State of New Jersey
Department of Environmental Protection

2024 NEW JERSEY STATEWIDE WATER SUPPLY PLAN

APPENDIX L

WATER RESOURCE AND SUPPLY MANAGEMENT OPTIONS

Appendix L:
Water Resource And Supply Management Options

TABLE OF CONTENTS

OVERVIEW

A legacy of water supply management experience combined with significant public and private investment have resulted in the sophisticated and highly interconnected network of public community water systems (PCWS) 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 (e.g., new reservoirs), the need to preserve and enhance the State's natural resources, increasing incidence of harmful algal blooms and other contamination concerns, 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 where necessary. In order to accomplish State water supply management objectives, the DEP 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 concepts that could be considered for future analysis. Many of these items are discussed in the main chapters of the 2024 Plan.

INCREASING WATER-USE EFFICIENCY

Concerted planning and significant public and private investment have vastly improved water supply storage, treatment, and distribution capabilities in the Garden State and new investments continue to do so. 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 and implement 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. Water that is not needed due to water use efficiency and conservation can be left for ecological and recreational uses or stored for later use. 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.

DEP continues multiple 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. The next section of this appendix discusses some options for improving this process.

DEMAND/SOURCE MANAGEMENT

As discussed in Chapter 4, excluding water used for power generation, water use declined slightly from 1990 to 2020, an average decline of 3.8 billion gallons a year. This decline is largely attributable to decreased water use in the industrial/commercial/mining sectors. The potable water use sector changes year to year but has been remarkably stable, despite increasing population. 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. 3.3).

The most significant change is the decrease in water demand for power generation. The few true hydropower generators in New Jersey 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 large reduction 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 steadily increased from 1990 to roughly 2010, but has been somewhat lower since then, varying year by year based on irrigation needs.

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 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 when water supplies tend to be most stressed. Statewide, public water supply demands in the summer months are roughly 20% to 30% higher than in non-summer months, primarily driven by outdoor consumptive water uses, as discussed in Chapter 4.

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. As noted in Chapter 4, population growth will drive water demands higher if no offsetting water conservation or other actions are taken. Without conservation, meeting future water supply needs will require significant, additional expenditures for treatment, distribution, and storage infrastructure. Accordingly, this appendix 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. Agricultural demands are also addressed, as they can stress local water supplies in watersheds where agricultural irrigation is a large fraction of demands.

An additional component of demand/source management is the proper maintenance of transmission pipes to minimize water loss. This is discussed below as well.

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.

PUBLIC EDUCATION AND OUTREACH

Since adoption of the 1981 New Jersey Statewide Water Supply Plan, DEP has developed and implemented a variety of approaches to inform the public about water supply issues, drought management responses, and individual water conservation and water use efficiency approaches. In recent years, some of this effort has shifted to digital formats such as the DEP website. In other cases, partnerships with outside entities have resulted in additional public outreach and education approaches. For example, DEP partnered with the Rutgers Cooperative Research and Extension – Water Resources Program to develop the New Jersey Water Savers (**New Jersey Water Savers**), which was funded through an EPA matching grant and State appropriations from the Water Supply Bond Fund in 2007. The goal of the Water Savers 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, and
- 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.

The New Jersey 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. This effort was followed by development of a consumer-based website (**New Jersey Water Savers**), which highlights the results of the pilot projects to inspire others to replicate statewide, along with expansion of one of the most successful projects, "Water Champions".

The program then 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.

The pilot projects and programs undertaken with the New Jersey Water Savers project included the following basic approaches. Some of these are continued through the New Jersey Watershed Ambassadors program funded by AmeriCorps, managed by DEP, and hosted at 20 regional entities, one for each Watershed Management Area. Others have been incorporated into Rutgers Cooperative Extension courses on landscape and grounds management (**Landscape and Grounds Management Courses – Rutgers NJAES Office of Continuing Professional Education**). In addition, the Delaware River Watershed Initiative continued the Water Savers approach in the Kirkwood-Cohansey aquifer area of southern New Jersey (see **South Jersey Water Savers - Protecting the Kirkwood Cohansey Aquifer**).

- **Indoor Water Conservation programs:** educate the public about the importance of indoor water efficiency and easy ways to accomplish water savings.
- **Outdoor Water Conservation programs:** educate the public about the importance of outdoor water efficiency and easy ways to accomplish water savings. Some of these approaches include green stormwater infrastructure (e.g., rain gardens, and natural retention basins), and Build-A-Rain Barrel Workshops and rain barrel art publicity events by Watershed Ambassadors and others; smart irrigation controller and irrigation system upgrades/maintenance education; and turf management demonstrations and programs.

- **The 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 New Jersey Water Savers project, the Rutgers University publication, "Landscaping for Water Conservation, A Guide for New Jersey" was updated.
- **The 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. New Jersey 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 New Jersey Water Savers have worked with Sustainable Jersey to create a Water Conservation Education tool using the New Jersey Water Savers pilot programs as models for replication. More information on Sustainable Jersey can be found at: **Sustainable Jersey**.

As mentioned, New Jersey Water Savers implemented a program called Water Champions, a program that has been expanded upon by DEP in recent years. Water Champions is a supplemental science-based education program about water conservation. It is designed to educate middle and high school students about the status of their current potable water supply, the impacts of overuse, and reveal opportunities in which they can increase efficiency and conservation practices as well as influence their school and community to do the same. It is the goal of the Water Champions program to create replicable curricular infrastructure to support the education of these issues and to provide a platform for authentic student research, assessment, discussion and outreach.

The program begins in the classroom where students learn about responsible water management through the Water Champions supplemental curriculum. Once the lessons have been completed, the students are tasked with performing three different water audits: a home audit, a school audit and, a business audit. In order to complete the business audit, students recruit local businesses to engage in the program. The goals of the school and business audits are to identify old and wasteful fixtures such as faucets or toilets and retrofit them with newer models that save both energy and water. Students present their results to their schools and community and encourage their communities to implement water and energy saving practices. Throughout the program, students not only learn about water conversation but also develop leadership skills through their engagement with their community.

The initial implementation of the Water Champions program in New Jersey was a partnership between USEPA and New Jersey Water Savers. It was implemented in three high schools in the Rahway and Central Delaware regions of the state between 2011 and 2013. In 2016, DEP partnered with EPA and the American Littoral Society (ALS) to continue the program in Cape May County and the Delaware Bayshore area. The curriculum was tailored to each region; the Cape May program addressed the regional concerns of saltwater intrusion, while the Delaware Bayshore program shifted its focus towards the impact of aquifer withdrawal on the streams feeding into the Delaware Bay. Through the most recent partnership with EPA, DEP and ALS have engaged with 5 schools, and performed audits and retrofits at 7 local businesses. Over 250 energy and water efficient devices have been installed at the schools and businesses, resulting in an estimated 3 million gallons of water saved.

DEP will continue the Water Champion program's implementation through the AmeriCorps Watershed Ambassadors Program. The three regional Source Water Protection Ambassadors will receive training each year to share the Water Champions lessons with New Jersey students, as well as encourage schools and businesses across the state to install more efficient devices. More information on the implementation of Water Champions can be found on the DEP's water conservation website.

DEP continues to promote water conservation and efficiency Statewide through active involvement with both the Sustainable Jersey program and the Environmental Protection Agency's WaterSense and Water Champions programs. Long-term improvements that could improve public outreach and education during both drought and normal times are discussed later in this appendix.

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. 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 higher the water losses, the more water is being withdrawn from reservoirs, rivers and aquifers that is not used effectively, placing higher stresses on these resources.

Current state regulations (N.J.A.C. 7:19-6.4) refer to water losses as unaccounted-for water, which means water withdrawn by a purveyor from a source and not accounted for as being delivered to customers in measured amounts. This concept has evolved through the years to be better expressed as nonrevenue water. Nonrevenue water can be defined as the unbilled water demands from in water system, expressed as a percentage (gallons of water billed/gallons of water entering the distribution system). However, as the term unaccounted-for water is somewhat antiquated due to the numerous ways water can be 'lost' in a distribution system, the Department intends to phase out this language in future rulemakings. Previously, this water loss data was collected as part of Water Conservation Plans bi-annually, for those systems with Water Allocation Permits. However, since April 2017, DEP has collected this water loss data annually through an electronic portal, including from systems who are interconnected and serve at least 1,000 people. Under pending rulemaking from the Department to fully implement the Water Quality Accountability Act (WQAA), roughly 300 PCWS would be required to submit this information, alongside the completion of the American Water Works Association Water Loss Audit. An annual review of water loss data would allow DEP the ability to better identify those systems with excessive water losses. Existing regulations at N.J.A.C. 7:19-6.4 allows DEP to require systems with excessive water loss to take appropriate corrective action. Systems with excessive water losses (15%, N.J.A.C. 7:19-6.4(a)) may be required to take corrective action, with a focus on the purveyors that have the highest water losses in each purveyor size class.

Since 2013, the Delaware River Basin Commission (DRBC) requires that water purveyors using basin water resources use a more detailed system of measurement, the Water Audit program of the American Water Works Association (AWWA), which assesses water losses as "real" (e.g., leakage from the system) and "apparent" (e.g., data coding errors, meter error). This requirement applies to 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. 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**. More information can also be found at **DRBC Water System Audits**.

As a result, New Jersey public water systems are subject to a mix of water loss accounting requirements and expectations. The DEP regulations use a metric that includes all types of non-revenue (i.e., unaccounted for) water, whether real (i.e., system leakage, hydrant flushing and firefighting) or apparent (i.e., theft, meter errors, accounting errors). The DRBC regulations require accounting of the multiple metrics in the AWWA software: losses per connection per day (real and apparent); Infrastructure Leakage Index (ILI). The ILI is the ratio of real losses to the Unavoidable Annual Real Losses (UARL), a theoretical indication of the leakage reduction possible with application of the current best technology. DRBC also continues to collect data on non-revenue water as a percentage of total treated water. The most recent published DRBC water audit report (2018, using 2016 data) indicates that a UARL calculation "has not yet been proven as fully valid for very small or low-pressure water distribution systems", noting that the AWWA software doesn't calculate UARL values for such systems. Annual DRBC data collection continues.

Actual water use by customers and the PCWS itself can be billed or unbilled, neither of which is considered a water loss. Under the AWWA methodology, nonrevenue water is a combination of water loss (real and apparent) and known but unbilled water demands (e.g., hydrant use for firefighting). The following graphic shows how total water delivered by a PCWS into water mains is subdivided into these components.

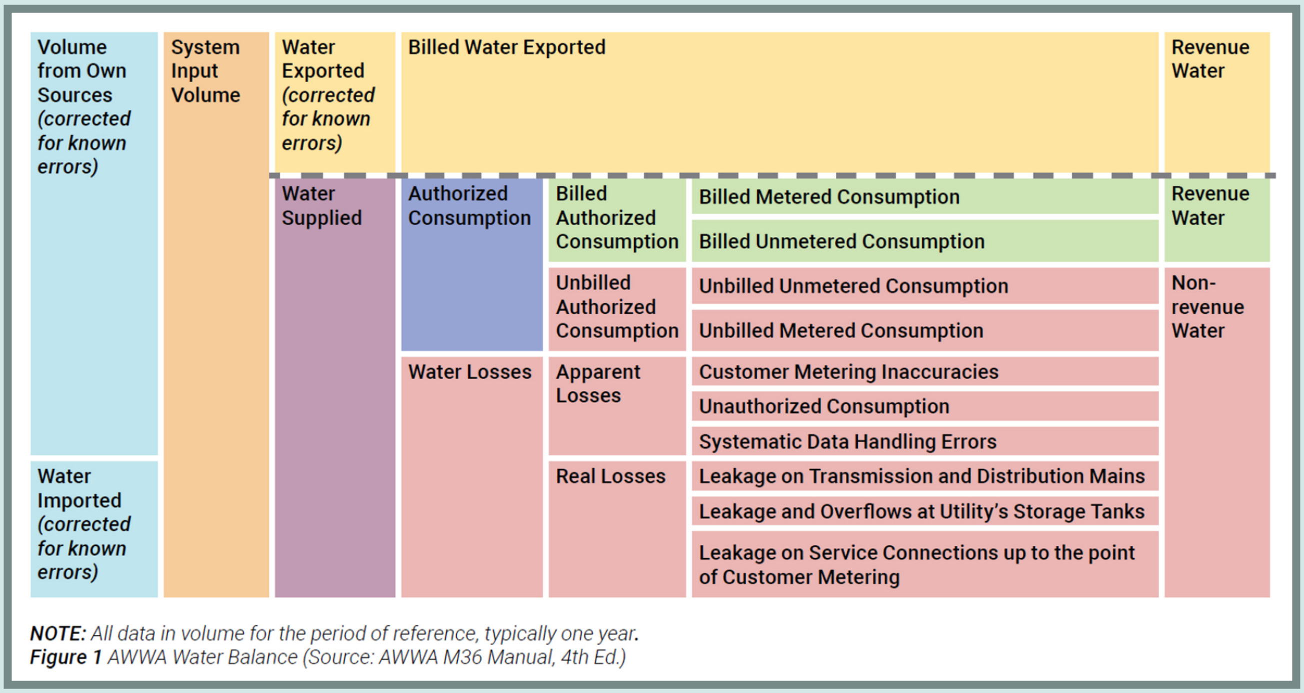

Figure L.1 AWWA Water Balance Diagram (AWWA M36 Manual, 4th Edition)

Though DEP currently does not require AWWA audits be submitted for most systems outside of the DRBC's authority, DEP recognizes the value of AWWA audits. In an effort to promote the AWWA water system audit methodology, the DEP 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. After the rulemaking to fully implement the WQAA has been proposed and adopted, DEP would establish a submittal portal to ensure that data could be compiled and analyzed electronically.

