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**February 19, 2010**

**Mr. John Piazza**  
**Chairman, Planning Board**  
**Town of Mamakating**  
**2948 Route 209**  
**Wurtsboro, NY 12790**

**RE:** Review of Draft Environmental Impact Statement  
Section 3.2 Groundwater & Appendix E  
For Seven Peaks at Mountain Road,  
Town of Mamakating, Sullivan County, NY  
Dated January 22, 2010, prepared by The Chazen Companies

Dear Chairman Piazza and Planning Board Members,

Mid-Hudson Geosciences has been retained by Basha Kill Area Association to Review the Groundwater Resources sections of the above referenced project.

**Section 3.2 Groundwater Resources (page 3.2-1) begins with the following statement:**

“A hydrogeologic study, including deep bedrock test wells, short-term hydraulic aquifer tests, and numerical model was prepared for the proposed project by Ground Water Investigations, Inc. The full study is included in Appendix E of this DEIS. The study concluded that there is adequate groundwater to serve the project without adversely impacting surrounding property owners and that recharge rates will exceed withdrawal rates after build-out, including potential future project elements.”

Reading Section 3.2 of the DEIS suggests that there is sufficient water for this project, but a probing review into Appendix E clearly found several lines of evidence that there is limited water supply beneath the site. Those findings will be addressed in the order listed in the above quotation.

**Deep Bedrock Test Wells**

Seven bedrock wells (numbered W-1 to W-7) were drilled on the site to a depth of 500 feet with the exception of well W-5, which has a total depth of 550 feet. Of those seven wells, three wells were reported to have yields of less than 2 gallons per minute (gpm). On page 7 in Appendix E: discharge rates for W-4 and W-7 were less than 1 gpm; on the NYSDEC Water Well Completion Form for W-6, a 4-hour test showed a well yield of less than 2 gpm. W-6 is the well for the model house at the site.

NYS Department of Health Manual technical reference CSFP dated 11/6/00 RE: Realty Subdivision Individual Water Supply Criteria on page 3 of 8 states: “Wells with yields of less

than 2 gpm should not be used for individual household water supply". Given that three out of the seven existing wells produce less than 2 gpm, that fact alone indicates there is limited water under the site. If that same ratio applies to 49 luxury homesites, then 21 of the sites will not have sufficient water to meet Town, County and State criteria for well yield.

One of the bedrock wells (W-7) was drilled on the footprint of the proposed 125-room Resort and reported to yield less than 1 gpm (see above). The resort will need sufficient wells to supply the project when the best well is out of service. Clearly, there is a question if there will even be sufficient groundwater to supply the demand of the proposed Resort..

## **Short-Term Aquifer Pumping Tests**

Two pumping tests were conducted by pumping W-3 and W-5.

### **Pumping Test for W-3**

Well W-3 was pumped for 24-hours (8AM on 5/5/09 to 8AM on 5/6/09) at an average pumping rate of 12.98 gpm. The water levels were examined in 4-hour increments to look for stabilization of the water level. The NYS DOH states (same reference as above) " 'the stabilized well water level' should not fluctuate more than plus or minus 0.5 foot for each 100 feet of water in the well and the plotted measurements should not decrease during the four hour constant flow test period." With 480 feet of water in the well (static water level is given as 20 feet on 4/8/07 listed on Driller's Well Record shown in Appendix E), the water level should not fluctuate more than plus 2.4 feet or minus 2.4 feet for a total variation of 4.8 feet. Four 4-hour intervals were examined beginning at 4PM on 5/5/09 and ending at 8AM on 5/6/09, the variations from first reading to last were 6.2, 5.0, 5.8 and 7.2 feet. All of those values are greater than 4.8 feet indicating that the pumping test was not conducted with 4-hours stabilized pumping, let alone 6-hour as erroneously reported by the applicant on page 3.2-1 in Section 3.2 and page 8 of Appendix E: "The NYS DOH criterion for stabilized drawdown during the last 6 hours of pumping was satisfied for both aquifer tests at each pumping well location." Pumping W-3 at 12.98 gpm was too high a yield to sustain stabilization of the water level in the well. A lower pumping rate of perhaps 12 gpm might satisfy the stabilization criterion.

