WARREN TOWNSHIP
ENVIRONMENTAL RESOURCE INVENTORY

Date: September 2014
Rev. August 2015

Prepared by: Warren Township Environmental Commission
EXECUTIVE SUMMARY

The Environmental Resource Inventory (ERI) for Warren Township (Warren) presented herein is a comprehensive compilation of text, maps, and geographic information system (GIS) data that describe Warren's key environmental resources. This ERI provides information and guidance pursuant to the protection, preservation, and conservation of these resources. The primary objective of this document is to accurately present spatial and statistical information in a framework that assists the Township in future planning decisions. The ERI is intended to provide critical data used in the crafting of resource conservation measures and the development of related ordinances. In addition to providing information on the Township's sensitive natural resources, this ERI also includes maps to be used in the assessment of environmental resource protection initiatives, and planning and development of related impacts. The ERI also provides recommendations to further the environmental goals of the community. All the recommendations herein are subject to the particular aspects of each site's plan, as well as applicable statutes, ordinances, and codes extent at this time.

This ERI updates the environmental inventory prepared for the Township in 1986. The current environmental inventory builds upon earlier work and evaluates present conditions. The text has been gathered from existing resources, reports and studies provided by the Township, Somerset County, New Jersey Department of Environmental Protection, and the United States Environmental Protection Agency. The ERI should be periodically reviewed and updated with regard to changes in land use, the quality and quantity of environmental resources and local, State and Federal laws.

The ERI is designed to serve as a general guideline for determining Warren's priority resources and their locations within the Township. No fieldwork was conducted specifically for this report and this document should not be a substitute for site-specific surveys. Activities such as wetland delineations, wildlife studies, and groundwater testing would be needed for site-specific conditions.
ACKNOWLEDGEMENTS

This plan was prepared for Warren Township by the Warren Township Environmental Commission. This plan was prepared with the assistance of a Smart Growth Planning Grant from the Association of New Jersey Environmental Commissions (ANJEC).

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Appendix I: Warren Township Environmental Commission's Approved List of Plant Species

Appendix II: Warren Township Wildflower Species

Appendix III: Environmental Resource Maps
INTRODUCTION

One of the most attractive communities in New Jersey, Warren Township, has a great history and an even greater future.

Originally inhabited by the Lenape Native Americans, the territory was settled by European farmers in the early 1700’s. In 1806, Warren was carved from part of surrounding towns and was incorporated. The town was named after General Joseph Warren who was a hero in the Battle of Bunker Hill during the American Revolution.

Warren Township is comprised of 19.3 square miles. It is nestled in the Watchung Mountains. Once described as “the greenest place in New Jersey”, Warren Township residents and elected officials are working to keep its rural character and charm while recognizing that there will be growth due to the town’s beauty, favorable property taxes and strategic location.

Less than 35 miles to Manhattan makes Warren Township a favorite suburb for commuters to New York City and other Tri-State locations. Businesses and residents alike chose Warren as their home because of the access to major roads including Route 78, Route 22, and Route 287. Today, Warren Township is home to over 600 businesses. These include restaurants, retail, and manufacturing & office occupancies.

The Warren Township Master Plan has kept our commercial and industrial growth to only a few main streets. Most of the commercial property is found on Mountain Boulevard, Mount Bethel and Stirling Road.

After explosive population growth from 1940 – 2000, recent population growth has stabilized. In 2010, the census reported 15,311 residents. A 2000 report associated the growing needs of the town to the formation of various committees over the years. These committees work together in order to meet the environmental and economic needs of the Township.

Warren Township has a great diversity of resources that need to be protected and addressed. The goal of this ERI is to highlight these resources and provide recommendations for future development and preservation of Warren Township.
CHAPTER 1: NATURAL RESOURCE SETTING

1.1 Location and Extent of Area

Warren Township is located in the southwest quadrant of the Watchung Mountains, between 74° 27'W and 74° 35'W longitude and 40° 35'N and 40° 41'N latitude. It is at the extreme easterly end of Somerset County, New Jersey, being bordered to the north by Bernards Township in Morris County, to the east by Berkeley Heights in Union County, to the south by Watchung and Green Brook in Somerset County and to the West by Bridgewater Township and Bernards Township in Somerset County. The land area of Warren Township is approximately 19.3 square miles.

1.2 Topography

The dominant topographic features of Warren Township are the First and Second Watchung Mountains. Second Mountain transects the Township in a northeasterly to southeasterly direction until it reaches the western edge of the Township where it swings northwesterly along the border. First Mountain parallels Second Mountain approximately one mile to the south and west and enters Warren only at the Township’s southernmost extremity. Second Mountain is divided lengthwise by a valley which is most prominent in the eastern half of the Township. There it is occupied by the Story Brook and the Stirling Brook (known locally as Carnelian Brook). West of Mt. Bethel Road, this valley broadens and is less distinct. Here the northern ramparts are known as Mt. Bethel, Roundtop, and Mr. Horeb.

The highest point in Warren Township is located on the Second Watchung Mountain near the radio tower just east of Dock Watch Hollow. The elevation there is approximately 570 feet above mean sea level. The lowest points in town are those where the Passaic River and the Middle Brook exit the Township. Both are at elevations of just under 200 feet. Thus the total relief is approximately 370 feet.
1.3 Geology

Structurally, Warren Township’s bedrock consists of thick sheets of basalt and diabase (both derived from lava flows) interspersed with shale’s and some sandstone. This structure, known as the Newark Group, was laid down during the Triassic Epoch (recent research is suggesting the Jurassic Epoch), roughly 200 million years ago. This was the age of the small dinosaurs. Downfaulting in the Piedmont Plateau, of which the Watchungs are part, produced a string of basins which run from Nova Scotia to North Carolina.

Locally, these terrestrial basins filled with the sediments derived from Precambrian and Paleozoic rocks in mountains which stood to the southeast. Lithification produced the typical red shale’s and sandstones of the Brunswick Formation, a sub-unit of the Newark Group. Late in the Triassic Epoch or early in the Jurassic Epoch, the huge Palisades diabase sill intruded the formation and episodic lava flows, probably from fissures and feeder pipes located slightly to the northwest, covered the land. These flows became the Watchung Mountains.

Warren Township is underlain entirely by the Brunswick Formation and the Watchung Basalt. The First and Second Watchung Mountains represent at least three separate lava flows. Following the First Mountain flow, there was a period of deposition when expressed topographically as Washington Valley and its easterly extension through Watchung Borough. The Second Watchung Mountain is a double lava flow interrupted by a short period of deposition. Here the two flows account for the parallel double ridges with the sediments being expressed as the valley between them (Stony Brook and Stirling Brook). Finally, within Warren, another depositional period laid
down the sediments which are now the valley of the Dead River and the Passaic River. To the north, in Long Hill and
Bernards Townships another and later lava flow created Long Hill. Because the basalt is much harder than the
shale’s, erosion has left the basalt as the ridges and removed the shale’s to form the valleys.

The Brunswick Formation consists of thinly bedded mudstones, shale’s, and sandstones. Due to its high iron content,
the color is usually a deep reddish-brown. Although none are known to have been reported within Warren, ripple
marks, mud cracks, and occasional dinosaur footprints found in the same formation in nearby communities indicate
that the sediments were deposited in a shallow water environment.

The Watchung Basalt is densely aphanitic (microcrystalline), having cooled rapidly on extrusion. The ground-mass
(body of the rock) is predominantly augite and feldspar. Phenocrysts (larger crystals) of augite, and occasionally
feldspar, are not uncommon.

Both formations strike approximately northeast and dip 5 to 13 degrees toward the northwest.

During the Pleistocene Epoch (last ice age) which ended approximately 10,000 years ago, a tongue of ice
advancing from the east created a dam across the valley of the present Passaic River in the vicinity of Short Hills.
The outwash from the terminal moraine flowed westerly and appears as stratified drift in the outwash plain along
the northern edge of Warren Township.

The only noteworthy mineralization in Warren Township is the occurrence of carnelian, a reddish translucent form of
quartz found in the clays along the Story Brook and the Stirling Brook. The carnelian has been collected by
amateur mineralogists who cut and polish it as a semi-precious gemstone.
CHAPTER 2: SOILS

Soil is defined as:

The total complex of rock particles, organic material, air and water that lie on a specific site between the vegetative cover and the bedrock or other underlying material.

In analyzing soil, scientists study what is termed a “soil profile”, that is, the layers or “horizons” that extend from the surface down to the bedrock.

Soil profiles are made up of several layers, “soil horizons”, the characteristics of which help define the soil type. The top horizon, or surface layer, is usually the topsoil, which overlays the subsoil. Topsoil most often has a high organic composition (4% or more by volume). Subsoil’s are generally mineralogical, but may have a small organic composition. Soils occurring below the subsoil are known as the substratum.

The soil mapping for the Warren Township ERI are derived from the US Department of Agriculture’s (USDA) Natural Resource Conservation Service (NRCS) soil Survey Geographic (SSURGO) database available from NJDEP GIS data. The mapping is a compilation of data from geologic, topographic, and aerial maps and extensive field surveys. Soil scientists walk the survey area, taking auger borings, excavating pits, and studying the vegetation and wildlife. Information is recorded and soil samples sent to laboratories for additional analysis. The soils are classified and named according to a national system.

Some of the properties used to classify soils are: flood hazard, wetness (natural drainage classes or water table height and duration), slope, depth to and kind of bedrock, rockiness, stoniness, coarse fragments (gravel, cobbles, etc.), texture (sand, silt, clay proportions), permeability and percolation, shrink/swell potential, natural fertility, available water capacity, frost action potential, erosion hazard, and prior erosion.

2.1 Soils Series

A Soils Series basic unit of soils alike in their profiles, although sometimes varying in surface texture, stoniness, slope or some other attribute, are grouped and given a Soil Series name. A series is named for the town or geographic location where the soil is first observed and mapped. For example the Watchung Series (Wc) is named for the level soils located on the low lying flats, depressions, and drainage ways in the Watchung Mountains.

A soil 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, soil areas cannot be as precisely delineated, as they appear to be on survey maps. Soils blend into each other across bands of varying widths. In most cases, soil series and soil mapping units are synonymous. The soil survey is intended as an overview of soil conditions, and onsite investigation is always required.
2.2 Soils of Warren Township

There are 20 soil series found in Warren Township and 48 different soil-mapping units. These 48 mapping units are listed in the table below, along with several important properties of these soils, such as depth to bedrock and depth to the seasonal high water table.

**WARREN TOWNSHIP SOIL MAPPING UNITS AND THEIR CHARACTERISTICS**

<table>
<thead>
<tr>
<th>Label</th>
<th>Name</th>
<th>Notes</th>
<th>Depth to Bedrock</th>
<th>Drainage Class</th>
<th>Depth to Seasonal High Water Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>AbrB</td>
<td>Abbotstowns silt loam, 2 to 2% slopes</td>
<td>SI</td>
<td>40 - 60&quot;</td>
<td>Somewhat poorly drained</td>
<td>0 - 2.5'</td>
</tr>
<tr>
<td>AmdB</td>
<td>Amwell gravelly loam, 2 to 6% slopes</td>
<td>SI</td>
<td>40 - 60&quot;</td>
<td>Somewhat poorly</td>
<td>30'</td>
</tr>
<tr>
<td>AmdC</td>
<td>Amwell gravelly loam 6 to 12% slopes</td>
<td>SI</td>
<td>42 - 53&quot;</td>
<td>Somewhat poorly</td>
<td>30'</td>
</tr>
<tr>
<td>AmhB</td>
<td>Amwell silt loam, 2 to 6% slopes</td>
<td>SI</td>
<td>42 - 53&quot;</td>
<td>Somewhat poorly</td>
<td>30'</td>
</tr>
<tr>
<td>AmnrB</td>
<td>Amwell gravelly silt loam, rock substratum, 2 to 6% slopes</td>
<td>SI</td>
<td>42 - 53&quot;</td>
<td>Somewhat poorly</td>
<td>30'</td>
</tr>
<tr>
<td>Soil Series</td>
<td>Description</td>
<td>Slope</td>
<td>pH</td>
<td>Drainage (0) to (10)</td>
<td>Depth</td>
</tr>
<tr>
<td>-------------</td>
<td>-------------</td>
<td>-------</td>
<td>----</td>
<td>-----------------</td>
<td>-------</td>
</tr>
<tr>
<td>AmnrC</td>
<td>Amwell gravelly silt loam, rock substratum, 6 to 12% slopes</td>
<td>SI</td>
<td>42 - 53''</td>
<td>Somewhat poorly</td>
<td>30'</td>
</tr>
<tr>
<td>BhnB</td>
<td>Birdsboro, silt loam, 2 to 6% slopes</td>
<td>P</td>
<td>6 - 20''</td>
<td>Well drained and moderately well drained</td>
<td>&gt;60'</td>
</tr>
<tr>
<td>BhnC</td>
<td>Birdsboro silt loam, 6 to 12% slopes</td>
<td>SI</td>
<td>6 - 20''</td>
<td>Well drained and moderately well drained</td>
<td>&gt;6'</td>
</tr>
<tr>
<td>BoyAt</td>
<td>Bowmansville silt loam, 0 to 2% slopes</td>
<td>H, SI</td>
<td>6''</td>
<td>Poorly drained and somewhat poorly drained</td>
<td>0-6'+</td>
</tr>
<tr>
<td>CoxA</td>
<td>Croton silt loam, 0 to 2% slopes</td>
<td>H, SI</td>
<td>3.5 - 5''</td>
<td>Poorly drained</td>
<td>0-2.5'</td>
</tr>
<tr>
<td>DunB</td>
<td>Dunellen sandy loam, 3 to 8% slopes</td>
<td>P</td>
<td>10''</td>
<td>Well drained</td>
<td>&gt;6'</td>
</tr>
<tr>
<td>DunC</td>
<td>Dunellen sandy loam, 8 to 15% slopes</td>
<td>SI</td>
<td>10''</td>
<td>Well drained</td>
<td>&gt;6'</td>
</tr>
<tr>
<td>DuxA</td>
<td>Dunellen moderately well –drained sandy loam, 0 to 2% slopes</td>
<td>P</td>
<td>10''</td>
<td>Well drained</td>
<td>&gt;6'</td>
</tr>
<tr>
<td>FmrAt</td>
<td>Fluvaquents loamy, 0 to 3% slopes, not a soil series</td>
<td>H</td>
<td>6''</td>
<td>Frequently flood</td>
<td>0-6'</td>
</tr>
<tr>
<td>KkoC</td>
<td>Klinesville channery loam, 6 to 12% slopes</td>
<td>10 - 20''</td>
<td>Somewhat excessively drained</td>
<td>0-1'</td>
<td></td>
</tr>
<tr>
<td>KkoD</td>
<td>Klinesville channery loam, 12 to 18% slopes</td>
<td>10 - 20''</td>
<td>Somewhat excessively drained</td>
<td>&gt;6'</td>
<td></td>
</tr>
<tr>
<td>LbgA</td>
<td>Lamington silt loam, 0 to 2% slopes</td>
<td>H</td>
<td>5''</td>
<td>Poorly</td>
<td>3'</td>
</tr>
<tr>
<td>LbtA</td>
<td>Landsdowne silt loam, 0 to 2% slopes</td>
<td>H, SI</td>
<td>40''</td>
<td>Moderately drained and somewhat poorly drained</td>
<td>1.0-3.0'</td>
</tr>
<tr>
<td>LbtB</td>
<td>Landsdowne silt loam, 2 to 6%</td>
<td>SI</td>
<td>40''</td>
<td>Moderately well drained and somewhat poorly drained</td>
<td>1.0-3.0'</td>
</tr>
<tr>
<td>MonB</td>
<td>Mount Lucas silt loam, 2 to 6% slopes</td>
<td>H, P</td>
<td>48''</td>
<td>Moderately well drained and somewhat poorly drained</td>
<td>0.5-3.5'</td>
</tr>
<tr>
<td>MooC</td>
<td>Mount Lucas gravelly silt loam, 6 to 12% slopes</td>
<td>H, SI</td>
<td>48''</td>
<td>Moderately well drained and somewhat poorly drained</td>
<td>0.5-3.5'</td>
</tr>
<tr>
<td>MopCb</td>
<td>Mount Lucas Watchung silt loams, 6 to 12% slopes, very stony</td>
<td>H</td>
<td>48-</td>
<td>Moderately well drained and somewhat poorly</td>
<td>0-6'+</td>
</tr>
<tr>
<td>Soil Code</td>
<td>Soil Name</td>
<td>Slope (%)</td>
<td>P</td>
<td>SI</td>
<td>Well Drained</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------------------------------</td>
<td>------------</td>
<td>---</td>
<td>----</td>
<td>--------------</td>
</tr>
<tr>
<td>NehB</td>
<td>Neshaminy silt loam, 2 to 6% slopes</td>
<td></td>
<td>P</td>
<td>4 - 6+</td>
<td>Well drained</td>
</tr>
<tr>
<td>NehC</td>
<td>Neshaminy silt loam, 6 to 12% slopes</td>
<td></td>
<td>SI</td>
<td>4 - 6+</td>
<td>Well drained</td>
</tr>
<tr>
<td>NehCc</td>
<td>Neshaminy variant silt loam, 2 to 6% slopes</td>
<td></td>
<td>SI</td>
<td>4 - 6+</td>
<td>Well drained</td>
</tr>
<tr>
<td>NehEb</td>
<td>Neshaminy silt loam, 18 to 35% slopes very stony</td>
<td></td>
<td>SI</td>
<td>4 - 6+</td>
<td>Well drained</td>
</tr>
<tr>
<td>NemCb</td>
<td>Neshaminy-Mount Lucas silt loams, 6 to 12% slopes, very stony</td>
<td></td>
<td>SI</td>
<td>4 - 6</td>
<td>Well drained</td>
</tr>
<tr>
<td>NemDb</td>
<td>Neshaminy-Mount Lucas silt loams, 12 to 18% slopes, very stony</td>
<td></td>
<td>SI</td>
<td>4 - 6+</td>
<td>Well drained</td>
</tr>
<tr>
<td>NenB</td>
<td>Neshaminy-urban land complex, 0 to 6% slopes</td>
<td></td>
<td>SI</td>
<td>4 - 6+</td>
<td>Well drained</td>
</tr>
<tr>
<td>NeopB</td>
<td>Neshaminy variant silt loam, 2 to 6% slopes</td>
<td></td>
<td>SI</td>
<td>3.5 - 4.5'</td>
<td>Somewhat poorly</td>
</tr>
<tr>
<td>NeopC</td>
<td>Neshaminy variant silt loam, 6 to 12% slopes</td>
<td></td>
<td>SI</td>
<td>3.5 - 4.5'</td>
<td>Somewhat poorly</td>
</tr>
<tr>
<td>NotB</td>
<td>Norton loam, 2 to 6% slopes</td>
<td></td>
<td>P</td>
<td>3.5-10</td>
<td>Well drained</td>
</tr>
<tr>
<td>PHG</td>
<td>Pits, sand, and gravel, Not a soil series</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PbpAt</td>
<td>Parsippany silt loam, 0 to 3 percent slopes, frequently flooded</td>
<td></td>
<td>H, SI</td>
<td>4 - 20'</td>
<td></td>
</tr>
<tr>
<td>PbpuAt</td>
<td>Parsippany-urban land complex, 0 to 6% slopes</td>
<td></td>
<td>H, SI</td>
<td>4 - 5'</td>
<td>Frequently flooded</td>
</tr>
<tr>
<td>PbtAt</td>
<td>Parsippany-variant silt loam, 0 to 6% slopes</td>
<td></td>
<td>H, SI</td>
<td>10 - 20'</td>
<td>Very poorly drained</td>
</tr>
<tr>
<td>PenA</td>
<td>Penn silt loam, 0 to 2% slopes</td>
<td></td>
<td>P</td>
<td>20 - 40&quot;</td>
<td>Well drained</td>
</tr>
<tr>
<td>PenB</td>
<td>Penn silt loam, 2 to 6% slopes</td>
<td></td>
<td>P</td>
<td>20 - 40&quot;</td>
<td>Well drained</td>
</tr>
<tr>
<td>PenC</td>
<td>Penn silt loam, 6 to 12% slopes</td>
<td></td>
<td>SI</td>
<td>20 - 40&quot;</td>
<td>Well drained</td>
</tr>
<tr>
<td>PeoB</td>
<td>Penn channery silt loam, 2 to 6% slopes</td>
<td></td>
<td>P</td>
<td>20 - 40&quot;</td>
<td>Well drained</td>
</tr>
<tr>
<td>PeoC</td>
<td>Penn channery silt loam, 6 to 12% slopes</td>
<td></td>
<td>SI</td>
<td>20 - 40&quot;</td>
<td>Well drained</td>
</tr>
<tr>
<td>QY</td>
<td>Quarry, Not a Soil Series</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RarAr</td>
<td>Raritan Silt loam, 0 to 3% slopes,</td>
<td></td>
<td>HI, P</td>
<td>5 - 20'</td>
<td>Moderately well drained and</td>
</tr>
</tbody>
</table>