The AWWA Water Audit methodology has been changing, and the current guidance from AWWA (Version 6) is that no single threshold of "real water loss" is appropriate for regulatory purposes, given the major system differences including utility age and location, water use patterns, the number of customer connections per mile of water main and per million gallons delivered, the diversity of customers (i.e., whether a major customer accounts for much of demand), etc.[1] AWWA's focus is on metrics that help utilities understand what actions will best improve the utility through loss reductions. For instance, reduction of apparent losses will shift more yield into revenue-producing flows, but it may have no impact on the total withdrawals from the source waters. Reduction of real losses, such as water leakage reductions, will increase the percentage of treated water that makes it to the water user. The need to address the diversity of utilities is certainly important.

This latest AWWA Water Audit guidance poses new challenges for determining actions. The needs of utilities for system management can differ substantially from the needs of the state for protection of public trust water resources. As a major

[1] Jernigan and Sayers. 2021. AWWA's Free Water Audit Software: Updates and Improvements. Journal AWWA.

example, in most cases the calculation of cost-effective leakage reductions (from the utility perspective) compares loss reduction costs against the cost of the lost treated water. Where project costs are less than the costs of water losses (on a present-value basis), the leakage reduction project is financially worthwhile. While valid for internal financial decisions, this approach ignores externalities, such as where water losses exacerbate an existing or future stress on the source waters. The higher the losses, the more water is being withdrawn and wasted. The more stressed that water resource is, the greater the external cost of water losses become. The AWWA methodology does allow for such externalities to be considered, but this step is rarely taken. As the Department compiles Water Audits from systems over the years, it would be better able to identify what the impacts of these externalities are and identify follow-up actions where appropriate.

As discussed in Chapter 4, water loss data from both DEP and DRBC for the years 2018 and 2019 were used to assess the current situation in New Jersey. Data from 234 PCWS yielded a statewide median water loss rate of 14.1 percent (average of 15.9%); individual results vary widely to a high of more than 50 percent. Importantly, the median results for PCWS in bedrock geology and coastal plain geology were significantly different, at 17 and 12 percent, respectively, emphasizing that there is no "one size fits all" threshold for how much water loss should be considered excessive. The AWWA methodology emphasizes this point as well. Therefore, future water loss requirements will need to consider a combination of factors, including the characteristics of the PCWS (e.g., geologic location, number of customer connections, percentages of water delivered to various customer classes, water loss per customer connection) and the extent to which the source water resources are stressed. The AWWA method provided a good sense of water losses as they affect system operations and costs, but rarely is used to also assess the impacts of water losses on source waters.

REDUCE EXCESSIVE OUTDOOR WATER USE

As prior figures suggest, residential and commercial landscaping contributes to the increased consumption of potable water supplies, particularly during the peak use growing season. This trend offsets moderately diminished per capita usage realized through indoor plumbing efficiencies and personal water conservation. It also increasingly strains surface water 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, local authorities and investor-owned suppliers that may impose water use restrictions at any time based on local needs (e.g., to ensure that peak demands do not cause low water pressure in the distribution system), DEP may impose mandatory restrictions only 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, cost and energy use. The increase in 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 implement 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 municipal ordinances (in coordination with applicable water suppliers) to regulate sprinkler irrigation. State regulatory requirements could require that new or replacement lawn irrigation systems use digital controllers to avoid water waste. DEP permits, bulk water sale contract approvals or Environmental Infrastructure Financing Program funding could also include conditions requiring peak demand reductions where appropriate to protect system capacity or source water resources.

RESIDENTIAL IRRIGATION WATER USE SCHEDULING

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.) that maximized plant health and minimizes evaporative losses. 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 an equal number of homes are permitted to water every day.

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 -- 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.

NON-AGRICULTURAL 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 (i.e., digital, zoned) controllers that incorporate weather conditions) that permit watering when conditions warrant. Devices certified through the USEPA WaterSense program should be preferred.

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.

DEP 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 (see Water Conservation Ordinance action)**.

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. DEP recommends that this requirement at a minimum 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, as all such demands stress source water supplies.

AGRICULTURAL IRRIGATION SYSTEM TECHNOLOGIES

The New Jersey Department of Agriculture, State Soil Conservation Committee (SSCC), State Agriculture Development Committee (SADC), Soil Conservation Districts and the Natural Resources Conservation Service (NRCS) of the U.S. Department of Agriculture collaborate on providing technical assistance and cost-share funding for implementation of agricultural production and resource conservation practices, using a combination of state funds and federal Farm Bill. The SADC is able to fund up to 50 percent of the actual cost for approved soil and water conservation projects for farms that are permanently preserved or enrolled in 8-year or 16-year term preservation programs, through the Soil and Water Conservation Cost-Sharing

Program. These projects can include irrigation system improvements to reduce consumptive water losses. (See **New Jersey Farmland Preservation Program | Soil and Water Grants**). The NRCS likewise provides both technical services and access to funding for a variety of soil and water conservation projects that are identified as appropriate through a conservation plan, through the Environmental Quality Incentives Program (see **Environmental Quality Incentives Program**).

The Rutgers New Jersey Agricultural Experiment Station (NJAES) Cooperative Extension provides services with New Jersey agricultural businesses, including field research, consultation, and education on various agricultural and natural resources management issues. NJAES is not a funding source for agricultural businesses, but it provides technical support that can result in grant proposals through the state and federal programs.

In all cases, these programs have and will continue to help farm operations optimize their use of irrigation, to reduce water use and contamination while maintaining or improving crop production and profitability. It is through these collaborative and voluntary efforts that many irrigation systems have been modified from high-pressure (and high evaporation) systems to more efficient operations such as low-pressure and micro-irrigation systems.

Irrigation involves a significant energy cost to farmers. Improved understanding of soil moisture deficits, plant water demands, and actual water delivery through the irrigation system all can improve proper cost-benefit management, resulting in more sustainable farm operations and potentially higher profits. For this reason, DEP developed a pilot project in collaboration with the U.S. Geological Survey, New Jersey Department of Agriculture and Rutgers Agricultural Experiment Station to compare irrigation volumes using standard estimation methods (calculation of pump capacity multiplied by the hours of operation) versus two types of flow meters on ten farms growing a variety of crops, including nursery plants and trees, fruit trees, blueberries, and field crops.

All meters were monitored throughout the 2021 growing season (May through November). At the conclusion of the project monthly meter readings were compared to reported estimates submitted by the resident farmers. This preliminary study found that the estimation methodology most frequently used by agricultural irrigators in New Jersey does not produce statistically similar results to that of a properly installed flow meter, which can be considered the industry standard best practice for accurately recording water withdrawals. It also found that the estimates typically exceeded the metered readings especially as monthly withdrawals began to exceed approximately 2 million gallons per month. While the study did not investigate specific causes, one major possibility is that nominal (manufacturer-specified) pump capacity (the flow rate through a pump at its designed conditions) varies from actual pump capacity (the flow rate through a pump in field conditions, which may include lengthy small-diameter piping); in other words, the same pump in two different fields would have different actual pump capacities, and those capacities are likely different from the nominal capacities. Pumping estimates are based on the nominal pump capacity, as the capacity of each specific pump has not been calibrated to field conditions and is likely lower than the nominal levels.

This was a small study that included just ten water sources, but its completion does contribute to the overall understanding of the underlying water use data with respect to agriculture. Future work should build upon this initial study by focusing next steps in areas where LFM results notes limited availability with agriculture as a dominant use.

RAINWATER HARVESTING

In an effort to promote the lowest quality water for the intended use, DEP began a residential rainwater harvesting program with the New Jersey Watershed Ambassadors program in 2014. By encouraging the use of rainwater 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, thousands of 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 large-scale rainwater 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 Resources Program has designed and installed a number of large-scale cisterns for landscape watering purposes and as a green stormwater infrastructure approach.

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 applications of water and fertilizers to overcome poor soil conditions. One cost-effective alternative is for the developer to retain a balanced soil composition and soil/subsoil infiltration rates 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 the Soil Restoration Act (P.L. 2010, c. 113) was adopted. This law required amendments and supplements 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. The SSCC adopted amendments 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"; restoration of compacted soils must meet specific requirements. Municipal boards and officials should work in collaboration with the local Soil Conservation Districts to ensure that these requirements are successfully implemented to reduce water demands and improve landscape health.

INITIATIVES FOR LOCAL CONSIDERATION: CONSERVATION SUBDIVISION ORDINANCES

Conservation subdivision ordinances are based on the principles of low impact development (including retention of natural vegetation), xeriscaping and other low-water and water-efficient 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 outdoor 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**.

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 water utility financial tools: **USEPA Financial Technical Assistance and Tools for Water Infrastructure**.

The New Jersey Board of Public Utilities (BPU) authorizes rates that investor-owned public utilities may charge customers for the treatment, distribution and use of water. 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 also oversees the water rates of a small number of systems (about 40 of the approximately 600 PCWS in New Jersey) but who serve about 3.1 million customers.[2] 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, but the DCA does not have a rate approval system analogous to that of the BPU. DEP 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 DEP and the Board of Public Utilities." A recent study of water utility rates (Van Abs et al., 2022)[3] found that the weighted average household cost for drinking water was roughly $345 for a household using 45,000 gallons of water per year.

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 et al., 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. However, conservation rates are less effective for both high- and low-income households, for different reasons. Water costs for high income households are a small percentage of income; increases do not drive behavior significantly. Low-income households already tend to have financial stresses that drive reduced water use, often have no outdoor water demands, or are in rental housing where they do not pay water bills directly. Therefore, it is in the middle income ranges that conservation rates have the greatest effect on residential demands. Also, setting the top water demand for the first tier requires consideration of different household sizes, so that larger households are not penalized for larger total demands that reflect a similar per capita demand as smaller households. Finally, the benefits of conservation rate structures can be diluted by heavy dependence on fixed charges, where a change in water demand results in a much smaller change in the water bill.

Historic 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 protect 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.

[2] 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 rate to customers in the separate municipalities.

[3] Van Abs, D.J., T. Evans and K. Irby. (2022). Assessing Statewide Water Utility Affordability at the Census Tract Scale. AWWA Water Science, https://doi.org/10.1002/aws2.1287.

