STATE OF DELAWARE
DEPARTMENT OF NATURAL RESOURCES &
ENVIRONMENTAL CONTROL
DIVISION OF WATER RESOURCES
89 KINGS HIGHWAY
DOVER, DELAWARE 19901

June 28, 2010

Eastern Geosciences, Inc.
Attn: Tom Dwyer
420 Commerce Lane, Suite 9
West Berlin, NJ 08091

RE: The Lands of Wandendale Farms, Inc. Basin Infiltration Test

Dear Mr. Dwyer,

The Basin Infiltration Test results have been reviewed by Scott Strohmeier of the Groundwater Protection Branch. Please find attached his conclusions and recommendations for the proposed Rapid Infiltration Basins treatment and disposal system. The GWDS will also take into advisement his recommendations pertaining the regional requirements which will be addressed during the permitting phase of the project as well as the phased approach suggested by Scott. The GWDS has utilized this approach before when permitting regional systems and appears to be the most logical approach by using operational results to confirm/observe system performance.

INTRODUCTION

On January 12, 2010 the Groundwater Protection Branch (GPB) completed a review of the Preliminary Groundwater Impact Assessment (PGIA) for the proposed large on-site wastewater treatment and disposal system at the Lands of Wandendale Farms. The site hydrogeology was found to be acceptable for the disposal of wastewater; however, the GPB required additional information to supplement data presented in the PGIA and large scale infiltration testing to determine whether the large capacity proposed, 1.6 mgd, would be feasible. GPB concerns were in regards to the spare area available and the aquifer test analyses (see Wandendale file memo dated 1/12/10 for further detail).

A meeting was held at the DNREC office on February 4, 2010 to discuss the supplemental information Eastern Geosciences, Inc. (EGI) submitted in response to the GPB inquiries. In addition, a thorough discussion of plans for basin infiltration testing in RIB Area A was discussed. The supplemental information provided by EGI was found to be satisfactory in addressing the concerns noted by the GPB; however, it was determined that the maximum proposed capacity would be limited to 1.45 mgd due to the required spare area available. Tidewater stated that additional land may be purchased in the future, if needed, to meet the proposed 3 mgd submitted in the Coastal Zone Permit application (see Wandendale file).

The location and construction of two (2) basin infiltration tests and associated monitoring was agreed upon by all parties to further evaluate the infiltration rates and potential for perching within the vadose zone of RIB Area A. A work plan was submitted by EGI, which included location and construction details for each basin and accompanying monitor wells (see Wandendale file). The GPB approved the work plan on April 14, 2010.

FINDINGS/DISCUSSION

Test Layout

The two (2) basin infiltration tests (IT1 & IT2) were conducted adjacent to existing piezometers P11 and P13 (see figure 1 of the basin infiltration test addendum). Each basin was 10 feet in diameter with an infiltration area of 78.5 square feet. The infiltration surface was finished 4.25 feet below land surface (bls) in IT1 and 4.8 feet bls in IT2. At these depths surficial silts and clay-textured soils would be bypassed, as recommended for final basin construction in the SIR. Monitoring for each basin consisted of one (1) deep piezometer (pre-existing), one (1) shallow piezometer screened within the top of the water table, and two (2) unsaturated piezometers within the vadose zone. Water for the test was obtained from Test Well 1, which was used to perform an aquifer pump test during the PGIA. This well was reported to be at a sufficient distance not to impact either test.

Infiltration Tests (IT1 & IT2)

Prior to commencing each test, background monitoring was completed in the existing deep piezometer and shallow piezometer screened in the top of the water table. The results of a regression analysis identified a declining water-level trend in both the IT1 and IT2 tests. The background trends were applied to correct the mounding and recovery data in each test, resulting in a slightly higher water table.

Infiltration at IT1 began at 10:25 a.m. on April 22, 2010. The pumping rate was adjusted until a constant head of 0.2 ft was maintained. A stabilized flow of 10.54 gpm was achieved approximately 530 minutes into the test. Mounding was observed in TPZ1 and P11 approximately 140 and 200 minutes into the test. The maximum mound height in TPZ1 was approximately 1.3 ft and approximately 0.2 ft in P11. The wells, TPZ2 and TPZ3, completed in the unsaturated zone did not record any water levels.

The 2006 U.S. EPA Process Design Manual - Land Treatment of Municipal Wastewater Effluent recommends that the annual design hydraulic loading rate for basin infiltration tests should be no greater than 7 to 10 percent of measured basin test infiltration rates.

Using 10 percent of the measured infiltration rate resulted in a design infiltration rate of 2.58 ft/day, or 19.3 gpd/ft^2. The resulting hydraulic loading rate observed during the IT1 basin infiltration test is higher than the 1.92 ft/day, or 14.4gpd/ft^2 derived from the double-ring infiltrometer tests performed during the SIR investigation using the maximum 4 percent of measured infiltration rate. The U.S. EPA (2006) recommends that the annual design hydraulic loading rate for cylinder infiltration tests should be no greater than 2 to 4 percent of the minimum measured infiltration rate. EGI reported that the U.S. EPA (1981) states the maximum design infiltration rate for the cylinder test should not exceed 5 percent of the field infiltration rate; however, this reference was checked and it was in agreement with the 2 to 4 percent referenced in the U.S. EPA (2006) document.

