MEMORANDUM

To: Joseph M. Cermele, PE
Kellard Sessions Consulting, P.C.
500 Main Street
Armonk, New York 10504

From: William A. Canavan, PG, LSRP
HydroEnvironmental Solutions, Inc.
One Deans Bridge Road
Somers, New York 10589

RE: Review of Water District No. 2 Well Field Assessment – Final Report
Brynwood Golf & Country Club, North Castle, New York

Date: February 4, 2016

As requested, HydroEnvironmental Solutions, Inc. (HES) has reviewed the Town of North Castle Water District No. 2 Well Field Assessment Report prepared by Leggette, Brashears & Graham, Inc. (LBG) on behalf of the Applicant and dated December 2015. The report was prepared to evaluate the feasibility of the proposed Brynwood Country Club Development joining existing Water District No. 2 (The District) in the Town of North Castle. In this regard, HES offers the following related to this matter:

- The Well Field Evaluation Report (the Report) provides a water budget for the Water District No. 2 Well Field recharge area using an annual recharge rate of 7-inches per year to the bedrock aquifer (Snavely, 1980). Using a recharge value of 7 inches annually is a very conservative estimate for recharge to the bedrock aquifer. The Applicant could have used a recharge value of 8.45 inches annually based on the 1995 United States Geological Survey (USGS) Study for Recharge to a Bedrock Aquifer in the Lower Hudson Valley. Thus, the recharge values estimated in the report are very conservative. The recharge value of 539,000 gallons per day (gpd) of recharge to the bedrock aquifer beneath the well field using 7-inches of annual recharge would actually be 17% higher or 630,000 gpd using the USGS recharge value. Nonetheless, based on both recharge numbers, sufficient water is available in the underlying marble bedrock aquifer to support the water demand of the Brynwood project, even in a severe drought.

- As per the Applicants hydrogeologic consultant (LBG), the original demand for the project was 45,105 gpd, or 31.3 gpm (gallons per minute) based on the 1988

NYSDEC Design Standard for Water Usage (see attached table). However, the Standard was revised in 2014, and using the new water demand design numbers, the project demand is now 34,154 gpd, or 24 gpm. Thus, the project demand will place less stress on the underlying bedrock aquifer and recharge than originally anticipated.

- In the recent past, concerns have been expressed (Mianus River Gorge Preserve) about pumping groundwater from the Mianus River Drainage Basin and then discharging the water to the Byram River Drainage Basin, an inter-basin transfer of water. However, given the annual total recharge to the Mianus River Drainage basin, the original water demand of 46,000 gpd was only 0.3% of the available recharge to the Mianus River Drainage Basin. Using the revised water budget of 34,154 gpd, the inter-basin transfer of water would be 0.225% of the available recharge. Therefore, HES believes that the daily demand of the project will have a negligible effect on the Mianus River watershed. Additionally, supplying the project from bedrock wells will also minimize the effects of the inter-basin transfer as bedrock wells will have less of an effect on surface water bodies and the shallow sand and gravel aquifer. The Applicant will confirm this by conducting a 72-hour pump test on the newly installed bedrock well(s) and monitoring existing sand and gravel wells, nearby surface water bodies, wetlands and existing surrounding bedrock wells.

- In order to join the Water District the Applicant proposes to find double the daily demand for the project by drilling bedrock wells in the well field in accordance with NYSDEC requirements and the Ten States Standard. The demand for the project based on the 1988 Design Standard was 32 gpm. However, it should be noted that this number is now 24 gpm according to the new design standard (2014). Thus, a minimum of 48 gpm (double the daily demand) will be required from the proposed bedrock wells to meet the project demand. HES recommends that the Applicant agree to find a minimum of 100 gpm from one or several bedrock wells during their proposed test drilling and subsequent testing. This will provide a surplus of at least 52 gpm for The District. The surplus water is needed during peak demand times such as during the drier summer months (irrigation season). According to the December 2015 LBG Well Field Assessment Report and The District demand numbers, during the summer months and peak demand times, the District pumps 314 gpm which is 24 gpm more than the NYSDEC withdrawal permit that allows 290 gpm. Thus, The

District would benefit greatly from finding surplus available water in the bedrock aquifer beneath the well field.

