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May 16, 2019

Ms. Jeanne Rich, Chair
Lancaster Zoning Board of Appeals
701 Main Street
Lancaster, MA 01523

RE: Goodridge Brook Estates, Sterling Road, Lancaster, MA

Dear Ms. Rich and Board Members:

I have reviewed the proposed project "Goodridge Brook Estates" located on Sterling Road in Lancaster, MA. Specifically, I reviewed the Stormwater Management Report prepared by GLM Engineering Consultants, Inc. dated July 5, 2018 and revised December 27, 2018 and the Site Plans prepared by GLM Engineering Consultants, Inc. dated and revised March 7, 2019.

The proposed project now includes 96 apartments, 56 single family homes, parking areas, and access roads. The project area is 45.4 acres and contains extensive wetland systems that include a stream that drains southerly. A recent report by CEI has identified a vernal pool on the site within this stream channel.

The project includes significant increases in impervious surfaces associated with rooftops, parking areas and access roads that will alter the hydrology of the site. In general, impervious surfaces preclude infiltration of rainfall, reduce recharge to groundwater and increase surface runoff rates. In an attempt to mitigate these impacts, the Applicant has designed a stormwater management system that relies upon six detention/infiltration basins. Stormwater runoff is directed from impervious areas to these detention/infiltration basins where the majority of water is infiltrated to the subsurface. Despite this attempt at mitigation, my analysis found that the Applicant's proposed plan still fails to meet the Massachusetts Department of Environmental Protection (MADEP) requirements for Stormwater Standards, as explained below.

The MADEP Stormwater Standards provide criteria to ensure that the hydrologic budget of associated wetlands is maintained. Wetlands are dependent upon both surface water and groundwater inputs and are sensitive to hydrologic shifts and alterations. They are impacted by both short-term runoff events and longer-term groundwater recharge rates that provide baseflow. MADEP Standard 2 requires that pre-development surface runoff rates be maintained for a series of design storms (2, 10, 25, and 100-year storm events). MADEP Standard 3 requires that annual groundwater recharge rates be maintained.

The Applicant's Stormwater Report provides a comparison of surface runoff rates and volumes for four design storms (2, 10, 25, and 100-year storm events). It indicates that post-development peak runoff rates and volumes will be maintained close to pre-development conditions.

MADEP Stormwater Standard 3 is designed to maintain the hydrologic balance in wetlands. It requires that post-development recharge "approximate" existing pre-development recharge. Recharge provides baseflow to wetlands and contributes to their hydroperiod (the natural cycle of water levels through the seasons). Standard 3 provides design criteria for each of four soil types (A, B, C, and D hydrologic soil groups). These criteria were developed to provide the proper sizing of infiltration facilities such that the annual recharge rates are maintained. The Table below shows these design criteria and their corresponding annual recharge rates.

| Hydrologic Soil Group | Design volume (inches) | Annual Recharge (inches/year) |
|---|---|---|
| A | 0.6 | 23.5 |
| B | 0.35 | 17.2 |
| C | 0.25 | 13.5 |
| D | 0.1 | 6.5 |

The Applicant's Stormwater Report provides recharge calculations for each of the six detention/infiltration basins. It indicates that five of the six basins are oversized and will recharge significantly more stormwater than is required. The following table summarizes these volumes.

| Detention Basin | Required Volume (CF) | Provided Volume (CF) | Existing Recharge (CF/year) | Post-Development Recharge (CF/year) | Percent Increase |
|---|---|---|---|---|---|
| 1 | 583 | 1253 | 31509 | 56483 | +79 |
| 2 | 1841 | 3717 | 90512 | 131558 | +45 |
| 3 | 455 | 1125 | 24546 | 42729 | +74 |
| 4 | 623 | 819 | 33639 | 43606 | +30 |
| 5 | 2078 | 7027 | 112240 | 224480 | +100 |
| 6 | 2182 | 2230 | 107264 | 112253 | +5 |
| Total | | | 399710 | 611108 | +53 |

Utilizing these data, I have prepared a hydrologic budget for each detention basin that compares existing and post-development annual groundwater recharge volumes. This analysis shows that the six detention/infiltration basins will increase the amount of recharge by 211,399 cubic feet/year or 53% over existing conditions. This will result in higher groundwater levels in these areas. This finding is consistent with the groundwater mounding analyses also provided in the Applicant's Stormwater Report. These analyses indicate that groundwater levels will increase 1-2 feet. These altered groundwater levels will alter the hydroperiod of wetlands on the site, will alter the associated plant communities and habitats and therefore does not comply with MADEP Stormwater Standard 3.

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:

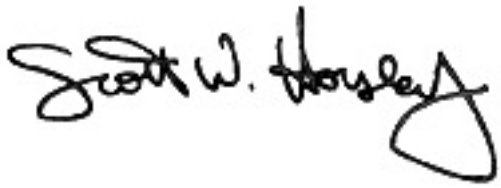
"Evaluate Where Recharge Is Directed

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. For example, if Watershed "A" contains a vernal pool within a Bordering Vegetated Wetland, and the vernal pool is fed by groundwater, and runoff from Watershed "A" is proposed to be directed to Watershed "B" for infiltration, an evaluation is necessary to determine if redirecting the runoff will cause an alteration to the vernal pool. In such instances, Water Budgeting using the Thornthwaite method or equivalent must be employed. TR-20/TR-55 methods are not sufficient for water budgeting purposes. Water budgeting analysis is not required, if the recharge is directed to the same subwatershed where the impervious surfaces are proposed."

