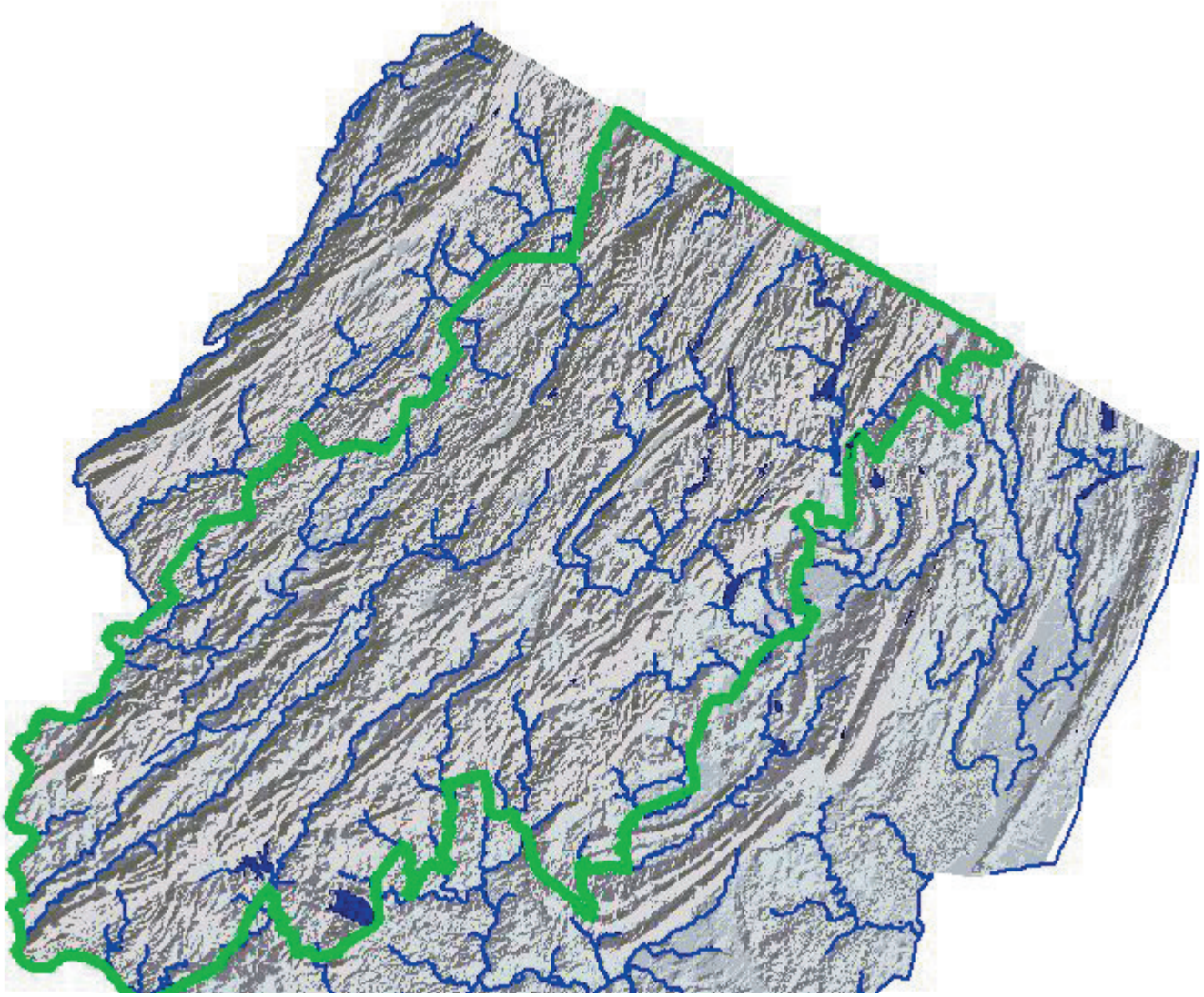
New Jersey Department of Environmental Protection

New Jersey Geological Survey

Potable Water Supplied in 1999 by New Jersey's Highlands



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New Jersey's Highlands

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NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

The mission of the New Jersey Department of Environmental Protection is to assist the residents of New Jersey in preserving, sustaining, protecting and enhancing the environment to ensure the integration of high environmental quality, public health and economic vitality.

