

February 27, 2017

Topsfield Planning Board
Topsfield Town Hall
461 Boston Street, Unit E-6
Topsfield, MA 01983
Martha A. Morrison; Chairwoman

RE: A&M Project #2165-01A
Rolling Green Elderly Housing
Development
470 Boston Street
Topsfield, MA 01983
**A&M Response Horsley Witten
Review Letter**

Dear Ms. Morrison:

On behalf of the applicant, Sarkis Development Company, Allen & Major Associates, Inc. (A&M), respectfully submits this peer review response letter regarding the comments generated by the Larson's (applicant's neighbor) engineer Horsley Witten Group for the proposed Elderly Housing Development known as Rolling Green, located at 470 Boston Street, Topsfield, Massachusetts.

The following comments below were noted by Ms. Janet Carter Bernardo, P.E., of Horsley Witten Group on January 26, 2017, and pertain to general comments and comments related to the stormwater management; each comment is followed by A&M's response in **bold**.

COMMENTS:

1. The Planning Board and Conservation Commission should realize that as requested in HW's December 21, 2016 letter, the Applicant has revisited the area of woodlands under existing and proposed conditions. The October 2016 submission included a decrease of 0.17 acres of woods while the reissued submittal includes a decrease of 1.31 acres.

A&M Response: The error has been previously corrected and the post-development watershed plan and HydroCAD model have been updated accordingly.

2. As requested by Beals + Thomas and as listed in Volume 3, Chapter 1, page 28 of the Massachusetts Stormwater Handbook (MSH) a mounding analysis must be provided, Allen & Major Associates, Inc. (A&M) has stated that one will be provided. HW recommends that in the event that the mounding analysis requires a design change of one or more of the infiltration systems the hearings are not closed until the information has been provided and has been reviewed by Beals + Thomas.

Volume 3, Chapter 1, page 28:

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).

A&M Response: A mounding analysis has been performed by New England Environmental (a division of SWCA, Incorporated). Please see attached information.

3. A&M have stated that the three study points will not result in a net increase in flow or volume during all analyzed storm events. However it appears that there will be an increase in flow during the 100-year storm event at Study Point (SP) 3 and at the down gradient property line. Furthermore as a simple analysis the HydroCAD model provided by the Applicant cumulatively adds the three study points together to evaluate the impacts at the down gradient property line. However to more accurately evaluate the flows at the property line, SP1 should be routed through the culvert to SP2 and then SP1 and SP2 should be routed through the onsite wetland system to SP3. In accordance with the MSH, Volume 1, Chapter 1, page 1, Standard 2: *Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.* The concern is the potential flooding of the Larson property as well as the overtopping of North Street. As stated in HW's December 21, 2016 letter, the Larsons have witnessed the overtopping of North Street once in the past 20 years, indicating that the flooding of North Street does not happen often, however it can happen.

A&M Response: The HydroCAD model has been updated as suggested above. Refer to the drainage report revised through February 27, 2017, for the updated HydroCAD model as well as pre- and post-development peak flow data. In conclusion, the peak flows have been reduced in the post-development watershed, as compared to the pre-development watershed peak flows.

4. The Applicant has conducted additional soil testing within the footprint of UIS-1 in December 2016. TP#17 appears to be the controlling test hole with an Estimated Seasonal High Ground Water (ESHGW) at 56.5. In 1999 a number of test pits were conducted within the same area for a potential septic system and witnessed by the Town Engineer. It appears that the range of ESHGW within the same area in 1999 was between 62.3 and 62.5, considerably higher than the 2016 elevation. HW recommends that the Applicant explain the discrepancy in ESHGW.

A&M Response: The Soil Evaluations performed by Certified Soil Evaluators from Allen & Major Associates (A&M) in December of 2016, Eaglebrook Engineering & Survey, LLC in July 2016, New England Environmental (a division of SWCA, Incorporated), in December 2016, and portions of the Septic System Plan prepared by Hayes Engineering in 1999 were reviewed. It has been determined that the soils on-site are well drained, and water moves quickly and easily throughout the soil matrix. It was also determined that the soil testing near UIS-1 on the Drainage Plan yielded an estimated seasonal high groundwater table (ESHGW) at elevation 56.5, which corresponds to the adjacent wetland elevation of 57.0-58.0. Wetlands are often an indicator of the approximate ESHGW, as the wetlands are formed where the ESHGW breaks out from land. It should also be noted that three *independent* soil evaluators from Allen & Major Associates, Eaglebrook and New England Environmental, a division of SWCA, Incorporated, tested the soils on-site and all three attained

similar and consistent results. Based on currently accepted scientific standards including Title V Regulations, it is Allen & Major's professional opinion that the soil evaluations performed by Eaglebrook Engineering & Survey, LLC, New England Environmental (a division of SWCA), and A&M are correct in identifying the ESHGW elevation. See also attached response from Eaglebrook Engineering & Survey, LLC, which expounds further upon the test pit data.

5. A&M has stated that the use of Calcium Chloride will be reduced to only that which is necessary for public safety. The Larsons appreciate that concern for their drinking water supply and the wetlands at 470 Boston Street as well as 109 North Street have been considered. HW requests that a condition be included requiring the Applicant to minimize the amount of road salt utilized at 470 Boston Street to the maximum extent practicable.

A&M Response: The Applicant accepts the condition whereby calcium chloride will be used at the minimum amount practicable to maintain a safe environment at the proposed Elderly Housing Development.

6. The Applicant has located one of the proposed subsurface wastewater systems 10 feet from the Larson's property boundary. HW requests that the system be shifted further from the property boundary or relocated to the proposed reserve area. A 25 foot landscaped buffer zone is required per Section 3.16.C.1.q, and the subsurface system will limit the landscaping opportunities in this area.

A&M Response: See updated Sewage Disposal System plan set for septic redesign. Sheets SDS-1 and SDS 1.1 clearly show the redesigned septic system layout. In conclusion, the primary system has been moved further from the property line and the proposed reserve location allows for a landscaped buffer with proposed evergreen trees.

7. A&M has stated that the landscape screening materials are being reviewed. HW suggests that the proposed plantings along the western property boundary be replaced with conifer trees for a denser buffer in accordance with Section 3.16.E.2.

A&M Response: See updated landscape architecture plans by Brown + Sardina, particularly the Planting and Lighting Plan, Sheet L-1.

8. HW understands that the Applicant is seeking a waiver from the Conservation Commission to shift the final discharge point of FES 3. HW supports this relocation and appreciates the Applicant's cooperation in responding to the Larsons' concern.

A&M Response: The discharge location of FES-3 has been revised as shown on the design plans to a new location further away from the Larson property. The Applicant requests Conservation Commission approval for the updated location.

If you have any questions or comments, please do not hesitate to contact me at (781)-935-6889. We look forward to further discussing the project at the Topsfield Planning Board public hearing on March 7, 2017. Please provide A&M with the time and place of that public hearing.

Very truly yours,

ALLEN & MAJOR ASSOCIATES, INC.



Ryan Bianchetto, LEED AP
Project Manager

Cc via email: Sarkis Development Company
Eaglebrook Engineering & Survey, LLC
Brown + Sardina
New England Environmental (a division of SWCA, Incorporated)
Beals + Thomas, Inc.
Town of Topsfield Conservation Commission

Enclosures:

- 1) Revised Site Plans for Rolling Green Elderly Housing Development, prepared by Allen & Major Associates, revised through February 27, 2017
- 2) Drainage Report, prepared by Allen & Major Associates and revised through February 27, 2017
- 3) Additional Information prepared by New England Environmental, a division of SWCA, Incorporated
- 4) Soil Test Pit letter from Eaglebrook Engineering & Survey, LLC



Eaglebrook Engineering & Survey, LLC

Civil Engineers, Land Planners and Land Surveyors

February 27, 2017

Mr. John Sarkis
Sarkis Development Company
2 Elm Square
Andover, MA 01810

**Re: 470 Boston Street
Topsfield, MA**

Dear Mr. Sarkis:

Eaglebrook Engineering & Survey has had the opportunity to review the request for clarification from Horsley Witten Group in their January 26, 2017 letter, comment number 4:

4. The Applicant has conducted soil testing within the footprint of UIS-1 in December 2016. TP#17 appears to be the controlling test hole with an Estimated Seasonal High Ground Water (ESHGW) at 56.5. In 1999 a number of test pits were conducted within the same area for a potential septic system and witnessed by the Town Engineer. It appears that the range of ESHGW within the same area in 1999 was between 62.3 and 62.5, considerably higher than the 2016 elevation. HW recommends that the Applicant explain the discrepancy in ESHGW.

We reviewed the Soil Evaluations performed by Eaglebrook Engineering & Survey in July 2016, the Soil Evaluations performed by Allen & Major Associates in December 2016, the Soil Evaluations performed by New England Environmental in December 2016, and excerpts of the Septic System Plan prepared by Hayes Engineering in 1999.

Eaglebrook Engineering & Survey conducted several deep hole and percolation tests throughout the site in July 2016 for the purposes of assessing the suitability of the on-site soils for subsurface sewage disposal systems associated with the proposed multi unit residential development. Our investigations determined the parent soils on-site at 470 Boston Street are coarse-to-fine, gravelly sandy alluvial deposits. They are well drained with high permeability, demonstrated by the rapid percolation rates. The soil matrix is crudely stratified and uncompacted with a high percentage of open pores. Water moves quickly through the matrix. The rock aggregate contains a high percentage of both Iron and manganese and is highly weathered. As Certified Soil Evaluators, we are trained to



Eaglebrook Engineering & Survey, LLC

Civil Engineers, Land Planners and Land Surveyors

determine the estimated seasonal high groundwater based on areas of reddish to purple iron and manganese concentrations (oxidation) juxtaposed with areas of gray to green concentrations (reduction). It is crucial to see both the reduction and oxidation colors together.

In 1995 the State Environmental Code, Title V, was revised with major updates from the previous 1978 Code. One major revision was the methodology to determine the ESWG. Prior to 1995, engineers and designers relied on observed groundwater elevations during anticipated seasonal high water periods of the year. Starting in 1995 the Massachusetts Department of Environmental Protection (MADEP) established the certified soil evaluator designation to train designers and engineers to evaluate soils based on redoximorphic features (oxidation and reduction concentrations). The initial years following the Code revision, Board of Health Agents and Soil Evaluators alike often estimated the ESHGW when any color was observed in the soil. The MADEP education program for Certified Soil Evaluators has progressed significantly in the past 15 years to better train soil evaluators to understand the geology of the site they're assessing, understand the physical as well as chemical processes associated with soil formation, and the relationship to seasonal high groundwater observations.

It is our interpretation that the colors observed in 1999 were a result of variegation and not the true seasonal high water table. Water that falls as precipitation moves quickly through the soil. The soil is wet to moist for a period of time and then returns to a lower moisture content as the supply of water is diminished. Due to the weathered nature of the rock content, it is highly susceptible to chemical erosion. As a result the iron and manganese is expressed as "rust" stains. Color variegations were observed in the soil evaluations performed by Eaglebrook in 2016, but are not an indication of Estimated Seasonal High Groundwater. These colors stood alone and were associated with individual rock fragments and were present at a depth just beneath the subsoil. Reduction colors were not associated with any of the oxidized colors until further depth in the test holes were reached indicating the elevation of ESHGW.

Additionally, in high permeability soils ESHGW generally normalizes to a consistent elevation since there are no restrictive soils to hold groundwater at a higher elevation. The soil testing in the vicinity of UIS-1 performed by Allen & Major Associates determined the ESWG at elevation 56.5, which corresponds to the adjacent bordering vegetated wetland elevation of approximately 57.0-58.0.

Three individual soil evaluators conducted testing on the site in 2016 independently for different aspects of the site design and the data showed consistent results. It is our



Eaglebrook Engineering & Survey, LLC

Civil Engineers, Land Planners and Land Surveyors

professional opinion that the soil evaluations performed by Eaglebrook Engineering & Survey and Allen & Major Associates correctly determined the Estimated Seasonal High Groundwater elevation and the Estimated Seasonal High Groundwater elevation identified in the 1999 evaluation represents variegated colors of water moving down through the soil matrix as opposed to the phreatic water table rising to the surface.

If you have any questions please do not hesitate to contact me at any time. Thank you.

Sincerely,

EAGLEBROOK ENGINEERING & SURVEY, LLC

Kenneth C. Knowles, P.E., CSE#1247
Principal

Alexander Parker

Alexander F. Parker, CSE#1848



Hydrogeologic Investigation

**Proposed Residential Development
470 Boston Street
Topsfield, Massachusetts**

Submitted: February 28, 2017



A DIVISION OF
SWCA[®]
ENVIRONMENTAL CONSULTANTS

Prepared for:

Sarkis Development Company
2 Elm Square
Andover, MA 01801

SWCA Project No. 039312.00



New England Environmental, Inc.

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A DIVISION OF
SWCA
ENVIRONMENTAL CONSULTANTS

February 28, 2017

John Sarkis
Sarkis Development Company
2 Elm Square
Andover, MA 01801

e-mail: jtsarkis@sarkisdevelopment.com

RE: Hydrogeologic Investigation
Proposed Residential Development
470 Boston Street
Topsfield, Massachusetts

Dear Mr. Sarkis:

New England Environmental, a division of SWCA, Incorporated (NEE/SWCA), is pleased to provide you this report regarding a hydrogeologic evaluation of subsurface drainage conditions for the above-referenced site. The objective of the hydrogeologic investigation is to evaluate 1) subsurface soil and groundwater conditions, 2) the infiltration capacity of the soil, and 3) groundwater mounding relative to septic and stormwater infiltration systems proposed for the "Rolling Green" residential development. As part of the field investigation, three test pits were advanced to collect representative soil samples. Published information and on-site deep hole observations made by others were also reviewed to prepare a conceptual site model.

The Hantush equation was utilized to estimate groundwater mounding. The groundwater mounding calculations indicated that each of the three planned wastewater leaching facilities have minimal mounding with no adverse impact to the adjacent wetlands or to the planned infiltration pond. The stormwater infiltration basins also have little or no impact resulting from mounding. The groundwater model indicates that each of the basins completely drain the volume of a 25-year 24-hour storm event.

This report also addresses the following preliminary comments received by the Town of Topsfield:

Horsley Witten (HW) comment:

As requested by Beals + Thomas and as listed in Volume 3, Chapter 1, page 28 of the Massachusetts Stormwater Handbook (MSH) a mounding analysis must be provided, Allen & Major Associates, Inc. (A&M) has stated that one will be provided. HW recommends that in the event that the mounding analysis requires a design change of one or more of the infiltration systems the hearings are not closed until the information has been provided and has been reviewed by Beals + Thomas.

MSH Volume 3, Chapter 1, page 28:

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).

Beals & Thomas (B+T) Comment:

Standard 3 of the Handbook requires a mounding analysis for infiltrative best management practices (BMPs) when separation to groundwater is less than four (4) vertical feet. The Applicant acknowledges only a two (2) foot vertical separation exists, but states that these BMPs are not attenuated systems and the mounding analysis is not required. However, for both systems, the inflow rate is greater than the outflow rate, indicating that some level of attenuation is occurring within each system. We request that the Applicant clarify the design intent of these BMPs relative to the required mounding analysis and provide the noted calculations as applicable.

Applicant's Response: The Applicant has contracted with New England Environmental to conduct such mounding analyses for the applicable systems and will provide such report upon completion.

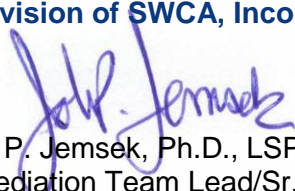
Current B+T Response: We acknowledge the response provided by the Applicant and reiterate the intent of our original comment pending the submission of the outstanding mounding analysis. We recommend that full compliance with Handbook and Standard 3 be made a condition of the decision if the Project is approved prior to the submission of the required analysis.

NEE response to above HW and B+T Comments: The stormwater infiltration designs meet the above MSH criteria for a 25-year 24-hour rainfall event.

If you have any questions or comments, please contact us at 413-256-0202.

Sincerely,

NEW ENGLAND ENVIRONMENTAL
a division of SWCA, Incorporated



John P. Jemsek, Ph.D., LSP
Remediation Team Lead/Sr. Hydrogeologist

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Figure 2 – Aerial Photo

Figure 3 – Subsurface Exploration Location Plan

TABLES

Table 1 – Summary of Hazen Estimate for Hydraulic Conductivity

Table 2 – Summary of Hydraulic Conductivity Estimation from Perc Tests

Table 3 – Groundwater Level Estimation using the Frimpter Method

Table 4 – Stormwater Mounding Calculations using Hantush Method

ATTACHMENTS

Attachment A – Test Pit Logs

Attachment B – Grain Size Analyses

Attachment C – Groundwater Mounding Worksheets

1.0 INTRODUCTION

New England Environmental, a division of SWCA, Incorporated (NEE/SWCA) has conducted a hydrogeologic evaluation of the proposed residential development at 470 Boston Street, Topsfield, Massachusetts. The study was conducted on behalf of Sarkis Development Company (Sarkis). The objective of the hydrogeologic investigation is to evaluate the following:

- 1) Subsurface soil and groundwater conditions,
- 2) Infiltration capacity of the soil, and
- 3) Groundwater mounding relative to proposed subsurface wastewater and stormwater infiltration systems.

NEE advanced three test pits to collect soil, evaluate soil hydraulic properties, and confirm overburden conditions. Deep hole observations and percolation tests logs prepared by others were also reviewed, as well as published information. Utilizing the Frimpter (1981) method, seasonal high water table estimates were compared to regional groundwater conditions to assess the hydrogeologic setting. The groundwater information was utilized to develop a conceptual site model, and estimate aquifer properties applicable to the site. Potential groundwater mounding for the three subsurface wastewater disposal systems and various stormwater infiltration systems proposed was then estimated utilizing the Hantush (1967) equation. Results were compared to applicable local and state regulatory guidelines and codes. The work was completed in general accordance with our proposal dated November 30, 2016 and subsequent authorization on December 1, 2016.

Three attachments have been provided within this document: one concerning the available test pit logs (**Attachment A**), one regarding grain size analyses conducted on representative soil samples (**Attachment B**), and one providing sample worksheets concerning the groundwater mounding (**Attachment C**). Also provided with this report are figures and summary tables.

2.0 SITE AND PROJECT DESCRIPTION

The project site is located off Boston Street (Route 1) in Topsfield, Massachusetts (see **Figure 1 Site Locus** and **Figure 2 Aerial Photo**). The site is about 16.3 acres and is currently developed with a single-family home and out-buildings. Boston Street borders the site to the east, wetlands and a church to the north, wetlands and the Ipswich town line to the west, and a woodlands and an apartment complex to the south. An open field exists in the central and western portion of the site. The surface topography at the site is undulating, ranging from elevation (El) 83 feet in the southern portion of the Site to about El 57 feet in the wetlands.

Proposed development of the site includes construction of a 15 duplexes (30 units total) for elderly housing, along with pavement and stormwater appurtenances. Three community subsurface sewage disposal systems (SDS) totaling 4,500 gallons per day (GPD) are planned for the development. The individual systems will include a 1,200 GPD system (western, SDS #1), 1,800 GPD system (central, SDS #3) and a 1,500 GPD system (eastern, SDS #2) system. Additionally, stormwater runoff will be collected and directed to a series of nine (9) underground infiltration systems (UIS-1 through UIS-9) and an infiltration pond in the center of the site (D-1).

Eaglebrook Engineering & Survey, LLC (Eaglebrook) of Danvers, Massachusetts advanced 12 deep hole observations (test pits) at the site in July 2016 to estimate seasonal high water table (SHWT) elevations in the vicinity of the proposed SDS units. The SHWT was determined to be

7.5 to 10 feet below grade in the vicinity of the proposed SDS units, based on soil mottling evidence. The SHWT depths generally increased from east to west on the upland flat where the development is planned. Eaglebrook also conducted two (2) percolation tests in each of the three system areas, and obtained rates ranging from 1.0 minutes per inch (MPI) for the western system to 7.33 MPI for the eastern system. Eaglebrook's Soil Suitability Assessment Report utilizing DEP Form 11 is provided within **Attachment A**, and includes the logs for TP16-1 through TP16-4 (SDS#1), TP16-5 through TP16-8 (SDS#3), and TP16-9 through TP16-12 (SDS#2), along with the summary of percolation tests 1 through 6.

Allen & Major Associates, Inc. (Allen & Major) of Woburn, Massachusetts also advanced test pits to support a general engineering evaluation, including the design of the planned stormwater infiltration units and pond. Test pits TP-1 through TP-9 were advanced in July 2016 and TP-10 through TP-17 were advanced in December 2016. The test pit logs are summarized on DEP Form 11s (see **Attachment A**).

The location of the test pits and infiltration features are shown on **Figure 3 Subsurface Exploration Location Plan**, and are based on plans prepared by Allen & Major as well as Eaglebrook.

3.0 FIELD AND LAB PROGRAM

3.1 Test Pit Observations

NEE monitored a subsurface exploration program which included the advancement of three test pits, one each in the vicinity of SDS #1 through SDS #3. Test pits SWTP-1 through SWTP-3 were coordinated with Allen & Major on December 9, 2016, utilizing an excavator operated by T.W. Excavating. Five (5) representative soil samples were collected and submitted for grain size analyses at the UMass Extension Soil and Nutrient Testing Laboratory utilizing sieve and hydrometer methodology. The test pit logs are provided in **Attachment A**, and the grain size analyses in **Attachment B**. The locations were estimated from existing site features and provided on **Figure 3**.