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. In some cases, water utilities incorporate an initial water volume within their fixed charges, which works well with an inclining block rate structure.
- **Seasonal Rate Structures:** Outdoor water use during the peak seasonal demand period, May through October, presents the greatest strain on water availability and utility infrastructure, because it coincides with relatively lower rainfall and higher evapotranspiration rates. In New Jersey, seasonal outdoor water use has risen significantly since the 1970s, largely attributable to continued suburbanization, vast increases in residential and commercial lawn and landscape areas and, ultimately, dramatic increases in irrigated 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, either for the full demand volume or for only that portion of demand that exceeds non-summer demands, 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. This practice is also applicable to areas with high summer tourism demands; it is equitable because infrastructure must be maintained year-round for seasonal use. Through the use of seasonal rates, the non-summer customers (i.e., year-round residents and businesses) do not pay a disproportionate share of annual utility revenues.
- **Decoupling Rate Structures:** Some utilities have found that effective water conservation efforts significantly reduce water consumption, which in turn reduced their earnings and (for investor-owned systems) profitability. Seasonal rates, especially, can result in large revenue streams from one year to the next, due to weather-related changes in outdoor water demands. One option is to periodically modify the rate schedule (price per volume) to offset the loss in volume; users that conserve will then pay less than those who do not. A second option is to use the more variable part of the billing to build utility financial reserves, which can then be drawn down over time to defer rate changes or to fund smaller capital projects out of reserves.

  A third but rarely used option is decoupling. 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. Essentially, the utility would rely primarily on fixed charges rather than volumetric charges, a common approach for sewer utilities but uncommon for drinking water utilities. In decoupling water utility sales from earnings, the disincentive to promote the conservation of water is eliminated. Because 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 decoupling rate structures.

INDOOR PLUMBING AND APPLIANCES

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. The 1992 Energy Policy Act (EPAct) established maximum allowable water flow rates for plumbing fixtures including toilets, urinals, showerheads and faucets for new and renovated residential and nonresidential facilities. A major goal was to reduce energy demands from indoor hot-water uses; reductions in water utility energy demands were an additional benefit.

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 were 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, DEP joined as a State partner of the WaterSense program. For more information pertaining to WaterSense please visit **EPA Water Sense**. A third national program relevant to water conservation is the Energy Star program (**Energy Star**), a certification program for energy-efficient appliances. Clothes washers are a major water-demanding appliance that has Energy Star certification requirements; the two issues work together because heating water for the washer is energy-intensive, and the less water is used (a reduction of 33 percent or more from non-certified washers), the lower the energy demand. The EPAct requirements, WaterSense and Energy Star programs contributed to a 40 percent reduction in per capita water demands from 1970 to 2010 (Diringer et al., 2018). Evidence from New Jersey indicates that per capita water demands continue to decline.

In 2021, Governor Phil Murphy signed into law **P.L. 2021, c. 464** which established minimum efficiency standards for several categories of residential and commercial appliance. This includes stricter water efficiency standards for products such as faucets, showerheads, spray sprinkler bodies, urinals, and toilets. The Department is developing a rule proposal to fully implement these standards. While a complete analysis of the impacts of these standards is pending, products which are WaterSense labeled use at least 20% less water than standard products.

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 et al., 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, most of these improvements have pay-back (return on investment) periods that they are worthwhile to households. Public water systems have invested in outreach programs to help households that are experiencing financial inability to pay water bills, and energy utilities help support energy-saving audits for qualifying households that can point to water-saving appliances and fixtures. A major constraint is in helping households that rent, as the landlord is often the owner of all major household appliances and water fixtures.

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 DEP's regulatory authority. Further investigation and consideration should be given to whether and how sub-metering could be implemented in New Jersey.

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 (e.g., southern Florida, Arizona and southern California), 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 for specific purposes. "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 has the advantage of being feasible at both the development and the utility scale. For example, several residential towers in Battery Park City use an internal RWBR to use treated wastewater for toilet flushing water, resulting in a 55 percent reduction in potable water demand and a 60 percent reduction in wastewater generation (**Battery Park City Wastewater & Rainwater Reuse**). On a far different scale, Bergen County Utilities Authority sends treated wastewater to a nearby electrical power generating plant.

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, DEP 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, DEP 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 DEP'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 DEP 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. For example, it may not be appropriate to approve RWBR proposals that would reduce stream flow in waters that currently receive discharges of treated wastewater. Highest priority for RWBR will be using treated effluent from wastewater facilities that discharge to saline waters.

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. DEP is proposing to strengthen these rules to further 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 DEP'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 **DEP RWBR website**.

Over the years, the NDJEP, specifically the Division of Water Quality (DWQ) has been working to promote and implement the beneficial reuse of wastewater for domestic and industrial wastewater dischargers via the New Jersey Pollution Discharge Elimination System (NJPDES) permitting program. The Bureau of Surface Water and Pretreatment Permitting program currently has issued over 125 NJPDES/Discharge to Surface Water permits that allow permittees to implement, upon approval, a reclaimed water program for a variety of public and restricted access uses. Permittees file their annual use report detailing the water use activities taking place and the volume of reclaimed water utilized. A detailed annual accounting of these activities can be found at **New Jersey Wastewater Reuse Program - Reuse Report Data**.

In an effort to promote RWBR, DEP 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. A Determination of Environmental Benefit (See **DEP DWQ Determination of Environmental Benefit Application**) issued by the Department can be submitted to the New Jersey State Department of Treasury, Division of Taxation for a corporate business tax credit and/or sales tax refund for the eligible treatment or conveyance equipment purchased for the exclusive purpose of reusing further treated effluent in their industrial processes.

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 L1 for a summary of total annual water use savings through the use of RWBR. 2021 RWBR data is the most recent data available. Refer to **New Jersey Wastewater Reuse Program - Reuse Report Data** for the most up to date information.

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.

DEP recognizes that RWBR presents 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.

Table L1. Reported RWBR Water Use

Year	Reported Use (bg)
2005	1.175
2006	2.23
2007	2.6
2008	3
2009	3.24
2010	4.2
2011	4.45
2012	5.07
2013	5.96
2014	9.82
2015	12.78
2016	4.59
2017	13.63
2018	9.34
2019	11.18
2020	9.89
2021	13.27
2022	13.43

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. DEP will continue to promote RWBR, recognizing the need to develop strategic plans and goals to ensure long-term program success and will investigate the possibility of using a true-cost-of-water [4] approach.

APPROACHES FOR IMPROVING NEW JERSEY'S WATER SUPPLY FUTURE

EFFICIENT USE OF THE STATE'S FRESHWATER RESOURCES

Water conservation and water use efficiency 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. These measures also reduce stress on natural water resources.

[4] The True Cost of Water combines three types of costs: (a) direct costs: price of water, operational costs and investments in water infrastructure; (b) indirect costs: administrative, legal and corporate social responsibility costs; and (c) costs related to risks such as operational risks: e.g., water shortages, flooding, financial and regulatory risks.

The goals of DEP's existing water conservation policy include:

- promoting a responsible water use ethic by all users;
- reducing real water losses;
- reducing indoor water demands;
- reducing consumptive water demands, particularly of potable water sources from activities such as outdoor water use, which this Plan has recognized as a growing concern; and
- increasing use of non-potable sources of supply for non-potable purposes, including through Reclaimed Water for Beneficial Reuse (RWBR).

A responsible water use ethic can be achieved through a combination of regulatory and educational efforts. DEP regulations ensure that water allocations are appropriate to the anticipated needs of the permit holder, whether a self-supplied industrial or agricultural water user or a public water system. DEP also has educational materials on its website and has supported efforts by Rutgers Cooperative Extension and others to improve public understanding of the value of water and the importance of water use efficiency.

Regarding the last goal, DEP has advocated RWBR as a drought mitigation strategy and as a long-term water supply management tool in appropriate locations, particularly for highly consumptive, non-potable purposes. RWBR should remain a component of DEP's goal of matching water quality with the intended purpose, thus reserving the highest quality sources for drinking water and other related needs.

REDUCE REAL WATER LOSSES

The reduction of water losses will be critical to optimizing water demands through the year 2050, as discussed in Chapter 4 for PCWS demand projections. Three major options are available for consideration.

1. First would be to have a consistent approach for assessing real and apparent water losses using a consensus approach that provides the most useful information possible. As DRBC already requires use of the AWWA Water Audit Methodology and DEP encourages (but does not require at this time) the same, DEP would require that all regulated under the Water Quality Accountability Act conduct periodic AWWA Water Audits, reporting losses per connection per day (real and apparent) and ILI values; reports to the DRBC and DEP would thus be the same. Initially, this approach could continue to collect an overall real water loss percentage as a rough indicator of distribution system integrity, but this value should only be used for targeting further evaluation.
2. The second action for consideration is to establish a set of thresholds for water losses that provide a good indication of which utilities need to focus attention to real or apparent water loss reductions because their metrics are not in line with effective utility management practices. The thresholds should be established once there is a sufficient database (including the multiple years of data submitted to DRBC) and should include consideration of the water resource externalities caused by excessive real water losses. As one example of a data need, multiple years of data would help determine the extent to which real water losses vary year-to-year within individual systems (i.e., periods of high demand may have different water loss percentages than periods of low demands). Based on available information, a single statewide threshold is not appropriate. More research is needed, but requires statewide results using a consistent analysis methodology, such as the AWWA methodology. Therefore, this action would follow the first, with the thresholds being based upon a detailed analysis of the audit results.
3. A third action would be to directly relate the results from the water audits to requirements under the Water Quality Accountability Act. DEP is authorized to develop regulations implementing the WQAA. Under this policy option, the rules could require that systems with unusually high losses demonstrate that their capital projects contribute to a reduction in losses toward the thresholds. The policy should acknowledge that other asset management projects may have higher priority than water loss reductions (e.g., MCL compliance), but the higher the water loss, the greater the burden of proof that loss reductions are a lower priority. This approach could be implemented prior to the first two policies, using a high threshold of total water loss (e.g., above the 75th percentile value of current data).

REDUCE INDOOR WATER DEMANDS

Indoor water demands in residential and commercial buildings have been declining for decades, as discussed previously. Much of this reduction is driven by improved water efficiencies in plumbing fixtures and water-using appliances in response to federal regulations, national certification programs (WaterSense and Energy Star), and uniform building codes. A major question is whether the Building Code reflects modern technology. For example, the EPAct regulations require that toilets use a maximum of 1.6 gallons per flush. The WaterSense threshold is 1.28 gallons per flush, or 20 percent less. However, multiple models are available at just 0.8 gallons per flush, half of the EPAct requirement. In addition, because the Building Code only addresses plumbing fixtures, not appliances, the large savings available from efficient clothes and dish washers are not mandated. There are no data on what percentage of appliances sold in New Jersey meet either WaterSense or ENERGY STAR requirements. In addition, there is a major difference between building owners and renters, regarding financial incentives for reduced water demands. Residential renters often do not pay water bills directly, especially for multi-family housing, as no sub-meters allow for demand tracking. One option is to assess whether updates to the Uniform Building Code or other regulations would achieve a significant reduction in water demands beyond current trends.

Another approach for reducing indoor water demands is to help water customers understand their water demands in comparison to others, between seasons, and with identification of possible water leaks within the house, which are not addressed by water loss audits at the utility scale. Digital (aka "smart") metering combined with online customer portals and notification systems can help inform customers and encourage more efficient water uses.

There are two major policy questions regarding smart metering. First is the extent to which state government (e.g., BPU, DCA, DEP) should allow, encourage or require transition to smart metering, and what metrics should be used to determine the most beneficial approach. The related question is how to allow utilities to include smart meter system costs in their budgets, which affects rate schedules. Smart metering is more costly upfront (though requiring fewer operational resources for meter reading and billing) and involves additional cybersecurity concerns and costs. Given the 15 to 20 year lifespan of residential water meters, making the right decision to replace them with analog or digital meters is important for future water management capacity and net utility costs. Choosing smart meters will be more important for utilities with elevated water losses, high per capita residential water demands, or stressed source waters. One policy option is to allow smart meter installation and use (and rate recovery) only where a utility makes a sound case for doing so. This approach is used by BPU in rate cases. Another option is for state government to provide guidance on smart metering but otherwise leave the issue to utility choice. A third option is for the state to require smart metering (and allow its costs) where utility water losses or source water stresses show a strong cause for action, and otherwise to leave the issue to utility choice.

The second policy issue is whether and to what extent the state government should provide guidance or rules for how smart meter data are provided to customers. This question is less time-sensitive, as smart meters can be put in place for utility-centered reasons and then the customer interface can evolve. Still, part of the justification for smart meters (and ratepayer impacts) is the customer benefits. One problem here is the ongoing software evolution and the costs of data management for smaller utilities. One option is for the state to provide only basic guidance or rules on customer data access and privacy. Another option is for the state to develop more detailed guidance on building customer data interfaces without specifying a software package.

