9/19/2011

**SAFE YIELD**
**STAFF REPORT**

**In the matter of**

**Wanaque Water System**

**Reevaluation of the Wanaque Water System Safe Yield**

In accordance with the provisions of N.J.S.A. 58:1A-1 et seq., and in accordance with N.J.A.C. 7:19-6.3, the North Jersey District Water Supply Commission (NJDWSC) filed a report with the Department of Environmental Protection (Department) on December 12, 2005 for the approval of 208 million gallons per day (mgd) as the Wanaque Water System safe yield. By letter dated January 4, 2011 the Department's Bureau of Water Allocation (Bureau) informed NJDWSC that the request could not be approved due to the incomplete information that was provided. Therefore, the Wanaque Water System's previously approved safe yield of 173 mgd was retained at that time. Enclosed with the January 4, 2011 letter were a December 15, 2010 Staff Report that described the Bureau's findings in more detail and a Staff Report Addendum that contained additional information. On January 25, 2011, NJDWSC filed an appeal of the safe yield decision.

The Wanaque Water System safe yield is derived from the existing Wanaque and Monksville reservoirs along with the Two Bridges Pump Station (TBPS) and Ramapo River Pump Station (RRPS). The TBPS diverts water through an intake located on the Pompton River near the Pompton/Passaic confluence and the RRPS diverts water through an intake located on the Ramapo River at the Pompton Lake Dam. A portion of the Wanaque Water System known as the Wanaque South Project was constructed as a joint venture between NJDWSC and United Water New Jersey (UWNJ) during the 1980's. The Wanaque South Project included construction of the dam that forms the Monksville Reservoir, construction of the TBPS, and expansion of the RRPS. UWNJ is a 50% partner (25 mgd each) in the expansion of the RRPS from 100 mgd to 150 mgd, and a 50% partner in the 250 mgd permitted capacity of the TBPS. NJDWSC operates the TBPS and RRPS and diverts surface waters authorized by both NJDWSC's and UWNJ's water allocation permits for the pumping station locations. Water from either pump station or from the Wanaque Reservoir can be transferred to the UWNJ system through the Pompton Lakes Pump Station.

On February 16, 2011, UWNJ requested to be allowed to intervene in the January 25, 2011 appeal of NJDWSC. On February 22, 2011 Bureau staff participated in a settlement meeting with NJDWSC and UWNJ. As a part of the settlement discussions, NJDWSC indicated their intent to provide more complete information to the Department regarding the Wanaque Water System safe yield. This

additional information was provided to and evaluated by the Department as described below.

## Background/Findings of Fact

1. The NJDWSC Wanaque Reservoir Safe Yield and Two Bridges - Ramapo Diversion Simulation Model (Wanaque Model) submitted in support of the December 12, 2005 report is based on data with a period of record from October 1, 1919 through December 31, 2003.

2. In a letter dated July 1, 2008, the Department informed NJDWSC of issues with the daily reconstructed surface water flow data for the Wanaque Model. An attachment to the letter indicated that, based on a preliminary analysis, some of the issues identified with the 2001-2002 drought period data also may extend back in time to October 1, 1979. NJDWSC was requested to address these issues by submitting the raw data, daily calculations and natural flows that were used to create the reconstructed flow record and time series inputs for all of the control points in the NJDWSC Wanaque Model to the Department for review. This included the time period from October 1, 1919 through December 31, 2003.

   Given the issues with the reconstructed flow data for the time period since October 1, 1979, the Department also wanted to review the basis of the reconstructed flow data for the time period from October 1, 1919 through September 30, 1979. NJDWSC was advised to include an explanation and justification for the methodologies used to create the natural flows and reconstructed flow record for the time period since October 1, 1979 in the submittal.

3. In response to the Department's July 1, 2008 letter, NJDWSC submitted a separate Microsoft Excel spreadsheet model that was focused on estimating the sustainable supply of the Wanaque Water System during the 2001-2002 drought. The term "sustainable supply" as used here has a meaning similar to safe yield except that it is based on only a portion of the Wanaque Water System's period of record rather than the entire period of record. The spreadsheet model did not address the Department's concern with NJDWSC's daily reconstructed surface water flow data back to October 1, 1979 and did not provide any additional basis for the Wanaque Model's reconstructed flow data.

