Water Supply

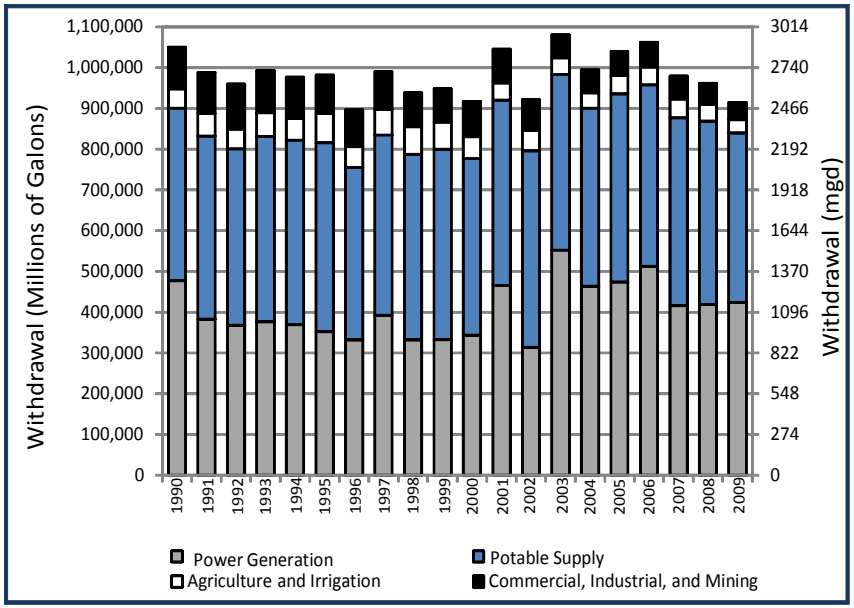
Background

Annual water usage in New Jersey is close to one trillion gallons. This water comes from aquifers or surface water sources including rivers and reservoirs. The water is used for a variety of purposes including potable drinking water; agriculture and irrigation; industry, including commercial use and mining operations; and power generation (Figure 1).

Sustainable water supply is a key factor in the potential development and redevelopment of the State. Despite statewide average precipitation of 45 inches per year[1], New Jersey must plan its water use carefully to prevent regional shortages and avoid ecological impacts associated with water overuse.

New Jersey has a formal water supply planning process. The New Jersey Statewide Water Supply Plan provides a framework to guide the management, conservation, and development of the State's water resources. It balances the demand for potable, industrial, recreational, and ecological uses to ensure that a safe and adequate water supply will be available into the foreseeable future, including during drought. The Plan and its periodic revision are mandated by the 1981 Water Supply Management Act[2]. The first plan was released in 1982 and the first major revision in 1996. An update of the New Jersey Statewide Water Supply Plan is in preparation.

Figure 1. Annual withdrawals per year (1990 - 2009) by group.

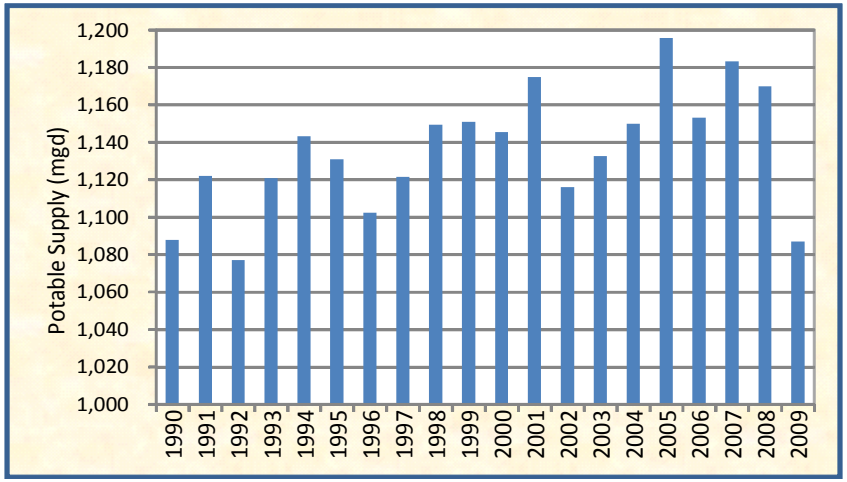


Trend

The population of New Jersey grew by almost 380,000 individuals, or 4.5%, between 2000 and 2010 and is expected to grow by another 10% over the next two decades[3]. This population growth and associated population shifts place an additional demand on the State's water resources and water-supply infrastructure, particularly in geographic areas that have not previously experienced high water demand.

