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May 29, 2019

Mr. Chuck Tirone
Conservation Administrator
Town of Reading
16 Lowell Street
Reading, MA 01867-2683

Re: Peer Review of Notice of Intent – 135, 139, 149R Howard Street, Reading, MA
MassDEP File No. 270-0714

Dear Mr. Tirone:

The Horsley Witten Group, Inc. (HW) is pleased to provide the Town of Reading Conservation Commission with this letter report summarizing our initial review of the Notice of Intent, Drainage Report, and plans for developing the site at 135, 139 & 149R Howard Street, Reading, Massachusetts. The plans were prepared for Infrastructure Holdings LLC (Applicant) by Civil Design Consultants, Inc. The project consists of the demolition of two single family residential houses and the construction of a six-lot residential subdivision with a 346-foot roadway, including landscaping, utility installation, and stormwater management. The 4.1-acre project site includes 0.53 acres of bordering vegetated wetlands (BVW) on the northern end of the site. The proposed work is within the 100-foot buffer zone of the BVW. The proposed new development includes a 25-foot zone of natural vegetation from the BVW.

The following documents for 135, 139 & 149R Howard Street were received by HW:

- Letter to Town of Reading, referencing Howard Street Development, prepared by Charles Castelluccio, dated February 26, 2019;
- Notice of Intent, prepared for Infrastructure Holdings LLC, prepared by Civil Design Consultants, Inc., dated December 28, 2018;
- Drainage Report, prepared for Infrastructure Holdings LLC, prepared by Civil Design Consultants, Inc., dated December 21, 2018;
- Definitive Subdivision Application with cover letter prepared for Infrastructure Holdings LLC, prepared by Civil Design Consultants, Inc., dated December 21, 2018; and
- Definitive Subdivision Plans for 135, 139 & 149R Howard Street, Reading, Massachusetts, prepared by Civil Design Consultants, Inc., dated December 21, 2018, which includes:
    - Cover Sheet C-1
    - Existing Condition Plan C-2

○ Plan of Land	C-2A
○ Subdivision Plan	C-3
○ Roadway Plan & Centerline Profile	C-4
○ Grading, Drainage & Landscaping	C-5
○ Construction Details	D-1
○ Construction Details	D-2
○ Construction Details	D-3

Site Visit

HW staff conducted a site visit on May 6, 2019 with representatives from Norse Environmental as well as the Reading Conservation Commission to observe existing conditions and review the wetland resource area boundaries as well as additional areas of concern as expressed by the Conservation Commission and its staff.

The site consists of three adjacent lots, two of which support existing residences, (collectively "the Site") and an expanse of lawn to the north of the houses, with an open forested area to the rear (north) of the properties where the delineated Bordering Vegetated Wetland (BVW) exists. Topography generally slopes to the north from the road with the exception of the southeastern corner of the lot which is depressed below the elevation of the road. Here, HW observed some corrugated plastic pipes (tile drains) among the landscape vegetation, and nearly the entire lawn area was "spongy" underfoot at the time of our site visit. Both observations are indicative of potentially poor drainage conditions.

Photo 1. Corrugated tile drains observed in southwestern corner of site. View facing south; all photos taken on May 6, 2019.

Along the western property line, there exists a drainage channel, which is fairly well-defined, and extends from a point just north of the exposed corrugated pipe(s) and leads into the BVW, where flow was observed within this intermittent stream (inland Bank) at the time of our site visit. Water from this stream eventually discharges from this site through a 12-inch concrete pipe off-site toward Westcroft Road. The existing conditions plans indicate that there is an existing drainage easement between house #s 66 and 70 Westcroft Road.

Just prior to HW's arrival on-site, the Applicant's consultants (Norse Environmental) performed a test pit within a portion of this drainage feature (excavator visible in Photo 2).

Photo 2. Area of concern includes a linear feature along the western property boundary. Note presence of wetland indicator vegetation (jewelweed, sensitive fern). This feature becomes a more well-defined channel that has been identified as an intermittent stream within the BVW interior.

Wetlands Review

Bordering Vegetated Wetland

HW first reviewed the BVW boundary in the northern portion of the site, where a forested swamp dominated by a canopy of red maple (*Acer rubrum*) with occasional ash (*Fraxinus* sp.) exists. The shrub community is somewhat sparse with individuals of arrowwood (*Viburnum dentatum*) and highbush blueberry (*Vaccinium corymbosum*) and clumps of winterberry (*Ilex verticillata*). The groundcover is dominated by skunk cabbage (*Symplocarpus foetidus*) and various ferns, including cinnamon fern (*Osmundastrum cinnamomeum*), royal fern (*Osmunda regalis*), and interrupted fern (*Osmunda claytoniana*).

Photo 3. View of delineated wetland area in northern portion of site. Photo taken May 6, 2019.

In general, HW found that the delineated wetland boundary accurately depicted the limits of the hydric soils and hydrophytic vegetation. We note that the boundary abruptly stops at the northern property line and cannot comment on the extent of the BVW that may occur off-site. HW recommends one change to the wetland boundary.

