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Joseph Berman, Chair
Weston Conservation Commission
11 Town House Road | P.O. Box 378 | Weston, MA 02493

RE: 518 South Avenue, Weston, MA

Dear Mr. Berman and Commissioners:

I have been retained by Attorney Daniel Hill to review the proposed project located at 518 South Avenue, Weston, MA. I have reviewed the Notice of Intent and its appendices, documents posted on the town web site, and other relevant data and resources published by the Massachusetts Department of Environmental Protection (MADEP), Massachusetts Geographic Information System (MAGIS), United States Geological Survey (USGS), USDA Natural Resources Conservation Service (NRCS) and United States Environmental Protection Agency (USEPA).

Qualifications: I have over 30 years of professional experience in the field of water resources management and on a broad range of water contamination and restoration projects. I have been retained as a consultant to federal, state, and local government agencies, non-governmental organizations (NGOs), and private industry throughout the United States, Central America, the Caribbean, the Pacific Islands, Bulgaria, and China. I have served as an instructor for a nationwide series of U.S. Environmental Protection Agency (USEPA) workshops on drinking water protection and watershed management. I have also served on numerous advisory boards to the USEPA, the National Academy of Public Administration, Massachusetts Department of Environmental Protection (DEP), Massachusetts Executive Office of Energy and Environmental Affairs (EEA), and the National Groundwater Association. I have received national (USEPA) and local awards for my work in the water resources management fields. I serve as Adjunct Faculty at Harvard University Extension School and Tufts University, where I teach courses in water resources policy, wetlands management, green infrastructure, and low impact development (LID). These courses focus on the critical role of local governments who have the primary responsibility and authority of regulating land uses in critical water resource protection areas.

General Comments: The proposed project includes a wastewater treatment plant with a design flow of 38,000 gallons per day (GPD) that will be discharged to the ground and a stormwater infiltration system that will discharge an additional 13,250 GPD. Combined this would be a total of 51,250 GPD to be infiltrated from wastewater and stormwater runoff from approximately four acres of newly created impervious surfaces adjacent to a jurisdictional wetland system that includes a bordering vegetated wetland and Bogle Brook, a headwater stream that is a tributary to Nonesuch Pond. Camp Nonesuch is located on the shore of Nonesuch Pond (downstream from the proposed project) and provides sailing, swimming, and fishing activities to children in the community.

The proposed infiltration of 51,250 GPD of wastewater and stormwater will result in a rise in groundwater levels throughout the site and on adjacent parcels. The Applicant has provided an incomplete assessment

of the groundwater mounding associated with the wastewater discharge but has limited their analysis to the 10-year design storm for only one of the stormwater infiltration areas. A complete analysis would require evaluation of all the infiltration areas and include the 25-year and 100-year storm events. But even this partial analysis (limited to the 10-year storm) shows that the water table will rise as much as 2.7 feet beneath the wastewater disposal area due to the effect of groundwater mounding. This analysis shows that the facility as designed does not comply with the minimum vertical separation distances required by MADEP and will require a re-design of the facility and regrading of the site. MADEP's review of the groundwater mounding requires a redesign of the facility which will result in changes in regrading between the leaching facility and the wetlands.

Although the NOI does not provide any analysis of these water level alterations upon the adjacent wetland, I have plotted the boundary of the bordering vegetated wetland (BVW) on their computer plots. This shows that water levels will also rise approximately 0.5 – 0.6 feet in the wetland. This increase in water levels constitutes an alteration of the wetland that is prohibited by the MADEP Stormwater Standards.

My independent review shows that Applicant's NOI does not provide a full evaluation of the impacts of the project and underestimates the hydrologic alterations. First, the groundwater mounding analysis does not take into account cumulative impacts associated with the full range of rainfall events and stormwater infiltration impacts because it fails to include the increase in annual recharge rates as well as additional storm events such as the 25-year and 100-year storms. Second, the NOI does not provide any assessment of water quality impacts including thermal effects and nutrient loading that will impact the headwater stream and downstream surface waters. Third, the NOI fails to take into account the combined effects of wastewater and stormwater infiltration. A more detailed impact assessment is required.