4. The Department identified a number of additional issues with the NJDWSC Excel spreadsheet model and began to verbally communicate these issues to NJDWSC. On August 6,

2008, NJDWSC informed the Department that NJDWSC believed the Department had all of the information necessary to reach a decision regarding approval of 208 mgd as the Wanaque Water System safe yield and that NJDWSC did not intend to provide any further information prior to that decision.

5. With a letter dated February 13, 2009, the Department provided the NJDWSC with its February 11, 2009 draft staff report and technical evaluation regarding the Wanaque Water System safe yield. The letter indicated that the Department was unable to verify that the NJDWSC safe yield could be increased at that time and that the key concern remained the stream flow reconstruction issues identified in the Department's July 1, 2008 letter to the NJDWSC. The February 11, 2009 draft staff report again indicated that examination of the reconstructed stream flow data indicates that the issues identified with the 2001-2002 drought period data may extend back to October 1, 1979. The February 13, 2009 letter provided NJDWSC with an additional opportunity to address the Department's concerns.

6. At an April 14, 2009 meeting between NJDWSC, the Department and UWNJ, NJDWSC provided the Department with an updated version of their Excel spreadsheet model that was focused on estimating the sustainable supply of the Wanaque Water System during the 2001-2002 drought. The model was updated to address some of the concerns raised in the Department's February 11, 2009 draft staff report and was peer reviewed by Najarian Associates. The Department reviewed the updated NJDWSC Excel spreadsheet model and confirmed that it addressed many of the issues that had been raised in the Department's February 11, 2009 draft staff report. However, the updated spreadsheet model, which is focused on the 2001-2002 drought, did not address the Department's concern with NJDWSC's daily reconstructed surface water flow data back to October 1, 1979 and did not provide any additional basis for the Wanaque Model's reconstructed flow data.

7. As indicated above, the Bureau's January 4, 2011 letter informed NJDWSC that 208 mgd could not be approved as the Wanaque Water System safe yield due to the incomplete information that was provided.

8. Prior to the February 22, 2011 settlement meeting, NJDWSC indicated they only had the reconstructed flow record for the NJDWSC Wanaque Model and did not have the associated raw data, daily calculations, natural flows, or the methodologies used for the time period since October 1, 1979. NJDWSC had also indicated that obtaining the requested data from the applicable engineering firm would

require hundreds of thousands of dollars in expenditures and at least one year of time.

At the settlement meeting, NJDWSC indicated that the requested data could not be provided because it no longer existed and proposed to submit a new Excel spreadsheet computer model. The new model would address the time period from January 1, 1980 through December 31, 2003 and would be similar to the previously submitted spreadsheet models in that the raw surface water input data would be provided.

9. In this instance, the Department agreed to review the new spreadsheet model for the years 1980 through 2003 because:

- NJDWSC had indicated that the requested data for the Wanaque Model no longer existed;
- The raw surface water input data for the new spreadsheet model for the time period January 1, 1980 through December 31, 2003 would be provided; and
- The Department had not identified any specific issues with the Wanaque Model's reconstructed flow data for the time period from October 1, 1919 through September 30, 1979.

10. On March 10, 2011 NJDWSC submitted a new draft Excel spreadsheet computer model that addressed the time period from January 1, 1980 through December 31, 2003.

**Staff Analysis and Conclusions**

1. The Department reviewed the new draft NJDWSC spreadsheet computer model and examined the model structure, documentation, assumptions, input data, logical functions and calculations. This model simulates the operations of the Wanaque Water System and performs calculations on a daily time step from January 1, 1980 through December 31, 2003. The new draft NJDWSC spreadsheet model reconstructed gravity inflows into the Monksville and Wanaque reservoirs by calculating the net change in observed combined storage volume from the previous day, subtracting observed NJDWSC and UWNJ diversions from the RRPS and TBPS, adding observed NJDWSC and UWNJ withdrawals from the Wanaque Reservoir, and then adding observed releases from the Wanaque Reservoir as measured at United States Geological Survey (USGS) Gage No. 01387000 located just below the reservoir. Daily storage values for the Monksville Reservoir prior to its construction and first filling are assumed to be 7 billion gallons. The new draft NJDWSC spreadsheet model

