Water Use and Conservation Management Plan

For Pilot Area 3:

HUC14 02030103070060 Meadow Brook/High Mountain Brook,
HUC14 02030103070070 Wanaque River/Posts Brook (below Reservoir)

Pilot Area includes all or portion of the following municipalities:
Wanaque Borough, Ringwood Borough (Passaic County)

Prepared by the State of New Jersey Highlands Water Protection and Planning Council as part of the Highlands Water Use and Conservation Management Plan (WUCMP) Pilot Program. This WUCMP was developed through the provisions of a State of New Jersey Highlands Water Protection and Planning Council Grant and may assist in the development of municipal WUCMPs in support of Highlands Regional Master Plan Conformance.

January 2016

WATER USE AND CONSERVATION MANAGEMENT PLAN

for

HIGHLANDS REGIONAL MASTER PLAN CONFORMANCE

HUC14 02030103070060
MEADOW BROOK/HIGH MOUNTAIN BROOK

HUC14 02030103070070
WANAQUE RIVER/POSTS BROOK (BELOW RESERVIOR)

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Executive Summary

Introduction

There are 183 subwatersheds within the Highlands region. One of the highest priority objectives described in the Regional Master Plan (RMP) is to protect restore and enhance water resources within the Highlands region. To help achieve this objective, the Highlands Council has developed model Water Use and Conservation Management Plans (WUCMPs) for pilot areas throughout the Highlands region.

The development of WUCMPs specific to HUC14 subwatersheds is intended to address the requirements of this objective in a practical way that is applicable to each study area. The pilot areas were chosen to include a wide range of use types and water availability, and are geographically dispersed throughout the Highlands region. Pilot areas range in size and include between one and three subwatersheds. While the pilot areas were not developed based on municipal boundaries, the WUCMPs are intended to be used as Planning Tools to help municipalities develop their own plans.

Each WUCMP includes the following components:

- **WUCMP Area Characteristics** – Summarizes high level information such as land use capability/land cover, land use/zoning, major hydrologic features, geology, and soil characteristics.
- **Identification of Water Sources and Types –** The Highlands region uses both groundwater and surface water for potable water supply. Additional use types include, but are not limited to agricultural, commercial, industrial, and institutional.
- **Stakeholders** – a listing of stakeholders who can assist in the implementation of the WUCMP.
- **Revaluation of Net Water Availability** - Original calculations of Net Water Availability (NWA) were based on maximum water use in 2003 using a region-wide analysis at the HUC14 scale. This analysis has been expanded to include available data from 2000-2009 and has several refinements to the NWA computations. Since NWA is calculated on a HUC14 subwatershed basis, municipalities can calculate NWA for each subwatershed using the approach outlined within these WUCMPs.
- **Deficit Mitigation Strategies** – Strategies are provided on both supply-side conservation measures (e.g., leak detection, water auditing, well network optimization) and demand-side conservation measures (such as high efficiency irrigation techniques, rainwater harvesting, and low-flow plumbing fixtures), review of reuse potential, and storage alternatives have been identified. While each WUCMP includes a comprehensive list of deficit mitigation strategies, it is understood the application of individual strategies will vary amongst municipalities. In addition, municipalities may have additional strategies that are not included. Deficit mitigation strategies have been ranked within these WUCMPs but the rankings are subject to change, based on municipal preference.

- **Funding opportunities** –Funding opportunities are listed that may be available to fund the mitigation actions.
- **Monitoring Plan** – Each WUCMP will include a description of ongoing monitoring of water use and validation of the performance of mitigation actions.
- **Deficit Mitigation Implementation Plan** – Each planning tool identifies deficit reduction targets, responsible parties, a schedule for action and implementation, and funding mechanisms.

While only a portion of a municipality may be included in certain study areas, that particular municipality can utilize these Planning Tools to help characterize a portion of the water use and conservation management requirements within their municipality.

Municipal based WUCMPs should reflect all HUC14 subwatersheds within the municipality. However, the implementation for municipal based WUCMPs will only include the portions of the HUC14 subwatersheds that lie within the boundary of the municipality. Municipalities can and should use information included in these Planning Tools where subwatersheds intersect their WUCMP planning boundary.

The WUCMP Planning Tools outline a straightforward approach and provide a solid framework that can be directly modified by municipalities to develop specific municipal based WUCMPs.

Summary

This Planning Tool covers the following HUC14 subwatersheds:

- 02030103070060 (Meadow Brook/High Mountain Brook)
- 02030103070070 (Wanaque River/Posts Brook (Below Reservoir)

These subwatersheds collectively intersect with Ringwood Borough, Wanaque Borough, Bloomingdale Borough, West Milford Township, Pompton Lakes Borough, with a small portion in Mahwah Township.

Major water services included in planning are Ringwood Water Department, Wanaque Water Department, Bloomingdale Water Department, Pompton Lakes MUA, Passaic Valley Water Company (Post Brook) – West Milford Township.

Net Water Availability

The analysis of net water availability (NWA) for this planning area indicates the following variation in NWA between 2000 and 2009.

Summary of Variation in Net Water Availability - 2000 - 2009

HUC14	Minimum	Maximum
02030103070060 (Meadow Brook/High Mountain Brook)	-0.6833	-0.2159
02030103070070 (Wanaque River/Posts Brook (below reservoir)	-0.6673	-0.2602
02030103070060 (Meadow Brook/High Mountain Brook)	-0.6833	-0.2159

Summary of Significant Causes of Deficit

Causes of the NWA deficits noted above include:

- HUC14 02030103070060 (Meadow Brook/High Mountain Brook) – the deficit in this subwatershed is driven by the consumptive uses from public supply pumpage in the Ringwood Water Department and the Wanaque Water Department systems.
- HUC14 02030103070070 (Wanaque River/Posts Brook (below reservoir) - the deficit in this subwatershed is driven by the consumptive uses from public supply pumpage in the Wanaque Water Department and Pompton Lakes MUA systems.

Water Conservation and Deficit Reduction and Elimination Strategies

The following preliminary strategies have been identified for this planning area. These strategies are not prescriptive. All municipalities are able to select alternative strategies that best suit the needs and goals of their specific WUCMP.

- Water Bill Structure/Comparison – highlight historical use patterns for residential customers
- Irrigation System Design – promotion of intelligent irrigation system design
- Leak Detection and Repair – implement programs to identify water system leaks and eliminate them.
- Rate Structure – develop water utility rate structures that promote water conservation.
- Golf Course Water Use – work with golf courses to promote water conservation efforts
- Stormwater Ordinance – promote recharge and or infiltration within the subwatershed.

Monitoring and Implementation Plans

The mitigation strategies selected to reduce the deficit in the subwatersheds must be evaluated periodically. An annual review of each strategy will be conducted to determine its effectiveness, and a more detailed biennial review will update the Net Water Availability tables of this WUCMP.

It is important that annual determinations/analysis/monitoring be conducted to verify the effectiveness of the implementation plan.

Introduction

Purpose and Scope

The Highlands Regional Master Plan (RMP) requires that conforming municipalities develop a "Water Use and Conservation Management Plan" that reflects the policies and objectives of the RMP. Specifically, conforming municipalities are required to develop Water Use and Conservation Management Plans "that will set priorities for the use of available water (where net water availability is positive) and will establish methods to reduce and, where feasible, eliminate deficits where they exist".[1]

Implementation of the RMP will require extensive cooperation among all municipal governing bodies and major water users in the region. Conformance with the RMP is intended to align municipal and county plans, regulations and programs with the goals, policies, and objectives of the RMP, including preservation of the availability and quality of surface water and ground water resources throughout the Highlands region.

One of the highest priority objectives described in the RMP is to restore and protect water resources within the Highlands Region. The development of Water Use and Conservation Management Plans specific to HUC14[2] subwatersheds is intended to address the requirements of this objective in a practical way that is applicable to each subwatershed.

The RMP provides a method for determining how much water is routinely available for human use, as differentiated from water available for maintenance of ecosystem integrity and for maintenance of minimum levels in reservoirs and other surface water. The method determines Net Water Availability for each HUC14 subwatershed.[3] Where Net Water Availability is positive, future human use of water supply is supported. Where Net Water Availability is negative, action is needed to address the deficit.

This document serves as a Planning Tool for municipalities to ultimately develop Water Use and Conservation Management Plans specific for that particular municipality. Although HUC14s included within this document do not encompass an entire municipality, municipalities can use the Plan developed for these subwatersheds as examples and guidelines for developing full scale municipal plans.

1 Highlands Regional Master Plan, (Highlands Council, 2008), p. 159.

2 Referring to the Hydrologic Unit Code (HUC) system established by the United States Geological Survey.

3 Highlands Regional Master Plan, (Highlands Council, 2008), p. 160, Policy 2B2.

Water Use and Conservation Management Plan (WUCMP) Goals and Policy Overview

Net Water Availability is total available groundwater minus consumptive and depletive water uses. Net Water Availability varies greatly from one area within the Highlands Region to another. Some areas have a water surplus (positive Net Water Availability). Other areas are in significant deficit (negative Net Water Availability). To reduce or eliminate the water deficits within the Region, Water Use and Conservation Management Plans are required under RMP Objective 2B8c:

> *Water Use and Conservation Management Plans shall be required through municipal Plan Conformance for all subwatersheds to meet the policies and objectives of Goal 2B, to ensure efficient use of water through water conservation and Low Impact Development Best Management Practices, and to avoid the creation of new deficits in Net Water Availability. Where developed for Current Deficit Areas, the plans shall include provisions to reduce or manage consumptive and depletive uses of ground and surface waters as necessary to reduce or eliminate deficits in Net Water Availability, or to ensure continued stream flows to downstream Current Deficit Areas from Existing Constrained Areas, to the maximum extent practicable within each HUC14 subwatershed. Water Use and Conservation Management Plans shall demonstrate through a detailed implementation plan and schedule how and when the current deficit will be resolved in a subwatershed prior to approval for new water uses in the subwatersheds with the most severe deficits (e.g., in excess of 0.25 million gallons per day or mgd), and the plan shall be implemented prior to initiation of new water uses.*

Implementation Strategy

Implementation of the goals, policies and objectives of the RMP regarding water deficit restoration consists of the following components, which will be incorporated into each WUCMP by subwatershed for the Highlands Region (from Highlands Council, 2008):

- Identify HUC14 subwatersheds that have a deficit of water availability or a surplus of water availability
- Verify the net water availability analysis and any associated deficits
- Develop a Water Use and Conservation Management Plan for conforming municipalities, especially those whose water supply is in a deficit subwatershed
- For complex systems or where the development of deficit reduction plans for multiple subwatersheds is more appropriate, collaborate with NJDEP and affected interests to develop Water Use and Conservation Management Plans at a larger scale
- Coordinate with NJDEP so that the water allocation permit process, including transfers of water between subwatersheds where required, supports the reduction and elimination of water deficits.

This WUCMP includes the following components:

- **Identification of water sources and uses** – The Highlands Region uses both groundwater and surface water for potable water supply. Additional uses include irrigation (including agricultural), commercial, industrial and institutional.
- **Expanded evaluation of Net Water Availability** (expanded from the original analysis in the RMP) – Original calculations of Net Water Availability were based on maximum water use in 2003. This analysis has been expanded to include available data from 2000-2009.
- **Deficit mitigation strategies** – This section includes water conservation measures (such as high efficiency irrigation techniques, rainwater harvesting, and low-flow plumbing fixtures), review of reuse potential, and storage alternatives.
- **Funding opportunities** – Approaches that may be available to fund the mitigation actions specified within this plan.
- **Monitoring plan** – Ongoing monitoring of water use and validation of the performance of mitigation actions.
- **Deficit reduction and elimination strategy and implementation plan**– Identify deficit reduction targets, responsible parties, a schedule for action and implementation, and funding mechanisms.

Scope and Applicability

This WUCMP covers 16.8 square miles within the Highlands Region and includes Ringwood Borough, Wanaque Borough, Bloomingdale Borough, West Milford Township, Pompton Lakes Borough, with a small portion in Mahwah Township (Figure 1). The area included in this WUCMP consists of two subwatersheds designated by Hydrologic Unit Code (HUC14) as follows:

- 02030103070060 (Meadow Brook/High Mountain Brook)
- 02030103070070 (Wanaque River/Posts Brook (Below Reservoir)

As mentioned above, the WUCMP presented within this document serves as a Planning Tool for each municipality. Implementation strategies presented herein are offered as examples, and may not be suitable for each particular municipality. Participants are encouraged to review various implementation strategies (whether listed in this WUCMP or not) and identify those that represent the best opportunity to achieve their planning goals.

Municipal plans including parts of this study area may include numerous HUC14 subwatersheds beyond those included in this document. For example, six HUC14 subwatersheds intersect the boundary of Wanaque Borough. However, there are several subwatersheds that intersect the Township boundary, but have no major water uses or returns within Wanaque Borough. Therefore, only the anticipated water use associated with domestic supply for that portion of the Township within those subwatersheds is required for inclusion into the municipal WUCMP. A full calculation of Net Water Availability for the remainder of these subwatersheds is not necessary.

However, in cases where significant water use occurs within a subwatershed, and is located both within and outside the Township boundary, a full analysis on that particular subwatershed would be required.

Responsibility for implementing strategies within that subwatershed would be assigned to each contributing municipality based on a flow (or use)-weighted approach.

WUCMP Area Characteristics

Background

This WUCMP area is in Ringwood Borough, Wanaque Borough, Bloomingdale Borough, West Milford Township, Pompton Lakes Borough, with a small portion in Mahwah Township. The two subwatersheds are addressed through a single WUCMP because they are hydrologically connected, share water resources through public utilities, and have similar land uses. Therefore, improved results can be achieved through a single planning process.

Land Use Capability/Land Cover

Land Use Capability Zones

The Highlands Region is classified into three Land Use Capability Zones:

- **Protection Zone** – Areas having high value in terms of forested resources, critical habitat, water quality and quantity, and ecological function, and having limited or no capacity to support human development without adversely affecting the overall ecological function of the Highlands Region. This zone has one sub-zone, Wildlife Management.
- **Conservation Zone** - Areas that have significant environmental features that should be preserved and protected from non-agricultural development. This zone has one sub-zone, Conservation Environmentally-Constrained.
- **Existing Community Zone** - Areas characterized by extensive and intensive existing development that may have capacity to support additional human development without adversely affecting the ecological value of the Highlands Region. This zone has two sub-zones: Existing Community Environmentally-Constrained, and Lake Community.

Of the 16.8 square miles covered by this WUCMP, 72% of the land falls within the Protection Zone and 20% of the land falls within the Existing Community Zone, and 8% of the land falls within the Lake Community Subzone. Figure 2 shows the Land Use Capability Map of the three zones described above for this WUCMP.

Preservation and Planning Areas

This WUCMP is divided between the Highlands Planning and Preservation Area boundaries. Approximately 21% is in the Highlands Planning Area and the remaining 79% is in the Highlands Preservation Area.

Figure 3 shows the delineation of the Preservation and Planning Areas in the vicinity of this WUCMP area.

Land Use/Zoning

The WUCMP area is primarily residential, state owned, and forested land. Figure 4 depicts the layout of all land use within the WUCMP area.

There are developed centers along County Route 511 (Ringwood Avenue) in and around Haskell and Wanaque. The remainder of the subwatersheds is forested, with significant areas of no development.

