1.16 WMA 4 - WATER SUPPLY AVAILABILITY

Introduction

The hydrologic cycle (see Figure 1.16.1) describes the natural movement of water from the atmosphere to the Earth's surface and into surface and ground water systems. The simplified “natural” water budget equation can be written as:

$P = I + ET + R$ where;

P = precipitation
I = infiltration below root level
ET = evapotranspiration
R= direct surface runoff

Managing water supply availability on a watershed basis requires that the water budget equation is expressed to account in more detail for "artificial" or man-made withdrawals of surface and ground water from the natural system, changes in storage of surface and groundwater reservoirs, and also the disposition of wastewater (effluent) (see Figure 1.16.2). Simplified, on an annualized basis, the modified water budget can be written as:

$$P + I_{GW} + I_{IW} + I_{SS} + I_{GS} = ET + O_{SW} + O_{GW} + O_C + O_D + O_{SS} + O_{GS}$$ where;

P = precipitation
I_{GW} = regional groundwater flow into the watershed
I_{IW} = imported water supply
I_{SS} = decreased surface water storage, i.e., lowering reservoirs, draining wetlands.
I_{GS} = decreased groundwater storage by depleting or mining groundwater

ET = evaporation from all surfaces plus plant transpiration
O_{SW} = total streamflow leaving the watershed
O_{GW} = groundwater flow out of the watershed
O_C = within watershed consumptive uses (excluding ET)
O_D = depletive use (transfer out of the watershed)
O_{SS} = increased surface water storage, i.e., raising reservoir levels, flooding wetlands
O_{GS} = increased groundwater storage, i.e., artificial recharge, recharge enhancement

The purpose of this task is to characterize the water supply-side artificial modifications to the water budget to characterize water supply availability related to the Watershed Management Area (WMA). The characterization and assessment contained herein provide baseline information and references on water supply availability for ongoing watershed planning. This information is relevant to the future development of the water budget for the Passaic Basin, to be undertaken by NJDEP.

Background

To ensure that New Jersey would be able to meet projected future water needs, the Water Supply Management Act and the Water Supply Bond Act (Bond Fund) were approved in 1981. These acts provided a management framework and a $350 million source of funding to evaluate existing water supply and plan accordingly for future growth. In 1982, NJDEP adopted the first New Jersey Statewide Water Supply Master Plan (NJSWSP), as required by the Water Supply Management Act. In 1996, the NJSWSP was completely revised and updated to replace the 1982 Plan.

To improve the NJDEP's ability to characterize and assess water supply availability, the 1996 Plan divides the state into twenty-three Regional Water Resource Planning Areas based upon watersheds. These watershed-planning areas are somewhat different in size and delineation than the current WMA's adopted by the State.

The NJSWSP and supporting documentation is a statewide characterization and assessment of water supply availability, and a substantial amount of the information in this report is drawn from these documents.

Concepts

There are several concepts related to water supply availability that will be presented throughout this report. An explanation of these concepts and the definitions of frequently used terms are as follows:

- **Diversion –** is the removal of either groundwater or surface water from the natural hydrologic cycle. The NJDEP Bureau of Water Allocation is responsible for granting the privilege to a person to divert over 100,000 gallons per day (gpd) of water for any purpose other than agricultural or horticultural use. The NJDEP maintains extensive databases on water usage. The ability to use full diversions is typically related to satisfying other criteria (e.g., surface water diversion can be limited based upon requirements to maintain a certain stream flow past the diversion – **passing flow**).
- **Depletive Water Use –** "surface or ground water withdrawn from a selected watershed and discharged in another watershed. Also referred by others as **out-of-basin transfers** (or inter-basin transfers) and wastewater and water exportations, depletive use has become a significant issue in New Jersey over the last several years as competition for water has increased."[1]
- **Safe Yield From Surface Sources –** means the yield maintainable by a water system continuously throughout a repetition of the most severe drought of record, after compliance with requirements of maintaining minimum passing flows, assuming no significant changes in upstream or upbasin depletive withdrawals.
- **Minimum Passing Flow –** surface water diversions are limited by requirements to maintain a certain stream flow, or passing flow, downstream of the water intake. The New Jersey Department's Bureau of Water Allocation has set these passing flow requirements. Where not specified, statutory minimum passing flow is calculated as 125,000 gallons per square mile of contributing upstream-unappropriated watershed for public water supplies.

