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Sustainability Brief: Water Availability

New Jersey depends on water resources for the health of its people, the strength of its economy, and the vitality of its ecosystems. The availability of water resources is a fundamental element of sustainable communities. Many other resources are important to New Jersey – water is irreplaceable.[1]

Water is a public trust resource owned by current and future generations; it is managed on their behalf by the State of New Jersey. Water resources are not and cannot be alienated from the public through ownership by individuals in New Jersey, but they can be allocated to uses that benefit the public interest. Water is a natural resource supporting aquatic and terrestrial ecosystems, aesthetic enjoyment, recreation and fisheries. It is also a public resource commodity, used for public and domestic water supplies, irrigation and industry. The viability of every urbanized area depends on public water supplies. Use of water resources beyond environmentally sustainable levels will damage their long-term viability in support of our economy and quality of life.

1 Background

Water availability is the quantity of water that can be used for human purposes without significant harm to ecosystems or other users. Consideration is given to demands from human and ecosystem needs, equitable apportionment of water among uses, and indicators of stress to the water resource. All water resources in New Jersey are linked in some way, through the hydrologic cycle. Surface waters receive water from both runoff and discharges from ground water. Ground water, in turn, relies on water recharge from the land surface. Aquifers are ground waters that can provide economically useful amounts of water for human use, and are divided generally into surficial (i.e., unconfined or water table) aquifers near the land surface, and confined aquifers that are separated from the surface and upper levels of ground water by relatively impermeable layers of geologic materials such as clay. These aquifer types are connected also.

New Jersey receives sufficient precipitation to support current human uses and protect aquatic ecosystems in normal rainfall years, in most areas of the state. Roughly 60 percent of potable water demands are met by surface water supplies; the other 40 percent are met by aquifers. We have many large and small reservoirs built over more than a century that support our urban areas, especially in northeastern and central New Jersey. Aquifers also provide high quality water in many areas, especially in southern and northwestern New Jersey. The Delaware River is also a major supply source. Water is rarely transported

[1] Much of the information provided in this report is drawn from the Water Resources Baseline Assessment Report prepared for the Together North Jersey project, funded in part by the U.S. Department of Housing and Urban Development.

more than 40 miles from its source in New Jersey, and so water availability for our state is an inherently local or regional issue.[2] Unfortunately, mild to severe droughts are fairly frequent, and New Jersey's population increases are adding to and shifting the location of demands, stressing some resources.

The current national practice regarding sustainability for water availability is to address the three classes of water resources separately, while recognizing that they often interconnect and those interconnections must be addressed. Reservoir systems have artificial storage available support drought demands and releases to streams – availability from a reservoir system is termed its "safe yield."[3] Surficial aquifers lack artificial storage and therefore the focus is on impacts on other users and on stream flows during dry periods. Confined aquifers are not directly linked to surface water features and related aquatic habitats, may have restricted or no recharge potential, and may or may not have potential for artificial storage. Withdrawals from confined aquifers may include saltwater intrusion (from oceans, estuaries or underlying saline ground waters), induced infiltration from underlying or overlying aquifers, reductions in flows to other wells, dewatering of the aquifer, or land subsidence. The use of confined aquifers is considered sustainable when the potentiometric surface (indicating aquifer pressure) is high enough that harmful effects are avoided.

However, new ecological studies indicate that reservoir release schedules and surficial aquifer withdrawals have a major influence on downstream aquatic ecosystems, both within streams and in downstream estuaries. The Ecological Limits of Hydrologic Alteration (ELOHA) approach is the emerging standard for assessing such effects (see Poff, et al. 2009, Kennen, et al. 2007). A sustainable safe yield therefore would be one that provides for a quantity and pattern of reservoirs releases that minimize or effectively mitigate downstream ecological effects. A sustainable aquifer withdrawal would be one that likewise minimizes downstream ecological effects. However, this approach is highly data intensive and therefore can be difficult to apply.

2 Sustainability Issues

2.1 Unsustainable Water Demands

Where water resources are not managed in a sustainable fashion, society can expect to incur costs and economic inefficiencies due to insufficient water for users. Unsustainable water withdrawals result in aquifer depletion, streams running dry, loss of wetlands, and draconian water restrictions during dry periods and droughts. Unaddressed competition issues for water may result also in essential and beneficial water uses going unmet due to economic competition or unwillingness on the part of existing users to relinquish allocations.

