Stantec

Memorandum

To:	Daryl Beardsley, Chair Sherborn Board of Health, Town Hall, Sherborn, MA	From:	Mark S. Bartlett, P.E. Stantec, Hingham, MA
Project/File:	Sherborn, Project Review	Date:	January 7, 2025

Reference: Review of 34 Brush Hill Road Shared Septic System

Introduction

On behalf of the Sherborn Board of Health (Board), Stantec Consulting Services, Inc. (Stantec) has reviewed submittals to the Board in support of a proposed subsurface sewage disposal (septic) system at 34 Brush Hill Road (the Site). This project review memorandum offers our comments on the latest application (including design plans and soil testing reports) dated June 26, 2024, and as substantially revised through December 23, 2024, submitted by DGT Associates of Framingham, MA (the Engineer) on behalf of Fenix Partners Brush Hill, LLC of Sherborn, MA (the Applicant).

The Applicant proposes to construct four (4) single family residences on a 5.1124± acres parcel with current address of 34 Brush Hill Road under a Comprehensive Permit (M.G.L. Ch. 40B) (the Project) for which an application is currently before the Sherborn Zoning Board of Appeals (ZBA). The December 23rd plans indicate that each of the four homes will have three (3) bedrooms, and the total proposed wastewater flow is 1,320 gallons per day (gpd)[1]. Wastewater from two homes will be combined and pre-treated via a shared 2000-gallon septic tanks[2] which then contribute pre-treated effluent to a shared Soil Absorption System (SAS) consisting of twelve (12) 2-ft x 2-ft x 73.5-ft leaching trenches. The total proposed SAS leaching area is 5,292 square feet which exceeds the required area[3] per Title 5 of 5,280 sq.ft. based on a LongTerm Acceptance Rate (LTAR) of 0.25 gpd/sq.ft.[4]

Lot 18, Assessor's Map 1 (the Site) is reportedly owned by the Applicant (however the Assessors records indicate the owner as James A. Trombi, 300 Bishop St., Framingham, MA). It is located on the north side of Brush Hill Road east of Western Ave. and west of Perry St.

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[1] Per 310 CMR 15.203 (Title 5) flow is based on a total of 12 bedrooms at 110 gpd/bedroom = 12 x 110 = 1,320 gpd

[2] Septic Tank #1 serves Homes 1 & 2 and effluent from this tank flows by gravity to the SAS, and Septic Tank #2 serves Homes 3 & 4 and effluent from this tank is pumped up to the distribution box at the SAS.

[3] Required leaching area = 1,320 gpd / 0.25 gpd/sf = 5,280 sf

[4] The LTAR is based on a 39 minutes per inch perc rate (max value in tested area) and Class III soils (sandy loam)

Site Characteristics Relevant to Septic System Design

The Site geologic landform is glacial moraine, and the proposed septic SAS is located on a westward facing slope of this moraine. The Site is on a hill and elevations slope from east to west: Elevations vary from 249 to 246 at the point where the property meets Brush Hill Road to 184 at the northeast lot corner. At the proposed septic SAS, existing Site elevations at the southern SAS half slope down from 215 to 211 over about 55-ft (existing slope of 7.3%), and at the northern SAS half slope down from 213 to 209 over about 53-ft (existing slope of 7.5%).

NRCS[5] Soils Maps for the Site indicate the presence of "Paxton fine sandy loam, 8 to 15 percent slopes" which are classified as having the following characteristics which are consistent with the test pit soil evaluation that have been provided by the Applicant:

Typical profile

Ap - 0 to 8 inches: fine sandy loam

Bw1 - 8 to 15 inches: fine sandy loam

Bw2 - 15 to 26 inches: fine sandy loam

Cd - 26 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 8 to 15 percent

Depth to restrictive feature: 20 to 39 inches to densic material

Drainage class: Well drained

Runoff class: Medium

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)

Depth to water table: About 18 to 37 inches

Hydrologic Soil Group: C

MassMapper GIS data for the Site provides the following reported hydrogeologic data which we have assumed as relevant for use in Hantush method reviews of mounding at the proposed SAS:

***Specific Yield* (Sy)[6] of 0.18**

***Saturated Hydraulic Conductivity* (Ksat)[7] of 10 ft/day max and 3 ft/day avg.**

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[5] NRCS is Natural Resources Conservation Service (formerly the Soil Conservation Service) of the USDA.

[6] Sy is a dimensionless value between 0 and 1. Sy is sometimes referred to as Fillable Porosity.

[7] Ksat is the vertical saturated hydraulic conductivity. Horizontal conductivities are typically 10 times the vertical.