**Table Notes:**
- **P** indicates a well-drained soil with a depth greater than 6 feet.
- **SI** indicates a moderately well-drained soil with a depth greater than 6 feet.
- **H, SI** indicates a poorly drained soil with a depth greater than 6 feet.
- **HI, P** indicates a very poorly drained soil with a depth greater than 6 feet.
- All depths are in feet.
2.3.1 Hydric Soils (H)
Hydric soils are defined by the National Technical Committee for Hydric Soils (NTCHS) as:

Soils that are formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part.

This definition identifies soils that are either saturated or long enough during the growing season to support growth and reproduction of hydrophytic vegetation.

In order to determine whether a specific soil is or is not hydric, specific information such as inundation depth and duration is needed. For that reason, criteria that identify those soil properties unique to hydric soils have been established. These criteria are utilized to phases of soil series that are normally associated with wetlands.

Hydric soils have low permeability, are poorly drained and have a water table at or near ground surface during the growing season. These soils frequently pond or flood for a long duration or very long duration during the growing season. Hydric Soils are moderately acidic to neutral, with a high frost action potential. Generally, Hydric Soils are protected by the NJDEP Freshwater Wetland regulations. There are only five hydric soils series in Warren Township, Bowmansville, Croton and Lamington, Mount Lucal Watchung Parsippany, and Watchung.

2.3.2 Hydric Inclusions (HI)
Soils present pockets of wetlands scattered through an area are called Hydric Inclusions Soils.

2.3.3 Prime Farmland (P)
The NRCS has identified soils based on their agricultural significance, or Land Capability Classification. The best quality soils are termed Prime Farmlands, which are followed by Soils of Statewide Importance. Prime Farmlands include all those soils in Land Capability Class I and selected soils from Land Capability Class II. Prime Farmlands are lands that have the best combination of physical and chemical characteristic for producing food, feed, forage, fiber and oilseed crops. It has quality soils, growing season, and moisture supply needed to economically produce a sustained high yield of crops.

2.3.4 Soils of State Wide Importance (SI)

Soils that do not meet the criteria of Prime Farmland but nevertheless support agriculture are classified as Soils of the Statewide Importance. These soils may be suited to certain crops or require special conservation practices to maintain productivity.

2.4 Soil Erosion and Sediment Control

The NJDEP Soil Erosion and Sediment Control Act (N.J.S.A. 4-24-42 et seq.), requires that a Soil Erosion and Sediment Control Plan be prepared for any clearing or disturbance of 5000 square feet or more. The plan should be prepared in accordance with the Standards for Soil Erosion and Sediment Control in N.J.A.C 2:90. Soil disturbance of one acre or more during construction also requires a New Jersey Pollutant Discharge Elimination System (NJPDES) permit and a Request for Authorization (RFA) from NJDEP’s Bureau of Nonpoint Pollution.

These documents and information can be obtained through the County's Soil Conservation District. The SCD monitors compliance with the SESC plan during construction. Information about Soil Erosion and Sediment Control may be obtained from the Somerset County Soil Conservation District at http://www.co.somerset.nj.us/division/soilconserve.html.

2.5 Recommendations

- Prior to undertaking any development of the land for whatever the end use, a thorough examination of the existing soils should be reviewed by an engineer knowledgeable in the structure of soils. Certain soils are deep, providing a favorable environment for construction and septic disposal. Other soils may be shallow offering a more readily available supply of groundwater. Shallow soils indicate there is shallow depth to bedrock where fissures occur in the bedrock and groundwater is found. Shallow bedrock may create the need to blast in order to prepare the land for development, which is costly and not desirable.

- Some soils contain extremes of chemical composition, from both of the highly corrosive ends of the acidity and alkalinity spectrum, to the neutral middle ground of pH levels. Excessive corrosiveness could have an adverse impact upon foundations, utilities, and vegetation.

- Depth to water table, steep slopes, and the potential for erosion are additional areas where soils come into play when planning for any development of the land.

- All development should seek to minimize soil disturbance.
CHAPTER 3: HYDROLOGY

Hydrology is the study of the presence, distribution, movement, and quality of water. It includes the hydrologic cycle, water resources, and environmental watershed sustainability. The central theme of hydrology is water circulates throughout the earth via different paths at different rates. This is demonstrated through the hydrologic cycle. There are various factors that play a role in hydrology, such as climate, geology, soil conditions, vegetation, water and air quality.

Drainage, which is controlled by the structure of the bedrock, is a trellis pattern in which tributaries flow at essentially right angles to the major streams. This is a consequence of the major streams flowing parallel to the ridges and the tributaries flowing perpendicularly off the ridges into them. The largest streams, forming the northern boundary of the Township, are the Passaic River and Dead River. Their flood plains are significant topographic features. The East Branch of the Middle Brook occupies the broad valley between the First and Second Watchung Mountains. All streams north of the second ridge of Second Mountain are part of the Passaic River drainage basin. Those south of that ridge exit the Township through either the Middle Brook or the Story Brook and are part of the Raritan River basin.

3.1 Aquifers

An underground layer of water-bearing permeable rock from which ground water can be extracted is called an aquifer.

Aquifers occur at various depths. Since rocks have different porosity and permeability qualities, water does not move around the same way in all rocks below the ground. The closer to the surface aquifers are found the more likely they will be used for water supply. The most common aquifers are those geologic formations that have relatively high hydraulic conductivity values, such as unconsolidated sands and gravels, permeable sedimentary rocks such as sandstone and limestone, and heavily fractured sedimentary, volcanic and crystalline rocks.

Aquifers generally represent the name of the geologic formation in which they exist, but do not actually correspond to the defined boundary of the mapped geologic formation. NJDEP mapping shows that the primary aquifer associated with Warren Township is the Brunswick Aquifer.

Both the Brunswick Formation’s Buried Valley Aquifer and the Watchung Basalt serve as aquifers within Warren Township. The Brunswick Formation has nearly vertical joints and is highly fractured. Both joints and fractures are more open near the surface than at depth. The Watchung Basalt is strongly jointed, forming nearly vertical columns. Vesicles, formed from gas bubbles trapped in the molten lava, account for some porosity in the basalt.

The Brunswick Formation is the major aquifer in the Township. Its highly fractured nature assures that a borehole is almost certain to intersect joint and fracture systems which provide a fair to excellent source of water. The Watchung Basalt is less predictable. Here the yield of a well depends on drilling into a joint system, which is open and extensive (Warren Township ERI, 1989). The Brunswick Formation’s Buried Valley Aquifer system is located in Western Essex and southeastern Morris counties. The northern boundary of the aquifer is Hook Mountain and the western boundary is defined by the Ramapo fault. The Watchung Mountains form the southeast boundary. The
aquifer is replenished by recharge zones such as precipitation, streams, swamps, and lakes draining from valley floors and upland areas.

Records for selected wells in Berkeley Heights show that the yield for the Brunswick Formation averages 171 gallons per minute with an upper yield of 270 gallons per minute and a lower of 62 gallons per minute. The average in Berkeley Heights for the Watchung Basalt is about 12 gallons per minute with an upper boundary of 30 gallons per minute and a lower of 1 gallon per minute (gpm).

The Brunswick Aquifer derives its name from its association with the Brunswick Formation, currently known as the Passaic Formation. Aquifers within the Newark Basin (part of the Brunswick Formation) exist within weathered joint and fracture systems of shale within the upper 200-300ft. It is approximately 6,000 feet thick and is composed of shale with local occurrences of sandy and pebbly consolidated beds. The sandstone ranges from a few inches to 20 feet in thickness. Ground water flow in the Brunswick Formation appears to be influenced primarily by partings along bedding and by contrast in degree of fracturing between beds. Fracture areas are smaller and water availability lessens below 500 feet within the formation. Intergranular spaces within the aquifer and coarser grained sandstones also hold water. The shale and sandstone portions of the Brunswick Aquifer tend to be the most productive and contain wells known to yield up to 1500 gpm (Carswell and Rooney, 1976). The many fractures and joints in the rock allow for the retention and transport of a fairly large volume of ground water. Wells of greatest yield are usually those which are between 200 and 500 feet deep where several source zones feed the well.

The Watchung Basalt Formation serves as an aquifer and flows off the Watchung Mountains. It serves as a small source of ground water. Basalt is one of the poorest aquifers with typically low domestic yields. Water is usually concentrated in gas-created vesicles and fractures in the rocks.

3.1.1 Aquifer Recharge

The New Jersey Department of Environmental Protection (NJDEP) defines aquifer recharge as “the process by which rain water seeps down through the soil into an underlying aquifer”. A ground water recharge area is the land area that allows precipitation to seep into a saturated zone. These areas are usually at topographically high areas with discharge areas at lower elevations.

There are many processes which determine just how much rainwater actually reaches and replenishes an aquifer. Most ground water flows through shallow layers of soil and bedrock. The porosity and permeability of the superficial material, the slope of the land, the amount and kind of natural and artificial cover along with the intensity and amount of precipitation play a role in determining how much rainwater reaches the recharge area. In addition, evaporation, and the amount of precipitation which runs off the ground surface into streams, rivers, lakes and oceans also affects the amount of ground water that reaches the aquifer. It’s a small amount of the total ground water that penetrates deeper to recharge the aquifer.
The purity and quantity of the water lying beneath the land is an important measurement of environmental quality. All vegetation depends in some way upon the aquifer as well as most surface water. Aquifer purity is a major concern in a developed area. It is sensitive to many sources of intrusion and contamination, and once defiled it is either very costly or virtually impossible to correct.

**Recommendations**

- This commission continues to support all measures to protect our aquifer quality by monitoring any source of intrusion into the aquifer. These intrusions are, but not confined to, such sources as water run off, landfill operation, improper maintenance or use of wells and septic systems, dumps and other waste sites, hazardous storage, use or disposal of a variety of chemicals, pesticides, herbicides, fertilizers, road salts, construction materials and other products or by-products of manufacture or development or commerce. The aquifer level or “water table” is very sensitive to a variety of natural and man-caused conditions. In general, the higher the aquifer level the healthier the environment. The natural conditions include seasonal and climate conditions, such as spring flooding and autumn or drought. The conditions related to human enterprise, which tend to increase the aquifer are listed below, along with preferred conditions which the commission supports.

<table>
<thead>
<tr>
<th>FACTORS TENDING TO RAISE THE WATER TABLE</th>
<th>FACTORS TENDING TO LOWER THE WATER TABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservation Measures</td>
<td>Development Projects</td>
</tr>
<tr>
<td>Public Water Supply</td>
<td>Individual Well Supply</td>
</tr>
<tr>
<td>Septic Disposal</td>
<td>Sanitary Sewer Disposal</td>
</tr>
<tr>
<td>Permeable Surface (stone)</td>
<td>Paving</td>
</tr>
<tr>
<td>Overland Runoff</td>
<td>Storm Sewer Runoff</td>
</tr>
<tr>
<td>Mulch and Leaf Cover</td>
<td>Lawns or Gardens</td>
</tr>
<tr>
<td>Swales and Berms</td>
<td>Ditches, Drains, Underground Utility Lines &amp; Pipes</td>
</tr>
<tr>
<td>Contour Development</td>
<td>Slope Development: Erodible Uses</td>
</tr>
<tr>
<td>On Site Dry Wells</td>
<td>Roof and Building Runoff Unchecked</td>
</tr>
<tr>
<td>Rural Zoning</td>
<td>High-density Zoning</td>
</tr>
<tr>
<td>Variable Lot Size Layout</td>
<td>Conventional Site Layout</td>
</tr>
<tr>
<td>Wet-bottom Retention Basins, Ponds, Wetlands, Stream Riffs</td>
<td>Dry detention Basins, Drainage “Improvements”, Stream Channeling</td>
</tr>
<tr>
<td>Vegetation Replacement</td>
<td>Vegetation Removal</td>
</tr>
<tr>
<td>Easement or Open Space Protection of Aquifer Recharge Areas</td>
<td>Draining, Filling or Development of Aquifer Recharge Areas</td>
</tr>
</tbody>
</table>
The Commission notes that the geology Warren provides is a relatively limited aquifer base. We are concerned that much of the past development activity involved factors which tend to lower the water table and recommend that all future development be cognitive of these factors when planning future improvement projects or new building projects in the Township.

Future development should seek to reduce impervious cover, expansive lawns, and artificial water drainage systems.

3.2 Ground Water

Ground water is defined as:

that part of the subsurface water that is in the saturated zone or the subsurface zone in which all voids are filled with water.

Ground water is that fraction of the precipitation on the land surface that has worked its way downward by gravity through the soil and into the underlying bedrock in areas underlain by bedrock. Ground water includes all water in the saturated zone; however, only a fraction of all ground water is in aquifers, even though all aquifers contain ground water.

In Warren Township ground water recharge varies greatly. It is due to Township topography, landscape environmental conditions and development. It ranges from 1 to 21 inches per year.

Ground water in Warren Township derives from precipitation infiltration either within the Township or in closely surrounding areas. From late fall through mid-spring the water table tends to rise when plants are dormant, evaporation rates are minimal, and precipitation increases. From late spring to mid-autumn the water table tends to lower due to draw down and increased evaporation. Thus the maximum height of the water table and therefore the most recharge tends to occur in late fall through mid spring and the minimum level in late spring to mid fall.

In Warren Township groundwater drainage is controlled by the structure of bedrock. It is a trellis pattern in which tributaries flow at essentially right angles to the major streams. This is a major consequence of the major streams following parallel to the ridges and the tributaries flowing perpendicularly off the ridges into them. The largest streams, forming the northern
boundary of the Township, are the Passaic River and Dead River, and their flood plains are topographic significant features. The east branch of the Middle Brook occupies the broad valley between the First and Second Watchung Mountains. All streams north of the second ridge of the Second Mountain are part of the Passaic River drainage basin, and include tributaries of Dead River and Cory’s Brook. Over half of Warren Township is in the Passaic River Basin Water Management Area #6. Streams south of that ridge exit the Township through either the Middle Brook or the Stony Brook and are part of the Raritan River Basin.

3.2.1 Ground Water Quality

The quality of shallow ground water is important because it is this water which recharges deeper aquifers used for potable water supplies and provides the base flow to streams and wetlands, both of which exist in Warren Township. The water table is the doorway into the ground water system and is most vulnerable to contamination. Water quality characteristics, such as temperature, dissolved oxygen (DO), pH, and total dissolved solid concentrations yield information about the general character of the shallow ground water as a function of geology and land use. The chemical quality of ground water is of primary concern where it is used for public and domestic supply. The chemical properties are determined by the chemical properties of the precipitation, mineralogy of the substrate through which the ground water moves and the length of time the water is in contact with the substrate. The chemical content can be altered by the introduction of contaminants into the environment. These pollutants may enter the environment from discrete sources where concentrations may be elevated or spread over large areas, from storm water runoff from pavement and vehicle emissions which settle on the ground and infiltrate with precipitation. A combination of factors can also affect ground water quality, such as high water table conditions, high permeability of the soil, and its low attenuation capability allow for the transport of contaminants from land surface into ground water and ultimately into an aquifer.

Natural ground water quality also reflects regional differences in geology. Comparing ground water quality in undeveloped areas with that in agricultural and urban areas gives clues as to whether the sources of various constituents are natural or the result of human activity. Dissolved-oxygen concentrations are generally lower in urban areas. It is believed to be the result of the large percentage of heat-absorbing impervious surface areas resulting in poorer exchange with atmospheric oxygen, higher temperature surface effects on the density of air, and the reaction of oxygen with organic wastewater contaminants. Urban areas are also affected by higher levels of dissolved solids due to road salts, and agricultural areas are also affected by higher levels of lawn and agrochemical applications (such as fertilizers and pesticides and PCB’s).

3.3 Private Wells and Septic Systems

In September of 2002, the New Jersey Private Well Testing Act (N.J.S.A. 58:12A-36 et seq.), became effective, which mandates private well testing upon the sale of a house. Warren Township has approximately 30% of its residents using private well water as their potable water supply.