Dependable Yield of Subsurface Sources – means that yield of water from a subsurface source or sources available continuously during projected future conditions, including a repetition of the most severe drought of record, without creating undesirable effects. Undesirable effects may include adverse impact on other wells of a depth of 50 feet or more, increased risk of introducing or spreading saline water or polluted water in the aquifer or unacceptable reduction of surface flow of streams. Estimating dependable yield of subsurface sources is a complex undertaking, and for planning purposes is typically established as a percentage of the estimated groundwater recharge (i.e., natural or artificial recharge)

Characterization of Water Supply Availability in WMA 4

Types of Diversions and Diversion Summary

The NJDEP Bureau of Water Allocation is responsible for approving requested diversions, and maintains an extensive database of existing withdrawals of water from natural sources. This effort is a balancing act of providing approvals for the benefit of potential users, but at the same time insuring that new diversions do not adversely impact existing users or adversely impact the existing ecosystem.

The New Jersey Geological Survey (NJGS) has extensively researched the Bureau of Water Allocation's database to develop summaries of water diversion based upon different types of use classifications[3]. The NJGS has indicated that there are known errors of assigning diversions to specific watersheds based upon: inaccurate location information; and combined withdrawals from different geographic locations provided as a single location. However, for general planning purposes, the diversion summary is very useful in assessing how water is used within the watershed.

The general use classifications are: public water supply; agriculture; irrigation; power generation; mining; industrial; and commercial. Table 1.16.1 (see following pages; codes for uses are on the fourth page of the table) is a summary of specific water users and total water used, and is given as the average daily withdrawal in millions of gallons per year (MGY) in the time period between 1990 and 2000. The following table indicates percentage of water withdrawn by use group:

Table 1.16.2
Summary of Average Annual Withdrawals 1990 – 2000
By Use Group (WMA 4 - New Jersey Only)

WMA 4: Use Groups	Amount (MGY)	Percent
Power Generation	78162	68.6
Mining	0	0
Industrial	6000	5.3
Commercial	25	0.02
Public Supply	29521	25.9
Irrigation	297	0.26
Agricultural	1.5	0
Total	**114007**	

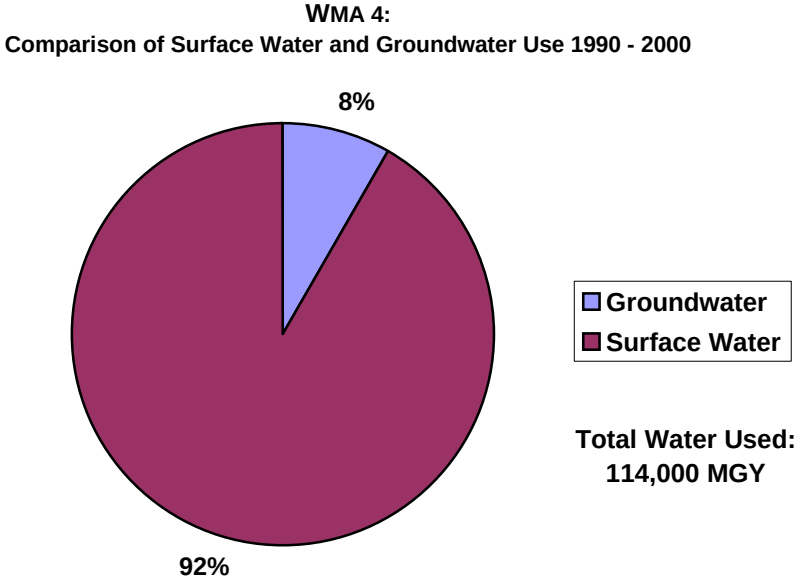
Under the Power Generation use group, the Great Falls Hydroelectric Company is the largest water user within WMA 4. In addition the Passaic Valley Water Commission (PVWC) has a hydroelectric generating station at its Little Falls Water Treatment Plant. These diversions are based upon water supply availability, primarily during periods of above average river discharge and are non-depletive and non-consumptive as the water is immediately returned to the Passaic River.