NJDEP 2007 impervious surface estimates for these subwatersheds are shown on Figure 5.

A number of public open spaces are located in these subwatersheds. They include:

- Norvin Green State Forest
- Ramapo Mountain Reservation
- Wanaque Ridge
- Addis Park
- Memorial Park
- Pioneer Park/Painted Forest
- Back Beach Park
- Dragonfly Meadows
- Federal Hill

Figure 6 shows an aerial view of the subwatersheds.

Major Hydrologic Features

The HUC14 subwatersheds addressed by this WUCMP consists of many hydrological features, which include rivers, streams, tributaries and a number of lakes.

Wanaque Reservoir is situated in a subwatershed immediately upstream of the study area.

Lakes located within the WUCMP area include:

- Brushwood Pond
- Hidden Valley Lake
- Skyline Lakes
- Fountain Spring Lake
- Stephens Lake
- Lake Washington
- Twin Lakes
- Upper Twin Lake
- Lower Morse Lake
- Upper Morse Lake
- Lake Iosco
- Glen Wild Lake
- Post Brook Farms Lake
- Algonuian Lake
- Gordon Lakes
- Zeliff Pond
- Shady Lake.

The major rivers and streams in the WUCMP include:

- Wanaque River
- High Mountain Brook
- Meadow Brook
- Green Swamp Brook
- Posts Brook

The largest hydrologic features are the Wanaque River, Lake Ioscoe and Glen Wild Lake. The Wanaque River is a tributary of the Pequannock River which flows through northern Passaic County. From the north, the Wanaque River flows into the Wanaque Reservoir and leaves from the Raymond Dam, at the southeast end of the reservoir, to its confluence with the Pequannock River further downstream.

The United States Geological Survey (USGS) maintains multiple stream gauges and monitoring stations are within the subwatersheds. Figure 7 shows the locations of USGS stream gauges in the vicinity of the subwatersheds.

The subwatersheds in this WUCMP area also wrap around the south and east border of the Wanaque Reservoir.

Geology and Soil Properties

The subwatersheds in the WUCMP area are located within the Highlands Physiographic Province, characterized by a series of discontinuous rounded ridges separated by deep narrow valleys. The Highlands Physiographic Province consists of igneous and metamorphic formations, although sedimentary and meta-sedimentary rocks are also present.

Overall, the bedrock in these subwatersheds is made up of igneous and metamorphic rocks (granite, gneiss and schist). The bedrock in the Pompton Lakes region of the subwatersheds is made up of not only igneous and metamorphic rock but also bedrocks including the Martinsburg Formation and Jutland Sequence, Brunswick aquifer and Basalt bedrock. Figure 8 displays the bedrock geology within the subwatersheds. Igneous rock is formed through the cooling and solidification of magma or lava. Metamorphic rock is rock created by transformation of an existing rock type when subjected to heat and pressure. These rock types consist of dense rocks as compared to sedimentary rock. These hard rock produces lateral flow (above the bedrock and toward streams) once water reaches the bedrock. Martinsburg Formation and Jutland Sequence refer to bedrock of claystone slate, siltstone, sandstone, with minor limestone and dolomite. Groundwater from the bedrock in this area is typically fresh, slightly alkaline and moderately hard. The Brunswick aquifer refers to bedrock of sandstone, siltstone and shale of the Passaic, Towaco, Feltville and Boonton Formations. Groundwater from this bedrock is normally fresh, slightly alkaline, non-corrosive and hard. Basalt bedrock is hard, dense and highly-fractured igneous rock. The ground water which is stored and transmitted in the fractures is normally fresh, slightly to highly alkaline, moderately hard and of the calcium-bicarbonate type.

Identification of Water Sources and Uses

Water System Profile

Description

This WUCMP area is served by five water systems: the Bloomingdale Water Department, Pompton Lakes MUA, Ringwood Water Department, Wanaque Borough Water Department, and the Passaic Valley Water Commission. Homes and businesses outside the public water service areas are served by privately owned ground water wells.

Facilities

Figure 9 indicates the public supply wells identified within the WUCMP area, only some of which are associated with the two township utilities.

Service Areas

The service areas within the WUCMP area are:

- Ringwood Water Department -
- Wanaque Water Department
- Bloomingdale Water Department
- Pompton Lakes MUA
- Passaic Valley Water Company (Post Brook) – West Milford Township

The above service areas can be seen in Figure 9.

Allocation and Firm Capacity

Table 2 lists the existing public groundwater wells in this WUCMP.

Firm capacity is defined as the pumping and/or treatment capacity of the water system when the largest pumping unit or treatment unit is out of service. Subtracting the total peak daily demand from the firm capacity may result in a water supply deficit (when the total peak is greater than firm capacity) or a surplus.

Firm capacity and allocation are based on an entire water system, not individual wells. There may be wells outside of the particular HUC14 that are included within the water system, and thus the allocation and firm capacity numbers.

Table 1 - Summary of Public Groundwater Wells in HUC14 02030103070060, 02030103070070

Water Purveyor	System	Well ID No.	Pump Rate (GPM)	Allocation (MGM)	Firm Capacity (MGD)
Ringwood Water Department	Main Supply	Well 7*	200	40	2.554
		Well 9R	510		
Wanaque Water Department	Not specified	Meadow Brook Well 1	500	39	2.660
		Midvale Well 3	180		
		Haskell Well 1	725		
Pompton Lakes MUA	Not specified	Well 3	1,280	60	2.671

* pumpage not reported for well during the study period.

Remaining Firm Capacity

The Remaining Firm Capacity of the water systems in these subwatersheds is shown below. All data provided below is the most current available through NJDEP's Division of Water Supply and Geoscience (accessed May 9, 2012).

Ringwood Water Department

The total peak daily demand for this system was 1.473 mgd which occurred in July 2007.

The Remaining Firm Capacity of this system is 1.081 mgd.

Wanaque Water Department

The total peak daily demand for this system was 1.852 mgd which occurred in December 2007.

The Remaining Firm Capacity of this system is 0.808 mgd.

Pompton Lakes MUA

The total peak daily demand for this system was 1.604 mgd which occurred in June 2007.

The Remaining Firm Capacity of this system is 1.067 mgd.

Wastewater Management

Description

Three areas within these subwatersheds are served by public centralized wastewater collection and treatment. The Sewer Service Areas are shown in Figure 10.

Wanaque Valley RSA DSF

The service area for the Wanaque Valley RSA Domestic Sewerage Facility (DSF) primarily serves the areas in an around Haskell and Wanaque.

Pompton Lakes MUA DSF

The service area for the Pompton Lakes MUA DSF is Pompton Lakes Borough.

Bloomingdale Sewer Utility

The service area for Bloomingdale Borough Sewer Utility consists of residential lots around Glen Wild Lake, Lake Iosco, Morse Lake, Upper Morse Lake, and the parcels south of these lakes in the subwatersheds.

Treatment for wastewater collected through the Bloomindale Sewer Utility is provided by the Two Bridges Sewerage Authority (TBSA).

The remaining areas within these subwatersheds are served by individual subsurface sewage disposal (septic systems).

Facilities

Following are wastewater treatment facilities that discharge within the subwatersheds

- Wanaque Valley RSA
- Ringwood Acres
- Ringwood Plaza

The location of the wastewater treatment facilities is shown in Figure 10.

Stakeholders

Potential stakeholders within these subwatersheds include the following:

- Primary municipal stakeholders: Pompton Lakes Borough, Wanaque Borough, Ringwood Borough, Ringwood Water Department
- Wanaque Water Department
- Wanaque Valley RSA
- Pompton Lakes MUA
- Bloomindale Borough Sewer Utility
- Residents of Wanaque Borough, Pompton Lakes Borough, Ringwood Borough, and West Milford Borough

Additional stakeholders include Ringwood Association (Ringwood Plaza) which operates commercial DSF facilities which discharge to groundwater.

While these subwatersheds includes portions of Mahwah Township (Bergen), West Milford Township, and Bloomingdale Borough, these areas are relatively unpopulated and unserved by water service, and do not play a meaningful role in water use for this WUCMP area. Therefore, they are not been listed as stakeholders above.

Analysis of Net Water Availability

Introduction

Net Water Availability is Ground Water Availability minus consumptive and depletive water uses. Ground Water Availability is the portion of Ground Water Capacity that can be provided for human use without harm to other ground water users, aquatic ecosystems or downstream users. The Highlands RMP defines Ground Water Capacity based on the Low Flow Margin component of the Low Flow Margin of Safety Method. Low Flow Margin and Ground Water Availability are discussed below.

Low Flow Margin

Low Flow Margin is the margin between two stream low flow statistics: September median flow and 7 day-10 year low flow (7Q10). Low Flow Margin is derived for each HUC14 subwatershed using data from streams in a relatively unaltered state. The 7Q10 is the lowest total flow over seven consecutive days during a ten year period. It has been used in quantifying passing flow requirements. The 7Q10 is also often used to define an extreme low flow condition for water quality based effluent limits applied to wastewater discharges. A critical flow regime for aquatic ecosystems is the lowest monthly flow, which in New Jersey and the Highlands tends to occur in September. The Low Flow Margin is the difference between 7Q10 and September median flow, which in the Highlands is always a positive sum.[4]

Low Flow Margin is used to calculate Ground Water Capacity, or the natural ability of the watershed to support base flow.[5] Ground Water Capacity is derived from Low Flow Margin, but is adjusted for the consumptive uses incorporated into the stream flow statistics used to derive Low Flow Margin. Ground Water Capacity equals Low Flow Margin multiplied by 1.02, based on a USGS study that showed existing consumptive uses are roughly 2 percent of Low Flow Margin.

Ground Water Availability

Ground Water Availability is that portion of Ground Water Capacity that is available for human uses (absent other constraints).[2]

The following threshold values were established by the Highlands Council:

[4] Highlands Council Technical Report, Water Resources Volume II Water Use and Availability" (Highlands Council, 2008), p. 46.

Table 2 - Ground Water Availability Thresholds as Percentage of Ground Water Capacity[5]

Land Use Capability Zone	Standard Threshold Capability
Protection Zone	5% LFM
Conservation Zone	5% LFM (non-agriculture) 10% LFM (agriculture)
Existing Community Zone	20% LFM

These subwatersheds addressed by this WUCMP are predominantly within the Protection Zone, so according to the rules established in the Highlands RMP and Technical Report Vol. II, Ground Water Capacity is multiplied by 5% to arrive at Ground Water Availability. Ground Water Availability for the two subwatersheds is presented below:

Table 3 - Ground Water Availability

HUC14 Description	Ground Water Availability (mgd)
02030103070070 Meadow Brook/High Mountain Brook,	0.0386
HUC14 02030103070070 Wanaque River/Posts Brook (below Reservoir))	0.0836

Net Water Availability

Calculation of Net Water Availability

Net Water Availability (NWA) is Ground Water Availability minus any consumptive and depletive uses within the subwatersheds. When NWA is positive, ground water supply is available for human uses. When NWA is negative, insufficient ground water is available to support additional human use.

Consumptive water use is defined as water that is lost within the subwatersheds and is not returned as recharge or as discharge to a stream within the subwatersheds. An example of a consumptive use is irrigation, in which most of the water evaporates and does not recharge the aquifer system. Depletive water uses are those in which water is exported out of the subwatersheds. A typical example of depletive use is conveyance of wastewater out of the subwatersheds to a wastewater treatment plant that discharges in another subwatershed.

NWA was originally calculated using maximum water withdrawals from 2003, which represented the most recently available compiled and checked data. The NWA values for the subwatersheds in the

[5] Highlands Council Technical Report, Water Resources Volume II Water Use and Availability" (Highlands Council, 2008), p. 121.

Highlands Council Technical Report "Water Resources Volume II Water Use and Availability" (2008) for the subwatersheds are presented below:

Table 4 - Published Net Water Availability

HUC14 Description	Net Water Availability (mgd)
02030103070060 (Meadow Brook/High Mountain Brook)	-0.6428
02030103070070 (Wanaque River/Posts Brook (below reservoir)	-0.3543

This total published NWA reflects a deficit of nearly 1.0 million gallons per day.

As part of this analysis, updates to the NWA calculation were performed for these subwatersheds to adjust for the following:

- Additional data for the period 2000-2002 and 2004-2009
- Septic system return for those areas served by public water but not by public sewer.

Water uses within these subwatersheds are domestic ground water and community public supply with public community supply use far exceeding that of domestic ground water. There are no surface water withdrawals or other use types (e.g., commercial, agricultural) reported within the subwatersheds.

Public Community water supply use is listed in Table 5.

Water Supply

Public Community Supply

Following is a summary of Community Public Supply withdrawals within these subwatersheds:

Table 5 - Water Supply Withdrawals

HUC14/Water Purveyor	Category	Withdrawals*	
		Peak Summer Month	Peak Withdrawal (MGM)
02030103070060 (Meadow Brook/High Mountain Brook)			
Ringwood Water Department	Public Supply	Jul 2000	21.0
Wanaque Water Department	Public Supply	Jun 2005	8.0
02030103070070 (Wanaque River/Posts Brook (below reservoir)			
Pompton Lakes MUA	Public Supply	Jun 2007	27.0
Wanaque Water Department	Public Supply	Jul 2002	32.3

*Raw pumpage
MGM = million gallons per month

Domestic Well Ground Water Usage

Domestic Well Ground Water Usage is an estimate of private well withdrawals within the subwatersheds for areas not served by the public supply. It was calculated based on population estimates for the subwatersheds from the 2000 Census, multiplies by a factor of 100 gallons per person per day as identified by the Highlands Council.[6]

Table 6 - Domestic Ground Water Usage

HUC14	Domestic Ground Water Usage (mgd)
02030103070060	0.0618
02030103070070	0.1271
TOTAL	0.1889

Municipal Consumptive/Depletive Uses

Groundwater models used in support of the Highlands Regional Net Water Availability analysis show that the impact on September stream flows of consumptive/depletive (C/D) ground water use during the summer is not 1:1, but roughly 1:0.9.[7] In other words, 1 gallon of C/D water use is calculated to

[7] Highlands Council Technical Report, "Water Resources Volume II Water Use and Availability" (Highlands Council, 2008), p. 116.

[7] Highlands Council Technical Report, "Water Resources Volume II Water Use and Availability" (Highlands Council, 2008), p. 116.

reduce Ground Water Availability in September by 0.9 gallons. Therefore, ground water use (raw pumpage) during the summer month with the highest demand was multiplied by 0.9 to reflect this impact. The factor is not applied to surface water diversions, which are based on September withdrawals that have an immediate impact on stream flows.

Consumptive water uses such as irrigation are further adjusted using consumptive use coefficients. In many instances, the water is not conveyed a long distance through a water utility network. Therefore, it is assumed that the withdrawal, use and discharge occur in the same location. Consumptive use coefficients reflect the percentage of the consumptive use that is lost and is not returned to the aquifer. [8]

For public community water uses, the calculation of consumptive and depletive uses must consider the possible import/export of water, and the potential return of the water as a wastewater discharge. In these situations, consumptive/depletive use in the portion of the water supply service area that is coincident with a wastewater service area is associated with the wastewater discharge from that sewered area. Any remainder of the consumptive use is allocated among the areas on public water service that discharge to individual septic systems. Water exported to a different subwatershed, such as a wastewater treatment plant, are considered depletive. Depletive uses, by their nature, have an effective consumptive use coefficient of 1.0.