The Department's data indicates that statewide total annual water withdrawals has remained stable with two use groups, agriculture/irrigation and commercial/industrial/mining, showing a steady decrease in withdrawals since 1990 (Kendall Tau correlations, tau = -0.432, $p < 0.01$ and tau = -0.832, $p < 0.001$, respectively) (Figure 1). Similar trends are seen for annual usage except that

Figure 2. Annual potable supply use (million gallons per day, mgd) for the period 1990 – 2009.



potable supply usage has slightly increased between 1990 and 2009 (Kendall Tau correlation, tau = 0.442, $p < 0.01$) (Figure 2). Excluding water used for power generation, about three quarters of total use goes to potable supply (Figure 3).

The source of this water is either from surface waters (streams, rivers, and reservoirs) or from the ground (confined and unconfined aquifers) (Figure 4). In

Figure 3. Pie charts showing the average annual use (million gallons per day, mgd) for the period 1990 – 2009 (top) and the average annual consumptive use (million gallons per day, mgd) for the period 1990 – 2009). Water used by the power generation sector is not included because virtually all NJ power plants either use saline water for cooling or use freshwater in a flow-through, i.e. non-consumptive, manner.

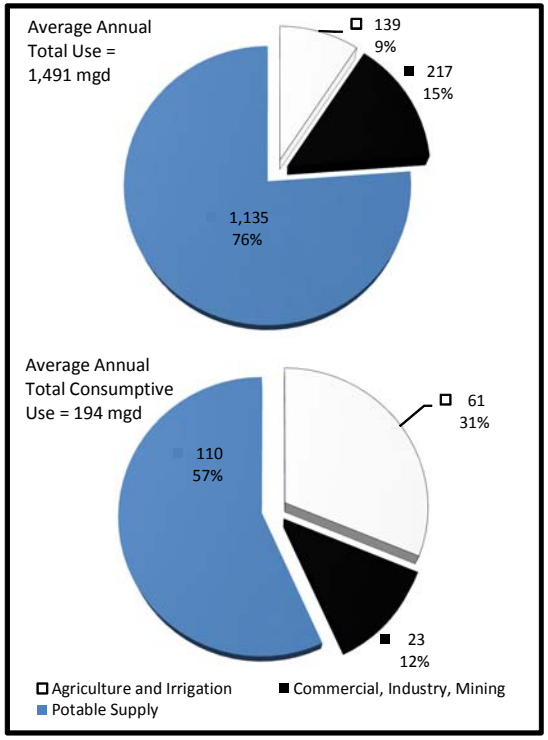
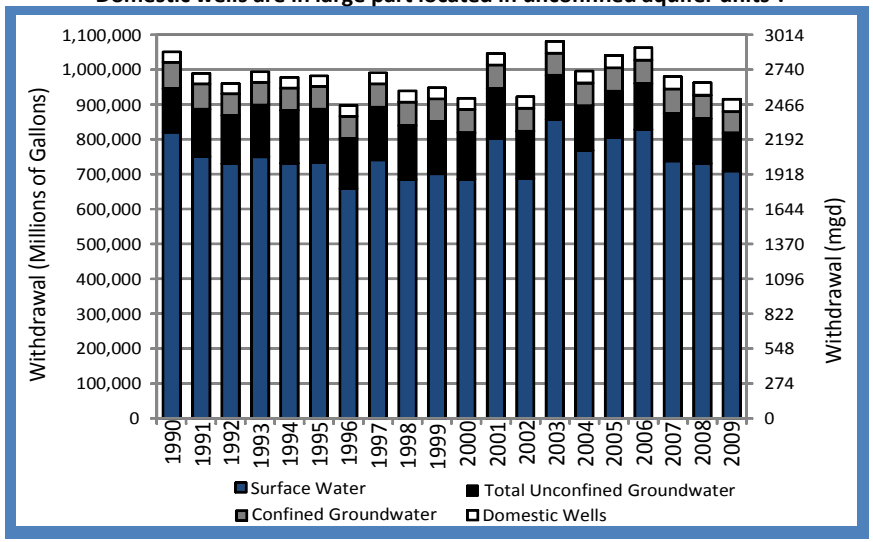


Figure 4. Source of water withdrawals for the period 1990 – 2009. Domestic wells are in large part located in unconfined aquifer units[3].