1. *HW recommends that flagging station 9A-1 be added between stations WFA-9 and WFA-10 to incorporate a dense area of ferns and hydric soils, and that this flagging station be added to the existing conditions plan.*

East of the delineated wetland boundary, HW observed that the vegetation community becomes somewhat sparse and supports occasional clumps of skunk cabbage. Topography in this area is somewhat irregular and it was noted that percolation tests had been performed in this portion of the site (Photo 4). While we were on site, Norse Environmental performed numerous soil borings with a hand-held auger, and HW is satisfied that the area immediately north and east of the delineated BVW dos not support hydric soils.

Photo 4. Area east of delineated wetland boundary where vegetation is sparse with occasional clumps of skunk cabbage. Orange stake in background indicates the location of a percolation test pit.

Isolated Vegetated Wetland

However, in one area, just south of TP-5 (test pit 5) as shown on the existing conditions plan, HW observed a fallen boxelder (*Acer negundo*) tree with a population of Jack-in-the-Pulpit (*Arisaema triphyllum*) and jewelweed (*Impatiens capensis*) and water-stained leaves in a slightly depressed area (Photo 5). Here, soils probes revealed underlying hydric soils.

Photo 5. View of potential isolated vegetated wetland in northwestern corner of the site.

HW and the Conservation Commission requested that the extent of wetland vegetation and hydric soils be delineated to determine if this area would be a jurisdictional wetland under the Reading General Bylaw - Section 7.1 and associated Wetlands Protection Regulations (November 2012) as a Fresh Water Wetland, defined as follows:

> *Because of the history, geography, geology and hydrology of Reading some wetlands may not qualify for state protection under 310 CMR 10.55 due to being isolated or disconnected from water bodies. These will be protected under the local By-Law provided that: (1.) they are 500 or more square feet in area, and (2.) they meet all of the other criteria of 310 CMR 10.55 with the exception of connection to water bodies.*

Since our site visit, we understand that the Applicant's consultant has revisited the site and delineated the limits of this potentially jurisdictional fresh water wetland. HW has not received a copy of a revised plan, but based upon our site observations, we believe that this area may be large enough to be regulated under the local bylaw.

2. *HW recommends that the Applicant survey-locate the delineated isolated wetland area and provide a revised plan to the Conservation Commission along with an opinion of*

whether the apparent wetland area observed during our site visit is jurisdictional under the local bylaw (i.e., is 500 SF or greater in size).

Drainage Channel

Following our review of the remaining portions of the site, HW spent additional time reviewing the channel and the upgradient plant community and soils. As noted, just prior to our arrival on site, a test pit was excavated in the upper reaches of this channel (Photo 6). HW understands that the intent of this test pit was to confirm the type of soils found at this site and to justify the delineation along the western property boundary. However, we have some concerns regarding the data presented and our site observations.

The Applicant's consultant provided a profile of the Haven Series type soils (Attachment A) that describes these types of soils are "well-drained soils formed in very fine sandy loam eolian (wind-blown deposit of silt and fine sand) material underlain by gravelly glacial fluvial or ice-contact deposits." The soil profile also describes the underlying layer as "gravelly coarse sand that causes a 'hanging' watertable during periods of heavy rainfall" that will drain rapidly through the underlying outwash deposits once enough hydraulic head is present.

Photo 6. Excavated test pit in the upper reaches of the area of concern. Note the dark A_p layer greater than 12 inches, with an underlying light-colored B horizon and standing water.

The NRCS soil profile describes these soils as well-drained soil on glacial outwash plains and terraces. HW reviewed briefly the Massachusetts USGS Surficial Geologic Quadrangles (Attachment B) for Reading (Quadrangle 124 – Reading), which identifies this area as "Thin Till" rather than outwash plain.

The photos in the description of the Haven Series are somewhat dissimilar from our observation of the underlying soils, which were largely silty and lack the gravelly glacial fluvial deposits (Photo 7).

HW did not conduct a full investigation of the soil test pit but noted that the soils formed a ball and a durable ribbon and contained considerable fine silty particles consistent with a silty clay loam. These textures combined with inconsistencies between our observations and the soil profile provided by the Applicant leave HW unconvinced that the soils found at this site are consistent with the Haven Series description.

Photo 7. Excavated soils from the test pit. While the brightly colored soil material underlying the A_p and B horizons are brightly colored, the soil texture differs from that in the Haven Series profile provided by the Applicant.

Photo 8. Plant community along channel is dominated by jewelweed and clumps and individuals of Jack-in-the-Pulpit, each hydrophytic plant species. The channel is indicated by the red arrow.

HW believes that the fine silt particles likely allow water to be held close to the surface in a perched condition. This condition has allowed a prevalence of wetland indicator vegetation to dominate the non-lawn areas in the western part of the site, which we believe creates a jurisdictional wetland condition.

Further, we believe that the “ditch” as described by the Applicant is likely an intermittent stream that extends from this wetland plant-dominated community along a hydrologic gradient, thereby rendering it a jurisdictional inland Bank, and consequently the surrounding plant community a BVW that is hydrologically connected to the delineated BVW in the northern part of the site (Photo 8).

3. *HW recommends that the Applicant revisit the delineation in this portion of the site, delineate the extent of wetland soils and hydrophytic vegetation and the extent of inland Bank, and provide this to the Commission on a revised existing conditions plan.*

Notice of Intent

At this time, given our site observations and pending potential changes to the wetland resource areas, HW will reserve comment regarding the proposed project with respect to the performance standards for the various wetland resource areas.

