

APPENDIX G

Aquifer Mapping &
Groundwater Protection Zone

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Mr. Yechiel Lebovits
3 Ashel Lane
Monsey, NY 10952

C/O Leonard Jackson Associates
26 Firemens Memorial Drive
Pomona, NY 10970

RE: Accuracy of Aquifer Mapping and Related
Town of Ramapo Groundwater Protection Zone
Map Associated with the Proposed Patrick Farm
Development Area
Town of Ramapo, New York

Dear Mr. Lebovits:

As per your request, the hydrogeologic and environmental consulting firm of Leggette, Brashears & Graham, Inc. (LBG) has reviewed the accuracy of aquifer mapping as presented in the 2007 ("Draft") "Aquifer and Well Field Protection Zone Law for the Town of Ramapo" (aka Chapter 96) relative to the location and areal extent of the proposed Patrick Farm Development (the Development Site) in the Town of Ramapo (the Town). This review of the aquifer mapping is intended to be a supplement to our previous assessment findings regarding the potential for groundwater impacts associated with the proposed Development as summarized in our letter report of November 29, 2010. The prior assessment was initiated in response to the need for the application for the proposed Development to be reviewed by the Town relative to the goals of Chapter 96 and the corresponding "Aquifer and Well Field Protection Zone Map" (the Protection Zone Map) due to the resulting changes in land-use activities at the Site.

Chapter 96 identifies land-use activities that the Town indicates are either prohibited or regulated due to water-quality impact potential relative to the aquifers and well fields occurring within its boundaries. In addition, Chapter 96 identifies those land-use activities which require review by the Town's Department of Public Works and Building Inspector to ensure protection of the local groundwater flow and quality. It should be noted that the Protection Zone Map identifies areas corresponding to "Aquifers" and "Groundwater Protection Zones", but does not identify Well Field Protection Zones as suggested by the title of Chapter 96. Further, the list of prohibited activities identified by Chapter 96

pertains only to lands occurring within the Aquifer and Well Field Protection Zone, and not adjoining land areas. As such, the location of the Site relative to the boundaries of the "Aquifer and Well Field Protection Zone" corresponding to the nearby upper Mahwah River valley as identified on the respective map, is integral to a determination of the applicability of Chapter 96 to the proposed Development (see attached Figure 1 for respective delineations).

The Protection Zone Map was developed by Frederick P. Clark Associates, Inc. (FPCA) in 2004 on behalf of the Town, using GIS-based shape files obtained from public agencies (e.g., DOT, RCDOH). Based on the "Metadata" that is associated with the respective Aquifers and Groundwater Protection Zones mapped by FPCA, the source shape files were derived from the "New York State Aquifers" hyperlink developed by the New York State Department of Health (NYSDOH) in 2001. The respective aquifer delineation associated with the Mahwah River valley as provided in the NYSDOH hyperlink is reportedly derived from U.S. Geological Survey (USGS), Water Resources Investigations (WRI) Report 874274. The mapping of the Mahwah River valley aquifer provided in USGS WRI Report 874274 are based on detailed mapping presented and summarized in USGS Open File Report 82115 ["Geohydrology of the Valley Fill Aquifer in the Ramapo and Mahwah Rivers Area, Rockland County, New York" (1982)] and USGS WRI Open File Report 82553 ["Atlas of Eleven Selected Aquifers in New York" (1984)]. Based on these source references, along with that of earlier hydrogeologic investigators (Perlmutter, 1959), the aquifer of concern relative to the proposed Development consists of the glacially deposited sand and gravel underlying the Mahwah River and the immediately bordering valley floor. The geologic deposits comprising the Mahwah River valley aquifer in the Site area are classified as "Kame and kame terrace sand and gravel; high permeability", and "Outwash sand and gravel; high permeability", which may be locally overlain by "Peat, muck and clay; bog deposits; low permeability" that provide a locally protective confining unit for the aquifer where it occurs. The kame and kame terrace deposits in the Site area also comprise high permeability materials that are adjacent to the aquifer and as such can act as a major groundwater recharge source and pathway for the Mahwah River valley aquifer.

A GIS-based map of the aquifer and comprising deposits, as well as the corresponding area of adjoining high permeability material (kame and kame terrace deposits), as presented in the respective references is provided as Figure 1 (attached). Based on the respective delineations, none of the aquifer materials as identified by the USGS occurs within the proposed Development area, and only a very limited portion of the adjoining high permeability material occurs locally within the western boundary of the Site, proximal to the west side of Route 202. As such, the Site does not overlie the Mahwah River Valley aquifer as identified by the USGS and NYSDOH. The attached Figure 1 map also shows the extent of the Aquifer and Groundwater Protection Zone in the proposed Development area as presented by Chapter 96.