Soil at the site consists of a veneer of outwash deposit soils (Sand) over a crudely stratified ablation till (Sand and Gravel). Refusal was met at 14.5 feet, 12 feet and 6 feet at SWTP-1 through SWTP-3, respectively. The shallow refusal at 6 feet below grade at SWTP-3 was assumed to be a result of angular boulders, as adjacent test pits by Eaglebrook did not meet refusal at depths greater than 12 feet below grade. Groundwater was observed to be at or below 12 feet below grade on the day of the observations.

3.2 Hydraulic Conductivity Estimates

3.2.1 Grain-size Analysis

The representative soil samples from several soil strata encountered at the site were analyzed for grain-size distribution using sieve and/or hydrometer methods. The grain-size distribution curves have been included in **Attachment B**. An empirical relationship known as the Hazen Estimator allows the hydraulic conductivity of a granular soil to be estimated from the effective grain size, D_{10} , which is the effective grain size of the soil corresponding to 10 percent material finer by weight (see Lambe and Whitman, 1969). This relationship is considered reasonably

approximate for clean sands with D_{10} sizes between 0.1 and 3.0 millimeters. The hydraulic conductivity, k (centimeters/second [cm/sec]), of the material was calculated using the following equation:

$$k \text{ (cm/s)} = D_{10}^2$$

where D_{10} is in millimeters. A summary of the hydraulic conductivity estimates are provided in **Table 1**. A mean hydraulic conductivity of 20 feet/day was obtained for the overburden soils. It should be noted that the range of hydraulic conductivity for soils is the greatest of any single soil parameter. Large deviations in hydraulic conductivity within a given soil deposit are common. Also, a number of uncontrollable factors influence the results of tests designed to measure hydraulic conductivity. Therefore, the results of these tests should be considered to be only an indicator of the soils hydraulic conductivity and not an absolute value. Additionally, actual hydraulic conductivity values are known to be 10 times or more in a horizontal direction versus the vertical direction, especially in the presence of stratification.

3.2.2 Percolation Tests

The percolation tests conducted by Eaglebrook were utilized as a second line of evidence for estimation of hydraulic conductivity of the overburden soils at the site. The empirical equation of Fritton et al. (1986) was utilized for this purpose. As shown in **Table 2**, the estimated hydraulic conductivity for the three SDS areas range from about 7 to 13 feet/day, which is consistent with the Hazen estimate provided in **Table 1**.

3.3 Seasonal High Groundwater Table Estimate with Frimpter Method

An estimate of the SHWT has been provided on the Eaglebrook and Allen & Major test pit logs utilizing the soil redoximorphic or mottling observations. For the Allen & Major test pits, the elevation for the SHWT is also shown as SHGWE on **Figure 3**. The edge of the wetland boundary also represents an estimate of the SHWT.

An independent estimate of the SHWT was made by employing methods developed by the US Geological Survey (USGS), specifically Frimpter (1981), where actual groundwater levels at a point in time are compared to USGS index wells. The USGS index wells have a long history of observations where seasonal trends are well-documented. The ratio of the potential water level rise at a site, to the potential water level rise at a USGS index well in a similar hydrogeologic setting, is found to be equal to ratio of the water level ranges at both locations.

NEE evaluated appropriate USGS index wells in the area and found the USGS Georgetown GCW 168 well to exhibit a similar range as the site. The Georgetown 168 well is located in an outwash deposit within a valley flat hydrogeologic setting. This setting is associated with relatively permeable soil with excellent drainage enhanced by local hydraulic relief provided by wetlands and/or surface water. As shown on **Table 3**, the Frimpter method suggests that the maximum range in water level at the site would be on the order of 4 feet, i.e., the SHWT would be about El 59 feet in the SDS #1 area, which is consistent with the SHGWE estimates in this area.

4.0 CONCEPTUAL SITE MODEL

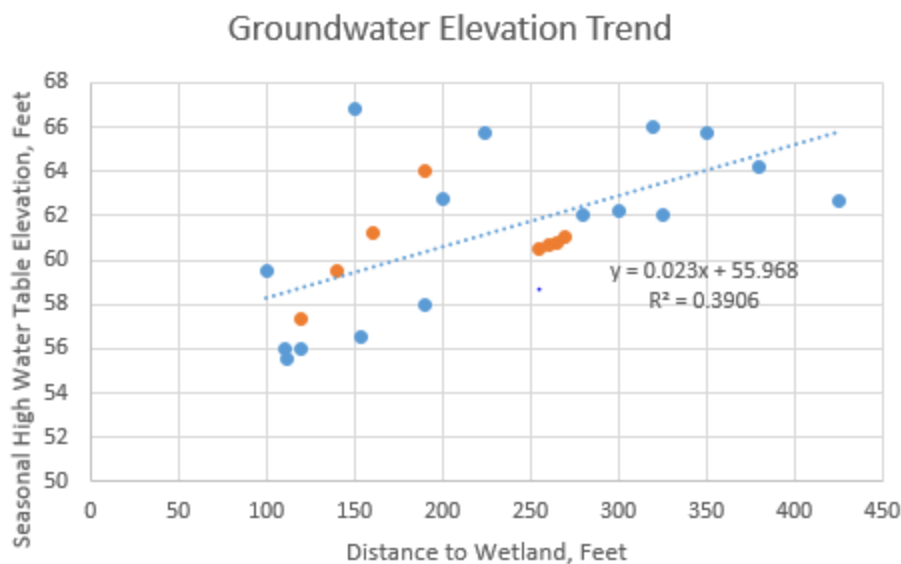
The surficial geology of the site has been mapped by USGS (Cuppels, 1969) and shows permeable outwash sand (Qgi) throughout the majority of the site. The outwash is projected to underlie wetlands to the north, and lie above a glacial till deposit that is exposed to the south of the site along the local topographic high (EI 80 to 100 feet). The wetland to the north of the site has an intermittent drainage feature that discharges to Howlett Brook, located to the south of the Site. The presence of the wetlands to the north and Howlett Brook to the south provides hydraulic relief for groundwater flow at the site.



Insert 1 - Surficial Geology from USGS GQ-850 (Cuppels, 1969)

The outwash and glacial till has been shown to have high sand and gravel content and to be crudely stratified and having moderate permeability. Bedrock is not known to outcrop in the site area. USGS has mapped the bedrock formation to be the Topsfield granodiorite (Zen et al, 1983).

Groundwater at the site appears to flow to the north as higher groundwater elevations (and SHWT) trend to the south, and mirror higher ground surface elevations. Below, the SHWT elevation for the various test pits have been plotted versus distance to the wetland boundary. The overall trend suggests a 1 to 3 percent gradient exists. Variability properties within the outwash and till leads to scatter of the data. As expected, the groundwater data supports that the bordering wetland to the north serves as a constant head boundary, providing hydraulic relief for the site.



Insert 2 - Allen & Major (blue) and Eaglebrook (orange) SHWT observations from test pitting

5.0 GROUNDWATER MOUNDING EVALUATION

5.1 Groundwater Model Selection and Calibration

Based on the local hydrogeologic observations, the saturated subsurface zone at the site is assumed to consist with an idealized one-layer water-table aquifer that is comprised of the outwash and stratified till underlying the site. Although the depth to bedrock is not known, upper bedrock in New England is typically fractured (horizontal sheeting and jointing) and also facilitates groundwater movement, and therefore contributes to some extent to the observed groundwater table surface. Based on the depth to groundwater observed in the test pits, the till unit is well-drained, as mapped by the Soil Conservation Services (see Allen & Major Drainage Report).

The drainage provided by Howlett Brook, its tributaries and the bordering wetlands act as a hydraulic relief for the site. A watershed divide is anticipated near the topographic divide located south of the site. The divide is located about 800 feet south of the wetland boundary located at and north of the site. These hydraulic features control the shape and slope of the unconfined groundwater table surface.

The Dupuit-Forchheimer (DF) equation for unconfined flow was utilized to estimate the effective transmissivity of the site. The DF equation that was utilized incorporates recharge. This creates a rise in the water table between two constant head boundaries of similar elevation. The rise creates a groundwater drainage divide or effective no-flow boundary between the two constant head boundaries. The available groundwater data at the site was incorporated as control points for the groundwater table surface, and the input to the DF equation was calibrated to match the control points. A recharge of 20 inches/year was assumed, and a constant head boundary of El 56 feet at the wetland boundary. The average water table heights were estimated to be about El 57.9, El 60.7 and El 63.7 at distances of 150, 300 and 450 south of the wetlands. The resultant transmissivity for the unconfined aquifer was estimated to be about 180 feet²/day, and this transmissivity was assumed within the subsequent mounding analyses (see **Attachment C** for DF model output). The average hydraulic conductivity assumed within the groundwater model is also consistent with the overburden estimates presented in **Tables 1** and **2**, and a nominal 20 feet saturated thickness. The assumptions provide a “best-fit” estimate to the observed groundwater data, with a root mean squared (RMS) effort of about 1.0 feet.

The Hantush (1967) equation for simulating groundwater mounding beneath an infiltration basin was utilized within the mounding estimates presented in the following sections. The spreadsheet provided by USGS SIR 2010-5102 (Carleton, 2010) was used for the calculations, and a sample spreadsheet output is provided within **Attachment C**. The Hantush model assumes a uniform application rate from the subject infiltration basin to the groundwater table. Horizontal groundwater flow within an unconfined aquifer, similar to the assumptions within the DF equation, is also assumed within the Hantush formula. A transmissivity of 180 feet²/day and a specific yield of 0.30 were assumed within each mounding calculation. The flow rates, duration and basin size was varied based on the design input provided by Eaglebrook for the SDS units and Allen & Major for the stormwater infiltration units.

5.2 Subsurface Sewage Disposal System Mounding Analysis

The input parameters and results for each SDS unit are provided in **Attachment C**. The mounding calculations indicate that a groundwater mound of less than 0.5 foot will result at each

of the SDS units. The mounding assumes a duration of 365 days, Title V flow rates for infiltration (maximum daily flow), and the SHWT as the ambient water table. Although the wetlands provide hydraulic relief to natural groundwater flow at the site, the mounding has no significant impact on the water table configuration adjacent to the wetlands, i.e., no breakout will occur adjacent to the wetlands.

The minimum bed bottoms elevations (bottom of sand) for each SDS, which is calculated as being 4 feet above the maximum mound height for each of the SSD systems, is summarized below:

Unit	Mounding Height (ft)	SHWT EI (ft)	SHWT + Mounding EI (ft)	Min Bed Bottom EI (ft)
SDS#1 (west)	0.2	58.0	58.2	62.2
SDS#3 (central)	0.5	60.8	61.3	65.3
SDS#2 (east)	0.3	64.0	64.3	68.3

Pursuant to Topsfield's *R:I-2 Supplemental Regulations to 310 CMR 15.00 The State Environmental Code, Title 5, Section 11, Geohydrological Report on Clusters and Subdivisions*, the SDS systems are located in areas with adequate hydraulic capacity to accept the proposed design flows. Wastewater effluent plumes generated by the system are located at a sufficient upgradient distance to the wetlands, which are the nearest point of hydraulic relief, so that no impact to any environmental receptors is anticipated. The ground water mounding heights are predicted to be less than 0.5 feet, so that standard Title V design standards will be more than satisfactory for the proposed development.

5.3 Stormwater Basin Infiltration Capacity

Allen & Major has completed a design study for nine (9) subsurface stormwater infiltration beds (UIS-1 through UIS-9) and an infiltration pond (D-1) using run-off calculations for the Required Recharge Volume (RRV), 2-year, 10-year, 25-year and 100-year 24-hour rainfall events. The calculations were generated utilizing HydroCad. The Town of Topsfield requires that the proposed development must handle run-off from a 25-year 24-hour storm event. The basin designs for the proposed development are detailed within the Allen & Major's January 17, 2017 Drainage Report.

Application of the Hantush model to a stormwater infiltration problem required developing reasonable estimates for a uniform infiltration rate and duration for each storm. The *Massachusetts Stormwater Handbook Volume 3: Documenting Compliance with the Massachusetts Stormwater Management Standard* (MA Stormwater Handbook) refers to a 72-hour evaluation period for the RRV and 24-hour storms. Consequently, the infiltration rate was assumed to be equal to the total storage volume calculated by the HydroCad model, divided by the basin area, with the infiltration of the storage volume metered over the 24-hour storm period followed by a 72-hour evaluation period for a total 4 days. Therefore, each basin had a unique infiltration rate for the 25-year storm, with the infiltration rate ranging from 0.92 feet per day for UIS-1 (the largest UIS) to 0.25 feet per day for UIS-9 (the smallest UIS).

Using the Hantush model, maximum mounding heights were evaluated for the five loading scenarios at each UIS and the drainage pond. An aquifer with a conductivity of 8 ft/day, a thickness of 23 feet and a specific yield of 0.3 were assumed, consistent with the SDS mounding

evaluations. **Table 4** provides a summary of the calculated maximum mounding heights compared to vertical separation between the design bed bottom and the SHWT elevation.

As specified within the MA Stormwater Handbook, the 25-year storm event scenarios at each UIS met the dewatering criteria for the 72-hour observation period following the 24-hour rainfall event.

Mounding effects beyond the individual stormwater basins are minimal and are not sufficient to cause surface breakout. Hydraulic mounding related to the proposed infiltration pond D-1 also will not cause adverse impacts to the wetlands. Regarding the proximal relationship of the infiltration pond to septic system SDS#2, the pond infiltration will serve to temporarily increase the hydraulic gradient upgradient of SDS#2, eliminating any potential pathway between the SDS#2 effluent and the pond area. Assuming the pond bottom has no clogging, the water within the pond should dissipate within an additional day or two of the 72-hour evaluation period.

6.0 FINDINGS

The Hantush analytical model was utilized to calculate the potential effects of hydraulic mounding that would occur beneath proposed subsurface stormwater infiltration basins during various rainfall scenarios. Additionally, groundwater mounding beneath SDS units for three septic systems was evaluated.

Overall, the site has excellent hydraulic capacity to handle infiltration from engineered stormwater and wastewater disposal systems. This is based on the hydrogeologic setting featuring permeable sand and gravel, allowing well-drained upland conditions, with hydraulic relief facilitated by the adjacent wetland to the north of the site. Specifically, the results of the mounding analyses indicate the following:

1. Groundwater mounding beneath the proposed septic systems is minimal. Adding 0.5 foot of vertical separation in addition to the required 4 feet between the bed bottom and SHWT will achieve the performance standards expected under Title V.
2. For the stormwater infiltration systems, the 25-year 24-hour rainfall event is sufficiently handled in each of the nine (9) UIS;
3. No “breakout” of the effluent plume or stormwater discharge plume to the ground surface is predicted, either at the wetland boundary or any offsite location; and
4. No negative impact between SDS#3 and the D-1 pond is anticipated due to the hydraulic relationship of the features.

The one-dimensional unconfined groundwater flow models presented herein are a mathematical representation of the groundwater system and hydrogeologic setting. Due to the natural complexity of these entities, a model can only achieve a simplified representation of the future groundwater conditions, and therefore must be considered as a generalized screening tool for use in studying this Site. Furthermore, the calibration and validation of any model is limited by the availability and accuracy of field data and historical records of site activities.

7.0 REFERENCES

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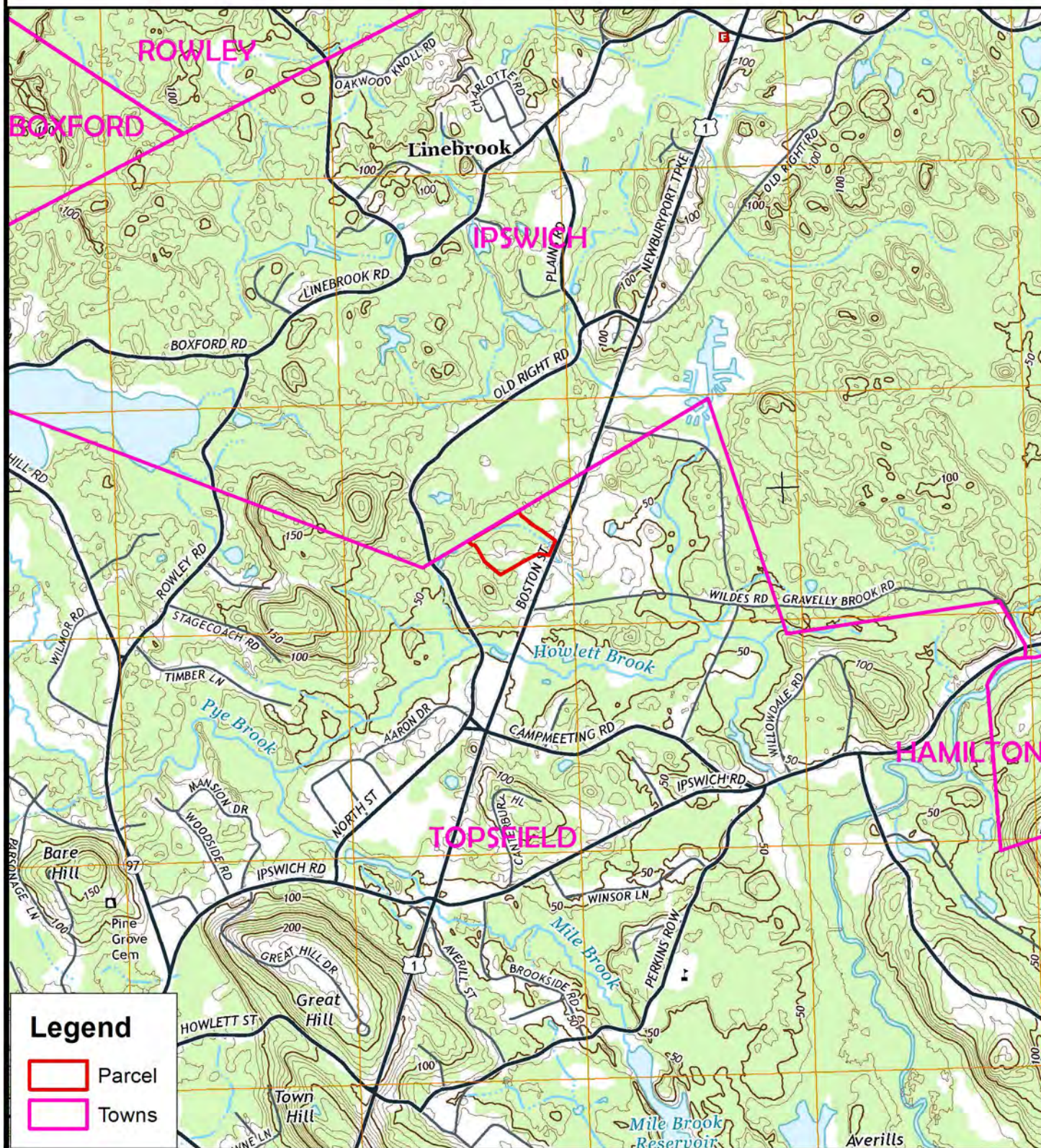
Town of Topsfield, *R:I-2 Supplemental Regulations to 310 CMR 15.00 The State Environmental Code, Title 5, Section 11, Geohydrological Report on Clusters and Subdivisions*,



FIGURES

- | | |
|----------|--------------------------------------|
| Figure 1 | Site Locus |
| Figure 2 | Aerial Photo |
| Figure 3 | Subsurface Exploration Location Plan |





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Figure 1 Site Locus

**470 Boston Street
Topsfield, MA**

06 Janl 2017
NEE Job # 039312.00

Data Source:
Office of Geographic Information
(MassGIS)

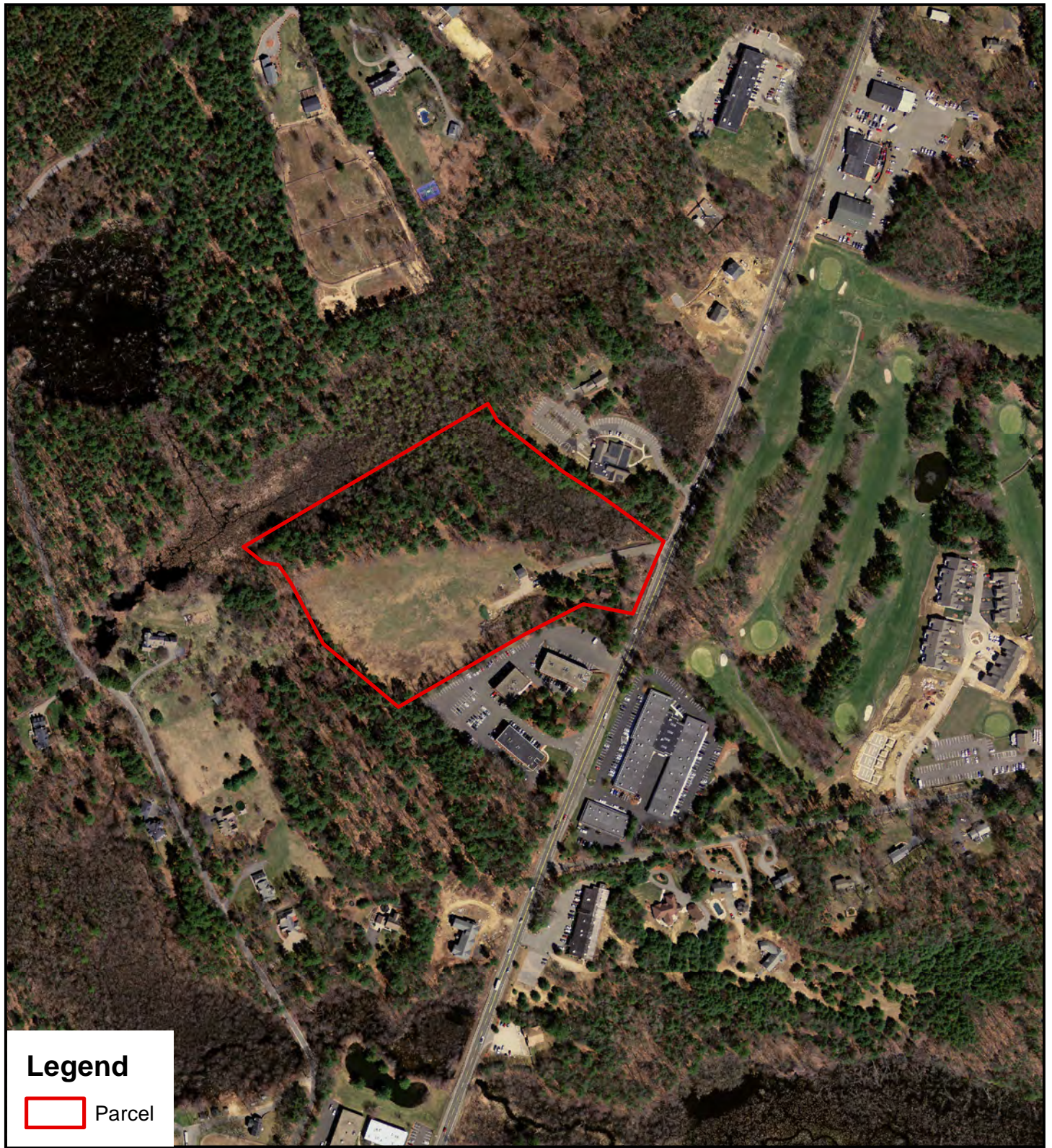
USGS Topographic Quadrangle Images

USGS Georgetown Quadrangle

0 1,000 2,000
Feet



Latitude 42.395199° N
Longitude 70.555217° W



Legend



Parcel



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Figure 2 Aerial Photo

**470 Boston Street
Topsfield, MA**

06 Jan. 2017
NEE Job # 039312.00

Data Source:
Office of Geographic Information
(MassGIS)

