State of New Jersey
Department of Environmental Protection

2024 NEW JERSEY STATEWIDE WATER SUPPLY PLAN

APPENDIX I

AN ASSESSMENT OF REGIONAL WATER AVAILABILITY AND DEMAND FOR WATERSHED MANAGEMENT AREA (WMA) 13: BARNEGAT BAY WATERSHEDS

AN ASSESSMENT OF REGIONAL WATER AVAILABILITY AND DEMAND FOR WATERSHED MANAGEMENT AREA (WMA) 13: BARNEGAT BAY WATERSHEDS

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EXECUTIVE SUMMARY

Water Management Area (WMA) 13 is located in central eastern New Jersey, within the Atlantic Coastal Region. It encompasses all of Ocean County and portions of municipalities in Burlington and Monmouth County. WMA 13 is comprised of 15 HUC11 watersheds that flow into Barnegat Bay. The Metedeconk River, Toms River, Forked Rivers, and Cedar Creek are significant surface waters in WMA 13.

WMA 13 is experiencing some of the fastest population growth in the state, and this report conducts a population analysis of the area. The report designates six municipalities as areas of focus due to their significant population changes. These municipalities are Barnegat Township, Brick Township, Berkeley Township, Lakewood Township, Jackson Township, and Toms River Township.

The report explores WMA 13 and the municipalities of focus through the analysis of social vulnerability, land use trends, water availability and demand projections, water utilities and infrastructure, and climate change projections. Future water demand is projected through 2050.

Water withdrawals in WMA13 primarily occur in HUC11 watersheds 02040301080 (Toms River, below Oak Ridge Parkway), 02040301040 (Metedeconk River), and 02040301130 (Lower Little Egg Harbor Tributary). However, according to estimates from the Low Flow Margin, the HUC11 watersheds that are most stressed include 02040301050 (Kettle Creek / Barnegat Bay North), 02040301060 (Toms River, above Oak Ridge Parkway), and 02040301080 (Toms River, below Oak Ridge Parkway).

Water quality is a significant concern for WMA13, with 32 impaired water designations as defined by the New Jersey's 303(d) since 2012. The analysis of these pollutants has determined that stormwater is the primary source of these impairments.

The planning period for this report is 2020-2050, and policy recommendations are listed as strategies to reduce the region's water supply vulnerabilities. These policy recommendations include higher density residential development and stormwater utility fees to raise revenues to mitigate the region's stormwater runoff.

1. INTRODUCTION

The Barnegat Bay Watershed is designated by the NJDEP as Watershed Management Area (WMA) 13. WMA13 is located in central eastern New Jersey, in the Atlantic Coastal Region (see Figure I1). WMA 13 includes all of Ocean County and portions of municipalities in Burlington and Monmouth County. The total area of WMA 13 is over 508,000 acres.

The coastal and ecological features of WMA 13 are distinctive which draws thousands of visitors throughout the year, especially during the summer months. WMA 13's coastline begins at the Point Pleasant Canal and ends at the Little Egg Harbor Inlet. The Metedeconk River has immediate impacts on the ecological health of the Barnegat Bay Estuary (Metedeconk River Watershed Plan, 2017). WMA 13 is an important estuary ecosystem for various species.

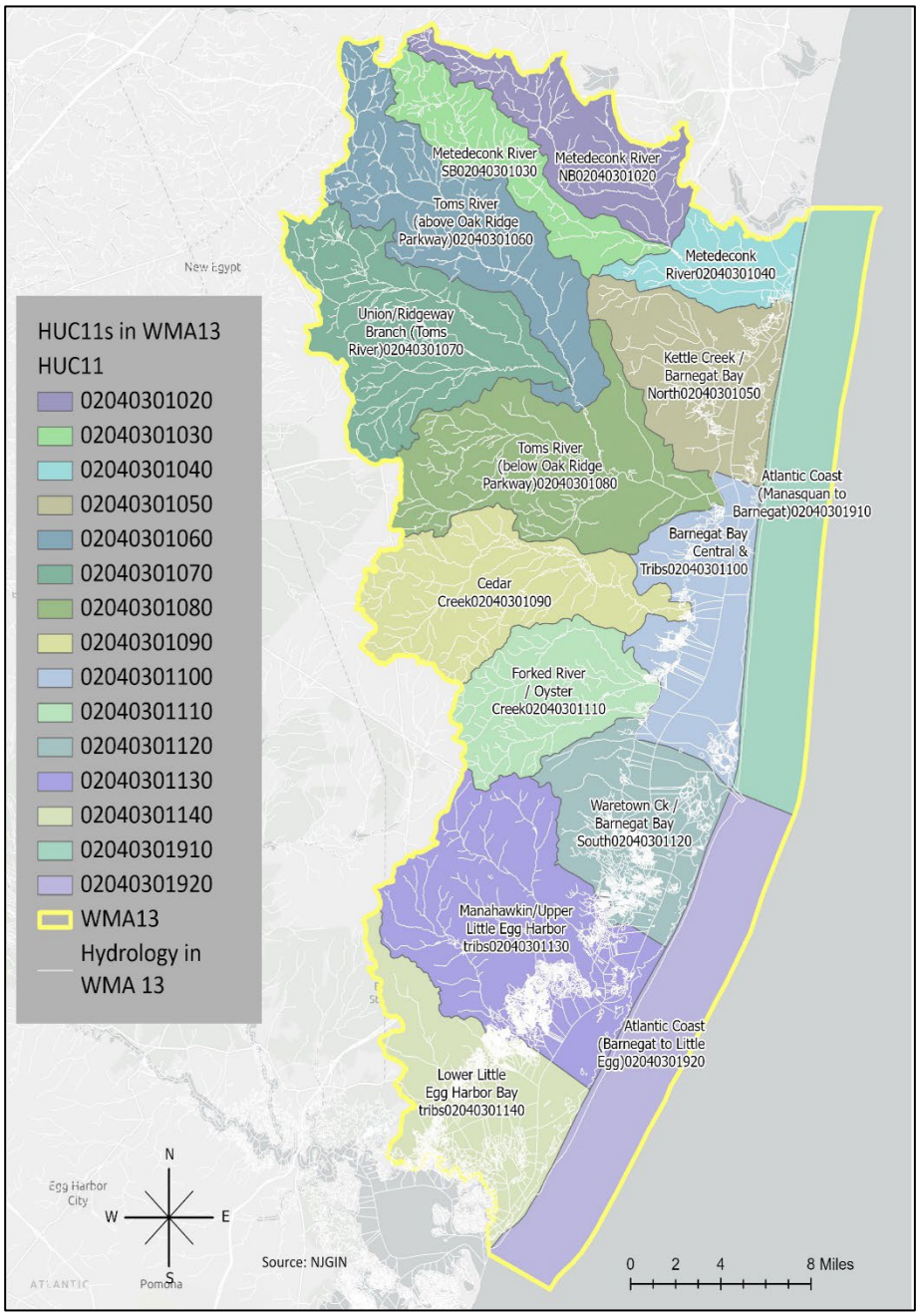

Figure I1. HUC11 Map of WMA 13

The watershed's water resources provide immense economic value to WMA 13. Economic value is extracted from WMA 13's water resources and habitats, ecosystem goods and services, and watershed related employment (Kauffman & Curz-Ortíz, 2012). In 2012, the watershed was estimated to contribute $2 to $4 billion annually to the state's economy (Kauffman & Curz-Ortíz, 2012).

The protection of the health of the watershed is vital for the future of the region, not only for preserving its natural ecosystems and wildlife but also for ensuring the sustainability of recreational activities in the area. As a result of development patterns in WMA 13, the ecological health of the watershed has declined. To mitigate the impact of development on water supplies and the ecological health of the area, NJDEP enforced regulations that protect waterways and reduce development in protected areas. Regulations include the following: the Coastal Area Facilities Review Act (CAFRA), water supply critical areas, category one waterways designation, and the Pinelands Protection Act of 1979.

1.1 GOALS

This report aims to characterize WMA 13 as it relates to its water supplies and suggests policies to make WMA 13 water supplies more resilient. This report examines current water availability and demands and uses projections for future water availability and demands. The planning period for this report is 2020-2050. Following these findings, policy recommendations are listed as strategies to reduce the region's water supply vulnerabilities.

2. METHODOLOGY

In short, this paper aims to characterize the current and future water supply conditions, and present regional specific policy recommendations. Understanding the watershed requires an analysis that explores multiple scopes of analysis (at the watershed, county, and municipality level of analysis).

2.1 DEMOGRAPHIC ANALYSIS

To understand WMA 13's water demands, a demographic analysis was performed. This analysis identified communities that could be vulnerable to water stress. This involved a deep dive of population trends in WMA 13 and the land use changes. This report focuses on a planning period for 2020-2050 and explores the data at a county and municipality level of analysis. Population data was obtained from the 2020 U.S Census Bureau. Population projections were developed by two Metropolitan Planning Organizations in the region: New Jersey Transportation Planning Authority (NJTPA) and the Delaware Valley Regional Planning Commission (DVRPC). NJTPA's geographic area of analysis included most of WMA 13, except for municipalities in Burlington County. DVRPC's data analyzed Burlington County municipalities.

One of the first steps in understanding WMA 13's water demand was a descriptive analysis of the population count at the county and municipal level. Examining population projections at the county-level of analysis was the first step in identifying regions within WMA 13 that were experiencing population changes. To learn more, the level of analysis was focused on WMA 13's municipalities. Municipalities that experienced extensive population changes were identified as municipalities of focus for this report.

Following an evaluation of population trends between 2020-2050 in WMA 13, a socioeconomic analysis was conducted to identify vulnerable populations in the region and factors contributing to their vulnerability. These findings were then used to develop policy recommendations that consider the unique challenges faced by these vulnerable groups. Social vulnerability in the region was explored using the CDC's Social Vulnerability Index (SVI) Tool and New Jersey's definition of an overburdened community (OBC) as defined by the 2021 New Jersey Environmental Law. SVI examines the relative vulnerability of each U.S Census tract in the watershed (CDC SVI Documentation, 2020). New Jersey's definition of an OBC requires that any census block group meets at least one of the following definitions:

1. at least 35 percent of the households qualify as low-income households (at or below twice the poverty threshold as determined by the United States Census Bureau);
2. at least 40 percent of the residents identify as a minority or as members of a State recognized tribal community; or
3. at least 40 percent of the households have limited English proficiency (without an adult that speaks English "very well" according to the United States Census Bureau).

(Source: NJDEP, 2021)

The final step in the demographic analysis was examining land use changes in the watershed from 2012 and 2015. Land use changes are one of the primary indicators of a watershed's water supply experiencing stress. Data for land use/land cover was obtained from NJDEP's GIS Data. Priorities and presentation strategies of publicly owned land and other important resources were obtained from

Ocean County's 2020 Open Space, Parks, and Recreation Plan and the 2021 Comprehensive Conservation and Management Plan for the Barnegat Bay-Little Egg Harbor Estuary.

2.2 WATER AVAILABILITY AND DEMAND ANALYSIS

WMA 13's water availability and water demand were analyzed by exploring water quantity data, water quality reports, and the physical water infrastructure available.

Water quantity was examined with NJDEP's data for withdrawal and discharge at the HUC11 level of analysis. This report focused on data from 1990-2020 for withdrawal trends by source group and use type from 1990-2020. Discharge data was explored by its source for the same period. Finally, the five-year average of water withdrawals from each HUC11 in WMA 13 was analyzed.

Water quality was evaluated using New Jersey's 2016 Integrated Water Quality Assessment Report for the Barnegat Bay watershed, NJDEP Metedeconk River Watershed Protection Plan for WMA 13 and Brick Township Municipal Utilities Authority (BTMUA) Metedeconk River Watershed Protection Plan.

Water infrastructure in WMA 13 was characterized using GIS analysis of public community water systems (PCWS).

2.3 CLIMATE CHANGE AND SEA LEVEL RISE ASSESSMENT

Climate change's threats to WMA13's water supplies were quantitatively assessed through the use of sea level rise and assessment of water supply infrastructure. Climate change as it relates to water supplies was examined through the following: sea level rise and its impact on withdrawal and discharge sites in WMA 13, PCWS service areas routinely flooded by 2ft and 5ft of sea level rise, and overburdened routinely flooded by 2ft and 5ft of sea level rise. Data for withdrawal and discharge sites for 2016-2020 was provided by NJDEP. Sea level rise estimates come from NOAA's Sea level Rise Viewer, which represents the mean higher water conditions: the average of the higher of the daily high tides over the National Tidal Datum Epoch (1983-2001) (NOAA Sea level Rise Viewer, 2022). PCWS service areas were obtained from NJDEP's publicly available GIS data. The overburdened community data came from NJDEP's publicly available data sheet.

2.4 DEVELOPMENT OF DRAFT POLICY OPTIONS

To develop policy recommendations for WMA 13, information from the water quantity and demand analysis and the vulnerable community assessment was used to determine specific areas of focus.

3. WMA 13 WATERBODIES

3.1 SURFACE WATER SURFACES

WMA 13 is comprised of 15 HUC11 watersheds that flow into the Barnegat Bay (see Figure I1). The Metedeconk River, Toms River, Forked Rivers, and Cedar Creek are significant surface waters in WMA13 (NJDEP WSP, 2017). Another component of the watershed's water availability is its surface water reservoirs. WMA 13's major surface water supply reservoir is the Brick Township reservoir, whose source is the Metedeconk River. The reservoir is owned by Brick Township MUA and has 0.9 bg of usable storage.

