RESPONSIBLE PLANNING FOR FUTURE GROUND WATER USE FROM THE GREAT FLATS AQUIFER : TWO CASE STUDIES: THE GEP ENERGY PROJECT AND THE SI GREEN FUELS BOILER PROJECT

Thomas M. Johnson
Hydrogeologist, Vice President
Alpha Geoscience
679 Plank Road
Clifton Park, NY 12065

Introduction

The Great Flats Aquifer is a sole source water supply for the City of Schenectady, the Towns of Glenville and Rotterdam, the Village of Scotia, and the Hamlet of Rotterdam Junction. The Town of Glenville also serves neighboring water districts in the Towns of Clifton Park, Charlton and Ballston. Careful consideration should be given to the potential impacts from proposed projects on the availability and quality of ground water to adequately preserve and protect this resource. Two projects within the last 8 years provide examples of comprehensive hydrogeologic studies to evaluate potential impacts to the aquifer.

The Glenville Energy Park (GEP) project proposed withdrawing an average of 2.4 million gallons per day (MGD) of water with a peak of 4.0 million gallons per day from the City of Schenectady municipal well field on Rice Road in the Town of Rotterdam. The Green Fuels Boiler project by Schenectady International (SI) proposed withdrawing and additional 0.22 MGD from existing production wells owned by SI. The areas of study for these projects are shown in Figure 1.

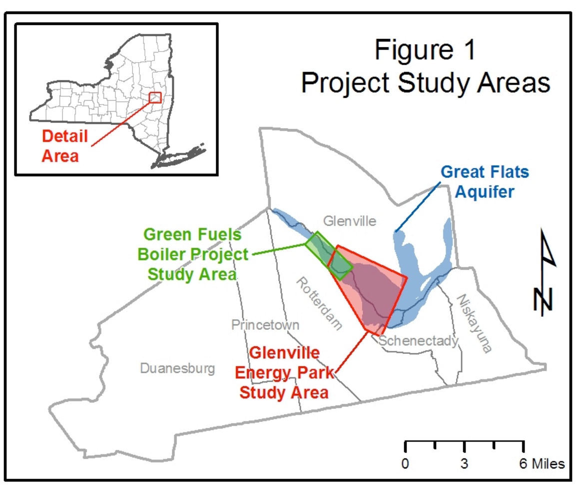

Figure 1
Project Study Areas

The results of the hydrogeologic studies for each project are presented in reports submitted with project applications to the New York State Department of Environmental Conservation (NYSDEC). The report for the GEP project is dated December 2001 and titled *“Hydrogeology of the Great Flats Aquifer in the Vicinity of the Glenville Energy Park Site”*. Two reports were prepared for the Green Fuels Boiler Project. The first report is dated April 5, 2006 and titled *“Hydrogeologic Evaluation for the Green Fuels Boiler Project at Rotterdam, NY”*. The second report is dated June 9, 2006 and titled *“Supplemental Hydrogeologic Evaluation for the Green Fuels Boiler Project at Rotterdam, NY”*.

The objectives and the scope of work for both of these projects were similar. The objectives generally were to evaluate whether the withdrawal of additional water from the Great Flats Aquifer for the projects would adversely affect ground water availability and quality, particularly at residential wells or at the municipal well fields. The work scope of both projects generally included compiling available geologic and hydrogeologic data, characterizing and evaluating of the existing aquifer geologic and hydrogeologic conditions, and predicting of the potential affects

In: Cockburn, J.M.H. and Garver, J.I., Proceedings from the 2009 Mohawk Watershed Symposium, Union College, Schenectady NY, 27 March 2009

of increased ground water withdrawal for the proposed projects. A qualitative hydrogeologic model was used to evaluate the potential affects associated with the GEP project. A quantitative computer ground water flow model was used to simulate various pumping scenarios and evaluate the potential affects of the Green Fuels Boiler Project.

GEP Hydrogeologic Study

The purpose of the evaluation was to determine the potential affects of withdrawing additional ground water (2.4 MGD average and 4.0 MGD peak) from the Schenectady municipal well field. The City of Schenectady well field has a permitted capacity of 35 million gallons per day and has been pumping at an average rate of approximately 12.7 MGD.

The geologic evaluation identified five primary geologic units including, in ascending order, bedrock, glacial till, outwash sand and gravel, glaciolacustrine sand, silt and clay, and alluvial sand and silt. The Great Flats Aquifer, from which municipalities obtain water, consists of outwash sand and gravel that filled the Mohawk River Valley as the glaciers receded.