Table 1.16.2 indicates that over 25 percent of the water withdrawn within WMA 4 (29,521 MGY average), was used for public water supply purposes.

On Table 1.16.1 the records indicate that private home wells have used an average of 553 MGY between 1990 and 2000. The private home well records was compiled by NJGS using 1990 Census Data that includes information on the number of persons with private water system. A usage of 75 gpd was applied per person and the value was extrapolated proportionately based upon current populations.

Comparison of Groundwater and Surface Water Diversion

The following chart provides a comparison of groundwater and surface water diversions, on average for the period between 1990 and 2000:



Potable Water Users and Sources

Diversion of raw water for potable water use is a large component of the water budget within a watershed, and therefore, is an integral consideration in watershed planning and management. Management of potable water use has additional complexities related to impacts of inter-basin transfers and depletive use on watersheds, diversion rights, and impacts on other water users. The following information characterizes these users and their sources for both surface water and groundwater diversions. The majority of information on water sources was taken from the 1996 New Jersey Statewide Water Supply Plan (NJSWSP) – Task 2 Report "Water Supply Baseline Data Development and Analyses", and also from available Water Allocation Permits.

Surface Water Sources

WMA 4 is comprised of the following subwatersheds (based upon Hydrologic Unit Code Group 11):

Subwatershed	Area (sq. miles)
Lower Passaic River (Pompton River to Saddle River)	83
Lower Passaic River (Saddle River to Newark Bay)	54
Saddle River	59
Totals	196

The following information is specific to those sources and users within the watershed:

- **Lower Passaic River Basin –** The Passaic River supply is used by the Passaic Valley Water Commission (PVWC) at their Little Falls Water Treatment Plant located in Totowa. The Commission may divert a maximum of 2,325 million gallons during any month from the Pompton and Passaic Rivers at the Two Bridges site, or at their Little Falls intake, or jointly from both sites, at a maximum daily rate of 75 MGD. The portion of the Commission's water diverted at Two Bridges is considered to be derived from WMA 3, and the location of the Commission's Little Falls intake is such that that withdrawal, although within WMA 4, is dependent on the WMA 3 and WMA 6 watersheds.

  PVWC is the primary public water user within WMA 4. PVWC has a very complex arrangement for obtaining and supplying water to its customer base. PVWC supplies water to its retail customers (cities of Paterson, Passaic, and Clifton) and wholesale customers with a combination of supply, either from the Little Falls Treatment Plant (raw water supply from Passaic or Pompton River) or redistributing treated water received from the North Jersey District Water Supply Commission (NJDWSC). Table 1.16.3 provides a summary of the different entities that PVWC supplies water to, and an estimate of inter-basin transfer.

- **Saddle River –** The United Water Company diverts water from the Saddle River (Allocation Permit No. 5107) in Paramus Borough to Oradell Reservoir located in WMA 5.

- The water diversion summary also includes a use for the Borough of Haledon Water Department for 1990-2000. This reservoir system is no longer in use, and Haledon now receives supply from PVWC.

PVWC Wholesale Customers using Passaic River (WMA 4) Supply
Table 1.16.3

Name	Avg. Demand (MGD)	Amount of Inter-Basin Transfer (MGD)
Township of Cedar Grove	0.14	0
Borough of Haledon	0.28	0
Town of Harrison	1.07	0
Borough of Elmwood Park	0.37	0
Township of Fairfield	1.47	0
Borough of Fair Lawn	1.37	0
City of Garfield	1.48	0
New Jersey-American Water Co.	6.3	6.3
(Commonwealth System)		
New Jersey-American Water Co.	0	0
(Little Falls System)		
Borough of North Arlington	1.71	0
Borough of North Caldwell	0	0
Township of Nutley	3.26	0
Southeast Morris County MUA	1.4	1.4
Borough of Totowa	0.94	0
Township of Verona	1.43	0
Borough of Walllington	1.2	0
Borough of West Paterson	0.74	0
Total	23.16	7.7

Table adopted from PVWC Water Distribution System Master Plan - Historical Demands, Killam Associates, 1999

Evaluation of Surface Water Use for Public Supply

Table 1.16.4 provides a summary of important statistical information for the primary public water supply surface water user in WMA 4:

Table 1.16.4
Summary Statistics on Surface Water Diversion

Purveyor	Location	Safe Yield (MGD)	Allocation (MGD)	Diversion Avg. 1990-1999 (MGD)	Diversion Avg. 1999 (MGD)	Reservoir Capacity (BG)	Drainage Area (sq. mi.)	Min. Passing Flow (MGD)	Interbasin Transfer (MGD)	Depletive Use (MGD)
PVWC	Passaic River (Totowa)	na	75	47.4	47.3	see note 1	-	see note 2	-7.7	-7.7

(1) The Point View Reservoir derives pumped supply from the Pompton River in WMA 3. This reservoir has a capacity of 2.8 BG
(2) refer to table below
Note: PVWC does have interbasin transfer of raw water from WMA 3 into WMA 4 from the Two Bridges Pump Station. The listed diversion is the total diversion by PVWC from Two Bridges and Little Falls for pubic supply. The listed interbasin transfer is an estimate of net transfer of finished water out of WMA 4.

The table indicates that on an annual average basis, PVWC is using approximately 63 percent of their allocation amount. PVWC fully utilizes its maximum daily allocation of 75 MGD during maximum demand periods.

Review of Passing Flow Requirements

Minimum passing flow requirements for water purveyors are established in NJAC 7:19-4.6 (e), with the following purveyor specified in WMA 4 (with associated passing flows in WMA 3):

Table 1.16.5
Passing Flows

Purveyor	Gaging Station	Passing Flow per NJAC 7:19 (Cu. Ft./Sec)	Passing Flow per Permit (Cu. Ft./Sec)
Passaic Valley Water Commission	Pompton River at Pompton Plains	92.8	136 (1,2)
Passaic Valley Water Commission	Passaic River at Little Falls	89.0	---- (1)
Passaic Valley Water Commission	Passaic River at Two Bridges	27.2	27.2 (1,2)

(1) Permit 5099
(2) Diversion located in WMA 3

The code indicates that where passing flow is not specified, it will be fixed by the Department based on an amount equal to the average daily flow for the driest month from records, or in lieu thereof, 125,000 gallons for each square mile of unappropriated watershed above the point of diversion (in addition to flows from any appropriated watershed above the point of diversion).

The code also indicates (NJAC 7:19-4.6 (d), 1) that fees will be paid by purveyors at a minimum charge of $1.00 per million gallons for each million gallons below the passing flow requirement, when the purveyor is diverting water. The maximum charge of $10.00 per million gallons shall apply on those days when the passing flow below the point of diversion is zero.

Groundwater Sources

Detailed information of the groundwater sources (aquifers) for WMA 4 is presented in Section 1.8 of this report. Section 1.8 also provides information of the anticipated yield from these aquifers, ranging from poor producing to prolific groundwater sources.

Table 1.16.1 provides a summary of the average usage of groundwater, by user, within WMA 4.

Evaluation of Groundwater Availability for Potable Supply

In general, groundwater sources are developed for use locally within a watershed. There are instances where regional water purveyors will produce groundwater that is transmitted over longer distances for consumption outside of the local area. Ridgewood Village supplies water to the neighboring municipalities of: Wyckoff Township; Midland Park Borough; and Glen Rock Borough. This water is all used within WMA 4, and there is no inter-basin transfer.

From available reference material, it was determined that NJGS uses at least two methods for calculating the availability of groundwater within a geographic region (e.g. watershed). Both approaches first estimate groundwater recharge in the area, and then calculate water availability as a percentage of recharge.

In the NJSWSP – Task 2 Report "Water Supply Baseline Data Development and Analyses", the groundwater availability calculation was based upon NJGS' methodology of estimating recharge based upon a recharge rate per physiographic province. In WMA 4 these physiographic provinces and their estimated recharge rates from the NJSWSP are as follows:

Physiographic Province	Annual Average Recharge (inches)
Inner Coastal Plain	15
Piedmont (Newark Basin) – glaciated	15
Piedmont (Newark Basin) – unglaciated	10

For the NJSWSP, the State was divided into Regional Water Resource Planning Areas (RWRPA). WMA 4 fell within RWRPA No. 5. It was estimated in this study, that the recharge and available groundwater in RWRPA No. 5 was 236 MGD and 47 MGD, respectively (based on available groundwater as 20 percent of recharge). The delineation of WMA 4 is somewhat smaller than RWRPA No. 5, and is located entirely within the Piedmont (Newark Basin) Glaciated physiographic province.