Surface water is stored in reservoirs during abundant streamflow conditions and withdrawn during drier conditions. These surface-water reservoirs have a defined safe yield, which limits the amount of water that can be withdrawn. NJDEP defines safe yield as, "the maintainable yield of water from a surface or ground water source or sources which is available continuously during projected future conditions, including a repetition of the most severe drought, without creating undesirable effects"(p.2) (N.J.S.A 58:1A).

The Metedeconk River watershed is 90-square miles and drains into the northern portion of the Barnegat Bay. The Metedeconk River flows through parts of Monmouth and Ocean County, eventually emptying into the bay. The river has a North and South Branch; they converge at the Forge Pond in Brick Township. The Metedeconk River is a resource for the region's drinking water supply (Metedeconk River Watershed Plan, 2017).This led to its designation as a Category One (C1) Waterway.

The Toms River watershed is 124 square miles, is composed of small tributaries, and drains into the bay. Toms River flows southeast through the western Ocean County, through parts of the New Jersey Pinelands, eventually emptying into the Barnegat Bay. Toms River watershed includes residential areas and the New Jersey Pinelands, which are protected. Toms River and its tributaries are designated as C1 waterways.

Cedar Creek watershed is 54.3 square miles, flows eastward along the southern portion of Berkeley Township and drains into the bay. The subwatershed is almost entirely within the Pinelands National Reserve, which is mostly forested (89%) (Barnegat Bay Partnership, 2021).

The Forked River subwatershed is 26 square miles (Ocean County, 2016). The Forked River has three branches: North Branch (16.8 square miles), the Middle Branch (4.9 square miles), and the South Branch (4.3 square miles). Portions of this subwatershed are in the New Jersey Pinelands, with more forested areas, and areas protected for species and recreational enjoyment. A section of the Edwin B. Forsythe National Wildlife Refuge is in Middle Branch of the Forked River. The eastern portion of the North Branch is residentially and commercially developed.

HUC11	HUC 11 Name	HUC 11 Area (mi^2)	Watershed Area (mi^2)	Pinelands	Critical Area	Municipalities in Ocean County (except where noted)
02040301020	Metedeconk River NB	38	38		Partial	Brick Township, Freehold Township (Monmouth County), Howell Township, Jackson Township, Lakewood Township, Millstone Township (Monmouth County), Wall Township
02040301030	Metedeconk River SB	31	31		Partial	Brick Township, Freehold Township (Monmouth County), Jackson Township, Lakewood Township, Millstone Township (Monmouth County)
02040301040	Metedeconk River	20	89		All	Bay Head Borough, Brick Township, Lakewood Township, Mantoloking Borough, Point Pleasant Borough, Point Pleasant Beach Borough
02040301050	Kettle Creek / Barnegat Bay North	31	31		All	Berkeley Township, Brick Township, Island Heights Borough, Lavallette Borough, Mantoloking Borough Lakewood Township, Seaside Heights, Toms River Township
02040301060	Toms River (above Oak Ridge Parkway)	60	123	Partial	Partial	Freehold Township (Monmouth County), Jackson Township, Lakewood Township, Manchester Township, Millstone Township, Toms River
02040301070	Union/Ridgeway Branch (Toms River)	63	63	Partial	Partial	Jackson Township, Lakehurst Borough, Manchester Township, Plumsted Township, Toms River Township
02040301080	Toms River (below Oak Ridge Parkway)	68	191	Partial	All	Beachwood Borough, Berkeley Township, Island Heights Borough, Lacey Township, Manchester Township, Ocean Gate Borough, Pine Beach Borough, South Toms River Borough, Toms River Township
02040301090	Cedar Creek	68	68	Partial	Partial	Berkeley Township, Lacey Township, Manchester Township, Ocean Township
02040301100	Barnegat Bay Central & Tribs	46	468		Partial	Barnegat Light Borough, Berkeley Township, Lacey Township, Ocean Gate Borough, Ocean Township, Seaside Heights Borough, Seaside Park Borough, Toms River Township
02040301110	Forked River / Oyster Creek	39	39	Partial	Partial	Barnegat Township, Lacey Township, Ocean Township
02040301120	Waretown Ck / Barnegat Bay South	25	25	Partial		Barnegat Light Borough, Barnegat Township, Harvey Cedars Borough, Long Beach Township, Ocean Township, Stafford Township

HUC11	HUC 11 Name	HUC 11 Area (mi^2)	Watershed Area (mi^2)	Pinelands	Critical Area	Municipalities in Ocean County (except where noted)
02040301130	Manahawkin/ Upper Little Egg Harbor Tribs	72	72	Partial		Barnegat Township, Bass River Township, Eagleswood Township, Little Egg Harbor Township, Long Beach Township, Ocean Township, Ship Bottom Borough, Stafford Township, Surf City Borough
02040301140	Lower Little Egg Harbor Bay Tribs	35	35	Partial		Bass River Township, Beach Borough, Eagleswood Township, Little Egg Harbor Township, Long Beach Township, Tuckerton Borough
02040301910	Atlantic Coast (Manasquan to Barnegat)	139	139		Partial	Barnegat Light Borough, Bay Head Borough, Berkeley Township, Lavallette Borough, Manasquan Borough, Ocean Township, Point Pleasant Beach, Seaside Heights Borough, Seaside Park Borough, Toms River Township
02040301920	Atlantic Coast (Barnegat to Little Egg)	122	122			Barnegat Light Borough, Beach Haven Borough, Berkeley Township, Harvey Cedars Borough, Long Beach Township, Ship Bottom Borough, Surf City Borough

Table I1. HUC11 Information for WMA13 (Source: GIS Analysis Performed using Data from NJDEP & NJGIN, 2023)

3.2 GROUNDWATER SOURCES

The primary source of groundwater in this watershed management area is the Kirkwood-Cohansey aquifer system. The Kirkwood-Cohansey aquifer is an unconfined aquifer that supplies water throughout the Outer Coastal Plain of southern New Jersey. This is the major unconfined aquifer in the area. The aquifer supplies freshwater also to Barnegat Bay, directly and by contributing to stream flow. There are seven confined aquifers underneath the Kirkwood-Cohansey system. In addition to the Kirkwood-Cohansey system, water purveyors in Ocean County use the Potomac-Raritan-Magothy (PRM) system; it is the second most used source of groundwater in the county (Ocean County, 2011). Other aquifers in the watershed used less often include the Englishtown, Wenonah-Mt. Laurel, Vincentown, Piney Point, and the Atlantic City 800 Foot Sand (Ocean County, 2011).

4. DEMOGRAPHIC ANALYSIS

KEY FINDINGS

- Every county in WMA 13 population grew between 2010-2020. Ocean County increased its total population by 10.5% from 2010-2020, which makes it the 2nd fastest growing county in New Jersey (U.S Census Bureau, 2020).
- Counties in WMA 13 are growing faster than MPO projections. Ocean County population was larger than NJTPA's estimates by 6.4% percent. Monmouth County population was 2.1% larger than NJTPA's estimates. Burlington County's population was 2.9% larger than DVRPC estimates.
- There are municipalities in WMA 13 experiencing significant changes in their population growth. The municipalities of focus are the following: Barnegat Township, Berkeley Township, Brick Township, Jackson Township, Lakewood Township, and Toms River Township.

4.1 POPULATION ANALYSIS AND INTRODUCTION TO FOCUS MUNICIPALITIES

To analyze the population of WMA 13, data from the 2020 Census and population projections from NJTPA and DVRPC were used. First, the 2020 census population for each county and municipality in WMA 13 was explored. Next, the population projections for 2020 at both the county and municipality levels were compared to 2020 Census populations. The population projections from NJTPA and DVRPC were published before the 2020 Census was released. There was variability between actual and projected populations for the region, which was factored in the analysis. The analysis identified municipalities in WMA 13 that experienced population growth or decline, which designated them as municipalities of focus.

COUNTY-WIDE ANALYSIS

Table I2 lists Census population data for WMA 13. On par with state trends, every county in WMA 13 experienced population growth. In WMA 13, Ocean County grew the most, a 10.5% increase in its census population between 2010-2020. Burlington and Monmouth counties grew modestly between 2010-2020.

County	2020 Census Population	Percent Change 2010-2020
Burlington	461,860	3
Monmouth	643,615	2
Ocean	637,229	11
New Jersey	9,288,994	6

Table I2. Census Data for Counties in WMA 13
(Source: U.S Census Bureau, 2020)

Table I3 shows economic and household demographic information for counties in WMA13, relative to the state (indicated in red). Despite having the largest population growth in the county, Ocean County's economic characteristics fall below state averages. Ocean County has the highest poverty rate at 11.4% and the lowest median household income of counties in WMA13, at $72,679. This is lower than the state's average by $12,566 dollars.

Area	Burlington County	Monmouth County	Ocean County	New Jersey
2010 Census Population	448,734	630,380	576,567	8,791,894
2020 Census Population	461,860	643,615	637,229	9,288,994
Median Household Income (2020)	$90,329	$103,523	$72,679	$85,245
Poverty Rate	8%	7%	11%	10%
Unemployment Rate (NJ BLS)	5%	6%	6%	6%
2020 Population Density (per mi^2)	578	1,375	1,1014	1,263
2020 Real GDP Per Capita	$44,735	$53,886	$37,041	$44,153
2020 Real GDP (Billions of Dollars)	25,828	32,246	19,318	535,324

Table I3. WMA 13 County Demographics Sources: Unemployment Rate: NJ Department of Labor and Workforce Development: Labor Force Estimates (2022), 2020 U.S Census Bureau, 2020 5-Year Estimate (American Community Survey, 2022), GDP by County, (Bureau of Economic Analysis, 2022)

MUNICIPALITY-WIDE ANALYSIS

Similar to trends at the county level, municipalities in Ocean County experienced significant changes in their population between 2010-2020. WMA 13 municipalities in Burlington and Monmouth County experienced modest population changes. This report focuses on municipalities that experienced significant population changes between 2010-2020. Table I4 lists the municipalities of focus in this report as indicated in orange shading.

Municipality	County	2020 Census Population	Percent Change 2010-2020 (%)
Barnegat Light Borough	OCEAN	640	11.5
Barnegat Township	OCEAN	24,296	16.0
Bass River Township	BURLINGTON	1,355	-6.1
Bay Head Borough	OCEAN	10,859	-1.7
Beach Haven Borough	OCEAN	24,296	16.0
Beachwood Borough	OCEAN	10,859	-1.7
Berkeley Township	OCEAN	43,754	6.1
Brick Township	OCEAN	73,620	-1.9
Eagleswood Township	OCEAN	1,722	7.4
Freehold Township	MONMOUTH	35,369	-2.3
Harvey Cedars Borough	OCEAN	391	16.0

Municipality	County	2020 Census Population	Percent Change 2010-2020 (%)
Howell Township	MONMOUTH	53,537	4.8
Island Heights Borough	OCEAN	1,650	-1.4
Jackson Township	OCEAN	58,544	6.7
Lakewood Township	OCEAN	135,158	45.6
Lavallette Borough	OCEAN	1,787	-4.7
Manchester Township	OCEAN	45,115	4.7
Mantoloking Borough	OCEAN	331	11.8
Millstone Township	MONMOUTH	10,376	-1.8
Ocean Gate Borough	OCEAN	1,932	-3.9
Ocean Township	OCEAN	8,835	6.0
Plumsted Township	OCEAN	8,072	-4.1
Seaside Heights Borough	OCEAN	2,440	-15.5
Seaside Park Borough	OCEAN	1,436	-9.1
Ship Bottom Borough	OCEAN	1,098	-5.0
South Toms River Borough	OCEAN	3,643	-1.1
Stafford Township	OCEAN	28,617	7.8
Toms River Township	OCEAN	95,438	4.6
Tuckerton Borough	OCEAN	3,577	6.9

Table I4. Census Data for Municipalities in WMA 13 (Source: U.S Census Bureau, 2020)

Quick Facts about the Municipalities of Focus

- Barnegat Township is a suburban, coastal community in Ocean County.
- Berkeley Township is an established suburban community in Ocean County; it has some area along the Jersey Shore.
- Brick Township is an established suburban, partially shore-based community in Ocean County that has a limited amount of vacant land available for development.
- Jackson Township is an established suburban, interior community in Ocean County that began growing in the 1970s (Jackson Township, 2009).
- Lakewood Township is a rapidly growing interior community in Ocean County.
- Toms River Township is a suburban, coastal community in Ocean County.

PROJECTION ANALYSIS

Several planning agencies created county population forecasts for counties and municipalities in New Jersey prior to the 2020 Census data release. Burlington County, Monmouth County, and Ocean County exceeded 2019 New Jersey Department of Labor (DOL) population projections with their 2020 Census population. Burlington County and Ocean County grew so much that they've already exceeded New Jersey DOL's projection estimates for 2024. 2020 Census populations exceed every county projection

forecasted by DVRPC and NJTPA. Population projections indicate that these three counties will continue to grow throughout the planning period. Ocean County is expected to grow the most out of the three counties. In 2020, the percentage difference between NJTPA's 2020 forecast and its 2020 Census population was 6.43%. By 2050, NJTPA estimates that Ocean County's population will increase by 100,000 people, making it the largest county in WMA 13.