Revised Net Water Availability

As part of this analysis, revisions to the Net Water Availability calculation were conducted to include more recent public supply water use data.

Net Water Availability was calculated for each of the years 2000-2009, incorporating additional water supply pumpage data from users in the subwatersheds. Pumping during summer months is typically greatest and has the largest impact on September base flow, which is used in calculating Net Water Availability. Therefore, maximum aggregate monthly water usage from June, July or August was used to calculate updated C/D use for these subwatersheds.

It should be noted that the maximum month in this planning document may vary from subwatershed to subwatershed. There are instances where a portion of a water supply system is included within the subwatershed from more than one purveyor. For the municipal analysis, the total distribution system pumping (by pressure zone, if available) for each water purveyor should be calculated for each water purveyor and the maximum month chosen based off of that calculation.

[8] Highlands Council Technical Report, "Water Resources Volume II Water Use and Availability" (Highlands Council, 2008), p. 119.

Table 7 - Re-evaluated Net Water Availability
02030103070060 (Meadow Brook/High Mountain Brook)

Year	Ag Ground Water Availability (mgd)	Non-Ag Ground Water Availability (mgd)	Total Non-Ag Consumptive Use (mgd)[1]	Imported Septic Return (mgd)[2]	Ag Net Water Availability (mgd)	Non-Ag Net Water Availability (mgd)[3]	Surplus for Potential Use (mgd)[4]
Published	0	0.0386	0.681	0	0	-0.6428	N/A
2000	0	0.0386	0.725	0	0	-0.6867	0
2001	0	0.0386	0.538	0	0	-0.4995	0
2002	0	0.0386	0.269	0	0	-0.2301	0
2003	0	0.0386	0.547	0	0	-0.5083	0
2004	0	0.0386	0.482	0	0	-0.4430	0
2005	0	0.0386	0.461	0	0	-0.4228	0
2006	0	0.0386	0.370	0	0	-0.3315	0
2007	0	0.0386	Missing Data	0	0	N/A	N/A
2008	0	0.0386	Missing Data	0	0	N/A	N/A
2009	0	0.0386	Missing Data	0	0	N/A	N/A

[1] [Adjusted Consumptive Domestic Use] + [Consumptive Public Supply Use] + [Total Non-Ag Consumptive Use from Surface Water] + [Other Non-Ag Consumptive Uses].

[2] From Public Supply wells outside the HUC and/or wastewater return to groundwater originating outside HUC.

[3] [Non-Ag Ground Water Availability] – [Total Non-Ag Consumptive Use] + [Imported Septic Return]

[4] Occurs when there is an import of water which is returned to the HUC through septic return

"Missing Data": One or more sources of data were not reported.

"N/A": One or more of the components to C/D use is missing and C/D use and NWA could not be calculated.

Refer to Appendix for further explanation of terms.

Table 8 - Re-evaluated Net Water Availability
02030103070070 (Wanaque River/Posts Brook (below Reservoir)

Year	Ag Ground Water Availability (mgd)	Non-Ag Ground Water Availability (mgd)	Total Non-Ag Consumptive Use (mgd)[1]	Imported Septic Return (mgd)[2]	Ag Net Water Availability (mgd)	Non-Ag Net Water Availability (mgd)[3]	Surplus for Potential Use (mgd)[4]
Published	0	0.0836	0.438	0	0	-0.3543	N/A
2000	0	0.0836	0.406	0	0	-0.3220[5]	0
2001	0	0.0836	0.698	0	0	-0.6145	0
2002	0	0.0836	0.752	0	0	-0.6686	0
2003	0	0.0836	0.392	0	0	-0.3083	0
2004	0	0.0836	0.344	0	0	-0.2606	0
2005	0	0.0836	0.727	0	0	-0.6430	0
2006	0	0.0836	0.479	0	0	-0.3954	0
2007	0	0.0836	N/A	No Data	0	N/A	N/A
2008	0	0.0836	N/A	No Data	0	N/A	N/A
2009	0	0.0836	N/A	No Data	0	N/A	N/A

[1] [Adjusted Consumptive Domestic Use] + [Consumptive Public Supply Use] + [Total Non-Ag Consumptive Use from Surface Water] + [Other Non-Ag Consumptive Use from Ground Waters].

[2] From Public Supply wells outside the HUC and/or wastewater return to groundwater originating outside HUC.

[3] [Non-Ag Ground Water Availability] – [Total Non-Ag Consumptive Use] + [Imported Septic Return]

[4] Occurs when there is an import of water which is returned to the HUC through septic return

[5] Missing septic return data for June 2000 although likely not significant to NWA.

"Missing Data": One or more sources of data were not reported.

"N/A": One or more of the components to C/D use is missing and C/D use and NWA could not be calculated.

Refer to Appendix for further explanation of terms.

Summary of Significant Causes of Deficit

Following is a summary of the range of re-evaluated NWA calculations:

Table 9 - Summary of NWA Results

HUC14	NWA – Minimum (mgd)	NWA Maximum (mgd)
02030103070060 (Meadow Brook/High Mountain Brook)	-0.6833	-0.2159
02030103070070 (Wanaque River/Posts Brook (below reservoir)	-0.6673	-0.2602

mgd = million gallons per day

Causes of the deficits noted above include:

- HUC14 02030103070060 (Meadow Brook/High Mountain Brook) – the deficit in this subwatershed is driven by the consumptive uses from public supply pumpage in the Ringwood Water Department and the Wanaque Water Department systems.
- HUC14 02030103070070 (Wanaque River/Posts Brook (below reservoir) - the deficit in this subwatershed is driven by the consumptive uses from public supply pumpage in the Wanaque Water Department and Pompton Lakes MUA systems.

Characterization of Deficit

The Net Water Availability in these subwatersheds is categorized as severe deficit (>0.25 mgd). Data through 2009 suggest that the use patterns are consistent, and that no significant trend upward or downward is evident. Therefore, the years for which data are available appear to be appropriate years on which to base deficit mitigation planning.

Water Conservation/Deficit Mitigation Strategies

The following table summarizes the deficit mitigation strategies that these subwatersheds could use to reduce and/or eliminate the water deficit in these subwatersheds.

Table 10 - Summary of Conservation and Deficit Mitigation Strategies

Measure	Res	Com/ Indust/ Inst	Water Purveyor	Ag	Mun
Water Use Reduction					
Heating System Upgrades		✓			
Hot Water Heater Upgrade	✓	✓			
Hydrant Locks			✓		
Avoid Overspray	✓	✓		✓	
Building and Pipe Insulation	✓	✓			
Cleaning	✓	✓		✓	
Community Garden	✓				✓
Cooling System Upgrades		✓			
Crop and Soil Selection				✓	
Dishwasher Upgrade	✓	✓			
Drip Irrigation	✓	✓			
Drought Contingency Plans			✓		✓
Equipment Condensation		✓	✓		
Irrigation Conservation	✓	✓		✓	✓
Irrigation Education			✓		✓
Irrigation System Design	✓	✓		✓	✓
Landscape Design	✓	✓			
Landscape Incentive Program					✓
Leak Detection and Repair	✓	✓	✓	✓	
Low Flow Faucets/Faucet Aerators	✓	✓			
Low Flow Shower Fixtures	✓	✓			
Low Flow Toilet Fixtures	✓	✓			
Low Volume Irrigation	✓	✓			
Maintenance	✓	✓	✓	✓	
Meter Calibration/Replacement			✓		
Night Watering	✓	✓		✓	
Plumbing Incentive Program		✓			✓
Pre-Rinse/Commercial Kitchen Upgrades		✓			
Process Water Optimization		✓			
Public Education Handouts		✓	✓		✓

Table 10 - Summary of Conservation and Deficit Mitigation Strategies

Measure	Res	Com/ Indust/ Inst	Water Purveyor	Ag	Mun
Public Workshops					✓
Rate Structure			✓		
Revised Irrigation Ordinance					✓
School Conservation Programs			✓		✓
Submetering	✓	✓	✓		
Swimming Pool Covers	✓				
Turfgrass Selection					
Washing Machine Upgrade	✓	✓			
Water Bill Structure/Comparison	✓	✓	✓		
Water Conservation Programs		✓	✓	✓	✓
Water Treatment Improvements			✓		
Waterless Urinals		✓			
Well Optimization			✓		
Reuse and Reclamation					
Graywater Recharge	✓	✓			
Graywater Reuse for Irrigation	✓	✓			
Internal Infrastructure Graywater Reuse		✓			
Internal Infrastructure Stormwater Reuse		✓			
Storage					
Composting	✓	✓		✓	
Install Geotextiles Under Plantings	✓	✓			
Rainwater Harvesting/Rainwater Cistern	✓	✓			
Water Storage Tank Management			✓		
Recharge					
Assisted Infiltration/Enhanced Recharge	✓	✓			✓
Building Interceptor Dykes, Swales and Berms	✓	✓			✓
Injection Wells		✓			
Modifications to Zoning					✓
Stormwater Ordinance					✓
Porous Paving	✓	✓			✓
Rainwater Harvesting/Rain Gardens	✓	✓			
Retrofit Existing Detention Basins		✓			✓

Res = Residential; Com = Commercial; Indust = Industrial; Inst = Institutional; Ag = Agricultural; Mun = Municipal

Evaluation and Ranking of Water Conservation Strategies

Evaluation

To determine the best mitigation strategies for this WUCMP, a simple qualitative ranking system was developed. This system considers seven attributes of each potential strategy from the perspective of a user in these subwatersheds. The seven attributes are:

1. *Feasibility* – Can the strategy be implemented by a specific type of user? Strategies that have a high ranking for Feasibility can be implemented relatively easily. Implementing a night watering program is considered a highly feasible deficit mitigation strategy.
2. *Effectiveness* – If the strategy is implemented by a specific type of user, will it create the desired effect? Strategies that have a high ranking for Effectiveness offer the best opportunity to directly reduce the NWA deficit. Example: Using a broom rather than a hose or power washer to clean a driveway is considered a highly effective deficit mitigation strategy.
3. *Resilience and Reliability* – Once the strategy is implemented, how susceptible is it to failure, and how much maintenance will it require to remain in operation? Strategies that have a high ranking for Resilience and Reliability are expected to be implemented consistently over long periods. Example: Installation of a graywater system is considered a highly resilient and reliable deficit mitigation strategy.
4. *Reduction Potential and Market Penetration* – Once the strategy is working, what regional reduction in deficit can be expected, based on the number of users likely to implement the strategy? Strategies that have high rankings for Reduction Potential and Market Penetration offer opportunity for implementation by the greatest number of stakeholders. Example: Installation of low-flow plumbing fixtures is highly ranked for reduction potential and market penetration.
5. *Administrative Complexity and Availability of Implementing Entities* – How difficult will it be to launch, monitor, and evaluate the effectiveness of the mitigation strategy? Strategies that are highly ranked for Administrative Complexity and Availability of Implementing Entities are simple to implement and can be implemented by existing entities. Examples: modifying a stormwater ordinance or implementing a new rate structure.
6. *Cost and Cost Effectiveness* – What is the efficiency of a mitigation strategy in terms of cost per unit of reduction? Strategies that are highly ranked for Cost and Cost Effectiveness offer the "biggest bang for the buck". Examples: plumbing incentive programs and drought contingency plans.
7. *Schedule* – How long will it take to implement the mitigation strategy? Strategies that are highly ranked for Schedule can be implemented quickly. Example: public education handouts.

Each mitigation strategy was ranked for each of the seven attributes listed above. A value of 1, 2 or 3 was assigned based on the degree to which each strategy embodies each attribute. A ranking of 3 indicates:

- Highly feasible
- Very effective
- Highly resilient and reliable
- High potential for deficit reduction and market penetration
- Simple strategy to administer; implementing entities available
- Short time required to implement

Scores for each strategy are listed in Tables 11 through 15 for residential, commercial/industrial/institutional and water purveyors, agriculture, and municipalities respectively.

The evaluation was conducted under two scenarios and it is anticipated that it will be repeated based on stakeholder input regarding weights to be assigned to each attribute. The following scenarios were evaluated:

- Equal weight – each of the seven attributes was weighted equally. This is analogous to simply summing the scores in each table.
- Weighted for consumptive/depletive use reduction – a weight of 50% was assigned to the C/D reduction attribute and all other attributes were weighted equally (8.3% each).

Table 11 - Scoring for Conservation and Deficit Mitigation Strategies Applicable to Residential Users

Measure	Feasibility	Effectiveness	Resilient/ Reliable	Reduction Potential	Complexity	Cost	Schedule
Avoid Overspray	3	2	1	2	1	3	3
Building and Pipe Insulation	3	2	2	1	1	2	2
Cleaning	3	3	1	2	1	2	2
Community Garden	3	2	2	1	1	2	1
Composting	3	2	2	1	1	3	3
Dishwasher Upgrade	3	2	3	2	1	2	2
Hot Water Heater Upgrade	3	2	3	2	1	2	2
Install Geotextiles Underneath Plantings	3	2	2	1	1	2	2
Irrigation Conservation	3	2	1	2	1	3	3
Irrigation System Design	3	2	3	1	1	2	2
Landscape Design	3	2	2	1	1	2	2
Leak Detection and Repair	1	1	1	1	1	1	1
Low Flow Faucets/Faucet Aerators	3	2	3	2	1	3	3
Low Flow Shower Fixtures	3	2	3	2	1	3	3
Low Flow Toilet Fixtures	3	2	3	2	1	2	3
Maintenance	3	2	2	1	1	2	3
Night Watering	3	2	2	2	1	3	3
Porous Paving	1	3	2	2	1	1	1
Rainwater Harvesting/Rain Barrels	3	3	2	1	1	2	2
Rainwater Harvesting/Rain Gardens	3	2	2	1	1	2	2
Submetering	1	1	2	1	1	1	1
Swimming Pool Covers	3	2	2	1	1	1	3
Washing Machine Upgrade	3	2	3	2	1	2	3
Water Bill Structure/Comparison	3	3	3	3	3	3	3

Table 12 - Scoring for Conservation and Deficit Mitigation Strategies Applicable to Commercial/Industrial/Institutional Users

Measure	Feasibility	Effectiveness	Resilient/ Reliable	Reduction Potential	Complexity	Cost	Schedule
Avoid Overspray	3	2	1	2	2	3	3
Building and Pipe Insulation	3	2	2	1	2	2	2
Building Interceptor Dykes, Swales and Berms	1	2	2	2	2	2	2
Cleaning	3	3	2	2	2	2	2
Composting	2	1	1	1	2	2	3
Cooling System Upgrades	2	2	2	2	1	1	1
Dishwasher Upgrade	3	2	3	2	2	2	2
Graywater Systems	3	2	3	2	2	2	1
Heating System Upgrades	2	2	2	2	1	1	1
Hot Water Heater Upgrade	3	2	3	2	2	2	2
Install Geotextiles Underneath Plantings	3	2	2	1	2	2	2
Internal Infrastructure Graywater Reuse	1	2	2	2	1	1	1
Internal Infrastructure Stormwater Reuse	3	2	2	2	2	2	1
Irrigation Conservation	3	2	1	2	2	3	3
Irrigation System Design	3	3	3	3	2	2	3
Landscape Design	3	2	2	1	2	2	2
Leak Detection and Repair	2	2	2	1	2	1	1
Low Flow Faucets/Faucet Aerators	3	2	3	2	2	2	3
Low Flow Shower Fixtures	2	2	2	2	2	2	3
Low Flow Toilet Fixtures	3	2	3	2	2	2	3
Maintenance	3	2	2	1	2	2	3
Night Watering	3	2	2	2	2	3	3
Pre-Rinse Spray Valve and Commercial Kitchen Conservation	3	2	2	2	2	2	2
Public Education Handouts	3	2	1	1	1	3	3
Rainwater Harvesting/Rain Barrels	3	2	2	1	1	2	2