REDUCE CONSUMPTIVE WATER DEMANDS

Residential outdoor irrigation is the other major consumptive water demand in New Jersey. Residential irrigation demand is seasonal and weather-dependent, but it also is affected by landowner preferences, awareness of lawn and landscape watering needs, and local ordinances. It is common for people to misunderstand plant water needs, as few people are trained in this area and many people want their lawns to be green despite the fact that cool-weather grasses will tend to brown out in high heat, regardless of lawn watering. Outdoor water uses for low and medium density development may increase as summer average and peak temperatures increase through global warming (Arbues et al., 2002; Corbella & Pujol, 2009), to address increased soil moisture deficits caused by the rising temperatures (Dawadi & Ahmad, 2013; Dziegielewski & Chowdhury, 2012). These increased needs may offset improvements in lawn irrigation practices.

Several methods for reducing residential outdoor irrigation demands were previously discussed in this appendix. These approaches can be implemented in two ways. First, DEP could require that a PCWS with large lawn areas within their service area identify areas with high summer peak demands and develop approaches to minimize consumptive water demands. Second, as discussed previously, changes to state laws could incorporate provisions for better irrigation controllers on existing, replacement and new lawn irrigation systems. Similar requirements could be extended to major non-residential lawns, such as business campuses. Finally, utilities can incorporate seasonal demands into their rate schedule, where customers would pay a higher rate for summer demands that exceed their non-summer demands. Because summer peaks are not as predictable as normal demands, the utility would need to ensure that a low-demand summer does not create a problematic revenue shortage; methods include putting second-tier revenue into rate stabilization funds, reserves, a fund for capital projects, conservation incentive programs, etc. The use of summer rates likely would improve affordability issues, as lower-income households often use less water during summers than other households. A second policy option is for the state (e.g., DCA with support from DEP and BPU) to develop general guidelines for rate schedule development, incorporating useful concepts from the AWWA M1: Water Rates, Fees and Charges. This would help publicly-owned utilities understand the implications of different rate structures and perhaps would encourage the use of common units (e.g., thousands of gallons) and a better balance between fixed and volumetric charges. Guidance could help a utility overcome customer resistance to increased outdoor water demand costs.

Agricultural irrigation is a relatively small percentage of total water demand in New Jersey, when compared to total statewide water uses, and almost none of it comes through public water supply systems. However, in some watersheds, agriculture is the primary total demand. Agricultural irrigation is a much larger percentage of total <u>consumptive</u> water demands, which means that in a watershed where agriculture demand is high, it may constitute most of the consumptive water loss. Agricultural irrigation also tends to be highest at the same time that natural water resources such as streams and shallow aquifers are most stressed, which exacerbates the water stresses. Yet the crops are more likely to fail without irrigation at this time. Depending on the crop and the farmer, irrigation technology may range from high-pressure spray irrigation (generally seen as low-efficiency due to excessive evaporation) to micro-irrigation (a high-efficiency but higher-cost technology that is appropriate for some crops but generally not for field crops such as grains). For these reasons, New Jersey and its farmers benefit from agricultural irrigation but also have an interest in making sure that water withdrawals occur only when truly needed, as required by N.J.A.C. 7:20A.

Agricultural irrigation is <u>very</u> different from indoor residential, commercial and industrial water demands, as agriculture is highly weather dependent. Residential lawn irrigation also is weather dependent, but it gets bundled with other public water supply demands and the browning of a lawn doesn't threaten a homeowner's income. Golf course irrigation is more equivalent to agricultural irrigation, as both are growing a crop, but most golf courses are required to have water allocation permits; agriculture is treated differently, receiving water use certifications that require less detailed information. The difficulty is knowing how much agricultural irrigation water is needed at a watershed level, when each farm will have different needs based on soils, crops, planting times, local rainfall events, etc. Some factors can be known ahead of time, but not local precipitation.

Another difficulty is that agricultural irrigation is mostly measured through a simple calculation of pumping capacity times pumping duration (e.g., 100 gallons per minute for 100 minutes is 10,000 gallons). Every NJSWSP to date has noted that agricultural withdrawal data are more uncertain than other withdrawals that routinely use metering. As discussed previously, DEP conducted a pilot study to evaluate the effectiveness of agricultural metering, finding that metered withdrawals tend to be less than reported withdrawals. The cost of accurate metering has been dropping with new technology, however, creating the potential for improved understanding of actual irrigation quantities.

At this time, DEP has not concluded that statewide changes are necessary for agricultural water reporting. There are, however, several options for evaluating this issue further. One option to consider in conjunction with the Department of Agriculture would be mandatory metering using cost-effective technology only for the largest agricultural water use certifications and for those certifications that constitute a large fraction of the total water availability for a specific watershed, especially for stressed watersheds. These data might then be used to help assess and calibrate the water use information from other farms. Requiring meters for any agricultural operations may require a statutory or regulatory change. A second option is to specifically incorporate the concept of variability in the agricultural water use certifications, so that a low use in one year does not affect the certified volume. Options include multi-year volumes or peak year volumes with an expectation of lower years. Provisions of N.J.A.C. 7:20A-2.4(d)4 might be clarified to allow the concept of variable annual needs to be included in a water management plan developed for a farm unit. Requirements of N.J.A.C. 7:20A-2.5(a)11 currently require information demonstrating that "under standard operating conditions" certain water impacts will not occur, but there is no definition provided of "standard operating conditions"; inclusion of inter-annual variations in irrigation needs may be useful here. A third option combines continued technical and cost-sharing assistance to farmers toward use of the most efficient but cost-effective technology being used for agricultural irrigation, such as drip irrigation in place of broadcast irrigation.

NEW JERSEY'S APPLIANCE AND EQUIPMENT EFFICIENCY STANDARDS

In 2022, the legislature passed The Appliance and Equipment Efficiency Standards Act (Act) (P.L. 2021, c.464). The Act establishes that beginning January 18, 2023, no person shall sell, offer for sale, lease or install a new product identified within the legislation, unless the new product includes a mark, label, or tag denoting the product meets or exceeds the prescribed efficiency standards. The law also prohibits the installation for compensation of any product identified in the law unless the new product has a mark, label, or tag denoting the product meets or exceeds the standards. The water-related categories defined in the law include commercial dishwashers, commercial steam cookers, faucets, portable electric spas, showerheads, spray sprinkler bodies, urinals, toilets, and water coolers. The Appliance Standards Awareness Project estimates that 136 billion gallons of water would be saved through 2035.

WATER SYSTEM RESILIENCE

New Jersey is the eleventh largest state by population and by far the most densely populated, with roughly 90 percent of all residents (and associated businesses and government facilities) being served by PCWS. The water infrastructure represents massive expenditures over more than 150 years. The Water Quality Accountability Act of 2017 (WQAA) establishes a formal framework for ongoing asset management of water systems, including the treatment and delivery components. The WQAA was adopted in recognition of aging infrastructure and increased issues with water system resilience in the face of more severe wet weather events. It enhances DEP authority to ensure proper maintenance of water systems. Water system resilience also requires attention to each public water system's ability to provide sufficient water through intense droughts, through a combination of internal and external resources and emergency connections to other systems. Finally, resilience and sustainability of a PCWS requires that its customers pay their bills; therefore, affordability is recognized nationally as an aspect of utility resilience.

PROMOTE WATER SYSTEM INFRASTRUCTURE RESILIENCE

Management of distribution system water losses primarily addresses either ongoing losses or the net effect of many pipeline breaks. Regardless of the level of loss, the overall system continues in operation and meets customer needs. In this section, the focus is on short events that fundamentally damage infrastructure and disrupt system operations, including catastrophic loss of function. Examples include flooding of treatment plants, loss of primary water transmission lines, and mass damage of water mains and customer connections in a coastal erosion event (e.g., Hurricane Sandy). Regarding contamination, episodic events such as Harmful Algal Blooms (HABs) caused by cyanobacteria blooms can disrupt treatment facilities.

"Black swan" events[5] do happen. In each case, the timing and severity of such events is not predictable. However, risk assessment combines risk probabilities with potential damages to determine what facilities are of greatest concern in the event of a severe or destabilizing event. The question then is whether to modify the facility to avoid potential damages. If potential damages are high, system modifications could be worthwhile even at relatively low event probabilities. Conversely, the lower the potential damages, the greater the probability of damage must be to justify action. Climate change is predicted and demonstrably has already begun to exacerbate risks from severe weather events.

[5] A "high-impact event that is difficult to predict under normal circumstances but that in retrospect appears to have been inevitable." Britannica.

This kind of event-based risk assessment is a component of overall asset management. However, system resilience often is not directly assessed in general utility asset management efforts, as utilities tend to focus on the potential for "normal" damages such as pump or pipe failure due to aging. These are threats from within and based on the nature of the system – endogenous threats. External (exogenous) threats (e.g., severe weather events, terrorism, construction excavations not related to the utility) are more often addressed through separate efforts such as the New Jersey Hazard Mitigation Plan from the New Jersey Office of Emergency Management. Federal requirements since the 9/11 (2001) terrorist attacks included a new focus on drinking water treatment plants, reservoir dams and pipelines. The federal American Water Infrastructure Act of 2018 requires utilities to assess natural and man-made risks and update their emergency response plans. In addition, utilities often focus specific attention on well-known weak points of their system, such as major pipelines or treatment plants in flood plains, as shown in the raising of the Bridgewater-Raritan Plant flood wall, which successfully prevented Hurricane Ida flooding. Dam safety requirements are also a routine component of reservoir operations, maintenance, and upgrades.

Open storage of finished drinking water is a special case for system resilience. In general, federal and state policy requires that finished drinking water be stored in closed facilities. A few New Jersey utilities have open storage, which provides considerable storage at low cost but are subject to introduction of pollutants from wildlife, air deposition and, in a few cases, storm runoff. There is a trade-off between storage volume and quality protection, and exogenous events exacerbate the potential for contamination, which would occur at times where the utility customers are already stressed by flooding or other regional events. The Department is working with the utilities which have these sources to identify the best options which balance water supply flexibility with water quality protection and security concerns.

After Superstorm Sandy, DEP 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 the resources provided below.

- DEP Division of Water Supply & Geoscience Home Page (**DEP-DWSG**)
- Asset Management Policy Program: Renewing New Jersey's Water Infrastructure web site (**DEP Asset Management**)
- DWSG Emergency Response and Preparedness web site (**Emergency Response & Preparedness**)
- Emergency Response Preparedness/Planning Guidance and Best Practices (**Guidance pdf**)

DEP 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, DEP continues to work with water purveyors to implement asset management requirements of the Water Quality and Accountability Act, as discussed earlier in this appendix.

It is appropriate for DEP and other state agencies to explore the benefits of providing additional guidance and clarity on expectations for severe weather and incident/event scenarios that should be used in resilience planning, such as riverine flooding, coastal storm surge and erosion, HABs, and compounding problems (e.g., long-term erosion of a river that exposes a transmission line, making it more prone to damage from a catastrophic event). The most appropriate method for developing such guidance would be a compilation of best practices from existing utility practices, national guidelines, etc. Another option is to require a formal risk assessment for a small number of assets that pose the greatest threats if they fail catastrophically. The third option is to require use of the risk assessment or the Utility Resilience Index approach[6] in the asset management process under the WQAA.

6 American Water Works Association. 2021. ANSI/AWWA J100-21 – Risk and Resilience Management of Water and Wastewater Systems. https://engage.awwa.org/PersonifyEbusiness/Store/Product-Details/productId/88116441

EMERGENCY AGREEMENTS BETWEEN PURVEYORS

Emergency agreements to provide water are a fundamental response to the potential for temporary system failure (e.g., a well failure or treatment plant issue) or temporary need (e.g., drought). The existing Water Allocation rules at N.J.A.C. 7:19-6.9(g) (Operation of Interconnections) require DEP approval of all such agreements. These reviews are typically reviewed as part of the Emergency Response Plan each system is required to submit and have on file. 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 or routine 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 AND SYSTEM STORAGE REQUIREMENTS

DEP continues 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), the New Jersey RiverWare Model and or equivalent tools, 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. Recently the Department worked with North Jersey District Water Supply Commission and Veolia Hackensack to modify normal operations of the Wanaque aqueduct. This work resulted in reduced drought risk with minimal impacts to day-to-day operations. For more information on the Interconnection Study and the WSMDST, please refer to: **Interconnection Summary**.