The aquifer primarily receives recharge from precipitation directly to the valley surface and from runoff onto the ground surface from the upland adjacent to the Mohawk River Valley. Additional recharge is derived from the bedrock and glacial till below the aquifer. The primary discharge zone for the aquifer is the Mohawk River. However, the aquifer is recharged by the river where flow is induced from the river to the aquifer by pumping at the Glenville, Schenectady, and Rotterdam well fields. This recharge to groundwater by the river is a reversal of the normal relationship between the Mohawk River and the aquifer. The ability of the Mohawk River to sustain the Schenectady, Rotterdam, and Glenville well fields limits the susceptibility of those systems to drought conditions.

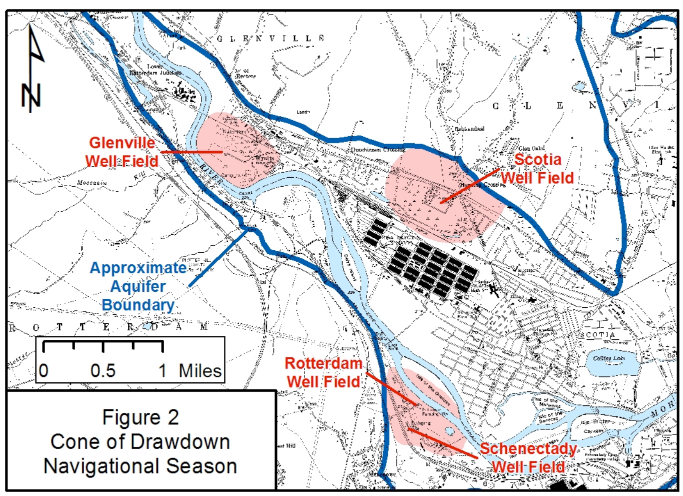

Figure 2
Cone of Drawdown
Navigational Season

The water level in the Mohawk River is controlled by canal locks that are used for navigational purposes. The water level in portions of the aquifer adjacent to the river is dependent on the river level, which varies between navigational and non-navigational seasons. The cones of drawdown at the Schenectady, Rotterdam and Glenville well fields during the navigation season are shown in Figure 2. The cones of drawdown at these well fields are smaller during the navigational season than during the non-navigational season because of the higher head in the Mohawk River. Portions of the aquifer that are not located adjacent to the Mohawk River, such as where the Scotia well field is located, are not affected by river levels and exhibit normal seasonal cycles.

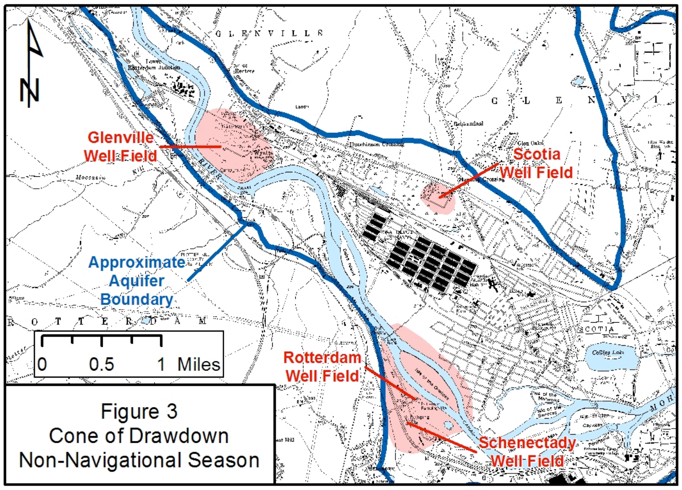

Figure 3
Cone of Drawdown
Non-Navigational Season

The susceptibility of the Schenectady, Rotterdam, and Glenville well fields to summer drought conditions is limited due to their proximity to the Mohawk River; however, they are susceptible to brief periods of dry, cold weather in late January and early February (i.e., non-navigation season). During such conditions of reduced contribution by the Mohawk River, the well fields will remove greater volumes of water from storage in the aquifer resulting in an expansion of the cone of drawdown at each well field. Figure 3 shows the expanded cones of drawdown during the non-navigation season. Pumping test results indicate that the water supplied by the Mohawk River to the Schenectady/ Rotterdam well field limits the cone of drawdown north of the well field, except during periods of severe climatic conditions and very high pumping rates. The short-term variations in the well field pumping rate have very little effect on the cone of drawdown because of the very high aquifer transmissivity and the hydraulic connection between the well field and the Mohawk River.