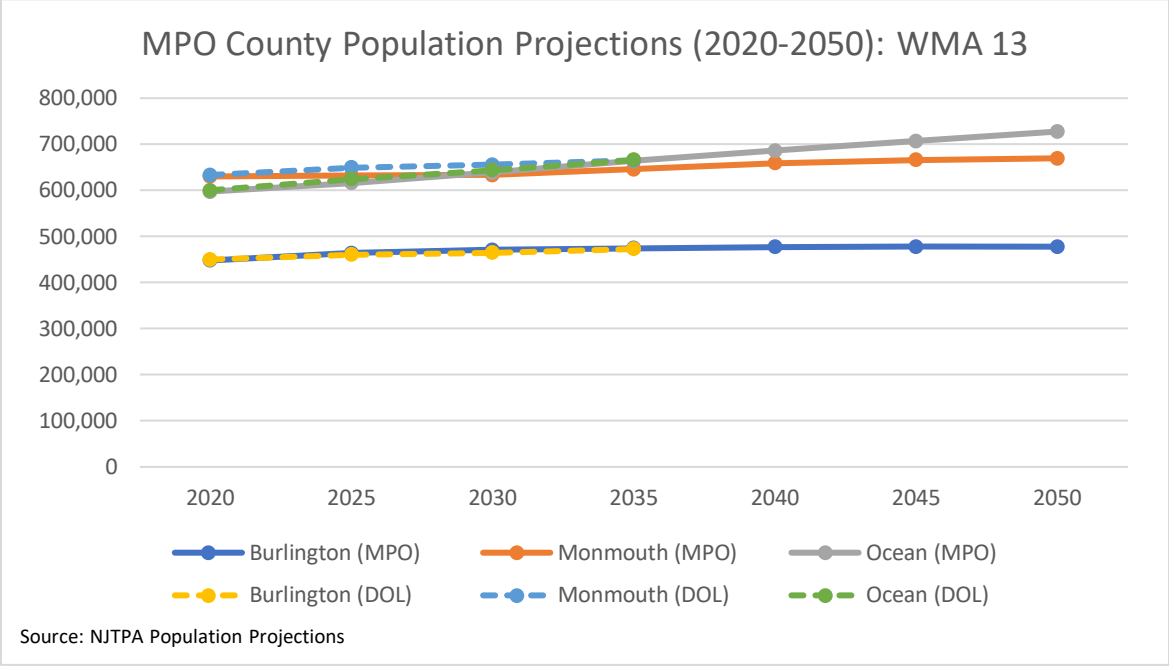

Figure I2. NJ DOL & MPO Population Projections for WMA 13 (Source: NJTPA & NJ DOL)

NJTPA 2020 population were analyzed to support the methodology for determining municipalities of foucs. Figure I3 demonstrates the percent differences between the 2020 Census population and the 2020 NJTPA of municipalities designated as municipalities of focus. Municipalities with signficant percent change differences from the 2010-2020 Census also had signficant percent differences between their 2020 census populations and 2020 NJTPA projections. This supports the decision to make these six municpalities focus areas. Figure I4 shows projected population growth from 2020-2050 in each municipality of focus.

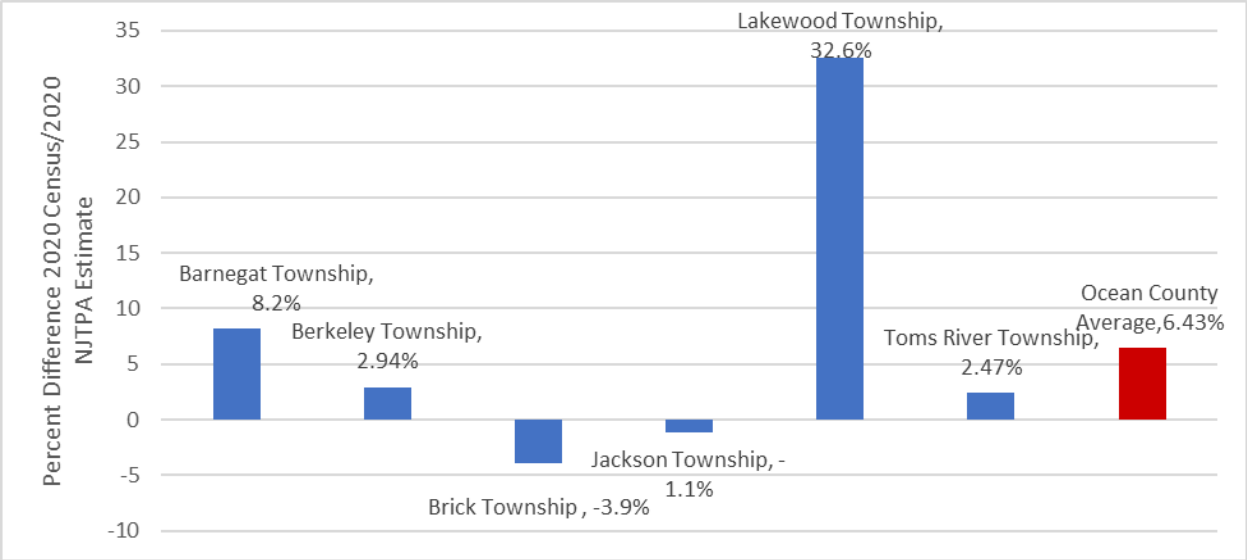

Figure I3. Percent Difference between 2020 Census Population & NJTPA Population Estimates for 2020 (Source: NJTPA & U.S Census Bureau, 2020)

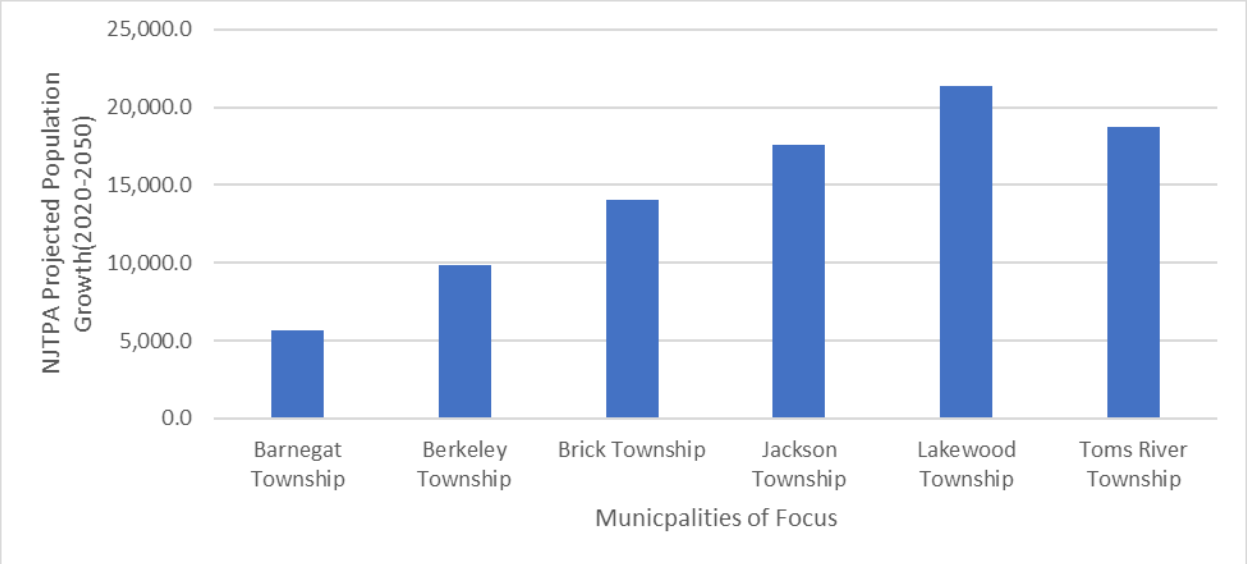

Figure I4. NJTPA Population Growth Forecasts between 2020-2050 for Municipalities of Focus in WMA 13 (Source: NJTPA, 2020)

5. SOCIAL VULNERABILITY

KEY FINDINGS

- There are 70 census block groups in WMA 13 identified as overburdened, and 46 of those are within the six municipalities of focus.
- The CDC Social Vulnerability Index for counties in WMA 13 is relatively low compared to the entire state. However, there are census tracts in WMA 13 with some of the highest overall SVI index scores in the state (Primarily in Lakewood Township).

5.1 NJDEP OVERBURDENED COMMUNITIES

In 2020, New Jersey's Environmental Justice Law was signed, which introduced the overburdened community definition for the state. Figure I5 shows communities defined as Overburdened in WMA 13. "Overburdened community" means any census block group, as determined in accordance with the most recent United States Census, in which: (a) at least 35 percent of the households qualify as low-income households; (b) at least 40 percent of the residents identify as a minority or as members of a State recognized tribal community; or (c) at least 40 percent of the households have limited English proficiency (NJDEP, 2022). Table I5 lists every municipality in WMA 13 that meets the overburdened definition and lists how many census block groups are overburdened. Table I6 focuses on each municipality of focus that has overburdened census blocks and lists which part of the overburdened community definition they met.

County	Number of Census Block Groups Overburdened	Municipality Name
Ocean	3	Barnegat Township
Ocean	7	Berkeley Township
Ocean	3	Brick Township
Ocean	1	Jackson Township
Ocean	1	Lacey Township
Ocean	2	Lakehurst Borough
Ocean	26	Lakewood Township
Ocean	1	Little Egg Harbor Township
Ocean	1	Long Beach Township
Ocean	10	Manchester Township
Ocean	1	Ocean Gate Borough
Ocean	2	Seaside Heights Borough
Ocean	2	South Toms River Borough
Ocean	3	Stafford Township
Ocean	6	Toms River Township
Ocean	1	Tuckerton Borough
Monmouth	4	Freehold Township
Monmouth	1	Howell Township

Table I5. Municipalities in WMA 13 with Census Block Groups Defined as Overburdened (Source: NJDEP, 2022)

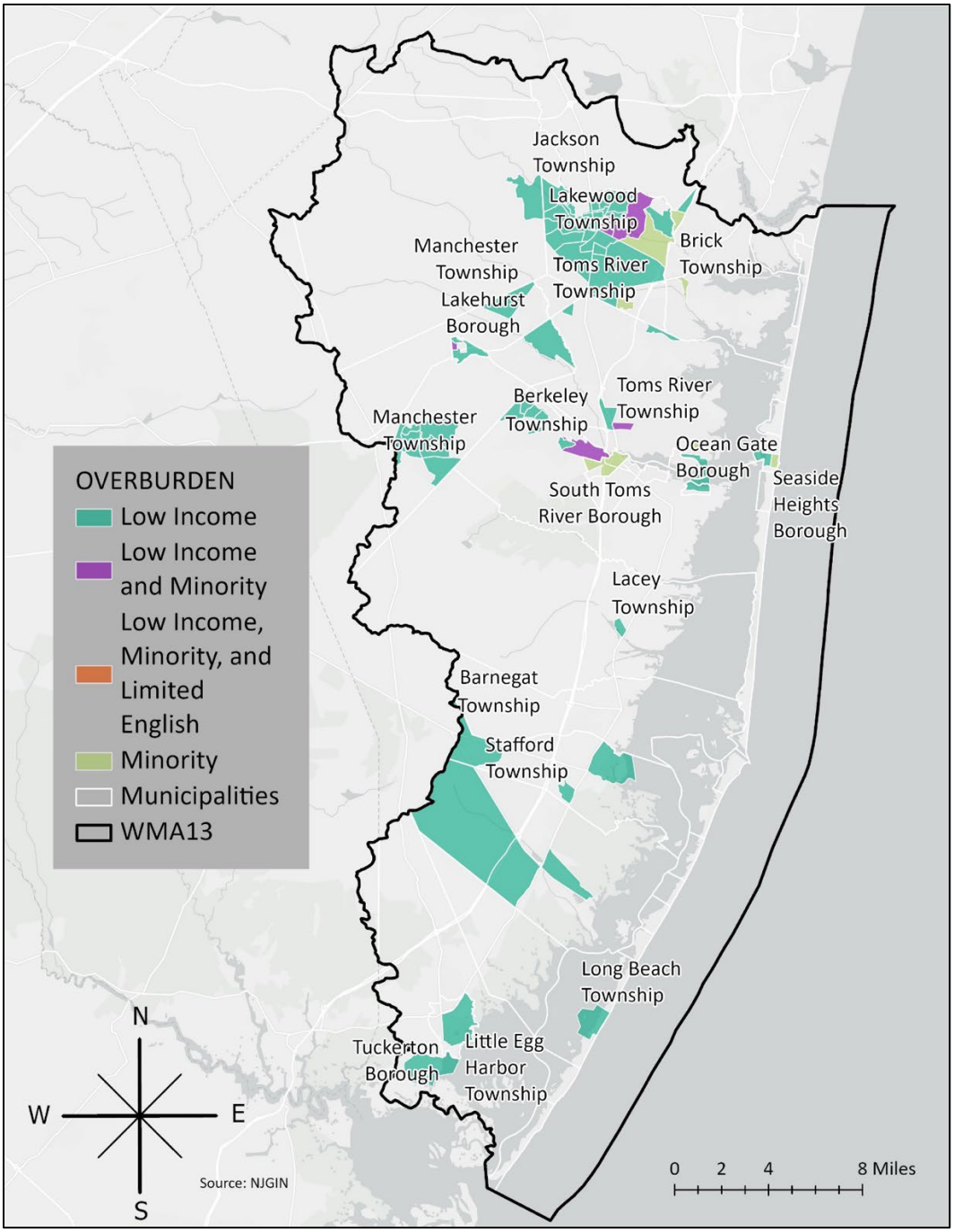

Figure I5. Communities Defined as Overburdened Communities in WMA 13 (Source: NJDEP, 2022)

Municipality	Number of Census Block Groups Overburdened	Overburdened Community Criteria in Census Block Groups
Barnegat Township	3	Low Income
Berkeley Township	7	Low Income (6), Minority (1)
Brick Township	4	Low Income (1), Minority (3)

Municipality	Number of Census Block Groups Overburdened	Overburdened Community Criteria in Census Block Groups
Jackson Township	2	Low-Income (2)
Lakewood Township	38	Low-Income (32), Low-Income & Minority (3) Minority (2), Minority & Limited English (1)
Toms River Township	9	Low-Income (4), Low-Income & Minority (4), Minority (1)

Table I6. Municipalities of Focus with Census Block Groups Defined as Overburdened (Source: NJDEP, 2022)

5.2 SOCIAL VULNERABILITY INDEX

While the overburdened community definition is helpful, there are more ways to capture the social vulnerability of a community. The CDC's Agency for Toxic Substances and Disease Registry created the Social Vulnerability Index (SVI) to define social vulnerability for census tracts in the U.S. The tool ranks census tracts by examining 16 social factors that relate to social vulnerability. Then, the CDC SVI aggregates these 16 factors by grouping them into the following themes: socioeconomic status, household characteristics, racial and ethnic minority status, and housing type/ transportation. Each census tract receives a ranking for each theme, as well as an overall ranking (Agency for Toxic Substances and Disease Registry, 2022). This database contains every census tract in New Jersey, so the social vulnerability of census tracts in WMA 13 is relative to every census tract in New Jersey. As vulnerability increases, the score increases (0-1).