One issue that deserves further consideration is the relative reliance on internal system resilience, including the ability to store sufficient finished drinking water to meet emergency needs such as system malfunction and emergency needs to off-line water supplies due to finished drinking water quality issues (e.g., Legionnaire disease, contamination of open water storage), versus reliance on interconnections that provide external water supplies during emergency situations. Reliance on interconnections means that the resilience of the sending system should be assessed as well, to ensure that contracts are in place and the sending system can verify availability and provision of water at needed times, even if their system is also undergoing a stressed condition. The value of regional connections between large systems, such as in the Northeast Region (e.g., Passaic to Hackensack, Upper Passaic to Lower Passaic/Hudson County, Raritan to Passaic) in responding to drought conditions also requires assessment of resilience between systems.

With the more recent emphasis on water quality, particularly with regard to lead release since 2016, water purveyors have shown to be more reluctant to make bulk transfers of water outside of emergencies, or routine bulk sales. Ordered bulk transfers during the drought of 2016-2017 were generally disregarded by purveyors in the Northeast.

SURFACE WATER RESERVOIR SYSTEM MODELING

Most reservoir-based water systems have developed safe yield models to determine the amount of water than can be routinely provided during a repeat of the drought of record for that system (usually the 1960s multi-year drought, but a few systems use other droughts as the drought of record as a shorter but more severe rainfall deficit period). Two models have been developed by the New Jersey Water Supply Authority (for the Raritan System, using the RiverWare modeling platform) and the North Jersey District Water Supply Commission (for the Wanaque/Monksville System) to update safe yield estimates. DEP will continue to develop computer models to simulate water availability under a variety of assumptions for regional and inter-regional groups of water systems. One has been developed using RiverWare for the Hackensack/Passaic River Basins and is used in water allocation reviews. An inter-basin model linking the Hackensack/Passaic and Raritan models may be valuable, given the existing and potential interconnections between the two basins. DEP will be expanding the scope of this model to address all surface water systems, including interconnection flow scenarios. 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). DEP expects that systems update WCDMP's to ensure that they are accurate and implementable. All water purveyors will implement their WCDMPs as approved by DEP. DEP will enforce the requirements of the existing rules to ensure that drought management and response plans are up to date. 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 water loss, or which otherwise have the effect of maximizing water supplies during periods of low precipitation or below-normal water supply storage; and
- for purveyors with reservoirs, rule curves for reservoirs that can be used to establish storage level thresholds that will trigger appropriate actions.

DEP 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 that is compatible with and capable of incorporating reported results under the Delaware River Basin Commission requirements, inclusive of best management practices and reporting requirements. Water auditing, as discussed previously in this appendix, 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 DEP 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 WATER ALLOCATION REGULATIONS TO ADDRESS 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. The Department is considering amendments to the existing rules (NJAC 7:19), which have been readopted without substantiative change since 1990. Amendments to the rules are needed to reflect amendments to the Water Supply Management Act, N.J.S.A. 58:1A-1, enacted in 2002 that related to temporary water allocation permits in Salem and Gloucester Counties; in 2004 related to provisions of the Highlands Water Protection and Planning Act (Highlands Act), N.J.S.A. 13:20; in 2006 exempting the payment of water use registration annual fees for volunteer fire companies pursuant to N.J.S.A. 40A:14-70; and the enactment in 2008 of the Environmental Enforcement Enhancement Act in accordance with N.J.S.A. 58:1A-16d. Other proposed amendments are intended to simplify the water emergency surcharge schedule, modernize and simplify business process, increase flexibility, incorporate stakeholder input and create consistency across Department programs. This includes proposed amendments to address issues recognized after the 2002 drought emergency. A number of problems with the existing rule have been identified, which inhibit the Department and permittees to efficiently and effectively respond during drought emergencies.

One of the issues recognized in past drought declarations is the need to reduce purveyor minimum passing flows prior to declaring a drought warning. Current rules permit passing flow reductions to occur under a drought warning declaration. Generally, by the time a drought warning is declared, stream flows are low enough that reductions do not provide a significant net gain in storage as it would if the passing flows could be reduced earlier when stream flows are higher. The ability to reduce minimum passing flows during drought watch would keep more water in storage when flows are higher and could mitigate the need to declare a drought warning.

DISCONTINUATION OF GENERAL "OVERDRAFT" PROVISIONS

DEP assesses the impact of seasonal variations in water use 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 provisions they should be supported by both safe yield models and guaranteed contracts between water purveyors. DEP 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 works with water supply purveyors to ensure they have proper financial and technical assistance in meeting the requirements of the Water Quality Accountability Act (WQAA). DEP has developed or helped develop appropriate standards and check lists with the Department of Community Affairs and the Board of Public Utilities to achieve the goals of the Act. To simplify compliance with the WQAA, DEP developed an online portal for submittal of all required information using standardized forms; this approach also makes it possible for DEP to then provide the results for public review and to conduct statistical analyses of the data.

The New Jersey Environmental Infrastructure Financing Program (NJEIFP) is a joint effort of DEP's State Revolving Fund (referred to here as DWSRF), the New Jersey Infrastructure Bank, and additional funds as appropriated by the Legislature, including federal funds such as the Infrastructure Investment and Jobs Act of 2021 (Bipartisan Infrastructure Law), the Disaster Relief Appropriations Act for Hurricane Sandy (2013), and the American Recovery & Reinvestment Act of 2009. DWSRF and associated funding is made available in conformance with the Intended Use Plan adopted each year by DEP (see **DWSG Loans and Capacity Development**).

AFFORDABILITY AND PCWS RESILIENCE

Good planning is only as valuable as the implementation that follows, and all implementation requires funding. In some cases, capital projects may reduce operation, maintenance and rehabilitation costs, offsetting some or all of the capital costs. However, in many cases, rates will need to rise to provide sufficient revenue for effective O&M and asset management, including both structural and personnel assets. As a result, customers will be required to increase their payments, which can be financially stressful for lower-income households and businesses. The USEPA has used affordability as a factor in determining whether a utility has a sufficient financial capacity to meet drinking water and wastewater requirements, but their guidance is not focused on customer affordability per se. National and New Jersey evidence shows that drinking water and sewer (water) utility costs have been rising for decades in response to regulatory requirements and asset management needs.

There is an extensive literature on the affordability of costs for water utilities, but no national consensus yet exists on the best approach or whether a "best approach" can even be defined. However, there is growing consensus that use of median household incomes (in line with 1990s USEPA guidance on utility financial capacity) is not appropriate, as household financial stress is more likely at lower income levels, such as the 20th percentile income (aka Lowest Quintile Income). These issues are discussed in two reports that provide the only New Jersey-specific evaluation of household financial stress from a combination of drinking water and sewer utility costs relative to 20th percentile income (Van Abs & Evans, 2018; Van Abs et al., 2021). The latter report estimated that roughly 20 percent of New Jersey household have water utility costs that exceed a baseline affordability threshold, assuming that all households directly pay their water utility bills (recognizing that some pay indirectly through rents or are subsidized through affordable housing programs). These households are concentrated in historic urban areas, as expected, but also are common in inner ring suburbs, more recent suburban areas, and some rural town centers.

For this reason, affordability will be an ongoing concern in many areas of New Jersey, potentially harming the resilience of drinking water utilities that face strong opposition to rate increases despite their asset management and improvement needs. High inflation rates which occurred over the last several years need to be considered in future cost analyses as well.

INTERCONNECTIONS, CONJUNCTIVE USE AND MANAGED AQUIFER RECHARGE

PCWS in New Jersey range from very small, isolated systems serving individual developments or buildings to very large systems serving nearly 1 million people. Many of the smallest systems serve residential developments that use septic systems or other discharges to groundwater, and therefore have a limited impact on water availability. However, the medium and large systems have larger withdrawals or rely on other water purveyors for bulk purchases of treated drinking water; they often are in areas with sewer systems, which can result in significant depletive and consumptive water demands. These systems may also face more significant drought impacts. Several approaches can reduce the sensitivity of these systems to drought or seasonal shortages.

WATER SUPPLY SYSTEM INTERCONNECTIONS

One approach to offset supply risk is to interconnect with other systems for routine or seasonal water supplies to optimize the use of regional water resources (separate from emergency transfer issues). Many systems in the more densely populated areas are interconnected with neighboring systems and transfer water on a regular or emergency basis. Interconnections and bulk purchase contracts are reviewed by DEP. Interconnections add to overall reliability and resiliency. It is important that the quality of the transferred water not be detrimental to the receiving system and that the sending system's resilience is not diminished by the transfers. DEP will work with purveyors make sure any such problems are prevented or minimized. See discussion of Interconnection Study and WSMDST above under Water System Resilience, above.

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. One example is where a system diverts water from an unconfined aquifer at times of high availability and then relies on confined aquifers when water use, temperatures and sparse precipitation could more adversely affect surface water resources. Another example is the use of "run of the river" withdrawals during higher flows, and then shifting to reservoir supplies in times of low flows. In New Jersey, where few sites remain for additional conventional water supplies (e.g., new reservoirs sites, untapped rivers, unused aquifers), conjunctive use offers significant potential to extract the most use from available supplies for some but not all systems. 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 are other forms, including the combined use of various surface water 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.

MANAGED AQUIFER RECHARGE

There is established benefit and continued interest in using confined aquifers as storage reservoirs to provide water stored during off-peak periods to meet peak demands. Managed Aquifer Recharge (MAR) is the process of pumping excess allocation waters into an underlying aquifer for storage and future recovery. This may be more commonly known as Aquifer Storage & Recovery (ASR), but DEP prefers the term MAR as it more broadly covers the multiple operational permutations that may go into these types of projects, of which one is ASR. While the injected water is treated to meet the drinking water Maximum

Contaminant Levels (MCLs), revised review procedures were developed to ensure compliance with the Ground Water Quality Standards, N.J.A.C. 7:9C (GWQS). The Division of Water Quality (DWQ) in coordination with the Division of Water Supply and Geoscience (DWSG) developed comprehensive review procedures for MAR projects with the goal of safeguarding the drinking water supply, while maintaining compliance with the Safe Drinking Water Act and protecting ground water quality by ensuring compliance with the GWQS.

As of May 2023, there were 20 approved MAR wells in 16 DEPS permits in the state of New Jersey. Nine (9) of the MAR operations are considered permit-by-rule (PBR), meaning no New Jersey Pollutant Discharge Elimination System (NJPDES) Discharge to Ground Water (DGW) permit was previously issued for the operation. The DWQ is currently in the process of obtaining additional information from these 9 entities to properly regulate and monitor these operations through issuance of an individual NJPDES DGW permit. This additional requested information includes, but is not limited to, pollutant characterization scans of the underlying aquifer water quality and the injectate water quality to review compliance with the GWQS. Scans for pollutants of emerging concern are also being required under the updated review procedures. This additional information will aid the facility in better understanding their system and will facilitate consistent permitting for all MAR operations.

The 2008 Statewide Interconnection Study recommended that DEP continue to promote MAR 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 MAR is contingent upon the geology of an area and the ability to use the wells without interference to other aquifer users. MAR wells can be used to manage saltwater intrusion in Areas of Critical Water Supply Concern as well as in Cape May County.

MAR is a water supply management alternative that has been effectively used by water purveyors in New Jersey since the last century. Sites are typically located on the Atlantic coast where supplies are limited, and summer demands can be very high. It is often used to meet seasonal demands and to prevent saltwater intrusion. MAR is a very valuable water supply management tool and will continue to be utilized and supported by the Department where appropriate.

WATER SOURCE SUBSTITUTION

Water users generally rely on water supplies that are appropriate for their needs. Households, office buildings and commercial facilities rely on public water supply systems (ground or surface water supplies, treated) or self-supplied wells (mostly untreated). Agriculture, golf courses and mining rely primarily on untreated water from surface waters or shallow groundwater systems. Manufacturing facilities may use water either from public water systems or local raw water resources, but in either case they will often pre-treat the water to match manufacturing specifications. Electric power generation facilities will typically use local surface waters, also pre-treated to reduce fouling of the power plant and cooling facilities. Each of these uses places some level of stress on the natural water supplies. Water use efficiency and water conservation reduce these stresses. However, in certain circumstances, a shift in water source can reduce an existing stress. There are several key factors in water source substitution. First is to ensure that the substitution does not cause its own problems. For example, shifting from an unstressed supply to a stressed supply is inappropriate even if less expensive to the user. Regarding Reclaimed Water for Beneficial Reuse, or RWBR, wastewater treatment plant discharges to freshwaters are important to streamflow, and reduction of that discharge through diversion to beneficial reuse would harm aquatic ecosystems. Conversely, RWBR is a net positive for any wastewater discharge to ocean waters. It is important to note that RWBR is distinct from historic indirect reuse, such as when wastewater effluent is discharged to a river and subsequently withdrawn for a new use downstream. That process is common in rivers across the country, and especially relevant in the Passaic River Basin.

