State of New Jersey
Department of Environmental Protection

NEW JERSEY WATER SUPPLY PLAN 2017-2022

STATE OF NEW JERSEY
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NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION

NJDEP's core mission is and will continue to be the protection of the air, waters, land and natural and historic resources of the State to ensure continued public benefit. The Department's mission is advanced through effective and balanced implementation and enforcement of environmental laws to protect these resources and the health and safety of our residents.

At the same time, it is crucial to understand how actions of this agency can impact the State's economic growth, to recognize the interconnection of the health of New Jersey's environment and its economy, and to appreciate that environmental stewardship and positive economic growth are not mutually exclusive goals: we will continue to protect the environmental while playing a key role in positively impacting the economic growth of the state.

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Cover Photo: "Delaware River from the Calhoun Street Bridge, Trenton, NJ". *Photo by Chelsea DuBrul*.

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NEW JERSEY WATER SUPPLY PLAN 2017-2022

EXECUTIVE SUMMARY

AUTHORITY

The 1981 New Jersey Water Supply Management Act (N.J.S.A. 58:1A-1 et. seq.) directs the Department of Environmental Protection (NJDEP) to develop and periodically revise the New Jersey Statewide Water Supply Plan (NJSWSP or Plan) in order to improve the management and protection of the State's water supplies. The first NJSWSP was adopted in 1982, followed by periodic updates released in 1983, 1985, 1987, 1991, and 1993. The first major revision of the NJSWSP occurred in 1996. The most recent update, entitled "Water Supply Action Plan 2003-04," included a progress report on key capital infrastructure projects and water resource evaluations previously identified in the 1996 NJSWSP. This 2017-2022 NJSWSP constitutes the second complete revision of the plan. The goal of this document is to form the foundation of a "living" resource able to be updated on a continuous basis as reliable new data becomes available and improved upon as new scientific methods are identified.

BACKGROUND

Periodic revisions to the NJSWSP are intended to improve the management and protection of the State's water supplies. This revised Plan emphasizes the need to balance traditional water use with water resource protection, and outlines a range of policy options to achieve that balance amid an array of competing interests and issues. The 2017-2022 NJSWSP differs from preceding plans as it is designed to allow for continuous updates, as ongoing water resource evaluations, water use data, and more refined water demand projections become available. The release of future NJSWSP updates will be made available through the NJDEP's web site (NJ State Government). This updated Plan and the evolving planning process it initiates, will serve as a tool to help the management, regulation, conservation, and development of the State's water resources for the foreseeable future.

KEY OBJECTIVES

- Define current water use trends and quantify the volumes of water used in New Jersey from 1990-2015 (Chapter 2);
- Calculate current depletive (losses resulting from water or wastewater transfers out of the watershed) and consumptive (losses resulting from evapotranspiration) water loss values, both positive (net loss) or negative (net gain) (Chapter 3);
- Estimate future residential water demands based on population projections through 2040 (Chapter 3; Appendix D);

- Develop water budgets for each of the 150 onshore HUC11 watersheds and confined aquifer planning areas to determine which areas have exceeded or are in danger of exceeding planning thresholds (Chapter 3);
- Determine whether existing approved (allocated) resources and developed water supply infrastructure (firm capacity) can accommodate anticipated growth (Chapters 3 and 7);
- Identify and quantify the location of potential supplemental sources of supply, including future infrastructure needs, to ensure future demands are satisfied (Chapter 3, 7, 8 and Appendix A);
- Define overarching water supply policies, including the preservation of existing water supplies, water resource and ecosystem protection, and the support of future economic growth and development (Chapters 6 and 7);
- Identify policy and/or regulatory actions necessary to ensure an adequate and secure statewide water supply to meet anticipated demand and respond in the event of an emergency (Chapters 6 and 7); and
- Provide a support tool to inform and assist local, regional and State planning decisions. (Watershed Management Area (WMA) summaries are included as Appendix A.)

KEY FINDINGS AND SUMMARY

- New Jersey typically has ample precipitation on average and the State's geology allows the storage of large quantities of groundwater as well as supports large surface water reservoirs.
- Generally, New Jersey has sufficient water available to meet needs into the foreseeable future provided we effectively:
    - Increase water efficiency through conservation and reuse;
    - Promote public education and outreach;
    - Address deteriorating infrastructure and ensure proper operation and maintenance of our water storage, treatment and distribution systems;
    - Pursue key water supply projects, including enhanced system interconnections and regional optimization of system networks and resources; and
    - Fully fund current monitoring efforts/assessment studies
- Using best available analysis of peak demand data, water availability in New Jersey is about 1,509 million gallons per day (mgd) while 207 mgd remains unused.
- Annual water use in New Jersey peaked at just over one trillion gallons during the period of 1990-2015, though overall usage decreased in the last few years of this period to 610 billion gallons in 2015.
- Per capita potable water use in NJ decreased from about 155 gallons per day to 125 gallons per day between 1990 and 2015, due in part to diminished indoor usage associated with more efficient plumbing fixtures (EPAct of 1992).

- Consumptive water use while variable, continues to rise. As much as one-third of all potable water evaporates (consumptively lost to the atmosphere), in any given peak season month (with considerably higher losses during daily and weekly periods). This can significantly strain water availability when supplies are most scarce and the need for plentiful, high quality water is greatest.
- Water availability is a function of all water resources in a specific area and of site-specific resource limitations. Region-specific sustainability thresholds (such as the Highlands Regional Master Plan, Pinelands Comprehensive Management Plan, or watershed-specific water quality management plans) may affect water availability.
- A water-budget approach to withdrawals from both surface water and groundwater is necessary to balance human needs while sustaining ecological functions. This approach shows that three (3) of the State's twenty (20) watershed management areas are currently stressed and nine (9) more would become stressed if pumped at volumes authorized under existing permits.
- The greatest stresses involve water being lost to evaporation through outdoor water use and out-of-basin wastewater transfers.
- The Plan presents specific findings and recommendations for each of New Jersey's twenty (20) watershed management areas (WMAs).
- The Plan promotes efficient management and investment into our existing infrastructure assets, enhancing the resilience of our systems to withstand and quickly recover from adverse conditions, and otherwise optimizing the use of available water through innovative techniques and cooperative strategies.
- New data will be evaluated and incorporated into the Plan as they become available to the NJDEP. New models and methods will be periodically reviewed and, if determined to be appropriate for NJ, will be utilized to revise and improve the Plan and its recommendations.

POLICIES FOR IMPROVING THE STATE'S WATER SUPPLY

Based upon the assessed results of categorical water use, resource availability, ecologically protective planning thresholds and projected water demands, Chapter 6 of the Plan identifies the following initiatives as critical to guide water supply management in the future:

1. Promote the efficient use of the State's freshwater resource by enhancing water conservation initiatives, encouraging reductions in outdoor water use, and matching highly consumptive non-potable uses with non-potable water sources.
2. Improve New Jersey's drought management capabilities and water system resilience.
3. Promote optimized use of existing water supplies through interconnections, conjunctive use and aquifer storage and recovery (ASR).
4. Encourage the development of new and expanded sources of supply, including the use of innovative technologies, especially in deficit areas. Support of new or expanded sources of supply will also be provided to those areas interconnected with deficit areas, where additional supplies could be transferred to help offset deficits.
5. Evaluate the impact of new or increased allocations for highly consumptive non-potable uses.

6. Coordinate sustainable water supply policies with the Highlands Regional Master Plan and the Pinelands Comprehensive Management Plan.
7. Support detailed hydrologic regional assessments to assess the status and sustainability of any given water source and identify feasible water supply alternatives that protect New Jersey's natural resources.
8. Coordinate with the agricultural community to more accurately assess future agricultural water demands
9. Continue to assist water systems in ensuring adequate financial investment to improve, repair, rehabilitate, replace and/ or update water supply infrastructure.
10. Maintain New Jersey's extensive surface water, groundwater and drought monitoring systems and assessment tools. Information obtained from these networks is critical to planning for our future.

All of these initiatives must be carefully planned and implemented based on sound scientific data and thoughtful analysis.

CHAPTER 1

INTRODUCTION

New Jerseyans have a reasonable expectation that statewide water supply resources will be sufficient to meet existing and future needs. Section 13.1 of the Water Supply Management Act (N.J.S.A. 58:1A-13) directs the Department of Environmental Protection (NJDEP) to prepare and adopt the New Jersey Statewide Water Supply Plan (NJSWSP or Plan). Essentially, the NJSWSP is a document that analyzes relevant water supply data, examines growth projections, and provides recommendations on how those expectations can be met.

The first New Jersey Water Supply Plan was adopted in 1982, following by updates in 1983, 1985, 1987, 1991 and 1993. The first major revision of the NJSWSP occurred in 1996. This Plan constitutes the second comprehensive revision of the NJSWSP. This document is a dynamic, "living document" whose data will be updated on an ongoing basis as new information and analyses becomes available and improved scientific methods are incorporated. This Plan is to be revised and updated in five years (2022), consistent with the requirements of the Water Supply Management Act.

This Plan meets the requirements of the Water Supply Management Act ("Act") N.J.S.A. 58:1A-13. Specifically:

1. The Act requires "an identification of existing Statewide and regional ground and surface water supply sources, both interstate and intrastate, and the current usage thereof." This Plan satisfies this requirement in Chapter 2. New Jersey receives ample precipitation, has significant ground and surface water sources, and sufficient storage capacity. Additionally, historic investments in water supply storage, transmission infrastructure, and interconnections have proven to be advantageous to the State for both normal and periodic drought and water emergency conditions, generally.
2. The Act requires "projections of Statewide and regional water supply demands for the duration of the plan." This Plan satisfies these requirements in Chapter 3 and Appendices A and B. This Plan takes the additional step of providing conservative estimates of excess or shortfalls by Watershed Management Area (WMA). Data are presented in a detailed, resource-specific manner making its usefulness in a site-specific manner limited, as water availability is a function of all water resources in a specific area and potential of site-specific resource limitations. The Plan looks at expected demand increases through 2040.
3. The Act requires "recommendations for improvements to existing State water supply facilities, the construction of additional State water supply facilities, and for the interconnection or consolidation of existing water supply systems, both interstate and intrastate." This Plan satisfies this in Chapters 6 and 7. Implementation of the recommendations and strategies contained in this Plan must be carefully planned based on sound scientific data and thoughtful analyses.
4. The Act requires "recommendations for the diversion or use of fresh surface or ground waters and saline surface or ground waters for aquaculture [agricultural] purposes." Chapter 7 of this Plan meets this requirement.
5. The Act requires recommendations "for potential legislative and administrative actions to provide for the maintenance and protection of watershed areas." This is satisfied in Chapter 7 of the Plan.
6. The Act requires "identification of lands purchased by the State for water supply facilitates that are not actively used for water supply purposes." Chapter 2 meets this requirement. Chapter 7 provides recommendations as to the future use of these lands for water supply purposes.

7. The Act requires "administrative actions to ensure the protection of ground and surface water quality and supply sources." Chapter 7 provides recommendation on appropriate actions. Chapter 5 provides an overview of water resource protection and planning efforts.

In addition, in accordance with the Act, preparation and revisions of the plan were conducted in consultation with many entities, including but not limited to the Highlands Council, the Pinelands Commission, the New Jersey Water Supply Authority, the New Jersey Environmental Infrastructure Trust, as well as public and private water purveyors. In addition, in accordance with the Act, NJDEP released a draft version of the proposed Plan in May, 2017, collected public comment through July 21, 2017, and held four public meetings in July 2017 across the State to allow additional public comment. All submitted comments have been evaluated and, where appropriate and practicable, changes made to the Plan.

Exceeding the minimum requirements of the Water Supply Management Act, this Plan also includes:

- A summary of New Jersey's drought/emergency strategies in Chapter 4 (Planning for Drought and an Uncertain Future), including active monitoring, management area designations and authorities to act in the event of a water supply emergency. This chapter also includes "lessons learned" from Super Storm Sandy and other extreme weather events;
- A comprehensive statewide water conservation strategy is presented in Chapter 6 (Increasing Water-Use Efficiency); and
- Appendix A presents specific findings and recommendations for each of New Jersey's twenty WMAs. These data are presented in a detailed, resource-specific manners making its useful in the broad scale. Because water availability is a function of all water resources, and their limitations, in a specific area, there are too many site-specific variables to be considered in a state-wide plan

This Plan promotes improved asset management, targeted investment in our existing infrastructure and new projects that will improve the interconnection and operability of our existing water supply assets. Investment in our water infrastructure is also needed to enhance the ability of our systems to withstand and quickly recover from adverse conditions such as extreme weather events and unexpected water supply emergencies (e.g. water main breaks).

Challenges identified in this Plan include, but are not limited to:

- Shifts in residential populations, energy production and industry base, making projections based on historic trends more difficult;
- Growth of consumptive water use;
- Finished water losses from existing, aged transmission infrastructure and lack of widespread public awareness of the needs to invest in water supply infrastructure; and
- Risks from times of drought and unpredictable weather.

The Plan concludes that although New Jersey faces some water supply challenges, we have sufficient water available to meet our needs as long as we continue to take certain actions to bolster and manage our supply. New Jersey can continue to grow economically while protecting and improving its water resources if we actively manage its water supplies properly, as has been done in the past. A key to this Plan is to increase water use efficiency through conservation and increased efficiencies. Another key is to ensure that water systems more readily apply the principles of asset management. In doing so, New Jersey's water systems will be equipped with the decision-making tools to prioritize the replacement of antiquated infrastructure and make priority-based decisions on investments in new infrastructure.

This Plan is expected to serve as a key tool for NJDEP and various government agencies to inform enhanced management of one of New Jersey's key assets, its water supply. In doing so, the public will be able to trust that their expectations for current and future water supply needs will be met. Meeting these expectations will be challenging but must be considered a top-priority for the overall health and well-being of New Jersey's residents and businesses.

CHAPTER 2

WATER USE CHARACTERIZATION (1990-2015)

A. INTRODUCTION

New Jerseyans withdraw and use up to one trillion gallons of water each year. About three quarters of total water withdrawals come from surface water. This water supports a variety of uses -- potable supply, power generation, commercial/industrial/mining, and both agricultural and non-agricultural irrigation. Each use sector consumes (evaporatates) a different percentage of water and this percentage varies from summer to winter. For example, power generation consumes only a very small percentage of water it uses, while agricultural use consumes almost all of the water it withdraws in the summer.

Water withdrawals and use vary both spatially and temporally across the State. Statewide total water withdrawals (excluding power generation) have decreased by an average of 3.8 billion gallons per year (bgy) over the study period (1990-2015). The decline is due primarily to reduced demands in the commercial/industry/mining sectors. At the same time, both potable withdrawals and consumptive water losses[1] have risen. The consumptive use trend reflects, in part, increased potable supply uses (from public water systems and private wells) for water-intensive recreational and for agricultural and non-agricultural irrigation practices. Consumptive losses varied between 53 and 98 bgy for the study period with over half of the losses coming from the potable supply sector alone. Consumptive losses are rising at a rate of a slightly more than half a billion gallons per year. (This excludes trends associated with the power generation use sector.)

Within any sub-region of the State, different and even converse trends may be observed. A larger amount of water withdrawal can be sustained without adverse environmental impacts if the water remains within the watershed and/or there is a significant volume of available water. On the other hand, a smaller amount of water loss in places with limited water availability is unsustainable. Chapter 3 discusses the approach used to estimate available water and the amount of water remaining after current uses are considered. More information is available in the supporting documentation listed at the end of this chapter.

New water data are continually submitted to the NJDEP and the related water demand forecasts and availability can change in response to the new data. As such, the NJDEP will continuously update its water data, revise its water availability and forecast analyses and review the results, and incorporate policy and/or regulatory changes, if necessary, in response to the continually evolving information.

[1]Consumptive loss means water is removed from the source, used, and lost, generally through evapotranspiration; depletive losses occur when water is removed from, but not returned to, the original source (e.g. exported out of the watershed) – although it is potentially available for use elsewhere in the state. These terms are used throughout this NJSWSP.

B. WATER SOURCES

DATA SOURCES

New Jersey has a long history of monitoring water withdrawals and use. The current monitoring and reporting system stems from the 1981 Water Supply Management Act and corresponding Water Supply Allocation Permits rules (N.J.A.C. 7:19). These regulations require monthly reporting of water withdrawals for sources that have the pump capacity to withdraw 100,000 gallons per day (gpd) or more of fresh water.

The water use characterization summarized in this chapter originates from the withdrawal data reported by permittees as well as certification and registration holders. It also includes supplemental data such as private domestic well withdrawal estimates. Sources include:

- Water Allocation Permits, Water Use Registrations, Agricultural Certifications, Agricultural Registrations;
- Safe Drinking Water public community systems and bulk transfer of potable water between systems;
- NJ Pollution Discharge Elimination System sanitary sewer surface water and groundwater (>20,000 gpd) discharges; and
- Private domestic well withdrawal estimates by municipality (assumes 80 gpd per person annual average and 3 people per well) developed from US Census and well permit datasets.

The data and analyses in this chapter are taken from information in the New Jersey Water-Transfer Data Model (NJWaTr – see support documentation at end of chapter). This data base contains information on sites of water withdrawal, use, and discharge quantities associated with each site on a monthly basis, and linkages between the sites. The NJWaTr water use characterization data presented here cover the period 1990 through 2015 and represents the best data available to assess water use and estimate water availability in New Jersey.

SOURCES OF WATER

New Jersey withdraws fresh water from one of three sources: surface water, and both confined and unconfined aquifers. Figure 2.1 shows annual total surface water, unconfined and confined groundwater withdrawals for the period 1900-2015. On average, New Jersey gets 7% of its water from confined groundwater sources, 16% from unconfined groundwater sources, and 77% from surface water sources. Figure 2.4a below also shows the proportion of water sources geographically across New Jersey’s five water regions.

The summary of water withdrawals by source is complicated by two factors. First, surface water is stored in reservoirs when streamflows are high during wet periods and withdrawn later when drier conditions prevail. These withdrawals typically do not lower streamflows excessively since NJDEP requires minimum stream passing flows to be maintained. Second, unconfined aquifers are hydraulically connected to the streams. Water may flow upwards (forming baseflow in the streams) or downwards (recharging the groundwater but decreasing streamflow) depending on relative water levels. These factors complicate estimating how much water is available for use now and in the future. This is discussed in more detail in Chapter 3.

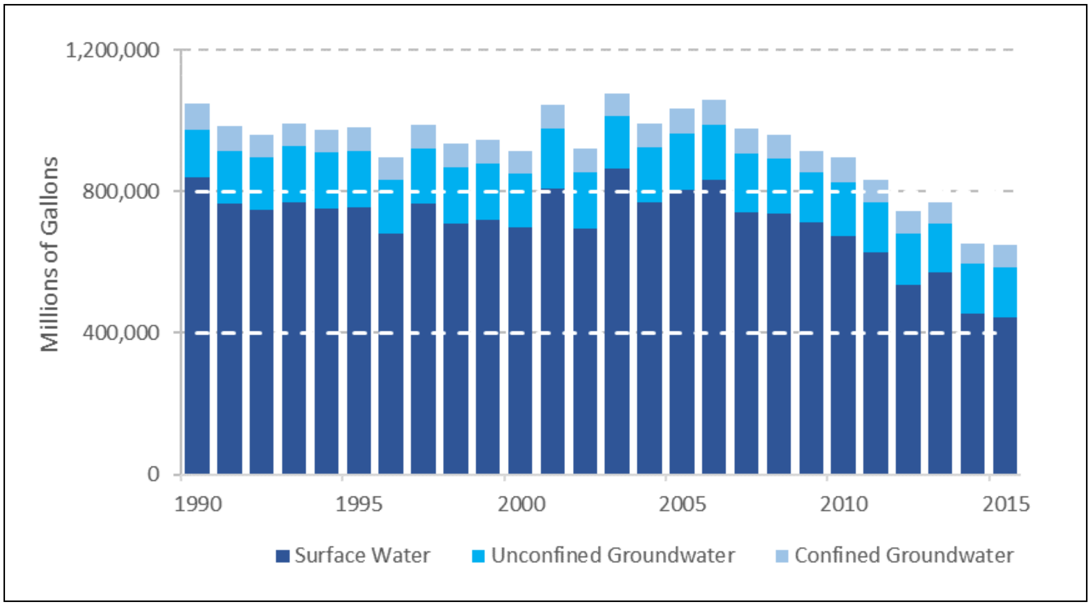

Figure 2.1
Annual Statewide Source of Water Withdrawal, 1990-2015.

C. WATER WITHDRAWALS AND USE

STATEWIDE WITHDRAWALS

Figures 2.2, 2.3 and Table 2.1 show annual withdrawal volumes from 1990 – 2015 by water use sector. Annual water withdrawals in New Jersey peaked at one trillion gallons during the period of 1990-2015, although overall withdrawals have decreased in the last few years to 610 billion gallons in 2015. The changes are partially the result of a shift by power generators to natural-gas powered stations (which use less water than coal-powered stations). This shift is a function of falling prices of natural gas and could reverse if coal becomes a more economical energy source.

Withdrawals for power generation, attributable to only sixteen individual users in 2015[2], represent approximately one-half of all water used statewide in some years. Since this type of water use generally is neither depletive[3] nor consumptive (in other words, it is a non-consumptive use that is not transferred), water used for power generation is sometimes removed from the withdrawal summaries, such as in Figure 2.3 and 2.8.

Agricultural water withdrawals summarized here and throughout this plan include traditional agricultural uses like irrigation of crops, plants and animals, frost protection, and cranberry harvesting, as well as other horticultural uses as identified in the Agricultural, Aquacultural and Horticultural Water Usage Certification Rules (N.J.A.C.

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[2]In 2015, two of the 16 power generation users are specifically hydropower generators. These two hydropower users represent over 90% of the total power generation withdrawal. The withdrawal, use and discharge occurs at essentially the same location with minimal consumptive loss associated with it.

[3] Depletive loss means the withdrawal of water from a water supply resource (ground or surface water) where the water, once used, is not discharged to the same water supply resource in such a manner as to be useable within the same watershed.

7:20A). New Jersey law (N.J.S.A. 58:1A-1 et seq.) specifically exempts the NJDEP from regulating salt water diversions, so aquacultural activities in salt water or any salt water diversion used for cooling or other purposes is not included in these summaries (see N.J.A.C. 7:19 – 1.4).

Potable water withdrawals include both self-supplied potable sources (e.g. private domestic wells or drinking water wells serving only one business or facility) as well as withdrawals by public community water systems. These public community systems have a residential, industrial, commercial and irrigation use component which varies between water system. All of the withdrawals by public community water systems are considered in the potable supply sector since most systems do not have the ability to distinguish the exact use of the water they provide.

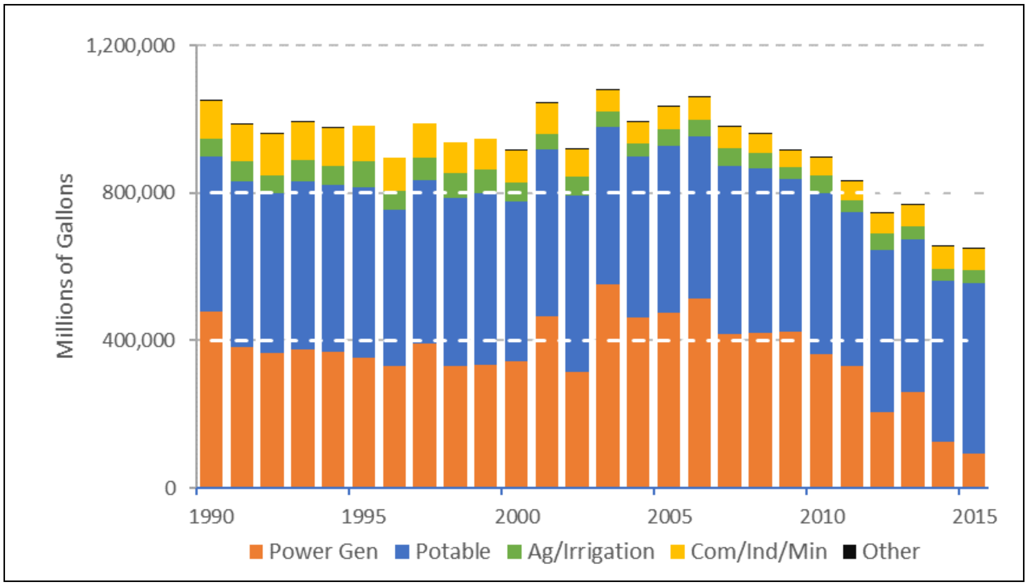


Figure 2.2 Water Withdrawals by Use Sector, 1990-2015.

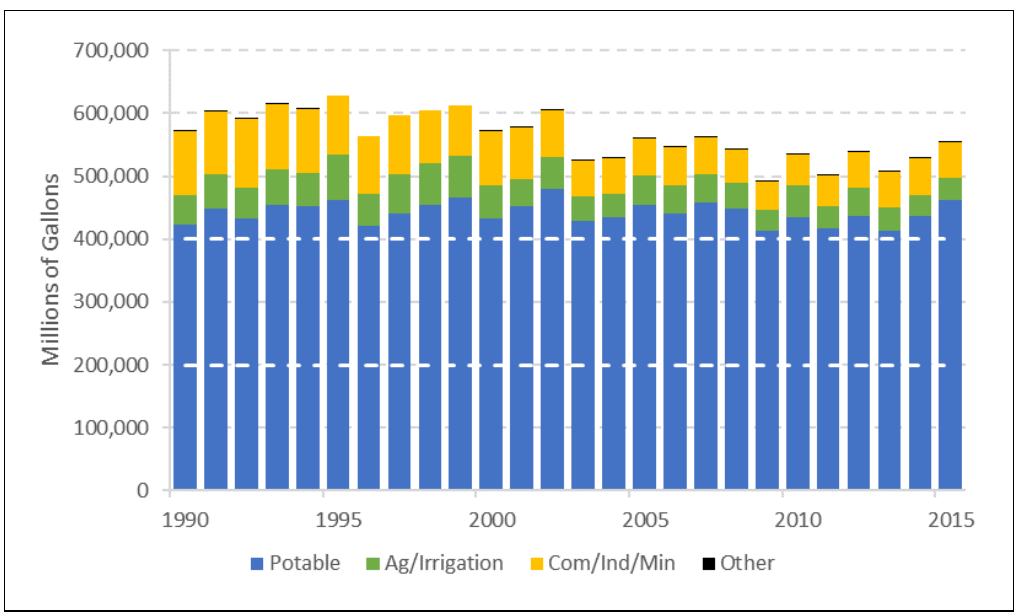


Figure 2.3 Water Withdrawals by Use Sector, 1990-2015, excluding power generation

Statewide water withdrawals vary from year to year and from sector to sector (figures 2.2 and 2.3, table 2.1) primarily in response to weather conditions but also due to changes in economics and public policies. Annual withdrawals of water, excluding power generation, ranged from 491 bg in 2009 to 628 bg in 1995, with an average of 564 bg. Potable supply accounted for the majority of non-power generation use, 78% on average. Combined commercial/industrial/mining use made up another 13%, while agriculture and irrigation was 9% of average use. Over the period 1990-2015 total withdrawals in New Jersey, excluding power generation, showed an average decline of 3.1 billion gallons per year.

Table 2.1 Annual Water Withdrawals by Water Use Sector, in millions of gallons

Year	Water Use Sector								Sum
	agricultural	commercial	industrial	irriga-tion	mining	other	potable supply	power genera-tion	
1990	44,698	459	75,307	2,090	26,521	33	422,272	477,355	1,048,737
1991	52,183	534	70,251	3,033	29,418	26	448,308	383,202	986,954
1992	45,942	497	70,267	2,543	39,698	47	432,235	367,699	958,929
1993	54,202	620	70,485	3,896	32,684	20	453,729	376,575	992,210
1994	49,399	557	63,029	3,384	38,273	7	451,737	369,511	975,896
1995	67,860	596	52,250	4,155	41,747	-	462,388	351,934	980,930
1996	48,447	617	51,937	2,684	38,061	-	421,674	331,985	895,406
1997	58,727	473	47,958	4,243	43,881	0	441,103	392,357	988,741
1998	63,005	554	46,874	4,620	36,248	-	453,575	332,256	937,132
1999	62,068	300	46,531	4,383	34,785	-	465,579	333,018	946,666
2000	49,696	525	50,009	3,636	36,036	106	432,148	343,483	915,638
2001	35,860	554	46,061	6,483	35,925	175	452,952	466,088	1,044,097
2002	45,912	492	35,948	4,273	39,030	255	480,106	314,050	920,066
2003	36,045	508	42,135	4,418	13,484	56	427,938	552,717	1,077,300
2004	32,368	569	42,678	5,107	13,889	32	433,779	463,704	992,126
2005	38,071	608	44,101	7,000	14,681	36	455,220	473,899	1,033,618
2006	37,852	581	39,632	6,094	20,830	28	441,215	512,714	1,058,945
2007	38,790	431	38,750	6,941	18,164	30	458,362	416,489	977,957
2008	35,658	437	36,644	6,292	14,712	78	448,143	419,363	961,327
2009	28,704	476	33,071	4,203	10,356	138	414,115	424,259	915,321
2010	44,133	368	31,054	7,103	16,508	209	434,510	363,445	897,330
2011	29,288	401	29,797	5,276	19,511	205	416,839	330,204	831,520
2012	39,862	482	32,845	5,786	22,748	408	436,938	207,340	746,409
2013	31,994	475	32,889	5,338	23,234	584	412,556	260,988	768,058
2014	27,560	387	33,101	5,408	25,518	506	437,194	124,415	654,089
2015	30,033	243	35,149	6,780	21,268	530	461,343	94,101	649,448

Figure 2.4a shows the average annual source of water withdrawn in New Jersey's five Water Regions, based on data from the 1990 to 2015. Water Regions are compiled from entire Watershed Management Areas, which themselves are compiled from HUC11s (Appendix G). The size of the pie chart is proportional to the volume of the withdrawal. The data show the regional variations in source of water and in water demands.

USE OF WATER

The amount of water withdrawn does not necessarily equal the amount of water used. This is particularly true for the potable supply sector where water may be withdrawn one month, stored, and then used several months later. One example is pumped water (sometimes referred to as pumped storage) used to fill a reservoir. In this case water is withdrawn from a river and pumped into a reservoir, where it is stored until it is withdrawn at a later time into the water treatment plant. From here the water is treated and sent into the distribution system for use by its customers.

Figure 2.4b shows the average annual water use by sector in each of New Jersey's five Water Regions based on data from the 1990 to 2015 period. The size of the pie chart is proportional to the volume of the water used and may be different than the size of the corresponding withdrawal chart, figure 2.4a. This is the result of stored potable water withdrawal which are used later and from the movement of water from one water region where it is withdrawn to another water region where it is used.

Water use trends, similar to withdrawal trends, vary from month to month as well as year to year. In New Jersey, water use typically peaks during the summer when outdoor and irrigation/agricultural demands are high. Figure 2.5 shows statewide average monthly use for the study period. February is the month with the lowest average withdrawals, 35.4 billion gallons, and July the greatest, 58.1 billion gallons. (This summary excludes withdrawals for power generation.)

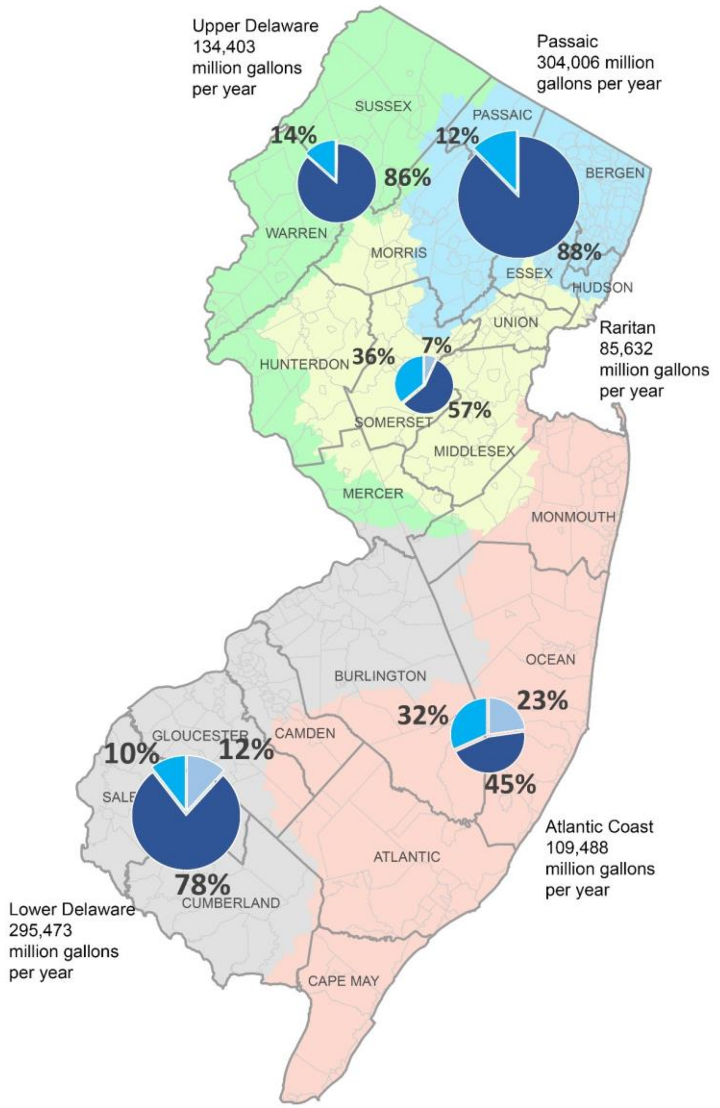


Figure 2.4 (a) Average annual source of water withdrawal by water region, 1990-2015 (millions of gallons).