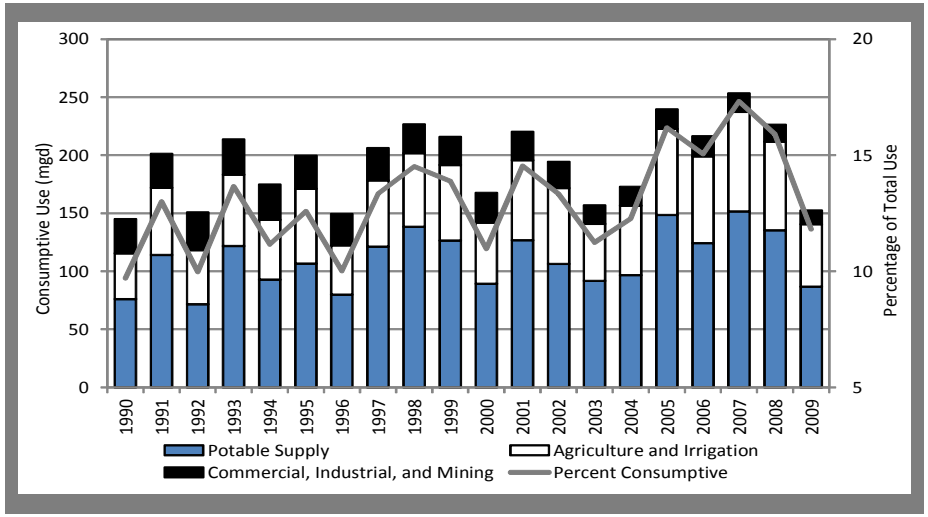


New Jersey, nearly 75% of all withdrawals come from a surface-water source. The remaining withdrawals are distributed among confined and unconfined aquifers. State-wide production from domestic wells totals about 3% of total withdrawals. Most of the domestic wells are located in unconfined aquifers.[4] Withdrawals from surface water and groundwater sources have remained fairly consistent between 1990 and 2009 (Figure 4). While no significant change is present for total groundwater withdrawals, a significant reduction is present among withdrawals from unconfined aquifer sources (Kendall tau Correlation, tau = -0.326, $p < 0.05$). Furthermore, this reduction from unconfined aquifers is only present for withdrawals in South Jersey's coastal plain region (Kendall Tau Correlation, tau = -0.347, $p < 0.05$); no trend is evident in the unconfined aquifers of North Jersey or confined aquifers. Withdrawals from domestic wells have increased by 1% on average each year since 1990.

Consumptive use describes water that is lost via evapotranspiration or that is otherwise unavailable for reuse. The amount of consumptive use depends on the specific user and the season but is typically greatest as a percentage of total use for agricultural and irrigational purposes. Excluding water used for power generation, over half of the consumptive use is associated with potable

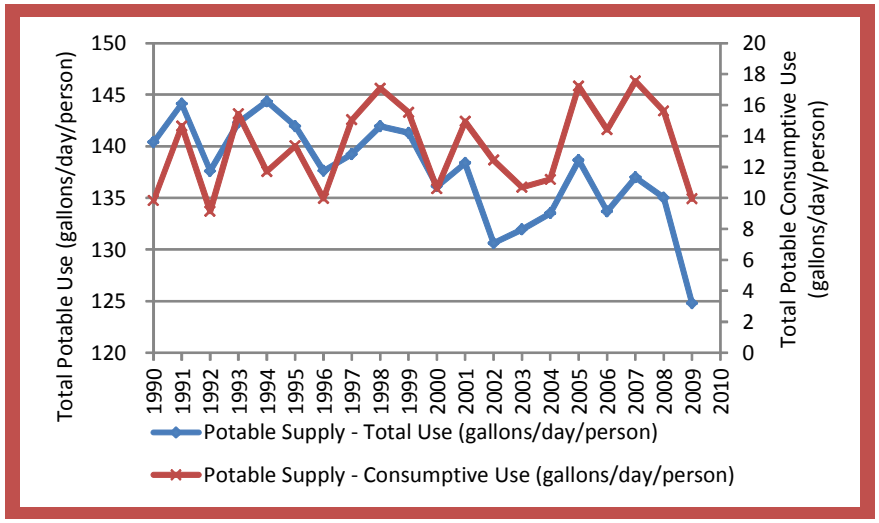
supply (Figure 3). Between 1990 and 2008 total consumptive use increased significantly, but a relatively wet 2009[5] and subsequent lower than normal consumptive use rates masks this trend when 2009 data are included (Figure 5). Although, the amount of annual consumptive use as a percentage of the total annual use ranged from 9.7 to 17.3% (Figure 5) and showed a slight upward trend (Kendall Tau Correlation, tau = 0.421, $p < 0.01$). Consumptive use for agriculture and irrigation purposes ranged from 30.4 to 68.5% of total agricultural and irrigation use and has steadily increased over the same period (Kendall Tau Correlation, tau = 0.653, $p < 0.0001$). This may be in part, due to an increase in the number of golf courses and shifting agricultural crops[6].