Table 12 - Scoring for Conservation and Deficit Mitigation Strategies Applicable to Commercial/Industrial/Institutional Users

Measure	Feasibility	Effectiveness	Resilient/ Reliable	Reduction Potential	Complexity	Cost	Schedule
Rainwater Harvesting/Rain Gardens	3	2	2	1	2	2	2
Submetering	1	1	2	1	1	1	1
Washing Machine Upgrade	2	2	3	1	2	2	3
Water Bill Structure/Comparison	2	2	3	3	3	3	3
Water Conservation Programs	3	2	1	2	2	3	3
Water Treatment Improvements	2	2	1	1	1	1	1
Waterless Restroom	1	2	1	2	1	1	1
Assisted Infiltration/Enhanced Recharge	3	2	2	2	2	2	2
Porous Paving	2	2	2	1	1	1	1
Injection Wells	1	3	2	2	1	1	1
Equipment Condensation	3	1	2	1	3	3	3
Retrofit Existing Detention Basins	3	3	3	3	2	2	1

Table 13 - Scoring for Conservation and Deficit Mitigation Strategies Applicable to Water Purveyors

Measure	Feasibility	Effectiveness	Resilient/ Reliable	Reduction Potential	Complexity	Cost	Schedule
Water Bill Structure/Comparison	3	3	3	3	3	3	3
Rate Structure	3	3	3	3	3	3	3
Meter Calibration/Replacement	2	2	2	2	3	2	1
Drought Contingency Plans	2	2	2	3	3	3	3
Water Treatment Improvements	3	3	3	3	3	3	2
Hydrant Locks	2	1	2	1	3	1	1
Well Optimization	3	2	2	2	3	2	2
Public Education Handouts	2	1	1	1	3	2	1
School Conservation Programs	2	2	2	1	3	3	1
Irrigation Education	2	2	2	1	2	3	1
Water Conservation Programs	3	3	1	1	3	2	3
Leak Detection and Repair	3	3	3	3	3	3	3
Submetering	2	2	2	2	3	2	3
Equipment Condensation	3	1	2	1	3	3	3
Maintenance	3	3	2	2	2	3	3
Water Storage Tank Management	3	2	3	2	3	2	3

Table 14 - Scoring for Conservation and Deficit Mitigation Strategies Applicable to Agriculture

Measure	Feasibility	Effectiveness	Resilient/ Reliable	Reduction Potential	Complexity	Cost	Schedule
Avoid Overspray	3	2	1	2	2	3	3
Cleaning	3	3	2	2	2	2	2
Compost	1	1	1	1	2	2	3
Crop and Soil Selection	1	2	1	2	1	3	3
Irrigation Conservation	3	2	1	2	2	3	3
Irrigation System Design	2	2	3	1	2	2	2
Leak Detection and Repair	2	2	2	1	3	2	2
Maintenance	3	2	2	1	2	3	3
Night Watering	2	2	2	2	2	3	3
Water Conservation Programs	3	2	1	2	2	3	3

Table 15 - Scoring for Conservation and Deficit Mitigation Strategies Applicable to Municipalities

Measure	Feasibility	Effectiveness	Resilient/ Reliable	Reduction Potential	Complexity	Cost	Schedule
Assisted Infiltration/Enhanced Recharge	3	2	2	2	1	2	2
Building Interceptor Dykes, Swales and Berms	2	1	2	2	1	2	2
Community Garden	3	2	2	1	1	2	1
Drought Contingency Plans	2	2	2	1	1	3	3
Irrigation Education	3	2	1	2	1	3	3
Irrigation System Design	3	2	3	1	1	2	2
Landscape Incentive Program	3	2	2	1	1	1	3
Modifications to Zoning	1	1	3	3	3	3	3
Modify Stormwater Ordinance	3	2	3	3	3	3	3
Plumbing Incentive Program	3	2	2	1	1	3	2
Porous Paving	1	3	2	2	1	1	1
Public Education Handouts	3	2	1	1	1	3	3
Public Workshops	3	2	1	1	2	3	3
Retrofit Existing Detention Basins	3	3	3	3	2	2	1
Revised Irrigation Ordinance (Odd/even, rain sensor requirements, etc.)	3	2	3	3	1	2	3
School Conservation Programs	3	2	1	1	2	2	3
Water Conservation Programs	3	2	1	2	1	3	3

Ranking of Deficit Mitigation Strategies

Deficit mitigation strategies that are relevant to the subwatersheds included in this WUCMP have been ranked and the top ten strategies for each water user category are listed in Tables 16 through 20. An evaluation program called EVAMIX was used to rank each strategy. EVAMIX is a well-tested multi-criterion evaluation program used to rank alternatives. The program takes raw data, both quantitative and qualitative, normalizes it, and uses the data to compare alternatives while helping stakeholders understand which factors have greater or lesser impact on the outcome. This process uses the scores that were assigned in Tables 11 through 15 and determines the *relative* weight of each of the categories or attributes. The weights for each attribute are relative to each other and the sum of the weights must equal 1.0 (100%). For example, a stakeholder who thought feasibility was the most important attribute might assign a weight of 40% to that attribute and 10% to each of the others.

Table 16 - Ranked Mitigation Management Strategies for Residential Users

Rank	Equal Weight	Weighted to C/D Reduction	Rank
1	Water Bill Structure/Comparison	Water Bill Structure/Comparison	1
2	Irrigation System Design	Irrigation System Design	2
3	Low Flow Faucets/Faucet Aerators	Low Flow Faucets/Faucet Aerators	3
3	Low Flow Shower Fixtures	Low Flow Shower Fixtures	3
5	Low Flow Toilet Fixtures	Low Flow Toilet Fixtures	5
5	Washing Machine Upgrade	Night Watering	5
7	Night Watering	Washing Machine Upgrade	5
8	Avoid Overspray	Avoid Overspray	8
8	Irrigation Conservation	Irrigation Conservation	8
10	Dishwasher Upgrade	Dishwasher Upgrade	10

Table 17 - Ranked Mitigation Management Strategies for Commercial/Industrial/Institutional Users

Rank	Equal Weight	Weighted to C/D Reduction	Rank
1	Irrigation System Design	Irrigation System Design	1
2	Water Bill Structure/Comparison	Water Bill Structure/Comparison	2
3	Retrofit Existing Detention Basins	Retrofit Existing Detention Basins	3
4	Low Flow Faucets/Faucet Aerators	Low Flow Faucets/Faucet Aerators	4
4	Low Flow Toilet Fixtures	Low Flow Toilet Fixtures	4
6	Night Watering	Night Watering	6
7	Cleaning	Cleaning	7
8	Dishwasher Upgrade	Dishwasher Upgrade	8
8	Hot Water Heater Upgrade	Hot Water Heater Upgrade	8
10	Water Conservation Programs	Water Conservation Programs	10

Table 18 - Ranked Mitigation Management Strategies for Water Purveyors

Rank	Equal Weight	Weighted to C/D Reduction	Rank
1	Leak Detection and Repair	Leak Detection and Repair	1
1	Rate Structure	Rate Structure	1
1	Water Bill Structure/Comparison	Water Bill Structure/Comparison	1
4	Water Treatment Improvements	Water Treatment Improvements	4
5	Water Storage Tank Management	Drought Contingency Plans	5
6	Maintenance	Water Storage Tank Management	6
7	Drought Contingency Plans	Maintenance	7
8	Equipment Condensation	Well Optimization	8
9	Water Conservation Programs	Submetering	9
10	Well Optimization	Meter Calibration/Replacement	10

Table 19 - Ranked Mitigation Management Strategies for Agriculture

Rank	Equal Weight	Weighted to C/D Reduction	Rank
1	Night Watering	Night Watering	1
2	Avoid Overspray	Avoid Overspray	2
2	Irrigation Conservation	Irrigation Conservation	2
2	Water Conservation Programs	Water Conservation Programs	2
5	Maintenance	Cleaning	5
6	Cleaning	Crop and Soil Selection	6
7	Leak Detection and Repair	Maintenance	7
8	Crop and Soil Selection	Leak Detection and Repair	8
9	Irrigation System Design	Irrigation System Design	9
10	Compost	Compost	10

Table 20 - Ranked Mitigation Management Strategies for Municipalities

Rank	Equal Weight	Weighted to C/D Reduction	Rank
1	Stormwater Ordinance	Stormwater Ordinance	1
2	Retrofit Existing Detention Basins	Retrofit Existing Detention Basins	2
3	Modifications to Zoning	Modifications to Zoning	3
4	Revised Irrigation Ordinance (Odd/even, rain sensor requirements, etc.)	Revised Irrigation Ordinance (Odd/even, rain sensor requirements, etc.)	4
5	Public Workshops	Irrigation Education	5
6	Irrigation Education	Water Conservation Programs	5
6	Water Conservation Programs	Assisted Infiltration/Enhanced Recharge	7
8	School Conservation Programs	Porous Paving	8
9	Public Education Handouts	Building Interceptor Dykes, Swales and Berms	9
10	Plumbing Incentive Program	Public Workshops	10

Funding Opportunities

Public Funding Sources

Highlands Council Planning Grants

The Highlands Council will approve the WUCMP following an opportunity for formal public review and comment. Upon approval, the WUCMP will become a component of the Plan Conformance process for the affected municipalities. The Highlands Act provides for state funding to support planning efforts necessary to implement Plan Conformance. In the case of a WUCMP, state funding is available to address necessary modifications (if any) to the Highlands Area Land Use Ordinance, and implementation planning for other components. In addition, the municipality may request additional planning funds to develop mitigation strategies. The Highlands Council is not currently authorized to provide capital grants for project implementation, but the Highlands Council will work with the municipalities to identify and obtain funding from other state and federal agencies (see below) for such purposes.

State Program Grants

The following state agencies should be considered for state program grants:

- New Jersey Department of Agriculture (NJDA)
- New Jersey Department of Environmental Protection (NJDEP)
- New Jersey Department of Community Affairs (DCA)

The official website for the State of New Jersey provides links to various grant opportunities throughout the state. The following is a direct link to state grants by department or agency:

http://www.nj.gov/nj/gov/njgov/grants.html

In addition, water supply, wastewater and stormwater infrastructure improvements may be eligible for low-interest loans from the New Jersey Environmental Infrastructure Financing Program:

http://www.njeit.org/

The Small Cities Community Development Block Grant (CDBG) program offers funding for local needs for which no other source of funding is available.

http://www.nj.gov/dca/divisions/dhcr/offices/cdbg.html

Federal Program Grants

Federal funding is available for water conservation and water use technology. Grants are one way to obtain funding for a water conservation project. A searchable database of federal program grants can be accessed at www.grants.gov. For federal grants the following agencies and their components should be considered:

- Environmental Protection Agency (EPA) – of note are:
  - The Catalog of Federal Funding Sources for Watershed Protection (http://cfpub.epa.gov/fedfund/)
  - Office of Wetlands, Oceans, and Watersheds – Watershed Funding (http://water.epa.gov/aboutow/owow/funding.cfm)
- United States Department of Agriculture (USDA)
- United States Department of Energy (USDOE)
- United States Department of the Interior (USDOI)
- United States Department of Housing and Urban Development (HUD) – including Community Development Block Grants (CDBG)
- USGS – including cooperative agreements

Grants may be available from multiple components of the agencies listed above, so when searching for grants, do not immediately rule out agencies with names different from those listed. Each grant in the Grants.gov database has a summary/description and eligibility requirements.

The Natural Resources Conservation Service (NRCS) is a notable component of the USDA to consider for funding.

Activities in planning for green building, including activities in the Leadership in Energy and Environmental Design (LEED) program, are supported by EPA through funding for governments, non-profit organizations, consumers and industries who are striving to conserve energy. The following website details some of the funding opportunities provided by EPA regarding green building:

http://www.epa.gov/greenbuilding/tools/funding.htm

Private Funding Sources

Development

Funding from development activities can be implemented through changes to construction codes and development review ordinances, including the Highlands Area Land Use Ordinance.

Commercial Entities

Cooperative events with local businesses can be used to raise funds or provide discounts to local stakeholders to promote water conservation.

Foundations

The following are some foundations that offer funding opportunities:

- National Fish and Wildlife Foundation (http://www.nfwf.org/)
- River Network (http://www.rivernetwork.org/)

- American Rivers (http://www.amrivers.org/)
- Center for Watershed Protection (http://www.cwp.org/)
- Trout Unlimited (http://www.tu.org/)

Other Non-Governmental Organizations

The American Water Works Association (AWWA) participates in grant and research programs for water conservation and technology. The following is a link to AWWA's website where current grant information may be found:

http://www.awwa.org/

The American Water Resources Association (AWRA) has information about water resources education, management and research.

http://www.awra.org/

Municipalities and Utilities

Municipal Capital Projects

Municipalities periodically repair, rehabilitate or replace municipal facilities. In municipal capital projects, incorporation of improved fixtures, irrigation methods, stormwater capture and recharge, and other methods for reducing water consumption and depletion can be highly cost-effective. Some water conservation methods have relatively short payback periods, especially those that reduce hot water use.

Utility Operations

Utilities also periodically repair, rehabilitate or replace their capital facilities, with most of the costs funded through user charges. These projects, when part of a planned preventive maintenance program, can reduce the long-term costs of operating the utility by minimizing the potential for emergency repairs. Utilities also may address constraints on water line service capacity by encouraging water conservation by customers. Such projects reduce both water losses and system stress.

Water Conservation, Deficit Reduction and Elimination Strategies

Note: Deficit Reduction Targets and Strategies will be established upon development of a full municipal WUCMP

Selected Strategies

Since these subwatersheds are primarily residential and the Net Water Availability deficit is severe, the selected strategies are focused around residential users and water purveyors.

Water Bill Structure/Comparison

This strategy highlights for the residents their usage in comparison to historical patterns and other users. Behavioral studies have found that people respond to peer pressure and normative behavior. This strategy aims to take advantage of that response. The premise is that when water users are aware of the positive behavior of others in their peer group, they are more likely to change their own behavior in a positive way.

Irrigation System Design

This strategy involves the promotion of intelligent irrigation system design for residential and commercial irrigation water use. Through the incorporation of scheduling techniques, efficient technology, and soil moisture sensors, the amount of water used for irrigation can be reduced.

Agricultural irrigation is not addressed under this strategy because no agricultural water use statistics are available for this subwatershed.

Leak Detection and Repair

The strategy involves the use of sonic or other methods to detect water escaping the distribution system. Leaks at stream crossings are among the most difficult to detect and repair.

Proactive programs for leak detection can reduce downtime for emergency repairs. Such programs should look to survey the entire system at least once every 5 years in a phased manner.

Rate Structure

This strategy entails the development of water utility rate structures that promote water conservation. Generally, these rate structures encourage customers to use less water while still providing affordable water, and informing the public about the real cost of this limited critical resource. Revenue from surcharge rates charged to high-use customers can be used to promote conservation through incentive and education programs.

