D.W. KOZERA, INC.

PROFESSIONAL ENGINEERS & GEOLOGISTS

February 19, 2018

Hekemian & Company, Inc.
505 Main Street
Annapolis, Maryland 21403

Attn: Mr. Christopher P. Bell, Senior Vice President
(cbell@hekemian.com)

Re: 444 Maple Avenue, West, Vienna, Virginia (DWK Contract Number 14107.D)

Dear Mr. Bell:

Based on the latest concept drawings, this project has undergone a redesign which will raise the lower level up to EL 375. Although this elevation is generally still slightly below the water table, the groundwater issues raised in our report dated November 17, 2014 are significantly abated.

The groundwater below the site in the test borings was noted at the following elevations.

Boring No.	Location	Groundwater Elevation
B-1	West Corner	EL 377.9
B-5	North Corner	EL 379.5
B-10	South Corner	EL 372.8
B-15	East Corner	EL 377.9

From this data, the groundwater table is approximately 11 to 13 feet below the ground surface and flows in a southerly direction, mimicking the surface topography.

Based on the data we previously obtained at this site, the building at EL 375, can be placed on a shallow foundation (spread footings), and sized for allowable bearing pressures of 3,000 to 4,000 psf. A high groundwater table can lower the allowable bearing capacity of a shallow foundation. However, the governing criteria for sizing shallow foundations is not actual failure (bearing capacity), as there is always a minimum Factor of Safety of 3.0 provided for this, criteria, regardless of the water table. The governing criteria for shallow foundations is the settlement. The foundations have to be sized to ensure total settlements of less than one inch. The settlement analysis used to design the foundation accounts for the water table at the site. If one considers soil as a box full of marbles with void space between the marbles, any load applied to the box of marbles is transferred from marble to marble (particle to particle) regardless of whether the void is filled with water or air, see Figure 3.7 below.

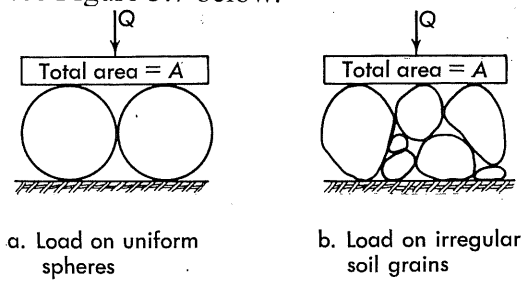
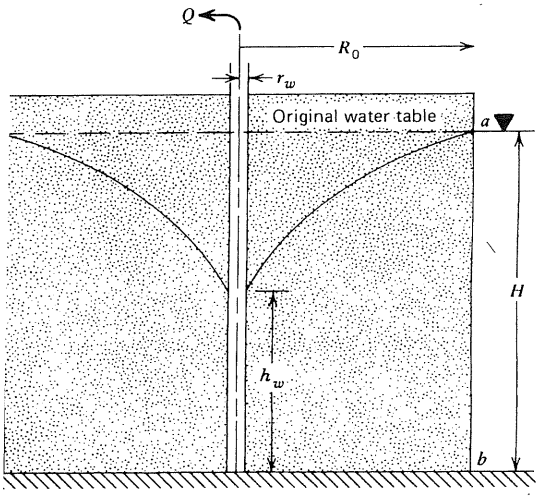


Figure 3.7 *Distribution of a load, Q or Q', to soil grains.*

1408 Bare Hills Avenue, Suite 200
Baltimore, MD 21209 Phone: 410.823.1060 Fax: 410.823.1062

A subdrainage system will still need to be installed as the lower floor grade could be as much as 5 feet below the water table. We have computed the flow into the subdrainage system for a finished floor grade of EL 375 and estimated that the flow quantity will be approximately 5 gpm (gallons per minute) for the entire building area. The drawdown radius, Ro, is estimated to be less than 20 feet outside building envelope. See Figure 5.3 below.

$$Q_w = \frac{\pi K(H^2 - h_w^2)}{\ln R_0/r_w} \qquad (6.3)$$



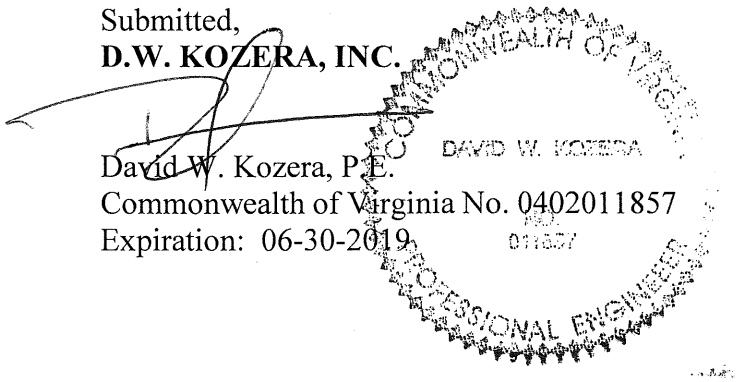
5.3 Equilibrium radial flow to a frictionless well in a water quifer.

In summary, the effect of raising the lower level to EL 375 will greatly reduce the flow of water into the subdrainage system. The regional groundwater will continue to flow from north to south below this building. However, the amount of water into the subdrainage system (5 gpm) is rather small, and the narrow drawdown curve should not affect structures outside your property.

Note that the placement of buildings at or below the water table has become a more common occurrence with the shortage of real estate in urban areas. A few of the projects where a permanent subdrainage system has been installed and functioning are:

- Ritz Carlton, Key Highway, Baltimore, Maryland
- Martin Luther King Memorial, Washington, DC
- Johns Hopkins University, Decker Quad Building, Baltimore, Maryland
- North Gate at Falls Church, Virginia

Submitted,
D.W. KOZERA, INC.



David W. Kozera, P.E.
Commonwealth of Virginia No. 0402011857
Expiration: 06-30-2019