County	Socioeconomic Status Percentile Ranking	Household Composition and Disability Percentile Ranking	Minority Status and Language Percentile Ranking	Housing Type and Transportation Percentile Ranking	Total SVI Index Percentile Ranking
Burlington	0.39	0.44	0.40	0.35	0.37
Monmouth	0.38	0.37	0.30	0.42	0.36
Ocean	0.48	0.41	0.17	0.37	0.39

Table I7. Social Vulnerability Index Percentile Values for Counties in WMA 13 (Source: CDC Agency for Toxic Substances and Disease Registry, 2022)

Census Track	Municipality	County	Socioeconomic Status Percentile Ranking	Household Composition and Disability Percentile Ranking	Minority Status and Language Percentile Ranking	Housing Type and Transportation Percentile Ranking	Total SVI Index Percentile Ranking
34029715202	Lakewood	Ocean	0.95	0.51	0.54	0.98	0.91
34029715001	Lakewood	Ocean	0.94	0.66	0.54	0.86	0.87
34029728004	Seaside Heights	Ocean	0.65	0.82	0.51	0.98	0.84
34029715304	Lakewood	Ocean	0.75	0.40	0.24	0.99	0.79
34029715301	Lakewood	Ocean	0.52	0.87	0.35	0.97	0.77

Table I8. Census Tracts in Ocean County with High Overall SVI Scores (Source: CDC Agency for Toxic Substances and Disease Registry, 2022)

Relative to New Jersey, counties in WMA 13 are less socially vulnerable. Ocean County has the highest overall SVI ranking in WMA 13, but it's not significantly different between the three counties. While it looks like communities in WMA 13 aren't socially vulnerable, it's important to note that there are some census block tracts in Ocean County that have high SVI indexes. Several examples come from Lakewood Township, a municipality of focus. Table I8 demonstrates how despite having a low county SVI Index, several census tracts in Ocean County have some of the highest census tracts overall SVI scores.

5.3 COMPARISON OF OVERBURDENED COMMUNITY AND SVI FINDINGS

When WMA 13's social vulnerability is compared to other areas of the state, using the CDC SVI tool, socially vulnerable census tracts get lost in the statewide data. Despite Ocean County having a low SVI score relative to the state, some census tracts in WMA 13 have the highest overall SVI scores in the state. Using the SVI tool in conjunction with the NJDEP OBC definition helps identify communities that might have gotten lost by one definition of socially vulnerable.

6. CURRENT LAND USE

KEY FINDINGS

- Several municipalities have urban land uses that account for more than 50% of their total land cover. Several municipalities of focus are built out, with minimal barren land.
- Development strategies aim to preserve the available open space and reduce the amount of development near category one waterways and other environmentally sensitive areas.

Area	Urban	Forest	Wetlands	Barren Land	Water	Agriculture
WMA 13 (2015)	22%	27%	17%	2%	32%	1%
Focus Municipalities						
Barnegat Township	23 %	22%	25%	2%	27%	0%
Berkeley Township	25%	32%	19%	3%	22%	0%
Brick Township	52%	8%	16%	1%	24%	0%
Jackson Township	27%	40%	27%	2%	2%	2%
Lakewood Township	62%	22%	11%	2%	2%	1%
Toms River Township	52%	13%	10%	1%	23%	0%

Table I9. Land Use/Land Cover for WMA 13 and Municipalities of Focus (Source: 2015 Land Use/Land Cover GIS Analysis from Data Obtained from NJGIN)

Table I9 presents land use data from the 2015 Land Use assessment for WMA 13. Overall, natural resources define the watershed, with 32% land cover designated as water, 27% forested, and 17% of WMA 13 is covered by wetlands. Second to the natural resources, is the development of urban land, which is almost 22% of the WMA. There isn't much barren land (2%), and almost no agriculture use (1%). Similar trends follow the municipalities of focus. The table shows how land use total percentages vary by municipality. There are several municipalities (Brick Township, Lakewood Township, and Toms River Township) with urban land use greater than 50%. These municipalities are near two C1 waterways (Toms River and the Metedeconk River).

Lakewood Township is the fifth largest municipality in the state. The municipality is growing. To address future land use concerns, the municipality is exploring the following:

- clustering and reasonable density household developments, and
- finding new areas to designate as park and recreation space.

(Source: Lakewood Master Plan, 2017)

6.1 OPEN SPACE, PARKS & RECREATION

Managing Ocean County's publicly owned land is an ongoing priority of WMA 13. The natural landscape of WMA 13 provides amenities from its water resources and habitats and ecosystem goods and services (Kauffman & Curz-Ortíz, 2012). Ocean County's Open Space, Parks, and Recreation Plan identifies that the county is growing, which means more lands need to be preserved to protect water quality and provide recreation spaces for its growing population. Since 1997, Ocean County has had a natural land tax, which was recently expanded in 2019. The tax is used to support Ocean County's Natural Land Trust land acquisitions for recreation and conservation purposes (Ocean County, Open Space Plan, 2020). Table I10 lists the total number acres owned by state, county, and federal agencies.

Landowner	Total Number of Acres
Federal	47,669
State	107,648
Ocean County	155,318
Total	310,635

Table I10. Open Space, Parks, and Recreation Owned by Federal, State, and Local Agencies (Source: Ocean County's Open Space, Parks, and Recreation Plan, 2020)

According to the Open Space Plan, future acquisitions will prioritize the following areas in Ocean County (Ocean County, 2020):

1. stream corridors and other flood prone areas;
2. aquifer recharge areas;
3. buffer areas surrounding potable well fields;
4. environmentally sensitive areas;
5. active farms and lands with prime agricultural soils;
6. lands adjacent to environmentally sensitive areas; and
7. lands in close proximity to Joint Base McGuire-Dix-Lakehurst.

(Source: Ocean County Open Space, Parks, and Recreation Plan, 2020)

7. WATER AVAILABILITY AND DEMAND ANALYSIS

KEY FINDINGS

- The weighted average of water use in WMA 13 from 2016-2020 was 26,867 million gallons per year.
- Water withdrawals for potable supply uses drives water demand in WMA13. In 2020, potable drinking supply water withdrawals accounted for 77.3% of total withdrawals in WMA 13.
- The majority of withdrawals in WMA13 are from HUC11 02040301080 (Toms River, below Oak Ridge Parkway), 02040301040 (Metedeconk River), and HUC11 02040301130 (Lower Little Egg Harbor Tributary).
- Based on estimates from the Low Flow Margin the following HUC11s are stressed: HUC 11 02040301050 (Kettle Creek / Barnegat Bay North), HUC11 02040301060 (Toms River, above Oak Ridge Parkway), HUC11 02040301080 (Toms River, below Oak Ridge Parkway), and HUC11 02040301040 (Metedeconk River).
- The Northern portion of WMA13 (near the Metedeconk River) continues to experience high levels of nutrient loading, which is leading to eutrophication of the bay. The Southern portion of WMA13 is experiencing turbidity issues (Comprehensive Conservation and Management Plan for the Barnegat Bay-Little Egg Harbor Estuary, 2021).
- Since 2012, there have been 32 impaired water designations as defined by the New Jersey's 303(d), to waterbodies designated as public water supply in WMA 13. Stormwater was the primary source of these impairments (Metedeconk River Watershed Protection Plan, 2021).

Figure I6 shows water withdrawals from 1990-2020. In 2020, water withdrawals in WMA 13 came from the following sources: surface water (23%), unconfined groundwater (34%), confined groundwater (43%). Between 2018-2020, the total percentage of withdrawals by source is similar. Since 2018, more water has been withdrawn from surface waters sources.

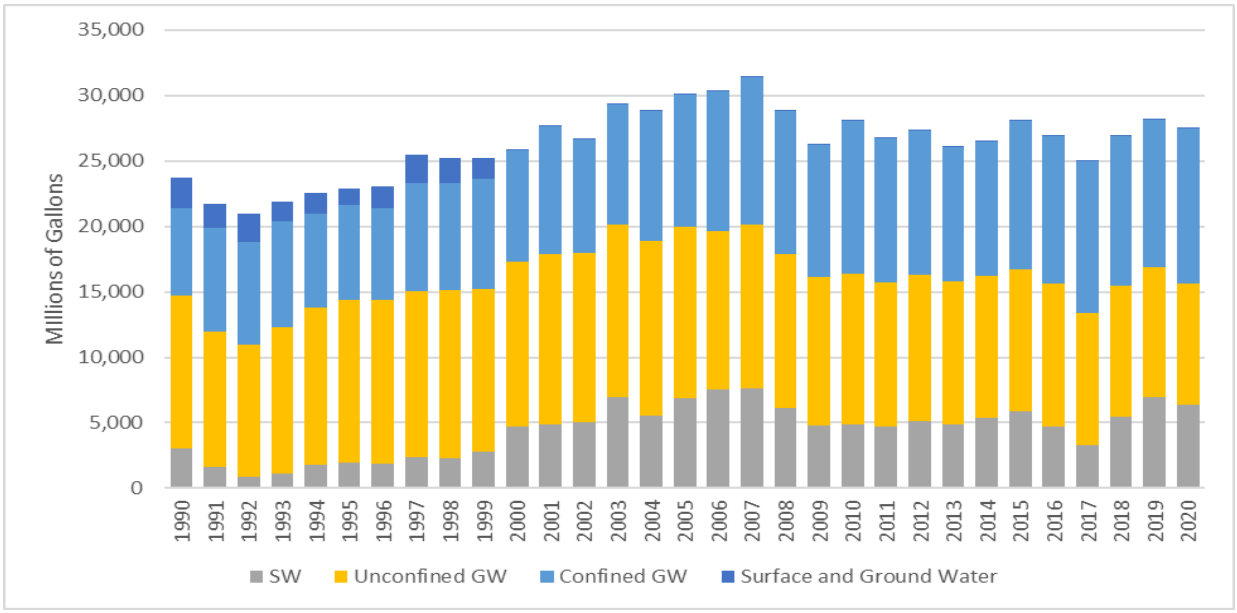

Figure I6. WMA 13 Annual Withdrawals by Source (Source: NJDEP DGS-10-3, 2022)

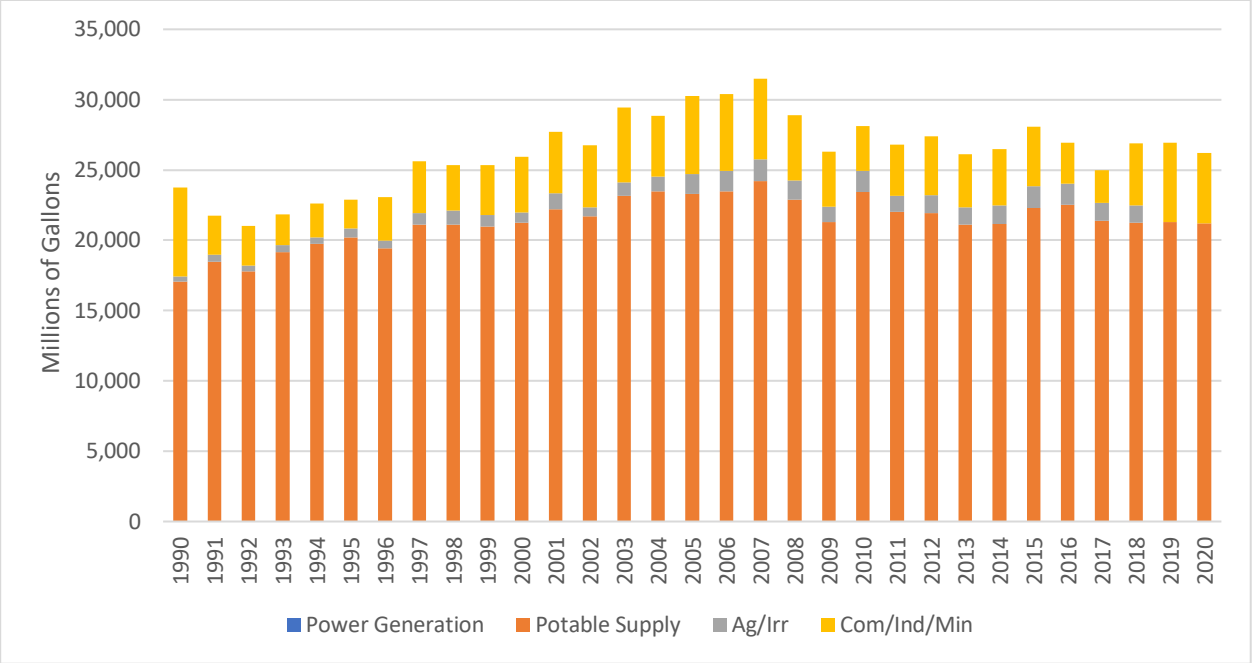

Figure I7. Annual Withdrawals by Use Sector (Source: NJDEP DGS 10-3, 2022)

Figure I7 shows how withdrawals are used in WM13. As shown in Figure I7, annual withdrawals grew steadily between 1990-2007, peaking in 2007. After 2008, total water withdrawals decreased slightly. Over time, the percentage of water going to each water use has remained similar. Potable supply drives most water withdrawals in WMA 13. In 2017, the total percentage of water withdrawals going to potable supply uses peaked at 85.7%. Since 2017, that number decreased slightly. In 2020, potable drinking supply water withdrawals accounted for 77.3% of total withdrawals in WMA 13. The percentage of water withdrawals for commercial industries was the following in 2020: commercial (0.0%), industrial (12.2%), and mining (5.9%). In 2020, 3.8% of total water withdrawals went to irrigation uses. Less than 1% of WMA13'S total water withdrawals in WMA13 went to agriculture (0.8%).