The Ground Water Quality Standards (GWQS), N.J.A.C 7:9C, establish the designated uses of the State’s ground waters. It also classifies ground waters based on those uses, and specifies the water quality criteria and other provisions and policies necessary to attain those designated uses. Ground water is classified according to its hydro geologic characteristics and designated uses. The GWQS establish three major classes of groundwater. Class I, Ground Water of Special Ecological Significance,
Class II, Ground Water for Potable Water Supply, and Class III, Ground Water With Uses Other Than Potable Water Supply.

Contamination of groundwater is the result of septic tanks, a liquid surface spill, from streams or lakes or it can be the result of a solid which is buried and has dissolved into groundwater as a result of water percolation. As in the case of petroleum, contamination can be less dense than water and float, or it may sink within an aquifer as is the case with many solvents. Some chemicals which dissolve into the water may travel thousands of feet from the original source in the form of a “plume”. The introduction of certain biodegradable materials may result in changes in the chemical properties of groundwater, and these chemical changes may result in the freeing of previously bound naturally occurring metals into groundwater. The release of metals from chemical changes has been associated with aquifers located near or under landfills.

3.4 Recommendations

- Sewage systems should be designed, constructed, and maintained to prevent pollution of both ground and surface waters. In the past, some septic systems installed in Warren were installed in soils that were not suitable for conventional septic systems. Although State and Township regulations are stricter than in the past, special care should still be taken in planning septic installations. Now, although a large number of homes in the Township are served by the sewage system, it is still not available to all homes. It is also important that any areas of the Township that have been or is now being used for dumping is closely monitored as to the pollutants which may be entering or potentially entering the ground and surface water system. Therefore, it is the recommendation of this committee that the Township’s authorities make sure that all new construction takes into account the impact it will have on water quality and management in the Township and make sure our town is not exploited by over development.

3.5 Potable Water Supply

Water systems are classified as community and non-community systems. Community water systems include municipal systems, public water supply systems and mobile home community systems. Both the NJ American Water Company and the Elizabethtown Water Companies supply public community water to most residents in Warren Township.

Approximately 30% of the residents rely on private wells for their water supply. These wells vary in depth from 30 feet to as much as 400 feet due to the topography and obtain water from underground streams or aquifers. Private wells represent a potential source of ground water contamination as they can be injection points into an aquifer. Well water contamination has occurred in several areas (east and west) of the Township. The most common pollutants found in private wells are bacteria and volatile organics. Some private wells located in the higher points in the Township have experienced pressure issues. Township policy is to encourage public water supply where practical. Public water supplies are likely to be safer because the water system is regulated and monitored while most private well users do not often test their water to determine potability (Warren Township Master Plan, 2006).

There have been numerous complaints by residents about the high mineral content in the public water system. The Township Committee has also shared concern regarding PFOA in the water public water supply.
3.6 Wellhead Protection

The Federal Safe Drinking Water Act Amendments, (1982), (Section 1428, P.L. 93-523, 42 USC 300 et. Seq.), directed all states to develop a Well Head Protection Program Plan (WHPP) for both public community and public non-community water supply wells. The goal of the Wellhead Protection Plan is to prevent contamination of ground water resources, which provide drinking water to approximately forty-two percent of New Jersey's population.

A wellhead protection area is the area from which a well draws its water within a specified timeframe. Once delineated, the wellhead protection area is considered a priority area for efforts to prevent and clean up ground water contamination. Other integral parts of the Plan include pollution-source inventories, development and implementation of best management practices to protect ground water, land-use planning, and education to promote public awareness of each person's role in protecting ground water resources. Once WHPA's are delineated, potential pollution sources may be managed in relation to their location within the WHPA and protective land uses such as preserved open space may be established.

There are three tiers in wellhead protection areas each based on the time of travel to the well. The outer boundaries of each tier and corresponding travel time are: Tier 1, two years, Tier 2, five years, and Tier 3, 12 years (these are represented in pink, purple and blue, respectively). The time of travel equated to the amount of time it would take a ground water contaminant to reach the well from a given location. The time of travel determination aids in restricting sources that pose an imminent threat to a well water source.

See graphic above for Public Non-community Wellhead Protection areas, as of March 23, 2004, are: Watchung Hills Regional High School, Warrenbrook Park and Golf Course, and American Legion Post 2936. This list is updated periodically by NJDEP.
CHAPTER 4: SURFACE WATER

Surface water is water collecting on the ground or in a stream, river, lake, pond, wetland, canal, reservoir, swamp, marsh, or ocean. Surface water quality standards (SWQS) are the rules in chapter N.J.A.C. 7:9B, which sets 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 and other policies and provisions 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)), also known as the Clean Water Act (CWA), and the Federal Water Quality Standards Regulation at 40 CFR 131.

The highest level of protection for surface water is applied to Outstanding Natural Resource Waters (ONRW). Some surface waters in Warren Township are classified as Freshwater 1 (FW1) because of their unique ecological significance, exceptional recreational significance, or exceptional water supply significance. FW1 waters are non-degradation waters and are not to be subject to any manmade wastewater discharges or any activity that might alter the existing water quality is prohibited. Freshwater (FW2) are all other freshwaters. Freshwaters are further classified based on trout status, trout production (FW2-TP), trout maintenance (FW2-TM), and non-trout (FW2-NT).

The Dead River and its many tributaries are classified as FW2-TM and FW2-TP; Dock Watch Hollow Brook and Tributaries are classified as FW2-TM.

4.1 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. This includes surface water features and the surrounding land itself. Topographical features such as hills and slopes define the boundaries of watershed management areas. Sub-water sheds are smaller drainage areas that make up a larger watershed.

Warren Township lies within the watersheds of two rivers, the Passaic River and the Raritan River. All streams south of the second ridge of the second Watchung Mountain lead into the Middle Brook or Stony Brook are part of the Raritan River Basin. The Passaic River, all the tributaries of Dead River, the east branch of the Middle Brook, and Cory’s Brook are part of the Passaic River Basin.

Dead River is the one major tributary to the Passaic River. It flows in an easterly direction and has a drainage area of about 20.4 square miles, most of which is in Bernards and Warren Township. Unlike the Passaic Watershed, which is formed by one major stream (the Passaic River and its lesser tributaries), the Raritan Watershed within Warren Township includes three major streams: the Stony Brook, the Middle Brook and the Dock Watch Hollow Brook. More information regarding Warren's two watersheds are discussed below.

4.1.1 Passaic River Watershed

On the map “Ponds, Watersheds & Streams”, the Passaic River watershed has been broken down into nine subwatersheds, following topographical contours and the model of Report Upon the Drainage and Storm Water Runoff Within Warren Township by Elson T. Killam (hereafter referred to as the “Killam Report”). As the streams in many of these subwatersheds are small and have no names, Killam, for report purposes, assigned a number to each one. In order to provide easy reference between this inventory and the Killam Report, the same procedure was followed. P-1 through P-7 are subwatersheds of the Passaic River. Streams D-1 and D-2 are subwatersheds of the Dead River. (P-6) is Corey’s Brook subwatershed, D-1 is Pound Brook Branch subwatershed.
4.1.2 Raritan River Watershed

Whereas the Passaic Watershed is formed by one major stream (the Passaic River and its lesser tributaries), the Raritan Watershed within Warren Township includes three major streams: the Stony Brook, the Middle Brook, and the Dock Watch Hollow Brook.

Again, following topographical contours and the “Killam Report”, the Raritan Watershed was divided into six subwatersheds. On the map, areas demoted with an “R” are subwatersheds of the Raritan Watershed. R-1, R-2, and R-3 are, respectively, the Main Branch, the West Branch and the Lower Branch of the Stony Brook Watershed. R-4 is the East Branch of the Middle Brook Watershed. R-5 and R-6 are, respectively, the East and Main Branch of the Dock Watch Hollow Watershed.

The “Killam Report” is a detailed analysis of the watersheds of Warren Township. Each watershed, as broken down into subwatersheds, is described in terms of area, topography, location, zoning and present and future development. For existing culverts in each drainage basin, the report present the tabular form:

1. Capacity of culvert (estimated peak flow, cubic feet per second)
2. Determination of adequacy of culverts for storms of various recurrence intervals (25 – and 100- year storms)
3. Estimated future flow under full development with
   a) Present 1 ½ acre zoning
   b) 2 acre zoning
   c) “Open space” or ¾ acre cluster zoning (1)

The report summarizes, by subwatershed, recommendations to reduce flooding conditions, such as desnagging of channels, construction of check dams and retention basins, and planting slopes for control of erosion.

The following table describes the tributary drainage of each of the subwatersheds.

<table>
<thead>
<tr>
<th>WATERSHEDS / SUBWATERSHED</th>
<th>TRIBUTARY DRAINAGE AREAS (Acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Raritan River Watershed:</strong></td>
<td></td>
</tr>
<tr>
<td>Stony Brook</td>
<td>900</td>
</tr>
<tr>
<td>Main Branch (R-1)</td>
<td>840 (Includes 420 acres directly tributary to the West Branch)</td>
</tr>
<tr>
<td>West Branch (R-2)</td>
<td>420</td>
</tr>
<tr>
<td>Lower Stony Brook (R-3)</td>
<td>480</td>
</tr>
<tr>
<td>East Branch of Middle Brook (R-4)</td>
<td>2500 (Includes 30 acres – Watchung, 530 acres – Greenbrook, 160 acres – Bridgewater)</td>
</tr>
<tr>
<td>Dock Watch Hollow Brook</td>
<td>1980 (Includes 150 acres – Bernards Twp., 150 acres – Bridgewater)</td>
</tr>
<tr>
<td>East Branch (R-5)</td>
<td>630</td>
</tr>
<tr>
<td>Main Branch (R-6)</td>
<td>1350 (Includes 150 acres – Bernards Twp.)</td>
</tr>
</tbody>
</table>
4.2 Floodplains and Flood Hazard Areas

A floodplain is the flat or low-lying land bordering a stream which is subject to flooding. It is the area inundated by a flood of certain frequency, such as the 100-year flood. The floodplain is a valuable natural resource which serves many purposes such as flood storage, dissipation of flood water velocity, ground water recharge, wildlife propagation and feeding, and acts as a natural filter for sediments and pollutants.

Physical alteration of the floodplain can dramatically change the natural environment. For example, removal of stream vegetation may raise water temperatures, thereby reducing oxygen content, which in turn reduces the viability of many forms of aquatic life. The removal of debris from streams, realignment, or dumping of fill increases stream turbidity, erosion, and downstream sedimentation which adversely affect the streams aquatic life as well as wildlife in adjacent areas. The misuse of the floodplain can be costly both economically and environmentally.

The limits of the flood hazard area are determined by the statistical recurrence interval of a flood which is the average length of time in which a given flood will be equaled or exceeded once. A flood with a statistical recurrence interval of ten years has a ten percent chance of occurring in any year; a 50 year flood has a two percent chance of occurring in any year, and a 100-year flood has a one percent chance. Warren Township has adopted the 100-year flood as its base flood for the purpose of
delineation and protection. The determination of the flood hazard areas is required as part of a federal program to provide flood insurance to property owners in flood-prone areas.

Activities in floodplains (aka Flood Hazard Areas) are regulated by the NJDEP under the NJ Flood Hazard Area Control Act. (N.J.S.A. 58:16A-50 et seq.). This area, defined in N.J.A.C. 7:13-1.2 as the land and space above that land, which lies below the Flood Hazard Area Design Flood. The area of the Flood Hazard Area Design Flood is determined by a discharge 25% larger than the discharge resulting from a 100 year storm in order to account for the effects of future development in the water shed (NJDEP Flood Control). The Flood Hazard Area includes both the flood fringe (the portion of the floodplain contiguous with the floodway) and the channel and inner portions of the floodplain adjoining the channel, which are reasonably required to carry and discharge the regulatory flood, known as the floodway. The floodway is subject to high velocity flows during flooding occurrences. The flood fringe experiences flooding, but is inundated to a lesser degree than the floodway (NJDEP).

Certain types of development activities within the Flood Hazard Area (the floodway and flood fringe) and Riparian Zone should be authorized by a Flood Hazard Area Permit which is issued by NJDEP in accordance with the NJ Flood Hazard Area Control Act (FHACA) rules (N.J.A.C. 7:13). The Riparian Zone exists along every regulated water (as defined in the Flood Hazard Area Rules N.J.A.C. 7:13-2.2) and includes the land and vegetation in the regulated water and a portion of land extending from the centerline of a linear feature such as a stream or from the normal water surface limit for a pond or lake.
The Riparian Zone was established and falls under the revised rules (N.J.A.C. 7:13 – 4.1). Any activities involving the clearing of vegetation in the Riparian Zone are regulated and the amounts permitted to be cleared have been established within these rules.

This zone is also substantially impacted by the Floodplain of the Dead River and the Passaic River. NJDEP has conducted a special Flood Hazard Study of the Passaic River and has mapped the findings. It was found the area east of King George Road has an elevation below the calculated 100-year flood boundary. In the Master Plan, development of homes and other structures generally terminates at the floodplain of the Passaic and Dead Rivers, as separately defined from wetlands. The plan also calls for continued environmental suitability analysis for future development of land to conform to the requirement and standards set forth in the Municipal Land Use Law N.J.S.A 40:55D-28 et seq.

Through regulation and limiting the development in the Flood Hazard Area and Riparian Zone, it not only is protecting the floodplain as a resource, but it also protects against property loss. The development and filling of floodplains removes the capacity of the floodplain to provide flood storage benefits which increases the likelihood of increased upstream and downstream flooding. Floodplains with vegetation reduce the velocity of storm water and thereby reduce erosion and increase flood storage. Floodplains also serve as vital habitats and travel corridors for wildlife.

For Warren Township the three available sources of information for delineation of the floodplain are the USDA Soil Conservation Service “Soil Survey”, the Warren Township Engineering Department’s “Flood Delineation Map” and the “Flood Insurance Study for the Township of Warren”. The US Flood Emergency Management Agency (FEMA) also has prepared mapping and classifies floodplain areas in a similar manner to the State of New Jersey. More detailed flood delineation maps may be obtained from NJDEP.

4.2.1 Flood Plain Hazards

It is estimated that in the Warren Township, 200 residents live within the 1% annual chance flood area (NFIP Special Flood Hazard Area). $43,887,611 (0.8%) of the municipality’s general building stock replacement cost value (structure and contents) is located within the 1% annual chance flood area.

There are 91 NFIP policies in the community and there are 32 policies located within the 1% annual chance flood area. FEMA has identified 2 Repetitive Loss (RL) properties including 0 Severe Repetitive Loss (SRL) properties in the municipality.

HAZUS-MH estimates that for a 1% annual chance flood, $4,417,815 (0.08%) of the municipality’s general building stock replacement cost value (structure and contents) will be damaged, 630 people may be displaced, 309 people may seek short-term sheltering, and an estimated 1,427 tons of debris could be generated.

Further information regarding the summary of the community’s participation in the NFIP is provided in the table below.
4.3 Riparian Areas

Riparian areas are ecosystems immediately adjacent to rivers, streams, ponds, and lakes. It is not the same as a floodplain, which is the area inundated by a flood of certain frequencies. The riparian area is the land along each side of a water body and may or may not be in the floodplain, but is not the same as a floodplain. The riparian improves aquatic habitat by trapping sediment, contaminants, and nutrients from storm water runoff. It also provides shade to the body of water helping to protect the water from temperature extremes. Riparian areas which are vegetated provide habitat for terrestrial wildlife, serve as ground water recharge areas, and stabilize stream banks. The width of a riparian buffer can vary depending on soil permeability and slopes. Areas with flatter slopes and with soils having a greater portion of sand would not require a buffer as wide as area with steeper slopes and soils containing less sand. Effective riparian buffers should be typically 100 feet or wider. Generally, a smaller buffer is required for bank stabilization and for shade to a water body, while larger buffers are required for it to benefit fisheries habitat, nutrient removal, sediment control, and wildlife habitat.

Riparian areas have begun to become popular for open space acquisition, passive recreation facilities, and stream bank stabilization/restoration projects. Restoration can include litter cleanup, implementing natural methods of stream bank stabilization instead of constructed methods, and restoring or allowing native plants to flourish by limiting mowing and livestock grazing. Communities can adopt riparian protection ordinances to limit activities within riparian areas. NJDEP regulates development (removal of vegetation) within the vicinity of stream corridors and within floodplains. Under revised NJDEP regulation, the protection of vegetation or Riparian Zone extends for a distance of 50, 150 or 300 feet from the top of the bank along streams, depending on several factors. For example a 50 foot wide riparian may provide some limited stream corridor functions, such as shade and bank stabilization, but will provide less filtering sediment or pollutants or uptake of nutrients. In New Jersey a 300-foot wide Riparian Zone has been adopted to protect all Category 1 (C1) waters. A 300-foot wide buffer will provide significantly greater benefits to aquatic biota and other wild life than a narrower one would. Efforts should be made to preserve existing natural riparian lands. Currently riparian areas along the Dead River meet screening criteria.
4.4 Ponds

Prior to development, Warren’s only open water existed as intermittent submergence of flood plain areas. The hilly and rocky configuration of ridges, well drained by rivers and streams, did not support ponding as a natural state. Consequently, all the open water now in Warren has been impounded by humans and consists primarily of one of four types of ponds, or in some cases, combinations of these:

1. WATERCOUSE POND: a dammed stream or brook, creating an impoundment; or a stream diverted to fill a depression not actually in the watercourse.

2. SPRING-FED POND: A depression created to retain the water from an existing spring. Warren has few if any ponds exclusively fed by this source.

3. SKY POND: An engineered depression to capture surface water run-off from a naturally sloped surface. Sky Ponds were commonly created during the 1940’s and 1950’s under the impetus of an Army Corps of Engineering program offering free engineering assistance to property owners willing to assume the expense of construction. The objective of the program was to reduce and control the erosion of soil. The majority of Warren’s open water are currently in this category.

4. RETENTION BASIN: A similar depression to capture the surface water run-off created by the development of property. Engineering regulates the rate at which excess water flows from the basin while retaining a controlled maximum amount of water all the time. By contrast a detention basin is engineer to catch excess storm water and control its rate of flow from the developed property. It does not create a permanent impoundment and is not considered to be a ponding feature. This has been a popular way to manage water run off and should be discouraged in the future in favor of natural systems that use appropriate vegetation and manage water run off within the developed property.
4.5 Recommendations

- Ponds are an endangered resource in Warren, vulnerable to natural eutrophication and particularly to the pressures of development. Draining or filling of ponds should be discouraged as it reduces aquifer recharge, depletes populations of fish, amphibians, and aquatic plant life, removes sources of water for non-aquatic animals, eliminates an important scenic amenity, and removes opportunities for a variety of summer and winter outdoor recreational activities. Developers, homeowners, and township officials should share responsibility for preserving this resource.