Stormwater Ordinance

This strategy involves developing a stormwater ordinance or improving an existing stormwater ordinance to promote recharge and/or infiltration within the subwatersheds as development occurs, beyond typical minimum standards such as those contained in N.J.A.C. 7:8 et seq, N.J.A.C. 5:21 et seq. (Residential Site Improvement Standards), or the Highlands Area Land Use Ordinance.

Deficit Reduction Target

TBD upon development of a full municipal WUCMP.

Deficit Reduction Estimates

Water Bill/Structure Comparison

There are an estimated 14,000 persons in the water service areas within the WUCMP area (based on 2010 Census data). Approximately half the users will have above average water usage and could potentially be targeted by the strategy. It is reasonable to assume a 1% reduction in water usage using this deficit mitigation strategy, but higher rates are possible.[9]

Average water withdrawal in the existing areas served by public water supply in this WUCMP area is as follows:

- Ringwood Water Department – 0.423 mgd
- Wanaque Water Department – 1.050 mgd
- Pompton Lakes MUA – 0.610 mgd

Accordingly, the average total daily withdrawal is 2.083 mgd. Using the 1% reduction rate indicated above, approximately 20,800 gallons per day can be conserved.

Irrigation System Design

Some experts estimate that up to 50 percent of commercial and residential irrigation water use goes to waste due to evaporation, wind, improper system design, or overwatering.[10]. This strategy is focused on the design of intelligent irrigation system that utilize current technologies such as irrigation controllers, soil moisture sensors, rain shut off switches, or efficient sprinkler heads.

As the basis for this strategy, the total amount of irrigated land in the subwatersheds was estimated using a GIS analysis. Using NJDEP's 2007 Land Use/Land Cover feature dataset, land use types associated with residential, commercial, and athletic field land uses were isolated for this subwatershed.

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[9] Hoffman, Jeff, "*Calculating Conservation: The Competitive Power of the Water Bill*", The Aquifer, Vol 24, No. 4, Spring 2010.

[10] Outdoor Water Use in the United States, Environmental Protection Agency, Water Sense – An EPA Partnership, Retrieved from < http://www.epa.gov/WaterSense/pubs/outdoor.html >.

The total irrigated portion of the land use types indicated above was estimated to be 10% of the total pervious land area identified in the residential, commercial, and athletic field land use types.

The peak irrigation rate for residential, commercial, and athletic fields was estimated to be 8 gpm/acre. This is consistent with 1-inch of water per irrigation, occurring for 8 hours over a 7 day period.[11]

Based on the GIS analysis described above, the following table of acreage by land use type was developed:

Table 21 – Estimated Total Pervious Acres and Irrigated Acres by Land Use Type

County	Pervious Acres by Land Use Type			Total
	Residential	Commercial	Athletic Field	
Passaic	1,251	65	20	1,336
Total Acres	1,251	65	20	1,336
Estimated Total Irrigated Acres*	125	7	2	134

*Estimated Total Irrigated Acres = Total Pervious Acres x 10%

Based on the total irrigated acreage and a peak irrigation rate of 8 gpm/acre, a total of 1,069 gpm peak irrigation is estimated. However, this rate is estimated to occur for a total of 8-hours over the course of a 7-day period. Using these boundary conditions, this equates to an average irrigation water usage of approximately 73,000 gallons per day.

We have conservatively estimated irrigation water usage can be reduced by 10% using this strategy. Using this estimate, approximately 7,300 gallons per day can be conserved.

Leak Detection and Repair

Estimates of leak detection and repair will be based on "non-revenue water" which describes water that has been produced and supplied to the distribution system by the water purveyor, but is not delivered to customers. Leaks (real loss) are one component of non-revenue water. Other components include unauthorized consumption, customer metering inaccuracies, overflows at storage tanks, leakage at service connections. Real water loss within distribution systems are typically 10%.[12] This is consistent with current estimates of distribution system in New Jersey.[13]

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[11] New Jersey Irrigation Guide (June 2005), United States Department of Agriculture, Natural Resources Conservation Service, Somerset, NJ, Chapter 6, Table NJ 6.7, page NJ6-15.

[12] Lambert, Allan, Assessing non-revenue water and its components, Water Loss – IAP Task Force, Water21, August 2003, Issue 5.4, pp. 50-51.

[13] Caroom, Eliot, (2012-05-12), "Water utilities cleared by state to make swifter repairs (and increases to bills)", *The Star Ledger*. Retrieved from <http://www.nj.com/business/index.ssf/2012/05/water_utilities_cleared_by_sta.html>

A conservative estimate of 10% can be applied to the reduction of real water loss volume as the potential savings in water use.[14]

Average water withdrawal in the existing areas served by public water supply in this WUCMP area is as follows:

- Ringwood Water Department – 0.423 mgd
- Wanaque Water Department – 1.050 mgd
- Pompton Lakes MUA – 0.610 mgd

Accordingly, the average total daily withdrawal is 2.083 mgd. Based on the assumptions indicated above, the real water loss is estimated at 10% or 208,300 gallons per day. Using the 1% reduction rate indicated above, approximately 20,800 gallons per day can be conserved.

Rate Structure

The relationship between water rates and water usage/conservation has been the subject of study for many years. The economics of this unique relationship have been explored in various studies, and it is recognized that even within the Highlands, different rate structures may be required.

However, for the purposes of estimating potential water conservation, it is reasonable to assume reductions in water usage of 1% assuming a rate increase of 10%.[15]

Average water withdrawal in the existing areas served by public water supply in this WUCMP area is as follows:

- Ringwood Water Department – 0.423 mgd
- Wanaque Water Department – 1.050 mgd
- Pompton Lakes MUA – 0.610 mgd

Accordingly, the average total daily withdrawal is 2.083 mgd. Given a 10% increase in rates, and the resulting 1% reduction in water use, approximately 20,800 gallons per day can be conserved.

Stormwater Ordinance

The premise of this deficit mitigation strategy is that baseflow could be enhanced by the construction of recharge and/or infiltration basins.

In keeping with current NJDEP guidance, this strategy is based on the infiltration facilitated by a design storm of 0.31 inches (one-quarter of the NJDEP stormwater quality design storm of 1.25

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[14] Guidance Document, Water Leak Detection and Repair Program (August 2007), Georgia Environmental Protection Division, Watershed Protection Branch, Retrieved from <http://www1.gadnr.org/cws/Documents/Leak_Detection_and_Repair.pdf>

[15] American Water Works Association (AWWA). (2000). Principles of Water Rates, Fees, and Charges. *American Water Works Association Manual of Water Supply Rates, M1*. (Fifth Edition). Published by American Water Works Association.

inches).[16] For the purpose of this estimate, we are assuming 50% of the total rainfall is infiltrated and the basin is approximately 3 acres in size.

The above assumptions equate to 18,938 gallons of additional infiltration. Over a 90 day period, this equates to 210 gallons per day for an individual rainstorm. Larger basins or more frequent recharge will increase this estimate.

Summary of Savings Potential

Following is a summary table of the potential savings in water use estimated under this Plan:

Table 22 - Summary of Potential Water Use Reductions

Strategy	Potential Savings (gpd)
Water Bill/Structure Comparison	20,800
Irrigation System Design	7,300
Leak Detection and Repair	20,800
Rate Structure	20,800
Stormwater Ordinance*	210

*Note: this is on a per rainfall event basis.

The above table presents potential savings that are representative of withdrawals during the June-July-August period.

Selection of a combination of the above strategies should be considered as measures to help work toward achieving the Net Water Availability targets for this WUCMP area.

[16] Carleton, Glen B, Simulation of Groundwater Mounding Beneath Hypothetical Stormwater Infiltration Basins, Scientific Investigations Report 2010-5102, USGS, Reston, VA, 2010.

Monitoring

The mitigation strategies selected to reduce the deficit in the subwatershed must be evaluated periodically. A cursory annual review of each strategy will be conducted to determine its effectiveness and a more detailed biennial review will update the Net Water Availability tables of this WUCMP. The biennial review will include an analysis of the likelihood of achieving the target reduction in the Net Water Availability deficit via the mitigation strategy. The same analytical techniques used in the initial Net Water Availability determination will be used to determine the future deficit or surplus within the subwatershed.

For municipal plans, annual monitoring will be required. A monitoring form has been included here as Appendix B. This form will be made available online to facilitate efficient completion and submittal. It is anticipated that the form will be submitted to the Highlands Council on October 30th of each year, corresponding with submittal of water use forms to DEP. The monitoring period that will be reflected by the form will be October 1 through September 30 (although data will represent June through September of that particular year). One form will be submitted for each HUC14 subwatershed within the municipality. Appendix B includes an example subwatershed for Sparta Township.

Each year, a review will be conducted of water use data for these watersheds for the preceding year. This data can be obtained from the water purveyor (currently Ringwood Water Department, Wanaque Water Department, and Pompton Lakes MUA).

The NJDEP well database, which identifies well systems by Public Water System Identification (PWSID) numbers, should also be monitored annually to see if any public, residential, commercial/industrial, irrigation, or other category of well has been constructed in the preceding year. Once the population is adjusted and new wells are identified, water use in these watersheds should be re-calculated and compared to the results of the initial calculation.

USGS stream gauges and monitoring stations are present within these subwatersheds, and may be a valuable source of data. Each gauge and station should be evaluated to determine if it offers a viable means for monitoring Deficit Mitigation Strategies.

A re-evaluation of septic system returns for these subwatersheds should be performed biennially. The re-evaluation should update the total number of septic systems and identify any new or expanded public sanitary sewer service within the subwatersheds.

The existing ArcGIS database should be updated to show any new stormwater management basins where enhanced recharge has been implemented and any new sewer discharge points. After identification of new water return systems such as these, a new water return calculation will be performed and compared with the baseline calculation.

The re-evaluation will end with a calculation of the current deficit/surplus. As the WUCMP is implemented and adjusted, the results of each biennial review should show a reduced deficit or a surplus.

Stakeholder Participation and Ongoing Monitoring

Public education plays a significant role in the success of deficit mitigation strategies. Before any strategies are eliminated or adjusted, a comparison of actual public efforts and projected public efforts should be made. This comparison can be made using the results of public surveys or inquiries to utilities and municipalities regarding their participation. The survey data should be tabulated and analyzed statistically. Statistical analysis is necessary because only a fraction of the population will respond to the survey. In preparation of this plan, an initial participation rate for each mitigation strategy was assumed. The results of the survey will provide a basis for estimating the actual participation rate for each strategy. These results may show that a mitigation strategy was unsuccessful primarily due to low participation. In that case, other strategies should be considered that may be more effective.

Implementation Plan

Annual Program Implementation Plan

If a deficit remains after an annual review is conducted, several issues need to be addressed. It is expected that as the implementation plan is tested and fine-tuned, it will be refined throughout the process.

The annual review to refine the implementation plan should include:

- Verification of implementation for each mitigation strategy
- Assessment of effectiveness for each mitigation strategy
- Verification of effectiveness for each mitigation strategy
- If proven non-effective, where is the process going wrong? Where can improvements be made?
- Elimination/addition of strategies.
- Creation/revision of timeline to achieve deficit reduction/elimination.

Overall, it is important that annual determinations/analysis/monitoring be conducted to verify the effectiveness of the implementation plan. A database that stores annual monitoring data should be kept, beginning with implementation of this plan and continuing after deficit elimination, to document continued compliance and ensure that a deficit does not become apparent. If monitoring is efficient and thorough, elimination of deficits should be reasonably achievable.

Strategies

The following deficit mitigation strategies have been chosen for implementation.

Water Bill Structure/Comparison

The implementation plan consists of coordinating with Ringwood and Wanaque Water Departments to develop a customizable charts or tables to compare and contrast individual water usage based on subwatershed totals.

Irrigation System Design

The implementation plan for this strategy involves water usage data review with the water department and performance of a water audit on the largest irrigation water users in the subwatershed. Once the water audit is complete, a plan can be developed with the irrigation system owners to incorporate intelligent irrigation system design parameters and measure water conserved.

Leak Detection and Repair

The implementation plan for this strategy is a study by the local water utilities, potentially in concert with other stakeholders, to identify leaks within the subwatersheds, and repairs to eliminate any meaningful leaks found.

Estimates of quantities lost from the identified leaks should be kept for reference and for comparison with the results of water use reduction measurements.

Rate Structure

Implementation of a rate structure to promote water conservation will include determination of revenue requirements, costs of services, the marginal price of water, and future water demand targets. The responsible entity should evaluate different cost structures and implement the one best suited to the service area and its residents.

Education and engagement of customers and elected officials are highly recommended for all phases of this strategy.

Stormwater Ordinance

The implementation plan for this strategy involves research from municipal stakeholders to determine what elements are required for inclusion in the stormwater ordinance, or how the existing stormwater ordinance will be modified.

Schedule to Achieve Water Balance

It is anticipated that a full year will be required for implementation of the Water Bill Structure/Comparison and Rate Structure strategies, and that it will be several years before significant reductions result from them. If a 10% rate increase is implemented, it is recommended that it be implemented over a period of several years.

The Irrigation System Design strategy will require several years to implement from education of the public and business community, through implementation of water conserving irrigation-based measures.

The leak study can be completed in phases over the first five years, and associated modest repairs can be performed under existing maintenance budgets. Larger or more widespread repairs may require several years to implement.

Development of the new or revised ordinances can be accomplished in a year, and savings can be evident in the first year after adoption.

However, due to the size of the deficit in these subwatersheds it is difficult to predict when water balance can be achieved. This topic should be revisited after implementation of the strategies mentioned above to determine a reasonable timeframe.

Responsible Parties

Responsible parties are the following:

- Wanaque Water Department
- Ringwood Water Department
- Pompton Lake MUA
- Residents of Wanaque Borough, Pompton Lakes Borough, and Ringwood Borough, and Bloomingdale Borough.
- Municipal Governments of Wanaque Borough, Pompton Lakes Borough, and Ringwood Borough, and Bloomindale Borough.

We recommend development of committees representing each community to monitor and promote progress at the municipal level.

Funding Commitments

TBD

Next Steps

To be determined by Stakeholders.

Appendix A

Background

Net water availability is defined as Ground Water Availability minus consumptive and depletive water uses. Following is a description of the different components that were used to derive the estimate of Re-Evaluated Net Water Availability in this Water Use and Conservation Management Plan (WUCMP).

Basis for Net Water Availability

The following columns of data have been provided in the WUCMP:

Year	Ag Ground Water Availability (mgd)	Non-Ag Ground Water Availability (mgd)	Total Non-Ag Consumptive Use (mgd)	Imported Septic Return (mgd)	Net Water Availability (mgd)	Surplus for Potential Use (mgd)

The columns of data shown above are explained in the following sections.

Year

This column refers to the calendar year from which the data was obtained.

Ground Water Availability

Ground Water Availability is that portion of Ground Water Capacity that is available for human uses, absent other constraints. For the purpose of the WUCMP calculations, Ground Water Availability is divided into two components. They are:

Agricultural (Ag) Ground Water Availability

Agricultural (Ag) Ground Water Availability – Ag Ground Water Availability is not applicable in each watershed. This type of Ground Water Availability is used when the Conservation Zone covers a majority of the watershed. In this case, Ag Ground Water Availability is established and tracked separately to support sustainable agriculture.[17]

Non- Agricultural (Non-Ag) Ground Water Availability

Non-Agricultural (Non-Ag) Ground Water Availability is the predominant type of Ground Water Availability and is used as the basis for net water availability for most watersheds.