USGS Color Ortho Imagery (2013/2014)

0 250 500
Feet



Latitude 42.395199° N
Longitude 70.555217° W



TABLES

Table 1	Summary of Hazen Estimate for Hydraulic Conductivity
Table 2	Summary of Hydraulic Conductivity Estimation from Perc Tests
Table 3	Groundwater Level Estimation using the Frimpter Method
Table 4	Stormwater Mounding Calculations using Hantush Method



Table 1 - Summary of Hazen Estimate for Hydraulic Conductivity

470 Boston Street
Topsfield, Massachusetts

Well ID	Depth (feet)	Geologic Material	D10 Grain Size (mm)	Hydraulic Conductivity Est.	
				(cm/s)	(ft/d)
<i>Subsurface Disposal System #1</i>					
SWTP-1	3-5	coarse SAND (outwash)	0.085	7.2E-03	20
SWTP-1	8-9	Gravelly loamy coarse SAND (ablation till)	0.065	4.2E-03	12
SWTP-1	11-12	Gravelly loamy coarse SAND (ablation till)	0.15	2.3E-02	64
<i>Subsurface Disposal System #3</i>					
SWTP-2	10-12	Gravelly loamy coarse SAND (ablation till)	0.04	1.6E-03	4.6
<i>Subsurface Disposal System #2</i>					
SWTP-3	5-6	Gravelly loamy coarse SAND (ablation till)	0.015	2.2E-04	0.6
			arithmetic mean:	7.2E-03	20
			geometric mean:	3.0E-03	8

Notes:

Hazen Estimator = $D_{10} \text{ (mm)}^2 \text{ (cm/s)}$ used to estimate hydraulic conductivity from grain size results

Table 2 - Summary of Hydraulic Conductivity Estimation from Perc Tests

470 Boston Street
Topsfield, Massachusetts

System #3 - PERC-1 at TP-2

Percolation Rate	mpi	1.66		
Hydraulic Conductivity	m/s	3.8E-05	cm/s	3.8E-03
Hydraulic Conductivity	feet/day	10.8		

System #3 -PERC-4 at TP-5

Percolation Rate	mpi	1		
Hydraulic Conductivity	m/s	4.4E-05	cm/s	4.4E-03
Hydraulic Conductivity	feet/day	12.7		

System #2 -PERC-6 at TP-10

Percolation Rate	mpi	7.33		
Hydraulic Conductivity	m/s	2.4E-05	cm/s	2.4E-03
Hydraulic Conductivity	feet/day	6.8		

Notes:

Emprical equation from D.D. Fritton, T.T. Ratvasky, and G.W. Petersen, "Determination of Saturated Hydraulic Conductivity from Soil Percolation Test Results", Soil Science of America Journal, Vol 50, No. 2, p 273-276, March 1986.

Table 3 - Groundwater Level Estimation using the Frimpter Method

470 Boston Street
039312.00
Topsfield, Massachusetts

SWCA Project Name
SWCA Project Number
Site Location

Frimpter Equation:

$$\frac{S - S_h}{OW - OW_{\max}} = \frac{S_r}{OW_r}$$

Where the following parameters are defined (water levels referenced to feet from ground surface):

- S = Water level at site well
- Sh = Estimated depth to seasonal high water level at site well
- Sr = Estimated range of water level at site well (using topographic and lithologic setting)
- OW = Water level at USGS index well
- OWmax = Maximum water level at USGS index well
- OWr = Range of water level at USGS index well

Select USGS Well with similar topographic and lithologic setting as the site well:

Georgetown Well GCW 168	Name of Selected USGS Index Well exhibiting similar
Valley Flat	Topographic Setting
Outwash	Lithologic Setting
2.25	OWmax (historic high water level)
4.40	OWr (LOW- OWmax or USGS-provided number)
5.22	OW
see below	Date of observation (OW)

Notes on OW:	5.34 on November 25, 2016 observed 4.86 on December 30, 2016 observed estimate 5.22 for December 9, 2016
--------------	--

Input data for site well:

Test Pit SWTP-1	Site Well ID
12/9/2016	Date of Observation
68.25	Ground surface elevation
56.25	Water level surface elevation
12.00	S (calculated depth below ground surface)
4.4	Sr

Calculate estimated depth to seasonal high water level:

9.03	Sh
2.97	S-Sh
59.22	Estimated seasonal high water level elevation

Note: = input data = calculated

Notes:

See 1981 U.S. Geological Survey Water-Resource Investigation Report (WRI-80-1205) by Frimpter

Table 4 - Stormwater Mounding Calculations utilizing Hantush Method

470 Boston Street
Topsfield, Massachusetts

							Hantush Mounding Calculation		
System I.D.	Basin L (Ft)	Basin W (Ft)	Finish Grade El (ft)	Bottom of Stone El (ft)	SHWT (ft)	Bottom El minus SHWT	Stormwater Volume (ft3) from HydroCad	3-Day Infiltration Rate (Ft/d)	Maximum Mounding Height (Ft)
Required Recharge Volume									
UIS-1	69	50	68	60	56.5	3.5	965	0.07	0.3
UIS-2	73.5	16	68.2	61.5	59.5	2	837	0.18	0.3
UIS-3	10	10	76.4	71.7	63.8	7.9	195	0.49	0.1
UIS-4	10	10	77.2	72.5	67.9	4.6	195	0.49	0.1
UIS-5	10	10	77.8	73.1	69	4.1	195	0.49	0.1
UIS-6	10	10	77	72.3	65.7	6.6	195	0.49	0.1
UIS-7	10	10	76.5	71.8	64.5	7.3	195	0.49	0.1
UIS-8	10	10	75.8	71.1	62.8	8.3	195	0.49	0.1
UIS-9	10	10	74.9	71.3	64	7.3	195	0.49	0.1
D-1	69	69	66	66	62	4	2,959	0.16	0.8
2-Year 24-hour Rainfall									
UIS-1	69	50	68	60	56.5	3.5	4,105	0.30	1.2
UIS-2	73.5	16	68.2	61.5	59.5	2	1,100	0.23	0.4
UIS-3	10	10	76.4	71.7	63.8	7.9	130	0.33	0.1
UIS-4	10	10	77.2	72.5	67.9	4.6	134	0.34	0.1
UIS-5	10	10	77.8	73.1	69	4.1	136	0.34	0.1
UIS-6	10	10	77	72.3	65.7	6.6	137	0.34	0.1
UIS-7	10	10	76.5	71.8	64.5	7.3	136	0.34	0.1
UIS-8	10	10	75.8	71.1	62.8	8.3	136	0.34	0.1
UIS-9	10	10	74.9	71.3	64	7.3	81	0.20	0.1
D-1	69	69	66	66	62	4	7,349	0.39	1.8
10-Year 24-hour Rainfall									
UIS-1	69	50	68	60	56.5	3.5	8,986	0.65	2.5
UIS-2	73.5	16	68.2	61.5	59.5	2	1,956	0.42	0.7
UIS-3	10	10	76.4	71.7	63.8	7.9	135	0.34	0.1
UIS-4	10	10	77.2	72.5	67.9	4.6	141	0.35	0.1
UIS-5	10	10	77.8	73.1	69	4.1	144	0.36	0.1
UIS-6	10	10	77	72.3	65.7	6.6	146	0.37	0.1
UIS-7	10	10	76.5	71.8	64.5	7.3	144	0.36	0.1
UIS-8	10	10	75.8	71.1	62.8	8.3	144	0.36	0.1
UIS-9	10	10	74.9	71.3	64	7.3	91	0.23	0.1
D-1	69	69	66	66	62	4	13,275	0.70	3.2

Table 4 - Stormwater Mounding Calculations utilizing Hantush Method (cont.)

470 Boston Street
Topsfield, Massachusetts

							Hantush Mounding Calculation		
System	Basin	Basin	Finish	Bottom		Bottom El	Stormwater	4-Day	Maximum
I.D.	L (Ft)	W (Ft)	Grade	of Stone	SHWT (ft)	minus	Volume (ft3)	Infiltration	Mounding
			El (ft)	El (ft)		SHWT	from HydroCad	Rate (Ft/d)	Height (Ft)
25-Year 24-hour Rainfall									
UIS-1	69	50	68	60	56.5	3.5	12,660	0.92	3.4
UIS-2	73.5	16	68.2	61.5	59.5	2	2,548	0.54	0.8
UIS-3	10	10	76.4	71.7	63.8	7.9	137	0.34	0.1
UIS-4	10	10	77.2	72.5	67.9	4.6	146	0.37	0.1
UIS-5	10	10	77.8	73.1	69	4.1	151	0.38	0.1
UIS-6	10	10	77	72.3	65.7	6.6	154	0.39	0.1
UIS-7	10	10	76.5	71.8	64.5	7.3	151	0.38	0.1
UIS-8	10	10	75.8	71.1	62.8	8.3	151	0.38	0.1
UIS-9	10	10	74.9	71.3	64	7.3	99	0.25	0.1
D-1	70	70	66	66	62	4	14,288	0.73	3.4
100-Year 24-hour Rainfall									
UIS-1	69	50	68	60	56.5	3.5	13,284	0.96	3.6
UIS-2	73.5	16	68.2	61.5	59.5	2	2,860	0.61	1
UIS-3	10	10	76.4	71.7	63.8	7.9	141	0.35	0.1
UIS-4	10	10	77.2	72.5	67.9	4.6	153	0.38	0.1
UIS-5	10	10	77.8	73.1	69	4.1	159	0.40	0.1
UIS-6	10	10	77	72.3	65.7	6.6	163	0.41	0.1
UIS-7	10	10	76.5	71.8	64.5	7.3	159	0.40	0.1
UIS-8	10	10	75.8	71.1	62.8	8.3	159	0.40	0.1
UIS-9	10	10	74.9	71.3	64	7.3	111	0.28	0.1
D-1	72	72	66	66	62	4	16,629	0.80	3.7

Notes:

L = Length, W= Width, El = Elevation, SHWT = Seasonal High Water Table estimate

Hantush (1967) equation for groundwater mounding beneath an infiltration basin utilized

Basin dimension, elevations and HydroCad stormwater flow volumes taken from January 17, 2017 Drainage Report prepared by Allen & Major Associates, Inc.



ATTACHMENT A

Test Pit Logs



SOIL SUITABILITY ASSESSMENT REPORT

COMMONWEALTH OF MASSACHUSETTS

TOPSFIELD, MASSACHUSETTS

SOIL EVALUATION FOR NEW CONSTRUCTION OF ON-SITE SUBSURFACE DISPOSAL SYSTEMS

SITE INFORMATION

Topsfield Assessor's Parcel ID: 7-3

Street Address: 470 Boston Street Town: Topsfield State: Massachusetts Zip Code: 01983 County: Essex
Land Use: Undeveloped; open meadow Latitude: ~42° 39' 50.1" N Longitude: ~70° 55' 51.1" W

PUBLISHED SOIL DATA AND MAP UNIT DESCRIPTION

Physiographic Division: Appalachian Highlands Physio. Province: New England Physio. Section: Seaboard lowland section
NRCS/USDA web soil survey: Essex County, Massachusetts, Northern part Map Scale: 1:300'
Soil map unit: 420B - Canton fine sandy loam (coarse loamy over sandy, mixed, mesic, Typic Dystrochrepts), 03-08% slopes
Soil temperature regime: Mesic Soil moisture regime: Udic Drainage Class: Well drained Hydrologic Soil Group: A
Ksat: High (2.00 – 6.00 in/hr) Available water capacity: Low (~4.4") Soil hydric/ upland: Upland
Depth to restrictive feature: Variable depths to bedrock Frequency of flooding: None Frequency of ponding: None
Soil limitations: Moderate permeability, gravelly substratum, variable seasonal groundwater table, shallow to bedrock in areas.

CLOSEST USGS WELL MEASUREMENTS and WETLAND AREA

Current Water Resource Condition (USGS): Well Site # 423115071032001- MA-WAW 38 Wakefield, MA
Middlesex County, Massachusetts, Hydrologic Unit 01090001 Latitude: ~42° 31 '00.2" N Longitude: ~71° 02' 54.4" W
Well depth: 25.5 feet Borehole depth: 28.2 feet Land surface altitude: 80.00 feet above NGVD29
Most recent data value: 7.94' on 7/04/16 (depth to water level in feet below land surface). Range: Much below normal
National Wetland Inventory Map: NA Wetlands Conservancy Program: NA Bordering vegetative wetland: >100' feet

SURFICIAL & BEDROCK GEOLOGY:

Surficial geology: Geological Quadrangle Map, Surficial Geology – Georgetown Quadrangle, Mass, 1958 – 1959
Ogi: Deposits in the Ipswich River area; Light-brown to light-gray, medium, well sorted sand in the valleys of the Ipswich River
and its tributaries in the southern part of the quadrangle. Sandy deposits underlain by lodgment till.
Geomorphic landform: Kame plain Landform position (2D): Foot slope Landform position (3D): Baseslope
Slope aspect: Easterly Slope gradient: ~00-03% Down slope shape: Concave Across slope shape: Concave
Slope complexity: Simple Bedrock outcropping in vicinity: Not observed Glacial erratics in vicinity: None observed
Bedrock Type: Topsfield granodiorite – Gray to gray-green, porphyritic granodiorite containing blue quartz; cataclastically foliated.

TP16-1 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

Date: Wednesday, July 06, 2016 Time: 08:15 Weather: Sunny, dry, ~85°F, Northeast breeze
 Position on landscape: Backslope Slope aspect: Northwesterly Land Cover: Meadow grass
 Property line: 10⁺ feet Drainage way: 50⁺ feet Drinking water well: 100⁺ feet
 Wetlands: 100⁺ feet Ipswich River: 400⁺ feet Open water body: 400⁺ feet Abutting septic system: NA

SOIL PROFILE ► TP16-1

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 14"	A _p	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; weak cohesive matrix; fine grained mineral content; slightly damp; common fine to medium roots; free of clasts; clear wavy boundary.
14 → 34"	B _w	Sandy Loam	2.5Y 6/6 olive yellow	none observed	Very friable; weak-grade fine to medium angular blocky structure; weak cohesive matrix; gritty; mixed medium to mostly fine grained mineral content; damp; ~05% subrounded gravel content; diffuse wavy boundary.
34 → 88"	C ₁	Sand gravelly	10YR 4/4 dark yellowish brown	none observed	Loose; structurless; unstable; mixed fine to coarse grained sand; crudely stratified and well graded; ~10 -15% rounded to subrounded gravel content of mixed lithology; few strong red variegated iron stains on clasts and along bedding planes; stratified beds slightly dipping to the East; no refusal at test hole depth.
88 → 119"	C ₂	Sandy Loam gravelly	7.5YR 5/3 brown	none observed	Friable; moderate-grade medium-to-coarse subangular platy structure; mixed fine to coarse grained mineral content; well-graded; moderately compact matrix; crudely stratified with minor imbrication of clasts; somewhat silty; damp; ~15-20% scattered subangular-to-subrounded gravel and ~10% scattered subangular-cobble content of mixed lithology; clasts somewhat tightly nested in matrix; compactness slightly increases with depth; no bedrock contact at test hole depth and no apparent water observed.

Depth to bedrock: >119" Seasonal High Groundwater Table: >119" Apparent water table: >119"
420B - Canton fine sandy loam (coarse loamy over sandy, mixed, mesic, Typic Dystrochrepts), 03-08% slopes

TP16-1 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face: _____ (below land surface) Depth to stabilized apparent water: _____ (below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE: None Observed

Depth of Estimated Seasonal High Groundwater Table: _____ (below land surface)

Type: _____ Abundance: _____ Size: _____ Contrast: _____

Shape: _____ Moisture state: _____ Location: _____

Hardness: _____ Boundary: _____ Concentration color: _____ Reduction color: _____

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: _____ inches below grade

Observed water weeping from side of deep hole: _____ inches below grade

Observed depth to redoximorphic features: _____ inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 8.75 feet

Depth of naturally occurring pervious material in TP16-1 Upper boundary: 14"
Lower boundary: 119"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *Certified Soil Evaluator #1848*

Printed name of evaluator & certification number

June 1998

Date of Soil Evaluator Certification

Mr. John Coulon, Topsfield Director of Public Health

Town of Topsfield witness

07/06/16

Date of soil testing

TP16-2 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

Date: Wednesday, July 06, 2016 Time: 08:30 Weather: Sunny, dry, ~85°F, Northeast breeze
Position on landscape: Backslope Slope aspect: Northwesterly Land Cover: Meadow grass
Property line: 10⁺ feet Drainage way: 50⁺ feet Drinking water well: 100⁺ feet
Wetlands: 100⁺ feet Ipswich River: 400⁺ feet Open water body: 400⁺ feet Abutting septic system: NA

SOIL PROFILE ► TP16-2

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 08"	A _p	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; weak cohesive matrix; fine grained mineral content; slightly damp; common fine to medium roots; free of clasts; clear wavy boundary.
08 → 26"	B _w	Sandy Loam	2.5Y 6/6 olive yellow	none observed	Very friable; weak-grade fine to medium angular blocky structure; weak cohesive matrix; gritty; mixed medium to mostly fine grained mineral content; damp; ~05% subrounded gravel content; diffuse wavy boundary.
26 → 117"	C	Sandy Loam gravelly	7.5YR 5/3 brown	none observed	Friable; moderate-grade medium-to-coarse subangular platy structure; mixed fine to coarse grained mineral content; well-graded; moderately compact matrix; crudely stratified with minor imbrication of clasts; somewhat silty; damp; ~15-20% scattered subangular-to-subrounded gravel and ~10% scattered subangular-cobble content of mixed lithology; clasts somewhat tightly nested in matrix; compactness slightly increases with depth; no bedrock contact at test hole depth and no apparent water observed.