- One avenue for increasing the number of ponds within the township is in the provision during development for retention, or “wet-bottom” basin in the place of dry bottom basins. Such features even if only a few feet in depth, would do much to restore this important natural resource to Warren.

- Future development should include ways to naturally manage storm water run off on the property by planting appropriate native vegetation. Detention basins should be discouraged.
4.6 Wetlands

Wetlands can be defined as:

An area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and under normal circumstances does support a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation (New Jersey Freshwater Wetlands Protection Act [NJSA 13:9A-1 et seq]).

Also known as “swamp,” “bog,” “fen,” and “marsh,” wetlands are home to vegetation suited for saturated soil conditions.

4.6.1 Natural Functions of Wetlands

Wetlands are an important natural resource. They provide natural flood control by absorbing water during storm events, recharge areas for ground water, natural purification of water by filtering sediments and absorbing nutrients and pollutants, and provide habitat for fish and wildlife.

Wetland delineation is determined by the dominance of hydrophytic vegetation, the presence of hydric soils, and the evidence of long-term wetland hydrology.

4.6.2 Wetland Communities

Wetlands can be separated into the following ecological systems: Marine, Estuarine, Riverine, Palustrine, and Lacustrine. Warren Township’s wetlands can be considered both Riverine and Palustrine. The wetland areas in the Township can be found along the rivers and floodplains of the Middle Brook and Passaic.
Riverine System

The riverine system includes all wetlands and deep-water habitats contained within a channel, with two exceptions: (1) wetlands dominated by trees, shrubs, persistent emergent's, emergent mosses, or lichens and (2) habitats with water containing ocean derived salts in excess of 0.5%. A channel is defined as an open conduit which periodically or continuously contains moving water, or which forms a connecting link between two bodies of standing water.

Water is usually, but not always flowing in this system. Upland islands, or palustrine wetlands, may occur in the channel, but they are not included in the riverine system.

The riverine system is divided into four subsystems: (1) tidal (not found in Warren), (2) lower perennial, (3) upper perennial, and (4) intermittent.

Lower Perennial: The gradient is low and water velocity is slow. There is non-tidal influence, and some water flows throughout the year. The substrate consists mainly of sand and mud. Oxygen deficits may sometimes reach their maximum abundance in still water, and true planktonic organisms are common. The gradient is lower than that of the upper perennial subsystem and the flood plain is well developed.

Examples of this part of the system in Warren are the East Branch of the Middle Brook in the vicinity of King George and Brookside Roads and the Dead River.
Upper Perennial: The gradient is high and velocity of the water is fast. There is no tidal influence and some water flows throughout the year. The substrate consists of rock, cobbles, or gravel with occasional patches of sand. The natural dissolved oxygen concentration is normally near saturation. The fauna is characteristic of running water, and there are few or no planktonic forms. The gradient is high compared with that of the lower perennial subsystem, and there is very little floodplain development.

Examples are Dock Watch Hollow Brook and the East Branch of the Middle Brook in the vicinity of Washington Valley and Morning Glory Roads.

Intermittent: The channel contains non-tidal flowing water for only part of the year. When the water is not flowing, it may remain in isolated pools or surface water may be absent.

Intermittent streams are scattered throughout Warren.

**Palustrine System**

The palustrine system includes all non-tidal wetlands dominated by trees, shrubs, persistent emergents, emergent mosses or lichens. It also includes wetlands lacking such vegetation but must have the following characteristics: area less than 20 acres, active wave-formed or bedrock shoreline features lacking, water depth in the deepest part of basin less than 2 meters at low water, and salinity due to ocean-derived salts less than 0.5%.

The palustrine system was developed to group the vegetated wetlands traditionally called as: marsh, swamp, bog and fen. It also includes the small, shallow permanent or intermittent water bodies often called ponds. Palustrine wetlands may be situated shoreward of lakes, river channels, or on floodplains.

Many of the environmentally sensitive features of the Township are presently being regulated by Federal, State, and local ordinances and the wetlands are protected from development by Federal and State legislation. The Warren Township Master plan describes the EP-250 Land Use District as “The environmentally sensitive planning area which has large contiguous land area with valuable ecosystems and wild life habitats. These lands have remained somewhat underdeveloped or rural in character.” The wetlands in this area are substantial.

Human threats include discharges of materials, filling wetlands for development, dredging and stream channelization for navigation of channels, and flooding wetlands for creating reservoirs.

**4.7 Recommendations**

- In Warren Township the quality of the ground and surface water systems are affected by the geology of the area. A prime factor affecting the quality of the water in the soil in this area is the slope of the land; it impacts storm water management, determines how well and septic systems will function, where new construction will interfere with ground and surface water quality, as well as, effects on the flood plains. For example, on a steep slope where there is dense clay, rock or other impervious materials near the surface, the septic effluent may flow above the impervious layer to the surface and run unfiltered down the slope and eventually enter water recharge areas. Storm water runoff is increased by the construction of impermeable surfaces such as roofs, driveways, and roads, which in turn affects the quality of surface water entering the water system.

- Rather than drain or fill wetlands, seek compatible uses of those areas.
- Donate wetlands or funds to purchase wetlands to private or public conservation agencies
- Maintain wetlands as open space
- Work with other agencies and groups to inform public about wetland values
CHAPTER 5: WILDLIFE

Warren Township supports a healthy number of a wide variety of wildlife species. While regulatory issues regarding wildlife typically focus on threatened and endangered species, it is important to consider the diversity of non-listed wildlife to depict Warren’s biodiversity.

5.1 Species Inventory

The following subsections are species that have been identified to date in Warren Township by residents. This list is not indicative of all species that may or may not be present in the community.

5.1.1 Invertebrates

Many species of mites, bugs, snails, worms, insects, spiders, beetles, dragonflies, crickets, grasshoppers, flies, ants, bees, wasps, and butterflies

5.1.2 Fishes

Carp, eel, minnow, sucker, catfish, trout, sunfish, bluegill, bass, perch

5.1.3 Reptiles

Snakes: green, brown, ribbon, garter, milk, ring-necked, water

5.1.4 Mammals

Possum, shrew, bat, raccoon, skunk, coyote, red fox, woodchuck, chipmunk, vole, mole, red squirrel, gray squirrel, flying squirrel, mouse, rabbit, deer

5.1.5 Birds

Canada Geese, Snow Geese, Blue Heron, Green Heron, Great Egret, Mallard Duck, Wood Duck, Black Duck, Teal Duck, Pintail Duck, Merganser Duck, Woodcock, Turkey, Pheasant, Sharp-shinned Hawk, Broad-winged Hawk, Cooper’s Hawk, Red-tailed Hawk, Re-Shouldered Hawk, Kestrel Hawk, Eagle, Osprey, Culture, Screech Owl, Horned Owl, Snowy Owl, Barn Owl, Sandpiper, Yellow-legs, Mourning Dove, Cuckoo, Black and yellow billed hummingbird, Red-bellied Hairy Woodpecker, Downyh Woodpecker, Pileated Woodpecker, Flicker, Flycatcher, Sapsucker, Phoebe, Pewee, Barn Swallow, Tree Swallow, Crow, Blue Jay, Chickadee, Titmouse, Nuthatch, Catbird, Mockingbird, Robin, Hermit Thrush, Wood Thrush, Swainsons, Veery, Vireo, Ovenbird, Black bird, cowbird, Grackle, Starling, Warblers: parula, black-throated green and blue, black and white, yellow-rumped, redstart, blue-winged, yellow, yellowthroat, Connecticut, bay-breasted, Tennessee, Nashville, palm; Summer and Northern Orioles, Junco, Cardinal, House Finch, Purple Finch, Gold Finch, Indigo Bunting, Grosbeaks, Rose Breasted, Evening; Towhee, Tanagers, Summer and Scarlet; Blackpoll, White-throated Sparrow, White-Crowned Sparrow, Chipping Sparrow, Tree Sparrow, Fox Sparrow, Song Sparrow, Clay-Colored Sparrow, Clay-colored Sparrow, Field Sparrow, Savannah Sparrow, Lincoln's Sparrow, Swamp Sparrow, House Sparrow, English Sparrow
5.2 Habitat

Development has favored certain species and threatened others. Like other parts of suburban New Jersey, deer and Canadian Geese have thrived with human development. As in other areas, native bees, butterflies, bats, and wild turkey are no longer as abundant as they used to be.

5.3 Endangered and Threatened Wildlife Species

Endangered species are those whose survival is in immediate danger because of a loss or change in habitat, over-exploitation, predation, competition, disease, disturbance, or contamination. Threatened species are those that may become endangered if conditions surrounding them begin or continue to deteriorate.

Warren Township does not have any specific studies that document threatened or endangered species.

5.4 Recommendations

- Maintain vegetative land cover to provide food, shelter, and protection for wildlife.
- Undeveloped and natural areas should be continuous not isolated, with hedgerows, stream corridors, natural trail protections, sloped ridges, and other linear sheltered features maintained as developments encroach.
- Landowners should be educated to understand practical best wildlife terrains.
- When improved land is planted, species of grasses and shrubs and trees that provide special forage and cover for wildlife should be given priority. Shelters for those animals and birds that thrive in them should also be provided. Seasonal feedings, if it is consistent and dependable, is also encouraged for bird species.
- Vehicles and household pets are constant threats to wildlife safety. Road crossings should be marked and observed and pets confined, to lessen this damage.
CHAPTER 6: VEGETATION

Prior to the suburban development in the 1970’s through the 1990’s most of Warren was either woodlands or farmland areas.

Trees, shrubs, and grasses that surface the land provide not only aesthetic value to our community but also

- Absorb the carbon dioxide of development and produces oxygen
- Stabilize the moisture content of our air
- Filter our groundwater and controls its runoff and percolation
- Provide food and shelter for human and animal life
- Cool the summer air and slows winter winds
- Abate noise pollution
- Provide screening from visual pollution

6.1 Native Plants

Native plants have many beneficial properties and have evolved themselves to live with the local climate, soil types, and animals.

Many of the varieties, being native, can be insect and disease resistant. Over time, they have evolved themselves to become resistant to these things which means lower use of pesticides and ultimately, a cleaner water supply and less toxins into the soil and surrounding areas.

Native plants offer a good source for pollinators. Native species prefer native plants.

Native plants are also low maintenance being that they have adapted so well to the area that they often require no more than rainfall, also allowing us to save water in the community.

It is important we keep the native species in our community in abundance, both for their aesthetic properties, ease of maintenance, and value to the environment. Listings of native plantings that the Environmental Commission recommends can be found in Appendix II.

6.2 Invasive and Nuisance Species

Invasive species (also known as alien or introduced species) are a threat to Warren’s natural areas. These species have been introduced by people to an area for either landscaping purposes or to manage unwanted pests. These species can adapt well to their new environment and can compete with native species, thus becoming invasive.

6.3 Tree Removal

Numerous complaints have been recorded over the number of trees being removed by developers. This is addressed by the revision of Warren’s tree removal ordinance. Very specific guidelines are set regarding the purpose for removal and the number of trees that could be removed. Fines are established and our tree replacement program was enhanced.
6.4 Plant Inventory

An inventory of wildflower species observed on Warren trails can be found in Appendix III.

6.5 Recommendations

- Selective cutting
- Minimize paving
- Promote succession planting
- Systematic tree replacement requirements
CHAPTER 7: LAND USE

Warren Township has a total land area of 12,355 acres (approx. 19.3 sq. miles). Warren was historically an agricultural community. However, today Warren has developed into a rural/suburban community area.

Warren, like most large Somerset County communities, over the last two decades, was faced with increasing development pressures. Throughout this dynamic growth period the township worked exceeding hard to maintain the rural character of the community, with great success. Today, approximately 85% of all privately owned and suitable for development, is developed.

The rapid land development of the last twenty years has somewhat declined for two factors. First, because the economic recession of 2008. Second, there is a lack of large and medium tracts of land available that are suitable for any type of development. Most of the new development applications are for minor subdivisions of one to three residential building lots. Many of these applications are by homeowners looking to subdividing older home lots which are on 3 to 4 plus acres.

Good land use planning through the implantation of strict zoning districts by ordinance, undertaken by the Warren Municipal Government, has resulted in a community that appeals to discerning potential residents and both large and small businesses.

Presently Warren has 23 Zoning Districts which encompass 10 zoning districts dealing with residential housing, five of these deal with affordable housing. Seven Zoning Districts are necessary to handle Office- Research, business, Commercial and Retail. One district is specified for Environmentally Critical Land.

Residential:

The largest single land use in the Warren Township is residential. The majority of Warren's residential development are single family homes on one to one and one half acres. These lots sizes fall into R-65 Zoning Districts and are predominantly located in the western section the Township. A few neighborhoods in the far eastern section are also R-65. Clusters of R-20, half-acre lots, are spread throughout the Township. Most of the homes on half-acre lots are 50 plus years old.

Office-Research:

Office use is the largest non-residential land use in Warren. The Zoning District is "OR" and this entire district is concentrated at the two I-78 exits into Warren. Three large-scale Office Building developments are located in this area adjacent to I-78. The three major projects are the Somerset Hills Corporate Center, Chubb Headquarters, and Citi. The remaining office development is along King George Road – Mount Bethel Road and along Mountain Boulevard.

With few exceptions all commercial development has been limit to existing commercial zones, (Mountain Boulevard, Mountain Boulevard Extent ion, Old Washington Valley Road, Stirling Road and the Mount Bethel Area). The Town Center, intersection of Warreenville and Mountain Boulevard, is zoned CB – Community Business. Three retail shopping centers, Bardy Farms, Pheasant Run and Flag Plaza contain the bulk of the retail business in Warren.

Vacant Land:

The majority of the remaining private vacant land in Warren is bounded by the north side of I-78 and both the Dead River and Passaic River. This area is Zoned EP-250 – Six 6 acre Environmentally Critical Lands. Most of this area is wetlands and not suitable for development.
The plan entitled Open Space/Conservation Areas/Agricultural Lands depicts various land-use categories by ownership and jurisdiction located throughout the Township. The plan has been prepared utilizing municipal tax records, aerial photography and field inspection. The zoning plan overlay identifies the use districts in which open space, agricultural and conservation lands exist. The plan also differentiates Township owned property included within the Recreation Open Space Inventory (ROSI) and property owned by the Township and Somerset County.

7.1 Open Space

The Warren Township Planning Board with input from other relevant committees such as the Open Space Site Acquisition Advisory Committee, Recreation Committee, Environmental Commission, and Historic Sites Committee analyzes potential development and recommends the purchasing of land to preserve it for public use. In recent years, the Town and/or Somerset County purchased over 400 acres. Most of this space would have been available for residential development. Purchases include Wagner Farm, 90 acres; Meyers Farm; Coddington Farms, 45 acres, Coddington and Linder property in 2008; Michellar property 60 acres; Williams property in 2008, 95 acres; D’Angelo property in 2008, 90 acres. Not all of the open space was at cost to Warren Township or the County. A very large parcel, included a pond, was donated to Warren Township by Atlantic Development and is used as a nature trail and home of our fishing derby.

Possibly the most important development regarding Open Space in Warren Township was the adoption of Ordinance 2-35 on 9/12/02. This ordinance titled “Open Space, Recreation, and Farmland and Historic Preservation Trust Fund / Open Site Acquisition Advisory Committee” created a funding method for the purchase of Open Space. In 1997 voters approved special tax rate of one ($.01) cent per hundred ($100.00) dollars of the annual assessed valuation of each property was added to the total township tax rate. In 2001 the voters approved an increase to two ($.02) cents per hundred. Funds collected are deposited
into a Trust Fund and must be used only for acquisition of open space, following the guidelines set forth in the ordinance. The Township may use a Green Acres Planning Incentive Grant or a Somerset County Open Space Grant to assist with purchases.

The Township Committee reviews the Planning Board’s recommendations and makes the final decision to purchase, or not to purchase.

7.2 Community and Recreational Resources

Trails in Warren Township allow users to experience about 660 acres of open space which equates to 23 active and non-active trails. The Warren Township trail systems began in 2004 with 150 acres of land at Glenhurst Trails off of Mountain Avenue. Township trails are managed by an advisory board which assists the Recreation Commission. The board members volunteer by clearing trails, picking up trash, installing signs, applying for grants, and organizing trail walks. Other groups who help the trails advisory board have been the Blue Ridge Sportsmen Club, Boy Scouts, Citi Group, and resident volunteers. The Township Public Works Department assists the trails advisory board as needed by clearing brush, adding mulch, etc. Every spring there is a cleanup day on a trail.

7.2.1 Codington Woods

Located on 15 & 23 Mt. Horeb Road and 19 & 29 Casale Drive, Codington Woods has forty five hilltop wooded acres; a working farm and woodlot from before 1742 (when the adjoining historic farmstead was begun) until the 1960’s when cultivation yielded to re-vegetation, in 2003 still occupied by descendants of the original Codington family. In 1998 Lora Codington (b.1910), avoided development pressures by selling the house, farmland, furnishings and equipment to Warren, to assure historic and natural preservation.

Rough and rocky blazed trails form two loops, together exploring the entire tract. The southern loop includes a fruit orchard of old but productive apple, pear, and cherry trees, two farm fields now overgrown with bushes and young trees, a large open grove of mature maples and oaks, and a former sheep pasture now colorful with dogwood, cedar and birch trees and flowering shrubs. The northern loop is dense with very large old hardwood groves and vines typical of a virgin piedmont forest. Throughout are rows of basalt rocks cleared from tillable farmlands, and occasional old iron farm machinery.

Trail Access points: Behind the homestead, at the hydrant by 23 Mt. Horeb Rd. Terrain is dry and shady. This tract provides the only tree cover for wildlife movement between second & third mountain ridges when combined with Mt. Horeb Springs tract.

7.2.2 Dealaman Nature Trail and Pond

Dealaman Nature Trail and pond is located on Mt. Horeb Road about a 1/2 mile from the intersection of Mt. Horeb Rd. and Mt. Bethel Rd. past the Central School on the right. Parking for the Dealaman Nature Trail and Pond is available at 182 Mount Horeb Road. From the parking lot you can walk to the pond 100 yards through the woods. Parking off of Powderhorn Drive and Technology Drive to access this recreation areas prohibited. The following rules apply:
Fish must be returned to the pond
No barbed hooks
No cooking/barbecues at the pond
Please help pick up litter around the pond, use garbage cans supplied
No parking on the lawn

7.2.3 Ehlems Brook
Ehlems Brook can be accessed by 70 Mountainview, 12 Timber Ridge, the end Nottingham, 11 Fox Hill West, 11 Hazelwood. A triangular 46 acres of old hardwood forest valley containing 5 brooks, steep hillsides abutting large wooded home sites built in 70s & 80s, and 2 large detention basins, which add 30 more acres of public land to south. Conservation easements abutting, add more wild space. Terrain is shady, open under story, wet near brooks, scenic rock outcrops. Lofty hardwood forests are located throughout this site. Deer have eliminated brush and plants. Features include natural beauty throughout and water amenities along all trails. Trail status in 2005 – existing streamside pathways, not planned, marked or cleared. Surface is rocky, rooted, many stopovers. Following streams is the easiest traverse.