[17] Highlands Council Technical Report, Water Resources Volume II Water Use and Availability" (Highlands Council, 2008), p. 123.

Consumptive/Depletive Uses

Consumptive and Depletive (Water) Use totals are derived from Ground Water Pumpage and Surface Water Withdrawals. These uses are divided into two categories: Consumptive and Depletive. These two types of water use are defined as follows:

- Consumptive Uses - That part of water withdrawn that is evaporated, transpired, incorporated into products or crops, consumed by humans or livestock or otherwise removed from the immediate water environment other than by transport through pipelines and other conveyances as potable water or wastewater.
- Depletive Uses - Those water uses that physically transfer water from one watershed to another through pipelines and other conveyances as potable water or wastewater, resulting in a loss of water to the originating watershed.

Total Non-Ag Consumptive Use

Non-Ag Consumptive Use is the calculated as follows:

Total Non-Ag Consumptive Use = [Adjusted Consumptive Domestic Use] +
[Consumptive Public Supply Use] +
[Total Non-Ag Consumptive Use from Surface Water]+
[Other Non- Ag Consumptive Use from Ground Water]

Adjusted Consumptive Domestic Use

Adjusted Consumptive Domestic Use is an estimate of the consumptive uses from areas within the watershed that are served by private residential ground water wells and are served by septic systems.

Adjusted Consumptive Domestic Use is based on the Highlands estimate of residential well pumpage, when reduced by that portion that may be served by public sewer.

Consumptive Public Supply Use

Consumptive Public Supply Use is based on the Public Potable Supply pumpage for all public potable water facilities in the watershed that get their raw water supplies from ground water. The cumulative (raw) pumpage for these facilities was multiplied by 0.9 to account for the observed impact of maximum month pumping on annual base (stream) flows. The resultant is referred to as Adjusted Public Potable Supply.

To calculate Consumptive Public Supply, the Adjusted Public Potable Supply is reduced by the following amounts:

- Septic Return from Public Supply - This value represents the non-consumptive portion of public supply use that is returned to the watershed through septic systems.
- September Wastewater Return to Surface Water – This value represents the cumulative discharges from wastewater treatment plants, where the discharge is located in the watershed.

Total Non-Ag Consumptive Use from Surface Water

Total Non-Ag Consumptive Surface Water Use is a measure of the cumulative consumptive uses from within the watershed where the source is taken from surface water.

This quantity often includes golf course irrigation.

Other Non-Ag Consumptive Use from Ground Water

Other Non-Ag Consumptive Uses include the following where the source is taken from ground water

- Golf course irrigation (where this use is distinguished from that supplied by surface water)
- Commercial facilities with metered usage (e.g. restaurants, businesses, and other typical non-residential uses)
- Industrial facilities with metered usage (e.g. manufacturing)
- Cooling water with metered usage
- Institutional facilities with metered usage (e.g. hospitals, schools)

Imported Septic Return

Imported Septic Return occurs when an existing area served by public potable water supply, and the same areas are also served by septic systems. In addition, Imported Septic Return only applies when the source of public potable water supply under comes from outside the watershed.

Net Water Availability

In most circumstances, Non-Ag Net Water Availability is referred to as simply Net Water Availability and is distinguished from Ag Net Water Availability.

(Non-Ag) Net Water Availability is the amount of Non-Ag Ground Water Availability remaining after deducting Total Non-Ag Consumptive Uses and adding Imported Septic Return.

Net Water Availability cannot exceed Ground Water Availability, whether it is Ag or Non-Ag.

When the watershed has been designated as a Conservation Zone, Ag Net Water Availability will be calculated.

Surplus for Potential Use

When Imported Septic Return is sufficiently large, the calculation of (Non-Ag) Net Water Availability can exceed Non-Ag Ground Water Availability. In such cases, (Non-Ag) Net Water Availability is set to Non-Ag Ground Water Availability and the remaining portion is allocated under Surplus for Potential Use.

Appendix B – Monitoring Form

Appendix B includes a sample Water Use and Conservation Management Monitoring Form. See "Monitoring" section (pg. 40) for instructions.

Water Use and Conservation Management Plan (WUCMP)
Monitoring Form

Sparta Township

Year:	**2012**	**Prepared By:**	
HUC14:	02040105040050		
Name:	Sparta Junction tribs	**Title:**	
Ground Water Availability (mgd):	0.1008		
Baseline Net Water Availability (mgd):	-0.6163	**Date:**	

Diversion / Recharge Inventory

Owner	Type		No. of Wells / Intakes / Discharges	MGD[1]	Adjusted MGD	Total C/D Water Use (mgd)	Net Water Availability (NWA; mgd)
	Recharge or Withdrawal	GW or SW					
Wells / Intakes						**0.8390**	**-0.7317**
Domestic Supply (private wells)	Withdrawal	Ground Water	100	0.1418	0.1277		
Sparta Township	Withdrawal	Ground Water	8	1.2958	1.1662		
Diamond Sand and Gravel	Withdrawal	Ground Water	1	0.0051	0.0046		
Skyview Golf Club	Withdrawal	Ground Water	2	0.0084	0.0075		
Limecrest Quarry Developers/Crest Aggregates	Withdrawal	Ground Water	1	0.0000	0.0000		
Diamond Sand and Gravel	Withdrawal	Ground Water	1	0.0242	0.0217		
P Michelotti & Sons	Withdrawal	Ground Water	1	0.0000	0.0000		
Skyview Golf Club	Withdrawal	Surface Water	1	0.0030	0.0030		
Diamond Sand and Gravel	Withdrawal	Surface Water	1	0.0867	0.0867		
Limecrest Quarry Developers/Crest Aggregates	Withdrawal	Surface Water	3	0.0000	0.0000		
P Michelotti & Sons	Withdrawal	Surface Water	1	0.0000	0.0000		
Wastewater Discharge							
On-site Wastewater Disposal Systems (septic)	Recharge	Ground Water	100	0.3871	0.3937		

Water Use and Conservation Management Plan (WUCMP)
Monitoring Form

Sparta Township

Year:	**2012**	**Prepared By:**	
HUC14:	02040105040050		
Name:	Sparta Junction tribs	**Title:**	
Ground Water Availability (mgd):	0.1008		
Baseline Net Water Availability (mgd):	-0.6163	**Date:**	

Mitigation Strategies

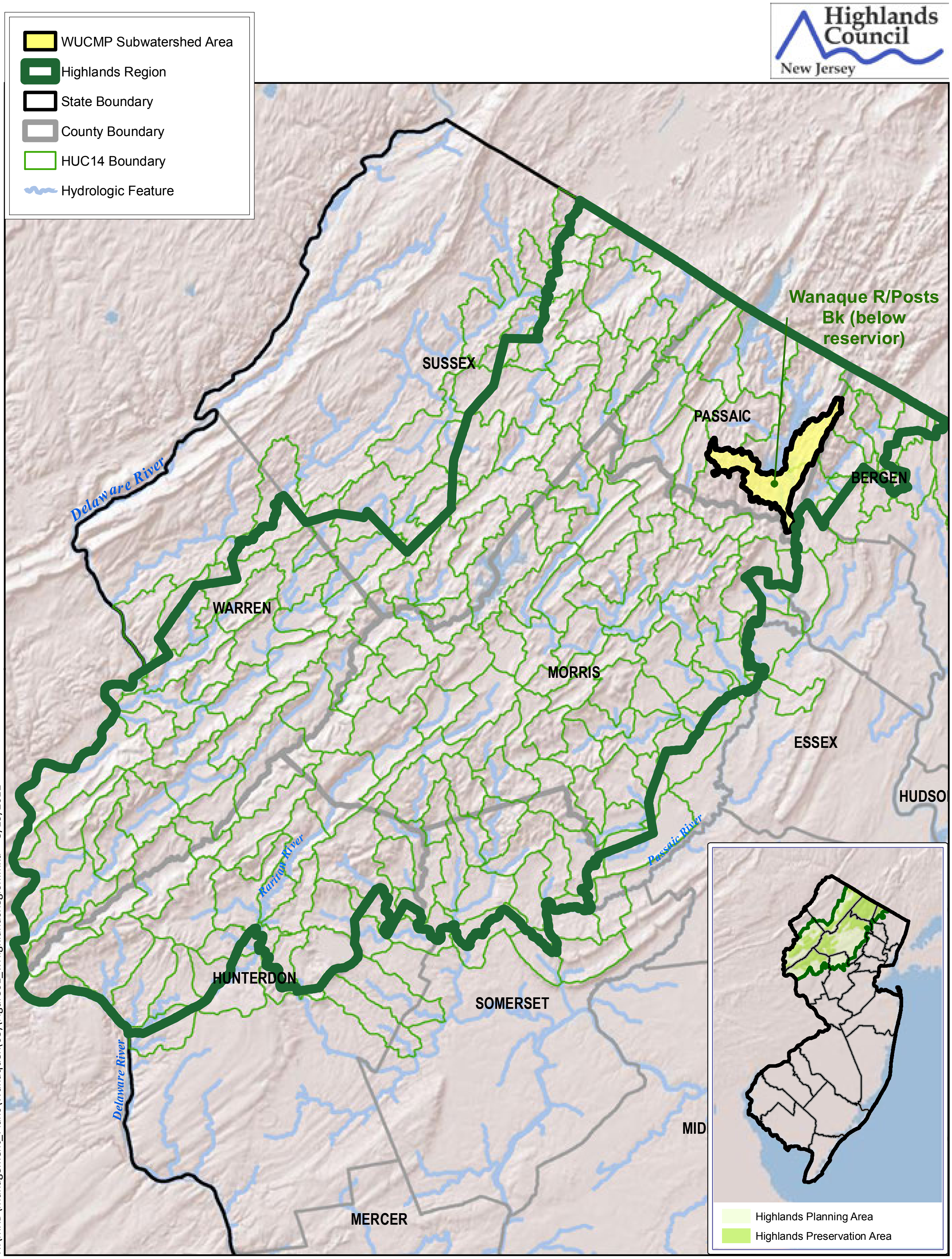
Owner	Type	Year Installed	Anticipated Benefit (gpd)	Adjustment Required to NWA? (Y/N)[2]	Revised NWA (mgd)	Planned Mitigation Strategies for Next Year
					-0.7317117	
					-0.7317117	

Monitoring Sites

Stream	Gage Location	Year Installed	Collection Frequency	Minimum September Flow of Record (cfs)	Minimum September Flow (cfs)

1. Maximum withdrawal from June, July or August and associated return for groundwater (must be consistent month within HUC). September withdrawal or return for surface water.
2. For mitigation strategies that are not directly related to water use (rate structures, water conservation structures). Stormwater BMPs are an example.
3. Use one table per HUC14.

Highlands Council New Jersey



H:\MXD\Management_Plans\WanaqueR(03)\Figure01_wHighlandsRegion.mxd 3/19/2012

Miles
0 2 4 8
0 4 8 16
Kilometers
N

HUC14	Subwatershed Name
02030103070060	Meadow Brook/High Mountain Brook
02030103070070	Wanaque R/Posts Bk (below reservior)

Figure 1
Highlands Region and WUCMP Location

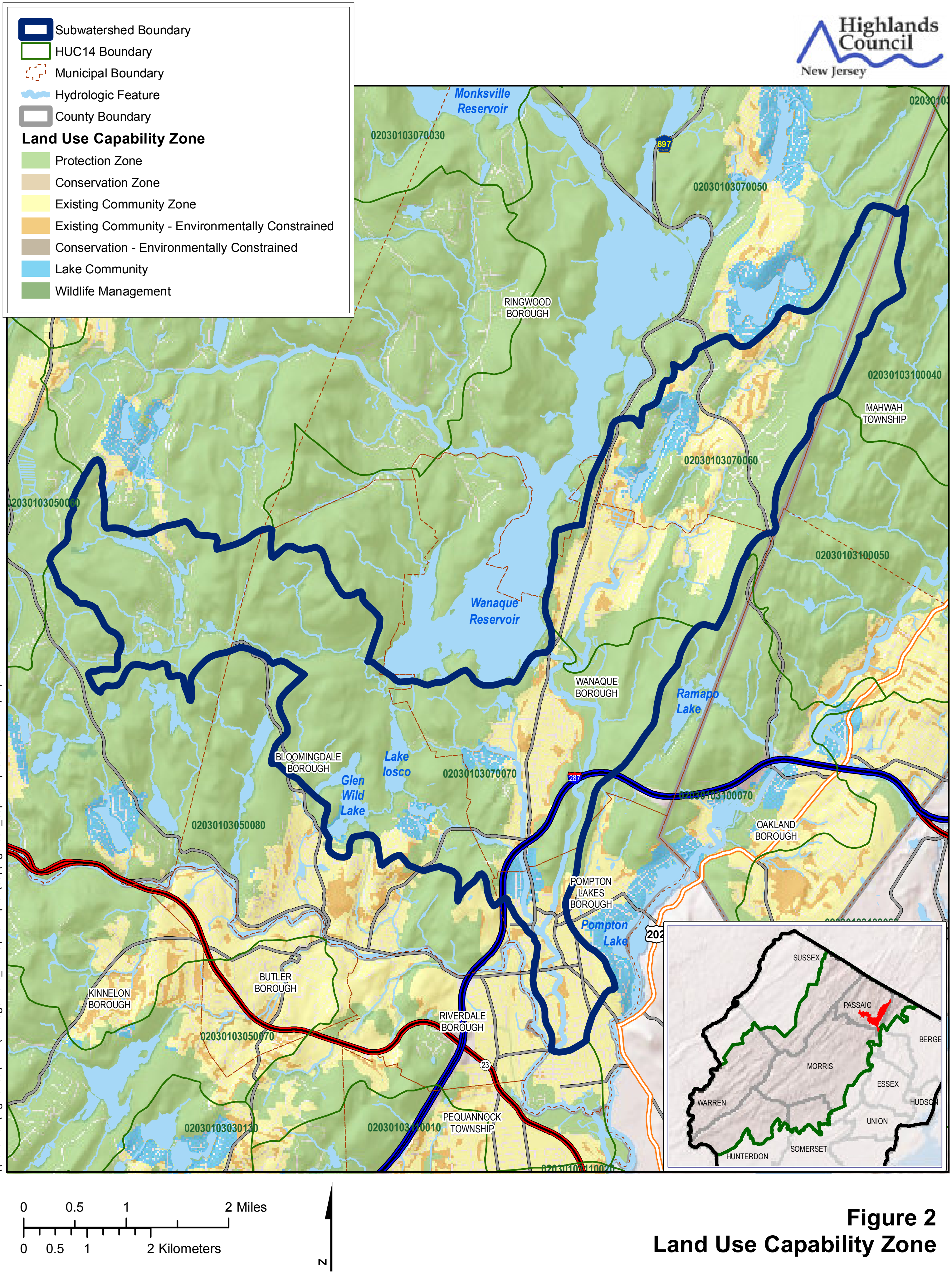


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Figure 2
Land Use Capability Zone