My specific comments regarding the proposed project are as follows:

1. The Project Does Not Comply with the MADEP Stormwater Standards

The MADEP Stormwater Standards and Stormwater Handbook provide guidance and criteria to ensure that the hydrologic budget of associated wetlands is maintained and protected. Wetlands are dependent upon both surface water and groundwater inputs and are sensitive to hydrologic shifts and alterations (they can be impacted by both increases and decreases of water levels and flow). They are impacted by both short-term runoff events and longer-term groundwater changes in recharge rates that alter baseflow. Recharge is the process of precipitation infiltrating into the ground and replenishing the underlying groundwater. MADEP Stormwater Standard 3 requires that annual groundwater recharge rates be maintained and preserved.

MADEP Stormwater Standard 3 is designed to maintain the hydrologic balance in wetlands. It requires that post-development recharge is maintained at existing pre-development recharge. MADEP Stormwater Handbook, Volume 2, Chapter 1 provides guidance and clarification regarding this requirement to maintain natural hydrology. Page 6 of this document states, *"Standard 3 of the Stormwater Management Standards requires that proponents* ***preserve infiltration at predevelopment levels*** *in order to* ***maintain base flow and groundwater recharge****"*. Recharge provides baseflow to wetlands and contributes to their hydroperiod (the natural cycle of water levels through the seasons). Changes to this hydrologic balance of recharge areas to a wetland constitute "alterations" to the wetland. This project will result in significant alterations to these recharge rates and to the hydrologic regime of the wetland.

The Applicant's Stormwater Report provides recharge calculations for some, but not all the proposed of the stormwater infiltration systems (it omits the porous driveways and the northern stormwater infiltration basins). The analysis that is presented in the NOI indicates that the basins will recharge significantly more stormwater post-development compared to pre-development conditions, resulting in significant alterations to the wetlands. This will result in water level rises that have not been accounted for in the project design and impact assessment.

Appendix C of the NOI provides the recharge calculations for Standard 3. They indicate that the "*required volume*" of stormwater recharge is 9,670 cubic feet and that the "*provided volume*" is 30,146 cubic feet. This means that their stormwater infiltration system is oversized by more than a factor of three. This will cause an alteration (increase) in water levels on the site and adjacent wetlands. It will result in a "new normal" of hydrology on the site post-development and this would be the new base condition upon which the groundwater mounding of design storms such as the 10, 25, and 100-year storm events should be added to. The groundwater model should take into account this increased recharge rate as the baseline for their even-based groundwater mounding conditions. They are additive and cumulative. This has not been taken into account in the applicant's analysis – they have limited their analysis to only one of the stormwater infiltration systems, have not considered increases in annual recharge throughout the year, and have limited their analysis to only the 10-year storm. This does not comply with MADEP Stormwater Standard 3 – to *"preserve infiltration at predevelopment levels in order to maintain base flow".*

2. The Groundwater Mounding Analysis is Incomplete

The site plans submitted with the NOI show five stormwater infiltration areas. These include two rectangular basins (shown on sheet C-6), two c-shaped basins (shown on sheet C-7), and a porous pavement driveway (shown on both sheets C-6 and C-7). However, the groundwater mounding model simulated only the two C-shaped infiltration areas and omitted the two rectangular areas and the porous pavement driveway. Therefore, the analysis underestimates the cumulative groundwater mounding. The analysis also omits the post-development steady state conditions that will result from the increased year-round infiltration/recharge associated with smaller storms.

The Stormwater Report attached to the NOI presents a third scenario and indicates that there are three infiltration basins and porous pavement. On page 1 it states, *"the proposed stormwater management system will consist of deep sump, hooded catch basins, water quality inlets, porous pavement and three infiltration basins* ***and porous pavement****".*

The groundwater mounding analyses were **limited to the 10-year storm event** and does not include the analysis for any other events such as the 25 and 100-year storm events. If the stormwater infiltration basins are intended to recharge storm events greater than the 10-year storm the groundwater mounding analysis should evaluate these larger storms.

The groundwater mounding analysis does not include the **cumulative impacts of year-round stormwater infiltration** (of all storm events) that will result in an altered post-construction water table. The average annual volume of infiltration from these smaller storms greatly exceeds the average annual infiltration from the far less frequent, larger storm events. The larger, event-based mounding discussed above should be added on top of the post-development steady-state water table.