Depth to bedrock: >117" Seasonal High Groundwater Table: >117" Apparent water table: >117"

420B - Canton fine sandy loam (coarse loamy over sandy, mixed, mesic, Typic Dystrochrepts), 03-08% slopes

TP16-2 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face: _____ (below land surface) Depth to stabilized apparent water: _____ (below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE: None Observed

Depth of Estimated Seasonal High Groundwater Table: _____ (below land surface)

Type: _____ Abundance: _____ Size: _____ Contrast: _____

Shape: _____ Moisture state: _____ Location: _____

Hardness: _____ Boundary: _____ Concentration color: _____ Reduction color: _____

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: _____ inches below grade

Observed water weeping from side of deep hole: _____ inches below grade

Observed depth to redoximorphic features: _____ inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 8.25 feet

Depth of naturally occurring pervious material in TP16-2 Upper boundary: 08"
Lower boundary: 117"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *Certified Soil Evaluator #1848*

Printed name of evaluator & certification number

June 1998

Date of Soil Evaluator Certification

Mr. John Coulon, Topsfield Director of Public Health

Town of Topsfield witness

07/06/16

Date of soil testing

TP16-3 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

Date: Wednesday, July 06, 2016 Time: 08:46 Weather: Sunny, dry, ~85°F, Northeast breeze
 Position on landscape: Backslope Slope aspect: Northwesterly Land Cover: Meadow grass
 Property line: 10⁺ feet Drainage way: 50⁺ feet Drinking water well: 100⁺ feet
 Wetlands: 100⁺ feet Ipswich River: 400⁺ feet Open water body: 400⁺ feet Abutting septic system: NA

SOIL PROFILE ► TP16-3

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 10"	A _p	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; weak cohesive matrix; fine grained mineral content; slightly damp; common fine to medium roots; free of clasts; clear wavy boundary.
10 → 24"	B _w	Sandy Loam	2.5Y 6/6 olive yellow	none observed	Very friable; weak-grade fine to medium angular blocky structure; weak cohesive matrix; gritty; mixed medium to mostly fine grained mineral content; damp; ~05% subrounded gravel content; diffuse wavy boundary.
24 → 102"	C	Sandy Loam gravelly	7.5YR 5/3 brown	none observed	Friable; moderate-grade medium-to-coarse subangular platy structure; mixed fine to coarse grained mineral content; well-graded; moderately compact matrix; crudely stratified with minor imbrication of clasts; somewhat silty; damp; ~15-20% scattered subangular-to-subrounded gravel and ~10% scattered subangular-cobble content of mixed lithology; clasts somewhat tightly nested in matrix; compactness slightly increases with depth; no bedrock contact at test hole depth and no apparent water observed.
102"	R	Hard Bedrock			Continuous and coherent contact with granodioritic rock 300 Series excavator unable to proceed deeper

Depth to bedrock: 102" Seasonal High Groundwater Table: >102" Apparent water table: >102"

420B - Canton fine sandy loam (coarse loamy over sandy, mixed, mesic, Typic Dystrochrepts), 03-08% slopes

TP16-3 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face: _____ (below land surface) Depth to stabilized apparent water: _____ (below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE: None Observed

Depth of Estimated Seasonal High Groundwater Table: _____ (below land surface)

Type: _____ Abundance: _____ Size: _____ Contrast: _____

Shape: _____ Moisture state: _____ Location: _____

Hardness: _____ Boundary: _____ Concentration color: _____ Reduction color: _____

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: _____ inches below grade

Observed water weeping from side of deep hole: _____ inches below grade

Observed depth to redoximorphic features: _____ inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 7.66 feet

Depth of naturally occurring pervious material in TP16-3 Upper boundary: 10"
Lower boundary: 102"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *Certified Soil Evaluator #1848*

Printed name of evaluator & certification number

June 1998

Date of Soil Evaluator Certification

Mr. John Coulon, Topsfield Director of Public Health

Town of Topsfield witness

07/06/16

Date of soil testing

TP16-4 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

Date: Wednesday, July 06, 2016 Time: 08:15 Weather: Sunny, dry, ~85°F, Northeast breeze
 Position on landscape: Backslope Slope aspect: Northwesterly Land Cover: Meadow grass
 Property line: 10⁺ feet Drainage way: 50⁺ feet Drinking water well: 100⁺ feet
 Wetlands: 100⁺ feet Ipswich River: 400⁺ feet Open water body: 400⁺ feet Abutting septic system: NA

SOIL PROFILE ► TP16-4

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 10"	A _p	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; weak cohesive matrix; fine grained mineral content; slightly damp; common fine to medium roots; free of clasts; clear wavy boundary.
10 → 16"	B _w	Sandy Loam	2.5Y 6/6 olive yellow	none observed	Very friable; weak-grade fine to medium angular blocky structure; weak cohesive matrix; gritty; mixed medium to mostly fine grained mineral content; damp; ~05% subrounded gravel content; diffuse wavy boundary.
16 → 97"	C ₁	Sand gravelly	10YR 4/4 dark yellowish brown	none observed	Loose; structurless; unstable; mixed fine to coarse grained sand; crudely stratified and well graded; ~10 -15% rounded to subrounded gravel content of mixed lithology; few strong red variegated iron stains on clasts and along bedding planes; stratified beds slightly dipping to the East; no refusal at test hole depth.
97 → 123"	C ₂	Sandy Loam gravelly	7.5YR 5/3 brown	none observed	Friable; moderate-grade medium-to-coarse subangular platy structure; mixed fine to coarse grained mineral content; well-graded; moderately compact matrix; crudely stratified with minor imbrication of clasts; somewhat silty; damp; ~15-20% scattered subangular-to-subrounded gravel and ~10% scattered subangular-cobble content of mixed lithology; clasts somewhat tightly nested in matrix; compactness slightly increases with depth; no bedrock contact at test hole depth and no apparent water observed.

Depth to bedrock: >123" Seasonal High Groundwater Table: >123" Apparent water table: >123"

420B - Canton fine sandy loam (coarse loamy over sandy, mixed, mesic, Typic Dystrochrepts), 03-08% slopes

TP16-4 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face: _____ (below land surface) Depth to stabilized apparent water: _____ (below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE: None Observed

Depth of Estimated Seasonal High Groundwater Table: _____ (below land surface)

Type: _____ Abundance: _____ Size: _____ Contrast: _____

Shape: _____ Moisture state: _____ Location: _____

Hardness: _____ Boundary: _____ Concentration color: _____ Reduction color: _____

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: _____ inches below grade

Observed water weeping from side of deep hole: _____ inches below grade

Observed depth to redoximorphic features: _____ inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 9.42 feet

Depth of naturally occurring pervious material in TP16-4 Upper boundary: 10"
Lower boundary: 123"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *Certified Soil Evaluator #1848*

Printed name of evaluator & certification number

June 1998

Date of Soil Evaluator Certification

Mr. John Coulon, Topsfield Director of Public Health

Town of Topsfield witness

07/06/16

Date of soil testing

TP16-5 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

Date: Wednesday, July 06, 2016 Time: 09:47 Weather: Sunny, dry, ~85°F, Northeast breeze
 Position on landscape: Backslope Slope aspect: Northwesterly Land Cover: Meadow grass
 Property line: 10⁺ feet Drainage way: 50⁺ feet Drinking water well: 100⁺ feet
 Wetlands: 100⁺ feet Ipswich River: 400⁺ feet Open water body: 400⁺ feet Abutting septic system: NA

SOIL PROFILE ► TP16-5

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 11"	A _p	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; weak cohesive matrix; fine grained mineral content; slightly damp; common fine to medium roots; free of clasts; clear wavy boundary.
11 → 16"	B _w	Sandy Loam	2.5Y 6/6 olive yellow	none observed	Very friable; weak-grade fine to medium angular blocky structure; weak cohesive matrix; gritty; mixed medium to mostly fine grained mineral content; damp; ~05% subrounded gravel content; diffuse wavy boundary.
16 → 121"	C	Sandy Loam gravelly	2.5Y 5/4 lite olive brown	119" (f,2,d) 7.5YR5/8 10Y7/1	Friable; moderate-grade medium-to-coarse subangular platy structure; mixed fine to coarse grained mineral content; well-graded; moderately compact matrix; crudely stratified with minor imbrication of clasts; somewhat silty; damp; ~15-20% scattered subangular-to-subrounded gravel and ~15% scattered subangular-cobble content of mixed lithology; clasts somewhat tightly nested in matrix; compactness slightly increases with depth; no bedrock contact at test hole depth and no apparent water observed.

Depth to bedrock: >121" Seasonal High Groundwater Table: 119" Apparent water table: >121"

420B - Canton fine sandy loam (coarse loamy over sandy, mixed, mesic, Typic Dystrochrepts), 03-08% slopes

TP16-5 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face: _____ (below land surface) Depth to stabilized apparent water: _____ (below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 119" (below land surface)

Type: Masses on and within blocky peds Abundance: Few Size: Medium Contrast: Distinct

Shape: Irregular spheroidal Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5YR 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: _____ inches below grade

Observed water weeping from side of deep hole: _____ inches below grade

Observed depth to redoximorphic features: 119" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 9.16 feet

Depth of naturally occurring pervious material in TP16-5 Upper boundary: 11"
Lower boundary: 121"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *Certified Soil Evaluator #1848*

Printed name of evaluator & certification number

June 1998

Date of Soil Evaluator Certification

Mr. John Coulon, Topsfield Director of Public Health

Town of Topsfield witness

07/06/16

Date of soil testing

TP16-6 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

Date: Wednesday, July 06, 2016 Time: 09:54 Weather: Sunny, dry, ~85°F, Northeast breeze
 Position on landscape: Backslope Slope aspect: Northwesterly Land Cover: Meadow grass
 Property line: 10⁺ feet Drainage way: 50⁺ feet Drinking water well: 100⁺ feet
 Wetlands: 100⁺ feet Ipswich River: 400⁺ feet Open water body: 400⁺ feet Abutting septic system: NA

SOIL PROFILE ► TP16-6

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 12"	A _p	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; weak cohesive matrix; fine grained mineral content; slightly damp; common fine to medium roots; free of clasts; clear wavy boundary.
11 → 25"	B _w	Sandy Loam	2.5Y 6/6 olive yellow	none observed	Very friable; weak-grade fine to medium angular blocky structure; weak cohesive matrix; gritty; mixed medium to mostly fine grained mineral content; damp; ~05% subrounded gravel content; diffuse wavy boundary.
16 → 137"	C	Sandy Loam gravelly	2.5Y 5/4 lite olive brown	120" (f,2,d) 7.5YR5/8 10Y7/1	Friable; moderate-grade medium-to-coarse subangular platy structure; mixed fine to coarse grained mineral content; well-graded; moderately compact matrix; crudely stratified with minor imbrication of clasts; somewhat silty; damp; ~15-20% scattered subangular-to-subrounded gravel and ~15% scattered subangular-cobble content of mixed lithology; clasts somewhat tightly nested in matrix; compactness slightly increases with depth; no bedrock contact at test hole depth and no apparent water observed.

Depth to bedrock: >137" Seasonal High Groundwater Table: 120" Apparent water table: >137"

420B - Canton fine sandy loam (coarse loamy over sandy, mixed, mesic, Typic Dystrochrepts), 03-08% slopes

TP16-6 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face: _____ (below land surface) Depth to stabilized apparent water: _____ (below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 120" (below land surface)

Type: Masses on and within blocky peds Abundance: Few Size: Medium Contrast: Distinct

Shape: Irregular spheroidal Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5YR 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: _____ inches below grade

Observed water weeping from side of deep hole: _____ inches below grade

Observed depth to redoximorphic features: 120" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 10.41 feet

Depth of naturally occurring pervious material in TP16-6 Upper boundary: 12"
Lower boundary: 137"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *Certified Soil Evaluator #1848*

Printed name of evaluator & certification number

June 1998

Date of Soil Evaluator Certification

Mr. John Coulon, Topsfield Director of Public Health

Town of Topsfield witness

07/06/16

Date of soil testing

TP16-7 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

Date: Wednesday, July 06, 2016 Time: 10:15 Weather: Sunny, dry, ~85°F, Northeast breeze
 Position on landscape: Backslope Slope aspect: Northwesterly Land Cover: Meadow grass
 Property line: 10⁺ feet Drainage way: 50⁺ feet Drinking water well: 100⁺ feet
 Wetlands: 100⁺ feet Ipswich River: 400⁺ feet Open water body: 400⁺ feet Abutting septic system: NA

SOIL PROFILE ► TP16-7

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 13"	A _p	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; weak cohesive matrix; fine grained mineral content; slightly damp; common fine to medium roots; free of clasts; clear wavy boundary.
13 → 38"	B _w	Sandy Loam	2.5Y 6/6 olive yellow	none observed	Very friable; weak-grade fine to medium angular blocky structure; weak cohesive matrix; gritty; mixed medium to mostly fine grained mineral content; damp; ~05% subrounded gravel content; diffuse wavy boundary.
38 → 130"	C	Sandy Loam gravelly	2.5Y 5/4 lite olive brown	120" (f,2,d) 7.5YR5/8 10Y7/1	Friable; moderate-grade medium-to-coarse subangular platy structure; mixed fine to coarse grained mineral content; well-graded; moderately compact matrix; crudely stratified with minor imbrication of clasts; somewhat silty; damp; ~15-20% scattered subangular-to-subrounded gravel and ~15% scattered subangular-cobble content of mixed lithology; clasts somewhat tightly nested in matrix; compactness slightly increases with depth; no bedrock contact at test hole depth and no apparent water observed.

Depth to bedrock: >130" Seasonal High Groundwater Table: 120" Apparent water table: >130"

420B - Canton fine sandy loam (coarse loamy over sandy, mixed, mesic, Typic Dystrochrepts), 03-08% slopes

TP16-7 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face: _____ (below land surface) Depth to stabilized apparent water: _____ (below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 120" (below land surface)

Type: Masses on and within blocky peds Abundance: Few Size: Medium Contrast: Distinct

Shape: Irregular spheroidal Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5YR 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: _____ inches below grade

Observed water weeping from side of deep hole: _____ inches below grade

Observed depth to redoximorphic features: 120" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 10.41 feet

Depth of naturally occurring pervious material in TP16-7 Upper boundary: 12"
Lower boundary: 137"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker Certified Soil Evaluator #1848

Printed name of evaluator & certification number

June 1998

Date of Soil Evaluator Certification

Mr. John Coulon, Topsfield Director of Public Health

Town of Topsfield witness

07/06/16

Date of soil testing

TP16-8 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

Date: Wednesday, July 06, 2016 Time: 10:25 Weather: Sunny, dry, ~85°F, Northeast breeze
 Position on landscape: Backslope Slope aspect: Northwesterly Land Cover: Meadow grass
 Property line: 10⁺ feet Drainage way: 50⁺ feet Drinking water well: 100⁺ feet
 Wetlands: 100⁺ feet Ipswich River: 400⁺ feet Open water body: 400⁺ feet Abutting septic system: NA

SOIL PROFILE ► TP16-8

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 12"	A _p	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; weak cohesive matrix; fine grained mineral content; slightly damp; common fine to medium roots; free of clasts; clear wavy boundary.
12 → 23"	B _w	Sandy Loam	2.5Y 6/6 olive yellow	none observed	Very friable; weak-grade fine to medium angular blocky structure; weak cohesive matrix; gritty; mixed medium to mostly fine grained mineral content; damp; ~05% subrounded gravel content; diffuse wavy boundary.
23 → 133"	C	Sandy Loam gravelly	2.5Y 5/4 lite olive brown	130" (f,2,d) 7.5YR5/8 10Y7/1	Friable; moderate-grade medium-to-coarse subangular platy structure; mixed fine to coarse grained mineral content; well-graded; moderately compact matrix; crudely stratified with minor imbrication of clasts; somewhat silty; damp; ~15-20% scattered subangular-to-subrounded gravel and ~15% scattered subangular-cobble content of mixed lithology; clasts somewhat tightly nested in matrix; compactness slightly increases with depth; no bedrock contact at test hole depth and no apparent water observed.

Depth to bedrock: >133" Seasonal High Groundwater Table: 130" Apparent water table: >133"

420B - Canton fine sandy loam (coarse loamy over sandy, mixed, mesic, Typic Dystrochrepts), 03-08% slopes

TP16-8 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face: _____ (below land surface) Depth to stabilized apparent water: _____ (below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 130" (below land surface)

Type: Masses on and within blocky peds Abundance: Few Size: Medium Contrast: Distinct

Shape: Irregular spheroidal Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5YR 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: _____ inches below grade

Observed water weeping from side of deep hole: _____ inches below grade

Observed depth to redoximorphic features: 130" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 10.08 feet

Depth of naturally occurring pervious material in TP16-8 Upper boundary: 12"
Lower boundary: 133"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *Certified Soil Evaluator #1848*

Printed name of evaluator & certification number

June 1998

Date of Soil Evaluator Certification

Mr. John Coulon, Topsfield Director of Public Health

Town of Topsfield witness

07/06/16

Date of soil testing

TP16-9 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

Date: Wednesday, July 06, 2016 Time: 11:15 Weather: Sunny, dry, ~85°F, Northeast breeze
 Position on landscape: Backslope Slope aspect: Northwesterly Land Cover: Lightly wooded
 Property line: 10⁺ feet Drainage way: 50⁺ feet Drinking water well: 100⁺ feet
 Wetlands: 100⁺ feet Ipswich River: 400⁺ feet Open water body: 400⁺ feet Abutting septic system: NA

SOIL PROFILE ► TP16-9

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 07"	A	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; weak cohesive matrix; fine grained mineral content; slightly damp; common fine to medium roots; free of clasts; clear wavy boundary.
07 → 16"	B _W	Sandy Loam	2.5Y 6/6 olive yellow	none observed	Very friable; weak-grade fine to medium angular blocky structure; weak cohesive matrix; gritty; mixed medium to mostly fine grained mineral content; damp; ~05% subrounded gravel content; diffuse wavy boundary.
16 → 90"	C ₁	Sand gravelly	10YR 4/4 dark yellowish brown	none observed	Loose; structurless; unstable; mixed fine to coarse grained sand; crudely stratified and well graded; ~10 -15% rounded to subrounded gravel content of mixed lithology; few strong red variegated iron stains on clasts and along bedding planes; stratified beds slightly dipping to the East; no refusal at test hole depth.
90 → 115"	C ₂	Sandy Loam gravelly	7.5YR 5/3 brown	93" (c,3,p) 7.5YR5/8 10Y7/1	Friable; moderate-grade medium-to-coarse subangular platy structure; mixed fine to coarse grained mineral content; well-graded; moderately compact matrix; crudely stratified with minor imbrication of clasts; somewhat silty; damp; ~20-25% scattered subangular-to-subrounded gravel and ~10% scattered subangular-cobble content of mixed lithology; clasts somewhat tightly nested in matrix; compactness slightly increases with depth; no bedrock contact at test hole depth and apparent water observed at 135".

Depth to bedrock: >115" Seasonal High Groundwater Table: 93" Apparent water table: 135"

420B - Canton fine sandy loam (coarse loamy over sandy, mixed, mesic, Typic Dystrochrepts), 03-08% slopes

TP16-9 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE:

Apparent water seeping from pit face: 135" (below land surface) Depth to stabilized apparent water: 135" (below land surface)

Soil moisture state: Damp to wet

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 93" (below land surface)

Type: Masses on and within blocky peds Abundance: Common Size: Coarse Contrast: Prominent

Shape: Irregular spheroidal Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5YR 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: 135" inches below grade

Observed water weeping from side of deep hole: 135" inches below grade

Observed depth to redoximorphic features: 93" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 8.75 feet

Depth of naturally occurring pervious material in TP16-9 Upper boundary: 14"
Lower boundary: 119"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *Certified Soil Evaluator #1848*

Printed name of evaluator & certification number

June 1998

Date of Soil Evaluator Certification

Mr. John Coulon, Topsfield Director of Public Health

Town of Topsfield witness

07/06/16

Date of soil testing

TP16-10 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

Date: Wednesday, July 06, 2016 Time: 11:32 Weather: Sunny, dry, ~85°F, Northeast breeze
 Position on landscape: Backslope Slope aspect: Northwesterly Land Cover: Lightly wooded
 Property line: 10⁺ feet Drainage way: 50⁺ feet Drinking water well: 100⁺ feet
 Wetlands: 100⁺ feet Ipswich River: 400⁺ feet Open water body: 400⁺ feet Abutting septic system: NA

SOIL PROFILE ► TP16-10

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 12"	A	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; weak cohesive matrix; fine grained mineral content; slightly damp; common fine to medium roots; free of clasts; clear wavy boundary.
12 → 18"	B _W	Sandy Loam	2.5Y 6/6 olive yellow	none observed	Very friable; weak-grade fine to medium angular blocky structure; weak cohesive matrix; gritty; mixed medium to mostly fine grained mineral content; damp; ~05% subrounded gravel content; diffuse wavy boundary.
18 → 124"	C	Sandy Loam gravelly	2.5Y 5/4 lite olive brown	90" (f,2,d) 7.5YR5/8 10Y7/1	Friable; moderate-grade medium-to-coarse subangular platy structure; mixed fine to coarse grained mineral content; well-graded; moderately compact matrix; crudely stratified with minor imbrication of clasts; somewhat silty; damp; ~15-20% scattered subangular-to-subrounded gravel and ~15% scattered subangular-cobble content of mixed lithology; clasts somewhat tightly nested in matrix; compactness slightly increases with depth; no bedrock contact at test hole depth and no apparent water observed.

Depth to bedrock: >124" Seasonal High Groundwater Table: 90" Apparent water table: >124"

420B - Canton fine sandy loam (coarse loamy over sandy, mixed, mesic, Typic Dystrochrepts), 03-08% slopes

TP16-10 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face: _____ (below land surface) Depth to stabilized apparent water: _____ (below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 90" (below land surface)

Type: Masses on and within blocky peds Abundance: Few Size: Medium Contrast: Distinct

Shape: Irregular spheroidal Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5YR 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: _____ inches below grade

Observed water weeping from side of deep hole: _____ inches below grade

Observed depth to redoximorphic features: 90" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 9.33 feet

Depth of naturally occurring pervious material in TP16-10 Upper boundary: 12"
Lower boundary: 124"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker Certified Soil Evaluator #1848

Printed name of evaluator & certification number

June 1998

Date of Soil Evaluator Certification

Mr. John Coulon, Topsfield Director of Public Health

Town of Topsfield witness

07/06/16

Date of soil testing

TP16-11 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

Date: Wednesday, July 06, 2016 Time: 11:40 Weather: Sunny, dry, ~85°F, Northeast breeze
 Position on landscape: Backslope Slope aspect: Northwesterly Land Cover: Lightly wooded
 Property line: 10⁺ feet Drainage way: 50⁺ feet Drinking water well: 100⁺ feet
 Wetlands: 100⁺ feet Ipswich River: 400⁺ feet Open water body: 400⁺ feet Abutting septic system: NA

SOIL PROFILE ► TP16-11

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 08"	A	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; weak cohesive matrix; fine grained mineral content; slightly damp; common fine to medium roots; free of clasts; clear wavy boundary.
08 → 21"	B _w	Sandy Loam	2.5Y 6/6 olive yellow	none observed	Very friable; weak-grade fine to medium angular blocky structure; weak cohesive matrix; gritty; mixed medium to mostly fine grained mineral content; damp; ~05% subrounded gravel content; diffuse wavy boundary.
21 → 143	C	Sandy Loam gravelly	2.5Y 5/4 lite olive brown	96" (f,2,d) 7.5YR5/8 10Y7/1	Friable; moderate-grade medium-to-coarse subangular platy structure; mixed fine to coarse grained mineral content; well-graded; moderately compact matrix; crudely stratified with minor imbrication of clasts; somewhat silty; damp; ~15-20% scattered subangular-to-subrounded gravel and ~15% scattered subangular-cobble content of mixed lithology; clasts somewhat tightly nested in matrix; compactness slightly increases with depth; no bedrock contact at test hole depth and no apparent water observed.