> ***However, two on-site tests by the Applicant found Ksat = 2.018 and 3.027 in/hr which converts to 4.036 and 6.054 ft/day…for Hantush analysis K=4 was used.***
>
> ***Depth to Bedrock* has not been investigated at the Site, but MassMapper GIS data reported in the vicinity of the site varies from 18-ft to of 27-feet[8]**

Site plans indicate that there are wetlands and associated wetland buffer zones[9] located at the northern corner of the Site. At its closest point, the proposed septic SAS is located about 28-ft away from the 100-ft Buffer Zone. Wetland resources at/near the Site are regulated under the Massachusetts WPA[10] and the local wetlands bylaw[11]. Because perimeter grading associated with the northern end of the septic SAS will extend into the 100-ft Buffer Zone, the Sherborn Conservation Commission will require a Notice of Intent (NOI). It is not clear if an NOI has been filed for the project. In checking MassMapper GIS data, the Site does not contain and is not near Priority Habitats[12] of Rare Species, Estimated Habitats of Rare Wildlife, or certified or potential vernal pools, or other protected areas of environmental concern.

We offer the following comments on the Site septic system design and soils data and analysis that support the design. Our review is based on compliance with the latest[13] version of Title 5 (310 CMR 15.00), and Sherborn "Regulations of the Board of Health" (BOH Regulations).

SUBMITTALS CONSIDERED

A. Septic system plans and details for "Brush Hill Homes, 34 Brush Hill Road, Sherborn, MA 01770", prepared by DGT Associates, Framingham, MA for Applicant / Owner – Fenix Partners Brush Hill, LLC, 177 Lake Street, Sherborn, MA 01770, consisting of 5 sheets dated June 26, 2024 and last revised December 23, 2024.

B. Pump Design Calculations for Brush Hill Homes at 34 Brush Hill Road, Sherborn, MA, prepared by DGT Associates, Framingham, MA, dated December 23, 2024.

C. Letter from DGT Associates to Sherborn Zoning Board of Appeals dated December 23, 2024, re: Brush Hill Homes Residential Development – Comprehensive Permit 34 Brush Hill Road in Sherborn, MA

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[8] Depth to bedrock (dtb) can be used to estimate the initial thickness of the saturated zone (aquifer) below the SAS (in feet). See additional discussion under comments 15 and 16 below

[9] A 50-ft No Alteration Zone and a 100-ft wetland buffer zone

[10] The Wetlands Protection Act [M.G.L. c. 131 § 40] and Regulations [310 CMR 10.00].

[11] Chapter 17 of the Town Bylaw, the General Wetlands By-Law, and the Sherborn Wetland Regulations.

[12] Per mapping by the Massachusetts Natural Heritage and Endangered Species Program (NHESP)

[13] 310 CMR 15.00 as corrected 8/4/23

D. Existing condition "Plan of Land, 34 Brush Hill Road, Sherborn, MA " prepared by Samiotes Consultants, Inc., dated 8/17/2023.

E. Septic system plans and details for "Brush Hill Homes, 34 Brush Hill Road, Sherborn, MA 01770", prepared by DGT Associates, Framingham, MA for Applicant / Owner – Fenix Partners Brush Hill, LLC, 177 Lake Street, Sherborn, MA 01770, consisting of 5 sheets dated June 26, 2024 and revised 9/23/24. (Superseded by Submittal A above.)

F. Draft Brush Hill Road Sherborn Waiver List dated June 2024 (10-page table)

G. Updated Draft Brush Hill Road Sherborn Waiver List dated January 2025 (10-page table)

H. 34 Brush Hill Homes soil test log-book November 4, 2024.

I. Memo to Sherborn Zoning Board of Appeals, ZBA, from Daryl Beardsley, Julie Dreyfus, Mark Oram -- Sherborn Board of Health (BOH), dated November 2, 2024, re: 34 Brush Hill Homes 40B – Supplemental Percolation Testing.

J. Email memo from Bob Murchison bob.murchison@me.com dated Tuesday, November 05, 2024 2:37 PM, to Jeanne Guthrie and Jeremy Marsette, with cc: to Zachary McBride, and paul@bbhslaw.net, re: Brush Hill Reply BOH memo for Brush Hill Homes 40B.

K. Letter from DGT Associates to Mark Oram, Sherborn Health Agent dated November 27, 2023 re: 34 Brush Hill Road – Soil Testing; including attachments (1) Deep Test Hole, Percolation, and Permeability Test Logs, (2) Soil Test Hole Location Plan, and (3) NRCS and USGS Soil Maps and Information.