reconstructed stream flows in the Ramapo River at Pompton Lake Dam by adding observed NJDWSC and UWNJ diversions at the RRPS to observed stream flows at USGS gage No. 01388000 at that location. The new draft NJDWSC spreadsheet model reconstructed stream flows in the Passaic River at Little Falls by adding observed NJDWSC, UWNJ and Passaic Valley Water Company (PVWC) diversions at the RRPS, TBPS and Little Falls intake to observed stream flows at USGS gage No. 01389500 in the Passaic River at Little Falls. The new draft NJDWSC spreadsheet model reconstructed stream flows at the confluence of the Passaic and Pompton rivers by subtracting 7.05 mgd of treated wastewater discharge (Wayne Township Mountainview wastewater treatment plant) from the reconstructed stream flows in the Passaic River at Little Falls and then dividing the result by a drainage area ratio of 1.0283.

2. The Department and NJDWSC reached consensus regarding a number of specific modifications to the new draft NJDWSC spreadsheet model data, calculations, logical functions, and documentation. The Department also identified a number of general issues with the model that remained to be addressed and are discussed in more detail below.

3. On June 6, 2011, NJDWSC formally submitted the new NJDWSC spreadsheet model to the Department for review as a part of the settlement process. Again, the Department reviewed the new NJDWSC spreadsheet model and examined the model structure, documentation, assumptions, input data, logical functions and calculations. The Department verified that NJDWSC had made the specific modifications to the model data, calculations, logical functions, and documentation upon which consensus had been reached with the Department.

4. With regard to the raw surface water input data for the new NJDWSC spreadsheet model:

   - All observed stream flow data used were from USGS records;

   - All observed storage volumes of the Wanaque and Monksville Reservoirs, observed NJDWSC and UWNJ diversions from the RRPS and TBPS, and observed NJDWSC and UWNJ withdrawals from the Wanaque Reservoir were from Wanaque Water System daily operating records compiled by NJDWSC. In general, the Department has determined that, for diversion data, the Bureau of Water Allocation water diversion report records should be used to estimate safe yield because this data is certified by a representative of the permitted entity as being accurate and the data is periodically checked by the Bureau of Water Allocation

for accuracy. However, in this case, the NJDWSC Wanaque Water System daily operating records compared favorably with the monthly values in Bureau of Water Allocation water diversion report records and were used instead of the Bureau's data because they were already at the daily time-step needed for the model calculations; and

- All observed PVWC diversions at the TBPS and Little Falls used in the model calculations for the purpose of estimating the safe yield of the Wanaque Water System as documented herein are from Bureau of Water Allocation water diversion report records. The water diversion report records contain monthly values, which were prorated into daily values for use in the daily model calculations. The model also contains 5 other datasets of observed PVWC diversions from other sources but this aspect of the model was not reviewed by the Department or used for the present purpose.

5. One of the general issues with the new NJDWSC spreadsheet model that remained to be addressed was that the reconstruction of gravity inflows into the Monksville and Wanaque reservoirs did not subtract additional releases, above the minimum daily passing flow of 3 mgd from Greenwood Lake that were made to lower the lake water level to provide a means of aquatic weed control. Such releases lower the water level about 5 feet below the lake's normal spillway crest elevation. This type of draw-down appears to have occurred only 4 times during the time period from January 1, 1980 through December 31, 2003 and is planned to occur about once every 4 years in the future in accordance with the Greenwood Lake Water Level Management Plan. There is no guarantee that such additional releases will coincide with any particular drought, therefore the safe yield of the Wanaque Water System cannot rely on such additional releases.

   To begin addressing this issue, NJDWSC submitted a computer model that simulated the daily operation of Greenwood Lake without the draw-downs for aquatic weed control and with a minimum daily release of 3 mgd. The NJDWSC Greenwood Lake model simulated daily operation during years 2001 and 2002.

