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## MEMORANDUM

**TO:** Chairman Zuckerman and Members of the Philipstown Planning Board

**CC:** Kate Liberman, Davis McCallum and members of the HVSF development team

**FROM:** Paul Woodell, PG, LEP

**DATE:** April 13, 2022

**RE:** Response to comments from Dr. Michalski regarding The Garrison groundwater

**FILE NO.:** 4348-001

At the February 17, 2022 Philipstown Planning Board meeting, a member of the public presented an opinion statement prepared by Andrew Michalski, PhD, PG, CGW entitled *On Groundwater and Well Water Supply Issues, Presented in the Expanded EAF for the Proposed Hudson Valley Shakespeare Festival*. The statement is undated. This Memorandum provides GEODesign's responses to the main points in Dr. Michalski's statement (in bold below).

***1) The EAF relies on an inappropriate bedrock groundwater calculation model to assess groundwater recharge rate at the Garrison Golf site.***

***a) the EAF fails to acknowledge that the recharge rate calculated based on infiltration capacity of surficial onsite soil types is different from the recharge rate to the bedrock aquifer.***

The Groundwater Budget portion of the EAF (Utilities, Section IV-G), uses methods as described and required in the Philipstown Zoning Code (Section 175-16F) to calculate aquifer recharge. Land areas for hydrologic soil groups on the HVSF site and the upland recharge area to the east, were determined using data available from the USDA Natural Resources Conservation Service via their web soil survey online application. The data-gathering and calculation methods fully comply with Philipstown zoning requirements.

***b) This approach (using the recharge capacity of the upland basin east of the site) fails to account for the layout of topographic contours...shallow bedrock groundwater from the east discharges to...the ponded tributary (irrigation pond) to the Philipse Brook.***

The layout of topographic contours is in fact, the reason that using the upland basin recharge capacity as part of the total HVSF groundwater capacity calculation is valid. A basic assumption in hydrogeology is that bedrock groundwater elevations beneath a basin are approximately similar to surface topography and groundwater flow directions mirror those of

surface drainage (which is based on topography). Therefore, it is appropriate to conclude that groundwater at the HVSF site is partially recharged through flow initiating in the upland basin.

The irrigation pond receives inflow primarily from a surface stream originating within the upland basin. It is likely that the stream receives water from a combination of localized overland flow (during storm events) and shallow overburden groundwater discharge into the stream bed. A smaller secondary source of inflow to the irrigation pond is likely to be from local, shallow groundwater in unconsolidated sediments. The stream discharge into the pond has not been measured. Based on visual estimates during summer baseflow, stream inflow does not exceed 5 to 10 gallons per minute, a small percentage of the 153 gallons per minute estimated for the upland basin recharge (based on the 221,333 gallons per day of recharge calculated from the zoning code).

Dr. Michalski states that project water consumption will increase *significantly* from 9,820 gpd to 18,344 gpd under full build out. First, the projected consumption has been revised downward to 13,353 gpd, which accounts for the elimination of the indoor theater and hotel from the development plan. Therefore, the demand under the proposed condition is 36 percent greater than the existing demand and 12.8 percent *less* than the 2005 GPPD approved plan (15,320 gpd). Second, the zoning code requires a conservative safety factor where estimated consumption is multiplied by a factor of six in order to perform the water balance (recharge vs. consumption). The estimated groundwater recharge is significantly greater than projected demand. Third, the projected demand is calculated for peak demand, a condition which will be met only on isolated occasions and for a full build-out which will not be realized for many years.

***2) Several offsite wells showed drawdown induced by the (1999) pumping tests. Although the EAF gives only sketchy information on the tests...supply wells located more than 400 ft from the pumped wells were impacted.***

All available data and reports regarding the 1999 irrigation well pumping tests were provided in Appendix 3 of the Phase I Environmental Site Assessment.

Withdrawal of groundwater from bedrock aquifers naturally induces some degree of drawdown influence in surrounding wells. The degree of influence depends on many factors including drawdown (directly related to discharge rate) in the pumping well(s), distance between wells, interconnectedness of water-bearing features and duration of pumping. Induced drawdown (influence) in an offsite well should not automatically be construed as detrimental impact.

Whether the induced drawdown or influence in the offsite domestic well is detrimental depends in part, on the condition of the well under influence. Records of the 1999 pumping test and the influence in domestic wells appears to indicate that the domestic wells exhibiting greatest detrimental impact (those which were remediated) were shallow (limited available drawdown) and/or old (potentially with reduced capacity due to bacterial or sediment fouling of water-bearing rock fractures).

The proposed Well B, closest to those offsite wells exhibiting influence in 1999, will be used for domestic purpose. The withdrawal rate, and thus the induced drawdown, will likely be significantly less than the 1999 irrigation wells (which were pumped at maximum flow for 72 hours continuously). Proposed Well A is sited to be approximately 1,400 feet north of the 1999 irrigation well which induced the greatest offsite-well drawdown. The proposed Well A location is roughly central to the HVSF parcel which maximizes distance from, and minimizes potential influence of, offsite wells.

***3) The results of testing of existing wells for contaminants...are incomplete.***

The Phase II ESA investigation scope was agreed to by the Town's consultant (AKRF) and was not intended to be a complete site characterization. The EAF describes future additional soil sampling and analysis to provide greater spatial resolution of development areas exceeding Soil Cleanup Objective including the protection of groundwater standard. Additionally, a Soils Management Plan will be developed to address SCO exceedances.

The October 2021 EAF submission includes a response to comments provided in an AKRF memorandum dated September 15, 2021. GEODesign responses contained therein include:

- Mitigation measures to address the Commercial SCO exceedances will additionally minimize the threat to groundwater quality through capping (reduction of infiltration) or removal. Existing data indicate that Commercial and Protection of Groundwater SCO exceedances correspond.
- Existing and future public-supply wells will be monitored by the Putnam County Department of Health under 10NYCRR Part 5.1 requirements.
- The Applicant will voluntarily test for additional contaminants of concern if not part of the default requirements.

***4) The EAF provides no information as to the depth of proposed new water supply well A or to the parameters for its water-level monitoring program. ...as a minimum, offsite private wells located northeast to southwest from the proposed onsite wells...should be included in the water-level monitoring program.***

The proposed well depth and details of the monitoring program are beyond the scope of the EAF discussion. Well depth would be determined during drilling based on positions of water-bearing fractures and desired casing storage. The water-monitoring program will be approved by the Putnam County DOH, including any offsite well-monitoring requirements, as required. Siting and construction of future wells will be in full compliance with State, County and local regulations and requirements.