 7.6** and **Figure 7e)**.

Table 7.6: Landscape Project Habitat Rank Definitions

Rank	Definition
1	**Suitable Habitat** – Rank 1 is assigned to patches that meet habitat-specific suitability requirements such as minimum size criteria for endangered, threatened or priority wildlife species, but that do not intersect with any confirmed occurrences of such species.
2	**Special Concern** – Rank 2 is assigned to patches containing one or more occurrences of species considered to be species of special concern
3	**State Threatened** – Rank 3 is assigned to patches containing one or more occurrences of State threatened species.
4	**State Endangered** – Rank 4 is assigned to patches with one or more occurrences of State endangered species.
5	**Federally Listed** – Rank 5 is assigned to patches containing one or more occurrences of wildlife listed as endangered and threatened pursuant to the Federal Endangered Species Act of 1973.
Source: NJDEP Division of Fish and Wildlife, 2012	

Table 7.7: Landscape Project v.3.3

Rank	Definition	Acres	Percent
Rank 1	Suitable Habitat	138.6	19.3%
Rank 2	Special Concern	46.5	6.5%
Rank 3	State Threatened	157.2	21.9%
Rank 4	State Endangered	115.9	16.1%
Rank 5	Federally Listed	0.0	0.0%
No rank	No documented habitat	260.4	36.2%
Total Acres		718.5	100.0%

Source: NJDEP DFW, Endangered Nongame Species Program. May 9, 2017

Natural Heritage Grid and Priority Sites

The NJDEP Office of Natural Lands Management (ONLM) has developed the Natural Heritage Grid Map which provides a general representation of the locations of rare plant species and natural communities, including both historically and recently documented habitat. The purpose of the Grid Map is to document rare plant species and natural community habitats to inform decision-makers who need to address the conservation of natural resources.

According to a Natural Heritage Program data request dated December 15, 2016, the species recently found within Frenchtown is Lowland Fragile Fern (*Cystopteris protrusa*), which is S2-imperiled in New Jersey (see **Table 7.4** for description). The most recent Grid Map GIS data available (2009) does not reflect this more recent (2015) observation. The Grid Map does not include habitat for animal species, and not all areas have been surveyed (NJDEP ONLM, November 2009).

In addition, the Natural Heritage Program makes lists of New Jersey rare plant species and ecological communities by county (see **Appendix D.5**). If suitable habitat exists in the borough, it is possible that these some of species could be found in Frenchtown (NJDEP ONLM NHP, July 30, 2008).

Legend

- Frenchtown
- Roads
- Redevelopment Zone
- Parcels
- Water

Landscape Project version 3.3 Rank

- Rank 1 - Habitat specific requirements
- Rank 2 - Special Concern
- Rank 3 - State Threatened
- Rank 4 - State Endangered
- Rank 5 - Federal Listed (none in Frenchtown)
- Rank 3 - State Threatened Freshwater Mussel Habitat

0 0.25 0.5 Miles

N

Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 7e: Borough of Frenchtown Landscape Project version 3.3

Natural Heritage Priority Sites have been identified by the ONLM as areas critically important for preservation of New Jersey's biological diversity. These are considered some of the best and most viable occurrences of endangered and threatened plant species and natural communities, but other occurrences of endangered and threatened plant species may exist. There are presently no Natural Heritage Priority Sites in Frenchtown (NJDEP ONLM, 2007).

F. Invasive Nonindigenous Species

Flora

Non-native species (also called alien, exotic or introduced species) are those species that have been introduced outside their natural geographic range as a result of human actions, whether 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). Executive Order 13112 defines an *invasive species* as a species that is non-native to the ecosystem and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (USDA, February 3, 1999). The most problematic of these displace native species, contribute to local elimination of species or even extinctions, alter the community structure, and may eventually disrupt ecosystem processes (Snyder and Kaufman, 2004). Preliminary research in NJ has documented over 1,200 species of nonindigenous plant species, or as much as 62% of the state's total vascular flora (Snyder and Kaufman, 2004).

Native plants can be susceptible to introduced diseases, which they have not evolved resistance to. The chestnut blight fungus was an accidental introduction that destroyed all mature American chestnut (*Castanea dentata*) trees, once one of the dominant trees in the New Jersey landscape. Another introduced fungus, Dutch elm disease, destroyed the American elm (*Ulmus americana*).

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. Introduced insects, which may be impacting Frenchtown's trees, include the hemlock wooly adelgid, gypsy moth, scarlet oak sawfly and Beech Bark Disease (which is caused by a non-native scale insect that introduces a fungal disease) (NJ Forest Service, 2010). They weaken their host trees, which often succumb to successive years of infestation, to diseases carried by the insect pests, such as bacterial leaf scorch, or other environmental stresses.

For these reasons, the Final Report of the New Jersey Comparative Risk Project, which evaluated the relative risks of environmental problems to the people and ecosystems of New Jersey identified invasive species (including plants, insects, and other organisms) as one of the state's top environmental problems (Steering Committee of the New Jersey Comparative Risk Project, 2003).

Some of the most problematic invasive exotic species in Frenchtown include Japanese honeysuckle, Norway maple, autumn olive, multiflora rose, mugwort, barberry and stiltgrass.

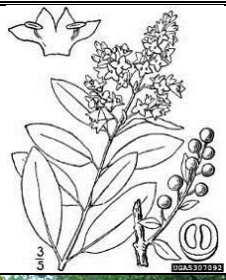
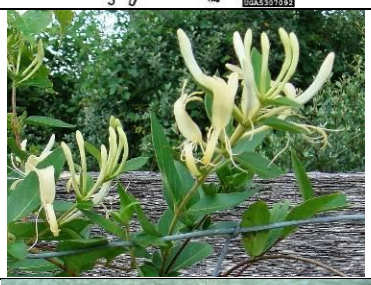
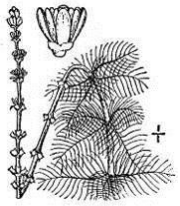
While there is no official invasive species list for New Jersey, An Overview of Nonidigenous Plant Species in New Jersey (Snyder and Kaufman, 2004) profiles 27 well-established nonindigenous plant species that aggressively invade natural plant communities in New Jersey, which are summarized in **Table 7.8**. The New Jersey Invasive Species Strike Team (NJISST) focuses on preventing the spread of newer invasive species throughout the state (NJISST, 2018). Although the NJISST does not currently have any data points located within Frenchtown Borough, the team is tracking 42 invasive species in Hunterdon County, 39 of which are plants (**Appendix E**). The strike team provides links to fact sheets which provide information regarding identification, threat levels and control measures for each species tracked

in their system (NJISST, 2018). Although their focus is on eradicating newly introduced species before they can establish and spread, fact sheets are also available for many of the widespread invasives. Two emerging invasive plants recently found in Frenchtown are shown in **Table 7.9**.

Table 7.8: Invasive Nonindigenous Plants

Scientific Name	Common Name	Problems Caused	Illustration	Illus. Source
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.		Jan Samanek, State Phytosanitary Administration, Bugwood.org
Ailanthus altissima	tree of heaven	Aggressive in disturbed areas, crowding out native plants.		Britton and Brown, 1913, Vol. 2: 446.
Alliaria petiolata	garlic mustard	Aggressive in shady habitats, crowding out native plants.		Deborah J. Kratzer
Artemisia vulgaris	Mugwort or common wormwood	Aggressive, crowding out native plants.		Deborah J. Kratzer
Berberis thunbergii	Japanese barberry	Can grow so thick in the understory of open forests that it shades out indigenous understory plants. Affects soil properties, particularly pH, which can affect plant establishment. Can form nearly impenetrable thorny thickets that impact the recreational value of natural lands.		Deborah J. Kratzer

Scientific Name	Common Name	Problems Caused	Illustration	Illus. Source
Celastrus orbiculatus	Oriental bittersweet	The vine twines around surrounding plants, impeding sap flow. Also makes host plants too heavy, increasing wind, snow & ice damage.		Deborah J. Kratzer
Cirsium arvense	Canada thistle	Competes with crops and degrades pastures (inedible to livestock).		Deborah J. Kratzer
Dipsacus fullonum	wild teasel	Highway mowing equipment and discarded dried teasel heads from flower arrangements can lead to the establishment of new colonies, often forming a monoculture that displaces native communities.		Steve Dewey, Utah State University, Bugwood.org
Elaeagnus umbellate	autumn olive	Sprouts vigorously in disturbed areas, produces shade, preventing sprouting of native trees.		Deborah J. Kratzer
Euonymus alatus	burning bush	Grows well in many sites, especially upland forests and pastures, crowding out native plants.		James H. Miller, USDA Forest Service, Bugwood.org
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.		Deborah J. Kratzer

Scientific Name	Common Name	Problems Caused	Illustration	Illus. Source
Ligustrum vulgare	common privet	Crowds out more desirable native plants.		USDA PLANTS Database, Bugwood.org
Lonicera japonica Thunberg	Japanese honey-suckle	Spreads aggressively in disturbed habitats, crowding out native plants. Aggressive roots can decrease the growth of native trees and vines. Vines engulf small trees and shrubs, causing them to collapse. Leafs out very early in spring, which could inhibit flowering by spring ephemerals.		Deborah J. Kratzer
Lythrum salicaria	purple loosestrife	Spreads aggressively in wetlands, eliminating open water habitats and crowding out native plants. Contributes to the loss of wildlife that depend on native wetland plants.		John D. Byrd, Mississippi State University, Bugwood.org
Microstegium vimenium	Japanese stiltgrass	Spreads aggressively in disturbed, moist, shady areas, crowding out native plants. May raise pH and reduce organic soil horizon.		Deborah J. Kratzer
Myriophyllum spicatum L.	Eurasian water-milfoil	An aquatic plant that begins growing earlier in spring than most indigenous aquatic plants, it quickly overtops, outshades, and outcompetes surrounding vegetation.		Britton and Brown, 1913, Vol. 2: 614.
Miscanthus sinensis	Chinese silver grass	Escapes from ornamental plantings and can form large clumps along disturbed areas, crowding out native vegetation. It is also extremely flammable and increases fire risks where it grows.		James H. Miller, USDA Forest Service, Bugwood.org

Scientific Name	Common Name	Problems Caused	Illustration	Illus. Source
Phyllostachys aurea	Golden bamboo	Forms dense monocultural thickets that crowd out other plants. Difficult to eradicate once established.		Chuck Bargeron, Univ. of Georgia, Bugwood.org
Polygonum cuspidatum	Japanese knotweed	Spreads aggressively in disturbed, sunny areas, especially river banks and wetlands, crowding out native plants.		Tom Heutte, USDA Forest Service, Bugwood.org
Potamogeton crispus L.	curly leaf pondweed	An aquatic plant that begins growing earlier in spring than most indigenous aquatic plants, it quickly overtops, outshades, and outcompetes surrounding vegetation. Can form dense mats that disrupt boating, swimming, and fishing.		Mohlenbrock , 1995
Rosa multiflora	multiflora rose	Spreads everywhere, except standing water, crowding out native plants and degrading pastures.		James H. Miller, USDA Forest Service, Bugwood.org
Rubus phoenicolasius	wineberry	Forms an extensive, nearly impenetrable understory layer in favorable locations such as moist soils in forests over dolomite, marble, shale, diabase, and traprock, crowding out native plants.		Jil M. Swearingen, USDI National Park Service, Bugwood.org
Viburnum plicatum	Japanese viburnum	Shade tolerant shrub considered highly threatening to native plant communities.		Richard Webb, Self-employed horticulturist, Bugwood.org

Scientific Name	Common Name	Problems Caused	Illustration	Illus. Source
Vinca minor	periwinkle	Spreads in shady forests, crowding out native plants.		Jil M. Swearingen, USDI National Park Service, Bugwood.org
Wisteria floribunda and W. sinensis	Japanese and Chinese Wisteria	Aggressive climbing vines that girdle tree trunks and branches. Dense canopies weigh down branches and shade underlying areas.		Ted Bodner at USDA-NRCS PLANTS Database
Sources: Snyder & Kaufmann, 2004; Swearagain et al., 2002; Courtney, 1997; Center for Invasive Species and Ecosystem Health (bugwood.org), 2010; Britton and Brown, 1913; Mohlenbrock , 1995; Bodner at USDA-NRCS PLANTS Database				

Table 7.9: Two Emergent Invasives in Frenchtown

Scientific Name	Common Name	Description	Threat	Location
Anthriscus sylvestris	Wild Chervil	Herbaceous perennial with small white flowers; similar to Queen Anne's lace	moderately threatening native plant communities	found along the Nishisakawick and along the Delaware River corridor in Frenchtown
Rhodotypos scandens	Jetbead	Deciduous multistemmed shrub growing 6' with toothed, opposite leaves and large white 4 petaled flowers in April to June	highly threatening to native communities	found in Frenchtown Preserve
Source: Randi Eckel, personal communication, January 7, 2018; NJISST, 2018				

Loss of Biodiversity

The deciduous forests of Northern New Jersey are not as static as they appear. For many people, the forest is a stable place; trees never move and from year to year they look the same, save the effects of storms and other destructive processes. The truth is, the forests of Northern New Jersey are constantly changing. The presence of invasive species is a hazard to both the function and stability of a healthy forest (Morin et al., 2007). This threat is exacerbated by other factors that stress the ecosystem, such as climate change and direct human interference (Evans et al., 2010). The structure of plant communities and dynamics of the vegetation can be affected, as well as the importance values[37] of the species present in the ecosystem (Morin et al., 2007). There are a large number of species that are having an adverse effect on the forests of New Jersey, however the major contributors are Beech Bark Disease, Dutch Elm Disease, Chestnut Blight and the introduction of the Norway Maple (*Acer platanoides*). All of these invasive species and pathogens were introduced by humanity, both intentionally and unintentionally.

[37] The importance value is a measure of the dominance of a species in a particular community.

Oak and chestnut trees dominated the forest prior to European arrival. **Table 7.10** presents forest inventory data from the USDA Forest Service that shows that forest composition is changing. The American Chestnut (*Castanea dentata*) is completely missing from the forest. All of the species of oak, while still present, are only present in their mature sizes. The most predominant juvenile species group is that of maple. Within that group is the Norway Maple (*Acer platanoides*). This table shows how the mature oak species are being replaced by maples. The process, in conjunction with the effects of the other invasive species, decreases the number of species present in the forest, thus attacking at the roots of the ecosystem and reducing biodiversity.

Table 7.10: Number of Live Trees on Forest Land by Species Group and Diameter Class

Tree species groups	Tree diameter classifications									
	5.0-6.9"	7.0-8.9"	9-10.9"	11-12.9"	13-14.9"	15-16.9"	17-18.9"	19-20.9"	21-28.9"	Total
Select white Oaks (25)	-	-	0	40,122	-	-	-	-	-	40,122
Select red oaks (26)	-	40,122	120,367	40,122	120,367	40,122	120,367	40,122	40,122	561,711
Other white oaks (27)	-	0	40,122	120,367	120,367	-	0	40,122	-	320,978
Hickory (29)	80,244	80,244	-	40,122	-	-	-	-	-	200,611
Yellow birch (30)	80,244	-	-	-	-	-	-	-	-	80,244
Hard maple (31)	40,122	80,244	-	40,122	-	-	-	-	-	160,489
Soft maple (32)	120,367	160,489	80,244	0	80,244	-	40,122	-	-	481,467
Tupelo and black gum (35)	40,122	40,122	80,244	-	-	-	-	-	-	160,489
Ash (36)	-	40,122	-	-	-	-	-	-	-	40,122
Yellow-poplar (39)	-	-	-	-	-		-	40,122	-	40,122
Other eastern hard hardwoods (42)	0	40,122	240,733	-	-	-	-	-	-	280,856
Totals:	361,100	481,467	561,711	280,856	320,978	40,122	160,489	120,367	40,122	2,367,212

Source: USDA Forest Service, 2012 (http://apps.fs.fed.us/fido/standardrpt.html, using the following search terms: Area of Interest=NJ, Bergen County; Reports=Tree Count Reports; Survey Years=2012 (which gives you 2008-2012); Filter Options=none; Submit request; Display 4.1 - Number of live trees (at least 1 inch d.b.h./d.r.c.) by species group and diameter class

Beech Bark Disease

Beech Bark disease is a disease that is decimating the populations of the American Beech tree (*Fagus grandifolia*) in the northeastern areas of its native range (Busby and Canham, 2011). It is a general term given to the combined effects of the beech scale insect (*Cryptococcus fagisuga* Lind.) and two different canker causing fungi, *Neonectria coccinea* var. *faginata* Lohm., a non-native species, and *Neonectria galligena* Bres., a native species (Busby and Canham, 2011; Evans and Finkral, 2010; Morin et al, 2007). The scale insect feeds on the beech bark causing injuries that the fungi use as a vector to enter the tree and infect it. The fungus can also be spread from tree to tree by the insect.

Beech Bark disease came to the continent of North America in Nova Scotia around 1890 and has been spreading ever since (Busby and Canham, 2011) (Morin et al., 20007). It began affecting trees in this area around 1960 (Busby and Canham, 2011). It caused an 80-90% morality rate when first introduced to a new location and the residual effects maintain the population at very low levels (Busby and Canham, 2011). The forest is changing from a healthy population of Beech trees to "diseased thickets of small trees" and indicates a drastic change in the carbon balance of the forest overall (Morin et al., 2011).

Dutch Elm Disease

Dutch Elm Disease is a fungal infection by *Ophiostoma ulmi* (Buisman) Nanf. and *Ophiostoma novo-ulma Basier* (Evans and Finkral, 2010; Flores, 2006). The fungus is spread by exotic beetles that feed in the American Elm tree (*Ulmus americana*) (Evans and Finkral, 2010). The disease enters the xylem and inhibits the tree's ability to transport water and nutrients (Evans and Finkral, 2010).

This disease was introduced to the United States in 1931 (Flores, 2006). It came to Cleveland, Ohio from France aboard elm logs (Flores, 2006). It has been estimated that this disease has killed approximately 77 million elm trees (Flores, 2006).

Chestnut Blight

The American Chestnut (*Castanea dentata*) was once one of the most common species of the deciduous forest of the Eastern United States, making up 25% of trees in many of these forests (Evans and Finkral, 2010). A disease, *Cryphonectria parasitica*, was introduced from Asia that decimated the populations of American Chestnut (Evans and Finkral, 2010; Griffin, 2000). The disease does not fully kill the tree, as it does not affect the roots, however any stem that appears above the surface of the soil is susceptible to the disease (Griffin, 2000). The disease forms a canker on the bark of the tree that attacks the cambium, starving the tree of nutrients and water and killing it (Griffin, 2000).

Chestnut Blight was first observed in New York City in 1904 (Griffin, 2000). It originated somewhere in Asia, likely Japan (Evans and Finkral, 2010). As early as the 1950s, the American Chestnut was "functionally removed from its ecological role" in the forests of Eastern North America (Griffin, 2000).

Norway Maple (Acer platanoides)

Norway Maple (*Acer platanoides*) is native to much of Europe (Galbraith-Kent et al., 2008). It was introduced intentionally in 1756 (Galbraith-Kent et al., 2008).

The Norway maple does not directly attack native species as other invasive species do. Instead, it outcompetes native species for resources and thus causes the native species to become less prevalent. A study performed in 2004-2006 at Duke Farms in Central New Jersey, determined that Norway Maple has a distinct, negative impact on the growth of juvenile native species (Galbraith-Kent et al., 2008). The survey found that the presence of mature Norway Maple has such a negative effect that the presence of juvenile Norway Maple is irrelevant (Galbraith-Kent et al., 2008). When no mature Norway Maple is present, the presence of saplings does have a negative impact on the growth rate of sapling native species (Galbraith-Kent et al., 2008).

Fauna

As with exotic plant species, the introduction of non-native animal species can have a devastating effect on natural communities. This most often occurs due to competition with native animals for limited resources such as food and shelter, but it may also be due to predation on native species. An example of the latter is the feral cat (*Felis domesticus*), which is the sole mammal tracked by the New Jersey Invasive Species Strike Team that is likely to occur in Frenchtown Borough. Feral cats are a widepread problem around the state, and are considered highly threatening to native communities (NJISST, 2018).

Fact sheets with information about identification, threat levels and control measures for invasive animal species are also provided by the Strike Team (NJISST, 2018). All five of the invasive bird species tracked are commonly encountered throughout New Jersey, including Hunterdon County (see **Appendix C.1**), and are likely to be present in Frenchtown. Both the

house finch and the house sparrow are classified as mildly threatening to natural communities. The European starling, which poses a moderate threat to native species, is frequently seen in large flocks: the high count for this species in Hunterdon County was estimated at 20,000 birds in 1991 (Sullivan et. al., 2009). Both the mute swan and brown-headed cowbird are rated as highly threatening to native communities. In addition to competing with native birds for resources, the brown-headed cowbird is a brood parasite, laying its eggs in the nests of other bird species, which then raise the young cowbirds at the expense of their own offspring.

The sole invasive reptile likely to be encountered in Hunterdon County is the red-eared slider, which is classified as highly threatening. This turtle is widespread in New Jersey, and may be found in ponds, lakes, swamps, streams, or slow-flowing rivers. No amphibians are currently tracked by NJISST.

The state Division of Fish and Wildlife (2016) lists nine species that pose a serious threat to freshwater resources, and which must be destroyed when encountered. Those invasive fish include the swamp eel, grass carp, bighead carp, silver carp, flathead catfish, brook stickleback, green sunfish, warmouth, and oriental weatherfish. The NJISST tracks all of those species, and one additional freshwater fish. The northern snakehead (*Channa argus*) is not included on the state list of freshwater fish provided in **Appendix C.5**, although the Strike Team fact sheet states that it is widespread in New Jersey. No threat level is given for the snakehead.

The Invasive Species Strike Team additionally tracks a number of invertebrate species in the state, including 18 insects, 12 mollusks, 4 crustaceans and 1 worm. Fact sheets are also available for the invasive invertebrates (NJISST, 2018).

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Wildlife and Plants

Backyard Habitats & Conservation:

Deer Tolerant/Resistant Native Plants: http://www.bhwp.org/cms/files/file_ID96121.pdf
Gardening for Butterflies: http://www.state.nj.us/dep/fgw/ensp/pdf/literature/butterfly_gardening.pdf
National Audubon Society: http://www.audubon.org/bird/at_home/
New Jersey Audubon Society: http://www.njaudubon.org/SectionBackyardHabitat/Welcome.aspx
NJDEP Outdoor Classroom links: http://www.state.nj.us/dep/seeds/syhart/outclass.htm
USDA NRCS:
http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/newsroom/features/?cid=nrcs143_023574

Bear Facts for Homeowners: http://www.state.nj.us/dep/fgw/bearfacts_homeowner.htm

Checklists

Birds of NJ: http://www.state.nj.us/dep/fgw/chkbirds.htm
Butterflies of NJ: http://www.naba.org/chapters/nabanj/butterflies.html
Endangered & Threatened Wildlife of NJ: http://www.njfishandwildlife.com/tandespp.htm
Freshwater Fish Of NJ: http://www.njfishandwildlife.com/chkfish.htm
Mammals of NJ: http://www.state.nj.us/dep/fgw/chkmamls.htm
Native Plants of Bergen County: http://www.npsnj.org/plant_lists/native_plants__Hunterdon.xls
Reptiles and Amphibians of NJ: http://www.state.nj.us/dep/fgw/ensp/fieldguide_herps.htm
Species of Special Concern of NJ: http://www.njfishandwildlife.com/ensp/pdf/spclspp.pdf

Cornel Lab of Ornithology, All About Birds: http://www.birds.cornell.edu/AllAboutBirds/BirdGuide/

Injured birds & baby wildlife: http://www.co.bergen.nj.us/index.aspx?nid=607

Native Plants:

Bowman's Hill Wildflower Preserve: http://www.bhwp.org
Native Plant Society of NJ: http://www.npsnj.org/
USDA Plants Database: http://plants.usda.gov

NJDEP:

Conserve Wildlife Foundation of New Jersey: http://www.conservewildlifenj.org/
Division of Fish and Wildlife Home Page: http://www.njfishandwildlife.com/wildlife.htm
Environmental Rules: http://www.nj.gov/dep/rules/nj_env_law.html
Endangered and Nongame Species Program Home Page: http://www.state.nj.us/dep/fgw/ensphome.htm
Landscape Project: http://www.state.nj.us/dep/fgw/ensp/landscape/
NJ Wildlife Action Plan: http://www.state.nj.us/dep/fgw/ensp/wap/wap_outline.htm
Rare Plants & Communities: http://www.state.nj.us/dep/parksandforests/natural/index.html

North American Butterfly Association, North Jersey Butterfly Club: http://www.naba.org/chapters/nabanj/

Long dash (*Polites mystic*): http://www.naba.org/chapters/nabanj/butterflies/long_dash.html

Rare Wildlife Sighting Form: http://www.njfishandwildlife.com/ensp/rprtform.htm

Rare Plant Report Form:
http://www.state.nj.us/dep/parksandforests/natural/heritage/natherrareplantspeciesreportform1_2008.doc

Invasive Species

Invasive Species – New Jersey: http://www.invasivespeciesinfo.gov/unitedstates/nj.shtml

Native Plant Society of New Jersey – Invasive Species: http://www.npsnj.org/pages/nativeplants_Plant_Lists.html

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8: OPEN SPACE & RECREATION

A. Purposes & Funding

The purposes of open space preservation include:

- provide adequate active and passive recreation recreational opportunities on an equal and accessible basis for all citizens;
- protect the quantity and quality of surface and ground water;
- protect sensitive environmental features such as wetlands, steep slopes and critical habitats;
- link community resources and support the community's need for safe, multi-modal circulation through a system of greenways and trails;
- protect historic areas;
- maintain plant and animal biodiversity;
- minimize erosion or damage from flooding;
- maintain rural character;
- coordinate programs with local boards and surrounding communities;
- maintain consistency with State land use plans (ANJEC, 2011).

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.

Hunterdon County assesses a tax which is designated for an Open Space, Recreation, Farmland and Historic Preservation Trust Fund. The rate is not to exceed three cents per $100 of total county equalized real property valuation, and funds may be utilized to protect drinking

water sources and water quality; preserve open space, natural areas, farmland and historic sites or structures; and to acquire and develop lands for recreation and conservation purposes Hunterdon County Open Space Trust Fund Plan, 2016). The tax provides approximately $6 million annually (Hunterdon County Budget, 2016).