Figure I8 shows annual discharges in WMA 13 by source. Following trends of previous years, almost all discharges are to surface water saline sources (see Figure I8), through regional wastewater treatment facilities. In recent years, a small percentage of annual discharges are to surface water fresh sources.

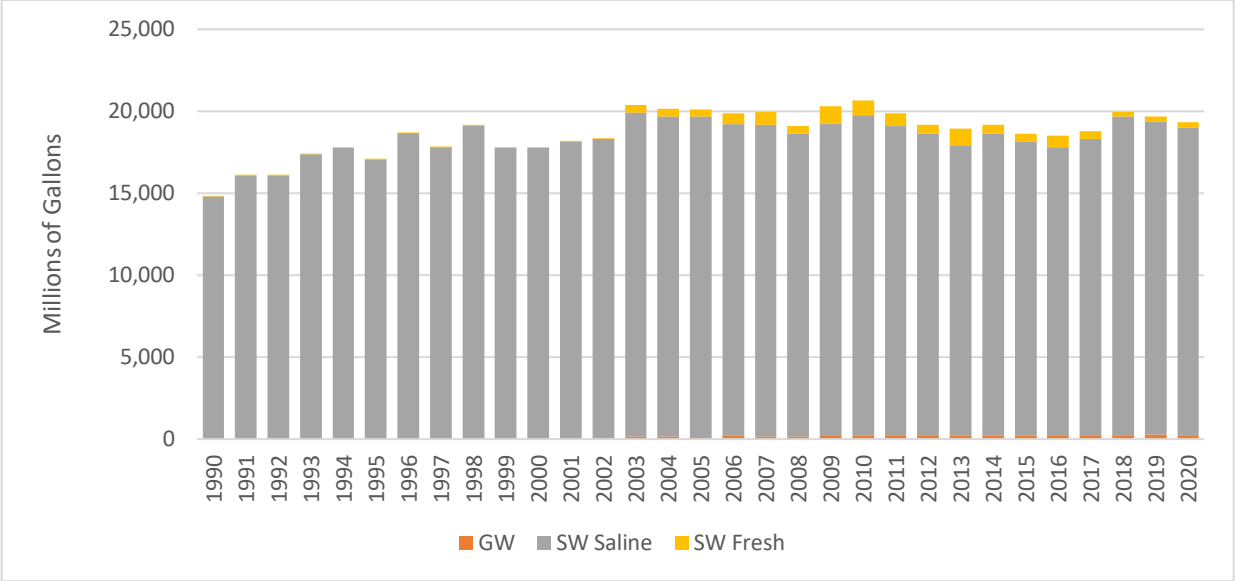

Figure I8. WMA 13 Annual Discharges by Source (Source: NJDEP DGS 10-3, 2022)

7.1 WATER QUANTITY

Figure I9 shows the 5-year (2016-2020) average water withdrawals in WMA 13 by HUC11. From 2016-2020, HUC11 02040301080 (Toms River, below Oak Ridge Parkway) had the largest average water withdrawal, averaging 5,022 million gallons. The second largest average water withdrawal was HUC11 02040301040 (Metedeconk River), with an average of 3,936 million gallons. HUC 11 02040301130 (Manahawkin/Upper Little Egg Harbor tribs) averaged 3,226 million gallons.

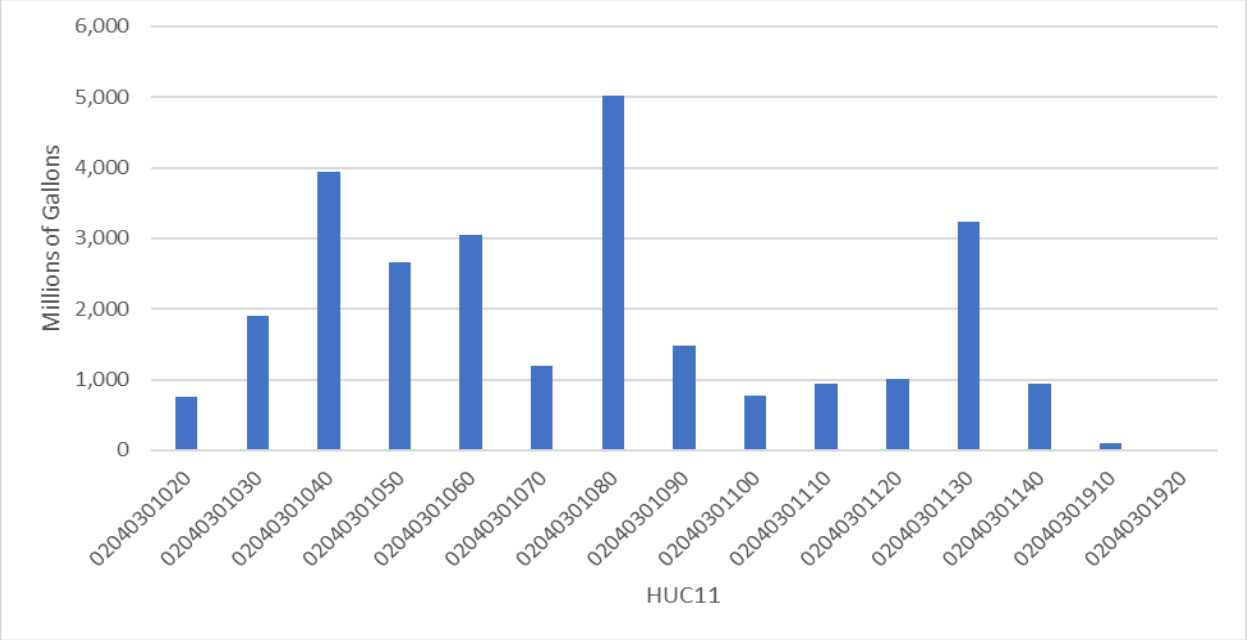

Figure I9. 5-Year (2016-2020) Average Water Withdrawals by HUC11 in WMA 13 (Source: NJDEP DGS 10-3, 2022)

NJDEP's streamflow Low Flow Margin method is a metric NJDEP uses to assess which HUC11'S are potentially limited in a watershed. The method examines the 3-year average peak in consumptive/depletive water loss, for unconfined aquifers and surface waters sources. This assessment looks at the consumptive/depletive water from 2010-2020. Table I11 presents the status of each HUC11 in WMA 13, which is based on the percentage of total available water used in each HUC11. There are two designations for HUC11s in WMA13: not stressed (11) and potentially limited (4). HUC11s are potentially stressed when the HUC11's depletive/consumptive loss is greater than their total water availability.

Status	Number of HUCs	HUC 11 Name
Not Stressed	11	Metedeconk River NB (02040301020) Metedeconk River SB (02040301030) Union/Ridgeway Branch (Toms River) (02040301070) Cedar Creek (02040301090) Barnegat Bay Central & Tribs (02040301100) Forked River / Oyster Creek (02040301110) Waretown Ck / Barnegat Bay South (02040301120) Manahawkin/Upper Little Egg Harbor tribs (02040301130) Lower Little Egg Harbor Bay tribs (02040301140) Atlantic Coast (Manasquan to Barnegat) (02040301910) Atlantic Coast (Barnegat to Little Egg) (02040301920)
Potentially Stressed	4	Metedeconk River (02040301040) Kettle Creek / Barnegat Bay North (02040301050) Toms River (above Oak Ridge Parkway) (02040301060) Toms River (below Oak Ridge Parkway) (02040301080)

Table I11. WMA 13 Percent of Total Water Available Used (Average 3-Year Peak Depletive and Consumptive Loss, 2011-2020) (Source: NJDEP LFM V3, 2023)

Figure I10 shows the remaining available water from the highest 3-year peak demand experienced by each HUC11 (from 2010-2020). While HUC11 02040301040 (Metedeconk River) is the most stressed in terms of the current percent of available water used, HUC11 02040301080 (Toms River, below Oak Ridge Parkway) had the largest deficit where its 3-year average peak withdrawal (2012-2014) greatly exceeded, total available water as calculated by the LFM methodology, the net amount was less than 0 mgy. The Metedeconk River's remaining available water from its 3-year average peak loss (2011-2013) also exceeded total water availability (LFM methodology), which resulted in its net amount being less than 0 mgy (Source: NJDEP LFM, 2023). As always, the withdrawal data have a higher degree of certainty than the LFM methodology; these values are used as indicators of stress and are not used as definitive results by NJDEP.

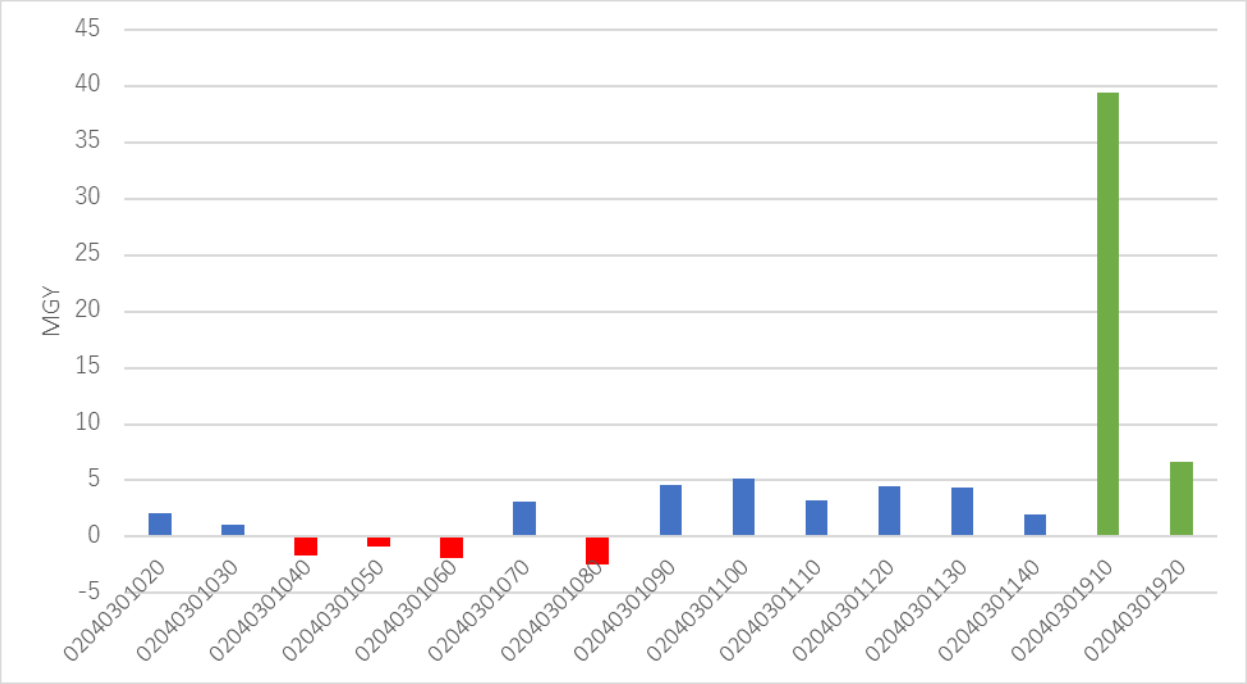

Figure I10. WMA 13 HUC11's Remaining Available Water for the Average 3-Year Peak Loss (Source: NJDEP LFM V3, 2023)

7.2 WATER QUALITY

There are a variety stakeholders and organizations at the federal, state, county, and municipal level working to restore and improve water quality in WMA 13. In 2016, NJDEP released the New Jersey Integrated Water Quality Assessment Report. In 2021, NJDEP created the Metedeconk River Watershed Protection Plan for WMA 13. In 2017, Brick Township Municipal Utilities Authority (BTMUA) created the Metedeconk River Watershed Protection Plan, and in 2021, the Barnegat Bay Partnership addressed water quality issues in the Bay in its Comprehensive Conservation Management Plan.

Sources of Pollutants in WMA13:

- **Point Source:** In WMA13, point sources are not a major concern; there's only one active point source discharge regulated by NJDEP (Metedeconk River Watershed Protection Plan, 2021).
- **Nonpoint Source:** A lot of pollutant loading in the watershed comes from non-point sources. Examples of non-point sources include stormwater discharges not subject to regulation and stormwater runoff (Metedeconk River Watershed Protection Plan, 2021).
- **Land Use:** As land use changes in the watershed to more urban uses, the amount of impervious surfaces increase, which increases stormwater runoff (nonpoint source) in the watershed.