NEW JERSEY GEOLOGICAL SURVEY

The mission of the New Jersey Geological Survey is to map, research, interpret and provide scientific information regarding the state's geology and ground-water resources. This information supports the regulatory and planning functions of DEP and other governmental agencies and provides the business community and public with information necessary to address environmental concerns and make economic decisions.

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On the cover

A digital elevation grid of northern New Jersey plotted using a hillshade grid (Herman, 1999). This also shows an outline of the NJ highlands municipalities (in green) and major streams and reservoirs (in blue).

Epigram

The Highland watersheds are the best in the State in respect to ease of collection, in scantiness of population, with consequent absence of contamination; in elevation, giving opportunity for gravity delivery, and in softness as shown by chemical analysis. These watersheds should be preserved from pollution at all hazards, for upon them the most populous portions of the State must depend for water supplies. There has been too much laxness in the past regarding this important matter.
Potable Water Commission, 1907.

Potable Water Supplied in 1999 by New Jersey's Highlands

Jeffrey L. Hoffman & Steven E. Domber

Executive Summary

The New Jersey Highlands is a vital source of potable water for the State. The New Jersey Highlands supplied 34% of the potable water used in New Jersey in 1999. Highlands water is estimated to have been distributed to 292 municipalities in 16 counties. These municipalities are home to 64% of the State's population.

Potable water is supplied by the New Jersey Highlands in two different ways. Some water is withdrawn from surface-water intakes and ground-water wells physically located in the Highlands. This water supplies communities in the Highlands itself as well as some municipalities in northeastern New Jersey. Additionally, runoff from the Highlands contributes to downstream surface-water supplies. The Highlands is the headwaters of the Raritan, Passaic and Walkill Rivers. It also contributes runoff to the Delaware River. There are 11 potable-supply surface-water intakes in New Jersey that are downstream of the Highlands and thus are partially supplied by Highlands water.

This analysis is based on a water tracking model developed by the New Jersey Geological Survey done in support of the state water supply plan.

Introduction

The Highlands is a unique region in New Jersey. It was declared a 'Special Resource Area' under New Jersey's Development and Redevelopment plan. This is defined as "an area or region with unique characteristics or resources of statewide importance which are essential to the sustained well being and function of its own region and other regions or systems—environmental, economic, and social—and to the quality of life for future generations."

The New Jersey Highlands is the headwaters area for the Passaic, Raritan and Walkill Rivers. The special characteristics of the Highlands allow it to provide abundant, high quality waters to the citizens of New Jersey. As such, it is an important source of potable water. On September 19, 2003 Governor McGreevey established the Highlands Task Force by signing executive order 70. The Task Force is charged with protection of water quality and of potable water supplies.

Quantifying the importance of this region to the water supply of New Jersey assists understanding the State's reliance on the Highlands. This report provides that quantification.

Highlands Definition

Four different physiographic provinces are defined in New Jersey based on relief, landforms, and geology (Salisbury, 1898). The New Jersey Highlands province extends from the Delaware River northeast to the New York border (fig. 1). Physically its "rugged topography consists of a series of discontinuous rounded ridges separated by deep narrow valleys" (Dalton, 2003). It is a region of mountains underlain by Precambrian crystalline bedrock with intermontane limestone valleys. Its physical boundaries cut across many political boundaries (fig. 1).

The State Development and Redevelopment Plan references 90 municipalities in 7 counties as 'Highlands Municipalities' (U.S. Forest Service, 2002). These are listed in table 1 and shown in figure 1. The Highlands municipalities cover 1,355 mi^2 or about 17% of New Jersey.

For the purposes of the water-supply analysis in this report, the Highlands was considered to be defined by the outer boundaries of the Highlands municipalities.