The Borough of Frenchtown established an open space trust fund in 2014 (Ordinance No. 2014-746). The funds may be utilized for the acquisition, development and maintenance of lands for recreation and conservation purposes as well as the preservation of farmland and historic properties. The trust fund, which is based on a tax not to exceed two cents per $100 of assessed property valuations, enables the borough to apply for other open space grant money for which it would not otherwise be eligible.

The Garden State Preservation Trust Act provides state funds for land acquisition and park development through the Green Acres program.

Private land trusts working to preserve land in northern New Jersey 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).

Frenchtown Preserve parking area on Horseshoe Bend Road

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 land preservation, private land trusts, and conservation easements to meet the Borough's open space 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).

One of the five major initiatives of the Regional Plan Association (RPA) (a planning organization focused on the New York/New Jersey/Connecticut metropolitan region) is a regional Greensward. Establishment of a regional network of greenways and revitalized urban parks and open spaces helps to safeguard water supplies and parkland, and also shapes future growth by integrating protected large-scale landscape resources. Benefits of a regional greenway include aquifer protection, habitat preservation, recreational opportunities and aesthetically pleasing viewsheds (RPA, 1996).

C. Open Space & Recreation in Frenchtown

A variety of active and passive open space and recreation opportunities are available within the Borough of Frenchtown. An updated inventory of the preserved open space & recreation properties within the Borough is presented in **Table 8** and **Figure 8a**. Closer views of open space with aerial photos taken in 2015 are shown in **Figures 8b, 8c and 8d.** Using the acreage figures from the deeds (NJ-GeoWeb, 2017), a total of 203 acres (176.5 acres state and 26.5 acres municipal land) have been preserved in Frenchtown, which is nearly a quarter (23.7%) of the acreage within the Borough.

Table 8: Preserved Open Space & Recreation Areas

Owner	Park Name	Block	Lot	Acres
Frenchtown Borough	Frenchtown Boro Park	16	13	16.000
Frenchtown Borough	Old Frenchtown Field	3	1.01	8.845
Frenchtown Borough	Trenton Avenue Park	52	7 & 8	1.309
Frenchtown Borough	Frenchtown Community Garden	60	1	0.387
State of NJ DEP	D&R Canal State Park Trail	14	50, 100, 102 & 103	-
State of NJ DEP	D&R Canal State Park Trail	53	101	-
State of NJ DEP	D&R Canal State Park Trail	54	100	-
State of NJ DEP	D&R Canal State Park Trail	60	100	15.410
State of NJ DEP	Nishisakawick Preserve	16	2, 2.01 & 2.02	10.690
State of NJ DEP	Frenchtown Preserve	52	29.01, 36.05, & 36.06	150.43
			Total Acres:	203.071

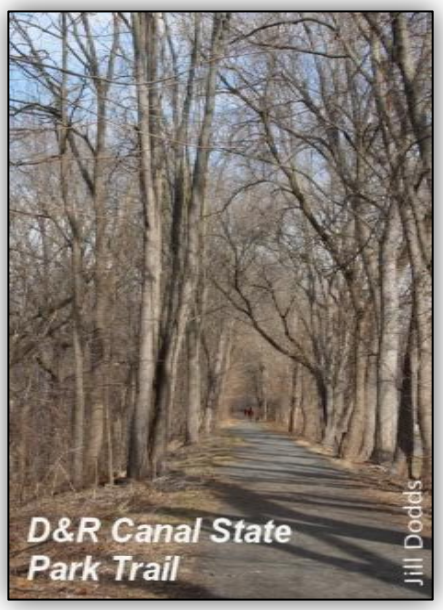
State Open Space

Frenchtown Preserve

The Hunterdon Land Trust coordinated the acquisition of this 150-acre preserve in 2006 in partnership with Frenchtown Borough, the New Jersey Green Acres Program, New Jersey Division of Parks and Forestry, the New Jersey Department of Transportation, Hunterdon County, and the Open Space Institute. The parcel is important to the local community for water protection, species habitat and recreational opportunities. The preserve is an extension of the D&R Canal State Park, and is managed by the New Jersey Division of Parks and Forestry (Hunterdon Land Trust, 2017). See the **Internet Resources** for a link to a trail map for the preserve's eight miles of trails.

D&R Canal State Park Trail

Delaware and Raritan Canal State Park is a 70-mile linear park that runs from just south of Milford to New Brunswick. The original park was established in 1974 to preserve the historic canal which begins at the northern end of Bull's Island in Kingwood Township. During the 1980s, the park was extended north along the Belvidere-Delaware Railroad corridor, and its trail system was designated as a National Recreation Trail in 1992. Approximately 1.3 miles of the trail pass through Frenchtown along the western edge of the Borough, with official ace ss points located at both 12th Street and Bridge Street. The park is presently owned and managed by the New Jersey Division of Parks and Forestry, and the trail is a popular site for hiking, jogging, bicycling, and horseback riding (Delaware and Raritan Canal Commission, 2017).



Nishisakawick Preserve

This 10.7 acre plot was purchased in 2000 by the Hunterdon Land Trust and the New Jersey Green Acres Program. The property was preserved in order to protect the Nishisakawick Creek and to serve as an anchor for a potential greenway along the creek corridor (Frenchtown Borough, 2017).

Municipal Open Space

Frenchtown Borough Park

At 16 acres, this is the largest municipal park in the Borough. The property extends along the Nishisakawick Creek corridor and includes a one mile loop hiking trail. A playground, benches, picnic sites and a seasonal ice rink are located at the southern end of the park, while the more natural area to the north favors activities such as birdwatching and fishing (Frenchtown Borough, 2017).

Old Frenchtown Field

This park, located near the northwestern corner of the Borough, is nearly nine acres in size. It is primarily used for sports activities and picnicking. It is listed as Plessy Field in the Green Acres database (Frenchtown Borough, 2017; NJDEP Green Acres Program, 2017).

Trenton Avenue Park

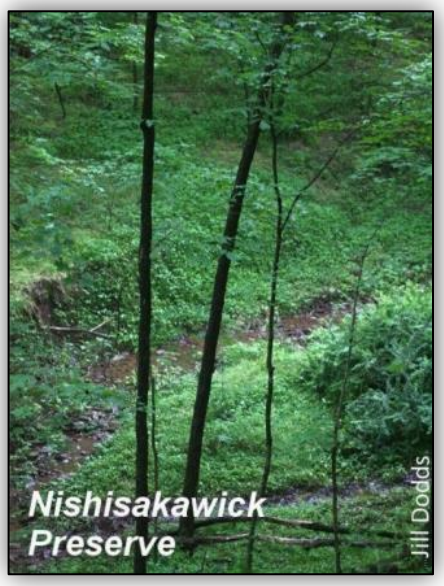
This small park, a little over an acre in size, is located along the west bank of the Nishisakawick Creek not far from the center of town. In addition to creek access, it offers a quiet place to sit or enjoy a picnic (Frenchtown Borough, 2017).

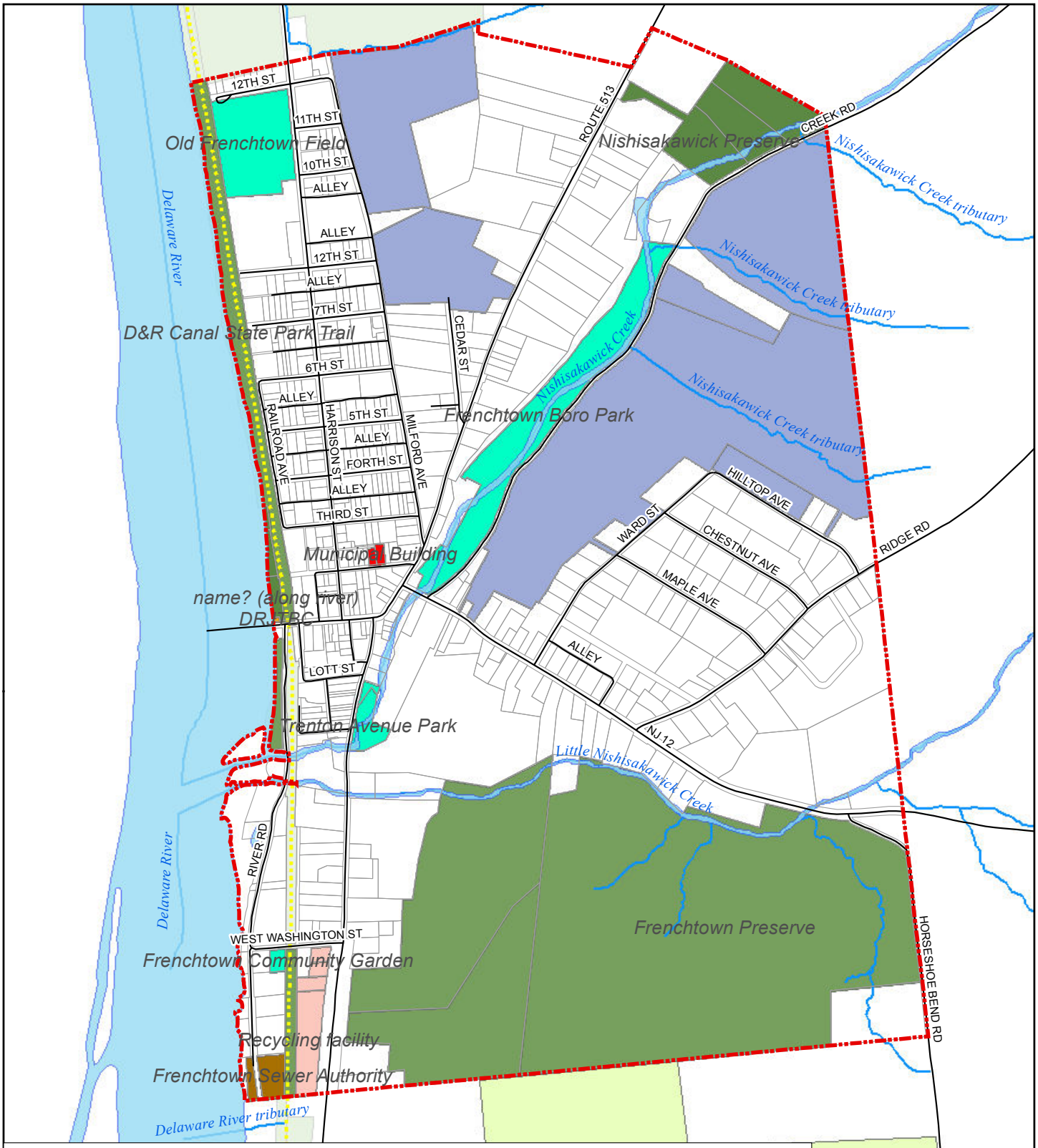
Frenchtown Community Garden

In 2010, a small plot of land in the southwestern section of the Borough was set aside for the use of Frenchtown residents who wish to grow organic produce (Frenchtown Borough, 2017).

Frenchtown in the Landscape

Beyond the borders of Frenchtown Borough, the Hunterdon County landscape is dotted with numerous patches of preserved farmland (**Figure 8e**). A large patch of state-owned open space is present in Alexandria Township adjacent to Frenchtown's northern boundary. Immediately south of the Borough, several large parcels of preserved farmland form a link between Frenchtown Preserve and Horseshoe Bend Park in Kingwood Township. Due to the high quality natural resources located in Frenchtown and the surrounding area, plans are being developed to preserve additional land that will help to connect and protect existing open spaces. Targeted zones for future conservation efforts in the Frenchtown area include the Delaware River corridor, the Nishisakawick Creek corridor and the Frenchtown Greenbelt (Hunterdon Land Trust, 2011).





Legend

- Frenchtown
- Roads
- Streams
- Waterbodies
- State Owned Open Space
- Preserved Farmland (SADC)
- State Park Trails

Open Space (owner)

- DRJTBC
- Easement?
- Frenchtown Borough
- Frenchtown Sewer Authority
- Municipal Building
- Recycling facility
- State of NJ DEP

0 0.05 0.1 0.2 0.3 0.4 0.5 Miles

N

Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 8a: Borough of Frenchtown Preserved Open Space & Farmland

Frenchtown ERI 2018 Kratzer Environmental Services

Figure 8b: Northwest Frenchtown OpenSpace and 2015 Aerial Photos

Frenchtown ERI 2018 Kratzer Environmental Services

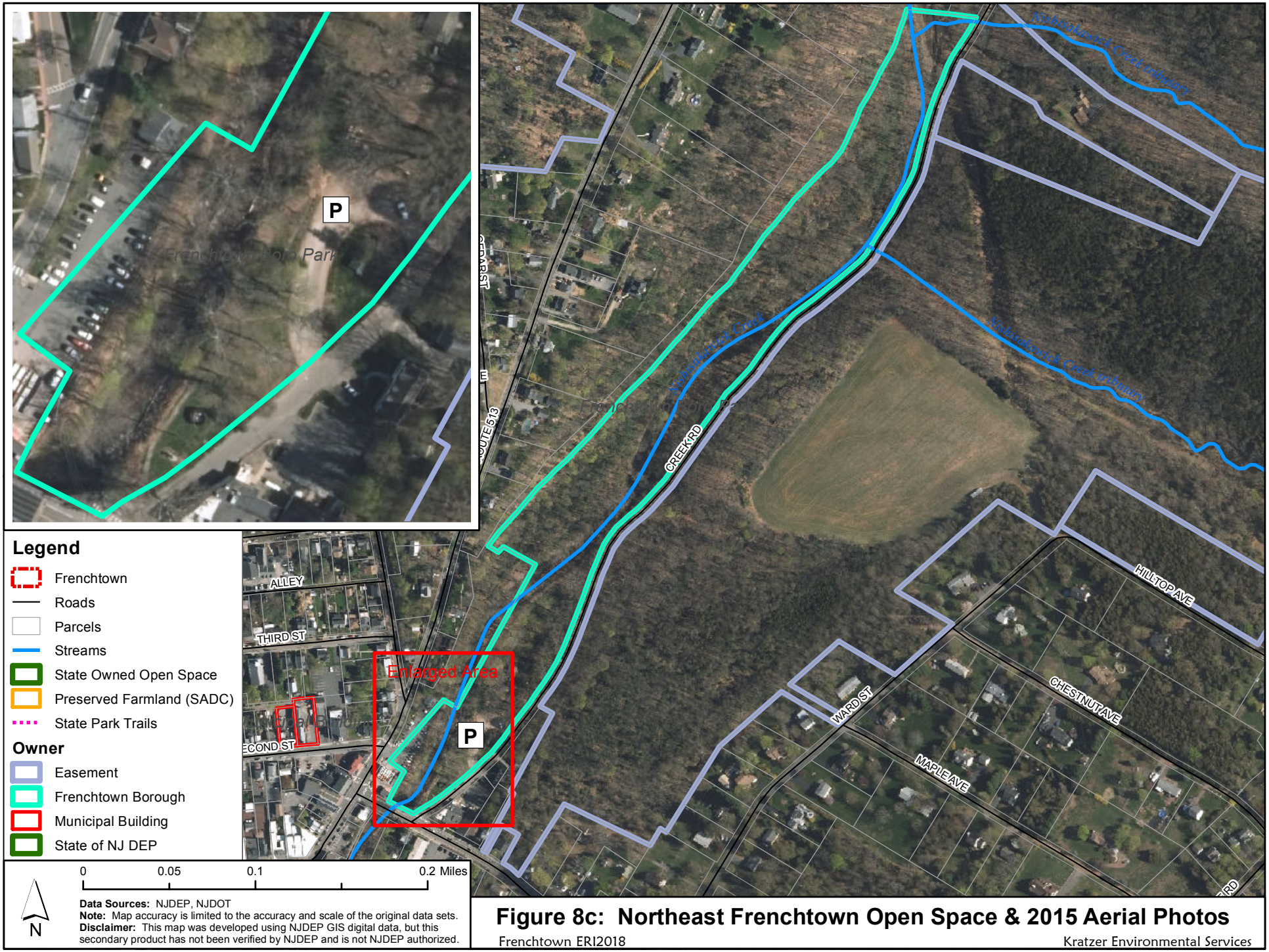


Figure 8c: Northeast Frenchtown Open Space & 2015 Aerial Photos

Frenchtown ERI2018 Kratzer Environmental Services

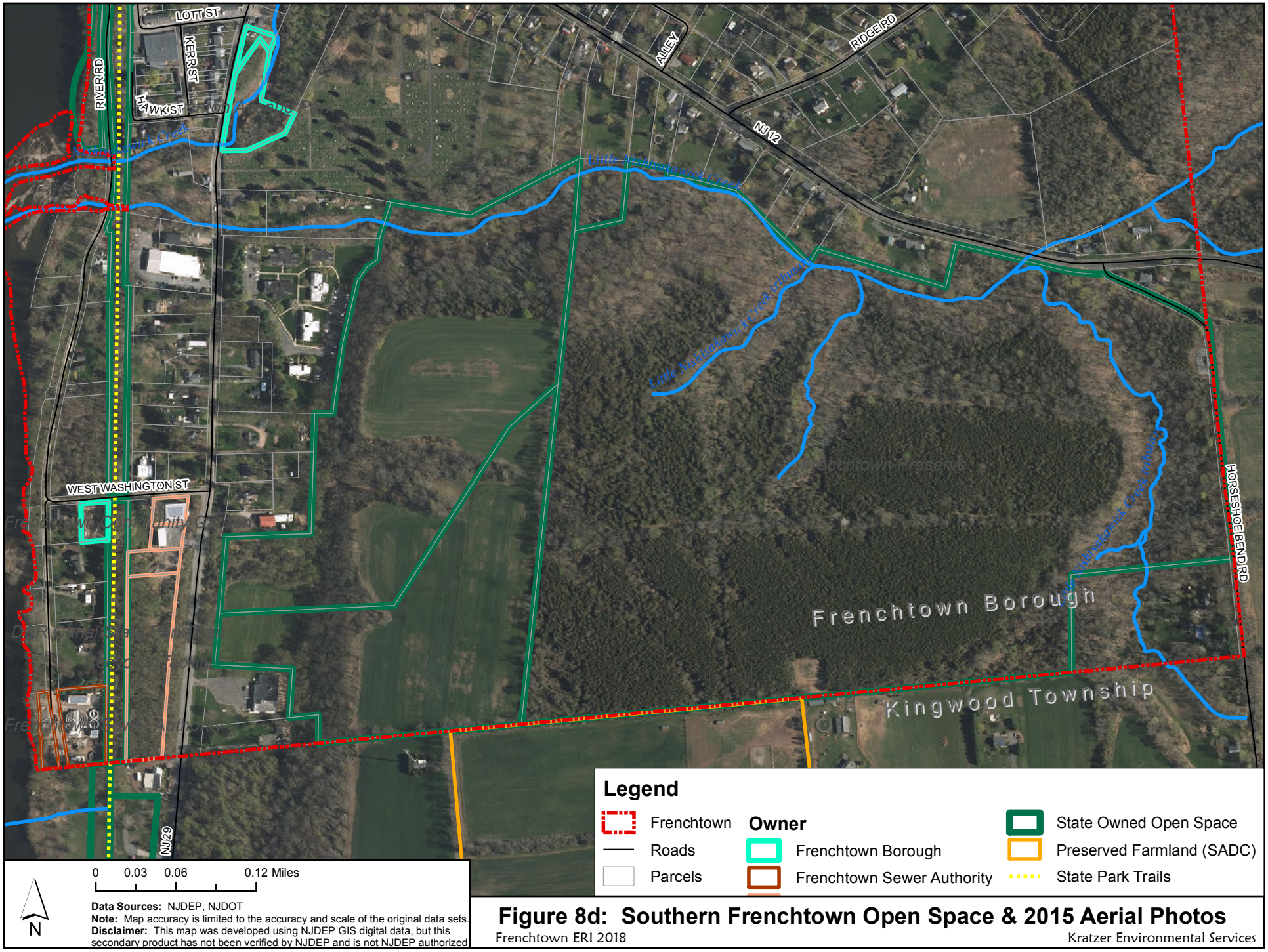
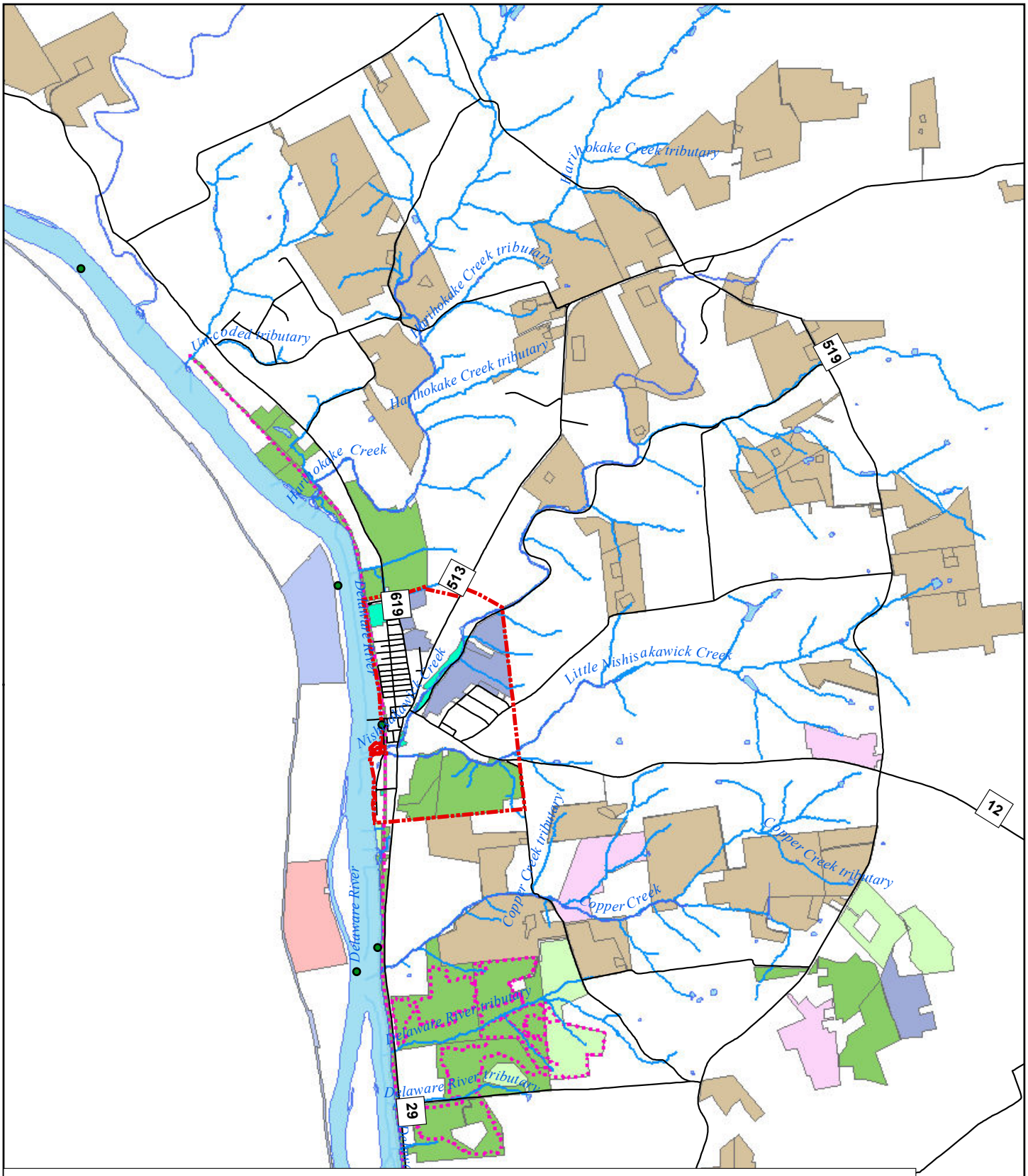


Figure 8d: Southern Frenchtown Open Space & 2015 Aerial Photos

Frenchtown ERI 2018

Kratzer Environmental Services



Legend

Frenchtown
Roads
Waterbodies
River Access
Frenchtown Open Space
Easement
Frenchtown Borough
NJ State Owned Open Space
NJ Preserved Farmland (SADC)
NJ State Park Trails
Pennsylvania State Park: Giving Pond
Bucks Co. PA Park: Tinicum County Park

0 0.5 1 2 Miles

N

Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 8e: Frenchtown & Surrounding Areas Preserved Open Space & Farmland

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NJ-GeoWeb. New Jersey Department of Environmental Protection, Bureau of Geographic Information Systems, Online mapping tool. http://www.state.nj.us/dep/gis/geowebsplash.htm. Accessed February 2017.

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Internet Resources: Open Space

Association of New Jersey Environmental Commissions: http://anjec.org

Garden State Greenways: http://www.gardenstategreenways.org

Hunterdon Land Trust: http://hunterdonlandtrust.org/

Native Plant Society of New Jersey: http://www.npsnj.org

New Jersey Conservation Foundation: http://www.njconservation.org/

New Jersey Natural Lands Trust: http://www.njnlt.org/

NY-NJ Trail Conference: http://www.nynjtc.org/

Rain Garden Manual: http://www.npsnj.org/pages/nativeplants_Rain_Gardens.html

Rutgers New Jersey Agricultural Experiment Station (NJAES) – information & links for farmers, gardeners, & consumers: http://njaes.rutgers.edu/

Park Websites:

D&R Canal State Park Trail: http://www.dandrcanal.com/gen_info.html

Frenchtown Preserve:

Hunterdon Land Trust: http://hunterdonlandtrust.org/portfolio/frenchtown-preserve/

New Jersey Trails Association (NJTA): http://njtrails.org/trail/frenchtown-preserve/

Frenchtown Borough Open Space: https://frenchtownboro.com/parks-recreation-open-space/parks-facilities/

9: HISTORIC RESOURCES

A. History of the Municipality

The area that is now Frenchtown has been inhabited by humans for thousands of years. The native inhabitants called the area Lenapehoking, which means land of the Lenape. Lenapehoking encompassed all of what is now New Jersey, eastern Pennsylvania, southeastern New York State, northern Delaware and a small section of southeastern Connecticut. The people in the southern half of Lenapehoking, below the Raritan River and the Delaware Water Gap, spoke the Unami dialect of the Eastern Algonquin Delaware language (Lenape Lifeways, 2002).