Using available GIS datasets, the groundwater recharge and availability was recalculated specific to WMA 4 as follows:

Physiographic Province	Annual Average Recharge (inches)	Geographic Area (sq. miles)	Average Daily Recharge (MGD)	Available Water (MGD)
Piedmont (glaciated)	15	196	140	28

Comparing the available groundwater estimate of 28 MGD to actual water allocation data and private well estimates from census data of 25 MGD indicates that very little additional available groundwater exists.

The second methodology for determining groundwater availability as supported by NJGS[4], calculates groundwater recharge based upon land use and soils types. This methodology may yield more significant answers since more specific criteria are used.

Groundwater availability can also be estimated based on trending the water levels in the aquifers during pumping and non-pumping conditions. The Bureau of Water Allocation maintains a database on these levels. The Water Supply Management Act (NJAC 7:19-6.3 (b) 1.) states "A progressive reduction in the potentiometric surface of an aquifer will be considered presumptive evidence that the dependable yield of a subsurface source is less than current withdrawals, subject to acceptable evidence to the contrary."

Assessment of Water Availability

Adequacy of Current Supplies for Current Demands

A summary of current surface water and groundwater demands compared to surface water supply capacity and estimates of groundwater availability are provided in the following table:

Table 1.16.6
WMA 4 – Surface Supply and Demand Comparison (New Jersey Only)

Water System	Available Surface Supply (MGD)	Current Surface Demand (MGD)	Surface Supply/Deficit (MGD)	Estimated Ground Supply (MGD)	Current Ground Demand (MGD)	Ground Supply/Deficit (MGD)
PVWC	75 (1)	47	+28			
All Groundwater Systems				28	25	+3

(1) based upon allocation of 75 MGD.

These data indicate that on an annual average basis, PVWC is using approximately 63 percent of its allocation amount. However, PVWC fully utilizes its maximum daily allocation of 75 MGD during maximum demand periods.

The groundwater availability estimating criteria used by NJGS and adopted by the NJSWSP indicates that groundwater supplies in WMA 4 are used almost to their full extent. Since the estimates are based upon a very general methodology for estimating groundwater supply, much more investigation is required to improve this determination. As mentioned in the previous sections of this report, there are alternate methods for estimating groundwater availability that can be employed.

Water supply to the population within WMA 4 is very dependent on inter-basin transfers into WMA 4 from adjoining watersheds. The primary transfer of water occurs between WMA 3 and WMA 4 with large quantities of water supplied from the Pequannock Watershed (City of Newark) and the Wanaque Watershed and Pompton River (NJDWSC). The Pequannock Watershed provides approximately 47 MGD of supply to the City of Newark. NJDWSC contracting municipalities have allotments totaling 133.5 MGD plus 39.5 MGD of raw water allocated to United Water NJ. United Water NJ is a 50 percent partner in the Wanaque South Project. United Water's allotment of 39.5 MGD constitutes a transfer from WMA 3 to WMA 5. In addition, PVWC through a wholesale agreement with New Jersey-American Water Company, transfers approximately 8 to 12 MGD of finished water from its Little Falls Water Treatment Plant in WMA 4 to customers in WMA 6. Finally, there are numerous interconnections of the transmission systems of the major public water purveyors with supplies originating in WMAs 3,4 or 6. These interconnections are activated to meet water demands on an as-needed basis and can result in changes in the disposition of water diverted within each management area.