Table 1. New Jersey Highlands Municipalities (as defined by the NJ State Development and Redevelopment Plan)

BERGEN COUNTY	MORRIS COUNTY (cont)	PASSAIC COUNTY	WARREN COUNTY
Mahwah Twp	Hanover Twp	Bloomingdale Boro	Allamuchy Twp
Oakland Boro	Harding Twp	Pompton Lakes Boro	Alpha Boro
	Jefferson Twp	Ringwood Boro	Belvidere Town
HUNTERDON COUNTY	Kinnelon Boro	Wanaque Boro	Franklin Twp
Alexandria Twp	Mendham Boro	West Milford Twp	Frelinghuysen Twp
Bethlehem Twp	Mendham Twp		Greenwich Twp
Bloomsbury Boro	Mine Hill Twp	**SOMERSET COUNTY**	Hackettstown Town
Califon Boro	Montville Twp	Bernards Twp	Harmony Twp
Clinton Town	Morris Twp	Bernardsville Boro	Hope Twp
Clinton Twp	Morris Plains Boro	Far Hills Boro	Independence Twp
Glen Gardner Boro	Morristown Town	Peapack-Gladstone Boro	Liberty Twp
Hampton Boro	Mount Arlington Boro		Lopatcong Twp
High Bridge Boro	Mount Olive Twp	**SUSSEX COUNTY**	Mansfield Twp
Holland Twp	Mountain Lakes Boro	Andover Boro	Oxford Twp
Lebanon Boro	Netcong Boro	Andover Twp	Phillipsburg Town
Lebanon Twp	Parsippany-Troy Hills Twp	Byram Twp	Pohatcong Twp
Milford Boro	Pequannock Twp	Franklin Twp	Washington Boro
Tewksbury Twp	Randolph Twp	Green Twp	Washington Twp
Union Twp	Riverdale Boro	Hamburg Boro	White Twp
	Rockaway Boro	Hardyston Twp	
MORRIS COUNTY	Rockaway Twp	Hopatcong Boro	
Boonton Town	Roxbury Boro	Lafayette Twp	
Boonton Twp	Victory Gardens Boro	Ogdensburg Boro	
Butler Boro	Washington Twp	Sparta Twp	
Chester Boro	Wharton Boro	Stanhope Boro	
Chester Twp		Vernon Twp	
Denville Twp			
Dover Town			

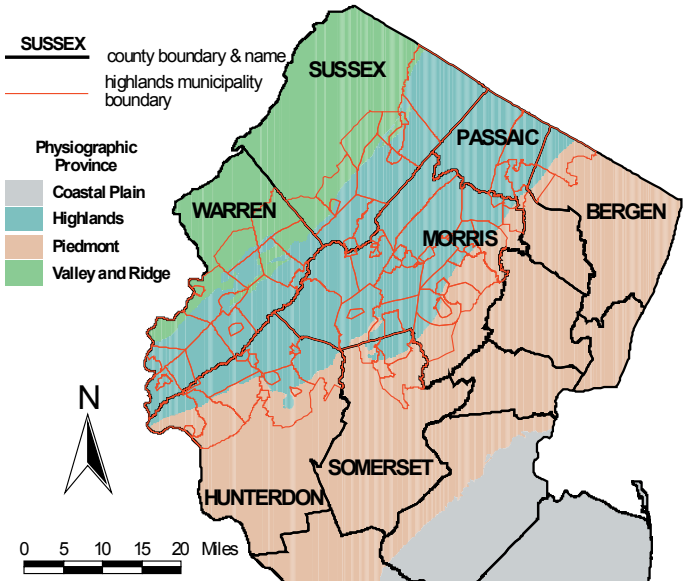

Figure 1. Physiographic provinces in northern New Jersey with county boundaries and highlands municipalities (Pristas, 2002).

Highlands Watersheds

The New Jersey Highlands municipalities fall into four different basins - the Delaware, Passaic, Raritan and Walkill (fig. 2). These municipalities have a total area of about 1,355 square miles (mi^2) (table 2). The Delaware and Passaic basins each cover a little more than a third of the municipalities - 484 mi^2 or 36% for the Delaware and 470 mi^2 (35%) for the Passaic watershed. The Raritan watershed covers 20% (275 mi^2) of the Highlands municipalities. The remainder (126 mi^2 or 9%) is in the Walkill watershed.