3. The Groundwater Mounding Analysis Shows Impacts to Wetlands

Notwithstanding the previous comments, the groundwater mounding analysis does show alterations to the adjacent bordering vegetated wetland (BVW). Appendix F Groundwater Mounding Documentation includes three figures that present the findings of their mounding analysis and modeling. The first figure shows predevelopment conditions (with the stormwater and wastewater disposal *"not operating"*). The second figure shows post-development conditions (with the stormwater and wastewater disposal *"operating*"). The figures omit the location of the wetland resource areas. Given the jurisdiction of the Wetlands Protection Regulations, the purpose of the NOI, and the role of the Conservation Commission this would seem to be critical information for your review.

To assist the Conservation Commission in analyzing these modeling results on the jurisdictional wetlands I have added the approximate location of the BVW boundary that is located 50 feet to the east of the wastewater disposal area (see blue line in the following figures). Please note that east on these figures is to the bottom of the figures. To determine the hydrologic alterations on the BVW I have compared the modeled water table elevations at the BVW under both pre-development and post-development conditions. This is also not presented or discussed in the NOI. Table 1 summarizes the modeled water table elevations at the BVW boundary under pre- and post-development conditions and the alterations at the BVW.

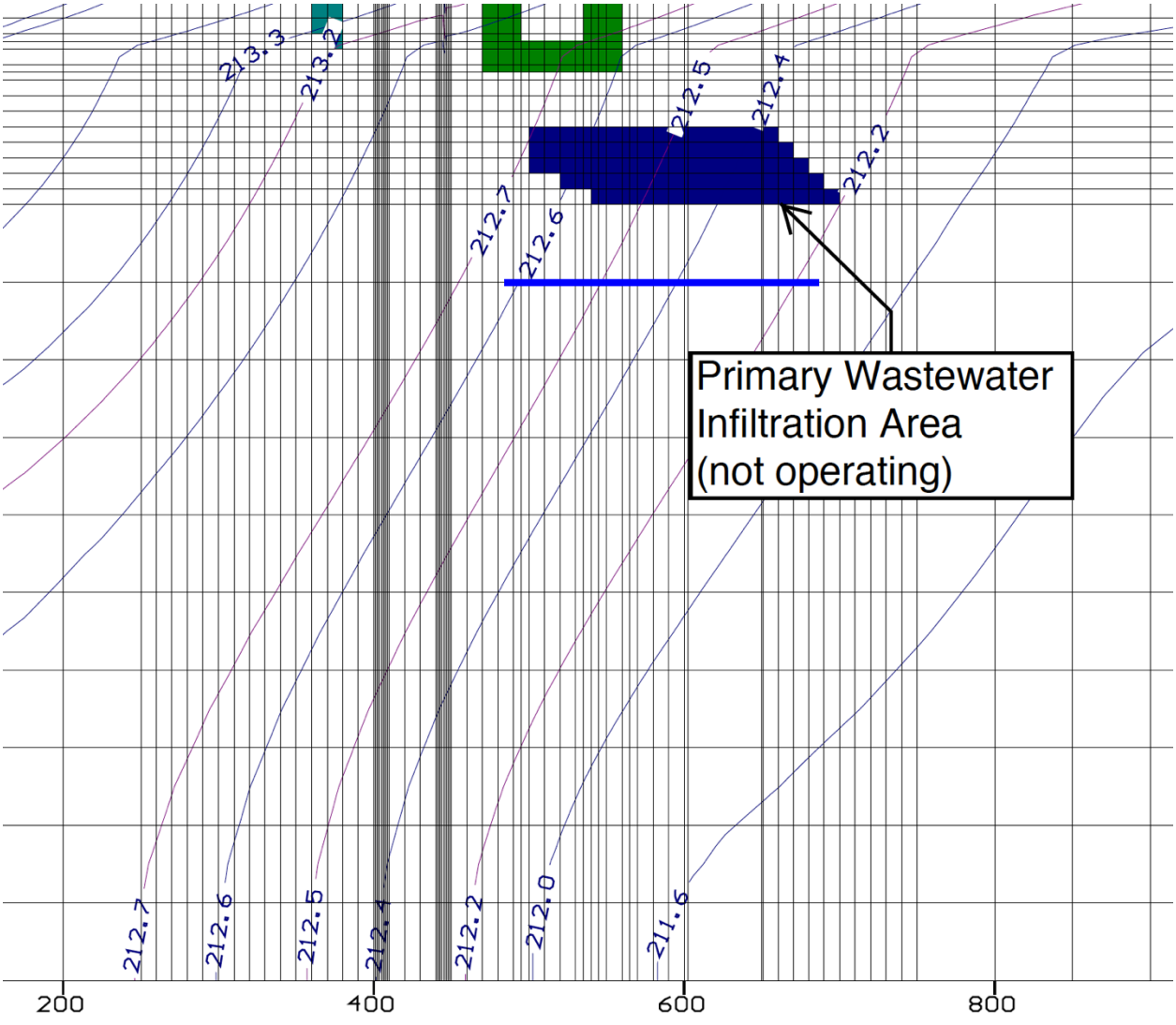

Figure 1 - Pre-development Water Table

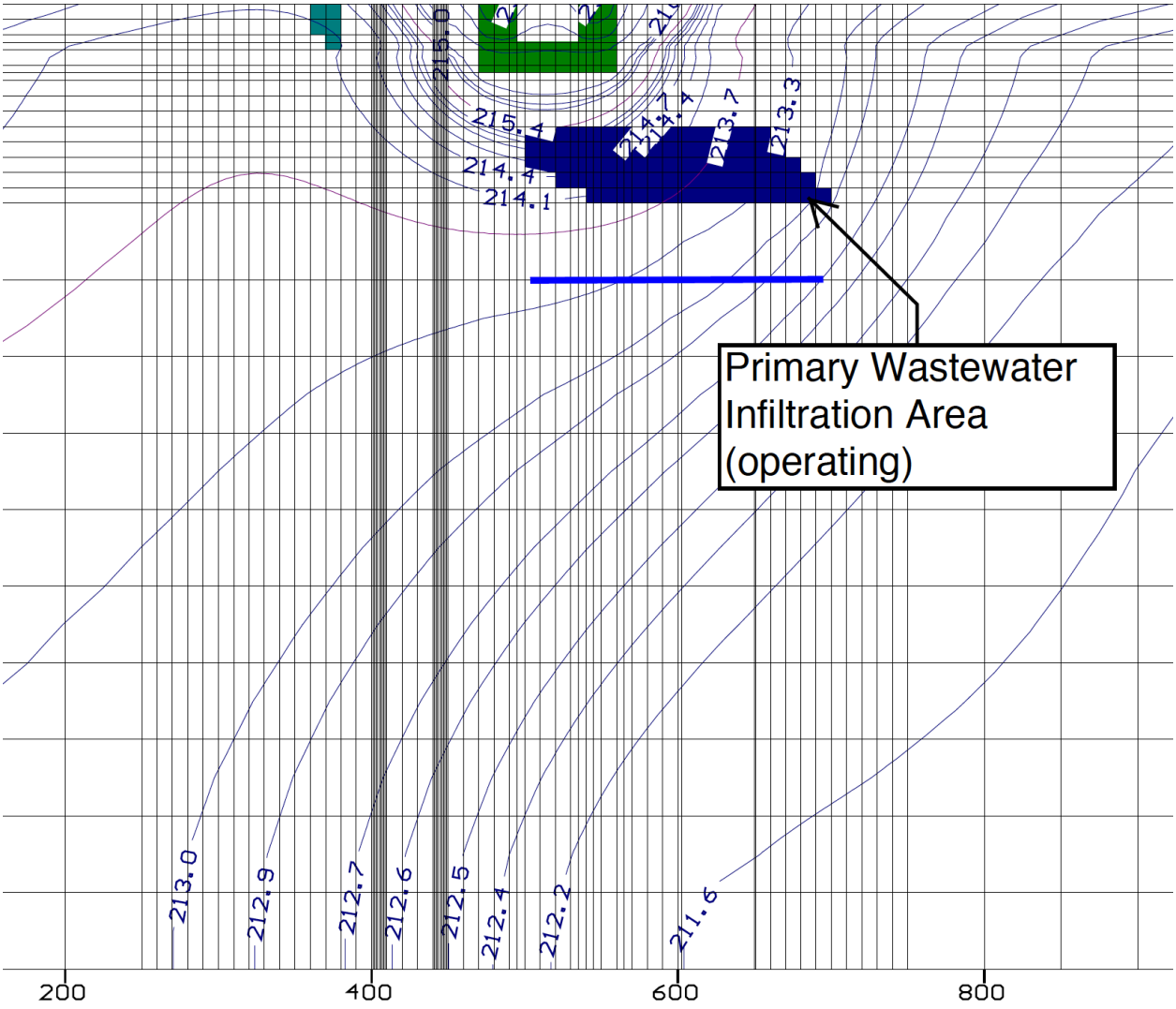

Figure 2 - Post-development Water Table

Table 1 - Groundwater Mounding Impacts on BVW (results shown in feet)