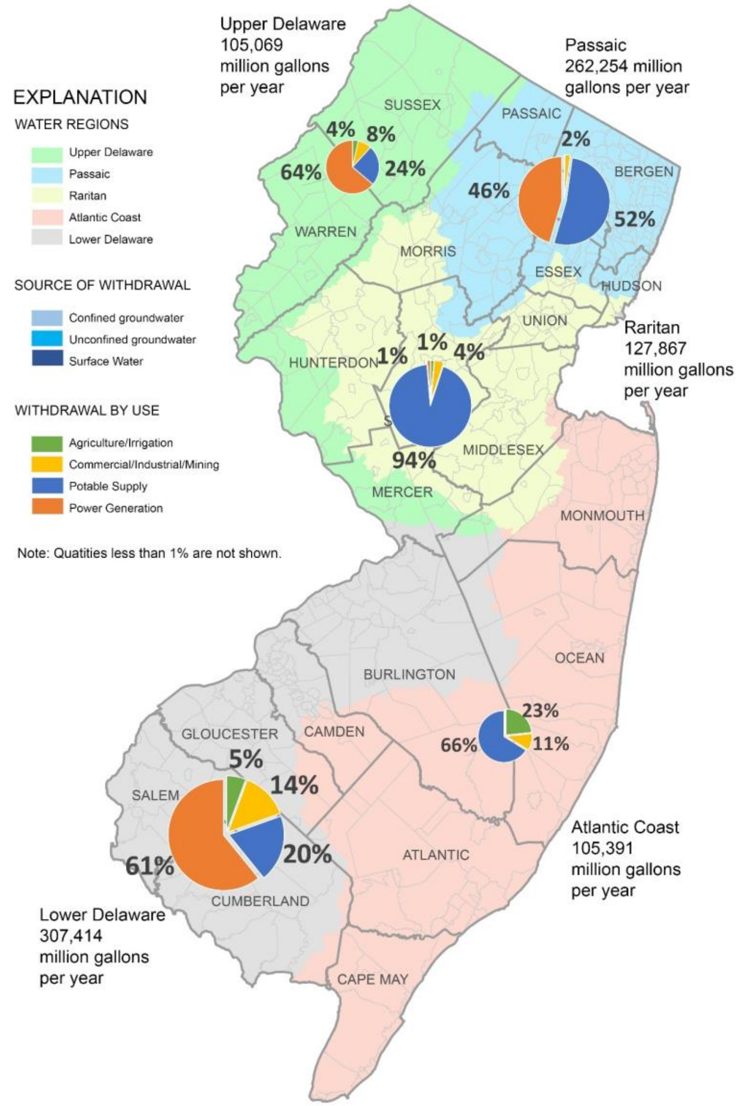


Figure 2.4 (b) Average annual use of water by water region, 1990-2015 (millions of gallons).

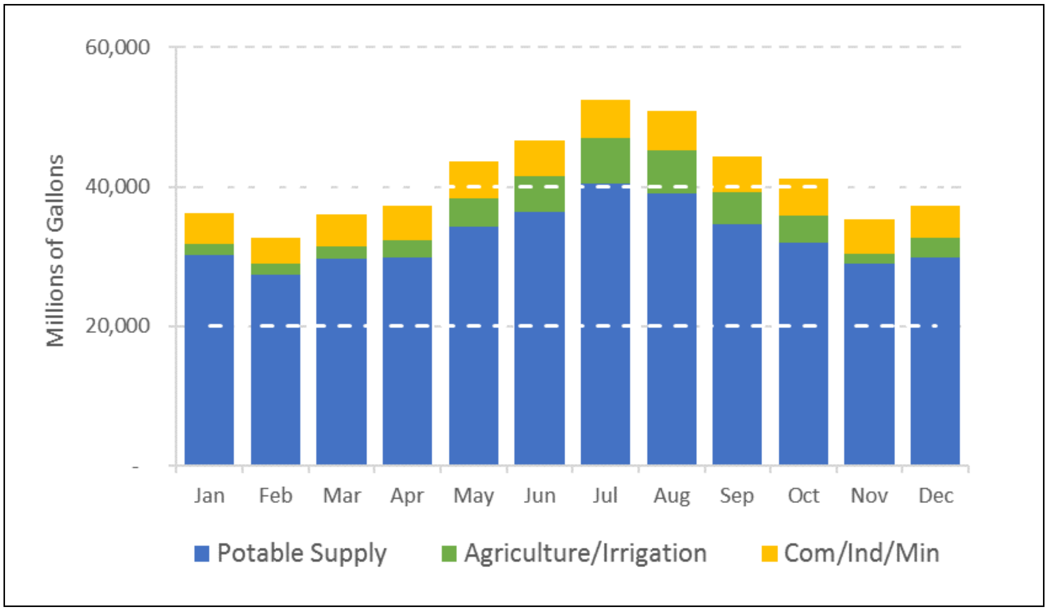


Figure 2.5 Statewide Average Monthly Use by Sector, 1990-2015.

CONSUMPTIVE USE

Total withdrawal and total use can be somewhat misleading when it comes to determining hydrologic impacts, because not all water use results in a consumptive or depletive loss to the basin. Hydrologic impacts are a function of many site-specific and regional factors and include the consumptive or depletive loss[3] of a withdrawal, the combined consumptive and depletive loss in a watershed, the seasonal withdrawal pattern, and the hydrogeology and water budget of the watershed. Figure 2.6 shows statewide annual consumptive water use by sector for the period 1990-2015. Consumptive use is increasing statewide, at an average rate of over half a billion gallons a year. Over the period 1990-2015 consumptive loss associated with potable use has increased on average by about 466 million gallons a year. Consumptive loss due to agricultural and non-agricultural irrigation has increased by 398 million gallons a year. On the other hand, consumptive loss associated with commercial, industrial, and mining uses has decreased by 278 million gallons a year. The net amounts to an average annual increase in consumptive loss of 586 million gallons a year.

Consumptive use varies from year to year based upon temperature, precipitation and changing demand patterns (e.g. agricultural irrigation practices or population growth), but the trend line indicates that consumptive use is generally increasing over the period of record. The rising consumptive losses are primarily due to increased use of potable supplies and associated outdoor water uses.

Figure 2.7 is a comparison of the estimated statewide total water use and consumptive water use for each water use sector for the period 1990-2015. Note that the y-axis scales on the four subgraphs varies considerably. Figure 2.8 summarizes total average use over the period 1990-2015 by water use sector (a) and consumptive losses attributable to those user groups (b). Potable supply total use accounted for 77% of the total use, but only 57% of the consumptive loss. Agricultural and non-agricultural irrigation accounted for 9% of the total use, but 32% of the consumptive loss.

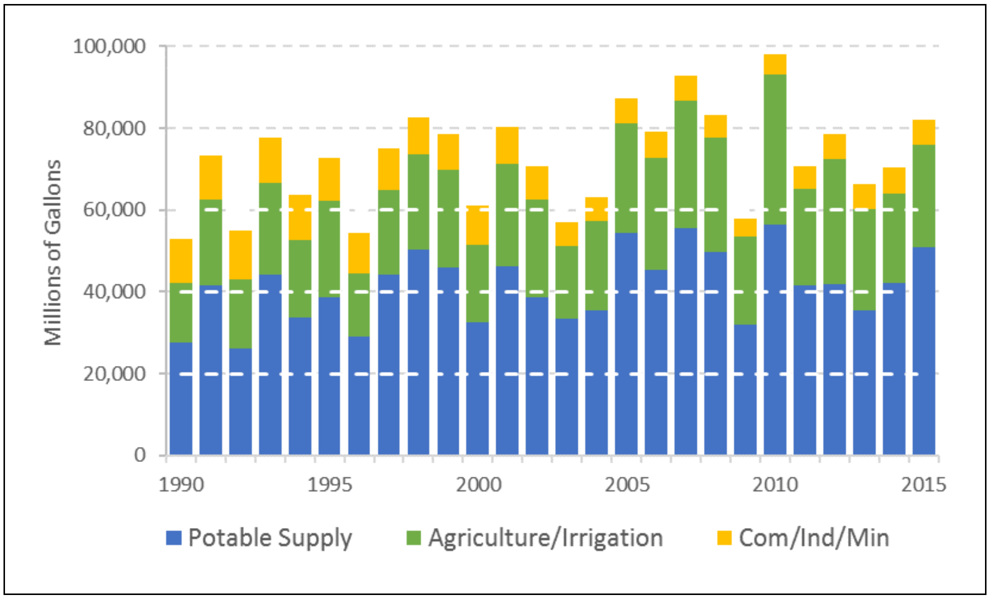


Figure 2.6 Statewide Annual Consumptive Water Loss from All Use Sectors except power generation (1990 – 2015).

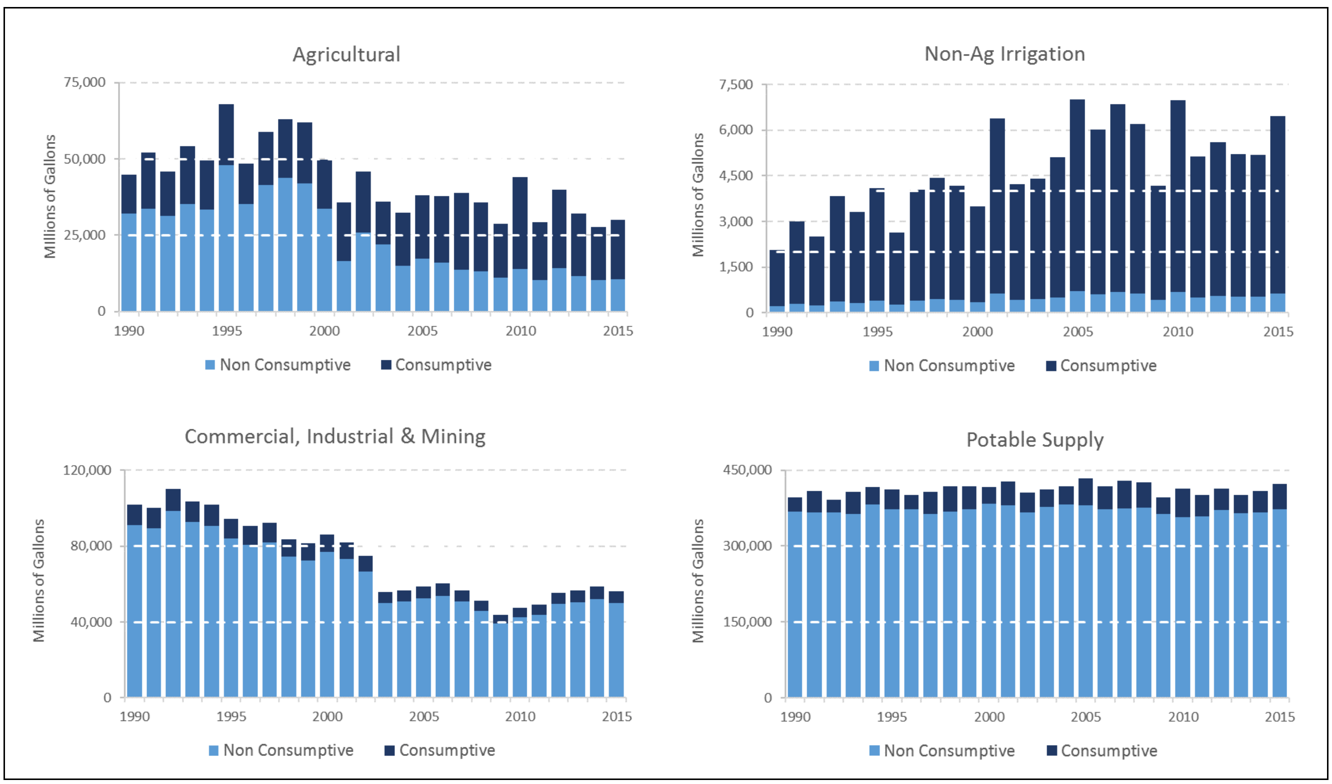


Figure 2.7 Statewide Water Withdrawals and Consumptive Use by Water Use Sector, 1990-2015.

(Note: The vertical axis scale varies significantly in magnitude between graphs.)

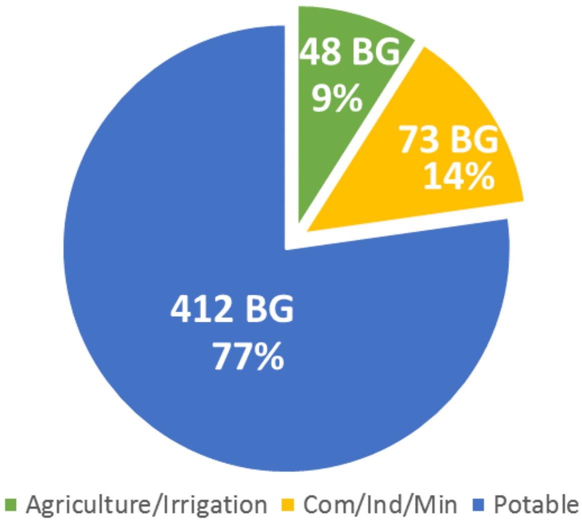


Figure 2.8 (a) Average total water use by sector (billions of gallons and % of total), 1990-2015

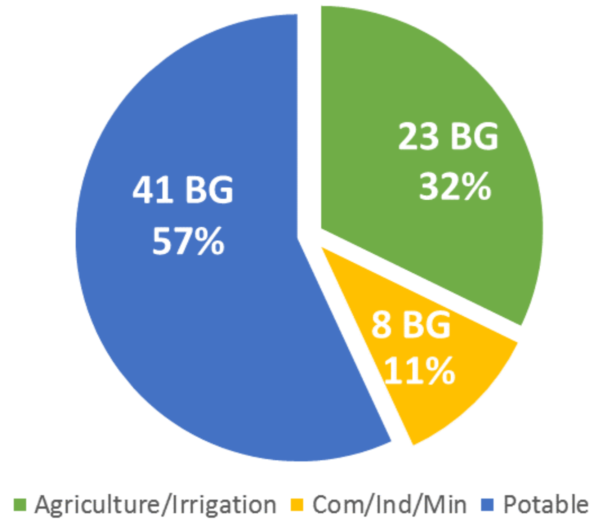


Figure 2.8 (b) Average consumptive losses by sector (billions of gallons and % of total), 1990-2015

POTABLE SUPPLY USE

Potable supply consists of the water provided by New Jersey's public water systems and individual private wells. Water use by this sector represents 787 of the statewide total and 57% of consumptive use (excluding power generation). Figure 2.9 illustrates monthly statewide potable consumptive and non-consumptive use for the study period. The data show that overall non-consumptive use remains relatively constant and that year-to-year variability is driven primarily by changes in consumptive water use. July 1999 is the month with the greatest potable use, 48.5 billion gallons. This is also the month with the greatest reported consumptive loss associated with potable use (16.6 bg) and the greatest percent of monthly consumptive loss (34.2%).

Another important factor associated with potable supply water use is population. According to the U.S. Census Bureau, New Jersey's population has grown more than 13%, from 7.76 million people in 1990 to 8.96 million in 2015. This increase in population and the associated water demand has been tempered by reductions in non-residential (i.e. commercial/industrial) water use and the integration of low-flow plumbing fixtures in new construction and the replacement of old appliances with new water efficient versions. Figure 2.10 shows gross total per capita use rates for potable supplies. Use varies annually, but the data clearly show a general downward trend in per capita use rates.

At the same time, per capita consumptive use in the potable supply sector, where the trend, though variable, is certainly not decreasing and possibly slightly increasing (fig. 2.11). The variability is driven, in part, by normal precipitation and temperature variations. The trend is driven, in part, by increases in outdoor water use for non-potable purposes such as landscape irrigation and recreation.

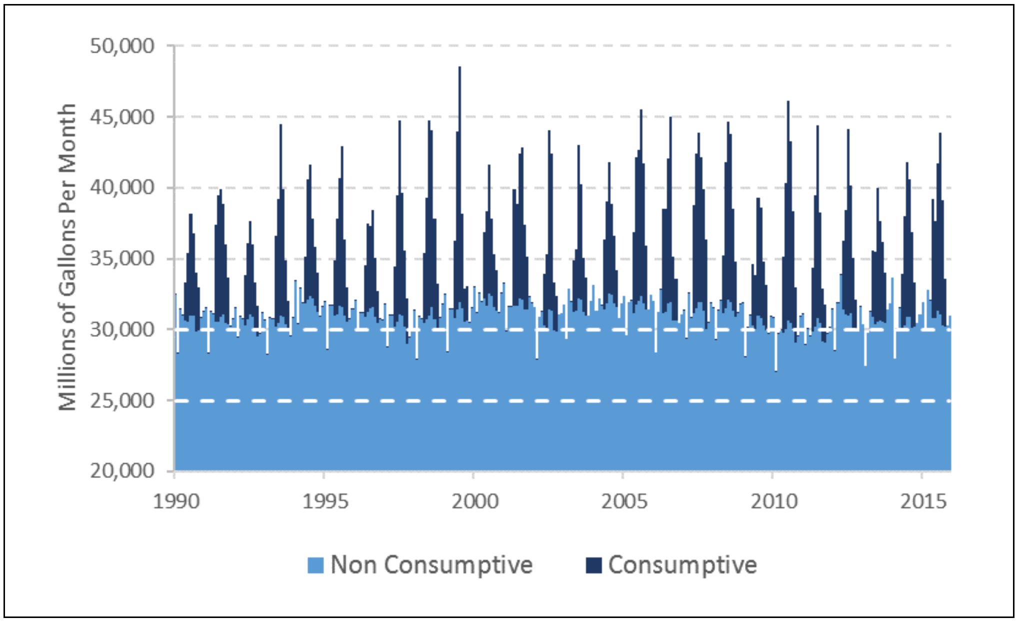


Figure 2.9

Statewide Monthly Consumptive and Non-Consumptive Potable Supply Use

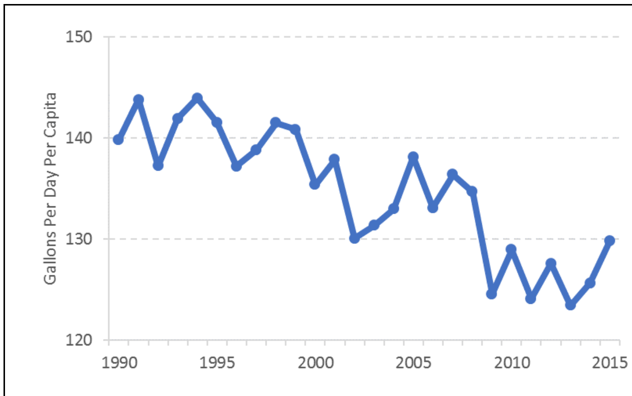


Figure 2.10 Gross Potable Supply Per Capita, 1990 to 2015

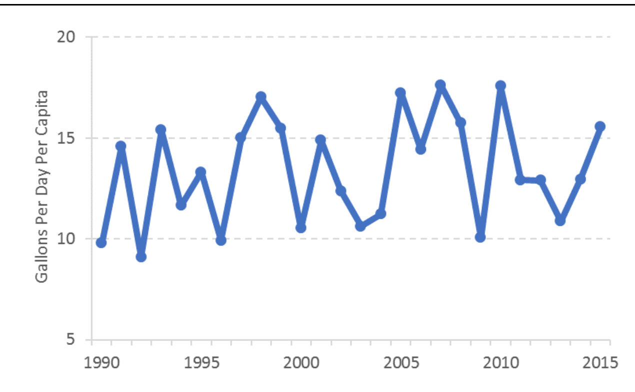


Figure 2.11 Potable Supply Consumptive Use Per Capita, 1990 to 2015

CHAPTER 3
WATER SUPPLY AVAILABILITY, DEMAND AND SHORTFALLS

A. OVERVIEW

The analysis of current and future water supply availability has four components:

1. Natural water-resource availability. A quantification of how much water can be withdrawn without causing adverse impacts. This is a function of water availability from three different sources:
    - surface-water reservoirs with a defined safe yield
    - streams and unconfined aquifers
    - confined aquifers
2. Administratively-approved availability. A quantification of the water that can be withdrawn under current NJDEP permits.
3. Current and future water demands. The volume of water currently used and estimates of what will be needed to meet population demands as well as changes in other uses.
4. Impacts and shortfall analysis. An accounting of current and future impacts and where shortfalls are anticipated in the future.

Each of these components is summarized below. More information is available in the supporting documentation listed at the end of this chapter.

- Peak water demands for the analysis period are estimated at 1,302 million gallons per day (mgd) for the 2000 through 2015 analysis period. The demand for potable water is expected to increase by an estimated 31.9 mgd by 2020. Demand estimates for other use sectors are difficult to determine due to significant unknowns.
- Total natural water resource availability, although not evenly distributed throughout the state, is an estimated 1,509 mgd. Reservoirs, surface water and unconfined groundwater, and confined aquifers provide 781 mgd, 387 mgd, and 341 mgd, respectively.
- Comparing water availability with peak water demands indicates that 17 Watershed Management areas have a current surplus of water and three have shortfalls. Some WMAs (e.g. in the Raritan River watershed) have significantly more available water. In contrast, water demand in urban northeast New Jersey is supported by imports.

The goal for water supply planners is to establish strategies to ensure that water supplies, as well as necessary infrastructure, are in place and coordinated to meet future demands.

New water use data are continually submitted to the NJDEP and the related water demand forecasts and availability can change in response to the new data. As such, the NJDEP will continuously update its water use data, revise its water availability and forecast analyses, review the results, and incorporate policy and/or regulatory changes, if necessary, in response to the continually evolving information.

B. NATURAL WATER RESOURCE AVAILABILITY

Fresh water is withdrawn from several different sources in New Jersey, each with differing characteristics that have significant impacts on how withdrawals affect other users and the environment. There are three very different water sources -- surface-water reservoirs with a defined safe yield, stream and river intakes and unconfined aquifers, and confined aquifers. Each is briefly discussed below

RAW WATER STORAGE

Surface water supply reservoir systems are built to store water accumulated during relatively wet periods for use when demands are high and supplies may not be as plentiful. The construction of major water supply reservoir systems in New Jersey began in the 19^{th} century. The major water-supply reservoirs are shown on figure 3.1 and described in table 3.1.

On-stream reservoirs are built across the path of a stream where the topography is favorable to impound water. The total amount of water an on-stream reservoir can provide for water supply is a function of the flows entering the reservoir from the upstream watershed, the capacity of the impoundment, and required releases. An example of this is Spruce Run Reservoir in Hunterdon County. Off-stream reservoirs generally are built on relatively smaller streams that can be dammed to form a large storage pool. They are then filled primarily by pumping from a larger stream or river nearby. An example of this is Round Valley Reservoir, also in Hunterdon County. In New Jersey the yield of some on-stream reservoirs is increased by replenishing it with pumping from another water source. For example, the Wanaque Reservoir dams the Wanaque River, but water can be added to the Wanaque Reservoir through large pump intakes near the confluence of the Pompton and Passaic Rivers. Appendix C has information on the major surface water supply reservoir systems in New Jersey.

The 'safe yield' of a reservoir system is the volume of water the reservoir system can supply during a repeat of the driest conditions yet experienced. For New Jersey, this "drought-of-record" is often, but not always, the multi-year drought of the mid-1960s. A reservoir system's safe yield is a function of the water flowing into the reservoir, the infrastructure available to store and transmit that water, and the operating rules which govern reservoir operation. NJDEP limits the amount of water that the owner of a reservoir can contract to deliver to the safe yield. The uncontracted safe yield represents the volume of water available to supply future demand increases.

The practice of aquifer storage and recovery (ASR) involves pumping water from a source when extra water is available and storing it in the ground for later use. In this case, the aquifer acts as a groundwater reservoir. In general, this counts as a water use at the time the water is withdrawn originally. When it is withdrawn from the aquifer for use later it does not count towards the allocation limit for that time period. Currently 19 ASR wells at 16 locations in New Jersey are in production or are undergoing testing. Most ASR wells are located in confined aquifers but the original water source may not be. Thus, accounting for the original source of the water, the volume withdrawn from the ASR, and eventual use of the water, introduces a layer of complexity into the accounting of this water use.

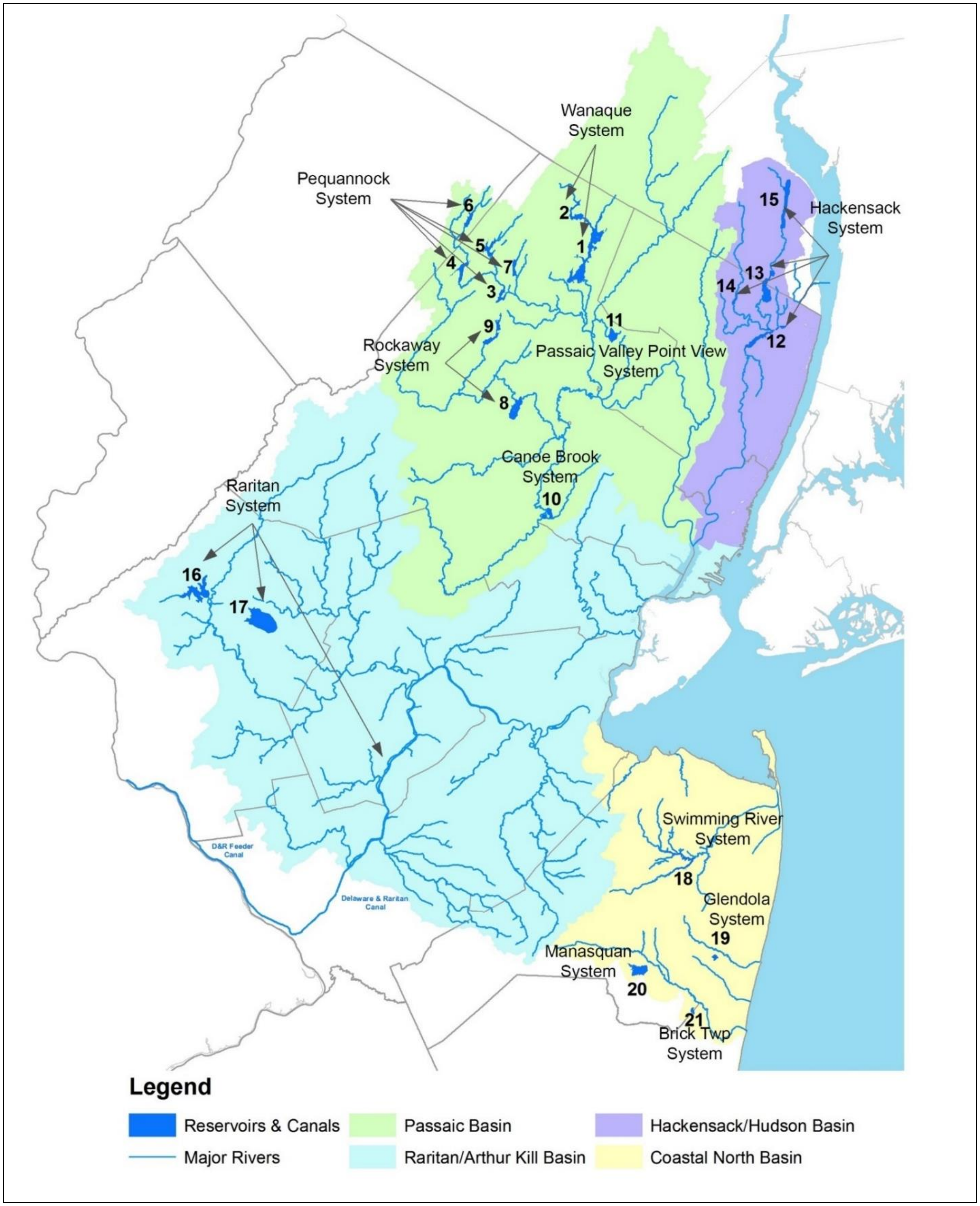


Figure 3.1 Major Surface Water Supply Reservoir Systems

Table 3.1 Major Surface Water Supply Reservoirs that serve New Jersey

Map ID	Reservoir Name	Owner	Usable Storage (bg)	Water Source
Wanaque System				
1	Wanaque	NJDWSC/ SUEZ NJ	29.49	Wanaque River; pumping from Pompton River
2	Monksville		6.86	
Pequannock System				
3	Charlottesburg	City of Newark	2.41	Pequannock River
4	Oak Ridge		3.91	Pequannock River
5	Clinton		3.51	Clinton Brook
6	Canistear		2.41	Pacack Brook/Pequannock River
7	Echo Lake		1.60	Macopin River
Rockaway System				
8	Boonton	Jersey City	7.10	Rockaway River
9	Split Rock		2.90	Beaver Brook
Canoe Brook System				
10	Canoe Brook #1, 2 & 3	New Jersey American (NJAW)	2.45	Canoe Brook/Passaic River
Passaic Valley Point View System				
11	Point View	Passaic Valley Water Comm.	2.85	Pumping from Pompton River
Hackensack System				
12	Oradell Reservoir	SUEZ NJ	3.27	Hackensack River
13	Lake Tappan		3.85	Hackensack River
14	Woodcliff Lake		0.87	Pascack Brook
15	Lake DeForest	SUEZ NY	5.37	Hackensack River
Raritan System				
16	Spruce Run	NJ Water Supply Authority (NJWSA)	11.0	Spruce Run
17	Round Valley		55.0	Pumping from Raritan, South Branch
	Delaware & Raritan Canal		n/a	Delaware River
Swimming River System				
18	Swimming River	NJAW	1.8	Swimming River
Glendola System				
19	Glendola	NJAW	0.9	Shark River/Jumping Brook
Manasquan System				
20	Manasquan	NJWSA	4.7	Manasquan River/Timber Swamp Brook
Brick System				
21	Brick Township	Brick Twp. MUA	0.9	Pumping from Metedeconk River

SURFACE-WATER INTAKES AND UNCONFINED AQUIFERS

The unconfined aquifer system (also called the water-table system) is in contact with the surface waters above it. Where groundwater levels are high, water leaves the ground and enters the surface water system. Where groundwater levels are low, leakage from the stream recharges the water table.

Groundwater pumpage can reverse the flow direction and induce leakage. Figure 3.2 shows this relationship. For these reasons, withdrawals from surface-water intakes are combined with withdrawals from unconfined aquifers when calculating water availability.

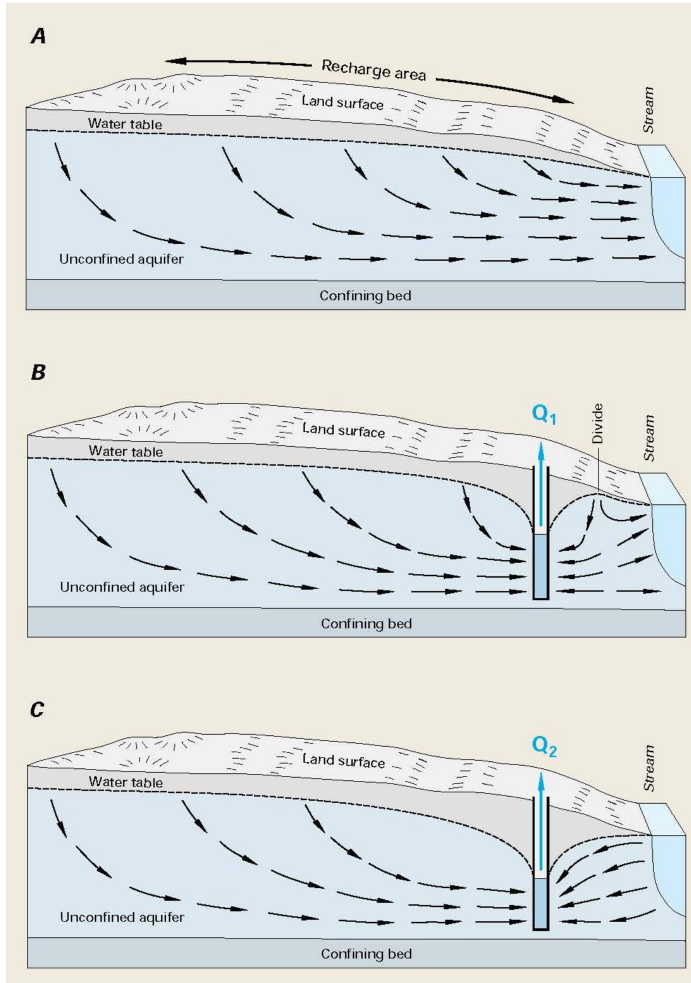


Figure 3.2 Unconfined Groundwater and Stream Flow: (A) natural conditions; (B) impacted by a pumping well; (C) as impacted by a pumping well with induced leakage. (Modified from Winters and others, 1998)

The impact of these combined volumes on the surface water system is a function of net withdrawals (total withdrawals minus returns) compared to how much water can be removed from the stream without creating unacceptable ecological impacts. The low flow margin (LFM) approach provides a method to estimate the amount of water that can be withdrawn sustainably (Domber and others, 2013).