HW notes that if the project moves forward as proposed, the additional wetland areas will require submittal of additional documentation for the Commission's consideration. There are provisions in the Massachusetts Wetlands Protection Act regulations that allow for alteration of up to 5,000 SF of BVW alteration at the discretion of the issuing authority (here, the Conservation Commission), so long as the performance standards under 310 CMR 10.55(4)(d)(1 through 7) are met. Likewise, HW notes that Section 3(C) of the local wetland regulations (Performance Standards for Resource Areas) indicates that the Conservation Commission may allow alteration of up to 5000 square feet of fresh water wetland, provided the performance standard outlined under Section 3C(3)(a through g) are met.

4. *Should the project move forward with proposed resource area alteration, HW recommends that the Applicant provide a robust discussion of how the project will first avoid and minimize resource area alteration, and how the project would mitigate for the loss of freshwater wetlands.*

We note that because the proposed project is related to a real estate subdivision, that should the Applicant propose wetland alteration as part of the project, the Applicant will be required to also file an application with Massachusetts Department of Environmental Protection (MassDEP) for a Water Quality Certification (WQC) in accordance with the regulations at 314 CMR 9.04(3). HW notes that alterations above certain thresholds may also require review under the Massachusetts Environmental Policy Act (MEPA) and additional permitting through the U.S. Army Corps of Engineers.

5. *HW recommends that the Applicant provide a list of all permits required for implementation of the proposed project to the Conservation Commission so that the Commission has a complete understanding of the anticipated permitting, particularly as it pertains to the protection of jurisdictional wetlands.*

Stormwater Review

After reviewing the documents listed above, HW offers the following comments concerning the stormwater management design per the standards of the Massachusetts Wetlands Protection Act (310 CMR 10.00), the Massachusetts Stormwater Handbook dated February 2008, the Town of Reading Wetlands Protection Regulations dated November 2012 and the Town of Reading Subdivision regulations. Below are comments relating to the standards as presented in the Massachusetts Stormwater Handbook (MSH):

1. *Standard 1 states that no new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.*

a. The proposed stormwater management design consists of directing the runoff from the houses, driveways, and roadway via swales and culverts into a forebay and then into an infiltration basin. The outlet control structure discharges towards the BVW via an 8-inch HDPE pipe. The flow from the 8-inch pipe has been calculated as 1.1 cubic feet per second (cfs) during the 100-year storm event. The Applicant has added a riprap apron at the discharge point which is greater than 35 feet from the BVW. It does not appear that the proposed discharge will cause erosion in the wetlands.

b. The existing contour elevations along the northern property boundary are not clearly labeled and it is difficult to verify that the proposed contours tie into the existing contours properly. Furthermore, the outlet from the infiltration basin, flared end section (FES) 5 has an invert of 158.2 which may be lower than the existing grade at this point. HW recommends that the Applicant clarify the contours and verify that the existing contours near FES-5 will direct runoff west towards the BVW and not north towards the abutting parcels.

2. *Standard 2 requires that Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.*

a. The Applicant has provided HydroCAD results for the 2-, 10-, 25-, and 100-year events which indicate that the proposed conditions peak discharge rates will not exceed the pre-development rates at all design points leaving the property. The volume of runoff to the BVW increases for the 100-year event. The values utilized for area, curve numbers and times of concentration appear reasonable for pre-development and post-development conditions.

b. In accordance with Section O of the Reading Wetlands Protection Regulations and Section 7.4.4.1.d. of the Reading Subdivision Regulations the peak rates and volumes of stormwater runoff should not increase. The HydroCAD model indicates that the volume towards Design Point 1, the BVW, will increase from 0.174 acre-feet to 0.201 acre-feet under proposed conditions. HW recommends that the Applicant revisit the design to eliminate the increased volume.

c. Section 7.4.4.2 of the Reading Subdivision Regulations requires specific standards to be used in designing a stormwater basin including maintenance of side slopes with a ratio less than 4:1, provision of a low flow channel, provision of a trash rack, and maintaining a minimum distance of 10 feet to any property line. HW recommends that the Applicant verify it is complying with the Town of Regulations Storm Drainage requirements.

d. The Applicant has modeled the proposed development including the roof runoff from the 6 houses. It is not clear how the Applicant will direct the runoff from the houses towards the proposed roadway and swales. Individual subsurface chambers or rain gardens designed to capture the roof runoff is a preferred design that disconnects the clean roof runoff from the roadway runoff. HW recommends that the Applicant clarify how the roof runoff will be managed.

e. The contours on the Existing Watershed Plan dated December 5, 2018 are slightly different from those on the Existing Conditions Plan dated December 21, 2018. In the

vicinity of WFA 5 at the end of the stonewall the revised contours alter the subcatchment divide slightly. HW recommends that the Applicant clarify the discrepancy.

f. HW recommends that the Applicant provided additional spot grades between Howard Street and the Proposed House on Lot 1 to ensure that the proposed catchment area is accurate.

g. The Applicant has noted that swales will be placed behind the houses on Lots 2 and 3. The swales appear relatively close to the houses and may create ponding in the rear of these parcels. HW recommends that the Applicant revisit the design and the proposed contours.

h. The proposed grades of Lot 1 and Lot 2 have the potential of sending stormwater towards the existing property at 149 Howard Street. HW recommends that the Applicant provide clear direction for the future contractor's use in grading these properties in a manner such that the runoff will not flow towards 149 Howard Street. Future homeowners should be made aware that any swales installed in the rear of their properties are not to be altered.