Second, costs often limit water source substitution. Major water source substitutions may require new facilities, such as the Manasquan Reservoir (Water Supply Critical Area #1) and the New Jersey American Delran Intake (Water Supply Critical Area #2). RWBR requires a means of transporting the treated effluent to its users, which may be expensive. For street sweeping and sewer jetting, the cost will be lower for areas close to a wastewater treatment plant, but higher for a longer trip. For RWBR to golf courses and industry, pipeline costs will be a major factor. And, if additional treatment is necessary prior to reuse (e.g., for food crop agricultural purposes), that additional treatment cost can make a project nonviable.

One option is to improve the planning process to identify water sources and public water systems that face stresses amenable to water source substitution and RWBR, and also to identify wastewater treatment plants where loss of discharge flow would not cause harm to downstream resources (e.g., ocean discharges). The planning process would then identify opportunities for effective water source substitution as well as regulatory changes that might be needed.

A second option is to identify public water systems, especially smaller systems with their own water sources, that are most at risk for contamination that makes their existing supply financially nonviable, and identify opportunities for water source substitution, including interconnections, that would be cost-effective.

A third option is to assess changes to New Jersey laws and building codes that would reduce barriers to beneficial reuse of stormwater and wastewater within a project's boundaries (as with Battery Park City in New York City), with appropriate consideration to long-term maintenance and management of the facilities.

POTENTIAL NEW AND EXPANDED SOURCES OF SUPPLY

As discussed in Chapter 4 and in more detail in Chapter 6, some water supply resources in New Jersey are showing confirmed or possible current or future stresses where existing or future water withdrawals may harm stream ecosystems or exacerbate saltwater intrusion, if not managed. The DEP Water Allocation program is responsible for ensuring that water allocation permits protect other water users and the integrity of water resources. Through past planning efforts, some capital projects have been identified as potential future water supply resources. Most are not needed immediately but hold potential for meeting future needs.

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 1980s using 1981 Water Supply Bond Fund monies.

The Virginia Street Interconnection/Pump Station was constructed over 35 years ago and is currently limited in size; in addition, limited resources have been devoted to operation and maintenance. The primary question is how to distribute costs for a facility that involves multiple parties, each with their own systems, but could be critical to Northeast water systems during droughts. DEP 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. However, the Raritan System has ample remaining safe yield for normal purposes, and so Passaic to Raritan transfers would be for limited periods only.

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 significantly 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 greatly reduced, if all other factors had remained the same.

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. DEP will work with purveyors to evaluate the utility of these improvements to strengthen the Northeast Drought region.

ADDITIONAL INTERCONNECTION OPTIONS

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 DEP'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 New Jersey can greatly increase 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

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, as the NJWSA Raritan System as of early 2023 has 59 mgd of safe yield (of 241 mgd total) that has not been contracted for sale to water systems within the Raritan region. DEP 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.

KINGSTON QUARRY RESERVOIR

This project was proposed by Trap Rock Industries, Inc. as the eventual reclamation plan for their rock quarry when operations cease. It was studied in the Eastern Raritan Basin Water Feasibility Study and incorporated into the 1996 and 2017-2022 NJSWSPs. The quarry is located in Franklin Township, Somerset County, directly adjacent to the Delaware and Raritan Canal and Millstone River. At completion, it is anticipated to have two large areas that extend well below the Canal level, providing an opportunity to store unused Delaware and Raritan flows and high flows from the Millstone River for release during low-flow periods. Water diversions from these sources will flow by gravity into 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 nearly one-quarter of NJWSA Raritan System safe yield still available, increased conservation and changing population projections, it is still uncertain as to when the increased safe yield will be needed.

The Kingston Quarry Project has been shown to be the most cost effective of the projects. However, due to quarrying rates as of 2023, the quarry is still actively being used, and it is unclear when it might be available for use for water supply. DEP 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; and
- 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 was 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 to the Delaware & Raritan Canal, (discussed in detail in Delaware River Basin Commission section in Chapter 5), the total additional safe yield is estimated to be 120 mgd.

In addition to the Kingston Quarry Project, DEP 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.

CONFLUENCE PUMPING STATION

This project would be located where the North Branch and the South Branch of the Raritan meet to form the mainstem 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 if additional safe yield is needed in the NJWSA Raritan System.

The existing release pipeline from Round Valley Reservoir to the South Branch of the Raritan River 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 2015 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 confluence 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 pipeline 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 final issue is how the introduction of water from the confluence would affect water quality of Round Valley Reservoir, which currently receives water only from the South Branch Raritan River, through the Hamden pumping station. Round Valley Reservoir has been designated Category One (C1), such that no reduction in water quality is allowed. For these reasons, the Kingston Quarry project may involve fewer issues regarding water quality and would not entail creation of a new pipeline, reducing issues of property acquisition. The confluence project is currently not being actively pursued but is a potential project for the future.

MULTI-DAY PASSING FLOW AVERAGING

The New Jersey Water Supply Authority was created by New Jersey Statute NJSA 58:1B-1 et seq. and the Raritan System passing flows are also defined in the same statute. This is atypical in New Jersey as most of the other passing flows are defined in Water Allocation permits. The statute states:

> *"8. a. Whenever the flow of water in the south branch of the Raritan river is less than 40 million gallons daily at the United States Geological Survey stream gauging station at Stanton, or less than 70 million gallons daily at the United States Geological Survey stream gauging station at Manville, or less than 90 million gallons daily at the United States Geological Survey stream gauging station at Bound Brook, a sufficient amount of water shall be released from the Spruce Run reservoir, or from the Round Valley reservoir or any other reservoir or reservoirs as may be constructed on the Raritan river or its tributaries, and from the Round Valley reservoir in the amounts as will maintain not less than the aforementioned flows of 40 million gallons daily at Stanton and 70 million gallons daily at Manville and 90 million gallons daily at Bound Brook…"*

The statute also states that:

> *"b. The commissioner is authorized to alter the passing flow requirements set forth in subsection a. of this section as necessary to ensure the protection of the public health, safety or welfare, or the protection of the environment."*

In order to meet the passing flow requirements, reservoirs releases are made anywhere from 24 to 72 hours in advance. Releasing too much water wastes storage which might be needed later in a water supply emergency. Releasing too little water results in a violation and can negatively impact downstream ecology and water users. Predicting the precise amount of water to release requires perfect weather and hydrologic forecasting skills- which is problematic at best. Accurate releases require accurate weather forecasts and specifically accurate rainfall-runoff forecasts and river travel time estimates- all of which are highly variable and dependent on antecedent conditions in the watershed. These forecasts are inherently imprecise and in order to prevent a miss of the passing flow, the Authority ends of releasing too much water. Initial assessments suggest that a multi-day averaged passing flow scheme would allow the Authority to reduce over releases, because they would have additional time to balance out an under release over the next several days. More efficient use of stored water results in increased water supply and system resiliency and decreased costs to customers. Additional work is required to quantify appropriate flow ranges that are protective of instream ecology and downstream users and multi-day averaging length, and statutory changes may be needed.

Most reservoir passing flow requirements in the state are immediately downstream of reservoirs so forecast inaccuracy is not a major problem, however if there are other systems that would benefit from this passing flow method it should be considered for them as well.

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. 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 Middlesex Water to purveyors in the South River Basin 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, DEP recommends that Middlesex Water and all involved water supplies work with DEP 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, DEP 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 (after the Kingston Quarry and Confluence Pumping Station), and will remain on the list of potential water supply projects. Except for a few smaller properties, the entire site has been purchased and is managed as a passive recreational resource by DEP State Park Service. The DEP 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 NJSWSP 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 a portion of the property which would have held the reservoir has been sold to private parties. Another portion is part of Allamuchy State Park. As part of this Plan the reservoir is retained on the list of potential projects even though its future development has multiple technical and geologic hurdles that needs to be addressed.

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 DEP will 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.

In addition, as discussed in Chapter 2, some existing water supply resources have been or may soon be contaminated by substances that are difficult or costly to treat. Where a water system may determine that continued use of that water resource is currently not cost-effective, improvements in technology could result in continued or resumed use of the water resource.

The continued and possibly expanded use of desalination, advanced treatment, reuse, ASR and conjunctive use will be considered as part of the multifaceted solution to long-term water supply needs in that region. DEP 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.

OTHER ACTIONS TO USE WATER EFFICIENCY AND REDUCE IMPACTS

NEW OR INCREASED ALLOCATIONS FOR HIGHLY CONSUMPTIVE NON-POTABLE USES

Decisions to allow for new or increased water allocations and water use registrations 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) provide that potable supplies would be preserved for potable purposes where appropriate, and RWBR would be encouraged for non-potable purposes. Such policies 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.

ASSESSING 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 2020,[7] New Jersey's agriculture which includes fresh fruits and vegetables, feed crops, livestock, greenhouse and nursey has a $13.6 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, many of New Jersey's highest-value 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 use 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. DEP 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. 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).

Based upon the last five years of agricultural use data reported to DEP through 2020, agricultural users are using only about 25% of their annual allocation. The results of the surface water and unconfined groundwater availability assessment (see Chapter 4 and Appendix A) indicates water withdrawals would exceed water availability at full allocation in 90 of the 151 onshore HUC11 watersheds; 28 of these would have agriculture as the major source of diversion. 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. Further efforts between the DEP, the State Agriculture Development Committee, the Department of Agriculture, Rutgers Agricultural Agents and other agriculture stakeholders can help obtain a solution for gathering better agricultural water use data.

[7] Northeast Economic Engine: Agriculture, Forest Products and Commercial Fishing, accessed May 8, 2023 from **Farm Credit East Knowledge Exchange**

A USGS funded study conducted by DEP installed meters on 10 existing agricultural diversions. The metered results were then compared to the reported estimates. Results showed that metered results were significantly different than the estimates which are currently required under the Agricultural Certification requirements. Of note, was the observation that larger diversions, approximately greater than 2 million gallons per month, were statistically different than the reported value and almost always with the reported value greater than the estimated value. This has ramifications for planning and modeling in regions where agriculture water use is large.

DIVERSION IMPACTS TO WETLANDS

Water diversions, located outside of wetlands and transition areas, and therefore outside the jurisdictional area of the Freshwater Wetlands Protection Act (N.J.S.A. 13:9B), have the potential to adversely affect groundwater dependent threatened and endangered species habitat through drawdown of groundwater levels. However, the cooperative review of impacts to wetland impacts by the Divisions of Water Supply & Geoscience (DWSG) and of Land Use Regulation (now Watershed and Land Management) ceased following a 2009 decision, In Re Agricultural, Aquaculture and Horticultural Water Usage Certification Rules, N.J.A.C. 7:20A-1.1 et seq. that held that agricultural impacts to wetlands should not be regulated under the Water Supply Management Act, but rather should be regulated pursuant to the Freshwater Wetlands Protection Act (FWPA). However, as noted above, the actual drawdown that impacts wetland habitat often originates (e.g., a pumping well) outside of the jurisdictional limits of the FWPA. Such diversions are known to impact the hydrology and therefore vegetation and habitat value of the wetlands. Consistent with Federal law, DWSG continues to review impacts to Federally Threatened or Endangered species habitat as part of the standard review for new or modified permits in accordance with N.J.A.C. 7:19-2.2 et seq.

DWSG is reviewing its legal authority to proceed using the protocol for the review of wetland impacts used prior to 2009, which was already focused on endangered and threatened species habitat coincident with wetlands. These habitats are in need of protection because the species they support cannot easily sustain habitat degradation resulting from alterations to the hydrology. The review of these impacts is equivalent to the existing review of instream impacts to surface waters that occurs for the protection of aquatic species. The review of impacts to wetland habitats is not only supported by the above-referenced statutes and cases but also by the Water Supply Management Act itself, at N.J.S.A. 58:1A-2, where Legislature finds that DEP must manage the water supply in order to, among other things, protect natural environment of the waterways.