Threats to the Metedeconk River's Water Quality include the following:

- **Nutrient Loading:** The amount of nitrogen and phosphorus in the Metedeconk River Watershed is causing eutrophication in parts of the Metedeconk River, lakes in the watershed, and harming the Metedeconk River Estuary and Barnegat Bay (Metedeconk River Watershed Protection Plan,

2017). Residential development and its impervious surface composition in the northern part of WMA 13 is contributing to the higher Nitrogen loading counts in bay.

- **Algal Blooms:** The Northern part of the Bay is experiencing algal blooms with increasing frequency and intensity, which is related to the nutrient loading issues previously mentioned (Comprehensive Conservation and Management Plan for the Barnegat Bay-Little Egg Harbor Estuary, 2021).

Pollutant Causing a Designated Use Impairment	Impaired Waterbodies Count
Arsenic ***TMDL Priority Ranking: Low***	23
Benzene ***TMDL Priority Ranking: Low***	1
Lead ***TMDL Priority Ranking: Low***	3
Mercury in Water Column ***TMDL Priority Ranking: Low***	2
Tetrachloroethylene ***TMDL Priority Ranking: Low***	1
Total Dissolved Solids (TDS) ***TMDL Priority Ranking: Medium***	1
Vinyl Chloride ***TMDL Priority Ranking: Low***	1
Total Count of Impaired Waterbodies in WMA 13	**32**

Table I12. 2020 3030(d) List of Impaired Waterbodies, Designated for Public Water Supply (EPA, 2020)

NJDEP has been monitoring nonpoint source pollutants relates to public water supply (EPA NJ Impaired Waters List, 2020). Table I12 shows how many times a pollutant has impaired a waterbody in WMA13 from 2012-2020. Stormwater runoff was the primary cause of most of these pollutants (Metedeconk River Watershed Protection Plan, 2021). To mitigate these impairments, NJDEP established Total Maximum Daily Loads (TMDL) plans for five high priority pollutants identified in Integrated Water Quality Assessment Reports. Pollutants regulated by TMDLs are the following: fecal coliform, total coliform, nitrogen, mercury, and total phosphorous (Metedeconk River Watershed Protection Plan, 2021).

Strategies to Improve and Restore WMA13's Water Quality:

- Category One Waters
    - New Jersey Pollutant Discharge Elimination System (NJDPES) Rules at N.J.A.C.7:14A
    - Flood Hazard Ara Control Act Rules at N.J.A.C. 7:13
- Public Law 2010
- New Jersey State Fertilizer Law P.L. 2010, c.112 (C.58:10A-64 et seq.)
- Soil Restoration Act (P.l.2010, c. 113)

(Source: Metedeconk River Watershed Protection Plan, 2021)

8. WATER UTILITIES AND WATER INFRASTRUCTURE

KEY FINDINGS

- In WMA 13, Berkeley Township MUA (16.13%), Brick Township MUA (34%), and Lakewood Township MUA (21.56%) had some of the highest large water demand increases between 2011-2020.
- Water demands projections for PCWS in 2050 show that system's surpluses will decline. Barnegat Township MUA, Jackson Township MUA, and Ocean Township Department of Utilities are projected to experience surplus deficits by 2050.

There are 39 public community water systems that serve over 1,000 residents in WMA 13 (NJDEP Data Miner, 2022). Table I13 lists the PCWS that serve the municipalities of focus in this report.

County	Municipality of Focus Served	PWID	System Name	Max Population Served	Water Sources	Number of Wells
Ocean	Jackson Twp	1511001	Jackson Twp MUA	35,424	Englishtown Aquifer, Vincentown Aquifer, Upper Potomac-Raritan-Magothy Aquifer System	9
Monmouth	Brick Twp, Lakewood Twp, Toms River Twp	1345001	NJ American - Coastal North	69,730	Englishtown Aquifer, Kirkwood-Cohansey, Mount Laurel-Wenonah, Potomac-Raritan-Magothy, Upper Potomac-Raritan-Magothy, Vincentown	19
Ocean	Brick Twp	1506001	Brick Twp MUA	86,898	Metedeconk River, Potomac-Raritan-Magothy Aquifer, Kirkwood-Cohansey Aquifer	11
Ocean	Berkeley Twp, Toms River Twp	1507005	Veolia Water-Toms River	123,187	Kirkwood-Cohansey, Piney Point, Potomac-Raritan-Magothy, Upper Potomac-Raritan-Magothy	24
Ocean	Barnegat Twp	1520001	Ocean Twp Department of Utilities	2,836	Rio Grande Water-Bearing Zone, Atlantic City "800-foot" Sand Aquifer System	5
Ocean	Barnegat Twp	1533001	Barnegat Twp Water & Sewer Utilities	20,000	Kirkwood-Cohansey Aquifer	6
Ocean	Barnegat Twp	1533002	Pinewood Estates-Brighten	1,493	Kirkwood-Cohansey Aquifer	3

County	Municipality of Focus Served	PWID	System Name	Max Population Served	Water Sources	Number of Wells
Ocean	Berkeley Twp	1505002	Aqua NJ – Eastern Division	12,000	Kirkwood-Cohansey Aquifer System	3
Ocean	Berkeley Township	1505003	Shore Water Company	6,600	Kirkwood-Cohansey Aquifer System	3
Ocean	Berkeley Twp	1505004	Berkeley Twp MUA	11,235	Piney Point Aquifer	3
Ocean	Lakewood Twp	1514002	Lakewood Twp MUA	21,750	Potomac-Raritan-Magothy Aquifer System, Englishtown Aquifer, Kirkwood-Cohansey Aquifer System	9

Table I13. PCWS (>1,000) that Serve the Six Municipalities of Focus (Source: NJ Community Water System Source Water Assessment Summaries, 2022)

Table I14 analyzes the current demand patterns of the large purveyors (>1,000 people served) that serve the municipalities of focus. In 2020, New Jersey American Water Company (NJAWC)-Coastal had the largest water demand of 8,960 mgy. Brick Township MUA's water demand increased the most, with a 34% percent change between 2011 to 2020. Table I15 explores different water demand forecasts for 2050, considering various conservation options for PCWS. Most PCWS surpluses are projected to decrease by 2050. Under 2050 Conservation scenarios, Berkeley Township MUA and NJAWC-Coastal North surpluses are projected to increase. Barnegat Township MUA, Jackson Township MUA, and Ocean Township Department of Utilities are projected to experience negative water loss scenarios by 2050.

System Name	2020 Demand (mgy)	Demand Percent Change (2011-2020) (%)	Average Demand (mgy)	Max Demand (mgy)	Average Demand (mgd)
Aqua NJ – Eastern Division (Berkeley Water Co)	282	-8	288	305	1
Barnegat Twp Water & Sewer Utilities	723	0	678	725	2
Berkeley Twp MUA	284	16	256	284	1
Brick Twp MUA	2,269	34	1,912	2,348	5
Jackson Twp	1,131	-9	1,183	1,281	3
Lakewood Twp MUA	1,272	22	1,214	1,561	3
NJAWC -Coastal North	8,960	-3	12,724	14,883	35
Ocean Twp Department of Utilities	382	16	360	392	1
Pinewood Estates-Brighten	31	-8	32	36	0
Shore Water Company	59	5	58	66	0

System Name	2020 Demand (mgy)	Demand Percent Change (2011-2020) (%)	Average Demand (mgy)	Max Demand (mgy)	Average Demand (mgd)
Veolia-Toms River	3,907	-15	4,421	4,618	12

Table I14. Public Community Water Systems (That Serve >1,000 People) in WMA 13 and Their Water Demands (Source: NJDEP, 2022)

Purveyor and 2020 Status				2050 No Conservation Scenario		2050 Conservation Scenario	
PSWID	Purveyor Name	Average Daily Demand (2020) (mgd)	2020 Deficit Surplus (mgd)	Nominal Water Loss Scenario (mgd)	Optimal Water Loss Scenario (mgd)	Nominal Water Loss Scenario (mgd)	Optimal Water Loss Scenario (mgd)
NJ1505002	Aqua NJ – Eastern Division	0.8	0.4	0.0	0.1	0.1	0.2
NJ1533001	Barnegat Twp Water & Sewer Utilities	1.9	0.7	-0.6	-0.4	-0.4	0.1
NJ1505004	Berkeley Twp MUA	0.7	0.8	1.9	1.9	1.9	1.6
NJ1506001	Brick Twp MUA	8.7	7.4	5.1	5.9	5.7	6.8
NJ1511001	Jackson Twp MUA	3.1	2.4	-0.7	-0.3	-0.3	0.9
NJ1514002	Lakewood Twp MUA	4.2	0.4	0.7	1.2	0.9	1.0
NJ1345001	NJAWC-Coastal North	47.5	9.3	4.7	8.7	10.7	12.7
NJ1520001	Ocean Twp Dept. of Utilities	1.1	0.4	-0.2	-0.1	-0.2	0.1
NJ1533002	Pinewood Estates-Brighten	0.1	0.0	0.0	0.0	0.0	0.03
NJ1505003	Shore Water Company	0.2	0.1	0.1	0.1	0.1	0.1
NJ1507005	Veolia Water-Toms River	10.8	7.1	4.0	5.0	4.9	6.3

Table I15. 2050 Demand Projections for PCWS Serving Municipalities of Focus (Source: NJDEP, 2023)

8.1 RELATIONSHIP BETWEEN WATER USE AND PROJECTED DEMOGRAPHIC CHANGES

Most PCWS discussed above serve major population centers in WMA 13. Veolia Toms River serves Toms Rivers Township and sections of Berkeley Township (NJ DEP Data Miner, 2022). Berkeley Township and Toms River are municipalities of focus in WMA 13 because their population growth exceeded MPO estimates in 2020. New Jersey American Water Coastal North serves 35 municipalities, mostly north of WMA 13 but including Brick Township, Lakewood Township, and Toms River Township (NJ DEP Data Miner, 2022). These townships are municipalities of focus.

The population these purveyors serve is going to increase. As shown through the 2050 demand projections, water demand is going to increase for communities in WMA 13.

9. CLIMATE CHANGE AND SEA LEVEL RISE ASSESSMENT

KEY FINDINGS

- The major drivers of climate change as they relate to WMA 13's water supplies are precipitation, temperature, and sea level rise.
- In WMA 13, when sea level rises 2ft, 63 wells associated with water allocation sites are at risk of inundation. When sea level rises to 5ft, 305 wells are at risk.
- In WMA 13, when sea level rises 2ft and 5ft, 9.8% to 20.5% of the total PCWS service areas becomes inundated respectively.
- In WMA 13, when sea level rises 2ft, 15 overburdened census block groups are completely inundated. When sea level rises to 5ft, the number of overburdened census block groups increases to 18.

9.1 CLIMATE CHANGE DRIVERS AND THEIR IMPACT ON WATER SUPPLIES

PRECIPITATION

New Jersey precipitation models predict that the average annual precipitation will increase slightly over time in the state, with minimal regional differences (2020 NJ Scientific Report on Climate Change, 2020). New Jersey's coastal areas average 44 inches of rain, which is less than northern and southern parts of the state (Office of New Jersey State Climatologist, 2020). In addition, coastal areas are expected to experience more precipitation extremes in the fall and spring relative to inland areas (2020 NJ Scientific Report on Climate Change, 2020).

Despite the minimal change in the average annual precipitation, the frequency and severity of precipitation will change. Precipitation intensity will increase and

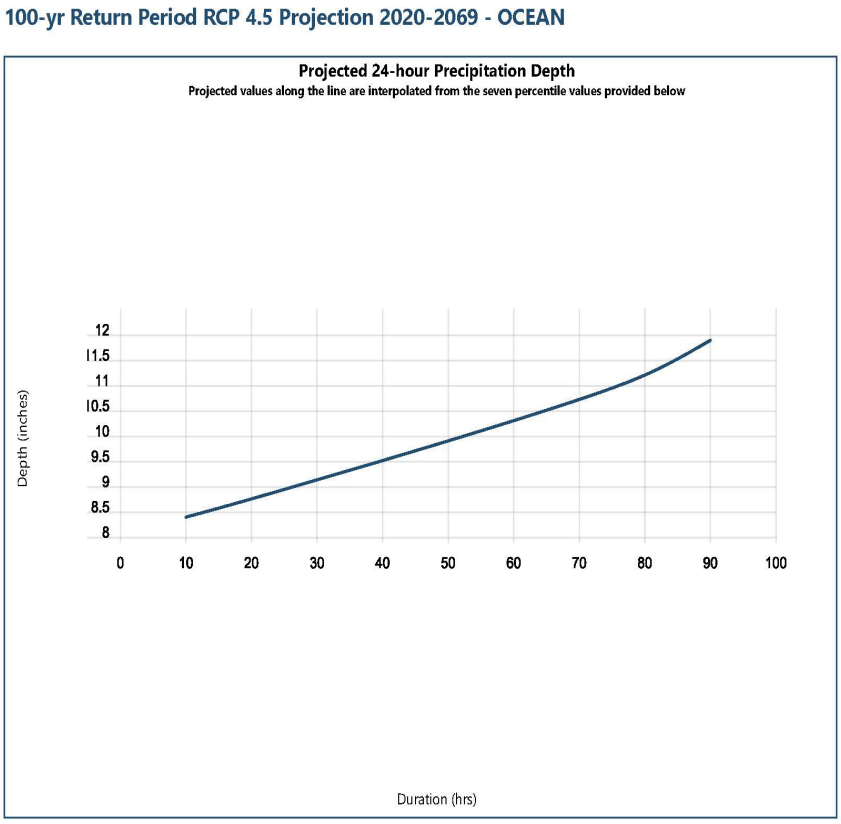

Figure I11. Precipitation Depth (Inches) Associated with a 24-hour Storm with a 1% Chance (100-year Storm) of Occurring in Any Given Year under a Moderate Emission Scenario (RCP 4.5). Prediction for 2020-2069 Future Emission Scenario. (Source: NJ Extreme Precipitation Projection Tool, 2023)

there will be longer durations of drier periods (Agel et al., 2015). These variations in water availability could put stress on water systems, which could lead to more water-supply declared droughts.