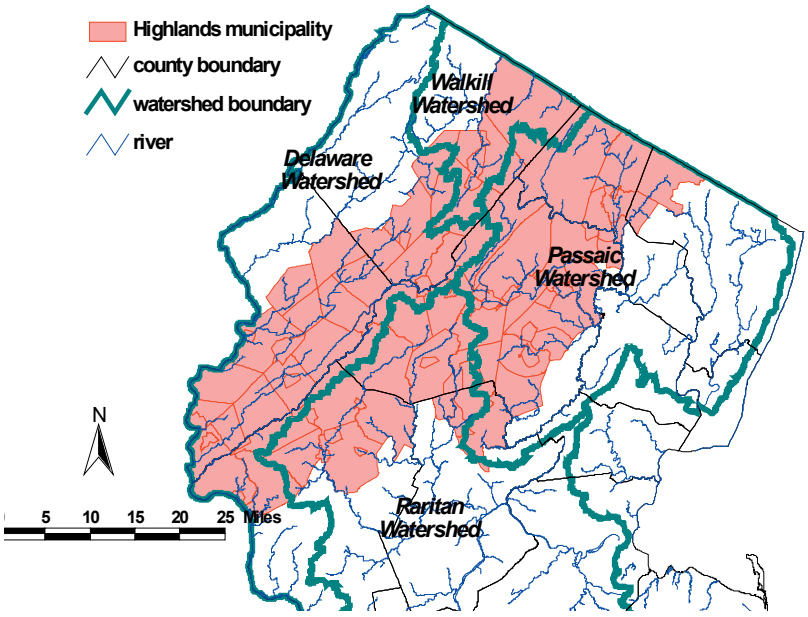

Figure 2. New Jersey Highlands municipalities with major watersheds

Table 2. Area of Highlands in each major watershed

Watershed	Area (sq mi)	% of total
Delaware	484	36%
Passaic	470	35%
Raritan	275	20%
Walkill	126	9%
TOTAL:	1,355	

Potable Water Volumes, 1999

The volume of water that is supplied by the New Jersey Highlands municipalities is calculated as the sum of two components - withdrawals in the Highlands and prorated withdrawals downstream of the Highlands.

All surface-water and ground-water intakes physically located in a NJ Highlands municipality were assumed to receive 100% of their water from the Highlands. In 1999 there were reported withdrawals at 444 potable-supply intakes (ground and surface) in the Highlands municipalities. The reported volume of withdrawals was 76.948 billion gallons of surface water and 22.774 billion gallons of ground water. There was an additional approximately 7.578 billion gallons of ground-water withdrawals by domestic wells. Thus total volume of potable water supplied by wells and surface-water intakes located in the Highlands municipalities was 107.300 billion gallons in 1999.

There are 11 potable-supply surface-water intakes in New Jersey in the Delaware, Raritan, and Passaic watersheds that are downstream of the Highlands municipalities (table 3). The total watershed area above each intake was estimated based on the watershed areas of nearby surface-water gages (Reed and others, 2000). That portion of the watershed which is in the NJ Highlands municipalities was then calculated (table 3). Total withdrawals for potable use at these 11 intakes in 1999 was 120.035 billion gallons. Of this total, 40.487 billion gallons is estimated to have come from the Highlands municipalities.

Thus the total volume of potable water used that came from the New Jersey Highlands municipalities in 1999 is estimated to be 147.787 billion gallons. The total volume of potable water used by New Jersey in 1999 was 430.543 billion gallons. Thus the New Jersey Highlands municipalities supplied an estimated 34% of all potable water used in the State in 1999.