The LFM is defined as the difference between the median September flow and the 7Q10 flow at the lowest elevation of each Hydrologic Unit Code (HUC) 11. The NJDEP uses 25% of the LFM as a planning threshold of excessive depletive and consumptive water loss. If there is more water loss than this threshold a HUC11 is considered to be stressed. In these areas, no additional depletive and consumptive water loss from the surface water system is recommended. Figure 3.3 shows the estimated amount of water available from the surface water system of each HUC11 (in mgd).

NJDEP chose to use HUC11s as the basis for analysis instead of the smaller and more numerous HUC14s because of the greater difficulty in tracking water movement from source to service area and then to sewer service area on the smaller scale, as well as the difficulty of accurately determining the September median and 7Q10 at the smaller HUC14 scale. Additionally, as a state-wide planning effort analysis of the 150 HUC11s which have an onshore extent in New Jersey was more practical than of the 921 HUC14s.

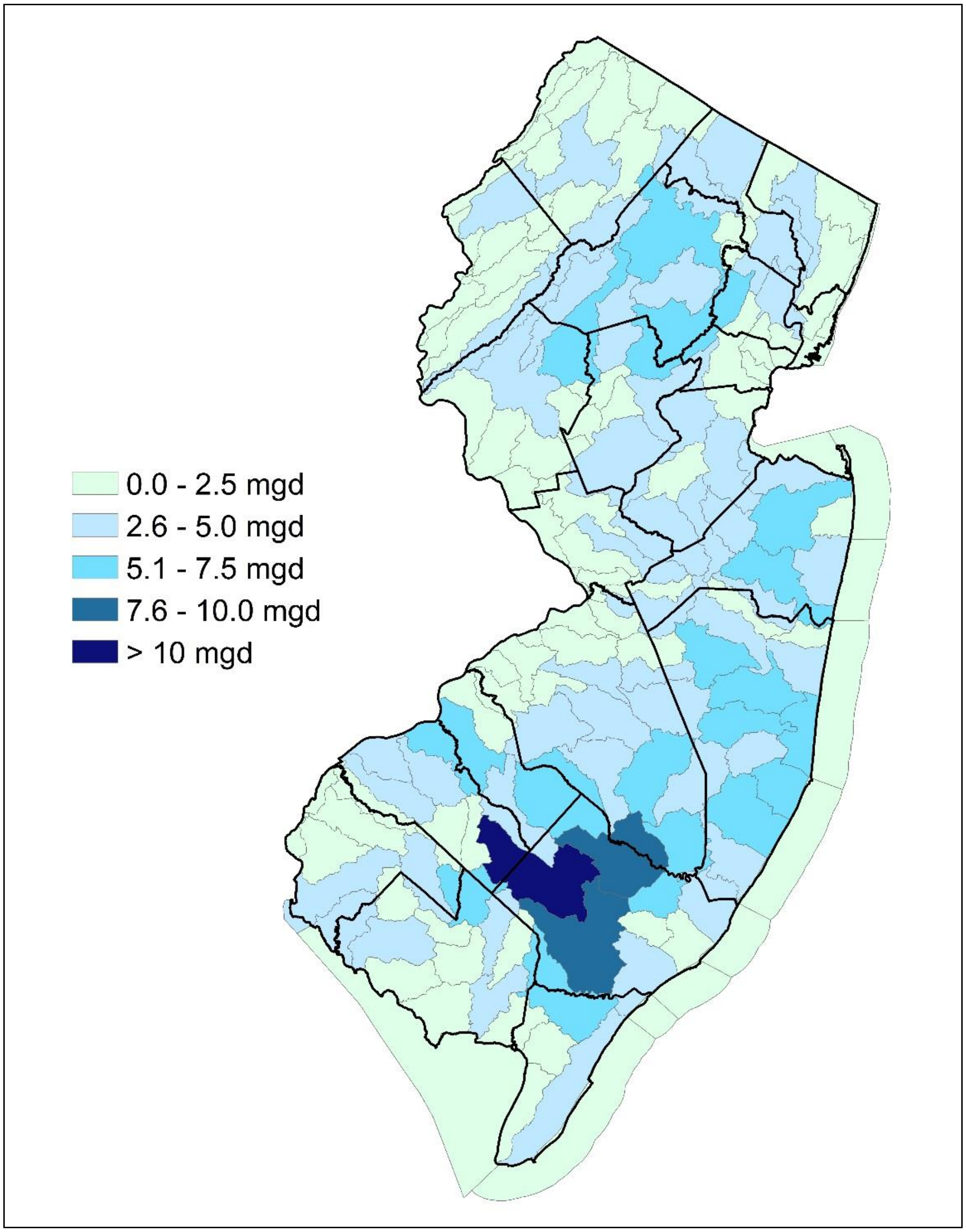


Figure 3.3 Map showing total unconfined groundwater and surface water available for depletive and consumptive use by HUC11, in millions of gallons per day (mgd).

CONFINED AQUIFERS

In New Jersey confined aquifers underlie much of New Jersey's Coastal Plain. These aquifers are separated from the surface by one or more geologic units that hinder the vertical movement of water (Fig. 3.4). Withdrawals from them do not have an immediate effect on the surface waters above them. Groundwater modeling indicates that confined aquifer pumping can increase the amount of water leaving the watershed where the confined aquifer outcrops and becomes unconfined. This is referred to as leakage. For this reason, leakage to and from the confined aquifer is a factor accounted in the low flow margin method.

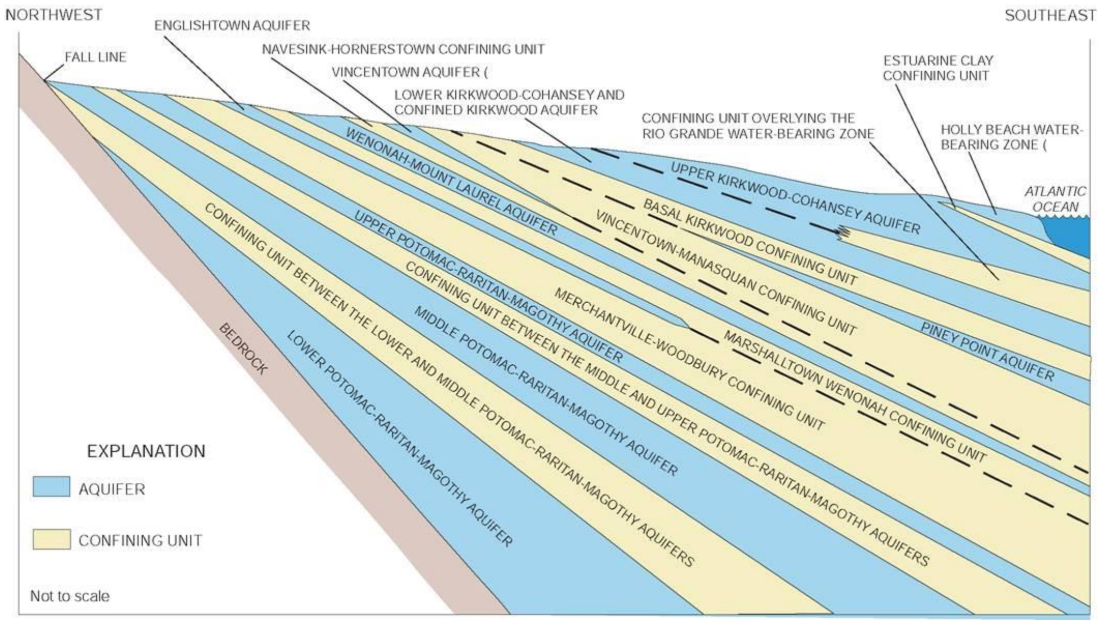


Figure 3.4 Generalized Cross Section of New Jersey's Coastal Plain Aquifer System. (from Charles et al., 2011).

Confined aquifers are a significant water supply source for New Jersey, providing the majority of potable water supplies to users in the State's coastal plain. Steadily increasing use of these aquifers has caused progressive declines in water levels in some areas and saltwater intrusion in others. Hydrogeologic analysis of the Coastal Plain confined aquifer systems has revealed the interconnected nature of the individual aquifers and their eventual hydraulic connection to water table systems. Due to this interrelationship, new diversions from most confined aquifers draw water from an overlying or underlying aquifer and/or the water table system. This emphasizes the need for a comprehensive, regional water supply planning perspective in assessing the potential impacts of developing additional supplies.

C. ADMINISTRATIVELY APPROVED AVAILABILITY

The Water Supply Management Act recognizes that the water resources of the State are essential to the health, safety, economic welfare, recreational and aesthetic enjoyment, and general welfare, of the people of New Jersey. To protect these resources, the Legislature granted the NJDEP authority to plan and manage water supplies as a common resource to meet State, regional and local water needs. The Act directs the NJDEP to administer a regulatory program that manages the State ground and surface water supplies to safeguard quantity and quality, thereby protecting public health and safety as well as the natural resource itself. To that end, the NJDEP adopted the Water Supply Allocation Permits Rules (N.J.A.C. 7:19), and the Agricultural, Aquacultural and Horticultural Water Usage Certification Rules (N.J.A.C. 7:20A), which together establish a uniform water allocation permit program that sets standards for diversions, and includes provisions related to planning, project review, monitoring, reporting, and enforcement.

The water allocation permitting program is administered by the NJDEP's Division of Water Supply & Geoscience (DWSG). As of January 1, 2017, DWSG managed approximately 727 active water allocation permits, 741 water usage registration, 811 agriculture water usage certifications, and 178 agricultural water usage registrations. The rules require that applicants for a diversion provide sufficient information and analysis to show that the diversion will not:

- exceed the natural replenishment or safe yield;
- adversely impact other users or natural resources;
- increase the rate of saltwater intrusion; or
- lead to the spread of groundwater contamination; or
- Increase drawdown in a Water Supply Critical Area (fig. 3.5) unacceptably.

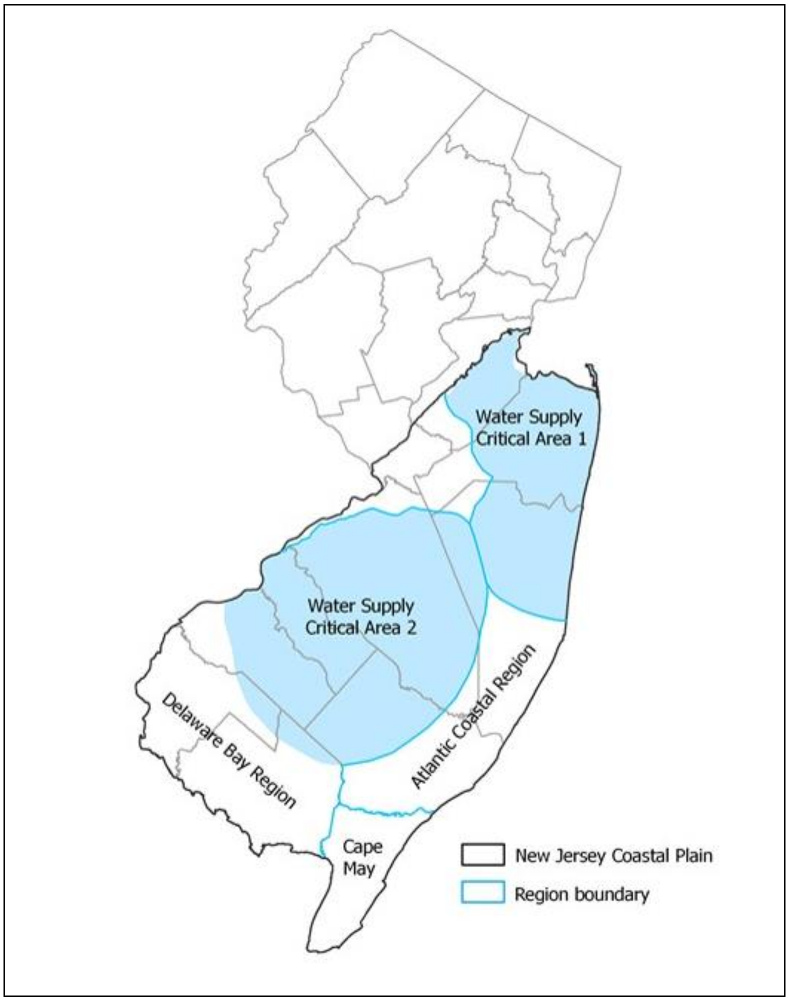


Figure 3.5 Water Supply Critical Areas of New Jersey

Allocation permits and modifications of existing allocation permits, are approved or denied on a case-by-case basis. Each application goes through an extensive process including a pre-application meeting(s), an extensive technical report, preparation of a water conservation and drought management plan, site inspections, aquifer testing (if applicable), staff review, public notification and comment, and a public hearing (if requested). In addition, permits and certifications being reviewed during the renewal application process are examined for compliance to permit requirements and water usage. If a facility has consistently used substantially less water than they are allocated, then DWSG may reduce the allocation upon renewal. On the other hand, if a facility does not appear to have enough water for future growth, the DWSG will notify the facility that they need to obtain another source (i.e. additional allocation via permit modification or add a bulk purchase contract).

To ensure sustainability of all diversions and prevent the impacts described above, the DWSG sets controls on allocations, which include:

- limits on the volume of water that may be withdrawn on a monthly and annual basis;
- precise identification of sources from which water may be diverted;
- defined uses of the diversion and effective term limit;
- specific monitoring and reporting requirements;
- passing flow requirements, if appropriate;
- contingency plans and/or mitigation requirements for adverse impacts, if appropriate; and
- review of any contracts a water supplier has entered in for sale or purchase of water on a non-emergency basis to ensure all water demands can be met.

The monthly and annual diversion limits in a water allocation permit represent administratively approved water availability. Each permit application is evaluated to determine if the sustainability requirements set forth in the rules are met. Some of the permit-wide limits are further managed with source or water resource-specific limits (e.g. well field, intake, or aquifer-specific limits). The sub-permit limits do not necessarily equate to permit-wide limits but rather are designed to allow permittees the flexibility to best manage their individual demands or resource constraints. In 2015 there were 7,288 mgd of surface water allocations, 779 mgd of unconfined groundwater allocations, and 341 mgd of confined groundwater allocations. These source-specific limits reflect availability constraints which, in some cases, are different than the permit-wide allocation limits granted in water allocation permits. They provide a more accurate estimate of the resource-specific withdrawal limits of each allocation. Thus these source-specific are used in this analysis.

Water used for potable supply must also meet the requirements of the Safe Drinking Water Act (N.J.S.A. 58:12A-1 et seq.) and implementing rules (N.J.A.C. 7:10). These rules require that each purveyor meet a minimum firm capacity, which is defined as pumping and/or treatment capacity (excluding coagulation, flocculation, and sedimentation) available to meet peak daily demand when the largest pumping station or treatment unit is out of service. In other words, firm capacity is the volume of water a purveyor can reliably deliver when its largest source or facility is offline.

D. FUTURE WATER NEEDS

In order to elicit the most conservative scenario for public water systems, the following assumptions were used in this analysis: each person uses 125 gallons of water per day (refer to Figure 2.10); no changes to water supply infrastructure or additional permitted allocations (new or expanded sources of supply); all projected population growth is served by a public water system (i.e. private potable wells were not considered for future growth); and, since a deficit/surplus analysis was not conducted for many small water systems, a surplus of zero was assumed for these systems.

In addition, the following model inputs were used:

- Projected population growth for each municipality (using 2015 as base year, the most relevant data with MPO projections);

- Total population served by public water purveyors in each municipality (as of 2016, the most recently available);
- The ratio of the municipal population served by a public water supplier; and
- Surplus for each water purveyor as of May 2017 (the most recently available).

The final analysis suggests that an additional 32 mgd (over 2015 rates) will be needed by 2020 to meet the anticipated growth in potable demand, 68 mgd by 2025, 103 mgd by 2030, 134 mgd by 2035, and 164 mgd by 2040. This analysis does not include an estimate of changes in water demand by other use types. Agricultural needs may increase if the climate grows warmer, but may decrease if more efficient irrigation techniques are adopted broadly or if precipitation increases. Changes in water demands by commercial/industrial users will depend greatly on the future development of this water use type, and how effectively water efficiency techniques are implemented.

Details of the analysis and the input and output dataset can be found in Appendix D - Assessing Future Population Growth Demand - Service Area Analysis Utilizing Metropolitan Planning Organization Projections.

Potable water use is the second largest water use sector and largest consumptive use sector in NJ. As such accurate estimates of population projections, per capita water use, and percent non-residential water use by water system are important factors to consider. The NJDEP is working with Rutgers University to improve the existing data at much smaller scales. As these data become available they will be utilized to revise the future water availability projections.

E. IMPACTS AND SHORTFALL ANALYSIS

Natural resource availability from New Jersey's three primary resources; surface water supply reservoirs, streams and unconfined aquifers, and confined aquifers, was quantified and then compared to current and future demand to determine net resource availability. These results were also compared to the administrative availability. Each resource has a specific set of concerns and limitations and are discussed below. The results of the three individual analyses are combined in Section F and summarized in Tables 3.2 and 3.3. In general, New Jersey is a water rich state, but regional and sub-regional shortfalls do occur and water-supply droughts and emergencies periodically occur. The information contained below is meant to be used for water resource management and needs to be used in conjunction with the established permitting/regulatory process.

UNCONFINED GROUNDWATER AND SURFACE WATER

The withdrawal of water from the surface water and unconfined aquifer system reduces streamflow. This is a function of water depletion due to depletive and consumptive water loss balanced by any water gains from imports. The net loss is then compared to the low-flow margin, an estimate of the amount of water that can be lost from the surface water and unconfined aquifer system without creating unacceptable ecological impacts. The availability of water supply from unconfined and surface water may be additionally constrained by the following:

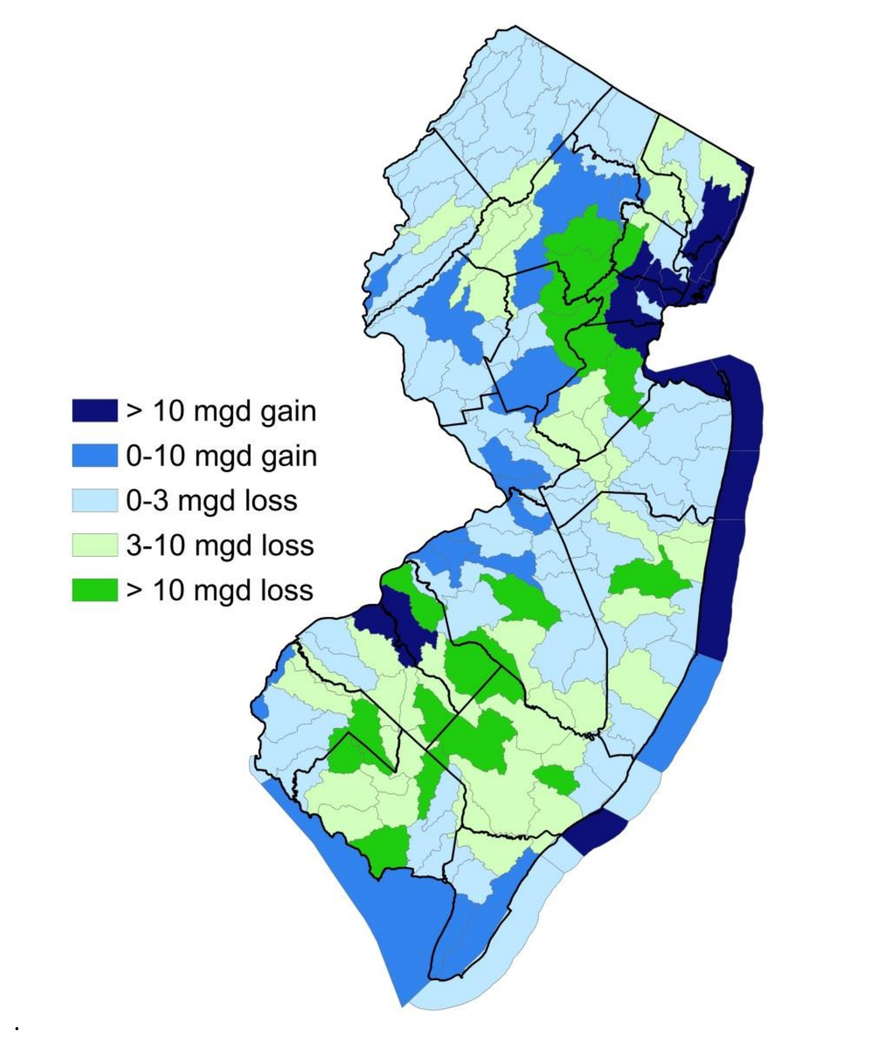
- wetlands and ecologically sensitive areas
- interference with other water users
- contamination and other water quality issues

The following charts depict water loss by HUC11 and how different uses impact overall water loss:

- Figure 3.6 shows the estimated amount of water lost from each HUC11.
- Figure 3.7 shows the water use that results in the greatest water loss in each HUC11.

- Figure 3.8 shows what the amount of water lost would be if withdrawals were diverting at the full allocation rate.
- Figure 3.9 shows the water use type causing the greatest amount of water lost at full allocation.
- Figure 3.10(a) was determined by subtracting peak water loss between 2000-2015 (Fig. 3.6) from available water (Fig 3.3) results in the remaining volume of water than can be depletively and/or consumptively lost from each HUC11. On this graph the Highlands Region is whited out as the Highlands Council's planning water resource planning efforts have primacy.
- Figure 3.10(b) shows the amount of water remaining for use in each HUC11 assuming full allocation withdrawal. On this graph the Highlands Region is whited out as the Highlands Council's planning water resource planning efforts have primacy.

The HUC11s where peak withdrawals between 2000-2015 were greater than 25% of the low-flow margin are indicated as having limited availability for future withdrawals from the surface water and unconfined aquifer system.



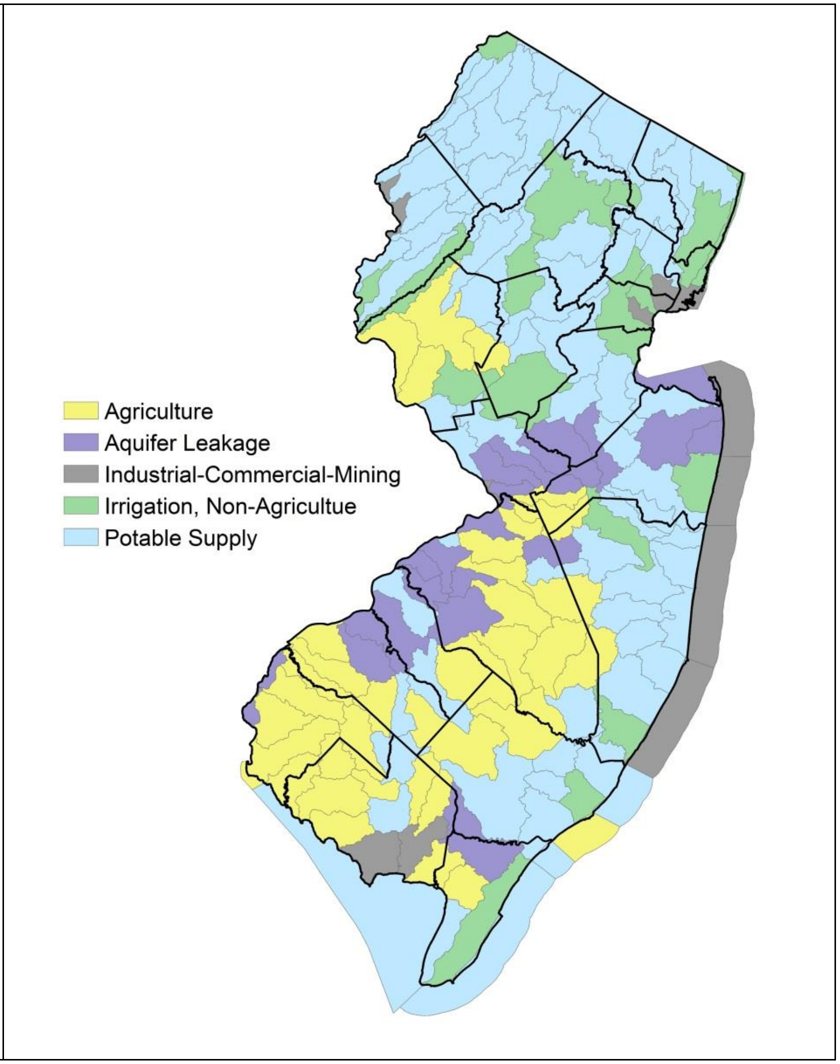


Figure 3.6 Depletive and consumptive loss from unconfined groundwater and surface water sources at peak use rates used in analysis.

Figure 3.7 Primary causes of depletive and consumptive loss at peak use rates used in analysis.

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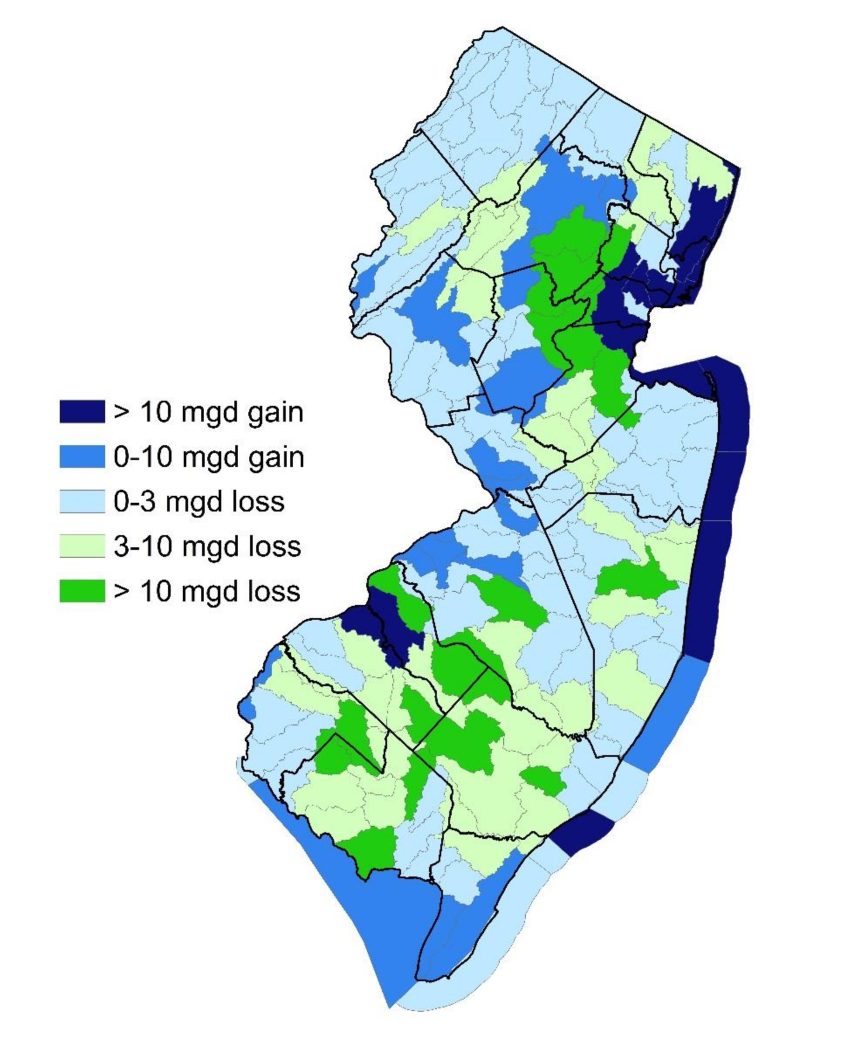


Figure 3.8 Depletive and consumptive loss from unconfined groundwater and surface water sources at full allocation use rates as of 2015.

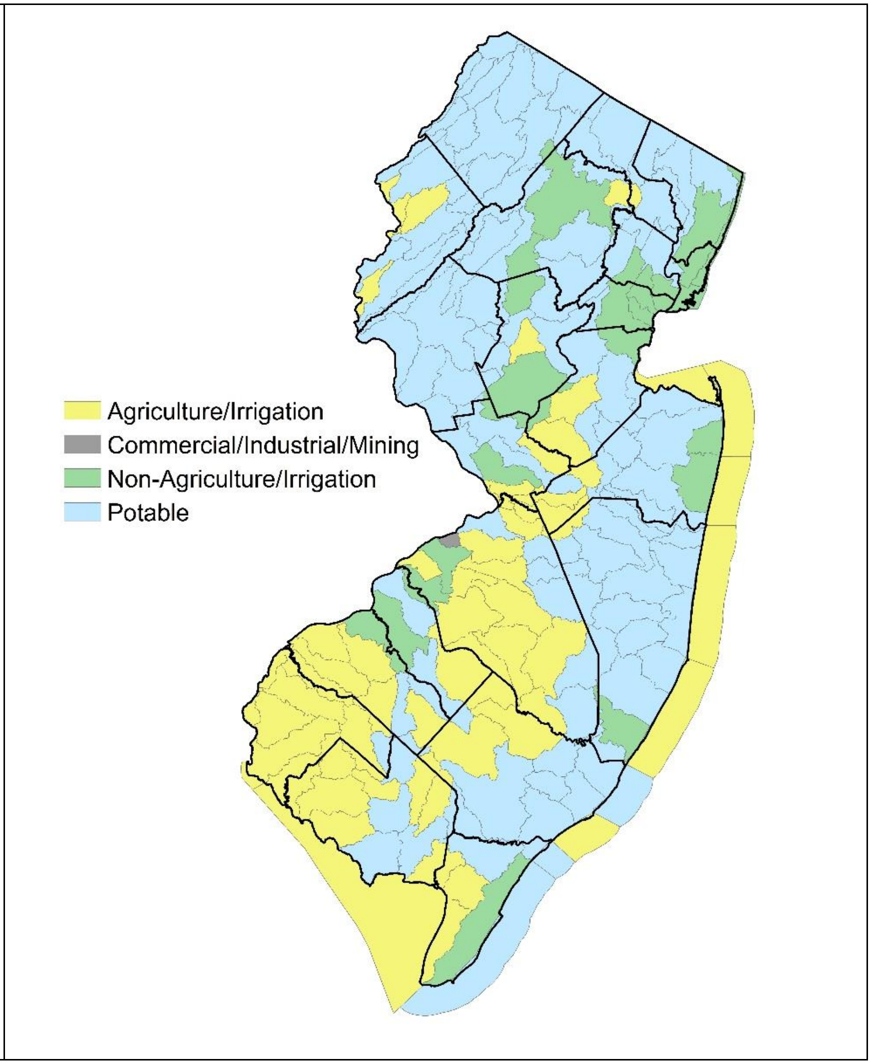
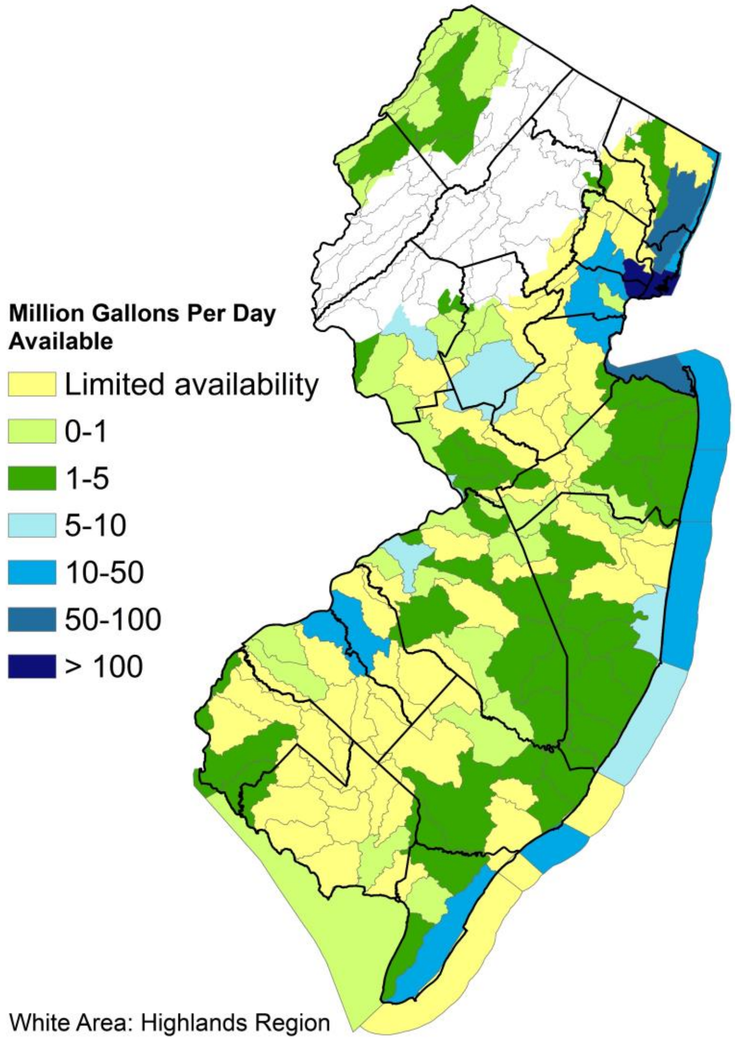


Figure 3.9 Primary causes of depletive and consumptive loss at full allocation use rates as of 2015.