   Based on the NJDWSC Greenwood Lake model, the Department created a similar Greenwood Lake computer model for the time period December 31, 1979 through December 31, 2003. The Department used its Greenwood Lake model to calculate the daily differences between simulated and observed spills and releases from the lake over this time period such that the additional releases above the minimum daily passing flow of 3 mgd are represented as negative values. The

Department then integrated these daily differences into the new NJDWSC spreadsheet model by adding them to the daily reconstructed gravity inflows into the Monksville and Wanaque reservoirs.

6. Another one of the general issues with the new NJDWSC spreadsheet model that remained to be addressed was that it did not ensure that the effects of the surface water diversions of some major upstream surface water supply reservoir systems were accounted for when each system is operating at its approved safe yield. These major upstream surface water supply reservoir systems that divert surface water within the portion of the Passaic River drainage area that is tributary to the Wanaque Water System include the following:

   - The City of Newark Pequannock River Reservoir System;
   - The Jersey City Boonton/Splitrock Reservoir System; and
   - The New Jersey American Water (NJAW) Canoe Brook Reservoir System.

   To address this issue, the Department focused on the three droughts for which combined water storage in the Wanaque Water System declined to less than one-third of total combined storage in the new NJDWSC spreadsheet model simulations. The critical drawdown periods of these droughts for the Wanaque Water System are:

   - June 12, 1980 (date last full) through February 1, 1981 (date of minimum simulated storage);
   - June 30, 1998 (date last full) through January 2, 1999 (date of minimum simulated storage); and
   - June 30, 2001 (date last full) through March 2, 2002 (date of minimum simulated storage).

7. The Department evaluated the potential effects of the City of Newark Pequannock River Reservoir System diversions and the Jersey City Boonton/Splitrock Reservoir System diversions and determined that they do not affect which of the three droughts identified above is the most severe for the Wanaque Water System, and do not affect the safe yield estimate of the Wanaque Water System. The Department evaluated the potential effects of the NJAW Canoe Brook Reservoir System diversions and determined that they do not affect which of the three droughts identified above is the most severe for the Wanaque Water System. Based on these evaluations, the most severe drought for the Wanaque Water System during the time period from January 1, 1980 through December 31, 2003 is the drought that occurred during years 2001 and 2002.

8. The Department evaluated the potential effects of the NJAW Canoe Brook Reservoir System diversions during the 2001-2002 drought and determined that these diversions, as well as the safe yield of this system, were not being fully utilized at this time. The Department estimated the daily reduction in surface water flows at the Two Bridges diversion location over the critical drawdown period of the 2001-2002 drought for the Wanaque Water System that would result from full utilization of the NJAW Canoe Brook Reservoir System diversions and integrated these daily values into the new NJDWSC spreadsheet model by subtracting them from the daily reconstructed stream flows at the confluence of the Passaic and Pompton rivers.

9. The Wanaque Water System simulated storage calculations in the new NJDWSC spreadsheet model assumed that Wanaque Reservoir daily releases are always at the 10 mgd passing flow requirement and, therefore, that actual releases above 10 mgd are retained in simulated storage. However, actual releases above 10 mgd are not subtracted from daily reconstructed stream flows at the confluence of the Passaic and Pompton rivers (the Two Bridges diversion location). In this way, these flows are being double counted in the model. This issue was corrected in the model by subtracting flows above the 10 mgd passing flow requirement from daily reconstructed stream flows at the confluence of the Passaic and Pompton rivers during the critical drawdown periods of the 3 droughts identified above. This did not affect the conclusion that the most severe drought for the Wanaque Water System during the time period from January 1, 1980 through December 31, 2003 is the drought that occurred during years 2001 and 2002.

10. Based on the new NJDWSC spreadsheet model and the above considerations, the sustainable supply of the Wanaque Water System for the time period from January 1, 1980 through December 31, 2003 is 190 mgd. Based on the previous results of the NJDWSC Wanaque Model as documented in the Department's December 15, 2010 Staff Report, 190 mgd is less than the sustainable supply for the time period from October 1, 1919 through December 31, 1979. As a result, if the portion of the Wanaque Model from October 1, 1919 through December 31, 1979 is accepted as a satisfactory basis for that time period in relation to estimating the safe yield of the Wanaque Water System, then the safe yield of the Wanaque Water System should be approved as 190 mgd.