Figure 5. Annual (1990 – 2009) consumptive water use by group and the amount of consumptive use as a percentage of total water usage for the combined groups. Water used by the power generation sector is not included because virtually all NJ power plants either use saline water for cooling or use freshwater in a flow-through, i.e. non-consumptive, manner.



Potable supply has a number of users, mainly domestic consumers but some water is also directed to industrial and commercial users[7]. Potable use has shown a general increase over the twenty years of summarized data (Figure 2). Consumptive use of potable water ranged from 6.6 to 12.8% of total potable use and shows no appreciable change over time. Over the twenty-year period consumptive loss of potable supply has accounted for 48 to 62 percent of the total consumptive loss showing a slight increasing

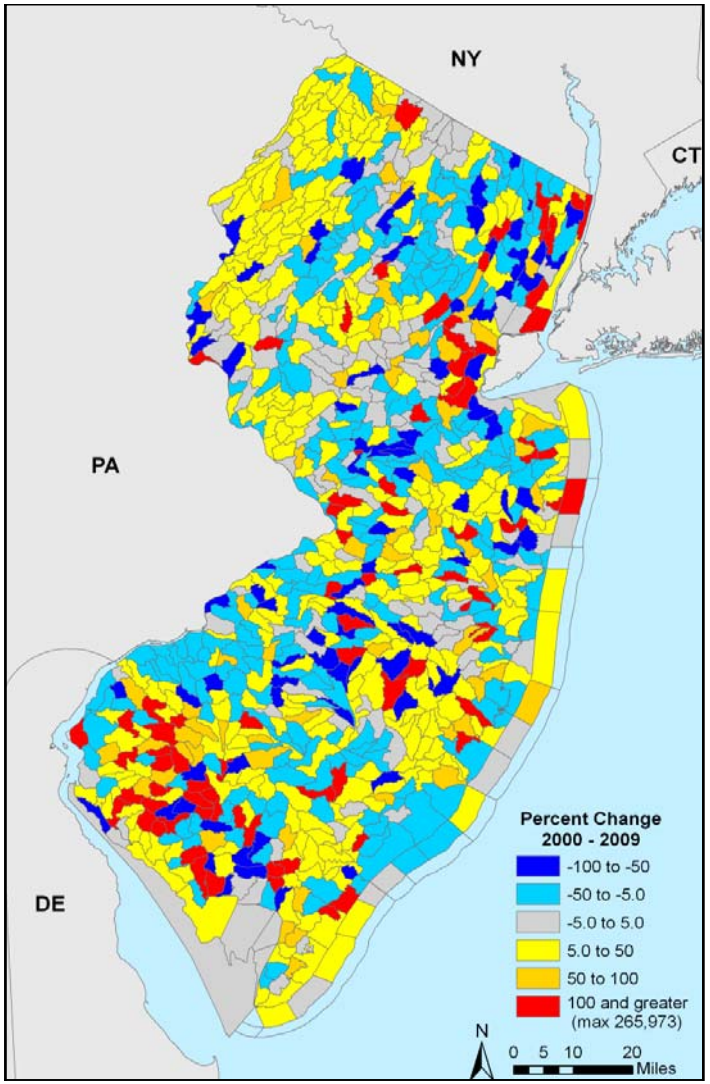
Figure 6. Per capita use rate of potable water supply.



trend over time (Kendall Tau Correlation, tau = 0.400, $p < 0.05$). Total per capita potable use rates are declining (Kendall Tau Correlation, tau = -0.526, $p < 0.005$) due in large part to plumbing code changes, increasing water efficiencies, and education. Consumptive per capita rates of potable water show a moderately significant increase over time (Kendall Tau Correlation, tau = 0.322, $p = 0.054$) (Figure 6) when the atypical consumptive use rates for 2009 are excluded.

Regional changes in water withdrawals from 2000 to 2009 are illustrated in Figure 7. The largest changes were for those watersheds whose withdrawal increased between 5% and 50%. That range of increase occurred in 35 percent of the watersheds. Twenty-six percent of the watersheds saw withdrawals decrease between 5% and 50% while 14% of the watersheds experienced minor changes (between -5% and +5%) in withdrawals. A cluster of rather large increases is present in the agricultural areas of southern New Jersey. It should be noted though that percent changes can be quite large when withdrawals in 2000 were nonexistent or low and were present, or substantially greater, in 2009. For example, the largest percentage change occurred in the Stony Brook Watershed, Mercer County. Withdrawals in 2000 totaled 0.016 MG and in 2009 withdrawals totaled 42.8 MG, primarily due to new withdrawals for industrial use.