A comparison between the respective delineations indicates that the Groundwater Protection Zone roughly corresponds to an area consisting of portions of both aquifer and high permeability material as identified by the USGS. This suggests that the Chapter 96 Groundwater Protection Zone is intended to represent the aquifer underlying the local portion of the Mahwah River valley. From this comparison it is also apparent that locally the Groundwater Protection Zone coincides mainly with the USGS high permeability materials area, and not the USGS aquifer area. As such, it is questionable as to what the area identified as "Aquifer" by Chapter 96 actually represents. Furthermore, the portion of the Chapter 96 Aquifer mapped as occurring in the proposed Development area significantly exceeds the extent mapped

as aquifer by the respective source references (USGS). As such, it appears that this excess represents an error and/or GIS based exaggeration associated with the Protection Zone Map for Chapter 96 relative to the proposed Development area. Therefore, based on the contradictions between the technical source data and the FPCA mapping, the mapping basis for the applicability of Chapter 96 to the proposed Development is not hydrogeologically supported. As such, it does not appear the Site occurs within the boundaries of the Mahwah River valley aquifer as mapped by the technical resources directly responsible for the hydrogeologic mapping in the proposed Development area.

Applicability of Chapter 96 to Proposed On-Site Land Uses

As previously indicated in our November 29, 2010 letter report, the proposed Development will consist of residential housing, religious buildings, and transportation routes. Water supply will be provided by United Water from off-site sources, and domestic wastewater will be piped off-site to the Rockland County Sewer District for appropriate treatment and disposal. Energy (natural gas for heating and cooking, and electricity) will be provided by Orange and Rockland Utilities from off-site sources. No industrial or commercial activities at the Development are proposed. As such, none of the land uses and related activities proposed for the Development correspond to the "Prohibited activities" listed by Chapter 96 in Section 96-5 (A. thru H.), as well as the "Regulated activities" listed by Chapter 96 in Section 96-6 [A(1) thru (7)].

In addition, the Development as designed will include the installation and use of four retention basins to collect precipitation runoff routed from 17 acres of on-site roof area. The current design assumes that collected rooftop runoff will be retained in the respective basins and allow to infiltrate into the subsurface environment where it will be assimilated as groundwater recharge for the local aquifer system. This will result in a surplus for the local groundwater system when compared to existing conditions. As we understand it, stormwater runoff generated from non-rooftop impervious surfaces (e.g., roads, parking areas, sidewalks) at the proposed Development will be routed to on-site detention basins where the water quality will be treated using the appropriate NYSDEC Best Management Practices (BMPs) that have been incorporated into the stormwater management plan for the Site. This effort in conjunction with the use of clean rooftop runoff as groundwater recharge should provide for adequate protection of the local aquifer and surface-water resources of the nearby Mahwah River valley.

Summary

Based on our review of available information regarding the hydrogeology of the Site area, and the proposed land-usage and stormwater management plan for the proposed Development we conclude the following:

- 1) The proposed Patrick Farm Development Site does not overlie the Mahwah River Valley aquifer as defined and delineated by the USGS and NYSDOH.
- 2) The Chapter 96 Groundwater Protection Zone Map is inconsistent with hydrogeologic conditions established by the USGS and the NYSDOH for the Site area.
- 3) The land-use activities associated with the proposed Development are not prohibited or regulated by Chapter 96.
- 4) The proposed stormwater management plan for the Development is intended to follow NYSDEC BMPs and afford maintenance of current groundwater recharge

potential, thus providing for adequate protection of the yield capacity and water quality of the Mahwah River and the underlying aquifer.

If you have any questions or need additional information, please call.

Very truly yours,

LEGGETTE, BRASHEARS & GRAHAM, INC.

A handwritten signature in black ink that reads "Frank Getchell". The signature is written in a cursive, slightly slanted style.

Frank Getchell, PG
Hydrogeologist/Principal

FG:fg
Attachment

REFERENCES

Bugliosi, E.F., and R. Trudell, 1988, "Potential Yields of Wells in Unconsolidated Aquifers In Upstate New York -- Lower Hudson Sheet": U.S. Geological Survey, Water Resources Investigations Report 874274.