7.2.4 Glenhurst Meadows
Glenhurst Meadows can be accessed by Mountain Avenue at Cory’s Brook. There are also trails from Wagner’s Farm. This area contains over 100 acres of Passaic River floodplain and uplands, formerly farmland, pasture, golf course and riverside wetlands compensation (ponds) area.

Extensive wildflower meadows among old oak groves and other hardwood stands along the Passaic River. In 2004, about 50 acres were added to the east, mostly woodlands along former Old Stirling Road extension with informal trail access. Parking on the cul de sac off of Mountain Avenue. Also by Wagner Farms trails and Old Stirling Road extension paths.

This trail is over two miles of mostly level, moved trails loop along all edges, across central meadow sections, around two large open ponds, and along the berms at the river edges. Short blazed side trails access three small woodland ponds and three steel bridges over Cory’s Brook. Some trails cross small wetland areas and are subject to river flooding and rain-ponding at times.

This is the largest complex of open space areas owned solely by Warren and is popular for bird-watching, nature study, photography and extensive hiking activities.
7.2.5 Stransky Farm
This site is a 21-acre farm and woodlot purchased in 1998 from the Stransky family. The driveway leads to an informal parking area and small vacant dwelling. Behind this, the mowed trails loop around the large meadow in both open and shaded areas, connecting with blazed wooded trails along Cory’s Brook, also around rear blackberry meadows and along a young maple woodlot connecting to Dealaman Pond Trails. A wide variety of wildflowers, shrub and trees, aged and young line the level, generally smooth trails. A few large old farm equipment items add historical interest. A variety of species and settings, plus convenience and ease of walking, combine to make a popular outdoor retreat. Brookside or wooded trails are blazed, open land paths are mowed.

7.2.6 Town Hall Circles – Holfheimer Woods
The Town Hall Circles (Open space site 13C) encloses the building complex on this site, and is mostly paved. From the library parking area the walk follow the edge of the play area and along the brook, around the rescue squad building and across Bardy road up to the traffic light, then crosses the front lawn, on grass, back to the start. Wheelchairs may use the front parking area to complete the circle on pavement.

The Ballfield Circle (Open space site 13C) is a similar loop, connected by either of two bridges over the brook, to the Town Hall Circle. The path surrounds the five southerly baseball fields along the wooded edges of this tract, crossing 3 driveways, passing the Hofheimer Woods Trailhead and the public works complex, keeping in or next to wooded areas throughout. Most of this trail may not be paved, but cleared & smoothed for easy access.

The Hofheimer Woods (Open space site 13D) is a 15-acre rectangle sloping up into Greenbrook and toward the golf course is totally wooded. The mostly smooth trail winds around the Hofheimer Mausoleum tract in its center and is part of the 1956 town purchase of the estate as the government center for Warren; in 1957 our new high school improved it for a cross country running course, still one of its uses.

7.2.7 Wagner Farm Arboretum
Wagner Farm trails can be accessed at 197 Mountain Avenue or Glenhurst trails from the West. 50 acres are dedicated to trails. 20% of trails are shaded and the terrain is mostly grassy, level, at times muddy in the old hardwood groves along the river. Trails enter flood plain or wetland areas along the Passaic River and connect to Glenhurst trails at 3 locations. Enter trails between barns and gardens, or from Glenhurst trails.

There are 92.6 acres remaining of the former Wagner Dairy Farm, which was owned and operated by the Wagner family since 1917. When active, it was a complete operation. There was a herd of Holsteins that was nourished by feed raised on the farm, grazed on its pastures, and milked in the milking parlor. The milk was pasteurized and bottled in the creamery adjacent to the barn. Milk and milk products, including the best chocolate milk and eggnog available by some people's standards, were delivered to local homes and later sold at the farm’s store. The farm operated in this manner until around 1987.
On May 31, 2001, Warren Township purchased the Wagner Farm property for the purpose of preserving it as open space. In June of that year, the Warren Township Committee created an ad hoc committee, commonly known as the Wagner Farm Advisory Committee to identify and recommend possible uses of the Wagner Farm property for the residents of Warren.

On March 14, 2002 the Wagner Farm Advisory Committee submitted its final report, which identified several potential uses including the design, construction, and operation of an arboretum. The Warren Township Committee then directed the Wagner Farm Advisory Committee to further develop the arboretum proposal and authorized funds for the employment of a professional to provide a conceptual sketch of how the arboretum would fit into the total Wagner Farm property.

In March 2004, the Wagner Farm Advisory Committee presented the more detailed conceptual plan of an arboretum design and a recommendation that a non-profit corporation be established to raise funds to design, construct and operate an arboretum, both of which the Warren Township Committee unanimously found acceptable. In May 2004 the Warren Township Committee formally declared support for the formation of a non-profit corporation for the aforementioned purposes.

The Wagner Farm Arboretum Foundation, Inc. (WFAF) was organized and incorporated on June 11, 2004.

7.2.8 Dubois Road Fields / Duderstadt Turf Field Site
The Dubois Road site offers two multi-purpose fields for use by various community sports groups. The lower field is a synthetic field.

7.2.9 East County Reserve Athletic Complex
The East County Reserve Complex is located on Old Stirling Road, across from the Warren Middle School, and includes a synthetic turf multipurpose field and a grass practice field.

7.2.10 Municipal Grounds Athletic Complex
The Municipal Grounds include a multi-purpose field and one ball field behind the Warren Public Library. In addition, behind the municipal complex there are five lighted ball fields for organized play and public use. Three lighted tennis courts are also available to the public.

7.2.11 Greenwood Meadows Park Ball Field and Courts
Green Meadows houses one softball field and two tennis courts that are open to the public.

7.2.12 Warrenbrook Park (Somerset County)
Located on Warrenville Road, Warrenbrook Park is a facility operated by the Somerset County Park Commission. The public facility includes an 18-hole golf course, pro shop and clubhouse, swimming pools for adults and children, cross-country skiing, and is the location for the Somerset County Multipurpose Senior Center. This center is run by member contributions and voluntary direction through the Somerset County Office on Aging and offers programs and hot lunches all week. Programs include trips, theatrical groups, dancercise, arts and crafts, shopping trips, yoga, bingo, oil painting and holiday parties.

7.3 Recommendations
- Heed trail rules.
- Be quiet and respectful of nearby private dwellings when on public trails.
- Pick up after yourself.
8.1 State Development and Redevelopment Plan

Warren Township has participated in the State Cross Acceptance process from the inception to present. The Township reviewed and falsely commented on preliminary plans and presented its findings to the Somerset County Planning Board acting as the agents of the State.

The goals and objectives of the Township long-range plan are consistent with those expressed in the preliminary/draft State Development and Redevelopment Plan. The Township continues to participate in the cross acceptance process as the community continues to update its long-range plan.

8.2 County Master Plan and Open Space Plan

The Township's Open Space Plan accepts and reinforces the Somerset County Master Plan and in particular the Open Space Plan Element. The Township and County have formed a partnership to acquire and develop open space and recreation facilities to serve the residents of the Township as well as the County at large.

The Township and County have a long working relationship focused on the development and improvement of the community. The Township's long-range plan is consistent with the long-range plan of Somerset County.

8.3 Regional Plans

The Township is not located within any of the State Regional Planning Districts i.e. Highlands, Meadowlands, Delaware Valley Regional Planning Commission (DVRPC), etc. The Township does recognize the goals and objectives of each of these plans and how these may potentially impact the Township.
CHAPTER 9: CLIMATE

New Jersey’s Climate map is divided into five zones: North, Central, Southwest, Pine Barrens and Coastal Regions by the Office of the New Jersey State Climatologist. Warren is located in the central zone, with some characteristics of north and central zones. Given Warren's elevation of 300 feet above sea level, the temperature is apt to be cooler than low-lying areas. The Office of the New Jersey State Climatologist states that “the dominant feature of the atmospheric circulation over North America, including, New Jersey, is the broad, undulating flow from west to east across the middle latitudes of the continent. These “prevailing westerly’s” shift north and south during the course of the year, exerting a major influence on the weather throughout the state.” The prevailing winds in the northern climate zone come from the southwest in the summer and from the northwest in the winter. In the warm months the majority of the rainfall occurs during thunderstorms. These thunderstorms typically generate from Pennsylvania and New York State. Average annual snowfall is 40 to 50 inches in the northern zone.

In the Northern Climate Zone, the growing season is approximate 155 days with the average last killing spring frost date occurring May 4 and the first Fall frost is around October 7. FEMA classifies New Jersey in Zone II (with winds up to 160 miles per hour) and as a Hurricane-Susceptible Region. Data from the New Jersey Office of Emergency Management shows that Somerset County experiences between 20 – 30 thunderstorms per year, while the northwestern portion of the county experiences 32 – 44 thunderstorms per year (NJOEM, 2011). According to the Somerset County Hazard Mitigation Plan Update published in 2013, Somerset County has been declared a disaster area 11 times due to severe storm related disasters between 1955 and 2012.

9.1 Precipitation

For Warren Township, on average July is both the warmest month as well as the month with the most precipitation. January is the coldest month on average.

Average precipitation is approximately 50 inches. Based on New Jersey’s Climate data from 1981 – 2010 the closest data collection station to Warren with the most complete data is Plainfield. The monthly records show July as the month is the highest average participation of 5.50 inches and with February showing the least average precipitation of 2.95 inches. The maximum temperatures occur in July with the highest average temperatures of 86.9 degrees and January has the lowest average monthly temperature of 39.3 degrees. The minimum monthly temperatures are 23 degrees for January and 64.3 for July. The mean temperatures have a high of 76.1 in July and a low of 31.1 in January. Days where the temperature is above 65 degrees is 345 days in July and 0 days in January, February, November, and December. The highest temperature recorded is 106 degrees (July 10, 1936) and the lowest recorded temperature is -17 degrees (February 9, 1934) Tracked from 1893 – 2011, the median minimum daily temperature is 42 degrees and the median maximum daily temperature is 62 degrees. The maximum annual snowfall recorded is from the winter of 1994 – 1995 with 71 inches and the winter of 1972 – 1973 which showed the lowest minimum is 4 inches. The median annual snowfall is 26.9 inches.

Warren is located between two ridges of the Watchung Mountains and tends to have fog-bound areas. The mountain ridges also can separate precipitation patterns.
This graph shows the record high, low, and average temperatures reported in Warren.

This graph shows average precipitation.
9.2 Storms

Recent years have brought some severe storm conditions. Hurricane Floyd in 1999 brought heavy flooding to area, particularly to the South of Warren where the Raritan River flooded. On October 29, 2011 a powerful nor’easter snowstorm shut down the region for several days. Numerous trees were uprooted and downed power lines. The winds from Hurricane Sandy hit the area on October 29, 2012. There was significant damage to local homes and the roof to Gym 7/8 in the older building of Watchung Hills Regional High School was destroyed. Power outages lasted for up to three weeks for some residents of the township. Due to downed trees, many roads in Warren were impassable during the days and weeks after Hurricane Sandy. To address the need to maintain better control of the power supply, the Warren Utility Committee was formed. In addition road closures, school schedules and business hours were disrupted with these storms.

The winter of 2013/2014 has extensive snowstorms leading to three days when the Governor declared New Jersey a state of emergency on January 21, February 5, and February 12, 2014.

The table below summarizes the vulnerability risk rankings of potential hazards of the Township of Warren, as provided by Somerset County resources.

<table>
<thead>
<tr>
<th>Hazard type</th>
<th>Estimate of Potential Dollar Losses to Structures Vulnerable to the Hazard</th>
<th>Probability of Occurrence</th>
<th>Risk Ranking Score (Probability x Impact)</th>
<th>Hazard Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood</td>
<td>1% Annual Chance: $4,417,815 0.2% Annual Chance: $12,643,177</td>
<td>Frequent</td>
<td>18</td>
<td>Medium</td>
</tr>
<tr>
<td>Severe Storm</td>
<td>100-Year MRP: $3,323,033 500-Year MRP: $20,576,112 Annualized Loss: $248,149</td>
<td>Frequent</td>
<td>30</td>
<td>High</td>
</tr>
<tr>
<td>Severe Winter Storm</td>
<td>1% of GBS: $32,950,241 5% of GBS: $164,751,207</td>
<td>Frequent</td>
<td>27</td>
<td>High</td>
</tr>
<tr>
<td>Earthquake</td>
<td>500-Year MRP: $2,782,554 2,500-Year MRP: $60,656,611 Annualized Loss: $54,257</td>
<td>Occasional</td>
<td>12</td>
<td>Low</td>
</tr>
<tr>
<td>Drought</td>
<td>Not available</td>
<td>Occasional</td>
<td>20</td>
<td>Medium</td>
</tr>
<tr>
<td>Extreme Temperature</td>
<td>Not available</td>
<td>Frequent</td>
<td>18</td>
<td>Medium</td>
</tr>
<tr>
<td>Wildfire</td>
<td>Not available</td>
<td>Occasional</td>
<td>32</td>
<td>Medium</td>
</tr>
</tbody>
</table>

9.3 Climate Change

The NJ Department of Environmental Protection released the report, “Climate Change in New Jersey: Temperature, Precipitation, Extreme Events, and Sea Level.” This report based on research by the State Climatologist at Rutgers predicts more and increasingly frequent extreme weather patterns. Winter and spring are expected to have increased precipitation, while the summer season is expected to become longer and dryer. Winter precipitation is projected to increase by 20 to 30 percent. New Jersey’s average temperatures rose more than 1.5 degrees between 1970 – 2000 with winter temperatures 4 degrees warmer between 1970 – 2000. Both temperature and precipitation rates have increased in New Jersey since reliable measurements have been recorded since 1895. In addition, the rise in ocean temperatures contributes to storm intensity as exemplified with Hurricane Sandy. See the charts for the Northern NJ Mean Annual Temperature and Northern NJ Annual Precipitation. Changing conditions
increases the risk of flash flooding, storm bank and soil erosion, and storm damage to local property and vegetation. In this scenario, the reduction of greenhouse gas emissions and the preservation of wetlands and use of natural buffer plantings take on a heightened importance. Higher temperatures are also projected to bring an increase in vector-borne diseases, such as diseases spread by mosquitoes and ticks.

9.4 Recommendations

- All new development should carefully weigh the environmental impact. Clear cutting of vegetation should be avoided. Measures should be taken to reduce car idling and increase car-pooling. Solar installations should be incentivized for public and residential projects. Energy conservation should be encouraged. Efficient methods of transportation should be encouraged through ride sharing, use of low polluting vehicles, and a park and ride station for commuters.
CHAPTER 10: AIR QUALITY

In general, the air quality in New Jersey has improved significantly since the passage of the Clean Air Act in 1970. New Jersey is now in compliance with all National Ambient Air Quality (NAAQS) Standards for criteria pollutants, except for ozone.

Air quality standards in Warren follow the New Jersey Administrative code as per Warren’s General Ordinance: 16-23.3:

Air Pollution. Users shall be bound by standards contained and enumerated in the Air Pollution Control Code of the Township and by the New Jersey Administrative Code, Title 7, Chapter 27, as it may be amended from time to time or as it may be succeeded. (Ord No. 93-24)

The Federal Standard for Air Quality Index (AQI) follows a numerical ranking system of Good (0 – 50), Moderate (51 – 100), Unhealthy for Sensitive Groups (101 - 150), Unhealthy (151 – 200), and Very Unhealthy (201 – 300). New Jersey’s Air Quality Index is observed according to nine regions. Warren is located in New Jersey’s Region 3, called the Suburban Region, which includes air-monitoring stations in Chester, New Brunswick, and Rutgers University.

The last New Jersey Air Quality Report available is dated from 2010. In 2010, the Suburban Region had 286 days of Good Air Quality, 136 days of Moderate Air Quality, 14 days of Unhealthy Air Quality for Sensitive Groups, and 2 days of Unhealthy Air Quality. The AQI is based on the National Air Quality Standards (NAAQS) as established with the Clean Air Act.

Pollutants that are monitored by station in the Suburban Region for the Air Quality Index:

<table>
<thead>
<tr>
<th>Station</th>
<th>Carbon Monoxide</th>
<th>Sulfur Dioxide</th>
<th>Particulate Matter</th>
<th>Ozone</th>
<th>Nitrogen Dioxide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chester</td>
<td>---</td>
<td>X</td>
<td>---</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Morristown</td>
<td></td>
<td>---</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Brunswick</td>
<td></td>
<td>---</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perth Amboy</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rutgers University</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

NJ DEP 2010 Air Quality Index Summary 1

While Warren does not have commercial facilities that are significant sources of stationary emission, particles can travel hundreds of miles. Somerset county has low levels of NOx Emissions, VOC Emissions, PM 2.5 Emissions (Particulate Matter), SO 2 Emissions (Sulfur Dioxide) compared to other areas of the state.

Regarding vehicular mobile emissions, Warren is intersected by Route 78, where three exits to the interstate highway exist and US Highway Route 22 which is located south of the town’s border. In New Jersey cars, trucks, and buses contributed 30% of the Volatile Organic Compounds (VOC’s) and Nitrogen Oxides (NOx) in 2009,
point sources such as industrial plants contribute 13%, Homes and small businesses contribute 29%, and non-road mobile sources, such as construction equipment, planes, trains, boats, contribute 28%.

Air toxins can pose serious health risks and are difficult to track as they are constantly in motion and air, like water, does not observe boundaries. There are four air toxic monitoring sites in New Jersey: Chester, Elizabeth, New Brunswick, Rider University, and Camden. In addition, there are 25 stations in New Jersey measuring air quality.