3. *Standard 3 requires that the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type.*

   a. The Applicant has provided the required test pits and calculations to verify compliance with Standard 3. The proposed infiltration basin will have the required 2 feet of separation from the estimated seasonal high ground water (ESHGW), a mounding analysis was provided to verify the storage within the basin will not be impacted, and the basin will draw down as required within 72 hours. Groundwater appears to be high throughout the property, though the test pits indicate that the two feet of separation can be provided it may be beneficial to install a monitoring well in the area of the basin to confirm the depth to groundwater prior to construction.

   b. HW recommends that the Applicant provide an additional mounding analysis to verify that the stormwater infiltrating into the basin will not raise the groundwater elevation directly north or east of the infiltration basin.

4. *Standard 4 requires that the stormwater system be designed to remove 80% Total Suspended Solids (TSS) and to treat 0.5-inch of volume from the impervious area for water quality.*

   a. The Applicant has documented a TSS removal percentage of greater than 80% for the proposed treatment train, which includes street sweeping. Volume 2, Chapter 1, page 9 of the Massachusetts Stormwater Handbook describes the various methods for street sweeping and the percentage of TSS removal allowed depending on the method to be used. HW recommends that the Applicant confirm that the Town of Reading will be conducting street sweeping in accordance with Table SS1 or remove the 5% credit for street sweeping.

   b. The Applicant has provided a calculation to address the water quality volume requirement of Standard 4. The proposed infiltration basin provides the required water

quality volume and the forebay provides the required pretreatment.

The Applicant complies with Standard 4.

5. *Standard 5 is related to projects with a Land Use of Higher Potential Pollutant Loads (LUHPPL).*

   Residential subdivisions are not considered LUHPPLs therefore Standard 5 is not applicable to this project.

6. *Standard 6 is related to projects with stormwater discharging into a critical area, a Zone II or an Interim Wellhead Protection Area of a public water supply.*

   The proposed development is not located within a critical area. Therefore Standard 6 is not applicable.

7. *Standard 7 is related to projects that are considered redevelopment.*

   The 6-lot subdivision is significantly increasing the impervious area. Therefore, the site is considered new development and Standard 7 is not applicable.

8. *Standard 8 requires a plan to control construction related impacts including erosion, sedimentation or other pollutant sources during construction shall be developed and implemented.*

   a. The Applicant has provided an erosion control barrier along the down gradient boundary of the limit of disturbance and has also provided erosion control notes and details on Sheet D-1. HW recommends that the Applicant include a tree protection detail and reference Section L of the Reading Wetlands Protection Regulations.

   b. HW recommends that potential locations for soil stockpiles be located on the plans with a note stating that soil stockpiles shall be located outside the 100-foot buffer zone to ensure proper protection of the adjacent wetland resource areas. The proposed stockpiles will also require additional erosion control protection.

   c. HW recommends that the Applicant indicate where the construction entrance will be located on the plans.

9. *Standard 9 requires long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.*

   a. The Applicant has provided an Operation and Maintenance Plan (O&M Plan) dated December 4, 2018, within the Drainage Report.

   b. HW recommends that a simple sketch be included with the O&M Plan, the Grading & Drainage Plan noted has too many other notations. The sketch should be easy to read with clear labels of the infiltration basin, the forebay, and the swales that need to be maintained to function properly.

   c. HW recommends that the Applicant clarify if the stormwater system will be maintained by the Town of Reading or a homeowner’s association.

10. *Standard 10 requires that an Illicit Discharge Compliance Statement is provided.*

a. An Illicit Discharge Statement signed by the property owner must be provided to the Reading Conservation Commission prior to construction.

11. Additional Comments:

a. During the site visit a number of large trees were observed that will be removed to construct the infiltration basin. It is not obvious from the plan set the number or size of trees that will be removed. The Reading Conservation Commission may find that replacement trees within the 100-foot buffer zone would be beneficial to protect the resource area as well as the wildlife habitat.

b. During the site visit an IVW was located along the eastern property boundary possibly in the vicinity of the infiltration basin. The Applicant may need to revise the basin layout to provide the required natural vegetation buffer to this locally jurisdictional resource area. HW recommends that the Applicant locate the IVW on the plan and provide the required buffers.

c. HW recommends that the Applicant provide additional low impact design (LID) features and manage the stormwater on each individual lot rather than providing one large infiltration basin at the downgradient property boundary. As noted previously disconnecting the roof runoff is a preferred design alternative.

d. HW also conducted a brief review of available historic USGS maps to see if this provided any insight regarding the site hydrology as suggested in the letter by one of the abutters (letter by Charles Castelluccio dated February 26, 2019). Unfortunately, these maps (Historic USGS Maps of New England & NY available from the University of New Hampshire Library, Government Information Unit; http://docs.unh.edu/towns/MassachusettsTownList.htm) do not provide definitive evidence of a wetland or stream channel in this general area (see Figures 1 through 3).