During 2011 and 2012, an archeological study was done on the property of the Frenchtown Wastewater Treatment Plant, located along the Delaware River in the southern part of the borough. The excavation recovered more than 3,400 Native American artifacts, including some dating back nearly 10,000 years. Radiocarbon dating indicates that the site, which was utilized as a short-term camp, was repeatedly occupied from approximately 7460 B.C. to at least A.D. 1220 (Richard Grubb & Associates, undated).

Early European settlers in the Frenchtown area crossed the Delaware River via hand-poled ferries or flat boats at a site just downstream of the present bridge (Brasch and Hall, 1979). The importance of this crossing in the latter part of the 18th century was underscored by the fact that the earliest names for the district were based on its ownership. Before the name Frenchtown came into use, the community was variously known as Calvin's or Colvin's Ferry, Sherrerd's Ferry, Lowrey's Ferry, Prevost's Ferry and Mallet-Prevost's Ferry (D'Autrechy, 1992). The ferry at this location was also utilized during the Revolutionary War following the Battle of Brandywine and the Battle of Saratoga (Fargo, 1933). The town was also identified as Sunbeam on a single map from 1775, which would fall somewhere in between Calvin/Colvin's and Lowrey's ferries (D'Autrechy, 1992).

Although there was a grist mill in what was to become Frenchtown as early as 1736, ferry owner Thomas Lowrey is credited with establishing a village on the site when he built both a grist mill and a saw mill after the Revolutionary War (Brasch and Hall, 1979). Ferry owner Paul Henri Mallet-Prevost built the town's first hotel in 1805 at the site of what is now The Frenchtown Inn. Mallet-Prevost was a fugitive from the French Revolution, and when he settled in the area he brought his family, servants and other associates along with him. Subsequently, people began to refer to the community as 'Frenchtown' due to the language spoken by many of its inhabitants (The Gombach Group, 2017). The ferry service was replaced by a bridge across the river in the early 1840s, and Frenchtown became incorporated as a Borough on April 4, 1867 (Fargo, 1933).

B. Archeological Inventory

Archaeological Sites are locations of prehistoric or historic occupation or activity possessing archaeological value. The NJ Historic Preservation Office created a grid of approximately ½ mile cells indicating the presence of archaeological districts or sites. The dataset does not preclude the existence of other archaeological districts or sites that have not yet been identified or documented and is for informational (not regulatory) purposes. These archaeological sites in and near Frenchtown are shown on **Figure 9a** (NJDEP HPO, September 22, 2016a).

C. Historical Inventory

According to Brasch and Hall (1979), Frenchtown is unique in Hunterdon County because it was developed as a "speculator" town. The mid-1800s building boom was precipitated by anticipation that the Pennsylvania Railroad and another large factory were planning to locate there. Homes erected during this period were generally one of ten types described in **Table 9.1**.

Table 9.1. Typical historic housing structures in Frenchtown Borough.

Number of houses	Description of type
31	A three bay, two story frame and brick gable roof structure with one or two chimneys, perhaps a rear ell or porch across the front; many of them have been altered but the basic shape is still perceived
38	A four bay, two story frame or stone gable-roofed structure with center or double entries; chimney in one or both gables, perhaps a rear ell
34	A five bay, two story frame gable-roofed structure
24	A four, five or six bay, two story frame gable-roofed structure with a center gable
21	A three bay, two story frame gable-end-to-the-street structure; perhaps L-shaped with porches; many of them have been altered
1	A two-and-a-half story frame Second Empire mansard roof structure, Victorian trim
5	A Victorian planbook, L-shaped, five bay center entry, two and a half story high style 'Italianate' structure
10	A three bay, two story frame structure with center gable; porches with Victorian trim
7	A six, seven or eight bay, two story frame, one or two family structure
5	A two bay, two story frame structure with porches and rear or side additions, some with gable end to the street
Source: Brasch and Hall, 1979	

Brasch and Hall (1979) listed 176 homes that followed the "typical" patterns, as well as 25 other homes in the Borough, as being of historical interest. Those account for approximately three-quarters of the homes that were eventually included in the Frenchtown Historic District. Frenchtown Borough was added to the New Jersey Register of Historic Places on March 14, 1994, and to the National Register of Historic Places on May 19 of the same year (NJDEP Historic Preservation Office, 2017). The listing from the National Register is shown in **Table 9.2**.

The boundaries of the Historic District are shown in **Figure 9a**. In addition to 264 residential structures (including freestanding barns and garages), the Frenchtown Historic District includes two bridges, a cemetery, seven churches or church-related structures, three mills/mill storehouses, and 51 other commercial or community structures, for a total of 328 properties.

Table 9.2. Frenchtown Historic District

Frenchtown Historic District: added 1994 - - #94000438	Bounded by 12th St., Washington St., the Delaware R. and Nishisakawick Cr., Frenchtown
Historic Significance:	Architecture/Engineering, Event
Architect, builder, or engineer:	Multiple
Architectural Style:	Federal, Italianate, Greek Revival
Area of Significance:	Commerce, Transportation, Architecture, Community Planning And Development
Period of Significance:	1750-1799, 1800-1824, 1825-1849, 1850-1874, 1875-1899, 1900-1924, 1925-1949
Owner:	State , Private , Local
Historic Function:	Commerce/Trade, Domestic, Religion, Social, Transportation
Historic Sub-function:	Department Store, Hotel, Meeting Hall, Religious Structure, Single Dwelling
Current Function:	Commerce/Trade, Domestic, Religion, Transportation
Current Sub-function:	Business, Department Store, Religious Structure, Restaurant, Single Dwelling, Water-Related
Source: NJDEP HPO, September 22, 2016b	

Table 9.3 lists the structures included in the Frenchtown Historic District and also provides a key to **Figures 9b - 9d**, which depict the locations of the structures in the northern, central and southern sections of the borough.

Table 9.3: Properties Included in the Frenchtown Historic District
Property descriptions reflect available information at time of the 1994 listing.

ID #	Feature Name	Location	Figure
Bridges			
17872	Delaware River Bridge	crosses Delaware River	9c
19213	River Road Bridge	River Road over Little Nishisackawick Creek	9d
Cemeteries			
19242	Frenchtown Cemetery	Trenton Avenue	9d
Churches and Associated Structures			
18457	Baptist Parsonage (Rev. Armstrong, 1873)	33 Second Street	9c
18458	Baptist Church	35 Second Street	9c
18459	Methodist Parsonage	14 Third Street	9c
18460	Methodist Church	16 Third Street	9c
18455	Borough Hall (Presbyterian Church, 1873)	29 Second Street	9c
18469	Presbyterian Manse	20 Fourth Street	9c
18470	Presbyterian Church	22 Fourth Street	9c
Commercial and Community Structures			
17874	Gem Building (Oliver Worman Block)	10 Bridge Street	9d
17877	Frenchtown Liquors (Gregorchuk's Notions)	22 Bridge Street	9d
17879	Frenchtown Dry Cleaners and Country Crafts (Worman-Brink Store)	24-26 Bridge Street	9d
17881	Anthony Danzo Law Office (Okey Pittinger Store)	32 Bridge Street	9d
17882	Ye Olde Carpet Shop and Laundromat (Eddy Block)	36 Bridge Street	9d
17883	Mondo Mick's Restaurant (Eddy Block Annex)	44 Bridge Street	9d
17884	Jack's Pizzeria (Lewis M. Provost's "Big Gun")	48 Bridge Street	9d
17886	Frenchtown Inn (Railroad House - Warford House - Lower Hotel)	7 Bridge Street	9c
17887	Oddfellows Building (Magnolia Lodge #57)	17 Bridge Street	9c
17888	First Fidelity Bank (Union Bank)	21 Bridge Street	9c
17889	Hummer Block (Williams Block)	25-37 Bridge Street	9c
17890	Edward Johnson Funeral Home	41 Bridge Street	9c
17891	Healing Journey Bookstore	43 &43A Bridge Street	9c

ID #	Feature Name	Location	Figure
17892	Lula's, Running Fox Antiques	47-51 Bridge Street	9c
17893	Yellow Brick Commercial Block	53 & 59 Bridge Street, 13-19 Race Street	9c
17894	Race Street Street Cafe	2 Race Street	9d
17895	Antique Shops (Leather Factory)	8 Race Street	9d
17896	Office and Gallery	16 Race Street	9d
17897	Mobil Gas Station (Cooley's)	22 Race Street	9d
17898	K & K Automotive	26 Race Street	9d
17899	Citgo Gas Station	Race Kingwood	9c
17902	Store/Apartment & Frenchtown Deli (part of National Hotel Complex)	29 Race Street	9c
18050	National Hotel	31 Race Street	9c
18053	Telephone company building	114 Harrison Street	9c
18065	Delaware Valley Veterans' Association Hall	510 Harrison Street	9c
18267	Eichlin & Sons Garage	203 Harrison Street	9c
18268	Delaware Valley News Office (Walbert Wheelwright Shop)	209 Harrison Street	9c
18439	Office building	711 Harrison Street	9b
18440	Office building	809 Harrison Street	9b
18816	A & P Store	Sixth Street at Milford Road	9c
18817	Factory (formerly Crosby Manufacturing Company)	1 Sixth Street	9b
18828	Industrial building	3 Seventh Street	9b
18829	House (Factory Office, Crosby Manufacturing Company 1891)	3 Seventh Street	9b
18836	William F. Hillpot Hatchery Complex	30 Seventh Street	9b
18840	Contractor's Office	1 Seventh Street	9b
18856	Warehouse	28 Eighth Street	9b
18857	Former Frenchtown Porcelain Works	1 Eighth Street	9b
19020	New Jersey-American Water Company Building	Everittstown Road	9c
19039	Commercial Complex	4 Kingwood Avenue	9d
19040	Blacksmith Shop (A. Slack, B. S. S. 1873)	14 Kingwood Avenue	9d
19044	Small Factory	28A Kingwood Avenue	9d
19215	Bio-Serv Industries	Front Street, south side Lott Street	9d
19235	Factory and Cottage/Monument Works/Cotton Factory, 1873)	50 Trenton Avenue	9d
19240	Office	19 Trenton Avenue	9d
19391	Freeman's Bicycle Shop (French Theater)	52 Bridge Street	9c
19410	Incubator House	NE corner Front & Lotts Streets	9d
19411	Frenchtown Post Office	NW corner Trenton Avenue & Lott Street	9d
17873	Bel-Del Railroad Passenger Depot (now Bridge Cafe)	6 Bridge Street	9d
17885	Bridge Tender's office	1 Bridge Street	9c
18077	Evelyn Ort Elementary School (Frenchtown High School)	904 Harrison Street	9b
18456	Union Fire Company	31 Second Street	9c
Mills and Associated Structures			
19236	Stone Mill	62 Trenton Avenue	9d
19238	Worman Grist Mill	15 Trenton Avenue	9d
19239	Office / former Frenchtown Feed Mill Storehouse	17 Trenton Avenue	9d
Residential and Associated Structures			
17875	Hunterdon House (Worman-Apgar Residence)	12 Bridge Street	9d
17876	House & Doctor's Office (Ishmael Brink Residence)	20 Bridge Street	9d
17878	Frame house (Ishmael Brink, 1873)	16 South Bridge Street aka Warford Alley	9d

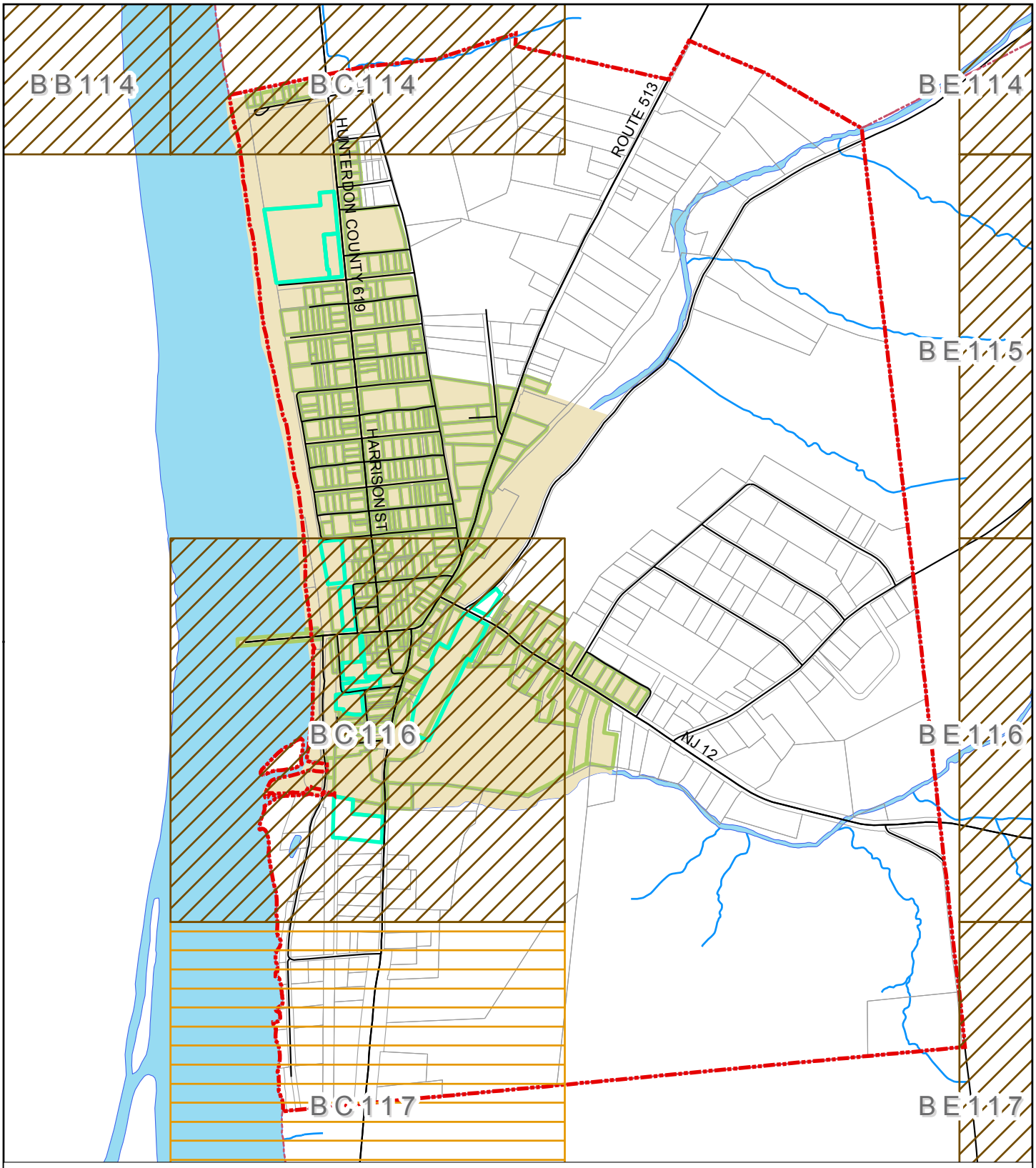
ID #	Feature Name	Location	Figure
17880	Kurfiss Real Estate (H. H. Pittinger House)	28 Bridge Street	9d
17900	House	21 Race Street	9c
17901	House	23 Race Street	9c
18051	House (G. Stintsman, 1873)	33 Race Street	9c
18052	Lorenzo & Carrie Hagaman House	112 Harrison Street	9c
18054	Double house (T. C. Taylor, 1873)	208 Harrison Street	9c
18055	Barn	Alley between Second and Third Streets	9c
18056	House	212 Harrison Street	9c
18057	House (T. C. Taylor, 1873)	214 Harrison Street	9c
18058	W. Slater, 1873	302 Harrison Street	9c
18059	House	306 Harrison Street	9c
18060	House	308 Harrison Street	9c
18061	Double house (D. R., 1873)	310-312 Harrison Street	9c
18062	Fargo House (Ann Hickson, 1873)	412 Harrison Street	9c
18063	House (P. Lair, 1873)	502 Harrison Street	9c
18064	House	506 Harrison Street	9c
18066	Homestead House (Lorenzo S. D. Kerr House)	602 Harrison Street	9b
18067	House (A. Seals, 1873)	604 Harrison Street	9b
18068	Double house (D. C. Robinson, 1873)	606-608 Harrison Street	9b
18069	House	610 Harrison Street	9b
18070	House	612 Harrison Street	9b
18071	Dr. Arthur M. Jenkins House	616 Harrison Street	9b
18072	House	702 Harrison Street	9b
18073	House	706 Harrison Street	9b
18074	House	708 Harrison Street	9b
18075	House	712 Harrison Street	9b
18076	House	804 Harrison Street	9b
18078	House	906 Harrison Street	9b
18079	House	908 Harrison Street	9b
18080	House	1002 Harrison Street	9b
18261	House	1004 Harrison Street	9b
18262	House	1006 Harrison Street	9b
18263	House	1008 Harrison Street	9b
18264	James E. Sherman House	111 Harrison Street	9c
18265	Pittinger-Hoff Double house	113-115 Harrison Street	9c
18266	House	201 Harrison Street	9c
18269	Barn	Alley between Second and Third Streets	9c
18270	Double house (R. R. Wright, 1873)	301 Harrison Street	9c
18271	House	303 Harrison Street	9c
18272	House (D. Taylor, 1873)	305 Harrison Street	9c
18273	Double house (J. V. Gordont, 1873)	309-311 Harrison Street	9c
18274	House (Captain William H. Slater, 1873)	315 Harrison Street	9c
18275	House (J. Walbert, 1873)	215 Harrison Street	9c
18276	House (N. D. Williams, 1873)	401 Harrison Street	9c
18277	House (S. M. Kugler, 1873)	405 Harrison Street	9c
18278	House (J. R. Harsham, 1873)	407 Harrison Street	9c
18279	House (Slater, 1873)	409 Harrison Street	9c
18280	House (Levi Troxell, 1873)	411 Harrison Street	9c
18281	House (Burket-Grim House / Rev. C. S. Conkling, 1873)	501 Harrison Street	9c
18282	House (O. Stout, 1873)	503 Harrison Street	9c
18428	House (Chandler, 1873)	507 Harrison Street	9c
18429	House (W. S. White, 1873)	509 Harrison Street	9c

ID #	Feature Name	Location	Figure
18430	House (T. Palmer, 1873)	513 Harrison Street	9c
18431	House (Mary & William Stover House, 1873)	601 Harrison Street	9c
18432	House (E. Rittenhouse, 1873)	607 Harrison Street	9c
18433	House (Charles Burket, 1873)	505 Harrison Street	9c
18434	House (W. J. Bowne, 1873)	611 Harrison Street	9b
18435	Dutch Colonial house	701 Harrison Street	9b
18436	Bungalow	703 Harrison Street	9b
18437	American Foursquare house	705 Harrison Street	9b
18438	House (J. Burgstressor, 1873)	709 Harrison Street	9b
18441	Garage Dwelling	504-506 Railroad Avenue	9c
18442	House (S. Wright, 1873)	508 Railroad Avenue	9c
18443	House (Brink, 1873)	510 Railroad Avenue	9c
18444	Double house	306-312 Railroad Avenue	9c
18445	Triple house (C. Kline, 1873)	10-12 Second Street	9c
18446	Godown house	22 Second Street	9c
18447	House (C. A. Slade, 1873)	24 & 26 Second Street	9c
18448	House (E. Hinkle,1873)	28 Second Street	9c
18449	House (Dr. E. K. Deemy,1873)	9 Second Street	9c
18450	House (A & B Kachline, 1873)	11 & 13 Second Street	9c
18451	House (Dr. L. Cooper / Frenchtown Star, 1873)	17 Second Street	9c
18452	Double house (A. Kerr & W. Search, 1873)	19 &21 Second Street	9c
18453	Double house (W. Allpaw & W. Smith, 1873)	23 &25 Second Street	9c
18454	House (P. Lair, 1873)	27 Second Street	9c
18461	L. S. D. Kerr House	26 Third Street	9c
18462	L. S. D. Kerr House	28 Third Street	9c
18463	House (A. Battenburg, 1873)	30 Third Street	9c
18464	Car barn	4 Fourth Street	9c
18465	House (M. Maxwell, 1873)	6 Fourth Street	9c
18466	House (J. West, 1873)	8 Fourth Street	9c
18467	House (H. Danley, 1873)	10 Fourth Street	9c
18468	Double house (1873)	16 & 18 Fourth Street	9c
18471	House (H. Lott, 1873)	30 Fourth Street	9c
18621	House (M. Worman, 1873)	32 Fourth Street	9c
18622	House (Johnson, 1873)	34 Fourth Street	9c
18623	House (Harsden, 1873)	36 Fourth Street	9c
18624	House (H. Lott, 1873)	38 Fourth Street	9c
18625	House	40 Fourth Street	9c
18626	House (W. Green, 1873)	42 Fourth Street	9c
18627	House	5 Fourth Street	9c
18628	House	7 Fourth Street	9c
18629	House	9 Fourth Street	9c
18630	Samuel Hudnut House	15 Fourth Street	9c
18631	Double house (R. Slack, 1873)	17 & 19 Fourth Street	9c
18632	House (C. Roberson, 1873)	21 & 23 Fourth Street	9c
18633	House (T. Barcroft, 1873)	25 Fourth Street	9c
18634	House (W. H. Eddy, 1873)	27 Fourth Street	9c
18635	House	29 Fourth Street	9c
18636	House (J. D. Hoff, 1873)	31 Fourth Street	9c
18637	Double house (Webster-Rounsaville, 1873)	33 & 35 Fourth Street	9c
18638	House (P. S. Kugler, 1873; Former Frenchtown Country Club)	37 Fourth Street	9c
18639	Israel Niece House	41 Fourth Street	9c
18640	House	2 Fifth Street	9c
18641	House (N. Thatcher, 1873)	4 Fifth Street	9c
18642	House	6 Fifth Street	9c

ID #	Feature Name	Location	Figure
18643	Double house	8 & 10 Fifth Street	9c
18644	House (Mrs. Kugler, 1873)	14 Fifth Street	9c
18645	House (R. R. Wright, 1873)	22 Fifth Street	9c
18646	Mary Plum House	24 Fifth Street	9c
18647	House	26 Fifth Street	9c
18648	Double house	28 & 30 Fifth Street	9c
18649	House	32 Fifth Street	9c
18650	Double house	34 & 36 Fifth Street	9c
18651	House	38 Fifth Street	9c
18652	Chester A. Niece House	40 Fifth Street	9c
18653	House (D. M. Mathews, 1873)	5 Fifth Street	9c
18654	House (J. W. Britton, 1873)	7 Fifth Street	9c
18655	House (J. R. Laird, 1873)	11 Fifth Street	9c
18656	House (R. K. Niece, 1873)	21 Fifth Street	9c
18657	House (S. Rockafellow, 1873)	23 Fifth Street	9c
18658	House (Oliver Stout, 1873)	25 Fifth Street	9c
18659	House (E. Lair, 1873)	27 Fifth Street	9c
18660	House	29 Fifth Street	9c
18661	House	31 Fifth Street	9c
18662	House (T. Swallow, 1873)	33 Fifth Street	9c
18663	House (George M. Britton House)	35 Fifth Street	9c
18664	House (D. Rittenhouse, 1873)	2 Sixth Street	9c
18665	House (Elisha Rittenhouse, 1873)	4 Sixth Street	9c
18666	House (S. Phillips, 1873)	6 Sixth Street	9c
18667	House	8 Sixth Street	9c
18818	House (J. Roberson, 1873)	5 Sixth Street	9b
18819	Double house (Slater & Hudnut, 1873)	7 & 9 Sixth Street	9b
18820	Double house (Slater & Hudnut, 1873)	11 &13 Sixth Street	9b
18821	House (C. Landon, 1873)	21 Sixth Street	9b
18822	House (J. Brink Estate, 1873)	23 Sixth Street	9b
18823	House	25 Sixth Street	9b
18824	House (J. Brink Estate, 1873)	27 Sixth Street	9b
18825	House (J. Brink Estate, 1873)	29 Sixth Street	9b
18826	House (W. Britton, 1873)	31 Sixth Street	9b
18827	House (J. Slater, 1873)	33 Sixth Street	9b
18830	House (Slater & Hudnut, 1873)	6 Seventh Street	9b
18831	House (Slater & Hudnut, 1873)	8 Seventh Street	9b
18832	House (Slater & Hudnut, 1873)	10 Seventh Street	9b
18833	House (Slater & Hudnut, 1873)	12 Seventh Street	9b
18834	Car barn	14 Seventh Street	9b
18835	Apartment house	26 Seventh Street	9b
18837	House	36 1/2 Seventh Street	9b
18838	Hillpot House	36 Seventh Street	9b
18839	House	609 Milford Road	9b
18841	House (Slater & Hudnut, 1873)	5 Seventh Street	9b
18842	House (Slater & Hudnut, 1873)	7 Seventh Street	9b
18843	House (Slater & Hudnut, 1873)	9 Seventh Street	9b
18844	House (Slater & Hudnut, 1873)	11 Seventh Street	9b
18845	House (Slater & Hudnut, 1873)	13 Seventh Street	9b
18846	House (Opdyke, 1873)	25 Seventh Street	9b
18847	House	27 Seventh Street	9b
18848	House	31 Seventh Street	9b
18849	House	33 Seventh Street	9b
18850	House	37 Seventh Street	9b
18851	House	6 Eighth Street	9b