Also the static water level prior to pumping was about 1245.4 feet and after pumping the water level returned to 1237.6 after 24 hours and the highest it ever reached was 1240.5 on 5/11/09 while monitoring recovery after the test. One can conclude from this observation that 4.9 feet of water was pumped out of the aquifer and did not return via vertical or lateral recharge in the next 5 days. If this lack of recharge is common in the bedrock aquifer beneath the site, residential or resort wells could drain the portions of the aquifer under the ridge and their individual wells could go dry.

### **Pumping Test for W-5**

Well MW-5 was pumped for 19 hours 40 minutes beginning at 9:30AM on 6/2/09 at an average pumping rate of 3.6 gpm. Examination of water levels indicates that stabilization of the water level was achieved for about 12 hours of the test. Recovery was within 2.6 feet of static water level after 24 hours and within 0.5 feet when the transducer record ends on 6/5/09. This incomplete recovery may indicate lack of recharge described in well W-3. Because the water level record was truncated 28 hours after pumping stopped, it is not possible to tell. The W-5 pumping rate of 3.6 gpm was about one third the 13 gpm in W-3, so a smaller volume of water

would be removed from the aquifer.

Drawdown occurred in nearby well W-2 in response to pumping W-5. A lack of recovery of about 6 feet is shown on the graphs indicating that recharge to W-2 did not result in full recovery in two days following the pumping.

### **Transmissivities Calculated from Pumping Tests**

The pumping test data was used to calculate transmissivity or the rate at which water is transmitted through an aquifer. You can think of it as the rate at which water moves toward a well on the cone of depression developed when the pumping is draining the area around the well. For W-3, W-5 and W-2, transmissivities were calculated at 13.5, 5.3, and 6.3 ft<sup>2</sup>/day, with an average of 8.4 ft<sup>2</sup>/day. A transmissivity of 10 is rated between poor and fair for domestic wells in the Ground Water Manual issued by the US Department of Interior, Bureau of Reclamation in 1985 (page 28, Figure 2.4). Hence, an aquifer with this range of transmissivity can barely support a residence, let alone huge houses and a resort.

### **Numerical Groundwater Model**

A two-dimensional groundwater model was used to estimate water levels resulting from pumping of the existing 7 wells and 45 un-drilled residential wells. The model does not take into account the 13 other single-family lots. The only well on the Resort Parcel is W-7, which was reported as capable of producing less than one gpm. The model is too generalized to portray future impacts of pumping. Input to the model assumes the aquifer is homogeneous and has the same transmissivity everywhere, which we know is not true from their calculations. The model also assumes vertical recharge from precipitation is the same throughout the site.

The daily demand for the entire project is given as 64,060 gpd (Appendix E, page 2). The model uses a pumping rate of 650 gpd for each well for 180 days to estimate drawdown under the project site. However, when demand of 64,060 gpd is divided by 650 gpd for each pumping well, 99 wells would be needed to pump enough water to meet the demand. The maps (Sheets 1-14) only show 52 wells. In round numbers, if the demand is 65,000 gpd, each of 50 wells would have to produce 1300 gpd.

The resultant map show a drawdown of 54 feet near the ridge top dropping off on both sides to 40 feet at the NW and SE boundaries. The final map (Sheet 14) assumes no vertical recharge over the site for 180 days. If modeling pumping rate is only half of the daily demand, perhaps the drawdown should actually be 108 feet under the ridge top?

The model seems to be an exercise in futility and much too general to approximate site conditions. By omitting the resort demand from it's proposed location on the northeast corner of the site, the model does not represent the area of greatest need for water. Real data must be collected to document actual recharge on this site and the presence of water wells, which can meet the Resort demand.