Water Table Contour	Pre-development	Post-development	Alteration
1	212.6	213.2	+0.6
2	212.5	213.0	+0.5
3	212.4	212.9	+0.5
4	212.2	212.7	+0.5

These water level alterations constitute a significant alteration to the BVW and the stream. They show a six inch rise in water levels at the BVW. According to the MADEP Stormwater Handbook these water level alterations in wetlands are not allowed. MADEP Stormwater Manual, Volume 3, Chapter 1, page 17 provides guidance on how to evaluate impacts on wetlands associated with proposed infiltration/recharge

facilities designed in accordance with Stormwater Standard 3. It states, *"Evaluate Where Recharge Is Directed: The infiltration BMP must be evaluated to determine if the proposed recharge location will alter a Wetland Resource Area by causing changes to the hydrologic regime".*

MADEP Stormwater Handbook, Volume 3, Chapter 1, page 28 provides criteria by which to evaluate groundwater mounding impacts on wetlands. It states: *"Mounding analysis is required when the vertical separation from the bottom of an exfiltration system to seasonal high groundwater is less than four (4) feet and the recharge system is proposed to attenuate the peak discharge from a 10-year or higher 24-hour storm (e.g., 10-year, 25-year, 50-year, or 100-year 24-hour storm). In such cases, the mounding analysis must demonstrate that the Required Recharge Volume (e.g., infiltration basin storage) is fully dewatered within 72 hours (so the next storm can be stored for exfiltration). The mounding analysis must also show that the groundwater mound that forms under the recharge system will not break out above the land or water surface of a wetland (e.g., it doesn't increase the water sheet elevation in a Bordering Vegetated Wetland, Salt Marsh, or Land Under Water within the 72-hour evaluation period)".*