ID #	Feature Name	Location	Figure
18852	House	10 Eighth Street	9b
18853	House	12 Eighth Street	9b
18854	House (J. Taylor, 1873)	24 Eighth Street	9b
18855	House (J. Chandler, 1873)	26 Eighth Street	9b
18858	House (M. K. Everett, 1873)	25 Eighth Street	9b
18859	House	29 Eighth Street	9b
18860	House (Slater & Hudnut, 1873)	31 Eighth Street	9b
19010	House (Slater & Hudnut, 1873)	33 Eighth Street	9b
19011	Double house	35 Eighth Street	9b
19012	House (S. Duckworth, 1873)	1 Twelfth Street	9b
19013	House (J. Apgar, 1873)	3 Twelfth Street	9b
19014	Double house (Slater & Hudnut, 1873)	5 & 7 Twelfth Street	9b
19015	Double house (Slater & Hudnut, 1873)	9 & 11 Twelfth Street	9b
19016	House	13 Twelfth Street	9b
19017	House	15 Twelfth Street	9b
19018	House (Slater & Hudnut, 1873)	21 Twelfth Street	9b
19019	Double house (Slater & Hudnut, 1873)	23 & 25 Twelfth Street	9b
19021	House (F. LaRue, 1873)	2 Everittstown Road	9c
19022	House (B. Everitt, 1873)	8 Everittstown Road	9c
19023	House	10 Everittstown Road	9c
19024	House	12 Everittstown Road	9c
19025	House	18 Everittstown Road	9c
19026	House (Ishmael Brink, 1873)	20 Everittstown Road	9c
19027	Double house (V. Eckel, 1873)	1 Everittstown Road	9c
19028	House (A. Salter, 1873)	5 Everittstown Road	9c
19029	House (R. T. Rittenhouse, 1873)	13 Everittstown Road	9c
19030	House	19 Everittstown Road	9c
19031	House (P. Sinclair, 1873)	15 Everittstown Road	9c
19032	House	17 Everittstown Road	9c
19033	House	1 Cedar Street	9c
19034	House	1 Reading Avenue	9c
19035	Philip G. Reading House	3 Reading Avenue	9c
19036	House	3 Cedar Street	9c
19037	W. W. Hedges House	5 Cedar Street	9c
19038	House (J. Savage, 1873)	2 Kingwood Avenue	9d
19041	Double house (G. Stark, 1873)	16 & 18 Kingwood Avenue	9d
19042	House (A. Slack, 1873)	20 Kingwood Avenue	9d
19043	House (J. Roberson, 1873)	24 Kingwood Avenue	9d
19045	House (W. W. Rittenhouse, 1873)	28 Kingwood Avenue	9d
19046	House (Bryan Hough, 1873)	30 Kingwood Avenue	9d
19047	House (J. M. Voorhees, 1873)	34 Kingwood Avenue	9d
19048	Paul Cronce House	36 Kingwood Avenue	9d
19049	House (Misses M & A Crowel, 1873)	40 Kingwood Avenue	9d
19050	House (site of Mrs. H. Robinson, 1873)	44 Kingwood Avenue	9d
19051	House (J. Lair, 1873)	46 Kingwood Avenue	9d
19052	House (D. Rittenhouse, 1873)	13 Kingwood Avenue	9d
19053	Double house (former Christian Church 1873)	15 & 17 Kingwood Avenue	9d
19201	House (D. O. Roberson, 1873)	19 Kingwood Avenue	9d
19202	House (D. Rittenhouse residence, 1873)	23 Kingwood Avenue	9d
19203	House (D. T. Rittenhouse, 1873)	25 Kingwood Avenue	9d
19204	House (J. Lequear, 1873)	27 Kingwood Avenue	9d
19205	Double house (D. Roberson, 1873)	29 & 31 Kingwood Avenue	9d
19206	House (Brink & Rittenhouse, 1873)	33 Kingwood Avenue	9d
19207	House (site of D. Roberson, 1873)	37 Kingwood Avenue	9d
19208	House (W. Britton, 1873)	41 Kingwood Avenue	9d

ID #	Feature Name	Location	Figure
19209	House (E. Rittenhouse, 1873)	45 Kingwood Avenue	9d
19210	Sears-Roebuck bungalow	47 Kingwood Avenue	9d
19211	House	49 & 51 Kingwood Avenue	9d
19212	House	53 Kingwood Avenue	9d
19214	Prevost Second House (J. Stillwell, 1873)	12 Front Street	9d
19216	House (Lundy, 1873)	25 Front Street	9d
19217	House (Mrs. E. Kane, 1873)	27 Front Street	9d
19218	House (Mrs. E. Brink, 1873)	29 Front Street	9d
19219	House (Nancy and Amelia Brink, 1873)	31 Front Street	9d
19220	House (F. Worman, 1873)	33 Front Street	9d
19221	House	5 South Harrison Street	9d
19222	Double house (A. Roberson, 1873)	7 & 9 South Harrison Street	9d
19223	Double house (J. Taylor, 1873)	11 & 13 South Harrison Street	9d
19224	Double house (A. Huber, 1873)	15 & 17 South Harrison Street	9d
19225	Paul Henri Mallet-Prevost House (J. Hawk, 1873)	1 Hawk Street	9d
19226	Lewis M. Prevost House (A. Roberson, 1873)	8 Trenton Avenue	9d
19227	House	18 Trenton Avenue	9d
19228	Double house (Mrs. Surbisch, 1873)	20 & 22 Trenton Avenue	9d
19229	Double house (J. Case, 1873)	24 & 26 Trenton Avenue	9d
19230	Double house (J. Case, 1873)	28 Trenton Avenue	9d
19231	Double house (J. Case, 1873)	32 & 34 Trenton Avenue	9d
19232	Double house (A. Roberson, 1873)	36 & 38 Trenton Avenue	9d
19233	House (L. Hans, 1873)	40 Trenton Avenue	9d
19234	Double house (C. Suydam, 1873)	44 Trenton Avenue	9d
19237	James S. White House / D. R. Worman, 1873	9 Trenton Avenue	9d
19241	House (W. Updike, 1873)	23 Trenton Avenue	9d
19390	House	53 Trenton Avenue	9d
19392	House (S. Stout, 1873)	13 Third Street	9c
19393	House (Slater & Hudnut, 1873)	15 Third Street	9c
19394	House (M. H. Everitt, 1873)	17 Third Street	9c
19395	Triple house (L. Rounsaville, 1873)	21-25 Third Street	9c
19396	House (H. Hagerman, 1873)	29 Third Street	9c
19397	House (Mrs. Saunders, 1873)	31 Third Street	9c
19398	House (Mrs. Rittenhouse, 1873)	35 Third Street	9c
19399	House (F. Fargo, 1873)	37 Third Street	9c
19400	House (Mrs. Meiler, 1873)	39 Third Street	9c
19401	House	301 Milford Road	9c
19402	House	307 Milford Road	9c
19403	House (W. S., 1873)	305 Milford Road	9c
19404	House (G. Llair, 1873)	215 Milford Road	9c
19405	Double house (Mrs. Voorhees, 1873)	211-213 Milford Road	9c
19406	House (O. P. Thatcher, 1873)	207 Milford Road	9c
19407	House (Sinclair, 1873)	203-205 Milford Road	9c
19408	House (Nathaniel Shurtz, 1873)	3 Third Street	9c
19409	House	26 Third Street	9c
Sources: NJDEP HPO, September 22, 2016c; NJEP HPO, September 22, 2016d			



Legend

- Frenchtown Borough
- Municipalities
- Roads
- Parcels
- Redevelopment Zone
- Waterbodies
- Streams
- Historic Properties
- Historic District (Listed)

Archeological Grid (2016)

- ELIGIBLE
- IDENTIFIED

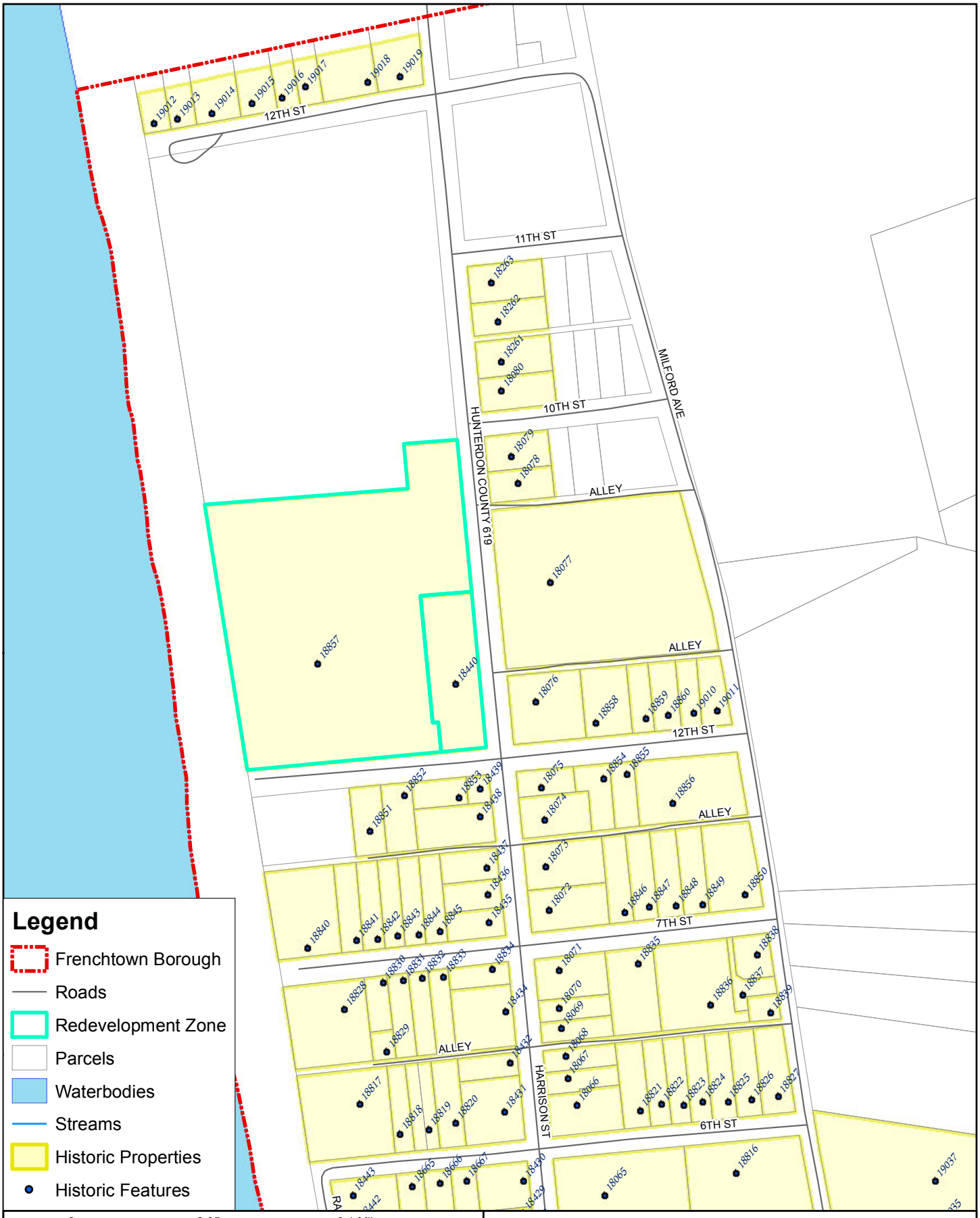
0 0.2 0.4 Miles

N

Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 9a: Borough of Frenchtown Historical & Archeological Resources

Frenchtown ERI 2018 Kratzer Environmental Services



Legend

- Frenchtown Borough
- Roads
- Redevelopment Zone
- Parcels
- Waterbodies
- Streams
- Historic Properties
- Historic Features

0 0.05 0.1 Miles

N

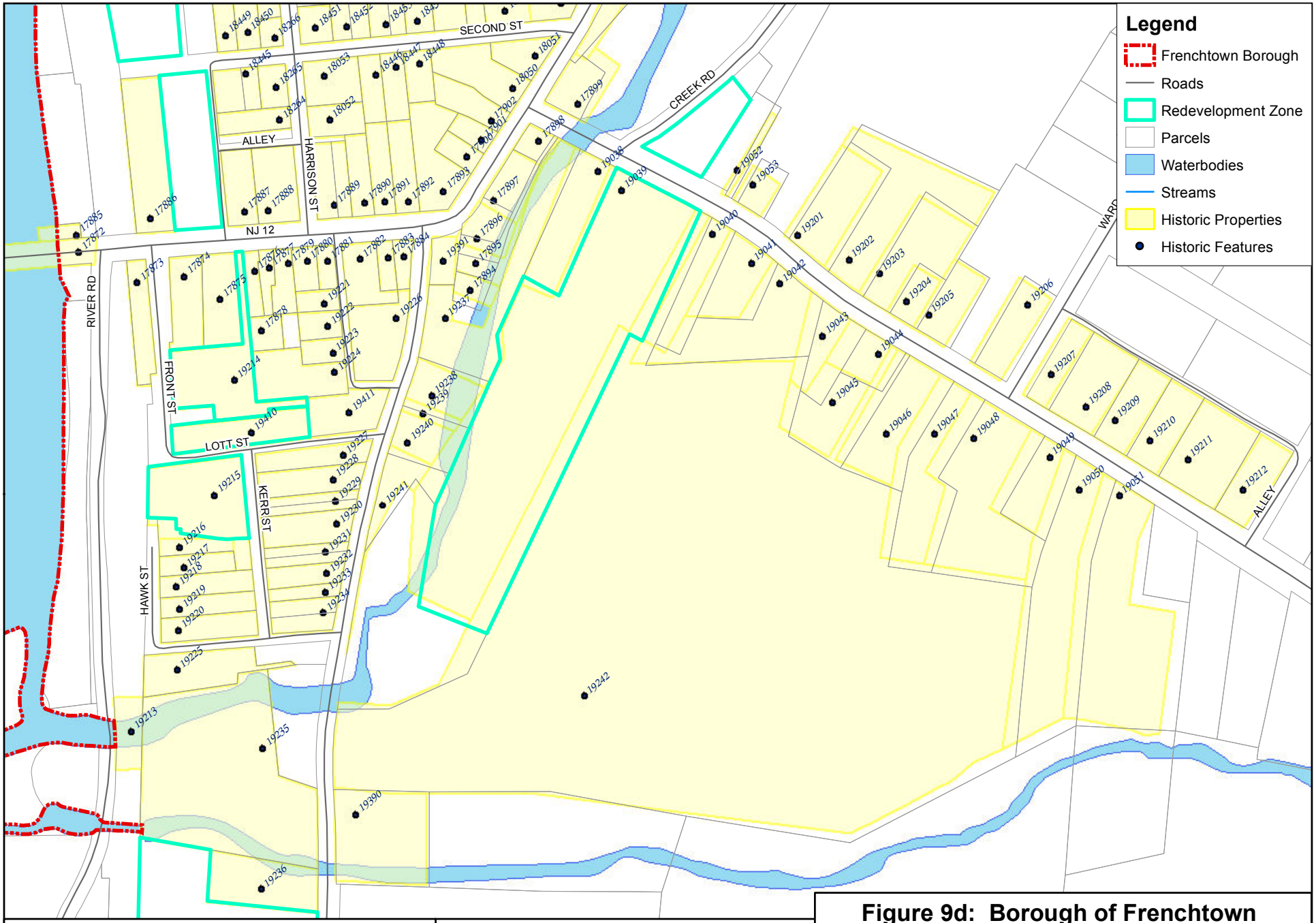
Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 9b: Borough of Frenchtown Historical Properties (12th St. to 6th St.)

Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 9c: Borough of Frenchtown Historical Properties (6th St. to Bridge St.)

Frenchtown ERI 2018 Kratzer Environmental Services



Data Sources: NJDEP, NJDOT
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 9d: Borough of Frenchtown Historical Properties (southern third)

Frenchtown ERI 2018 Kratzer Environmental Services

References: Historic Resources

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https://geodata.state.nj.us/arcgis/rest/services/Features/Land_Use_and_Land_Cover/MapServer/6

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The Gombach Group. 2017. Frenchtown Historic District.
http://www.livingplaces.com/NJ/Hunterdon_County/Frenchtown_Borough/Frenchtown_Historic_District.html

Internet Resources: Historic Resources

Ancient America:

Learning Lenape: http://www.njskylands.com/hs_lenape_083.htm
Lenape Lifeways: http://www.lenapelifeways.org/lenape1.htm

History of Frenchtown: https://frenchtownboro.com/about-frenchtown/history-of-frenchtown/
And http://www.livingplaces.com/NJ/Hunterdon_County/Frenchtown_Borough/Frenchtown_Historic_District.html

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

New Jersey Historic Preservation Office: http://www.nj.gov/dep/hpo/

West Jersey History Project: Historic Images of Hunterdon County - Frenchtown page.
http://westjerseyhistory.org/images/hunterdon/frenchtown/

Read more about Frenchtown:

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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)

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10: REGIONAL RELATIONSHIPS

A. Sustainable Jersey

According to the organization's website, "Sustainable Jersey is a nonprofit organization that provides tools, training and financial incentives to support communities as they pursue sustainability programs. By supporting community efforts to reduce waste, cut greenhouse gas emissions, and improve environmental equity, Sustainable Jersey is empowering communities to build a better world for future generations." (Sustainable Jersey, 2017a)

The voluntary Sustainable Jersey certification is a significant achievement for municipal governments in New Jersey. Municipalities are awarded points for completing and documenting actions that increase sustainability. Nearly 80% of New Jersey's municipalities are listed as participating in the program, while 44% of these are currently certified at either the Bronze or Silver level.

Frenchtown Borough received a *Sustainable Jersey Community Bronze Certification* on December 6, 2016 with 205 points (see **Table 10.1**) (Sustainable Jersey, 2017b).

Table 10.1: Sustainability Actions Implemented in Frenchtown for Bronze Certification

Category	Action	Points	Comment
Animals in the Community	Pledge Supporting NJ Wildlife Action Plan	10	
Arts & Creative Culture	Establish a Creative Team	10	
Community Partnership & Outreach	Community Education and Outreach	10	
Community Partnership & Outreach	Create Green Team	10	Bronze Mandatory
Diversity & Equity	Lead Education and Outreach Programs	10	
Municipal Energy Audits and Upgrades	Inventory and Upgrade All Buildings	50	Bronze Priority Silver Priority
Food Production	Community or School Gardens	10	
Health & Wellness	Smoke-Free and Tobacco-Free Public Places	10	
Land Use & Transportation	Complete Streets Program	20	
Natural Resources	Environmental Commission	10	
Natural Resources	Environmental Commission Site Plan Review	10	
Tree & Woodlands Management	Community Forestry Plan and Tree Cover Goal	20	
Waste Management	Prescription Drug Safety and Disposal	10	Bronze Priority Silver Priority
Recycling	Community Paper Shredding Day	5	
Waste Reduction	Materials Reuse Program	10	
	Total:	**205**	
Source: Sustainable Jersey, 2017b.			

B. Water Supply Planning

The goal of statewide water supply planning, mandated by the Water Supply Management Act (N.J.S.A. 58:1A-1), is to improve the management and protection of the State's water supplies to ensure that the State's water supplies could withstand foreseeable drought and that aquifers are not depleted.

The first New Jersey Water Supply Plan (NJSWSP) was adopted in 1982, and has been periodically updated and revised. A draft plan was released for public comment in June 2017. The goal of this 5 year (2017-2022) NJSWSP is "to form the foundation of a "living" resource able to be updated on a continuous basis as reliable new data becomes available and improved upon as new scientific methods are identified." (NJDEP Division of Water Supply and Geoscience, June 2017)

Appendix A of the plan presents a characterization of confined and unconfined groundwater and surface water supplies on a HUC11 basis. DEP analyzed data available from 1998 through 2015 to determine a period of time representing peak consumptive demand in New Jersey. Frenchtown is within the HUC11 that includes the Hakihokake, Harihokake, Nishisakawick and Little Nishisakawick Creeks. The method calculated the quantity of water available for depletive/consumptive loss to be 2.2 million gallons per day (mgd) in this HUC11. The full allocation of depletive/consumptive water loss is calculated to be 1.4 mgd, therefore, there is estimated to be a surplus of water available of 0.8 mgd, i.e. the ground water resources are not stressed (NJDEP Division of Water Supply and Geoscience, June 2017).

C. Water Quality Management Planning

In 2015, NJDEP released a new Continuing Planning Process (CPP) document, which was prepared pursuant to the federal Clean Water Act (CWA) and the New Jersey Water Pollution Control Act (WQPA), both of which require the NJDEP to formulate a continuing planning process (CPP) to achieve the water quality standards and maintain, improve, and protect water quality throughout the State. The CPP is intended to serve as an easily accessible planning tool, to be used not only as a listing of current NJDEP programs and rules relating to water quality, but as a resource for planning entities and members of the public on current policies and technical guidance on water quality issues, including:

- Establishing water quality standards and goals
- Assessing water quality and identify priority problems
- Water Quality Management Planning
- Identifying and controlling sources and causes of water quality impairment
- Intergovernmental Coordination (NJDEP, December 18, 2015).

The *Water Quality Management Planning* rules at N.J.A.C 7:15 represent one component of the CPP. The current rules were adopted November 7, 2016, repealing and replacing the prior rules from 2008. The new rules streamline the wastewater planning process and eliminate the some of the requirements found previously in both wastewater planning and other permitting programs. These rules focus on procedures for adopting new or amended areawide water quality management (WQM) plans, including Wastewater Management Plans (WMPs); Lists of water quality limited (impaired) waters; and total maximum daily loads (TMDL) for impaired waters. The CPP describes how these processes, along with other Department programs, integrate and unify water quality management planning processes, establish and assess attainment of water quality goals and standards, and implement control measures necessary to maintain, improve,

and protect water quality throughout the State (NJDEP, December 18, 2015; NJDEP, November 7, 2016).

A *Wastewater management planning agency* or *WMP agency* is defined in the rule as a governmental entity that has wastewater management planning responsibility (NJDEP, November 7, 2016). The Board of Chosen Freeholders of Hunterdon County is the responsible wastewater management planning agency for Hunterdon County, including the Borough of Frenchtown. One of the WQM agency's roles is to update the WMP at least once every 10 years (NJDEP Office of Water Resources Management Coordination, July 29, 2015).

A July 29, 2015 public notice adopted an amendment to the Upper Delaware and Upper Raritan WQM Plan (see **Figure 2c**) which adopted a Frenchtown WMP chapter. Areas were identified as either Future Sewer Service Area of the Frenchtown Borough Wastewater Treatment Plant (WWTP), or Septic Areas (planning flows of 2,000 gallons per day (GPD) or less). The WMP chapter also evaluates future wastewater treatment needs, water supply demands, and nonpoint sources of pollution. The adopted WMP chapter makes modifications to the existing sewer service area (SSA) within the boundaries of Frenchtown Borough, as well as areas in Alexandria Township adjacent to the Frenchtown Borough boundary served by the Frenchtown Borough WWTP, while environmentally sensitive areas (ESA) were assessed and usually are not included in the proposed SSA. The current *Sewer Service Areas* (SSAs) for Frenchtown are shown in **Figure 2c**. A build-out analysis was conducted and it was determined that the current (2012 to 2013) plus future wastewater flow exceeded permitted capacity. Therefore, the need for a new WWTP was identified. The new WWTP was completed in 2015.

The existing Frenchtown Borough WWTP discharges to a segment of the lower Delaware River that is designated as a Special Protection Water. As such, the construction of the new WWTP is subject to Delaware River Basin Commission (DRBC) jurisdiction, review, and oversight (NJDEP Office of Water Resources Management Coordination, July 29, 2015).

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, 2017).

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. Frenchtown Borough joined others in their support of the designation and is one of 22 designated municipalities

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 (Lower Delaware River Wild and Scenic River Study Task Force, 1997).

References: Regional Relationships

Sustainable Jersey

Sustainable Jersey. 2017a. Sustainable Jersey. http://www.sustainablejersey.com/. Website accessed September 4, 2017.

Sustainable Jersey. 2017b. Frenchtown Sustainable Jersey Community Certification Report. HTML version of Frenchtown report or PDF version of Frenchtown report. Website accessed September 4, 2017.

Water Supply Planning

NJDEP Division of Water Supply and Geoscience. June 2017. Draft New Jersey Water Supply Plan 2017-2022. http://www.state.nj.us/dep/watersupply/wsp.html

Water Quality Management Planning

NJDEP. Date last amended: November 7, 2016. N.J.A.C. 7:15: Water Quality Management Planning. http://www.nj.gov/dep/rules/rules/njac7_15.pdf

NJDEP Office of Water Resources Management Coordination. August 15, 2017. Water Quality Management Planning Program: Adopted Water Quality Management Plan Amendments and Revisions. http://www.nj.gov/dep/wqmp/wmpadopted.html#upperdelaware . Website accessed September 4, 2017.

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NJDEP Water Resources Management. December 18, 2015. New Jersey's Continuing Planning Process. http://www.nj.gov/dep/wrm/docs/cpp.pdf.

NJDEP Office of Water Resources Management Coordination. July 29, 2015. Public Notice: Adopted Amendments to the Upper Delaware Water Quality Management Plan and Upper Raritan Water Quality Management Plan. http://www.nj.gov/dep/wqmp/docs/wqmp/upperdelaware/20150729-hunterdon-co-wmp-frenchtown-chapter.pdf

Lower Delaware Wild and Scenic River

Lower Delaware Wild and Scenic River Home Page. 2017. https://www.lowerdelawarewildandscenic.org/. Website accessed September 4, 2017.

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. https://www.lowerdelawarewildandscenic.org/index.php/resources/documents/lower-delaware-wild-and-scenic-management-plan

Internet Resources: Regional Relationships

Sustainability

- NJDEP Office of Sustainability: http://www.nj.gov/dep/aqes/sustainability.html
- Rethink Energy NJ: http://rethinkenergynj.org/
- Sustainable Jersey: http://www.sustainablejersey.com/
- USEPA Greener Living: https://www.epa.gov/environmental-topics/greener-living

NJDEP Water Supply Planning: http://www.state.nj.us/dep/watersupply/wsp.html

NJDEP Water Quality Management Planning: http://www.nj.gov/dep/wrm/index.html

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

Lower Delaware River Official Map and Guide: https://www.lowerdelawarewildandscenic.org/index.php/resources/maps/nps-lower-delaware-scenic-recreational-river

11: COMPOSITE MAP OF ENVIRONMENTALLY CRITICAL AREAS

Throughout this document, many environmental and natural features of the Borough of Frenchtown have been documented, described and mapped. One of the greatest values of mapping with GIS is to easily combine features in new ways. To accomplish this, **Figure 11** combines some of the mapped layers from previous sections, displaying features that make an area environmentally critical together on one map.