<table>
<thead>
<tr>
<th>Somerset County Top Air Quality Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cancer Risk</strong></td>
</tr>
<tr>
<td>Formaldehyde</td>
</tr>
<tr>
<td>Benzene</td>
</tr>
<tr>
<td>Acetaldehyde</td>
</tr>
<tr>
<td>Carbon tetrachloride</td>
</tr>
<tr>
<td>Naphthalene</td>
</tr>
<tr>
<td><strong>Respiratory Health Risk</strong></td>
</tr>
<tr>
<td>Acrolein</td>
</tr>
<tr>
<td>Formaldehyde</td>
</tr>
<tr>
<td>Acetaldehyde</td>
</tr>
<tr>
<td>Diesel engine emissions</td>
</tr>
<tr>
<td>Naphthalene</td>
</tr>
<tr>
<td><strong>Neurological Health Risk</strong></td>
</tr>
<tr>
<td>Cyanide compounds</td>
</tr>
<tr>
<td>Methyl chloride</td>
</tr>
<tr>
<td>Xylenes</td>
</tr>
<tr>
<td>Manganese compounds,</td>
</tr>
<tr>
<td>Lead compounds</td>
</tr>
</tbody>
</table>

NATA 2005, US EPA 1

10.1 Radon

Radon is a natural occurring substance that occurs in New Jersey rocks, soil, and groundwater. Radon can be a carcinogen if not properly ventilated in buildings built over radon deposits. According to the NJDEP Radiation Protection and Release Prevention, Warren Township in Somerset County is listed as Tier I Designation. Tier II is classified as High Radon Potential.

Indoor radon can be measured and remediated on a case-by-case basis.

10.2 Ozone

Air pollution from ground level ozone is a serious health concern across most of New Jersey. Ozone is a gas that forms when nitrogen oxides and VOCs react in the presence of sunlight and heat.

10.3 Recommendations

- The Commission emphasizes the importance of anti-idling. Idling for more than three minutes is prohibited in New Jersey.
- Pay attention to anti-idling signage placed in public and private right-of-ways.
CHAPTER 11: KNOWN CONTAMINATED SITES AND RESOURCE CONTAMINATION

11.1 Known Contaminated Sites

Known Contaminated Sites are sites where contamination of soil and/or groundwater is confirmed at levels greater than the applicable cleanup criteria or standard. Remedial activities, which may be as simple as soil removal and replacement, or which are very complex may be underway. The sites may be handled under one or more State and/or Federal regulatory programs. A site may be active, or may be pending when the site has not yet been assigned to a specific remediation program, or may be closed with restrictions. The NJDEP may be contacted for detailed information on the nature, extent and severity of contamination at a specific site. All of the active sites are in a stage of remediation and have a particular State Bureau overseeing remediation.

Contaminated Sites are sites where contamination of soil and/or groundwater is confirmed at levels greater than the applicable cleanup criteria or standard. Remedial activities, which may be as simple as soil removal and replacement, or are complex, may be underway. The sites may be handled under one or more State and/or Federal regulatory programs. A site may be pending or may be active, or may be closed with restrictions.

The Site Remediation Reform Act (SRRA) set forth sweeping changes to the way in which sites are remediated in New Jersey. SRRA established the affirmative obligation for responsible parties to remediate contaminated sites in a timely manner and created a category of remediation professionals known as Licensed Site Remediation professionals (LSRP). The following is a list of sites in Warren Township that have active cases in the NJDEP Site Remediation Program as of August 2015.

<table>
<thead>
<tr>
<th>PI NUMBER</th>
<th>PI NAME</th>
<th>ADDRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>G000041900</td>
<td>120 MOUNTAIN BLVD</td>
<td>PHEASANT RUN CLEANERS</td>
</tr>
<tr>
<td>4974</td>
<td>141 MT BETHEL RD</td>
<td>PLASMA GRAPHICS</td>
</tr>
<tr>
<td>9326</td>
<td>15 MOUNTAIN VIEW RD</td>
<td>THE CHUBB CORP WORLD HEADQUARTERS</td>
</tr>
<tr>
<td>12595</td>
<td>171 MT BETHEL RD</td>
<td>MT BETHEL EXXON</td>
</tr>
<tr>
<td>G000037336</td>
<td>19 MOUNTAIN BLVD</td>
<td>GARDEN STATE FLORIST</td>
</tr>
<tr>
<td>27051</td>
<td>19 WASHINGTON VALLEY RD</td>
<td>WASHINGTON VALLEY AUTO REPAIR</td>
</tr>
<tr>
<td>11517</td>
<td>214 MOUNTAIN VIEW RD</td>
<td>DEALAMAN ENTERPRISES INC</td>
</tr>
<tr>
<td>3223</td>
<td>2 MT BETHEL RD</td>
<td>SHELL SERVICE STATION 8779 0106</td>
</tr>
<tr>
<td>13442</td>
<td>40 MOUNTAIN BLVD</td>
<td>BILLS AUTOMOTIVE SERVICE</td>
</tr>
<tr>
<td>G000034014</td>
<td>40 REINMAN RD</td>
<td>40 REINMAN ROAD</td>
</tr>
<tr>
<td>25599</td>
<td>57 STIRLING RD</td>
<td>THERMOPLASTIC PROCESSES INC</td>
</tr>
<tr>
<td>6336</td>
<td>69 STIRLING RD</td>
<td>GULF #61894</td>
</tr>
<tr>
<td>6505</td>
<td>82 MORNING GLORY RD</td>
<td>WARREN AUTO INC</td>
</tr>
<tr>
<td>G000011406</td>
<td>ELM AVE &amp; 9TH ST</td>
<td>ELM AVENUE &amp; 9TH STREET GRD WTR CONTAM</td>
</tr>
<tr>
<td>G000011456</td>
<td>SPRING LN</td>
<td>SPRING LANE WELL CONTAMINATION</td>
</tr>
<tr>
<td>G000011636</td>
<td>STONINGHAM DR &amp; MT VIEW RD</td>
<td>STONINGHAM DRIVE GROUND WATER CONTAM</td>
</tr>
<tr>
<td>228498</td>
<td>12 INDIAN ROCK RD</td>
<td>12 INDIAN ROCK ROAD</td>
</tr>
</tbody>
</table>
Because these sites have been assigned a LSRP, this ERI makes no recommendations regarding these sites. Also note that the status of these cases may change. Updated statuses can be found at NJDEP online databases.

Should development occur adjacent or nearby these listed properties, further investigation should be conducted to ensure that any contaminant plumes do not affect the subject property.

11.2 Superfund Sites

EPA’s Superfund Program was established in 1980 under the Comprehensive Response, Compensation, and Liability Act (CERCLA) to locate, investigate and clean up hazardous waste sites throughout the United States.

The EPA Region 2 program oversees long-term cleanups at National Priorities List (NPL) and other sites, short-term cleanups ("removal actions") and responses to chemical and oil spill emergencies. Warren Township does not currently have any Superfund sites.

11.3 Groundwater Contamination

The Northwest New Jersey aquifer system (15 Basin), which includes the Raritan River, is considered to be highly vulnerable to contamination by the USEPA (1988). The 15 basin Aquifer is associated with Ridge and Valley, Highlands and Piedmont Geology. Reasons cited for its vulnerability include thickness of the soils, the shallow depth to ground water, and the fractured nature of some of the bedrock. Potential sources of contamination cited by the USEPA include transportation routes, septic systems, highway, rural and urban runoff, commercial and industrial facilities, and agricultural practices (USEPA, 1988). The USEPA identified the Buried Valley Aquifer System (which includes the Passaic Watershed) as being vulnerable to contamination through its recharge zone. The EPA identified septic tanks and leaching of discharges to streams and rivers in the recharge and stream flow source zones as potential threats to aquifer quality.

Contamination of groundwater may be the result of a surface spill of a liquid, from streams or lakes, or be the result of a buried solid, which is dissolved into groundwater as the result of water percolation. Contamination may be less dense than water and float, as in the case of petroleum products, or may sink within the aquifer as many solvents do. Certain chemicals may mix with aquifer water and become solutions such as chlorides. Some chemicals that dissolve into the water may travel distances of thousands of feet from the original source in the form of a “plume.” The introduction of certain biodegradable materials into an aquifer may result in changes to the chemical properties of the groundwater. These chemical changes may result in the freeing of previously bound naturally occurring metals into groundwater. The release of metals from chemical changes has been associated with aquifer portions located under landfills.

According to NJDEP databases, there are three areas in Warren that have Groundwater Contamination Areas. There are four areas that are well-head protection areas and there are three groundwater contamination areas (CEA).

11.4 Source Water Assessment

According to New Jersey American Water, Warren Township is served by the Short Hills or Raritan System. Water from the Raritan System comes from seven intakes on the Raritan River, Millstone River, Delaware & Raritan Canal, and approximately 129 wells in the Brunswick, Passaic, Stockton, Glacial Drift and Basalt Aquifers. Source water from the Short Hills System comes from seven intakes on the Raritan River, Millstone
River, Delaware & Raritan Canal, and approximately 129 wells in the Brunswick, Passaic, Stockton, Glacial Drift and Basalt Aquifers.

The New Jersey Department of Environmental Protection produces a Source Water Assessment Report under the Source Water Assessment Program (SWAP) for all public water systems within the state. This report determines the susceptibility of a water system to various contaminants and does not reflect actual contaminants being consumed by customers of that water supply system. Under this program the following parameters are considered: Pathogens including bacteria and viruses; nutrients including nitrogen and phosphorus; volatile organic compounds (VOCs) such as solvents, degreasers and gasoline components; pesticides; inorganics including asbestos, arsenic, lead and other metals; radionuclides including uranium and radium; radon; and disinfection byproduct precursors (DBP) that include solutions of organic matter and disinfecting agents such as chlorine.

Public water systems are required to monitor for regulated contaminants and must install treatment if any contaminants are detected at frequencies and concentrations above allowable levels. Additional details and information regarding source water protection data in Warren and throughout New Jersey may be obtained through the NJDEP at www.nj.gov/dep/swap.

11.4.1 Volatile Organic Compounds (VOCs)
VOCs are the most common organic groundwater contaminants in New Jersey. VOC contaminants may be derived from point or nonpoint in origin and typically include solvents, degreasers, and additives of gasoline including MTBE (methyl tertiary-butyl ether). Gas stations, chemical plants, and other industries are typical sources of VOCs. In addition to being linked to adverse health problems, VOCs contribute to the development of ground level ozone (O\textsubscript{3}). VOC aquifer contamination is common in urban and industrialized areas within the state. MTBE is a common VOC groundwater contaminant used as a fuel additive to increase oxygen content in gasoline. Leaking underground fuel tanks can result in MTBE contamination.

11.4.2 Nutrients
Nutrient contamination is linked with high levels of nitrogen and phosphorus. High nutrient levels may be connected to fertilizers from agricultural areas or lawns, or may result from sewerage treatment effluent, leaky septic systems, livestock or excessive waterfowl (e.g. Canada goose) populations. Nutrients can have environmental and human health impacts by enhancing the growth of harmful pathogens such as E. coli bacteria or creating eutrophic conditions in open waters. NJ American surface water intakes were found to have a high potential for pathogen contamination (see Table 2). Nutrient overloads and sedimentation, or the occurrence of fine particulate matter in water, may result in eutrophic conditions. Eutrophism is caused by an exponential population increase of photosynthetic organisms including algae, which in turn results in reduced oxygen levels in the water. Ultimately, this may result in inhospitable conditions for many fish and other aquatic wildlife. Residential development, golf courses or other sources of maintained lawn may contribute to excessive nitrogen or phosphorus through application of fertilizers for grass maintenance. Soil erosion from development and increases in impervious surfaces may result in increased sedimentation.

11.4.3 Inorganics
Inorganics include a variety of non-organic substances ranging from asbestos to heavy metals like lead and arsenic. Industrial waste is a typical source of these metal contaminants. Certain metals including cobalt, manganese, molybdenum, vanadium, strontium, zinc, nickel, copper and iron are utilized by all living organisms in trace amounts. However, mercury, cadmium, chromium, arsenic and lead are metals considered particularly dangerous to humans and wildlife in surface waters.

11.4.4 Disinfection Byproduct Precursors (DBP)
DBPs are byproducts resulting from the reaction between disinfectants and organic and inorganic compounds in water. Chlorine is the most common disinfectant associated with DBPs. Chlorine is typically used in public water supplies as a means of controlling water-borne pathogens. Natural organic matter has been determined to be a primary organic component of DBPs (Stevens et al. 1976). DBPs may be naturally occurring or the result of septic system effluent coming in contact with surface water bodies or groundwater supplies.

11.4.5 Pesticides

Pesticides are a group of chemicals used to kill or control pests. Subcategories of pesticides include herbicides (plants), fungicides (fungi), rodenticides (rodents), algicides (algae), insecticides (insects and other arthropods), nematocides (nematode worms), and bactericides (bacteria and similar pathogens). They are typically distributed from non-point sources such as agricultural fields, golf courses, residential lawns, transportation rights-of-way, commercial and industrial sources and atmospheric deposition. Variables that may impact pesticide contamination potential include organic content of soil (wells), surrounding land use, and distance from the water source to agricultural operations and minimum distances to golf courses.

11.5 Recommendations

- Eliminate use of the abovementioned pollutants.
- Report any petroleum, gasoline spills, or hazardous waste contamination to NJDEP at 1-877-WARNDEP (1-877-927-6337).
CHAPTER 12: INFRASTRUCTURE

12.1 Stormwater Management

Stormwater runoff occurs when precipitation from rain or snow flows over the land surface. The runoff is carried to our local streams, lakes, wetland, and rivers and can cause flooding, erosion and wash away important habitat for animal life that live in the streams. Stormwater runoff also picks up and carries many different pollutants that are found on paved surfaces such as sediment, nitrogen, phosphorus, bacteria, oil, grease, trash, pesticides and metals. Stormwater runoff is the number one cause of stream destruction in urban areas. The increase in land development and impervious surfaces causes an increase in stormwater runoff quantity and velocity. Clearing and grading a site can remove depressions that store rainfall and construction activities may also compact soil and diminish its infiltration ability. This in turn causes downstream areas to peak faster and higher than under natural or predevelopment conditions, which can result in downstream flooding and erosion problems. It can also have a negative impact on adjacent wetlands and the health of biological communities. Sedimentation and erosion can destroy habitat which adversely impacts some species that cannot readily adapt to these changes.

New Jersey adopted two sets of rules in 2005 that affect stormwater management as a result of the quality and quantity issues associated with stormwater. Phase II New Jersey Pollutant Discharge Elimination Stormwater Regulation Program Rule (N.J.A.C. 7-14A-q et seq.) is the first set of rules. These rules address pollutants associated with exiting stormwater runoff, as required under the Federal Clean Water Act. These rules govern the issuance of permits to certain public entities, including municipalities, which operate or own small municipal storm sewer systems (MS4s). The permit program establishes the Statewide Basic Requirements that must be put in force to reduce nonpoint source pollutant loads from these sources. These statewide requirements include measures such as the adoption of ordinances to control litter, pet waste, wildlife feeding, proper waste disposal, etc. They also include the development of a municipal stormwater management plan and implementation ordinances which require certain maintenance activities, such as street sweeping and catch basin cleaning. It also requires implementing solids and floatable controls, locating discharge points and stenciling catch basins, as well as public education components.

The second set of rules for Stormwater Management (N.J.A.C. 7:8-1 et seq.) apply to stormwater systems associated with new and proposed development. These rules establish the design and performance standards and replace the stormwater management rules that apply to residential development under the Residential Site Improvement Standards (RSIS), and include residential subdivisions, site plan and building permit approvals.

There are 26 permitted domestic wastewater treatment facilities that discharge to surface waters in the WMA 6 (Water management area 6 of the Passaic River Basin). They are permitted to discharge an average daily flow of approximately 67.2 MGD to the surface waters of the Passaic River Basin. The reported actual average daily flow was 47.4 MGD for the year 2001. Below is a table summarizing the New Jersey Pollution Discharge Elimination System (NJPDES) permit number, design average flow, and principal and tertiary treatment process for the facilities with a design capacity of 0.1 million gallons per day or more for Warren Township.
12.2 Wastewater Treatment

Water from Warren Township is treated with a UV system at the Stage IV Wastewater Treatment Plant. The current one we use has many benefits, but we will be upgrading the unit in the coming months:

9.2.1 UV Treatment versus Conventional Treatment

- UV doesn’t add anything to the water as gaseous chlorine and sulfur dioxide
- UV does not have a negative impact on the receiving waters.
- UV has a lower carbon footprint versus chlorine and is a safer option for the community than chlorine gas, which is toxic if released
- UV has a lower life-cycle cost due to lower annual operating costs, as frequent chemical purchases outpace the cost of electricity and replacement of lamps
- With UV, no chemicals are stored, transported or handled.
12.3 Transportation

The main mode of transportation in Warren by personal vehicle. A map of the major roads in Warren is shown below.

Warren Township does not have any bus stops or train stations. This is not to say that bus stops or train stations are not nearby. Visit NJ Transit to find a list of nearby stations. Information regarding ridesharing and bicycle commuting, along with traffic information can be found on the Township website.

12.4 Recommendations

- Stormwater run off should be minimized by recharging water within the property through reducing impervious cover, appropriate plantings and use of rain barrels.

- There is a recent trend in New Jersey and across the county for areas with public transit in and near urban areas gaining more desirable to live in. While Warren does not offer mass transit, a park and ride facility if feasible could a desirable feature. Careful planning will make Warren a clean, healthy place to live and work and a desirable community in the years and decades ahead.
CHAPTER 13: HISTORICAL RESOURCES

13.1 The History of Warren Township

The Lenape Indians roamed the area we now call Warren thousands of years before the Europeans came, but they left little history: a few arrowheads and grinding stones have been found along the Passaic River; Dock Watch Hollow is the only locale that bears an Indian name.

English and Scots-Irish from Turkey (now New Providence) and Scotch Plains first settled the township in the 1720's. Farmers from New Providence followed the Passaic River into what is now Union Village and Smalleytown. To the south, pioneers from the lowlands moved through Lincoln Gap (Somerset Street, Watchung) and into Washington Valley. Philip Cox may have arrived here as early as 1727, the year he bought 200 acres “betwixt the first and second mountain called the Blue Hills…” Until 1743, when the borders on Somerset County shifted northward, Warren was part of Elizabeth Borough in Essex County.

By the time of the American Revolution, fewer than a hundred families lived in what would become Warren, eking out a living from the stone-scattered fields. There were saw and grain mills on Cory’s Brook, Dock Watch Hollow, and elsewhere. A Baptist Church on Old Church Road and a schoolhouse on Mount Bethel Road were the centers of community life. Twenty or so men from Warren served in the state militia. One of them, David Smalley, rose to the rank of captain.

Not until 1806 was Warren Township created from portions of Bridgewater and Bernards. Warren was named in honor of Joseph Warren, hero of the Battle of Bunker Hill. Warren grew slowly. In the 1830s Germans settled in Washington Valley, soon followed by French and Swiss, and later by Italians, all of whom turned their industrious hands to whatever work there was to do. Throughout the late nineteenth century and into the early twentieth, the principal industries were livestock, fruit and grain raising, dairy farming and logging.