4. The Project does not meet the required Minimum Depth to Seasonal High Water Table

The groundwater mounding analysis also indicates that the project as designed and submitted to the Conservation Commission for review will not comply with the minimum vertical separation of four feet between the bottom of the wastewater disposal field. A letter from MADEP dated June 16, 2020 (page 2) states, *"to meet the separation requirements between the mounded estimated seasonal high groundwater and the base of the soil absorption system will require the system to be raised by approximately 4 feet".* This will result in significant changes to the site plan including grading. These changes should be incorporated and a revised NOI should be submitted to the Conservation Commission. The revised plans should also include a revised groundwater mounding analysis that accounts for all of the stormwater infiltration areas and includes year-round stormwater infiltration as well as additional storm events (25 and 100-year storms)

5. Water Quality Impacts to Bogle Brook and Downstream Water Resources

Bogle Brook is adjacent to and downgradient of the proposed wastewater and stormwater infiltration systems and is a headwater stream. According to recent publications from MADEP, headwater streams are critical to downstream ecosystems and water supplies. MADEP's website states, *"Massachusetts is the most populous state in New England, and 98% of our state's population is served by drinking water supply systems that rely on isolated waters, including ephemeral, intermittent, and headwater streams"* (https://www.mass.gov/guides/mapping-and-protecting-vulnerable-wetlands-and-stormwater-management-planning-project#-headwater-streams-).