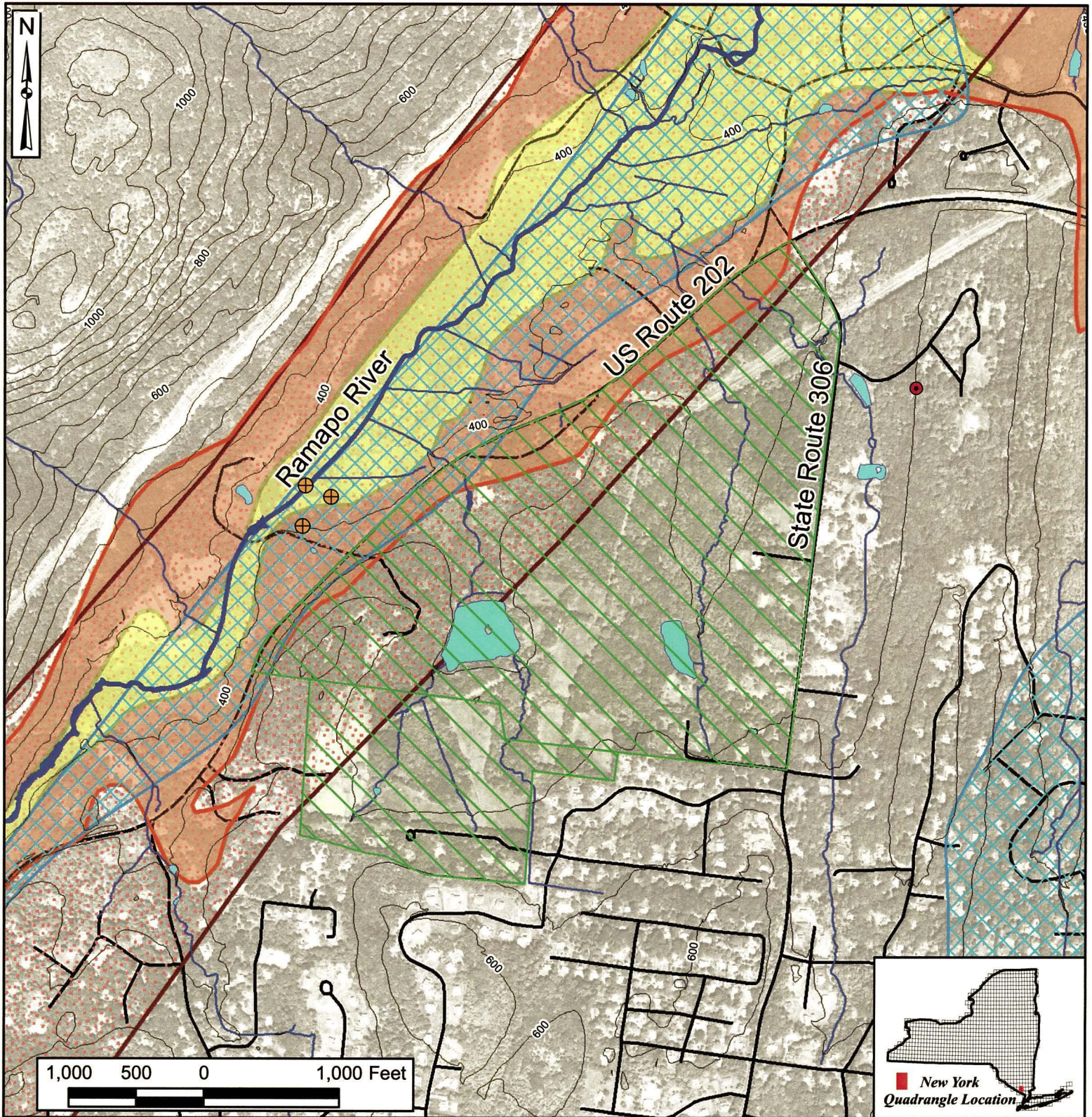
Moore, R.B., 1984, "Atlas of Eleven Selected Aquifers in New York": U.S. Geological Survey, Water Resources Investigations Open File Report 82553.

Moore, R.B., D.H. Caldwell, W.G. Stelz, and J.L. Belli, 1982, "Geohydrology of the Valley Fill Aquifer in the Ramapo and Mahwah Rivers Area, Rockland County, New York": U.S. Geological Survey, Open File Report 82114.

New York State Department of Health, 2001, "New York State Aquifers": GIS-based shape files <http://www.nysgis.state.ny.us/gisdata/inventories/details.cfm?DSID=309>

Perlmutter, N.M., 1959, "Geology and Ground Water Resources of Rockland County, New York": U.S. Geological Survey, Bulletin GW 42.

Town of Ramapo, 2007, "'Draft' Chapter 96, Aquifer and Well Field Protection Zone": Code of the Town of Ramapo. Attached map and respective GIS-based shape files from Frederick P. Clark Associates, Inc. (May 2004).



Legend

- United Water Well
- Public Non-Community Supply Well
- Approximate Patrick Farm Area
- Aquifer (NYSDOH, NYSGS, & USGS, 1982)
- High Permeability Material Adjacent to the Aquifer (NYSDOH, NYSGS, & USGS, 1982)
- Aquifer (Town of Ramapo, Chapter 96)
- Groundwater Protection Zone (Town of Ramapo, Chapter 96)

BASE SOURCE: USGS Topography, DOT Roads, USDA 2009 Orthoimagery.

**PROPOSED PATRICK FARM DEVELOPMENT
TOWN OF RAMAPO**

**COMPARISON OF NEW YORK STATE AND
TOWN OF RAMAPO AQUIFER MAPPING**

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