2.2 Assessment of Net Water Availability

The NJ Department of Environmental Protection (NJDEP) and the Highlands Water Protection and Planning Council (Highlands Council) have developed improved Water Availability methods. Based on these

[2] "Local" in this case is used as meaning within watersheds and river basins, but not referring to neighborhoods or municipalities.

[3] Most reservoir safe yields remain unchanged from the previous NJ Statewide Water Supply Plan (NJDEP 1996), with the NJ Water Supply Authority and the North Jersey District Water Supply Commission having been increased less than 10 percent, to 241 MGD to 190 MGD, respectively.

methods, it is clear that some aquifers have been over-exploited, representing a threat to aquatic ecosystems as well as competing human uses. It is important to note that a major source of new information, the anticipated NJ Statewide Water Supply Plan (NJSWSP), has been pending public release for some time. As the draft NJSWSP is not yet public, a large amount of useful information was not available for inclusion in this report. Only the results of the Highlands Regional Master Plan (Highlands Council 2008a, 2008b) are currently available to the public for use regarding the new water availability approach.

2.3 New Jersey Water Demands

Reservoirs in the Raritan River basin have significant capacity for growth. Reservoir systems in the Passaic and Hackensack watersheds have less capacity, and some municipalities with significant projected growth may be constrained by current reservoir limitations. Some reservoirs in Monmouth and Ocean Counties have capacity while others are more constrained. Most other reservoirs in New Jersey are relatively small.

Ground water uses are termed “consumptive” and “depletive.” Consumptive withdrawals result in losses to evaporation (e.g., from cooling systems and irrigation) and transpiration (from plants). Consumptive loss percentages can range from very low (e.g., indoor household uses, water cooling closed systems) to very high (e.g., agricultural and lawn irrigation, evaporative cooling systems). Depletive uses result in the transport of water across watershed boundaries as untreated water, potable water or wastewater. Depletive losses to the source water are always 100%, but the transported water can become an addition to the receiving water, if not discharged to the ocean or estuarine waters. However, roughly 80 percent of all water delivered to customers by public water supply systems is ultimately discharged to the ocean or estuarine areas.

Some confined and surficial aquifers in the state are known to be constrained, such as Water Supply Critical Area #1 (Monmouth and northern Ocean Counties), Water Supply Critical Area #2 (the Camden Area), the lower Cape May County area, the Central Passaic Buried Valley Aquifers (eastern Morris and western Essex Counties), the Lamington Valley Aquifer (western Morris County), and the Maurice River watershed area (Gloucester and Cumberland Counties); the first three are confined aquifer systems. In addition, nearly two-thirds of the Highlands Region has been identified as having aquifer deficits based on the new ecologically-based analytical approaches (Highlands Council 2008b). The pending NJSWSP is likely to identify additional aquifers of concern.

2.4 Water Availability Challenges in New Jersey

One major challenge is that per capita water demands have gone down despite major efforts to conserve water. Per capita demands indicate the efficiency of water use to meet needs. Total demands most years have been 130 gallons per capita per day (GPCD) or more in the period from 1990 to 2007. Meanwhile, per capita <u>winter</u> demands are declining in many locations, while consumptive demands have gradually increased, reflecting a shift to increased lawn and agricultural irrigation uses. These trends put a major burden on water resources during peak summer months, and especially during droughts.

The other major challenge will be explicit and meaningful incorporation of ecological considerations into water availability calculations and water allocation regulations. While important to New Jersey, it is clear that during drought periods heavy emphasis will be placed on providing water for human needs.

However, both of these challenges also constitute opportunities. Regarding per capita demands, there are many opportunities to reduce residential lawn irrigation demands, reduce water losses from water supply infrastructure, increase the efficiency of agricultural water uses, and continue reduction of indoor water demands through water conserving devices and appliances. Incorporation of ecological issues in the water allocation process can lead to improved or sustained water ecosystems, with significant societal benefits. As can be seen, all of these opportunities will entail significant challenges in their implementation.