The proposed project has not disclosed the wastewater treatment technology or its proposed effluent limitations. While wastewater treatment plants do remove some pollutants to a limited degree they still result in pollutant loads that can only be assessed and evaluated in the context of the receiving waters carrying capacity. This wetland system includes a small headwater stream that is highly vulnerable to relatively low pollutant loads.

The headwater stream adjacent to the site is tributary to Nonesuch Pond where Rivers Camp Nonesuch is located, providing swimming, boating, and fishing to children in the community. Like many other lakes

and ponds in the Commonwealth this pond is believed to be vulnerable to excessive nutrient loads of nitrogen and phosphorus.

Harmful algal blooms (HABs) including cyanobacteria has become a significant public health hazard throughout the Commonwealth. These blooms are believed to be caused by excessive nitrogen and phosphorus loads. According to USEPA guidance for the development of maximum nutrient loads to prevent impaired waters threshold values of 1900 ug/liter (1.9 mg/liter) for nitrogen and 84 ug/liter (0.084 mg/liter) for phosphorus above which eutrophic conditions are probable (USEPA, 1999).

The MADEP Guidelines for Small Wastewater Treatment Plants states, *"Phosphorus is a critical parameter in most fresh water systems, and can be the limiting parameter with regard to eutrophication of surface waters. For this reason, controlling phosphorus in wastewater discharges is important. In subsurface effluent disposal systems, phosphorus is often, but not always, bound to particulates in the soil. Most all groundwater discharge permits require sampling of effluent and monitoring wells for both total phosphorus and orthophosphorus, to monitor for fate and transport of phosphorus. In some cases, based on monitoring well data, or risk of surface water impacts, phosphorus limits for effluent may be incorporated into the permit requirements. Phosphorus is present in raw wastewater at typical concentrations of 6-12 mg/l. A typical biological treatment unit will remove at least 2 mg/l of phosphorus"*. This would result in an effluent concentration of approximately 4-10 mg/liter at a design flow of 38,000 gallons/day.

To determine the impact on the stream and downstream waters I have conducted a preliminary phosphorus loading assessment using the lower value of 4.0 mg/liter. According to the USGS StreamStats modeling submitted to the Conservation Commission, the 7Q10 flow that is representative of summer baseflow in the stream is estimated at 0.00586 cubic feet per second or 3797 gallons/day. Using a simple water mixing equation this would result in a concentration of approximately 3.6 mg/liter in the headwater stream (assuming there are no other phosphorus sources in the watershed).

The U.S. Environmental Protection Agency has established a standard of 0.050 mg/liter for freshwater streams (USEPA, 1986) and 0.084 mg/liter for lakes (USEPA, 1999) to prevent eutrophication. This suggests that proposed wastewater discharge will result in phosphorus concentrations of more than forty times higher than allowed under the EPA standards for freshwater systems. This preliminary calculation warrants a detailed assessment of phosphorus loading by the Applicant. The NOI provides no analysis of phosphorus loading.

Similarly, I prepared a preliminary nitrogen loading analysis. The proposed project includes a wastewater discharge of 38,000 gallons/day with an effluent concentration of 10 mg/liter. Utilizing the same summer baseflow this results in an estimated nitrogen concentration of 9.1 mg/liter in the stream. This is nearly five times higher than the USEPA threshold of 1.9 mg/liter nitrogen. The NOI provides no analysis of nitrogen loading.

These analyses assume that 518 South Ave is the only nutrient source to the stream. In reality the permissible loading needs to be substantially lower to take into account other sources. MADEP has developed a nutrient loading approach that allocates loads per land area (for example kg/acre). Such an approach should be applied to more comprehensively evaluate the impacts of the project.

6. Thermal Impacts

Where the project site is located immediately adjacent to bordering vegetated wetland and a headwater stream and proposes to discharge 38,000 gallons/day of sewage and heated runoff from 4 acres of impervious surfaces, thermal impacts must also be evaluated. Streams and wetlands are sensitive to temperature changes. Thermal impacts are considered alterations under the Massachusetts Wetlands Protection Regulations. However, no analysis of thermal impacts is presented in the NOI.