L. "Stormwater Management Design and Runoff Calculations Report" for Brush Hill Homes, 34 Brush Hill Road, Sherborn, MA 01770 dated June 26, 2024, and revised September 19, 2024; prepared by DGT Associates, Framingham, MA 01701; prepared for Bob Murchison, 177 Lake Street, Sherborn, MA 01770.

M. Letter from Scott Horsley, Water Resources Consultant to Mr. Zachary McBride, Chair, Sherborn Zoning Board of Appeals and Ms. Daryl Beardsley, Chair, Sherborn Board of Health, dated September 30, 2024, re: 34 Brush Hill Road, Sherborn, MA.

N. Letter from Scott Horsley, Water Resources Consultant to Mr. Zachary McBride, Chair, Sherborn Zoning Board of Appeals and Ms. Daryl Beardsley, Chair, Sherborn Board of Health, dated January 2, 2025, re: 34 Brush Hill Road, Sherborn, MA.

O. Memo to the Sherborn Zoning Board of Appeals, from the Sherborn Groundwater Protection Committee dated 10-21-24, re: Groundwater Protection Committee Comments to the ZBA on the proposed Brush Hill Homes (34 Brush Hill Road) 40B

P. Letter from TetraTech to the Sherborn Zoning Board of Appeals dated October 17, 2024, re: Brush Hill Homes Residential Development – Comprehensive Permit Engineering Peer Review – Site/Civil, 34 Brush Hill Road, Sherborn, Massachusetts

REFERENCES

A. Sherborn "Regulations of the Board of Health, Section I Sewage Disposal" dated January 2020; and Sherborn "Board of Health Regulatory Changes Approved at 10/4/2023 Public Hearing (effective 11/9/2023)", (collectively referenced herein as BOH Regulations).

B. Massachusetts Department of Environmental Protection regulations 310 CMR 15.000: The State Environmental Code, Title 5: Standard Requirements for the Siting, Construction, Inspection, Upgrade and Expansion of On-Site Sewage Treatment and Disposal Systems and for the Transport and Disposal of Septage. (last revised 8/4/23).

Comments on the Proposed Septic System Plans Dated December 23, 2024:

1. Explain the Special Note on Sheet BOH-1 that reads: "Leaching catch basins or drywalls are located near components of the proposed sewage disposal system". If any such drainage structures are proposed they should be shown along with required setback from septic components.

2. Explain the statement that "Foundation Drains are proposed for the subject building." Show the locations of proposed foundation drains including depth, elevations, outlets, and design details for such under drain(s), including setback from septic components. This is supported by BOH Regulation 3.4.1.B which requires…*The location of all drains*.

3. Benchmarks are not noted on the septic plan. Per BOH Regulations 3.4.1 E. *Two benchmarks and datum plane notation. One of the benchmarks shall be within fifty (50) feet of the proposed leaching area*.

4. The Locus Map is incomplete in the latest submittal. Per BOH Regulations 3.4.1.F. *A locus map including the distance to the nearest intersecting street*.

5. Per BOH Regulations 3.4.1.G. *The results of the soil logs, as provided by the soil evaluator, soil classification and maximum water table elevations encountered for all test holes, and the name of the individual who witnessed the tests for the Board of Health.* (underline emphasis added). Test pit locations are shown on the plans; however, the following test pit logs are missing: 24-04, 24-05, 24-07, 24-08, 24-09. Also, the field notes in Submittal H above "soil test log-book November 4, 2024" are not clear and it was not possible to relate the field notes to the logs shown on Soils Information Sheet BOH-5.

6. The Applicant should include any recorded elevations of groundwater weeping on the test pit logs on Sheet BOH-5, and within the cross-section of trenches on Sheet BOH-2

7. Per BOH Regulations 4.B.5. *An "Environmental Health Impact Report" and "Environmental Health Permit" are required under Regulation III – PUBLIC AND ENVIRONMENTAL HEALTH REVIEW REGULATIONS AND STANDARDS FOR SELECTED SITE DEVELOPMENT ACTIVITIES OR OTHER SPECIAL CONDITIONS, OR FOR OTHER THAN A SINGLE-FAMILY DWELLING ON A SINGLE LOT.* The proposed project will require an "*Environmental Health Impact Report" and "Environmental Health Permit."* However, we understand that the Applicant is seeking a waiver of this local requirement[14].

8. Per BOH Regulations 8.1. *The bottom of any leaching area shall be a minimum of five (5) feet above the maximum high ground water table*. The proposed plans do not comply with this local requirement. We understand that the Applicant is seeking a waiver of this requirement and proposes compliance with Title 5 only.