Table 1.16.7
NJDWSC Contracting Municipalities and Allotments

Municipality	Wanaque North		Wanaque South	
	% Share	Allotment (MGD)	% Share	Allotment (MGD)
Newark	40.50	38.070	14.342	11.33
Paterson[a]	20.00	18.800	n/a	n/a
Kearny	12.00	11.280	2.177	1.72
Bayonne	n/a	n/a	13.291	10.50
Passaic[a]	11.00	10.340	n/a	n/a
Wayne	n/a	n/a	11.392	9.00
Bloomfield	4.00	3.760	3.481	2.75
Clifton[a]	6.75	6.345	n/a	n/a
Montclair	5.00	4.700	n/a	n/a
Nutley	n/a	n/a	3.798	3.00
Cedar Grove	n/a	n/a	1.519	1.20
Glen Ridge	0.75	0.705	n/a	n/a
United Water[b]	n/a	n/a	50.00	39.50
Total	***100***	***94***	***100***	***79***

Notes for Table 1.16.7:

[a] Represented by Passaic Valley Water Commission
[b] Receives untreated water through aqueduct to Oradell Reservoir
Data from Annual Report of the Consulting Engineer (Killam Associates 2000)

United Water provides water supply to the following municipalities within or partially within WMA 4: Franklin Lakes, Paramus Borough, Upper Saddle River, Montvale, Saddle Brook, Rochelle Park, Maywood, Rutherford, East Rutherford, Carlstadt, Hasbrouck Heights, Wood-Ridge, and Wallington. United Water's supply originates from New York State, with supply from the Lake Deforest, from within WMA 5, with

supply from Lake Tappan, Woodcliff Lake, and Oradell Reservoirs, from WMA 3 from the Wanaque South Project, and is also augmented with diversion from the Saddle River to Oradell Reservoir. The Oradell Reservoir receives raw water supply from NJDWSC (WMA 3) of up to 39.5 MGD.

Adequacy of Current Supplies for Future Demands

Future demands can be estimated based upon population projections. In the NJSWSP Task 3 Report – Development and Projection of Water Demands and Comparison to Net Available Water, population projections were provided by Regional Water Resource Planning Area (RWRPA). The Rutgers University, Center for Urban Policy Research (CUPR) is cited as a source of population projections.

WMA 4 is approximately the size and delineation of RWRPA No. 5 (although a little smaller in size), and the population projections for RWRPA No. 5 were estimated by NJSWSP as follows:

Population Growth (NJSWSP)

RWRPA	Year 2000	2005	2010	2020	2030	2040
No. 5	1,826,062	1,805,866	1,785,662	1,751,534	1,717,899	1,687,100

This table indicates a moderate decline in population of approximately 9.2 percent in the next 40 years.

Population projections recently developed by the New Jersey Department of Labor, Division of Labor Market & Demographic Research as part of the department's economic and demographic projections series, indicate the following population growth within Bergen, Passaic, and Essex Counties:

Table 1.16.8
Population Forecast (New Jersey Department of Labor)

County	Est. 1998	2005	2008	2010	2015
Bergen	875,200	905,600	918,800	928,800	953,500
Passaic	494,900	498,600	501,100	503,800	505,300
Essex	766,400	778,400	783,600	787,000	800,600
Total	2,136,500	2,182,600	2,203,500	2,219,600	2,259,400

This indicates a trend for increase in population with WMA 4 of 5.7 percent by the Year 2015.

The New Jersey Division of Labor population estimates are more recent than those prepared for the NJSWSP, and may be considered more accurate. In this case, the

moderate growth will likely be served primarily through additional surface supply. It is noted that PVWC still has spare capacity in their allocation.

Proposed Projects to Provide Additional Water

The NJSWSP recommended consideration of capital projects such as new interconnections within the region and with adjacent management areas (such as the Raritan Basin), sharing a Hudson River project with New York City (if initiated), increasing the size of existing storage facilities, constructing new storage facilities (including ASR systems in buried valley aquifers), and direct and indirect wastewater re-use. Among the management initiatives to be evaluated are programs aimed at modifying demand and improving operations, such as water conservation, improved drought rule curves, depletive use reduction programs, and improved coordination among presently interconnected purveyors. In addition, it was recommended that a detailed simulation model be developed of the Passaic and Hackensack Rivers that evaluates the region's storage facilities' capability to withstand various drought conditions and changing demand scenarios. The model would include a means for assessing groundwater diversions and wastewater flows in the region in order to properly model available water resources[5].

Conclusions

The surface water diverted for potable supply within WMA 4 originates from and is therefore dependent on watershed areas WMA 3 and WMA 6. Surface water generated from runoff within WMA 4 is primarily not used for potable supply.