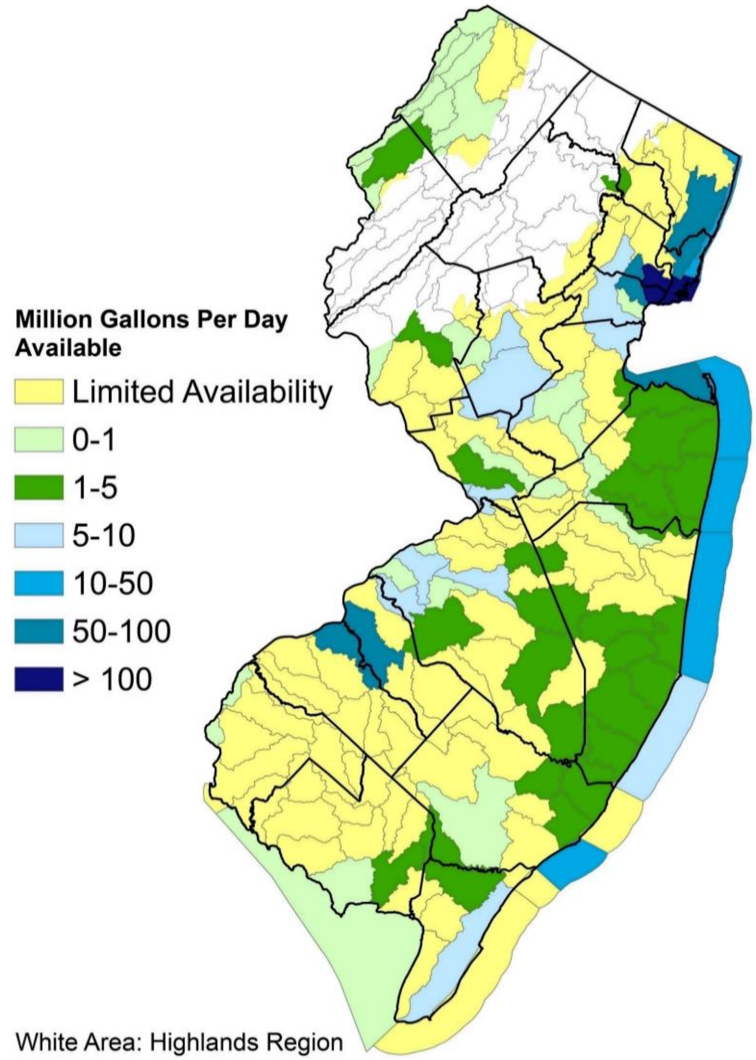


Figure 3.10 (a) Remaining available unconfined groundwater and surface water for depletive and consumptive use by HUC11 at peak current use rates.

Figure 3.10(b) Remaining available unconfined groundwater and surface water for depletive and consumptive use by HUC11 at full allocation use rates.

CONFINED AQUIFERS

The future availability of water supply from the confined aquifers is constrained by a number of factors, including:

- Water Supply Critical Areas – Due to significant historic depletion, allocations in both Critical Areas (fig. 3.5) were significantly reduced in the 1980's by revisions to the Water Supply Management Act. This resulted in a rebound in groundwater levels over the following decades. Additional withdrawals from certain designated Critical Area aquifers are not allowed, except in accordance with the Act.
- Saltwater intrusion - The threat of saltwater intrusion in estuarine, seaward and bayward margins of the aquifers limits additional withdrawals. Pumping is usually reduced in these areas in order to not exacerbate the problem.
- Depleted water levels – Additional withdrawals are discouraged where groundwater levels are declining and not stabilizing.
- Wetlands – Near outcrop areas, confined aquifer drawdowns may migrate up-dip and affect groundwater levels under wetlands and surface waters. This potential impact may limit additional withdrawals in some areas.
- Interference – Additional pumpage may create significant drawdowns in existing wells. In some areas this prevents the NJDEP from approving significant additional groundwater withdrawals.

ADMINISTRATIVELY APPROVED POTABLE SUPPLIES

The volume of water loss relative to natural resource water availability is part of the analysis. The currently allocated water volume needs to be considered along with projected future demands. Figure 3.11 shows the deficit between the allocated amount of potable water and the estimated potable water needs by community water systems based solely on demands resulting from municipal population growth projections. Results show areas of the State with surplus or deficit supplies in relation to currently approved potable supply, not natural resource capacity. This assessment, when combined with the natural resource limitations, provides an overview of the status (i.e. surplus or deficit) of areas of approved potable water supplies.

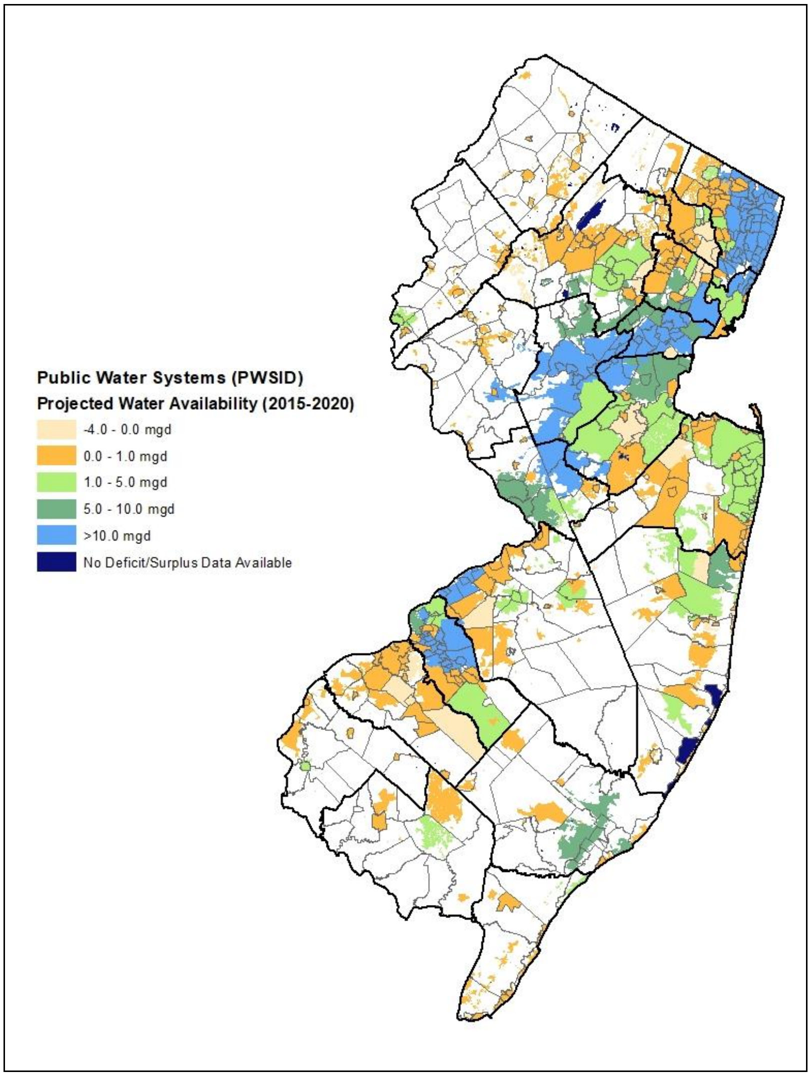


Figure 3.11 Water Administrative Availability for Public Water Systems: Results show areas of the State with surplus or deficit supplies in relation to currently approved potable supply, not natural resource capacity. This assessment, when combined with the natural resource limitations, provides an overview of the status (i.e. surplus or deficit) of areas of approved potable water supplies. Based on May, 2017 data available at: NJDEP Public Water Systems

The analysis identifies, geographically, those water systems that appear to have adequate approved allocations to satisfy future projected population growth, if they continue to rely on their current water provider, at the current ratios of water service. In 2020, 80 systems will be in deficit. As the public water system deficit/surplus analysis is updated with revised demand and/or allocation volumes these results will change. Figure 3.11 is a summary of results. While the utility of this assessment for a case-by-case analysis is limited, it is extremely useful for statewide planning with respect to targeted economic growth, optimization of existing infrastructure, identification of infrastructure needs, and development of additional sources of supply. However, to be protective of resources and provide for sustainable and reliable supply into the future, this analysis should also be considered in conjunction with the natural capacities of the resource. Refer to Appendix D for more detail.

F. STATEWIDE WATER AVAILABILITY SUMMARY

The data described above are summarized by WMAs in Tables 3.2 and 3.3 below. In order to develop these WMA summaries, unconfined groundwater and surface water availability for each HUC11 watershed had to be combined into one total. These summaries of water use and availability reflect the "big picture" of water availability throughout the State. Also, note that confined aquifer ground-watersheds do not follow surface watershed (HUC11) boundaries. At the larger WMA scale these confined vs. unconfined differences are less significant, however they may be important when a site-specific analysis is conducted.

Table 3.2 summarizes water availability for all 20 WMAs. The availability analysis included the following factors: surface water from reservoirs (safe yield), unconfined aquifer and non-reservoir surface water, and confined aquifer availability based on regulatory and sustainable ecological planning thresholds. Each availability analysis recognized and accounted for the hydraulic linkages between the resource categories, but the total identified availability estimates were based on each individual resource (e.g. reservoir system, unconfined or confined groundwater wells). The actual volume of water available to any specific area is a function of the total of all the water resources present in that area combined with any site-specific resource limitations.[4] This table also shows net demand from each of these resources and remaining availability. Statewide, total resources are estimated to be 1,509 mgd and net demand to be 1,302 mgd. Table 3.2 also shows an estimated increase in potable use of 32 mgd by 2020.

Table 3.3 shows total water allocated by source as of 2015 by WMA. On a statewide basis, total annual allocations, as a daily average, are 8,408 million gallons per day (mgd). Allocations are greater than consumptive demands due to unused allocations (especially by agricultural users) and returns of the non-consumed portion of water use (especially by power generation facilities). Table 3.3 shows how much water is estimated to be available from three different, currently unused sources: treated wastewater currently discharged offshore to saline water (559 mgd), enhanced conservation methods (40 mgd), or unbuilt water supply projects that currently reserved for future consideration (293 mgd).

Table 3.2 shows that current demands exceed sustainable thresholds in WMAs 7, 15 and 17. Table 3.3 shows that twelve (12) of the twenty (20) WMAs would exceed sustainable thresholds based on the full allocation scenario. The majority of these deficits can be attributed to outdoor water uses and depletive losses (i.e. wastewater transfers to large regional treatment plants that discharge to the ocean and/or bay). This highlights the importance of using water more efficiently and minimizing exports. The large deficit identified in WMA 17 (-109 mgd at full allocation) is primarily the result of industrial withdrawals and allocations for agricultural uses.[5]

The summaries of water use and availability in Tables 3.2 and 3.3 are helpful in that they combine the multiple, detailed, resource-specific availabilities in a comprehensive manner. This water use and availability is also pre-

[4]Availability in a given area is a complex function of several factors. For example, administrative availability is associated with a permit and its designated use, while safe yield is related to a water system and its network of interconnections. Unconfined groundwater and surface water are derived at the watershed (HUC11) scale. Confined aquifer availability is a function of aquifer extent, groundwater divides, and critical area boundaries. Due to the nature of this information (i.e. differing or overlapping boundaries and differences in scale), summarizing water availability for any one geographic area in New Jersey is complicated.

[5]Forty percent of agricultural users use less than 10% of their approved allocations, and 20% used none; thus, the projected deficits in these regions may never be realized. Addressing reasonable future agricultural needs through the Agricultural Development Plans and better defining agricultural needs is a priority in this region (see policy item #8 in Chapter 7).

sented in Figures 3.12, 3.13, and 3.14. However, their usefulness in identifying appropriate water supply management options in a site-specific manner is limited. For example, to develop the WMA summaries, unconfined groundwater and surface water availabilities for each HUC11 watershed were combined into one total. The water available to any one new diversion is highly dependent on the location of the new diversion, the location of the HUC11 with the availability, as well as available infrastructure and resources to move water to the desired location. In addition, the underlying cause of a deficit in a WMA may result from a specific type or volume of use that can be modified, or from an allocation that will never be fully used. Also, site-specific details may limit the availability of a proposed diversion in a WMA with a surplus (e.g. adverse interference with other users and limited water availability at the site because of in-situ aquifer conditions).

To ensure sustainable water supplies, the NJDEP will continue to review detailed data and demonstrations of alternative region specific sustainability thresholds. The NJDEP considered the results of the Highlands Regional Master Plan (HRMP) process to define available water supply in the Highlands Region. Future water allocation and safe drinking water permit decisions, for new or modified permits as well as renewals, will be made consistent with the adopted Highlands rules (N.J.A.C. 7:38) and the HRMP. NJDEP also will continue to work with the Pinelands Commission to ensure water allocation decisions meet Pinelands Comprehensive Management Plan (CMP) objectives.

G. SUMMARY

In summary, the data suggest the potential for water savings through; conservation and reuse; the continued reliance on reservoir systems; the need to further assess new sources of supply; and the reassessment of approved unused allocations to ensure that the supply is needed and supports statewide objectives. The detailed water assessments and recommended management options for each WMA is provided in Appendix A and provides a framework to inform future decisions regarding water supply. Users looking for availability at a specific location should be aware that site-specific conditions may be more limiting than the WMA-wide analysis might indicate.

Table 3.2 Natural Resource Availability, net demand and remaining availability, and 2020 estimates of potable use.

WMA#	WMA Name	Natural Resource Availability (mgd)				Net Demand (mgd)				Remaining Availability (mgd)				Estimated increase in potable use 2015 to 2020 (mgd)	Estimated remaining water availability in 2020 (mgd)
		Reservoirs	SW Intakes/ Un-conf GW	Conf GW (sub to revision)	Combined	Reservoirs	SW Intakes/ Un-conf GW	Conf GW	Combined	Reservoirs	SW Intakes/ Un-conf GW	Conf GW	Combined		
1	Upper Delaware		30		30		12		12		18		18	1.1	16.9
2	Wallkill		6		6		4		4		2		2	0.4	1.6
3	Pompton, Pequannock, Wanaque, and Ramapo	191.1	8		199.1	160	13		173	31.1	-5		26.1	0.7	25.4
4	Lower Passaic and Saddle	75	9		84	53	12		65	22	-3		19	4.3	14.7
5	Hackensack, Hudson and Pascack	126.5	6		132.5	122	3		125	4.5	3		7.5	3.7	3.8
6	Upper and Middle Passaic, Whippany and Rockaway	67.6	15		82.6	58	21		79	9.6	-6		3.6	1	2.6
7	Arthur Kill		6		6		21		21		-15		-15	4.9	-19.9
8	North and South Branch Raritan		21		21		12		12		9		9	0.5	8.5
9	Lower Raritan, South, and Lawrence	241	13	21.7	275.7	187	44	14	245	54	**-31**	7.7	30.7	3.9	26.8
10	Millstone		8	9.2	17.2		0	9	9		8	0.2	8.2	1	7.2
11	Central Delaware		8	3.5	11.5		1	2	3		7	1.5	8.5	0.3	8.2
12	Monmouth	62.6	21	21.3	104.9	55	7	17	79	7.6	14	4.3	25.9	1.4	24.5
13	Barnegat Bay	17	54	50.4	121.4	6	42	37	85	11	12	13.4	36.4	4.1	32.3
14	Mullica		39	10.4	49.4		30	7	37		9	3.4	12.4	0.5	11.9
15	Great Egg Harbor		36	27.2	63.2		59	22	81		-23	5.2	-17.8	1.2	-19
16	Cape May		7	13.6	20.6		1	12	13		6	1.6	7.6	-0.2	7.8
17	Maurice, Salem and Cohansey		47	28.2	75.2		122	11	133		-75	17.2	-57.8	0.7	-58.5
18	Lower Delaware		24	113.3	137.3		19	74	93		5	39.3	44.3	1.2	43.1
19	Rancocas		19	20.2	39.2		11	15	26		8	5.2	13.2	0.7	12.5
20	Assiscunk, Crosswicks and Doctors		10	22.2	32.2		-8	15	7		18	7.2	25.2	0.5	24.7
	TOTAL	**780.8**	**387**	**341.2**	**1,509**	**641**	**426**	**235**	**1,302**	--	--	--		**31.9**	--

Table 3.3 Full allocation rates, remaining water, and options for additional water supply

WMA#	WMA Name	Water Availability Allocation (mgd)			Full Allocation Remaining Available Water (mgd)				Options for Additional Water Supply (mgd)		
		SW	Unconf GW	Conf GW	Reservoirs	SW intakes/unconf GW	Conf GW	Combined	Ocean/ bay sewer discharges	Potable conservation savings	Unbuilt water supply projects
1	Upper Delaware	2,530	44			1.1		1.1		0.6	40
2	Wallkill	5	9			-2.9		-2.9		0.3	
3	Pompton, Pequannock, Wanaque, and Ramapo	521	19		0	-6.4		-6.4		0.9	
4	Lower Passaic and Saddle	1,509	42		0	-11.4		-11.4		3.6	
5	Hackensack, Hudson and Pascack	150	8		0	13.9		13.9	82	4.1	
6	Upper and Middle Passaic, Whippany and Rockaway	81	79		0	-19.8		-19.8		2.5	30
7	Arthur Kill	17	27			-7.3		-7.3	276	2.2	20
8	North and South Branch Raritan	431	22			-3.6		-3.6		3.4	
9	Lower Raritan, South, and Lawrence	251	63	22	0	-62.9	0	-62.9		2.9	135
10	Millstone	69	17	9		-5.6	0	-5.6		0.5	
11	Central Delaware	151	9	4		2.6	0	2.6		1	
12	Monmouth	186	4	21	0	28.5	0	28.5	122	4	23.2
13	Barnegat Bay	37	74	50	0	15.3	0	15.3	44	3.4	
14	Mullica	46	53	10		-15.6	0	-15.6		0.4	
15	Great Egg Harbor	34	59	27		-29.4	0	-29.4	25	2.1	
16	Cape May	2	10	14		-3.1	0	-3.1	6	0.4	
17	Maurice, Salem and Cohansey	179	206	28		-109.4	0	-109.4	4	1.5	
18	Lower Delaware	133	22	113		52.3	0	52.3		3	35
19	Rancocas	31	5	20		13.8	0	13.5		2.6	
20	Assiscunk, Crosswicks and Doctors	925	7	22		8.3	0	8.3		0.4	
	TOTAL	**7,288**	**779**	**341**	--	--	--	--	**559**	**39.8**	**283.2**

Notes for Tables 3.2 and 3.3:

- The information summarizing Statewide Water Availability is extensive, and the Tables have been divided to properly fit the format of this document. Refer to Appendix A for additional details.
- All volumes are in millions of gallons per day (mgd).
- Columns that are blank are due the fact that the identified resource for each region are not available there. Columns with a “0 “indicate regions where that resource is present but not currently a viable supply.
- The total resource availability is based on the best available analysis using the combined sum of the amount of water available from unconfined sources of supply and surface waters based on the stream low flow margin method, the approved safe yields of existing reservoir systems, and the total permitted allocations in the confined aquifers.
- Remaining Availability is WMA specific and it is not appropriate to include a total sum for the entire state.
- Net demand is based upon the peak use of the resource for each HUC11 between 2000 and 2015. Not all HUC11s may have the same peak year.
- The remaining availabilities are not summed statewide because a large loss in one WMA does not offset a surplus in another WMA. Similarly, a large loss in one resource does not mean that a new source may be added (assuming all permitting requirements are met) which utilizes another source in the same WMA which has availability.
- The 2020 water demand estimates assume only 2015 to 2020 potable supply increases; all other uses remain the same as past peaks.
- Increases in the resource availability may occur for reservoirs if new infrastructure is built and permitted and in confined aquifers depending upon the specifics location and construction of a new source.
- Ocean and bay discharges are not included as part of the stream low-flow margin availability, since the waters are ‘lost’ to the freshwater system; instead these discharges are separated to indicate their reuse potential (see Chapter 6 for a discussion pertaining to reuse).
- Water Availability Allocations are allocated rates that include sub-permit limits that have an effect on water withdrawal amounts that effect specific water resource availability and do not necessarily equal the actual water allocation rates permitted by the NJDEP.

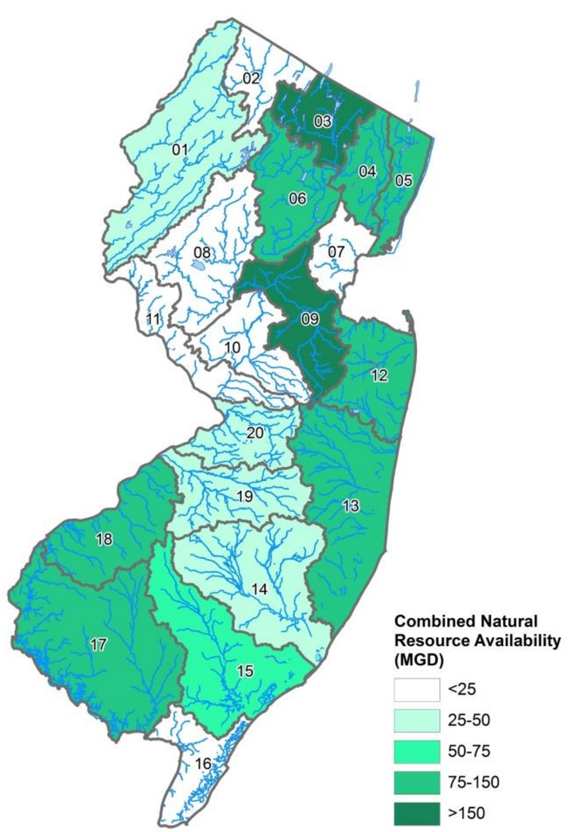


Figure 3.12 Combined Natural Resource Availability by WMA based on most recent available data analyses.

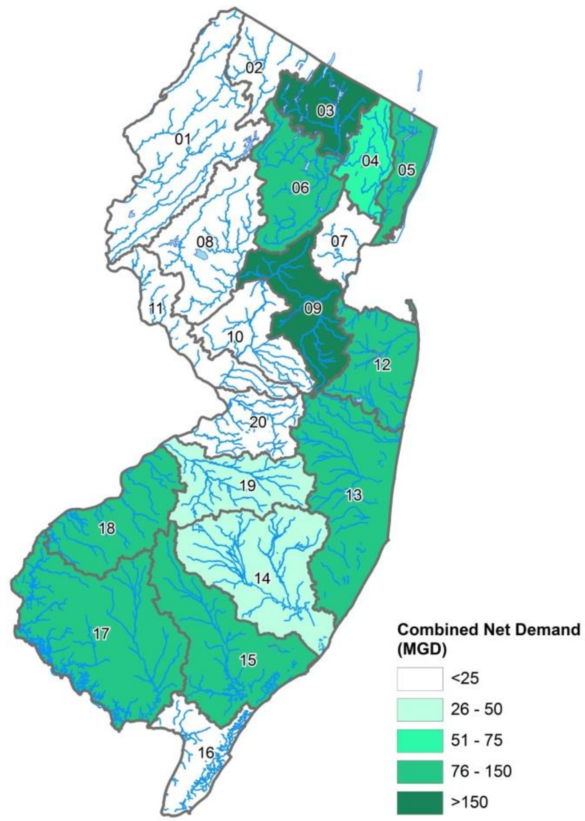


Figure 3.13 Combined Net Demand by WMA based on most recent available data analyses.

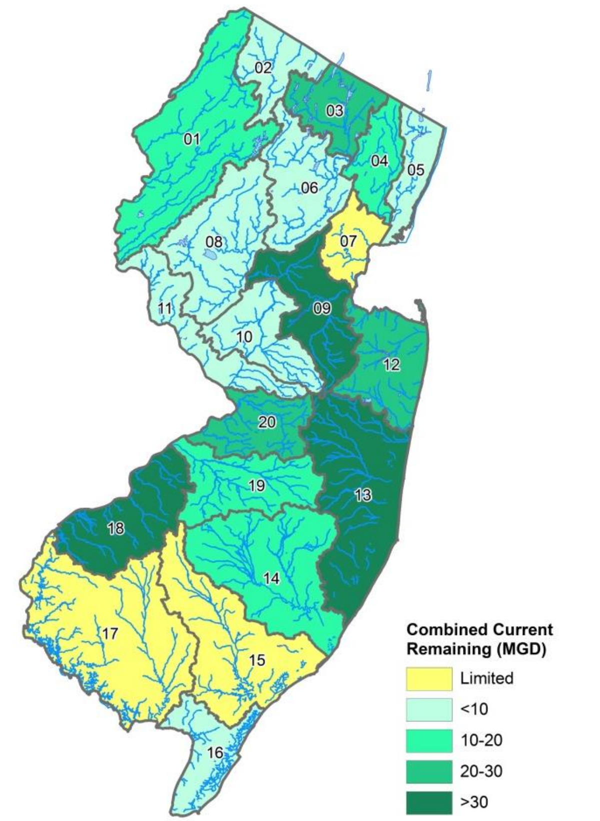


Figure 3.14 Combined Current Remaining Availability by WMA based on most recent available data analyses.

CHAPTER 4
PLANNING FOR DROUGHT AND AN UNCERTAIN FUTURE

A. EXTREME WEATHER AND DROUGHT

Precipitation varies across New Jersey -- from year to year, month to month, and even within a single rain event. On average, the State's hilly northwestern region is wetter (up to 50 inches per year) than the coastal plain to the south and east (as low as 39 inches per year) (fig.4.1) This precipitation variability, coupled with concentrated population centers, can produce wide fluctuations in water availability and demands. Over the past five decades, New Jersey has experienced several episodes of drought that resulted in water shortages of varying degrees, the most notable of which occurred in the mid-1960's, the early-to-mid 1980's, and again in 2001-02. Drought watches were declared for short periods of time in 2005, 2006, 2010 and 2015. New Jersey experienced a drought condition in 2016 going into 2017 and a drought warning was declared for 14 counties in October 2016 that ended for all but two counties on April 12, 2017. The drought warning was lifted in full on August 11, 2017.

It is important to note that New Jersey also experiences potential water shortages during relatively short periods of dry weather that technically may not qualify as "official" droughts according to climate experts. Such periods, while exhibiting some of the characteristics of a drought in terms of the relative scarcity of rainfall and/or above-average temperatures, might best be characterized as demand-driven events marked by significantly increased water demands and rapidly depleted surface and groundwater reserves. This is exacerbated when system reservoir storage is less than full as the high-demand season begins. These demand-driven periods occurred in 1995, 2005, 2006, and 2010, necessitating enhanced scrutiny and action by the NJDEP -- either formally or otherwise -- to ensure an adequate water supply.

The recurrence of these episodes is even more notable since they occurred during New Jersey's wettest period on record, based on annual precipitation.[6] Declines in overall water use have been observed over the past two decades. However, steadily increasing water consumption for potable use, agricultural needs, and non-agricultural irrigation presents a challenges to meeting essential water needs, especially in hot, dry summers. The developing statewide trend of more and more fresh water -- much of it highly treated drinking water-- being used to irrigate lawns and landscapes quickly strips water reserves during demand-driven water shortages.

There has been concern with the possibility of changing climate in the future. The NJDEP's Science Advisory Board, Climate and Atmospheric Sciences Standing Committee was asked to weigh on the potential impact of such changes on water supply. The Committee reviewed available literature and issued a report of findings. The final report cited the probability of increased frequency of extreme high temperatures, decreased frequency of extreme low temperatures, a lengthening of the frost-free season, and an increased short-term hydrologic variability. This report then lists a number of potential impacts on water supply. The report concludes "All of these studies and informational resources indicate that climate change will make extreme events, including floods, heat waves,

[6]Since 1970, state-wide-average annual precipitation has increased about 3 inches. Average annual rainfall for the period 1895-1970 was 44.2". For the period 1971-2016 average precipitation is 47.1".

and droughts, more likely. They stress the need to build capacity at the local, regional, and state level to develop and institutionalize strategies to cope with extreme events." NJDEP is committed to monitoring and responding to events in such a way as to preserve the water supply of the State as well as working to ensure an adequate supply into the future.

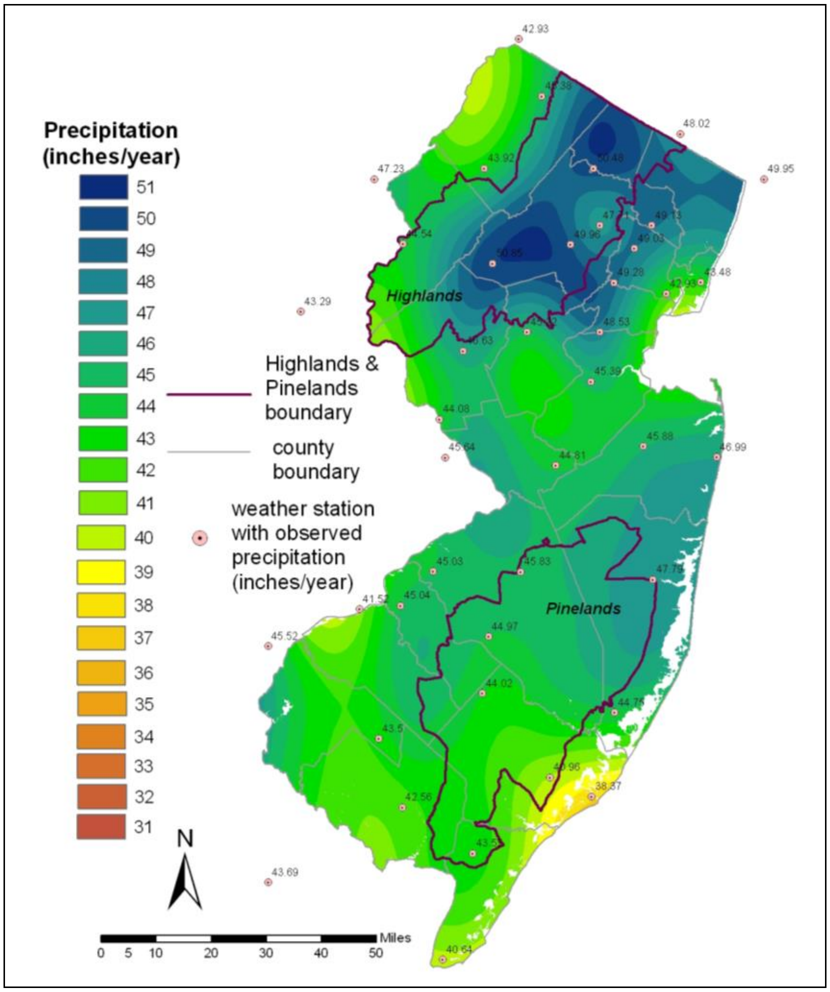


Figure 4.1 New Jersey annual average precipitation.

B. DROUGHT AND WATER SUPPLY MANAGEMENT

TYPES OF DROUGHT

According to the National Drought Mitigation Center, drought is a normal, temporary, and recurrent feature of climate, which occurs practically everywhere in the world. Drought can be described as a period of unusual or persistent dry weather of a duration and magnitude that results in a shortage of water and adversely affects some activity, group, or environmental sector. For more information see the National Drought Mitigation Center. Drought is based on an assessment of existing conditions compared to some long-term average. There are different types of drought:

- A precipitation drought occurs when recorded rainfall is significantly below normal for a protracted period.
- An agricultural drought occurs when the soil-moisture deficit hinders crop growth.

- An <u>environmental</u> drought occurs when an ecological community is affected by a lack of water (e.g. low stream flows that impact water quality and, in turn, stress fish and other aquatic organisms).
- A <u>water-supply</u> drought occurs when there is the potential for water demands to exceed available water supplies. This definition combines: (1) amount of water in storage, (2) anticipated water demands, (3) the severity of the precipitation deficit, and (4) specific water sources available to an affected area.

This Plan concentrates on water-supply droughts.