9. Per BOH Regulations 8.2. *Subsurface sewage disposal systems shall not be constructed in fill that is to be placed directly on or near ledge, hardpan or other impervious materials or in any area where peat is present or when the maximum groundwater level is five (5) feet or less below natural surface grade. A depth of at least five (5) feet of pervious material (determined by percolation test) <u>in natural soil shall be maintained below the bottom of the leaching area</u>.* (underline emphasis added). The proposed system is not compliant with this requirement as only 2' to 3' of natural soil is present from existing Site grade to the Estimated Seasonal High Groundwater (ESHGW). The SAS design (with removal of A & B horizons, replaced by Title 5 sand) will provide 4-ft minimum separation between the leaching trenches and ESHGW per Title 5. Also, natural soil will be present to more than 5-ft below the proposed system's remove & replace zone, and bedrock has not been found. We understand that the Applicant is seeking a waiver of this local requirement and proposes compliance with Title 5 only.

10. Provide a detail for the 2-inch force main (FM) connection to the distribution box (D-box); and include a baffle and/or "T" fitting at the end of the FM to protect D-box contents from disruption and/or short-circuiting of flow. [Per 310 CMR 15.232(3) - *(a) when the soil absorption system is to be dosed or the slope of the inlet pipe exceeds 0.08 feet per foot, an inlet tee, baffle or splash plate extending to one inch above the outlet invert elevation shall be provided to dissipate the velocity of the influent*]

11. Call out the remove and replace (R&R) limits on the plan view of the leaching area, and the limits should extend 5-feet (min) past the limits of the trenches (active or reserve).

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[14] BOH Regulations III.3.1g.under the heading *ENVIRONMENTAL HEALTH IMPACT REPORT ("EHIR")* states that an EHIR is required for applications for approval of a Comprehensive Permit under M.G.L. c. 40B, s. 20-23

12. The SAS is proposed as a mounded system with construction in fill per 310 CMR 15.255 and proper breakout separation between the top of the leaching trenches and a 3:1 surface slope is provided, and a 4-ft high retaining wall is proposed on the downslope portion of the system and the wall extends to a 3:1 slope area at its base also complying with the 15-ft setback requirements of 310 CMR 15.255(2). Our review of mounding at the system indicates that trench effluent added to ESHGW should not intersect the proposed retaining wall (see comments under 15 below). Nevertheless, we recommend that an impervious barrier should be added to the SAS side of the wall as a precaution. The wall plan view and detail should be modified to include an appropriate durable membrane to direct any infiltration (e.g., rain or effluent, vertically and prevent lateral movement (through wall) from the adjacent SAS. Such membrane should be extended to the base of the retaining wall. The retaining wall is proposed to be 4-feet in height. We recommend that it be approved by the Building Department and be designed by a Massachusetts registered Structural Engineer and include calculations for factor of safety against overturning, sliding, and bearing capacity; and conditions of high groundwater, if any, should be factored into the design. If structural plans are provided by a wall manufacturer, then the Board should require that such plans be based on site specific geotechnical information, and the Board should not accept plans that are qualified by requiring further determination of geotechnical conditions after issuance of the signed and sealed structural drawings.

13. The septic system is proposed as a "shared system" per 310 CMR 15.290, which is approvable by the Board subject to the requirements established in 310 CMR 15.292. In addition to the plans provided, the Applicant must also submit the following information, per 310 CMR 15.290 (2), which reads as follows:

    (b) a proposed operation and maintenance plan for the shared system;

    (c) a description of the form of ownership which each component of the system serving more than one Facility will take, together with relevant legal documentation describing or establishing that ownership including, without limitation, easements, condominium master deed, or homeowners' association documents. All forms of private ownership of system components serving more than one Facility shall establish that each user of the system has the legal ability to accomplish any necessary maintenance, repair, or upgrade of the component;

    (d) a description of the financial assurance mechanism proposed to ensure effective long-term operation and maintenance of the system. Acceptable financial assurance mechanisms may include, but are not limited to, an escrow account, letter of credit, performance bond, or insurance policy, which names the Approving

Authority as beneficiary, and which provides for upgrade of the shared system in the event the shared system fails to protect public health, safety, welfare or environment pursuant to the criteria established in 310 CMR 15.303. A copy of the final financial assurance mechanism shall be provided to the Approving Authority prior to construction of the system; and

(e) a copy of a proposed Grant of Title 5 Covenant and Easement essentially identical to that contained in 310 CMR 15.000: Appendix 1 shall be recorded and/or registered with the appropriate Registry of Deeds and/or Land Registration Office within 30 days of the Approving Authority's approval of the Covenant and Easement. The applicant shall file a certified Registry copy of this Covenant and Easement with the Approving Authority within 30 days of its date of recordation and/or registration, and prior to construction of the system.