Depth to bedrock: >143" Seasonal High Groundwater Table: 96" Apparent water table: >143"

420B - Canton fine sandy loam (coarse loamy over sandy, mixed, mesic, Typic Dystrochrepts), 03-08% slopes

TP16-11 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face: _____ (below land surface) Depth to stabilized apparent water: _____ (below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 96" (below land surface)

Type: Masses on and within blocky peds Abundance: Few Size: Medium Contrast: Distinct

Shape: Irregular spheroidal Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5YR 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: _____ inches below grade

Observed water weeping from side of deep hole: _____ inches below grade

Observed depth to redoximorphic features: 96" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 9.33 feet

Depth of naturally occurring pervious material in TP16-11 Upper boundary: 12"
Lower boundary: 124"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker Certified Soil Evaluator #1848

Printed name of evaluator & certification number

June 1998

Date of Soil Evaluator Certification

Mr. John Coulon, Topsfield Director of Public Health

Town of Topsfield witness

07/06/16

Date of soil testing

TP16-12 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

Date: Wednesday, July 06, 2016 Time: 11:59 Weather: Sunny, dry, ~85°F, Northeast breeze
 Position on landscape: Backslope Slope aspect: Northwesterly Land Cover: Lightly wooded
 Property line: 10⁺ feet Drainage way: 50⁺ feet Drinking water well: 100⁺ feet
 Wetlands: 100⁺ feet Ipswich River: 400⁺ feet Open water body: 400⁺ feet Abutting septic system: NA

SOIL PROFILE ► TP16-12

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00 → 12"	A	Sandy Loam	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine to medium subangular granular structure; weak cohesive matrix; fine grained mineral content; slightly damp; common fine to medium roots; free of clasts; clear wavy boundary.
12 → 28"	B _W	Sandy Loam	2.5Y 6/6 olive yellow	none observed	Very friable; weak-grade fine to medium angular blocky structure; weak cohesive matrix; gritty; mixed medium to mostly fine grained mineral content; damp; ~05% subrounded gravel content; diffuse wavy boundary.
28 → 123	C	Sandy Loam gravelly	2.5Y 5/4 lite olive brown	94" (f,2,d) 7.5YR5/8 10Y7/1	Friable; moderate-grade medium-to-coarse subangular platy structure; mixed fine to coarse grained mineral content; well-graded; moderately compact matrix; crudely stratified with minor imbrication of clasts; somewhat silty; damp; ~15-20% scattered subangular-to-subrounded gravel and ~15% scattered subangular-cobble content of mixed lithology; clasts somewhat tightly nested in matrix; compactness slightly increases with depth; no bedrock contact at test hole depth and no apparent water observed.

Depth to bedrock: >123" Seasonal High Groundwater Table: 94" Apparent water table: >123"

420B - Canton fine sandy loam (coarse loamy over sandy, mixed, mesic, Typic Dystrochrepts), 03-08% slopes

TP16-12 DEEP OBSERVATION HOLE

470 Boston Street, Topsfield, Massachusetts

DEPTH TO APPARENT/ PHREATIC GROUNDWATER TABLE: None Observed

Apparent water seeping from pit face: _____ (below land surface) Depth to stabilized apparent water: _____ (below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 94" (below land surface)

Type: Masses on and within blocky peds Abundance: Few Size: Medium Contrast: Distinct

Shape: Irregular spheroidal Moisture state: Damp Location: C matrix

Hardness: Soft Boundary: Diffuse Concentration color: 7.5YR 5/8 (red) Reduction color: 10Y 7/1 (bluish gray)

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to stabilized phreatic water: _____ inches below grade

Observed water weeping from side of deep hole: _____ inches below grade

Observed depth to redoximorphic features: 94" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 9.25 feet

Depth of naturally occurring pervious material in TP16-12 Upper boundary: 12"
Lower boundary: 123"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker Certified Soil Evaluator #1848

Printed name of evaluator & certification number

June 1998

Date of Soil Evaluator Certification

Mr. John Coulon, Topsfield Director of Public Health

Town of Topsfield witness

07/06/16

Date of soil testing

SOIL SUITABILITY PERCOLATION TEST

COMMONWEALTH OF MASSACHUSETTS

TOPSFIELD, MASSACHUSETTS

470 Boston Street, Topsfield, Massachusetts

<u>Percolation Test</u>	<u>Percolation Test-1</u> TP16-2	<u>Percolation Test-2</u> TP16-4
Depth of test:	Depth to shelf: 48" 66" Depth of hole: 18"	Depth to shelf: 24" 42" Depth of hole: 18"
Start presoak:	13:10	12:29
End presoak:	13:25	12:44
Time at 12"→	13:25	12:44
Time at 9"→	13:28	12:46
Time at 6"→	13:33	12:49
Total time 9" to 6"→	5 minutes	3 minutes
Rate (minutes per inch)	1.66 MPI	1.00 MPI

Alexander F. Parker License #1848
Printed name of evaluator & license number

07/06/16
Date of percolation testing

Mr. John Coulon, Topsfield Director of Public Health
Town of Topsfield witness

SOIL SUITABILITY PERCOLATION TEST

COMMONWEALTH OF MASSACHUSETTS

TOPSFIELD, MASSACHUSETTS

470 Boston Street, Topsfield, Massachusetts

<u>Percolation Test</u>	<u>Percolation Test-3</u> TP16-8	<u>Percolation Test-4</u> TP16-5
Depth of test:	Depth to shelf: 45" 63" Depth of hole: 18"	Depth to shelf: 36" 54" Depth of hole: 18"
Start presoak:	14:10	13:55
End presoak:	14:25	12:44
Time at 12"→	14:25	12:44
Time at 9"→	14:30	12:46
Time at 6"→	14:44	12:49
Total time 9" to 6"→	14 minutes	3 minutes
Rate (minutes per inch)	4.66 MPI	1.00 MPI

Alexander F. Parker License #1848
Printed name of evaluator & license number

07/06/16
Date of percolation testing

Mr. John Coulon, Topsfield Director of Public Health
Town of Topsfield witness

SOIL SUITABILITY PERCOLATION TEST

COMMONWEALTH OF MASSACHUSETTS

TOPSFIELD, MASSACHUSETTS

470 Boston Street, Topsfield, Massachusetts

<u>Percolation Test</u>	<u>Percolation Test-5</u> TP16-12	<u>Percolation Test-6</u> TP16-10
Depth of test:	Depth to shelf: 26" 54" Depth of hole: 18"	Depth to shelf: 36" 54" Depth of hole: 18"
Start presoak:	15:03	15:55
End presoak:	15:18	16:10
Time at 12"→	15:18	16:10
Time at 9"→	15:24	16:30
Time at 6"→	15:31	16:52
Total time 9" to 6"→	7 minutes	22 minutes
Rate (minutes per inch)	2.33 MPI	7.33 MPI

Alexander F. Parker License #1848
Printed name of evaluator & license number

07/06/16
Date of percolation testing

Mr. John Coulon, Topsfield Director of Public Health
Town of Topsfield witness



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Sarkis Development Company

Owner Name

470 Boston Street

Street Address

Topsfield

City

MA
State

Map 2, Lot 5

Map/Lot #

01983

Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair
2. Soil Survey Available? ☒ Yes ☐ No If yes: UC Davis Web Soil Survey 420B, 421C
Source Soil Map Unit
Canton Fine Sandy Loam
Soil Name
Sandy till
Soil Limitations
Bedrock
Geologic/Parent Material
Morraine
Landform
3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: Map Unit
4. Flood Rate Insurance Map
Above the 500-year flood boundary? ☒ Yes ☐ No Within the 100-year flood boundary? ☒ Yes ☐ No
If Yes, continue to #5. FEMA Zone A
5. Within a velocity zone? ☐ Yes ☒ No
6. Within a Mapped Wetland Area? ☒ Yes ☐ No MassGIS Wetland Data Layer: Wooded Swamp Deciduous/Mixed Trees
Wetland Type
7. Current Water Resource Conditions (USGS): June, 2016
Month/Year Range: ☐ Above Normal ☐ Normal ☒ Below Normal
8. Other references reviewed: N/A



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: TP-1 7/7/2016 8:00AM Overcast, 65 degrees
Date Time Weather

1. Location

Ground Elevation at Surface of Hole: 74.0 feet Latitude/Longitude: 42.664163 / -70.930328

Description of Location: Crushed stone drive near end of paved driveway

2. Land Use

Open field N/A 0-3%
(e.g., woodland, agricultural field, vacant lot, etc.) Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)
Grass Moraine N/A
Vegetation Landform Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from:

Open Water Body N/A Drainage Way N/A Wetlands 200+ feet
feet
Property Line 110' Drinking Water Well N/A Other N/A
feet feet

4. Parent Material:

Sandy till Unsuitable Materials Present: ☒ Yes ☐ No

If Yes: ☐ Disturbed Soil ☐ Fill Material ☒ Impervious Layer(s) ☒ Weathered/Fractured Rock ☒ Bedrock

5. Groundwater Observed:

☐ Yes ☒ No

If yes:

N/A N/A
Depth Weeping from Pit Depth Standing Water in Hole

Estimated Depth to High Groundwater: 100" 65.7
inches elevation



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-1

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
2-0	Crushed stone										
0-66	2C ₁	5R3/6				SL	5%	10%			
66-108	2C ₂	5R3/6	100	7.5YR6/8	2%	SL	5%	15%			

Additional Notes:

Fractured/weathered rock throughout. No water noted, no weeping.

ESHWT @ 100" (2% mottles - concentrations)

Refusal @ 108" (Ledge)



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Sarkis Development Company

Owner Name

470 Boston Street

Street Address

Topsfield

City

MA
State

Map 2, Lot 5

Map/Lot #

01983

Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair
2. Soil Survey Available? ☒ Yes ☐ No If yes: UC Davis Web Soil Survey 420B, 421C
Source Soil Map Unit
Canton Fine Sandy Loam
Soil Name
Sandy till
Soil Limitations
Bedrock
Geologic/Parent Material
Morraine
Landform
3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: _____
Map Unit
4. Flood Rate Insurance Map
Above the 500-year flood boundary? ☒ Yes ☐ No Within the 100-year flood boundary? ☒ Yes ☐ No
If Yes, continue to #5. FEMA Zone A
5. Within a velocity zone? ☐ Yes ☒ No
6. Within a Mapped Wetland Area? ☒ Yes ☐ No MassGIS Wetland Data Layer: Wooded Swamp Deciduous/Mixed Trees
Wetland Type
7. Current Water Resource Conditions (USGS): June, 2016
Month/Year Range: ☐ Above Normal ☐ Normal ☒ Below Normal
8. Other references reviewed: N/A



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: TP-2 Date: 7/7/2016 Time: 8:00AM Weather: Overcast, 65 degrees

1. Location

Ground Elevation at Surface of Hole: 75.0 feet Latitude/Longitude: 42.664163 / -70.930328

Description of Location: Slope along southern property line, 110' from PL

2. Land Use

Open field N/A 3-8%
(e.g., woodland, agricultural field, vacant lot, etc.) Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)
Grass Moraine N/A
Vegetation Landform Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body N/A Drainage Way N/A Wetlands 300+ feet
feet feet feet
Property Line 110' Drinking Water Well N/A Other N/A
feet feet feet

4. Parent Material: Sandy till Unsuitable Materials Present: ☒ Yes ☐ No

If Yes: ☐ Disturbed Soil ☐ Fill Material ☒ Impervious Layer(s) ☒ Weathered/Fractured Rock ☒ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: N/A N/A
Depth Weeping from Pit Depth Standing Water in Hole

Estimated Depth to High Groundwater: 108" 66.0
inches elevation



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-2

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-8	A	10YR5/6				FSL					
8-24	B	10YR4/6				SL	5%	15%			
24-150	C	10YR3/6	108	7.5YR6/8	2%	S&G	5%	15%			

Additional Notes:

Fractured/weathered rock 60"-150". No water noted, no weeping.

ESHWT @ 108" (2% mottles - concentrations)

No Refusal



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Sarkis Development Company

Owner Name

470 Boston Street

Street Address

Topsfield

City

MA
State

Map 2, Lot 5

Map/Lot #

01983

Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair
2. Soil Survey Available? ☒ Yes ☐ No If yes: UC Davis Web Soil Survey 420B, 421C
Source Soil Map Unit
Canton Fine Sandy Loam
Soil Name
Sandy till
Soil Limitations
Bedrock
Geologic/Parent Material
Morraine
Landform
3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: Map Unit
4. Flood Rate Insurance Map
Above the 500-year flood boundary? ☒ Yes ☐ No Within the 100-year flood boundary? ☒ Yes ☐ No
If Yes, continue to #5. FEMA Zone A
5. Within a velocity zone? ☐ Yes ☒ No
6. Within a Mapped Wetland Area? ☒ Yes ☐ No MassGIS Wetland Data Layer: Wooded Swamp Deciduous/Mixed Trees
Wetland Type
7. Current Water Resource Conditions (USGS): June, 2016
Month/Year Range: ☐ Above Normal ☐ Normal ☒ Below Normal
8. Other references reviewed: N/A



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: TP-3 7/7/2016 8:00AM Overcast, 65 degrees
Date Time Weather

1. Location

Ground Elevation at Surface of Hole: 81.0 Latitude/Longitude: 42.664163 / -70.930328

Description of Location: Southwestern corner

2. Land Use Open field N/A 0-3%
(e.g., woodland, agricultural field, vacant lot, etc.) Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)
Grass Moraine N/A
Vegetation Landform Position on Landscape (SU, SH, BS, FS, TS)
3. Distances from: Open Water Body N/A Drainage Way N/A Wetlands 500+ feet
feet
Property Line 45' Drinking Water Well N/A Other N/A
feet
4. Parent Material: Sandy till Unsuitable Materials Present: ☒ Yes ☐ No

If Yes: ☐ Disturbed Soil ☐ Fill Material ☒ Impervious Layer(s) ☒ Weathered/Fractured Rock ☒ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: N/A N/A
Depth Weeping from Pit Depth Standing Water in Hole
Estimated Depth to High Groundwater: 102" 72.5
inches elevation



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-3

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-8	A	10YR4/4				FSL					
8-32	B	10YR3/6				LS		10%			
32-108	C	10YR3/6	102	7.5YR6/8	2%	LS		10%			Ref.@108"

Additional Notes:

No water noted, no weeping. ESHWT @ 102"

Angular cobbles and fractured rock throughout B & C layers

Refusal @ 108" (Ledge)



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Sarkis Development Company

Owner Name

470 Boston Street

Street Address

Topsfield

City

MA

State

Map 2, Lot 5

Map/Lot #

01983

Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair
2. Soil Survey Available? ☒ Yes ☐ No If yes: UC Davis Web Soil Survey 420B, 421C
Source Soil Map Unit
Canton Fine Sandy Loam
Soil Name Bedrock
Sandy till Soil Limitations
Geologic/Parent Material Moraine
Landform
3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: Map Unit
4. Flood Rate Insurance Map
Above the 500-year flood boundary? ☒ Yes ☐ No Within the 100-year flood boundary? ☒ Yes ☐ No
If Yes, continue to #5. FEMA Zone A
5. Within a velocity zone? ☐ Yes ☒ No
6. Within a Mapped Wetland Area? ☒ Yes ☐ No MassGIS Wetland Data Layer: Wooded Swamp Deciduous/Mixed Trees
Wetland Type
7. Current Water Resource Conditions (USGS): June, 2016 Range: ☐ Above Normal ☐ Normal ☒ Below Normal
Month/Year
8. Other references reviewed: N/A



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: TP-4 7/7/2016 8:00AM Overcast, 65 degrees
Date Time Weather

1. Location

Ground Elevation at Surface of Hole: 73.0 feet Latitude/Longitude: 42.664163 / -70.930328

Description of Location: Southwest corner of property

2. Land Use

Open field N/A 3-8%
(e.g., woodland, agricultural field, vacant lot, etc.) Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)
Grass Moraine N/A
Vegetation Landform Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from:

Open Water Body N/A Drainage Way N/A Wetlands 500+ feet
feet
Property Line 110' Drinking Water Well N/A Other N/A
feet feet

4. Parent Material:

Sandy till Unsuitable Materials Present: ☐ Yes ☒ No

If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No

If yes: N/A 144"
Depth Weeping from Pit Depth Standing Water in Hole

Estimated Depth to High Groundwater: 88" 65.7
inches elevation



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-4

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-10	A	10YR3/1				SL					
10-22	B	10YR3/2				SL					
22-80	B/C	10YR5/6				Sand					
80-144	C	10YR5/4	88	7.5YR5/8	5%	F. Sand					Moist

Additional Notes:

Standing water @ 144". ESHWT @ 88" (Some mottling in B/C transition layer - concentrations & depletions)

Concentrations - 5YR5/8, depletions - 10YR6/1

No Refusal.



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Sarkis Development Company

Owner Name

470 Boston Street

Street Address

Topsfield

City

MA
State

Map 2, Lot 5

Map/Lot #

01983

Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair
2. Soil Survey Available? ☒ Yes ☐ No If yes: UC Davis Web Soil Survey 420B, 421C
Source Soil Map Unit
Canton Fine Sandy Loam
Soil Name
Sandy till
Soil Limitations
Bedrock
Geologic/Parent Material
Morraine
Landform
3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: _____ Map Unit
4. Flood Rate Insurance Map
Above the 500-year flood boundary? ☒ Yes ☐ No If Yes, continue to #5.
Within the 100-year flood boundary? ☒ Yes ☐ No
FEMA Zone A
5. Within a velocity zone? ☐ Yes ☒ No
6. Within a Mapped Wetland Area? ☒ Yes ☐ No MassGIS Wetland Data Layer: Wooded Swamp Deciduous/Mixed Trees
Wetland Type
7. Current Water Resource Conditions (USGS): June, 2016
Month/Year Range: ☐ Above Normal ☐ Normal ☒ Below Normal
8. Other references reviewed: N/A



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: TP-5 7/7/2016 8:00AM Overcast, 65 degrees
Date Time Weather

1. Location

Ground Elevation at Surface of Hole: 70.0 feet Latitude/Longitude: 42.664163 / -70.930328

Description of Location: Crushed stone drive near end of paved driveway

2. Land Use

Open field N/A 0-3%
(e.g., woodland, agricultural field, vacant lot, etc.) Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)
Grass Moraine N/A
Vegetation Landform Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body N/A Drainage Way N/A Wetlands 375+ feet
feet feet feet
Property Line 220' Drinking Water Well N/A Other N/A
feet feet feet

4. Parent Material: Sandy till Unsuitable Materials Present: ☐ Yes ☒ No

If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: N/A 132"
Depth Weeping from Pit Depth Standing Water in Hole

Estimated Depth to High Groundwater: 96" 62.0
inches elevation



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-5

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-8	A	10YR3/2				SL					
8-34	B	10YR3/1				SL					
34-72	2C ₁	10YR5/8				M. sand					Moist
72-132	2C ₂	10YR5/4	96	7.5YR6/8	5%	Sand			Loose, SG		

Additional Notes:

ESHWT @ 96" (5% mottles - concentrations & depletions)

Standing water @ 132" (bottom)

No Refusal, coarse sand layer at 60-70".



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Sarkis Development Company

Owner Name

470 Boston Street

Street Address

Topsfield

City

MA

State

Map 2, Lot 5

Map/Lot #

01983

Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair
2. Soil Survey Available? ☒ Yes ☐ No If yes: UC Davis Web Soil Survey 420B, 421C
Source Soil Map Unit
Canton Fine Sandy Loam
Soil Name Bedrock
Sandy till Soil Limitations
Geologic/Parent Material Moraine
Landform
3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: Map Unit
4. Flood Rate Insurance Map
Above the 500-year flood boundary? ☒ Yes ☐ No Within the 100-year flood boundary? ☒ Yes ☐ No
If Yes, continue to #5. FEMA Zone A
5. Within a velocity zone? ☐ Yes ☒ No
6. Within a Mapped Wetland Area? ☒ Yes ☐ No MassGIS Wetland Data Layer: Wooded Swamp Deciduous/Mixed Trees
Wetland Type
7. Current Water Resource Conditions (USGS): June, 2016 Range: ☐ Above Normal ☐ Normal ☒ Below Normal
Month/Year
8. Other references reviewed: N/A



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: TP-6 Date: 7/7/2016 Time: 8:00AM Weather: Overcast, 65 degrees

1. Location

Ground Elevation at Surface of Hole: 70.5 feet Latitude/Longitude: 42.664163 / -70.930328

Description of Location: Crushed stone drive near end of paved driveway

2. Land Use

Open field N/A 0-3%
(e.g., woodland, agricultural field, vacant lot, etc.) Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)
Grass Moraine N/A
Vegetation Landform Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body N/A Drainage Way N/A Wetlands 175+ feet
feet feet feet
Property Line 115' Drinking Water Well N/A Other N/A
feet feet feet

4. Parent Material: Sandy till Unsuitable Materials Present: ☐ Yes ☒ No

If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: N/A N/A
Depth Weeping from Pit Depth Standing Water in Hole

Estimated Depth to High Groundwater: 92" 62.8
inches elevation



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-6

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-8	A	10YR4/3				FSL					
8-28	B	10YR6/6				FSL					
28-72	B/C	10YR3/3				FSL	5%	2%			
72-136	C	10YR3/3	92"	7.5YR6/8	2%	FSL	5%	2%			

Additional Notes:

ESHWT @ 92". No refusal, no weeping, no standing water.