DROUGHT MONITORING

Today, the NJDEP regularly monitors various water supply conditions in six water supply regions, and is in regular communication with key water purveyors. The water supply conditions, which are monitored at least weekly (during watch, warning, or emergency) or every other week (during normal conditions), aid the NJDEP and the State of New Jersey in declaring and changing drought status.

New Jersey's drought monitoring program grew out of an analysis of historic water-supply data and the State's experience and response to drought events during the 1980's, 1990's, and 2002. Previous decisions about the severity of drought conditions were based largely on precipitation deficits and storage in drinking water reservoirs as well as a broad assessment of data related to stream flows and groundwater levels.

In the fall of 1998, staff recognized a developing precipitation deficit that extended through January of 1999, a relatively wetter period through spring, and a return of drought conditions by summer 1999. The post-drought analysis revealed that the entire period (summer 1998 through fall 1999) was an extended drought interspersed with a few relatively wetter months that temporarily alleviated conditions. In fact, following a continuation of severely dry conditions that culminated in the 2002 water emergency, some observers considered the event to have been a multi-year drought interrupted by torrential rains associated with Hurricane Floyd (1999).

This post-drought evaluation also showed the need for a more consistent method of comparing precipitation, stream flow and groundwater levels to historical values. Additionally, the State's effectiveness to manage the situation had been compromised by the lack of a means to easily compare the severity of drought conditions in different parts of the State and then communicate this information to the public. As a result, in 2000, the NJDEP revised its methods, as described below, for monitoring and objectively assessing water-supply conditions, and communicating with decision makers and the public.

DROUGHT MANAGEMENT REGIONS

The NJDEP divides New Jersey into six drought regions: Central, Coastal North, Coastal South, Northeast, Northwest and Southwest (fig. 4.2). The regional approach recognizes that precipitation patterns, water-supply sources, water demands, and existing infrastructure vary considerably across the State. The approach also acknowledges the distinction between sources of water, such as ground and surface water, and, more specifically, differences between surface water withdrawn from reservoirs and rivers, and between confined and unconfined groundwater diversions.

For the purpose of administering and enforcing water use restrictions and other emergency orders when they become necessary, drought region borders align with municipal or county boundaries. This regional emphasis allows the State to tailor drought restrictions according to conditions within each designated region, thus avoiding the imposition of restrictions in areas with sufficient supply. Regional boundaries may be modified as needed to increase their usefulness.

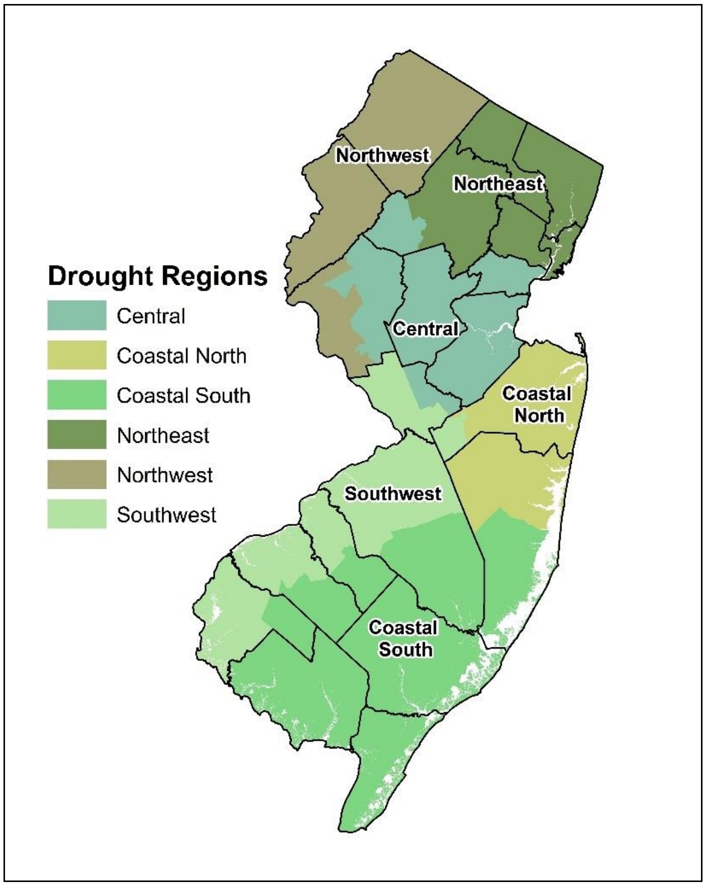


Figure 4.2 New Jersey Drought Regions.

DROUGHT INDICATORS

The tools NJDEP uses to assess waters supplies and monitor drought conditions have grown progressively more sophisticated in the last decade. Information about precipitation, stream flow, reservoir storage, and groundwater levels that are gathered from reference monitoring sites inform the State's drought indicators. The goal of each drought indicator is to summarize the status of a single factor affecting water supply in a given region. The indicators are designed to:

- integrate large amounts of available data about water-supply sources;
- be based on real-time data;
- be distributed quickly over the Internet; and
- relate accurate information about water supplies to the public and decision makers.

The drought indicators do not automatically trigger a change in drought status; rather, NJDEP staff evaluates the indicators using best professional judgment and input from water suppliers and other professionals in the formulation of an appropriate drought status for each region (normal, watch, warning or emergency). The basis and background for the indicators and their application is summarized in New Jersey Geological and Water Survey (NJGS) Information Circular, entitled "New Jersey Water-Supply Drought Indicators", which is available at NJ Drought Indicators. The indicators themselves are updated regularly and they, and a wealth of other drought-related information, are available at NJ Drought.

ADMINISTRATIVE DROUGHT ACTIONS

When demand threatens to outstrip available water supplies, as with extended periods of below-average precipitation and/or above-average temperatures, the NJDEP -- after evaluation of drought indicators in the State's six drought regions -- may designate a drought watch or drought warning condition to avert a more serious water shortage. New Jersey's governor may declare a state of water emergency when drought conditions persist (or in the event of a serious water system compromise or failure). In New Jersey, the relative status of water-supply conditions is classified as follows:

- A normal condition indicates that an average or above-average amount of precipitation has fallen, or that the conditions relevant to water supply are not far enough below average to be of concern.
- A drought watch condition implies degraded, but not significantly compromised, water supply indicators. This status level was added in 2000 following drought conditions experienced in 1998-1999. The purpose of the designation of a drought watch by the NJDEP is to alert water-supply professionals to monitor the situation closely and prepare for the initial stages of drought response. The public also is encouraged to conserve water to the extent possible.
- A drought warning condition, designated by the NJDEP commissioner, reflects a continued worsening of water supply conditions. Under a drought warning, water-supply professionals actively monitor conditions and implement appropriate requirements, in accordance with N.J.A.C. 7:19. The drought warning requirements consist primarily of supply-side management measures designed to forestall a significant water shortage and avert a water emergency. Continued voluntary water conservation by the public is urged at this time as well as cooperation by affected water suppliers. The NJDEP also may exercise its non-emergency powers to order: tests of water system interconnections, water transfers between water systems, modifications of permitted passing flows and reservoir releases, and other measures to ensure an adequate water supply.
- A state of water emergency may be declared by the Governor when a potential or actual water shortage endangers the public health, safety and welfare. Under an emergency, the NJDEP may impose mandatory water restrictions and require specific actions to be taken by water suppliers. Such actions may include the interconnection of water systems; reduction, reapportionment or cessation of a particular supply; bans on adjustable water uses; and additional water transfers between affected water systems and/or drought regions. A water emergency provides for a priority-based, phased system of mandatory water restrictions, which seek to reduce water consumption and preserve available supplies, while causing as little disruption as possible to commercial activity and employment. The phases are:
  - Phase I measures limit water use for "non-essential" purposes (e.g. lawn/ landscape watering, non-commercial car and power washing, and swimming pool maintenance).
  - Phase II involves selective indoor water rationing when the severity of the water emergency poses a substantial threat to the public health and welfare.
  - Phase III requires further rationing to all sectors, including the selective curtailment of industrial water uses.
  - Phase IV, the disaster stage, is reserved for when public health and safety cannot be guaranteed and water quality is of utmost concern; maintenance of health facilities is at emergency levels, and industrial use is further curtailed and selective closures may become necessary.

DECISION SUPPORT TOOL TO BALANCE WATER SUPPLY DURING DROUGHT AND OTHER WATER SUPPLY EMERGENCIES

In 2005, the NJDEP contracted with Gannett Fleming, Inc. for an evaluation of the State's interconnected water supply infrastructure. The result of this evaluation, formally known as the "Interconnection Study – Mitigation of Water Supply Emergencies" (*Statewide Interconnection Study*) is an update to previous studies, the most recent of which dates back to 1986.

The *Interconnection Study* found that if water transfers had been initiated sooner during past droughts, all but two of the past five water emergencies since the 1960's could have been avoided. Working cooperatively with water suppliers to balance water supplies between areas of surplus and deficit in order to avert or lessen the impact of an impending water emergency is a critical water supply management tool. Therefore, as part of the 2016 Drought Warning, water transfers were ordered between several systems in order to preserve storage for those systems at highest risk. As a result, an estimated 1.8 billion gallons of water was preserved in critical reservoirs as a result of water transfers ordered between 2016 and 2017.

The goals of the *Statewide Interconnection Study* were threefold:

- Provide recommendations on how to optimize current water diversions and transfers between systems to avert and mitigate drought-related water supply emergencies;
- Identify procedures to lessen the impacts on the State's water supply systems due to catastrophic losses; and
- Recommend how to optimize existing system interconnections during "normal operations" to help increase overall water transmission efficiencies across the State.

The full *Statewide Interconnection Study* report can be found on the NJDEP's web site at: Interconnection Study

Specific infrastructure findings/ recommendations from the Interconnection Study appear in Chapter 7.

The report recommends use of the Water Supply Management Decision Support Tool (WSMDT) to evaluate and, if necessary, initiate communication and earlier transfers of water from areas with adequate supply to areas of deficit. The WSMDST will assist in averting seasonal water shortages and managing water supplies during drought. The WSMDST integrates the use of three models developed as part of the Interconnection Study:

- Hydraulic Model
- Interconnection Mass Balance Model (IMBM)
- Reservoir Mass Balance Model (RMBM)

The WSMDST was designed to predict the likelihood of reaching drought conditions within a specified time frame given a range of meteorological and hydrologic conditions. The general objective of the WSMDST is to specify transfers of water, using available interconnection capacities, to mitigate excessive depletion of water supplies in a single water system or drought region and adjust the drawdown through targeted water transfers that balance available supplies within affected systems or throughout a drought region. By anticipating various drought scenarios, the WSMDST can also be used to guide long-term planning efforts.

The NJDEP is also developing additional models and methods to better manage water supplies during normal, drought and water supply emergency periods.

C. WATER SYSTEM RESILIENCY

Water systems need to be able to prepare for, respond to, and recover from hazards and extreme weather events that threaten their operations. Superstorm Sandy is a good example. The storm hit New Jersey October 29-30, 2012. The storm surge damaged critical water supply infrastructure along the coast, and high winds compromised electrical and other energy distribution across much of the State, which in turn impacted the ability to supply water. The impacts of and experiences associated with Sandy have taught many lessons and informed the steps taken since then to recover and become more resilient to future hazards, which include the need:

- For sufficient fuel to supply auxiliary power equipment during a multi-day interruption in power.
- To protect and/or harden all infrastructure within flood hazard areas. This may involve moving, elevating, or flood-proofing key infrastructure assets (e.g. protecting it with seals or membranes or within floodwalls).
- To update delineated flood-hazard areas using the best available information.
- For secure communication to quickly share critical information among decision makers.
- To proactively plan appropriate response measures and responsibilities prior to an event or hazard.

In the wake of and other recent adverse weather events, the NJDEP developed new guidance aimed at ensuring that repairs, reconstruction, new facilities, and operation/maintenance were focused on enhancing the resilience of our critical infrastructure. The guidance documents address Auxiliary Power, Flood Protection, Emergency Response/ Planning, and Asset Management, available at NJDEP Water Supply and Asset Management. These documents present relevant material to address some of the core capabilities applicable to water systems regarding all hazards. These capabilities include establishing goals, threat assessment, response and resiliency planning, prevention, detection, investigation, and response and recovery protocols. In general, the guidance is applicable to both drinking water and wastewater systems. The long-term viability and effective operation of water systems can also be assured through asset management. This is discussed in more detail in Policy Item #9 in Chapter 7 and below.

WATER QUALITY ACCOUNTABILITY ACT

On July 21, 2017 the 'Water Quality Accountability Act' became law in New Jersey. This law, N.J.S.A. 58:31, sets some standards for asset management by certain water purveyors (i.e. public water systems with more than 500 service connections). Specifically:

- Testing valves and fire hydrants;
- Development of cybersecurity programs;
- Mitigation plans for addressing notices of violation, including maximum contaminant level exceedances;
- Annual notification of state authorities of compliance withal federal and state drinking water regulations; and
- Development of an asset management plan consistent with standards set by the American Water Works Association, including dedicated funds to enable addressing the highest priority projects and a progress report every 3 years. Asset management plans shall be designed to inspect, maintain, repair, and renew infrastructure and shall include analysis of the condition and estimated service lives of water mains as well as an appropriate replacement cycle.

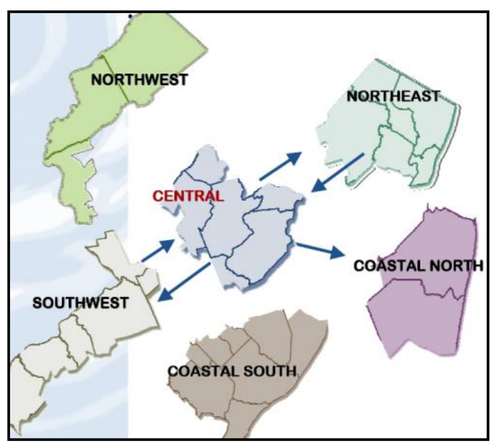


Figure 4.3 Water supply interconnections between drought regions.

DEP will work with water supply purveyors to ensure they have proper financial and technical assistance in meeting the requirements of the Water Quality Accountability Act. Meeting these requirements will help ensure water system resiliency and the water supply of New Jersey.

CHAPTER 5
WATER RESOURCE PROTECTION AND PLANNING EFFORTS

A. NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION PROGRAMS

In 2010 NJDEP released its "Vision-Priorities" Plan which outlined the strategic direction of the agency. The "Vision-Priorities" Plan confirmed that NJDEP's core mission continues to be the protection of the air, water, land, and natural and historic resources of the State to ensure continued public benefit. To support this vision, the NJDEP has focused its efforts on comprehensive water resources management -- a holistic approach to managing the State's water resources from a supply, quality, standards and monitoring perspective.

Figure 5.1 Black River, Morris County

PROTECTING SOURCE WATER

REGULATORY PROGRAMS

NJDEP has taken significant steps to improve the protection of New Jersey's water resources, including, source water assessment and protection, land acquisition, improved surface water quality standards and designations related to water supply, and stormwater management. NJDEP continues to be actively engaged in the management of the State's drinking water sources for both quantity and quality. Though the protection of water has two components, quantity and quality, the purpose of the water supply plan is to focus on the quantity of available water.

The quality of the water resource is an equally important component and NJDEP has numerous programs devoted to preserving and restoring the water quality of New Jersey's aquatic resources. In general, New Jersey's water quality has been improving since the 1970's, mainly due to NJDEP's focus on achieving better wastewater treatment. The net impact of this improvement is effectively summarized in the most recent version of the New Jersey Integrated Water Quality Assessment Report series, available at Integrated Water Quality Assessment Report. These reports "provide effective tools for maintaining high quality waters and improving the quality of waters that do not attain their designated uses."

However, water quality monitoring, assessment, and restoration is an ongoing process. The NJDEP has always regulated and continues to regulate source and drinking water quality through various programs implemented by the following rules:

- Coastal Zone Management Rules (N.J.A.C. 7:7)
- Freshwater Wetland Protection Act Rules (N.J.A.C. 7:7A)
- Stormwater Management Rules (N.J.A.C. 7:8)
- Standards for Individual Subsurface Sewage Disposal Systems (N.J.A.C. 7:9A)
- Surface Water Quality Standards (N.J.A.C. 7:9B)
- Ground Water Quality Standards (N.J.A.C. 7:9C)
- Well Construction Rules (N.J.A.C. 7:9D)
- Safe Drinking Water Act Rules (N.J.A.C. 7:10)
- Flood Hazard Area Control Act Rules (N.J.A.C. 7:13)
- Water Pollution Control Act Rules (N.J.A.C. 7:14)
- Pollutant Discharge Elimination System Rules (N.J.A.C. 7:14C)
- Underground Storage Tank Rules (N.J.A.C. 7:14B)
- Water Quality Management Planning Rules (N.J.A.C. 7:15)
- Water Supply Allocation Permits (N.J.A.C. 7:19)
- Highlands Water Protection and Planning Act Rules (N.J.A.C. 7:38)

SOURCE WATER ASSESSMENTS PROGRAM

As a requirement of the 1996 Amendments to the Safe Drinking Water Act, in 2004 NJDEP, in conjunction with the United States Geological Survey (USGS), performed source water assessments to predict the susceptibility of source water for all community and non-community water systems to contamination. While many regulatory programs were in place to protect the quality of drinking water, the results of the Source Water Assessment Program were designed to provide planning opportunities by allowing state and local agencies the ability to determine if increased regulatory controls were necessary, including local land use ordinances. Source water assessment reports for each of the approximately 600 community water systems and 3,545 non-community water systems were completed and released on the Source Water Protection Program (SWAP) web site. These reports provide information on the potential vulnerability of each of the water system's sources to the following contaminant categories: nutrients (nitrates), pathogens, pesticides, volatile organic compounds (VOCs), inorganics (metals), radionuclides/radon, and disinfection by-product precursors.

The reports and supporting documents are available to the public by searching for water systems at: SWAP Reports & Summaries.

These Source Water Assessments highlighted the importance of regulating surface activities in order to protect sources of potable supply. The NJDEP continues to bolster its efforts to protect potable sources through land acquisition and the regulation of land uses and discharges. More information regarding SWAP is at Source Water Assessment Program (SWAP).

NJDEP is considering the update of this assessment to reflect recent conditions and is working on a strategy to do so. However, there is currently no time frame for this update.

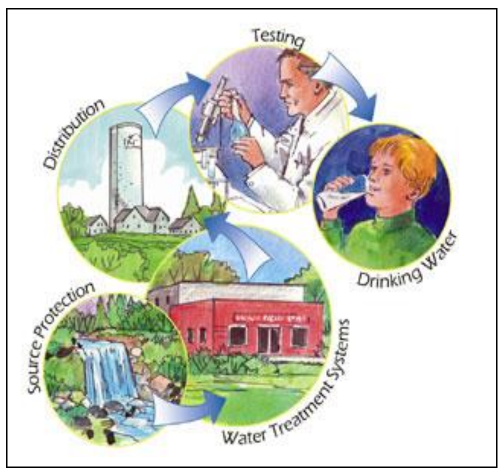


Figure 5.2 Water source and distribution cycle.

CATEGORY ONE (C1) WATERS

Water bodies that are designated as Category One (C1) waters according to the Surface Water Quality Standards (SWQS), N.J.A.C. 7:9B, are protected from any measurable change in water quality because of their exceptional ecological, recreational, water supply, or fisheries resources significance. C1 designation provides additional protection to water bodies that help prevent water quality degradation and discourage development where it would impair or destroy natural resources and environmental quality. The maintenance of water quality is important to all residents, particularly to the many communities that depend upon surface waters for public, industrial, and agricultural water supplies, recreation, tourism, fishing, and shellfish harvesting.

The 1996 New Jersey Statewide Water Supply Plan (see Chapters 7 and 9) proposed a better integration of New Jersey's SWQS with surface water supply management, including an evaluation of the surface water use designations and water quality criteria with respect to their adequacy to protect surface water supplies. The 1996 NJSWSP recommended designation of the following reservoirs: (Boonton, Charlottesburg, Doughty Pond, Glendola, Manasquan, Oradell, Round Valley, Swimming River, and Wanaque) as well as the Metedeconk River and parts of the Manasquan River, as C1 waters.

As of 2017, the NJDEP has designated over 6,813 stream miles and 12,374 acres of lakes and reservoirs as C1 waters. Most of these designations were made in 1985 based on State and Federal parks, wildlife management areas, and trout production waters. Between 1985 and 2002, only streams upgraded to Fresh Water Two (FW2) trout production, achieved C1 designation. In 2002, the NJDEP began an intensive effort to identify additional waters that warranted enhanced protections afforded by this designation. Since 2002, the NJDEP has expanded the C1 designation criteria to include waters of "exceptional ecological significance" and of "exceptional water supply significance."

The designation of these waters as C1 is a preventative measure aimed at protecting waters that are ecologically exceptional and drinking water sources. Land use and wastewater infrastructure decisions associated with C1 waters are required to meet the anti-degradation policies specified in the SWQS. This preventive strategy substantially enhances protection of the one-half the State's drinking water supplies population.

For more information pertaining to C1 Waters, please see the Division of Water Monitoring and Standards web site at : C1 Waters.

WATER QUALITY MANAGEMENT PLANNING (WQMP)

The Water Quality Management Planning (WQMP) rules, N.J.A.C. 7:15, implement the Water Quality Planning Act (WQPA), N.J.S.A. 58:11A-1 et seq., whose purpose is to maintain and, where attainable, restore the chemical, physical, and biological integrity of the surface and ground water resources of the State. The rules also establish a grant program to assist watershed management groups in carrying out watershed management activities, pursuant to the Watershed Protection and Management Act of 1997, N.J.S.A. 58:29-1 et seq. The WQMP rules are one component of the State's water quality continuing planning process (CPP) required by Sections 201, 208 and 303 the Federal Water Pollution Control Act, 33 U.S.C. §§ 1251 et seq. (33 U.S.C. §§ 1281, 1288, and 1313), commonly known as the Clean Water Act (CWA), as well as the State WQPA and the Water Pollution Control Act (WPCA), N.J.S.A. 58:10A-1 et seq. The WQMP rules better integrate wastewater planning with existing permitting programs. They also provide the framework to identify the anticipated municipal and industrial waste treatment needs and any gaps in providing capacity in the future. Water quality management planning is one part of the CPP, which is intended to integrate and unify water quality management planning processes, assess water quality, establish water quality goals and standards, and develop a Statewide implementation strategy to achieve the water quality standards. N.J.S.A. 58:11A-7. Properly implementing the WQMP rules will help preserve and protect the water supply of New Jersey. More information is at Water Quality Management Planning Program.

PROTECTING DRINKING WATER

SAFE DRINKING WATER PROGRAM

NJDEP's Division of Water Supply and Geosciences is responsible for regulating and guiding the proper operation of public water suppliers in New Jersey. The suppliers are responsible for meeting site-specific permit conditions and submitting regular reports. Many of these reports, including information on the system's licensed operators, reported water quality sampling, permit violations, and other relevant data, are available to the public at the New Jersey Drinking Water Watch web page: Drinking Water Watch. Although customers are directly notified of any violations in their annual consumer confidence reports, Drinking Water Watch increases the accessibility of this data to the public.

LEAD AND COPPER RULE

Lead is a pollutant that is not usually found in source water withdrawn from the streams, reservoirs, and aquifers of New Jersey. It is found when water chemically reacts with the pipes and fixtures when moving from a water treatment plant to the end user. Most recently NJDEP has dedicated resources to work full-time on issues related to lead in drinking water. The NJDEP Lead Team has worked to ensure that the Federal Lead & Copper Rule (LCR) requirements are fully being implemented in New Jersey and to create guidance to support the New Jersey Board of Education rules that require sampling for lead in water in New Jersey schools.

More information is at Lead in Drinking Water

NJDEP has undergone an assessment with respect to the implementation of the Federal Lead & Copper Rule and has taken many steps to enhance and improve this program. Systems subject to the Federal rule are incrementally being asked to submit their lead and copper sampling plans and if required, their water quality parameter sampling plans for review by NJDEP. Although many plans have been submitted, few have been approved due to significant deficiencies. NJDEP is adjusting their review process to address this issue and is meeting individually with many systems to craft an acceptable plan. In addition, to assist water systems with this requirement and implementation of the LCR, the NJDEP has developed a significant amount of LCR guidance, templates, training, forms and fact sheets.

Supporting information is at DWSG Lead in Drinking Water.

B. REGIONAL AND INTERSTATE WATER SUPPLY PLANNING

HIGHLANDS REGIONAL MASTER PLAN (HRMP)

The New Jersey Highlands is a 1,343-square mile area in the northwestern part of the State noted for its scenic beauty and environmental significance. The region includes 88 municipalities in all or parts of seven counties (Hunterdon, Somerset, Sussex, Warren, Morris, Passaic, and Bergen). The is a vital source of drinking water for over 5 million residents both in and outside of the Highlands. The Highlands Water Protection and Planning Act (Highlands Act), N.J.S.A. 13:20-1 et seq., was signed into law on August 10, 2004 (NJ Highlands Act).

Specific to water supply management, the Highlands Act rules (N.J.A.C. 7:38) limit the issuance of water allocation permits to projects that are exempt from the Highlands Act, or to those projects for which a Highlands Preservation Area Approval with waiver has already been issued. The rules also include standards for water supply diversion sources where a diversion source is located within the preservation area, and public community water systems serving authorized development in the preservation area (N.J.A.C. 7:38-3.2 and 3.3 respectively). The Highlands Act also amended the Water Supply Management Act to prohibit the NJDEP from issuing Water Allocation permits that are inconsistent with the Act and Highlands Regional Master Plan.

NJDEP has and will continue to coordinate and cooperate with the Highlands Water Protection and Planning Council on water supply related decision making. NJDEP's Division of Water Supply and Geoscience has frequent contact with Highlands Council staff, including pre-application and any pertinent follow up meetings, when reviewing water allocation permits located within the Highlands region. In addition, NJDEP has a monthly meeting with Highlands Council staff to discuss general permit coordination.

PINELANDS COMPREHENSIVE MANAGEMENT PLAN

The Pinelands National Reserve was created by the enactment of Section 502 of the National Parks and Recreation Act of 1978, followed by a State-designated Pinelands Area created by the New Jersey Pinelands Protection Act of 1979. This internationally significant ecological region covers 1.1 million acres and occupies 22 percent of New Jersey's land area across portions of seven counties (Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester and Ocean), and is underlain by aquifers containing an estimated 17 trillion gallons of water.

Figure 5.3 Stafford Forge Impoundment

The New Jersey Pinelands Protection Act (P.L. 1979, c. 111) established the Pinelands Commission and charged it with, among other things, developing a management plan to guide future development within the State's Pinelands region -- known today formally as the Pinelands Comprehensive Management Plan (CMP). The CMP sets forth regulations and standards designed to promote orderly development and, at the same time, preserve and protect the significant and unique natural, ecological, agricultural, archaeological, historical, scenic, cultural and recreational resources of the Pinelands. Residential and other development is limited and directed toward "growth areas" in order to protect the remaining unique, natural, ecological, agricultural, and horticultural resources.

Certain CMP regulations (N.J.A.C. 7:50-6.86 (a-e)) outline water management within the Pinelands. These regulations address inter-basin transfers, the export of water outside the Pinelands, water allocation and conservation, and criteria for withdrawals from the Kirkwood-Cohansey aquifer.

NJDEP's Division of Water Supply and Geoscience has frequent staff-to-staff contact when reviewing water allocation permits. NJDEP coordinates with the Pinelands Commission staff to ensure that the water supply permits it issues comport with the CMP goals and objectives. More information on the Pinelands Commission is available at: NJ Pinelands Commission

BARNEGAT BAY INITIATIVE

On December 9, 2010, Governor Chris Christie announced a comprehensive action plan to address the ecological health of the 660-square-mile Barnegat Bay watershed. Through this Ten-Point Action Plan (Phase One), the Department launched both long term efforts, such as closing Oyster Creek Nuclear Power Plant, funding comprehensive research and water quality model development and the development post-construction soil restoration standards, and short term actions such as funding stormwater mitigation projects, reducing nutrient pollution from fertilizer, public education and acquiring land in the Barnegat Bay watershed. Much of Phase One focused on research and the collection of sufficient hydrodynamic (flow and current), water chemistry, biological, and sediment flux data needed for model development.

The restoration, enhancement, and protection of Barnegat Bay remains a Department priority. The Department is preparing to transition from Phase One (Ten-Point Action Plan) to Phase Two (Moving Science into Action). Phase Two focuses on taking what was learned and moving science into action with a collective goal of having a healthy Barnegat Bay watershed which is critical to the state's tourism economy and quality of life for residents of the State.

INTERSTATE PLANNING ISSUES

An important facet of New Jersey's water supply inventory is its interstate rivers. New Jersey and New York State border on the Hudson River. The Wallkill River originates in New Jersey and flows northward into New York before turning to the east and entering the Hudson River. The Hackensack, Saddle and Ramapo Rivers originate in New York, flow south into New Jersey, and serve as important water sources for several water purveyors. The Delaware River is the largest of the interstate river basins, with a drainage area covering 13,539 square miles. The headwaters of the Delaware River are located in east central New York State and flow generally southward, dividing New Jersey from Pennsylvania and Delaware before emptying into the Delaware Bay, approximately 330 miles downstream.

The Delaware River Basin Commission (DRBC) is charged with the protection of the Delaware River and its watershed. The DRBC was established as part of the Delaware River Basin Compact, a cooperative agreement approved by Delaware, New Jersey, New York, Pennsylvania and the federal government in 1961. DRBC members include the Governors of the basin states or their designee, and a representative of the federal government from the U.S. Army Corps of Engineers. In addition to its planning and policy role, the DRBC has broad regulatory authority over some aspects of water supply, water quality, flood protection, and watershed management. For more information on the DRBC, visit their website at DRBC.

Water flow, allocation and diversions of water from the Delaware River were initially dictated by a 1931 United States Supreme Court Decree. The parties to the Decree are Delaware, New Jersey, New York City and State, and Pennsylvania. The Decree set limits and conditions for out-of-basin diversions by New York City and New Jersey. In 1954, the Decree was amended to revise diversions and releases based upon the drought of the 1930's (see the Delaware River Master's website at USGS Office of the Delaware River Master for more information on the 1954 Decree).

During the drought of the 1960's, historically the most severe and considered the drought-of- record for the Delaware Basin, the amount of water that New York City's Delaware Basin reservoirs could provide was less than previously calculated. As a result, in 1983 the Decree Parties reached an agreement on a reservoir operating plan for drought and near-drought conditions informally referred to as the "Good Faith Agreement."

The Good Faith Agreement has been modified several times to address new issues or incorporate new scientific information. These issues included improved cold-water fisheries flows, more efficient management of the salt-front in the lower Delaware, and incorporation of hydropower operations. All of the programs agreed to by the Decree Parties since the 1983 Good Faith Agreement have been temporary and any changes must be made by unanimous consent. In 2007, the Decree Parties instituted a new approach to water management known as the Flexible Flow Management Program (FFMP). The 2015-2016 FFMP includes:

- Releases for upper-basin fisheries based on forecast-based available water rather than the "storage bank" concept;
- A modest degree of uncontrolled spill mitigation; and
- A temporary increase to New Jersey's Delaware and Raritan Canal diversion during drought operations. Under non-drought conditions, New Jersey may withdraw 100 mgd from the Delaware River via the canal. While the 1983 Good Faith Agreement limits withdrawals under drought emergencies to 65 mgd, the current FFMP increases such withdrawals to 85 mgd. Since the higher drought diversion is not permanent, it cannot be allocated or contracted per New Jersey's Water Allocation program. Accordingly, a 65 mgd diversion during droughts must be assumed for water supply planning purposes.

New Jersey concludes that increasing New Jersey's canal diversion to 85 mgd can be maintained during a repeat of the record drought with de minimis effects, thus allowing an additional 20 mgd to be allocated via New Jersey's regulations. New Jersey continues to negotiate with the Decree Parties to restore the right to withdraw 85 mgd during a drought emergency, which increasingly plays a critical role in meeting New Jersey's current and future water supply needs, and enhances water system resiliency in the Central, Coastal North and Northeast drought regions

CHAPTER 6
INCREASING WATER-USE EFFICIENCY

Concerted planning and significant public and private investment have and continue to vastly improve water supply storage, treatment, and distribution capabilities in the Garden State. New Jersey's continued population growth and associated development -- coupled with the potential for hotter, more erratic weather, and increasing outdoor water use and consumptive water losses -- can deplete stored water supplies and lower ground and surface water levels. As a result, New Jersey must identify strategies to become "water wise."

Development of an effective adaptation strategy is essential to safeguard against increased weather variability and uncertain hydrologic conditions. One of the most effective strategies is perhaps the simplest – enhancing water-use efficiency. This strategy is accomplished through any one or combination of the following: *waste reduction* -- minimizing water lost in transport; *conservation* --using as little water as needed to accomplish or produce something; *productivity* -- getting more output per unit of water; and *substitution* -- using alternate sources as a means to match the quality of water with the intended uses.