14. The 2-inch force main should be insulated in any area where less than 4-ft of cover is provided.

15. Mounding analysis is not required by either Title 5 or BOH Regulations for systems with flow less than 2,000 gpd. Nevertheless, an abutter's consultant (Horsley) has raised the question of mounding. To check this issue, Stantec ran Hantush mounding analyses for both original design conditions (Submittal E above) and latest design conditions (Submittal A above). Our comparative findings from these mounding analyses are presented in the table below (and supporting Hantush spreadsheets are attached) and discussed further below. The Horsley mounding analysis of the former (9.23.24) SAS design is flawed because of the following input errors:

    - <u>Basin Length and Width Input Error</u>: The 9.23.24 design has 14 trenches which are 84-ft long, and total field length (including a 10-ft wide non-leaching area between the two sets of trenches) is 178-ft, and <u>the Hantush method requires input of ½ the area length and ½ the area width, therefore these inputs should have been x=89' (1/2 of 178') and y=25' (1/2 of 50')</u>. Mr. Horsley used a full field size of 180' x 50' and failed to use the required ½ value inputs. We ran one Hantush analysis using Mr. Horsley's inputs just to check his results for the larger field (see version 1 in Table 1 below) and then ran another using corrected and revised inputs (see version 2 in Table 1 below) as a comparison for the larger leaching field mounding estimate.

    - <u>Recharge (Infiltration) Rate Error: Recharge rate for a 90-day mounding analysis is calculated as 80% of the Title 5 flow distributed over the leaching system</u>

footprint. Mr. Horsley used 100% of the design flow. MassDEP guidance on mounding[15] states the following:

 An analysis of the ability of site to accept and disperse flow at the proposed discharge rate. (Maximum Monthly Flow)[16]

 Evaluation of the mounding potential, presence of confining layers, thickness and estimated aerial extent of unsaturated receiving formation. Mounding calculations or modeling to be evaluated for maximum monthly flow (defined as 80% of the design flow based on Title 5 calculations. However, it should be noted that the disposal field design is based on 100% of the design flow) for a duration of 90 days. Maximum daily flow may be higher, but the sum of the daily flows for the months over the 90 days shall not exceed the maximum monthly flow for the 90-day period evaluation of the site.

The Recharge Rate for the original and revised SAS designs is calculated as 80% of the Title 5 flow distributed over the leaching system footprint, as follows:

- Original design flow is 1,760 gpd, and leaching area is 50' wide and 178' long (89' + 10' + 89') = 8,900 sf
- Original design application rate = (0.8 x 1,760) / 7.48 / 8,900 = 0.0212 ft/day
- Revised design flow is 1,320 gpd, and leaching area is 42' wide and 157' long (73.5' + 10' + 73.5') = 6,594 sf
- Revised design application rate = (0.8 x 1,320) / 7.48 / 6,594 = 0.0214 ft/day

- Hydraulic Conductivity Value (K): MassMapper[17] data on hydraulic conductivity (K) at the Site is reported as a max value of 10 ft/day and average value of 3 ft/day, but more relevant on-site testing by the Applicant found values of 4 ft/day and 6 ft/day, therefore we believe the min. on-site K value of 4-ft/day is appropriate, (Horsley used K= 3).
- Initial saturated thickness (h): This is the most significant variable in the Hantush calculation. Mr. Horsley used a value for h of 7.9-ft based on the depths of most on-site test pits. However, if the mounding issue is to be pursued further, then we believe that the saturated depth should be verified (see comment 16 below)

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[15] Guidelines for the Design, Construction, Operation, and Maintenance of Small Wastewater Treatment Facilities with Land Disposal, Commonwealth of Massachusetts Department of Environmental Protection, Division of Watershed Permitting, Revised July 2018

[16] Maximum monthly flow is 80% of maximum daily flow, which is used for sizing the leaching area.

[17] MassMapper is an interactive map tool that provides access to geological information about Massachusetts. It was developed by the Bureau of Geographic Information (MassGIS).

before finalizing any conclusions on mounding. In the interim, we can look to the MassMapper GIS data on surficial geology which reports the Site area as "thick till", and nearby measurements of depth to bedrock (dtb) based on well driller logs are reported as 22.25-ft at 44 Brush Hill Rd, 27.13-ft and 25.3-ft at two wells at 60 Brush Hill Road, and 18.6-ft at 32 Brush Hill Rd. Also, we found that none of the Applicant's test pits encountered bedrock, and the lowest test pit (#23-01) at the Site did not encounter bedrock at elevation 180. Therefore, given the above noted data, we used a value of h=16-ft[18] as a more representative value in Hantush. As noted, we recommend further site testing on this issue, see comment 16 below.