Comparison of the groundwater contour maps prepared during the study for the navigational and non-navigational seasons show that there is little seasonal change in groundwater levels or groundwater flow directions, except near Lock 8. Damming of water at Lock 8 during the navigational season results in a 14.5 foot difference in surface water elevation from the upstream to the downstream side of the lock, which is open during the non-navigational season. This condition creates seasonal changes in the groundwater gradient and the groundwater flow direction in the area north of the lock.

The results of the hydrogeologic evaluation for the proposed GEP project showed that the proposed additional pumping of 2.4 million gallons per day (4.0 million gallons per day maximum) at the Schenectady well field could be implemented without adverse impacts. The hydrogeologic evaluation showed that the increased pumping rate would not affect the groundwater flow direction or the groundwater quality of private well users, or adversely affect other municipal well fields.

Green Fuels Boiler Hydrogeologic Study

The Green Fuels Boiler hydrogeologic study was conducted as part of an environmental impact assessment to permit an alternative fuels boiler at the Schenectady International (SI) facility in Rotterdam, New York. Figure 4 shows the location of production wells within the Green Fuels Boiler study area.

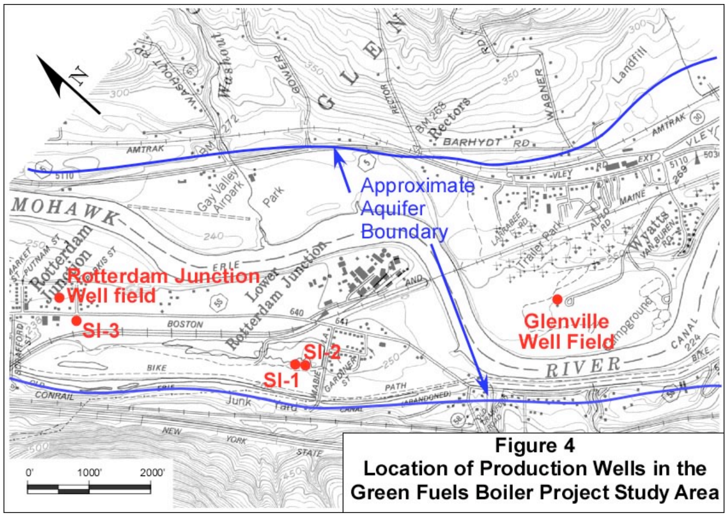

Figure 4
Location of Production Wells in the Green Fuels Boiler Project Study Area

Two of the primary objectives of the hydrogeologic study were to determine whether the Great Flats Aquifer has sufficient capacity to produce 0.22 MGD to the project and to assess the effects of additional pumping for the project at existing private or municipal pumping wells. The secondary objectives of the assessment included defining the extent of the hydrogeologic units, identifying recharge and discharge areas, defining ground water flow paths, and predicting changes in the ground water flow patterns and ground water gradients from the proposed increased pumping.

Considerable knowledge of the geologic and hydrogeologic setting in the Mohawk River valley was gained from the comprehensive evaluation of the Great Flats Aquifer as part of the GEP energy plant siting study. The results of that study were directly applicable to the hydrogeologic evaluation for the Green Fuels Boiler project.

The extensive information developed from the previous research and investigations of the Great Flats Aquifer and site area included geologic and hydrogeologic data from published reports, consulting reports to the municipalities that rely on the aquifer, well field data collected by the municipalities, subsurface data collected by others within the study area, and the results of the GEP energy plant siting study. Additional geologic, hydrogeologic and SI plant data were provided by SI. The available information was used to assess data that pertain to municipal well field production rates, historical pumping rates at the SI pumping wells, geologic logs and records for wells throughout the study area, and reports describing the hydrogeology of the Great Flats Aquifer and related geologic units. Geologic maps and cross sections were prepared to characterize the aquifer and to provide a basis for developing a computer ground water flow model to simulate existing and anticipated pumping scenarios.

The geologic and hydrogeologic maps prepared from the available information, the relevant pumping data, and the aquifer properties obtained from the existing reports were used to develop an analytical computer ground water flow model to evaluate various hydrologic and pumping conditions. The results of the ground water flow model are consistent with known hydrologic conditions, ground water flow patterns, and water levels during the navigation and non-navigation seasons.