Table 3. New Jersey potable-supply surface-water intakes downstream of the NJ Highlands municipalities, with % of each intake's watershed located in the NJ Highlands municipalities

Purveyor		Water Source	Highlands % of Watershed
Permit	Name		
4014PS	New Jersey Water Supply Auth.	D&R Canal	9%
5008	New Jersey-American Water Co.	Passaic River	50%
5033	Elizabethtown Water Company	D&R Canal	9%
5033	Elizabethtown Water Company	Raritan River	50%
5090	United Water New Jersey	Passaic/Pompton	59%
5094	North Jersey District W.S.C.	Passaic/Pompton	59%
5099	Passaic Valley Water Comm.	Passaic/Pompton	59%
5122	Burlington City	Delaware River	7%
5187	Trenton Water Works	Delaware River	7%
5274	North Jersey District W.S.C.	Ramapo River	10%
5298	Middlesex Water Co.	D&R Canal	9%
5337	New Brunswick Water Utility	D&R Canal	9%
5347	New Jersey-American Water Co.	Delaware River	7%
---	North Brunswick Water Dept.	D&R Canal	9%

Receiving Municipalities

Potable water is supplied to New Jersey municipalities via a complex series of water purveyor service areas and transfers. By making some assumptions about how water is distributed, it is now possible to quantify the movements of fresh water from source to use area by using the New Jersey Water Tracking Data Model (Tessler, 2003). This model was developed in support of an update of New Jersey's water supply plan.

Some water is exported directly from the Highlands. For example, the Boonton Reservoir in Morris County receives 100% of its water from the Highlands. Jersey City in Hudson County receives all of its potable water from this reservoir via a pipeline. Other cities in northeastern New Jersey also receive water from this reservoir.

In addition, downstream surface-water intakes receive a portion of their water from the Highlands. By analyzing the service area connected to these intakes, and accounting for additional water sources, it is possible to estimate the percentage of Highlands water delivered to the served municipalities. Figure 3 shows those municipalities in 1999 which received all or some of their potable water supply from Highlands water -- 292 municipalities in 16 counties.

It is important to realize that in some of these municipalities, especially those in southwestern New Jersey, the percentage of Highlands water in the potable supply is very small. In other municipalities in northern New Jersey, such as Jersey City in Hudson County, 100% of the potable water is Highlands water. As existing Highlands-dependant water sources are expanded or new ones added communities may receive a higher percentage of their water from the Highlands. This would be especially true in the Camden/Gloucester area where new water mains are projected to receive water from the Tri-County pipeline which carries Delaware River water, and thus a small portion of Highlands water.

There are a number of assumptions built into this analysis. The primary ones are:

- The GIS purveyor service area coverages on file with the DEP are accurate.
- Water that is supplied to a purveyor service area is uniformly distributed across the service area. Thus this analysis does not account for different pressure zones.
- The population in each municipality is evenly distributed in the municipality.
- The purveyor-supplied reports on volumes of water withdrawn are accurate.
- The percentage of water in a surface-water intake that comes from a defined subwatershed above the intake is directly proportional to what percentage that subwatershed is of the total upstream watershed.