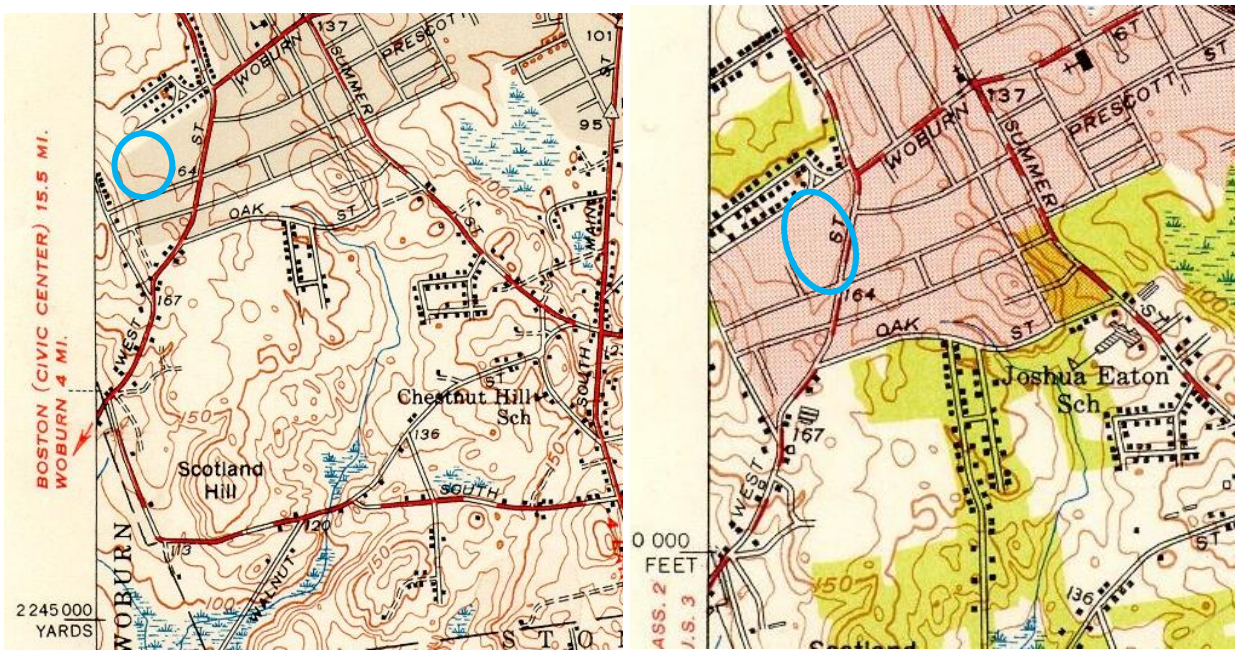


Figure 1. 1944 USGS Topographic Map Reading Quadrangle (southwest quadrant) (left image) and Figure 2. 1951 USGS Topographic Map Reading Quadrangle (southwest quadrant) (right image). The approximate location of the site is circled in blue.

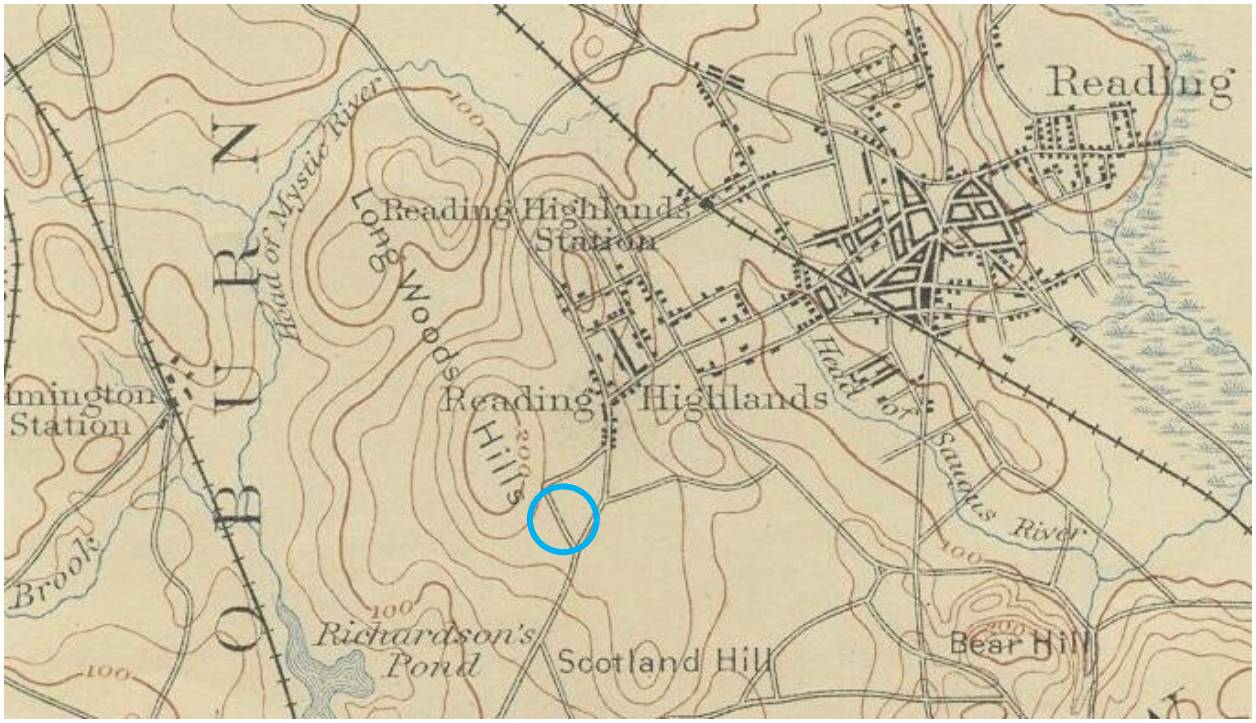


Figure 3. USGS Topographic map of area from 1893 (Reprinted 1916); Lawrence Quadrangle