Heavy manganese deposits throughout B/C and C layers, color 10R3/3



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Sarkis Development Company

Owner Name

470 Boston Street

Street Address

Topsfield

City

MA

State

Map 2, Lot 5

Map/Lot #

01983

Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair
2. Soil Survey Available? ☒ Yes ☐ No If yes: UC Davis Web Soil Survey 420B, 421C
Source Soil Map Unit
Canton Fine Sandy Loam
Soil Name
Sandy till
Soil Limitations
Bedrock
Geologic/Parent Material
Morraine
Landform
3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: Map Unit
4. Flood Rate Insurance Map
Above the 500-year flood boundary? ☒ Yes ☐ No Within the 100-year flood boundary? ☒ Yes ☐ No
If Yes, continue to #5. FEMA Zone A
5. Within a velocity zone? ☐ Yes ☒ No
6. Within a Mapped Wetland Area? ☒ Yes ☐ No MassGIS Wetland Data Layer: Wooded Swamp Deciduous/Mixed Trees
Wetland Type
7. Current Water Resource Conditions (USGS): June, 2016
Month/Year Range: ☐ Above Normal ☐ Normal ☒ Below Normal
8. Other references reviewed: N/A



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: TP-7 7/7/2016 8:00AM Overcast, 65 degrees
Date Time Weather

1. Location

Ground Elevation at Surface of Hole: 72.0 feet Latitude/Longitude: 42.664163 / -70.930328

Description of Location: Woodland area by wetlands

2. Land Use Woodland N/A 0-3%
(e.g., woodland, agricultural field, vacant lot, etc.) Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)

Grass Moraine N/A
Vegetation Landform Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body N/A Drainage Way N/A Wetlands 130+ feet
feet feet feet
Property Line 250' Drinking Water Well N/A Other N/A
feet feet feet

4. Parent Material: Sandy till Unsuitable Materials Present: ☐ Yes ☒ No

If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☒ No If yes: N/A N/A
Depth Weeping from Pit Depth Standing Water in Hole

Estimated Depth to High Groundwater: 62" 66.8
inches elevation



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-7

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-8	A	10YR3/3				FSL					
8-28	B	10YR5/6				FSL	5%	10%			
28-76	B/C	10YR4/4	62	7.5YR6/8	2%	FSL	5%	15%	Massive, fri.		
76-144	C	10YR4/4				FSL			Massive, fri.		5% cobbles

Additional Notes:

No water noted, no weeping. No refusal.

ESHWT @ 62" (Significant mottling - concentrations, color 7.5YR6/8)



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Sarkis Development Company

Owner Name

470 Boston Street

Street Address

Topsfield

City

MA

State

Map 2, Lot 5

Map/Lot #

01983

Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair
2. Soil Survey Available? ☒ Yes ☐ No If yes: UC Davis Web Soil Survey 420B, 421C
Source Soil Map Unit
Canton Fine Sandy Loam
Soil Name Bedrock
Sandy till Soil Limitations
Geologic/Parent Material Moraine
Landform
3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: Map Unit
4. Flood Rate Insurance Map
Above the 500-year flood boundary? ☒ Yes ☐ No Within the 100-year flood boundary? ☒ Yes ☐ No
If Yes, continue to #5. FEMA Zone A
5. Within a velocity zone? ☐ Yes ☒ No
6. Within a Mapped Wetland Area? ☒ Yes ☐ No MassGIS Wetland Data Layer: Wooded Swamp Deciduous/Mixed Trees
Wetland Type
7. Current Water Resource Conditions (USGS): June, 2016 Range: ☐ Above Normal ☐ Normal ☒ Below Normal
Month/Year
8. Other references reviewed: N/A



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: TP-8 7/7/2016 8:00AM Overcast, 65 degrees
Date Time Weather

1. Location

Ground Elevation at Surface of Hole: 68.5 Latitude/Longitude: 42.664163 / -70.930328

Description of Location: Northern treeline, 50' back corner existing garage

2. Land Use Open field N/A 0-3%
(e.g., woodland, agricultural field, vacant lot, etc.) Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)
Grass Moraine N/A
Vegetation Landform Position on Landscape (SU, SH, BS, FS, TS)
3. Distances from: Open Water Body N/A Drainage Way N/A Wetlands 115+ feet
feet feet feet
Property Line 275' Drinking Water Well N/A Other N/A
feet feet feet
4. Parent Material: Sandy till Unsuitable Materials Present: ☐ Yes ☒ No

If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: N/A 150"
Depth Weeping from Pit Depth Standing Water in Hole
Estimated Depth to High Groundwater: 108" 59.5
inches elevation



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-8

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-8	A	10YR4/3				LS					
8-18	B	10YR5/6				LS	5%				
18-45	B/C	10YR5/8				LS	20%				
45-150	C	10YR5/6	108	7.5YR6/8	2%	Fine sand			Loose, SG		

Additional Notes:

ESHWT @ 108", some mottling, concentrations, color 7.5YR6/8

Standing water @ 150"

No Refusal. Well defined transition from LS to fine sand.



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Sarkis Development Company

Owner Name

470 Boston Street

Street Address

Topsfield

City

MA

State

Map 2, Lot 5

Map/Lot #

01983

Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair
2. Soil Survey Available? ☒ Yes ☐ No If yes: UC Davis Web Soil Survey 420B, 421C
Source Soil Map Unit
Canton Fine Sandy Loam
Soil Name
Sandy till
Soil Limitations
Bedrock
Geologic/Parent Material
Morraine
Landform
3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: Map Unit
4. Flood Rate Insurance Map
Above the 500-year flood boundary? ☒ Yes ☐ No If Yes, continue to #5.
Within the 100-year flood boundary? ☒ Yes ☐ No
FEMA Zone A
5. Within a velocity zone? ☐ Yes ☒ No
6. Within a Mapped Wetland Area? ☒ Yes ☐ No MassGIS Wetland Data Layer: Wooded Swamp Deciduous/Mixed Trees
Wetland Type
7. Current Water Resource Conditions (USGS): June, 2016
Month/Year Range: ☐ Above Normal ☐ Normal ☒ Below Normal
8. Other references reviewed: N/A



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: TP-9 Date: 7/7/2016 Time: 8:00AM Weather: Overcast, 65 degrees

1. Location

Ground Elevation at Surface of Hole: 70.0 Latitude/Longitude: 42.664163 / -70.930328

Description of Location: Open field, proposed detention basin

2. Land Use Open field N/A 0-3%
(e.g., woodland, agricultural field, vacant lot, etc.) Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)
Grass Moraine N/A
Vegetation Landform Position on Landscape (SU, SH, BS, FS, TS)
3. Distances from: Open Water Body N/A Drainage Way N/A Wetlands 225+ feet
feet
Property Line 175' Drinking Water Well N/A Other N/A
feet
4. Parent Material: Sandy till Unsuitable Materials Present: Yes No

If Yes: Disturbed Soil Fill Material Impervious Layer(s) Weathered/Fractured Rock Bedrock

5. Groundwater Observed: Yes No If yes: 120" 138"
Depth Weeping from Pit Depth Standing Water in Hole
Estimated Depth to High Groundwater: 96" 62.0
inches elevation



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-9

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-8	A	10YR3/3				LS					
8-32	B	10YR5/4				LS					
32-72	2C ₁	10YR6/6				Sand					
72-138	2C ₂	10YR3/6	96	7.5YR6/8	2%	LS	10%				

Additional Notes:

Fractured/weathered rock throughout C layer. Standing water at 138", weeping at 120". ESHWT @ 96" (mottling)

No Refusal.



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Sarkis Development Company

Owner Name

470 Boston Street

Street Address

Topsfield

City

MA

State

Map 2, Lot 5

Map/Lot #

01983

Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair
2. Soil Survey Available? ☒ Yes ☐ No If yes: UC Davis Web Soil Survey 420B, 421C
Source Soil Map Unit
Canton Fine Sandy Loam
Soil Name
Sandy till
Soil Limitations
Bedrock
Geologic/Parent Material
Morraine
Landform
3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: _____ Map Unit
4. Flood Rate Insurance Map
Above the 500-year flood boundary? ☒ Yes ☐ No Within the 100-year flood boundary? ☒ Yes ☐ No
If Yes, continue to #5. FEMA Zone A
5. Within a velocity zone? ☐ Yes ☒ No
6. Within a Mapped Wetland Area? ☒ Yes ☐ No MassGIS Wetland Data Layer: Wooded Swamp Deciduous/Mixed Trees
Wetland Type
7. Current Water Resource Conditions (USGS): Dec, 2016
Month/Year Range: ☐ Above Normal ☐ Normal ☒ Below Normal
8. Other references reviewed: N/A



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: TP-10 12/9/2016 7:30AM Overcast, 35 degrees
Date Time Weather

1. Location

Ground Elevation at Surface of Hole: 68.0 Latitude/Longitude: 42.664163 / -70.930328

Description of Location: Northeast corner existing garage

2. Land Use

Open field N/A 0-3%
(e.g., woodland, agricultural field, vacant lot, etc.) Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)
Grass Moraine N/A
Vegetation Landform Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from:

Open Water Body N/A Drainage Way N/A Wetlands 120+/- feet
feet
Property Line 150'+/- Drinking Water Well N/A Other N/A
feet feet

4. Parent Material:

Sandy till Unsuitable Materials Present: ☐ Yes ☒ No

If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No

If yes: 150" 154"
Depth Weeping from Pit Depth Standing Water in Hole

Estimated Depth to High Groundwater: 150" 55.5
inches elevation



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-10

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-18	A	10YR2/3				SL					
18-28	B	10YR5/6				LS	10%				
28-60	1C	10YR5/6				SL		2%			
60-156	2C	10YR5/6				SL		2%			

Additional Notes:

Water noted at 154", weeping at 150. ESHWT @ 150"

Cobbles and stones throughout B & C layers, no refusal,

layer fine sand at 60-70", no mottling noted.



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Sarkis Development Company

Owner Name

470 Boston Street

Street Address

Topsfield

City

MA
State

Map 2, Lot 5

Map/Lot #

01983

Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair
2. Soil Survey Available? ☒ Yes ☐ No If yes: UC Davis Web Soil Survey 420B, 421C
Source Soil Map Unit
Canton Fine Sandy Loam
Soil Name
Sandy till
Soil Limitations
Bedrock
Geologic/Parent Material
Morraine
Landform
3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: _____
Map Unit
4. Flood Rate Insurance Map
Above the 500-year flood boundary? ☒ Yes ☐ No Within the 100-year flood boundary? ☒ Yes ☐ No
If Yes, continue to #5. FEMA Zone A
5. Within a velocity zone? ☐ Yes ☒ No
6. Within a Mapped Wetland Area? ☒ Yes ☐ No MassGIS Wetland Data Layer: Wooded Swamp Deciduous/Mixed Trees
Wetland Type
7. Current Water Resource Conditions (USGS): Dec, 2016
Month/Year Range: ☐ Above Normal ☐ Normal ☒ Below Normal
8. Other references reviewed: N/A



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: TP-11 12/9/2016 8:00AM Overcast, 35 degrees
Date Time Weather

1. Location

Ground Elevation at Surface of Hole: 69.0 Latitude/Longitude: 42.664163 / -70.930328

Description of Location: SouthWest corner existing garage

2. Land Use Open field N/A 0-3%
(e.g., woodland, agricultural field, vacant lot, etc.) Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)
Grass Moraine N/A
Vegetation Landform Position on Landscape (SU, SH, BS, FS, TS)
3. Distances from: Open Water Body N/A Drainage Way N/A Wetlands 120+/- feet
feet
Property Line 150'+/- Drinking Water Well N/A Other N/A
feet
4. Parent Material: Sandy till Unsuitable Materials Present: ☐ Yes ☒ No

If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 156" 174"
Depth Weeping from Pit Depth Standing Water in Hole
Estimated Depth to High Groundwater: 156" 56.0
inches elevation



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-11

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12	A	10YR2/3				SL					
12-36	B1	10YR5/4				LS					
36-66	B2	10YR5/6				Coarse sand	10-15%		Loose, SG		
66-120	1C	10YR5/8				Sand			Loose, SG		
120-180	2C	10YR5/8				LS					

Additional Notes:

Standing Water noted at 174", weeping at 156. ESHWT

@ 156", no refusal, no mottling noted.



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Sarkis Development Company

Owner Name

470 Boston Street

Street Address

Topsfield

City

MA

State

Map 2, Lot 5

Map/Lot #

01983

Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair
2. Soil Survey Available? ☒ Yes ☐ No If yes: UC Davis Web Soil Survey 420B, 421C
Source Soil Map Unit
Canton Fine Sandy Loam
Soil Name
Sandy till
Soil Limitations
Bedrock
Geologic/Parent Material Landform
Morraine
3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: _____ Map Unit
4. Flood Rate Insurance Map
Above the 500-year flood boundary? ☒ Yes ☐ No Within the 100-year flood boundary? ☒ Yes ☐ No
If Yes, continue to #5. FEMA Zone A
5. Within a velocity zone? ☐ Yes ☒ No
6. Within a Mapped Wetland Area? ☒ Yes ☐ No MassGIS Wetland Data Layer: Wooded Swamp Deciduous/Mixed Trees
Wetland Type
7. Current Water Resource Conditions (USGS): Dec, 2016
Month/Year Range: ☐ Above Normal ☐ Normal ☒ Below Normal
8. Other references reviewed: N/A



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: TP-12 Date: 12/9/2016 Time: 8:30AM Weather: Overcast, 35 degrees

1. Location

Ground Elevation at Surface of Hole: 68.0 Latitude/Longitude: 42.664163 / -70.930328

Description of Location: North west corner proposed UIS-2, along treeline

2. Land Use Open field N/A 0-3%
(e.g., woodland, agricultural field, vacant lot, etc.) Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)
Grass Moraine N/A
Vegetation Landform Position on Landscape (SU, SH, BS, FS, TS)
3. Distances from: Open Water Body N/A Drainage Way N/A Wetlands 100+/- feet
feet
Property Line 300'+/- Drinking Water Well N/A Other N/A
feet
4. Parent Material: Sandy till Unsuitable Materials Present: ☐ Yes ☒ No

If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 144" 158"
Depth Weeping from Pit Depth Standing Water in Hole
Estimated Depth to High Groundwater: 144" 56.0
inches elevation



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-12

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-6	A	10YR2/3				SL					
6-26	Bw	10YR5/4				LS	5-7%				
26-78	1C	10YR5/6				Med. sand			Loose, SG		Boulder, abrupt boundary
78-162	2C	10YR5/8				Sand					Angular cobbles

Additional Notes:

Standing Water noted at 158", weeping at 144.

ESHWI @ 144", no refusal, very little/no mottling

noted. Some fractured ledge at 160", easily broken up.



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Sarkis Development Company

Owner Name

470 Boston Street

Street Address

Topsfield

City

MA
State

Map 2, Lot 5

Map/Lot #

01983

Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair
2. Soil Survey Available? ☒ Yes ☐ No If yes: UC Davis Web Soil Survey 420B, 421C
Source Soil Map Unit
Canton Fine Sandy Loam
Soil Name
Sandy till
Soil Limitations
Bedrock
Geologic/Parent Material
Morraine
Landform
3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: _____ Map Unit
4. Flood Rate Insurance Map
Above the 500-year flood boundary? ☒ Yes ☐ No Within the 100-year flood boundary? ☒ Yes ☐ No
If Yes, continue to #5. FEMA Zone A
5. Within a velocity zone? ☐ Yes ☒ No
6. Within a Mapped Wetland Area? ☒ Yes ☐ No MassGIS Wetland Data Layer: Wooded Swamp Deciduous/Mixed Trees
Wetland Type
7. Current Water Resource Conditions (USGS): Dec, 2016
Month/Year Range: ☐ Above Normal ☐ Normal ☒ Below Normal
8. Other references reviewed: N/A



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: TP-13 Date: 12/9/2016 Time: 9:30AM Weather: Overcast, 35 degrees

1. Location

Ground Elevation at Surface of Hole: 72.5 Latitude/Longitude: 42.664163 / -70.930328

Description of Location: Southeast corner (See Test Pits Plan, TPP-1)

2. Land Use Open field N/A 3-8%
(e.g., woodland, agricultural field, vacant lot, etc.) Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)
Grass Moraine N/A
Vegetation Landform Position on Landscape (SU, SH, BS, FS, TS)
3. Distances from: Open Water Body N/A Drainage Way N/A Wetlands 450+/- feet
feet
Property Line 100'+/- Drinking Water Well N/A Other N/A
feet
4. Parent Material: Sandy till Unsuitable Materials Present: ☐ Yes ☒ No

If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 100" 122"
Depth Weeping from Pit Depth Standing Water in Hole
Estimated Depth to High Groundwater: 122" 62.3
inches elevation



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-13

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-10	A	10YR2/3				FSL					
10-40	Bw	10YR5/4				FSL					
40-132	C	10YR5/6				FSL		2%	Massive, friable		Some fractured
											ledge

Additional Notes:

Standing Water noted at 122", weeping at 100. ESHWT @ 100", no

refusal, very little/no mottling noted. Some fractured ledge in C

horizon, easily broken up.



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Sarkis Development Company

Owner Name

470 Boston Street

Street Address

Topsfield

City

MA

State

Map 2, Lot 5

Map/Lot #

01983

Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair
2. Soil Survey Available? ☒ Yes ☐ No If yes: UC Davis Web Soil Survey 420B, 421C
Source Soil Map Unit
Canton Fine Sandy Loam
Soil Name
Sandy till
Soil Limitations
Bedrock
Geologic/Parent Material
Morraine
Landform
3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: _____
Map Unit
4. Flood Rate Insurance Map
Above the 500-year flood boundary? ☒ Yes ☐ No Within the 100-year flood boundary? ☒ Yes ☐ No
If Yes, continue to #5. FEMA Zone A
5. Within a velocity zone? ☐ Yes ☒ No
6. Within a Mapped Wetland Area? ☒ Yes ☐ No MassGIS Wetland Data Layer: Wooded Swamp Deciduous/Mixed Trees
Wetland Type
7. Current Water Resource Conditions (USGS): Dec, 2016
Month/Year Range: ☐ Above Normal ☐ Normal ☒ Below Normal
8. Other references reviewed: N/A



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: TP-14 Date: 12/9/2016 Time: 10:30AM Weather: Overcast, 35 degrees

1. Location

Ground Elevation at Surface of Hole: 72.5 Latitude/Longitude: 42.664163 / -70.930328

Description of Location: Southern corner (See Test Pits Plan, TPP-1)

2. Land Use Open field N/A 3-8%
(e.g., woodland, agricultural field, vacant lot, etc.) Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)
Grass Moraine N/A
Vegetation Landform Position on Landscape (SU, SH, BS, FS, TS)
3. Distances from: Open Water Body N/A Drainage Way N/A Wetlands 430+/- feet
feet
Property Line 125'+/- Drinking Water Well N/A Other N/A
feet
4. Parent Material: Sandy till Unsuitable Materials Present: ☐ Yes ☒ No

If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 118" 122"
Depth Weeping from Pit Depth Standing Water in Hole
Estimated Depth to High Groundwater: 122" 62.7
inches elevation



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-14

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12	A	10YR2/3				LS					
12-36	Bw	10YR5/4				LS					
36-132	C	10YR5/6				FSL		2%	Massive, friable		

Additional Notes:

Standing Water noted at 122", weeping at 118. ESHWT @ 118",

no refusal, very little/no mottling noted.



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Sarkis Development Company

Owner Name

470 Boston Street

Street Address

Topsfield

City

MA

State

Map 2, Lot 5

Map/Lot #

01983

Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair
2. Soil Survey Available? ☒ Yes ☐ No If yes: UC Davis Web Soil Survey 420B, 421C
Source Soil Map Unit
Canton Fine Sandy Loam
Soil Name
Sandy till
Soil Limitations
Bedrock
Geologic/Parent Material
Morraine
Landform
3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: _____ Map Unit
4. Flood Rate Insurance Map
Above the 500-year flood boundary? ☒ Yes ☐ No Within the 100-year flood boundary? ☒ Yes ☐ No
If Yes, continue to #5. FEMA Zone A
5. Within a velocity zone? ☐ Yes ☒ No
6. Within a Mapped Wetland Area? ☒ Yes ☐ No MassGIS Wetland Data Layer: Wooded Swamp Deciduous/Mixed Trees
Wetland Type
7. Current Water Resource Conditions (USGS): Dec, 2016
Month/Year Range: ☐ Above Normal ☐ Normal ☒ Below Normal
8. Other references reviewed: N/A



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: TP-15 Date 12/9/2016 Time 11:00AM Weather Overcast, 35 degrees

1. Location

Ground Elevation at Surface of Hole: 72.2 Latitude/Longitude: 42.664163 / -70.930328

Description of Location: Southern corner (See Test Pits Plan, TPP-1)

2. Land Use Open field N/A 3-8%
(e.g., woodland, agricultural field, vacant lot, etc.) Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)
Grass Moraine N/A
Vegetation Landform Position on Landscape (SU, SH, BS, FS, TS)
3. Distances from: Open Water Body N/A Drainage Way N/A Wetlands 300+/- feet
feet
Property Line 125'+/- Drinking Water Well N/A Other N/A
feet
4. Parent Material: Sandy till Unsuitable Materials Present: Yes No

If Yes: Disturbed Soil Fill Material Impervious Layer(s) Weathered/Fractured Rock Bedrock

5. Groundwater Observed: Yes No If yes: 120" 136"
Depth Weeping from Pit Depth Standing Water in Hole
Estimated Depth to High Groundwater: 120 62.2
inches elevation



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-15

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-12	A	10YR2/3				FSL					
12-40	Bw	10YR5/4				FSL					
40-140	C	10YR5/6				SL		5%	Massive, friable		Angular cobbles

Additional Notes:

Standing Water noted at 136", weeping at 120. ESHWT @ 120", partial refusal west

side of pit @116", mottling noted below weep line. Some fine materials in C layer.