Table 1: Hantush Mounding Analysis Results for the proposed septic system

Ver #	Review By:	Septic Plan Date:	Recha Rate (R)	Specific Yield (Sy)	Hydraul Conductivity (K)	½ Basin Length (x)	½ Basin width (y)	Time (days)	Aquifer Saturated thickness hi(0)	Mound under basin center, ft (max)
0	Horsley	9.23.24	0.025	0.18	3	180	50	90	7.9	4.303
1	Stantec confirmatory re-run of #0	9.23.24	0.025	0.18	3	180	50	90	7.9	4.303
2	Stantec Original Design with revised inputs	9.23.24	0.0212	0.18	4	89	27	90	16	0.877
3	**Stantec Revised Design with revised inputs**	**12.23.24**	**0.0214**	**0.18**	**4**	**78.5**	**23**	**90**	**16**	**0.704**

We believe that the results for analysis version #3 (last row) in the table above provides the best current estimate of a mound height of (0.704-feet) that could form under the middle of the revised design leaching trench system. The mound height under the SAS area decreases with distance from the center of the field as shown in the Hantush output table and graph (Attachment 3). The mound would be seasonal and would not significantly reduce the effective treatment area below the SAS; however, the Board could ask that the elevation and grading at the SAS be raised to provide a consistent 4-ft

[18] Depth to bedrock (dtb) can translate to the initial thickness of the saturated zone below the SAS (in feet). Although bedrock was not encountered in test pits at the Site, as noted earlier, the MassMapper GIS has reported depths to bedrock (based on nearby wells) which can be used to estimate the depth of surficial aquifer below the SAS. In this case, assuming the 18.6-feet minimum value reported, and deducting a typical depth to ESHGW of 2.5-ft at the Site, provides an estimate of 16-ft as the saturated aquifer thickness which was used in our Hantush model).

separation[19]. The mound height decreases to 0.285-ft at 120-ft from the center of the SAS, and the water table gradient clearly drops also with distance from the SAS, therefore break out should not occur at any point on the Site. The mound elevation, when added to the ESHGW elevation below the system would not intersect with or come close to the side slopes or the downgradient retaining wall (19-ft from active trench, 15-ft from reserve trench). See Attachment 4 which is a sketch of the mound above ESHGW as shown on the Applicant's trenches cross-section.

16. We have discussed that there is uncertainty on depth to bedrock under the septic system SAS (which is critical to an accurate evaluation of mounding). Also, we have seen that the Sherborn Groundwater Protection Committee and some abutters have expressed concern about the possibility of fractured bedrock transport of SAS effluent. If the Board wishes to pursue these questions further, they should ask the Applicant to conduct and provide geologist logs for several (3 minimum) borings within the septic system SAS area to determine the value h (saturated aquifer thickness). All borings should be drilled to bedrock refusal; and at least one of the borings should be advanced as a bedrock coring to determine if the bedrock is competent or fractured, and then provide an opinion from a qualified hydrogeologist regarding the risk of SAS effluent entering the bedrock, and if so, opinion on the risk of effluent transport in the bedrock.

Sincerely yours,

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[19] The Board could ask that the elevation and grading at the SAS be raised to provide a consistent 4-ft separation. There is precedent in Title 5 for systems with a design flow of 2,000 gpd or greater regarding separation from mounded high groundwater: See 310 CMR 15.202 (4)(g) which states *for systems serving a facility with a design flow of 2,000 gpd or greater, the separation from high groundwater as required under 310 CMR 15.212 shall be calculated after adding the effect of groundwater mounding to the high groundwater elevation as determined pursuant to 310 CMR 15.103(3)*.