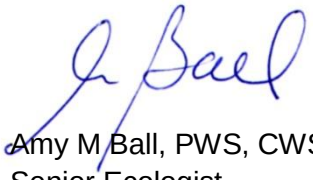
Summary

HW recommends that the Commission require the Applicant to address these comments as part of its review process. The Applicant is advised that provision of these comments does not relieve him/her of the responsibility to comply with all Reading Town Bylaws, Conservation Commission policies, Commonwealth of Massachusetts laws, and federal regulations as applicable to this project.

We appreciate the opportunity to assist the Reading Conservation Commission on this project review. Please contact Janet Bernardo at 857-263-8193 or at jbernado@horsleywitten.com if you have any questions regarding these comments.

Sincerely,

Horsley Witten Group, Inc.



Janet Carter Bernardo, P.E.
Senior Project Manager

Amy M Ball, PWS, CWS
Senior Ecologist

Enclosures

New England Soil Profiles
Haven Series

Download soil profile locations for viewing with Google Earth (500 KB KMZ file, requires Google Earth to be installed).

Open this Placemark (Link to Site)

Photo by Jim Turenne. Location: Westport Vineyards, Massachusetts.

Haven soils are well drained soils formed in very fine sandy loam eolian (wind-blown deposit of silt and fine sand) material underlain by gravelly glacial fluvial or ice-contact deposits.

This profile shows some interesting soil morphology. The dark surface layer is an Ap horizon (topsoil), below the Ap is a light colored horizon (Bw or E?) which typically is a result of lack of iron oxide (the mineral in NE soils which give the subsoil a yellowish-brown color). Below the light colored subsoil is a bright iron-rich layer which is underlain by the gravelly coarse sand 2C substratum. The strongly contrasting particle size between the silty solum (A and B horizon) and the gravelly coarse sand 2C horizon causes a "hanging" watertable during periods of heavy rainfall. Once enough hydraulic head is present, the water is able to push through the interface and move rapidly through the outwash deposits. The bright layer is believed to be caused by iron precipitating out as it enters the oxygen rich material. Some of the soils with this type of morphology are recognized as having dual drainage classes such as well to moderately well drained.

There are two different interpretations on how to describe this type of soil morphology (other soil which commonly have this morphology are the Bridgehampton and Enfield series). One theory is that the light colored soil above the iron-rich layer is simply un-weathered geologic material and would be described as a C-horizon (unless it has soil structure). The other theory is that the light colored layer has had iron moved out of it and eluviated into the bright layer below, making the light layer an E-horizon and the bright layer a B's horizon.

Haven Map Unit Description

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Substratum:
35 to 65 inches, pale olive silt loam with faint olive masses of iron accumulation and faint olive gray redoximorphic depletions

A few areas have more sand in the surface layer and subsoil.

Included with this soil in mapping are areas, generally smaller than 6 acres each, of Haven soils on subtle rises and Sudbury and Tisbury soils in similar landscape positions as the Scio soils. Minor soils comprise about 20 percent of the map unit.

Major soil properties—

Permeability: moderate throughout
Available water capacity: high
Soil reaction: very strongly acid or strongly acid above a depth of 30 inches, strongly acid or moderately acid below 30 inches
Depth to bedrock: more than 60 inches
Depth to seasonal high water table: 1.5 to 2 feet, March-May
Flooding: none
Hydrologic group: B

Most areas of this map unit are cropland or abandoned cropland. A few areas are woodland.

This map unit is well suited to cultivated crops and suited to pasture. The seasonal high water table is a management concern, as it may delay planting or harvesting. This map unit is suited for most forage grasses. Conservation tillage, contour farming, cover crops, and diversions help to control erosion.

Potential productivity for both eastern white pine and northern red oak is high. Plant competition at the time of regeneration is moderate if conifers are grown. Thinning crowded stands to standard stocking levels will allow more vigorous growth. Diseased, poorly formed, and otherwise undesirable trees should receive priority for removal during thinning. Shelterwood cutting, seed-tree cutting, and clearcutting can be used to establish regeneration or to provide suitable planting sites. Removal or control of competing vegetation may be necessary for optimum growth of newly established seedlings.

Wetness is a moderate limitation for the construction of dwellings without basements, and a severe limitation for the construction of dwellings with basements. Constructing buildings with basement floors above the seasonal high water table will help to avoid interior damage caused by the high water. The placement of footing drains around foundations will help to remove excess subsurface water. Landscaping designed to drain surface water away from buildings will provide added protection. Constructing roads on well-compacted, coarse-textured base material will help protect the roads from frost damage, which is a severe limitation.

This map unit has severe limitations for septic tank absorption fields. Seepage and a seasonally high water table are the main limitations. Placing leaching facilities in a mound of more suitable fill material will help to overcome these impediments.

This map unit has good potential for woodland wildlife habitat.

