

Kenneth Belitz
112 Johnson Road
Carlisle, MA 01741
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Town of Carlisle, Zoning Board of Appeals
Town of Carlisle, Board of Health
Town of Carlisle, Conservation Commission

ATTN: Lisa Davis Lewis, ZBA Chair; Peggy Wang, ZBA Secretary; Bill Risso, BOH Chair; Linda Fantasia, Health Agent; Luke Ascolillo, Chair, Conservation Commission; Sylvia R. Willard, Conservation Administrator, Conservation Commission

Dear Board and Commission Members,

I am a resident of Carlisle and I am writing to you regarding the potential hydrologic impacts of a proposed 40B housing development on the Brem property located at 100 Long Ridge Road (also known as "The Birches"). My concerns about the potential hydrologic impacts arise from my expertise as a hydrogeologist. I received a Ph.D. in Hydrogeology from Stanford University in 1985. I have taught classes and have held faculty appointments at the University of California – Santa Cruz, Stanford University, Dartmouth College, and the City University of New York – Queens College. I also have more than 25 years of experience as a research hydrologist and supervisory hydrologist with the U.S. Geological Survey. I currently serve as the Chief for groundwater studies for the USGS National Water Quality Assessment program. The views that I express in this letter are solely in my capacity as a resident of Carlisle. I mention my current employment only as an indicator of expertise.

My understanding of the site is based, in part, on several documents submitted over the past several months, including: a "groundwater impact analysis" prepared by Northeast Geoscience Inc (March 25, 2015), a "Phase 1 Report" by Nobis Engineering Inc (February 20, 2015), a "review of the March 25 letter report" prepared by the Horsely Witten Group (April 10, 2015), a "review of the proposed groundwater impact analysis" prepared by the Horsely Witten Group (October 17, 2014), two letters from Hill Law to the Carlisle Zoning Board of Appeals (July 22, 2014 and October 3, 2014), and two letters from Hill Law to the Carlisle Board of Health (September 8, 2014 and October 3, 2014). I have also used "OLIVER: MassGIS's Online Mapping Tool" to examine the topographic, hydrologic, and other features of the site and surrounding areas. Given the materials that I have reviewed, I have general concerns about the potential hydrologic impacts of the proposed development based on the intensity of development. I also have specific concerns related to some of information used in the groundwater impact analysis (NGI, March 25, 2015).

General concerns based on the intensity of development

The proposed development includes 20 homes drawing water from 10 wells, diversion of storm water to a number of features distributed across the site, and diversion of wastewater to three septic systems, with two located in the northwest corner of the property and one in the southwest corner of the property. A wetlands area and stream are present along the northeastern and eastern boundaries of the proposed development. Three of the proposed water supply wells are located within 100 feet of the "edge of the bordering vegetated wetland." The "footprint" of the proposed development (houses,

roads, lawn, etc) will be approximately 200,000 square feet.

Given the number and density of houses, the volume of pumping for household use may be a substantial proportion of the annual recharge rate over the area of the development. It is possible that the annual rate of pumping may equal or exceed the rate of recharge over the area. Consequently, the “cone of depression” around the set of wells may extend beyond the limits of the area of the development, and could affect the performance of existing water supply wells on neighboring properties. Three of the supply wells are within 100 feet of the wetlands and stream. Extraction of groundwater by these wells may reduce the flow of groundwater to the wetlands and stream, and negatively affect the function of those features. To some extent, recharge from the septic systems and storm water management facilities will reduce these impacts. Based on my reading of the documents, the potential impact of the pumping on neighboring wells and on the wetlands and streams has not yet been assessed. It is important these analyses be completed and that they be made an explicit deliverable in a report to the relevant Carlisle board(s). In my judgement, a quantitative, calibrated groundwater flow model would be needed for assessing the impacts of the proposed development on the neighboring wells, wetlands, and stream.

Specific concerns related to the groundwater impact analysis (NGI, March 25, 2015)

Permeability Testing (Appendix B) – the report relies upon “slug tests” for determination of permeability and the data from those tests are evaluated using the “Hvorslev” method. The Hvorslev method was developed in 1951 and is not suitable for unconfined aquifers. If the method were suitable, the data in Appendix B would plot as straight lines. Instead, the data plot as curves. There are other, more suitable, methods available. A more appropriate method should be used. It is likely that different values of permeability will be derived from the use of a different method. The updated values of permeability should then be used in the various computations.

Parameters used in the assessment of nitrate loading (Appendix C) – the methodology used by NGI for estimating nitrate concentrations uses assumed values for a number of important parameters including effective porosity, retardation factor, and decay coefficient. The values of these parameters can have a large effect on how long it takes for the nitrate plume to reach a given location and on the maximum concentration that will be reached at a given location. At present, there is insufficient documentation to judge whether the assumed values are appropriate for the site. In particular, a different assumption for the decay coefficient could lead to significantly higher nitrate concentrations at the various locations. A more thorough analysis is needed and should include a discussion of why the various values are appropriate to the site. In addition, the analysis should evaluate nitrate concentrations for a range of values for the various parameters. In particular, lower values should be used to evaluate the effective porosity (as low as .07), retardation factor (as low as 1.0), and decay coefficient (as low as 0.0).

Closing remarks

I appreciate the consideration of the various boards of these comments. I would be happy to appear before the Zoning Board of Appeal or the other boards as appropriate to discuss these comments.

Sincerely,

Kenneth Belitz