Reference: Review of 34 Brush Hill Road Shared Septic System

Attachments:
1 - Hantush_USGS_Horsley Replication_ortho to long side.pdf
2 - Hantush_USGS_orig_dn_total area_ortho to long side_revised inputs.pdf
3 - Hantush_USGS_rev.dn_total area_ortho to long side_revised inputs.pdf
4 - Trench Cross Section Elevations with Estimated Mound.pdf

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)

use consistent units (e.g. feet & days **or** inches & hours)

Input Values

0.0250	*R*	**Recharge (infiltration) rate (feet/day)**
0.180	Sy	**Specific yield, Sy (dimensionless, between 0 and 1)**
3.00	K	**Horizontal hydraulic conductivity, Kh (feet/day)***
50.000	x	**1/2 length of basin (x direction, in feet)**
180.000	y	**1/2 width of basin (y direction, in feet)**
90.000	t	**duration of infiltration period (days)**
7.900	hi(0)	**initial thickness of saturated zone (feet)**

Conversion Table

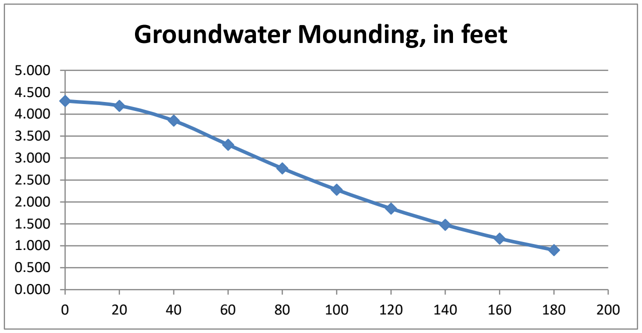
inch/hour	feet/day
0.67	1.33
2.00	4.00
hours	**days**
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

12.203	h(max)	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
4.303	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**
4.303	0
4.192	20
3.852	40
3.305	60
2.764	80
2.278	100
1.849	120
1.478	140
1.164	160
0.903	180

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.

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)

use consistent units (e.g. feet & days **or** inches & hours)

Input Values

0.0212	***R***	**Recharge (infiltration) rate (feet/day)**
0.180	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
4.00	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
25.000	**x**	**1/2 length of basin (x direction, in feet)**
89.000	**y**	**1/2 width of basin (y direction, in feet)**
90.000	**t**	**duration of infiltration period (days)**
16.000	**hi(0)**	**initial thickness of saturated zone (feet)**
16.877	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
0.877	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Conversion Table

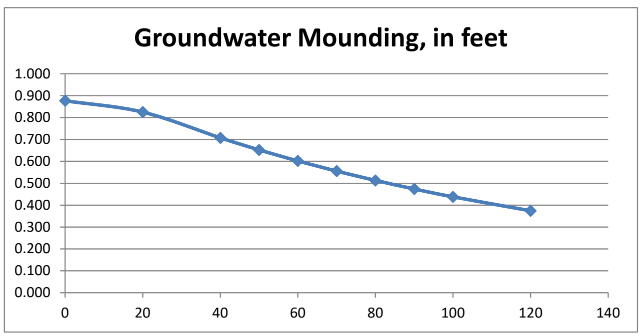
inch/hour	**feet/day**
0.67	1.33
2.00	4.00

hours	**days**
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

Ground-water Mounding, in feet	**Distance from center of basin in x direction, in feet**
0.877	**0**
0.825	**20**
0.707	**40**
0.652	**50**
0.602	**60**
0.555	**70**
0.513	**80**
0.474	**90**
0.438	**100**
0.374	**120**

Re-Calculate Now



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use consistent units (e.g. feet & days **or** inches & hours)

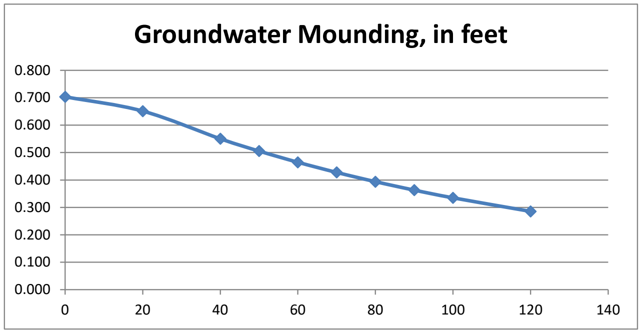
Input Values			**Conversion Table**	
			inch/hour	**feet/day**
0.0214	***R***	**Recharge (infiltration) rate (feet/day)**	0.67	1.33
0.180	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**		
4.00	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***	2.00	4.00
21.000	**x**	**1/2 length of basin (x direction, in feet)**		
78.500	**y**	**1/2 width of basin (y direction, in feet)**	**hours**	**days**
90.000	**t**	**duration of infiltration period (days)**	36	1.50
16.000	**hi(0)**	**initial thickness of saturated zone (feet)**		

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

16.704	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
0.704	**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**
0.704	**0**
0.651	**20**
0.550	**40**
0.505	**50**
0.465	**60**
0.428	**70**
0.394	**80**
0.363	**90**
0.335	**100**
0.285	**120**