Capability subclass: 2e

251A—Haven silt loam, 0 to 3 percent slopes

This very deep, nearly level, well drained soil is on glacial outwash plains and terraces (fig. 14). The areas of this soil are irregular in shape and range from 6 to 210 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 2 inches, black silt loam

Subsoil:
2 to 20 inches, yellowish brown silt loam
20 to 32 inches, olive yellow very fine sandy loam

Substratum:
32 to 45 inches, olive yellow fine sand
45 to 65 inches, light yellowish brown stratified medium and coarse sand

Included with this soil in mapping are areas of Merrimac soils, generally smaller than 6 acres in size, with a lower water-holding capacity, and small areas of Scio soils at slightly lower elevations on the landscape. Also included are areas where the solum extends to a depth of 40 inches or more and has more silt. Minor soils comprise about 15 percent of the map unit.

Major soil properties—

Permeability: moderately rapid in the solum, very rapid in the substratum
Available water capacity: moderate
Soil reaction: very strongly acid to moderately acid
Depth to bedrock: more than 60 inches
Depth to high water table: more than 6 feet
Hydrologic group: B

Figure 14.—An area of Haven silt loam, 0 to 3 percent slopes, is in the foreground. The wooded area in the background is a unit of Narragansett-Hollis-Rock outcrop complex, 3 to 15 percent slopes.

Many areas of this map unit are used for homesites, though some areas are cropland. A few areas are woodland.

This map unit is well suited to cultivated crops and pasture. Irrigation may not be necessary in years when rainfall is evenly distributed over the growing season. Motorized equipment is easily operated on this nearly level terrain.

Potential productivity is high for eastern white pine, and moderate for northern red oak. Plant competition at the time of regeneration is moderate if conifers are grown. Thinning crowded stands to standard stocking levels will allow more vigorous growth. Diseased, poorly formed, and otherwise undesirable trees should receive priority for removal during thinning. Shelterwood cutting, seed-tree cutting, and clearcutting can be used to establish regeneration or to provide suitable planting sites. Removal or control of competing vegetation may be necessary for optimum growth of newly established seedlings. Pruning can be used to improve the quality of white pine.

This map unit has slight limitations for use as a site for the construction of dwellings. It has moderate limitations for road construction, due to frost action.

This map unit has severe limitations for septic tank absorption fields, as the soil readily absorbs but is a poor filter of sewage effluent. This inadequate filtering capability may result in the pollution of ground water.

This map unit has good potential for woodland wildlife habitat.

Capability class: 1

251B—Haven silt loam, 3 to 8 percent slopes

This very deep, gently sloping, well drained soil is on glacial outwash plains and terraces. The areas of this soil are irregular in shape and range from 6 to 135 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 2 inches, black silt loam

Subsoil:
2 to 20 inches, yellowish brown silt loam
20 to 32 inches, olive yellow very fine sandy loam

Substratum:
32 to 45 inches, olive yellow fine sand
45 to 65 inches, light yellowish brown stratified medium and coarse sand

Included with this soil in mapping are areas where the surface layer and subsoil extend to a depth of 40 inches or more and have a higher content of silt. Also included are areas of Merrimac soils, generally smaller than 6 acres each, which have a lower water-holding capacity, and small areas of Scio soils at slightly lower elevations on the landscape. Minor soils comprise about 15 percent of the map unit.

Major soil properties—

Permeability: moderately rapid in the surface layer and subsoil and very rapid in the substratum
Available water capacity: moderate
Soil reaction: very strongly acid to moderately acid
Depth to bedrock: more than 60 inches
Depth to high water table: more than 6 feet
Hydrologic group: B

Many areas of this map unit are used for homesites. Some areas are cropland, and a few areas remain as woodland.

This map unit is well suited to cultivated crops and pasture. Irrigation may not be necessary in years when rainfall is evenly distributed over the growing season. Motorized equipment is easily operated on these slopes.

Potential productivity is high for eastern white pine and moderate for northern red oak. Plant competition at the time of regeneration is moderate if conifers are grown. Thinning crowded stands to standard stocking levels will allow more vigorous growth. Diseased, poorly formed, and otherwise undesirable trees should receive priority for removal during thinning. Shelterwood cutting, seed-tree cutting, and clearcutting can be used to establish regeneration or to provide suitable planting sites. Removal or control of competing vegetation may be necessary for optimum growth of newly established seedlings. Pruning can be used to improve the quality of white pine.

This map unit has slight limitations for the construction of dwellings. It has moderate limitations for road construction, due to frost action.

These soils have severe limitations for septic tank absorption fields, as they readily absorb but are a poor filter of effluent. The inadequate filtering capability may result in pollution of the ground water.

This map unit has good potential for woodland wildlife habitat.

Capability subclass: 2e

253A—Hinckley loamy sand, 0 to 3 percent slopes

This very deep, nearly level, excessively drained soil is on glacial outwash plains and terraces. The areas are irregular in shape and range from 6 to 165 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 7 inches, dark brown loamy sand

Subsoil:
7 to 17 inches, yellowish brown very gravelly loamy sand

Substratum:
17 to 65 inches, olive brown stratified extremely gravelly sand

Included with this soil in mapping are small areas of Merrimac, Windsor, and Quonset soils in similar landscape positions as the Hinckley soils, and Sudbury and Deerfield soils in depressions. Minor soils make up about 20 percent of the map unit.