Reducing water waste and improving water efficiency continues to be the most cost-effective, least disruptive, and most environmentally sound means of decreasing demands on our water resources. Maximizing efficiency also reduces pumping, treatment and distribution costs, thereby cutting energy consumption and resulting in further reductions in greenhouse gas emissions. Finally, wise use of water resources reduces the strain on the State's aging infrastructure and extends supplies to ensure water availability in times of need.

The NJDEP continues several initiatives to increase water efficiency with the aim of averting future water emergencies and the need to impose water use restrictions and other costly measures during emergencies and drought conditions. Adaptive water management promotes flexible decision-making that can be adjusted in the face of uncertainty as outcomes from management actions and other events are more clearly understood. The initiatives discussed below are divided into two sections, demand/source management and statewide water conservation strategies.

A. DEMAND/SOURCE MANAGEMENT

Excluding water used for power generation, water use declined slightly from 1990 to 2015, an average of 3.8 billion gallons a year. This decline is largely attributable to decreased water use in the industrial/commercial/mining sectors. Much of the reduction, however, was offset by steady increases in the potable water use sector, due primarily to population growth and increases in non-agricultural irrigation (i.e. residential irrigation). Potable water use, which includes public water systems and individual domestic wells, constituted the largest share (77%) of water use (excluding power generation) in New Jersey (fig. 2.8).

The most significant change is the decrease in water demand for power generation The few true hydropower generators in NJ combined with the periodic shutdown of the generators and power plants for repairs and/or upgrades can significantly change the reported water use for this entire category. Additionally, the recent trend of closing coal-fired power generation plants, which use more water, and replacing them with gas-fired plants using less water has created a lessening in water demand for the power generation sector. While this change decreases total water demand, it is not significantly changing consumptive water use as these uses have relatively low percentage of water lost to evaporation.

Most critical is the increasing trend of consumptive water losses. Much of the increase occurred in the public water supply and non-agricultural irrigation sectors, and specifically includes activities such as outdoor lawn/landscape irrigation, recreation, and household maintenance. The potable supply sector accounts for nearly 60% of the State's total consumptive water loss, which has steadily increased since 1990.

Nationally, water conservation initiatives have made considerable progress through both educational measures and mandatory plumbing code standards in the Energy Policy Act of 1992, 42 U.S.C. §13201 et seq. (EPAct). EPAct measures have led to decreased indoor water use in New Jersey and throughout the nation. However, while indoor water use has trended downward over the past two decades, the steady increase in outdoor, consumptive water loss noted above contributes significantly to the rapid depletion of stored ground and surface water reserves, particularly during the peak summer demand months.

To curtail water waste and extend New Jersey's water supplies into the future, reserving the highest quality waters for the intended use through both source and demand management is a key feature of this NJSWSP. Without conservation, meeting future water supply needs will require significant, additional expenditures for treatment, distribution, and storage infrastructure. Accordingly, this chapter outlines water conservation strategies that primarily target the potable supply sector, specifically focusing on outdoor "non-essential" or "non-potable" uses such as lawn/landscape watering, the single greatest source of the State's consumptive water loss.

An additional component of demand/source management is the proper maintenance of transmission pipes to minimize water loss. This is discussed below and in chapter 4 in the section on Water System Resiliency.

B. STATEWIDE WATER CONSERVATION STRATEGIES

The following water conservation actions will continue to improve the State's overall water use efficiency.

1. Enhanced Public Education and Outreach
2. Reduction of Non-Revenue Water and Real Losses
3. Enhanced Outdoor Water Use Efficiency
4. Consulting with BPU on Rate-making structures
5. Promotion of New and Retrofitted Indoor Fixtures
6. Promotion of Reclaimed Water for Beneficial Reuse

All of these measures will enhance the efficient use of water and curtail unnecessary waste of limited resources.

1. PUBLIC EDUCATION AND OUTREACH

In November 2007, the NJDEP partnered with the Rutgers Cooperative Research and Extension - Water Resources Program to develop the NJ Water Savers, which was funded through an EPA matching grant and State appropriations from the Water Supply Bond Fund. The goal of the WaterSavers program was to create replicable, community based water conservation projects and programs for various types of communities throughout the State. The projects and programs were designed to:

- Educate the public concerning New Jersey's water supply availability in comparison to current and projected demands;
- Promote awareness and guidance of the most efficient use of water both indoors and outdoors by:
  - Demonstrating simple and effective ways to save water;

- Educating the public about landscaping with indigenous and drought-resistant plants, efficient irrigation practices, and the use of alternate water sources (e.g. harvested rain water);
- Encouraging home water audits and the integration of indoor water saving devices, including low-flow fixture/plumbing retrofits, water-efficient appliances, etc.; and
- Instilling a new water use ethic through school related curricula, and empowering residents to positively impact their communities through modified attitudes and water-use habits.

Phase 1 of the NJ Water Savers project created a series of water conservation pilot programs for multiple community types (suburban, rural, urban and tourist areas) that could be easily replicated across the State. Participating municipalities included: Belmar (Monmouth), Livingston (Essex), Rahway (Union), East Greenwich (Salem) and Egg Harbor Township (Atlantic). Phase 2 of the Water Savers project was development of a consumer-based website (NJ Water Savers), which highlights the results of the pilot projects to inspire others to replicate statewide. Phase 2 also included an expansion of one of the most successful projects, "Water Champions" (NJ Water Savers Water Champions).

Phase 3 extended the Water Savers project to the business sector. In this phase, two projects were undertaken to explore opportunities and incentives that would induce businesses to take water conservation measures; landscape irrigation efficiency studies/cost-benefit analyses and larger scale rain water harvesting for irrigation purposes. Educational seminars and workshops were also offered to corporate employees. The results are highlighted on the Water Savers website at:
NJ Water Savers Goes Corporate.

The pilot projects and programs undertaken with the NJ Water Savers project are:

- Indoor Water Conservation Programs -- Educates the public about the importance of indoor water efficiency and easy ways to accomplish water savings. Projects include home retrofit rebate and "give-a-way" programs, plumbing retrofits in schools and public buildings, professionally produced consumer education videos featuring a "water wise" new home, sub-metering of Section 8 housing, and youth service learning initiatives (e.g. the Rahway Water Champions project and youth lead Project Wet Water Festivals).
- Outdoor Water Conservation Programs -- Educates the public about the importance of outdoor water efficiency and easy ways to accomplish water savings. Projects include: demonstration native plants gardens, rain gardens, and natural retention basins; rain water harvesting demonstrations and programs (e.g. larger scale rain water cisterns for irrigation, Build-A-Rain Barrel Workshops and rain barrel art publicity events); smart irrigation controller demonstration sites and irrigation system upgrades/maintenance education; and turf management demonstrations and programs regarding maintenance of lawn and landscaping as well as planting of species of plants and turf that use less water.
- Certification Program for Landscape and Irrigation workers -- Trains landscape and irrigation workers on the most current water efficient technologies and design techniques. Applicable courses are managed through Rutgers' Office of Continuing Professional Education-Landscape Programs at Rutgers University and award credits towards continuing education requirements. More information on current courses can be found at: Rutgers Landscape & Grounds Courses. In Phase 2 of the NJ Water Savers project, the Rutgers University publication, "Landscaping for Water Conservation, A Guide for New Jersey" was updated and can be found at Rutgers Landscaping for Water Conservation.

- Incorporation of key educational programs and a model outdoor irrigation ordinance into the Sustainable Jersey certification program -- Sustainable Jersey is a certification program for municipalities in New Jersey that provides tools, training and financial incentives to support communities as they pursue sustainability programs. NJ Water Savers and Sustainable Jersey staff have developed a model water conservation ordinance to be adopted by municipalities applying for certification. This ordinance is a priority action item in the Sustainable Jersey program. In addition, the NJ Water Savers have worked with Sustainable Jersey to create a Water Conservation Education tool using the NJ Water Savers pilot programs as models for replication. More information on Sustainable Jersey can be found at: Sustainable Jersey.

While the NJDEP continues to promote water conservation and efficiency Statewide through active involvement with both the Sustainable Jersey program and the Environmental Protection Agency's WaterSense program, most recently the water conservation efforts have shifted to Cape May to develop an educational program that addresses the regional concerns of saltwater intrusion. While a multifaceted approach to education is currently being developed including all community types in the County, two educational projects that focus on the tourist communities have been selected and are underway:

- In an effort to educate the masses of tourists that visit Cape May City each summer, the NJDEP in partnership with the NJ Watershed Ambassadors Program, Kohler Company, Cape May City Elementary School, and the Cape May City Office of the Mayor, retrofitted a busy restroom facility on the Promenade with low-flow WaterSense products. The result of the retrofit in 2016 has shown a 66% reduction in water use and a savings of approximately 800,000 gallons of water per year. To educate the public about the retrofit project, the students of Cape May City Elementary School created a series of murals highlighting the need for water conservation and the savings achieved at the site. The murals were hung outside of the Promenade restroom in December of 2016.
- Building off the success of the New Jersey Water Champions program, the NJDEP partnered with the USEPA Region 2 in October of 2016 to launch a similar program targeting tourist driven communities along the Cape May shoreline. Currently, the Cape May Water Champions program is being implemented in Ocean City New Jersey in partnership with the Ocean City High School and Ocean City Mayor's Office. Students from the High School learn about their regional water supply issues, their community's water footprint and how they can update water using technologies and increase their community's water conservation ethic to curb water use at home, at school and in their local business community. This program will result in: a water audit of the school and a retrofit of a school restroom; student led case studies of water use in multiple business types; and water audits and retrofits in businesses within their community. The Cape May Water Champions program is slated to move to Wildwood, New Jersey in 2017/18.

2. REDUCE NON-REVENUE WATER LOSSES AND PER CAPITA WATER USAGE

Water loss and the associated financial impacts are neither evaluated nor addressed in a consistent manner by the water industry in the United States. Water losses vary greatly throughout the nation and even among systems, with losses ranging from a few percent to over half of the water withdrawn from sources. A sample of over 100 systems required to submit water loss data (gallons of water billed/gallons of water entering the distribution system) as part of the 2016 Drought Warning, indicated an average of 18 percent water loss. Traditionally, the lack of a single comprehensive approach to identify and address water loss has hampered efforts to boost water efficiency. These losses are not the same as consumptive water use, where the water is lost to evapotranspiration and is essentially no longer available to the local water budget. Rather they refer to the potable supply water infrastructure.

The term previously commonly used for water loss, "unaccounted-for-water," has since been abandoned by industry and the American Water Works Association (AWWA). In 2004, a joint committee of the AWWA and the International Water Association recommended that water systems follow a consistent methodology to conduct thorough physical and financial audits to measure water losses, and whether those losses are "real" or "apparent" and their associated financial costs. Proponents of the methodology assert that reducing lost and/or unbilled water will more than offset the cost of implementing the new approach. More information on the AWWA Audit can be found at AWWA Water Loss Control.

Though NJDEP currently lacks the appropriate regulations to require AWWA audits be submitted, the DEP recognizes the value of AWWA audits and plans to require them in the future through regulatory amendments. In an effort to promote the AWWA water system audit methodology, the NJDEP has included a section to the required Water Conservation Plan to inform permitted purveyors about the benefits of the audit and has consistently encouraged its use. In addition, since 2013, public water suppliers within the Delaware River Basin who have been issued approvals by the DRBC to withdraw and use in excess of an average of 100,000 gallons per day (gpd) of water during any 30-day period, are required to perform the audit. More information at can be found at DRBC Water System Audits

However, the NJDEP is authorized under N.J.A.C. 7:19-6.4, to request water loss as a difference between gallons of water billed divided by gallons of water entering the distribution system (now commonly referred to as non-revenue water). Previously, this water loss data has been collected as part of Water Conservation Plans bi-annually, for those systems who have Water Allocation Permits. However, in April 2017, the NJDEP started to electronically collect this water loss data annually from systems who are interconnected and serve at least 1,000 people. This information is being submitted through an electronic portal so that the information is able to be data managed. Though currently conducted during water allocation permit modifications and renewals, an annual review of water loss data will allow the NJDEP the ability to target those systems with excessive water loss. Existing regulations at N.J.A.C. 7:19-6.4 allow the NJDEP to require systems with excessive water loss to take appropriate corrective action. The NJDEP believes this existing portal will be able to be used in the future to collect key AWWA audit information, allowing for a smoother transition to the implementation and analysis of the audits.

3. REDUCE EXCESSIVE OUTDOOR WATER USE

As prior figures suggest, residential and commercial landscaping contributes to the steadily increasing consumption of potable water supplies, particularly during the peak use growing season. This trend negates moderately diminished per capita usage realized through indoor plumbing efficiencies. It also increasingly strains surface and groundwater sources, drinking water treatment, storage and delivery facilities, and the dependable yield and infrastructure capacity of a growing number of water systems. Unlike municipalities and other local authorities that may impose water use restrictions that are more stringent than those of the State during a water emergency at any time, the NJDEP may only impose mandatory restrictions during a water emergency declared by the Governor.

While some irrigation may be considered necessary as a supplement to natural precipitation, there is growing evidence that excessive or inefficient watering leads to substantial water waste. The increase in artificial irrigation is not unique to New Jersey and is attributable to several factors, including misconceptions about the amount of water needed to efficiently irrigate turf and landscaping, inefficient sprinkler system design or operation, and lack of operational rain or soil moisture sensors on irrigation systems.

In recognition of these trends and limitations and the need to preserve high quality drinking water for potable uses, State and local policymakers should consider a variety of tools available to limit non-essential, non-agricultural, outdoor water use to what is reasonably required to support living plants and other landscape materials. Reducing consumptive water use could include measures such as: the adoption of local/county ordinances (in coordination with applicable water suppliers), State regulatory requirements, such as permit or public funding (SRF/NJEIT) conditions, and bulk water sale contract approvals.

SEASONAL OUTDOOR WATER USE

The adoption of irrigation standards could reduce excessive non-essential water use during the peak demand season (May-September). An example of ordinance-driven outdoor water use limits would be to allow watering two days per week within a specified time window (such as between 6-9 a.m. or 5-8 p.m.). Also essential is a limit on the watering of any single area to no more than 30 minutes per day. Such a strategy should be coordinated with appropriate water suppliers in order to avoid causing undue strain on the supply system's capability to meet peak demands. Odd/even calendar day watering schedules are not recommended, as evidence suggests that property owners tend to over-water on their allowable day of watering, regardless of whether watering is actually needed (Vickers, 2001). While some purveyors have expressed concern that watering two days a week may result in uneven and relatively unpredictable demand peaks, this can be avoided by distributing watering days among the town in such a way that every day receives equal homes permitted to water.

The two day per week irrigation regimen would allow for a thorough, less frequent saturation of the root zone to provide supplemental soil hydration when natural rainfall does not occur, as recommended in the Best Management Practices for Watering Lawns, Rutgers Cooperative Extension Fact Sheet No. FS555. This more responsible and beneficial form of irrigation sufficiently supports plant life, provides drought-proofing for many species, and would dramatically curtail the amount of water -- especially highly treated drinking water from public water systems -- from being wasted. By irrigating more efficiently, over-watering is all but eliminated and turf grasses develop a deeper root system. Less frequent, deep watering has proven to be better for a lawn than frequent short watering which only feeds shallow root systems (Mangiafico, 2012). A deep root system promotes turf health, enhances weed resistance, and is more protective of the lawn during times of drought.

IRRIGATION SYSTEM TECHNOLOGIES

Advancements in irrigation technology offer meaningful opportunities for water savings, particularly using state-of-the-art sensing components (soil-moisture/rain sensors and SMART controllers) that permit watering when conditions warrant.

SMART Irrigation Controllers

The installation of SMART controllers on all new irrigation systems can promote efficient landscape irrigation and further preserve the State's water supplies. SMART systems are a cost-effective way to ensure that lawn and landscape watering only occurs when necessary by taking into account soil moisture and/or atmospheric conditions before activation.

The NJDEP partnered with Sustainable Jersey to create an Outdoor Water Conservation model ordinance for municipal consideration. The ordinance recommends a 2-day-per-week watering schedule and includes an exemption for any property utilizing SMART irrigation controllers. This ordinance is promoted as a Priority Action Item in the Sustainable Jersey Program and can be found at: Sustainable Jersey.

Irrigation System Rain Sensors

An automatic rain sensor is a device that overrides the irrigation cycle of an automatic lawn sprinkler system when adequate rainfall has occurred. Rain sensors have been shown to be a cost-effective way to ensure responsible irrigation practices. The Handbook for Water Use and Conservation (Vickers, 2001) estimates that the use of rain sensors can save up to ten percent of outdoor water use at a single-family residence, estimated at 31.7 gpd. New Jersey law (N.J.S.A. 52:27D-119 et seq.) currently requires new irrigation systems (those installed after September 8, 2000) to be equipped with a rain sensor device. The NJDEP recommends that this requirement be extended to existing irrigation systems on all property types through legislation.

In the absence of a State rain sensor mandate, all municipalities are urged to adopt the restrictions described above by ordinance. The restrictions should apply uniformly regardless of whether the source of water is a private well or a public water system.

RAIN WATER HARVESTING

In an effort to promote the lowest quality water for the intended use, the NJDEP began a residential rain water harvesting program with the New Jersey Watershed Ambassadors program in 2014. By encouraging the use of rain water collection for plant watering needs, potable water supply is being saved for higher quality needs. This has the added environmental benefits of disconnecting rooftop runoff from the stormwater system. It also saves energy and CO2 emissions by watering plants with water that was not treated to drinking water standards and pumped to the end user.

Since the program's inception, close to 2,000 rain barrels have been built and distributed across the State. While the potable water savings achieved may be small compared to the State's overall use, it is also viewed as a catalyst for change from a community education perspective. This program gets the conversation started about the community's responsibility to be good stewards of their water supply and environment.

In addition, the use of larger-scale rain water harvesting cisterns has begun to gain momentum in New Jersey, in part due to the work of the Rutgers Water Resources Program. The Rutgers Water Resource Program has designed and installed a number of large scale cisterns for landscape watering purposes including one project jointly funded by the NJDEP and the USEPA at Raritan Valley Community College. More information on that project can be found at Water Savers Goes Corporate

NEW DEVELOPMENT & SOIL COMPOSITION ORDINANCES

In many areas of the State, developers commonly remove native soils prior to construction. This leaves heavily compacted subsoil with little or no topsoil on newly developed residential and commercial lots. As a result, the purchaser is often burdened with years of expensive rehabilitation, including excessive and sometimes unnecessary applications of water and fertilizers. One cost-effective alternative is for the developer to retain a balanced soil composition that will sustain and grow healthy turf and landscaping. This will prevent unnecessary water use and non-point source pollution from turf runoff.

To address this concern, in 2010 Governor Christie signed into law the Soil Restoration Act (P.L. 2010, c. 113). This law requires amendments and supplement to the Soil Erosion and Sediment Control Act, P.L. 1975, c. 251 for post-construction soil restoration through the development of "standards to provide for cost effective restoration, for specific soil types, and intended land use of the optimal physical, chemical, and biological functions". The State Soil Conservation Committee (SSCC) in the Department of Agriculture administers the Soil Erosion and Sediment Control program and was tasked with adopting modifications to the existing soil erosion and sediment control technical standards. On September 19, 2016, the SSCC proposed amendments in the New Jersey Register to the standards for top soiling and grading to include additional "requirements for amending soils disturbed by construction activities to address soil compaction where appropriate and allow for improved water infiltration". Through the committee, the NJDEP will continue working on the modified soil erosion and sediment control standards.

INITIATIVES FOR LOCAL CONSIDERATION: CONSERVATION SUBDIVISION ORDINANCES

Conservation subdivision ordinances are based on the principles of xeriscaping and other water-wise landscaping practices as a means to lessen the need to water turf and plants. Water-wise landscape design takes into account water efficiency, native and adaptive species, rainfall and climate. According to *The Handbook for Water Use and Conservation* (Vickers, 2001), households that have converted some or all of their property to less water-dependent vegetation have reported water savings from 20-50%. As a result, landowners can enjoy less maintenance, reduced supplemental watering needs and mowing requirements, deeper root systems (enabling the lawn and plants to survive through drought), and reduced dependence on lawn chemicals.

Such ordinances may be adopted alone or in conjunction with incentives that encourage the reduction of irrigable acreage. Effective ordinances include definable goals, such as retaining forested areas or incorporating 80% low and moderate water use plant varieties into the landscape design. The details of the conservation subdivision ordinances will vary by region and therefore should be developed by local governments. Communities can incorporate their own standards to align wise water use principles with their specific environmental goals.

More resources on water conservation in New Jersey can be found at: DWSG Water Conservation.

4. RATE-MAKING AND BILLING

In an effort to help utilities develop rates that reflect the true cost of treating and delivering water and promote long-term maintenance and operation of the system ("full-cost pricing"), the USEPA has created an extensive website on rate making/pricing innovations: EPA Pricing and Approvability of Water Services.

The New Jersey Board of Public Utilities (BPU) authorizes rates that investor-owned public utilities may charge customers for the distribution and use of water.[7] In establishing equitable rates, the BPU makes every effort to protect the interests of consumers, ensuring they are not overcharged for the cost of services. The BPU oversees the water rates of a small number of systems (about 30 of the approximately 600 public community water systems in New Jersey). Municipal and local/county/authority-owned and operated systems determine and implement rate structures in accordance with New Jersey Department of Community Affairs (DCA) guidelines. The NJDEP works with BPU, DCA, privately owned purveyors, and municipal systems to evaluate water conservation rates and water pricing structures that encourage conservation and allow recovery of conservation program costs through water rates. N.J.A.C 7:19-6.5(a)4 states "all public community water systems shall file water rates which provides incentives for water conservation with the NJDEP and the Board of Public Utilities."

[7]The BPU, in a limited number of cases, reviews rates charged by municipal public utilities if the utility provides water service to more than 1,000 billed customers in another municipality and the utility charges a different rates to customers in the separate municipalities.

WATER CONSERVATION RATES

Conservation rate structures, whereby rates increase commensurately with the volume of water used, are an effective method for reducing water demands. When compared to other conservation methods such as retrofit rebate programs or sprinkler ordinances, conservation rates are straightforward and cost efficient to implement. However, improperly set rates or unanticipated changes in water use and demand may positively or negatively affect the revenues of water suppliers. According to Janice Beecher, Ph.D., of the Institute of Public Utilities, Michigan State University, a review of over 100 studies of the price elasticity of demand concluded that a 10% increase in price lowers demand by a range of 2 - 4%. (Beecher and others, 1994). This equates to an expected water savings in the potable supply sector of roughly 28-55 MGD of water per day in New Jersey.

Current pricing practices quantify the costs of capturing, treating and distributing water, without accounting for the benefits of conserving water. The various conservation rate structures identified below are designed to achieve conservation through economic incentives. This method of demand management enables water purveyors to postpone the need to construct costly new or expanded water/wastewater treatment plants or supplies. The costs of conservation will be far less, since greater investments are required for infrastructure improvements and supply development.

Furthermore, two of the rate structures listed below (inclining block rates and seasonal rates) specifically protects the interests of the average water consumer when a select group of users cause the increased peak demand. By charging a higher rate for those who use more water, costs associated with any increased maintenance and development of infrastructure can be passed on to those using the resource excessively, instead of passing the costs on to all consumers in the form of “across the board” rate increases. Conservation rate structures are designed to help motivate consumers to reduce their excess water usage. When consumers choose not to cut back, they (not the average user) pay to cover the costs of building and maintaining the additional infrastructure necessary to provide that level of peak usage.

Water conservation rate structures for consideration include:

- Inclining Block Rates - An inclining block rate structure is one that encourages conservation by charging higher rates as use of the commodity increases. The lowest rate is based on the amount of water determined to be appropriate for basic human consumption and sanitary needs and other reasonable uses. Often such rates include an allowance for seasonal water use as well. Based on such allowances, a relative allocation figure is assigned and water usage above this amount is subject to the higher rates.

- Seasonal Rate Structures - Outdoor water use during the peak seasonal demand period, May through October, presents the greatest strain on water availability, because it coincides with relatively lower rainfall and higher evapo-transpiration rates. In New Jersey, seasonal, outdoor water use is steadily rising, largely attributable to continued suburbanization, vast increases in residential and commercial lawn and landscape areas and, ultimately, dramatic increases in irrigable acreage. In response, stream, river and reservoir depletion occurs at a much faster rate than during the rest of the year. In many communities across the country, water systems have instituted seasonal conservation rates to combat water supply shortages and other water treatment/ delivery issues during the peak demand season. Generally, higher rates are imposed during the summer season, coinciding with peak use and low water availability. The concept of differential water use rates aims to allow for reasonable seasonal use while discouraging excessive use and water waste. The increased rates also effectively appropriate the financial burden associated with water system infrastructure enhancement and maintenance to the subset of water users that are causing the increased peaks. Similar to inclining block rates, this rate structure commonly consists of three inclining tiers. These rates are usually based on water allotments for average winter consumption, with the second tier reflecting what is considered to be reasonable outdoor use for the area, and the third tier representing what is considered to be excessive outdoor use for the area. The seasonal component will vary by region and service area, reflecting the current and projected supply and demand scenarios for an area. Water use qualifying for different tiers can be determined through a simple estimation of how much is typically used for average winter consumption with seasonal usage above that amount being subject to higher use tiers. For a more accurate accountability of what is actually being used for non-potable outdoor irrigation, irrigation sub-meters may be used.

- Decoupling Rate Structures - Some utilities have found that effective water conservation efforts significantly reduce water consumption, which in turn reduced their earnings and profitability. By separating, or decoupling the utility’s recovery of fixed costs and profits from the volumes of product delivered, the utility could devise a rate structure that sufficiently covers overall costs and regulated profits regardless of the amount of water sold, thereby reducing overall water consumption and reducing adverse impacts to a utility’s financial condition. Therefore, by decoupling water utility sales from earnings, the disincentive to promote the conservation of water is eliminated. Since decoupled rates do not provide a financial reason for the end user to conserve water, this type of rate structure should be linked to mandatory water conservation programs that educate customers about how and why they should reduce their overall water consumption. Thus far, there are limited applications of decoupling rate structures in the United States for water purveyors. However, decoupling rate structures have shown significant success in both the electric and natural gas industries. As an alternative to inclining and seasonal rate structures, further research and consideration should be given to the implementation of a decoupling rate structures.

5. INDOOR RETROFITS

Through the DCA and the Uniform Construction Code (UCC), New Jersey has required the installation of water efficient plumbing on all new construction and development since 1992. The State plumbing code also requires the installation of water efficient models anytime a fixture is replaced or a property is renovated. Beyond State-mandated water efficiency standards, the Federal Government has also played a substantial role in ensuring water use efficiency standards in plumbing fixtures. In 1992, EPAct was enacted and established maximum allowable water flow rates for plumbing fixtures including toilets, urinals, showerheads and faucets for new and renovated residential and nonresidential facilities.

The flow rate limitation standards became effective for various plumbing fixtures between the years of 1994 and 1997 and are required of all devices manufactured or sold within the United States. The EPAct standards are expected to produce six to nine billion gallons per day in water savings by 2020. Furthermore, the USEPA has gone farther with fixture efficiency by encouraging the development and use of the lowest water using technology through the WaterSense Program. Similar to the Energy Star program, WaterSense is a partnership program that seeks to promote water efficiency and enhance the market for water-efficient products, programs, and practices. WaterSense helps consumers identify water-efficient products and programs by providing a label to indicate that the products and programs meet water efficiency and performance criteria. WaterSense labeled products perform well, help save money, and encourage innovation in manufacturing. In 2008, the NJDEP joined as a State partner of the WaterSense program. For more information, pertaining to WaterSense please visit EPA Water Sense.

OUTREACH PROGRAMS AND ENCOURAGING INFRASTRUCTURE RETROFITS

Considering that the average volume of water saved in a home with low-flow fixtures and appliances is approximately 35% of indoor water use, working towards retrofitting all properties with water efficient fixtures and appliances will further reduce indoor water demands. (Mangiafico and others, 2012).

Home water audits are a good method for identifying ways to conserve water within a home and to detect leaks. Typically, they are used as a precursor to installing water saving fixtures and appliances and can be done by the homeowner or by a participating utility and/or municipal inspector. When implemented in conjunction with retrofit programs, older homes can gradually become as efficient as newer homes, while newer homes will have the ability to find additional conservation options.

In addition to home water audits, plumbing retrofit ordinances and programs are effective ways to help ensure that older homes begin to make upgrades to low-flow fixtures. Examples of this are the adoption of a local ordinances requiring new homes and remodeling jobs to use low flow and/or WaterSense fixtures or incentivizing low flow and/or WaterSense fixtures through retrofit programs such as giveaways, subsidies, and exchanges of outdated fixtures for the latest in low-flow models.

A significant impediment to the implementation of home water audit and retrofit incentive programs is cost. However, grants through non-profit organizations and foundations such as Sustainable Jersey and the William Penn Foundation, as well as from the USEPA have been available in recent years.

METERING FOR WATER CONSERVATION

Source and service metering is a necessary component to New Jersey's water supply management program as it allows accurate accounting of water diverted, non-revenue water, evaluation of leak detection and repair programs, quantification of withdrawals in stressed areas, and motivation for individual users to understand their water use habits and take action to make a reduction. Metering of all water supply sources is a requirement of all Water Supply Allocation Permit and Registration holders. In addition, according to the current Water Supply Allocation Permits rules, certain water supply purveyors must meter every service connection. These efforts can be enhanced through increasing and enforcing meter accuracy standards and through sub-metering.

- Meter Accuracy – As per N.J.A.C. 14:9-4.1(b), the BPU sets forth a testing frequency schedule based on meter size. Most home meters are 5/8-inch and must be tested every 10 years or 750,000 gallons (whichever comes first). Since meter testing must take place under certain conditions, the meter must be removed and replaced at that time. If the meter is in good working order, it can be reinstalled at another location in order to save time and money. At this time, this requirement only applies to water utilities under BPU's jurisdiction. However, the 10 year/750,000 gallon code is the industry standard and could apply to all service areas/ connections regardless of ownership.
- Uses of advanced meter technology – Many utilities in the State of New Jersey have implemented Automated Meter Reading (AMR) systems. These systems send a radio signal with the meter readings at assigned intervals. These devices eliminate the greatest cause of inaccurate or missing meter readings - needing to gain access to a home to read the meter. These systems allow the purveyor to read the meter, either through a drive by system or remote antennae. This greatly reduces the cost and time needed for meter reading and promotes the ability of a water purveyor to bill monthly. These systems can also be used to provide the customer with information on excessive water use. Whether providing notification of excessive use in a timely manner (within 2 weeks of the event) or monthly billing, the customers will receive a timelier account of their water use, allowing customers to make adjustments as needed to avoid higher water bills, and give customers the ability to discover service

line, plumbing or irrigation system leaks sooner, allowing for prompt repairs and reducing the magnitude of high bills caused by leaks.

- Sub-metering – In some instances, including multi-family dwellings and non-residential buildings, service meters are provided for the entire building or complex instead of for each individual user. Requiring metering for each individual user in complexes such as these and for separate meters for indoor and outdoor use is not within the scope of the NJDEP's regulatory authority, although the NJDEP notes that the water conservation benefits of sub metering have been supported by the bi-partisan Red Tape Review Commission (see Red Tape Review Commission). Therefore, further investigation and consideration should be given to whether and how sub-metering could be implemented in New Jersey.

6. RECLAIMED WATER FOR BENEFICIAL REUSE

While Reclaimed Water for Beneficial Reuse (RWBR) has gained recognition as a useful water supply management tool in sections of the country with limited or constrained water resources, in the past, it has received less acceptance and limited implementation in New Jersey. With continued population increases and an ever-expanding competition for limited water supplies, applications of RWBR in New Jersey are gaining ground as a viable and attractive water source alternative. "RWBR involves taking what was once considered waste product, giving it a specialized level of treatment and using the resulting high-quality reclaimed water for beneficial use. In other words, the reclaimed water is used to replace or supplement a source of groundwater or potable water" (DEP, 2005).

RWBR is consistent with and supportive of state planning and economic development goals in that it ensures potable water is reserved for use in appropriate residential, commercial and industrial applications. RWBR also assists in the stabilization of increasing potable water sector demands allowing for more accurate forecasting, which can be valuable in the avoidance of demand-driven and drought-related water shortages. Increasingly, water users are encouraged to consider RWBR as a viable water supply option to meet growing demands facilitated by outdoor water use while protecting water supply resources, particularly in those areas where regional wastewater systems discharge to the ocean, thereby depleting local/regional water supplies.

The importance of RWBR in New Jersey gained ground during the emergence of drought conditions in 1999 and was reinforced during the subsequent and more severe 2002 drought event. In response, the NJDEP approved more than 70 temporary reuse authorizations under administrative orders issued during the water emergency. This allowed utilities and municipalities to reuse water for activities such as street sweeping, sanitary sewer jetting, and roadside corridor maintenance.