Re-Calculate Now



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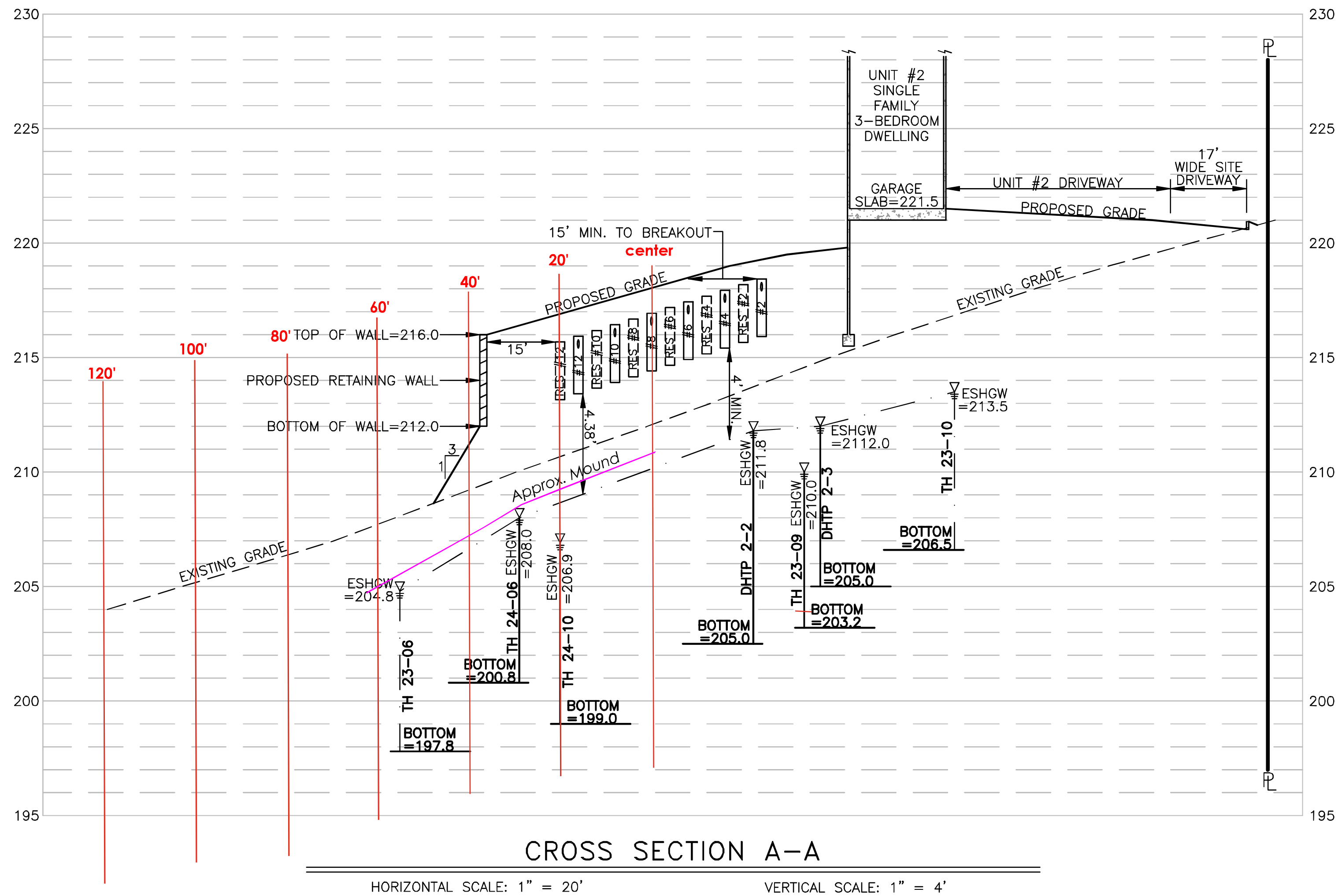

CROSS SECTION A-A

HORIZONTAL SCALE: 1" = 20'   VERTICAL SCALE: 1" = 4'

PRIMAR

TRENCH NO.	1
BREAKOUT ELEVATION AT BEGINNING	218
BREAKOUT ELEVATION AT END	218
INVERT ELEVATION AT BEGINNING	218
INVERT ELEVATION AT END	217
BOTTOM OF STONE ELEVATION	215
DESIGN GROUNDWATER ELEVATION	211

RESERV

TRENCH NO.	1
BOTTOM OF STONE ELEVATION	215
DESIGN GROUNDWATER ELEVATION	211