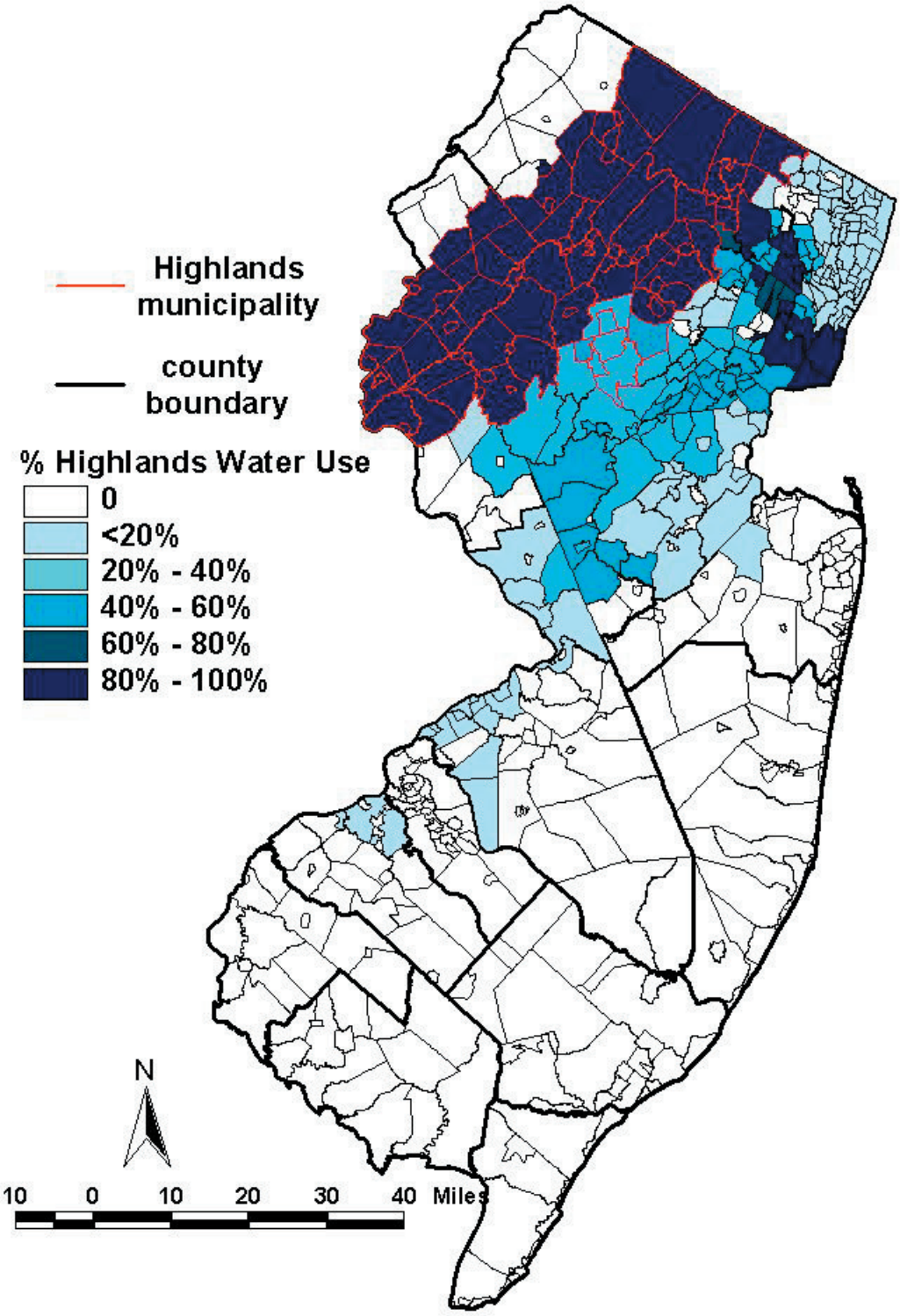

Figure 3. Percentage of potable-water supply in 1999 to NJ municipalities from the New Jersey Highlands

Conclusions

The New Jersey Highlands municipalities supplied about one third of the State's potable water in 1999. Highlands water was distributed to 292 municipalities in 16 counties in northern and southwestern New Jersey. These municipalities contain about 64% of New Jersey's population. It is important to note that in some of these municipalities the percentage of Highlands water is very small; in other municipalities all potable water comes from the Highlands.

This analysis considers direct withdrawal of water in the Highlands as well as downstream surface-water intakes. The Highlands is the headwaters of the Passaic, Walkill and Raritan Rivers. It also contributes water to the Delaware River. There are 11 surface-water potable-supply intakes in New Jersey that are downstream of the Highlands.

By necessity, there are a number of assumptions built into this analysis. This analysis was done using the New Jersey Water Tracking Data Model. This model was developed in support of an update of New Jersey's water supply plan. As data are added and errors are corrected the results shown may change slightly.

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Internet Resources

New Jersey Highlands Task Force	http://www.state.nj.us/highlands/highlandstf.htm
New Jersey Geological Survey	http://www.njgeology.org/
NJ Department of Environmental Protection GIS page	http://www.state.nj.us/dep/gis/
NJ State Development and Redevelopment Plan	http://www.nj.gov/dca/osg/plan/stateplan.shtml