ADEQUATE ASSET MANAGEMENT

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 New Jersey Chapter released its “2016 Report Card” for New Jersey infrastructure, which included a “C” (mediocre) grade for drinking water (see **New Jersey Infrastructure Report Card** and **New Jersey Infrastructure Report Card Summary**). In April 2023, the United States Environmental Protection Agency (EPA) estimated in its 7th Drinking Water Infrastructure Needs Inventory that $12.23 billion in capital investments are needed over the next 20 years to install, upgrade, and replace New Jersey’s drinking water infrastructure. These estimated needs are based on a national statistical survey of large, medium and small community water systems, in collaboration with state agencies and others. For the first time, information on lead service lines is included in the survey. USEPA reports that this inventory is the most detailed in several inventory cycles, representing a robust analysis of needs by state and nationally. While the Water Quality Accountability Act will provide additional needs information, the USEPA report provides a solid foundation for identified needs at this time. What it can’t necessarily achieve is an accounting of needs that have not been identified but will be in the coming years through improved assessment management planning.

MAINTAINING INFRASTRUCTURE

Beginning in 2008, the New Jersey Clean Water Council (CWC) conducted public hearings focused on water-related environmental infrastructure (including drinking water), regarding objectives, needs, financing, and management in the State. A recurring theme was the need for greater attention on asset management, including adequately funding related assets on a sustainable basis.

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 DEP and BPU/DCA (on the cost), such as:

- the elimination of disincentives for proper infrastructure management;
- a mandate for proper asset management;
- full cost pricing of delivered water; and
- municipal assistance.

In response, DEP developed asset management guidance consisting of the following elements: (a) a means of routine asset condition assessment; (b) a programmed and preventive maintenance system; and (c) a procedure for evaluating the life-cycle cost impacts of repair or replacement decisions. The Jersey Water Works collaborative (including USEPA and DEP as ex officio partners) engaged in further analysis of these issues. Subsequently, the legislature approved the Water Quality Accountability Act as one critical response to the need for improved management, as discussed earlier in this appendix.

DEP ASSET MANAGEMENT POLICY PROGRAM

In addition to the implementation of the Water Quality Accountability Act, DEP promotes responsible asset management and adequate infrastructure reinvestment, which are universally accepted practices essential to ensuring 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 (i.e., life cycle costs) 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 maintenance/rehabilitation/replacement approach 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 financial and human elements involved. Therefore, an effective strategy needs to include assurances that educated, adequately trained, and certified personnel (licensed operators) supervise and implement utility operation. This includes recognition that adequate succession planning is essential to assure the long-term viability of any utility. Financially, water systems must have sufficient revenue to support normal operation and maintenance, capital projects (using reserves, current revenues or debt financing), and reserves to address emerging needs, revenue instability and emergencies.

Implementation of sound asset management strategies will play a major role in enhancing New Jersey's public health, environment, and economy. DEP encourages asset management through 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 DEP's Asset Management webpage: **DEP Asset Management**.

USING THE DEP 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, DEP 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:

- reducing or eliminating the number of existing public water systems in significant non-compliance with the Federal and New Jersey SDWA rules;
- ensuring that public water systems have adequate technical, managerial, and financial capacity to achieve and maintain compliance with the Federal and NJSDWA Rules, and evaluating the TMF capacity of systems that are to receive funds through DEP's State Revolving Fund; and
- preventing the formation and operation of any new water system (community and non-transient, non-community water systems) that may be non-viable in the future, such as a small customer base.

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 DEP's Compliance and Enforcement section and county health departments, utilizing EPA's Enforcement Targeting Tool.

New Jersey's Capacity Development Strategy includes evaluating systems based on the capacities described below.

- **Technical capacity:** ensures 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:** ensures 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.
- **Financial capacity:** ensures that 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 continuing 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

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 New Jersey Water Bank has helped keep costs to the public as low as possible. The Department promotes utilization of the Water Bank to local water systems as a cost-efficient way to finance capital water projects, in partnership with the New Jersey Infrastructure Bank ("New Jersey I-Bank"). The New Jersey I-Bank was originally created by legislation enacted in 1986 to establish an independent State authority (originally as the New Jersey Environmental Infrastructure Trust) to manage efficient and low-cost financing for environmental infrastructure projects.

The two agencies partner to provide low-cost funding to finance critical projects including the construction and enhancement of safe drinking water infrastructure through the New Jersey Water Bank. Qualified projects enhance and protect ground and surface water resources, ensure the safety of drinking water, and facilitate responsible, sustainable economic development. They 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.

DEP's Bureau of Water System Engineering jointly manages the DEP's State Revolving Fund (from federal grants under the Safe Drinking Water Act) program with DEP's Municipal Finance and Construction Element and the New Jersey I-Bank. Leveraging by the New Jersey I-Bank (i.e., the sale of revenue bonds, the proceeds of which are used to fund the New Jersey I-Bank's portion of project loans), allows the State to provide low interest loans to more projects.

The Federal SDWA Amendments of 1996 authorized the DWSRF to assist both 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. In addition to assessing New Jersey's infrastructure needs, the Drinking Water Infrastructure Needs Survey (discussed previously in this section) is used as the basis to determine the amount of the federal grants allocated to each State's DWSRF program.

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 funds authorized by the SDWA Amendments. The IUP details how the State of New Jersey finances projects to be included in New Jersey's Water Bank Program and which projects are reviewed by DEP, with respect to the capitalization grant. The non-project set-asides provide for DWSRF activities that are not construction related, including 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 **DEP WIIP Intended Use Plan and Project Priority Lists**.

DEP's portion of a DWSRF loan provides a portion of the allowable project cost interest-free, with the possibility of principal forgiveness (i.e., loan funds that need not be repaid). The New Jersey I-Bank loan covers the remaining portion of the project's allowable cost at the New Jersey I-Bank's AAA-rated market rates, through the issuance of bonds secured with DWSRF funds. Through leveraging by the New Jersey I-Bank, the State is able to fund far more projects than would be possible with the federal grants alone. 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. It should be noted that the 1981 Water Supply Bond Act authorized financing only to publicly owned systems, and the federal 1996 SDWA amendments did not change this state law. In FFY2014, New Jersey developed a small systems loan program ("NANO") leveraged by the New Jersey I-Bank 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.

Funds available to the State for future appropriations will be allotted according to a formula that reflects the results of the Drinking Water Infrastructure Needs Survey conducted pursuant to Section 1452(h) of the SDWA. The DWSRF allotment to New Jersey for FFY2014 to 2017 was 1.90 percent of the Federal DWSRF appropriation and was 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%) occurred as New Jersey's reported percentage of the total national needs decreased. Based on the 2022 Drinking Water Infrastructure Needs Survey, published in April 2023, New Jersey's share of national estimated needs is now 1.96 percent, a slight increase. 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 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.

For the past 36 years, DEP and the New Jersey I-Bank have focused on cost and operational efficiencies to leverage State and federal funds through New Jersey I-Bank's publicly issued bonds that provide the lowest possible interest rate loans to Financing Program participants for the construction of environmental infrastructure projects. From 1998 to June, 2022, 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 (CWSRF). Thanks to a combination of low interest rates, principal forgiveness funds, and other cost saving features, from 1998 through June 2022, the Drinking Water component of the Water Bank has saved New Jersey ratepayers and taxpayers over $460 million.

The Water Bank Program has been averaging $59 million per year of funding for the construction of substantial drinking water treatment and distribution improvement projects, using federal capitalization grants from the USEPA at approximately $16 million annually.

The Water Bank however has recently been able to significantly enhance its funding capacity thanks to the enactment of the Bipartisan Infrastructure Law (BIL). This law provided $55 billion nationwide to support water projects, ranging from lead service line replacement, treatment for emerging contaminants, improve system resiliency, among many others. Of this, the New Jersey Water Bank is expected to receive $1 billion over the five-year appropriation of the BIL.

With the recent influx of money to support water infrastructure from the BIL, among other sources, the Department initiated the **Water Infrastructure Investment Plan** (WIIP). The WIIP is intended to highlight the availability of this low-cost funding to eligible borrowers, and defray the cost maintaining, and improving New Jersey's water infrastructure to its ratepayers.

The Water Bank program 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 sewer 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 DEP's joint DWSRF-CWSRF IUP. Prospective project sponsors complete a project information page that is ranked by DEP and included in the respective Priority Lists as a condition of eligibility for financing.

PROTECTION OF SOURCE WATERS

As discussed earlier in this appendix, DEP has an extensive program for planning, management and regulations of potential pollution threats to ground and surface waters. However, the increase in Harmful Algal Blooms, nonpoint source pollution and incidence of source water contamination from emerging contaminants of concern all indicate that further action is needed. DEP has been evaluating options for consideration in regulatory and non-regulatory programs, collaboration with other entities, and guidance for potential pollutant sources.

New development creates nonpoint source pollution that is subject to design requirements for soil erosion and sediment control during construction, and for stormwater management during and after construction. These requirements are technology-based to achieve some pollutant control, but they are not water-quality based in the same manner as NJPDES wastewater treatment plant permits. In addition, the technology-based requirements are the same regardless of whether the stormwater discharges to a stream that meets or does not meet the surface water quality criteria. These requirements only apply to new development; they do not apply retroactively to the vast areas of existing development. One option would be to vary the stringency of requirements for new development and redevelopment based on the existing water quality conditions, so that polluted waters are protected from further pollution. Another option would be to provide incentives for developers to improve existing water quality through both on-site and off-site pollutant control projects.

Agricultural practices have greatly improved from the mid-1900s but still, and perhaps inevitably, result in the movement of pollutants (e.g., fertilizers, pesticides, soil particles) into both ground and surface waters. Pesticide applications are regulated to minimize water quality pollution, primarily through a training and certification process. Fertilizer and soil erosion practices are encouraged through farmer education, but there are no specific regulatory requirements. The emphasis is on convincing farmers that excess or inappropriate nutrient use and application, and excessive soil erosion, are damaging to the long-term net profit of the farm and therefore against the farmer's interest. One option is to enhance both farmer education and the underlying research efforts showing what practices provide the greatest long-term net benefits. Agricultural pollutant control efforts could be targeted to water supply source waters, including use of the NRCS source water protection program through the federal Farm Bill.[8] DEP and the WSAC participated in a process that helped NRCS define source water protection areas where farmers are eligible for additional funding. NRCS is revisiting this process and may expand these regions modestly. A key step is to go beyond authorization of funding to a comprehensive implementation project.

Nondegradation policies have achieved benefits for water quality by ensuring that point source pollutant loads do not increase beyond levels permitted at the time of Category 1 or Class GW-1 designation, and by limiting development of undeveloped lands within 300 feet of the Category 1 surface waters (the riparian zone), through the Flood Hazard Area Control Act rules. However, only some water supply source waters are Category 1; in some waters, the automatic connection of Category 1 designation to the riparian zone (buffer) requirements (originally intended for ecological protection) may be inappropriate. While buffers are relatively easy to implement in upstream, less-developed areas, application of Category 1 buffers is more problematic for major river intakes such as New Jersey American's Delran water supply intake on the Delaware River, the Passaic Valley Water Commission intake at Little Falls on the Passaic River, and the New Jersey American intake at Bridgewater on the Raritan River. Applying Category 1 status to protect these waters would trigger buffers for large segments of the state. One option is to develop a nondegradation policy for regional water supply intakes that is tailored specifically to water quality protection, and then to apply the nondegradation to protection of all water supplies.

TMDL application is an important issue for source water protection. DEP has adopted TMDLs (Total Maximum Daily Loads, essentially a water quality improvement plan) for many streams, lakes and ponds, primarily for nutrients and fecal bacteria. Where point sources are required to reduce pollutant loadings, the regulatory process is straightforward. Permits are modified and a compliance schedule is imposed. Nonpoint source reductions are far more difficult and for the most part have been achieved only partly, if at all. Increasing rainfall intensity from climate change will only make success more difficult.