Infiltration at IT2 began at 10:05 p.m. on April 20, 2010. The pumping rate was adjusted until a constant head of 0.2 ft was maintained. A stabilized flow of 10.27 gpm was achieved approximately 501 minutes into the test. Mounding was observed in TPZ4 and P13 approximately 160 and 300 minutes into the test. The maximum mound height in TPZ4 was approximately 1.5 feet and approximately 0.1 feet in P13. Wells TPZ6 did not record any water level; however, a water level was observed in TPZ5. EGI reported that this was the result of the groundwater mounding observed in TPZ4 due to the similarity of the response and relative depth to water between the two wells. The GPB constructed a cross-section to further evaluate the mounding observed in TPZ4 and TPZ5. The cross-section confirms EGI's conclusion regarding the water observed in TPZ5. The reason being that well TPZ5 was completed at a depth and location that if a groundwater mound were to form it would intercept. The reason this was not observed in test IT1 was that TPZ2 was completed at a shallower depth; however, if the groundwater mound were greater it too, would have intercepted.

Using 10 percent of the measured infiltration rate results in a design infiltration rate of 2.5 ft/day, or 18.7 gpd/ft^2. The resulting hydraulic loading rate observed during the IT2 basin infiltration test is higher than the 1.92 ft/day, or 14.4 gpd/ft^2 derived from the double-ring infiltrometer tests performed during the SIR investigation using the maximum 4 percent of measured infiltration rate.

Groundwater Model

The results from the tests were input to the original MODFLOW model created during the PGIA to characterize groundwater mounding. The model revealed very similar responses between the simulated and observed groundwater mounding at the water table, especially in test IT1. Test IT2 had a slightly lower magnitude at the water table. The deeper aquifer results for each test had similar responses, but the magnitude was lower in each test and slightly slower in forming the groundwater mound.

CONCLUSIONS/RECOMMENDATIONS

The results of the two basin infiltration tests within the primary disposal area, RIB Area A, at the Wandendale Farms site has successfully demonstrated that infiltrated wastewater should reach the water table without perching in the vadose zone. In addition, the infiltration rates gathered from the tests are comparable to the proposed design infiltration rates previously stated in both the SIR and PGIA. Although the infiltration rates were determined to be slightly higher using the infiltration basins, the applicant will still be limited to a maximum of 1.45 mgd due to the limited spare area available.

Based on all information submitted to date for the Wandendale Farms site it appears the hydrogeology for RIB Area A is acceptable for a large capacity system; however, it remains difficult for the GPB to ascertain that the proposed system will perform as the basin tests and modeling have shown for the proposed 1.45 mgd capacity across the entire RIB Area A. The GPB would require the GWDS to permit the system in phases, so system performance can be proven over time due to the large capacity proposed.

The GPB requires the following:

- Three (3) phases total, with each phase based on the number of units connected to the wastewater disposal system (not flows);

- Each phase would consist of 1665 units;

- Proceeding through the phases would be contingent on system performance, which is to be demonstrated as outlined under item 4 of the Permit Renewal Requirements – Compliance Monitoring Report in the *Wastewater Treatment and Disposal System Siting, Design, and Operation: Supplemental Guidance to the Existing Regulations Governing the Design, Installation and Operation of Onsite Wastewater Treatment and Disposal Systems and the Regulations Governing the Land Treatment of Wastes* (DNREC, 2008). The reporting would be required when at least 80 percent of the phase is completed. Subsequent to the final project phase reports must be submitted annually and must span a reporting period ranging from June 1 thru May 31. Reports must be received by the Department before August 1 of the reporting year;

- A detailed monitor well plan must be submitted. The plan should include a map showing well locations (including easting and northings), DNREC ID's, top of casing elevations, and land surface elevations. The location and construction of the wells should be derived using the existing 3-D numerical model to address any sensitive receptors and adequately characterize the groundwater as a result of the additional recharge from the proposed RIBs;

- Establish ambient groundwater quality prior to system start-up. A minimum of three (3) independent sampling events, at least two (2) weeks apart, must be performed over a period of at least three (3) months;

- Quarterly monitoring of influent, effluent, and groundwater quality as outlined under Monitoring in DNREC (2008).

The GPB would also like to remind the GWDS that DNREC (2008) has regional system requirements that, to the GPB's knowledge, have not been submitted. The GPB will rely on the GWDS to see that these requirements are fulfilled prior to permit approval.

Please incorporate these requirements into your design, if you have not already. As always if you have any questions or require additional information please do not hesitate to contact either myself at (302) 739-9948 or Scott Strohmeier at (302) 739-9945.

Sincerely,

John G. Hayes Jr.
Environmental Scientist
Large Systems Branch

Pc: file
Tidewater Utilities, Inc.

REFERENCES

DNREC, 1999, Guidance and Regulations Governing the Land Treatment of Wastes; Department of Natural Resources & Environmental Control, 177 p.

DNREC, 2005, Regulations Governing the Design Installation, and Operation of Onsite Wastewater Treatment and Disposal Systems; Department of Natural Resources & Environmental Control Document No. 40-08/05/04/07/01, 73 p., 36 exhibits.

U.S. EPA, 1981, Process Design Manual – Land Treatment of Municipal Wastewater: United States Environmental Protection Agency, Center for Environmental Research Information, EPA/625/1-81-013, variously paged.

U.S. EPA, 2006, Process Design Manual – Land Treatment of Municipal Wastewater Effluent: United States Environmental Protection Agency, National Risk Management Laboratory, EPA/625/R-06/016, variously paged.