Since that time, the NJDEP has increasingly advocated RWBR as a drought mitigation strategy and as a long-term water supply management tool, particularly for highly consumptive, non-potable purposes. To that end, RWBR has become an integral component of the NJDEP's goal of matching water quality with the intended use, thus reserving the highest quality sources for drinking water and other potable needs. RWBR represents an opportunity for the NJDEP to work towards comprehensive management of water through the coordinated efforts of the programs that manage wastewater and water supply.

The agency also has moved to promote coordination among the programs responsible for the planning and permitting functions associated with water diversions and wastewater discharges.

DEP Water Allocation Rules require permit applicants to submit information substantiating the need for the proposed allocation and supporting the designated choice of water resource for the allocation (N.J.A.C. 7.19-2.2(g). The provision also requires applicants for non-potable diversions to document that the proposed water source is of the lowest acceptable quality water for the intended use. The NJDEP will study further revisions to the rules to discourage new or increased allocations for highly consumptive, non-potable purposes, except as possible sources of back-up emergency supplies to RWBR.

Additional resources on RWBR include the NJDEP's "Technical Manual for Reclaimed Water for Beneficial Reuse". Further, the issuance of a NJPDES General Permit for RWBR for restricted access simplifies the authorization process for restricted access reuse projects. Reuse is steadily gaining momentum, with increasing volumes of reclaimed water being utilized year after year. More information regarding reclaimed water for beneficial reuse and associated programs can be found at NJ Wastewater Reuse Program

Table 6.1 Reported RWBR Water use.

Year	Reported Use (BG)
2005	1.175
2006	2.23
2007	2.60
2008	3.00
2009	3.24
2010	4.20
2011	4.45
2012	5.07
2013	5.96
2014	9.82
2015	12.78

Over the past several years, the NJDEP instituted several financial assistance programs to aid the financing of new infrastructure and additional treatment requirements for RWBR projects. This included making low interest loans available through the Environmental Infrastructure Financing Program. Also, the New Jersey Department of Treasury adopted rules to allow tax credits for treatment and conveyance equipment purchased exclusively for the purpose of promoting RWBR.

IMPLEMENTING RWBR

The first application of public access RWBR was implemented in the spring of 2002, when Evesham Township began using reclaimed water for irrigation of its municipal golf course. The project was an immediate success, allowing for the effective maintenance of the course through the drought that summer. In August of 2006, New Jersey's first residential application of RWBR was implemented at an active adult community in Burlington County, where reclaimed water now provides an alternate water source for irrigating the extensive grounds of the community. See table 6.1 for a summary of total annual water use savings through the use of RWBR from 2005 to 2015.

The success and future promise of the above RWBR projects provide reassurance and incentive for more widespread implementation. Thus far, these demonstration projects have confirmed the critical need for cooperation among agencies responsible for wastewater treatment and the delivery of adequate water supply within a region.

The NJDEP recognizes that RWBR present challenges when compared to the relatively low costs and ease of pumping groundwater or access via existing potable infrastructure. However, the simplification of the regulatory process and the financial incentives make RWBR a more attractive management tool for wastewater utilities and highly consumptive/depletive non-potable users throughout the State. As areas of the State that were once "water-rich" face stresses due to increased consumptive uses and the exportation of wastewater (via discharges) to the ocean, bays and tidal rivers, RWBR remains a viable option to reduce stresses upon local water sources.

As the true costs of treating water for potable uses are fully realized, especially compared to pricey alternatives such as desalination, the cost differential between RWBR and traditional potable water supplies can be expected to diminish. The NJDEP will continue to promote RWBR, recognizing the need to develop strategic plans and goals to ensure long-term program success.

CHAPTER 7
POLICIES FOR IMPROVEMENTS IN STATE WATER SUPPLY

A legacy of water supply management experience combined with significant public and private investment have resulted in the sophisticated and highly interconnected public community water system network that New Jersey residents and businesses enjoy and rely on every day. To address increasing population, opportunities for economic growth, limited space for traditional water storage solutions (i.e. new reservoirs), the need to preserve and enhance the State's natural resources, and decreased predictability of future weather extremes, efforts must be focused to conserve and preserve available supplies, ensure the maintenance of the existing infrastructure that delivers that supply, and continue the development of new sources of supply. Many of the water supply management strategies/initiatives identified below are also discussed at length in Chapter 5. In order to accomplish State water supply management objectives, the NJDEP will assure that prudent and sound scientific practices, including the most current information and projections are applied to data presentation and policy decisions. The following are the policies that will be pursued:

POLICY ITEM #1: PROMOTE THE EFFICIENT USE OF THE STATE'S FRESHWATER RESOURCES

Water conservation can save water utilities and the State considerable capital expenses over the long term by delaying or even eliminating the need to develop new or expanded potable water supplies and additional infrastructure.

The goals of the NJDEP's water conservation policy:

- Promote a responsible water use ethic by all users;
- Reduce non-revenue water losses;
- Reduce consumptive water losses, particularly of potable water sources from activities such as outdoor water use, which this Plan has recognized as a growing concern; and
- Increase use of non-potable sources of supply for non-potable purposes.

The NJDEP will:

- Implement public education and outreach
- Reduce non-revenue water loss
- Minimize consumptive water use
- Encourage infrastructure retrofits and metering

In addition, the NJDEP has advocated Reclaimed Water for Beneficial Reuse (RWBR) as a drought mitigation strategy and as a long-term water supply management tool, particularly for highly consumptive, non-potable purposes. RWBR should remain a component of the NJDEP's goal of matching water quality with the intended purpose, thus reserving the highest quality sources for drinking water and other related needs. (See discussion in Chapter 6 and Policy Item #5 below).

POLICY ITEM #2: IMPROVE NEW JERSEY'S DROUGHT MANAGEMENT CAPABILITIES/ WATER SYSTEM RESILIENCE

PROMOTE WATER SYSTEM INFRASTRUCTURE RESILIENCE

After Superstorm Sandy, the NJDEP reviewed its rules governing the siting, construction, and operation of the State's drinking water systems. Focusing on four major subject areas – Auxiliary Power, Flood Protection, Emergency Management Planning and Preparedness, and Asset Management – staff developed guidance to ensure that future repair, rehabilitation, and construction efforts were conducted "safer, stronger, smarter." That guidance can be viewed at:

NJDEP Division of Water Supply & Geoscience;

DWSG Emergency Response & Preparedness;

Emergency Response Preparedness/Planning Guidance;

NJDEP Asset Management

The NJDEP continues to work with the drinking water sector to assure that it is prepared for extreme weather, dealing with emergencies, and implementing asset management. In addition, NJDEP will work with water purveyors to implement asset management requirements of the Water Quality and Accountability Act, as discussed in Chapter 4.

EMERGENCY AGREEMENTS BETWEEN PURVEYORS

The NJDEP will evaluate the existing Water Allocation rules at N.J.A.C. 7:19-6.9(g) (Operation of Interconnections) to determine whether it is appropriate to require agreements for all sizes and uses of interconnections. Each interconnection operation agreement should include the interconnection location, size, conditions for use and hydraulic capacity for both directions under the conditions expected for interconnection use. For those interconnection operation agreements proposing guaranteed bulk sale/purchase or guaranteed firm capacity supplement, additional Departmental approval must be obtained through a water contract review application under N.J.A.C. 7:19-7.

WATER SUPPLY SYSTEM INTERCONNECTIONS

DEP will continue to implement the recommendations of the *2008 Statewide Interconnection Study*, including: using existing interconnected water systems to mitigate and avoid the adverse impacts of drought conditions and other water shortages; using the Water Supply Management Decision Support Tool (WSMDT), or equivalent tool, to evaluate and, if necessary, facilitate communication and recommended, proactive transfers in cooperation with affected water suppliers between surplus and deficit areas; and ensure that the data are kept current. For more information on the Interconnection Study and the WSMDST, please refer to: Interconnection Summary

SURFACE WATER RESERVOIR SYSTEM MODELING

The NJDEP will continue to develop computer models to simulate water availability under a variety of assumptions; such those being developed using RiverWare or similar software for the Hackensack/Passaic River and Raritan River Basins. The primary goals include improved operations and coordination between systems to manage supplies during normal and emergency conditions.

IMPLEMENTATION OF WATER CONSERVATION AND EMERGENCY PLANS

Pursuant to N.J.A.C. 7:19-6.5(a)3, all water allocation permit holders must submit updated Water Conservation and Drought Management Plans (WCDMP). The NJDEP expects that systems update WCDMP's to ensure that they are accurate and implementable. The WCDMP's must include voluntary water use restrictions for corresponding stages of drought warning and water emergency, precipitation deficits or reservoir storage deficits; voluntary transfers of water via interconnected systems for use when prescribed reservoir storage level thresholds are reached; other measures designed to reduce demands, water usage or loss, or which otherwise have the effect of maximizing water supplies during periods of low precipitation or below-normal water supply storage; for purveyors with reservoirs, rule curves for reservoirs that can be used to establish storage level thresholds. All water purveyors will implement their WCDMPs as approved by the NJDEP. The NJDEP will enforce the requirements of the existing rules to ensure that drought management and response plans are up to date.

The NJDEP will review and evaluate the efficacy of amending the Water Allocation rules at N.J.A.C. 7:19-2.2(i) to enhance the current water conservation and drought management plan forms with a new water audit and water loss program, inclusive of best management practices and reporting requirements. Water auditing, as discussed in Chapter 6, is a mechanism to provide water suppliers with water system information that helps identify water losses, provides an opportunity to improve efficiency, and ultimately results in cost savings with respect to water pumping, treatment and infrastructure procurement, operation, and maintenance. The audit results will provide the NJDEP with a uniform, manageable, digital, database of water system information. Ultimately, the audits will provide greater water accountability, reduce water waste, and lead to greater water efficiency.

RESTRUCTURING DROUGHT MANAGEMENT AND WATER EMERGENCY PROCEDURES

Water supply emergency management procedures should continue to be streamlined to consolidate and reorganize existing rules that direct the management of water supplies, including the prioritization and restriction of water uses, during a water emergency.

DISCONTINUATION OF GENERAL "OVERDRAFT" PROVISIONS

The NJDEP recommends that the impact of seasonal variations in water use be assessed so that any overdraft provisions in water purchase contracts are supported by the safe yield of the source waters being impacted. If water purveyors need seasonal water or overdraft provision they should be supported by both safe yield models and guaranteed contracts between water purveyors. NJDEP will consult with water supply purveyors to make sure that this is done in such a way as to not adversely impact the ability of those purveyors to meet demands.

WATER QUALITY ACCOUNTABILITY ACT

DEP will work with water supply purveyors to ensure they have proper financial and technical assistance in meeting the requirements of the Water Quality Accountability Act. NJDEP will help develop appropriate standards and check lists to mark the goals of the Act.

POLICY ITEM #3: PROMOTE OPTIMIZED USE OF EXISTING WATER SUPPLIES THROUGH INTERCONNECTIONS, CONJUNCTIVE USE AND AQUIFER STORAGE AND RECOVERY (ASR)

WATER SUPPLY SYSTEM INTERCONNECTIONS

See discussion of Interconnection Study and WSMDST above under Policy Item #2.

CONJUNCTIVE USE OF MULTIPLE WATER SUPPLY SOURCES

Conjunctive use refers to the coordinated utilization of multiple water supply sources to maximize the sustainability of the overall resource (e.g. diverting water from an unconfined aquifer at times of high flow and moving it to confined aquifers when water use, temperatures and sparse precipitation could more adversely affect surface water systems). In New Jersey, where few conventional water supply options (e.g., new reservoirs sites, untapped rivers, unused aquifers, etc.) remain, conjunctive use offers significant potential to extract the most use from available supplies. Conjunctive use can strategically improve overall water supply reliability by providing a range of sources that can be systematically employed and rested on a seasonal basis, during drought or other water shortages, or used to reduce the strain from peak demands that otherwise might occur on a single water supply source. Conjunctive use alternatives operated in tandem with other strategic options such as water conservation, RWBR, aquifer storage and recovery, and non-depletive water/wastewater systems, can extend available water supplies and avoid or minimize the adverse effects of drought, while minimizing environmental impacts.

Conjunctive use traditionally has been implemented in areas of the country where surface water is the predominant source of supply, and groundwater is held in reserve for use during the dry season or periods of severe drought. While this type of conjunctive use has potential application in New Jersey, there is an array of other forms, including the combined use of various surface and confined and unconfined groundwater sources.

While aquifers afford a natural “underground reservoir” storage capacity, New Jersey’s aquifers are vulnerable to saltwater intrusion in certain locations and excessive withdrawals from unconfined aquifers may significantly deplete base flow leading to stream flow impacts. Integrated seasonal use of both confined and unconfined aquifer types, combined with optimized diversion points, may mitigate adverse resource impacts by redistributing and reducing overall demand on each aquifer. Withdrawals from unconfined systems can be limited by employing minimum passing flows that take into consideration current and projected withdrawal effects and are protective of downstream users and uses.

Most water supply purveyors have interconnections with neighboring purveyors and transfer water on a regular or emergency basis. This adds to overall reliability and resiliency. It is important, however, that the quality of the transferred water not be detrimental to the receiving system. NJDEP will work with purveyors make sure any such problems are prevented or minimized.

AQUIFER STORAGE AND RECOVERY

There is an interest in using confined aquifers as storage reservoirs to provide water stored during off-peak periods to meet peak demands. Aquifer storage and recovery (ASR) wells, which inject water from other sources, including other aquifers, treated surface water, and even treated wastewater, represent an option for conjunctive water use that increases the short-term availability of supply while avoiding long term impacts to confined aquifers. Furthermore, ASR wells can be used to manage saltwater intrusion in Areas of Critical Water Supply Concern as well as in

Cape May County. As indicated in Policy Item #4, expansion of ASR may be one of the many options considered to address saltwater intrusion issues along the Cape May peninsula. The issues that tend to limit the viability of ASR wells involve the contrasting geochemistry of water sources and its effect on well screens and the mechanics of well construction, development, and extraction. In addition, the emerging concern regarding the introduction of unregulated contaminants into the aquifer requires a comprehensive evaluation when developing an ASR system. There are currently 19 operating aquifer storage and recovery systems in the State and several in the test cycle phase. NJDEP supports ongoing study into the feasibility of expanding the ASR program where appropriate.

The *2008 Statewide Interconnection Study* recommended that NJDEP continue to promote ASR and multi-year water storage or "banking". This technology provides drought management through the transfer of demand from year to year, storage during wet years and recovery in dry years. The viability of ASR is contingent upon the geology of an area and the ability to use the wells without interference to other aquifer users. NJDEP has approved pilot studies for United Water Matchaponix, Suez Toms River, NJAW (Cherry Hill), and Mount Laurel MUA to operate their ASR wells in three-year banking pilot programs as part of their water allocation permits. It is anticipated that the results of these pilot studies will provide useful information to determine if multi-year banking is feasible, and if so, may help to identify other areas of the State that could take advantage of this technology.

POLICY ITEM #4: ENCOURAGE THE DEVELOPMENT OF NEW AND EXPANDED SOURCES OF SUPPLY, INCLUDING USE OF INNOVATIVE TECHNOLOGIES, ESPECIALLY IN DEFICIT AREAS. SUPPORT OF NEW OR EXPANDED SOURCES OF SUPPLY WILL BE PROVIDED TO AREAS INTERCONNECTED WITH DEFICIT AREAS, WHERE ADDITIONAL SUPPLIES COULD BE TRANSFERRED TO HELP OFFSET DEFICITS.

CAPITAL IMPROVEMENT PROJECTS

The 1981 Water Supply Bond Fund provided $350 Million to support loans for State or local projects to rehabilitate or repair water supply facilities and to plan, design, acquire and construct various State water supply facilities. To be eligible for funding under the 1981 Water Supply Bond Fund, projects or studies must be included in the NJSWSP.

The 1996 NJSWSP and the Eastern Raritan Basin Water Feasibility Study identified several projects in the Raritan River Basin that could be used to increase the safe yield of the New Jersey Water Supply Authority (NJWSA) within the Raritan Basin and Central Drought Region. In addition, these projects could potentially increase the firm capacity of certain water systems in the Northeast and Coastal North Drought Regions through inter-basin transfers from the Raritan Basin. The NJDEP will continue to work with the NJWSA and others to develop and prioritize preliminary steps, set timetables for action, and identify appropriate funding source(s) for projects in this region. These steps include preparation of background information for major permitting decisions, verification or acquisition of easements or property, the identification of coincident infrastructure needs, and evaluation of and preparation for potential legal issues.

NORTHEAST DROUGHT REGION

VIRGINIA STREET INTERCONNECTION/PUMP STATION

As identified in the 2008 *Statewide Water Supply Interconnection Study*, one opportunity for inter-basin transfers involves the following systems: The City of Newark, New Jersey American Water (NJAW) – Raritan system, and the North Jersey District Water Supply Commission (NJDWSC). The pivotal asset to effectuate meaningful transfers between these three systems is the Virginia Street Interconnection/Pumping Station, which is located in Newark and was constructed in the early 1980's using 1981 Water Supply Bond Fund monies.

The Virginia Street Interconnection/Pump Station was constructed over 35 years ago, and limited resources have been devoted to operation and maintenance. The NJDEP will work with key Central and Northeast drought region water suppliers to develop a strategy for enhancements to the Virginia Street Interconnection/Pump Station and related appurtenances so that it is fully functional and automated. The NJDEP will also work with these purveyors to pursue the opportunity to address potential water supply emergencies in the Central Drought Region by retrofitting the Virginia Street Pumping Station to include two-way pumping, which would allow high-volume transfers into the Raritan Basin.

The *2008 Interconnection Study* identified the Virginia Street Interconnection as a critical water supply asset and acknowledged the potential benefits of providing routine water transfers between drought regions. By transferring 10 mgd between the Central Drought Region (NJAW-Raritan system) and the Northeast Drought Region via Virginia Street, it might be possible to reduce the occurrence, duration and severity of water shortages in the Northeast Drought Region. The investigation indicated that if the 10 mgd routine transfers had been implemented between 1990 and 2003, the number of days that NJDWSC's reservoir storage was below the drought warning curve would have been significantly reduced, if all other factors had remained the same. The NJDEP will continue to work with key Central and Northeast drought region water suppliers to develop a strategy under which water transfers could be undertaken on a routine basis among the interconnected entities in this region.

The Virginia Street interconnection was constructed with a potential design capacity of 30–35 mgd. Two major factors limit the interconnection from realizing its full design capacity. Transmission improvements are needed in the NJAW - Raritan and Newark systems, and a new pumping station is needed at the Belleville Reservoir site. The NJDEP will work with purveyors to evaluate the utility of these improvements to strengthen the Northeast Drought region.

DEP analysis after the 2008 Interconnection Study has shown that additional enhancements and/or expansions to critical water supply infrastructure in the Passaic and Hackensack basins also greatly increase the region's ability to address water supply emergency conditions including drought and infrastructure repair. These projects work in conjunction with the Virginia Street project to greatly improve the resiliency of the region. These projects include, but are not necessarily limited to, expansion of the Chittenden Road interconnection to include North Jersey District and preservation of the full operational capacity of Newark's Cedar Grove Reservoir that meets EPA and the NJDEP's uncovered finished water reservoir safe drinking water requirements. Expanded or additional finished water interconnections in this region as well as any highly interconnected region within NJ, greatly increases that region's or water system's ability to meet drought or emergency water needs.

Another example of optimizing existing system assets is the interconnected distribution networks of the NJAW's Raritan and Passaic systems and the Northeast region. Part of the NJAW Passaic system demand is met with water from the NJAW Raritan system. Modeling shows benefits of strengthening the connections between these two regions. The NJAW Passaic system has an average demand of less than 40 mgd, approximately 30 mgd of which is met with supplies from the Northeast Region. If the demand of the NJAW Passaic system could be met through additional water transfers from the Central Region, potentially 30 mgd of supply could be made available to meet demands in other parts of the Northeast region. Further detailed investigation is necessary to determine the feasibility of this option.

CENTRAL DROUGHT REGION

CONFLUENCE PUMPING STATION

This project would be located where the North Branch and the South Branch of the Raritan meet to form the main stream of the Raritan River at the boundaries of Branchburg, Bridgewater, and Hillsborough Townships in Somerset County. As indicated in the 1996 Plan and the Eastern Raritan Basin Water Feasibility Study, there has always been an assumption that the Confluence Pump Station Project would be the first of the major capital improvement projects to be completed.

The existing release pipeline from Round Valley Reservoir to the South Branch of the Raritan River stopped working in 1988 due to a failure of the pre-stressed concrete cylinder pipe. The pipeline can presently be used for releases from Round Valley, but is proposed to be replaced to facilitate pumping, under pressure, into Round Valley Reservoir from the Confluence Project. The current capital cost estimate for the Confluence Project is $150 million for engineering and construction of a 200 mgd intake/pump station site at the confluence of the North and South Branches of the Raritan River and a 12-mile long 96”–108” diameter force main to Round Valley Reservoir, which will allow for pumping into and release from the reservoir. This project would increase the safe yield of the Raritan Basin by 46 mgd.

The project can be accomplished in two phases. Phase 1 calls for the replacement of 3.4 miles, 108” diameter release pipeline at a project cost of $40 million. There are no issues with respect to easements because the pipeline will be replaced along the existing corridor. Phase 2 calls for the construction of a pump station and installation of 7 miles of new 96” - 108” diameter pipe between the confluence of the North Branch and South Branch Raritan River and the existing release structure in Whitehouse Station at the terminus of the existing release pipelint a project cost of $173 million (in 2017 dollars). Earlier efforts to acquire the easements for the Confluence Pump Station Project pipeline resulted in some gaps along the proposed route. In addition, there has been some encroachment on acquired easements.

The confluence project is currently not being actively pursued but is a potential project for the future.

KINGSTON QUARRY RESERVOIR

This project was proposed by Trap Rock Industries, Inc. as the eventual reclamation plan for their rock quarry when operations cease. The quarry is located in Franklin Township, Somerset County, directly adjacent to the Delaware and Raritan Canal and Millstone River. The quarry would store unused Delaware and Raritan flows and high flows from the Millstone River. Water diversions from these sources will flow by gravity in to the reservoir and water storage releases will be pumped back to the Delaware and Raritan Canal. This project is a viable option only if legal issues pertaining to land, operation, and necessary storage volumes are satisfied at the required time of transference. With increased conservation and changing population projections, it is still uncertain as to when the increased safe yield is needed.

The Kingston Quarry Project has been shown to be the most cost effective of the projects. However, due to quarrying rates as of 2015, the quarry is still actively being used, and it is unclear when it might be available for use for water supply. The NJDEP and NJWSA will consider engaging a consultant to research the next steps required to pursue the Kingston Quarry Reservoir Project. These key aspects of this investigation, as identified in the Eastern Raritan Basin Water Feasibility Study, should include:

- Legal terms turning the site over to State ownership.
- A guaranteed schedule for State acquisition.
- A guaranteed rate of rock removal sufficient to provide the necessary water storage volume at the required date.

The capital cost for the Kingston Quarry Reservoir project is estimated to be $102 million for engineering and construction as of 2015. The project could be broken down into two phases. Phase 1 would provide for storage of 7.2 billion gallons at a cost of $51 million. Phase 2 would provide another 7 billion gallons of storage at an additional cost of $51 million.

The above two projects have the potential to provide over 100 mgd of additional water supply to address future development needs and/or offset existing or projected deficits. If the 20 mgd of New Jersey's originally approved 100 mgd allotment under the 1954 Supreme Court is re-established permanently, (discussed in detail under Interstate Planning Issues in Chapter 2), the total additional safe yield is estimated to be 120 mgd.

In addition to the Kingston Quarry Project, NJDEP is open to the possibility of any additional quarries located near surface-water sources which may be suitable for use as a water supply reservoir. For example, there are several quarries near the Delaware and Raritan Canal which might be suitable at some time in the future. However, any such action depends on the quarry reaching the end of its useful life, and the volume of potential storage sufficient to justify the cost of required infrastructure.

WATER TRANSFERS FROM CENTRAL TO COASTAL NORTH DROUGHT REGIONS

Bolstering the interconnection of water supply systems between the Central (Raritan River Basin) with Coastal North Drought Regions systems has long been considered a key State drought management objective. Area of Critical Water Supply Concern No. 1 encompasses most of the Coastal North Drought Region and limits the amount of groundwater available for withdrawal. Continuation of the construction of the third and final phase of Middlesex Water Company's (MW) South River Basin Pipeline, as identified in the South River Basin Water Supply Study for Critical Area No. 1, will provide for both routine and emergency water transfers between the two drought regions, but will be instrumental in averting and mitigating drought/emergency impacts for the Coastal North Region.

This interconnection could also support future targeted growth in Middlesex, Monmouth, and Ocean Counties and provide resiliency for the area. For more information on system interconnections and transfers in the Central and Coastal North Drought Regions (see the Statewide Water Supply Interconnection Study referenced above). The existing pipeline system (two of three total sections), completed in 1992, is estimated to be able to provide an average day demand of 16.5 mgd from MW to purveyors in the South River Bain area in southern Middlesex County and northern Monmouth County. The proposed final phase of the pipeline can be designed to transfer a cumulative supply of 30-40 mgd through the entire South River Basin Transmission pipeline depending on availability of supplies. While growth projections suggest that construction of the interconnection is not yet needed, the NJDEP recommends that MW and all involved water supplies work with NJDEP to continue discussions to develop a plan for completing the interconnection when projected demands indicate a need for additional water, and for improved resiliency between regions.

RETENTION OF PREVIOUSLY ACQUIRED WATER SUPPLY PROPERTIES:

While they do not presently figure in near-term capital water supply development, the NJDEP will ensure the following properties remain preserved for future water supply purposes:

SIX MILE RUN RESERVOIR

The Six Mile Run Reservoir site is located in Franklin Township, Somerset County. The 3000-acre reservoir site would be situated on a tributary to the Millstone River and would store excess flow from the Millstone River and unused allocation from the Delaware and Raritan (D&R) Canal. Water would be used for low-flow augmentation of the Millstone and D&R Canal. This project was identified as the third most cost effective project in the Eastern Raritan Water Feasibility Study, and will remain on the list of potential water supply projects. The NJDEP will work with the NJWSA to complete the acquisition of all property that would be in the pool elevation of the proposed Six Mile Run Reservoir.

HACKETTSTOWN RESERVOIR

The Hackettstown Reservoir was identified in the 1982 Plan as a means of augmenting Delaware River flow during periods of low precipitation in order to meet New Jersey's intra-state regional requirements with the Delaware River Basin Commission. The 1996 Plan stated that these reservoir properties should be preserved as a potential water supply facility in this region. The Hackettstown MUA states, however, that the property which would have held the reservoir has been sold to private parties. As part of this Plan the reservoir is retained on the list of potential projects even though its future development may be more complicated than originally planned.

ADVANCED TREATMENT TECHNOLOGIES

Sources of supply can also be developed through the application of advanced treatment technologies. In addition to the implementation of RWBR as a source of supply for existing and new non-potable purposes, the NJDEP should continue to assess and support proven treatment technologies to convert "non-potable" sources of supply to "potable sources." For example, Cape May is a peninsula surrounded by salt water. Water withdrawals from the confined Cohansey and Atlantic City 800-foot sand aquifers have lowered water levels and caused the intrusion of salt water inland. Supply wells in Wildwood, Cape May City, and Lower Township have already been abandoned due to saltwater intrusion. The Cape May City water department has reduced withdrawals from its confined Cohansey aquifer well field due to saltwater intrusion and now employs a desalination plant to treat brackish water withdrawn from the Atlantic City 800-foot sand. Keansburg Borough, Monmouth County also began using desalination in 2012. Other water systems within the Coastal Plain are also considering the expanded use of this technology and management options.

The continued and possibly expanded use of desalination, reuse, ASR and conjunctive use will be considered as part of the multifaceted solution to long-term water supply needs in that region. The NJDEP will continue to consider these technologies, within the context of sustainable energy use and waste disposal in order to address New Jersey's water supply needs.

POLICY ITEM #5: EVALUATE THE IMPACT OF DISCOURAGING NEW OR INCREASED ALLOCATIONS FOR HIGHLY CONSUMPTIVE NON-POTABLE USES.

The decision to allow for new or increased allocations for highly consumptive, non-potable uses (with some exceptions for remedial activities, dewatering activities, emergency backup for RWBR diversions, or when the RWBR supply is unavailable) should be studied. Such policies could provide that potable supplies would be preserved for potable purposes, and RWBR would be encouraged for non-potable purposes. Such policies would only apply to those entities regulated under N.J.A.C. 7:19, and not to agricultural diverters regulated under N.J.A.C. 7:20A. The NJDEP will study the feasibility and implications of potential rule amendments.

POLICY ITEM #6: COORDINATE SUSTAINABLE WATER SUPPLY POLICY WITH THE HIGHLANDS REGIONAL MASTER PLAN AND PINELANDS COMPREHENSIVE MANAGEMENT PLAN.

The NJDEP should examine the need to better coordinate the distribution of approved available and sustainable supply with the future need for residential, commercial or industrial uses based on available local data, information and analyses that may have been conducted for Water Quality Management planning, the Highlands Regional Master Plan and Pinelands Comprehensive Management Plan.

POLICY ITEM #7: SUPPORT DETAILED REGIONAL HYDROLOGIC ASSESSMENTS TO ASSESS THE STATUS AND SUSTAINABILITY OF THE RESOURCE AND IDENTIFY FEASIBLE WATER SUPPLY ALTERNATIVES THAT PROTECT NEW JERSEY'S NATURAL RESOURCES.

The capital projects listed in Policy Item #4 above and identified in previous NJSWSP's resulted from detailed regional assessments and/or feasibility studies paid for through previous Water Supply Bond funds. However, the studies do more than identify capital projects; they assess the existing and projected conditions of the resource to determine existing or projected shortfalls. These assessments and results are a critical source of information for permit program decisions. They have supplied valuable information regarding the available water supply, and have afforded the tools necessary for limiting allocations in these regions. The NJDEP reviews each new or modified allocation permit request on a case-by-case basis, and allocation requests are either denied or limited in areas of water supply concern.

The 1996 NJSWSP identified the need for conducting additional regional water supply assessments. Over the past decade, NJDEP has made substantial progress advancing some of the highest priority assessments.

Appendix E provides a detailed summary of these ongoing assessments as well as related published findings and reports. Appendix F lists reports by the U. S. Geological Survey and the N.J. Geological and Water Survey dealing with water supply issues.

POLICY ITEM #8: COORDINATE WITH THE AGRICULTURE COMMUNITY TO ACCURATELY ASSESS AGRICULTURAL WATER USE AND ANTICIPATED FUTURE DEMANDS.

One water supply management challenge in New Jersey is balancing the competing uses of our water supply (e.g. drinking water, agriculture, industry and commercial activities, and water-dependent species habitat) and ensuring the sustainability of this vital resource. Addressing current and projected agricultural water supply needs has always been a key component in striking that "balance."

The agricultural community, including aquaculture, contributes significantly to the economy and culture of the "Garden State." According to a Northeast Economic Engine report released by Farm Credit East in 2015[8], New Jersey's agriculture which includes fresh fruits and vegetables, feed crops, livestock, greenhouse and nursey has a $12.8 billion impact on the State's economic output. Agriculture is also a key component in maintaining open spaces that provide aesthetic, historical and environmental benefits to the State, including habitat and groundwater recharge. However, most agricultural crops rely extensively on highly consumptive irrigation; in fact, the USGS estimates that approximately 90% of agricultural irrigation is lost to evapotranspiration (Nawyn, 1997). Improved irrigation techniques and use of reclaimed water for non-edible crops can improve water efficiency.

The Agriculture, Aquaculture, and Horticulture Water Usage Certification (Ag Cert) rules (N.J.A.C. 7:20A) govern water usage by the agricultural community. Under these rules, certification holders are required to submit annually, a record of the amount of water withdrawn each month. The NJDEP reviews usage reports to determine if they are consistent with the irrigated acreage and previously reported totals. However, since most of the agricultural diversions are not metered, it is difficult to determine if reported actual diversion rates are consistent.

Based upon agricultural use data reported to the NJDEP through 2015, agricultural users are using only about 30% of their allocation (see Figure 8.1).

The results of the surface water and unconfined groundwater availability assessment (Chapter 3, Appendix A) indicates significant increases in water availability deficits at full allocation in 49 of the 150 onshore HUC11 watersheds where the major source of diversion is agriculture. In many instances the results of the unconfined groundwater availability assessment may reveal a more accurate, less stressed condition if the approved allocations for agricultural uses more realistically matched the actual quantity used. In order to obtain clearer information and thus provide the data necessary for more accurate projections in the future, the NJDEP is working with the State Agriculture Development Committee, the Department of Agriculture, Rutgers Agricultural Agents and other agriculture stakeholders to obtain a solution for gathering better agricultural water use data.