Almost from its beginning, Warren was a scattering of nine small villages, often mere crossroads centered about a church or school, even in their heyday these villages boasted only a post office and general store, perhaps a blacksmith shop and a few houses.
13.2 Neighborhoods

Mount Horeb:
The westernmost part of Warren has been known as Mount Horeb since the early nineteenth century when Methodist built their church at the corner of Mount Horeb and Liberty Corner Roads. The original Round Top School near the corner of Mount Horeb and Dock Watch Hollow Roads was built c. 1857 on land donated by Jacob and Lydia Giddes. The present building was erected after a fire destroyed the second schoolhouse at this site.

Coontown:
The area around the intersection of Mount Horeb and King George Roads was once known as Coontown, a name derived from the Coon family that farmed the area since the Revolution. Once the site of a distillery, cider mill, blacksmith shops, a hat factory, and two stores, by 1880 the area had reverted to farmland.

Mount Bethel Village:
Situated at the intersection of Mountain View Road and Mt. Bethel Road this area was settled before the American Revolution.
Mount Bethel had become the most densely populated village in the township by the time of the Civil War. During the late 19th and early 20th centuries the area was known as Gallia, in recognition of the large number of French Baptists who settled the area.

**Union Village:**
Situated at the intersection of Hillcrest Road and Mountain Avenue, Union Village is one of Warren's oldest settled areas, occupying a portion of a 3,000 acre tract acquired by William Dockwra in 1690. Settlers from New Providence moved into the area along the “Passaic River” in the late 1720’s, but it was not until July 4, 1824, when residents erected a liberty pole, that the place was named Union Village in honor of the American Union.

**Smalleytown:**
Smalleytown, more recently known as South Stirling, is the historic name of the area around the intersection of Mountain Avenue and Stirling Road. During the late eighteenth and early nineteenth centuries, members of the Smalley family owned most of the land thereabouts.

**Springdale:**
One of the original villages of Warren Township, Springdale is centered at the intersection of Washington Valley and Morning Glory Roads (formerly Springdale Road). The spring from which the village takes its name has been mentioned in the records since the 1720s. Still visible on the Sage Farm near the corner of Quail Run and the valley road, the conical springhouse built by Philip Mundy dates from c. 1900.

**Round Top:**
One of the higher peaks of the Second Watchung Range, it rises steeply from the corner of Mount Horeb and Round Top Roads to an elevation of 520’ above sea level. Viewed on a topographical map, the mountain’s highest point has a knobby appearance, thus accounting for the name.

**Dock Watch Hollow:**
A gap in the Second Watchung Mountain, in the southwest corner of the Township, the hollow was known in the 19th century as Dog Watch Hollar. A local landmark, the hollow is mentioned in historical records as early as 1708. Ruins of several milldams and the Dock Watch Hollow Brook itself mark one of the most romantic spots in Warren. The name is derived from the Indian word “dogwatch” or dokwache", meaning cold. Exposed basaltic columns testify to the volcanic origins of the Watchung Mountains. Warren’s highest point at 580 feet above sea level is on the eastern side of the brook, south of Ferguson road.

**Warrenville:**
First settled in late 1720s, Warrenville is the townships oldest village. Two Indian pathways crossed nearby: One led from Quibbletown to Basking Ridge (now Mount Bethel-King George Road), the other from the gap at Somerset Street through the valley and on toward Pluckemin (today’s Mountain Boulevard-Washington Valley Road). By the time of the Revolution several houses, a school and possibly a general store marked the site. A post office and tavern joined the mix in the early part of the 19th century. Later, the Hofheimer family built their country estates here. Now considered Warren’s
“downtown”, for the first two hundred years of its history Warrenville was just one of several tiny villages scattered across the town’s vast expanse.

13.3 Registered State and Federal Historic Sites

A Historic site means any real property, man-made structure, natural object or configuration or any portion or group of the foregoing of historical, archaeological, cultural, scenic, or architectural significance. Although there are many locations of historical interest only three are registered State and Federal Historic Sites.

Mount Bethel Meeting House:
The Baptist Meeting House was built c. 1761 on the Old Quibbletown Gap Road (now Church Street), then disassembled and moved to its present site on Stony Hill in 1785. Possibly the oldest existing Baptist Church in New Jersey, the meeting house was used by the congregation until 1960, then deeded to the township in 1978. The cemetery surrounding the Meeting House contains the graves of six veterans of the revolution.

Kirch-Ford House:
The original one-room section of the house, built by Justice of the Pease Thomas Terrill in 1750, is the oldest building in Warren Township. The two-story section, added by Terrill’s son and namesake, dates from c. 1800. The building’s bee-hive oven, walk-in fireplace, pine flooring and secret room are typical of the 18th century vernacular style. Warren acquired the building in 1980 following the death of its last occupant, farmer Ray Kirch. (Photo: Kirch-Ford House Circa 1740)

Smalley-Wormer House:
This private residence at 84 Mountain Avenue was built by Revolutionary war soldier David Smalley c. 1775, and is the only 18th century building still standing in Smalleytown. Owned by the Wormser family from 1845 to 1937, the house doubled in size c. 1850. The house features a large Dutch oven, eyebrow windows on the second floor and original exposed beams and wide plank floors throughout. Indoor plumbing arrived in 1946.

13.4 Locations of Historical Significance

Churches:
1. [D1] Union Village Methodist Church, 1825, Mountain Ave., Union Village
2. [C4] Springdale Methodist Church, 1874, intersection of Morning Glory Road and Washington Valley Roads.
4. [B3] Trinity United Church, 1872. (Original church built in 1846), 118 King George Road.

Cemeteries:
5. [A3] Cemetery with graves dating back to Revolutionary War, Liberty Corner Road
7. [C3] Springdale Methodist Church Cemetery, with graves of Revolutionary War soldiers who died after the war. Intersection of Morning Glory and Washington Valley Roads.
9. [D1] Tucker Cemetery with graves of soldiers from the Revolutionary War, Mountain Avenue, Union Village.
10. [B3] Coontown Church Cemetery, behind Trinity United Church, 118 King George Road.

**Schools:**
11. [D1] Smallytown School, 1803, corner of Mountain Avenue and Stirling Road. This school has been moved to the reconstructed community, New Jersey Old Town, in Piscataway. (Pictured right, circa 1800).
12. [C1] South Stirling School, 1885, 116 Mountain Avenue.

**13.5 Historic Preservation**

Historic preservation is the planned effort to help protect structures, objects and properties of historic importance.

The Warren Township Historical Society and the Warren Township Historic Sites Committee have taken action to preserve and protect the historic resources in Warren. The goals of these committees are to promote the preservation and restoration of Warren’s historic buildings and to protect historic structures.

**14.6 Recommendations**

Action taken to preserve and protect Warren Township’s historic resources should be performed in association with the Warren Township Historical Society and the Warren Township Historic Site Committee. The Township Committee amended the Master Plan in 2014 to include the designation of the Mount Bethel Village as an historic district. This “Historical District” concept should be utilized where appropriate to preserve and protect our historic resources.
RESOURCES

CHAPTER 1: NATURAL RESOURCE SETTING


CHAPTER 2: SOILS


CHAPTER 3: HYDROLOGY

New Jersey Department of Environmental Protection. New Jersey Source Water Assessment Program Plan. 1999. www.state.nj.us/dep/watersupply/swap.html


CHAPTER 4: SURFACE WATER


Susceptibility of Source Water to Community and Noncommunity Surface-Water Supplies and Related Wells in New Jersey to Disinfection Byproduct Precursors. www.nj.gov/dep/swap/reports/sw_dbp.pdf

CHAPTER 5: WILDLIFE

Field Observations. Warren Township Resident, Dave Peterson
Somerset County Planning Board. Somerset County ERI.1984

CHAPTER 6: VEGETATION

Field Observations by Warren Township Resident, Dave Peterson.
Somerset County Planning Board. Somerset County ERI.1984

CHAPTER 7: LAND USE

CHAPTER 8: CLIMATE


CHAPTER 9: AIR QUALITY


New Jersey Department of Environmental Protection Bureau of Air Monitoring. (2000 December).


Northern NJ Annual Precipitation. ND. http://climate.rutgers.edu/stateclim_v1/images/north_pcp.jpg

Northern NJ Mean Annual Temperature. ND. http://climate.rutgers.edu/stateclim_v1/images/north_temp.jpg


CHAPTER 10: KNOWN CONTAMINATED SITES AND RESOURCE CONTAMINATION


CHAPTER 11: INFRASTRUCTURE AND COMMUNITY RESOURCES


CHAPTER 12: HISTORICAL RESOURCES


Alan A. Siegel. Warren A TO Z. 2006. iUniverse, Lincoln, NE.
APPENDIX I
Warren Township Environmental Commission’s
Approved List of Plant Species

If a species you intend to plant is not on our approved list, please send a formal request with the species name, quantity to be planted and maintenance plan to:
Warren Township Environmental Commission, 46 Mountain Boulevard, Warren NJ 07059

<table>
<thead>
<tr>
<th>Species Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acalypha graciens</td>
<td>slender threeseed mercury</td>
</tr>
<tr>
<td>Acalypha rhomboidea</td>
<td>common threeseed mercury</td>
</tr>
<tr>
<td>Acalypha virginica</td>
<td>Virginia threeseed mercury</td>
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Botrychium oneidense
Botrychium virginianum
Buteloua curtipendula
Bromus pubescens
Bulbostylis capillaris
Callitriche heterophylla
Calopogon tuberosus
Calystegia spithamaea
Campanula apar
toides
Campanula rotundifolia
Cardamine angustata
Cardamine bulbosa
Cardamine concatenata
Cardamine parviflora
Cardamine pensylvanica
Cardamine pratensis
Carex abscondita
Carex annectens
Carex brevior
carex cephalophora
carex complanata
carex crawfordii
carex crinita
carex cristatella
carex digitalis
carex festucacea
carex frankii
carex glaucodea
carex grayi
carex grisea
carex hirtifolia
carex hyster
cina
carex lasiocarpa
carex laxiflora
carex lupuliformis
carex lupulina
carex lurida
Carex muehlenbergii
Carex nigromarginata
Carex normalis
Carex oligocarpa
Carex pallescens
Carex pensylvanica
carex platypyllya
Carex praiea
Carex rosea
Carex scoparia
Carex squarrosa
Carex stipata
Carex tribuloides
Carex typhina
Carex vesicaria
Carex vulpinoida
Carex wildekowa
Carpinus caroliniana
carya alba
Carya cordiformis
Carya glabra
carya ovalis
carya ovata
Castanea dentata
Castileja coccinea
Catalpa bignonioides
Caulophyllum thalictroides
Ceanothus americanus
Celastrus scandens
Celtis occidentalis
Cephalanthus occidentalis
Cerastium nutans
Ceratophyllum demersum
Cercis canadensis
Chaerophyllum procumbens
Chamaecrista fasciculata
Chamaecrista nictitans
Chamaelirium luteum
Chamaesyce maculata
Chamaesyce nutans
Cheilanthes lanos
Chelone glabra
Chenopodium standleyanum
Chimaphila maculata
Chimaphila umbellata
Chionanthus virginicus
Chrysophenium americanum
Cicuta maculata
Cinna arundinacea
Corallorhiza odontorhiza
Corallorhiza odontorhiza
Corallorhiza odontorhiza
Corallorhiza odontorhiza

big devils beggartick
smallspike false nettle
cutleaf grapefern
bluntnose grapefern
rattlesnake fern
sideoats grama
hairy woodland brome
densed uft hair sedge
twoheaded water-starwort
tubers gresspink
low false bindweed
marsh bellflower
bluebell bellflower
slender toothwort
bulbous bittercress
cutleaf toothwort
sand bittercress
Pennsylvania bittercress
cuckoo flower
thicket sedge
yellowfruit sedge
shortbeak sedge
ov-al leaf sedge
hir sute sedge
Crawford’s sedge
fringed sedge
crested sedge
slender woodland sedge
rescue sedge
Frank’s sedge
blue sedge
Gray’s sedge
inflated narrow-leaf sedge
pubescent sedge
bottlebrush sedge
woollyfruit sedge
broad looseflower sedge
false hop sedge
hop sedge
shallow sedge
Muhlenberg’s sedge
black edge sedge
greater straw sedge
richwoods sedge
pale sedge
Pennsylvania sedge
broadleaf sedge
prairie sedge
rosy sedge
broom sedge
squarrose sedge
wilt fruit sedge