Some angular cobbles in C layer (~5%)



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Sarkis Development Company

Owner Name

470 Boston Street

Street Address

Topsfield

City

MA

State

Map 2, Lot 5

Map/Lot #

01983

Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair
2. Soil Survey Available? ☒ Yes ☐ No If yes: UC Davis Web Soil Survey 420B, 421C
Source Soil Map Unit
Canton Fine Sandy Loam
Soil Name Bedrock
Sandy till Soil Limitations
Geologic/Parent Material Moraine
Landform
3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: Map Unit
4. Flood Rate Insurance Map
Above the 500-year flood boundary? ☒ Yes ☐ No Within the 100-year flood boundary? ☒ Yes ☐ No
If Yes, continue to #5. FEMA Zone A
5. Within a velocity zone? ☐ Yes ☒ No
6. Within a Mapped Wetland Area? ☒ Yes ☐ No MassGIS Wetland Data Layer: Wooded Swamp Deciduous/Mixed Trees
Wetland Type
7. Current Water Resource Conditions (USGS): Dec, 2016
Month/Year Range: ☐ Above Normal ☐ Normal ☒ Below Normal
8. Other references reviewed: N/A



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: TP-16 Date: 12/9/2016 Time: 11:30AM Weather: Overcast, 35 degrees

1. Location

Ground Elevation at Surface of Hole: 68.0 Latitude/Longitude: 42.664163 / -70.930328

Description of Location: Center of site (See Test Pits Plan, TPP-1)

2. Land Use Open field N/A 0-3%
(e.g., woodland, agricultural field, vacant lot, etc.) Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)
Grass Moraine N/A
Vegetation Landform Position on Landscape (SU, SH, BS, FS, TS)
3. Distances from: Open Water Body N/A Drainage Way N/A Wetlands 200+/- feet
feet
Property Line 180'+/- Drinking Water Well N/A Other N/A
feet
4. Parent Material: Sandy till Unsuitable Materials Present: ☐ Yes ☒ No

If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Impervious Layer(s) ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 120" 128"
Depth Weeping from Pit Depth Standing Water in Hole
Estimated Depth to High Groundwater: 120 58.0
inches elevation



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-16

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-18	A	10YR2/3				FSL					
18-24	Bw	10YR5/4				FSL					
24-60	1C	10YR5/6				Sand					
60-138	2C	10YR5/6				SL		5%			Angular cobbles

Additional Notes:

Standing Water noted at 128", weeping at 120. ESHWT @ 120", refusal @

138" (bedrock), Some angular cobbles in C layer (~5%)



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

A. Facility Information

Sarkis Development Company

Owner Name

470 Boston Street

Street Address

Topsfield

City

MA

State

Map 2, Lot 5

Map/Lot #

01983

Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair
2. Soil Survey Available? ☒ Yes ☐ No If yes: UC Davis Web Soil Survey 420B, 421C
Source Soil Map Unit
Canton Fine Sandy Loam
Soil Name
Sandy till
Soil Limitations
Bedrock
Geologic/Parent Material Landform
Morraine
3. Surficial Geological Report Available? ☐ Yes ☒ No If yes: Map Unit
4. Flood Rate Insurance Map
Above the 500-year flood boundary? ☒ Yes ☐ No Within the 100-year flood boundary? ☒ Yes ☐ No
If Yes, continue to #5. FEMA Zone A
5. Within a velocity zone? ☐ Yes ☒ No
6. Within a Mapped Wetland Area? ☒ Yes ☐ No MassGIS Wetland Data Layer: Wooded Swamp Deciduous/Mixed Trees
Wetland Type
7. Current Water Resource Conditions (USGS): Dec, 2016
Month/Year Range: ☐ Above Normal ☐ Normal ☒ Below Normal
8. Other references reviewed: N/A



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (minimum of two holes required at every proposed primary and reserve disposal area)

Deep Observation Hole Number: TP-17 Date 12/9/2016 Time 12:30AM Weather Overcast, 35 degrees

1. Location

Ground Elevation at Surface of Hole: 69.5 Latitude/Longitude: 42.664163 / -70.930328

Description of Location: Southern corner of existing garage (See Test Pits Plan, TPP-1)

2. Land Use Open field N/A 0-3%
(e.g., woodland, agricultural field, vacant lot, etc.) Surface Stones (e.g., cobbles, stones, boulders, etc.) Slope (%)
Grass Moraine N/A
Vegetation Landform Position on Landscape (SU, SH, BS, FS, TS)
3. Distances from: Open Water Body N/A Drainage Way N/A Wetlands 150+/- feet
feet
Property Line 160'+/- Drinking Water Well N/A Other N/A
feet
4. Parent Material: Sandy till Unsuitable Materials Present: Yes No

If Yes: Disturbed Soil Fill Material Impervious Layer(s) Weathered/Fractured Rock Bedrock

5. Groundwater Observed: Yes No If yes: 156" 166"
Depth Weeping from Pit Depth Standing Water in Hole
Estimated Depth to High Groundwater: 156 56.5
inches elevation



Commonwealth of Massachusetts

City/Town of

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (continued)

Deep Observation Hole Number: TP-17

Depth (in.)	Soil Horizon/ Layer	Soil Matrix: Color- Moist (Munsell)	Redoximorphic Features			Soil Texture (USDA)	Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
			Depth	Color	Percent		Gravel	Cobbles & Stones			
0-20	A	10YR2/1				LS					Heavily plowed
20-36	Bw	10YR5/8				SL					
36-60	1C	10YR5/6				Med. Sand		5%			Some coarse sand
60-168	2C	10YR5/6				SL					Angular cobbles
											manganese deposits

Additional Notes:

Standing Water noted at 166", weeping at 156. ESHWT @ 156", refusal

@ 168" (bedrock), Some angular cobbles in 1C layer (~5%)

New England Environmental
15 Research Drive
Amherst, MA 01002
(413) 256-0202



A DIVISION OF
SWCA
SUPERIOR ENVIRONMENTAL CONSULTANTS

PROJECT: 470 Boston St
LOCATION: Topsfield, MA
Project No.: 039312,00
Subcontractor: T.W. Excavating hired by Allen & Major Associates, Inc.

TESTPIT NO.: **SWTP-1**
SHEET NO.: 1 of 1
DATE: 9-Dec-16
NEE Engineer/Geologist: JPJ

GROUNDWATER READINGS			G.S. ELEVATION: EL 68.25 (estimated)
DATE	TIME	DEPTH to GW	DATUM:
Dec. 9, 2016	11:00 AM	12.0 ft	LOCATION: between TP-16-4 and TP-16-3

DEPTH	PHOTO #	SAMPLE COLLECTION DATA				SAMPLE DESCRIPTION	STRATUM DESCRIPTION
		ID	DEPTH (ft)	PID	Analysis		
2						0 - 0.5' Top Soil, Sandy Loam	LOAM
4						0.5 - 5' brown, Fine to Coarse SAND, little gravel, trace silt	OUTWASH DEPOSIT
6							
8							
10						5 - 14.5' brown COARSE SAND AND GRAVEL, trace silt, moist to wet, crudely stratified with angular clasts	SAND WITH GRAVEL (Ablation Till)
12							
14							
16							END OF EXPLORATION Refusal @ 14.5'

CROSS-SECTION:	REMARKS/NOTES: In SSDS #1 area
----------------	-----------------------------------

SWTP-1

New England Environmental
15 Research Drive
Amherst, MA 01002
(413) 256-0202



PROJECT: 470 Boston St
LOCATION: Topsfield, MA
Project No.: 039312,00
Subcontractor: T.W. Excavating hired by Allen & Major Associates, Inc.

TESTPIT NO.: **SWTP-2**
SHEET NO.: 1 of 1
DATE: 9-Dec-16
NEE Engineer/Geologist: JPJ

GROUNDWATER READINGS			G.S. ELEVATION: EL 71.0 (estimated)	
DATE	TIME	DEPTH to GW	DATUM:	
Dec. 9, 2016	11:30 AM	None Observed	LOCATION:	between TP-16-5 & 6 and TP-16-7 & 8

DEPTH	PHOTO #	SAMPLE COLLECTION DATA				SAMPLE DESCRIPTION	STRATUM DESCRIPTION
		ID	DEPTH (ft)	PID	Analysis		
2						0 - 0.5' Top Soil, Sandy Loam	LOAM
4						0.5 - 4' brown, Fine to Coarse SAND, little gravel, trace silt	OUTWASH DEPOSIT
6							
8							
10						4 - 12.0' brown COARSE SAND AND GRAVEL, trace to little silt, moist to v. moist, crudely stratified with angular clasts	SAND WITH GRAVEL (Ablation Till)
12							
14							
16							

CROSS-SECTION:	REMARKS/NOTES:
	In SSDS #3 area
	<div>SWTP-2</div>

New England Environmental
15 Research Drive
Amherst, MA 01002
(413) 256-0202



PROJECT:	470 Boston St	TESTPIT NO.:	SWTP-3
LOCATION:	Topsfield, MA	SHEET NO.:	1 of 1
Project No.:	039312,00	DATE:	9-Dec-16
Subcontractor:	T.W. Excavating hired by Allen & Major Associates, Inc.	NEE Engineer/Geologist:	JPJ

GROUNDWATER READINGS			G.S. ELEVATION:	EL 65.0 (estimated)
DATE	TIME	DEPTH to GW	DATUM:	
Dec. 9, 2016	12:00 PM	None Observed	LOCATION:	near TP-16-9

DEPTH	PHOTO #	SAMPLE COLLECTION DATA				SAMPLE DESCRIPTION	STRATUM DESCRIPTION
		ID	DEPTH (ft)	PID	Analysis		
2						0 - 0.5' Top Soil, Sandy Loam	LOAM
4						0.5 - 4' brown, Fine to Coarse SAND, little gravel, trace silt	OUTWASH DEPOSIT
6						4 - 6.0' brown COARSE SAND AND GRAVEL, trace to little silt, moist to v. moist, crudely stratified with angular clasts	SAND WITH GRAVEL (Ablation Till)
8							END OF EXPLORATION
							Refusal @ 6.0'
10							
12							
14							
16							

CROSS-SECTION:	REMARKS/NOTES: In SSDS #2 area
	<div>SWTP-3</div>



ATTACHMENT B

Grain Size Analyses



Particle Size Analysis - Comprehensive

Prepared For:

Jack Jemsek
SWCA Incorporated
15 Research Drive
Amherst, MA 01002

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413-658-2055

Sample Information:

Sample ID: SWTP 1, 3 to 5 '

Order Number: 26938

Lab Number: X161219-101

Received: 12/19/2016

Reported: 12/22/2016

<u>USDA Size Fraction</u>			<u>Percent of Whole Sample Passing</u>		
<u>Main Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>	<u>Size (mm)</u>	<u>Sieve #</u>	<u>Whole Sample % of Sample Passing</u>
Sand	0.05-2.0	91.2	2.00	#10	75.9
Silt	0.002-0.05	6.7	1.00	#18	68.3
Clay	<0.002	2.1	0.50	#35	51.9
			0.25	#60	28.7
			0.10	#140	12.4
			0.053	#270	6.7
			0.02	20 um	2.5
			0.005	5 um	1.9
			0.002	2 um	1.6
<u>Sand Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>			
Very Coarse	1.0-2.0	10.1			
Coarse	0.5-1.0	21.5			
Medium	0.25-0.5	30.6			
Fine	0.10-0.25	21.5			
Very Fine	0.05-0.10	7.5			
<u>Silt Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>			
Coarse	0.02-0.05	5.6			
Medium	0.005-0.02	0.7			
Fine	0.002-0.005	0.4			

USDA Textural Class: coarse sand

Gravel Content: (%) 24.1

Particle Size Analysis - Comprehensive

Prepared For:

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413-658-2055

Sample Information:

Sample ID: SWTP 1 8 to 9 '

Order Number: 26938

Lab Number: X161219-102

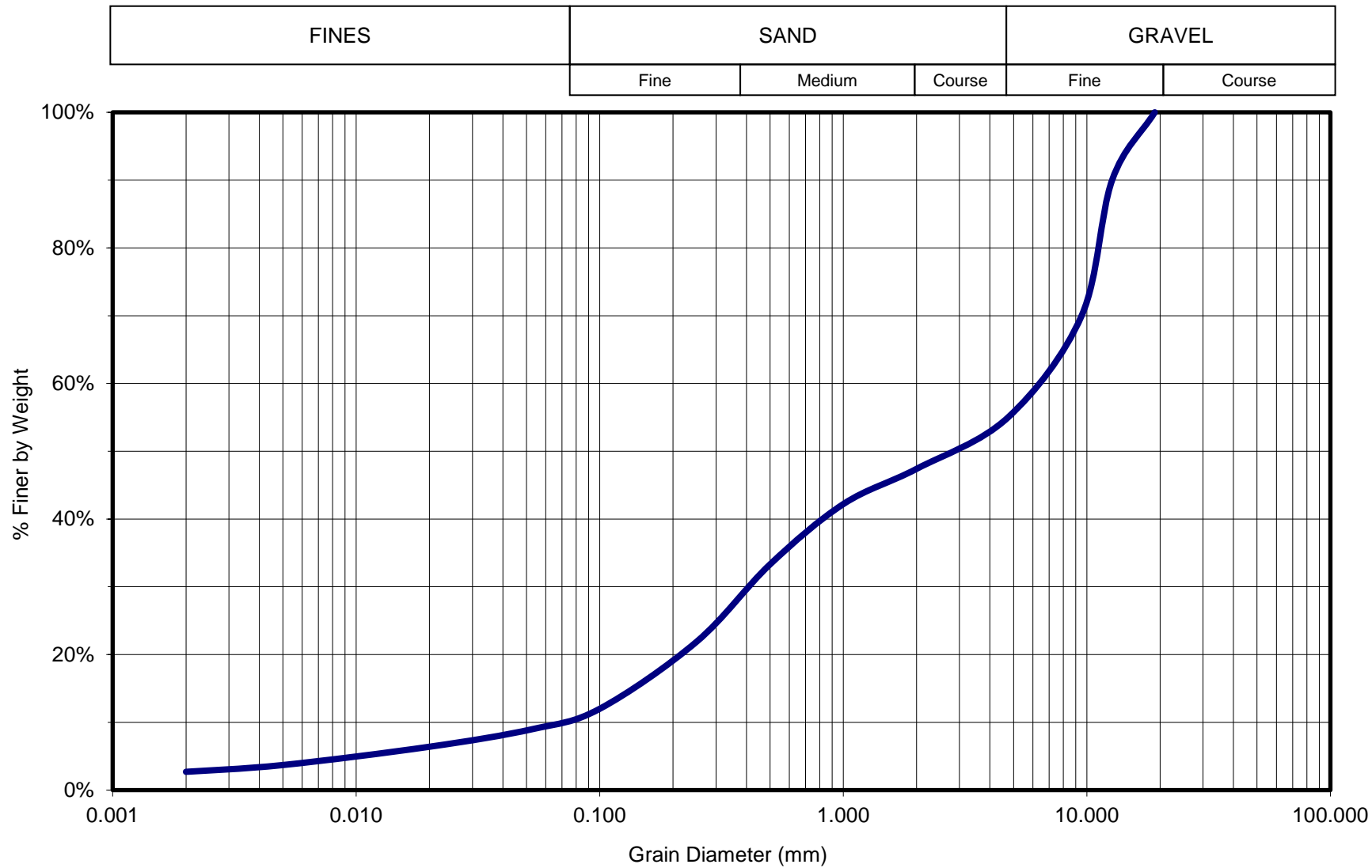
Received: 12/19/2016

Reported: 12/22/2016

<u>USDA Size Fraction</u>			<u>Percent of Whole Sample Passing</u>		
<u>Main Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>	<u>Size (mm)</u>	<u>Sieve #</u>	<u>Whole Sample % of Sample Passing</u>
Sand	0.05-2.0	81.1	2.00	#10	47.4
Silt	0.002-0.05	13.3	1.00	#18	42.2
Clay	<0.002	5.6	0.50	#35	33.3
			0.25	#60	21.9
			0.10	#140	12.0
			0.053	#270	9.0
			0.02	20 um	6.4
			0.005	5 um	3.7
			0.002	2 um	2.7
<u>Sand Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>			
Very Coarse	1.0-2.0	10.9			
Coarse	0.5-1.0	18.8			
Medium	0.25-0.5	24.0			
Fine	0.10-0.25	20.8			
Very Fine	0.05-0.10	6.5			
<u>Silt Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>			
Coarse	0.02-0.05	5.4			
Medium	0.005-0.02	5.7			
Fine	0.002-0.005	2.1			

USDA Textural Class: gravelly loamy coarse sand

Gravel Content: (%) 52.6



Grain size analysis for SWTP1, 8 to 9'

Particle Size Analysis - Comprehensive

Prepared For:

Jack Jemsek
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Sample Information:

Sample ID: SWTP 1 11 to 12'

Order Number: 26938

Lab Number: X161219-103

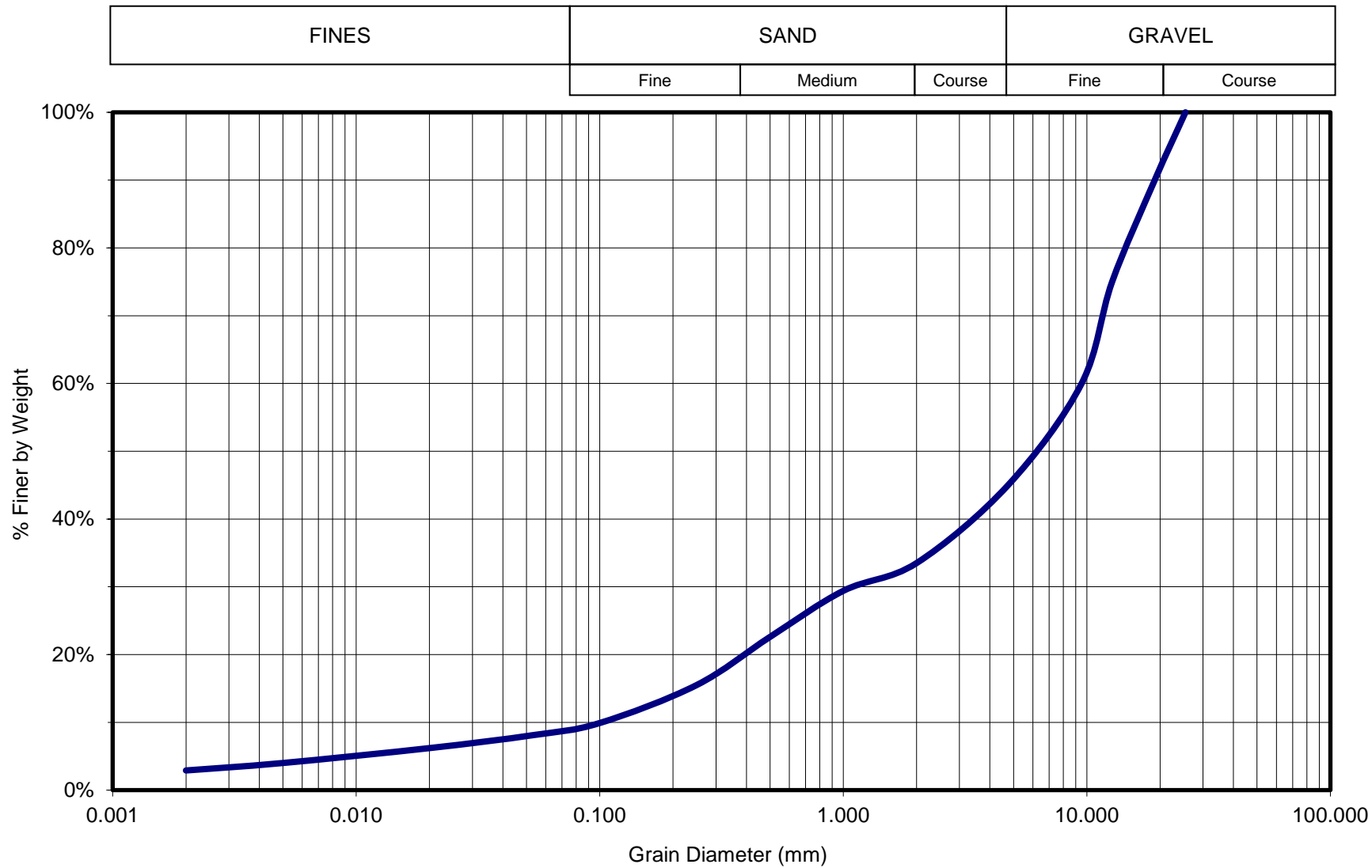
Received: 12/19/2016

Reported: 12/22/2016

<u>USDA Size Fraction</u>			<u>Percent of Whole Sample Passing</u>		
<u>Main Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>	<u>Size (mm)</u>	<u>Sieve #</u>	<u>Whole Sample % of Sample Passing</u>
Sand	0.05-2.0	75.8	2.00	#10	33.5
Silt	0.002-0.05	15.7	1.00	#18	29.4
Clay	<0.002	8.5	0.50	#35	22.6
			0.25	#60	15.5
			0.10	#140	9.9
			0.053	#270	8.1
			0.02	20 um	6.2
			0.005	5 um	4.0
			0.002	2 um	2.9
<u>Sand Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>			
Very Coarse	1.0-2.0	12.3			
Coarse	0.5-1.0	20.4			
Medium	0.25-0.5	21.0			
Fine	0.10-0.25	16.6			
Very Fine	0.05-0.10	5.4			
<u>Silt Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>			
Coarse	0.02-0.05	5.8			
Medium	0.005-0.02	6.6			
Fine	0.002-0.005	3.3			

USDA Textural Class: gravelly coarse sandy loam

Gravel Content: (%) 66.5



Grain size analysis for SWTP1, 11 to 12'

Particle Size Analysis - Comprehensive

Prepared For:

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Sample Information:

Sample ID: SWTP 2 10 to 12'