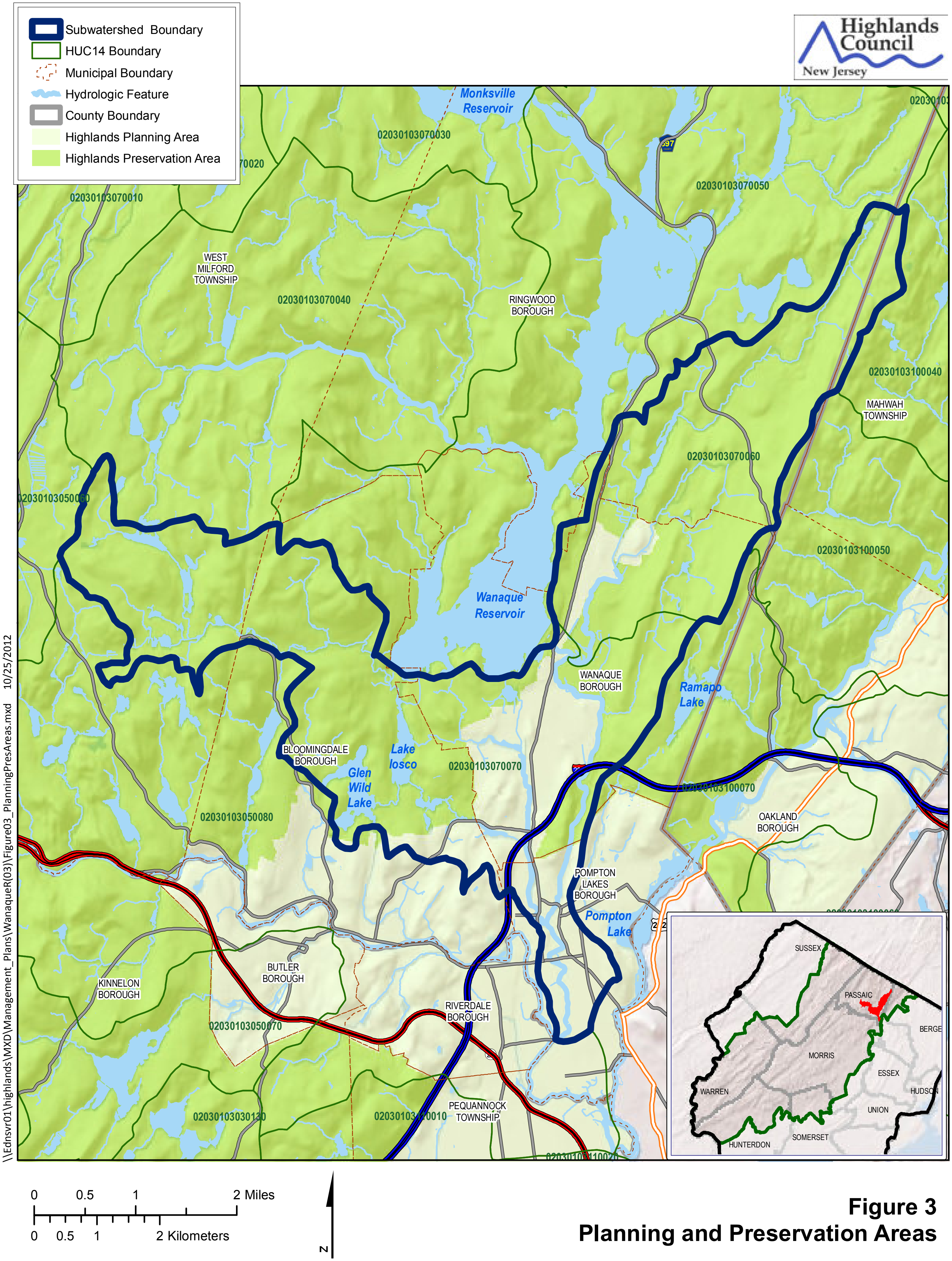
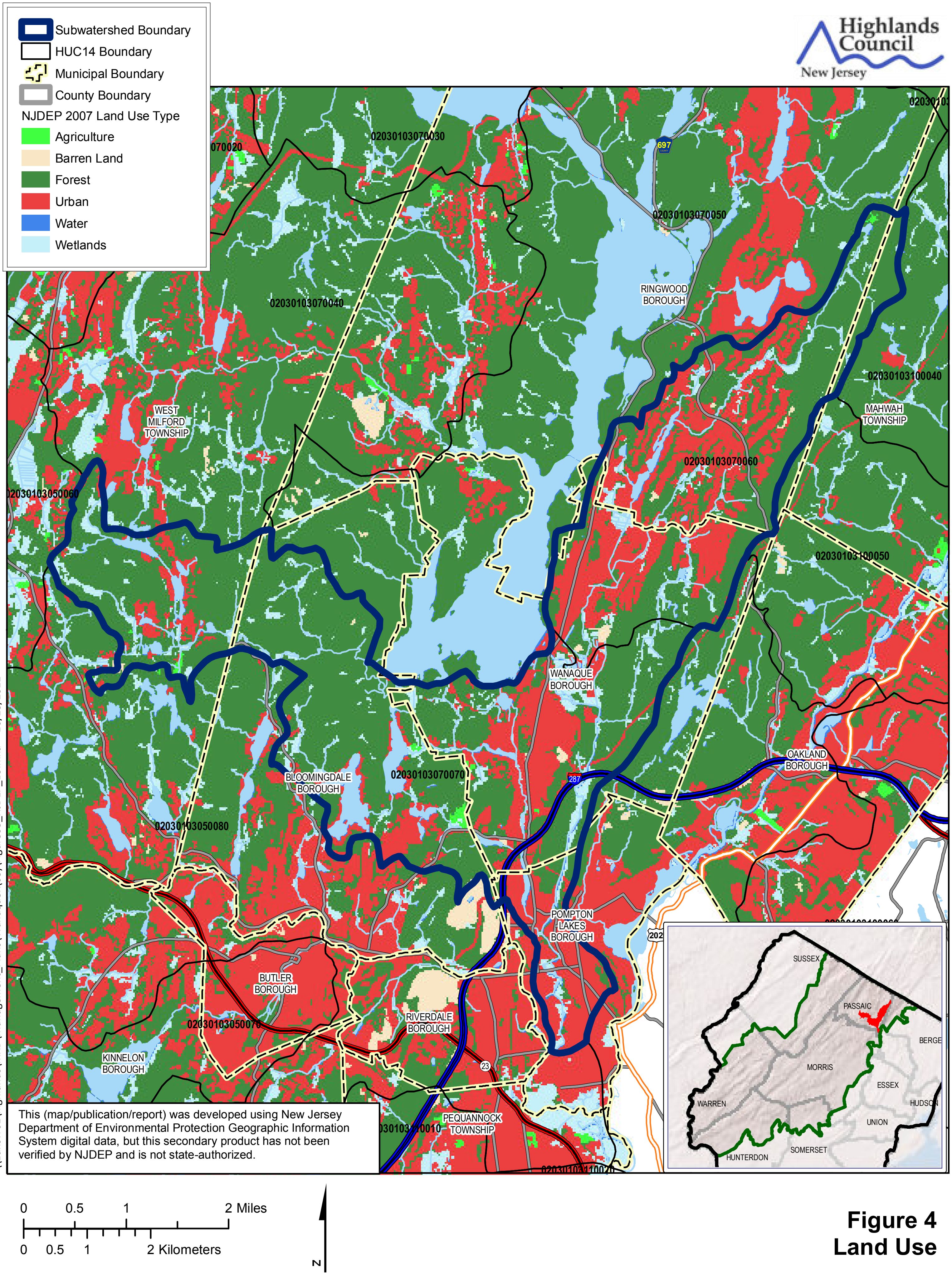


Figure 3
Planning and Preservation Areas



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

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Figure 4
Land Use

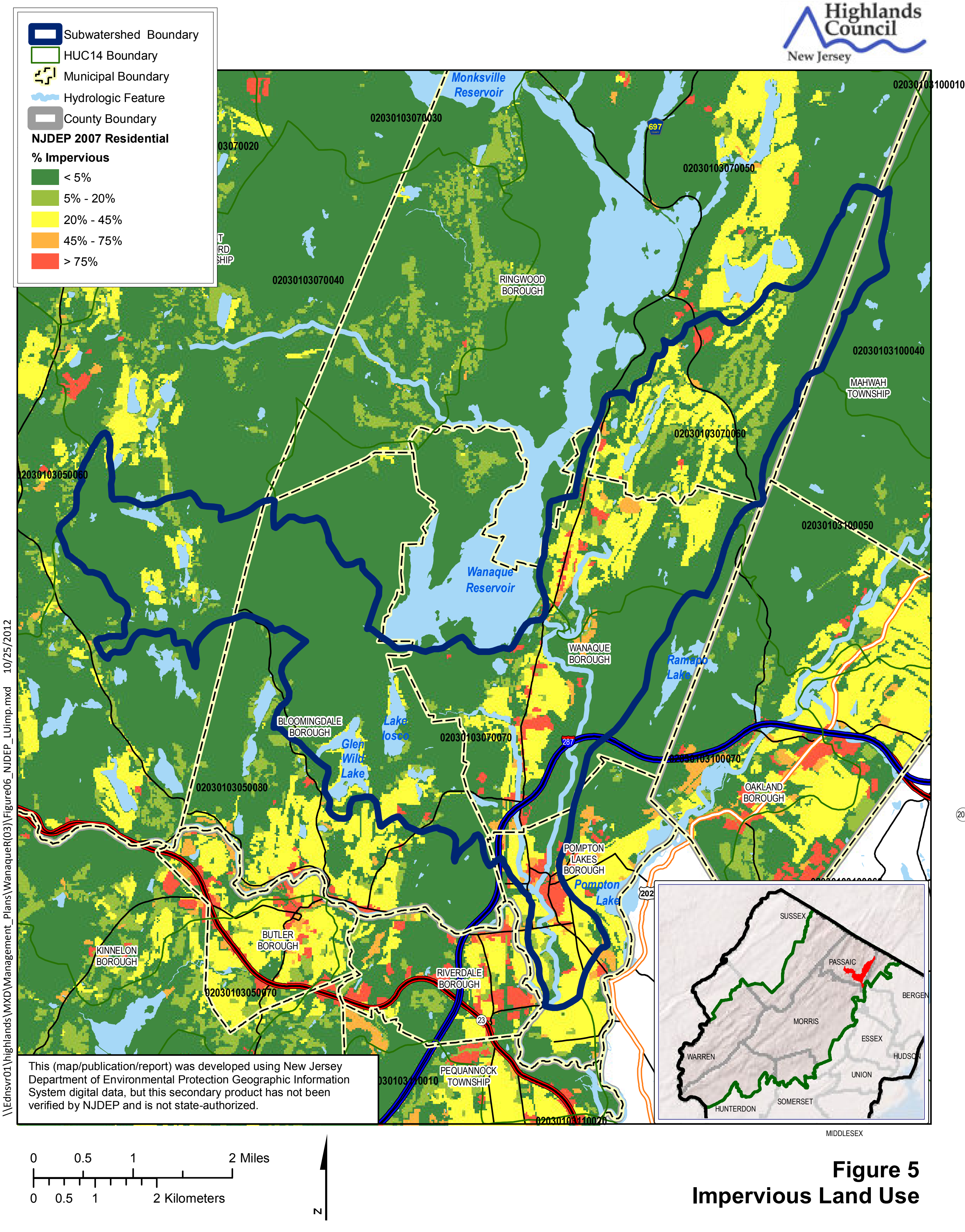
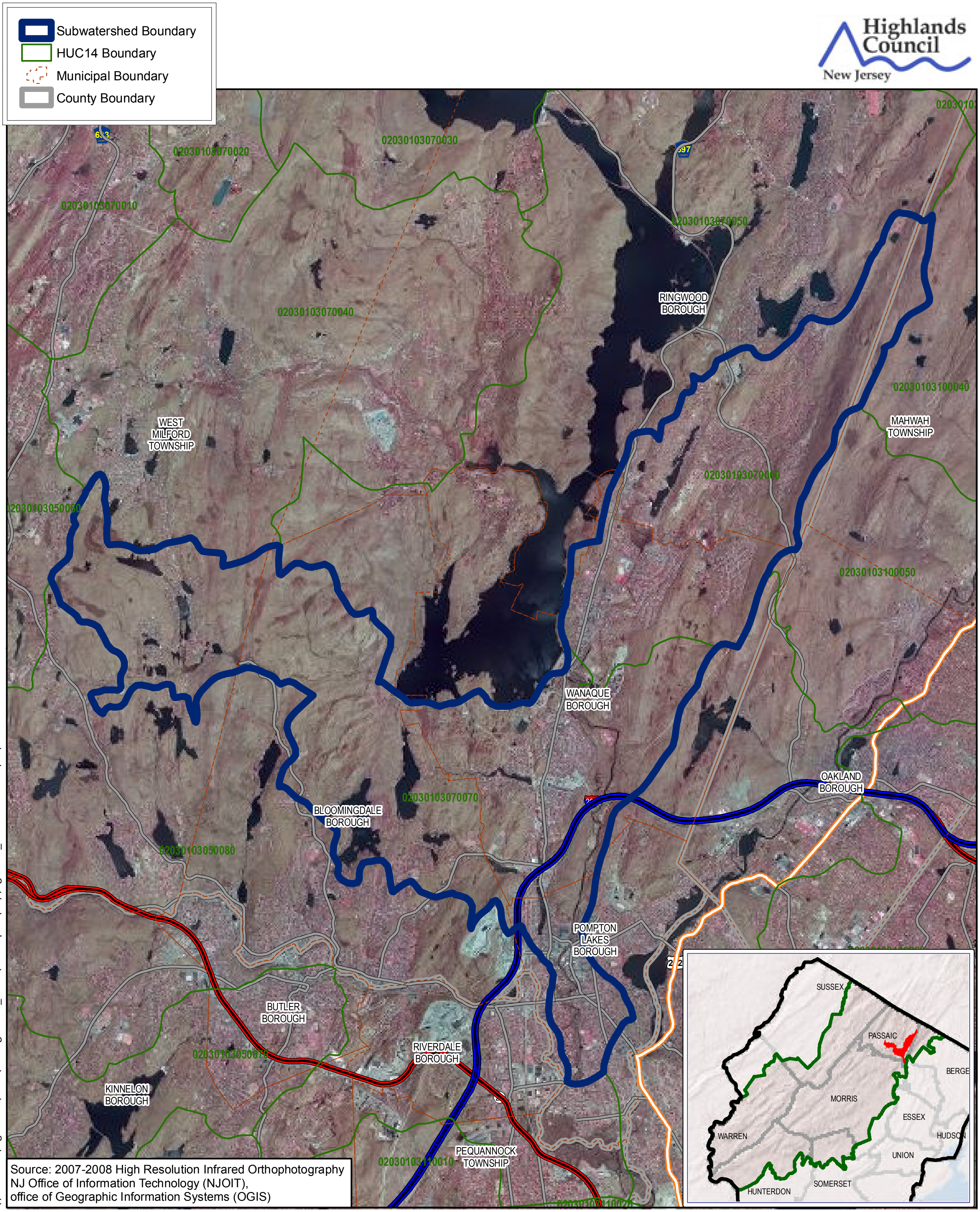


Figure 5
Impervious Land Use



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0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