blunt broom sedge
cattail sedge
blister sedge
fox sedge
Wildenow’s sedge
American hornbeam
mockernut hickory
bitternut hickory
pignut hickory
red hickory
shagbark hickory
American chestnut
scarlet Indian paintbrush
southern catalpa
blue cohosh
New Jersey tea
American bittersweet
common hackberry
common buttonbush
nooding chickweed
coon’s tail
eastern redbud
spreading chervil
partridge pea
sensitive partridge pea
fairy wand
spotted sandmath
eyebane
hairy lipfern
white turtlehead
Standley's goosefoot
striped prince's pine
pipsissewa
white fringe tree
American golden saxifrage
spotted water hemlock
sweet woodreed
broadleaf enchanter’s
nightshade
field thistle
swamp thistle
pasture thistle
Virginia spring beauty
western blue virgin bower
devil's darning needles
coastal sweet pepperbush
richweed
bastard toadflax
American cancer-root
Canadian horseweed
summer corail root
autumn corail root
Diospyros
Dichanthelium depauperatum
Dichanthelium boscii
Dichanthelium boreale
Dichanthelium candelanum
Dichanthelium latifolium
Dierilla lonicera
Digitaria sanguinalis
Diodia teres
Dioscorea villosa
Doellingeria infirma
Dryopteris carthusiana
Dryopteris marginalis
Echinochloa muricata
Echinocystis lobata
Eleocharis acicularis
Eleocharis ovata
Eleocharis palustris
Eleocharis tenuis
Ellisia nyctelea
Eloea canadensis
Eloea nuttallii
Elymus hystrix
Elymus virgicus
Epipogus virginianus
Epigaea repens
Epilobium ciliatum
Epilobium coloratum
Equisetum arvense
Equisetum hyemale
Equisetum sylvaticum
Eragrostis capillaris
Eragrostis spectabilis
Erechtites hieraciifolia
Erigeron annuus
Erigeron philadelphicus
Erigeron pulchellus
Erigeron strigosus
Erythronium americanum
Eubotrys racemosa
Euonymus americanus
Euonymus atropurpureus
Eupatoriadelphus fistulosum
Eupatoriadelphus maculatus
Eupatorium altissimum
Eupatorium perfoliatum
Eupatorium purpureum
Eupatorium rotundifolium
Eupatorium sessilifolium
Euphorbia corollata
Eurybia divaricata
Eurybia macrophylla
Eurybia schreberi
Euthamia graminifolia
Fagus grandifolia
Festuca subverticillata
Floerkea prosperinacoides
Fragaria vesca
Fragaria virginiana
Fraxinus americana
Fraxinus pennsylvanica
Galearis spectabilis
cornel-leaf whitetop
spinulose woodfern
marginal woodfern
rough barnyardgrass
wild cucumber
needle spikerush
ovate spikerush
common spikerush
slender spikerush
Aunt Lucy
Canadian waterweed
western waterweed
eastern bottlebrush grass
Virginia wildrye
beechdrops
trailing arbutus
fringed willowherb
purpleleaf willowherb
field horsetail
scouringrush horsetail
woodland horsetail
lace grass
purple lovegrass
American burnweed
eastern daisy fleabane
Philadelphia fleabane
robin's plantain
prairie fleabane
dogtooth violet
swamp doghobble
bursting-heart
burning bush
trumpetweed
spotted trumpetweed
tall thoroughwort
common boneset
sweptedged hoe pye weed
roundleaf thoroughwort
upland boneset
flowering spurge
white wood aster
bigleaf aster
Schreber's aster
flat-top goldentop
American beech
nodding fescue
false mermaidweed
woodland strawberry
Virginia strawberry
white ash
green ash
showy orchid
Galium boreale | northern bedstraw
Galium circinaeans | licorice bedstraw
Galium lanceolatum | lanceleaf wild licorice
Galium obtusum | blunthead bedstraw
Galium trifidum | threepetal bedstraw
Galium triflorum | fragrant bedstraw
Gamochaeta purpurea | spoonleaf purple everlasting
Gaylussacia baccata | black huckleberry
Gaylussacia frondosa | blue huckleberry
Gentiana andrewsii | closed bottle gentian
Gentiana clausa | bottle gentian
Gentiana saponaria | harvestbells
Gentianella quinquefolia | agueweed
gentianopsis crinita | greater fringed gentian
Geranium carolinianum | Carolina geranium
Geranium maculatum | spotted geranium
Geum allepicum | yellow avens
Geum canadense | white avens
Gleditsia triacanthos | honeylocust
Glyceria striata | melic mannagrass
Glyceria septentrionalis | floating mannagrass
Glycyrrhiza glabra | fowl mannagrass
Goodyera pubescens | downy rattlesnake plantain
Gratiola neglecta | clammy hedgehyssop
Hackelia virginiana | beggarlice
Hamamelis virginiana | American witchhazel
Hedeoma pulegioides | American false pennyroyal
Helenium autumnale | common sneezeweed
Helenium flexuosum | purplehead sneezeweed
Helianthemum bicknelli | hoary frostweed
Helianthus decapetalus | thinleaf sunflower
Helianthus divaricatus | woodland sunflower
Helianthus giganteus | giant sunflower
Helianthus tuberosus | Jerusalem artichoke
Heliopsis helianthoides | smooth oxeye
Hepatica nobilis | hepatica
Heracleum maximum | common cowparsnip
Heteranthera dubia | grassleaf mudplantain
Heteranthera reniformis | kidneyleaf mudplantain
Heuchera americana | American alumroot
Hibiscus moscheutos | crimsoneyed rosemallow
Hieracium gronovii | queendevil
Hieracium paniculatum | Allegheny hawkweed
Hieracium scabrum | rough hawkweed
Hieracium venosum | rattlesnake weed
Houstonia caerulea | azure blue
Hypericum lucidula | shining clubmoss
Hydrophyllum virginianum | eastern waterleaf
Hypericum gentianoides | orange grass
Hypericum mutilum | dwarf St. Johnswort
Hypericum punctatum | spotted St. Johnswort
Hypoxyris hirsuta | common goldstar
Ilex opaca | American holly
common winterberry
Ilex verticillata | jewelweed
Impatiens capensis | pale touch-me-not
Impatiens pallida | flaxleaf whitetop aster
Ionactis linariifolius | man of the earth
Ipomoea pandurata | harlequin blueflag
Isoetes engelmannii | Appalachian quillwort
Itea virginica | Virginia sweetspire
Juglans cinerea | butternut
Juglans nigra | black walnut
cumacuminus
Juncus effusus | tapertip rush
cumacuminus
Juncus effusus | toad rush
cumacuminus
Juncus effusus | common rush
Juncus marginatus | grassleaf rush
Juncus secundus | lopsided rush
Juncus tenuis | poverty rush
Juniperus virginiana | eastern red cedar
Justicia americana | American water-willow
Kalmia angustifolia | sheep laurel
Kalmia latifolia | mountain laurel
Krigia biflora | twoflower dwarf dandelion
Lactuca biennis | tall blue lettuce
Lactuca canadensis | Canada lettuce
Lactuca floridana | woodland lettuce
Laportea canadensis | Canadian wood nettle
Lechea intermedia | largepod pinweed
Lechea pulchella | Leggett's pinweed
Leersia oryzoides | rice cutgrass
Leersia virginica | white grass
Lemna minor | common duckweed
Lemna valdiviana | valdivia duckweed
Lepidium virginicum | Virginia pepperweed
Lespedeza capitata | roundhead lespedeza
Lespedeza frutescens | shrubby lespedeza
Lespedeza hirta | hairy lespedeza
Lespedeza procumbens | trailing lespedeza
tall lespedeza
Lespedeza stuevei | violet lespedeza
Lespedeza violacea | slender lespedeza
tall lespedeza
Lindera benzoin | dense blazing star
Lindernia dubia | Canada lily
Linum intercursum | wood lily
Linum medium | northern spicebush
Linum striatum | yellowseed false pimpernel
Liparis liliifolia | sandplain flax
Liparis loeselii | stiff yellow flax
Liquidambar styraciflua | ridged yellow flax
Liriodendron tulipifera | brown widelip orchid
Liriodendron tulipifera | yellow widelip orchid
Lithospermum pulchrum | sweetgum
Lithospermum pulchrum | tuliptree
<table>
<thead>
<tr>
<th>Latin Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oenothera parviflora</td>
<td>little evening primrose</td>
</tr>
<tr>
<td>Nyssa sylvatica</td>
<td>eastern white pine</td>
</tr>
<tr>
<td>Myosotis verna</td>
<td>common evening primrose</td>
</tr>
<tr>
<td>Muhlenbergia frondosa</td>
<td>raindrop lily</td>
</tr>
<tr>
<td>Muhlenbergia schreberi</td>
<td>daisy bay</td>
</tr>
<tr>
<td>Myosotis laxa</td>
<td>common evening primrose</td>
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<tr>
<td>Muhlenbergia schreberi</td>
<td>daisy bay</td>
</tr>
<tr>
<td>Lobelia inflata</td>
<td>Indian-tobacco</td>
</tr>
<tr>
<td>Lobelia siphilitica</td>
<td>Indian-potato</td>
</tr>
<tr>
<td>Lobelia spicata</td>
<td>palespike lobelia</td>
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<tr>
<td>Lonicera dioica</td>
<td>limber honeysuckle</td>
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<tr>
<td>Lonicera sempervirens</td>
<td>trumpet honeysuckle</td>
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<tr>
<td>Ludwigia alternifolia</td>
<td>seed box</td>
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<td>Ludwigia palustris</td>
<td>marsh seedbox</td>
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<tr>
<td>Luzula echinata</td>
<td>hedgehog woodrush</td>
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<tr>
<td>Lycopodium digitatum</td>
<td>fan club moss</td>
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<td>Lycopodium obscurum</td>
<td>rare club moss</td>
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<tr>
<td>Lycopus americanus</td>
<td>American water horehound</td>
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<tr>
<td>Lycopus uniflorus</td>
<td>Virginia water horehound</td>
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<td>Lycopus virginicus</td>
<td>maleberry</td>
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<td>Lysimachia ciliata</td>
<td>fringed loosestrife</td>
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<td>Lysimachia quadrifolia</td>
<td>arrowhead yellow loosestrife</td>
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<td>Lysimachia terestris</td>
<td>heart loosestrife</td>
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<tr>
<td>Maclura pomifera</td>
<td>sweet orange</td>
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<tr>
<td>Magnolia virginiana</td>
<td>sweet bay</td>
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<tr>
<td>Maianthemum canadense</td>
<td>Canada mayflower</td>
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<tr>
<td>Maianthemum racemosum</td>
<td>feathery false lily of the valley</td>
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<tr>
<td>Malus coronaria</td>
<td>sweet crab apple</td>
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<tr>
<td>Malus ioensis</td>
<td>prairie crab apple</td>
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<td>Menispermum canadense</td>
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<td>Mentha Â—piperita</td>
<td>peppermint</td>
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<tr>
<td>Mentha arvensis</td>
<td>wild mint</td>
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<td>Mertensia virginica</td>
<td>Virginia bluebells</td>
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<td>Mikania scandens</td>
<td>climbing hempvine</td>
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<td>Mimulus ringens</td>
<td>Allegheny monkeyflower</td>
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<td>Mirabilis nystagmea</td>
<td>heartleaf four o'clock</td>
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<td>Mitchellia repens</td>
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<td>Mitella diphylla</td>
<td>twoleaf miterwort</td>
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<td>Mollugo verticillata</td>
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<td>Monarda didyma</td>
<td>wild bergamot</td>
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<td>Monarda fistulosa</td>
<td>pinesap</td>
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<td>Monotropa hypophys</td>
<td>Indianpipe</td>
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<td>Monotropa uniflora</td>
<td>northern bayberry</td>
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<td>Morella pensylvanica</td>
<td>red mulberry</td>
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<td>Morus rubra</td>
<td>hairawn mulhly</td>
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<tr>
<td>Muhlenbergia capillaris</td>
<td>raindrop lily</td>
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</tr>
<tr>
<td>Myosotis laxa</td>
<td>bay forget-me-not</td>
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<tr>
<td>Myosotis verna</td>
<td>spring forget-me-not</td>
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<td>Najas flexilis</td>
<td>noding water nymph</td>
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<td>Nuphar lutea</td>
<td>yellow pond-lily</td>
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<tr>
<td>Nymphaea odorata</td>
<td>American white waterlily</td>
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<td>Nyssa sylvatica</td>
<td>blackgum</td>
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<tr>
<td>Obolalia virginica</td>
<td>Virginia pennywort</td>
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<tr>
<td>Oenothera biennis</td>
<td>common evening primrose</td>
</tr>
<tr>
<td>Oenothera fruticosa</td>
<td>narrowleaf evening primrose</td>
</tr>
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</table>
Plantago rugelii
Plantago virginica
Platanthera flava
Platanthera lacera
Platanthera psycodes
Platanus occidentalis
Poa sylvestris
Podophyllum peltatum
Podostenum ceratophyllum
Polemonium reptans
Polygala nuttallii
Polygala paucifolia
Polygala sanguinea
Polygala verticillata
Polygonatum biflorum
Polygonatum pubescens
Polygonum arifolium
Polygonum hydropiperoides
Polygonum lapathifolium
Polygonum pensylvanicum
Polygonum punctatum
Polygonum sagittatum
Polygonum tenue
Polygonum virginianum
Polypodium virginianum
Polystichum acrostichoides
Pontederia cordata
Populus grandidentata
Populus tremuloides
Potamogeton amplifolius
Potamogeton gramineus
Potamogeton natans
Potamogeton nodosus
Potamogeton perfoliatus
Potamogeton pusillus
Potamogeton robbinsii
Potentilla canadensis
Potentilla norvegica
Potentilla simplex
Prenanthes alba
Prenanthes altissima
Prosopis palustris
Prunella vulgaris
Prunus americana
Prunus maritima
Prunus pensylvanica
Prunus serotina
Prunus virginiana
Pseudognaphalium obtusifolium
Ptelea trifoliata
Pteridium aquilinum

blackseed plantain
Virginia plantain
palegreen orchid
green fringed orchid
lesser purple fringed orchid
American sycamore
woodland bluegrass
mayapple
hornleaf riverweed
Greek valerian
Nuttall's milkwort
gaywings
purple milkwort
whorled milkwort
smooth Solomon's seal
hairy Solomon's seal
halberdleaf tearthumb
swamp smartweed
curlytop knotweed
Pennsylvania smartweed
dotted smartweed
arrowleaf tearthumb
pleatleaf knotweed
jumpspeed
rock polyody
Christmas fern
pickerelweed
bigtooth aspen
quaking aspen
largeleaf pondweed
variableleaf pondweed
floating pondweed
longleaf pondweed
claspingleaf pondweed
small pondweed
Robbins' pondweed
dwarf cinquefoil
Norwegian cinquefoil
common cinquefoil
white rattlesnakeroot
tall rattlesnakeroot
marsh mermaidweed
common selfheal
American plum
beach plum
pin cherry
black cherry
chokecherry
rabbit-tobacco
common hoptree
western brackenfern

Pycnanthemum tenuifolium
Pycnanthemum virginianum
Pyrola americana
Pyrola eliptica
Quercus Á—heterophylla
Quercus alba
Quercus bicolor
Quercus coccinea
Quercus ilicifolia
Quercus palustris
Quercus prinus
Quercus rubra
Quercus velutina
Ranunculus abortivus
Ranunculus hispidus
Ranunculus pensylvanicus
Ranunculus pusillus
Ranunculus recurvatus
Rhexia virginica
Rhododendron maximum
Rhododendron pericylmenoides
Rhododendron prinophyllum
Rhododendron viscosum
Rhus aromatica
Rhus copallinum
Rhus glabra
Rhus typhina
Ribes americanum
Ribes rotundifolium
Robinia hispida
Robinia pseudoacacia
Robinia viscosa
Rorippa palustris
Rosa carolina
Rosa palustris
Rosa virginiana
Rubus allegheniensis
Rubus flagellaris
Rubus hispidus
Rubus occidentalis
Rubus odoratus
Rubus ostryfolius
Rubus pensylvanicus
Rudbeckia fulgida
Rudbeckia hirta
Rudbeckia laciniata
Rudbeckia triloba
Sabatia angularis
Sagittaria australis
Sagittaria latifolia
Sagittaria rigida

narrowleaf mountainmint
Virginia mountainmint
American wintergreen
waxflower shinleaf
white oak
swamp white oak
scarlet oak
bear oak
pin oak
chestnut oak
northern red oak
black oak
littleleaf buttercup
bristly buttercup
Pennsylvania buttercup
low spearwort
blisterwort
handsome Harry
great laurel
pink azalea
early azalea
swamp azalea
fragrant sumac
winged sumac
smooth sumac
staghorn sumac
American black currant
Appalachian gooseberry
bristly locust
black locust
clammy locust
bog yellowcress
Carolina rose
swamp rose
Virginia rose
Allegheny blackberry
northern dewberry
bristly dewberry
black raspberry
purpleflowering raspberry
highbush blackberry
Pennsylvania blackberry
orange coneflower
blackeyed Susan
cutleaf coneflower
browneyed Susan
rosepink
longbeak arrowhead
broadleaf arrowhead
sessilefruit arrowhead

not shown in this list:
Salix eriocephala - Missouri River willow
Salix humilis - prairie willow
Salix lucida - shining willow
Salix nigra - black willow
Salix sericea - silky willow
Sanguinaria canadensis - Canadian bloodroot
Sanicula odora - early saxifrage
Sanicula odora - little bluestem
Sanicula oregana - softstem bulrush
Sanicula oregana - green bulrush
Sanicula oregana - woolly bulrush
Sanicula oregana - leafy bulrush
Sanicula oregana - hairy skullcap
Sanicula oregana - helmet flower
Sanicula oregana - blue skullcap
Sanicula oregana - small skullcap
Sedum rubrotinctum - woodland stonecrop
Selaginella apoda - northern selaginella
Selaginella rupestris - American senna
Sagina procumbens - toothed whitetop aster
Sagina procumbens - marsh bristlegrass
Sagina procumbens - oneseed bur cucumber
Silene antirrhina - sleepy silene
Silene stellata - widowsfrill
Silphium perfoliatum - cup plant
Silphium perfoliatum - narrowleaf blue-eyed grass
Silphium perfoliatum - needletop blue-eyed grass
Silphium perfoliatum - hemlock waterparsnip
Silphium perfoliatum - cat greenbrier
Silphium perfoliatum - smooth carrionflower
Smilax herbacea - roundleaf greenbrier
Smilax herbacea - Carolina horsenettle
Smilax herbacea - West Indian nightshade
Solidago arguta - Atlantic goldenrod
Solidago bicolor - white goldenrod
Solidago bicolor - wreath goldenrod
Solidago bicolor - Canada goldenrod
Solidago bicolor - zigzag goldenrod
Solidago bicolor - giant goldenrod
Solidago bicolor - early goldenrod
Solidago bicolor - gray goldenrod
Solidago bicolor - wrinkleleaf goldenrod
Solidago bicolor - stout goldenrod
Solidago canadensis - Indian grass
Solidago canadensis - American bur-reed
Solidago canadensis - slender wedgescale
Solidago canadensis - prairie wedgescale
Solidago canadensis - white meadowssweet
Solidago canadensis - steepelebush
Solidago canadensis - nodding lady's tresses
Solidago canadensis - northern slender lady's tresses
Solidago canadensis - lacelip lady's tresses
Solidago canadensis - puffshate dropseed
Solidago canadensis - hairy hedgenettle
Solidago canadensis - smooth hedgenettle
Solidago canadensis - calico aster
Solidago canadensis - Lowrie's blue wood aster
Solidago canadensis - New England aster
Solidago canadensis - New York aster
Solidago canadensis - late purple aster
Solidago canadensis - hairy white oldfield aster
Solidago canadensis - willowleaf aster
Solidago canadensis - purplestem aster
Solidago canadensis - wavyleaf aster
Solidago canadensis - skunk cabbage
Solidago canadensis - yellow pimpernel
Solidago canadensis - Virginia tephrosia
Solidago canadensis - Canada germander
Solidago canadensis - early meadow-rue
Solidago canadensis - king of the meadow
Solidago canadensis - rue anemone
Solidago canadensis - hairyjoint meadowparsnip
Solidago canadensis - purple meadowparsnip
Solidago canadensis - New York fern
Solidago canadensis - eastern marsh fern
Solidago canadensis - American basswood
Solidago canadensis - pale false mannagrass
Solidago canadensis - eastern poison ivy
Solidago canadensis - purpletop tridens
Solidago canadensis - whip-poor-will flower
Solidago canadensis - clasping Venus' looking-glass
Solidago canadensis - yellowfruit horse-gentian
Solidago canadensis - feverwort
Solidago canadensis - eastern hemlock
Solidago canadensis - broadleaf cattail
Solidago canadensis - American elm
Solidago canadensis - Missouri River willow
Solidago canadensis - prairie willow
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Solidago canadensis - yellowfruit horse-gentian
Solidago canadensis - feverwort
Solidago canadensis - eastern hemlock
Solidago canadensis - broadleaf cattail
Solidago canadensis - American elm
Utricularia macrorhiza  common bladderwort  Zizia aurea  golden zizia
Uvularia perfoliata  perfoliate bellwort
Uvularia sessilifolia  sessileleaf bellwort
Vaccinium angustifolium  lowbush blueberry
Vaccinium corymbosum  highbush blueberry
Vaccinium fuscatum  black highbush blueberry
Vaccinium pallidum  Blue Ridge blueberry
Vaccinium stamineum  deerberry
Veratrum latifolium  slender bunchflower
Veratrum virginicum  Virginia bunchflower
Veratrum viride  green false hellebore
Verbena hastata  swamp vervena
Verbena simplex  narrowleaf vervain
Verbena urticifolia  white vervain
Vernonia noveboracensis  New York ironweed
Veronica anagallis-aquatica  water speedwell
Veronica peregrina  neckweed
Veronica scutellata  skullcap speedwell
Veronicastrum virginicum  Culver's root
Viburnum acerifolium  mapleleaf viburnum
Viburnum dentatum  southern arrowwood
Viburnum dentatum  southern arrowwood
Viburnum lentago  nannyberry
Viburnum prunifolium  blackhaw
Viburnum rafinesqueanum  downy arrowwood
Viburnum recognitum  southern arrowwood
Vicia caroliniana  Carolina vetch
Viola —palmata  early blue violet
Viola —primulifolia
Viola affinis  sand violet
Viola blanda  sweet white violet
Viola cucullata  marsh blue violet
Viola hirsutula  southern woodland violet
Viola labradorica  alpine violet
Viola lanceolata  bog white violet
Viola pedata  birdfoot violet
Viola pubescens  downy yellow violet
Viola rostrata  longspur violet
Viola rotundifolia  roundleaf yellow violet
Viola sagittata  arrowleaf violet
Viola sororia  common blue violet
Viola striata  striped cream violet
Viola triloba  three-lobe violet
Vitis aestivalis  summer grape
Vitis labrusca  fox grape
Vitis palmata  catbird grape
Vitis riparia  riverbank grape
Vitis vulpina  frost grape
Woodia ilvensis  rusty woodsia
Woodia obtusa  bluntlobe cliff fern
Woodwardia areolata  netted chainfern
Zannichellia palustris  horned pondweed
Zizia aquatica  annual wildrice
APPENDIX II
<table>
<thead>
<tr>
<th>Alfalfa</th>
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<th>Arrowhead</th>
<th>Asters</th>
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</table>
APPENDIX III
TOWNSHIP OF WARREN

Sources:
Flood Zones, Streams, Ponds, Watersheds and Elevation Contours
taken from N.J. DEP G.L.S. data sets.

AUGUST 2014
TOWNSHIP OF WARREN

Sources:
Flood Zones, Streams, Ponds, Watersheds and Elevation Contours taken from N.J. DEP/G.I.S. data sets.

500 YEAR FLOOD
100 YEAR FLOOD

FLOOD HAZARD AREAS
AUGUST 2014
TOWNSHIP OF WARREN

Sources:
Flood Zones, Streams, Ponds, Watersheds and Elevation Contours taken from N.J. DEP-G.I.S. data sets.

AUGUST 2014
Sources:
Base Map: Somerset County G.I.S. 2012
Flood Zones, Streams, Ponds, Watersheds,
Elevation Contours and Soil Units taken from
N.J. DEP G.I.S. data sets.
TOWNSHIP OF WARREN

KNOWN CONTAMINATED SITES

Sources:
Flood Zones, Streams, Ponds, Watersheds and Elevation Contours taken from N.J. DEP G.I.S. data sets.

AUGUST 2014