### **Recharge Rates**

Recharge is the process of water infiltrating downward into the ground through soils, unconsolidated sediments and into bedrock aquifers. Since the groundwater mound beneath

the ridge top exists, there must be some areas where vertical recharge occurs from precipitation. However, those areas are not likely the wetlands, although the applicant states that the wetlands are areas of recharge. If they are recharge areas, why is the water standing at the surface. Each of the wetlands is part of a stream flow system, except for two small ones, which may actually be connected through shallow overburden or soils. The wetland soil and unconsolidated sediments collect the stormwater, limit rate of the water flow, and slowly conduct the water to the streams.

No doubt there is surface recharge to groundwater, but it is probably associated with fractures and joints in the bedrock. Three onsite wells (W-1, W-2, and W-6) show similar rises and falls correlating with the precipitation events at the Wurtsboro Airport (Figures 2,3,and 4 in Appendix E). However, before and after the rainfall events, they all show a downward trend indicating that the recharge may raise the water level, but natural forces tend to drain the top of the aquifer continually.

## **Conclusions and Recommendations**

Based on the findings of this review of the details of the hydrogeologic investigation, water supply for this project remains uncertain at best.

### **Conclusions**

- If the sampling of the seven wells drilled for the DEIS is accurate, forty percent of the homeowner wells are likely to yield less than 2 gpm. The NYS DOH considers wells with less than 2 gpm inadequate for a domestic water supply.
- The best well tested was capable of pumping at about 12 gpm.
- The one well drilled in the Resort area has a yield of less than 1 gpm.
- The well for the Model House has a yield of less than 2 gpm.
- Both of the wells pumped did not fully recovery to pretest static water levels. Another well showed drawdown in reponse to pumping and did not recover. Two of these wells showed about 5 feet of unrecovered drawdown.
- The transmissivities calculated from pumping tests for the bedrock aquifer are on the order of 10 ft<sup>2</sup>/day and rated as poor to fair for domestic water supplies.
- The only source of recharge of groundwater beneath this ridge top location is vertical infiltration of rainfall and snowmelt.
- The wetlands are not likely sources of recharge because they are all connected with streams.
- Locations of recharge areas are unknown at this time.
- The numeric groundwater model developed to simulate drawdown from pumping wells on site does not contribute anything to the questions of water availability.

## Recommendations

- ◆ The groundwater problem on this site is recharge. It might be possible to drill enough wells, which could be pumped to supply the homes, but if recharge does not occur, the water levels will drop continuously. This was a problem, when Marriott wanted to build a Resort at Minnewaska. This same problem occurs in the hamlet of Cragmoor. Another proposed development north of Route 17 on the Ridge also has never been able to demonstrate adequate water supply.
- ◆ The hydrogeology of this site is complex. An understanding of the recharge and flow regime are necessary to demonstrate adequate water supply. It would be wise on the part of the site owner to continue to monitor precipitation and water levels in some of the existing wells. It is important to try to understand the seasonal and annual water level cycles. Also to see if any recharge occurs when the wetlands may be frozen, but snowmelt or rainfall finds its way downward through cracks and crevices.
- ◆ The applicants' consultant did demonstrate that precipitation does correlate with recharge, but the limited data also showed a trend of dropping water table. Monitoring the water levels for months and years will help resolve solve these mysteries.
- ◆ If this project is approved by the Town, before a building permit can be issued or prior to the sale of any lot, a well must be drilled and tested to demonstrate sufficient yield and recharge to provide enough water for the proposed home. Also drawdown in nearby wells should be investigated.
- ◆ If the applicant has any idea of continuing to propose a Resort on the site, adequate water will have to be demonstrated with drilled wells and testing. Monitoring of nearby wells will be necessary to try to determine the radial influence of pumping.

Yours truly,

*Katherine J. Beinkafner*



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cc: Paula Medley, President of Basha Kill Area Association