11. The new NJDWSC spreadsheet model that addresses the time period from January 1, 1980 through December 31, 2003 can be fully accessed by the Department. In addition, the Department's draft RiverWare model of the Wanaque Water

System can replicate the NJDWSC Wanaque Model results for the time period from October 1, 1919 through December 31, 1979. Based on this, the Department does not need NJDWSC to provide a fully accessible copy of the Wanaque Model.

12. The proposed increase in approved safe yield will be accomplished without altering the currently permitted diversions from the Ramapo, Pompton and Passaic Rivers. Within the currently permitted diversion limits, as water demand and draft from the Wanaque Water System increases, the NJDWSC will need to increase the frequency and duration of pumping in order to provide the needed yield. The largest proportion of the increased yield will be derived from pumping during higher flow events, which should have no significant impact on water quality during those events.

13. The increased pumping also has the potential to increase the frequency and duration of low flows. Water quality may be affected by changes in the hydrodynamic regime, especially during extended low flow periods. The Passaic River Basin phosphorus Total Maximum Daily Load (TMDL) was developed based on a known severe drought period, 1999 - 2002, including pumping simulations provided by NJDWSC assuming full utilization of the previously approved safe yield of 173 mgd. This TMDL concluded that wastewater discharges must be upgraded so as to achieve a long term average effluent limit of 0.4 mg/L of total phosphorus in order to attain the applicable water quality standards (watershed criteria established in terms of chlorophyll-a) in the two critical locations, Wanaque Reservoir and Dundee Lake. Increases in the frequency and duration of pumping to support a Wanaque Water System draft of 190 mgd may affect the productivity dynamics in these critical locations, and may create new critical locations. To address this issue, NJDWSC may be required to provide water quality monitoring and modeling, including recalibrated models if needed, sufficient for the Department to establish a revised TMDL and take appropriate regulatory action, beginning when the annual average use reaches 165 mgd.

## Recommendations

Because the Department did not identify any specific issues with the Wanaque Model's daily reconstructed surface water flow data for the time period from October 1, 1919 through September 30, 1979; and because the Department is already developing similar but fully documented data for a period of record that includes the time period from October 1, 1921 through December 31, 1979 as a part of the Passaic-Hackensack Water Supply Project; and because, as a matter of policy, the Department is not delaying safe yield approvals for surface water supply reservoir systems located in the northeastern part of the State until the Passaic-Hackensack Water Supply Project is completed; the portion of the Wanaque Model for the period October 1, 1919 through December 31, 1979 should be accepted as satisfactory for that time period in relation to estimating the safe yield of the Wanaque Water System.

Based on the information available at this time, the safe yield of the Wanaque Water System should be approved as 190 mgd, based on a period of record from October 1, 1919 through December 31, 2003, with a minimum storage of 0.290 billion gallons (including a dead storage of 0.282 billion gallons), and a critical drawdown period of the most severe drought of record from June 30, 2001 through March 2, 2002.

In regards to the Passaic River Basin phosphorus TMDL, the previously approved safe yield of 173 mgd was the basis for one of the critical condition assumptions in the TMDL. It may be a decade or more before the Wanaque Water System draft reaches this point. Further, the need to utilize the additional safe yield is not expected to occur for approximately 40 years. Nevertheless, recognizing the potential for water quality impacts that may result from realizing the revised safe yield as discussed above, the Department should reserve the right to require NJDWSC to conduct water quality monitoring needed for recalibration and to recalibrate the TMDL models (Passaic Watershed model and LA-WATERS), as well as to provide pumping scenarios consistent with use of the revised safe yield sufficient to support the Department's development of a revised TMDL. The Department may trigger this requirement upon the Wanaque Water System reaching 165 mgd annual average use. This will allow sufficient time for the Department to develop and implement the appropriate regulatory response through wastewater discharge and water supply diversion permits.

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Date: September 20, 2011

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