3 Sustainability Responses

New Jersey is at the cutting edge nationally regarding application of the ELOHA approach to withdrawals from surficial aquifers and streams without flow support from artificial storage, especially in the Highlands Region. Older approaches are not sustainable, as they focus primarily on local water supply effects, not ecosystem impacts. New Jersey's approach to safe yields uses normal practices, as the state has not applied the ELOHA approach to reservoir systems yet. Finally, New Jersey's approach to confined aquifers is state-of-the-art.

4 Implications

The water availability objective has several major implications and underlying assumptions, including:

- The focus of human use is on meeting needs (e.g., sufficient water for household use, sufficient water for crop production), not guaranteeing a specific rate, volume or allocation of water. Where the need may be met in a more efficient manner, it should be. Therefore, water conservation and efficient water delivery systems should be integrated in all areas, even where sufficient water is available at present. In other words, wasting water is unsustainable even where ample water currently exists.
- The threshold for ecological harm varies depending on the ecosystems involved. More sensitive ecosystems (e.g., trout production waters, low pH Pinelands waters, calcareous fens) will have less tolerance for water impacts than other waters.
- All water demands combined, including ecological needs, should not exceed water availability at any time, and specifically during dry periods and droughts.
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5 Defining & Tracking Sustainability

The following sustainable objectives are proposed for water availability:

- Water availability provides for human needs in an equitable manner that may be maintained through foreseeable drought periods without significant harm to the integrity of aquatic ecosystems, other water uses and confined aquifers.

Table 1 provides preliminary indicators and targets that apply universally. Municipal Actions focused on these indicators and targets will be feasible with regard to: remaining within reservoir safe yields, especially for small reservoirs; net water availability at the sub-watershed level (Highlands) or watershed level, with consideration for joint action regarding shared watersheds; and general water conservation efforts. NJDEP will manage withdrawals from confined aquifers, and owners of large reservoirs will address safe yield issues for their systems.

6 Conclusions

Water supply demands in parts of New Jersey have already reached or exceeded available supplies, while other areas (primarily those dependent on surface water supplies in central New Jersey and the Delaware River basin) have sufficient supplies for the foreseeable future. The definition and calculation of "available water" is evolving to include more consideration of watershed-based effects and damage to aquatic ecosystems. The pending NJ Statewide Water Supply Plan will provide a basis for more accurately and comprehensively assessing water availability statewide, using an approach already being implemented in the Highlands Region. With the anticipated effects of a changing climate such as more intensive but less frequent storms and higher temperatures, New Jersey will need to rely even more heavily on water conservation, equitable water allocations and monitoring of the effects of withdrawals on other water uses and ecosystems.

Table 1: Preliminary Sustainability Indicators and Targets for Water Resources

Category	Definition	Preliminary Indicators	Preliminary Targets	Scale of Analysis	Availability and Period of Data
Water Availability	*Water availability provides for human needs in an equitable manner that may be maintained through foreseeable drought periods without significant harm to the integrity of aquatic ecosystems.*	Water delivered from reservoir-based or –supported systems	Safe Yields (reservoir systems)	Reservoir system or intake watershed	All major and many minor systems, various dates
		•Total and consumptive/ depletive water withdrawals and trends by watershed or subwatershed (demand – including potable, industrial, agricultural, recreational) •Ground Water Availability by watershed or subwatershed	Net Water Availability[4] (surficial aquifers)	HUC14 subwatershed (Highlands Region), HUC11 watershed (statewide)	•Highlands NWA based on 2003 data or later; updates in pilot project areas •Statewide NWA based on 2009 data or later
		Potentiometric surface (measured level of aquifer pressure) established for each confined aquifer of concern	Saltwater/freshwater Interface[5] (confined aquifers)	Regional confined aquifers of the Coastal Plain Physiographic Province	Water Supply Critical Area models, updated

[4] Net Water Availability for a watershed or subwatershed is Ground Water Availability minus current or projected consumptive and depletive withdrawals from surficial aquifers and surface waters (other than reservoirs or streams augmented by reservoir releases). Ground Water Availability is that portion of Ground Water Capacity allowed for consumptive or depletive uses, based on thresholds that are protective of sensitive aquatic ecosystems where appropriate. Ground Water Capacity is based on the Low Flow Margin method, the difference between the September median flow and the 7Q10 flow for a watershed or subwatershed.

[5] The Saltwater/Freshwater Interface is a general location within the confined aquifer where water quality shifts from saline to very low salinity that is useable for potable water.

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