According to a recent report by CEI, Inc. a vernal pool has been identified in the area of the intermittent stream. Vernal pools are very sensitive to hydrologic alterations. I have delineated the drainage area (shown with blue lines on the attached map) to the central part of the vernal pool where groundwater currently flows towards and provides critical baseflow. The proposed construction of impervious surfaces within this drainage area (shown in highlighted red on the attached map) adjacent to and on both sides of the vernal pool will prevent groundwater recharge that currently provides baseflow to the vernal pool. This will result in lowered water levels and drying of the vernal pool and its habitat in these areas.

Conversely, stormwater detention/infiltration basin 5 is located at the southern end of the vernal pool and is proposed to recharge twice the amount of existing ambient conditions. The Applicant's proposal can be expected to raise water levels in this area, which would cause increased flow in the intermittent stream at the southerly point of outflow. This is likely to extend the time period where a surface water connection could be made between the vernal pool and the downstream portions of the stream that may be perennial. The Applicant's proposal to dramatically increase water flow in the southern area of the vernal pool could destroy the vernal pool and its habitat, because adding so much water in this location may change the stream from intermittent (ie. capable of supporting a vernal pool) to periods of constant flow that could allow fish into the vernal pool. This would threaten the vernal pool and its ability to function as safe habitat for reproduction of vernal pool species. Additional field work and hydrologic modeling is necessary to evaluate these impacts.

Sincerely,



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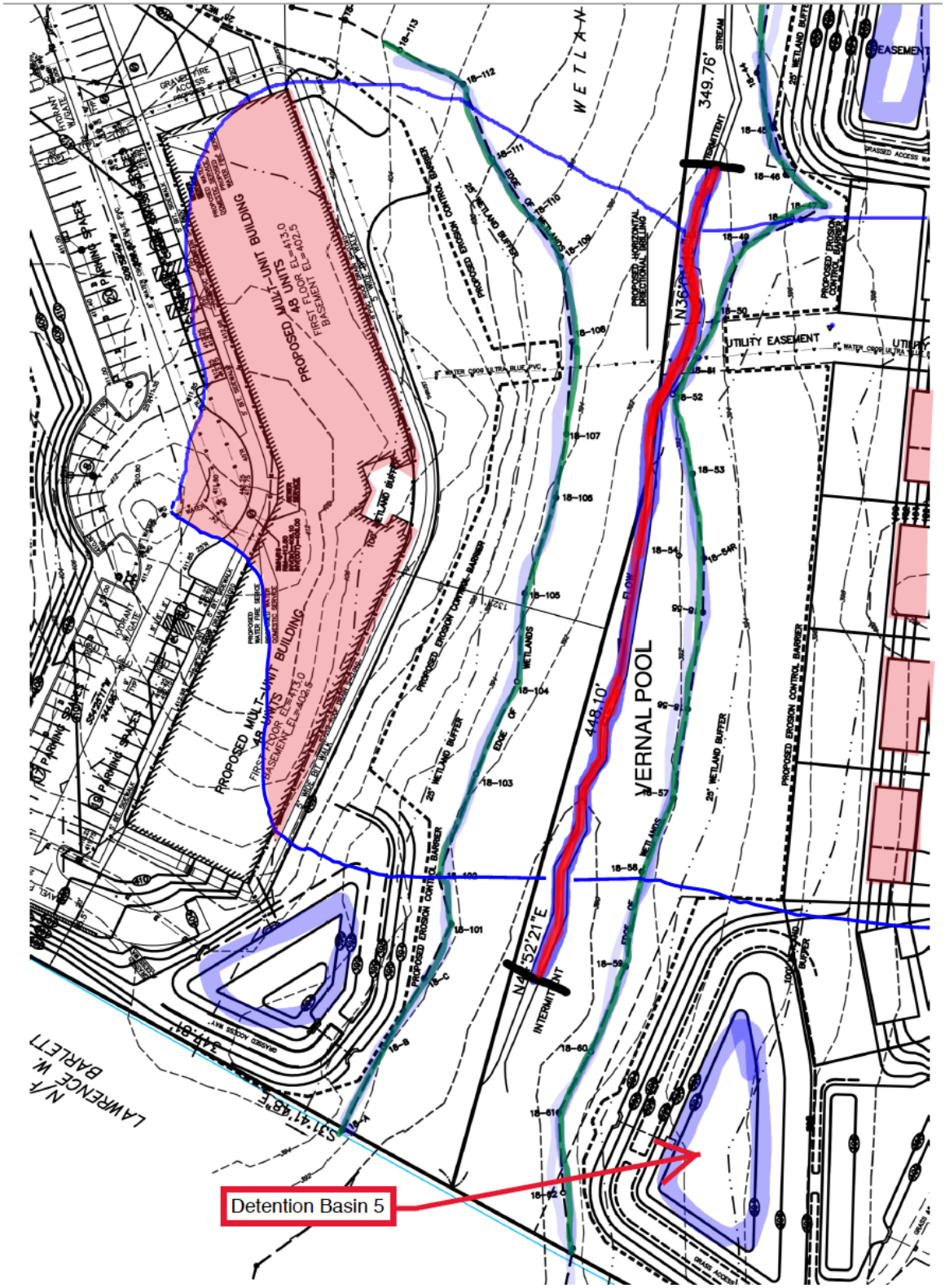
Detention Basin 5
VERNAL POOL
WETLAND
PROPOSED MULT-UNIT BUILDING
48 UNITS
UTILITY EASEMENT
448.10'
349.76'
N36°
N4°52'21"E
S31°41'48"E
LAWRENCE W. BARLETT