Major soil properties—

Permeability: rapid in the surface layer and subsoil, very rapid in the substratum
Available water capacity: very low
Soil reaction: strongly acid or moderately acid
Depth to bedrock: more than 60 inches
Depth to high water table: more than 6 feet
Hydrologic group: A

Most areas of this map unit are used for homesites. Some sections are cropland, pasture, or woodland.

This map unit is poorly suited for silage corn or legume hay, but may be suited for sweet corn. Droughtiness is a management concern; irrigation may be needed for optimum plant growth. Minimum tillage, cover crops, and contour farming will help reduce erosion. The main management objective for pasture should be the prevention of overgrazing, which reduces the hardiness and density of plants. Proper stocking rates, timely grazing, and restricting use during wet periods help maintain plant densities and reduce soil compaction.

Potential productivity for eastern white pine is moderate. It is low for northern red oak because of moisture stress caused by the soil's limited available water capacity. Thinning crowded stands to standard stocking levels will allow more vigorous growth. Diseased, poorly formed, and otherwise undesirable trees should receive priority for removal during thinning. Shelterwood cutting, seed-tree cutting, and clearcutting may be used to establish regeneration or to provide suitable planting sites. Seedling mortality is a management concern; removal or control of competing vegetation may be necessary for optimum growth of newly established seedlings. Minimizing soil disturbance to retain the surface mulch of leaves, and designing regeneration cuts to optimize shade and reduce evapotranspiration, will help to retain the limited soil moisture.

This map unit has slight limitations for the construction of dwellings and of local roads. It has severe limitations for septic tank absorption fields, as it readily absorbs but is a poor filter of sewage effluent. The soil's inadequate filtering capability can result in pollution of ground water.

This map unit has poor potential for woodland wildlife habitat.

Capability subclass: 3s

253B—Hinckley loamy sand, 3 to 8 percent slopes

This very deep, gently sloping, excessively drained soil is on glacial outwash plains and terraces. Areas of this soil are irregular in shape and range from 6 to 360 acres in size.

The typical sequence, depth, and composition of the layers of this soil are as follows—

Surface layer:
0 to 7 inches, dark brown loamy sand

Subsoil:
7 to 17 inches, yellowish brown very gravelly loamy sand

Substratum:
17 to 65 inches, olive brown stratified extremely gravelly sand

Included with this soil in mapping are small areas of Carver, Merrimac, Windsor, and Quonset soils in similar landscape positions as the Hinckley soils, and Sudbury and Deerfield soils in depressions. Minor soils comprise about 20 percent of the map unit.

Major soil properties—

Permeability: rapid in the surface layer and subsoil, very rapid in the substratum
Available water capacity: very low
Soil reaction: strongly acid or moderately acid
Depth to bedrock: more than 60 inches
Depth to high water table: more than 6 feet
Hydrologic group: A

Most areas of this map unit are used for homesites. Some areas are cropland, pasture, or woodland.

This map unit is poorly suited to silage corn or pasture, but suited to sweet corn. Droughtiness and a low content of plant nutrients are management concerns; irrigation, fertilizer, and the incorporation of plant residue into the plow layer are needed. Minimum tillage, cover crops, and contour farming will help reduce erosion. The main management objective for pasture should be the prevention of overgrazing which reduces the hardiness and density of plants. Proper stocking rates, timely

U.S. Department of the Interior
U.S. Geological Survey

Prepared in cooperation with the
Commonwealth of Massachusetts
Massachusetts Geological Survey
and Executive Office for Administration and Finance

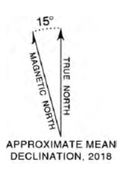
Scientific Investigations Map 3402
Quadrangle 124—Reading
Discussion of surficial materials and description of map units available at https://doi.org/10.3133/sim3402

Base from U.S. Geological Survey, 1951

Map was scanned, processed, georeferenced, rectified, and cropped by the Massachusetts Geological Survey

Lambert Conformal Conic projection. North American Datum of 1983

Massachusetts state plane coordinate system, mainland zone



SCALE 1:24 000

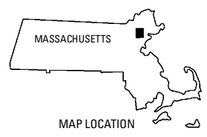
1 0.5 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0.5 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929



Map units were reproduced from Oldale (1962); some additional bedrock outcrops are from Bell (1976). Some units were mapped or revised from analysis of topographic (lidar) data and 2005 orthophoto images.

Surficial Materials Map of the Reading Quadrangle, Massachusetts

Compiled by
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2018

For sale by U.S. Geological Survey, Box 25286, Denver Federal Center, Denver, CO 80225; https://store.usgs.gov; 1–888–ASK–USGS (1–888–275–8747)

Suggested citation: Stone, B.D., Stone, J.R., and DiGiacomo-Cohen, M.L., comps., 2018, Surficial materials map of the Reading quadrangle, Massachusetts, quadrangle 124 *in* Stone, J.R., Stone, B.D., DiGiacomo-Cohen, M.L., and Mabee, S.B., comps., Surficial materials of Massachusetts—A 1:24,000-scale geologic map database: U.S. Geological Survey Scientific Investigations Map 3402, 1 sheet, scale 1:24,000, https://doi.org/10.3133/sim3402.

ISSN 2329-132X (online)
https://doi.org/10.3133/sim3402