A useful definition of an "environmentally critical area" is provided in the Stormwater Management regulations (N.J.A.C. 7:8):

> " 'Environmentally critical area' means an area or feature which is of significant environmental value, including, but not limited to: stream corridors; natural heritage priority sites; habitats of endangered or threatened species; large areas of contiguous open space or upland forest; steep slopes; and well head protection and groundwater recharge areas. Habitats of endangered or threatened species are identified using the Department's Landscape Project as approved by the Department's Endangered and Nongame Species Program." (NJDEP, June 20, 2016)

Figure 11 combines the following:

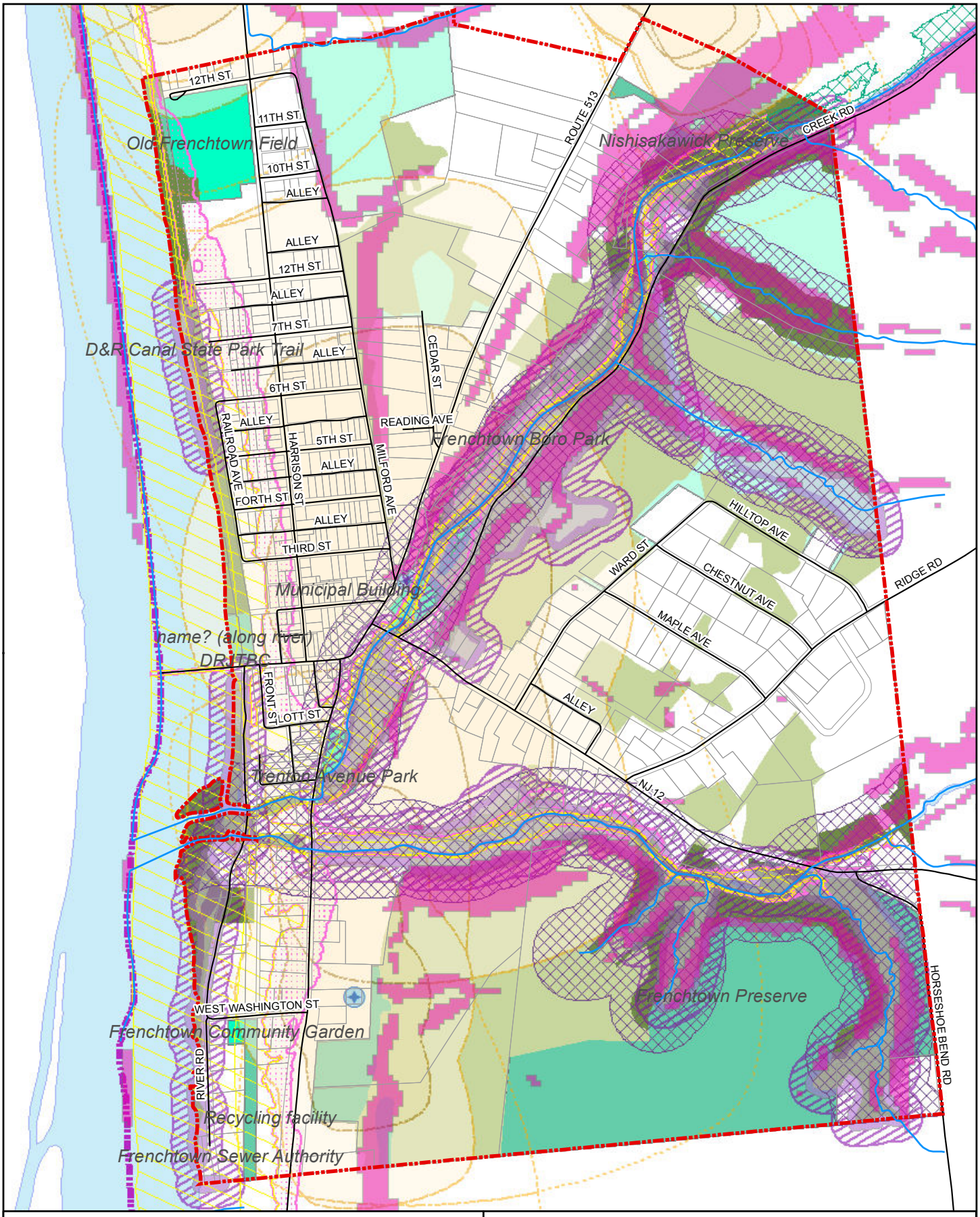
- Steep slopes greater than 25%
- Floodplains
- Wetlands (based on 2012 Land Use data; Note: an LOI is necessary to determine actual boundary of wetlands)
- 50 foot and 150 foot wetlands buffers (based on 2012 Land Use data; an LOI is necessary to determine actual buffer for wetlands – not all wetlands are given a 50 foot buffer)
- Riparian buffers: 300 foot buffers for C1 streams)
- Landscape Project version 3.3: Rank 3 or 4 habitats
- Open space
- Well Head Protection Areas

References: Environmentally Critical Areas

NJDEP. June 20, 2016. N.J.A.C. 7:8 Stormwater Management Rule. Date last amended: Date last amended: June 20, 2016. 39 pages. http://www.nj.gov/dep/rules/rules/njac7_8.pdf

GIS data:

Steep slopes: See Section 3B; Figure 3c
Floodplains: See Section 6B; Figure 6c
Wetlands & wetlands buffers: See Section 6C; Figure 6d
Riparian buffers: See Section 6D; Figure 6e
Landscape Project v3.3 Rank 3 or 4: See Section 7F; Figure 7e
Open Space: See Section 8C; Figure 8a
Well Head Protection Areas: See Section 2C or 5E



Data Sources: NJDEP, NJDOT, FEMA
Note: Map accuracy is limited to the accuracy and scale of the original data sets.
Disclaimer: This map was developed using NJDEP GIS digital data, but this secondary product has not been verified by NJDEP and is not NJDEP authorized.

Figure 11: Borough of Frenchtown Environmentally Critical Areas

Legend

- Frenchtown Borough
- Roads
- Water
- Parcels
- Steep Slopes > 25%
- Riparian Buffer: Category 1 300 foot buffer
- Wetlands (2012 Land Use)
- Wetlands: 50 foot buffer applies to some wetlands
- Wetlands: 150 foot buffer applies to some wetlands

Flood Zone

- Flood zone AE (base elevations determined)
- Flood zone A (base elevations not determined)
- Flood zone X (0.2 % annual chance flood hazard)

Landscape Project v.3.3 Rank

- Landscape Project Rank 3 - State Threatened
- Landscape Project Rank 4 - State Endangered
- Landscape Project Rank 3 - State Threatened Freshwater Mussels

Well Head Protection Area

- Tier 1
- Tier 2
- Tier 3
- Public Communitiy Water Supply (PCWS) Wells

Open Space (owner)

- Easement
- Frenchtown Borough
- State of NJ DEP

APPENDIX A: DATA USE AGREEMENTS

Contents

A.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.

A.2 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 Division of Land Use Regulation, P.O. Box 439, Trenton, NJ 08625-0439.

The Landscape Project was developed by the Division of Fish & Wildlife, Endangered and Nongame Species Program in order to map critical habitat for rare animal species. Natural Heritage Database response letters will also list all species (if any) found during a search of the Landscape Project. However, 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 THIS REPORT

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.

Figure	Data Source*	Data Title	Date	Scale	Online Linkage
All	NJDEP BGIS	Municipalities of New Jersey (Clipped to Coast), Edition 20121228 (Govt_admin_mun_coast_bnd)	12/28/2012	1:2,400	http://www.state.nj.us/dep/gis/stateshp.html#MUNCOAST
Most	NJDEP BGIS	National Hydrography Dataset (NHD) Streams 2002	11/1/2010	1:2,400	http://www.state.nj.us/dep/gis/digidownload/zips/statewide/nhdstreams2002shp.zip
	NJDOT	New Jersey Department of Transportation Statewide Public Road Network (1:2400)	12/1/2014	1:2,400	http://www.state.nj.us/transportation/gis/data.shtm
	NJDEP BGIS	NJDEP 2002 Waters of New Jersey (Lakes and Ponds), Version 20080501	5/1/2008	1:2,400	http://www.state.nj.us/dep/gis/digidownload/zips/statewide/njwaterbody.zip
	NJDEP BGIS	State of New Jersey Composite of Parcels Data, New Jersey State Plane NAD83 and MOD-IV Tax List Search Database	07/29/2011		https://njgin.state.nj.us/NJ_NJGINExplorer/IW.jsp?DLayer=Parcels by County/Muni
Figure 1a: Location of Borough	DRBC	Delaware River Basin creeks and rivers - clipped 2004	1/1/2004		http://www.pasda.psu.edu/uci/DataSummary.aspx?dataset=422
	DRBC	Municipal boundaries for Pennsylvania clipped to the Delaware River Basin 2004	1/1/2004		http://www.pasda.psu.edu/uci/DataSummary.aspx?dataset=430
	NJDEP BGIS	Municipalities of New Jersey (Clipped to Coast), Version 20090116	1/16/2009	1:2,400	http://www.state.nj.us/dep/gis/digidownload/zips/statewide/muncoast.zip
	NJDEP BGIS	NJDEP County Boundaries for the State of New Jersey	1/23/2003	1:24,000	http://www.state.nj.us/dep/gis/digidownload/zips/statewide/stco.zip
	NJDEP BGIS	NJDEP State Boundary of New Jersey	11/1/1998	1:24,000	http://www.state.nj.us/dep/gis/digidownload/zips/statewide/state.zip
	PADOT	PennDOT - Pennsylvania County Boundaries	1/1/2017	1:24,000	http://www.pasda.psu.edu/uci/DataSummary.aspx?dataset=24
Figure 1b: 1930 Aerial Photography	NJOIT OGIS	1930s Aerial Photography of New Jersey Web Map Service (WMS)	10/1/2009		WMS Server: http://geodata.state.nj.us/imagerywms/BlackWhite1930?
Figure 1c: 1995 Aerial Photography	USGS	1994/1995 Digital Orthophoto Quadrangles (DOQ)	1999	1:12,000	https://njgin.state.nj.us/NJ_NJGINExplorer/IW.jsp
Figure 1d: 2002 Aerial Photography	NJOIT OGIS	New Jersey 2002 High Resolution Orthophotography	7/31/2003	1:2,400	https://njgin.state.nj.us/NJ_NJGINExplorer/IW.jsp
Figure 1e: 2007 Aerial Photography	NJOIT OGIS	New Jersey 2007 - 2008 High Resolution Orthophotography, MrSID 5K Tiles	10/1/2008	1:19,200	https://njgin.state.nj.us/NJ_NJGINExplorer/IW.jsp

Figure	Data Source*	Data Title	Date	Scale	Online Linkage
Figure 1f: 2012 Aerial Photography	NJOIT OGIS	New Jersey 2012 - 2013 High Resolution Orthophotography, NAD83 NJ State Plane Feet, MrSID Tiles	3/1/2013	1:2,400	https://njgin.state.nj.us/NJ_NJGINExplorer/IW.jsp
Figure 1g: 2015 Aerial Photography	NJOIT OGIS	New Jersey 2015 High Resolution Orthophotography, NAD83(2011) NJ State Plane Feet, MrSID Tiles	2/24/2016	1:2,400	https://njgin.state.nj.us/NJ_NJGINExplorer/IW.jsp
Figure 1h: Land Use Type (2012)	NJDEP BGIS	Land Use/Land Cover 2012 Update, Edition 20150217 Subbasin 02040105 - Middle Delaware-Musconetcong	2/17/2015	1:2,400	http://www.state.nj.us/dep/gis/lulc12.html
Figure 1i: Land Use Change	NJDEP BGIS	Land Use/Land Cover 2012 Update, Edition 20150217 Subbasin 02040105 - Middle Delaware-Musconetcong	2/17/2015	1:2,400	http://www.state.nj.us/dep/gis/lulc12.html
	NJDEP BGIS	NJDEP 1986 Land Use/Land Cover for Hunterdon County, New Jersey	11/1/1998	1:24,000	http://www.nj.gov/dep/gis/lulcshp.html
	NJDEP BGIS	NJDEP 1995/97 Land use/Land cover Update, Central Delaware Watershed Management Area, WMA-11	12/1/2000	1:12,000	http://www.nj.gov/dep/gis/lulc95shp.html
	NJDEP BGIS	NJDEP 2002 Land use/Land cover Update, Central Delaware Watershed Management Area, WMA-11, Edition 20080304	3/4/2008	1:2,400	http://www.nj.gov/dep/gis/lulc02shp.html
	NJDEP BGIS	NJDEP 2007 Land use/Land Cover Update, Central Delaware Watershed Management Area, WMA11	7/12/2010	1:2,400	http://www.nj.gov/dep/gis/lulc07shp.html
	NJDEP BGIS	Land Use/Land Cover 2012 Update, Edition 20150217 Subbasin 02040105 - Middle Delaware-Musconetcong	2/17/2015	1:2,400	http://www.state.nj.us/dep/gis/lulc12.html
Figure 2a: Drought Regions and Air Quality Figure	NJDEP NJGS	DGS00-1: Drought Regions of New Jersey	5/1/2004	1:24,000	http://www.state.nj.us/dep/njgs/geodata/dgs00-1.htm
	NADP	NADP sites	2017		http://nadp.sws.uiuc.edu/data/
	NJDEP BAM	NJDEP Ambient Air Quality Monitors	3/1/2006	1:1600	http://www.state.nj.us/dep/airmon/04rpt.htm
Figure 2b: Public Water	NJGS	DGS02-2: Well Head Protection Areas For Public Community Water Supply Wells In New Jersey	4/19/2011	1:24,000	http://www.state.nj.us/dep/njgs/geodata/dgs02-2.htm#image
	NJGS	DGS97-1 NJDEP Public-Community Water-Supply Wells of New Jersey	7/7/2011	1:24,000	http://www.state.nj.us/dep/njgs/geodata/dgs97-1.htm
	NJDEP DSRT	NJDEP Public Community Water Purveyor Service Areas, 1998	7/12/2004	1:24,000	http://www.state.nj.us/dep/gis/digidownload/zips/statewide/watpurv1998.zip
Figure 2c: Public Sewer	NJDEP	Statewide Sewer Service Area for New Jersey, Edition 20170124 (Util_wastewater_servicearea)	1/24/2017		http://njogis-newjersey.opendata.arcgis.com/datasets/2ceba1ef852b4940afc3e0d94fb5d327_6
Figure 3a: Physio-graphic Provinces	NJGS	DGS02-7: Physiographic Provinces of New Jersey	6/30/2002	1:100,000	http://www.state.nj.us/dep/njgs/geodata/dgs02-7.htm
	NJGS	DGS04-1: Earthquakes Epicentered In New Jersey, Edition 20161107	11/7/2016		http://www.state.nj.us/dep/njgs/geodata/dgs04-1.htm
	NJDEP BGIA	NJDEP Hillshade Grid for New Jersey (100 meters)	1/1/2002	1:24,000	http://www.state.nj.us/dep/gis/digidownload/zips/statewide/nj100mhill.zip
Figure 3b: Elevation Contours	NJGS	DGS00-3 Topographic Elevation Contours for New Jersey (1:100,000 Scale) Flemington	12/29/1999	1:100,000	http://www.state.nj.us/dep/njgs/geodata/dgs00-3.htm
	NJGS	DGS99-4 Digital Elevation Grids for New Jersey (1:100,000 scale) (100 foot cell hillshade grid)	1/1/1999	3 meter	http://www.state.nj.us/dep/njgs/geodata/dgs99-4.htm

Figure	Data Source*	Data Title	Date	Scale	Online Linkage
	NJDEP BGIA	NJDEP Digital Elevation Grid for New Jersey (100 meter)	5/1/2002	1:24,000	http://www.state.nj.us/dep/gis/digidownload/zips/statewide/nj100mlat.zip
Figure 3c: Steep Slopes	NJDEP NJFFS	2002 NJFFS Wildfire Fuel Hazard for Hunterdon County, New Jersey	4/17/2009	1:2,400	http://www.state.nj.us/dep/gis/digidownload/zips/njfh/midfh02.zip
Figure 3d: Bedrock Geology	NJGS	DGS04-6: Bedrock Geology for New Jersey 1:100,000 Scale	6/30/1999	1:100,000	http://www.state.nj.us/dep/njgs/geodata/dgs04-6.htm
	NJGS	DGS07-2: Bedrock Outcrops of New Jersey	9/15/2006	1:100,000	http://www.state.nj.us/dep/njgs/geodata/dgs07-2.htm
Figure 3e: Surficial Geology	NJDEP NJG&WS	DGS04-7: Historic Fill For New Jersey as of January 2016	1/26/2016	1:100,000	http://www.state.nj.us/dep/njgs/geodata/dgs04-7.htm
	NJGS	DGS07-2: Surficial Geology of New Jersey	9/11/2013	1:100,000	http://www.state.nj.us/dep/njgs/geodata/dgs07-2.htm
figure 3f: Surficial Geology	NJDEP NJG&WS	DGS04-7: Historic Fill For New Jersey as of January 2016	1/26/2016	1:100,000	http://www.state.nj.us/dep/njgs/geodata/dgs04-7.htm
Figure 4a-h: Soils	USDA NRCS	Soil Survey Geographic (SSURGO) database for Hunterdon County, New Jersey (nj019)	9/28/2016	1:1,000	https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx
Figure 5c: Aquifer, GW Monitoring wells	NJGS	Ambient-Nutrients of New Jersey, Series DGS05-2, Edition 20140114	1/14/2014		http://www.state.nj.us/dep/njgs/geodata/dgs05-2.htm
	NJGS	DGS96-3 Ambient Ground-Water Quality of the New Jersey Part of the Newark Basin	11/5/1995	1:24,000	http://www.state.nj.us/dep/njgs/geodata/dgs96-3.htm
	NJGS	DGS98-5 Aquifers of New Jersey	5/21/1998	1:100,000	http://www.state.nj.us/dep/njgs/geodata/dgs98-5.htm
	NJGS	DGS98-6 NJDEP Sole-Source Aquifers in New Jersey	4/5/2000	1:24,000	http://www.state.nj.us/dep/njgs/geodata/dgs98-6.htm
Figure 5e: Ground Water Recharge & Aquifer Rank	NJGS	DGS02-3-Ground-Water Recharge for Hunterdon County, NJ	10/8/2004	1:24,000	http://www.njgeology.org/geodata/dgs02-3/dgs02-3.htm
	NJGS	DGS07-1-Aquifer Recharge Potential for Hunterdon County, NJ	1/4/2005	1:24,000	http://www.njgeology.org/geodata/dgs07-1.htm
Figure 5f: Ground Water Contamination	NJDEP	Brownfield Development Areas in New Jersey (Outline), NJDEP Edition 20170131 (Envr_mon_soil_brownfield_out)	1/31/2017		http://njogis-newjersey.opendata.arcgis.com/datasets/new-jersey-brownfield-development-area-outlines
	NJDEP	Classification Exception Areas-Well Restriction Areas for New Jersey, Edition 20170623 (Envr_mon_gw_CEA)	6/23/2017	1:1,000	http://njogis-newjersey.opendata.arcgis.com/datasets/groundwater-contamination-classification-exception-areas
	NJDEP	Deed Notice Extent in New Jersey, Edition 20170828 (Envr_mon_soil_DNA)	8/28/2017	1:24,000	http://njogis-newjersey.opendata.arcgis.com/datasets/076a3d08a34348d2bdb3c109ec349e53_17
	NJDEP	Known Contaminated Site List for New Jersey, Edition 20170427 (Envr_mon_gw_KCSL)	4/27/2017	1:1,000	http://njogis-newjersey.opendata.arcgis.com/datasets/6f11f6204ffa40a09527c8205aec4425_7
	NJDEP	New Jersey Pollution Discharge Elimination System (NJPDES) Regulated Facility Locations, Edition 20070718	7/18/2007		http://njogis-newjersey.opendata.arcgis.com/datasets/njdep-non-point-wastewater-sites
	NJDEP	NJDEP Known Contaminated Site List for New Jersey (Non-Homeowner), Edition 201202	4/26/2017		http://njogis-newjersey.opendata.arcgis.com/datasets/new-jersey-contaminated-sites
Figure 6a: Watersheds	NJGS	14 Digit Hydrologic Unit Code Delineations for New Jersey (Version 20110225)	2/25/2011	1:24,000	http://www.nj.gov/dep/gis/stateshp.html#HUC14
	DRBC	Boundary of the Delaware River Basin		1:24,000	http://www.state.nj.us/drbc/basin/map/GIS.html
	DRBC	Boundary of the DRB Special Protection Waters		1:24,000	http://www.state.nj.us/drbc/basin/map/GIS.html

Figure	Data Source*	Data Title	Date	Scale	Online Linkage
	DRBC	Delaware River Access			http://www.state.nj.us/drbc/basin/map/GIS.html
	NJDEP DWM	NJDEP Watershed Management Areas in New Jersey (Version 200901)	2009	1:24,000	http://www.nj.gov/dep/gis/stateshp.html#WMAS
	DRBC	Significant & Outstanding Water Classification for the Delaware River		1:24,000	http://www.state.nj.us/drbc/basin/map/GIS.html
	NJDEP	State of NJ Boundary	1998		http://www.nj.gov/dep/gis/stateshp.html#STATE
	NJDEP	NJDEP State Rivers for New Jersey (Third Order or Higher)	1993	1:24,000	http://www.nj.gov/dep/gis/stateshp.html#STATERIV
	NJDEP BGIS	National Hydrography Dataset (NHD) Streams 2002	11/1/2010	1:2,400	http://www.nj.gov/dep/gis/nhd2002.html
Figure 6b: Sub-watersheds	NJGS	14 Digit Hydrologic Unit Code Delineations for New Jersey (Version 20110225)	2/25/2011	1:24,000	http://www.nj.gov/dep/gis/stateshp.html#HUC14
	NJDEP DWM	NJDEP Watershed Management Areas in New Jersey (Version 200901)	1/1/2009	1:24,000	http://www.nj.gov/dep/gis/stateshp.html#WMAS
	NJDEP	NJPDES Surface Water Discharges in New Jersey, (1:12,000) Edition 20170614 (Strc_NJPDES_sw_pipe)	6/14/2017	1:12,000	http://njogis-newjersey.opendata.arcgis.com/datasets/55e8b1a25706431490a8f3becf861f91_5
Figure 6c: Floodplains	FEMA	FEMA's National Flood Hazard Layer (Official) (Bucks County, PA)	1/11/2017	1:12,000	http://fema.maps.arcgis.com/home/webmap/viewer.html
	FEMA	FEMA's National Flood Hazard Layer (Official) (Hunterdon County, NJ)	1/11/2017	1:12,000	http://fema.maps.arcgis.com/home/webmap/viewer.html
Figure 6d: Wetlands	NJDEP BGIS	Land Use/Land Cover 2012 Update, Edition 20150217 Subbasin 02040105 - Middle Delaware-Musconetcong (Land_lu_2012_hu02040105)	2/17/2015	1:2,400	http://www.state.nj.us/dep/gis/lulc12.html
Figure 6e: SWQS & riparian buffer	NJDEP WMS	NJDEP Surface Water Quality Standards of New Jersey (Version 201012)	12/1/2010	1:2,400	http://www.state.nj.us/dep/gis/stateshp.html#SWQS
	NJDEP	NJPDES Surface Water Discharges in New Jersey, (1:12,000) Edition 20170614 (Strc_NJPDES_sw_pipe)	6/14/2017	1:12,000	http://njogis-newjersey.opendata.arcgis.com/datasets/55e8b1a25706431490a8f3becf861f91_5
Figure 6f: Integrated List	NJDEP	Integrated List of Waters for New Jersey, 2012 (Integrated List), Edition 201503 (Envr_mon_water_IR_2012_use)	3/1/2015	1:24,000	http://www.nj.gov/dep/gis/irshp.html
Figure 6g: Impervious Surface	NJDEP BGIS	Land Use/Land Cover 2012 Update, Edition 20150217 Subbasin 02040105 - Middle Delaware-Musconetcong (Land_lu_2012_hu02040105)	2/17/2015	1:2,400	http://www.state.nj.us/dep/gis/lulc12.html
	NJDEP BGIS	National Hydrography Dataset (NHD) Streams 2002	11/1/2010	1:2,400	http://www.nj.gov/dep/gis/nhd2002.html
	NJDEP BGIS	National Hydrography Dataset (NHD) Waterbody 2002	11/1/2010	1:2,400	http://www.nj.gov/dep/gis/nhd2002.html
Figure 6h: Monitoring	NJDEP BFBM	Ambient Biomonitoring Network (AMNET), New Jersey, Edition 20170606 (Envr_mon_water_biopt)	6/6/2017	1:2,400	http://njogis-newjersey.opendata.arcgis.com/datasets/0dfc4d4e71154194a6939c5db62e5969_21
	NJDEP BFBM	Ambient Stream Quality Monitoring Sites (1998 - 2010)	11/20/2008	1:2,400	http://www.state.nj.us/dep/gis/digidownload/zips/statewide/swpts.zip
	NJDEP BFBM	Fish Index of Biotic Integrity Monitoring Network for NJ, Edition 2000-2011 (Envr_mon_water_fibi)	11/26/2014		http://www.nj.gov/dep/gis/digidownload/metadata/statewide/Envr_mon_water_fibi.html
	NJDEP BFBM	NJDEP Existing Water Quality Stations in New Jersey	10/19/2007	1:24,000	http://www.state.nj.us/dep/gis/digidownload/zips/statewide/ewqpoi.zip