Precipitation projections for Ocean County supports findings that there's a high likelihood that precipitation intensity will increase. Figure I11 shows the regional estimate for projected changes in extreme rainfall amounts (inches) within a 24-hour period in Ocean County. Using this projection, for the 100-year return period, moderate RCP4.5 emission scenario, and the 2050 to 2099 period for Ocean County, there is a 75% chance that the 24-hour precipitation amount will be equal to or less than 10.92 inches. There is a 25% chance that a 100-year 24-hour precipitation event will be equal to or less than 8.95 inches.

TEMPERATURE

New Jersey's annual temperature is rising and is expected to continue to rise over the 2050 planning period. Heatwave events are expected to occur more frequently with longer durations. It's estimated that by 2050, annual temperatures in the state will increase by 4.1°F to 5.7°F.

Here are some ways higher temperatures can impact water supplies:

- increased water demand;
- reduced water availability; and
- increased water loss through evapotranspiration.

(Source: 2020 NJ Scientific Report on Climate Change, 2020)

SEA LEVEL RISE

The rate of sea level rise in the Northeast U.S. has been higher than global rate and is expected to continue (2020 NJ Scientific Report on Climate Change, 2020). One of the key findings from the 2020 New Jersey Scientific Report on Climate Change is that "By 2050, there is a 50% chance that sea level rise will meet or exceed 1.4 feet and a 17% chance that it will exceed 2.1 feet. Those levels increase to 3.3 and 5.1 feet by the end of the century (under a moderate emission scenario)" (p. xi). Figure I12 presents the sea level rise projections noted above, with their likelihood estimates (Kopp et. al, 2019).

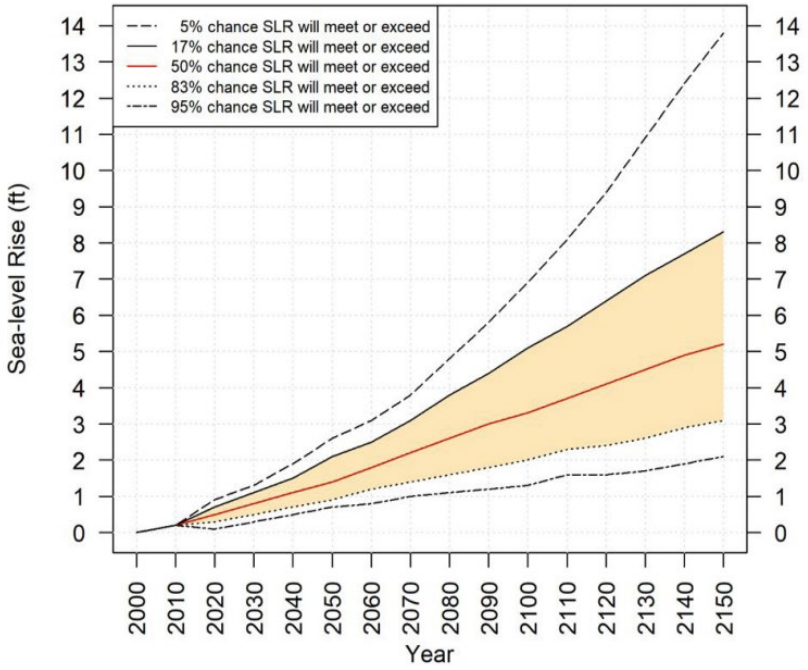

Figure I12. Moderate Emission Scenario (Kopp et al., 2019)

Based on these findings, climate change scenarios in this report will focus on 2ft and 5ft sea level rise scenarios for WMA 13.

Sea level rise is an important phenomenon to study regarding potable water supplies because of its ability to induce saltwater intrusion to freshwater sources (WSP Presentation: WSP Climate Change Impacts, 2023). In New Jersey, unconfined aquifers systems are the most at risk of SLR induced saltwater intrusion. Potable supply wells near the ocean and estuaries are especially at risk (2020 NJ Scientific Report on Climate Change, 2020). Most of the communities along the coast are actively managing their water supplies and water demand to prevent saltwater intrusion.

9.2 POTENTIAL CHANGES TO WMA 13 WATER AVAILABILITY DUE TO CLIMATE CHANGE

There are various ways climate change can impact water supplies in the future. Impacts to water supplies include:

- water demand;
- water quality/treatment;
- saltwater intrusion wells/intakes;
- changes to aquifer availability; and
- inundation of public infrastructure.

(Source: WSP Presentation: WSP Climate Change Impacts, 2023)

Below are some of the ways to assess how climate change will affect WMA 13's water supplies.

WMA 13 SITE INUNDATION FROM SEA LEVEL RISE

One way to examine threats to WMA13's water supplies is to examine the active withdrawal and discharge sites (from 2016-2020) that would be inundated under 2ft and 5ft sea level rise.

Using data of wells associated water allocation in WMA 16 (from 2016-2020), a GIS analysis was performed to determine the number of wells that would be inundated by 2ft and 5ft of sea level rise. The data for these wells is from the New Jersey Water Database, which includes primary water allocation permitted sites and NJDEPS sanitary sewer discharge points. While this analysis is useful, all estimates should be considered approximate. The actual number of sites may vary.

The sea level rise data comes from NOAA's Sea level Rise Viewer and represents the mean higher water

HUC11	Number of Inundated Permits(2ft)	Number of Inundated Permits (5ft)
Withdrawal Permits		
02040301040	14	54
02040301050	5	43
02040301080	20	43
02040301090		10
02040301100		25
02040301110		5
02040301120		23
02040301130		48
02040301140	5	35
Discharge Permits		
02040301910	14	14
02040301920	5	5

Table I16. Number of Inundated Sites by 2ft and 5ft Sea Level Rise in WMA 13 by HUC11 (Source: NJDEP, NOAA)

conditions: the average of the higher of the daily high tides over the National Tidal Datum Epoch (1983-2001) (NOAA Sea Level Rise Viewer, 2022). When sea level rises 2ft, 63 withdrawal wells associated with water allocation permits will be inundated (see Table I16). When sea level rise rises 5ft, 305 wells will be inundated (see Table I16). Exploring withdrawal permit use groups shows that between 2ft and 5ft sea level rise, potable supply wells become more vulnerable (see Figure I13).

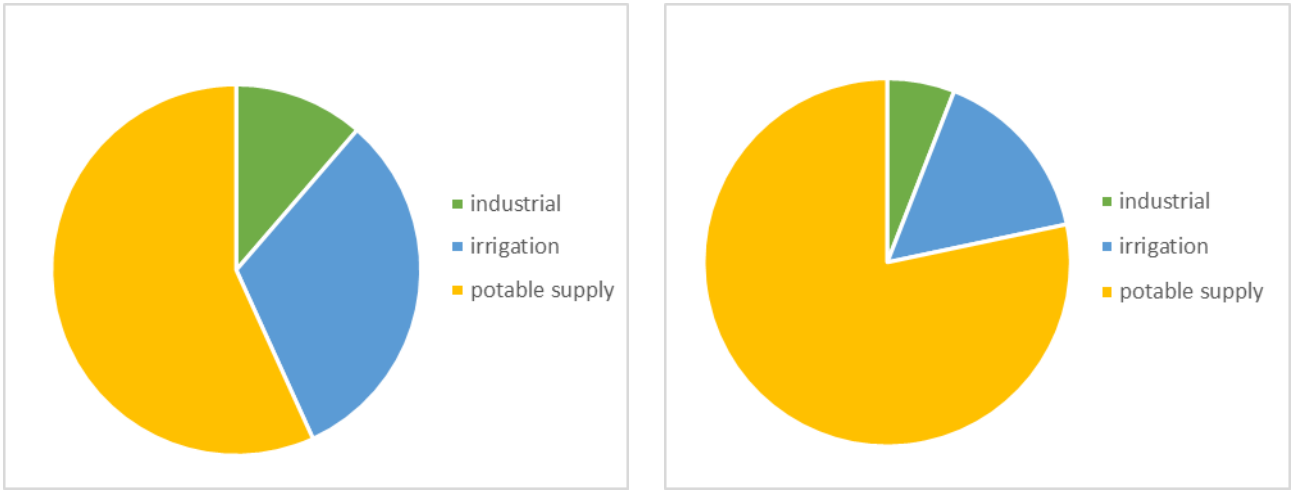

Figure I13. (Left) WMA 13 Withdrawal Permits Inundated by Use Group (2ft SLR); (Right) WMA 13 Withdrawal Permits by Use Group (5ft SLR)

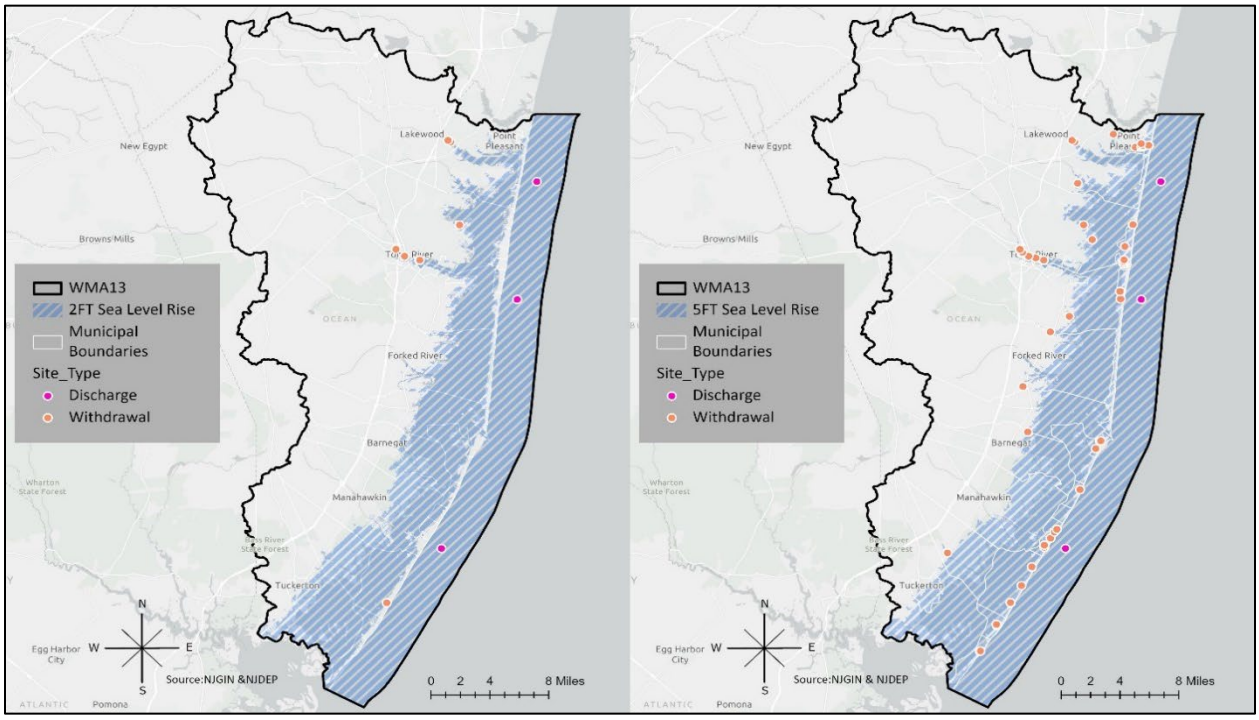

Figure I14. (Left) Map of the WMA 13 Region with 2ft of Sea Level Rise and Withdrawal and Discharge Sites with Use (between 2016-2020) That Would Be Inundated by 2ft of Sea Level Rise; (Right) Map of the WMA 13 Region with 5ft of Sea Level Rise and Withdrawal and Discharge Sites with Use (between 2016-2020) That Would Be Inundated by 5ft of Sea Level Rise

Figure I14 shows where withdrawal and discharge permit sites would become inundated under 2ft and 5ft sea level rise scenarios. Sites further inland become inundated as sea level rises in the 5ft scenario. Examining how many withdrawal and discharge permit sites are inundated by sea level rise scenarios is an important component to understanding threats to WMA 13's water supplies. As sites become inundated, they may become unusable from saltwater intrusion.

PUBLIC COMMUNITY WATER PURVEYOR SERVICE AREAS

Another threat to WMA 13's water supply is the service area of public community water systems that would be inundated by sea level rise. If PCWS service areas become inundated, water supplies may be impacted, communities may be hard to access, and purveyors' infrastructure could be at risk. A GIS analyses was performed that calculated the total area of purveyor service areas inundated by 2ft and 5 ft sea level rise. Under both scenarios, 35 PCWS service areas will experience at least some inundation and 10% of all service areas. When sea level rose to 5ft, the total percentage of PCWS service areas that will experience at least some inundation rose to 21% (see Table I17) of the total service area in WMA 13. Figure I15 shows how PCWS service areas (orange) become more inundated in 2ft (green) and 5ft (pink) sea level rise scenarios.