Requests for new or increased agricultural certifications will require the implementation of best management practices to reduce consumptive losses. Renewals of previously approved, but currently unused allocations for agriculture are required to justify the need through Agricultural Development Plans, as required under N.J.A.C. 7:20A-2.4(d).

[8] Northeast Economic Engine: Agriculture, Forest Products and Commercial Fishing, accessed January 9, 2017 from Farm Credit East Knowledge Exchange

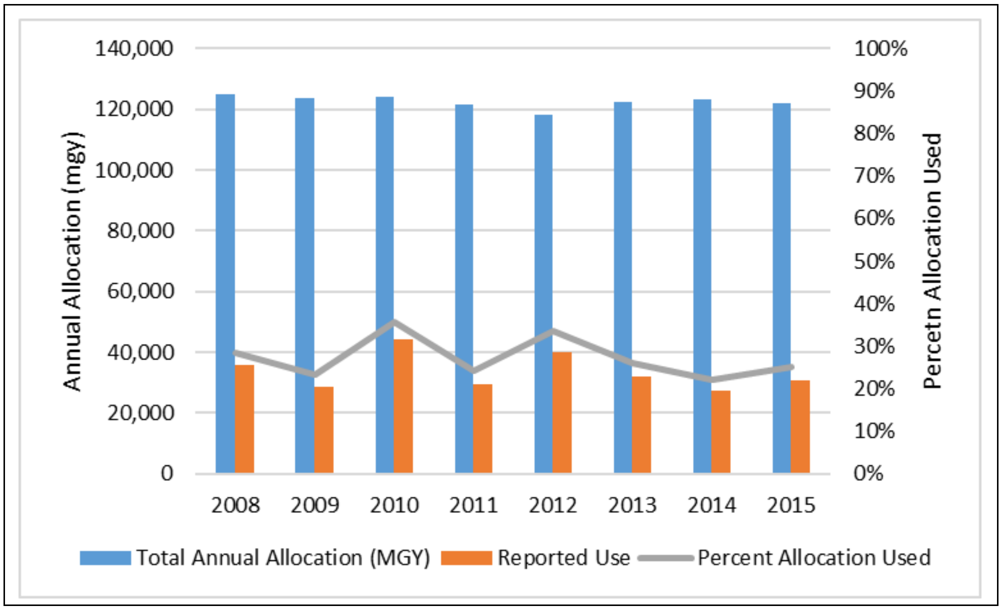


Figure 7.1 Agricultural Water Use in Relation to Approved Allocation

Note Pre-2008 numbers were not consistently maintained in NJDEP databases.

POLICY ITEM #9: CONTINUE TO ASSIST WATER SYSTEMS IN ENSURING ADEQUATE FINANCIAL INVESTMENT TO MAINTAIN AGING WATER SUPPLY INFRASTRUCTURE.

ESTIMATING INFRASTRUCTURE NEEDS

The USEPA released the *Clean Water and Drinking Water Gap Analysis Report* in 2002 which estimated the funding gap between projected infrastructure needs and projected infrastructure spending for the water industry nationwide. The Gap Analysis sought to develop a solid basis for understanding the magnitude of the national funding deficit for both water system capital infrastructure and operations and maintenance. For drinking water, a $102 billion ($5 billion per year) gap was identified for capital infrastructure projects, while the gap for operation and maintenance was estimated at $161 billion ($8 billion per year).

In further support of the *Gap Analysis Report* results, the American Society of Civil Engineers released its "*2016 Report Card*" for New Jersey infrastructure, which included a "C" (mediocre) grade for drinking water (see NJ Infrastructure Report Card and NJ Infrastructure Report Card Summary). In 2011, the United States Environmental Protection Agency (EPA) estimated that $7.9 billion in capital investments are needed over the next 20 years to install, upgrade, and replace New Jersey's drinking water infrastructure.

MAINTAINING INFRASTRUCTURE

Over the past several years, the New Jersey Clean Water Council (CWC) has conducted public hearings focused on environmental infrastructure, including drinking water, objectives, needs, financing, and management in the State. A recurring theme has been the need for greater attention on asset management, including adequately funding related assets on a sustainable basis. The Association of Environmental Authorities (AEA) specifically commented on the practice of local government's utilizing water rates as a general revenue source for unrelated budgetary purposes, at the expense of existing infrastructure repair and rehabilitation. The AEA recommended that local public agencies, rather than bonding for problem infrastructure, should also collect and retain funds specifically for regular and routine improvements.

Through the hearing process, many of the most pressing water infrastructure financing issues were discussed with stakeholders and the information gathered were used to provide recommendations to the NJDEP and BPU/DCA (on the cost), such as:

- Elimination of disincentives for proper infrastructure management
- Mandate proper asset management
- Full cost pricing of delivered water
- Municipal assistance

Through these recommendations and subsequent meetings with water industry stakeholders, the NJDEP has been advised that asset management should consist of the following three elements: (1) a means of routine asset condition assessment; (2) a programmed and preventative maintenance system; and (3) a procedure for evaluating the life-cycle cost impacts of repair or replacement decisions.

DEP ASSET MANAGEMENT POLICY PROGRAM

In addition to the implementation of the Water Quality Accountability Act (discussed in Chapter 4), NJDEP will continue to promote responsible asset management and adequate infrastructure reinvestment, which policies are universally accepted as being essential to assuring the long-term integrity of water system assets and the sustainable supply of safe drinking water to customers.

Water system asset management entails proactively managing infrastructure elements to minimize the total cost of ownership and operation while continuously delivering the desired level of service to customers. Asset management is implemented through a program that continuously evaluates the condition and expected life cycle of system assets in order to establish a replacement/maintenance plan that improves the efficiency and the reliability of the system, while reducing long-term operational costs. A comprehensive and effective plan incorporates a detailed asset inventory, operation and maintenance objectives, and a long-range financial planning strategy.

While the core of asset management refers to the physical infrastructure components of water and wastewater utilities, any successful asset management plan must also account for the human element involved. Therefore, an effective strategy needs to include assurances that educated, adequately trained, and certified personnel (licensed operators) supervise utility operation. This includes recognition that adequate succession planning is essential to assure the long-term viability of any utility.

Implementation of sound asset management strategies will play a major role in enhancing New Jersey's public health, environment, and economy. NJDEP encourages asset management through legislation, rules, and the ensuing permit requirements. To assist with this, guidance documents are provided to clarify permit requirements, in order to ensure best management practices for governing water system maintenance, operation, and management. With this information, system managers will be able to provide a detailed inventory of assets, a condition assessment, calculations for the useful remaining life of infrastructure assets, and long-term capital operating plans. Detailed information about asset management can be found at NJDEP's Asset Management webpage: NJDEP Asset Management.

USING THE NJDEP CAPACITY DEVELOPMENT PROGRAM TO IDENTIFY PROBLEM SYSTEMS

The Environmental Protection Agency's Drinking Water Infrastructure Needs Survey and the Gap Analysis Report begins to estimate the potential needs and financial shortfalls in developing and maintaining overall infrastructure but does not attempt to identify and quantify individual system problems. For that purpose, the NJDEP administers the Capacity Development (CapDev) Program. The Program is a mandate of the 1996 Federal Safe Drinking Water Act (SDWA) amendments, and is a tool to accurately identify specific water systems with technical, managerial, and financial (TMF) deficits. The CapDev program provides targeted systems with the tools needed to overcome their shortcomings and to assure long-term system viability.

The 1996 SDWA amendments focused on a public water system's ability to plan for, achieve, and maintain compliance with all applicable drinking water standards. Section 1420(a) requires states to develop and implement programs to ensure that new systems demonstrate TMF capacity, and section 1420(c) requires states to develop and implement programs to assist existing systems in acquiring and maintaining capacity.

The goals of New Jersey's CapDev program include:

- Reduce or eliminate the number of existing public water systems in significant non-compliance with the Federal and NJSDWA rules;
- Ensure that public water systems have adequate technical, managerial, and financial capacity to achieve and maintain compliance with the Federal and NJSDWA Rules, and to evaluate the TMF capacity of systems that are to receive monies through the Drinking Water State Revolving Fund (DWSRF); and
- Prevent the formation and operation of any new water system (community and non-transient, non-community water systems) that may be non-viable.

Every three years, the CapDev program identifies a list of non-compliant water systems that require assistance to resolve associated TMF issues. The list is developed with input from NJDEP's Compliance and Enforcement section and county health departments, utilizing EPA's Enforcement Targeting Tool.

New Jersey's Capacity Development Strategy was revised in 2010 and includes evaluating systems for the following:

- Technical capacity — adequate knowledge of source and infrastructure needs, adequate operation and maintenance of the system by qualified personnel, and oversight by a system operator of the proper license and classification. There should be adequate source and backup capacity, treatment, auxiliary power, and a properly inspected storage facility;

- Managerial capacity — that the water system has clear ownership, proper and organized staffing (including personnel expertise to operate the system), and effective interaction with regulators and with customers; and

- Financial capacity — the system has sufficient revenues, credit worthiness, and fiscal management/controls to cover the cost of operating, maintaining, and improving the water system. The water system needs to adequately charge for water, be metered and have a shut-off policy for non-payment.

Finally, there is a new focus on asset management as a central tool in developing long-term planning for affected water systems to help implement TMF and long-term planning and viability. Various technical assistance and training contracts are administered by the CapDev program to share the various tools needed to manage the water system. More information on this program is at: DWSG Capacity Development Program.

INFRASTRUCTURE FINANCING: NJEIT/DRINKING WATER STATE REVOLVING FUND

The Department will continue to promote the utilization of the NJ Environmental Infrastructure Financing Program ("Financing Program") to local water systems as a cost-efficient way to finance capital water projects.

The New Jersey Environmental Infrastructure Trust ("NJEIT" or "Trust") and the NJDEP partner to provide low cost funding to finance critical projects including the construction and enhancement of safe drinking water infrastructure through the Financing Program. Qualified projects enhance and protect ground and surface water resources, ensure the safety of drinking water, and facilitate responsible, sustainable economic development.

Providing safe, abundant drinking water requires heavy capital investment. Building environmental infrastructure is expensive and the costs are ultimately borne by ratepayers and taxpayers. Low-interest financing from the Financing Program has helped keep costs to the public as low as possible. Thanks to a combination of low interest rates, principal forgiveness funds, and other cost saving features, from 1998 through June, 2017, the Drinking Water component of the Financing Program has saved New Jersey ratepayers and taxpayers over $460 million.

The NJEIT was created by legislation enacted in 1986 to establish an independent State authority to manage efficient and low cost financing for environmental infrastructure projects. Through the Financing Program, the NJDEP, together with the NJEIT, make and administer loans for environmental infrastructure and ensure that the State's water infrastructure -- which is critical in protecting public health, water quality, and the State's natural resources -- is properly constructed to State and federal standards.

For the past 31 years, the NJDEP and the NJEIT have focused on cost and operational efficiencies to leverage State and federal funds through NJEIT's publicly issued bonds that provide the lowest possible interest rate loans to Financing Program participants for the construction of environmental infrastructure projects.

The Federal SDWA Amendments of 1996 authorized the DWSRF to assist publicly and privately owned community water systems and nonprofit noncommunity water systems to finance the costs of infrastructure needed to achieve or maintain compliance with SDWA requirements and to protect the public health in conformance with the objectives of the SDWA. The NJDEP's portion of a DWSRF loan provides a portion of the allowable project cost interest-free, with the possibility of principal forgiveness. The NJEIT loan covers the remaining portion of the project's allowable cost at the Trust's AAA-rated market rates, through the issuance of bonds secured with DWSRF funds. Through leveraging by the NJEIT, the State is able to fund more projects than the federal grants received. States are required to provide matching contributions equal to 20% for the USEPA's annual capitalization grants. The "Water Supply Bond Act of 1981" Bond Fund has been used for the source of match monies. In FFY2014, New Jersey proposed a small systems loan program ("NANO") leveraged by the Trust to assist systems serving populations of 10,000 or less with their capital infrastructure needs. The NANO Loan Program is limited to $4 million per annum and a portion of each loan is issued as principal forgiveness.

Section 1452 (b) of the SDWA requires each State to prepare an Intended Use Plan (IUP) annually to identify the use of funds in the DWSRF and describe the planned use of its allotment of federal moneys authorized by the SDWA Amendments. The IUP details how the State of New Jersey finances projects to be included in New Jersey's Financing Program and which projects are reviewed by the NJDEP, with respect to the capitalization grant. The non-project set-asides provide for DWSRF activities that are not construction related and include administration of the DWSRF, technical assistance for small systems, State public water system supervision (PWSS) programs, source water program administration, capacity development, and operator certification. Project expenditures involve loans made by the DWSRF to water systems for the planning, design, and construction of drinking water facilities. The most recent IUP can be found at: DWSG Loans and Capacity Development.

In addition to assessing New Jersey's infrastructure needs, the Drinking Water Infrastructure Needs Survey (discussed previously) is used as the basis to determine the amount of the federal grants allocated to each State's DWSRF program. From 1998 to June, 2017, the DWSRF Program provided long-term loan funding for approximately 430 projects totaling $1.625 billion, utilizing federal capitalization grants, loan repayments, interest earnings, State match monies, Trust-leveraged funds, and funds transferred from the Clean Water SRF Program. The Financing Program averages $59 million per year of funding for the construction of substantial drinking water treatment and distribution improvement projects. The federal capitalization grants from the USEPA are expected to remain steady at approximately $16 million annually over the near-term. While the DWSRF has provided New Jersey water systems with a relatively stable funding source for the past decade, it is important to recognize that it cannot be the sole source of funding and that individual systems must be prepared to fund projects through other means.

The 1996 Amendments to the SDWA initially authorized a total of $9.6 billion nationally for the DWSRF FFY1995 through FFY2003. The USEPA appropriated $919,400,000 for FFY2012 and $861,326,000 for FFY 2013 for the DWSRF. The allotment to New Jersey for FFY2014 to 2017 is 1.90 percent of the Federal DWSRF appropriation and is based on the results of the 2011 Drinking Water Infrastructure Needs Survey, published in June 2013. A gradual decrease since the 1997 Needs Survey (1995 data) in New Jersey's DWSRF allotment (from 2.44% to 1.90%) has occurred as New Jersey's reported percentage of the total national needs has decreased. Funds available to the State for future appropriations will be allotted according to a formula that reflects the results of the 2015 Drinking Water Infrastructure Needs Survey conducted pursuant to Section 1452(h) of the SDWA. The continued involvement of the water systems in New Jersey's Needs Surveys is critical if the State is to receive its fair share of future DWSRF allotments.

The DWSRF is administered as a component of the EIFP which also administers the State's Clean Water State Revolving Fund (CWSRF). The Clean Water component of New Jersey's EIFP provides low interest loans to publicly-owned systems for planning, design and construction of wastewater treatment facilities and other water quality improvement projects under the Federal Clean Water Act and State law. The CWSRF program is covered under a separate Priority List in NJDEP's joint DWSRF-CWSRF IUP. Prospective project sponsors complete a project information page that is ranked by the NJDEP and included in the respective Priority Lists as a condition of eligibility for financing.

The NJDEP's Bureau of Safe Drinking Water jointly manages the DWSRF program with the NJDEP's Municipal Finance and Construction Element and the Trust. Leveraging by the Trust (i.e. the sale of revenue bonds, the proceeds of which are used to fund the Trust's portion of project loans), allows the State to provide low interest loans to more projects. It should be noted that the 1981 Water Supply Bond Act authorized financing only to publicly owned systems, and the 1996 SDWA amendments did not change this.

POLICY ITEM #10: MAINTAIN NEW JERSEY'S EXTENSIVE SURFACE WATER, GROUNDWATER AND DROUGHT MONITORING SYSTEMS AND ASSESSMENT TOOLS, WHICH ARE CRITICAL TO PLANNING FOR OUR FUTURE.

AMBIENT AND DROUGHT MONITORING

As indicated in Chapter 4, the NJDEP maintains extensive ambient and drought monitoring networks. The ambient water monitoring program in New Jersey consists of four networks operated by USGS and cooperatively supported by the NJDEP. The networks include the following:

- *Stream Gauging* Network - Collects continuous stage and discharge data at 67 stream stations and low flow data at 45 stream stations. These data are critical for evaluating the impact of water supply allocation decisions;
- *Groundwater Level* Network - Collects water level data from 186 observation wells in all of the major aquifers of the State. It provides long-term status and trends on groundwater resources. It documents climatic and water use influences on these resources. This information is needed for water supply planning and for determination of allocations;
- *Coastal Plain Synoptic* Network - Determines long-term groundwater levels and chloride concentrations in approximately 800 wells in the confined aquifers of the State. Data collection and interpretation are distributed over a five-year cycle. The data are needed for water supply planning and allocation decisions and serves as an early warning system for salt-water intrusion, overuse of the aquifers of the State, as well as aquifer recoveries noted due to Critical Area allocation cut-backs; and
- *Drought Monitoring* Network - Designed in 2002, using satellite telemetry, the Drought Monitoring Network provides real-time conditions for streams (43) and groundwater wells (20). Additional stream low flow measurement stations (35) and continuous groundwater well level recorders (19) are also operated. This network provides information throughout the State on ambient conditions for quick response to drought (or flooding) events.

NJ WATER TRANSFER DATABASE

The water budgets and availability assessments presented in this Plan are based on statewide averages and HUC11 watershed water budgets. The NJ Water Transfer Database (NJWaTr) is used to determine the HUC11 watershed water budgets and water availability estimates and has approximately 38,000 sites, 24,000 conveyances and 2.1 million monthly transfers. These data must be maintained and continuously updated to provide the "living data document" framework envisioned for future water supply planning. This type of ongoing maintenance is necessary in order to support future planning efforts.

Assessments at this scale represent significant advancements from those provided in the previous updates of the NJSWSP (i.e. 150 HUC11s vs. 23 RWRPAs). However, they cannot reflect localized characteristics of the specific locations of the diversions or sub-watersheds (HUC14). This Plan also includes information provided by the much more detailed assessments and modeling efforts conducted by the USGS (under NJDEP contract) for groundwater systems in the southern portions of the State, e.g. Critical Areas 1 and 2, and the Atlantic region. Like many of the other water supply monitoring programs, the NJWaTr Database is primarily funded through the 1981 Water Supply Bond Fund.

CHAPTER 8
SUMMARY OF RESULTS AND MANAGEMENT OPTIONS BY WATERSHED MANAGEMENT AREA (WMA)

In Appendix A, unconfined groundwater and surface water supplies for all of New Jersey's HUC11 watersheds have been summarized and evaluated for each respective WMA (1-20). Each WMA consists of multiple HUC11 watersheds; however, water source and water use data for each HUC11 watershed has been aggregated for the purpose of characterizing the entire WMA. Each characterization includes a summary of the region's water sources as well as a description of categorical water usage during the peak water use year recorded between 2000 and 2015. The data and methodologies used in the development of these summaries are provided in Chapter 2 and referenced resources/documentation. Six principal water use categories may be represented within a WMA:

- Agriculture
- Commerce/Industry/Mining
- Domestic (individual, private wells)
- Non-agricultural Irrigation
- Potable Supply
- Power Generation

Use of the NJWaTr model (see Chapter 2) to identify water imports and exports along with the application of the LFM methodology (see Chapter 3) to quantify water availability aims to ensure the sustainability of surface and unconfined groundwater sources. It is important to emphasize that the quantification of net water availability provides a tool to help frame planning and regulatory decisions within HUC11s, but cannot be used in place of site-specific assessments for individual water allocation permit decisions.

Each WMA summary includes the following:

- Description of the planning area
- Summary of water withdrawals, consumptive loss and discharge
- Public community water systems and projected water demands
- Available water for depletive and consumptive uses from the unconfined groundwater and unregulated surface water
- Available water from major surface water supply reservoirs
- Available water from confined aquifers
- Summary and management options

To more accurately identify the location of a specific municipality in relation to the State's 150 onshore HUC11s, please use the DEPs interactive mapping tool at: NJDEP Bureau of GIS

To use this tool, position your cursor over the gray box and depress the left mouse button twice. You will see a small gray arrowed box appear in the bottom right hand corner of the gray cell. Depress the left mouse button in the "boxed arrow" to reveal the dropdown list. Select the county/municipality of interest by depressing the left mouse button. Once the municipality of interest is selected, a report is generated identifying the percentage of the HUC11 located within the municipal boundaries. You should now be able to identify which HUC11 is of your interest.

The recommended management options/initiatives for each WMA aim to protect and maximize the efficient use of New Jersey's water supplies and prevent or delay deficits caused by depletive or consumptive uses. These management options include capital infrastructure projects, water-use efficiency initiatives, source water protection (including protection of surface water watersheds, public water supply wells and aquifer recharge areas), and better matching source water quality with the intended use. Regardless of primary causes of stress identified in a particular HUC11 watershed, increasing water use efficiency and preventing unnecessary water losses, as identified in Chapter 5, is fundamental to responsible water resource management and is applicable throughout the State. Other modifications in water usage may involve conversion from natural surface and groundwater sources for non-potable, highly consumptive uses to RWBR or similar lower quality water sources.

Finally, Appendix B (Water Supply Options – Confined Aquifers of the New Jersey Coastal Plain) includes summarized assessments for the confined groundwater systems of the State's Coastal Plain province. The confined aquifer summary is organized into four regions: Atlantic Coastal Region, Cape May Peninsula, Water Supply Critical Area 1 and Water Supply Critical Area 2, and Delaware Bay Region.

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American Water Works Association Water Loss Control	https://www.awwa.org/resources-tools/water-knowledge/water-loss-control.aspx
Delaware River Basin Commission (DRBC)	http://www.nj.gov/drbc/
DRBC Water System Audits and Water Loss Control	http://www.state.nj.us/drbc/programs/supply/water-audit-program.html
Farm Credit East Knowledge Exchange Reports	https://www.farmcrediteast.com/knowledge-exchange/Reports
Infrastructure Report Card NJ	https://www.infrastructurereportcard.org/state-item/new-jersey/
Infrastructure Report Card NJ Brochure	https://www.infrastructurereportcard.org/wp-content/uploads/2013/02/NJ-Report-Card-Brochure-Final.compressed.pdf
National Drought Mitigation Center, University of Nebraska-Lincoln	http://drought.unl.edu/DroughtBasics/WhatisDrought.aspx
New Jersey Drinking Water Watch	https://www9.state.nj.us/DEP_WaterWatch_public/index.jsp
New Jersey Highlands Council	http://www.nj.gov/njhighlands/
New Jersey Water Savers	http://njwatersavers.rutgers.edu/
New Jersey Water Savers Goes Corporate	http://njwatersavers.rutgers.edu/NewJerseyWaterSaversGoesCorporate.html
New Jersey Water Savers Water Champions	http://njwatersavers.rutgers.edu/For%20Educators_WaterChampions.html
NJ Department of State Red Tape Review Commission Successes	http://www.state.nj.us/state/dos_red_tape_success.html
NJ Drought	http://www.njdrought.org/.
NJDEP 2014 Integrated Water Quality Assessment Report	http://www.nj.gov/dep/wms/bears/2014_integrated_report.htm
NJDEP Asset Management	http://www.nj.gov/dep/assetmanagement/.
NJDEP Bureau of GIS	http://www.nj.gov/dep/gis/
NJDEP Capacity Development Program	http://www.nj.gov/dep/watersupply/dws_loans_capdev.html

INTERNET LINKS MENTIONED IN THIS REPORT

NJDEP Category 1 (C1) Waters	http://www.state.nj.us/dep/wms/bears/c1waters.htm
NJDEP Division of Water Supply & Geoscience	http://www.nj.gov/dep/watersupply/
NJDEP Drought Indicators	http://njgeology.org/enviroed/infocirc/droughtind.pdf.
NJDEP Emergency Response & Preparedness	http://www.nj.gov/dep/watersupply/emergency.html
NJDEP Emergency Response & Preparedness/Planning Guidance	http://www.state.nj.us/dep/watersupply/pdf/dwerp.pdf
NJDEP Lead in Drinking Water	http://www.nj.gov/dep/watersupply/dwc-lead.html
NJDEP Loans and Capacity Development	http://www.nj.gov/dep/watersupply/dws_loans.html
NJDEP Source Water Assessment Program (SWAP)	http://www.nj.gov/dep/watersupply/swap/index.html
NJDEP SWAP Reports & Summaries	http://www.nj.gov/dep/watersupply/swap/assessments.htm
NJDEP Wastewater Reuse Program	http://www.nj.gov/dep/dwq/reuseff.htm
NJDEP Water Conservation	http://www.nj.gov/dep/watersupply/conserve.htm
NJDEP Water Quality Management Planning Program	http://www.nj.gov/dep/wqmp/wqmps.html
Rutgers Landscape & Grounds Management Courses	http://www.cpe.rutgers.edu/programs/landscape.html
Rutgers Landscaping for Water Conservation	http://njaes.rutgers.edu/pubs/publication.asp?pid=E341
Sustainable Jersey	http://www.sustainablejersey.com/
US EPA Pricing and Affordability of Water Services	https://www.epa.gov/sustainable-water-infrastructure/pricing-and-af-fordability-water-services
US EPA Water Sense	UShttps://www.epa.gov/watersense
USGS Office of the Delaware River Master	https://water.usgs.gov/osw/odrm/
Water Quality Accountability Act (NJSA 58:31-1)	http://www.nj.gov/dep/watersupply/g_reg-wqaa.html

GLOSSARY

ACCRETIVE means the addition of water to a watershed, generally through the imports of either fresh water or sewage or reclaimed wastewater.

ADMINISTRATIVELY APPROVED ABILITY is the amount of water a water supplier is approved to deliver under current regulatory permits.

AQUACULTURE specifically activities related to shellfish aquaculture, includes the propagation, rearing, and subsequent harvesting of shellfish in controlled or selected environments as well the processing, packaging, and marketing of the harvested shellfish.

AQUIFER means any water-saturated zone in sedimentary or rock stratum which is significantly permeable so that it may yield sufficient quantities of water from wells or spring in order to serve as a practical source of water supply.

AQUIFER STORAGE AND RECOVERY (ASR) is the injection of treated drinking water through wells into a suitable aquifer during periods of surplus water treatment plant capacity and recovery from the same wells during periods of peak demand for treated drinking water.

ALLOCATION PERMIT means the document issued by the NJDEP to a person, grating that person the privilege, so long as the person complies with the privilege, so long as the person complies with the conditions of the permit, to divert 100,000 or more gallons of water per day water for any purpose other than agricultural or horticultural use.

CONFINED AQUIFER is an aquifer which contains groundwater confined under pressure between relatively impermeable or significantly less permeable material so that its groundwater surface rises above the top of the aquifer.

CONSUMPTIVE WATER USE means the use of water in such a way that a portion of the water used is lost to evaporation, transpiration, incorporation in product, etc., and not discharged to any location.

CRITICAL WATER SUPPLY AREA or **CRITICAL AREA** means a water supply area of concern in which it is officially designated by the Commissioner of the DEP, after public notice and a public meeting, that adverse conditions exist, related to the ground or surface water, which require special measures in order to achieve the objectives of the Water Supply Management Act. The DEP will not issue new or increased diversions from affected aquifers within an area of critical water supply or from wells located outside, but that affect the area of critical water supply concern, concern except for certain cases as defined at N.J.A.C. 7:19-8.3(i) through (k).

DEPENDABLE YIELD means the yield of water by a water system which is available continuously throughout a repetition of the most severe drought of record, without causing undesirable effects.

DEPLETIVE WATER USE means the withdrawal of water from a water supply resource (ground or surface water) where the water, once used, is not discharged to the same water supply resource in such a manner as to be useable within the same watershed.

DROUGHT means a condition of dryness due to lower than normal precipitation, resulting in reduced stream flows, reduced soil moisture and / or lowering of the potentiometric surface in wells.

EVAPOTRANSPIRATION means the water lost to the atmosphere from the GROUND surface, EVAPORATION from the capillary fringe of the groundwater table, and the TRANSPIRATION of groundwater by plants whose roots tap the capillary fringe of the groundwater table.

FACILITY means a medium through which the base source its transmitted to the user. It is wither manmade or manipulated in an attempt to maximize the water that may be derived from a base source. A facility for groundwater is a well or wellfield and for surface water a reservoir or intake facility.

FIRM CAPACITY means adequate pumping equipment and/or treatment capacity (excluding coagulation, flocculation, and sedimentation) to meet peak daily demand when the largest pumping station or treatment unit is out of service.

FRESH WATER means all non-tidal and tidal waters generally having a salinity due to natural sources of less than or equal to 3.5 parts per thousand at near high tide.

HYDROGEOLOGY means the area of geology that deals with the distribution of movement and groundwater in the soil and rocks of the Earth.

HUC11 refers to a 11-digit Hydrologic Unit Code drainage area. This is a multi-level, hierarchical drainage system defined by the U.S. Geological Survey. There are 150 HUC11s onshore in NJ with an average size of 51.9 square miles.

HUC14 refers to a 14-digit Hydrologic Unit Code drainage area. This is a multi-level, hierarchical drainage system defined by the U.S. Geological Survey. There are 921 HUC11s onshore in NJ with an average size of 8.5 square miles.

INTERBASIN TRANSFER means the movement of water (as raw, treated or used water) from one watershed to another.

INTERCONNECTION means a water supply connection with another water supply system or systems.

LOW FLOW MARGIN means the difference between normal dry-season flow (September Median Flow) and drought flow (7Q10).

MULTIPLE SOURCES means one or more production wells, surface water intakes, or interconnection or a combination of wells, surface water intakes or interconnection utilized to meet the demands of a public community water system.

NATURAL RESOURCE AVAILABILITY means the naturally occurring baseline ability of a resource to maintain itself through the allocation and use of itself.

NJWaTr refers to the New Jersey Water Transfers Database developed by the U.S. Geological Survey and maintained by the N.J. Department of Environmental Protection to track water withdrawals, use, treatment, and discharge in New Jersey.

NON-CONSUMPTIVE WATER USE means that portion of water use which is not evaporated. This volume is available for use by a downstream user.

NON-REVENUE WATER means the difference between the annual volume input into the water supply system and billed authorized consumption (includes billed metered and billed unmetered consumption).

POTABLE WATER means water that does not contain objectional pollution, contamination, minerals, or infective agents and is considered satisfactory for domestic consumption using conventional water treatment processes (e.g., chemical coagulation / flocculation, clarification, filtration, disinfection).

PURVEYOR means any company, authority, or person who owns or operates a public community water supply system.

PUBLIC COMMUNITY WATER SYSTEM means a public water system which serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.

RWBR (Reclaimed water for beneficial reuse) means water that meets restricted access or public access reuse requirements specified in a NJPDES permit that authorizes that water to be directly reused for non-potable applications in place of potable water, diverted surface water, or diverted groundwater.

RESERVOIR means a large natural or artificial lake used as a source of water supply.

SAFE YIELD means the yield maintainable by a water system continuously throughout a repetition of the most severe drought of record, after compliance with requirements of maintaining minimum passing flows, assuming no significant changes in upstream or up-basin depletive withdrawals.

SEPTEMBER MEDIAN FLOW means half of the September flows will be higher and half will be lower during a critical time when streamflow tends to be the lowest in New Jersey.

transpiration is the process by which moisture is carried through plants from roots to small pores on the underside of leaves, where it changes to vapor and is released to the atmosphere.

TREATED WASTEWATER means the treated spent water of a community. From the standpoint of source, it may be a combination of the liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with any groundwater, surface water, and storm water that may be present. In this study, treated wastewater and industrial treated wastewaters. Consistent with available information, municipal wastewaters will be categorized into less than secondary level treatment, secondary level treatment, and advanced treatment.

UNACCOUNTED-FOR-WATER means water withdrawn by a purveyor from a source and not accounted for as being delivered to customers in measured amounts.

UNCONFINED OR SEMI–CONFINED AQUIFER means an aquifer close to the land surface with continuous layers of material with permeability in the high to low range, extending from the land surface to the base of the aquifer.

USER means any person other entity which utilizes water.

WATER ALLOCATION or **CERTIFICATION** means the authority to withdraw surface or groundwater for use, pursuant to a permit issued under N.J.A.C. 7:19-1 et seq. or & N.J.A.C. 7:20A-1.1 et seq, respectively.

WATERSHED means a geographic area in which all water, sediments and dissolved material drain to a particular receiving body.

WATER SUPPLY DEFICIT means the amount or amounts by which the available resources fall short of a given demand.

WATER SUPPLY SYSTEM means a physical infrastructure operated and maintained to deliver water on either a retail or wholesale basis to customers.

WATER SYSTEM IMPROVEMENT means any action or actions which increases the capacity, capability, or efficiency of a water system.

WATER TABLE means the water surface in the upper most part of the water saturated zone which is at atmos-pheric pressure.

WATER TABLE AQUIFER means a geological formation which carries water at atmospheric pressure at the top of the saturated zone.

XERISCAPING means the practice of the landscaping design so that little or no irrigation is needed.

7Q10 FLOWS means the seven-day, consecutive low flow with a ten-year return frequency; the lowest stream flow for seven consecutive days that would be expected to occur once in ten years.