Figure 7. Percent Change in Water Withdrawals in New Jersey HUC14 Watersheds from 2000 to 2009. Note that percent changes can be quite large when withdrawals in 2000 were nonexistent or low and were present or substantially greater in 2009. For example, the largest percent change occurred in the Stony Brook Watershed, Mercer County. Withdrawals in 2000 were 0.016 MG and in 2009 withdrawals totaled 42.8 MG.



In recent years, regional drought emergencies have been enforced in order to protect the State's water resources. Restrictions on water use during droughts may have an impact on the state's economy, but are necessary to protect potable supplies and aquatic resources. Potential adverse effects associated with extreme drought conditions include reduced assimilative capacity of streams, reduction of reservoir volume below sustainable levels, impacts to aquatic biota, increased saltwater intrusion in coastal estuaries, and added stress to water purveyor distribution systems. Increasing annual water demands without efficiency improvements and reduced consumptive losses represents a significant threat to the State's ecology because it translates to direct losses from the hydrologic system.

Outlook and Implications

Each day New Jersey discharges approximately 700 million gallons of sanitary sewer effluent directly to the ocean and bays[8]. Reclaimed Water for Beneficial Reuse (RWBR) involves using highly treated, reclaimed wastewater, to offset potable ground and surface water withdrawals. Reuse reduces demand on public water supplies and keeps water in the natural hydrologic system, which can be extremely beneficial during drought. Some examples of uses for RWBR are landscape and agricultural irrigation, industrial uses, fire protection, aesthetic fountains and lagoons, construction uses, and sewer flushing. Depending upon the specifics of a source, extensive treatment and disinfection may be required to protect public health and environmental quality, while other applications involving limited public access may require substantially less treatment. RWBR is especially promising in areas where regional sewage treatment plants discharge to the ocean or bays.

Preliminary estimates indicate that the water demand for potable water by golf courses and other major consumptive users in the coastal areas is over 5.5 billion gallons per year[2]. The use of reclaimed water for these activities in place of potable sources can protect a portion of the coastal water supply.

Statewide, sufficient water supplies exist to meet demands – both current and as projected through 2020 – provided efforts to increase efficiency, reduce consumptive water loss (outdoor water use/landscape irrigation),

and adequately maintain/enhance interconnections between water systems and other related infrastructure, are instituted. Regionally, some areas (for example, the Northeast drought region and the lower Cape May peninsula) currently face water supply challenges, which will require continued scrutiny and innovative water management strategies moving forward.

Much of this data, but not all, can be found in "New Jersey Water Transfer Model Withdrawal, Use, and Return Data Summaries" available on line at http://www.nj.gov/dep/njgs/geodata/dgs10-3.htm

More Information

Data summarized for this chapter were provided by the Department of Environmental Protection, Division of Water Supply and Geoscience. Visit their website at http://www.njgeology.org/ for additional information and data sources.

References

[1] New Jersey Office of the State Climatologist, available at http://climate.rutgers.edu/stateclim_v1/data/njhistprecip.html

[2] N.J.S.A. 58:1A-1 et. seq.

[3] New Jersey Department of Labor and Workforce Development. 2012. Population and Labor Force Projections for New Jersey: 2010 to 2030. Table 1. Available online at http://lwd.state.nj.us/labor/lpa/dmograph/lfproj/sptab1.htm

[4] Personal Communication with Steve Domber, New Jersey Geological and Water Survey. September 5, 2012.

[5] Office of the State Climatologist. Monthly Precipitation in New Jersey From 1895-2012. Data accessed October 24, 2012 at http://climate.rutgers.edu/stateclim_v1/data/njhistprecip.html.

[6] Personal Communication with Steve Domber, New Jersey Geological and Water Survey. October 16, 2012.

[7] Hoffman, J.L. and S.E. Lieberman. 2000. New Jersey Water Withdrawals 1990-1996. New Jersey Geological Survey Open-File Report OFR 00-1. Available online at www.state.nj.us/dep/njgs/pricelst/ofreport/ofr00-1.pdf

[8] Personal Communication with Steve Domber, New Jersey Geological and Water Survey. October 16, 2012.

[9] Personal Communication with Steve Domber, New Jersey Geological and Water Survey. October 24, 2012.