N

Figure 6
2007-2008 Aerial

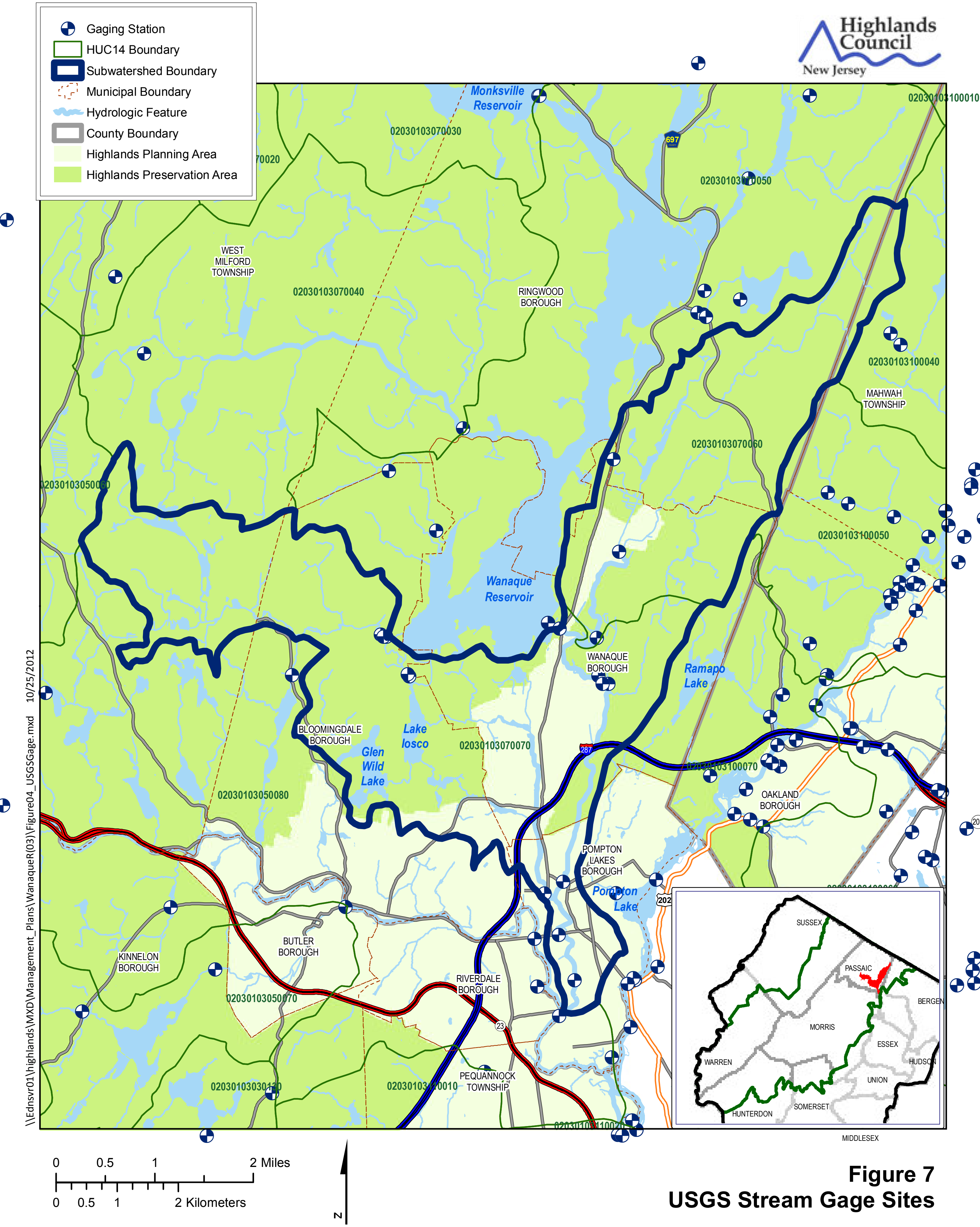


Figure 7
USGS Stream Gage Sites

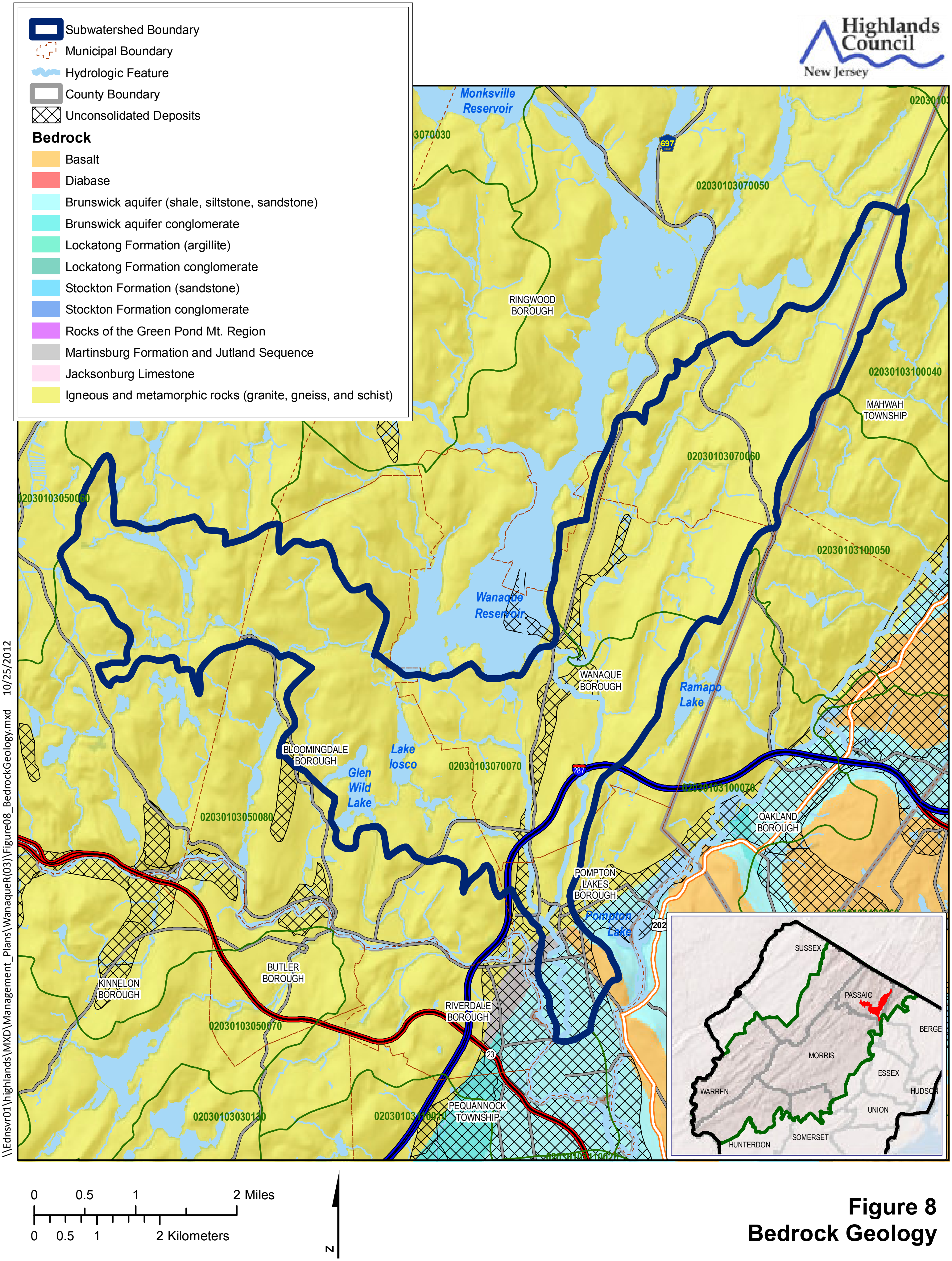
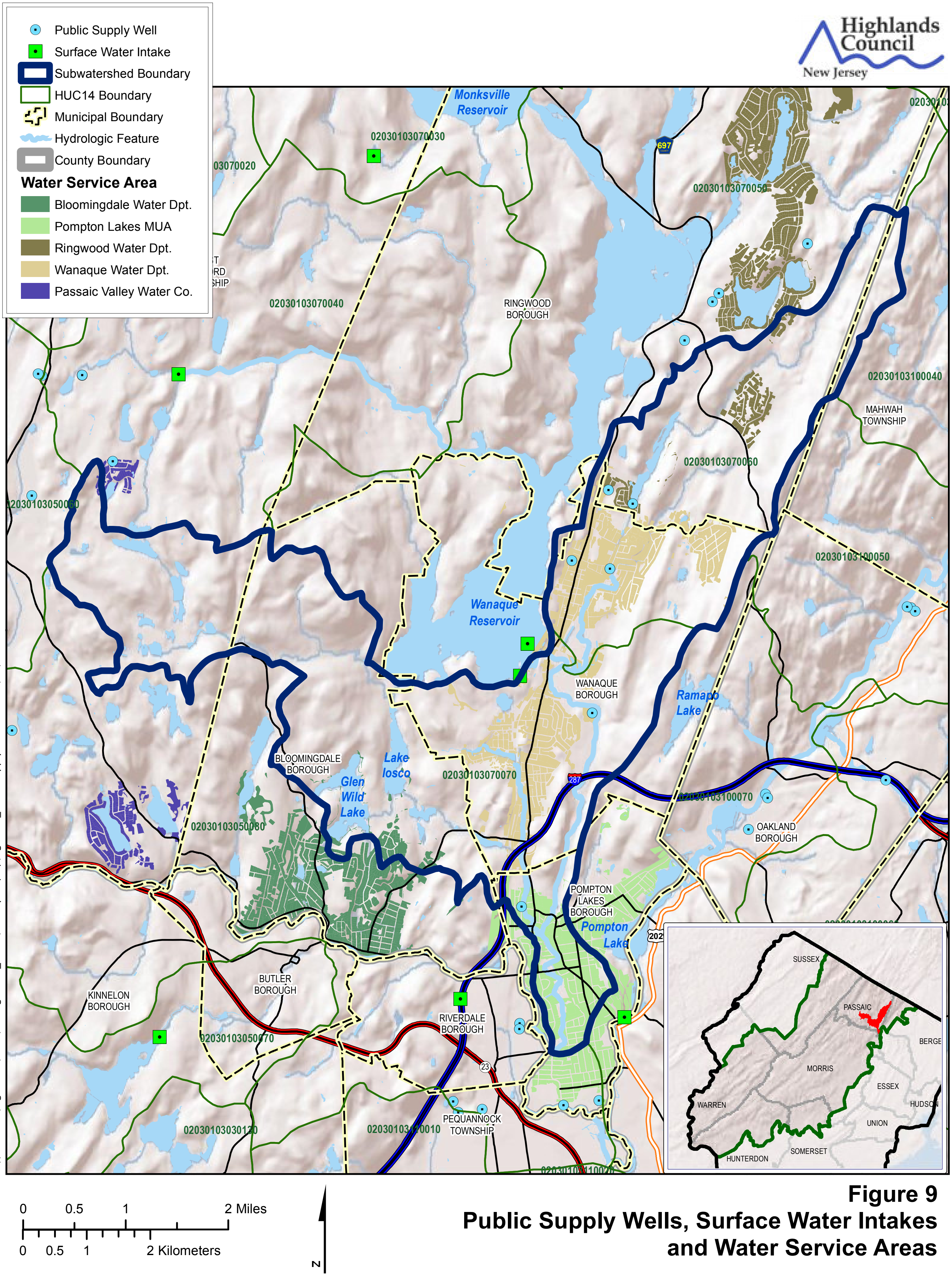


Figure 8
Bedrock Geology



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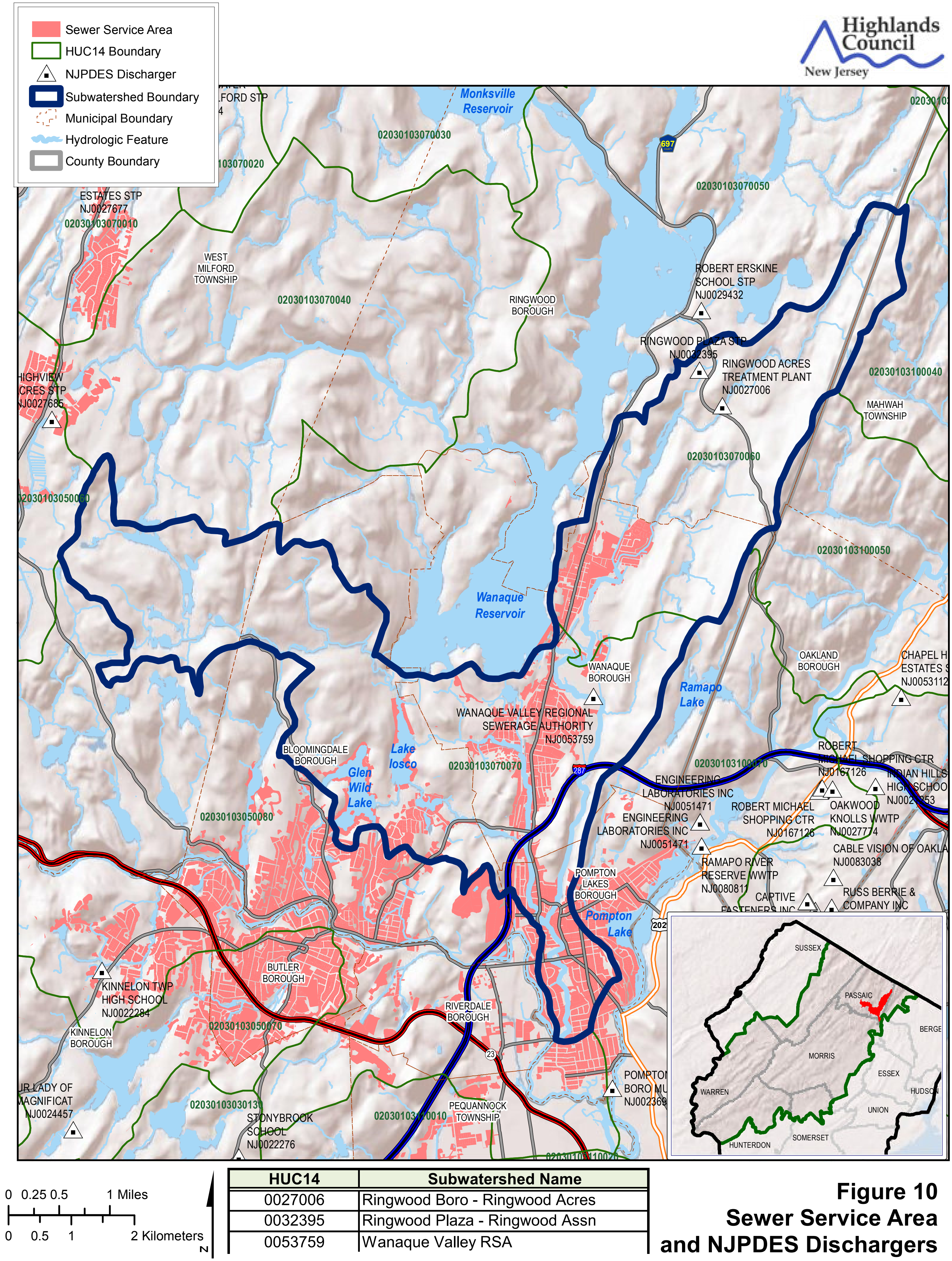
Highlands Council New Jersey

Figure 9
Public Supply Wells, Surface Water Intakes and Water Service Areas



HUC14	Subwatershed Name
0027006	Ringwood Boro - Ringwood Acres
0032395	Ringwood Plaza - Ringwood Assn
0053759	Wanaque Valley RSA

Figure 10
Sewer Service Area and NJPDES Dischargers