Figure	Data Source*	Data Title	Date	Scale	Online Linkage
	NJDEP BFBM	STORET Water Quality Monitoring Stations	8/1/2005		http://www.state.nj.us/dep/gis/stateshp.html#STORET
	USGS, WRD	USGS stream lowflow gaging locations in New Jersey	4/17/2002	1:24,000	http://www.njgeology.org/geodata/dgs02-5/lowflow.zip
	USGS, WRD	USGS surface-water quality gaging stations in New Jersey	4/17/2002		http://www.njgeology.org/geodata/dgs02-5/wqgages.zip
Figure 7a: Land Cover (2012) Ag & Forest	NJDEP BGIS	Land Use/Land Cover 2012 Update, Edition 20150217 Subbasin 02040105 - Middle Delaware-Musconetcong (Land_lu_2012_hu02040105)	2/17/2015	1:2,400	http://www.state.nj.us/dep/gis/lulc12.html
Figure 7b: Land Cover (2012) Urban	NJDEP BGIS	Land Use/Land Cover 2012 Update, Edition 20150217 Subbasin 02040105 - Middle Delaware-Musconetcong (Land_lu_2012_hu02040105)	2/17/2015	1:2,400	http://www.state.nj.us/dep/gis/lulc12.html
Figure 7c: Land Cover (2012) Water & Wetlands	NJDEP BGIS	Land Use/Land Cover 2012 Update, Edition 20150217 Subbasin 02040105 - Middle Delaware-Musconetcong (Land_lu_2012_hu02040105)	2/17/2015	1:2,400	http://www.state.nj.us/dep/gis/lulc12.html
Figure 7d: Wildfire Fuel Hazard	NJDEP NJFFS	2002 NJFFS Wildfire Fuel Hazard for Hunterdon County, New Jersey	4/17/2009	1:24,000	http://www.nj.gov/dep/gis/njfh.html
Figure 7e: Landscape Project version 3.3	NJDEP DFW ENSP	NJDEP Species Based Habitat, Freshwater Mussel Habitat	5/9/2017	1:12,000	http://www.state.nj.us/dep/gis/landscape.html#geodatabase
	NJDEP DFW ENSP	NJDEP Species Based Habitat, Skylands Region	5/9/2017	1:12,000	http://www.state.nj.us/dep/gis/landscape.html#geodatabase
Figure 8a: Preserved Open Space & Farmland	Municipal records	Frenchtown Borough Open Space	2/9/2017		Not available
	NJDEP GA	New Jersey State Park Service - Parks and Forests Trail System, Edition 20160621 (Land_use_trails)	6/21/2016	1:1,500	http://njogis.newjersey.opendata.arcgis.com/datasets/a36e0ae5cffb441abdb2adfd26356fb1_4
	NJDA SADC	NJFPP - New Jersey Farmland Preservation Program	6/29/2016		http://www.nj.gov/agriculture/sadc/farmpreserve/resources/njfpp.zip
	NJDEP GA	State Owned, Protected Open Space and Recreation Areas in New Jersey	2/23/2016	1:24,000	http://njogis.newjersey.opendata.arcgis.com/datasets/b75fe11ed90543c1b4ee87e66af63b8b_1
Figure 8b: Surrounding Open Space	Kingwood	Kingwood Township Open Space (selected from Hunterdon Parcels)	1/31/2017		Not available
	PA DCNR	Pennsylvania Local Parks	12/30/2015		http://www.pasda.psu.edu/uci/DataSummary.aspx?dataset=307
	PA DCNR	Pennsylvania Local Parks Access Points	12/30/2015		http://www.pasda.psu.edu/uci/DataSummary.aspx?dataset=308
	PA DCNR	Pennsylvania Wild and Natural Areas	12/30/2015		http://www.pasda.psu.edu/uci/DataSummary.aspx?dataset=932
	PA DCNR	State Park Boundaries	2/18/2009		http://www.pasda.psu.edu/uci/DataSummary.aspx?dataset=114
Figure 9a: Archeological & Historical	NJDEP/NHR/HPO	Historic Properties in New Jersey	9/22/2016		https://geodata.state.nj.us/arcgis/rest/services/Features/Land_Use_and_Land_Cover/MapServer/7
	NJDEP/NHR/HPO	Archaeological Site Grid of New Jersey, Edition 20160922 (Land_use_HPO_arch_grid)	9/22/2016		https://geodata.state.nj.us/arcgis/rest/services/Features/Land_Use_and_Land_Cover/MapServer/8

Figure	Data Source*	Data Title	Date	Scale	Online Linkage
Figure 9b & 9c: Historical Properties	NJDEP/NHR/HPO	Historic Districts of New Jersey, Edition 20160922 (Land_use_HPO_district)	9/22/2016	NA	https://geodata.state.nj.us/arcgis/rest/services/Features/Land_Use_and_Land_Cover/MapServer/9
	NJDEP/NHR/HPO	Historic Property Features of New Jersey, Edition 20160922 (Land_use_HPO_property_feature)	9/22/2016	NA	https://geodata.state.nj.us/arcgis/rest/services/Features/Land_Use_and_Land_Cover/MapServer/6

*Data Sources	Full Name of Data Source
DRBC	Delaware River Basin Commission
FEMA	Federal Emergency Management Agency
NADP	National Atmospheric Deposition Program
NJDA SADC	New Jersey Department of Agriculture, State Agriculture Development Committee
NJDEP BAM	NJDEP Dept of Environmental Regulation, Bureau of Air Monitoring
NJDEP BFBM	NJDEP Bureau of Freshwater Biological Monitoring
NJDEP BGIS	NJDEP BGIS
NJDEP DFW ENSP	NJDEP Division of Fish Wildlife, Endangered Nongame Species Program
NJDEP DSRT BEA	NJDEP Division of Science, Research, and Technology, Bureau of Environmental Assessment
NJDEP DWM	NJDEP Division of Watershed Management
NJDEP GA	NJDEP Green Acres
NJDEP NJFFS	NJDEP New Jersey Forest Fire Service
NJDEP NJG&WS	NJDEP New Jersey Geological and Water Survey
NJDEP ONLM	NJDEP Office of Natural Lands Management
NJDEP NHR HPO	NJDEP Historic Preservation Office
NJGIN	New Jersey Geographic Information Network
NJGS	New Jersey Geological Service
NJOIT OGIS	NJ Office of Information Technology, Office of GIS
PA DCNR	Pennsylvania Department of Conservation and Natural Resources
USDA/NRCS	USDA/NRCS

APPENDIX C: REGIONAL FAUNA

Contents:

C.1: Hunterdon County Birds

State	Common Name	*Scientific Name*	Hunterdon	Hunterdon
Ducks, Geese & Swans				
RV	Greater White-fronted Goose	*Anser albifrons*	7	11/30/2016
RV	Pink-footed goose	*Anser brachyrhynchus*	1	3/8/2016
	Snow Goose	*Chen caerulescens*	58000	3/10/2014
RV	Ross's Goose	*Chen rossii*	1	12/26/2016
	Brant	*Branta bernicla*	234	10/30/2012
RV	Cackling Goose	*Branta hutchinsii*	18	1/17/2015
	Canada Goose	*Branta canadensis*	9000	1/12/2013
RV	Barnacle goose	*Branta leucopsis*	1	12/31/2013
int	Mute Swan	*Cygnus olor*	13	4/22/2015
	Tundra Swan	*Cygnus columbianus*	39	3/18/2001
	Wood Duck	*Aix sponsa*	144	3/19/2009
	Gadwall	*Anas strepera*	116	12/31/2012
	Eurasian Wigeon	*Anas penelope*	1	2/16/2006
	American Wigeon	*Anas americana*	132	3/9/2010
	American Black Duck	*Anas rubripes*	600	12/22/1985
	Mallard	*Anas platyrhynchos*	475	12/31/2004
	Blue-winged Teal	*Anas discors*	26	9/14/2012
	Northern Shoveler	*Anas clypeata*	26	9/21/2010
	Northern Pintail	*Anas acuta*	326	3/15/1987
	Green-winged Teal	*Anas crecca*	375	3/12/2014
	Canvasback	*Aythya valisineria*	27	2/4/2014
	Redhead	*Aythya americana*	34	1/31/2014
	Ring-necked Duck	*Aythya collaris*	725	3/4/2011
	Greater Scaup	*Aythya marila*	50	3/21/2004
	Lesser Scaup	*Aythya affinis*	240	3/10/2004
	Surf Scoter	*Melanitta perspicillata*	6	5/1/2009
	White-winged Scoter	*Melanitta fusca*	54	5/15/2012
	Black Scoter	*Melanitta americana*	83	10/25/2012
	Long-tailed Duck	*Clangula hyemalis*	53	4/5/2014
	Bufflehead	*Bucephala albeola*	150	3/31/2012
	Common Goldeneye	*Bucephala clangula*	74	3/2/2015
	Hooded Merganser	*Lophodytes cucullatus*	52	11/18/2005
	Common Merganser	*Mergus merganser*	400	2/4/2017
	Red-breasted Merganser	*Mergus serrator*	34	4/23/2005
	Ruddy Duck	*Oxyura jamaicensis*	274	11/6/2014
Grouse, Quail & Allies				
	Northern Bobwhite	*Colinus virginianus*	1	7/9/2016
	Ring-necked Pheasant	*Phasianus colchicus*	5	5/18/2014
	Ruffed Grouse	*Bonasa umbellus*	1	10/17/2012
	Wild Turkey	*Meleagris gallopavo*	75	4/1/2001

State	Common Name	*Scientific Name*	Hunterdon	Hunterdon
Loons				
	Red-throated Loon	*Gavia stellata*	70	11/17/2002
	Common Loon	*Gavia immer*	377	4/23/2005
RV	Pacific Loon	*Gavia arctica*	1	5/13/1995
Grebes				
Ebr, SCnb	Pied-billed Grebe	*Podilymbus podiceps*	8	9/24/2012
	Horned Grebe	*Podiceps auritus*	133	4/17/2013
	Red-necked Grebe	*Podiceps grisegena*	15	3/4/2014
RV	Eared Grebe	*Podiceps nigricollis*	1	12/22/2016
Tubenoses				
	Leach's Storm-Petrel	*Oceanodroma leucorhoa*	1	10/30/2012
Frigatebirds, Boobies, Cormorants, Darters &				
	Northern Gannet	*Morus bassanus*	1	5/3/2009
RV	Brown Booby	*Sula leucogaster*	1	8/27/2016
RV	Neotropic Cormorant	*Phalacrocorax brasilianus*	1	6/11/2015
	Double-crested Cormorant	*Phalacrocorax auritus*	180	5/3/2005
	Great Cormorant	*Phalacrocorax carbo*	8	1/28/2005
Pelicans, Herons, Ibises & Allies				
RV	American White Pelican	*Pelecanus erythrorhynchos*	1	5/9/2016
Ebr, SCnb	American Bittern	*Botaurus lentiginosus*	3	5/7/2012
SC	Least Bittern	*Ixobrychus exilis*	1	5/15/2008
SCbr	Great Blue Heron	*Ardea herodias*	45	6/24/2010
	Great Egret	*Ardea alba*	22	7/23/2010
SCbr	Snowy Egret	*Egretta thula*	3	8/13/2016
SC	Little Blue Heron	*Egretta caerulea*	2	7/26/2014
Tbr, SCnb	Cattle Egret	*Bubulcus ibis*	5	4/29/1983
	Green Heron	*Butorides virescens*	18	8/10/2015
Tbr, SCnb	Black-crowned Night-Heron	*Nycticorax nycticorax*	3	8/7/2014
T	Yellow-crowned Night-Heron	*Nyctanassa violacea*	1	6/12/2012
SCbr	Glossy Ibis	*Plegadis falcinellus*	7	4/21/2004
Hawks, Kites, Eagles & Allies				
	Black Vulture	*Coragyps atratus*	165	10/25/2016
	Turkey Vulture	*Cathartes aura*	215	12/28/2005
Tbr	Osprey	*Pandion haliaetus*	8	7/17/2014
	Swallow-tailed Kite	*Elanoides forficatus*	1	5/27/2013
	Mississippi Kite	*Ictinia mississippiensis*	2	6/21/2004
Ebr, Tnb	Bald Eagle	*Haliaeetus leucocephalus*	6	10/28/2016
Ebr, SCnb	Northern Harrier	*Circus cyaneus*	12	2/24/1991
SC	Sharp-shinned Hawk	*Accipiter striatus*	22	9/27/2012
SCbr	Cooper's Hawk	*Accipiter cooperii*	6	8/6/2010

State	Common Name	*Scientific Name*	Hunterdon	Hunterdon
Ebr, SCnb	Northern Goshawk	*Accipiter gentilis*	1	11/22/2015
Ebr, SCnb	Red-shouldered Hawk	*Buteo lineatus*	8	4/6/2014
SCbr	Broad-winged Hawk	*Buteo platypterus*	850	9/17/2007
	Red-tailed Hawk	*Buteo jamaicensis*	30	2/17/2008
	Rough-legged Hawk	*Buteo lagopus*	3	3/2/2015
	Golden Eagle	*Aquila chrysaetos*	3	11/3/2013
Cranes & Rails				
	Virginia Rail	*Rallus limicola*	2	5/3/2015
	Sora	*Porzana carolina*	7	6/12/2004
	Purple gallinule	*Porphyrula martinica*	1	10/5/2003
	American Coot	*Fulica americana*	150	1/20/2012
	Sandhill Crane	*Grus canadensis*	9	12/1/2012
Plovers, Sandpipers & Allies				
	Black-bellied Plover	*Pluvialis squatarola*	10	9/11/1986
	American Golden-Plover	*Pluvialis dominica*	24	9/16/2013
RV	European Golden-Plover	*Pluvialis fulva*	1	7/20/2014
	Semipalmated Plover	*Charadrius semipalmatus*	35	8/29/1993
E	Piping Plover	*Charadrius melodus*	1	9/18/2004
	Killdeer	*Charadrius vociferus*	258	8/26/2016
SC	American Oystercatcher	*Haematopus palliatus*	2	10/30/2012
	American Avocet	*Recurvirostra americana*	1	7/21/2008
SCbr	Spotted Sandpiper	*Actitis macularius*	32	5/10/2013
	Solitary Sandpiper	*Tringa solitaria*	15	5/3/2016
	Greater Yellowlegs	*Tringa melanoleuca*	16	9/30/2010
	Willet	*Tringa semipalmata*	1	4/27/2007
	Lesser Yellowlegs	*Tringa flavipes*	52	8/1/2013
E	Upland Sandpiper	*Bartramia longicauda*	5	4/20/1985
SCnb	Whimbrel	*Numenius phaeopus*	1	9/10/2015
	Hudsonian Godwit	*Limosa haemastica*	3	9/19/2006
	Ruddy Turnstone	*Arenaria interpres*	10	5/25/2003
Enb	Red Knot	*Calidris canutus*	50	5/25/2003
SCnb	Sanderling	*Calidris alba*	9	9/9/2004
SCnb	Semipalmated Sandpiper	*Calidris pusilla*	150	8/21/2010
	Western Sandpiper	*Calidris mauri*	5	8/31/2016
	Least Sandpiper	*Calidris minutilla*	300	8/21/2010
	White-rumped Sandpiper	*Calidris fuscicollis*	64	9/11/1986
	Baird's Sandpiper	*Calidris bairdii*	5	9/3/2010
	Pectoral Sandpiper	*Calidris melanotos*	38	9/7/1986
	Dunlin	*Calidris alpina*	115	10/30/2012
	Stilt Sandpiper	*Calidris himantopus*	13	8/27/2006
	Buff-breasted Sandpiper	*Tryngites subruficollis*	4	9/18/2006
	Short-billed Dowitcher	*Limnodromus griseus*	23	8/28/2006
	Long-billed Dowitcher	*Limnodromus scolopaceus*	2	9/25/2016
	Wilson's Snipe	*Gallinago delicata*	45	4/8/2008

State	Common Name	*Scientific Name*	Hunterdon	Hunterdon
	American Woodcock	*Scolopax minor*	19	3/9/2016
	Wilson's Phalarope	*Phalaropus tricolor*	1	7/20/1986
	Red-necked Phalarope	*Phalaropus lobatus*	2	5/24/2013
	Red Phalarope	*Phalaropus fulicarius*	10	10/30/2012
	Bonaparte's Gull	*Chroicocephalus*	300	4/3/2006
	Little Gull	*Hydrocoloeus minutus*	4	4/10/2009
	Laughing Gull	*Leucophaeus atricilla*	5	10/4/2005
RV	Mew Gull	*Larus canus*	1	1/10/2013
	Ring-billed Gull	*Larus delawarensis*	12500	12/31/2014
	Herring Gull	*Larus argentatus*	3000	2/14/2013
	Iceland Gull	*Larus glaucoides*	13	3/22/2014
	Lesser Black-backed Gull	*Larus fuscus*	713	3/29/2013
	Glaucous Gull	*Larus hyperboreus*	2	1/16/2016
	Great Black-backed Gull	*Larus marinus*	25	3/5/2010
RV	Franklin's Gull	*Larus pipixcan*	5	11/13/2015
RV	Thayer's Gull	*Larus thayeri*	1	3/30/2015
SCbr	Caspian Tern	*Hydroprogne caspia*	9	4/21/2015
	Black Tern	*Chlidonias niger*	35	8/21/2008
SCbr	Common Tern	*Sterna hirundo*	13	5/4/2007
	Forster's Tern	*Sterna forsteri*	16	5/3/2004
RV	Arctic Tern	*Sterna paradisaea*	6	5/27/2005
RV	Sooty Tern	*Sterna fuscata*	4	8/28/2011
	Royal Tern	*Thalasseus maximus*	2	10/30/2012
E	Black Skimmer	*Rynchops niger*	1	10/31/2012
	Pomarine Jaeger	*Stercorarius pomarinus*	1	10/31/2012
Pigeons & Doves				
int	Rock Pigeon	*Columba livia*	130	2/19/2013
	Mourning Dove	*Zenaida macroura*	309	1/9/2013
Cuckoos				
	Yellow-billed Cuckoo	*Coccyzus americanus*	4	5/26/2015
SCbr	Black-billed Cuckoo	*Coccyzus erythropthalmus*	3	5/11/2016
Owls				
	Barn Owl	*Tyto alba*	2	2/27/2015
	Eastern Screech-Owl	*Megascops asio*	15	12/16/2012
	Great Horned Owl	*Bubo virginianus*	4	12/31/2013
	Snowy Owl	*Bubo scandiacus*	1	1/18/2014
T	Barred Owl	*Strix varia*	4	6/2/2010
T	Long-eared Owl	*Asio otus*	7	1/27/2002
Ebr, SCnb	Short-eared Owl	*Asio flammeus*	5	3/8/1991
	Northern Saw-whet Owl	*Aegolius acadicus*	2	12/28/2014
Nightjars				
SC	Common Nighthawk	*Chordeiles minor*	61	9/5/2012

State	Common Name	*Scientific Name*	Hunterdon	Hunterdon
SCbr, Unb	Eastern Whip-poor-will	*Antrostomus vociferous*	1	5/8/2015
Swifts & Hummingbirds				
	Chimney Swift	*Chaetura pelagica*	300	5/4/2016
	Ruby-throated Hummingbird	*Archilochus colubris*	6	9/11/2016
RV	Rufous Hummingbird	*Selasphorus rufus*	1	11/22/2006
RV	Calliope Hummingbird	*Selasphorus calliope*	1	11/21/2014
Kingfishers & Allies				
	Belted Kingfisher	*Megaceryle alcyon*	8	6/21/2014
Woodpeckers				
	Red-headed Woodpecker	*Melanerpes erythrocephalus*	6	1/10/2017
	Red-bellied Woodpecker	*Melanerpes carolinus*	21	12/19/2010
	Yellow-bellied Sapsucker	*Sphyrapicus varius*	7	12/20/2015
	Downy Woodpecker	*Picoides pubescens*	19	12/19/2010
	Hairy Woodpecker	*Picoides villosus*	7	6/17/2012
	Northern Flicker	*Colaptes auratus*	30	9/21/2006
	Pileated Woodpecker	*Dryocopus pileatus*	5	5/28/2011
Caracaras & Falcons				
RV	Crested Caracara	*Caracara cheriway*	1	1/3/2016
T	American Kestrel	*Falco sparverius*	20	10/1/2012
	Merlin	*Falco columbarius*	11	10/7/2006
Ebr, SCnb	Peregrine Falcon	*Falco peregrines*	3	10/17/2016
Perching Birds				
	Olive-sided Flycatcher	*Contopus cooperi*	2	5/28/2014
	Eastern Wood-Pewee	*Contopus virens*	16	8/8/2013
	Yellow-bellied Flycatcher	*Empidonax flaviventris*	2	9/1/2012
	Acadian Flycatcher	*Empidonax virescens*	16	6/5/2005
	Alder Flycatcher	*Empidonax alnorum*	3	5/27/2014
	Willow Flycatcher	*Empidonax traillii*	11	6/7/2012
SCbr	Least Flycatcher	*Empidonax minimus*	3	8/27/2013
	Eastern Phoebe	*Sayornis phoebe*	28	4/2/2007
	Great Crested Flycatcher	*Myiarchus crinitus*	9	5/18/2014
RV	Ash-throated flycatcher	*Myiarchus cinerascens*	1	6/15/2013
	Western Kingbird	*Tyrannus verticalis*	1	11/4/2004
	Eastern Kingbird	*Tyrannus tyrannus*	12	7/27/2002
	Northern Shrike	*Lanius excubitor*	1	3/8/2016
	White-eyed Vireo	*Vireo griseus*	7	5/21/1988
	Yellow-throated Vireo	*Vireo flavifrons*	7	5/14/2014
SCbr	Blue-headed Vireo	*Vireo solitarius*	8	5/1/2012
	Warbling Vireo	*Vireo gilvus*	12	4/30/2009
	Philadelphia Vireo	*Vireo philadelphicus*	3	9/21/2016
	Red-eyed Vireo	*Vireo olivaceus*	40	9/2/2005

State	Common Name	*Scientific Name*	Hunterdon	Hunterdon
	Blue Jay	*Cyanocitta cristata*	1927	9/27/2012
	American Crow	*Corvus brachyrhynchos*	300	1/11/2016
	Fish Crow	*Corvus ossifragus*	659	8/30/2014
	Common Raven	*Corvus corax*	13	9/26/2014
Tbr, SCnb	Horned Lark	*Eremophila alpestris*	240	11/28/2012
	Purple Martin	*Progne subis*	100	5/29/2009
	Tree Swallow	*Tachycineta bicolor*	1000	4/16/2007
	Northern Rough-winged	*Stelgidopteryx serripennis*	100	4/15/2014
	Bank Swallow	*Riparia riparia*	140	8/22/1999
SCbr	Cliff Swallow	*Petrochelidon pyrrhonota*	50	5/27/1984
RV	Cave Swallow	*Petrochelidon fulva*	2	11/7/2007
	Barn Swallow	*Hirundo rustica*	400	4/28/2002
	Carolina Chickadee	*Poecile carolinensis*	18	1/31/2009
	Black-capped Chickadee	*Poecile atricapillus*	65	12/19/2010
	Tufted Titmouse	*Baeolophus bicolor*	60	12/19/2010
	Red-breasted Nuthatch	*Sitta canadensis*	22	9/21/1997
	White-breasted Nuthatch	*Sitta carolinensis*	24	12/19/2010
	Brown Creeper	*Certhia americana*	8	1/1/2006
	House Wren	*Troglodytes aedon*	18	9/26/2006
SCbr	Winter Wren	*Troglodytes hiemalis*	14	10/25/2006
E	Sedge Wren	*Cistothorus platensis*	1	10/20/2005
	Marsh Wren	*Cistothorus palustris*	2	9/18/2016
	Carolina Wren	*Thryothorus ludovicianus*	22	12/31/2011
	Blue-gray Gnatcatcher	*Polioptila caerulea*	38	4/27/2002
	Golden-crowned Kinglet	Regulus satrapa	26	3/30/2008
	Ruby-crowned Kinglet	*Regulus calendula*	80	10/25/2006
	Eastern Bluebird	*Sialia sialis*	54	11/27/2016
SCbr	Veery	*Catharus fuscescens*	41	6/27/2007
SCnb	Gray-cheeked Thrush	*Catharus minimus*	10	9/30/2014
RV	Bicknell's Thrush	*Catharus bicknelli*	1	10/5/2011
	Swainson's Thrush	*Catharus ustulatus*	120	9/30/2014
	Hermit Thrush	*Catharus guttatus*	22	12/9/2007
SCbr	Wood Thrush	*Hylocichla mustelina*	33	6/18/2012
	American Robin	*Turdus migratorius*	40000	10/18/2010
RV	Northern Wheatear	*Oenanthe oenanthe*	1	9/19/1999
	Gray Catbird	*Dumetella carolinensis*	100	9/22/2006
	Northern Mockingbird	*Mimus polyglottos*	15	9/24/2013
SCbr	Brown Thrasher	*Toxostoma rufum*	14	9/8/2012
int	European Starling	*Sturnus vulgaris*	12000	12/15/1991
	American Pipit	*Anthus rubescens*	250	10/19/2006
	Cedar Waxwing	*Bombycilla cedrorum*	898	11/16/2007
	Lapland Longspur	*Calcarius lapponicus*	2	11/8/2016
	Snow Bunting	*Plectrophenax nivalis*	88	11/16/2010
	Ovenbird	*Seiurus aurocapilla*	76	7/3/2007
SCbr	Worm-eating Warbler	*Helmitheros vermivorum*	10	5/18/2003
	Louisiana Waterthrush	*Parkesia motacilla*	10	4/21/2014

State	Common Name	*Scientific Name*	Hunterdon	Hunterdon
	Northern Waterthrush	*Parkesia noveboracensis*	5	5/9/2014
Ebr,SCnb	Golden-winged Warbler	*Vermivora chrysoptera*	1	8/16/2014
	Blue-winged Warbler	*Vermivora cyanoptera*	14	5/6/2000
	Black-and-white Warbler	*Mniotilta varia*	20	5/14/2005
	Prothonotary Warbler	*Protonotaria citrea*	2	5/3/2013
	Tennessee Warbler	*Oreothlypis peregrina*	3	9/6/2013
	Orange-crowned Warbler	*Oreothlypis celata*	1	10/18/2016
SCbr	Nashville Warbler	*Oreothlypis ruficapilla*	13	5/10/2006
	Connecticut Warbler	*Oporornis agilis*	2	9/19/2013
	Mourning Warbler	*Geothlypis philadelphia*	2	5/29/2013
SC	Kentucky Warbler	*Geothlypis formosa*	4	5/11/2016
	Common Yellowthroat	*Geothlypis trichas*	40	5/18/2014
SCbr	Hooded Warbler	*Setophaga citrina*	7	6/16/2011
	American Redstart	*Setophaga ruticilla*	27	5/22/2009
	Cape May Warbler	*Setophaga tigrina*	8	9/28/2008
SCbr	Cerulean Warbler	*Setophaga cerulea*	15	5/11/1985
SCbr	Northern Parula	*Setophaga americana*	18	5/14/2007
	Magnolia Warbler	*Setophaga magnolia*	30	9/22/2006
	Bay-breasted Warbler	*Setophaga castanea*	3	5/15/2014
SCbr	Blackburnian Warbler	*Setophaga fusca*	15	5/10/2006
	Yellow Warbler	*Setophaga petechia*	40	5/7/2006
	Chestnut-sided Warbler	*Setophaga pensylvanica*	12	9/15/2013
	Blackpoll Warbler	*Setophaga striata*	22	5/16/1999
SCbr	Black-throated Blue Warbler	*Setophaga caerulescens*	13	5/12/2003
	Palm Warbler	*Setophaga palmarum*	50	10/6/2006
	Pine Warbler	*Setophaga pinus*	28	4/2/2000
	Yellow-rumped Warbler	*Setophaga coronata*	300	5/4/2012
	Yellow-throated Warbler	*Setophaga dominica*	7	4/26/1986
	Prairie Warbler	*Setophaga discolor*	10	5/5/2016
SCbr	Black-throated Green Warbler	*Setophaga virens*	42	5/10/2006
SCbr	Canada Warbler	*Cardellina canadensis*	8	8/25/2006
	Wilson's Warbler	*Cardellina pusilla*	4	5/14/2016
SCbr	Yellow-breasted Chat	*Icteria virens*	2	7/2/2014
	Eastern Towhee	*Pipilo erythrophthalmus*	25	6/25/2008
	American Tree Sparrow	*Spizella arborea*	149	12/17/1989
	Chipping Sparrow	*Spizella passerina*	150	4/24/2006
RV	Clay-colored Sparrow	*Spizella pallida*	1	10/16/2016
	Field Sparrow	*Spizella pusilla*	45	9/24/2013
Ebr, SCnb	Vesper Sparrow	*Pooecetes gramineus*	7	10/25/2014
	Lark Sparrow	*Chondestes grammacus*	1	10/15/2016
Tbr	Savannah Sparrow	*Passerculus sandwichensis*	200	10/7/2006
Tbr, SCnb	Grasshopper Sparrow	*Ammodramus savannarum*	16	6/24/2014
	Nelson's Sparrow	*Ammodramus nelsoni*	1	10/8/2012
E	Henslow's sparrow	*Ammodramus henslowii*	1	6/13/1964
	Fox Sparrow	*Passerella iliaca*	15	11/20/2005
	Song Sparrow	*Melospiza melodia*	225	10/25/2006