Order Number: 26938

Lab Number: X161219-104

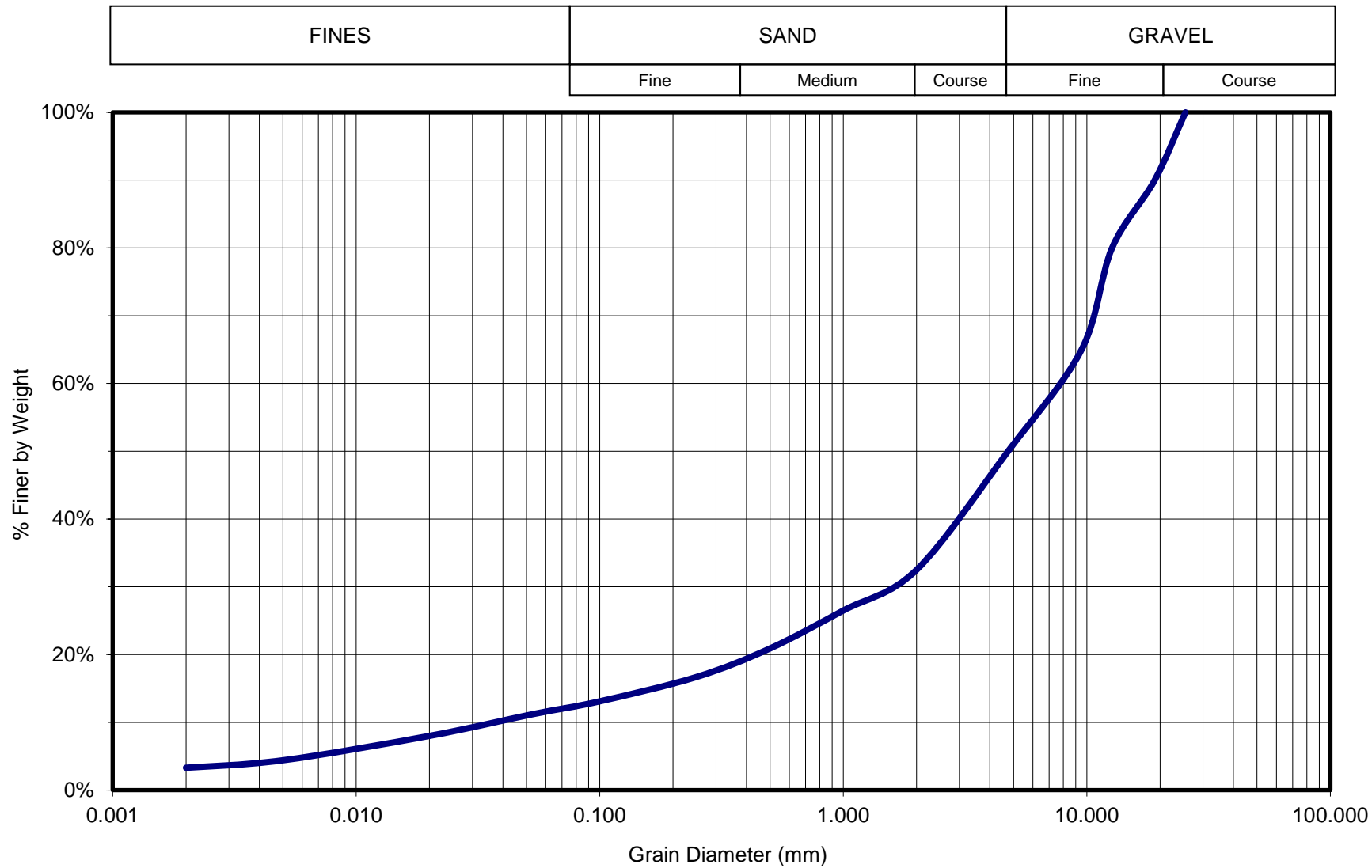
Received: 12/19/2016

Reported: 12/22/2016

<u>USDA Size Fraction</u>			<u>Percent of Whole Sample Passing</u>		
<u>Main Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>	<u>Size (mm)</u>	<u>Sieve #</u>	<u>Whole Sample % of Sample Passing</u>
Sand	0.05-2.0	65.4	2.00	#10	32.5
Silt	0.002-0.05	24.4	1.00	#18	26.5
Clay	<0.002	10.2	0.50	#35	20.9
			0.25	#60	16.7
			0.10	#140	13.1
			0.053	#270	11.2
			0.02	20 um	8.0
			0.005	5 um	4.4
			0.002	2 um	3.3
<u>Sand Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>			
Very Coarse	1.0-2.0	18.3			
Coarse	0.5-1.0	17.4			
Medium	0.25-0.5	12.8			
Fine	0.10-0.25	11.0			
Very Fine	0.05-0.10	5.9			
<u>Silt Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>			
Coarse	0.02-0.05	10.0			
Medium	0.005-0.02	11.0			
Fine	0.002-0.005	3.5			

USDA Textural Class: gravelly coarse sandy loam

Gravel Content: (%) 67.5



Grain size analysis for SWTP2, 10 to 12'

Particle Size Analysis - Comprehensive

Prepared For:

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413-658-2055

Sample Information:

Sample ID: SWTP 3 5 to 6'

Order Number: 26938

Lab Number: X161219-105

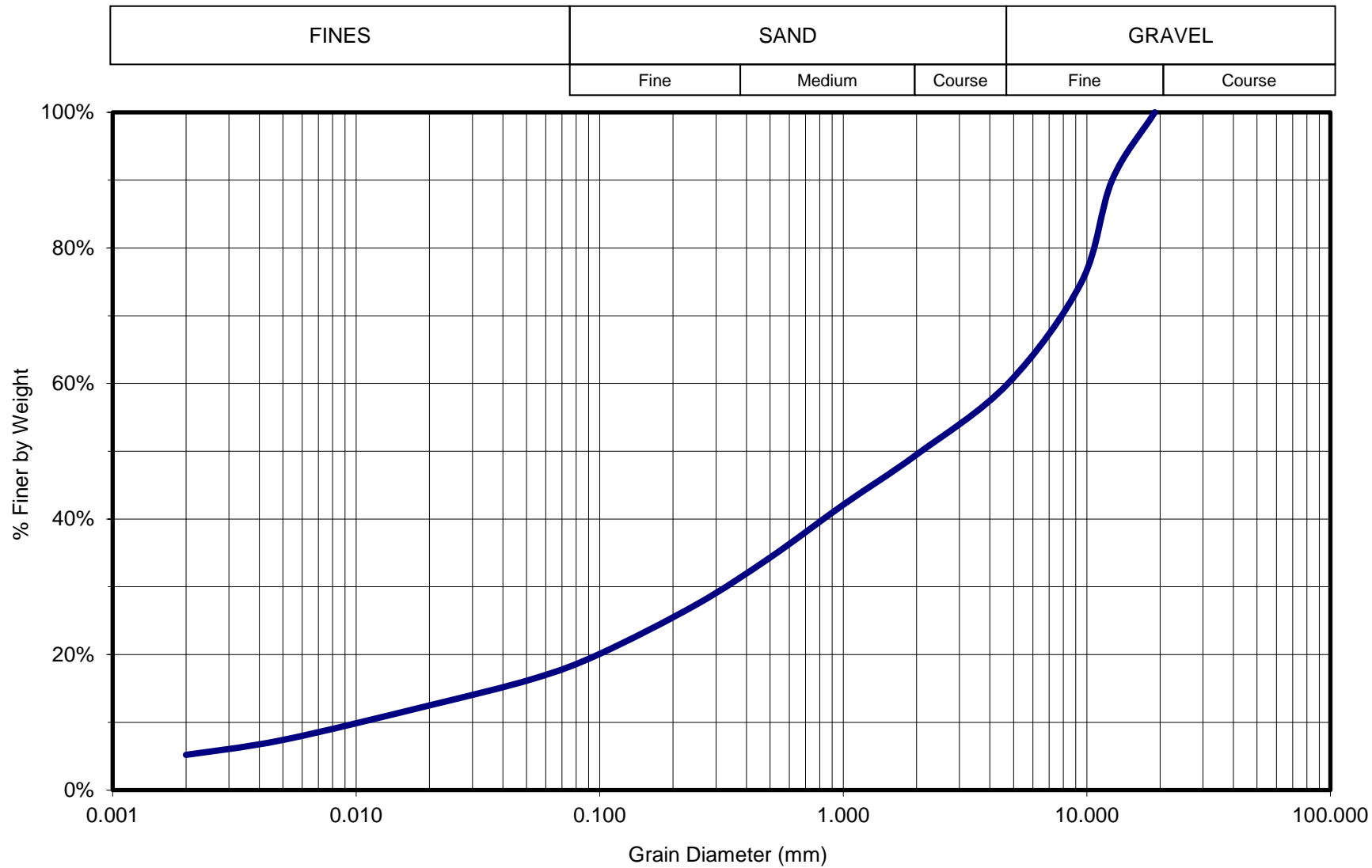
Received: 12/19/2016

Reported: 12/22/2016

<u>USDA Size Fraction</u>			<u>Percent of Whole Sample Passing</u>		
<u>Main Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>	<u>Size (mm)</u>	<u>Sieve #</u>	<u>Whole Sample % of Sample Passing</u>
Sand	0.05-2.0	66.9	2.00	#10	49.5
Silt	0.002-0.05	22.5	1.00	#18	42.1
Clay	<0.002	10.6	0.50	#35	34.3
			0.25	#60	27.4
			0.10	#140	20.1
			0.053	#270	16.4
			0.02	20 um	12.5
			0.005	5 um	7.4
			0.002	2 um	5.2
<u>Sand Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>			
Very Coarse	1.0-2.0	15.1			
Coarse	0.5-1.0	15.7			
Medium	0.25-0.5	14.0			
Fine	0.10-0.25	14.8			
Very Fine	0.05-0.10	7.4			
<u>Silt Fractions</u>	<u>Size (mm)</u>	<u>Percent</u>			
Coarse	0.02-0.05	7.9			
Medium	0.005-0.02	10.1			
Fine	0.002-0.005	4.5			

USDA Textural Class: gravelly coarse sandy loam

Gravel Content: (%) 50.5



Grain size analysis for SWTP3, 5 to 6'



ATTACHMENT C

Groundwater Mounding Worksheets



A DIVISION OF
SWCA
ENVIRONMENTAL CONSULTANTS

X-h Profile using Dupuit-Forcheimier Equation for Unconfined Flow

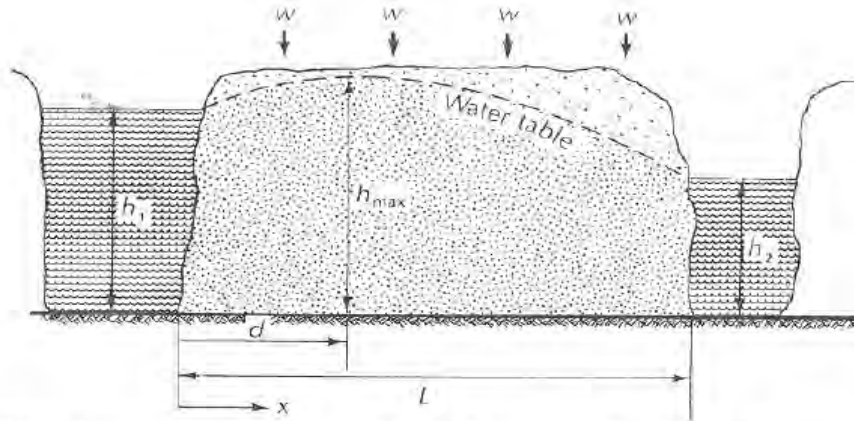


FIGURE 5.16. Unconfined flow, which is subject to infiltration or evaporation.

$$h^2 = h_1^2 - \frac{(h_1^2 - h_2^2)x}{L} + \frac{w}{K} (L - x)x$$

20 = h1, ft

$$20 = h_2, \text{ ft}$$

$$1600 = L, \text{ ft}$$
$$\underline{0.0046 = w, \text{ ft/d}}$$

8 = K, ft/d

20 inches/yr recharge


8=K, ft/d					Fitted	Estimated		
EL (ft)					SHWT	Ave WT	Diff	
offset =					36	EL (ft)	EL (ft)	(ft)
x	h	T (ft^2/day)	T (gpd/sf)					
	0	20.0	160	1197	56.0	56	56	0.0
	150	22.9	183	1370	58.9	59.45	57.85	1.0
	300	25.0	200	1493	61.0	62.9	60.7	0.3
	450	26.4	211	1578	62.4	66.35	63.65	-1.3
RMS:								0.96

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

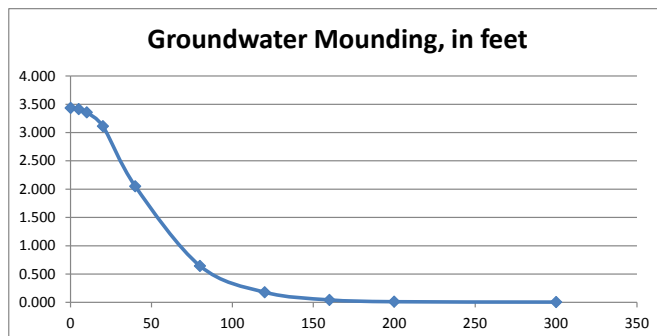
The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.

Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. **The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed** otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

Input Values		use consistent units (e.g. feet & days or inches & hours)	Conversion Table		
			inch/hour	feet/day	
0.9200	R	Recharge (infiltration) rate (feet/day)	0.67	1.33	
0.300	Sy	Specific yield, Sy (dimensionless, between 0 and 1)			
8.00	K	Horizontal hydraulic conductivity, Kh (feet/day)*	2.00	4.00	
34.500	x	1/2 length of basin (x direction, in feet)			
25.000	y	1/2 width of basin (y direction, in feet)	hours	days	
4.000	t	duration of infiltration period (days)	36	1.50	
23.000	hi(0)	initial thickness of saturated zone (feet)			
26.435	h(max)	maximum thickness of saturated zone (beneath center of basin at end of infiltration period)			
3.435	Δh(max)	maximum groundwater mounding (beneath center of basin at end of infiltration period)			
Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet				
3.435	0				
3.416	5				
3.356	10				
3.111	20				
2.052	40				
0.644	80				
0.179	120				
0.043	160				
0.011	200				
0.004	300				



Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

Western SDS #1
Area

Perc (mpi)	1.66
L (ft)	52
W (ft)	25
Area (SF)	1300
Loading	
GPD	1200
GPD/SF	0.92
FT/D	0.12

RESULTS

delta h(max) ft	0.5
Distance to wetland:	170
Image Source Effect	0.3
revised delta h(max)	0.2
Est. SHWT EI (ft)	58.0
EL + delta h(max) (ft)	58.2
Min Bed Bottom EI (ft)	62.2

SYSTEM #1	
BUILDING/FACILITY:	EIGHT (8) ELDERLY DWELLING UNITS
NUMBER OF BEDROOMS:	TWO (2) BEDROOMS PER UNIT, 16 TOTAL
DESIGN FLOW RATE:	150 GPD PER TWO BEDROOM ELDERLY UNIT
PERCOLATION RATE:	1.66 MPI (PERC-1 AT TP-2)
TOTAL DESIGN FLOW:	1,200 GPD
LEACHING AREA REQUIREMENTS (GPD/SF):	0.60 GPD PER SF
$(1,200 \text{ GPD}) / (0.6 \text{ GPD/SF}) = 2,000 \text{ SF PER TITLE 5 REQUIREMENT}$	
$(2,000 \text{ SF}) \times (40\% \text{ REDUCTION FOR PRESBY SYSTEM}) = 1,200 \text{ SF}$	
MINIMUM SAND BED AREA:	
$(8 \text{ UNITS}) \times (150 \text{ GPD}) / (1 \text{ GPD/SF FOR PRESBY SYSTEM}) = 1,200 \text{ SF}$	
LEACHING PROVIDED IN THE DESIGN:	
PRESBY SYSTEM USE 12 ROWS, 50' LONG PIPES, WITH 2' SPACING	
3 ROWS OF PIPES ARE CONNECTED AT END TO MAKE 4 TREATMENT SECTIONS	
LEACH FIELD 25' x 52' = 1,300 SF (BOTTOM AREA ONLY)	
REQUIRED PIPE LENGTH IS 546 L.F.; DESIGN 600 LF	

Input Values							
0.1200	R		Recharge (infiltration) rate (feet/day)				
0.300	Sy		Specific yield, Sy (dimensionless, between 0 and 1)				
8.00	K		Horizontal hydraulic conductivity, Kh (feet/day)*				
26.000	x		1/2 length of basin (x direction, in feet)				
12.500	y		1/2 width of basin (y direction, in feet)				
365.000	t		duration of infiltration period (days)				
23.000	hi(0)		initial thickness of saturated zone (feet)				

Central Area SDS #3

RESULTS

Perc (mpi)	1.00	delta h(max) ft	0.8
L (ft)	72	Distance to wetland:	240
W (ft)	25	Image Source Effect	0.3
Area (SF)	1800	revised delta h(max)	0.5
Loading			
GPD	1800	Est. SHWT El (ft)	60.8
GPD/SF	1.00	EL + delta h(max) (ft)	61.3
FT/D	0.13	Min Bed Bottom El (ft)	65.3

SYSTEM #3

BUILDING/FACILITY: TWELVE (12) ELDERLY DWELLING UNITS
 NUMBER OF BEDROOMS: TWO (2) BEDROOMS PER UNIT, 24 TOTAL
 DESIGN FLOW RATE: 150 GPD PER TWO BEDROOM ELDERLY UNIT
 PERCOLATION RATE: 1.00 MPI (PERC-4 AT TP-5)
 TOTAL DESIGN FLOW: 1,800 GPD
 LEACHING AREA REQUIREMENTS (GPD/SF):
 $(1,800 \text{ GPD}) / (0.6 \text{ GPD/SF}) = 3,000 \text{ SF}$ PER TITLE 5 REQUIREMENT
 $(3,000 \text{ SF}) \times (40\% \text{ REDUCTION FOR PRESBY SYSTEM}) = 1,800 \text{ SF}$
 MINIMUM SAND BED AREA:
 $(12 \text{ UNITS}) \times (150 \text{ GPD}) / (1 \text{ GPD/SF FOR PRESBY SYSTEM}) = 1,800 \text{ SF}$
 LEACHING PROVIDED IN THE DESIGN;
 PRESBY SYSTEM USE 12 ROWS, 70' LONG PIPES, WITH 2' SPACING
 3 ROWS OF PIPES ARE CONNECTED AT END TO MAKE 4 TREATMENT SECTIONS
 LEACH FIELD 25' x 72' = 1,800 SF (BOTTOM AREA ONLY)
 REQUIRED PIPE LENGTH IS 818 L.F.; DESIGN 840 LF

Input Values		USE CONSISTENT UNITS (e.g. feet & days or inches & hours)	
0.1300	R	Recharge (infiltration) rate (feet/day)	
0.300	Sy	Specific yield, Sy (dimensionless, between 0 and 1)	
8.00	K	Horizontal hydraulic conductivity, Kh (feet/day)*	
36.000	x	1/2 length of basin (x direction, in feet)	
12.500	y	1/2 width of basin (y direction, in feet)	
365.000	t	duration of infiltration period (days)	
23.000	hi(0)	initial thickness of saturated zone (feet)	

Eastern
Area SDS #2

RESULTS

Perc (mpi)	7.33	delta h(max) ft	0.7
L (ft)	62	Distance to wetland:	145
W (ft)	25	Image Source Effect	0.4
Area (SF)	1550	revised delta h(max)	0.3
Loading			
GPD	1500	Est. SHWT EI (ft)	64.0
GPD/SF	0.97	EL + delta h(max) (ft)	64.3
FT/D	0.13	Min Bed Bottom EI (ft)	68.3

SYSTEM #2

BUILDING/FACILITY: TEN (10) ELDERLY DWELLING UNITS
 NUMBER OF BEDROOMS: TWO (2) BEDROOMS PER UNIT, 20 TOTAL
 DESIGN FLOW RATE: 150 GPD PER TWO BEDROOM ELDERLY UNIT
 PERCOLATION RATE: 7.33 MPI (PERC-6 AT TP-10)
 TOTAL DESIGN FLOW: 1,500 GPD
 LEACHING AREA REQUIREMENTS (GPD/SF):
 $(1,500 \text{ GPD}) / (0.6 \text{ GPD/SF}) = 2,500 \text{ SF}$ PER TITLE 5 REQUIREMENT
 $(2,500 \text{ SF}) \times (40\% \text{ REDUCTION FOR PRESBY SYSTEM}) = 1,500 \text{ SF}$
 MINIMUM SAND BED AREA:
 $(10 \text{ UNITS}) \times (150 \text{ GPD}) / (1 \text{ GPD/SF FOR PRESBY SYSTEM}) = 1,500 \text{ SF}$
 LEACHING PROVIDED IN THE DESIGN:
 PRESBY SYSTEM USE 12 ROWS, 60' LONG PIPES, WITH 2' SPACING
 3 ROWS OF PIPES ARE CONNECTED AT END TO MAKE 4 TREATMENT SECTIONS
 LEACH FIELD 25' x 62' = 1,550 SF (BOTTOM AREA ONLY)
 REQUIRED PIPE LENGTH IS 682 L.F.; DESIGN 720 LF

Input Values		use consistent units (e.g. feet & days or inches & hours)	
0.1300	R	Recharge (infiltration) rate (feet/day)	
0.300	Sy	Specific yield, Sy (dimensionless, between 0 and 1)	
8.00	K	Horizontal hydraulic conductivity, Kh (feet/day)*	
31.000	x	1/2 length of basin (x direction, in feet)	
12.500	y	1/2 width of basin (y direction, in feet)	
365.000	t	duration of infiltration period (days)	
23.000	hi(0)	initial thickness of saturated zone (feet)	



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