The surface water assessment indicates that surface water diversions within WMA 4 are dependent on management of water resources in the upstream management areas, WMA 3, and WMA 6, as well as timing and use of purveyor interconnections and interbasin transfers of raw and finished water.

The groundwater characterization and assessment indicates a variety of groundwater sources that vary from low producing to prolific. Comparing current and projected groundwater withdrawals to estimated groundwater availability, there is evidence to suggest an increasing groundwater deficit. This is an area that requires significantly more investigation and improved methods of estimating the interrelationship between groundwater and surface water availability.

Planning Issues

The NJSWSP Task 4 Report - Preliminary Development of Water Supply Initiatives (Chapter 5)[6] includes a section on issues related to the RWRPA's. The task report provides an excellent summarization of these issues, and should be referred to for additional information. A summary of these issues and their magnitude of importance, as indicated in the Task Report, is provided in the following table:

Table 1.16.9

NJSWSP - SIGNIFICANT PLANNING ISSUES FOR RWRPA NO. 5

ISSUES	IMPORTANCE	EXISTING PROBLEM	POTENTIAL PROBLEM
Supply Contamination & Treatment Requirements	High	High	High
Salt Water Intrusion	Low	Low	Low
Protection & Augmentation of Aquifer Recharge	High	High	High
Impacts of Utilization of Shallow Aquifers	High	High	High
Baseflow Reductions to Reservoir Streams or Waterways	Low	Low	Low
Low Flow Augmentation	Low	Low	Low
Passing Flow Requirements	Low	Low	Low
Depletive Use	High	High	High
Strict Enforcement of the Municipal Land Use Law	Low	Low	Low
Demographics	Low	Low	Low
Facility Sources	Medium	Low	Medium
Source Over-Allocation	Low	Low	Low
Regionalization	Medium	Low	Medium
Deficit Quantification	Low	Low	Low

The information contained in the table is generally consistent with information provided in this report – for issues within WMA 4. For example, passing flow requirements, are of high importance as they relate to the overall safe yield of the water supply systems in WMAs 3, 4 and 6. This information will be updated as part of the New Jersey Statewide Water Supply Plan process.

Additional issues of concern that should be addressed in the watershed planning process include:

- Surface water system yields are dependent upon groundwater systems for baseflow to the streams and this must be considered when planning new groundwater sources to determine their impact on surface water systems. New groundwater sources also impact adjacent, existing groundwater sources.

- Innovation in the form of engineered environmental solutions must be reviewed. For example, direct groundwater recharge using wastewater treatment plant effluent must be evaluated. Direct groundwater recharge must be evaluated considering the impact to downstream purveyors, both in terms of quantity of water and quality of water. Innovation through using "gray water" wastewater treatment plant effluent as a source of irrigation within the watershed (e.g., golf courses).

- The methodology for determining future groundwater availability through estimates of recharge needs continued refinement.

- New developments must be engineered to minimize adverse impacts to groundwater and surface water systems. New developments that require additional water sources at the same time reduce available water by increasing impervious area in the watershed and channeling stormwater runoff directly to streams instead of allowing natural recharge.

- The information that has been collected by various agencies that is useful to watershed planning must be continuously refined. For example, the Bureau of Water Allocation database must be updated with accurate coordinate locations of water withdrawals so this information can be incorporated into GIS analysis. This will also require that some permits that cover more than one geographic location be separated into the required individual permits. Furthermore, the Bureau should enforce reporting of withdrawals from the individual sources, and not as "combined" withdrawals that cover all withdrawals contained in the permit.

- GIS has become a very effective tool for watershed planning. Additional efforts are required to develop sophisticated GIS watershed models specific and calibrated to the individual watersheds.

References

[1] N.P. Zripko, A. Hasan, NJDEP, Depletive Water Use Project for Regional Water Resource Planning Areas of New Jersey, July, 1994

[2] N.J. Geological Survey Digital Geodata Series DGS01-2, September 2001

[3] N.J. Geological Survey Report GSR-32 (Charles and others, 1993)

[4] NJIT, R. Dresnack, E. Golub, F. Salek, Safe Yield Study of Proposed Project to Provide Addtional Water to Northeast New Jersey, July 1984

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