Regarding nutrients, the 2011 Fertilizer Law prohibits use of phosphorus fertilizer unless a soil test shows it is needed, and it regulates the timing and location of fertilizer applications by both consumers and professional applicators. No reports to date demonstrate water quality improvements in phosphorus or nitrogen concentrations; it may be too early but if the Fertilizer Law has been effective, DEP's ongoing ambient water quality results should begin to show results in coming years. To date, phosphorus and total nitrogen reductions have been associated with wastewater treatment plant upgrades and closures (NJDEP, n.d.-a) rather than to the Fertilizer Law.

The DEP provides grants to a wide range of organizations and governmental entities to implement nonpoint source pollution controls, including green stormwater infrastructure, but available funds are a tiny percentage of total needs, including the retrofit of existing stormwater systems to control pollutants. Just as an example, in early 2022, DEP announced nonpoint source pollution grant funding for the years 2020-2022 that totals $9.4 million. In comparison, the New Jersey Department of Transportation announced provision of $47.3 million in 2022 grants for local bridge repairs, only one small part of an annual capital budget of $2.35 billion dollars.

8 See **Source Water Protection | NRCS** (usda.gov)

One option is to better harness the existing regulatory and funding programs, and specifically TMDLs, to better protect and restore surface waters that are used for public water supplies. Other states (e.g., Pennsylvania, Minnesota, Virginia, USEPA Region 1 in Massachusetts) have incorporated TMDL provisions in the MS4 permits, requiring municipalities to reduce the stormwater pollutant loads from their MS4s over time. DEP's new MS4 permit has begun this approach, requiring Watershed Improvement Plans to improve water quality from MS4 discharges.

A second option is to focus attention on road runoff that harms surface water quality and stream structure, and work with NJDOT and other transportation agencies to mitigate harm from past road and transportation facility development, not just from new projects.

The **Wellhead Protection Program** provided valuable information on source water risks but could be improved as well. Much more information is available on pollutant source locations and risks than existed 20 years ago, allowing for a better assessment of potential risks. Better protection of the lands that provide water to wells (through aquifer recharge) would be another option. Information on how the areas are defined is available here: **NJGS Wellhead Protection Area Delineation Guidelines**. Finally, DEP regulatory programs could reassess their regulations regarding protection of public wells.

Finally, the highly successful **land preservation programs** of DEP Green Acres, the State Agriculture Development Committee, other state agencies, counties, municipalities, water supply agencies and non-profit organizations can be better coordinated to enhance source water protection. First, preservation efforts can be targeted to preservation of critical lands for source water protection, reducing the potential for inappropriate land use changes. Second, the management of preserved lands can be improved to maximize groundwater recharge and minimize pollutant generation and transport to ground and surface waters, such as through agricultural conservation plans and restoration of preserved open lands that have suffered from past land uses.

WATER RESOURCE AND DROUGHT MONITORING AND ASSESSMENT SYSTEMS

There are two critical aspects to understanding water resources management. One is to understand current and past status, which requires measurements, monitoring, modeling and trend analysis. The second is to understand what the future might bring, to the extent feasible given available data, forecasts, projections and modeling methods. We can know history with good information, but we can't change it. We can't know the future, but we can change it, with sufficient insight and planning. The question is how we take an understanding of the past and current times and develop estimates for the future, especially when climate change means that past attributes of temperature and precipitation are no long reliable benchmarks for the future, if indeed they ever were.

DEP, the U.S. Geological Survey and many other parties including water supply utilities have been monitoring New Jersey ground and surface waters for many decades, and they have developed models to assess the data in a useable form, such as safe yields and aquifer withdrawal limitations. This approach is critical to our ongoing ability to understand current status and possible futures. The importance of collecting and properly managing field data is often underestimated. There is nothing more fundamental in water resources management.

AMBIENT AND DROUGHT MONITORING

As indicated in Chapter 5, DEP 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 DEP. The networks are described below.

- ***The Stream Gauging*** **Network:** collects continuous stage and discharge data at 90 stream stations and low flow data at 36 stream stations. These data are critical for evaluating the impact of water supply allocation decisions.
- ***The Groundwater Level*** **Network:** collects water level data from 173 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.

- ***The 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.

- ***The Drought Monitoring* Network:** was designed in 2002 using satellite telemetry and 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.

NEW JERSEY WATER TRANSFER DATABASE

The water budgets and availability assessments presented in this Plan are based on statewide and regional analyses, including confined aquifer budgets and HUC11 watershed water budgets. The New Jersey 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 v. 23 Regional Water Resource Planning Areas in the 1996 Plan and 6 planning regions in the 1982 Plan). 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 DEP contract) for groundwater systems in the southern portions of the State (e.g., Critical Areas 1 and 2, and the confined aquifers). Like many of the other water supply monitoring programs, the NJWaTr Database is primarily funded through the 1981 Water Supply Bond Fund.

PUBLIC OUTREACH AND EDUCATION

Much of water supply management happens within DEP and water supply utilities through standardized processes that don't draw much public attention. However, an educated and aware public is necessary for proper management of water supply resources and delivery systems. In general, people are not aware of the true value and cost of water in all its forms, including water supplies for various purposes. However, people are unlikely to put much attention to these issues when they are not faced with choices to make, such as whether to support or oppose rate increases, preserve important watershed lands, or purchase lawn irrigation systems, plumbing fixtures or appliances that may be more or less water efficient. When the public faces such decisions, they will be more open to learning, though they also may need to make decisions quickly, resulting in less time for learning.

Public outreach and education is difficult administratively as well. Untargeted efforts (that aren't associated with an issue) are hard to sustain, unlikely to be highly beneficial, and are difficult to assess. To the extent that these efforts are by DEP, they do show support of DEP for the issue, which has value. To the extent that schools (for general education of future adults) and water utilities (for education of customers and ratepayers) undertake education efforts, there will be limited resources and time available to get across key messages. To be cost-effective in the long-term, water supply public education and outreach needs to be strategic, and the tactics need to be collaborative. Continuity of the message is key, something that is difficult to achieve.

This section provides some general ideas for future consideration.

PRIORITIES FOR PUBLIC EDUCATION AND OUTREACH

Based on the literature and prior practice, the following concepts are of greatest importance in the water supply management field.

- **Awareness of the value of water:** This concept includes economic, financial, ecological and personal values of water in its natural state and as provided for public services.
- **Awareness of PCWS functions and costs of service:** Most people do not know the basics of water supply acquisition, storage, treatment and delivery, nor the costs of providing these services. DEP has begun acquiring rate information for most PCWS, which is incorporated by Jersey Water Works into the Jersey WaterCheck data portal.
- **Optimization of outdoor water demands:** While most people will not deliberately waste water for outdoor irrigation purposes, few will understand how to optimize water use through time-of-day controls, soil moisture monitoring, etc.
- **Drought response and support:** Considerable work has been done on the process of drought response, but public outreach and education can be improved through a greater and more strategic use of social media, network spread of information, involvement of water utilities in the education process, etc.
- **Optimization of indoor water demands:** The USEPA WaterSense program and the Energy Policy Act both have greatly improved the efficiency of indoor water use, but more is possible. In this case, education of potential buyers, especially at the point of sale, can help guide people to water efficient fixtures and appliances, including information on the return on investment from more water-efficient purchases.
- **Support for One Water concept:** A more difficult concept for public education is helping people understand that water in nature, water supply resources, drinking water, used water (i.e., wastewater) and stormwater are all part of one cycle involving one resource – water. The One Water concept suggests that management of all forms of water as a single resource can result in optimization of availability for ecological and human uses, with cost efficiencies through collaborative management.
- **Understanding the basis for potential regulatory or policy changes:** Finally, the public needs to understand enough about potential regulatory or policy changes to determine whether they would support or oppose these changes and why, and how to provide ideas for improving the regulatory and policy results.

POTENTIAL APPROACHES

With these objectives, the next question is how DEP could improve the results of public outreach and education regarding water resources, and specifically water supply issue.

- **DEP Web Site:** DEP's website has been improving over the years, as online technology improves, people more routinely seek information online, and as online meetings and webinars have improved and become common. Continuing improvements and updates are critical to public outreach and education, including routine updates for those who seek information. The website provides a foundation and a commitment of DEP interest in the topic.
- **Drought Preparedness:** Each drought is different, but all droughts have commonalities. DEP can improve the speed and effectiveness of drought outreach and education by pre-planning and preparing materials in advance of droughts, using lessons from past droughts as to what messaging approaches are most effective. A strategy should be prepared in advance for involvement and use of news and social media, identifying and gaining cooperation from a network of supporting agencies and entities, and funding sources for immediate implementation of the strategy in a drought situation.

- **Classroom and Student Education:** Public and private grade school and collegiate education are managed by many thousands of individual schools, overseen by the New Jersey Department of Education and the Secretary of Higher Education. DEP can provide information, ideas and materials that would be valued by these entities, using a collaborative process across relevant DEP programs, including divisions of Water Resources Management; Watershed and Land Management; Office of Environmental Justice; Office of Climate Resilience; and Environmental Education. While some of these units have some educational materials on water resources, there is no cohesive approach that works across all divisions and makes it easy for educators to find and use materials across programmatic lines. DEP can also continue working with and supporting water resources concepts within the Sustainable Jersey for Schools program, the New Jersey Higher Education Partnership for Sustainability, and the involvement of universities in New Jersey in the Sustainability Tracking, Assessment & Rating System (STARS) program of the Association for the Advancement of Sustainability in Higher Education.
- **General Public Awareness Campaigns:** One option to improve public outreach and education is for DEP to routinely collaborate with other programs, such as through statewide education campaigns highlighting national water campaigns, such as Leak Week, A Day Without Water, and Drinking Water Week. By piggy-backing on existing programs that are also used by water utilities and non-governmental organizations, cost-efficiencies can be achieved. In a similar manner, DEP can develop or help develop toolkits for the AmeriCorps Watershed Ambassadors program, local environmental commissions or green teams, and non-governmental organizations on water conservation measures (includes images, social media postings, actions community members can take), in multiple languages, making it easy for others to improve their own educational programs. These can include residential water awareness, water use efficiency, and water conservation materials, along with drought awareness information (e.g., conservation ideas for each step of a drought, status and trends website).
- **Strategic Collaborations for Water Use Efficiencies:** Saving money while saving water resources can be a strong motivational force and engaging with those who can either improve sales or reduce costs can make use of that incentive. DEP could work with major suppliers and retailers to offer customer education, perhaps along with plumbing and appliance manufacturers or store rebates and incentives. The New Jersey Builders Association membership has a strong interest in developer and customer selections and design standards for new homes, including indoor and outdoor water use, as does NAIOP-NJ regarding corporate purchases and indoor and outdoor water use. In the agricultural area, the New Jersey Farm Bureau and Rutgers Extension program have a strong interest in agricultural irrigation system designs. AWWA-NJ, with its membership of utility management and staff along with consultants, will be interested in DEP, New Jersey Department of Community Affairs and Board of Public Utilities guidance regarding approaches for using smart metering as an educational tool.
- **Water Awareness and Efficiency Tools for Individual Businesses:** New Jersey has a strong business sector, including manufacturing, office parks, retail sales, restaurants, golf courses, and many others, all of which have some need for water supplies and face the costs of accessing water services. DEP can work with relevant associations and experts to identify and share cost-effective methods for reducing water demands in a sustainable manner.
- **Preparation for new regulations or policy changes:** There are several broad DEP policy areas that affect water supply issues, including:
    - Agency Climate Change Action Plans;
    - Interagency Climate Action Work Group; and
    - Standards Work Group.

DEP would benefit from a standardized and robust approach to public outreach, education and involvement with the development, adoption and implementation of policies within these and other areas. In addition to public understanding of the proposed policies, the approach would include news and social media efforts to help the public understand the background for proposals. These policies all have implications for the One Water and cost issues discussed above. In coming years, potential water supply regulatory or policy changes might include:

  - water allocation rules;
  - water loss accounting;
  - increased beneficial reuse;
  - lawn irrigation system requirements;
  - source water protection; and
  - drinking water MCLs.

- **Preparation for local PCWS capital projects:** Finally, water utilities are experiencing increased public focus on rate schedules and costs. National experience indicates that the public is more likely to support rate increases if they fully understand how the additional revenues will be used to support capital projects that will maintain or improve critical services, and that the rate schedule distributes costs fairly. Water utilities would benefit from provision of basic educational approaches and materials for use by PCWS (not DEP) to build public understanding of the need for capital projects.