State	Common Name	*Scientific Name*	Hunterdon	Hunterdon
	Lincoln's Sparrow	*Melospiza lincolnii*	14	9/30/2006
	Swamp Sparrow	*Melospiza georgiana*	100	10/14/2006
	White-throated Sparrow	*Zonotrichia albicollis*	425	5/4/2007
	White-crowned Sparrow	*Zonotrichia leucophrys*	50	1/11/2011
RV	Harris's Sparrow	*Zonotrichia querula*	1	4/23/2009
	Dark-eyed Junco	*Junco hyemalis*	213	12/20/2009
	Summer Tanager	*Piranga rubra*	1	5/7/2014
	Scarlet Tanager	*Piranga olivacea*	23	5/8/2014
RV	Western Tanager	*Pinanga ludoviciana*	1	2/4/2007
	Northern Cardinal	*Cardinalis cardinalis*	75	12/19/2010
	Rose-breasted Grosbeak	*Pheucticus ludovicianus*	12	5/29/2011
	Blue Grosbeak	*Passerina caerulea*	4	7/4/2013
RV	Lazuli Bunting	*Passerina amoena*	1	1/26/2013
	Indigo Bunting	*Passerina cyanea*	27	5/18/2014
RV	Painted Bunting	*Passerina ciris*	1	1/9/1977
	Dickcissel	*Spiza americana*	7	9/22/2015
Tbr, SCnb	Bobolink	*Dolichonyx oryzivorus*	140	8/11/1985
	Red-winged Blackbird	*Agelaius phoeniceus*	10000	2/17/2008
SCbr	Eastern Meadowlark	*Sturnella magna*	38	10/31/2011
RV	Yellow-headed Blackbird	*Xanthocephalus*	2	2/17/2008
	Rusty Blackbird	*Euphagus carolinus*	93	2/10/2002
	Common Grackle	*Quiscalus quiscula*	100000	2/28/2012
int	Brown-headed Cowbird	*Molothrus ater*	5000	2/18/2008
	Orchard Oriole	*Icterus spurius*	11	7/16/2008
	Baltimore Oriole	*Icterus galbula*	25	7/21/2008
	Purple Finch	*Haemorhous purpureus*	216	10/26/2014
int	House Finch	*Haemorhous mexicanus*	172	12/18/1988
	Red Crossbill	*Loxia curvirostra*	24	11/24/2012
	White-winged Crossbill	*Loxia leucoptera*	25	1/27/2009
	Common Redpoll	*Acanthis flammea*	22	2/16/2004
	Pine Siskin	*Spinus pinus*	276	10/26/2014
	American Goldfinch	*Spinus tristis*	165	2/18/2009
	Evening Grosbeak	*Coccothraustes vespertinus*	7	11/9/2012
	Pine Grosbeak	*Pinicola euneucleator*	5	1/2/1982
int	House Sparrow	*Passer domesticus*	200	1/11/2011

Source: Sullivan, B.L., C.L. Wood, M.J. Iliff, R.E. Bonney, D. Fink, and S. Kelling. 2009. eBird: a citizen-based bird observation network in the biological sciences. Biological Conservation 142: 2282-2292. Available online: http://ebird.org/ebird/nj/places - Site Accessed February 2017.

C.2: List of New Jersey Land Mammals

Mammals have not been inventoried specifically in Frenchtown Borough or Hunterdon County.

Status	Common Name	*Scientific Name*
	Opossum	*Didelphis marsupialis*
	Masked shrew	*Sorex cinereus*
	Tuckahoe masked shrew	*Sorex cinereus nigriculus*
	Water shrew	*Sorex palustris*
	Smokey shrew	*Sorex fumeus*
	Long-tailed shrew	*Sorex dispar*
	Short-tailed shrew	*Blarina brevicauda*
	Least shrew	*Cryptotis parva*
	Pygmy shrew	*Sorex hoyii*
	Hairy-tailed mole	*Parascalops breweri*
	Eastern mole	*Scalopus aquaticus*
	Star-nosed mole	*Condylura cristata*
	Little brown bat	*Myotis lucifugus*
E	Indiana bat	*Myotis sodalis*
	Keen myotis	*Myotis septentrionalis*
	Small-footed myotis	*Myotis leibii*
	Silver-haired bat	*Lasionycteris noctivagans*
	Eastern pipistrel	*Pipistrellus subflavus*
	Big brown bat	*Eptesicus fuscus*
	Red bat	*Lasiurus borealis*
peripheral	Northern yellow bat	*Lasiurus intermedius*
	Hoary bat	*Lasiurus cinereus*
	Eastern cottontail	*Sylvilagus floridanus*
	New England cottontail	*Sylvilagus transitionalis*
int	European hare	*Lepus capensis*
int	Black-tailed jackrabbit	*Lepus californicus*
int	White-tailed jackrabbit	*Lepus townsendii*
	Eastern chipmunk	*Tamias striatus*
	Woodchuck	*Marmota monax*
	Gray squirrel	*Sciurus carolinensis*
	Red squirrel	*Tamiasciurus hudsonicus*
	Southern flying squirrel	*Glaucomys volans*
	Northern flying squirrel	*Glaucomys sabrinus*
	Beaver	*Castor canadensis*
int	Nutria	*Myocastor coypus*
	Marsh rice rat	*Oryzomys palustris*
	White-footed mouse	*Peromyscus leucopus*
E	Eastern woodrat	*Neotoma floridana*
	Red-backed mouse	*Clethrionomys gapperi*
	Meadow vole	*Microtus pennsylvanicus*
	Woodland vole	*Microtus pinetorum*
	Muskrat	*Ondatra zibethicus*
	Southern bog lemming	*Synaptomys cooperi*
int	Black rat	*Rattus rattus*
int	Brown rat	*Rattus norvegicus*
int	House mouse	*Mus musculus*
	Woodland jumping mouse	*Napaeozapus insignis*
	Meadow jumping mouse	*Zapus hudsonius*
	Porcupine	*Erethizon dorsatum*
	Eastern coyote	*Canis latrans, var*
	Red fox	*Vulpes vulpes*
	Gray fox	*Urocyon cinereoargenteus*
	Black bear	*Ursus americanus*
	Raccoon	*Procyon lotor*
	Ermine	*Mustela erminea*
	Long-tailed weasel	*Mustela frenata*
	Mink	*Mustela vison*
	Striped skunk	*Mephitis mephitis*
	River otter	*Lutra canadensis*
E	Bobcat	*Felis rufus*
	White-tailed deer	*Odocoileus virginianus*

Source: NJDEP Division of Fish and Wildlife. 2004. Checklist of NJ Mammals.
http://www.state.nj.us/dep/fgw/chkmamls.htm

C.3: Hunterdon County Reptiles

New Jersey reptile species that may occur in Hunterdon County.

Status	Common Name	*Scientific Name*
Lizards		
	Common five-lined skink	*Plestiodon fasciatus*
Snakes		
SC	Northern copperhead	*Agkistrodon contortrix mokasen*
	Eastern wormsnake	*Carphophis a. amoenus*
	Northern black racer	*Coluber c. constrictor*
	Northern ring-necked snake	*Diadophis punctatus edwardsi*
	Eastern hog-nosed snake	*Heterodon platirhinos*
	Eastern milksnake	*Lampropeltis t. triangulum*
	Northern watersnake	*Nerodia s. sipedon*
	Smooth greensnake	*Opheodrys vernalis*
	Eastern ratsnake	*Pantherophis alleghaniensis*
	Northern brownsnake	*Storeria d. dekayi*
	Northern red-bellied snake	*Storeria o. occipitomaculata*
	Eastern ribbonsnake	*Thamnophis s. sauritus*
	Eastern gartersnake	*Thamnophis s. sirtalis*
Turtles		
	Snapping turtle	*Chelydra serpentina*
	Eastern painted turtle	*Chrysemys p. picta*
SC	Spotted turtle	*Clemmys guttata*
T	Wood turtle	*Glyptemys insculpta*
E	Bog turtle	*Glyptemys muhlenbergii*
	Northern map turtle	*Graptemys geographica*
	Eastern musk turtle	*Sternotherus odoratus*
SC	Woodland box turtle	*Terrapene c. carolina*
int	Red-eared slider	*Trachemys scripta elegans*

Source: NJDEP Division of Fish and Wildlife. June 6, 2014. Online field Guide for Reptiles and Amphibians. http://www.state.nj.us/dep/fgw/ensp/fieldguide_herps.htm

C.4: Hunterdon County Amphibians

New Jersey amphibian species that may occur in Hunterdon County.

Status	Common Name	*Scientific Name*
Anurans		
	Eastern cricket frog	*Acris crepitans*
	American toad	*Anaxyrus americanus*
SC	Fowler's toad	*Anaxyrus fowleri*
	Northern gray treefrog	*Hyla versicolor*
	Bullfrog	*Lithobates catesbeianus*
	Green frog	*Lithobates clamitans*
	Atlantic coast leopard frog	*Lithobates kauffeldi*
	Pickerel frog	*Lithobates palustris*
	Wood frog	*Lithobates sylvaticus*
	Spring peeper	*Pseudacris crucifer*
	Upland chorus frog	*Pseudacris feriarum*
	Eastern spadefoot toad	*Scaphiopus h. holbrooki*
Salamanders		
SC	Jefferson salamander	*Ambystoma jeffersonianum*
E	Blue-spotted salamander	*Ambystoma laterale*
	Spotted salamander	*Ambystoma maculatum*
SC	Marbled salamander	*Ambystoma opacum*
	Northern dusky salamander	*Desmognathus fuscus*
	Northern two-lined salamander	*Eurycea bislineata*
T	Eastern long-tailed salamander	*Eurycea l. longicauda*
SC	Northern spring salamander	*Gyrinophilus p. porphyriticus*
	Four-toed salamander	*Hemidactylium scutatum*
	Red-spotted newt	*Notophthalmus v. viridescens*
	Red-backed salamander	*Plethodon cinereus*
	Northern slimy salamander	*Plethodon glutinosus*
	Northern red salamander	*Pseudotriton r. ruber*

Sources: NJDEP Division of Fish and Wildlife. June 6, 2014. Online field Guide for Reptiles and Amphibians. http://www.state.nj.us/dep/fgw/ensp/fieldguide_herps.htm and NJENSP (Endangered and Nongame Species Program). November 2014. The Leopard Frogs of New Jersey. http://www.njfishandwildlife.com/ensp/pdf/leopardfrog_guide.pdf

C.5: Freshwater Fish of New Jersey

State	Common Name	*Scientific Name*
Northern Lampreys		
	American Brook	*Lampetra appendix*
	Sea Lamprey	*Petromyzon*
Sturgeo		
E	Atlantic Sturgeon	*Acipenser*
E	Shortnose	*Acipenser*
Gars		
X	Longnose Gar	*Lepisosteus osseus*
Bowfins		
	Bowfin	*Amia calva*
Freshwater Eels		
	American Eel	*Anguilla rostrata*
Swamp		
int*	Swamp Eel	*Monopterus albus*
Herrings, Shads, Sardines,		
	Blueback Herring	*Alosa aestivalis*
	Hickory Shad	*Alosa mediocris*
	Alewife	*Alosa*
	American Shad	*Alosa sapidissima*
	Gizzard Shad	*Dorosoma*
Salmoni		
int	Rainbow Trout	*Oncorhynchus*
int	Brown Trout	*Salmo trutta*
	Brook Trout	*Salvelinus*
int	Lake Trout	*Salvelinus*
Smelts		
	Rainbow Smelt	*Osmerus mordax*
Mudminnows		
	Eastern	*Umbra pygmaea*
Pikes		
	Redfin Pickerel	*Esox americanus*
int	Northern Pike	*Esox lucius*
	Chain Pickerel	*Esox niger*
int	Muskellunge	*Esox masquinongy*
Carps, Minnows		
int	Goldfish	*Carassius auratus*
int*	Grass Carp	*Ctenopharyngodon*
	Satinfin Shiner	*Cyprinella*
	Spotfin Shiner	*Cyprinella*
int	Common Carp	*Cyprinus carpio*
	Cutlip Minnow	*Exoglossum*
	Eastern Silvery	*Hybognathus*
int*	Bighead Carp	*Hypophthalmichthy*
	Common Shiner	*Luxilis cornutus*
int	Allegheny Pearl	*Margariscus*
	Golden Shiner	*Notemigonus*
	Comely Shiner	*Notropis amoenus*
	Bridle Shiner	*Notropis bifrenatus*
	Ironcolor Shiner	*Notropis*
	Spottail Shiner	*Notropis husdonius*
	Swallowtail	*Notropis procne*
int	Fathead Minnow	*Pimephales*
int	Bluntnose	*Pimephales notatus*
	Blacknose Dace	*Rhinichthys*
	Longnose Dace	*Rhinichthys*
	Creek Chub	*Semotilus*
	Fallfish	*Semotilus*
Suckers		
	Quillback	*Carpiodes cyprinus*
	White Sucker	*Catostomus*
	Creek Chubsucker	*Erimyzon oblongus*
	Northern Hog	*Hypentelium*
Freshwater Catfishes		
	White Catfish	*Ameiurus catus*
int	Black Bullhead	*Ameiurus melas*
	Yellow Bullhead	*Ameiurus natalis*
	Brown Bullhead	*Ameiurus*
int	Channel Catfish	*Ictalurus punctatus*
	Tadpole Madtom	*Noturus gyrinus*
	Margined	*Noturus insignis*
int*	Flathead Catfish	*Pylodictis olivarus*
Pirate Perches		
	Pirate Perch	*Aphredoderus*
Killifish		
	Banded Killifish	*Fundulus*
	Mummichog	*Fundulus*
Poeciliid		
	Eastern	*Gambusia*
int	Mosquitofish	*Gambusia affinis*

State	Common Name	*Scientific Name*
Gasterosteidae:		
	Fourspine	*Apletes quadracus*
int*	Brook Stickleback	*Culaea inconstans*
	Threespoine	*Gasterosteus*
	Ninespine	*Pungitius pungitius*
Moronid		
	White Perch	*Morone americana*
	Striped Bass	*Morone saxatilis*
Sticklebacks, Tubesnouts		
	Mud Sunfish	*Acantharchus*
int	Rock Bass	*Ambloplites*
	Blackbanded	*Enneacanthus*
	Bluespotted	*Enneacanthus*
	Banded Sunfish	*Enneacanthus*
int*	Green Sunfish	*Lepomis cyanellus*
	Pumpkinseed	*Lepomis gibbosus*
int	Bluegill	*Lepomis*
	Redbreast Sunfish	*Lepomis auritus*
int*	Warmouth	*Lepomis gulosus*
int	Smallmouth Bass	*Micropterus*
int	Largemouth Bass	*Micropterus*
int	White Crappie	*Pomoxis annularis*
int	Black Crappie	*Pomoxis*
Perches		
	Swamp Darter	*Etheostoma*
	Tessellated Darter	*Etheostoma*
	Yellow Perch	*Perca flavescens*
	Shield Darter	*Percina peltata*
int	Walleye	*Sander vitreus*
Sculpins		
	Slimy Sculpin	*Cottus cognatus*
Loaches		
int*	Oriental	*Misgurnus*
Soles		
	Hogchoker	*Trinectes*

* indicates species that pose a serious threat to freshwater resources, and must be destroyed when encountered. An anticipated addition to this category, the silver carp (*Hypophthalmichthys molitrix*) has not yet been documented in NJ.

Source: NJDEP Division of Fish and Wildlife. 2016. Checklist of NJ Fish.
http://www.njfishandwildlife.com/chkfish.htm

APPENDIX D: ENDANGERED SPECIES

Contents:

D.1 Rare Plant Reporting Form
Source: http://www.nj.gov/dep/parksandforests/natural/heritage/natherrareplantspeciesreportform1_2008.doc
Note: Use the following address, not the one on the reporting form:
The New Jersey Natural Heritage Program
DEP - Office of Natural Lands Management
Mail Code 501-04
P.O. Box 420
Trenton, New Jersey 08625-0420

D.2 Rare Wildlife Reporting Form
Source: http://www.state.nj.us/dep/fgw/ensp/pdf/rptform.pdf

D.3. Habitat Requirements for Rare Wildlife Species Recorded in the Vicinity of Frenchtown Borough

D.4. Rare Bird Species Documented in Hunterdon County

D.5 List of Rare Plant Species of Hunterdon County
Source: http://www.state.nj.us/dep/parksandforests/natural/heritage/textfiles/hunterdon.pdf

D.1 Rare Plant Reporting Form

Natural Heritage Rare Plant Species Reporting Form

This form is used to report a personal field sighting of a rare plant species tracked by the Natural Heritage Database. It may also be used to summarize locational information from a published or unpublished report. Plant species tracked include those appearing on the State Endangered Plant Species List or the Plant Species of Concern List (http://www.nj.gov/dep/parksandforests/natural/heritage/spplant.html). The Office of Natural Lands Management can provide copies of the lists upon request. 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, P.O. Box 404, Trenton, NJ 08625-0404.

Today's Date: (date this form is being completed) _____

Common Name: _____ **Scientific Name:** _____

***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 U.S. Geological Survey 7.5 minute topographical map, and to also sketch a second map showing finer details. Be sure to provide the name of the USGS map.

GPS Coordinates (If available please provide the following)**:**

Datum Used:	☐ NAD 1983	☐ NAD 1927	☐ WGS84	☐ Other _____
Lat/Long (if applicable):	_____ N (Latitude)		_____ W (Longitude)	
UTM (if applicable)	18 N/S: _____ Northing		_____ Easting	
Accuracy Level:	+/-_____ ☐feet or ☐meters			

***Directions to Site:** Directions to the element occurrence using a readily locatable and relatively permanent landmark on or near the site (such as a road intersection, a prominent hill or cliff) as the starting point. Use clear, complete sentences so that someone who is unfamiliar with the area will be able to relocate the element occurrence using your written directions (e.g., "About 50 ft. N. of small stream draining Brindel Lake, 0.5 mi. SE of Brindeltown and 0.2 mi. WSW of jct. of Range Rd. and Rt. 539, Fort Dix").

***Date(s) of the Observation(s):** _____

Identification: How was the species identification made? Name the identification manuals used or the experts consulted. Were there identification problems?

***Number of Individuals Observed:**

☐ 1-10 ☐ 11-50 ☐ 101-1,000 ☐ 1,001-10,000 ☐ >10,000

If possible, provide the exact number of individuals and an estimated percentage of flowering/fruiting individuals. For rhizomatous plants such as grasses and sedges, what was counted as individual – separate culms or entire clumps or patches?

Life Stages Present: Check life stages observed or provide an estimate of the numbers of individuals for each life stage.

☐ vegetative ☐ in bud ☐ flower ☐ seed dispersing ☐ seedling ☐ dormant

Associated Species/Additional Biological Data: List any associated species and/or additional rare species observed at this site. What else was observed? Provide information on the general condition or vigor of the individuals and viability of the population(s).

Habitat Data: Describe the specific 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, describe the surrounding landscape.

Threats: Describe any current or potential threats to this occurrence. If invasive species are present, please list.

Ownership: If known, please provide landowner(s) name, address, phone #.

Information Source:

***Name, Address and Phone #** (of person filing report):

Name:	
Address:	
Phone Number:	

*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 video/digital format? ☐ a specimen?
If possible, attach a copy of the photograph or tape. 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)

D.2 Rare Wildlife Reporting Form

RARE WILDLIFE SIGHTING REPORT FORM

REPORT FORM MUST BE ACCOMPANIED BY AN AERIAL PHOTOGRAPH, SATELLITE IMAGE, OR TOPOGRAPHIC MAP WITH THE LOCATION PRECISELY MARKED. PLEASE PRINT LEGIBLY.
*The inclusion of a map is mandatory, please see other side for further information on obtaining a map.

General Information

Today's Date _____
Common Name _____ Scientific Name (If known) _____

Where did the sighting take place?

Municipality/ Township _____ County _____

Topographic quad (if known) _____ Coordinates in state plane feet (if known) _____ _____

Directions to location with landmarks, which will enable the future relocation of the site where the species was sighted:

_____

_____

_____

Land Owner (name, address and phone number, if known) _____
Describe habitat at the point of sighting and habitat in the general area of the sighting location.

_____

_____

Would you accompany a biologist to the site if needed? ☐ Yes ☐ No
Can you describe any immediate or future plans to develop or disturb the site? ☐ Yes ☐ No
If so, please describe. _____

_____

Locational Accuracy

1. Is your depiction of the sighting location on the topographic map or aerial photo within 6m (20ft) of the animals actual location on the ground? ☐ Yes ☐ No (if no, answer question 2 below)

2. Your mapping is accurate to within ___ meters ___ feet ___ miles of the actual location.

What was observed?

How was the species identification made? (ex. Sighting, Call, Road Kill, etc.) _____

Date and time of this sighting (ex. August 20, 2004, 10:30am) _____

How frequently has this species been sighted at this location and over how long a period of time? _____

_____

Number of individuals sighted: Adult ____ Immature ____ Larva ____ Unknown/Other ____

Describe sighting and activity observed (ex. Nesting, Perched, Flying, Sunning, etc.) _____

Describe physical features that identify the sighted animal as the species you are reporting. _____

_____

_____

Were photos taken? ☐ Yes ☐ No Was video recorded? ☐ Yes ☐ No Was audio recorded? ☐ Yes ☐ No
(PHOTOS/VIDEO/AUDIO ARE STRONGLY ENCOURAGED IN ORDER TO VERIFY THE ACCURACY OF A SIGHTING. Items should be identified with the date taken, location, and observer signature. Items will not be returned.)

List manuals used or experts consulted to verify identification. _____

Provide a brief background on wildlife knowledge and/or experience, or additional information that would add to the validity of the sighting. _____

_____

Can this be verified by someone else or can anyone vouch for your identification skills? ☐ Yes ☐ No _____

Describe any additional information that may be useful in regards to the condition of the animal or location.

_____

_____

Your Contact information

Name _____
Street _____
City _____ State _____ ZIP_____
Daytime Phone (____) - _____ E-mail _____

Preferred method of contact _____

Signature _____

Conserve Wildlife
N.J. Division of Fish, Game & Wildlife
Endangered & Nongame Species Program

Return to:
Endangered and Nongame Species Program
NJ Division of Fish and Wildlife
PO Box 400
Trenton, NJ 08625-0400
(609) 292-9400

NEW JERSEY DIVISION OF
Fish and Wildlife

Instructions

1. Complete this form for first-hand field observations only.
2. DO NOT COMPLETE THIS FORM if the source of your information is a report, letter, conversation, or other document. Send us the documentation instead.
3. Attach a copy of a map.(**see below*)
4. Only report one species at each location per form and map.

***Mapping**
A map is necessary to help our biologists determine if suitable habitat is present at the location. Once the suitability of the area is determined the map provided aids in the delineation of land to be protected. Ideally the most accurate form of map is an aerial photo, which can be obtained from http://www.state.nj.us/dep/gis/newmapping.htm, if you are comfortable with your ability to identify the location of the sighting accurately on them. In addition, satellite-derived images are available at http://www.maps.google.com. These images can be printed and clearly marked with a pen. An alternative to an aerial photo or satellite image is a topographic map. You may also print copies of topographic maps from the internet at http://www.topozone.com. Please use 1:24,000 scale topographic maps only. Please provide either an image or a topographic map, but NOT both. Thank you.

Refer to the DFW website for further information: http://www.njfishandwildlife.com/ensp/rprtform.htm

D.3. Habitat Requirements For Rare Wildlife Species Recorded In The Immediate Vicinity Of Frenchtown Borough.

Habitat notes are generally direct quotes, as excerpted from the cited sources.

Shortnose sturgeon
(Federally Endangered, State Endangered)
Shortnose sturgeon live along the bottom of large rivers and estuaries and rarely travel from their natal river. As water temperatures rise in the spring, shortnose sturgeon migrate to swift moving upstream reaches of rivers. The spawning season ranges from late February in Georgia to May in Canada. While spawning, female sturgeon broadcast thousands of adhesive eggs, about 3 millimeters in diameter, over the gravel bottom in the river. Once hatched, the young fish drift downstream and may eventually swim to brackish water. After spawning, the adult sturgeon move to downstream areas to forage for food. As water temperatures cool in the fall to early winter, they travel to overwintering sites within the river. Aggregations of several fish will reside in deep holes until the following spring when temperatures rise again. (USFWS, 2003).

Bald Eagle
(Endangered breeding, Threatened non-breeding)
Bald Eagles live near rivers, lakes, and marshes where they can find fish, their staple food. Bald Eagles will also feed on waterfowl, turtles, rabbits, snakes, and other small animals and carrion. Bald Eagles require a good food base, perching areas, and nesting sites. Their habitat includes estuaries, large lakes, reservoirs, rivers, and some seacoasts. In winter, the birds congregate near open water in tall trees for spotting prey and night roosts for sheltering. (USFWS, 2015).

Red-shouldered Hawk
(Endangered breeding, Special Concern non-breeding)
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. Red-shouldered hawks select large deciduous and, to a lesser extent, coniferous trees for nesting. 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. An-area sensitive species, the red-shouldered hawk typically nests away from residences, roads, and development. 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. (NJENSP, undated-a).