- The Applicant proposes to find the additional water supply from bedrock wells drilled into the Inwood Marble which is a sensible approach. Bedrock wells will likely not influence nearby surface water bodies and will not significantly affect groundwater recharge to the sand and gravel well field. Bedrock wells will also allow more flexibility for pumping the existing sand and gravel wells as these wells can be cycled and not operated continuously, thereby allowing for recharge to the sand and gravel aquifer during the drier times of the year.

- There will be a significant financial benefit to The District by allowing Brynwood to join. An additional 73 users plus the Brynwood Clubhouse will join The District lowering the per unit cost to existing users. The Applicant proposes to construct the necessary improvements to The District at its own expense including drilling new bedrock supply wells, upgrading the existing pump house to accommodate the new wells, installation of an underground chlorine contact tank, installation of a new water main across Route 22 and enlargement and/or replacement of the water main along the west side of Route 22.

Wolcott, Stephen W. and Robert F. Snow (1995) Computation of Bedrock-Aquifer Recharge in Northern Westchester County, New York, and Chemical Quality of Water from Selected Bedrock Wells. US Geological Survey Water Resources Investigations Report 92-4157, Albany, NY 1995.

Snavely, D. (1980) Ground-Water Appraisal of the Fishkill-Beacon Area, Dutchess County, New York. U.S. Geological Survey Water Resources Investigation Open-File Report 80-437, Albany, NY 1980.

The estimated average potable water demand for the 73 residential units and the clubhouse based on the New York State Department of (NYSDEC) 1988 Design Standards used in the FEIS was about 45,105 gpd (gallons per day) or about 31.3 gpm (gallons per minute). In March 2014 the NYSDEC issued new design standards with revised water usage multipliers for new development. The table below compares the Brynwood water demand under the 1988 standards and the new 2014 standards:

Usage Type	Subcategory	Number	1988 Design Standards Water Usage Rate	Water Demand (gpd)	2014 Design Standards Water Usage Rates	Water Demand (gpd)
Residential	2-bedroom residence	55 units	300 gpd/2-bedroom house	16,500	220 gpd/2-bedroom house	12,100
	3-bedroom residence	7 units	400 gpd/3-bedroom house	2,800	330 gpd/3-bedroom house	2,310
	4-bedroom residence	11 units	475 gpd/4-bedroom house	5,225	440 gpd/4-bedroom house	4,840
	Seasonal employee housing (dorm style)	12 employees	75 gpd/person	900	40 gpd/person[1/]	480
	Guest Suites	5-20 suites	120 gpd/room	600-2,400	110 gpd/room	550-2,200
Clubhouse	Club Members Peak Day	300-400 members	25 gpd/ member	7,500-10,000	16 gpd/ round of golf[1/]	4,800-6,400
	Restaurant/Bar	150 seats	35 gpd/seat	5,250	28 gpd/seat[1/]	4,200
Employees		10-92 employees[2/]	15 gpd/person	150-1,380	12 gpd/person[1/]	120-1,104
Golf Course Maintenance Shed		6,500 square feet	0.1 gpd/square foot	650	0.08 gpd/square foot[1/]	520
Total Water Demand			**Average Water Demand (1988)**	**39,575-45,105**	**Average Water Demand (2014)**	**29,920-34,154**

gpd gallons per day
1/ Rates include a 20% reduction for use of water saving fixtures
2/ Employee count will vary seasonally

Using the 2014 Design Standards water usage values, the average water demand for the Brynwood project is 34,154 gpd, which is about 23.7 gpm. The updated water usage rates are a more reasonable representation of actual water usage rates. For example, average water usage for the Brynwood Club based on information provided by the Water District is about 6,264 gpd (Appendix II). This water usage rate is more comparable to the 2014 Design Standard calculated value of 6,400 gpd for the Club than the 1988 Design Standard calculated value of 10,000 gpd.

The New York State Department of Health (NYSDOH) requires that a water-supply source capacity equal or exceed the peak water demand of a service area with the best well out of service. For a proposed development, the peak water demand is calculated as twice the average water demand estimate. Therefore, using the 2014 NYSDEC design standards calculated water