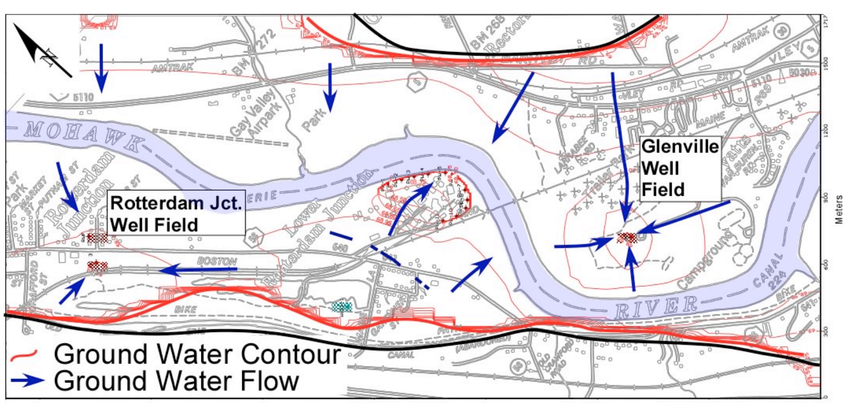

Figure 5: Computer Simulated Ground Water Flow
Non-Navigation Season

Figures 5 and 6 show typical computer model simulations for ground water pumping conditions at various wells under both navigational and non-navigational conditions.

The model simulation results show the ground water elevations, gradients and flow paths in the study area for currently existing conditions. The modeling simulations were used to predict changes in these conditions due to increased pumping for the boiler project. The simulations of existing conditions show that ground water elevations, gradients and flow paths normally vary as the level of the Mohawk River changes from the navigation to the non-navigation seasons. Simulations of projected conditions indicate that the impact of additional pumping would be minimal regardless of which existing SI pumping well was used. The aquifer readily produces sufficient water to support the proposed increased pumping rate without adversely affecting other pumping wells in the study area.

The hydrogeologic evaluation demonstrated that the Great Flats aquifer would support the proposed additional pumping for the green fuel boiler project without adversely impacting other pumping wells. The results of this hydrogeologic evaluation indicated that changes in local drawdown and ground water flow patterns by the proposed pumping would be minimal.

Conclusions

The Great Flats Aquifer is an essential and valuable resource for continued growth and development of the communities that rely on it for a source of clean, readily available water. Studies have shown that the aquifer can easily support withdrawal of quantities of water far in excess of those currently being pumped because of the hydraulic connection with the Mohawk River. However, not all portions of the aquifer benefit from this hydraulic connection. Studies should be performed on a case by case basis to identify the specific geologic and hydrogeologic conditions at proposed project sites or proposed wells to ensure that adequate water is available and sustainable.

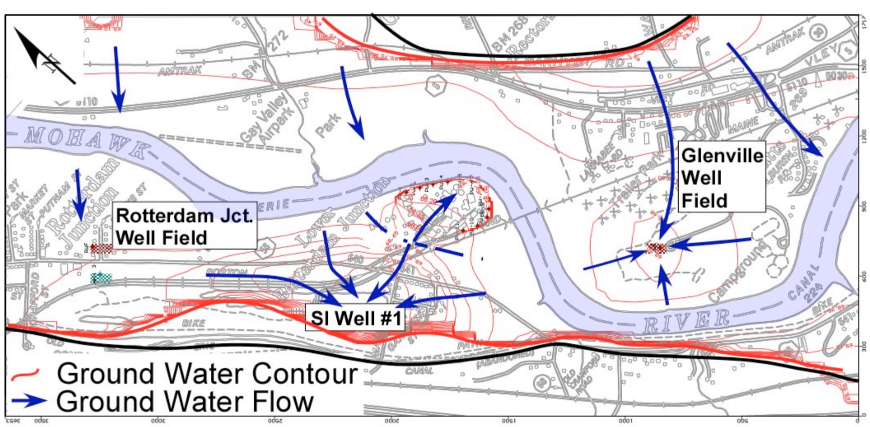

Figure 6: Computer Simulated Ground Water Flow; Navigation Season

Thomas M. Johnson is Vice President and a Hydrogeologist at Alpha Geoscience in Clifton Park, New York. He routinely provides geologic, hydrogeologic and environmental consulting services to a variety of private and public clients.

In: Cockburn, J.M.H. and Garver, J.I., Proceedings from the 2009 Mohawk Watershed Symposium, Union College, Schenectady NY, 27 March 2009