Longtail Salamander
(State Threatened)
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. 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. (NJENSP, undated-b).

American Kestrel
(Threatened, breeding and non-breeding)
American Kestrels favor open areas with short ground vegetation and sparse trees. They may be found in meadows, grasslands, deserts, parks, farm fields, cities, and suburbs. When breeding, kestrels need access to at least a few trees or structures that provide appropriate nesting cavities. American Kestrels are attracted to many habitats modified by humans, including pastures and parkland, and are often found near areas of human activity including golf courses, towns and cities. (Cornell Lab of Ornithology, 2015-a; Elphick et. al., 2001).

Bobolink
(Threatened breeding, Special Concern non-breeding)
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. 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. (NJENSP, undated-c).

Grasshopper Sparrow
(Threatened breeding, Special Concern non-breeding)
Grasshopper sparrows breed in grassland, upland meadow, pasture, hayfield, and old field habitats. Nesting grasshopper sparrows may occur on agricultural lands and airports where such habitats occur. Although grasshopper sparrows may use small grasslands, open areas of over 40 hectares (100 acres) are favored. Optimal habitat for these sparrows contains short- to medium-height bunch grasses interspersed with patches of bare ground, a shallow litter layer, scattered forbs, and few shrubs. Shrubs, fence posts, and tall forbs are used as song perches. However, habitats may become unsuitable for nesting grasshopper sparrows if shrub cover becomes too dense. Consequently, the presence and density of grasshopper sparrows at breeding sites varies annually due to habitat changes. Habitat use during the nonbreeding season is similar, although less restrictive, to that of the breeding season, as these sparrows may inhabit thickets, weedy lawns, vegetated landfills, fence rows, open fields, or grasslands. (NJENSP, undated-d).

Wood Turtle
(State Threatened)
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. Wood turtles may also be found on abandoned railroad beds or agricultural fields and pastures. (NJENSP, undated-e).

Yellow Lampmussell
(State Threatened)
Adult freshwater mussels are filter-feeders. They strain plankton (microscopic plants and animals), bacteria and other particles from the water column. The larval stage of the freshwater mussel, known as glochidia, are external parasites and feed on a host (usually a fish). The yellow lampmussel prefers large rivers that drain more than 1,200 sq. kilometers and is often found in sand/silt substrates. Known fish hosts include yellow and white perch. New Jersey occurrences of the yellow lampmussel are restricted to the Delaware River from Mercer County in the south to Sussex County in the north. (Conserve Wildlife, 2017).

Brown Thrasher
(Special Concern breeding, Stable non-breeding)
In eastern North America, brown thrashers nest in thickets, hedgerows, forest edges, and overgrown clearings in deciduous forest. They're often found in woodlands with cottonwood, willow, dogwood, American plum, saltcedar, hawthorn, pitch pine, or scrub oak. On rare occasions they breed in backyards and gardens, although they are more likely to breed in suburban settings in the western part of their range. (Cornell Lab of Ornithology, 2015-b; Ehrlich et. al., 1988).

Cliff Swallow
(Special Concern breeding, Stable non-breeding)
Formerly restricted to canyons, foothills, and river valleys with natural cliff faces and overhangs, cliff swallows have spread into a wide variety of habitats by nesting on buildings, bridges, and other human-made structures. They now live in grasslands, towns, broken forest, and river edges, but avoid heavy forest and deserts. In the south-central and northeastern states they are rare and localized breeders. Most colony sites are close to a water source, open fields or pastures for foraging, and a source of mud for nest building. Cliff Swallows spend the winter in grasslands, farmland, marshes, and the outskirts of towns in southern South America. (Cornell Lab of Ornithology, 2015-c).

Eastern Meadowlark
(Special Concern, breeding and non-breeding)
Eastern Meadowlarks are most common in native grasslands and prairies, but they also occur in pastures, hayfields, agricultural fields, airports, and other grassy areas. Because vast swaths of grasslands are hard to find in parts of eastern North America, eastern meadowlarks will breed in many kinds of grassy areas as long as they can find about 6 acres in which to establish a territory. (Cornell Lab of Ornithology, 2015-d).

Great Blue Heron
(Special Concern breeding, Stable non-breeding)
Great Blue Herons forage widely in both freshwater and saltwater habitats, and also in grasslands and agricultural fields, where they stalk frogs and mammals. Most breeding colonies are located within 2 to 4 miles of feeding areas, often in isolated swamps or on islands, and near lakes and ponds bordered by forests. . (Cornell Lab of Ornithology, 2015-e).

Wood Thrush
(Special Concern breeding, Stable non-breeding)

Wood thrushes breed throughout mature deciduous and mixed forests in eastern North America. They nest somewhat less successfully in fragmented forests and even suburban parks where there are enough large trees for a territory. Ideal habitat includes trees over 50 feet tall, a moderate understory of saplings and shrubs, an open floor with moist soil and decaying leaf litter, and water nearby. In their winter range, they are most abundant in the interior of mature, shady, broad-leaved and palm tropical forests in lowlands. As in their temperate range, they will also inhabit forest edges and the denser understory of second-growth forests. (Cornell Lab of Ornithology, 2015-f).

Cobra Clubtail
(State Special Concern)
The cobra clubtail is a medium-sized dragonfly that inhabits large, turbid rivers with ample mud substrates. It is found along the Delaware River at the confluence points of major tributary streams. The species' range in New Jersey is restricted to four counties along the northwestern edge of the state. (Barlow et. al., 2009).

Osprey
(Threatened breeding, Stable non-breeding)
As a piscivorous species, the osprey is strictly associated with bodies of water that support adequate fish populations. Consequently, ospreys inhabit coastal rivers, marshes, bays and inlets as well as inland rivers, lakes and reservoirs. Ospreys nest on live or dead trees, artificial nesting platforms, light poles, channel markers, abandoned duck blinds, or other artificial structures that are in close proximity to fishing areas and offer an unobstructed view of the surrounding landscape. Territories typically contain poles, snags, or structures near the nest on which the ospreys perch. (Beans and Niles, 2003).

Citations:

Barlow, A.E., D.M. Golden and J. Bangma. 2009. Field Guide to Dragonflies and Damselflies of New Jersey. PSI, Flemington, New Jersey.

Beans, B.E. and L. Niles. 2003. Endangered and Threatened Wildlife of New Jersey. Rutgers University Press, New Brunswick, New Jersey.

Conserve Wildlife Foundation of New Jersey. 2017. New Jersey Endangered and Threatened Species Guide: Yellow Lampmussel. http://www.conservewildlifenj.org/species/fieldguide/view/Lampsilis%20cariosa/

Cornell Lab of Ornithology. 2015-a. All About Birds: American Kestrel. https://www.allaboutbirds.org/guide/American_Kestrel/lifehistory

Cornell Lab of Ornithology. 2015-b. All About Birds: Brown Thrasher. https://www.allaboutbirds.org/guide/Brown_Thrasher/lifehistory

Cornell Lab of Ornithology. 2015-c. All About Birds: Cliff Swallow. https://www.allaboutbirds.org/guide/Cliff_Swallow/lifehistory

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D.4. Rare Bird Species Documented in Hunterdon County.

This is a subset of the full county list provided in Appendix C.1.

ENDANGERED		
E	Black Skimmer	*Rynchops niger*
E	Henslow's sparrow	*Ammodramus henslowii*
E	Piping Plover	*Charadrius melodus*
E	Sedge Wren	*Cistothorus platensis*
E	Upland Sandpiper	*Bartramia longicauda*
Ebr, SCnb	American Bittern	*Botaurus lentiginosus*
Ebr, SCnb	Northern Goshawk	*Accipiter gentilis*
Ebr, SCnb	Northern Harrier	*Circus cyaneus*
Ebr, SCnb	Peregrine Falcon	*Falco peregrines*
Ebr, SCnb	Pied-billed Grebe	*Podilymbus podiceps*
Ebr, SCnb	Red-shouldered Hawk	*Buteo lineatus*
Ebr, SCnb	Short-eared Owl	*Asio flammeus*
Ebr, SCnb	Vesper Sparrow	*Pooecetes gramineus*
Ebr, Tnb	Bald Eagle	*Haliaeetus leucocephalus*
Ebr,SCnb	Golden-winged Warbler	*Vermivora chrysoptera*
Enb	Red Knot	*Calidris canutus*
THREATENED		
T	American Kestrel	*Falco sparverius*
T	Barred Owl	*Strix varia*
T	Long-eared Owl	*Asio otus*
T	Yellow-crowned Night-Heron	*Nyctanassa violacea*
Tbr	Osprey	*Pandion haliaetus*
Tbr	Savannah Sparrow	*Passerculus sandwichensis*
Tbr, SCnb	Black-crowned Night-Heron	*Nycticorax nycticorax*
Tbr, SCnb	Bobolink	*Dolichonyx oryzivorus*
Tbr, SCnb	Cattle Egret	*Bubulcus ibis*
Tbr, SCnb	Grasshopper Sparrow	*Ammodramus savannarum*
Tbr, SCnb	Horned Lark	*Eremophila alpestris*
SPECIAL CONCERN		
SC	American Oystercatcher	*Haematopus palliatus*
SC	Common Nighthawk	*Chordeiles minor*
SC	Kentucky Warbler	*Geothlypis formosa*
SC	Least Bittern	*Ixobrychus exilis*
SC	Little Blue Heron	*Egretta caerulea*
SC	Sharp-shinned Hawk	*Accipiter striatus*
SCbr	Black-billed Cuckoo	*Coccyzus erythropthalmus*
SCbr	Blackburnian Warbler	*Setophaga fusca*
SCbr	Black-throated Blue Warbler	*Setophaga caerulescens*
SCbr	Black-throated Green Warbler	*Setophaga virens*
SCbr	Blue-headed Vireo	*Vireo solitarius*
SCbr	Broad-winged Hawk	*Buteo platypterus*
SCbr	Brown Thrasher	*Toxostoma rufum*

SCbr	Canada Warbler	*Cardellina canadensis*
SCbr	Caspian Tern	*Hydroprogne caspia*
SCbr	Cerulean Warbler	*Setophaga cerulea*
SCbr	Cliff Swallow	*Petrochelidon pyrrhonota*
SCbr	Common Tern	*Sterna hirundo*
SCbr	Cooper's Hawk	*Accipiter cooperii*
SCbr	Eastern Meadowlark	*Sturnella magna*
SCbr	Glossy Ibis	*Plegadis falcinellus*
SCbr	Great Blue Heron	*Ardea herodias*
SCbr	Hooded Warbler	*Setophaga citrina*
SCbr	Least Flycatcher	*Empidonax minimus*
SCbr	Nashville Warbler	*Oreothlypis ruficapilla*
SCbr	Northern Parula	*Setophaga americana*
SCbr	Snowy Egret	*Egretta thula*
SCbr	Spotted Sandpiper	*Actitis macularius*
SCbr	Veery	*Catharus fuscescens*
SCbr	Winter Wren	*Troglodytes hiemalis*
SCbr	Wood Thrush	*Hylocichla mustelina*
SCbr	Worm-eating Warbler	*Helmitheros vermivorum*
SCbr	Yellow-breasted Chat	*Icteria virens*
SCbr, Unb	Eastern Whip-poor-will	*Antrostomus vociferous*
SCnb	Gray-cheeked Thrush	*Catharus minimus*
SCnb	Sanderling	*Calidris alba*
SCnb	Semipalmated Sandpiper	*Calidris pusilla*
SCnb	Whimbrel	*Numenius phaeopus*

D.5. Rare Plant Species of Hunterdon County.

Species shown in red are known from Frenchtown Borough.

Scientific Name	Common Name	Habitat
Ferns & Allies		
Cheilanthes lanosa	hairy lipfern	dry, rocky soils of slopes, cliffs, rock outcrops
Pellaea glabella var glabella	smooth cliffbrake	calcareous cliffs or bluffs
Asplenium pinnatifidum	lobed spleenwort	crevices of non-calcareous rocks, rocky hillsides
Cystopteris protrusa	lowland fragile fern	floodplains; mesic woods
Gymnocarpium dryopteris	oak fern	cool woods and talus slopes
Botrychium oneidense	blunt-lobe grape fern	rich, moist soil of woods
Ophioglossum pusillum	northern adder's tongue	grassy marsh edges and ditches
Selaginella rupestris	rock spike-moss	dry, exposed ledges and slopes
Graminoids		
Carex aggregata	glomerate sedge	dry woods and thickets, especially in calcareous regions
Carex albursina	white bear lake sedge	rich woods, esp, in calcareous regions
Carex bushii	Bush's sedge	moist, open ground of thin woods, fields, meadows
Carex conjuncta	soft fox sedge	damp woods
Carex crawfordii	Crawford's sedge	open swamps, wet meadows and shores
Carex deweyana	Dewey's sedge	rich, open, cold woods, shady ravines, talus
Carex diandra	lesser panicled sedge	swamps, wet meadows and sphagnum bogs
Carex hitchcockiana	Hitchcock's sedge	rich moist woods
Carex jamesii	James' sedge	dry, rich soil of woods and shaded edges, stream banks
Carex leptonervia	fine-nerve sedge	moist, rich ground of woods and shaded edges
Carex meadii	Mead's sedge	dry open prairies and meadows
Carex oligocarpa	few-fruit sedge	rich soil of woods and shaded edges, bluffs, river islands
Carex pallescens	pale sedge	moist, open soil of woods and shaded edges, meadows, fields
Carex planispicata	narrow-leaf sedge	woods and fields
Carex prairea	prairie sedge	swamps, wet meadows and wet prairies
Carex willdenowii var willdenowii	Willdenow's sedge	dry or moist, usually acid, rocky soil of woods and edges
Eleocharis intermedia	matted spike-rush	wet soil
Rhynchospora recognita	coarse grass-like beaked-rush	low, wet to moist ground in swamps and bogs, sandy depressions
Eragrostis frankii	Frank's love grass	open, usually moist soil of riverbanks, sandbars, thin disturbed soils
Panicum acuminatum var acuminatum	Walter Benner's panic grass	occurs in a wide variety of habitats
Panicum oligosanthes var oligosanthes	few-flower panic grass	open woods and shaded edges, usually in dry, sandy soil
Sphenopholis pensylvanica	swamp oats	swamps and wet woods
Sporobolus compositus var compositus	long-leaf rush-grass	open uplands
Sporobolus neglectus	small rush-grass	dry sterile or sandy soil

Scientific Name	Common Name	Habitat
Terrestrial Herbs		
Chaerophyllum procumbens var procumbens	spreading chervil	moist woods and alluvial soil
Panax quinquefolius	American ginseng	rich woods
Aristolochia serpentaria	Virginia snakeroot	well-drained, rich, rocky often limestone ground of mixed deciduous woods
Asclepias quadrifolia	four-leaf milkweed	dry upland woods
Arnoglossum atriplicifoliium	pale Indian plantain	dry, open ground of woods and shaded edges
Aster praealtus var praealtus	willow-leaf aster	moist low ground
Brickellia eupatorioides var eupatorioides	false boneset	dry, open usu limestone/sandy ground of woods, edges, meadows, rocky slopes
Doellingeria infirma	cornel-leaf aster	dry ground of deciduous woods and shaded edges, rocky slopes
Eupatorium altissimum	tall boneset	woods, thickets, savannas, glades and clearings
Rudbeckia fulgida var fulgida	orange coneflower	moist or dry, open ground of pastures, meadows, floodplains
Solidago rigida var rigida	prairie goldenrod	dry, well-drnd open, rocky/sandy grnd of thin wds, edges, meadows, bog edges
Solidago speciosa var speciosa	showy goldenrod	open woods, fields, prairies and plains
Jeffersonia diphylla	twinleaf	well-drained, moist, rich, usually calcareous, open ground of woods
Cynoglossum virginianum var virginianum	wild comfrey	well-drained, open ground and thin, deciduous woods; usually on trap rock
Onosmodium virginianum	Virginia false-gromwell	well-drained, dry, open sandy ground of thin woods, barrens, rarely pinelands
Cardamine angustata	slender toothwort	rich woods
Draba reptans	Carolina whitlow-grass	dry, sterile or sandy soil
Triosteum angustifolium	narrow-leaf horse-gentian	well-drained, moist, rich, non-acid ground of mixed woods and shaded edges
Stellaria pubera	star chickweed	well-drnd, moist, rich, shaded, often rocky ground of wds, slopes, cult. fields
Chenopodium simplex	maple-leaf goosefoot	disturbed ground and moist woods
Chenopodium standleyanum	Stanley's goosefoot	dry, open woods
Lechea intermedia var intermedia	large-pod pinweed	dry, sterile open ground of uplands and beaches
Hypericum pyramidatum	great St. John's-wort	rich, moist open ground of streamsides, shaded woods edges
Tradescantia ohiensis	Ohio spiderwort	meadows, thickets and prairies
Calystegia spithamaea	erect bindweed	dry, rocky or sandy soil, fields and open woods
Sedum telephioides	Allegheny stonecrop	dry rocky places
Cuscuta cephalanthi	button-bush dodder	on a wide variety of hosts
Euphorbia corollata	flowering spurge	dry woods and old fields
Desmodium cuspidatum var cuspidatum	toothed tick-trefoil	dry upland woods and thickets
Desmodium humifusum	trailing tick-trefoil	dry sandy woods
Lathyrus venosus	veiny vetchling	moist, low ground of woods and shaded edges, streamsides, occ in waste places
Phaseolus polystachios var polystachios	wild kidney bean	moist woods and thickets
Vicia caroliniana	Carolina wood vetch	rich, usually limestone ground of woods and edges, watersides, bluffs
Adlumia fungosa	climbing fumitory	well-drained, moist rocky soil of upland woods on slopes and rock outcrops

Scientific Name	Common Name	Habitat
Dicentra canadensis	squirrel-corn	well-drained, rich ground of mixed deciduous woods, slopes
Gentiana andrewsii var andrewsii	fringed bottle gentian	moist prairies, open woods and swamps
Obolaria virginica	Virginia pennywort	rich woods
Ellisia nyctelea	Aunt lucy	rich, moist low ground of woods, shaded watersides, disturbed soil
Hydrophyllum canadense	broad-leaf waterleaf	moist or wet, rich ground of streamsides, woods
Agastache nepetoides	yellow giant-hyssop	open, rich soil of deciduous woods and shaded edges
Agastache scrophulariifolia	purple giant-hyssop	rich soil of usually upland woods and shaded edges, grassy places
Monarda clinopodia	basil bee-balm	woods and thickets
Monarda didyma	oswego-tea	moist woods and thickets
Pycnanthemum clinopodioides	basil mountain-mint	dry or moist, rocky ground of wooded slopes, watersides
Pycnanthemum torrei	Torrey's mountain-mint	dry or moist, open ground of thin woods and shaded edges, swamp edges
Scutellaria nervosa	veined skullcap	moist, often alluvial ground of woods and shaded edges
Stachys hyssopifolia	hyssop hedge-nettle	moist, usually sandy soil near the coast
Stachys tenuifolia	smooth hedge-nettle	rich, moist ground of swamps, meadows, low woods
Linum sulcatum	grooved yellow flax	dry, often sandy soil, prairies and upland woods
Cuphea viscosissima	blue waxweed	dry soil
Epilobium angustifolium ssp circumvagum	narrow-leaf fireweed	many habitats, esp. moist soils rich in humus, often abundant after fires
Epilobium strictum	downy willowherb	bogs and swamps
Isotria medeoloides	small whorled pogonia	dry, acid soil of woods (esp. hardwoods)
Malaxis unifolia	green adder's-mouth	damp woods and bogs
Spiranthes lucida	shining ladies'-tresses	damp woods, marshes and wet shores; calciphile
Phlox divaricata var divaricata	wild blue phlox	rich moist woods
Phlox maculata var maculata	spotted phlox	moist or wet, low ground of streamsides, meadows, floodplains
Phlox pilosa var pilosa	downy phlox	dry, open ground of upland deciduous woods and edges, sandhills, roadsides
Lysimachia hybrida	lowland loosestrife	sloughs, wet woods and wet prairies
Clematis occidentalIs var occidentalis	purple clematis	rocky woods
Ranunculus ambigens	water-plantain spearwort	swamps, marshes and shores, mostly in heavy soil
Ranunculus micranthus	rock buttercup	rich, often rocky ground of woods, cliffs
Ranunculus pusillus var pusillus	low spearwort	ditches, muddy ground and shallow water, mostly on the coastal plain
Agrimonia microcarpa	small-fruited grooveburr	woodlands
Porteranthus trifoliatus	Indian physic	dry or moist upland woods
Castilleja coccinea	scarlet indian paintbrush	root parasite on herbs in moist/wet, sandy grnd of meadows, shaded wds edges
Penstemon laevigatus	smooth beardtongue	moist, rich usu. limestone grnd of thin wds and shaded edges, bluffs, meadows
Valerianella radiata	beaked cornsalad	moist ground of streamsides, fields, meadows, woods and edges

Scientific Name	Common Name	Habitat
Verbena simplex	narrow-leaf vervain	dry, open, sandy or rocky non-acid ground of thin woods, fields, roadsides
Hybanthus concolor	green violet	rich, moist ground of slopes, ravines, bottomlands, trap rock escarpments
Viola canadensis	Canadian violet	rocky, upland ground of deciduous woods, ravines, bluffs
Viola rostrata	long-spur violet	shady slopes and woodlands, usually in deep humus
Aquatic Herbs		
Sagittaria subulata	awl-leaf arrowhead	tidal waters, or submersed in inland waters mainly near the coast
Callitriche palustris	marsh water-starwort	in quiet water
Lemna valdiviana	pale duckweed	floating on quiet waters of ponds, streams, swamps
Ranunculus flabellaris	yellow water buttercup	quiet water and muddy shores
Ranunculus longirostris	long-beak water buttercup	ponds and slow streams
Ranunculus trichophyllus var trichophyllys	thread-leaf water buttercup	quiet, fresh (sometimes brackish) waters of streams, ponds
Shrubs		
Asimina triloba	pawpaw	rich, moist, alluvial soil of low woods, streamsides, river islands
Ribes missouriense	Missouri gooseberry	moist or dry, open, ground of thin wds & shaded edges, fencerows, ridge tops
Crataegus calpodendron	pear hawthorne	usually in dry or rocky ground
Crataegus chrysocarpa var chrysocarpa	fireberry hawthorn	pastures, forest edges, open second growth woods, streamside thickets
Crataegus dodgei	Dodge's hawthorne	pastures, forest edges, open second growth woods, streamside thickets
Crataegus holmesiana	Holmes' hawthorne	pastures, forest edges, open second growth woods, streamside thickets
Crataegus succulenta	fleshy hawthorne	dry, rocky ground of woods, roadsides, streamsides
Prunus allegheniensis	Alleghany plum	dry, rocky ground of woods and shaded edges
Prunus pumila var depressa	low sand cherry	rocky/sandy open grnd of riversides, beaches, dunes, thin wds, cliffs; non-acid
Salix lucida ssp lucida	shining willow	moist, low ground of bogs, swamps, watersides
Taxus canadensis	American yew	coniferous woods and bogs
Dirca palustris	leatherwood	rich, moist woods
Trees		
Cercis canadensis	redbud	moist, rich soils of woods, ravines, streamsides
Quercus muehlenbergii	yellow oak	good, chiefly calcareous soils
Pinus pungens	table mountain pine	dry, sandy or rocky soil, esp. on slopes
Ptelea trifoliata var trifoliata	wafer-ash	rich, moist ground of wds and shaded edges, alluvium, rocky slopes, riversides

APPENDIX E: INVASIVE SPECIES

Species Tracked by the New Jersey Invasive Species Strike Team in Hunterdon County.

	Common Name	Scientific name	Taxa
ANIMALS	Bighead carp	*Hypophthalmichthys nobilis*	fish
	Viburnum leaf beetle	*Pyrrhalta viburni*	insect
	Chinese pond mussel	*Sinanodonta woodiana*	mollusk
PLANTS	Amur corktree	*Phellodendron amurense*	tree
	Callery pear (Bradford pear)	*Pyrus calleryana*	tree
	Japanese angelica tree	*Aralia elata*	tree
	Japanese maple	*Acer palmatum*	tree
	Kousa dogwood	*Cornus kousa*	tree
	Tree-of-heaven	*Ailanthus altissima*	tree
	Weeping Higan cherry	*Prunus subhirtella var. pendula*	tree
	White poplar	*Populus alba*	tree
	Common barberry	*Berberis vulgaris*	shrub
	Dog rose	*Rosa canina*	shrub
	European spindletree	*Euonymus europaeus*	shrub
	Jetbead	*Rhodotypos scandens*	shrub
	Linden viburnum	*Viburnum dilatatum*	shrub
	Multiflora rose	*Rosa multiflora*	shrub
	Orange-eye butterflybush	*Buddleja davidii*	shrub
	Oriental photinia	*Photina villosa*	shrub
	Siebold's arrowwood	*Viburnum sieboldii*	shrub
	Southern waxmyrtle	*Morella cerifera*	shrub
	Wine raspberry	*Rubus phoenicolasius*	shrub
	Black dog-strangling vine/ Black swallowwort	*Cynanchum louiseae*	vine
	Chocolate vine	*Akebia quinata*	vine
	English ivy	*Hedera helix*	vine
	Japanese hop	*Humulus japonicus*	vine
	Japanese wisteria	*Wisteria floribundum*	vine
	Mile-a-minute vine	*Persicaria perfoliata*	vine
	Sweet autumn virginsbower/Japanese clematis	*Clematis terniflora*	vine
	Winter creeper	*Euonymus fortunei*	vine
	Canarygrass	*Phalaris canariensis*	grass
	Chinese silvergrass	*Miscanthus sinensis*	grass
	Blue plantain lily	*Hosta ventricosa*	herb
	Chinese bushclover	*Lespedeza cuneata*	herb
	Japanese knotweed	*Fallopia japonica*	herb
	Lesser celandine/Fig buttercup	*Ficaria verna*	herb
	Mugwort	*Artemisia vulgaris*	herb
	Perilla mint/Beefsteakplant	*Perilla frutescens*	herb
	Poison-hemlock	*Conium maculatum*	herb
	Yellow iris	*Iris pseudacorus*	herb
	European water chestnut	*Trapa natans*	aquatic
	Giant/Water chickweed	*Myosoton aquaticum*	aquatic

Source: NJISST (2018). http://www.njisst.org/