Wastewater is commonly discharged at room temperature (average 68 degrees F). Ambient groundwater temperature in Massachusetts is 53 degrees F. According to the proposed plans, stormwater runoff from rooftops, parking lots, and driveways will be routed to the infiltration systems. The temperature of the stormwater runoff will be heated twice before it enters the receiving waters. It is increased first by contact with impervious surfaces, and then again in the stormwater basins that temporarily hold the stormwater being infiltrated. A study by the University of New Hampshire (UNH) Stormwater Center evaluated the effects of stormwater runoff on streams and documented the thermal impacts caused by stormwater runoff from impervious surfaces. It also evaluated a range of stormwater treatment practices and found that open basins (such as detention and retention basins), similar to those proposed for this project had the most significant thermal impacts.

The UNH report concludes: *"Surface systems that are exposed to direct sunlight have been shown to increase already elevated summer runoff temperatures. During the summer months, we can expect to see an increase in stormwater temperatures within the systems that have a large surface area. Conventional stormwater BMPs that include detention or retention of stormwater at the surface appear to exacerbate the temperature variations and extremes."* As temperature changes are "alterations" under the Wetlands Protection Act, the proposed project's impacts on the adjacent wetland and headwater stream must be further evaluated and regulated by the Commission.

7. Aquifer Protection District

The eastern portion of the project lies within the Town of Weston's Aquifer Protection District (Zoning Bylaw, Article VIII, Section 4. This District was adopted by the town as a zoning overlay with the stated purpose, *"to preserve and protect the quality and quantity of present and potential drinking water supplies, both public and private, and their recharge areas".* The District regulations (Section 5) state *"Any excavation or grading, <u>within 6 feet of the maximum high groundwater table elevation</u>, for any purpose that is not expressly allowed either by right or by special permit shall be prohibited".* The proposed development does not meet this requirement.

Furthermore, the Aquifer Protection District regulations require a Special Permit for sewage treatment plants and developments with 15 percent or more impervious surfaces. The Special Permit requirements include an *"analysis by a registered professional engineer experienced in groundwater evaluation and/or geohydrology, with an evaluation of the proposed use including its probable effects or impact on surface and groundwater quality and quantity, and naturel flow patterns of water courses".* No such study has been provided.

8. Wetlands and Flood Plain Protection District

The eastern portion of the project lies within the Town of Weston's Wetlands and Flood Plain Protection District (Zoning Bylaw, Article VIII, Section 4. This District was adopted by the town as a zoning overlay with the stated purposes:

• "*To protect, preserve, and maintain the water table and water recharge areas within the Town so as to preserve present and potential water supplies for the public health and safety of the Town and the Boston metropolitan area*

• "*To assure the continuation of the natural flow pattern of the water courses within the Town and to preserve natural floodwater storage areas so as to protect persons and property against the hazards of flood inundation"*

The Use Regulations (Section 5) prohibit the *"filling or relocation of earth materials"* within the District. The proposed project includes regrading of materials in these areas and is therefore prohibited.

9. Bogle Brook – Perennial Stream

I have reviewed the files regarding the status of Bogle Brook as an intermittent stream without a Riverfront Protection Area. The characterization of the stream as intermittent rather than perennial is based in part on its watershed size – reported at 0.42 square miles (slightly less than the 0.5 square mile threshold). Watershed size is intended as an approximation of a stream's contributing area (the land area that contributes water/flow to the stream). In reality a watershed is the land area that contributes only surface runoff (water moving across the surface of the land). More importantly, it is groundwater that provides the year-round baseflow and the associated year-round perennial flow.

As a first cut approximation it is sometimes assumed that groundwater flows synonymous with the surface water. However, in some cases groundwater can contribute to the stream from outside the surface watershed. This is true in this project and is demonstrated by the Applicant's groundwater levels and modeling. The applicant's groundwater model shows groundwater flow easterly throughout the project site towards the stream. However, the surface watershed shows a divide on the subject parcel that runs through the western portion of the site and excludes the area west of that. A more detailed evaluation of Bogle Brook's contributing area and perennial status is warranted.

Please contact me with any questions that you might have.

Sincerely,

Scott W. Horsley
Water Resources Consultant