Sea Level Rise	Number of PSA Inundated	Percent of total PSA Inundated
2ft	35	10%
5ft	35	21%

Table I17. PCWS Services Areas in WMA13 That Would Be Inundated by 2ft and 5ft of Sea Level Rise

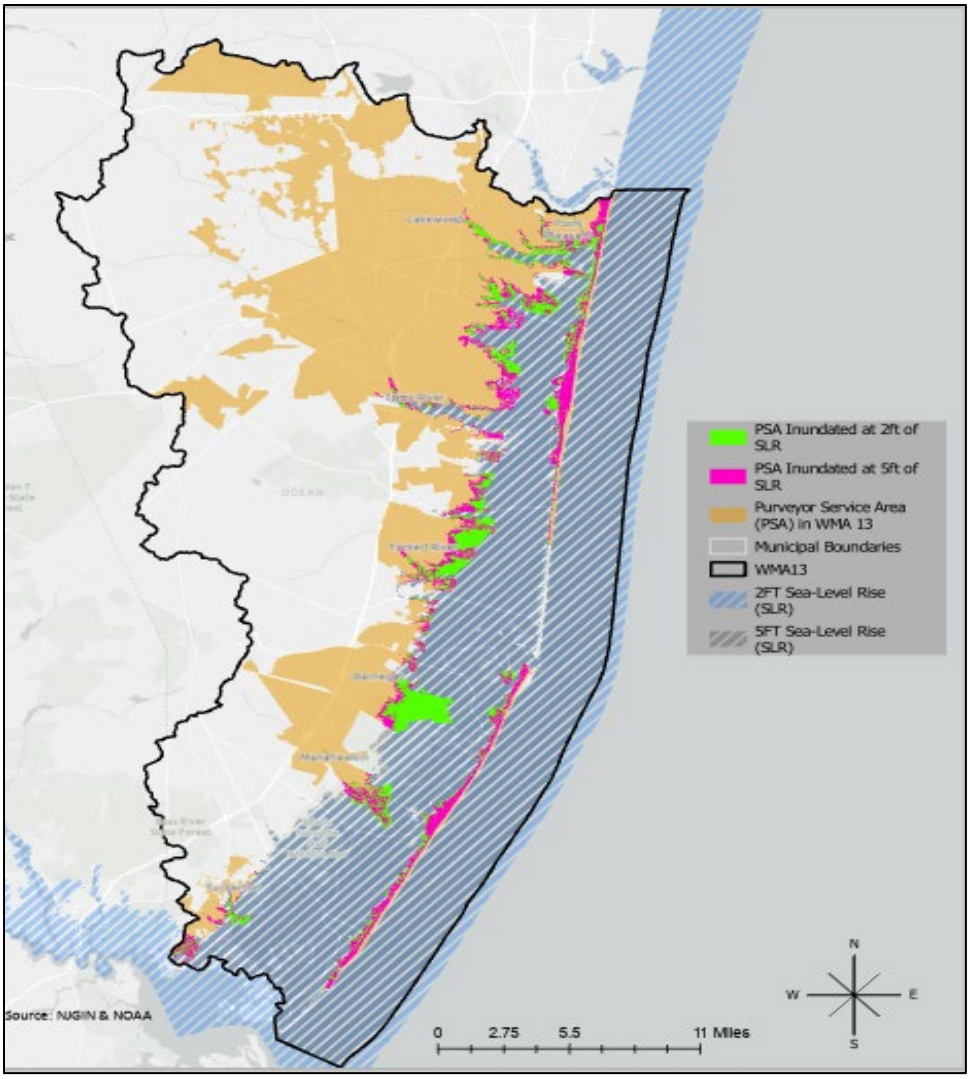

Figure I15. Map of the WMA 13 Region with 2ft of SLR, 5ft of SLR, Public Community Water Purveyor Service Areas (Orange), and the Area That Would Be Inundated by 2ft of SLR (Green) and the Area That Would Be Inundated by 5ft of SLR (pink)

Out of the 35 PCWS systems that would be inundated by 2ft and 5 ft sea level rise, there are 9 PCWS that serve the municipalities of focus in this report (see Table I18).

Sea Level Rise	Name of Purveyor in Municipalities of Focus that Experience Inundation	Percent of PSA Inundated by 2ft of SLR Compared to its Total Area	Sea Level Rise	Name of Purveyor in Municipalities of Focus that Experience Inundation	Percent of PSA Inundated by 5ft of SLR Compared to its Total Area
2ft	Aqua NJ-Eastern Division (NJ1505002)	6%	5ft	Aqua NJ-Eastern Division (NJ1505002)	15%

Sea Level Rise	Name of Purveyor in Municipalities of Focus that Experience Inundation	Percent of PSA Inundated by 2ft of SLR Compared to its Total Area	Sea Level Rise	Name of Purveyor in Municipalities of Focus that Experience Inundation	Percent of PSA Inundated by 5ft of SLR Compared to its Total Area
2ft	Barnegat Township (NJ1533001)	25%	5ft	Barnegat Township (NJ1533001)	29%
2ft	Brick Township MUA (NJ1506001)	14%	5ft	Brick Township MUA(NJ1506001)	23%
2ft	Berkeley Township (NJ1505004)	13%	5ft	Berkeley Township (NJ1505004)	27%
2ft	Lakewood Township MUA (NJ1514002)	<1%	5ft	Lakewood Township MUA(NJ1514002)	<1%
2ft	NJ American Company-Coastal North (NJ1345001)	5%	5ft	NJ American Company-Coastal North (NJ1345001)	12%
2ft	Ocean Township Department of Utilities (NJ1520001)	8%	5ft	Ocean Township Department of Utilities (NJ1520001)	22%
2ft	Shore Water Company (NJ1505003)	10%	5ft	Shore Water Company (NJ1505003)	41%
2ft	Toms River (NJ1507005)	3%	5ft	Toms River (NJ1507005)	23%

Table I18. PCWS That Serve Focus Municipalities and Would Experience Some Inundation at 2ft and 5ft SLR (Source: NOAA, NJDEP, 2023)

9.3 WMA 13 OVERBURDENED COMMUNITIES & SEA LEVEL RISE

In WMA 13, several municipalities defined as overburdened are at risk of sea level rise in WMA 13.

When sea level rises 2ft, 15 census block groups are partially indundated inundated in 13 different municipalities. When sea level rises 5ft, 18 census blocks are partially inundated, in 15 different municipalities. Census blocks groups from the municipalities of focus in this report represent 40% of census block groups in both scenarios that would be inundated in 2ft and 60% of the overburdened census block groups in 5ft sea level rise scenarios.

Figure I16 shows which census block groups become inundated under both scenarios. In both scenarios, communities inundated met either the low-income or minority definition of overburdened defined by the law.

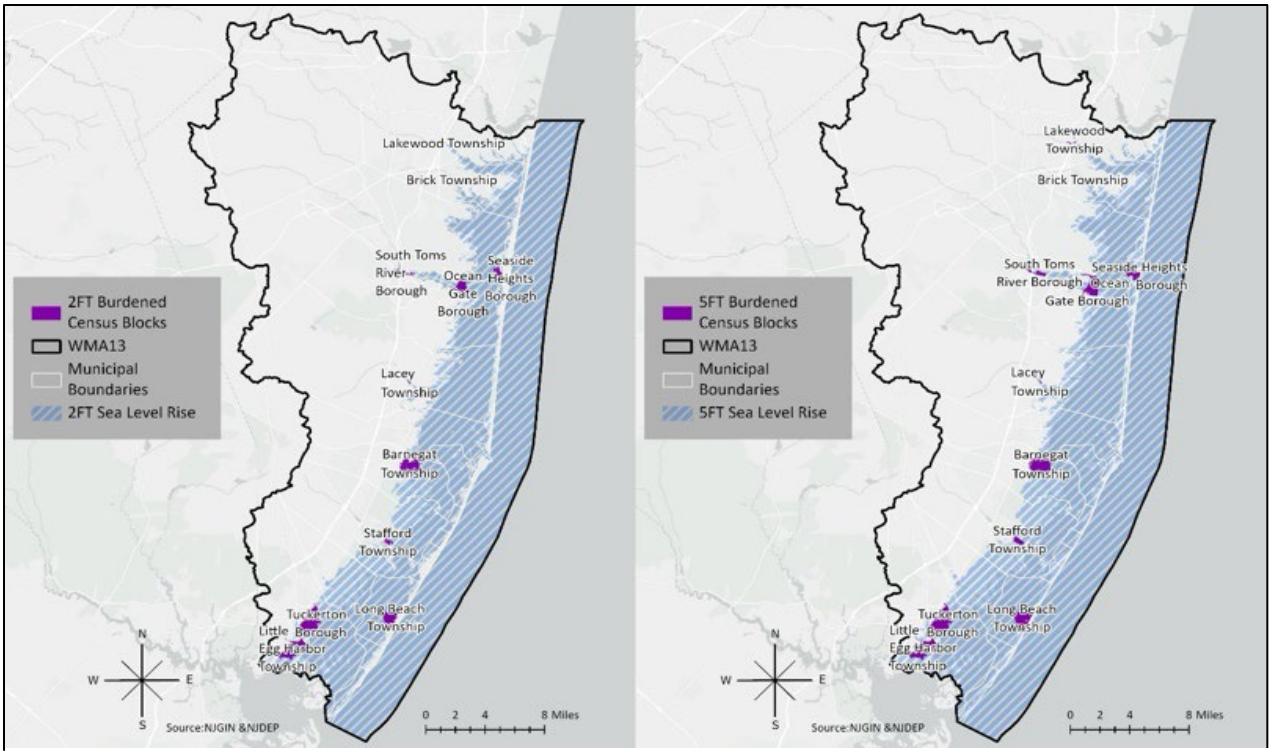

Figure I16. (Left) Map of the WMA 13 Region with 2ft of Sea Level Rise and Overburdened Census Block Groups Designated by New Jersey's Environmental Justice Law; (Right) Map of WMA 13 Region with 5ft of Sea Level Rise and Overburdened Census Block Groups Designated by New Jersey's Environmental Justice Law

Understanding which communities may be at risk of sea level rise inundation is an important consideration for municipalities. These communities may need more assistance leaving during flood events and emergency programming may need to develop communication resources in multiple languages.

CONCLUSION OF CLIMATE CHANGE AND ITS THREAT TO WMA13'S WATER SUPPLY

This discussion has considered some of ways climate change will affect WMA 13's water supplies. Under 2ft and 5ft sea level rise scenarios, water withdrawal and discharge sites in WMA 13 will become inundated. PCWS service areas will become inundated. And census block groups defined as overburdened will become inundated. This is not an exhaustive list.

Further consideration may include:

- the number of acres of aquifers and aquifer outcrop areas inundated by sea level rise;
- public infrastructure inundated by 2ft and 5ft sea level rise at WMA 13; and
- non-public community supply wells inundated by 2ft and 5ft sea level rise.

Sea Level Rise	Number of Census Block Groups Inundated	Number of Census Block Groups Inundated in Focus Municipalities
2ft	15	6
5ft	18	11

Table I19. Number of Overburdened Census Block Groups Inundated by 2ft and 5ft of Sea Level Rise (Source: NOAA, NJDEP, 2023)

10. MANAGEMENT OPTIONS

Based on population projections, water demand, climate change and sea level rise it's evident that smart water policies are necessary to protect the water supply sources of WMA 13. Municipalities in WMA 13 will need to consider current and future development. Below are several management options for consideration regarding WMA 13's water supply.

1. **Protection of PWCS wells in areas of potential inundation**

   Wells impacted by future sea level rise and storm surge should be hardened to prevent salt water from entering the well or migrating down the casing to contaminate confined aquifers.

2. **Protection of surface water intakes**

   Low elevation water supply intakes should be studied to determine if SLR will push saltwater upriver to the location of the intake. Brick Township MUA has implemented a source water protection program since 1991 to protect its intake in Forge Pond, including consideration of potential saltwater intrusion up the Metedeconk River. Further evaluation of this and potentially other intakes is warranted.

3. **Evaluation of PCWS service area risks**

   Sea level rise of 2ft or 5ft will have major implications for the long-term viability of development, which raises concerns about the costs and viability of maintaining water service to those areas. Elevating homes will likely continue to prolong the period where residential land uses remain possible. However, sea level rise will also increase groundwater levels, including saltwater intrusion in near-shore areas. That process will place utility services (water, sewer, electricity, telecommunications) at risk before the homes themselves are no longer viable due to street flooding. Future risk management programs may also prolong the viability of near-shore development. It will be important for PCWS to begin assessing risks, asset management needs and rate impacts as near-shore development transitions from year-round housing to rental, and perhaps to consolidation or removal of some buildings in later parts of the century.

4. **Protect development that meets high water use efficiency standards**

   WMA 13's population is growing. For most municipalities in WMA 13, more housing units will be needed. New proposed housing developments should continue to consider smart low impact development, proximity to current and future flood prone areas, and other measures to minimize additional water demands in WMA 13. The issue of housing types is important in at least two ways. First, greater density can achieve increased housing units on the same amount of impervious surface, reducing stormwater management needs per household. Second, higher density housing uses significantly less water per capita than low density residential development (Van Abs et al., 2018), in part due to lower per capita outdoor water demands. Dense development with high water efficiency is very appropriate in redevelopment scenarios, where existing impervious surfaces are replaced by new impervious surfaces, but with better stormwater management. Dense development should be avoided in environmentally sensitive areas.

5. **Stormwater Management and Mitigation of Recharge Losses**

Municipalities should consider establishing a stormwater program to protect and augment aquifer recharge and both ground and surface water quality, for protection of both water supplies and the Barnegat Bay. Where programs would entail significant costs, a fee-based stormwater utility may provide the most equitable method for financing those costs not supported by grants. In 2019, New Jersey signed the Clean Stormwater and Flood Reduction Act, which enables municipalities and counties to create fee-based stormwater utilities, becoming the 41st state to do so. Investing in stormwater utility strategies can protect WMA 13's water supply.

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